Lower Thames Crossing

Thurrock Council Local Impact Report

Appendix C - Transport and Modelling

Lower Thames Crossing

Thurrock Council Local Impact Report

Appendix C Annex 1 – Technical Summary of Local Junction Impacts

Contents

C1.1 Deficiencies in Modelling Approach

C1.1.1. National Highways (NH) has solely relied on LTAM model to inform the operational impacts of LTC during the operational phase of the scheme. LTAM as a strategic model, is better suited to informing scheme appraisal, but is a wholly inadequate tool to inform and understand the operational impacts of LTC on local junctions, links and local communities. By relying solely on the strategic model, NH has failed to accurately and robustly assess the impacts of the scheme on the Thurrock Local Road Network (LRN).

C1.1.2. The Council therefore has significant concerns about the accuracy of the impact assessment of LTC on the local roads in Thurrock using the LTAM. To address limitations of LTAM, adoption of a hierarchical approach to modelling is required by the Council and is common practice. In this hierarchical structure, the output from the strategic model is fed into operational models to assess the capacity and operation of local junctions. Operational models can either be junction modelling or micro-simulation modelling.

C1.1.3. Junction modelling can cover areas ranging from a single junction to a group or 'region' of junctions with linked signal timings. This level of modelling focuses in detail on the capacity of individual stop lines and junctions, and the interaction between them. Microsimulation modelling simulates the movements and reactions of individual vehicles, cyclists and pedestrians using behaviour models.

C1.1.4. In the Council's experience, NH would not allow a developer to rely solely on a strategic model for a planning application and instead would require the hierarchical approach to modelling to be adopted and presented, i.e. a strategic model feeding into more detailed operational models to assess the traffic impact of a scheme.

C1.1.5. Furthermore, there is a plethora of DCO application examples, including NH's Tier 1 schemes like LTC, which presented results of microsimulation modelling (often backed up with junction modelling) to report scheme impact assessment and address limitations of strategic modelling. Selected recent examples are presented in Table C1.1. These examples reiterate the point of the hierarchical approach to modelling being a well-established practice and substantiate the Council's concerns as to why microsimulation modelling results have not been presented in the DCO submission.

Table C1.1: A selection of DCO Applications Submitted by NH, which Included Detailed Operational Modelling

Scheme	Transport Modelling Approach presented in DCO
A30 Chiverton to Carland Cross DCO granted February 2020 Scheme cost: £330 million	Detailed operation modelling for the three junctions within the scheme was presented alongside strategic modelling as part of the DCO application. The operation modelling was undertaken in ARCADY (Junctions 9) and was informed using the flows from a strategic model (Saturn). HA551502-ARP-HGN-SW-FN-TR-000011 (planninginspectorate.gov.uk) – Detailed technical note for the three junctions. The results presented show ratio of flow to capacity, queues and delay at the junctions.
A303 Amesbury to Berwick Downs (Stonehenge) NH's Tier 1 scheme DCO: 2018 – on-going Scheme cost: £1.7 billion	The Combined Modelling and Appraisal Report (ComMA) and its appendices for the A303 Stonehenge scheme detail the microsimulation modelling (VISSIM) undertaken to support the scheme. The model is extensive and covers the A303, local routes north and south of the scheme. The model was supported and calibrated/validated using extensive data collection (including counts, Automatic Number Plate Records and journey time data). TR010025-000451-7-5-ComMA.pdf (planninginspectorate.gov.uk) – ComMA report, which presents results of the scheme assessment

Scheme	Transport Modelling Approach presented in DCO
	undertaken using the 'A303 Stonehenge SWRTM (DCO)' strategic model. The report states at paragraph 3.2.22 that the VISSIM model is *"more appropriate to use to inform the detailed operational performance of the Scheme to inform the design, verification and optimisation of its design."* 7.7 ComMA Appendix B TMP (planninginspectorate.gov.uk) – Appendix B of ComMA report, which details approach to strategic and microsimulation modelling. Paragraph 13.1.1 states that *"The purpose of operational microsimulation and junction modelling is to assess in detail the operational impacts on the network of the Scheme during normal operation, during tunnel incidents/ maintenance periods and during construction phases."* TR010025-000454-7-5-ComMA-Appendix-C.pdf (planninginspectorate.gov.uk) – Appendix C of ComMA report, which details operational assessment results.
A66 Northern Trans-Pennine NH's Tier 1 scheme DCO: 2022 – Awaiting decision of The Secretary of State (2023) Scheme cost: £1.3 billion	The TA for the A66 (Microsoft Word - 3.7 Transport Assessment (Rev 2) [clean] (planninginspectorate.gov.uk)) outlines the modelling undertaken to assess the scheme, which included strategic modelling and detailed microsimulation modelling and local junction modelling. Paragraph 6.1 of the report states that *"The purpose of operational junction modelling is to assess in detail the operational impacts on the network of the Project during normal operation."* A VISSIM model was undertaken for M6 Junction 40 and A1(M) Scotch Corner. In addition, a number of local junction models were built to assess the impact of the DCO scheme on the local highway network. Paragraph 6.4.1 of the report states *"Operational assessments were carried out at some of the key junctions on and around the Project. The scope of the operational assessment was discussed with officers of Cumbria County Council, Durham District Council and North Yorkshire County Council. Models have been developed for fifteen junctions in the vicinity of the A66."*
A428 Black Cat to Caxton Gibbet NH's Tier 1 scheme DCO: 2021 – 2022 Scheme cost: £810 to £950 million	The Traffic Forecasting Report (Appendix C of ComMA report - A428 Black Cat to Caxton Gibbet Improvements (planninginspectorate.gov.uk)) details the operational assessment undertaken using VISSIM and informed by strategic model data. Average speed plots are provided of the key scheme junctions. These are used to show that there is not significant issues at the scheme junctions with traffic speeds being in and around the speed limit of the links up until just before the junctions themselves. In addition, 5 local junction operational models were built as they either have new or modified layouts to sections of the junction or a change in demand flows passing through the junction as a result of the Scheme. The TA outlines the results for the VISSIM and Junctions 9 modelling. Junction 9 modelling results include RFC, delays and queuing data. Transport Assessment Part 1 provides more detail on the operational modelling (TR010044-000405-TR010044_A428_Black_Cat_to_Caxton_Gibbet_Improvements_7-2_Transport_Assessment_Report_Part_1.pdf (planninginspectorate.gov.uk))

C1.2 Impact on Local Traffic

C1.2.1. Over several years, the Council has raised numerous concerns about the suitability of relying solely on NH's strategic LTAM transport model for scheme impact assessment on the local highways network in Thurrock.

C1.2.2. The Council's response to the Supplementary Consultation (January to April 2020) set out its concerns about the validation of the LTAM base model of the local highways network in Thurrock, with the model data suggesting that baseline traffic flows were being under-estimated, thus undermining the ability of the model to be used for assessment of local highway impacts and mitigation in the future. Engagement on these issues has continued through the Design Refinement Consultation in July 2020 and until the withdrawn DCOv1 in November 2020. The Council reiterated its concerns about validation of the LTAM base model and its use for the purpose of the local junction assessment in 'Community Impacts Consultation' response issued in summer 2021.

C1.2.3. The Council subsequently suggested, through engagement at the time of the publication of the DCOv1 documents in December 2020, that an alternative approach be adopted by using locally validated micro-simulation models to assess local highway impacts at key junctions in the borough, including:

1 Orsett Cock junction;

2 The Manorway;

3 Daneholes roundabout; and

4 ASDA roundabout.

C1.2.4. Following this, the Council secured an undertaking from NH to develop local operational models to assess the impacts of traffic arising from LTC at Orsett Cock roundabout, The Manorway junction and the area west of the A1089, which includes Daneholes roundabout (referred to as the East-West model). Despite NH agreeing to undertake a series of VISSIM micro-simulation models for the local highway network almost 3 years ago, these assessments have not been completed by NH nor has an agreed position been reached about the impacts of LTC on the local highway network or any necessary mitigation.

C1.2.5. In May 2022 NH provided the Council with cordoned LTAM models to review, which were from the same version of LTAM used to support the DCOv2 application. The following DCO forecast cordon models were provided by NH:

1 Do Minimum scenario (without LTC)

2 Do Something scenario (with LTC)

C1.2.6. For each future scenario forecast years were provided for 2030, 2037, 2045 and 2051. All cordoned models were provided for morning peak hour (0700 - 0800), average interpeak hour (0900 - 1500) and evening peak hour (1700 - 1800).

C1.2.7. The Council's review of the Thurrock cordon LTAM model is included here as Sub-annex 1.1 of this Annex 1. The review identifies that, in addition to junctions identified through earlier reviews based on a previous version of the cordoned LTAM model (reflected by SoCG Matter 2.1.90), several additional key local junctions would be adversely impacted by LTC and hence that there is also a need to undertake detailed operational modelling of the following junctions to determine the precise nature of the impact and whether mitigation is required:

1 A126 Marshfoot Road junction;

2 A13 westbound merge at Five Bells junction; and

3 Devonshire Road/ A1012 junction.

C1.2.8. NH does not consider it necessary to prepare operational models of these local junctions.

C1.2.9. The Council's required hierarchical approach to modelling and the status of LTAM and each of the local junction models is graphically presented in 'Summary of Model Status', included in this LOR as Sub-annex 1.2 to this Annex 1. A RAG (Red/ Amber/ Green) approach has been used to present the status of each local model:

- Green – completed and approved by the Council;
- Amber –completed but not approved;
- Red – not completed.

C1.2.10. The diagram demonstrates that none of the junctions identified for operational modelling have been assessed by NH with the exception of Orsett Cock for which the base model has been provided to the Council and is approved but the forecast modelling is not yet approved by the Council. No operational models are included in the documents supporting the DCOv2 application.

C1.2.11. Each of the local junctions is discussed further below.

Orsett Cock

C1.2.12. The Council has continually raised its concerns about the operation of the Orsett Cock junction and the wider interchange with LTC, as indicated through a number of matters within the SoCG, including Matters 2.1.92, 2.1.147, 2.153 and 2.1.159.

C1.2.13. The Council's requirement for the development of Orsett Cock microsimulation model was accepted by NH in October 2021. It has taken NH over 10 months to develop the Orsett Cock microsimulation model with the forecast results shared with the Council on 15 September 2022, just 6 weeks prior to the DCOv2 submission. The results of the assessment have been summarised by NH in the following:

- NH document "Orsett Cock VISSIM Model Operational Assessment – 2030 & 2045 Preliminary Result" and
- NH document "Lower Thames Crossing. Orsett Cock 2030 Operational Appraisal Design Release. 4.3 Operational Modelling"

C1.2.14. These NH documents on the Orsett Cock VISSIM model are not included in the DCO application. They are therefore included within Attachment 1.3.1 and Attachment 1.3.2 of Sub-annex 1.3 to this Annex 1.

C1.2.15. The Orsett Cock VISSIM base model has been reviewed and agreed by the Council. The forecast VISSIM model for Orsett Cock has been audited by the Council and requires changes to be made to the model before it can be agreed.

C1.2.16. Notwithstanding that the Orsett Cock VISSIM forecast model is yet to be agreed, the results of the model confirmed the Council's concerns that LTAM has significantly underestimated the impacts of LTC on Orsett Cock. NH's own microsimulation modelling (Attachment 1.3.1 and Attachment 1.3.2 of Sub-annex 1.3 of this Annex 1) shows significantly worse operational performance of Orsett Cock in comparison with NH's own strategic modelling completed using LTAM.

C1.2.17. To illustrate, the 2045 strategic LTAM model predicts that, with LTC in place, average delays on any of the approaches to Orsett Cock roundabout will not exceed 77 seconds on a typical weekday morning between 0700 and 0800. However, the more detailed microsimulation assessment at this location during the same peak hour forecasts that average delays will reach 168 seconds on the A128 Brentwood Road (North) approach and 236 seconds on the A128 Brentwood Road (South) approach resulting in significant queuing predicted to reach a maximum of 357m and 534m correspondingly. Unlike the strategic model, the local microsimulation modelling reveals that the impact of LTC on Orsett Cock is severe on a typical weekday morning between 0700 and 0800 and will significantly worsen during the local network peak hour between 0800 and 0900, when the maximum queue length on the A128 Brentwood Road (North) is forecast to reach 794m.

C1.2.18. NH has not considered results of microsimulation modelling to make changes to the Orsett Cock roundabout design to mitigate the impacts. NH has been unable to put forward sufficient design modifications to Orsett Cock junction that would mitigate the severe impacts of LTC at Orsett Cock. The Council does not consider that there are any mitigation proposals that would mitigate the impact of LTC on Orsett Cock within the constraints of this current DCOv2 Order Limits and highway boundary.

C1.2.19. Most types of strategic models, including LTAM, distinguish between 'demand' flow and 'actual' flow. Demand flow represents the volume of vehicles that are expected to be made in a specific area or on a particular road network. It represents the desired or anticipated traffic flow based on factors such as population, economic activity and travel patterns. Actual flow, on the other hand, refers to the forecast real-time traffic volume that will occur on the roads. It is the measurement of the number of vehicles passing through a given point or section of the road network during a specific time period. Actual flows in most instances are lower than demand flows.

C1.2.20. The microsimulation modelling of Orsett Cock is based on actual rather than demand flows from LTAM. At Orsett Cock, demand flows can be 3% higher than actual flows. Therefore, the VISSIM modelling may be underestimating the impact of LTC on capacity of Orsett Cock and microsimulation modelling should be undertaken using demand flows as opposed to actual flows extracted from LTAM to reliably identify congestion hotspots and make informed decisions regarding mitigation.

C1.2.21. It should also be noted that the VISSIM model does not model the impact of emerging Local Plan growth or Freeport growth or the need to provide for WHR and so the Council’s concerns about capacity are under-stated.

C1.2.22. The discrepancy between strategic modelling and local microsimulation modelling at Orsett Cock highlights that the LTAM model has inaccurately assessed the impact of LTC on the LRN and that these local impacts have not been adequately considered or consulted on. The result of this goes beyond concerns about the performance of the Orsett Cock junction within LTAM. The findings have a bearing on realism of traffic routing in LTAM in the ‘with LTC’ scenario. If high level delays at Orsett Cock were correctly reflected in LTAM, this would result in traffic avoiding LTC and re-routing to Thurrock’s local roads. Furthermore, this example demonstrates that there may be issues at other parts of the LRN that have not been identified or fully assessed.

C1.2.23. Results of strategic LTAM modelling have also been used to inform Air Quality and Noise assessments within the Environmental Statement and therefore the Council’s concerns extend to the deficiency of these environmental impact assessments of the scheme.

The Manorway Junction

C1.2.24. In support of ongoing work with the Council regarding LTC DCOv2, NH agreed in 2022 to undertake a microsimulation modelling exercise to better understand traffic operational impacts of LTC on The Manorway roundabout and surrounding network. The Council has raised concerns with regards to the future operation of The Manorway roundabout through SoCG Matters 2.1.96 and 2.1.148.

C1.2.25. As part of this process NH shared forecast VISSIM models of The Manorway roundabout with the Council for review. The forecast models were made available for the AM peak period between 0700 to 0800 (SRN peak hour) and 0800 to 0900 (LRN peak hour) and the PM peak hour of between 1700 and 1800.

C1.2.26. The forecast microsimulation models developed and provided to the Council by NH included four core scenarios (2030 and 2045, with and without LTC). The forecast models were accompanied by the 'Manorway 2030 & 2045 Operation Appraisal Design Release 4.3 Operational Modelling' report issued by NH to the Council in September 2022. This NH document is not included in the DCO application and is therefore included as Sub-annex 1.4 of this Annex 1.

C1.2.27. Although progress has been made with regards to microsimulation modelling, the approach to the assessment of The Manorway completed by NH has a significant limitation. There is no Base Year microsimulation model of The Manorway and NH has solely relied on the flows from its strategic LTAM model to develop forecast VISSIM models of The Manorway roundabout. This is wholly inadequate considering that LTAM is a large strategic multi-modal model and its accuracy to represent turning flows at junctions has not been checked.

C1.2.28. There was no baseline data for The Manorway from which to develop a validated microsimulation base model at the time the approach to microsimulation modelling was discussed between NH and the Council in Spring 2022 – this was understandable at the time as there were construction works in this area of A13. However, since the construction works were completed on the A13, NH has had ample opportunity to collect baseline data and build an operational base model, which would follow established best practice in scheme assessment.

C1.2.29. Therefore, it is the Council's strong opinion that the models provided for The Manorway and the results included in NH's VISSIM report (Sub-annex 1.4 of this Annex 1) cannot be relied upon to make any decisions about the scheme impact or to inform mitigation options. Further work is required to refine and agree the assessment of impacts at The Manorway roundabout.

ASDA Roundabout

C1.2.30. The review of the LTAM models showed that the introduction of LTC exhibits performance concerns at ASDA roundabout in terms of Volume over Capacity (V/C) and delays. The Council has raised concerns with regards to the future operation of ASDA roundabout through SoCG Matters 2.1.97. Notwithstanding this, NH have not agreed to do any operational modelling of the ASDA roundabout.

C1.2.31. Comparing LTAM's 2045 Do Something (DS) against the 2045 Do Minimum (DM) shows that:

1. In the AM peak the 2045 DS flows are 3% higher than the 2045 DM flows and 7% higher in the PM peak.
2. In the PM peak LTC introduces more trips from Port of Tilbury (an increase of 27% or 257 passenger car units (pcu) from 941 pcu in the DM)

C1.2.32. In terms of approach arm V/C, the 2045 DS v 2045 DM LTAM comparison suggests that:

1. The introduction of LTC worsens the performance of the ASDA roundabout with weighted V/C increasing from 93% to 98% in the AM and from 79% to 91% in the PM.
2. In general, a V/C value of 85% and below indicates spare capacity. A V/C value of between 85% and 100% means that a junction or a turning movement operates within but approaching capacity with signs of queuing and delays; whereas a V/C value of 100% and above indicates that the junction operates at or above capacity, resulting in queues and delays.

3 In the AM peak the A1089 South approach is worse in the DS than in the DM and is overcapacity with V/C value of 114% (101% in the DM). The A1089 North approach is also forecast to be overcapacity with V/C at 102% both in the DM and DS.

4 The A1089 South approach shows significant increased delays in the AM peak of 234 seconds, which is unacceptable especially on a route from the Port of Tilbury.

5 In the PM peak access from the approach from ASDA is forecast to be over capacity with V/C of 109% compared to 104% in the DM.

6 Thurrock Park Way approach in the PM peak shows a significant increase in delay of 109 seconds.

C1.2.33. Considering the LTAM is a strategic model and the fact that the AM peak hour on the roads in Thurrock is 0800-0900 rather than 0700-0800, which was used in the LTAM model development, evidence is required (e.g. microsimulation / junction modelling) to determine the impact of LTC on the junction and whether mitigation is required.

C1.2.34. In the absence of any operational modelling at ASDA roundabout, the Council has completed an initial assessment of the junction using standalone junction modelling software Junctions 10 (ARCADY) based on 2018 traffic surveys reported within Thames Enterprise Park outline planning application (18/01404/OUT) and future growth from the LTAM. The results of this assessment are presented within Sub-annex 1.5 of this Annex 1.

C1.2.35. This assessment confirms that the operation of ASDA roundabout will deteriorate on all approaches to the junction with the LTC included. With LTC, delays on the northern approach to the roundabout from A1089 Dock Road may be as high as 495 seconds (PM peak) compared to 220 seconds reported by LTAM. Dock Road is an important link to the community in Tilbury and this impact is not mitigated.

C1.2.36. The Council is therefore concerned that the impact of LTC on ASDA roundabout has not been adequately assessed or presented using strategic modelling results only and that further work is crucial to understand the true impact of LTC.

Daneholes Roundabout

C1.2.37. The latest LTAM strategic model forecasts show that in the 2045 DS flows through Daneholes Roundabout are expected to reduce below the DM flows (6% lower). The reduction in the total flow going through the junction may be a result of the reconfiguring of the new link road from the Orsett Cock junction to A1089 southbound included in the DCOv2 LTC design. Overall, the junction performance in the DS is generally seen to remain similar to the DM or marginally to improve.

C1.2.38. However, the Council is aware that microsimulation assessment provides a more robust understanding of junction impacts and a more accurate understanding of likely performance. This has been demonstrated at Orsett Cock and the underestimating of impacts in LTAM. LTAM has several limitations associated with its strategic nature and therefore a microsimulation assessment is required to provide confidence to the Council that the operation of Daneholes Roundabout is not adversely affected by LTC. The junction is located along an important public transport corridor and access to schools and the Council is particularly concerned about its future operation.

C1.2.39. It is the Council’s position that the microsimulation modelling at Daneholes roundabout, as previously agreed with NH, is still required. Until the assessment using microsimulation is complete the Council will reserve judgement on the operation and impact of the junction.

A126 Marshfoot Road Junction

C1.2.40. The review of the LTAM models showed that the introduction of LTC would result in deterioration of performance of the A126 Marshfoot priority junction. Comparing the 2045 DS against the 2045 DM shows that:

1 In the AM peak the 2045 DS flows are 8% higher than the 2045 DM flows and 6% higher in the PM peak.

C1.2.41. In terms of approach arm V/C and delays the 2045 DS v 2045 DM comparison suggests that:

1 In the AM peak hour, no arms are over capacity although the minor arm approach from the west exceeds 85% in both the DM and DS. In the PM peak the same approach has V/C of 100% in the DM and gets slightly worse reaching 101% in the DS.

2 With the LTC included, the delays on the approach from the minor arm are forecast to increase from 71 seconds to 80 seconds in the AM peak hour and from 78 seconds to 95 seconds in the PM peak hour.

C1.2.42. The increase in movements at this junction are of concern to the Council, particular reflecting the current poor safety record at this junction. Considering LTAM is a strategic model and the fact that the AM peak hour on the roads in Thurrock is 0800-0900 rather than 0700-0800, which was used in the LTAM model development, evidence is required (e.g. microsimulation / junction modelling) to determine the impact of LTC on the junction and whether mitigation is required.

A13 Westbound On-slip Merge at Five Bells

C1.2.43. Examination of the LTAM results highlights capacity concerns on the A13 westbound on-slip merge at Five Bells.

C1.2.44. Comparing the 2045 DS against the 2045 DM shows that:

1 In the AM peak the 2045 DS flows are 2% higher than the 2045 DM flows and 8% higher in the PM peak.

2 The introduction of LTC substantially worsens the performance of the A13 westbound merge with maximum V/C increasing from 115% to 129% in the AM and from 92% to 103% in the PM.

C1.2.45. The LTAM strategic model forecasts significant worsening of congestion on the A13 westbound merge resulting in rat-running through communities of Corringham and Stanford-le-Hope.

C1.2.46. Further work is required from NH to refine the assessment of the merge performance (for example, using microsimulation modelling) and to mitigate the impact of LTC at this location such that the demand flows are accommodated at Five Bells so that rat-running does not occur through the communities of Corringham and Stanford-le-Hope.

Devonshire Road/A1012

C1.2.47. The review of LTAM shows that the introduction of LTC would result in increased flows at the Devonshire Road/ A1012 roundabout. Comparing the 2045 DS (DCOv2) against the 2045 DM shows that:

1 In the AM peak the 2045 DS flows are 4% higher than the 2045 DM flows and 11% higher in the PM peak.

2 There are no arms over capacity at the junction and no delays of note.

C1.2.48. Considering significant flow increases through the junction in the DS scenario, the strategic nature of the LTAM and the fact that the AM peak hour on the roads in Thurrock is 0800-0900 rather than 0700-0800, which was used in the LTAM model development, evidence is required (e.g. microsimulation / junction modelling) to determine the impact of LTC on the junction and whether mitigation is required. The Council reserves its final judgement on the junction operation until further modelling is provided.

C1.3 Impact of Traffic on Local Communities

C1.3.1. At the time of opening of LTC in 2030 NH is forecasting there will be a 6% increase in total vehicle trips in Thurrock in the AM and PM peak hours compared to 2030 DM scenario (i.e. without LTC). This increase occurs because of the new traffic that LTC will attract through Thurrock. In 2030 this could mean around an extra 4,000 vehicle trips in Thurrock at the busiest hours of the day.

C1.3.2. By 2045 LTC is forecast to generate an additional 7% vehicle trips in Thurrock, which is around 5,000 trips both in the morning and evening peak hours when compared to 2045 DM scenario (i.e. without LTC).

C1.3.3. NH's strategic transport model forecasts that LTC will substantially increase traffic on some of the most important and busiest roads in Thurrock including the:

1. A1089 is forecast to see 46% and 41% increases in northbound traffic in the morning and evening peak hours by 2045 as a result of LTC.
2. A13 east of the Orsett Cock roundabout is forecast to see increases in traffic ranging between 11% and 19% in the morning and evening peak hours by 2045 as a result of LTC.

C1.3.4. LTC is also forecast to increase traffic on some unsuitable local roads and through local communities in Thurrock. These concerns are raised by the Council through SoCG Matters 2.1.60 to 2.1.162. The places within Thurrock noted to be affected including:

1. Rectory Road in Orsett is forecast to see a significant increase in traffic in the morning (+18%) and evening (+20%) peak hours by 2045 as a result of LTC.
2. Brentwood Road (south of A13 Orsett Cock junction), between Orsett and Orsett Heath, is forecast to see increases in traffic of 59% and 24% in the morning and evening peak hours respectively by 2045 as a result of LTC.
3. Chadwell Hill in Chadwell St Mary is forecast to see increases in traffic of 11% and 6% in the morning and evening peak hours respectively by 2045 as a result of LTC.
4. Muckingford Road in Linford is forecast to see increases in traffic of 32% in the evening peak hours by 2045 as a result of LTC.
5. The LTAM strategic model forecasts significant worsening of congestion on the A13 westbound merge at Five Bells junction resulting in rat-running through communities of Corringham and Stanford-le-Hope.

C1.3.5. NH is not proposing any mitigation to local road congestion caused by LTC and traffic impacts through communities within Thurrock. The Council considers that these local impacts need to be mitigated and for mitigation to be secured through a Deed of Obligation.

Sub-annex 1.1 – Thurrock Council Review of DCOv2 Cordoned Operational Model

Lower Thames Crossing

Review of DCOv2 Cordon Transport Models

On behalf of **Thurrock Council**

thurrock.gov.uk

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Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: Caversham Bridge House, Waterman Pl, Reading RG1 8DN

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	Name	Position	Signature	Date
Prepared by:	Sam Ampomah/ Norbert Moyo/ Nadia Lyubimova	Graduate/ Principal Transport Planner / Director	SA/NM/NL	18/08/2022
Reviewed by:	Nick Blades/ Adrian Neve	Senior Associate/ Director	NB/ AN	22/09/2022
Approved by:	Nadia Lyubimova	Director	NL	28/09/22
For and on behalf of Stantec UK Limited				

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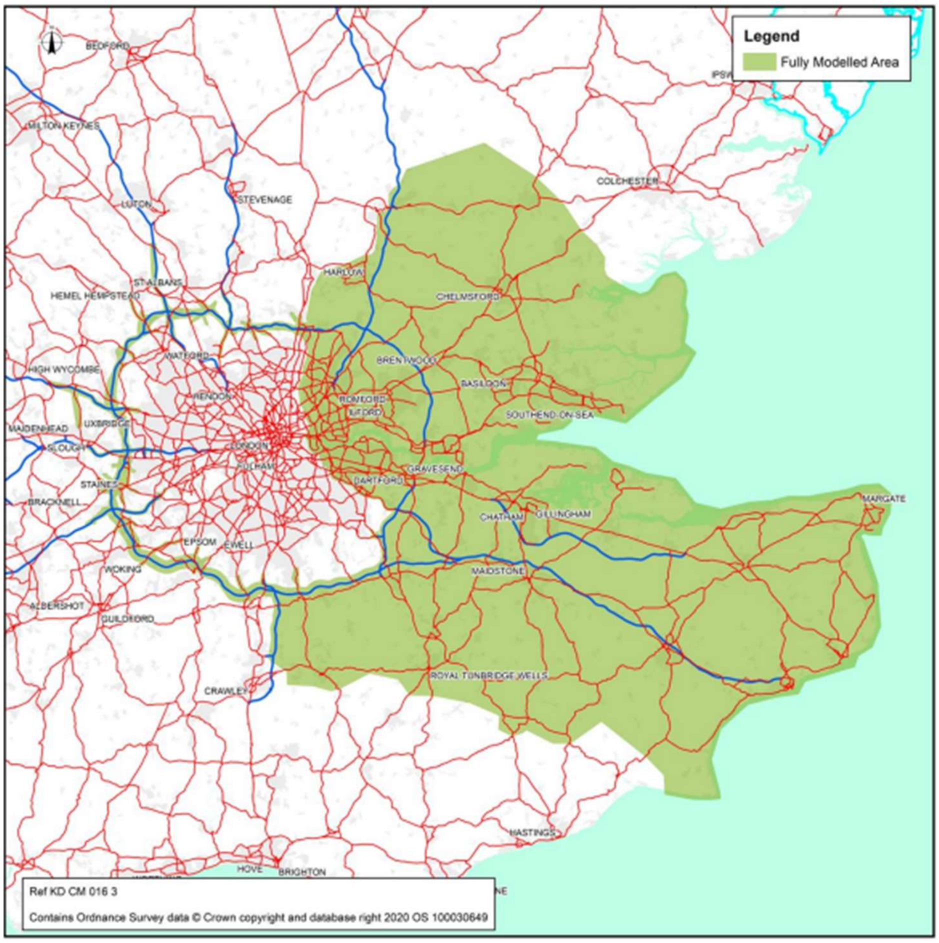
Executive Summary

Introduction and Purpose

In May 2022 National Highways (NH) provided Thurrock Council with updated versions of the Lower Thames Area Model (LTAM) - known as DCO2v2 - to review. LTAM is the main traffic modelling tool being used by NH to assess the impacts of changes in traffic flow forecast to arise as a direct result of construction of the proposed Lower Thames Crossing (LTC) scheme. The full LTAM covers a wide area of road network across the Lower Thames region, including Thurrock – see Figure 1.

Only Cordon versions of the full LTAM model have been provided to Thurrock Council just covering the extent of the highway across Thurrock. This has severely limited the Council ability to fully understand the scheme's strategic impacts and the cause of traffic flow changes in Thurrock. The Council has consistently asked NH to provide access to the full model but this has been refused.

Figure 1 LTAM Full Model Area



The following DCO2v2 cordon models were provided by National Highways:

- An updated 2016 base year model (which provides baseline traffic flows from which the future modelled scenarios are developed)
- Two main future scenario models:
  - (1) Do Minimum scenario (without LTC)
  - (2) Do Something scenario (with LTC)

Each future scenario was provided for a range of forecast years: 2030, 2037, 2045 and 2051. All cordoned models have been provided for morning peak hour (0700 - 0800), average interpeak hour (0900 - 1500) and evening peak hour (1700 - 1800).

Stantec were commissioned to undertake a review of the latest DCO2v2 models. The purpose of the review was to:

(1) Identify and assess the main forecast impacts of the operation of LTC on Thurrock roads considering updates made by NH to the model

(2) Identify the main updates made to the DCO2v2 Base Year and Forecast Year models (since the previous version of the model, DCO2v1, was provided to the Council in June/July 2021)

Summary of Review Findings

Model Development and Forecasting Approach

The review has considered the main changes made to the previous DCO2v1 models to produce the updated DCO2v2 models including the trip matrix totals, network coding, forecasting assumptions and the level of model validation achieved in the base year models. The review has identified several significant updates made to the models and concerns related to the models shared as summarised below:

Base Year Model, Trip Demand Matrix Changes - it was found that the total number of trips in the updated 2016 base model is between 3% and 5% higher compared to the previous models. Out of all the vehicle classes (cars, LGVs, HGVs) LGV trips demonstrate the biggest percentage change of all the vehicle classes (these are 13% to 15% higher than in the previous models). **An explanation of the reasons for the matrix changes is required particularly explanations of the reasons of the increase in LGVs is required to fully understand the implications to Thurrock's local highway network.**

Base Year Model Validation - the differences between 2016 observed and modelled data have been examined to ascertain how well the latest base year model is able to match observed traffic flows on the road network. The link validation results showing that 91% of road links selected for validation in the AM peak and 85% of road links in the PM models meet or exceed DfT's link validation criteria. This indicates that the base year model can replicate well observed traffic volumes on the selected road links.

However, it should be noted that the model validation cannot be limited to just link validation and good practice recommends that model validation should also consider matrix validation, validation of turning movements at key junctions and comparison of observed and modelled journey times. **Additional information as part of a Local Model Validation report is required from NH to ascertain if the base year DCO2v2 model represents a suitable basis for forecasting the impacts of the LTC on the strategic and local roads.**

Furthermore, in the past Stantec had raised concerns about the limited number of locations within Thurrock at which flow calibration and validation had been undertaken. **Overall significant concerns remain regarding the validation of the local road network within Thurrock and the Council's view is that higher standards of model validation of the highway network in Thurrock are required.**

Assessment Time Periods - The local network morning peak hour in the Thurrock is 0800 – 0900, but LTAM has only been developed to assess the Strategic Road Network (SRN) morning peak of 0700 – 0800. **The Council therefore continues to maintain significant concerns about the accuracy of the impact assessment of the LTC on the local roads in Thurrock using the LTAM.**

Forecast Models: Network Changes - The two main changes on the Thurrock network identified in the forecast models are (1) the provision of the new Orsett Cock junction link road that would provide a direct connection from Orsett Cock roundabout to the A1089 southbound. (2) update to Orsett Cock roundabout with an additional two signalised nodes resulting in the junction having four signalised nodes in the DCO2v2 models compared to the previous DCO2v1 models.

Forecast Models: Trip Demand Matrices - The total number of forecast vehicle trips on Thurrock roads in the new DS and DM DCO2v2 models are between 5% and 6% higher compared to the previous DCO2v1 models. LGV trips are 13% to 15% higher than in the previous models and show the biggest increases of all the vehicle classes. HGV trips are 0.5% to 3% higher. The differences in forecast matrix totals between DCO2v2 and DCO2v1 models are thought to be partially due to the increases in the base year trip matrices. **Explanation of the changes in the Base Year matrices is therefore required.**

It should be noted that a review of the previous DCO2v1 forecast models against DCO1 models concluded that there were more car trips forecast to travel from, to and through Thurrock in the DCO2v1 model compared to DCO1 model with increases ranging between 1% and 26% for different trip demand segments. **A sequence of reviews highlights a trend for higher traffic flows forecast in Thurrock with each subsequent model update and an explanation of this phenomenon is required from NH**.

Forecast Models: Future Development Uncertainty Log - A check of the updated Uncertainty Log for future new development indicates five new development sites in Thurrock have now been included in the DCO2v2 forecast scenarios. Development associated with London Gateway and Thames Enterprise Park have been accounted for in the forecast scenarios.

Sensitivity Tests and Reflecting Uncertainty in Transport Model Forecasts - **The Council has not been provided with evidence that DfT's guidance related to accounting for uncertainty in model forecasting has been followed and requests that at least DfT's Common Analytical Scenarios are considered to test uncertainty around LTAM model forecasts**. For example, we have not received any sensitivity test results providing further details on how traffic arising from the Thames Freeport proposals at the Port of Tilbury and London Gateway/DP World will impact on the highway network. Similarly, we have not received any sensitivity test results on how the 'with the LTC' highway network will perform with the Council's New Local Plan growth proposals.

Full LTAM Model Access - NH has only provided impacted local authorities with access to cordon versions of the LTAM model (covering their administrative areas) to help them understand local scheme impacts. **The Council view remains that access to the full LTAM model should be provided to enable a fuller understanding of the scheme's strategic impacts.**

Impacts of the LTC on the Council's Highway Network

Travel Demand in Thurrock

Overall, the introduction of the LTC is forecast to result in increases in the total number of car, LGV and HGV movements on the road network within the boundary of Thurrock (including those using LTC itself). In 2030 a 6% increase in trips is predicted in both the morning and evening peak hours (equivalent to 4,037pcu and 4,186pcu per hour). In 2045 a 7% increase in trips is predicted in both the morning and evening peak hours (which is equivalent to 5,346pcu and 5,335pcu per hour).

These increases can be due to changes in the reassignment or re-routing of existing traffic from the wider area resulting from the introduction of the LTC but may also be due to completely new trips on the network, model shift from public transport and a change in people's origins and destinations of travel across the wider area. The extent of each of the travel response cannot be fully understood from the cordon models made available to the Council.

An explanation is required as to the main cause of the forecast increase in trips crossing the river 'with the LTC' in place. Additional traffic on the highway network in Thurrock will inevitably result in increased congestion and impact on carbon emissions, air quality and noise levels, which is of huge concern to the Council.

Strategic Cross River Traffic Movements

Total cross-river traffic flows in the scheme opening year are forecast to increase by 38-40% with flows on Dartford Crossing dropping by 14-18%. However, 15 years after scheme opening the total volume of cross river trips is forecast to increase by 53-62%, whereas flows on Dartford Crossing are only forecast to drop by 1-8%.

The proposed LTC is promoted as a scheme that will provide an additional river crossing and relieve pressure from the existing A282 Dartford Crossing/Queen Elizabeth II bridge. However, it is evident that the updated (DCO2v2) and previous (DCO2v1) models predict that 15 years after opening, the flow reductions on the existing Dartford Crossing as a result of the LTC will have waned significantly particularly in the AM peak.

While in both the opening year and 15 years after opening the scheme provides a relief to the existing Dartford Crossing, the relief is now forecast to be less in the updated DCO2v2 models which will further undermine the Value for Money (VfM) case of the scheme. It is requested that an explanation and results be provided on the implications of the updated models on Value for Money category of the scheme including Initial and Adjusted Benefit Cost Ratio (BCR).

Lower Thames and Thurrock Cordon – Overall Modelled Network Performance

Global forecast network performance statistics from the full LTAM model have been provided by National Highway. These provide a very high level indication of the likely overall performance of the whole Lower Thames area road network that is covered by the model. **The global network statistics show that introduction of the LTC in 2045 is forecast to result in reduced congestion across the whole network.**

In comparison with the 2045 DM models, the DS models show that there is a reduction in transient queues (correspond to the queues that develop during the red phase and then dissipate in the subsequent green phase) of 0.4% and 0.6% in the morning and evening peaks respectively. Both peak hours are also forecast to see a reduction in over-capacity queues of 2% (these occur where a permanent queue builds up which is unable to clear in a single cycle). There is a forecast increase in overall average speed in the with LTC scenario, thus indicating reduced congestion - increases of 0.8% and 0.9% are forecast in the morning and evening peak respectively.

However, the statistics show that in 2045 total distance travelled by all vehicles across the network is expected to increase by 1% in both the morning and evening peaks. Total travel time by all vehicles is also predicted to increase by 0.1% and 0.2% in the morning and evening peak hours respectively. This demonstrates that the LTC is expected to increase the total vehicle km and vehicles hours on the network.

The network performance statistics from the Thurrock area only cordon models forecast that introduction of the LTC will results in a decrease in over-capacity queues of -26% and -23% in the morning and evening peaks. In the wider LTAM network a decrease in over-capacity queues of 2% for both the morning and evening peaks respectively. This again suggests that 'with the LTC' in place the road network in Thurrock will see reduced congestion. However, an increase of 13% in total vehicle travel distance is expected in the Thurrock area in the morning and evening peaks. An increase of 3% and 7% in total vehicle travel time is also forecast for the morning and evening peaks.

Impacts of Emissions of Pollutants in Thurrock

Emission statistics extracted from the LTAM model files (rather than from specific Air Quality or Carbon Assessments of which further data has not been provided for this review) forecast an increase in CO2 (kg) emissions in Thurrock of 10.5% and 12.5% in the morning and evening peak hours respectively. NOX (kg) emissions in Thurrock are forecast to increase by 6.6% and 8.8% in the morning and evening peaks. An increase in PM10 (kg) emissions in Thurrock is also predicted - of 3.7% and 7.1% for the morning and evening peak periods

Impacts on Strategic and Local Roads in Thurrock

The flow changes as a result of the LTC in Thurrock are quite complex although the pattern and location of predicted traffic flow changes is relatively similar across the AM and PM peak modelled hours. They are also similar to the flow changes observed in the previous DCO2v1 model review. National Highways' DCO2v2 traffic models are forecasting that LTC will substantially increase traffic on some of the most important and busiest roads in Thurrock including on the:

- A1089 is forecast to see 46% and 41% increases in northbound traffic in the morning and evening peak hours by 2045
- A13 east of the Orsett Cock roundabout is forecast to see increases in traffic ranging between 11% and 19% in the morning and evening peak hours by 2045

LTC is also forecast to increase traffic on some unsuitable local roads and through local communities in Thurrock including on:

- Rectory Rd, Orsett is forecast to see a significant increase in traffic in the morning (+18%) and evening (+20%) peak hours by 2045
- Brentwood Road (south of A13 Orsett Cock junction) is forecast to see increases in traffic of 59% and 24% in the morning and evening peak hours respectively by 2045
- Chadwell Hill, Chadwell St Mary is forecast to see increases in traffic of 11% and 6% in the morning and evening peak hours respectively by 2045
- Muckingford Road is forecast to see increases in traffic of 32% in the evening peak hours by 2045

The proposed new Orsett Cock link road (connecting the A13 Orsett Cock junction to the southbound A1089) which is now forms as part of the LTC scheme design, is expected to reduces flows on the A1013 Stanford Road to the west of Orsett Cock roundabout in both directions. However, on the A1013 to the east of the Orsett Cock roundabout, flows are seen to significantly decrease westbound and significantly increase eastbound. The latter is due to a significant number of additional trips generated by the LTAM for the area south east of Orsett Cock in the DS. The Orsett Cock link road also has a mixed impact on flows on Brentwood Road, which is predicted to see a drop in traffic north of the junction and a significant increase south of the junction thus impacting Chadwell St Mary community.

Further analysis of the implications of the traffic flow changes is required to fully assess the impacts on road capacity, local communities, vulnerable road users, active modes and sustainable transport. In particular, further analysis by the scheme promoter is required on:

- A1089/Marshfoot Road
- Orsett Village area
- Chadwell St Mary Area including Brentwood Road and Linford Road
- West Tilbury Area
- Local Network in Stanford-le-Hope and Corringham
- Purfleet area

Impacts on the Performance of Key Local Junctions

Analysis of junction performance for a set of key junctions have been undertaken. The analysis has summarised the predicted impact of the two main DCO2v2 scenarios – the Do Minimum (No LTC) and Do Something (with LTC) - on traffic flows at these critical local junctions in the morning and evening peak hours. The analysis has shown that with the introduction of the LTC scheme the junctions which are showing significant predicted flow increases, as well as exhibiting future operational performance concerns, are:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- A13 westbound merge at Five Bells junction

Updates have been made to coding in the model of the Orsett Cock roundabout with an additional two signalised nodes. This has resulting in the junction having four signalised nodes in the DCO2v2 model compared to the previous DCO2v1 model. The change in the junction configuration has not been discussed with the Council as local highway authority.

A fundamental feature of the NH's LTAM model is that it is strategic in nature and has not been validated at local junction level. Therefore, in areas of concerns either highlighted through strategic modelling or raised by the Council local junction assessments must be undertaken with the appropriate junction modelling software or micro-simulation packages using outputs from LTAM to confirm the junctions are not severely impacted by the introduction of the LTC.

Local junction modelling using Vissim is still being progressed by NH for Orsett Cock roundabout and the Manorway roundabout. Local junction modelling is also required for the ASDA Roundabout, Marshfoot Road/ A1089 Junction and Devonshire Road/ A1012 junction. The Council is awaiting the traffic assessment using Vissim and will reserve judgement on the operation of the junctions when results of the assessments emerge.

The latest LTAM strategic model forecasts show that in the 2045 DS flows through Daneholes Roundabout are expected to reduce below the DM flows. However, we are aware that microsimulation assessment provides a more robust understanding of junction impacts and a more accurate understanding of likely performance thus addressing limitations of the LTAM stemming from its strategic nature. It is the Council position that the microsimulation work at Daneholes Roundabout, as previously agreed with NH, is still required. Until the assessment using Vissim is complete we will reserve judgement on the operation of the junction.

1 Introduction

1.1 Overview

1.1.1 Thurrock Council (the Council) has been engaged in a consultation and engagement process being led by National Highways (NH) regarding the proposed Lower Thames Crossing (LTC). The LTC is a proposed new road and tunnel connecting Kent, Thurrock and Essex. The scheme has the following objectives:

- To support sustainable local development and regional economic growth in the medium to long term
- To be affordable to Government and users
- To achieve Value for Money
- To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free-flowing north-south capacity
- To improve resilience of the Thames crossings and the major road network
- To improve safety, and
- To minimise adverse impacts on health and the environment

1.1.2 The Lower Thames Area Model (LTAM) has been developed and used by NH as the scheme promoter to understand the impacts of the LTC scheme and also to provide evidence that the scheme achieves the objectives as set out above.

1.1.3 The LTAM is a variable demand model. For each model year the model is used to forecast how travellers will change their behaviour as a result of highway and public transport interventions, changes in the levels of congestion, the cost of fuel, and other external factors. he model forecasts the routes that drivers will take, given the higher levels of traffic on the network and their behavioural responses to the change in the time and cost of their planned trips[1]. These forecasts are prepared using a road network, which does not include the LTC (Do Minimum scenario, DM) and a road network, which includes the LTC (Do Something scenario, DS).

1.1.4 NH has only provided impacted local authorities, including the Council, with access to cordon versions of the LTAM model (covering their administrative areas) to help them understand local scheme impacts. This is despite repeated requests from the Council and other LAs for access to the full LTAM model to enable a fuller understanding of the scheme's strategic impacts.

1.1.5 NH is preparing an application for Development Consent to construct and operate the new crossing. The Development Consent Order (DCO) consultation process for the LTC has included the following key consultation stages, with the latter two stages being additional due to the withdrawal of the DCO application on 20 November 2020 based on early feedback from the Planning Inspectorate:

- Statutory Consultation - 2018
- Supplementary Consultation – early 2020
- Design Refinements Consultation – mid 2020
- DCO1 Application – October 2020
- Community Impacts Consultation – Summer 2021
- Local Refinement Consultation – Summer 2022 (the subject of this review)

1.1.6 Stantec is supporting the Council on technical engagement with NH and with consultation responses in relation to the LTC. Stantec previously reviewed the cordon model of Thurrock extracted from the wider LTAM developed for the Statutory Consultation (Stat Con) in 2018

[1] Trip is a one journey of a person between an origin and a destination.

and Supplementary Consultation in 2020. The transport model used to inform these elements is referenced as the DCO1 model.

1.1.7 Following review of the DCO1 model, Stantec subsequently reviewed the DCO2 model, the findings of which can be found within the document titled 'Lower Thames Crossing Consultation DCO2 Transport Modelling Review' dated November 2021. This model is referred to as the **DCO2v1** model in this report.

1.1.8 A model review reported in this document is the latest iteration of the LTAM model to be reviewed and has been produced using a version of LTAM, revised by NH for the Local Refinement Consultation (2022). This model is referenced as the Development Control Order 2 (**DCO2v2**) model in this report.

1.1.9 In summary, this report considers the updated model DCO2v2 and compares it to the previous model DCO2v1. It should be noted that this report does not compare the differences between DCO1 and DCO2v2 models.

1.2 Information received from National Highways

1.2.1 Cordon models representing the Thurrock area were provided from the LTAM for the forecast years of 2030, 2037, 2045 and 2051. Cordon models for the updated 2016 Base Year were also provided.

1.2.2 The models have been provided for the following time periods:

- AM peak hour, 0700 - 0800
- Average interpeak hour, 0900 - 1500
- PM peak hour, 1700 - 1800

1.2.3 The review presented in this report has focused on the AM and PM peaks, which are generally more congested than the IP representing an average hour.

1.2.4 It should be noted that in the past Stantec had raised concerns about the AM peak hour of the LTAM. The LTAM has only been developed to test the Strategic Road Network (SRN) AM peak of 7am – 8am. However, the peak hour observed on local network in Thurrock is 8am-9am. The Council therefore has significant concerns about the accuracy of the impact assessment of the LTC on the local roads in Thurrock using the LTAM.

1.2.5 Table 1-1 provides a summary of the received cordon models for this review.

Scenario	Model Folder	Remarks
2016 Base	LR_N108_2016	Updated 2016 Base Year Model, 2016 retained as base year
Do Minimum (DM)	LR_CM45_2030	Forecast Year 2030 **Do Minimum** without the Lower Thames Crossing
	LR_CM45_2037	Forecast Year 2037 **Do Minimum** without the Lower Thames Crossing
	LR_CM45_2045	Forecast Year 2045 **Do Minimum** without the Lower Thames Crossing
	LR_CM45_2051	Forecast Year 2051 **Do Minimum** without the Lower Thames Crossing
Do Something (DS)	LR_CS67_2030	Forecast Year 2030 **Do Something** with the Lower Thames Crossing – LTC Opening Year

Scenario	Model Folder	Remarks
	LR_CS67_2037	Forecast Year 2037 **Do Something** with the Lower Thames Crossing
	LR_CS67_2045	Forecast Year 2045 **Do Something** with the Lower Thames Crossing - LTC 15 years after Opening
	LR_CS67_2051	Forecast Year 2051 **Do Something** with the Lower Thames Crossing

Table 1-1 Summary of received information

1.2.8 In addition to the cordon models, other information provided for the review include:

- Global statistics from the wider LTAM model
- The Do Minimum (CM45) GIS shapefiles
- The Do Something (CS67) GIS shapefiles.

1.2.9 Accompanying summary documentation was provided with the models as follows:

- Cordon model note 'April 2022.pdf', which has listed the updated cordon models provided
- 'GIS shapefile note April 2022.pdf', which has summarised GIS shapefile information and the uncertainty log.

1.2.10 The later document also references a revised Transport Model Package (TMP) and a revised Transport Forecasting Package (TFP), which were being prepared and were expected to complete the NH assurance process during the summer of 2022. This information was not made available to the Council for this review.

1.2.11 No detailed supporting technical documentation has been provided on the changes made to the forecast DCO2v1 models although an accompanying summary document states that the new model runs (DCO2v2) reflect:

- Revised opening year of 2030 in the DCO2v2 models as opposed to 2029 in the DCO2v1 models previously reviewed
- Changes to the scheme design, most significantly at the LTC / A13 / A1089 interchange which now includes the provision of a new link road connecting the A13 Orsett Cock roundabout to the A1089
- Updated uncertainty log, which informs the forecasts for the DCO2v2 model.

1.3 Report Structure

1.3.1 Following this introduction, this report is structured as follows:

- Section 2: Updated base model 2016 review
- Section 3: Overview of model changes between DCO2v1 and DCO2v2
- Section 4: Overview of matrix changes between DCO2v1 and DCO2v2
- Section 5: Impact of the LTC on network-wide statistics
- Section 6: Impact of the LTC on link flows
- Section 7: Impact of the LTC on the strategic cross river traffic movements
- Section 8: Review of the impact of the LTC on key junction performance
- Section 9: Impact of the LTC on journey times from/to the Port of Tilbury
- Section 10: Overall summary and conclusions.

2 Updated 2016 Base Model Review

2.1 Introduction

2.1.1 NH has provided an updated 2016 Base Year model (as part of the DCO2v2 modelling pack). 2016 has been retained as the base year of the model. Despite requests from TC no accompanying documentation was made available by NH to explain what changes had been made to the previous base model to create the rebased model, nor was there an accompanying Local Model Validation Report (LMVR). Stantec has made some comparisons of the models to understand any changes made.

2.2 Overview of the Base Model Comparison

2.2.1 Following receipt of the 2016 updated model, Stantec has undertaken checks and comparisons of the updated base model (DCO2v2) against the previous base model Stantec reviewed as part of the Community Impacts Consultation (DCO2v1). This has included a check of matrix totals, key network and flow changes. In addition, a comparison of the modelled flows of the updated base year model against observed counts to check has been undertaken to ascertain if there has been a change in the way the updated model replicates observed flows in the borough.

2.3 Structural Network Changes

2.3.1 A GIS analysis of the networks indicates that there have been some 'structural' network additions in the 2016 updated cordon models compared to the previously released 2016 Base Year cordon models. The additional links are shown as red lines in Figure 2-1.

2.3.2 A key addition appears to be an inclusion of the Lower Dunton Road/B1007, which provides a connection between the A127 and A13 at the Manorway roundabout.

2.3.3 The reasons for these additions to the network are not clear. However, it is thought that some of these links were present in the original version of the full LTAM but were excluded from the previous Thurrock cordon.

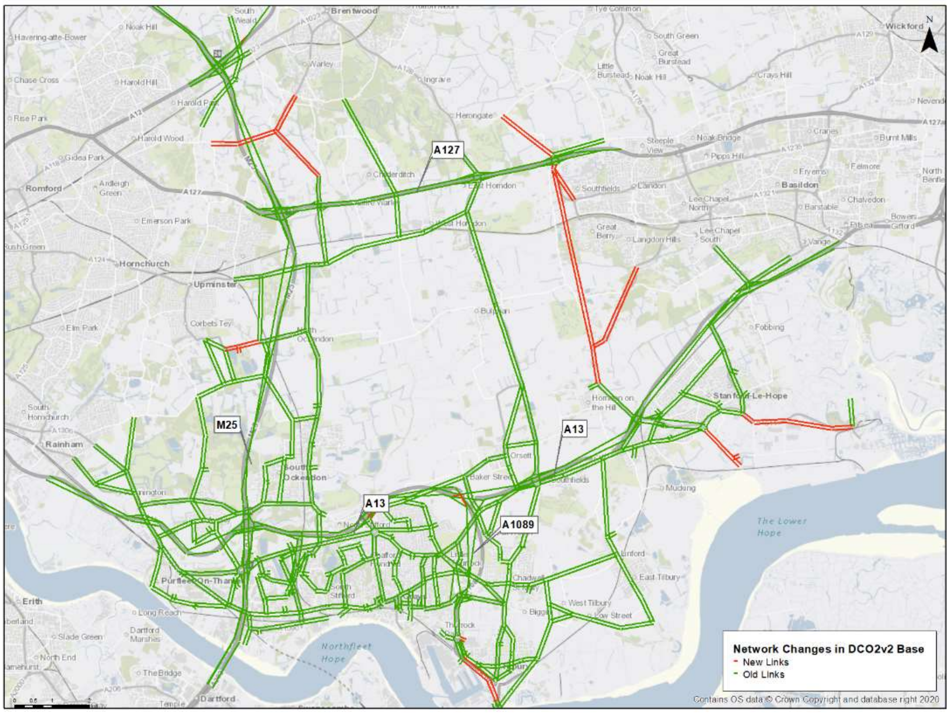


Figure 2-1 GIS indicated network differences in 2016 Updated Model

2.4 Base Matrix Comparison

2.4.1 Table 2-1 provides a summary of the changes observed between the previous DCO2v1 2016 Base model and DCO2v2 2016 updated base model matrices.

2.4.2 When comparing the DCO2v2 2016 updated model trip matrix totals to the DCO2v1 2016 Base previously reviewed, the following observations can be made across different peak hours:

- The total number of trips (expressed in the number of pcu[2] per hour) in the updated models are higher by between 3% and 5% compared to the previous models
- Car 'Employers Business' purpose trips in the new models are between -3% to 1% of the previous model trip numbers
- Car 'Commuting' trips are 3% to 5% higher than in the previous models
- LGV trips are 13% to 15% higher than in the previous models and show the biggest percentage increase of all the vehicle or user classes
- HGV port trips are 4% to 7% higher than in the previous models although non-port HGV trips are 0% to -1% of the previous numbers. Overall, HGV trips are 0% to 1% different to the previous ones.

2.4.3 To fully understand the implications to Thurrock's local highway network, an explanation regarding the matrix changes is required, particularly explanations of the reasons and evidence of the need for the increase in LGVs and HGV port trips.

User Class	Description	Difference (pcu/hr)	% Difference
Cars Employers Business	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	-142	-3%

[2] A Passenger Car Unit is a measure used primarily to assess highway capacity, for modelling purposes. Different vehicles are assigned different values, according to the space they take up. A car has a value of 1, and larger vehicles will have higher values.

User Class	Description	Difference (pcu/hr)	% Difference
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	+29	1%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+53	1%
Cars Commute	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	+461	3%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	+168	3%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+715	5%
Cars Other	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	+754	5%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	+607	3%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+952	5%
LGVs	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	+953	13%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	+686	14%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+784	15%
HGVs (non-Port)	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	-21	0%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	-162	-1%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	-45	-1%
HGVs (Port)	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	+123	7%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	+135	6%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+72	4%
HGVs (Total)	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	+102	1%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	-27	0%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+27	0%
Total Trips	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **AM peak**	+2,128	4%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **Inter peak**	+1,462	3%
	Difference between 2016 Rebase (DCO2v2) and 2016 Base (DCO2v1) **PM peak**	+2,530	5%

Table 2-1 Changes in Matrix Totals between previous 2016 Base (DCO2v1) and updated 2016 Base (DCO2v2)

2.5 Flow Difference

2.5.1 The network and matrix changes summarised earlier in this section are likely to have an impact on the 2016 Base Year modelled flows. The extent of this impact has been analysed by comparing modelled flows in the updated Base Year model (DCO2v2) with the previously reviewed DCO2v1 base year model. The results of this comparison are presented in Figure 2-2 and Figure 2-3 for the AM and PM correspondingly.

2.5.2 The biggest increases in traffic flows reaching around 500 pcus are observed along the A13. Stantec's review of 2016 base modelled traffic flows in DCO1 and DCO2v1 models highlighted that generally the local roads in the model are lower than observed, particularly on key links, like the A1013, Brentwood Road through Chadwell St Mary, The Manorway and the A1089. It appears that DCO2v2 Base Year model update has attempted to address some of these issues. However, no evidence or revised LMVR has been provided by NH to confirm this.

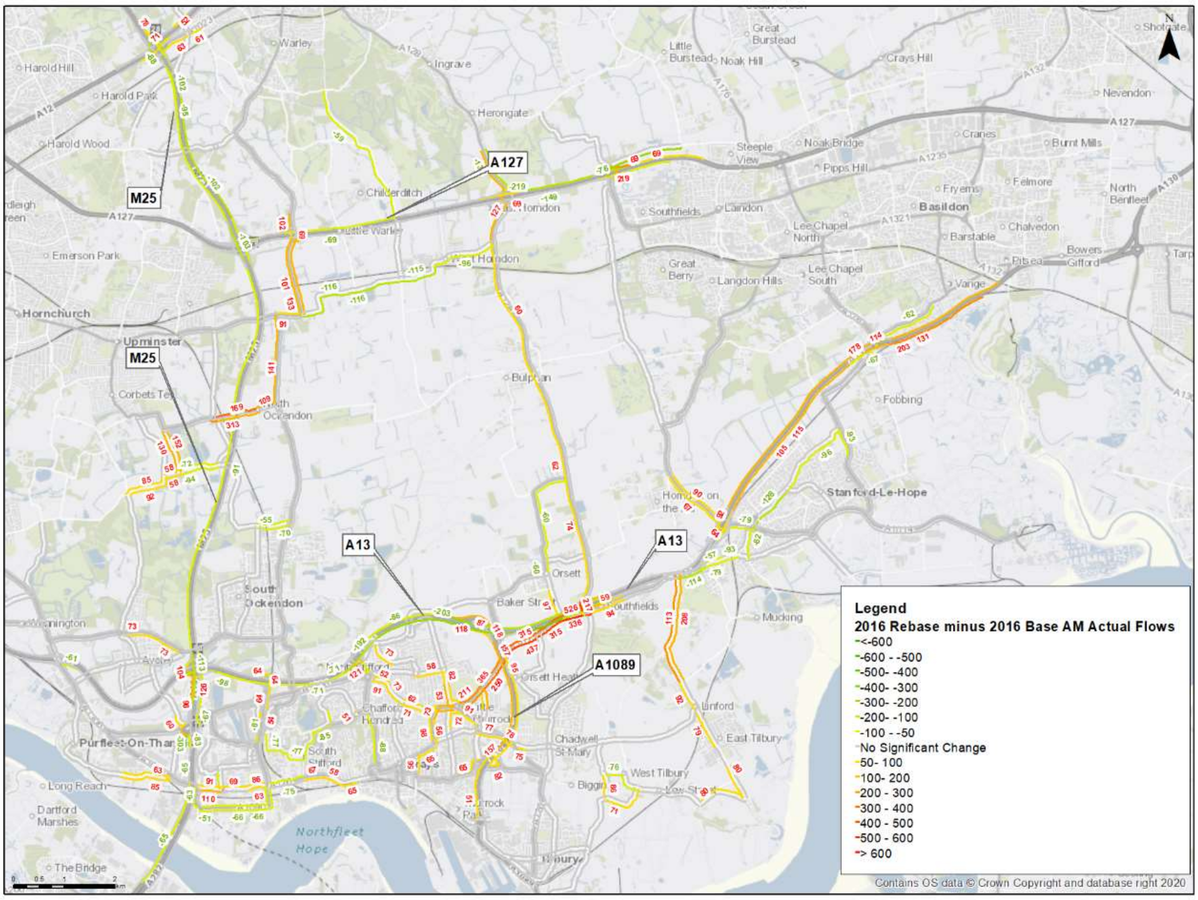


Figure 2-2 Traffic Flow Difference. 2016 DCO2v1 Base Year Model vs 2016 DCO2v2 Base Year Model

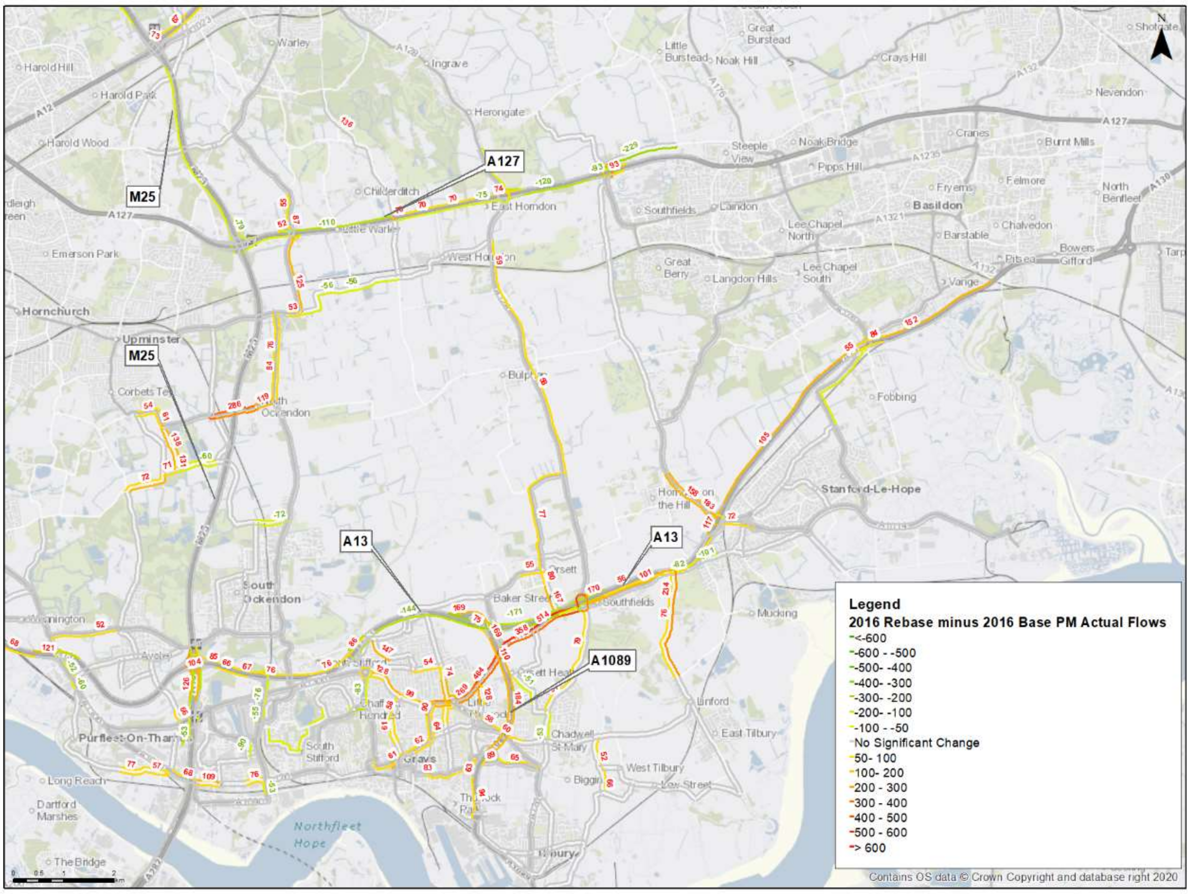


Figure 2-3 Traffic Flow Difference. 2016 DCO2v1 Base Year Model vs 2016 DCO2v2 Base Year Model

2.6 Base Year Model Validation

2.6.1 The differences between 2016 observed and modelled data have also been examined to ascertain how well the latest base year model is able to match observed traffic flows. This is one of the elements of the model validation process, which aims to determine the degree to which the LTAM is an accurate representation of the real world and if it represents a suitable basis for forecasting.

2.6.2 Stantec has used the data included within section '77777' of the model files to identify the model validation locations in Thurrock and to obtain the observed data used in the model validation. **In completing this analysis, Stantec has made an assumption that the data included in Section '77777' is the latest observed data used in LTAM model validation. However, a confirmation from NH is required.**

2.6.3 An analysis of how the modelled flows compare to the observed data has been undertaken for the AM and PM peaks. The analysis has been based on the DfT's Flow and GEH (Geoffrey E. Havers statistics) validation criteria, which is reproduced in Table 2-2.

Criteria	Description of Criteria	Acceptability Guideline
Flow Criteria	Individual flows within 100 vph of counts for flows less than 700 vph	>85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 vph	>85% of cases
	Individual flows within 400 vph of counts for flows more than 2,700 vph	>85% of cases
GEH Criteria	GEH < 5 for individual flows	>85% of cases

Table 2-2 DfT TAG Flow Validation Criteria Guidelines

2.6.4 A summary of the results of the validation analysis is presented in the table below, both for the DCO2v2 and DCO2v1 models. The validation results are also presented graphically in Figure A-1 and Figure A-2 for the AM and PM peak DCO2v2 model and in **Error! Reference source not found.** and **Error! Reference source not found.**-- for the DCO2v1 model in Appendix A 'Base Year Model Validation'. DCO2v1 results are provided for comparison.

Time Period	2016 Base. WebTAG criteria-GEH or FLOW							
	Cars		LGV		HGV		Total	
	DCO2v1	DCO2v2	DCO2v1	DCO2v2	DCO2v1	DCO2v2	DCO2v1	DCO2v2
AM (7-8)	91%	96% ↑	98%	97%↓	81%	86% ↑	86%	91% ↑
PM (5-6)	88%	90% ↑	100%	100%	92%	92% ↑	81%	85% ↑

Table 2-3 Base Year Validation. DCO2v2 and DCO2v1 Base Year Models

2.6.5 The link validation level in the AM and PM models meets or exceeds DfT's recommendation with the results showing that 91% of links in the AM and 85% or links in the PM selected for the validation meet the criteria. This indicates that the base year model can replicate well observed traffic volumes across a selection of roads.

2.6.6 It should be noted however that the model validation cannot be limited to just link validation and should consider other aspects including matrix validation, validation of turning movements at junctions, comparison of observed and modelled journey times. This additional local model validation information is required from NH to comment if the base year DCO2v2 model represents a suitable basis for forecasting the impacts of the LTC on the strategic and local roads.

2.1 Base Model Review Conclusion

2.1.1 NH has provided an updated 2016 Base Year model. Despite requests from the Council no accompanying documentation was made available by NH to explain what changes had been made to the previous base model to create the rebased model, nor was there an accompanying Local Model Validation Report (LMVR). Stantec has made some comparisons of the models to understand any changes made.

2.1.2 This has included a check of matrix totals, key network and flow changes. In addition, a comparison of the modelled flows of the updated base year model against observed counts to check has been undertaken to ascertain if there has been a change in the way the updated model replicates observed flows in the borough.

2.1.3 A GIS analysis of the networks indicated that there have been some 'structural' network additions in the 2016 updated model. The reasons for this addition to the network are not clear. However, it is thought that some of these links were present in the original version of the full LTAM but were excluded from the previous Thurrock cordon.

2.1.4 When comparing the 2016 updated model trip matrix totals to the 2016 Base previously reviewed, it was found that the total number of trips in the updated models are higher by between 3% and 5% compared to the previous models. Out of all the vehicle classes LGV trips demonstrate the biggest percentage increase of all the vehicle classes (these are 13% to 15% higher than in the previous models). To fully understand the implications to Thurrock's local highway network, an explanation of the reasons for the matrix changes is required, particularly explanations of the reasons of the increase in LGVs.

2.1.5 The differences between 2016 observed and modelled data have also been examined to ascertain how well the latest base year model is able to match observed traffic flows. Stantec has used the data included within section '77777' of the model files to identify the model validation locations in Thurrock and obtain the observed data used in the model validation. However, a confirmation from NH is required that the assumption made is correct.

2.1.6 The link validation level in the AM and PM models meets or exceeds DfT's recommendation. This indicates that the base year model can replicate well observed traffic volumes on the selected roads.

2.1.7 It should be noted however that the model validation cannot be limited to just link validation and should consider other aspects including matrix validation, validation of turning movements at junctions, comparison of observed and modelled journey times. This additional local model validation information is required from NH to ascertain if the base year DCO2v2 model represents a suitable basis for forecasting the impacts of the LTC on the strategic and local roads.

2.1.8 Furthermore, in the past Stantec had raised concerns about the 2016 Base model, including:

- the limited number of locations within Thurrock at which flow calibration and validation had been undertaken
- The local network AM peak hour is 0800 – 0900, but LTAM has only been developed to test the Strategic Road Network (SRN) AM peak of 0700 – 0800.

2.1.9 Stantec, therefore, continues to maintain significant concerns with the likely accuracy of the forecast modelling and outputs given the current and previous matters raised about the base model.

3 Forecast Model Network Changes - DCO2v1 vs DCO2v2

3.1 Introduction

3.1.1 This section provides details on the key changes made between the DCO2v1 and the updated DCO2v2 forecast models. No detailed supporting technical documentation has been provided on the changes made to the forecast models although an accompanying summary document states that the new model runs reflect:

- Revised opening year of 2030 in the DCO2v2 models as opposed to 2029 in the DCO2v1 models previously reviewed
- Changes to the scheme design, most significantly at the LTC / A13 / A1089 interchange which now includes the provision of a new link road connecting the A13 Orsett Cock roundabout to the A1089
- Updated uncertainty log, which informs the forecasts for the DCO2v2 model. Appendix B provides Thurrock development included in the Uncertainty Log.

3.1.2 The following aspects of the cordoned transport model have been reviewed to determine the changes between the DCO2v1 models and the updated DCO2v2 models:

- Zone changes
- Network changes
- Uncertainty log
- Matrix changes
- Model summary statistics
- Link flow differences

3.1.3 Zone changes and network changes are considered in this section, with the other elements listed above reported separately in other sections of this report. Matrix changes and Uncertainty Log changes are reported in Section 4. Section 5 deals with model summary statistics.

3.1.4 Link flow differences are presented in Section 6 and Section 7 for the cross-river movements.

3.2 Zone Changes

3.2.1 Additional zones have been identified to have been added to the base and forecast networks since the DCO2v1 model. These are shown within Figure 3-1 and indicate that up to 43 new zones are included in the DCO2v2 compared to the DCO2v1 model. It is thought that these zones have been introduced to refine either the Base Year model or Forecast Scenarios.

3.2.2 However, no further detail on zone disaggregation in the base year models or what developments additional zones might represent in forecast models has been included within any associated reporting provided by NH. It is therefore requested that additional information is provided.

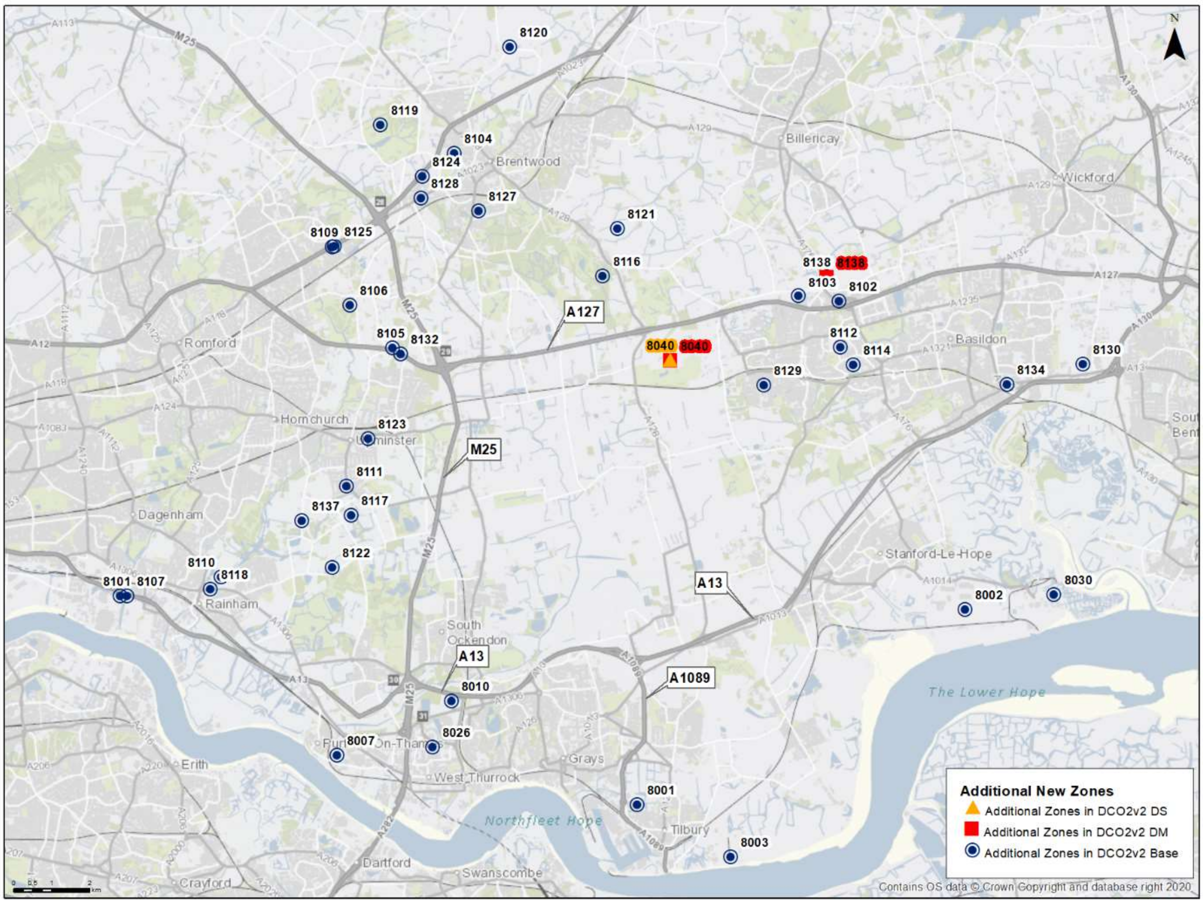


Figure 3-1: Additional Zones

3.3 Network Changes

3.3.1 It is understood from NH consultation documentation 'Lower Thames Crossing Guide to Local Refinement Consultation, May 2022' that NH has taken into account previous representations from the Community Impact Consultation (CIC) from stakeholders, including the Council, and made scheme design changes that are now included into the updated DCO2v2 models.

3.3.2 By far the biggest change on the Thurrock network is the provision of the new Orsett Cock junction link road that would provide a direct connection from Orsett Cock roundabout to the A1089 southbound. The change was introduced to address feedback from the Council and other stakeholders about the poor connectivity between the LTC and the A1089, and the resulting impacts on the local road network. It was the Council's assertion that traffic could be inclined to leave LTC and travel to the Manorway to return on A13 to access A1089 southbound or to use the Orsett Cock junction to access the Port of Tilbury via A1013, Stanford Road. The latter was indicated by additional demand and delays at A1013 Daneholes Road roundabout, in the DCO1 and DCO2v1 LTAM outputs. The recent network changes are illustrated in the figures below taken from NH's local refinement consultation document[3].

3.3.3 Figure 3-2 illustrates the arrangement at the Orsett Cock roundabout in the previous model (DCO2v1) without the Orsett Cock junction link road. Figure 3-3 shows the arrangement in the updated DCO2v2 model with the Orsett Cock junction link road included.

[3] 'Lower Thames Crossing Guide to Local Refinement Consultation, May 2022'

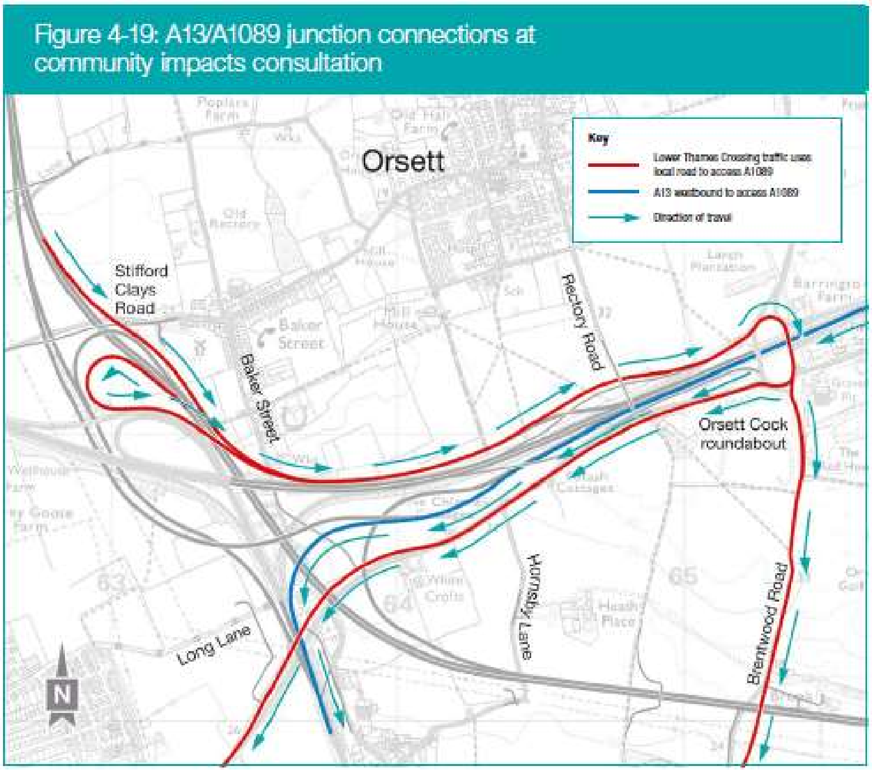


Figure 3-2: National Highways illustration of A13/A1089 junction connections at community impacts consultation (Without Orsett Cock junction link)

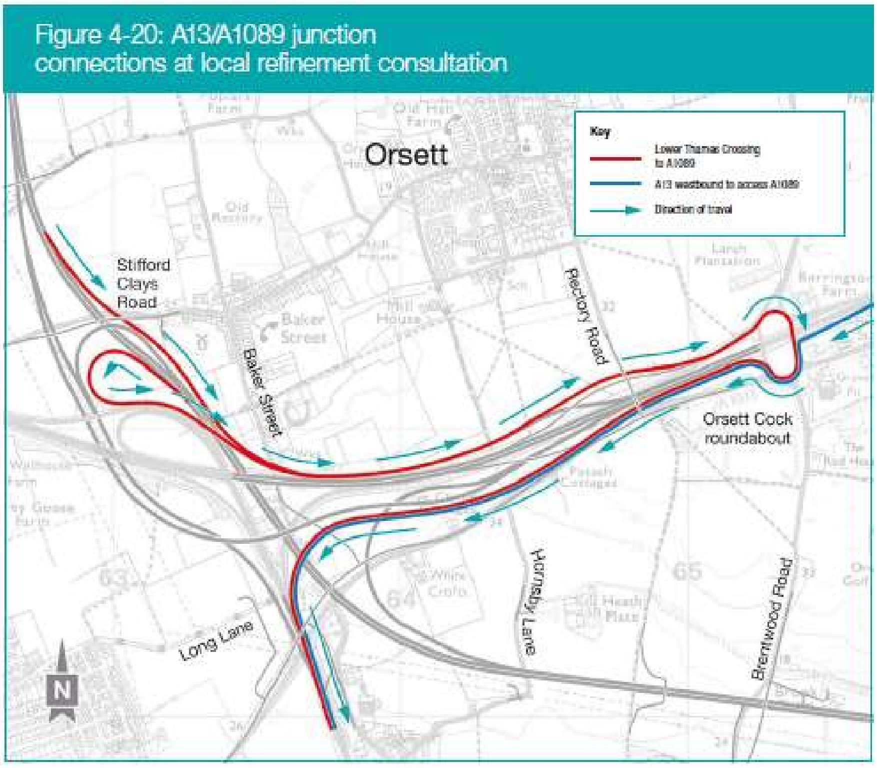


Figure 3-3 National Highways illustration of A13/A1089 junction connections updated With Orsett Cock junction link

3.3.4 A review of the models also indicates that in the updated model, Orsett Cock roundabout has four signalised nodes i.e. two additional signalised nodes 87595 and 87599 in the updated With LTC DC02v2 models compared to the previous DCO2v1 models. These two nodes were priority junctions in the previous model. The only two signal nodes in the previous models (Nodes 87597 and 87590) are retained in the new DS models as shown in -Figure 3-4. Nodes 87597 and 87590 are signal controlled within the current traffic controls, as a consequence of the widening and network capacity additions built by the Council. The additional signal nodes appear in the With LTC models but not in the DCO2v2 DM. This suggests that introduction of additional signals is part of the scheme which NH proposes as part of a mitigation package.

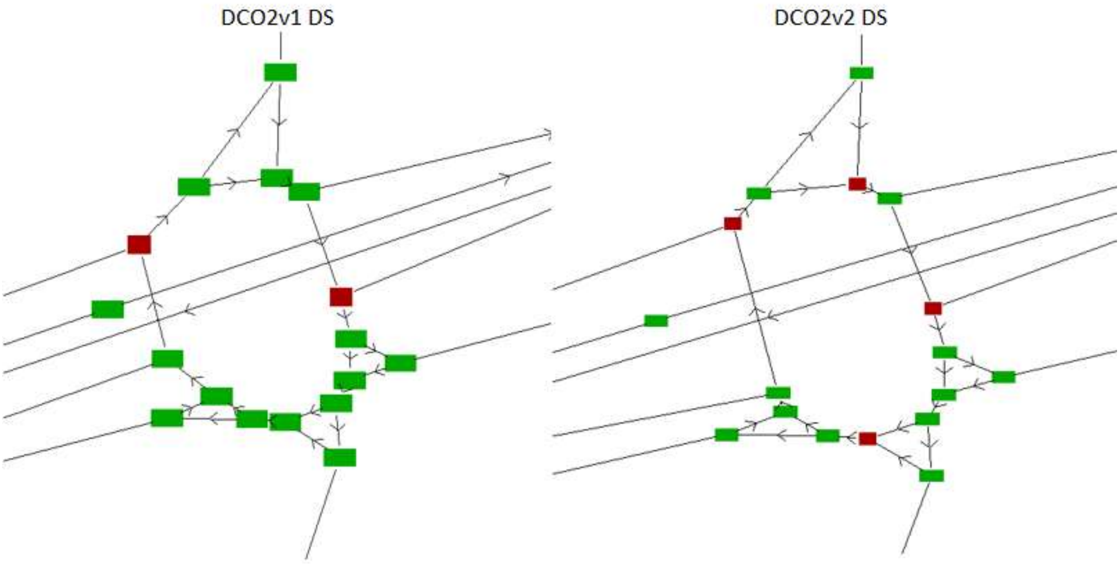


Figure 3-4 New Signals at Orsett Cock junction

3.4 Summary

3.4.1 This section has outlined the key zone and network changes in the DCO2v2 model compared to the previous DCO2v1 model. The key elements noted include:

- Additional zones added to the DCO2v2 base year and forecast models estimated at 43 new zones
- By far the biggest change on the Thurrock network is the provision of the new Orsett Cock junction link road that would provide a direct connection from Orsett Cock roundabout to the A1089 southbound.
- Update to Orsett Cock roundabout with an additional two signalised nodes resulting in the junction having four signalised nodes in the DCO2v2 model compared to the previous DCO2v1 model.

3.4.2 Matrix changes and the impacts on the network are discussed in subsequent sections of this report.

4 Overview of Matrix Changes

4.1 Introduction

4.1.1 This section provides a summary of the matrix changes in the updated models. The analysis provides:

- A summary of the Uncertainty Log assumptions in the updated models. Thurrock development included in the Uncertainty Log is provided in Appendix A.
- A summary of the matrix changes between the DCO2v2 (2030, 2045) DM and DS models as compared to the previous DCO2v1 (2029, 2044) models
- A summary of matrix changes between DM and DS for the updated DCO2v2 models for both 2030 and 2045

4.2 LTAM Thurrock Development Uncertainty Log Changes

4.2.1 A check of the updated Uncertainty Log (UL) against the previous version indicates the following key changes:

- Five new development sites in Thurrock are included in the updated UL. These are classed as 'More than likely' and hence have been included in the DCO2v2 forecast scenarios. These are:
  - Thames Park School, Chadwell Road - 7,414 square metres (SQM) of D1 (non-residential institution)
  - Top Sign Ensign Estate, Botany Way – 1,994 SQM (B2 general industrial)
  - Land to rear of Bannatynes Sport Centre, Howard Road, Chafford Hundred – 344 dwellings (C3)
  - Land Adjacent Blackshots Stadium and Stanford Road Grays – 8,678 SQM (Other F education use)
  - Land Abutting Armour Road, Stonehouse Land – 31,500 SQM (B8 -Storage r distribution)

4.2.2 Also notable is that in Brentwood Borough, Dunton Hills Garden Village previously included in the UL as 'Reasonably Foreseeable' is now marked as 'More than likely', implying that the development is now accounted for within the DCO2v2 scenarios. Dunton Hills Garden Village is a big development planned to comprise 3,750 dwellings, and 32,600 square metres of employment.

4.2.3 An additional development associated with London Gateway (Appendix B provides further details about the size of the development) and Thames Enterprise Park has also been accounted for in the forecast scenarios.

Reflecting Uncertainty in Forecasting

4.2.4 DfT's TAG (Transport Appraisal Guidance) Uncertainty Toolkit (August 2022, first published in May 2021) states "There is considerable uncertainty about how the transport system will evolve in the future, particularly with the potential for emerging trends in behaviour, technology and decarbonisation to drive significant change over time. The use of transport models, a fundamental aspect of scheme appraisal, can also introduce uncertainty to transport analysis, through the data, assumptions and model specifications required. To ensure decision-making is resilient to future uncertainty, decision makers need to understand how the outcomes of spending and policy proposals may differ under varying assumptions about the future."

4.2.5 The guidance carries on and provides a practical advice on the analysis and presentation of uncertainty, setting out techniques for exploring uncertainty as part of transport modelling and appraisal with a focus on the use of scenarios for assessing uncertainty around future travel demand.

4.2.6 There are four principles at the heart of the guidance, which clearly state that (the text is bold is DfT's highlight):

1. **The treatment of uncertainty is a core part of any transport analysis and is needed to inform robust decision-making.**
2. **Analysis should not focus exclusively on a core scenario. Uncertainty analysis and the consideration of wider 'what if' scenarios should be undertaken as standard**
3. **Proportionate appraisal techniques for defining, measuring and accounting for uncertainty within decision making should be used.**
4. **Uncertainty should be considered holistically across the strategic and economic cases and throughout the planning process.**

4.2.7 The Council has not been provided with evidence that DfT's guidance related to testing uncertainty in forecasting has been followed. The Base year of the model is 2016 and therefore forecasts do not take account of any changes due to Covid, Brexit, Government's decarbonisation strategy, current financial or energy crisis, and their consequent effects on travel choices and future trends.

4.2.8 We therefore conclude that the LTC assessment does not follow DfT's guidance, and we request that **at least** DfT's Common Analytical Scenarios are considered to test uncertainty around forecasts.

4.2.9 For example, we have not received any sensitivity test results providing further details on how traffic arising from the Thames Freeport proposals at the Port of Tilbury and London Gateway/DP World will impact on the highway network. Similarly, we have not received any sensitivity test results on how the 'with the LTC' highway network will perform with the Council's New Local Plan growth proposals. This needs to be considered as part of testing for uncertainty in forecasting.

4.3 Matrix Changes Between DCO2v1 Model and DCO2v2 Model, DM and DS

4.3.1 A review of the trip matrix totals has been undertaken to gain an understanding of the changes in the number of forecast trips on Thurrock roads between the DCO2v1 and the DCO2v2models.

4.3.2 Table 4-1 provides a summary of the changes observed between the 2029 and 2044 DCO2v1 models and the updated DCO2v2 for the respective forecast years of 2030 and 2045. Further breakdown of values by vehicle and purpose can be found within Appendix B.

User Class	Description	DM	DS
Cars Employers Business	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **AM peak**	-3%	-2%
	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **PM peak**	3%	3%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **AM peak**	-3%	-2%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **PM peak**	1%	1%
	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **AM peak**	3%	3%

User Class	Description	DM	DS
Cars Commute	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **PM peak**	4%	4%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) A**M peak**	5%	5%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **PM peak**	6%	6%
Cars Other	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **AM peak**	8%	9%
	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **PM peak**	9%	8%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) A**M peak**	6%	9%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **PM peak**	5%	5%
LGVs	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **AM peak**	13%	14%
	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **PM peak**	15%	15%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) A**M peak**	14%	14%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **PM peak**	15%	14%
HGVs	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **AM peak**	2%	3%
	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **PM peak**	1%	1%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) A**M peak**	2%	2%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **PM peak**	1%	0.5%
Total Trips	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **AM peak**	6%	6%
	Difference between 2030 (DCO2v2) and 2029 (DCO2v1) **PM peak**	6%	6%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **AM peak**	5%	5%
	Difference between 2045 (DCO2v2) and 2044 (DCO2v1) **PM peak**	6%	5%

Table 4-1:Summary of Matrix Changes between DC02v1 and DC02v2

4.3.3 The comparison analysis between the DCO2v2 (2030, 2045) and DCO2v1 (2029, 2044) matrix trip totals indicates:

- The total number of forecast trips in the new DS and DM models are higher by between 5% and 6% compared to the previous models.
- Car 'Employer Business' trips in the new models are 2-3% lower int the AM and 1-3% higher in the PM compared to the previous model trip numbers
- Car 'Commuting' trips are 3% to 6% higher than in the previous models both in the DS and DM scenarios
- LGV trips are 13% to 15% higher than in the previous models and show the biggest increases of all the vehicle or user classes.
- HGV trips are 0.5% to 3% higher than in the previous DCO2v1 models.

4.3.4 The differences in matrix totals between DCO2v2 and DCO2v1 models are thought to be partially due to the changes in the base year trip matrices. Explanation of the changes in the Base Year matrices is therefore required, along with supporting evidence that these changes are reasonable.

4.3.5 It should be noted that a review of DCO2v1 forecast models against DCO1 models concluded that there were more car trips forecast to travel from, to and through Thurrock in the DCO2v1 model compared to DCO1 model with increases varying for different trip demand segments, which ranged between 26% and 1%. Therefore, a sequence of reviews highlights a trend for higher traffic flows in Thurrock with each subsequent model update.

4.4 Matrix Changes Between DM and DS DCO2v2 Model

4.4.1 A comparison has also been undertaken to identify changes between the matrix totals between the DM and DS for both 2030 and 2045 in the updated DCO2v2 forecast models. This analysis provides an indication of the change in trips using the Thurrock network 'with the LTC' in place compared to the scenario without the LTC.

4.4.2 Table **4-2** below provides details on the change in matrix totals by user class between the DM and DS (DCO2v2 model) in the AM and PM peak hours.

User Class	2030 AM		2030 PM		2045 AM		2045 PM	
	Total Difference	% Difference	Total Difference	% Difference	Total Difference	% Difference	Total Difference	% Difference
Car employers business	438	7%	347	6%	528	8%	408	7%
Car commute	723	4%	1,082	5%	975	5%	1,408	7%
Car other	2,305	10%	2,436	8%	2,832	12%	3,091	9%
Car Total	**3,466**	**8%**	**3,865**	**7%**	**4,336**	**9%**	**4,908**	**8%**
LGV	**205**	**2%**	**131**	**2%**	**251**	**2%**	**166**	**2%**
HGVs (non-Port only)	305	3%	141	2%	676	6%	204	3%
HGVs (Port only)	60	2%	49	2%	83	3%	58	2%
Total (HGVs)	**366**	**2%**	**190**	**2%**	**759**	**5%**	**262**	**2%**
Total (Trips)	**4,037**	**6%**	**4,186**	**6%**	**5,346**	**7%**	**5,335**	**7%**

Table 4-2 Matrix Changes Between the DM and DS 2030 and 2045 Forecast Years AM and PM Peaks, pcu

4.4.3 Overall, the introduction of the LTC is forecast to result in increased demand for travel on roads falling within the boundary of Thurrock including LTC.

4.4.4 In 2030 a 6% increase in trips is predicted in both the AM and PM (equivalent to 4,037pcu and 4,186pcu per hour) while in 2045 a 7% increase in trips is predicted in both the AM and PM peak hours (which is equivalent to 5,346pcu and 5,335pcu per hour).

4.4.5 The largest increases are shown within the total car user class with a difference of 8% and 7% in the AM and PM peak respectively for the 2030 opening year model and 9% and 8% in the 2045 forecast year model respectively.

4.4.6 Key points to note are as follows.

4.4.7 In 2030 AM:

- There is a total increase in trips of 4,037 pcu/hr (+6% over the trips without the LTC)
- Car trips contribute 3,466 of this increase (86%) of which 2,305 trips are due to an increase in Car other trips
- LGV trips contribute 205 pcu/hr or 5% of the increase
- HGV (non-Port) contribute 305 pcu/hr or 8% of the increase
- HGV (Port) contribute an increase of 60 pcu/hr or 1% of the increase.

4.4.8 In 2030 PM:

- There is a total increase in trips of 4,186 pcu/hr (+6% over the trips without the LTC)
- Car trips contribute 3,865 of these trips (92%) of which 2,436 trips are due to an increase in Car other trips and 1,082 due to Car commute trips
- LGV trips contribute 131 pcu/hr or 3% of the increase
- HGV (non-Port) contribute 141 pcu/hr or 4% of increase
- HGV (Port) contribute an increase of 49 pcu/hr or 1% of the increase.

4.4.9 In 2045 AM:

- There is a total increase in trips of 5,346 pcu/hr (+7% over the trips without the LTC)
- Car trips contribute 4,336 of these trips (81%) of which 2,832 trips are due to an increase in Car other trips
- LGV trips contribute 251 pcu/hr or 5% of the increase
- HGV (non-Port) contribute 676 pcu/hr or 13% of the increase
- HGV (Port) contribute an increase of 83 pcu/hr or 2% of the increase.

4.4.10 In 2045 PM:

- There is a total increase in trips of 5,335 pcu/hr (+7% over the trips without the LTC)
- Car trips contribute 3,865 of these trips (92%) of which 3,091 trips are due to an increase in Car other trips and 1,408 are due to Car commute trips
- LGV trips contribute 166 pchr or 3% of the increase
- HGV (non-Port) contribute 204 pcu/hr or 4% of increase
- HGV (Port) contribute an increase of 58 pcu/hr or 1% of the increase.

4.4.11 These increases (called induced traffic) can be due to changes in the reassignment of traffic from the wider area resulting from the introduction of the LTC but may also be due to completely new (or more frequent) trips on the network, modal shift from public transport and a change of people's origins and destinations of travel across the wider area. Without access to the full LTAM model Stantec cannot confirm exactly how much each of these changes in behaviour are contributing to overall increases in trips.

4.4.12 For comparison, a review of the DCO2v1 model against DCO1 model concluded that overall, the introduction of the LTC is forecast to result in increases in car, LGV and HGV movements on Thurrock roads. The largest increases were shown within the total car user class with a difference of 7% in the AM and PM peak of the 2029 opening year model and 9% and 8% in the 2044 forecast year model respectively. This is consistent with the findings of the latest review of the DCO2v2 model against DCO2v1.

4.5 Summary

4.5.1 This section has provided a summary of the matrix and Uncertainty Log changes in the updated models.

4.5.2 A check of the updated Uncertainty Log (UL) against the previous DCO2v1 version indicates an inclusion of five new development sites in Thurrock, which have now been classed as 'More than likely' and hence have been included in the DCO2v2 forecast scenarios. Also notable is that Dunton Hills Garden Village in Brentwood Borough (planned to comprise 3,750 dwellings, and 32,600 square metres) that was previously included in the UL as 'Reasonably Foreseeable' is now marked as 'More than likely', implying that the development is now accounted for within the DCO2v2 scenarios. Sevelopment associated with London Gateway and Thames Enterprise Park has also been accounted for in the forecast scenarios.

4.5.3 We have not received any sensitivity test providing further details on how traffic associated with Thames Freeport expansion at the Port of Tilbury and London Gateway/DP World will impact on the highway network Similarly, we have not received any sensitivity test results on how the 'with the LTC' highway network will perform with Thurrock's New Local Plan growth proposals.

4.5.4 A review of the trip matrix totals has been undertaken to gain an understanding of the changes in the number of forecast trips on Thurrock roads in the DCO2v1 (2030, 2045) and the DCO2v2 (2029, 2044) models in the DM and DS scenarios.

4.5.5 The analysis indicates that the total number of forecast trips on Thurrock roads in the new DS and DM DCO2v2 models are higher by between 5% and 6% compared to the previous models. LGV trips are 13% to 15% higher than in the previous models and show the biggest increases of all the vehicle or user classes. HGV trips are 0.5% to 3% higher than in the previous DCO2v1 models.

4.5.6 The differences in forecast matrix totals between DCO2v2 and DCO2v1 models are thought to be partially due to the increases in the base year trip matrices. Explanation of the changes in the Base Year matrices is therefore required.

4.5.7 It should be noted that a review of the previous DCO2v1 forecast models against DCO1 models concluded that there were more car trips forecast to travel from, to and through Thurrock in the DCO2v1 model compared to DCO1 model with increases ranging between 1 and 26% for different trip demand segments Therefore, a sequence of reviews highlights a trend for higher traffic flows forecast in Thurrock with each subsequent model update.

4.5.8 A comparison has also been undertaken to identify changes between the matrix totals between the DM and DS for both 2030 and 2045 in the updated DCO2v2 forecast models. This analysis has provided an indication of the change in trips using the Thurrock network 'with the LTC' in place compared to the scenario without the LTC.

4.5.9 Overall, the introduction of the LTC is forecast to result in increased demand for car, LGV and HGV trips on Thurrock's road network and a section of the LTC falling within the boundary of Thurrock. In 2030 a 6% increase in trips is predicted in both the AM and PM (equivalent to 4,037pcu and 4,186pcu per hour) while in 2045 a 7% increase in trips is predicted in both the AM and PM peak hours (which is equivalent to 5,346pcu and 5,335pcu per hour). These increases (called induced traffic) can be due to changes in the reassignment of traffic from the wider area resulting from the introduction of the LTC but may also be due to completely new trips on the network, modal shift from public transport and a change in people's origins and destinations of travel across the wider area. Without access to the full LTAM model we cannot confirm exactly how much each of these changes in behaviour are contributing to overall increases in trips.

4.5.10 For comparison, a review of the DCO2v1 DS and DM models concluded that overall the introduction of the LTC is forecast to result in increases in car, LGV and HGV movements on Thurrock roads. The largest increases were shown within the total car user class with a difference of 7% in the AM and PM peak of the 2029 opening year model and 9% and 8% in the 2044 forecast year model respectively. This is consistent with the findings of the latest review of the DCO2v2 model against DCO2v1.

5 Highway Network Summary Statistics

5.1 Overview

5.1.1 The highway network performance has been examined through the assessment of the network-wide statistics. These statistics has been provided by NH for the whole LTAM model (DCO2v2 only), which Appendix E presents, and for the cordoned model (DCO2v2 and DCO2v1), which Appendix D presents.

5.2 Cordon Network Statistics

5.2.1 The cordon network statistics have been extracted from the assigned cordoned models and provide an indication on how the models are performing. In addition to examining key parameters related to highway network performance, carbon emissions and air quality statistics have also been extracted from the models provided (Saturn files). Though these are not typical outputs that are extracted from Saturn models, the values were calculated and included within the cordon files provided. With limited carbon emissions and air quality information regarding the scheme, these outputs have been analysed and they provide a high-level indication of how the cordon models operate and allow an understanding of the impact arising from the LTC on carbon emissions and air quality.

5.2.2 Appendix D shows the network-wide statistics for the DCO2v2 DS and DM models and their comparison.

5.2.3 Comparison of the 2045 DS with the DM DCO2v2 cordon models results in an additional 5,354 vehicles in the AM peak and 5,344 in the PM peak using roads in Thurrock (including LTC). This is an increase of 7% for both peak periods.

5.2.4 The results demonstrate that the introduction of the LTC in 2045 is forecast to result in reduced Transient Queues (e.g. those queues that might correspond to the queues that develop during the red phase at traffic signals and then dissipate in the subsequent green phase) during the AM peak by 3.5%. However, in the PM peak an increase by 2.5% is forecast. Both peaks witness a reduction in Over-Capacity queues (these occur where a permanent queue builds up which is unable to clear in a single cycle). Average delays are overall forecast to slightly reduce in the AM by 0.9% but increase by 1.9% in the PM.

5.2.5 However, the statistics show that in 2045 Travel Distance travelled by all vehicles in the network is expected to increase by 15.5% in both peak periods, with Total Travel Time also showing an increase by 4.2% and 7.4% in the AM and PM peak respectively. This demonstrates that the LTC is increasing the total vehicle km and vehicles hours on Thurrock's network.

5.2.6 The introduction of the LTC is estimated to result in an increase of average speeds from 56kph to 62kph in 2030 AM, and from 52kph to 57kph in 2045 AM. However, the average speeds in 2045 are forecast to be lower than in the Base (61kph) thus indicating that the relief provided by the LTC is temporary.

5.2.7 In terms of carbon emissions and air quality analysis extracted from the cordon model, it is shown through the summary statistics that with LTC included CO2 (kg) will increase by 10.5% and 12.5% in the AM and PM peak, whilst NOX (kg) will increase by 6.6% and 8.8% respectively. PM10 (kg) are also expected to increase between the DM and DS scenarios by 3.7% and 7.1% for the two peak periods.

5.2.8 Through this initial analysis the DS scenario demonstrates that carbon emissions and levels of AQ pollutants within the model are expected to increase with the Scheme. Further analysis of the AQ impact should be provided by the scheme promoter.

5.2.9 The patterns and the magnitude of change observed in the DCO2v2 results is comparable to the patterns and the magnitude of changed observed in the earlier version of the model (DCO2v1).

5.3 LTAM Wide Statistics

5.3.1 The LTAM statistics provided by NH for the whole model has enabled the highway network performance to be examined at a networkwide level. The global statistics included changes in:

- Transient queues in pcu.hrs
- Over-capacity queues in pcu.hrs
- Link cruise time in pcu.hrs
- Total travel time in pcu.hrs
- Travel distance in pcu.kms
- Overall average speed in kph

5.3.2 The results demonstrate that the introduction of the LTC in 2045 is forecast to result in reduced congestion across the wider LTAM network, although this is to a lesser extent when compared to the Thurrock cordon in terms of percentage changes. In comparison with the 2045 DM models, DS models show that there is a reduction in Transient Queues during the AM peak by 0.4% and by 0.6% in the PM peak. Both peaks also witness a reduction in Over-Capacity queues. Overcapacity queues reduce by 2.2% in the AM peak and 2.3% in the PM peak.

5.3.3 However, the statistics show that in 2045 Travel Distance travelled by all vehicles in the network is expected to increase by 1.1% in the AM peak and by 1.2% in the PM peak, with Total Travel Time also showing an increase by 0.1% and 0.2% in the AM and PM peak respectively. This demonstrates that the LTC is increasing the total vehicle km and vehicles hours on the network. However, across the wider area these changes are significantly lower than in Thurrock with respective increases of 15.5% and 4.2%-7.4% in vehicle km and vehicle hours.

5.3.4 No networkwide carbon emission and air quality outputs were provided to understand how the LTC would impact on parameters such as CO2, NOx, PM10 etc.

5.4 Summary

5.4.1 Comparison of the 2045 DS with the 2045 DM DCO2v2 cordon models network statistics suggests that introduction of LTC would results in:

- Additional 5,355 pcu in the AM peak and 5,344 in the PM peak on all the roads within Thurrock, an increase of approximately 7% in both peak periods.
- An increase of 13.4% for the AM and PM peak periods in Travel Distance (pcu/km) in Thurrock for the AM and PM peak periods respectively. For comparison, an increase in Travel Distance in the whole LTAM model is much lower and is 1.1% in the AM and 1.2% in the PM peak.
- An increase of 3.2% and 6.7% in Total Travel Time (pcu/hrs) across Thurrock for the AM and PM peak. This is 0.1% in the AM peak and 0.2% in the PM peak in the wider LTAM modelled network.
- A significant decrease in Over-Capacity Queues in Thurrock of -25.8% and -23.0% for the AM and PM. In the wider LTAM network a decrease in Over-Capacity Queues is 2.2 %

and -2.3% for the AM and PM peaks respectively. This suggests that ‘with the LTC’ in place the road network will be able to transfer more trips.

- An increase of average speeds from 56kph to 62kph in 2030 AM, and from 52kph to 57kph in 2045 AM. However, the average speeds in 2045 are forecast to be lower than in the Base (61kph) thus indicating that the relief provided by the LTC is temporary.
- *An increase in CO2 (kg) emissions in Thurrock of 10.5% and 12.5% in the AM and PM peak respectively.
- *An increase in NOX (kg) emissions in Thurrock for the AM and PM peak by 6.6% and 8.8%.
- *An increase in PM10 (kg) emissions in Thurrock of 3.7% and 7.1% for the AM and PM peak periods

*Note the emission statistics have been extracted from the Saturn assignment files, not from specific Air Quality Assessments of which further data has not been provided for this review.

6 Link Flows

6.1 Introduction

6.1.1 This section provides a comparison of DS and DM forecast models. This provides information about the impact of LTC on strategic and local roads within Thurrock. The analysis has focussed on the forecast year 15 years after opening i.e. 2045. Appendix F includes 2045 DCO2v2 flow difference plots and equivalent flow difference plots for the opening year.

6.1.2 A brief analysis of traffic flow differences between the DCO2v1 and DCO2v2 forecast models is also included within this section. This provides an indication of how traffic flow has changed between the updated models compared to the previous models. Appendix G presents flow difference plots.

6.2 LTC Impact on Strategic and Local Roads.

6.2.1 This section reports on key flow changes as a result of the LTC scheme in DCO2v2 models. The analysis focuses on the 2045 forecast year, i.e. 15 years after opening. 2045 is likely to demonstrate worse performance than the opening year 2030. Therefore, the analysis has concentrated on presenting the impacts of the LTC on the 2045 highway network compared to the 2045 Do Minimum (DM) network (no LTC scheme). The analysis has been presented for DCO2v2 and has been compared to previously reviewed DCO2v1results.

6.2.2 A comparison has been undertaken on the main road through-traffic at locations on a selection of local and strategic roads in Thurrock. Selected strategic road locations are shown in Figure 6-1. A summary of the 2045 forecast year flow changes is presented for strategic and local roads in Table 6-1 and Table 6-2 for the PM peak.

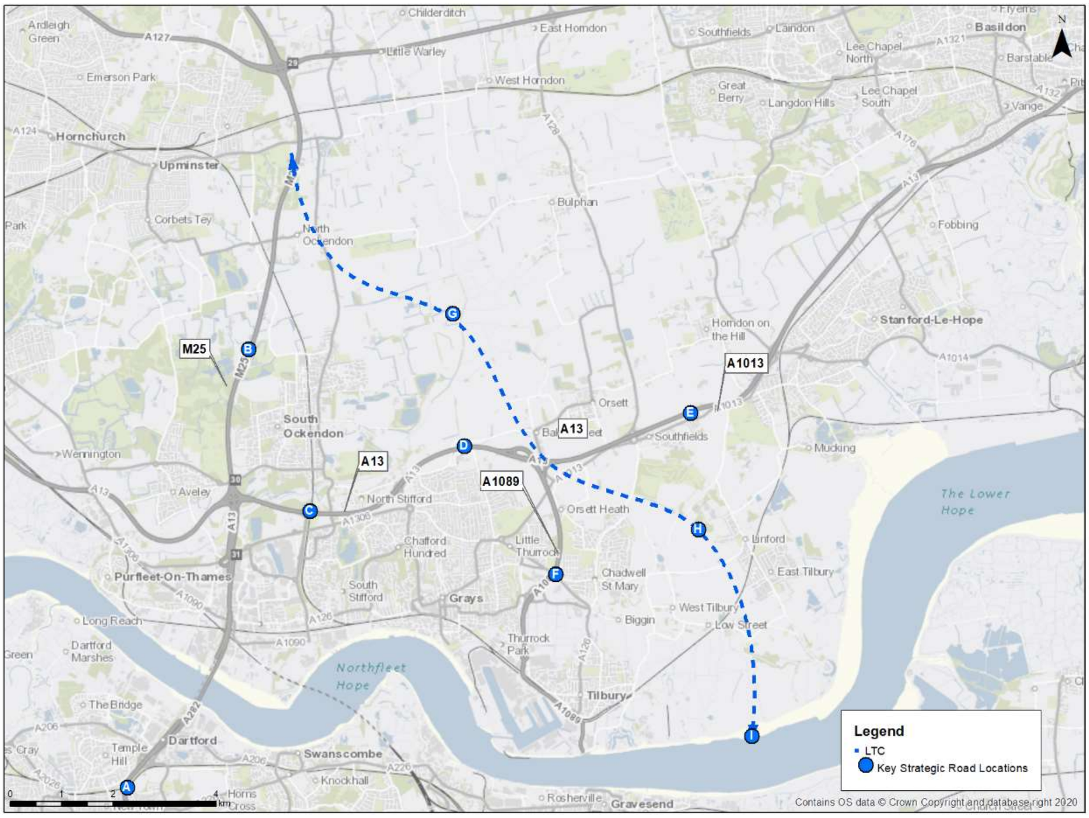


Figure 6-1 DCO2v2 DS (2045) vs DCO2v1 DS (2044) Strategic Road Locations

Links		2045 DCO2v2				2044 DCO2v1			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
A. Dartford X	NB	6981	6426	-555	-8%	6981	6398	-584	-8%
	SB	8500	8474	-26	0%	8500	8128	-372	-4%
B. M25 N of J30	NB	7459	5745	-1714	-23%	7382	5885	-1496	-20%
	SB	7703	6959	-744	-10%	7544	6932	-612	-8%
C. A13 West 1	EB	5884	5315	-569	-10%	5991	5507	-483	-8%
	WB	7470	6446	-1024	-14%	7544	6525	-1018	-13%
D. A13 West 2	EB	5018	4398	-620	-12%	5190	4646	-544	-10%
	WB	6159	5513	-646	-10%	6203	5620	-583	-9%
E. A13 East	EB	4989	5657	668	13%	4788	5713	925	19%
	WB	5305	5870	565	11%	5285	5872	587	11%
F. A1089	NB	2333	3413	1080	46%	1612	2956	1344	83%
	SB	2261	2304	43	2%	2160	1956	-204	-9%
G. LTC N of A13	NB	0	4674	4674		0	4639	4639	
	SB	0	2555	2555		0	2359	2359	
H. LTC S of A13	NB	0	5077	5077		0	4794	4794	
	SB	0	3883	3883		0	3927	3927	
I. LTC Crossing	NB	0	5077	5077		0	4794	4794	
	SB	0	3883	3883		0	3927	3927	

Table 6-1 LTC Impact on Strategic Roads. Flow Difference. AM Peak

Links		2045 DCO2v2				2044 DCO2v1			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
A. Dartford X	NB	6761	6695	-67	-1%	6762	6657	-104	-2%
	SB	8500	6866	-1634	-19%	8465	6774	-1691	-20%
B. M25 N of J30	NB	6756	5789	-967	-14%	6756	5950	-805	-12%
	SB	7592	6092	-1500	-20%	7339	5946	-1393	-19%
C. A13 West 1	EB	7076	6660	-416	-6%	6984	6594	-390	-6%
	WB	7030	6013	-1017	-14%	6963	5991	-973	-14%
D. A13 West 2	EB	5745	5710	-35	-1%	5491	5442	-49	-1%
	WB	6027	5000	-1027	-17%	6011	5023	-988	-16%
E. A13 East	EB	5069	6010	941	19%	4797	6068	1272	27%
	WB	4985	5865	880	18%	4789	5824	1035	22%
F. A1089	NB	2342	3311	970	41%	1880	2766	886	47%
	SB	2084	2289	205	10%	1809	1753	-56	-3%
G. LTC N of A13	NB	0	3199	3199		0	3011	3011	
	SB	0	3358	3358		0	2933	2933	
H. LTC S of A13	NB	0	4114	4114		0	4362	4362	
	SB	0	4700	4700		0	4572	4572	
I. LTC Crossing	NB	0	4114	4114		0	4362	4362	
	SB	0	4700	4700		0	4572	4572	

Table 6-2 LTC Impact on Strategic Roads. Flow Difference. PM Peak

6.2.3 A comparison has been undertaken on the main road through-traffic at locations on a selection of local roads in Thurrock shown in Figure 6-2. A summary of the 2045 forecast year flow changes is presented in Table 6-3 for the AM peak and Table 6-4 for the PM peak.

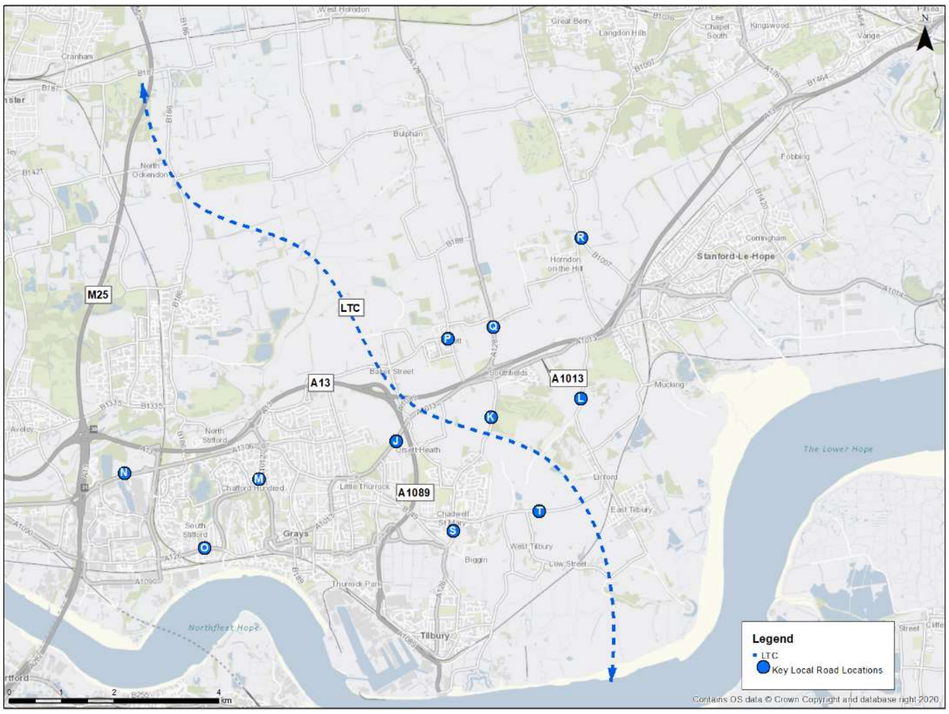


Figure 6-2 DCO2v2 DS (2045) vs DCO2v1 DS (2044) Local Road Locations

Links		2045 DCO2v2				2044 DCO2v1			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
J. A1013 Stamford Rd	2-way	1910	1773	-137	-7%	1387	1486	99	7%
K. Brentwood Rd	2-way	774	1230	455	59%	917	1022	105	11%
L. Buckingham Hill Rd	2-way	1170	966	-204	-17%	1023	878	-145	-14%
M. A1012 Elizabeth Rd	2-way	1334	1423	89	7%	1245	1429	185	15%
N. A1306 N. Arterial	2-way	1990	1879	-111	-6%	1962	1789	-173	-9%
O. London Rd, Grays	2-way	1807	1723	-84	-5%	1864	1812	-52	-3%
P. Rectory Rd, Orsett	2-way	447	526	79	18%	413	339	-74	-18%
Q. A128 Brentwood Rd	2-way	2216	1981	-235	-11%	2195	1849	-346	-16%
R. B1007 North Hill, Horndon	2-way	1156	1206	50	4%	1035	1056	20	2%
S. Chadwell Hill	2-way	828	919	91	11%	846	966	119	14%
T. Muckingford Rd	2-way	344	319	-25	-7%	337	256	-81	-24%

Table 6-3 LTC Impact on Local Roads. Flow Difference. AM Peak

Links		2045 DCO2v2				2044 DCO2v1			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
J. A1013 Stamford Rd	2-way	2214	1989	-225	-10%	1447	1484	37	3%
K. Brentwood Rd	2-way	1186	1466	280	24%	818	1228	410	50%
L. Buckingham Hill Rd	2-way	878	1089	211	24%	771	939	168	22%
M. A1012 Elizabeth Rd	2-way	1537	1756	219	14%	1518	1782	264	17%
N. A1306 N. Arterial	2-way	2046	1901	-145	-7%	2064	1919	-146	-7%
O. London Rd, Grays	2-way	2314	2235	-79	-3%	2345	2248	-96	-4%
P. Rectory Rd, Orsett	2-way	427	513	86	20%	456	367	-89	-19%
Q. A128 Brentwood Rd	2-way	1981	1528	-453	-23%	1888	1307	-581	-31%
R. B1007 North Hill, Horndon	2-way	1726	1706	-20	-1%	1022	1133	111	11%
S. Chadwell Hill	2-way	977	1038	61	6%	782	987	205	26%
T. Muckingford Rd	2-way	291	384	93	32%	247	289	42	17%

Table 6-4 LTC Impact on Local Roads. Flow Difference. PM Peak

6.2.4 It can be seen from the tables above that that the pattern of flow changes is similar across the time periods and different versions of the models in terms of the locations of impact. The key areas that show an increase in flows as a result of the LTC in the updated DCO2v2 models are:

Strategic Roads

- Substantial increase on the A1089 (northbound direction only) observed in the vicinity of Marshfoot Road/Old Dock Approach Road roundabout
- Sections of the A13 to the east of the Orsett Cock roundabout. It should be noted that the increase has become smaller in the DCO2v2 models and ranges between 11% and 19% in DCO2v2 compared to 11%-27% in DCO2v1.

Local Roads

- Brentwood Road south of the Orsett Cock junction (AM and PM)
- Buckingham Hill Rd (PM only)
- A1012 Elizabeth Rd (AM and PM)
- Rectory Road, Orsett Village (AM and PM)
- B1007 North Hill in Horndon (AM only)
- S. Chadwell Hill, Chadwell St Mary (AM and PM)
- Muckingford Road (PM only)

6.2.5 In addition, the following locations have been identified to demonstrate an increase in traffic through a visual analysis of the flow difference plots:

- Sections of the local network in Stanford-le-Hope and Corringham
- Linford Road in the Chadwell St Mary area
- Marshfoot Road including Marshfoot Road/Old Dock Approach Road roundabout
- Turnpike Lane/Gun Hill/Fort Road in the West Tilbury Area
- Brennan Road in the Tilbury area
- Sections of Arterial Road and A1090 in Purfleet

6.2.6 These areas are graphically shown in the figure below using 2045 flow difference flows as an example.

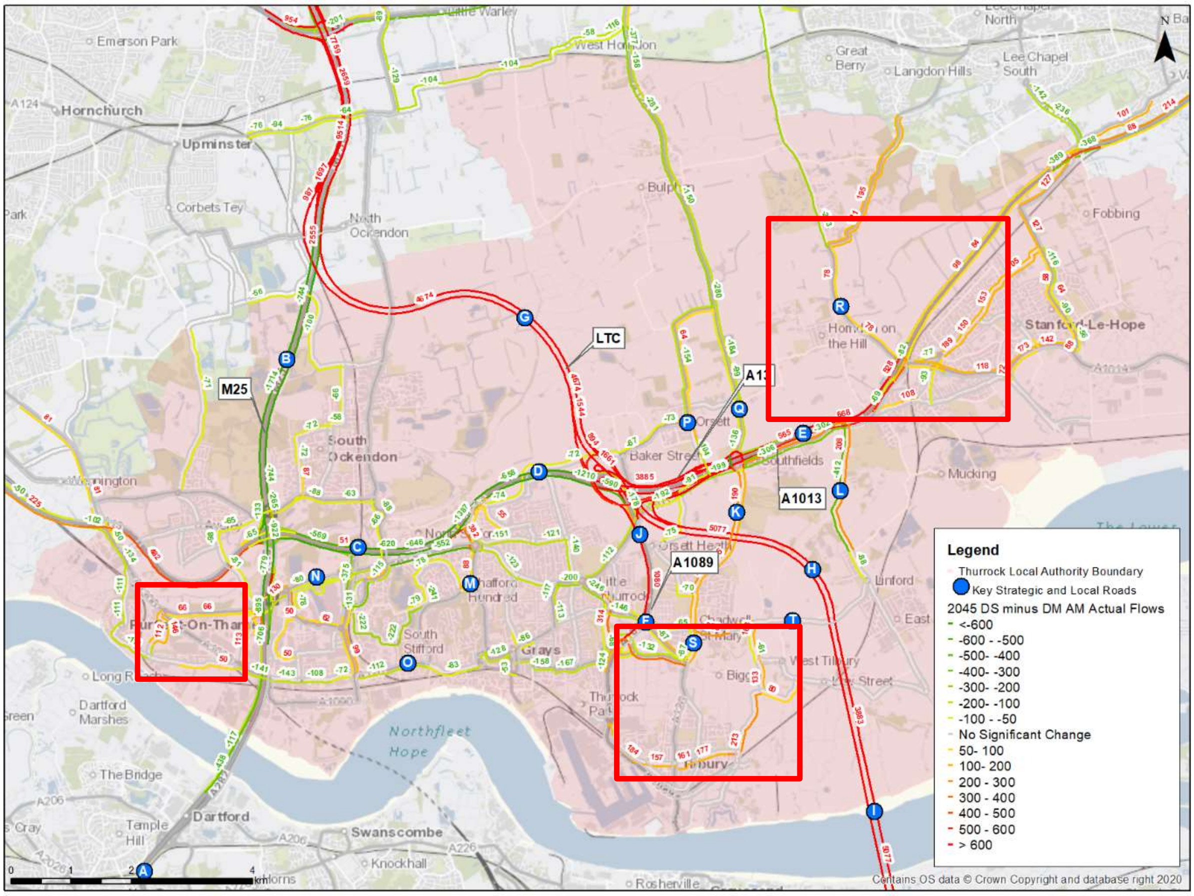


Figure 6-5 Additional Locations demonstrating an increase in traffic. 2045 AM Flow Changes DS minus DM (DCO2v2)

6.2.7 Key areas showing decreases in flows are:

<u>Strategic Roads</u>

- Dartford Crossing
- M25 North of J30
- A13 West to the west of the Orsett Cock roundabout

<u>Local Roads</u>

- A1013 Stamford Road (AM and PM)
- Buckingham Hill Road (AM only)
- A1306 North Arterial (AM and PM
- London Road in Grays (AM and PM)
- Brentwood Road North of Orsett Cock (AM and PM)
- B1007 North Hill in Hordon (PM only)
- Muckingford Road (AM only)

6.3 Commentary of Impacts on the A1013 Stanford Road and Brentwood Road

6.3.1 A key design change reflected in the updated models is the provision of the new link from Orsett Cock roundabout to the A1089 southbound to relieve impacts of the previous scheme design on the A1013 Stanford Road (including the Daneholes roundabout) and the Brentwood Road. The scheme design change was described in Section 3.3 ‘Network Changes’ of this report.

6.3.2 The change was introduced to address feedback from the Council and other stakeholders about the lack of connectivity between the LTC and the A1089, and the resulting impacts on the local road network, particularly high traffic flow on the A1013.

6.3.3 This section provides a summary of the flow changes on various sections of the A1013 Stanford Road east and west of Orsett Cock roundabout as well as sections of Brentwood Road north and south of Orsett Cock roundabout in DCO2v2 and aims to demonstrate if the scheme design changes have addressed earlier concerns. The analysed sections are shown in Figure 6-3.

6.3.4 The flow changes between 2045 DS against the 2045 DM flows are summarised in Table 6-6.

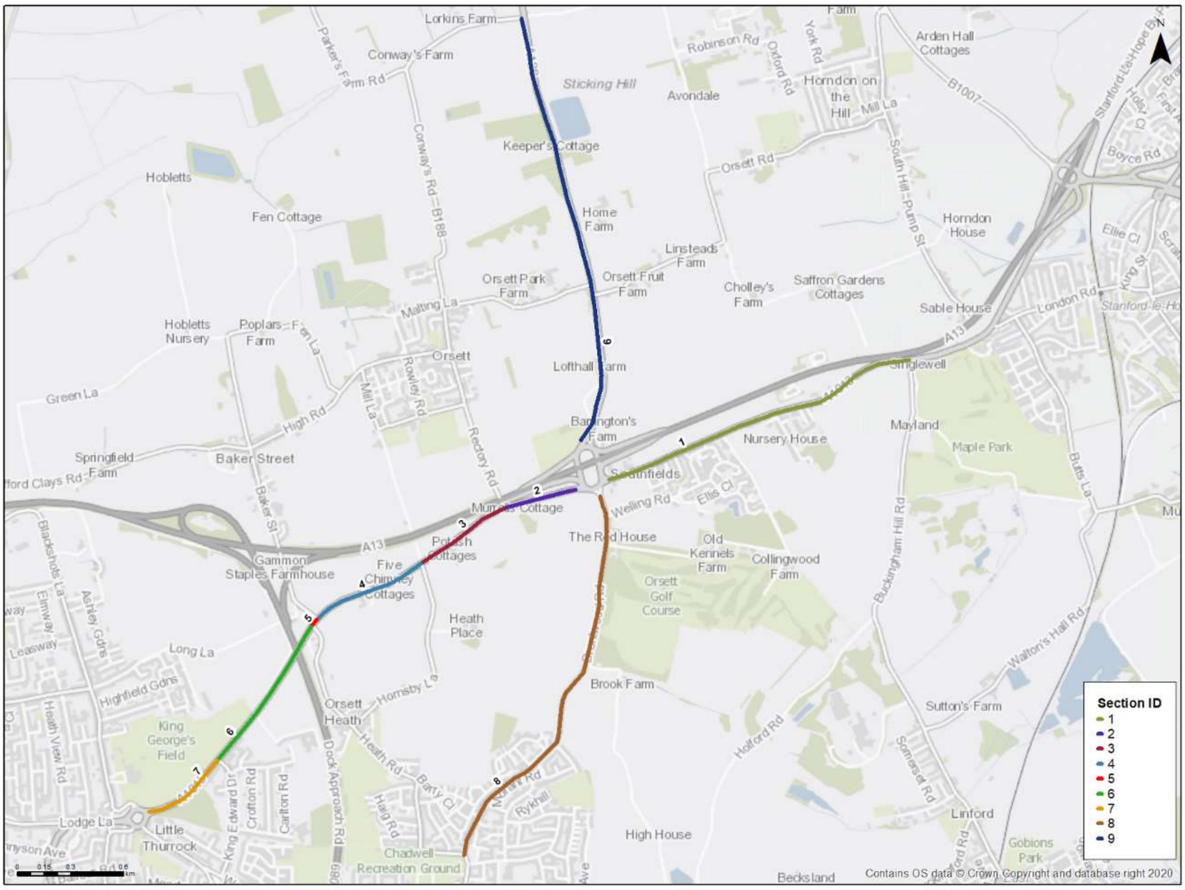


Figure 6-3 A1013 Stanford Road flow sections

Section ID	Direction	AM				PM			
		2045DM	2045DS	Change	%Change	2045DM	2045DS	Change	%Change
1	EB	451	720	268	59%	717	1255	538	75%
1	WB	1084	778	-306	-28%	682	521	-161	-24%
2	EB	871	594	-278	-32%	933	741	-192	-21%
2	WB	1068	869	-199	-19%	1087	970	-117	-11%
3	EB	1037	770	-267	-26%	1140	980	-160	-14%
3	WB	1064	973	-91	-9%	1063	1048	-15	-1%
4	EB	962	770	-192	-20%	1140	980	-160	-14%
4	WB	1064	973	-91	-9%	1063	1048	-15	-1%
5	NB	997	824	-173	-17%	1185	1010	-175	-15%
5	SB	1090	1057	-33	-3%	1170	1165	-5	0%
6	NB	873	761	-112	-13%	1164	985	-179	-15%
6	SB	1037	1012	-26	-2%	1050	1004	-46	-4%
7	NB	873	761	-112	-13%	1164	985	-179	-15%
7	SB	1051	1022	-30	-3%	1299	1254	-45	-3%

Table 6-6 A1013 Stanford Road Flow changes in pcu/hr – 2045 DCO2v2

Section ID	Direction	AM				PM			
		2045 DM	2045 DS	Change	% Change	2045 DM	2045 DS	Change	% Change
8	NB	231	421	190	82%	732	964	232	32%
8	SB	543	808	265	49%	454	502	48	11%
9	NB	971	835	-136	-14%	1102	856	-246	-22%
9	SB	1245	1146	-99	-8%	879	672	-207	-24%

Table 6-7 A1013 Brentwood Road Flow changes in pcu/hr – 2045 DCO2v2

6.3.5 It can be seen from Table 6-6 that on Stanford Road:

- In the main, the sections to the west of Orsett Cock roundabout including up to and leading into the Daneholes roundabout show reductions in flows in both directions, which range between -32% and 0%.
- Similarly, on section 1, which is east of Orsett Cock roundabout, there is a significant decrease westbound in both peak hours, which is equivalent to -28% in the AM and -24% in the PM.
- However, on the same section 1, which is east of Orsett Cock roundabout, there is a significant increase in flows in the eastbound direction reaching 59% in the AM and 75% in the PM. Interrogation of the cordon models suggests that this is due to additional trip generation forecast by LTAM from and to the area located to the south east of the Orsett Cock. To illustrate this, flows passing through Section 1 in the eastbound direction have been identified and compared between the DM and DS for the AM peak as illustrated in the figure below. The figure shows the 207 pcu on Buckingham Hill Road disappearing when it gets to Linford / East Tilbury and Muckingford Road, which indicates a location of additional trip generation in the DS that is due to the LTC.

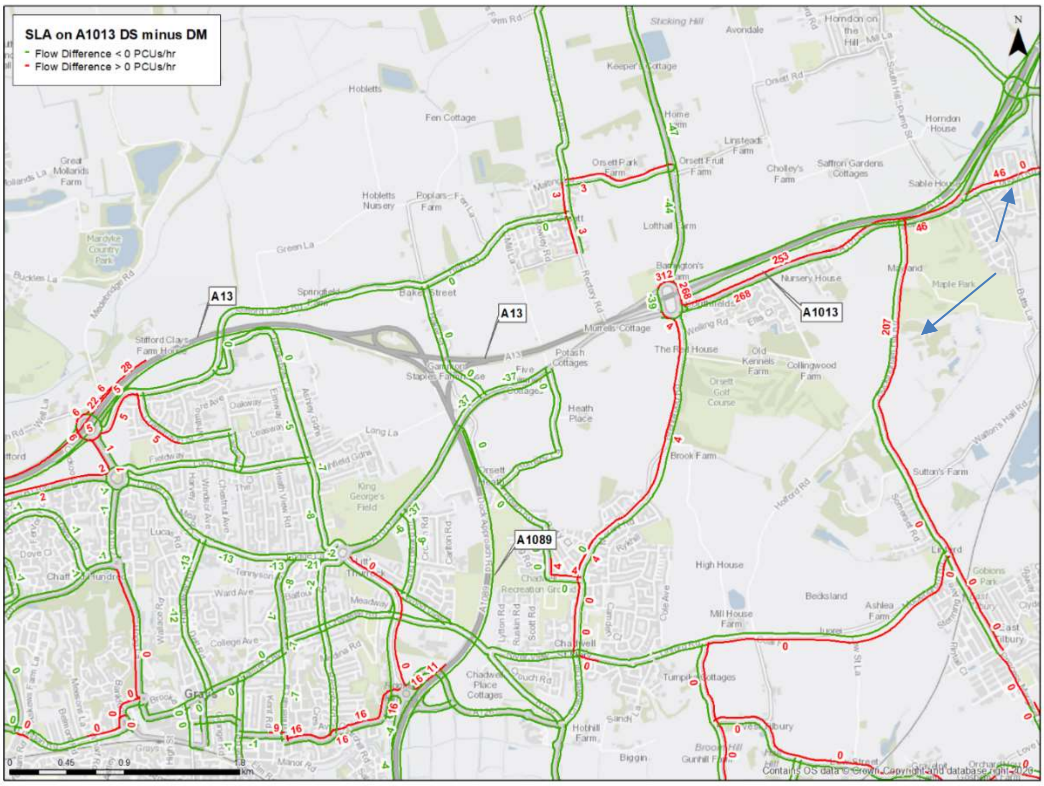


Figure 6-4 Differences in Eastbound Flow on Section 1. DM vs DS.

6.3.6 It appears that the proposed Orsett Cock link road, in the main reduces flows on the A1013 Stanford Road to the west of Orsett Cock roundabout and at Daneholes Roundabout (see section 8.5).

6.3.7 The impact on Brentwood Road is mixed as shown in Table 6-7 with the section north of the Orsett Cock roundabout showing a reduction in traffic whereas the section south of the Orsett Cock showing a substantial increase in traffic of up to 82% observed in the AM in the northbound direction thus suggesting much higher traffic flows on unsuitable roads through a local community of Chadwell St Mary 'with the LTC' in place.

6.4 Summary

6.4.1 The flow changes as a result of the LTC in Thurrock are quite complex although the pattern of flow changes in terms of location is relatively similar across the AM and PM peak modelled hours and are also similar to the flow changes observed in the DCO2v1 model review.

6.4.2 A comparison in flow between DM and DS models has been undertaken on a selection of local and strategic roads in Thurrock.

6.4.3 It can be seen from the tables above that that the pattern of flow changes is similar across the time periods and different versions of the models in terms of the locations of impact. The key areas that show an increase in flows as a result of the LTC in the updated DCO2v2 models are:

Strategic Roads

- Substantial increase on the A1089 (northbound direction only) observed in the vicinity of Marshfoot Road/Old Dock Approach Road roundabout

- Sections of the A13 to the east of the Orsett Cock roundabout. It should be noted that the increase has become smaller in the DCO2v2 models and ranges between 11% and 19% in DCO2v2 compared to 11%-27% in DCO2v1.

Local Roads

- Brentwood Road south of the Orsett Cock junction (AM and PM)
- Buckingham Hill Rd (PM only)
- A1012 Elizabeth Rd (AM and PM)
- Rectory Road in Orsett Village (AM and PM)
- B1007 North Hill in Horndon (AM only)
- S. Chadwell Hill in Chadwell St Mary (AM and PM)
- Muckingford Road (PM only)

6.4.4 In addition, the following locations have been identified to demonstrate an increase in traffic through a visual analysis:

- Sections of the local network in Stanford-le-Hope and Corringham
- Linford Road in the Chadwell St Mary area
- Marshfoot Road including Marshfoot Road/Old Dock Approach Road roundabout
- Turnpike Lane/Gun Hill/Fort Road in the West Tilbury Area
- Brennan Road in the Tilbury area
- Sections of Arterial Road and A1090 in Purfleet

6.4.5 It appears that the Orsett Cock link road which is now proposed as part of the LTC scheme design, in the main reduces flows on the A1013 Stanford Road to the west of Orsett Cock roundabout in both directions . However, on the A1013 to the east of the Orsett Cock roundabout, flows are seen to significantly decrease westbound and significantly increase eastbound. The latter is due to a significant number of additional trips generated by the LTAM for the area south east of Orsett Cock in the DS. The same Orsett Cock link road has a mixed impact on flows on Brentwood Road, which demonstrates a drop in traffic north of the junction and a significant increase south of the junction, including on roads in Chadwell St Mary.

6.4.6 Further analysis of the implications of the traffic flow changes is required by the scheme promoter to assess the impacts on road capacity, local communities, vulnerable road users, active modes and sustainable transport and to propose suitable local mitigation measures.

6.4.7 Further analysis by the scheme promoter is required on:

- A1089/Marshfoot Road
- Orsett Village area
- Chadwell St Mary Area including Brentwood Road and Linford Road
- West Tilbury Area
- Local Network in Stanford-le-Hope and Corringham and Five Bells junctions
- Purfleet area

6.4.8 Ultimately the Council is looking for confidence that the local roads will be protected and/or capable of accommodating the effects of the LTC and that the DCO scheme provides the best configuration for the borough and against the scheme objectives.

7 Strategic Cross River Traffic Movements. DCO2v2 vs DCO2v1

7.1 Introduction

7.1.1 This section summarises the change in cross river traffic flows. The proposed LTC is promoted as a scheme that will provide an additional river crossing and relieve pressure from the existing A282 Dartford Crossing/Queen Elizabeth II bridge. The flows are analysed for the opening year 2030 and for 2045, 15 years after opening for all three modelled time periods. The flows are also compared to the previous model DCO2v1 models for 2029 (previous Opening Year) and 2044. Different to the other sections, the flows presented in this Chapter are in vehicles as opposed to pcu.

7.2 Strategic River Crossing Flows - Opening Year

7.2.1 Table 7-1 summarises the flows across the river for the 'without the LTC' scenarios (DM) and for the 'with the LTC' scenarios (DS) for the Opening Year 2030. The equivalent flows in the previous model opening year 2029 are shown in Table 7-2.

7.2.2 It can be seen from Table 7-1 that in the Opening Year 2030:

- Total traffic crossing the river Thames will increase significantly. The increase is predicted to be 40% in the AM peak hour and 38% in the PM peak hour. This is equivalent to 4,971 additional vehicles in the AM and 4,751 vehicles in the PM.
- Traffic using the existing Dartford Crossing is predicted to reduce by 14% in the AM peak hour and 18% in the PM peak hour.
- It is evident that while the LTC will provide relief to the existing Dartford Crossing in the Opening Year 2030, more people will travel across the river as a result of the additional capacity provided by the LTC.
- The increase in trips crossing the River Thames is predicted to be due to a variety of people's travel behaviour responses to the additional highway capacity in the network (i.e reassignment of traffic, trip redistribution with some people changing origins and/or destinations of their trips, mode shift from public transport and completely new trips on the network). **The extent of each travel behaviour responses is not fully understood from the limited information made available to Thurrock and an explanation is required as to the main driver for the increase in trips crossing the river 'with the LTC' in place.**

7.2.3 The equivalent impacts from the 2029 Opening Year in the previous DCO2v1 model can be seen in Table 7-2. The trends in DCO2v1 model were similar to those seen in the updated DCO2v2 model for 2030 Opening Year:

- The increase in the number of vehicles crossing the river Thames was predicted to be 38% in the AM peak hour, 26% in the IP average hour and 40% in the PM peak hour.
- Traffic using the existing Dartford Crossing was predicted to reduce by 15% in the AM peak hour, 22% in the average IP hour and 17% in the PM peak hour.

Link	Direction	AM			PM		
		DM	DS	Diff (DS-DM)	DM	DS	Diff (DS-DM)
A282 Dartford Crossing (West & East) Tunnels	NB	5623	4736	-887	5672	5140	-532
A282 Queen Elizabeth II Bridge	SB	6854	5965	-888	6911	5185	-1726
	2WAY	**12476**	**10701**	**-1775**	**12583**	**10324**	**-2258**
LTC	NB		3924	3924		3092	3092
	SB		2822	2822		3917	3917
	2WAY		**6746**	**6746**		**7009**	**7009**
River Crossing Screenline Totals	NB	5623	8660	3037	5672	8232	2560
	SB	6854	8787	1933	6911	9102	2191
	2WAY	**12476**	**17447**	**4971**	**12583**	**17334**	**4751**
Percentage change in River Crossing Trips (%)		**40%**			**38%**		
Percentage change in existing Dartford Crossing Trips (%)		**-14%**			**-18%**		

Table 7-1 Summary of Strategic River Crossing Flows (Vehicles/hour) – 2030 DCO2v2 Model

Link	Direction	AM			PM		
		DM	DS	Diff (DS-DM)	DM	DS	Diff (DS-DM)
A282 Dartford Crossing (West & East) Tunnels	NB	5623	4678	-946	5010	3981	-1029
A282 Queen Elizabeth II Bridge	SB	6515	5693	-822	5058	3827	-1231
	2WAY	**12138**	**10371**	**-1767**	**10068**	**7808**	**-2260**
LTC	NB		3638	3638		2694	2694
	SB		2794	2794		2152	2152
	2WAY		**6432**	**6432**		**4846**	**4846**
River Crossing Screenline Totals	NB	5623	8316	2693	5010	6674	1665
	SB	6515	8487	1973	5058	5979	921
	2WAY	**12138**	**16803**	**4665**	**10068**	**12654**	**2585**
Percentage change in River Crossing Trips (%)		**38%**			**26%**		
Percentage change in existing Dartford Crossing Trips (%)		**-15%**			**-22%**		

Table 7-2 Summary of Strategic River Crossing Flows (Vehicles/hour) – 2029 DCO2v1 Model

7.3 Strategic River Crossing Flows - 15 Years After Opening

7.3.1 Table 7-3 summarises the flows across the river for the ‘Without LTC’ scenarios (DM) and in the ‘With LTC’ scenarios (DS) for 2045, 15 years after opening. The equivalent flows in the previous model are for 2044 and are shown in Table 7-4.

Link	Direction	AM			PM		
		DM	DS	Diff (DS-DM)	DM	DS	Diff (DS-DM)
A282 Dartford Crossing (West & East) Tunnels	NB	5691	5412	-279	5070	5020	-50
A282 Queen Elizabeth II Bridge	SB	6621	6829	209	6049	5026	-1023
	2WAY	**12312**	**12241**	**-70**	**11119**	**10046**	**-1073**
LTC	NB		4421	4421		3440	3440
	SB		3224	3224		3269	3269
	2WAY		**7645**	**7645**		**6709**	**6709**
River Crossing Screenline Totals	NB	5691	9833	4142	5070	8460	3391
	SB	6621	10053	3433	6049	8294	2245
	2WAY	**12312**	**19886**	**7574**	**11119**	**16755**	**5636**
Percentage change in River Crossing Trips (%)		**62%**			**51%**		
Percentage change in existing Dartford Crossing Trips (%)		**-1%**			**-10%**		

Table 7-3 Summary of Strategic River Crossing Flows (Vehicles/hour) – 2045 DCO2v2 Model

Link	Direction	AM			PM		
		DM	DS	Diff (DS-DM)	DM	DS	Diff (DS-DM)
A282 Dartford Crossing (West & East) Tunnels	NB	5699	5326	-373	5069	4808	-261
A282 Queen Elizabeth II Bridge	SB	6609	6533	-76	5913	4775	-1138
	2WAY	**12308**	**11859**	**-449**	**10982**	**9583**	**-1399**
LTC	NB		4222	4222		3378	3378
	SB		3303	3303		2649	2649
	2WAY		**7525**	**7525**		**6027**	**6027**
River Crossing Screenline Totals	NB	5699	9549	3849	5069	8186	3116
	SB	6609	9836	3227	5913	7424	1511
	2WAY	**12308**	**19384**	**7076**	**10982**	**15609**	**4627**
Percentage change in River Crossing Trips (%)		**57%**			**42%**		
Percentage change in existing Dartford Crossing Trips (%)		**-4%**			**-13%**		

Table 7-4 Summary of Strategic River Crossing Flows (Vehicles/hour) – 2044 DCO2v1 Model

7.3.6 It can be seen from Table 7-3 that in 2045, 15 years after opening:

- Total traffic crossing the River Thames will increase significantly compared to the 'without LTC' scenario. The increase is predicted to be 62% in the AM peak hour and 53% in the PM peak hour. This is equivalent to 7,574 additional vehicles in the AM and 6,883 vehicles in the PM.
- Traffic using the existing Dartford Crossing is predicted to reduce by only 1% in the AM peak hour and 8% in the PM peak hour. This is significantly lower than in the opening year (i.e., -14% and -18% in the AM and PM accordingly).
- It is evident that 15 years after opening, the flow reduction and relief provided by the LTC on the existing Dartford Crossing will have been eroded particularly in the AM peak although more people will continue to travel across the river 15 years after the scheme opening as a result of the additional capacity provided by the LTC.
- The increase in trips crossing the river Thames may be a result of the following travel behaviour responses: trip re-assignment, trip re-distribution with some people changing

the origins and destinations of their trips and appearance of completely new trips. **The extent of each of the travel response is not fully understood from the cordon models made available to Council and an explanation is required as to the main driver for the increase in trips crossing the river 'with the LTC' in place.**

7.3.7 The equivalent impacts from the 2044 forecast year from the previous DCO2v1 model can be seen in Table 7-4. The trends in 2044 were similar to those seen in the updated DCO2v2 model for 2045 forecast year:

- The increase in traffic crossing the River Thames (expressed in the units of vehicles per hour) was predicted to be 57% in the AM peak hour and 53% in the PM peak hour, which is slightly lower than in the DCO2v2 models.
- Traffic using the existing Dartford Crossing was predicted to reduce by 4% in the AM peak hour and 9% in the PM peak hour. The reductions in traffic on Dartford Crossing in DCO2v1 were slightly higher than in the updated DCO2v2 forecasts.

7.4 Section Summary

7.4.1 The changes in cross river traffic flows in the scheme opening year and 15 years after scheme opening have been presented in this section and are summarised in Table 7-5.

Opening Year	AM Peak	PM Peak
DCO2v2		
Percentage Increase in River Crossing Trips (%)	+40%	+38%
Percentage decrease in existing Dartford Crossing Trips (%)	-14%	-18%
DCO2v1		
Percentage Increase in River Crossing Trips (%)	+38%	+40%
Percentage decrease in existing Dartford Crossing Trips (%)	-15%	-17%
15 Years After Opening	**AM Peak**	**PM Peak**
DCO2v2		
Percentage Increase in River Crossing Trips (%)	+62%	+53%
Percentage decrease in existing Dartford Crossing Trips (%)	-1%	-8%
DCO2v1		
Percentage Increase in River Crossing Trips (%)	+57%	+53%
Percentage decrease in existing Dartford Crossing Trips (%)	-4%	-9%

Table 7-5 Summary of Strategic River Crossing Flow Changes

7.4.2 The proposed LTC is promoted as a scheme that will provide an additional river crossing and relieve pressure from the existing A282 Dartford Crossing/Queen Elizabeth II bridge. It is evident that the updated (DCO2v2) and previous (DCO2v1) models predict that 15 years after opening, the flow reductions on the existing Dartford Crossing as a result of the LTC will have waned significantly particularly in the AM peak.

7.4.3 While in both the opening year and 15 years after opening the scheme provides a relief to the existing Dartford Crossing, the relief is forecast to be less in the updated models which has a potential to further undermine the Value for Money (VfM) case of the scheme. It is requested that an explanation and results be provided on the implications of the updated models on Value for Money category of the scheme including Initial and Adjusted Benefit Cost Ratio (BCR).

8 Key Junction Flow Comparison and Performance 2045 DS vs DM

8.1 Introduction

8.1.1 This section provides further detail regarding the turning flows extracted from the DCO2v2 model and how these are compared to the previously reviewed DCO2v1 model. The analysis is presented from the AM and PM peak periods for a set of key junctions identified from earlier reviews as the main areas of scheme impact. The junctions are listed below and are graphically shown in Figure 8-1 below:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junction

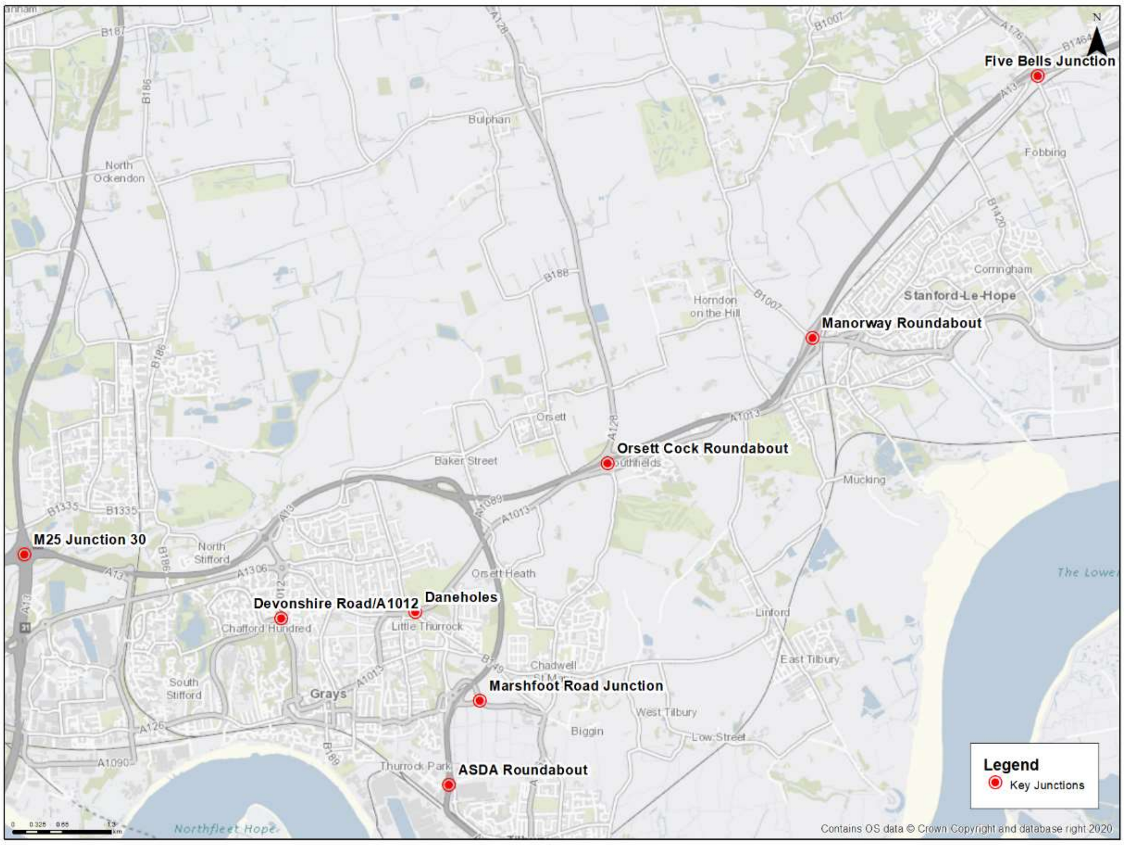


Figure 8-1: Key Junctions

8.1.2 Comparison of changes in delays and ratio of Volume over Capacity (V/C) between DS and DM scenarios presented with Appendix H identified no additional junctions that are forecast to experience increased congestion in the 'with the LTC' scenario.

8.1.3 The tables included within the following sections provide an overview of the impact of the LTC (DS scenario) compared to the 'without the LTC' (DM scenario) for the DCO2v2 model and analyses how these have changed since the last review of the DCO2v1 models for the AM and PM peak periods at the above listed junctions.

8.1.4 This aspect of the review has been undertaken to demonstrate how the key junctions within Thurrock may be impacted in traffic terms as a result of the operation of the LTC with any increases in traffic flows most likely resulting in the worsening of congestion and junction operation.

8.2 The Manorway Roundabout

8.2.1 The right-hand columns in Table 8-1 provide an indication of traffic flow differences between DS ('With LTC') and DM ('Without LTC') for the DCO2v2 models for 2045 for the AM and PM peak period respectively. Positive values indicate an increase in traffic flows as a result of the LTC, whereas negative values suggest that there is forecast to be a reduction in traffic volumes.

8.2.2 In addition, Table 8-1 provides information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively. Increases in delay and V/C values usually indicate worsening in congestion as a result of the LTC, whereas reductions suggest that there is likely to be a relief to traffic congestion.

8.2.3 In general, a V/C value of 85% and below indicates spare capacity. A V/C value of between 85% and 100% means that a junction or a turning movement operates within but approaching capacity with signs of queuing and delays; whereas a V/C value of 100% and above indicates that the junction operates at or above capacity, resulting in queues and delays.

8.2.4 Columns on the right-hand side of Table 8-1 show changes between DM and DS in DCO2v2, whereas columns on the left hand-side of the same table present how flows, delays and V/C have changed compared to the original DCO2v1 model.

8.2.5 Figure 8-2 provides a diagram of the junction within Saturn including the labels of each arm.

Figure 8-2 Manorway Junction arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	639	600	634	436
B	531	482	471	465
C	2300	2257	2844	2415
D	420	516	330	612
E	2037	2065	2046	2113
Total	**5927**	**5920**	**6327**	**6041**
% Increase	**0%**		**5%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	639	562	634	587
B	531	613	471	647
C	2300	2204	2844	2962
D	420	489	330	252
E	2037	1894	2046	1843
Total	**5927**	**5762**	**6325**	**6291**
% Increase	**3%**		**1%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	45	43	37	29
B	33	30	30	29
C	56	65	69	69
D	83	72	76	85
E	64	65	64	66
Maximum	**83**	**72**	**76**	**85**
Change	**11**		**-9**	
Weighted Average	**57**	**61**	**62**	**64**
Change	**-3**		**-2**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	45	49	37	45
B	33	38	30	41
C	56	53	69	72
D	83	76	76	77
E	64	59	64	58
Maximum	**83**	**76**	**76**	**77**
Change	**7**		**0**	
Weighted Average	**56**	**54**	**62**	**61**
Change	**3**		**1**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	458	447	47	80
B	28	27	27	27
C	10	16	14	17
D	28	16	27	23
E	16	16	16	16
Maximum	**458**	**447**	**47**	**80**
Change	**11**		**-33**	
Weighted Average	**63**	**61**	**20**	**23**
Change	**3**		**-3**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	458	317	47	72
B	28	28	27	28
C	10	10	14	15
D	28	19	27	33
E	16	15	16	15
Maximum	**458**	**317**	**47**	**72**
Change	**140**		**25**	
Weighted Average	**63**	**44**	**20**	**23**
Change	**19**		**-3**	

Table 8-1 DCO2v1 vs DCO2v2 Manorway roundabout Flows and Junction Performance

8.2.6 The above comparison suggests that introduction of the LTC in DCO2v2 results in additional 161 pcu/hr through the junction in the AM (which is equivalent to a 3% increase), and 36 additional pcu/hr in the PM (1% increase).

8.2.7 The increase in traffic flows predicted in the updated model is slightly higher than the increase observed in the earlier reviewed DCO2v1 model. Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2V1) suggests that:

- In the AM peak the increase in DS flows into the Manorway roundabout are only 3pcu higher, at 5923 pcu/hr compared to 5920 pcu/hr

- In the PM peak the flows into the Manorway roundabout are 5% higher in the updated models at 6327 pcu/hr v 6041 pcu/hr (+ 286 pcu/hr).

8.2.8 DCO2v2 DS model also forecasts an increase in V/C and delay values on around half of the junction approaches in comparison with the DM and in comparison, with the DCO2v1 DS model results. The maximum V/C is forecast in DCO2v2 DS model on the approach from the A1013 (arm D) in the AM Peak.

8.2.9 Significant delays are forecast on the B1007 approach (arm A) reaching 458 seconds in the AM peak in the DS compared to 317 seconds in the DM. This may be due to a high level of flow on the circulatory, which traffic approaching from the B1007 needs to give way to.

8.2.10 Given maximum V/C approaching 85% on arm D, a significant level of delays on the B1007 approach, the critical importance of the junction as a gateway to London Gateway/DP World, the Council's concerns with the likely accuracy of the forecast modelling and outputs given the current and previous matters raised about the base model, the Council remains concerned about the impact of the LTC on the Manorway and further operational Vissim modelling is being undertaken. We await the traffic assessment using Vissim and will reserve judgement on the operation of the junction when it emerges.

8.3 Orsett Cock Roundabout

8.3.1 Table 8-2 provides information about traffic flows in DCO2v1 and DCO2v2 scenarios for 2045 DS (‘With LTC’) and DM (‘Without LTC’) for the AM and PM peak periods respectively. The table also provides information about delay and V/C differences between the DCO2 2045 DS (‘With LTC’) and DM (‘Without LTC’).

8.3.2 Figure 8-3 provides a diagram of the junction within Saturn including the labels of each arm.

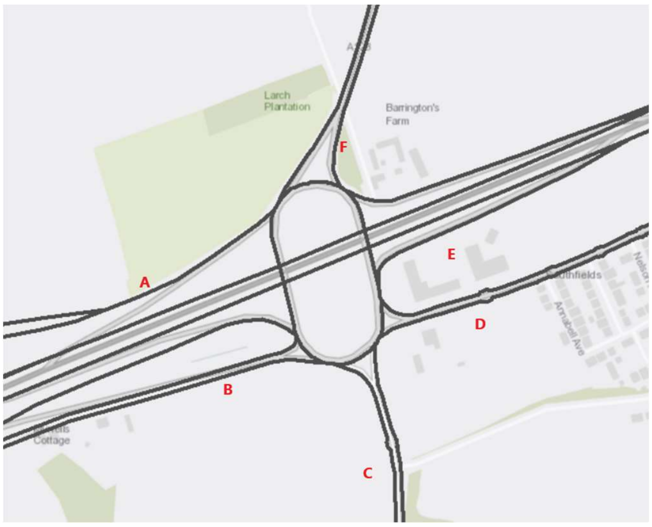


Figure 8-3 Orsett Cock Junction Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	2213	2020	2952	2840
B	594	467	741	476
C	808	590	502	386
D	778	1298	521	842
E	695	114	625	237
F	832	817	856	608
Total	**5920**	**5306**	**6197**	**5389**
% Increase	**12%**		**15%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	2213	674	2952	928
B	594	871	741	933
C	808	543	502	454
D	778	1084	521	682
E	695	1059	625	1126
F	832	971	856	1102
Total	**5920**	**5203**	**6197**	**5224**
% Increase		**14%**		**19%**

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	83	65	93	91
B	101	35	63	19
C	82	48	55	21
D	101	53	100	45
E	73	11	90	22
F	73	55	68	86
Maximum	**101**	**65**	**100**	**91**
Change	**36**		**9**	
Weighted Average	**84**	**55**	**83**	**69**
Change	**30**		**14**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	83	59	94	61
B	101	100	63	56
C	82	104	55	44
D	101	96	100	69
E	73	56	90	59
F	73	36	89	53
Maximum	**101**	**104**	**100**	**69**
Change	**-3**		**31**	
Weighted Average	**84**	**73**	**86**	**58**
Change	**11**		**29**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	18	10	21	17
B	77	1	9	5
C	33	8	27	5
D	74	5	62	6
E	28	20	47	21
F	28	7	41	55
Maximum	**77**	**20**	**62**	**55**
Change	**57**		**7**	
Weighted Average	**36**	**8**	**29**	**18**
Change	**28**		**11**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	18	26	21	22
B	77	49	9	7
C	33	132	27	8
D	74	32	62	12
E	28	13	47	13
F	28	4	41	6
Maximum	**77**	**132**	**62**	**22**
Change	**-55**		**40**	
Weighted Average	**36**	**35**	**29**	**11**
Change	**1**		**18**	

Table 8-2 DCO2v1 vs DCO2v2 Orsett Cock roundabout Flows and Junction Performance

8.3.3 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- The flows through the Orsett Cock roundabout are 12% higher in the AM and 15% higher in the PM peak in the DCO2v2 model, which is equivalent to an increase of 614 and 808 pcu respectively

8.3.4 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- The introduction of the LTC in the AM peak is forecast to result in an increase of 14% (720pcu) in the AM and 19% (972pcu) in the PM peak in comparison with the DM model.

8.3.5 In terms of approach arm V/C the 2045 DS v 2045 DM comparison suggests that:

- V/C is forecast to increase on all the approaches to the junction with the exception of approach C (Brentwood Road south) in the AM
- In the AM peak Arms B and D are worse than the DM and are overcapacity with V/C values reaching 101% (100% and 96% in the DM)
- In the PM peak Arm D reaches capacity with V/C of 100% (69% in the DM)
- In practice a V/C of 85% defines the threshold at which junction performance deteriorates rapidly manifested through rapid increase in delays and queues hence arms B and D have capacity issues.
- Furthermore, most of the junction arms show increased delays by up to 50 seconds in the AM peak and PM peak.

8.3.6 The A13 Orsett Cock junction performance has significantly deteriorated from previously reviewed DCO2v1 with high levels of delays and V/C forecast on selected junction approaches. This is despite the introduction of additional traffic signals at the junction.

8.3.7 Further work and evidence is required from NH (i.e. microsimulation modelling) to confirm that the junction will operate within capacity 'with the LTC' and additional mitigation measures and design changes proposed by the scheme promoter. This is because the LTAM is a strategic model ant thus has not been validated to a great level of detail at a junction level; the LTAM has also been developed to represent a morning peak hour on the strategic road network (i.e. 0700-0800) and is not suited to forecast congestion during a local peak hour, which is 0800-0900. We await the traffic assessment using Vissim and will reserve judgement on the operation of the junction until it is complete and reviewed by Stantec.

8.4 ASDA Roundabout

8.4.1 Table 8-3 provides an indication of traffic flow between DCO2v1 and DCO2v2 scenarios for 2045 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively. The table also provides information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC').

8.4.2 Figure 8-4 provides a diagram of the junction within Saturn including the labels of each arm.

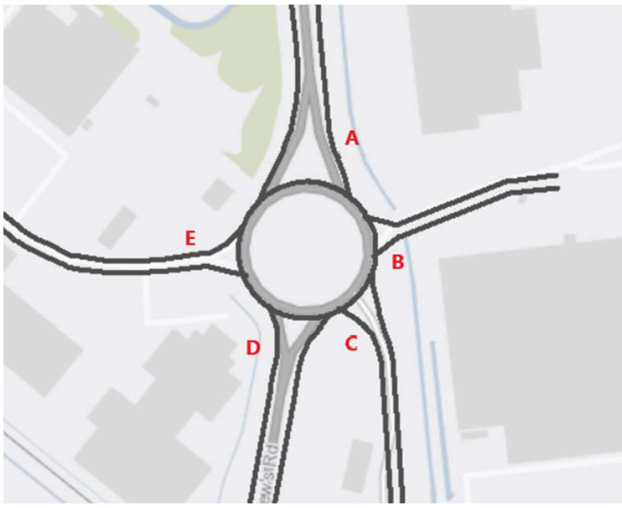


Figure 8-4 ASDA Junction Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	2547	2528	2280	2018
B	112	111	112	108
C	700	552	633	518
D	1038	1078	1198	979
E	343	299	616	813
Total	**4741**	**4568**	**4839**	**4436**
% Increase	**4%**		**9%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	2547	2537	2280	2068
B	112	112	112	112
C	700	527	633	522
D	1038	1084	1198	941
E	343	338	616	860
Total	**4741**	**4598**	**4839**	**4504**
% Increase	**3%**		**7%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	102	101	91	81
B	71	70	53	37
C	92	71	72	55
D	114	104	95	71
E	49	41	109	102
Maximum	**114**	**104**	**109**	**102**
Change	**10**		**7**	
Weighted Average	**98**	**94**	**91**	**79**
Change	**5**		**12**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	102	102	91	83
B	71	71	53	41
C	92	67	72	56
D	114	101	95	66
E	49	47	109	104
Maximum	**114**	**102**	**109**	**104**
Change	**12**		**5**	
Weighted Average	**98**	**93**	**91**	**79**
Change	**6**		**12**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	77	63	11	7
B	52	51	30	19
C	27	14	13	9
D	291	107	22	8
E	11	10	220	87
Maximum	**291**	**107**	**220**	**87**
Change	**184**		**133**	
Weighted Average	**111**	**64**	**41**	**22**
Change	**48**		**19**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	77	70	11	7
B	52	52	30	21
C	27	13	13	9
D	291	57	22	10
E	11	10	220	111
Maximum	**291**	**70**	**220**	**111**
Change	**221**		**109**	
Weighted Average	**111**	**56**	**41**	**28**
Change	**56**		**13**	

Table 8-3 DCO2v1 vs DCO2v2 ASDA roundabout Flows and Junction Performance

8.4.3 For the ASDA roundabout, comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- In the AM peak the flows at the ASDA roundabout are 4% higher in the DCO2v2 model and 9% higher in the PM peak

8.4.4 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 3% higher than the 2045 DM flows and 7% higher in the PM peak.
- In the PM peak the LTC introduces more trips from Port of Tilbury (an increase of 27% or 257 pcu from 941pcu in the DM)

8.4.5 In terms of approach arm V/C the 2045 DS v 2045 DM comparison suggests that:

- The introduction of the LTC worsens the performance of the ASDA roundabout with weighted V/C increasing from 100% to 106% in the AM and from 98% to 104% in the PM.
- In the AM peak Arm D (A1089 South) is worse in the DS than in the DM and is overcapacity with V/C value of 114% (101% in the DM). Arm A (A1089 North) is also forecast to be overcapacity with V/C at 102% both in the DM and DS.
- In the PM peak Arm E (access from ASDA) is forecast to be overcapacity with V/C of 109% compared to 104% in the DM
- In practice a V/C of 85% defines the threshold at which junction performance deteriorates rapidly manifested through rapid increase in delays and queues hence arms A, D and E will have capacity issues.
- Furthermore, Arm D shows significant increased delays in the AM peak of 234 seconds, which is unacceptable especially on a route from the Port of Tilbury, and
- Arm E in the PM peak shows a significant increase in delay of 109 seconds.

8.4.6 The ASDA roundabout performance has significantly deteriorated from the previously reviewed model with high levels of delays and V/C forecast on selected junction approaches. Considering the LTAM is a strategic model and the fact that the AM peak hour on the roads in Thurrock is 0800-0900 rather than 0700-0800, which was used in the LTAM model development, evidence is required (e.g. microsimulation modelling) to confirm the junction will operate within capacity 'with the LTC' operational and/or the mitigation measures and design changes proposed by the scheme promoter to achieve this.

8.4.7 As part of the analysis of the operation of the ASDA roundabout, NH should further assess the effects of introducing a strategic connection between the Port of Tilbury and LTC via a new route, referred to in other correspondence as the Tilbury Link Road. That assessment has been requested by the Council and other stakeholders and should form part of the assessment of alternatives for the LTC proposals.

8.5 Daneholes Roundabout

8.5.1 Table 8-4 provides an estimate of traffic flow changes between the DCO2 2045 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively. The table also provides information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC').

8.5.2 Figure 8-5 provides a diagram of the junction within Saturn including the labels of each arm.

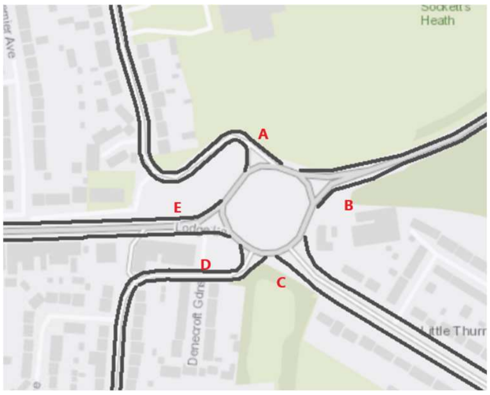


Figure 8-5 Daneholes Roundabout Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v1 2044 DS	PM DCO2v2 2045 DS	PM DCO2v1 2044 DS
A	625	555	653	538
B	1022	845	1254	919
C	472	403	375	331
D	333	249	326	214
E	878	752	1041	783
Total	**3330**	**2804**	**3649**	**2785**
% Increase	**19%**		**31%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v2 2045 DM	PM DCO2v2 2045 DS	PM DCO2v2 2045 DM
A	625	615	653	647
B	1022	1051	1254	1299
C	472	718	375	506
D	333	297	326	316
E	878	842	1041	1095
Total	**3330**	**3525**	**3649**	**3862**
% Increase	**-6%**		**-6%**	

V/C (%)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v1 2044 DS	PM DCO2v2 2045 DS	PM DCO2v1 2044 DS
A	86	69	96	67
B	58	48	71	52
C	57	23	21	19
D	63	47	61	40
E	42	32	49	33
Maximum	**86**	**69**	**96**	**67**
Change	**17**		**29**	
Weighted Average	**55**	**41**	**60**	**41**
Change	**13**		**19**	

V/C (%)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v2 2045 DM	PM DCO2v2 2045 DS	PM DCO2v2 2045 DM
A	86	85	96	99
B	58	59	71	73
C	27	41	21	30
D	63	56	61	60
E	42	42	49	56
Maximum	**86**	**85**	**96**	**99**
Change	**1**		**-3**	
Weighted Average	**53**	**53**	**60**	**65**
Change	**0**		**-5**	

DELAYS (SECONDS)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v1 2044 DS	PM DCO2v2 2045 DS	PM DCO2v1 2044 DS
A	42	32	56	31
B	25	18	35	20
C	12	11	11	11
D	37	26	19	10
E	14	13	15	13
Maximum	**42**	**32**	**56**	**31**
Change	**10**		**25**	
Weighted Average	**23**	**18**	**24**	**16**
Change	**4**		**8**	

DELAYS (SECONDS)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v2 2045 DM	PM DCO2v2 2045 DS	PM DCO2v2 2045 DM
A	42	42	56	66
B	25	27	35	39
C	12	15	11	13
D	37	35	36	35
E	14	14	15	16
Maximum	**42**	**42**	**56**	**66**
Change	**1**		**-9**	
Weighted Average	**23**	**23**	**27**	**30**
Change	**0**		**-3**	

Table 8-4 DCO2v1 vs DCO2v2 Daneholes roundabout Flows and Junction Performance

8.5.3 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- In the AM peak the flows at the Daneholes roundabout are 19% higher in the DCO2v2 model and 31% higher in the PM peak

8.5.4 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 6% lower than the 2045 DM flows and 6% lower in the PM peak, which is a result of a new link road from the Orsett Cock junction to the A1089 southbound introduced in DCO2v2 model

8.5.5 In terms of approach arm V/C the 2045 DS v 2045 DM comparison suggests that:

- In both the AM and PM peak hours no arms are overcapacity. Arm A has V/C of 85% or over in both the AM and PM peaks although this is also the case in the 2045 DM. Overall the junction performance in the DS is generally seen to remain similar to the DM or to improve.
- There are no significant delay increases or reductions forecast at the junction with the introduction of the LTC.

8.5.6 The latest LTAM strategic model forecasts show that in the 2045 DS flows through Daneholes Roundabout are expected to reduce below the DM flows. However, we are aware that microsimulation assessment provides a more robust understanding of junction impacts and a more accurate understanding of likely performance. LTAM has several limitations associated with its strategic nature and therefore a microsimulation assessment will provide confidence to Thurrock that the operation of Daneholes roundabout is not adversely affected by the scheme proposals. The junction is located along an important public transport corridor and the Council is particularly concerned about its future operation.

8.5.7 It is the Council position that the microsimulation work at Daneholes Roundabout, as previously agreed, is still required. Until the assessment using Vissim is complete we will reserve judgement on the operation of the junction.

8.6 M25 Junction 30

8.6.1 Table 8-5 provides an indication of traffic flow differences between DCO2 2045 DS (‘With LTC’) and DM (‘Without LTC’) for the AM and PM peak periods respectively. Figure 8-6 provides a diagram of the junction within Saturn including the labels of each arm. The table also provides information about delay and V/C differences between the DCO2 2045 DS (‘With LTC’) and DM (‘Without LTC’).

8.6.2 M25 Junction 30 generally appears to benefit slightly from the operation of LTC with flows going through the junction forecast to reduce by 5% both in the AM and PM and V/C and delays demonstrating minor changes.

Figure 8-6 M25 Junction 30 Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	1795	1857	1591	1622
B	2743	2762	2375	2549
C	2298	2200	3573	3564
D	456	287	635	530
Total	**7292**	**7107**	**8174**	**8265**
% Increase	**3%**		**-1%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	1795	1495	1591	1470
B	2743	3600	2375	3288
C	2298	2313	3573	3447
D	456	236	635	399
Total	**7292**	**7644**	**8174**	**8605**
% Increase	**-5%**		**-5%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	68	72	72	71
B	86	84	77	80
C	82	75	100	99
D	80	51	96	102
Maximum	**86**	**84**	**100**	**102**
Change	**2**		**-2**	
Weighted Average	**80**	**77**	**87**	**88**
Change	**3**		**-1**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	68	67	72	66
B	86	86	77	81
C	82	85	100	100
D	80	50	96	84
Maximum	**86**	**86**	**100**	**100**
Change	**1**		**0**	
Weighted Average	**80**	**81**	**87**	**86**
Change	**-1**		**1**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	19	20	24	23
B	27	26	24	25
C	22	19	45	43
D	48	38	75	144
Maximum	**48**	**38**	**75**	**144**
Change	**11**		**-69**	
Weighted Average	**25**	**23**	**37**	**40**
Change	**2**		**-3**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	19	23	24	23
B	27	22	24	21
C	22	24	45	51
D	48	40	75	57
Maximum	**48**	**40**	**75**	**57**
Change	**8**		**18**	
Weighted Average	**25**	**23**	**37**	**35**
Change	**2**		**2**	

Table 8-5 DCO2v1 vs DCO2v2 M25 Junction 30 Flows and Junction Performance

8.7 Marshfoot Junction

8.7.1 Table 8-6 provides an indication of traffic flow differences between the DCO2 2044 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively. The table also provides information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC').

8.7.2 Figure 8-7 provides a diagram of the junction within Saturn including the labels for each arm. Arm C in the figure below is a minor arm representing the on and off slip to the A1089.

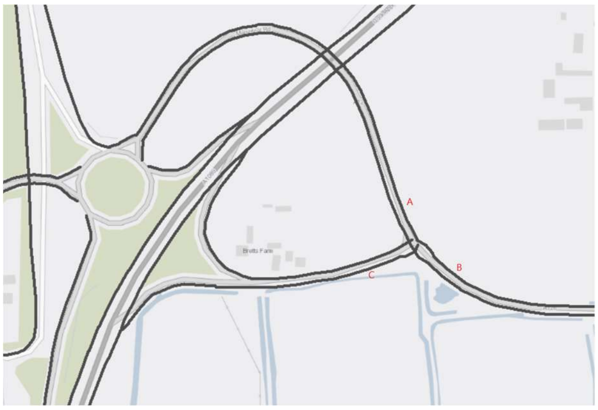


Figure 8-7 Marshfoot Junction Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 1 2044 DS	DCO2v 2 2045 DS	DCO2v 1 2044 DS
A	730	871	728	947
B	1180	1063	805	649
C	170	171	280	271
Total	**2081**	**2104**	**1813**	**1867**
% Increase	**-1%**		**-3%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 2 2045 DM	DCO2v 2 2045 DS	DCO2v 2 2045 DM
A	730	849	728	828
B	1180	840	805	558
C	170	232	280	316
Total	**2081**	**1921**	**1813**	**1702**
% Increase	**8%**		**6%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 1 2044 DS	DCO2v 2 2045 DS	DCO2v 1 2044 DS
A	71	90	48	65
B	72	65	49	40
C	94	83	101	88
Maximum	**94**	**90**	**101**	**88**
Change	**4**		**13**	
Weighted Average	**74**	**77**	**57**	**59**
Change	**-3**		**-3**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 2 2045 DM	DCO2v 2 2045 DS	DCO2v 2 2045 DM
A	71	63	48	51
B	72	51	49	34
C	94	96	101	100
Maximum	**94**	**96**	**101**	**100**
Change	**-2**		**1**	
Weighted Average	**74**	**62**	**57**	**54**
Change	**12**		**2**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 1 2044 DS	DCO2v 2 2045 DS	DCO2v 1 2044 DS
A	16	37	8	13
B	20	16	9	6
C	80	51	95	37
Maximum	**80**	**51**	**95**	**37**
Change	**30**		**58**	
Weighted Average	**24**	**27**	**22**	**14**
Change	**-4**		**8**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 2 2045 DM	DCO2v 2 2045 DS	DCO2v 2 2045 DM
A	16	12	8	9
B	20	10	9	4
C	80	71	95	78
Maximum	**80**	**71**	**95**	**78**
Change	**9**		**18**	
Weighted Average	**24**	**18**	**22**	**20**
Change	**5**		**2**	

Table 8-6 DCO2v1 vs DCO2v2 Marshfoot Junction Flows and Junction Performance

8.7.3 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2V1) suggests that:

- In the AM peak the flows at the Marshfoot junction are 1% lower in the DCO2v2 model and 3% lower in the PM peak

8.7.4 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 8% higher than the 2045 DM flows and 6% higher in the PM peak

8.7.5 In terms of approach arm V/C the 2045 DS v 2045 DM comparison suggests that:

- In the AM peak hour no arms are overcapacity although Arm C exceeds 85% in both the DM and DS. In the PM peak Arm C has V/C of 100% in the DM and gets slightly worse reaching 101% in the DS.
- There are no significant delay increases at the junction although Arm C indicates capacity concerns on that arm.

8.7.6 Considering the LTAM is a strategic model and the fact that the AM peak hour on the roads in Thurrock is 0800-0900 rather than 0700-0800, which was used in the LTAM model development, evidence is required (e.g. microsimulation modelling) to confirm the junction will operate within capacity 'with the LTC' operational and/or the mitigation measures and design changes proposed by the scheme promoter to achieve this. The increase in movements at this junction are of concern to the Council, particular reflecting the current poor safety record at this junction. NH should undertake a further review of the impact at this junction and propose suitable mitigation.

8.8 Devonshire Road/A1012

8.8.1 Table 8-7 provides an indication of traffic flow changes between DCO2 2045 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively. The table also provides information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC').

8.8.2 Figure 8-8 provides a diagram of the junction within Saturn including the labels of each arm.

Figure 8-8 Devonshire/A1012 Junction Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 1 2044 DS	DCO2v 2 2045 DS	DCO2v 1 2044 DS
A	615	594	910	942
B	125	96	131	119
C	331	330	512	462
D	659	667	469	514
Total	**1731**	**1687**	**2021**	**2037**
% Increase	**3%**		**-1%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 2 2045 DM	DCO2v 2 2045 DS	DCO2v 2 2045 DM
A	615	614	910	727
B	125	143	131	140
C	331	373	512	535
D	659	542	469	417
Total	**1731**	**1672**	**2021**	**1819**
% Increase	**4%**		**11%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 1 2044 DS	DCO2v 2 2045 DS	DCO2v 1 2044 DS
A	35	34	51	53
B	5	4	5	5
C	19	19	29	26
D	71	71	50	55
Maximum	**71**	**71**	**51**	**55**
Change	**-1**		**-4**	
Weighted Average	**43**	**44**	**42**	**45**
Change	**-1**		**-2**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 2 2045 DM	DCO2v 2 2045 DS	DCO2v 2 2045 DM
A	35	35	51	65
B	5	6	5	1
C	19	21	29	1
D	71	58	50	3
Maximum	**71**	**58**	**51**	**65**
Change	**13**		**-14**	
Weighted Average	**43**	**37**	**42**	**27**
Change	**6**		**15**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 1 2044 DS	DCO2v 2 2045 DS	DCO2v 1 2044 DS
A	6	6	10	11
B	4	4	4	4
C	5	5	6	6
D	15	15	11	12
Maximum	**15**	**15**	**11**	**12**
Change	**0**		**-1**	
Weighted Average	**9**	**9**	**9**	**10**
Change	**0**		**-1**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v 2 2045 DS	DCO2v 2 2045 DM	DCO2v 2 2045 DS	DCO2v 2 2045 DM
A	6	6	10	7
B	4	4	4	4
C	5	5	6	7
D	15	13	11	10
Maximum	**15**	**13**	**11**	**10**
Change	**3**		**1**	
Weighted Average	**9**	**8**	**9**	**8**
Change	**1**		**2**	

Table 8-7 DCO2v1 vs DCO2v2 Devonshire/A1012 Flows and Junction Performance

8.8.3 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- In the AM peak the flows at the junction are 3% higher in the DCO2v2 model and 1% lower in the PM peak

8.8.4 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 4% higher than the 2045 DM flows and 11% higher in the PM peak
- There are no overcapacity arms at the junction and no delays of note.

8.8.5 Considering significant flow increases through the junction in the DS scenario, the strategic nature of the LTAM and the fact that the AM peak hour on the roads in Thurrock is 0800-0900 rather than 0700-0800, which was used in the LTAM model development, evidence is required (e.g. microsimulation modelling) to confirm the junction will operate within capacity 'with the LTC' operational and/or the mitigation measures and design changes proposed by the scheme promoter to achieve this. We reserve our final judgement on the junction operation when results of the assessment emerge.

8.9 Five Bells Junctions and A13 Merge

8.9.1 Figure 8-9 provides a diagram of the two junctions and the westbound merge with the A13, which are of a particular interest.

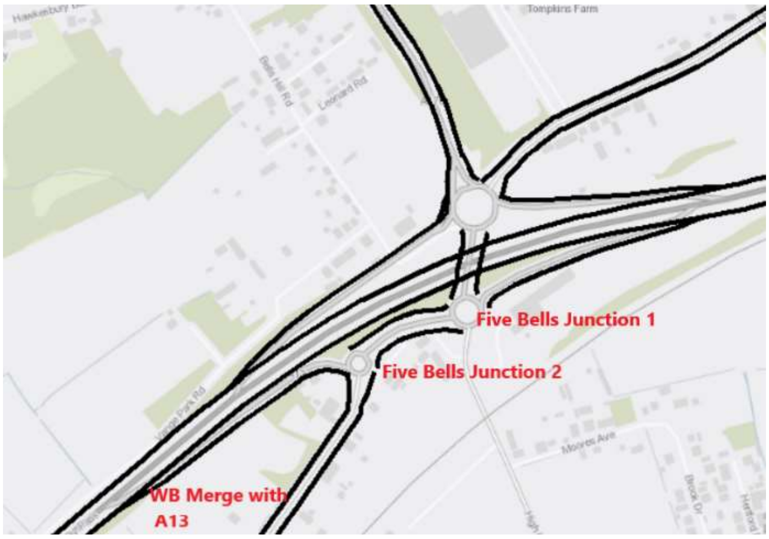


Figure 8-9: Five Bells Junctions and A13 Merge

8.9.2 Figure 8-10 10 provides a diagram of the Five Bells Junction 1 including the labels of each arm.

8.9.3 Table 8-8 provides an indication of traffic flow changes between DCO2 2045 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively for this junction. The table also provide information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC').

Figure 8-10: Five Bells Junction 1 Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v1 2044 DS	PM DCO2v2 2045 DS	PM DCO2v1 2044 DS
A	1204	1266	1018	1136
B	334	436	647	678
C	858	819	1066	1081
Total	**2396**	**2521**	**2731**	**2895**
% Increase	-5%		-6%	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v2 2045 DM	PM DCO2v2 2045 DS	PM DCO2v2 2045 DM
A	1204	1435	1018	1123
B	334	702	647	847
C	858	731	1066	776
Total	**2396**	**2868**	**2731**	**2746**
% Increase	-16%		-1%	

V/C (%)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v1 2044 DS	PM DCO2v2 2045 DS	PM DCO2v1 2044 DS
A	39	41	33	37
B	15	18	27	27
C	41	40	54	55
Maximum	**41**	**41**	**54**	**55**
Change	**0**		**-1**	
Weighted Average	**36**	**37**	**40**	**41**
Change	**0**		**-2**	

V/C (%)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v2 2045 DM	PM DCO2v2 2045 DS	PM DCO2v2 2045 DM
A	39	47	33	36
B	15	35	27	37
C	41	38	54	41
Maximum	**41**	**47**	**54**	**41**
Change	**-6**		**13**	
Weighted Average	**36**	**41**	**40**	**38**
Change	**-5**		**2**	

DELAYS (SECONDS)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v1 2044 DS	PM DCO2v2 2045 DS	PM DCO2v1 2044 DS
A	14	14	14	14
B	10	11	11	11
C	9	9	10	10
Maximum	**14**	**14**	**14**	**14**
Change	**0**		**0**	
Weighted Average	**12**	**12**	**12**	**12**
Change	**0**		**0**	

DELAYS (SECONDS)

APPROACH ARM	AM DCO2v2 2045 DS	AM DCO2v2 2045 DM	PM DCO2v2 2045 DS	PM DCO2v2 2045 DM
A	14	14	14	14
B	10	12	11	12
C	9	10	10	10
Maximum	**14**	**14**	**14**	**14**
Change	**0**		**0**	
Weighted Average	**12**	**12**	**12**	**12**
Change	**-1**		**0**	

Table 8-8 DCO2v1 vs DCO2v2 Five Bells Junction 1 Flows and Junction Performance

8.9.4 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- In the AM peak the flows at the Five Bells junction are 5% lower in the DCO2v2 model and 6% lower in the PM peak

8.9.5 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 16% lower than the 2045 DM flows and 1% lower in the PM peak
- There are no overcapacity arms at the junction and no delays of note.

8.9.6 Figure 8-11 provides a diagram of Five Bells Junction 2 within SATURN including the labels of each arm.

8.9.7 Table 8-9 provides an indication of traffic flow changes between DCO2 2045 DS (‘With LTC’) and DM (‘Without LTC’) for the AM and PM peak periods respectively of the two junctions and the westbound merge with the A13. The table also provide information about delay and V/C differences between the DCO2 2045 DS (‘With LTC’) and DM (‘Without LTC’).

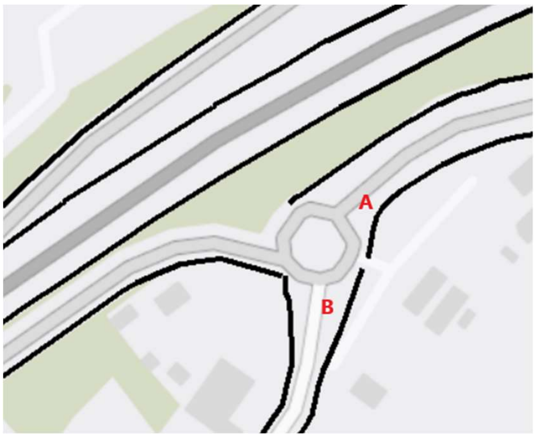


Figure 8-11: Five Bells Junction 2 Arm IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	1485	1569	1427	1552
B	859	821	1067	1083
Total	**2344**	**2390**	**2495**	**2635**
% Increase	**-2%**		**-5%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	1485	1844	1427	1596
B	859	732	1067	778
Total	**2344**	**2576**	**2495**	**2374**
% Increase	**-9%**		**5%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	59	63	57	62
B	61	58	76	77
Maximum	**61**	**63**	**76**	**77**
Change	**-2**		**-1**	
Weighted Average	**60**	**61**	**65**	**68**
Change	**-1**		**-3**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	59	74	57	64
B	61	52	76	55
Maximum	**61**	**74**	**76**	**64**
Change	**-13**		**12**	
Weighted Average	**60**	**68**	**65**	**61**
Change	**-8**		**4**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	11	11	12	12
B	27	26	36	37
Maximum	**27**	**26**	**36**	**37**
Change	**1**		**-1**	
Weighted Average	**17**	**16**	**22**	**22**
Change	**0**		**0**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	11	13	12	12
B	27	24	36	25
Maximum	**27**	**24**	**36**	**25**
Change	**3**		**11**	
Weighted Average	**17**	**16**	**22**	**17**
Change	**1**		**6**	

Table 8-9: DCO2v1 vs DCO2v2 Five Bells Junction 2 Flows and Junction Performance

8.9.8 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- In the AM peak the flows at the Five Bells junction 2 are 2% lower in the DCO2v2 model and 5% lower in the PM peak

8.9.9 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 9% lower than the 2045 DM flows and 5% higher in the PM peak
- There are no overcapacity arms at the junction and no delays of note.

8.9.10 Figure 8-12 provides a diagram of merge from Five Bells to A13 within SATURN including the labels of each arm.

8.9.11 Table **8-10** provide an indication of traffic flow changes between DCO2 2045 DS ('With LTC') and DM ('Without LTC') for the AM and PM peak periods respectively of the two junctions and the westbound merge with the A13. The table also provide information about delay and V/C differences between the DCO2 2045 DS ('With LTC') and DM ('Without LTC').

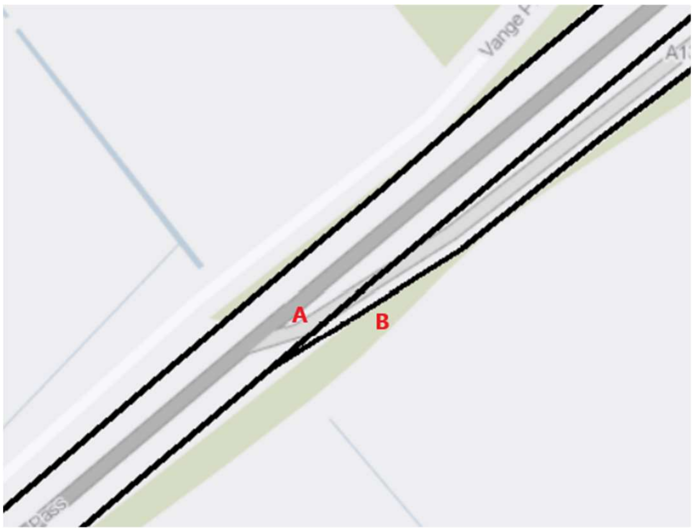


Figure 8-12: Merge with A13 Arms IDs

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	351	452	661	674
B	3916	3814	3460	3438
Total	**4267**	**4266**	**4122**	**4113**
% Increase	**0.01%**		**0.21%**	

ACTUAL FLOWS PCUs/HR

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	351	740	661	784
B	3916	3462	3460	3025
Total	**4267**	**4202**	**4122**	**3809**
% Increase	**2%**		**8%**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	129	127	103	102
B	100	100	100	100
Maximum	**129**	**127**	**103**	**102**
Change	**2**		**1**	
Weighted Average	**102**	**103**	**100**	**100**
Change	**-1**		**0**	

V/C (%)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	129	115	103	67
B	100	100	100	92
Maximum	**129**	**115**	**103**	**92**
Change	**14**		**11**	
Weighted Average	**102**	**103**	**100**	**87**
Change	**0**		**14**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v1 2044 DS	DCO2v2 2045 DS	DCO2v1 2044 DS
A	597	557	94	79
B	37	37	37	37
Maximum	**597**	**557**	**94**	**79**
Change	**40**		**15**	
Weighted Average	**83**	**92**	**46**	**44**
Change	**-9**		**2**	

DELAYS (SECONDS)

APPROACH ARM	AM		PM	
	DCO2v2 2045 DS	DCO2v2 2045 DM	DCO2v2 2045 DS	DCO2v2 2045 DM
A	597	319	94	8
B	37	37	37	11
Maximum	**597**	**319**	**94**	**11**
Change	**278**		**83**	
Weighted Average	**83**	**86**	**46**	**10**
Change	**-4**		**35**	

Table 8-10: DCO2v1 vs DCO2v2 Merge with A13 Flows and Junction Performance

8.9.12 Comparing the 2045 DS (DCO2v2) against the 2044 DS (DCO2v1) suggests that:

- In the AM and PM peak the flows at the merge to A13 are no significantly different in the DCO2v2 model.

8.9.13 Comparing the 2045 DS (DCO2v2) against the 2045 DM shows that:

- In the AM peak the 2045 DS flows are 2% higher than the 2045 DM flows and 8% higher in the PM peak
- The introduction of the LTC substantially worsens the performance of the A13 westbound merge with maximum V/C increasing from 115% to 129% in the AM and from 92% to 103% in the PM.

8.9.14 The LTAM strategic model forecasts significant worsening of congestion on the A13 westbound merge resulting in rat-running through communities of Corringham and Stanford-le-Hope. Further work is required from NH to mitigate the impact of the LTC at this location.

8.10 Summary

8.10.1 This section has provided further detail and analysis of the approach arm flows and junction performance for a set of key junctions, which were identified from earlier reviews as the main areas of scheme impact in Thurrock:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junctions including the A30 westbound merge

8.10.2 The analysis has summarised the impact of the DCO2v1 and DCO2v2 scenarios for 2045 DS and DM traffic flows at these junctions for the AM and PM peak periods.

8.10.3 As expected, the introduction of the LTC is forecast to result in reduced volume of traffic through the M25 Junction 30, which is estimated to be around 5%. However, this results only in minor variations in weighted average V/C and delays.

8.10.4 Comparison of changes in delays and V/C between DS and DM scenarios did not identify any additional junctions that are forecast to experience increased congestion in the 'with the LTC' scenario.

8.10.5 The analysis has shown that with the introduction of the LTC scheme the junctions which are showing significant flow increases and/or exhibiting performance concerns in terms of V/C and delays are:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- A13 westbound merge at Five Bells junction

8.10.6 A summary of the changes in junction throughput, V/C and delays for all the junctions considered has been presented in Table 8-11.

8.10.7 A fundamental feature of the NH's LTAM model is that it is strategic in nature and has not been validated at local junction level. Therefore, in areas of concerns either highlighted through strategic modelling or raised by the Council local junction assessments must be undertaken with the appropriate junction modelling software or micro-simulation packages using outputs from LTAM to confirm the junctions are not severely impacted by the introduction of the LTC.

8.10.8 Local junction modelling using Vissim is being progressed by NH for Orsett Cock roundabout and the Manorway roundabout . Local junction modelling is also required for the ASDA Roundabout, Marshfoot Road/ A1089 Junction and Devonshire Road/ A1012 junction.

8.10.9 We await the traffic assessment using Vissim and will reserve judgement on the operation of the junctions when results of the assessments emerge.

8.10.10 The latest LTAM strategic model forecasts show that in the 2045 DS flows through Daneholes Roundabout are expected to reduce below the DM flows. However, we are aware that microsimulation assessment provides a more robust understanding of junction impacts and a more accurate understanding of likely performance thus addressing limitations of the LTAM stemming from its strategic nature. It is the Council position that the microsimulation work at Daneholes Roundabout, as previously agreed with NH, is still required. Until the assessment using Vissim is complete we will reserve judgement on the operation of the junction.

8.10.11 The LTAM strategic model forecasts significant worsening of congestion on the A13 westbound merge from the introduction of the LTC resulting in rat-running through communities of Corringham and Stanford-le-Hope. Further work is required from NH to mitigate the impact of the LTC at this location.

	Actual Flow Change				Maximum V/C in DS, %		Maximum V/C Change, %		Weighted Average V/C in DS, %		Weighted Average V/C Change, %		Maximum Delay in DS, sec.		Maximum Delay Change, sec.		Weighted Average Delay in DS, sec.		Weighted Average Delays Change, sec.	
	AM		PM		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
The Manorway Roundabout	165 pcu	3%	34 pcu	1%	83	76	7	0	56	62	3	1	458	47	140	25	63	20	19	-3
Orsett Cock Roundabout	717 pcu	14%	973 pcu	19%	101	100	-3	31	84	86	11	29	77	62	77	62	36	29	1	18
ASDA Roundabout	143 pcu	3%	335 pcu	7%	114	109	12	5	98	91	6	12	291	220	221	109	111	41	56	13
Daneholes Roundabout	-195 pcu	-6%	-213 pcu	-6%	86	96	1	-3	53	60	0	-5	42	56	1	-9	23	27	0	-3
M25 Junction 30	-352 pcu	-5%	-431 pcu	-5%	86	100	1	0	80	87	-1	1	48	75	8	18	25	37	2	2
Marshfoot Road/ A1089 Junction	160 pcu	8%	111 pcu	6%	94	101	-2	1	74	57	12	2	80	95	9	18	24	22	5	2
Devonshire Road/ A1012	59 pcu	4%	202 pcu	11%	71	51	13	-14	43	42	6	15	15	11	3	1	9	9	1	2
Five Bells Junction, A13 WB slip	65 pcu	2%	313 pcu	8%	129	103	14	11	102	100	0	14	597	94	278	83	83	46	-4	35

Table 8-11 ~Summary of DCO2v2 Junction Performance

9 Journey Time Review from/to the Port of Tilbury. DCO2v2 DM and DS

9.1 Introduction

9.1.1 A number of routes to/from the Port of Tilbury have been analysed and the results are provided within the following section.

9.2 Journey Time Analysis

9.2.1 Journey time analysis provides an understanding of what routes and what locations between two points may witness either improvements or a deterioration in network operation as a result of the LTC.

9.2.2 The journey time routes that have been investigated for the AM and PM peak period, 2045 DM and 2045 DS have been undertaken for the following origin and destination locations:

- **Route 1a** SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128 and A1089
- **Route 1b** SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128, Chadwell St Mary and A1089
- **Route 2a** NB – Port of Tilbury (junction of A128/A127) to Brentwood via A1089 and A128
- **Route 2b** NB – Port of Tilbury (junction of A128/A127) to Brentwood via A1089, Chadwell St Mary and A128
- **Route 3** SB – Brentwood (junction of A128/A127) to the Port of Tilbury via M25 and A1089
- **Route 4** NB – Port of Tilbury to Brentwood (junction of A128/A127) via A1089 and M25
- **Route 5a** SB – Brentwood (junction of A128/A127) to Port of Tilbury via LTC and Orsett Cock
- **Route 5b** SB – Brentwood (junction of A128/A127) to Port of Tilbury via LTC, Manorway and A1089
- **Route 5c** SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128 Brentwood Road and A1089
- **Route 6a** NB – Port of Tilbury to Brentwood (junction of A128/A127) via LTC

9.2.3 Figure 9-1 provides an illustration of these routes. For the purposes of consistency and future reference in undertaking journey time route analysis, Brentwood (junction of A128/A127) has been taken to be Node 76129, which is on the northern approach to the junction within the SATURN model. The Port of Tilbury has been taken to be Zone 5154 with the journey time route starting or ending at Node 71706.

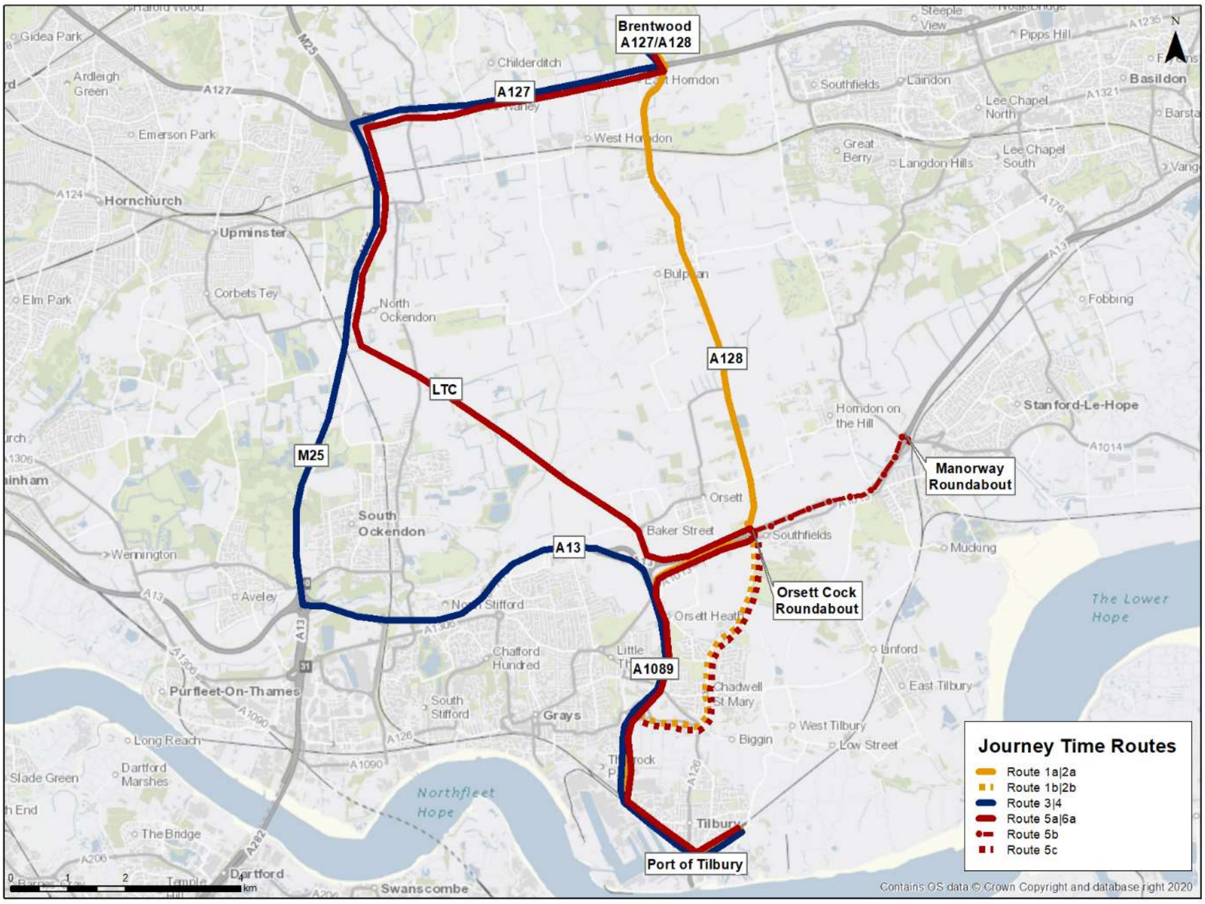


Figure 9-1 Thurrock Cordon Model Journey Time Routes

9.2.4 Table **9-1** and Table **9-2** summarise the results of the journey time analysis for the analysed routes to/from the Port of Tilbury for AM and PM peak hours respectively.

Route ID	2045 DM			2045 DS			
	Journey Time (hh:mm:ss)	Average Speed (kph)	Distance (km)	Journey Time (hh:mm:ss)	Average Speed (kph)	Distance (km)	Change in Journey Time (DS-DM) (hh:mm:ss)
1a SB	-	-	-	00:16:32	56.19	15.5	-
1b SB	00:19:36	47.95	15.6	00:20:28	45.92	15.7	+00:00:52 ↑
2a NB	-	-	-	00:22:00	45.28	16.6	-
2b NB	00:24:52	38.9	16	00:25:26	38.03	16.1	+00:00:34 ↑
3 SB	00:26:07	58.43	25.4	00:23:00	66.12	25.4	-00:03:07 ↓
4 NB	00:39:27	39.33	25.9	00:35:10	44.19	25.6	-00:04:17 ↓
5a SB	-	-	-	00:22:50	67.88	25.8	-
5b SB	-	-	-	00:37:03	54.14	33.4	-
5c SB	-	-	-	00:26:46	58.32	26	-
6a NB	-	-	-	00:29:47	44.82	22.3	-
Average	**00:27:30**			**00:25:55**			**-00:01:36↓**

Table 9-1 AM Peak Journey Times

Route ID	2045 DM			2045 DS			
	Journey Time (hh:mm:ss)	Average Speed (kph)	Distance (km)	Journey Time (hh:mm:ss)	Average Speed (kph)	Distance (km)	Change in Journey Time (DS-DM) (hh:mm:ss)
1a SB	-	-	-	00:15:59	58.14	15.5	-
1b SB	00:19:48	47.47	15.7	00:19:55	47.19	15.7	+00:00:07 ↑
2a NB	-	-	-	00:15:36	63.85	16.6	-
2b NB	00:19:03	50.79	16	00:19:12	50.39	16.1	+00:00:09 ↑
3 SB	00:26:43	57.13	25.4	00:23:22	65.1	25.4	-00:03:21 ↓
4 NB	00:33:56	45.73	25.9	00:27:29	56.53	25.6	-00:06:27 ↓
5a SB	-	-	-	00:22:48	67.98	25.8	-
5b SB	-	-	-	00:37:41	53.22	33.4	-
5c SB	-	-	-	00:26:44	58.37	26	-
6a NB	-	-	-	00:21:18	62.56	22.3	-
Average	**00:24:52**			**00:23:00**			**00:01:52** ↓

Table 9-2 PM Peak Journey Times

9.2.5 In the AM peak the analysis shows that journey time routes between Brentwood and the Port of Tilbury along Route 1b (southbound) and Route 2b (northbound) via the A128, Orsett Cock roundabout and Brentwood Road south of Orsett Cock will experience an increase in journey times of 52 seconds and 34 seconds respectively. In the PM peak the increase in journey times on this route is small and ranges between 7 and 9 seconds.

9.2.6 As expected, Route 3 southbound via the M25/A13 junction is expected to witness the largest decrease in travel time with approximately a three-minute plus reduction in journey time between Brentwood and the Port of Tilbury in both peak periods. In the northbound direction, Route 4 is predicted to have a large journey time decrease in excess of four minutes in the AM peak and in excess of six minutes in the PM peak towards Brentwood from the Port of Tilbury. The significant reductions on Routes 3 and 4 are consistent with the expected impacts of the LTC to reduce flows on A13 west of the LTC/A1089/A13 Junction and on the M25 north of M25 Junction 30.

9.2.7 Routes 5a (southbound) and 6a (northbound) use the LTC as part of their routeing and are forecast to provide slightly faster journey times compared to the routes via the M25/A13 junction in the 'with the LTC' scenario.

9.2.8 Route 5b is a southbound route via the LTC, Orsett Cock and the Manorway junction. This route is similar to route 5a but aims to test if the journey times via the Manorway junction in route 5b are quicker. Route 5b journey times via the Manorway are estimated to be around 15 minutes longer than via the Orsett Cock in route 5a suggesting that route 5b via the Manorway is unlikely to provide a reasonable travel alternative to traffic travelling from Brentwood to the Port of Tilbury.

9.2.9 Route 5c is a southbound route via the LTC and Brentwood Road. Route 5c uses similar routing to route 5a to get to the Port of Tilbury. However, if compared with route 5a, route 5c has an approximate four extra minutes added to a journey and thus is unlikely to provide an attractive alternative route to the A1089.

9.3 Summary

9.3.1 Across all the routes considered the journeys times between the Port of Tilbury and Brentwood are forecast to be less in DS than DM on average by 1 minute and 36 seconds in the AM and by 1minute 52 seconds in the PM.

9.3.2 Routes 5a and 6a via the LTC will provide slightly faster journey times in the DS scenario compared to the existing routes 3 and 4 via the A13 and M25.

9.3.3 Examination of journey time routes via the Manorway or Brentwood Road suggests that these may be significantly less attractive due to higher journey times suggesting that traffic is likely to remain on the LTC rather than diverting via the Manorway or local roads when travelling between Brentwood and the Port of Tilbury.

10 Overall Summary and Conclusion

10.1 Introduction

10.1.1 This report has considered the potential impacts of the operation of LTC on Thurrock roads in light of updates made by NH to the model, known as the DCO2v2 model. The model has been updated by NH following representations made in response to the Community Impact Consultation (Summer 2021) and is used to inform the Local Refinement Consultation (Summer 2022) and the separate issue of a Thurrock specific cordon of the LTAM model, referred to as DCO2v2.

10.1.2 This review has considered updates to the Base Year and Forecast Models as well as the impacts of the LTC on Thurrock's roads. Where relevant references have been made to the findings of Stantec's review of the impacts of the LTC on the Thurrock network from the previously reviewed model (DCO2v1) issued around the time of the Community Impact Consultation.

10.1.3 The review has been informed by cordon models representing the Thurrock area. The cordon models were provided by NH for forecast years of 2030, 2037, 2045 and 2051. Cordon models for the updated 2016 Base Year were also provided. All cordoned models have been provided for AM peak hour (0700 - 0800), average interpeak hour (0900 - 1500) and PM peak hour (1700 - 1800). The review has focused on the AM and PM peak hours, which are generally more congested than the IP representing an average hour, and a forecast year of 2045 (15 years from the scheme opening).

10.2 Model Development and Forecasting Approach Considerations

10.2.1 No detailed documentation has been provided on the changes made to the DCO2v1 model to produce the DCO2v2 models or to describe the DCO2v2 model development. However, the review has identified several updates to the models as summarised below. The review has considered changes in matrix totals, network coding, forecasting assumptions and the level of validation achieved in the base year models.

Base Year Models. Network Changes

10.2.2 A GIS analysis of the networks indicated that there have been some 'structural' network additions in the 2016 updated model. A key addition appears to be an inclusion of the Lower Dunton Road/B1007, which provides a connection between the A127 and A13 at the Manorway roundabout. The reasons for this addition to the network are not clear and a clarification is required.

Base Year Models. Zone Changes

10.2.3 An additional 41 zones have been identified as being added to the base models since the DCO2v1 model. Additional information is required explaining the rationale for introducing additional zones and describing the approach to matrix disaggregation.

Base Year Models. Matrix Changes

10.2.4 When comparing the 2016 updated model trip matrix totals to the 2016 Base previously reviewed, it was found that the total number of trips in the updated models are higher by between 3% and 5% compared to the previous models. Out of all the vehicle classes LGV trips demonstrate the biggest percentage increase of all the vehicle classes (these are 13% to 15% higher than in the previous models). An explanation of the reasons for the matrix changes is required particularly explanations of the reasons of the increase in LGVs is required to fully understand the implications to Thurrock's local highway network.

Base Year Models. Link Validation

10.2.5 The differences between 2016 observed and modelled data have been examined to ascertain how well the latest base year model is able to match observed traffic flows on roads where observed data was available.

10.2.6 Stantec has used the data included within section '77777' of the model files to identify the model validation locations in Thurrock and to obtain the observed data used in the model validation. However, a confirmation from NH is required that the assumption made is correct.

10.2.7 The link validation results in the AM and PM models meet or exceed DfT's link validation criteria with the results showing that 91% of links in the AM and 85% or links in the PM models, selected for the validation, meet the criteria. This indicates that the base year model can replicate well observed traffic volumes on the selected roads.

Base Year Model. Validation. Other Considerations.

10.2.8 It should be noted that the model validation cannot be limited to just link validation and should consider other aspects including matrix validation, validation of turning movements at junctions, comparison of observed and modelled journey times. Additional information set within a Local Model Validation report is required from NH to ascertain if the base year DCO2v2 model represents a suitable basis for forecasting the impacts of the LTC on the strategic and local roads.

10.2.9 Furthermore, in the past Stantec had raised concerns about the limited number of locations within Thurrock at which flow calibration and validation had been undertaken and previous concerns regarding the validation of the local road network within Thurrock remain.

Model Forecast Years

10.2.10 The DCO2v2 models have a revised opening year of 2030 as opposed to 2029 in the DCO2v1 models previously reviewed. 2045 (2044 in the DCO2v1 model) is the second forecast year and represents 15 years from the scheme opening.

Assessment Time Periods

10.2.11 The local network AM peak hour is 0800 – 0900, but LTAM has only been developed to test the Strategic Road Network (SRN) AM peak of 0700 – 0800.

10.2.12 Stantec therefore continues to maintain significant concerns about the accuracy of the impact assessment of the LTC on the local roads in Thurrock using the LTAM. It is acknowledged that some of these concerns are being further assessed with NH developing a set of microsimulation models in Vissim for Orsett Cock roundabout, the Manorway roundabout and for a west-east area covering junctions such as Daneholes and Marshfoot Road junctions.

Forecast Models. Network Changes

10.2.13 The key changes on the Thurrock network identified in the forecast models are:

- The provision of the new Orsett Cock junction link road that would provide a direct connection from Orsett Cock roundabout to the A1089 southbound. The change was introduced to address feedback from the Council and other stakeholders about the lack of connectivity between the LTC and the A1089, and the resulting impacts on the local road network.
- Update to Orsett Cock roundabout with an additional two signalised nodes resulting in the junction having four signalised nodes in the DCO2v2 model compared to the previous

DCO2v1 model. The change in the junction configuration has not been discussed with Thurrock highway authority.

Forecast Models. Zone Changes

10.2.14 Additional two zones (zone 8040 and 8138) have been identified to have been added to the forecast networks since the DCO2v1 model. Furthermore, the review of the earlier version of the forecast models identified additional zones (zone 8010, 8026 and 8030) introduced in DCO2v1. Further documentation regarding what these zones represent in terms of type of development, trip generation and distribution is required.

Forecast Models. Uncertainty Log

10.2.15 A check of the updated Uncertainty Log against the previous DCO2v1 version indicates an inclusion of five new development sites in Thurrock, which have now been classed as ‘More than likely’ and hence have been included in the DCO2v2 forecast scenarios. Also notable is that Dunton Hills Garden Village in Brentwood Borough (planned to comprise 3,750 dwellings, and 32,600 square metres) that was previously included in the UL as ‘Reasonably Foreseeable’ is now marked as ‘More than likely’, implying that the development is now accounted for within the DCO2v2 scenarios. Development associated with London Gateway and Thames Enterprise Park has also been accounted for in the forecast scenarios.

Reflecting Uncertainty in Forecasting

10.2.16 DfT’s TAG (Transport Appraisal Guidance) Uncertainty Toolkit (August 2022, first published in May 2021) states “There is considerable uncertainty about how the transport system will evolve in the future, particularly with the potential for emerging trends in behaviour, technology and decarbonisation to drive significant change over time. The use of transport models, a fundamental aspect of scheme appraisal, can also introduce uncertainty to transport analysis, through the data, assumptions and model specifications required. To ensure decision-making is resilient to future uncertainty, decision makers need to understand how the outcomes of spending and policy proposals may differ under varying assumptions about the future.”

10.2.17 We have not received any sensitivity test results providing further details on how traffic arising from the Thames Freeport proposals at the Port of Tilbury and London Gateway/DP World will impact on the highway network. Similarly, we have not received any sensitivity test results on how the ‘with the LTC’ highway network will perform with the Council’s New Local Plan growth proposals. This needs to be considered as part of testing for uncertainty in forecasting.

10.2.18 The Council has not been provided with evidence that DfT’s guidance related to testing uncertainty in forecasting has been followed. We therefore conclude that the LTC assessment does not follow DfT’s guidance, and we request that **at least** DfT’s Common Analytical Scenarios are considered to test uncertainty around forecasts.

Model Development and Forecasting Approach Considerations – Summary

10.2.19 A summary of findings is presented in Table 10-1 below using a RAG (Red, Amber, Green) classification. Red meaning the Council has major concerns about model development or its assumptions and an issue needs to be rectified. Amber is a warning, the Council has concerns and explanation is required. Green indicates a neutral impact, but clarification may be required.

	Check	Summary	RAG
1	LTAM Model Access	NH has only provided impacted local authorities, including the Council, with access to cordon versions of the LTAM model (covering their administrative areas) to help them understand local scheme impacts. **NH Action**: the Council is reiterating their request for access to the full LTAM model to enable a fuller understanding of the scheme's strategic impacts.	
2	Base Year Models. Network Changes	Inclusion of the Lower Dunton Road/B1007, which provides a connection between the A127 and A13 at the Manorway roundabout. **NH Action**: confirm reasons for adding this link to the cordon models.	
3	Base Year Models. Matrix Changes	The total number of trips in the updated models are higher by between 3% and 5% compared to the previous models with LGVs demonstrating the biggest percentage increase (13% to 15%).	
4	Base Year Models. Link Validation	Link validation results in the AM and PM models meet or exceed DfT's link validation criteria.	
5	Base Year Model. Validation. Other Considerations.	**NH Action**: Information about other aspects of the model validation is required (i.e. matrix validation, validation of turning movements at junctions, journey times) as well as revised LMVR.	
6		Lack of validation of the local road network within Thurrock. **NH Action**: higher standards of model validation of the highway network in Thurrock is required.	
7	Assessment Time Periods	The local network AM peak hour is 0800 – 0900, but LTAM has only been developed to test the Strategic Road Network (SRN) AM peak of 0700 – 0800. We have significant concerns about the accuracy of the impact assessment of the LTC on the local roads in Thurrock using the LTAM. **NH Action**: Continue developing existing Vissim models. New microsimulation models and a 0800-0900 LTAM may also be required.	
8	Forecast Models. Network Changes	Provision of the new Orsett Cock junction link road that would provide a direct connection from Orsett Cock roundabout to the A1089 southbound. The change was introduced to address feedback from the Council and other stakeholders about the lack of connectivity between the LTC and	

	Check	Summary	RAG
		the A1089, and the resulting impacts on the local road network. The Council has concerns about the impact of this change due to significant increases in traffic flows on the A1013 Stanford Road east of Orsett Cock and on Brentwood Road south of Orsett Cock. **NH Action**: mitigation or a modification to the scheme may be required.	
9		Update to Orsett Cock roundabout with an additional two signalised nodes resulting in the junction having four signalised nodes in the DCO2v2 model compared to the previous DCO2v1 model. The change in the junction configuration has not been discussed with the Council as local highway authority. **NH Action**: Engagement with the Council is required.	
10	Forecast Models. Zone Changes	Additional two zones (zone 8040 and 8138) have been identified to have been added to the forecast networks since the DCO2v1 model. Furthermore, the review of the earlier version of the forecast models identified additional zones (zone 8010, 8026 and 8030) introduced in DCO2v1.	
11	Forecast Models. Uncertainty Log	Inclusion of five new development sites in Thurrock, which have now been classed as 'More than likely' and hence have been included in the DCO2v2 forecast scenarios. Also notable is that Dunton Hills Garden Village in Brentwood Borough (planned to comprise 3,750 dwellings, and 32,600 square metres) that was previously included in the UL as 'Reasonably Foreseeable' is now accounted for within the DCO2v2 scenarios. Development associated with London Gateway and Thames Enterprise Park has also been accounted for in the forecast scenarios.	
12	Reflecting Uncertainty in Forecasting	The Council has not been provided with evidence that DfT's guidance related to testing uncertainty in forecasting has been followed. Stantec therefore concludes that the LTC assessment does not follow DfT's guidance, and requests that at least DfT's Common Analytical Scenarios are considered to test uncertainty around forecasts. In addition test of uncertainty should consider the impact from the Thames Freeport proposals at the Port of Tilbury and London Gateway/DP and the	

	Check	Summary	RAG
		Council's New Local Plan growth proposals. **NH Action**: Uncertainty in forecasting should be tested.	
13	Transport Planning Approach	NH continues to follow a transport planning approach to scheme case making and impact assessment that is based on predicting future demand to provide capacity ('predict and provide') rather than sets an outcome that communities want to achieve and provides the transport solutions to deliver those outcomes ('vision and validate'). This does not comply with best practice and latest policy, including revised DfT Circular C02/13. **NH Action**: Adopt 'vision and validate' approach.	

Table 10-1 Model Development and Forecasting Approach Considerations – RAG Summary

10.3 Impacts of the LTC on the Council's Highway Network

Impact of the LTC on Travel Demand in Thurrock

10.3.1 A comparison has been undertaken to identify changes in the matrix totals between the DM and DS for both 2030 and 2045 in the updated DCO2v2 forecast models. This analysis has provided an indication of the change in trips using the Thurrock network 'with the LTC' in place compared to the scenario without the LTC.

10.3.2 Overall, the introduction of the LTC is forecast to result in increases in car, LGV and HGV movements on all roads falling within the boundary of Thurrock including LTC. In 2030 a 6% increase in trips is predicted in both the AM and PM (equivalent to 4,037pcu and 4,186pcu per hour) while in 2045 a 7% increase in trips is predicted in both the AM and PM peak hours (which is equivalent to 5,346pcu and 5,335pcu per hour). These increases (called induced traffic) can be due to changes in the reassignment of traffic from the wider area resulting from the introduction of the LTC but may also be due to completely new trips on the network, model shift from public transport and a change in people's origins and destinations of travel across the wider area. The extent of each of the travel response is not fully understood from the cordon models made available to the Council and an explanation is required as to the main driver for the increase in trips crossing the river 'with the LTC' in place.

10.3.3 Additional traffic on the highway network in Thurrock will inevitably result in increased congestion and impact on air quality and noise levels, which is of a concern to the Council.

10.3.4 For comparison, a review of the DCO2v1 DS and DM models model concluded that overall, the introduction of the LTC is forecast to result in increases in car, LGV and HGV movements on Thurrock roads. The largest increases were shown within the total car user class with a difference of 7% in the AM and PM peak of the 2029 opening year model and 9% and 8% in the 2044 forecast year model respectively. This is consistent with the findings of the latest review of the DCO2v2 model against DCO2v1.

Forecast Demand Matrices. Comparison to Earlier Reviews

10.3.5 A review of the trip matrix totals has been undertaken to gain an understanding of the changes in the number of forecast trips on Thurrock roads in the DCO2v1 (2030, 2045) and the DCO2v2 (2029, 2044) models in the DM and DS scenarios.

10.3.6 The analysis indicates that the total number of forecast trips on Thurrock roads in the new DS and DM DCO2v2 models are higher by between 5% and 6% compared to the previous models. LGV trips are 13% to 15% higher than in the previous models and show the biggest increases of all the vehicle or user classes. HGV trips are 0.5% to 3% higher than in the previous DCO2v1 models.

10.3.7 The differences in forecast matrix totals between DCO2v2 and DCO2v1 models are thought to be partially due to the increases in the base year trip matrices. Explanation of the changes in the Base Year matrices is therefore required.

10.3.8 It should be noted that a review of the previous DCO2v1 forecast models against DCO1 models concluded that there were more car trips forecast to travel from, to and through Thurrock in the DCO2v1 model compared to DCO1 model with increases ranging between 1% and 26% for different trip demand segments Therefore, a sequence of reviews highlights a trend for higher traffic flows forecast in Thurrock with each subsequent model update. An explanation of this phenomenon is required from NH.

Network Statistics. Full LTAM

10.3.9 The LTAM statistics provided by NH for the full model has enabled the highway network performance to be examined at a networkwide level. The provided global statistics did not include SATURN emissions outputs such as CO2, NOx and PM10 but included changes in:

- Transient queues in pcu.hrs
- Over-capacity queues in pcu.hrs
- Link cruise time in pcu.hrs
- Total travel time in pcu.hrs
- Travel distance in pcu.kms
- Overall average speed in kph

10.3.10 The results demonstrate that the introduction of the LTC in 2045 is forecast to result in reduced congestion across the whole network, although this is to a lesser extent when compared to the Thurrock cordon in terms of percentage changes. In comparison with the 2045 DM models, DS models show that there is a reduction in Transient Queues (correspond to the queues that develop during the red phase and then dissipate in the subsequent green phase) during the AM peak by 0.4% and by 0.6% in the PM peak. Both peaks also witness a reduction in Over-Capacity queues (these occur where a permanent queue builds up which is unable to clear in a single cycle). Overcapacity queues reduce by 2.2% in the AM peak and 2.3% in the PM peak. There is an increase in Overall Average Speed thus indicating reduced congestion ‘with the LTC’ included. In the AM peak the overall average speed increases by 0.8% and by 0.9% in the PM peak.

10.3.11 However, the statistics show that in 2045 Travel Distance travelled by all vehicles in the network is expected to increase by 1.1% in the AM peak and by 1.2% in the PM peak, with Total Travel Time also showing an increase by 0.1% and 0.2% in the AM and PM peak respectively. This demonstrates that the LTC is increasing the total vehicle km and vehicles hours on the network.

Network Statistics in Cordon Models

10.3.12 Comparison of the 2045 DS with the 2045 DM DCO2v2 cordon models network statistics suggests that introduction of the LTC will results in:

- Additional 5,355 pcu in the AM peak and 5,344 in the PM peak on all the roads within Thurrock, an increase of approximately 7% in both peak periods.
- An increase of 13.4% for the AM and PM peak periods Travel Distance (pcu/km) for the AM and PM peak periods respectively. For comparison, an increase in Travel Distance in the whole LTAM model is much lower and is 1.1% in the AM and 1.2% in the PM peak.
- An increase of 3.2% and 6.7% in Total Travel Time (pcu/hrs) for the AM and PM peak. This is 0.1% in the AM peak and 0.2% in the PM peak in the wider modelled network.
- A significant decrease in Over-Capacity Queues of -25.8% and -23.0% for the AM and PM. In the wider LTAM network a decrease in Over-Capacity Queues is 2.2 % and -2.3% for the AM and PM peaks respectively. This suggests that 'with the LTC' in place the road network will be able to transfer more trips.
- An increase of average speeds from 56kph to 62kph in 2030 AM, and from 52kph to 57kph in 2045 AM. However, the average speeds in 2045 are forecast to be lower than in the Base (61kph) thus indicating that the relief provided by the LTC is temporary.
- *An increase in CO2 (kg) emissions in Thurrock of 10.5% and 12.5% in the AM and PM peak respectively.
- *An increase in NOX (kg) emissions in Thurrock for the AM and PM peak by 6.6% and 8.8%.
- *An increase in PM10 (kg) emissions in Thurrock of 3.7% and 7.1% for the AM and PM peak periods

*Note the emission statistics have been extracted from the Saturn assignment files, not from specific Air Quality Assessments of which further data has not been provided for this review.

Link Flows – Strategic and Local Roads

10.3.13 The flow changes as a result of the LTC in Thurrock are quite complex although the pattern of flow changes in terms of location is relatively similar across the AM and PM peak modelled hours and are also similar to the flow changes observed in the DCO2v1 model review.

10.3.14 A comparison in flow between DM and DS models has been undertaken on a selection of local and strategic roads in Thurrock. The pattern of flow changes is similar across the time periods and different versions of the models in terms of the locations of impact. The key areas that show an increase in flows as a result of the LTC in the updated DCO2v2 models are:

Strategic Roads

- Substantial increase on the A1089 (northbound direction only) observed in the vicinity of Marshfoot Road/Old Dock Approach Road roundabout
- Sections of the A13 to the east of the Orsett Cock roundabout. It should be noted that the increase has become smaller in the DCO2v2 models and ranges between 11% and 19% in DCO2v2 compared to 11%-27% in DCO2v1.

Local Roads

- Brentwood Road south of the Orsett Cock junction (AM and PM)
- Buckingham Hill Rd (PM only)

- A1012 Elizabeth Rd (AM and PM)
- Rectory Road (AM and PM)
- B1007 North Hill in Horndon (AM only)
- S. Chadwell Hill (AM and PM)
- Muckingford Road (PM only)

10.3.15 In addition, the following locations have been identified to demonstrate an increase in traffic through a visual analysis:

- Sections of the local network in Stanford-le-Hope and Corringham
- Linford Road in the Chadwell St Mary area
- Marshfoot Road including Marshfoot Road/Old Dock Approach Road roundabout
- Turnpike Lane/Gun Hill/Fort Road in the West Tilbury Area
- Brennan Road in the Tilbury area
- Sections of Arterial Road in Purfleet

10.3.16 It appears that the Orsett Cock link road which is now proposed as part of the LTC scheme design, in the main reduces flows on the A1013 Stanford Road to the west of Orsett Cock roundabout in both directions. However, on the A1013 to the east of the Orsett Cock roundabout, flows are seen to significantly decrease westbound and significantly increase eastbound. The latter is due to a significant number of additional trips generated by the LTAM for the area south east of Orsett Cock in the DS. The same Orsett Cock link road has a mixed impact on flows on Brentwood Road, which demonstrates a drop in traffic north of the junction and a significant increase south of the junction thus impacting Chadwell St Mary community.

10.3.17 Further analysis of the implications of the traffic flow changes is required to assess the impacts on road capacity, local communities, vulnerable road users, active modes and sustainable transport.

10.3.18 Further analysis by the scheme promoter is required on:

- A1089/Marshfoot Road
- Orsett Village area
- Chadwell St Mary Area including Brentwood Road and Linford Road
- West Tilbury Area
- Local Network in Stanford-le-Hope and Corringham
- Purfleet area

10.3.19 Ultimately the Council is looking for confidence that the local roads will be protected and/or capable of accommodating the effects of the LTC and that the DCO scheme provides the best configuration for the borough and against the scheme objectives.

Strategic Cross River Traffic Movements

10.3.20 The cross-river traffic flows in the scheme opening year are forecast to increase by 38-40% with flows on Dartford Crossing dropping by 14-18%. However, 15 years after scheme opening the total volume of cross river trips is forecast to increase by 53-62%, whereas flows on Dartford Crossing are forecast to drop by only 1-8%.

10.3.21 The proposed LTC is promoted as a scheme that will provide an additional river crossing and relieve pressure from the existing A282 Dartford Crossing/Queen Elizabeth II bridge. It is evident that the updated (DCO2v2) and previous (DCO2v1) models predict that 15 years after opening, the flow reductions on the existing Dartford Crossing as a result of the LTC will have waned significantly particularly in the AM peak.

10.3.22 While in both the opening year and 15 years after opening the scheme provides a relief to the existing Dartford Crossing, the relief is forecast to be less in the updated models which has a potential to further undermine the Value for Money (VfM) case of the scheme. It is requested that an explanation and results be provided on the implications of the updated models on Value for Money category of the scheme including Initial and Adjusted Benefit Cost Ratio (BCR).

Performance of Key Junctions

10.3.23 Analysis of junction performance for a set of key junctions, which were identified from earlier reviews as the main areas of scheme impact in Thurrock, have been undertaken:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junction including the A30 westbound merge

10.3.24 The analysis has summarised the impact of the DCO2v1 and DCO2v2 scenarios for 2045 DS and DM traffic flows at these junctions for the AM and PM peak periods. Comparison of changes in delays and V/C between DS and DM scenarios did not identify any additional junctions that are forecast to experience increased congestion in the 'with the LTC' scenario.

10.3.25 The analysis has shown that with the introduction of the LTC scheme the junctions which are showing significant flow increases as well as exhibiting performance concerns in terms of V/C and delays are:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- A13 westbound merge at Five Bells junction

10.3.26 A fundamental feature of the NH's LTAM model is that it is strategic in nature and has not been validated at local junction level. Therefore, in areas of concerns either highlighted through strategic modelling or raised by the Council local junction assessments must be undertaken with the appropriate junction modelling software or micro-simulation packages using outputs from LTAM to confirm the junctions are not severely impacted by the introduction of the LTC.

10.3.27 Local junction modelling using Vissim is being progressed by NH for Orsett Cock roundabout and the Manorway roundabout. Local junction modelling is also required for the ASDA Roundabout, Marshfoot Road/ A1089 Junction and Devonshire Road/ A1012 junction.

10.3.28 We await the traffic assessment using Vissim and will reserve judgement on the operation of the junctions when results of the assessments emerge.

10.3.29 The latest LTAM strategic model forecasts show that in the 2045 DS flows through Daneholes Roundabout are expected to reduce below the DM flows. However, we are aware that microsimulation assessment provides a more robust understanding of junction impacts and a more accurate understanding of likely performance thus addressing limitations of the LTAM stemming from its strategic nature. It is the Council position that the microsimulation work at Daneholes Roundabout, as previously agreed with NH, is still required. Until the assessment using Vissim is complete we will reserve judgement on the operation of the junction.

10.3.30 The LTAM strategic model forecasts significant worsening of congestion on the A13 westbound merge from the introduction of the LTC resulting in rat-running through communities of Corringham and Stanford-le-Hope. Further work is required from NH to mitigate the impact of the LTC at this location.

Journey Times from/to the Port of Tilbury

10.3.31 A number of routes to/from the Port of Tilbury have been analysed and the results are provided within the following section.

10.3.32 Across all the routes considered the journeys times between the Port of Tilbury and Brentwood are forecast to be less in DS than DM on average by 1 minute and 36 seconds in the AM and by 1minute 52 seconds in the PM.

10.3.33 Routes 5a and 6a via the LTC will provide slightly faster journey times in the DS scenario compared to the existing routes 3 and 4 via the A13 and M25.

10.3.34 Examination of journey time routes via the Manorway or Brentwood Road suggests that these may be significantly less attractive due to higher journey times suggesting that traffic is likely to remain on the LTC rather than diverting via the Manorway or local roads when travelling between Brentwood and the Port of Tilbury.

Impacts of the LTC on the Thurrock's Highway Network - Summary

10.3.35 A summary of the impacts of the LTC on the Thurrock's highway network is presented in Table **10-2** below using a RAG (Red, Amber, Green) classification. Red meaning the Council has major concerns about the impacts of the LTC. Amber is a warning, the Council has concerns and further work may be required. Green indicates a neutral impact, but clarification may be required.

	Check	Summary	RAG
1	Impact of the LTC on demand for travel on Thurrock roads	The introduction of the LTC is forecast to result in increased demand for car, LGV and HGV movements on Thurrock's road network and a section of the LTC falling within the boundary of Thurrock. In 2045 a 7% increase in trips is predicted in both the AM and PM peak hours. Increased volume of traffic passing through Thurrock will impact on the quality of life for local communities and residents which is of significant concern to Thurrock. Overall carbon emissions, air quality and noise levels will also increase in Thurrock, which is also of a significant concern to the Council. **NH Action:** the scheme must consider the impact on local communities in Thurrock	
2	Forecast Demand Matrices. Comparison to Earlier Reviews	Total number of forecast trips on Thurrock roads in the new DS and DM DCO2v2 models are higher than in the earlier reviewed DCO2v1 models.	

	Check	Summary	RAG
		A sequence of model reviews (DCO2v2, DCO2v1 and DCO1) highlights a trend for higher traffic flows forecast in Thurrock with each subsequent model update. **NH Action:** An explanation of this trend is required from National Highway.	
3	Network Statistics. Full LTAM	Introduction of the LTC in 2045 is forecast to result in reduced congestion as a global averaged figure across the full modelled LTAM network, although this is to a lesser extent when compared to the Thurrock cordon in terms of percentage changes and when considered at specific points within the Thurrock road network. The statistics shows that the LTC is increasing the total vehicle km and vehicles hours on the Thurrock network. **NH Action:** the scheme must consider the impact on local communities in Thurrock.	
4	Network Statistics in Cordon Models	Notwithstanding a significant decrease in over-capacity queues in the 'with the LTC' scenario, Thurrock is concerned about additional vehicles on Thurrock's roads, increases in total travel distance (pcu km) and total travel time (pcu hours) and more importantly increases in CO_2, NOX and PM10 emissions. **NH Action:** the scheme must consider the impact on local communities in Thurrock.	
5	Link Flows – Strategic and Local Roads	Multiple areas, local communities and key roads have been identified to experience a forecast increase in flows as a result of the LTC. **NH Action**: Further analysis of the implications of the traffic flow changes is required to assess the impacts on road capacity, local communities, vulnerable road users, active modes and sustainable transport. Appropriate mitigation measures to address these impacts are required to be provided by NH.	
6		The Orsett Cock link road, which is now proposed as part of the LTC scheme design, in the main reduces flows on the A1013 Stanford Road to the west of Orsett Cock roundabout in both directions. However, on the A1013 to the east of the Orsett Cock roundabout, flows are seen to significantly decrease westbound and significantly increase eastbound. The same Orsett Cock link road has a mixed impact on flows on Brentwood Road, which demonstrates a drop in traffic north of the junction and a significant increase south of the junction thus impacting Chadwell St Mary community. **NH**	

	Check	Summary	RAG
		Action: the scheme must consider the impact on local communities in Thurrock.	
7	Strategic Cross River Traffic Movements	The proposed LTC is promoted as a scheme that will provide an additional river crossing and relieve pressure from the existing A282 Dartford Crossing/Queen Elizabeth II bridge. It is evident from the analysis presented that the models predict that 15 years after opening, the flow reductions on the existing Dartford Crossing as a result of the LTC will have waned significantly particularly in the AM peak. **NH Action:** It is requested that an explanation and results be provided on the implications of the updated models on Value for Money category of the scheme including Initial and Adjusted Benefit Cost Ratio (BCR).	
8	Performance of Key Junctions	Introduction of the LTC scheme is forecast to result in significant flow increases as well as exhibit performance concerns in terms of V/C and delays at the following junctions: ▪ The Manorway Roundabout ▪ Orsett Cock Roundabout ▪ ASDA Roundabout ▪ Marshfoot Road/ A1089 Junction ▪ Devonshire Road/ A1012 ▪ A13 westbound merge at Five Bells junction **NH Action:** in areas of concerns either highlighted through strategic modelling or raised by the Council (e.g. Daneholes roundabout) local junction assessments must be undertaken.	
9		In the DCO2v2 DS model M25 Junction 30 is forecast to have reduced volume of traffic with minor variations in weighted average V/C and delays.	
10	Journey Times from/to the Port of Tilbury	Across all the routes considered the journeys times between the Port of Tilbury and Brentwood are forecast to reduce on average by around 1-2 minutes. There is no evidence that routes via Brentwood Road, which passes via Chadwell St Mary, or routes via the Manorway will provide an attractive alternative to traffic travelling between Brentwood and the Port of Tilbury.	

Table 10-2 Model Development and Forecasting Approach Considerations – RAG Summary

Appendix A Base Year Model Validation

Link Validation Results (green – pass; red – fail)

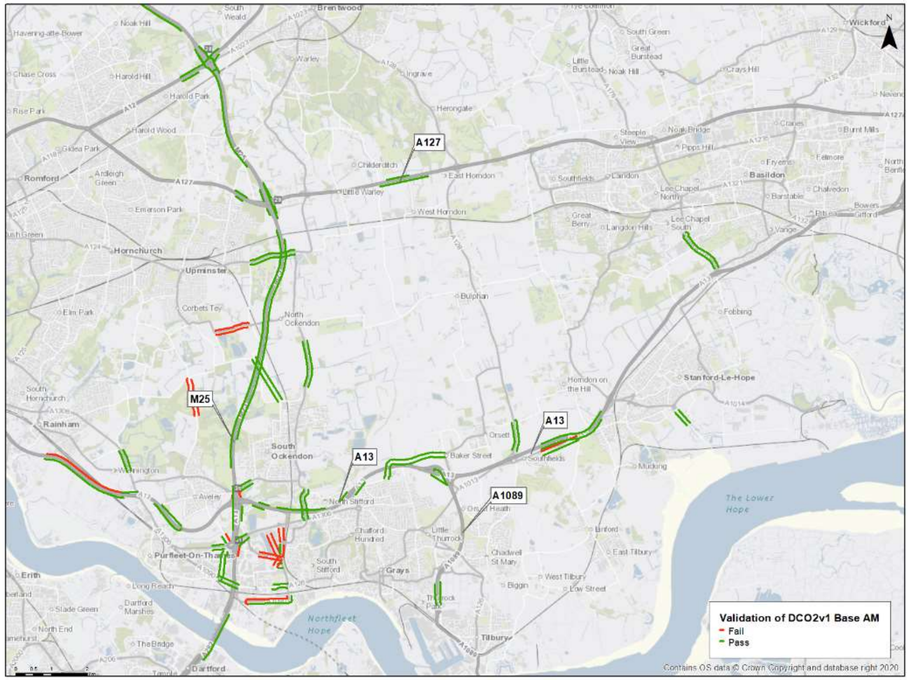


Figure A-1 2016 **DCO2v1** Base Year Model Validation. AM Peak.

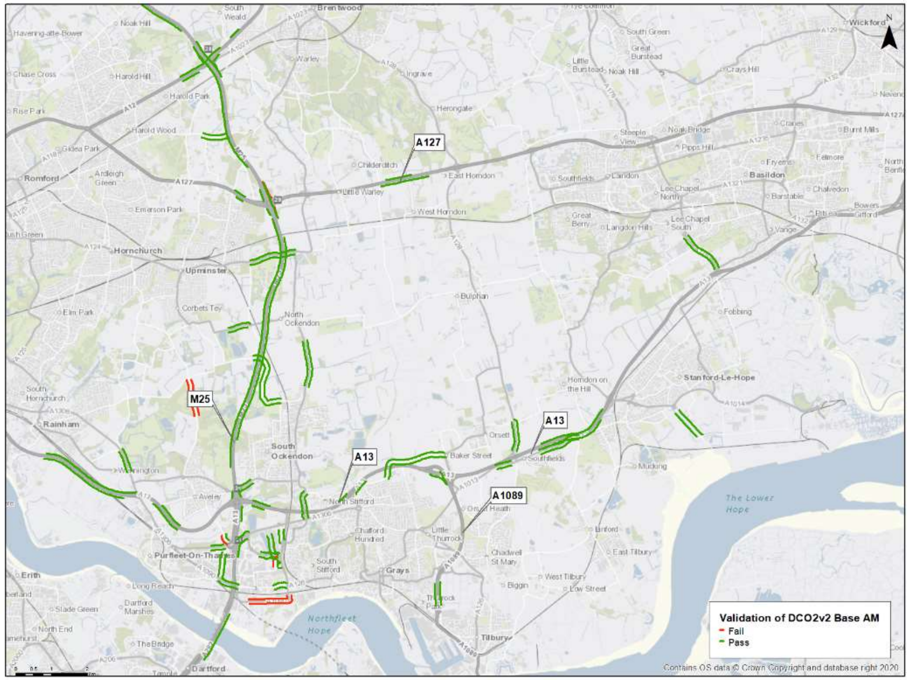


Figure A-2 2016 **DCO2v2** Base Year Model Validation. AM Peak.

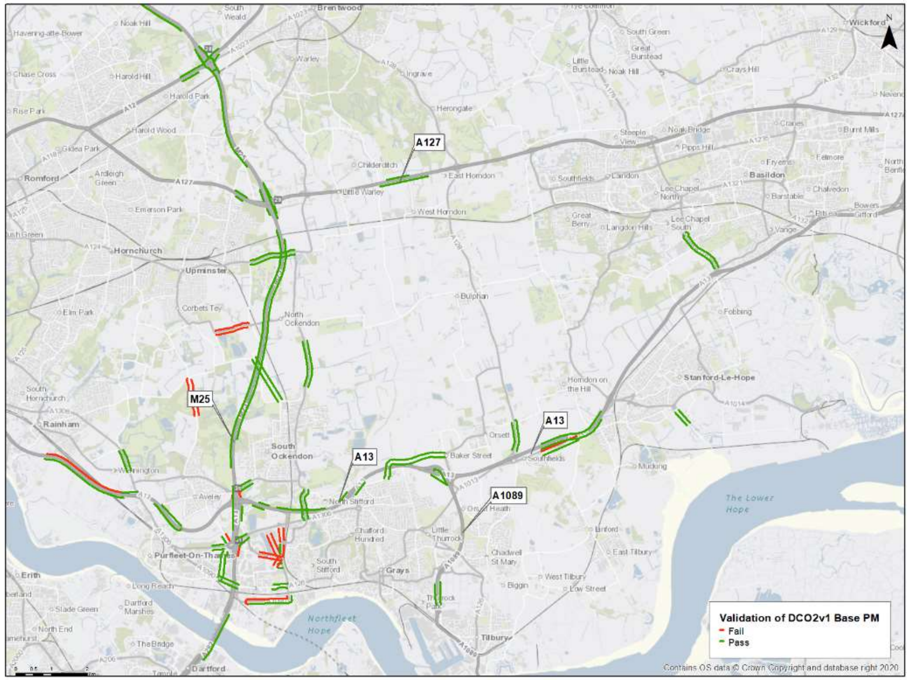


Figure A-3 2016 **DCO2v1** Base Year Model Validation. PM Peak.

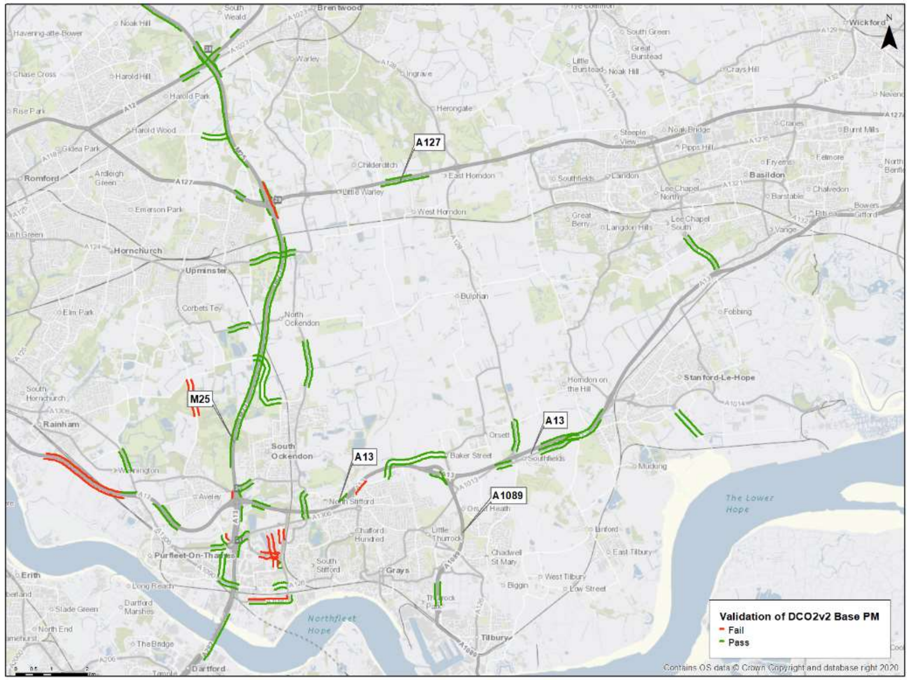


Figure A-4 2016 **DCO2v2** Base Year Model Validation. PM Peak.

Appendix B LTAM Thurrock Development Uncertainty Log

Note: Information extracted from LTC's Developments_UL to 30 Sept 2021_V1.12 spreadsheet provided alongside the DCO2v2 models.

Development	Land Use Type	Development measure	Total Size	Planning Status	Uncertainty
Aveley Village Extension, South of Aveley Bypass, Aveley	C3-Dwelling House	Res units	340	Planning Consent	Near Certain
Bata Field, East Tilbury	C3-Dwelling House	Res units	299	Planning Consent	Near Certain
Land at Thurrock Technical College, Wood View, Grays	C3-Dwelling House	Res units	362	Planning Consent	Near Certain
Arisdale Industrial Estate (remainder), South Ockendon	C3-Dwelling House	Res units	558	Planning Consent	Near Certain
Land at St Cleres golf club Stanford-le-Hope	C3-Dwelling House	Res units	350	Planning Consent	Near Certain
Purfleet Centre Regeneration	C3-Dwelling House	Res units	2,850	Application Submitted	More Than Likely
Purfleet Centre Regeneration	A1-Retail	Sq.m	8,360	Application Submitted	More Than Likely
Purfleet Centre Regeneration	A3-Restaurants and cafes	Sq.m	4,960	Application Submitted	More Than Likely
Purfleet Centre Regeneration	A4-Drinking Establishments	Sq.m	855	Application Submitted	More Than Likely
Purfleet Centre Regeneration	B1(a)-Business Office	Sq.m	3,483	Application Submitted	More Than Likely
Purfleet Centre Regeneration	B1(b)-Research & Development	Sq.m	3,483	Application Submitted	More Than Likely
Purfleet Centre Regeneration	B1(c)-Light Industry (Business Park)	Sq.m	3,483	Application Submitted	More Than Likely
Purfleet Centre Regeneration	C1-Hotels	Sq.m	19,000	Application Submitted	More Than Likely
Purfleet Centre Regeneration	D1-Non-residential Institutions	Sq.m	17,385	Application Submitted	More Than Likely
Purfleet Centre Regeneration	D2-Assembly and Leisure	Sq.m	5,890	Application Submitted	More Than Likely
London Gateway Logistics Park Plot 1020, 1070, 1080, 3010, 4010 & 4020a	B1(a)-Business Office	Sq.m	11,083	Planning Consent	Near Certain
London Gateway Logistics Park Plot 1020, 1070, 1080, 3010, 4010 & 4020a	B1(c)-Light Industry (Business Park)	Sq.m	2,569	Planning Consent	Near Certain
London Gateway Logistics Park Plot 1020, 1070, 1080, 3010, 4010 & 4020a	B2-Industry	Sq.m	3,295	Planning Consent	Near Certain
London Gateway Logistics Park Plot 1020, 1070, 1080, 3010, 4010 & 4020a	B8-Storage & Distribution	Sq.m	126,220	Planning Consent	Near Certain
Tilbury London Distribution Park	B8-Storage & Distribution	Sq.m	204,820	Planning Consent	Near Certain
Land to East of Euclid Way and South of West Thurrock Way (West Thurrock Green)	A1-Retail	Sq.m	6,694	Planning Consent	Near Certain
Land to East of Euclid Way and South of West Thurrock Way (West Thurrock Green)	C3-Dwelling House	Res units	214	Planning Consent	Near Certain

Development	Land Use Type	Development measure	Total Size	Planning Status	Uncertainty
Land to East of Euclid Way and South of West Thurrock Way (West Thurrock Green)	C3-Dwelling House	Res units	256	Planning Consent	Near Certain
Northlake, Lakeside Basin	C3-Dwelling House	Res units	2,500	Application Submitted	More Than Likely
Northlake, Lakeside Basin	A1-Retail	Sq.m	400	Application Submitted	More Than Likely
Northlake, Lakeside Basin	A3-Restaurants and cafes	Sq.m	100	Application Submitted	More Than Likely
Northlake, Lakeside Basin	D1-Non-residential Institutions	Sq.m	3,690	Application Submitted	More Than Likely
Tilbury 2	B8-Storage & Distribution	Sq.m	10,200	Planning Consent	Near Certain
Purfleet Commercial Park, Stonehouse Lane, Purfleet	B8-Storage & Distribution	Sq.m	31,424	Application Submitted	More Than Likely
Treetops Free School, Buxton Road, Grays	D1-Non-residential Institutions	Sq.m	3,522	Planning Consent	Near Certain
Langdon Hills Golf Club, Lower Dunton Road, Bulphan	C2-Residential institutions	Res units	238	Application Submitted	More Than Likely
Langdon Hills Golf Club, Lower Dunton Road, Bulphan	D2-Assembly and Leisure	Sq.m	3,181	Application Submitted	More Than Likely
Little Malgraves Farm, Bulphan	C2-Residential institutions	Sq.m	1,407	Application Submitted	More Than Likely
Little Malgraves Farm, Bulphan	C3-Dwelling House	Res units	80	Application Submitted	More Than Likely
Churchill Green, Little Thurrock, Grays	C3-Dwelling House	Res units	161	Application Submitted	More Than Likely
Churchill Green, Little Thurrock, Grays	B1(c)-Light Industry (Business Park)	Sq.m	2,550	Application Submitted	More Than Likely
Churchill Green, Little Thurrock, Grays	B2-Industry	Sq.m	2,550	Application Submitted	More Than Likely
Churchill Green, Little Thurrock, Grays	B8-Storage & Distribution	Sq.m	2,550	Application Submitted	More Than Likely
Unit A2C Lakeside Retail Park	D2-Assembly and Leisure	Sq.m	6,713	Application Submitted	More Than Likely
Unit A, Lakeside Retail Park, Thurrock	A1-Retail	Sq.m	8,374	Planning Consent	Near Certain
Thames Enterprise Park The Manorway Coryton Essex	B8-Storage & Distribution	Sq.m	480,000	Application Submitted	More Than Likely
East Tilbury (Land For Development Muckingford Road Linford Essex)	C3-Dwelling House	Res units	1,000	Application Submitted	More Than Likely
Star Industrial Estate Linford Road Chadwell St Mary Essex	C3-Dwelling House	Res units	203	Planning Consent	Near Certain
intu Lakeside Shopping Centre: Northern Extension	A1-Retail	Sq.m	37,651	Planning Consent	Near Certain
intu Lakeside Shopping Centre: Northern Extension	A2-A5	Sq.m	3,053	Planning Consent	Near Certain
intu Lakeside Shopping Centre: Northern Extension	Other - Multistorey car park	Sq.m	24,103	Planning Consent	Near Certain
intu Lakeside Leisure	A3-Restaurants and cafes	Sq.m	3,929	Planning Consent	Near Certain
intu Lakeside Leisure	D2-Assembly and Leisure	Sq.m	8,745	Planning Consent	Near Certain

Development	Land Use Type	Development measure	Total Size	Planning Status	Uncertainty
intu Lakeside Leisure	A1	Sq.m	725	Planning Consent	Near Certain
intu Lakeside Leisure	A3, A4, A5	Sq.m	6,645	Planning Consent	Near Certain
intu Lakeside Leisure	A1, A3, A4, A5	Sq.m	721	Planning Consent	Near Certain
intu Lakeside Leisure	C1-Hotels	Sq.m	5,340	Planning Consent	Near Certain
intu Lakeside Leisure	D2-Assembly and Leisure	Sq.m	13,348	Planning Consent	Near Certain
SERGO Logistics Park, Purfleet Road, Aveley (Land Adj A13 A1306 And Purfleet Road Aveley Essex)	B1(a)-Business Office	Sq.m	2,891	Planning Consent	Near Certain
SERGO Logistics Park, Purfleet Road, Aveley (Land Adj A13 A1306 And Purfleet Road Aveley Essex)	B8-Storage & Distribution	Sq.m	23,424	Planning Consent	Near Certain
Thurrock Council Civic Offices	Sui Generis	Sq.m	2,163	Planning Consent	Near Certain
Askews Industrial Estate, Askews Farm Lane, Grays, Essex	B2 & B8	Sq.m	4,479	Application Submitted	More Than Likely
Old State Cinema, George Street	A4-Drinking establishments	Sq.m	2,643	Planning Consent	Near Certain
Premier Freight Services Ltd, Wouldham Road, West Thurrock	B8-Storage & Distribution	Sq.m	5,544	Planning Consent	Near Certain
Previous Mecca Bingo, Quarry Hill	D1-Non-residential Institutions	Sq.m	1,650	Planning Consent	Near Certain
Land Adjacent Unit 53 Globe Industrial Estate Towers Road	B1(a)-Business Office	Sq.m	400	Planning Consent	Near Certain
Land Adjacent Unit 53 Globe Industrial Estate Towers Road	B1(c)-Light Industry (Business Park)	Sq.m	1,955	Planning Consent	Near Certain
Land north of Bannatynes Health Club, Howard Road, Chafford Hundred	C3-Dwelling House	Res units	203	Planning Consent	Near Certain
St Cleres School, Butts Lane, Stanford Le Hope	D1-Non-residential Institutions	Sq.m	2,244	Planning Consent	Near Certain
StaHEope Industrial Park,Wharf Road, Stanford Le Hope	B8-Storage & Distribution	Sq.m	8,100	Planning Consent	Near Certain
Squibb Group, StaHEope Industrial Estate	B1(a)-Business Office	Sq.m	2,280	Planning Consent	Near Certain
Squibb Group, StaHEope Industrial Estate	B1(c)-Light Industry (Business Park)	Sq.m	480	Planning Consent	Near Certain
Squibb Group, StaHEope Industrial Estate	B8-Storage & Distribution	Sq.m	1,260	Planning Consent	Near Certain
Purfleet Thames Terminal Car Deck	unilever car storage	Sq.m	210,000	Planning Consent	Near Certain
Fiddlers Reach	B1(c)-Light Industry (Business Park)	Sq.m	18,240	Planning Consent	Near Certain
Fiddlers Reach	B2-Industry	Sq.m	18,240	Planning Consent	Near Certain
Fiddlers Reach	B8-Storage & Distribution	Sq.m	18,240	Planning Consent	Near Certain
Purfleet Farm	B2-Industry	Sq.m	20,000	Planning Consent	Near Certain
Purfleet Farm	B8-Storage & Distribution	Sq.m	13,000	Planning Consent	Near Certain
Sports Direct, Thurrock Shopping Park	A1-Retail	Sq.m	2,833	Planning Consent	Near Certain
Sports Direct, Thurrock Shopping Park	D2-Assembly and Leisure	Sq.m	2,194	Planning Consent	Near Certain

Appendix C Matrix Comparisons - pcu/hour

User Class	Description	2029 AM DCO2v1 DM	2030 AM DCO2v2 DM	Difference	% Difference
1	Cars Employers Business	6,230.53	6,073.09	-157.44	-3%
2	Cars Commute Low Income	3,659.80	3,374.03	-285.77	-8%
3	Cars Commute Med Income	6,856.14	7,246.33	390.19	6%
4	Cars Commute High Income	6,666.45	7,130.58	464.13	7%
5	Cars Other Low Income	6,702.90	7,340.37	637.47	10%
6	Cars Other Med Income	7,134.28	7,692.00	557.72	8%
7	Cars Other High Income	6,731.40	7,270.73	539.33	8%
8	LGVs	9,699.18	10,975.57	1,276.39	13%
9	HGVs (non-Port only)	11,417.18	11,599.73	182.55	2%
10	HGVs (Port only)	3,103.02	3,252.39	149.37	5%
Total HGVs	Total HGVs	14,520	14,852	331.92	2%
Total All Trips	**Total Trips**	**68,201**	**71,955**	**3,753.94**	**6%**

Table C-1 Matrix Comparison AM DM (2029,2030)

User Class	Description	2029 AM DCO2v1 DS	2030 AM DCO2v2 DS	Difference	% Difference
1	Cars Employers Business	6,632.80	6,510.98	-121.82	-2%
2	Cars Commute Low Income	3,710.51	3,397.48	-313.03	-8%
3	Cars Commute Med Income	7,225.93	7,655.83	429.90	6%
4	Cars Commute High Income	6,997.94	7,420.74	422.80	6%
5	Cars Other Low Income	7,340.86	8,123.77	782.91	11%
6	Cars Other Med Income	7,854.53	8,483.37	628.84	8%
7	Cars Other High Income	7,448.50	8,000.84	552.34	7%
8	LGVs	9,790.82	11,180.62	1,389.80	14%
9	HGVs (non-Port only)	11,662.48	11,905.21	242.73	2%
10	HGVs (Port only)	3,135.44	3,312.82	177.38	6%
Total HGVs	Total HGVs	14,798	15,218	420.11	3%
Total All Trips	**Total Trips**	**71,800**	**75,992**	**4,191.85**	**6%**

Table C-2 Matrix Comparison AM DS (2029,2030)

User Class	Description	2029 PM DM	2030 PM DM	Difference	% Difference
1	Cars Employers Business	5,333.67	5,498.25	164.58	3%
2	Cars Commute Low Income	3,489.58	3,138.03	-351.55	-10%
3	Cars Commute Med Income	7,345.39	7,944.20	598.81	8%
4	Cars Commute High Income	8,711.50	9,200.64	489.14	6%
5	Cars Other Low Income	9,063.74	9,968.47	904.73	10%
6	Cars Other Med Income	10,143.95	11,050.62	906.67	9%
7	Cars Other High Income	8,773.87	9,375.75	601.88	7%
8	LGVs	6,984.98	8,038.61	1,053.63	15%
9	HGVs (non-Port only)	7,293.96	7,313.64	19.68	0%
10	HGVs (Port only)	3,017.14	3,138.12	120.98	4%
Total HGVs	Total HGVs	10,311	10,452	140.66	1%
Total All Trips	**Total Trips**	**70,158**	**74,666**	**4,508.55**	**6%**

Table C-3 Matrix Comparison PM DM (2029,2030)

User Class	Description	2029 PM DCO2v1 DS	2030 PM DCO2v2 DS	Difference	% Difference
1	Cars Employers Business	5,662.36	5,845.41	183.05	3%
2	Cars Commute Low Income	3,587.83	3,191.08	-396.75	-11%
3	Cars Commute Med Income	7,643.05	8,292.11	649.06	8%
4	Cars Commute High Income	9,322.78	9,882.09	559.31	6%
5	Cars Other Low Income	9,717.17	10,702.60	985.43	10%
6	Cars Other Med Income	10,821.28	11,738.59	917.31	8%
7	Cars Other High Income	9,760.32	10,389.33	629.01	6%
8	LGVs	7,116.53	8,169.27	1,052.74	15%
9	HGVs (non-Port only)	7,473.09	7,454.53	-18.56	0%
10	HGVs (Port only)	3,067.13	3,187.36	120.23	4%
Total HGVs	Total HGVs	10,540	10,642	101.67	1%
Total All Trips	**Total Trips**	**74,172**	**78,852**	**4,680.83**	**6%**

Table C-4 Matrix Comparison PM DS (2029,2030)

User Class	Description	2044 AM DCO2v1 DM	2045 AM DCO2v2 DM	Difference	% Difference
1	Cars Employers Business	6,546.84	6,318.09	-228.75	-3%
2	Cars Commute Low Income	4,004.15	4,161.80	157.65	4%
3	Cars Commute Med Income	7,218.60	7,576.70	358.10	5%
4	Cars Commute High Income	6,822.15	7,251.05	428.90	6%
5	Cars Other Low Income	8,026.90	8,554.42	527.52	7%
6	Cars Other Med Income	7,808.58	8,280.66	472.08	6%
7	Cars Other High Income	7,069.85	7,523.16	453.31	6%
8	LGVs	11,037.53	12,572.90	1,535.37	14%
9	HGVs (non-Port only)	11,694.72	11,816.07	121.35	1%
10	HGVs (Port only)	3,101.23	3,240.14	138.91	4%
Total HGVs	Total HGVs	14,796	15,056	260.26	2%
Total All Trips	**Total Trips**	**73,331**	**77,295**	**3,964.44**	**5%**

Table C-5 Matrix Comparison AM DM (2044,2045)

User Class	Description	2044 AM DCO2v1 DS	2045 AM DCO2v2 DS	Difference	% Difference
1	Cars Employers Business	7,010.39	6,846.38	-164.01	-2%
2	Cars Commute Low Income	4,081.69	4,249.70	168.01	4%
3	Cars Commute Med Income	7,687.45	8,079.52	392.07	5%
4	Cars Commute High Income	7,189.84	7,635.76	445.92	6%
5	Cars Other Low Income	9,064.67	9,597.99	533.32	6%
6	Cars Other Med Income	8,757.08	9,258.30	501.22	6%
7	Cars Other High Income	7,892.68	8,333.78	441.10	6%
8	LGVs	11,287.03	12,823.90	1,536.87	14%
9	HGVs (non-Port only)	12,285.61	12,492.56	206.95	2%
10	HGVs (Port only)	3,149.18	3,322.83	173.65	6%
Total HGVs	Total HGVs	15,435	15,815	380.60	2%
Total All Trips	**Total Trips**	**78,406**	**82,641**	**4,235.10**	**5%**

Table C-6 Matrix Comparison AM DS (2044,2045)

User Class	Description	2044 PM DCO2v1 DM	2045 PM DCO2v2 DM	Difference	% Difference
1	Cars Employers Business	5,699.91	5,763.14	63.23	1%
2	Cars Commute Low Income	3,897.20	4,168.27	271.07	7%
3	Cars Commute Med Income	7,739.80	8,232.05	492.25	6%
4	Cars Commute High Income	8,771.51	9,249.62	478.11	5%
5	Cars Other Low Income	10,729.11	11,417.76	688.65	6%
6	Cars Other Med Income	11,242.95	11,871.81	628.86	6%
7	Cars Other High Income	9,236.91	9,643.82	406.91	4%
8	LGVs	7,979.59	9,191.17	1,211.58	15%
9	HGVs (non-Port only)	7,583.71	7,636.95	53.24	1%
10	HGVs (Port only)	3,031.97	3,133.21	101.24	3%
Total HGVs	Total HGVs	10,616	10,770	154.48	1%
Total All Trips	**Total Trips**	**75,913**	**80,308**	**4,395.14**	**6%**

Table C-7 Matrix Comparison PM DM (2044,2045)

User Class	Description	2044 PM DCO2v1 DS	2045 PM DCO2v2 DS	Difference	% Difference
1	Cars Employers Business	6,083.89	6,171.35	87.46	1%
2	Cars Commute Low Income	4,037.81	4,330.12	292.31	7%
3	Cars Commute Med Income	8,116.05	8,654.44	538.39	7%
4	Cars Commute High Income	9,590.87	10,073.39	482.52	5%
5	Cars Other Low Income	11,752.94	12,505.53	752.59	6%
6	Cars Other Med Income	12,048.87	12,720.94	672.07	6%
7	Cars Other High Income	10,379.05	10,798.32	419.27	4%
8	LGVs	8,205.39	9,356.83	1,151.44	14%
9	HGVs (non-Port only)	7,909.12	7,840.91	-68.21	-1%
10	HGVs (Port only)	3,073.43	3,191.35	117.92	4%
Total HGVs	Total HGVs	10,983	11,032	49.71	0%
Total All Trips	**Total Trips**	**81,197**	**85,643**	**4,445.76**	**5%**

Table C-8 Matrix Comparison PM DS (2044,2045)

Appendix D Cordon Network Summary Statistics. DCO2v2 and DCO2v1

Scenario	Total Trips Loaded (Pcu/Hr)	Transiet Queues (Hrs/hr)	Over-Capacity Queues (Pcu.Hrs/Hr	Link Cruise Time (Pcu.Hrs/Hr)	Free Flow (Pcu.Hrs/Hr)	Delays (Pcu.Hrs/Hr)	Total Travel Time (Pcu.Hrs/Hr)	Travel Distance (Pcu.Kms/Hr)	Overall Average Speed (KPH)	Monetary Toll (£/Hr)	Fuel Consumed during time period (1hr) (litres	Pollutants in Kg within this time period					
												CO (Kg)	CO2 (Kg)	NOX (Kg)	HC (Kg)	PB (Kg)	PM10 (Kg)
2016 Base AM	54,967	1,733	595	10,870	9,229	1,641	13,197	804,573	61	36,155	60,863	4,280	62,977	1,168	783	5	5
2016 Base IP	46,140	875	113	8,677	7,822	855	9,665	678,073	70	31,793	49,724	3,187	51,167	922	586	3	3
2016 Base PM	54,797	1,330	173	10,377	9,045	1,332	11,880	774,341	65	28,861	57,430	3,918	59,364	1,107	719	4	4
2029AMDM	67,985	2,809	741	13,026	11,062	1,964	16,576	967,927	58	44,617	74,824	5,291	76,869	1,418	966	6	6
2029AMDS	71,591	2,492	583	13,881	11,993	1,853	16,957	1,083,084	64	35,693	81,635	5,373	83,651	1,488	984	6	6
Change	3,606	-317	-158	855	931	-112	381	115,157	6	-8,924	6,811	82	6,782	70	18	0	0
% Change	5.3%	-11.3%	-21.3%	6.6%	8.4%	-5.7%	2.3%	11.9%	9.4%	-20.0%	9.1%	1.5%	8.8%	4.9%	1.9%	3.1%	3.1%
2029PMDM	69,954	2,526	192	12,908	11,096	1,811	15,626	950,844	61	38,029	72,250	5,089	74,513	1,394	931	5	5
2029PMDS	73,974	2,361	189	13,849	12,062	1,787	16,399	1,064,274	65	29,475	79,919	5,331	82,152	1,490	977	6	6
Change	4,020	-165	-4	942	966	-25	773	113,430	4	-8,555	7,668	242	7,639	96	46	0	0
% Change	5.7%	-6.5%	-1.8%	7.3%	8.7%	-1.4%	4.9%	11.9%	6.6%	-22.5%	10.6%	4.7%	10.3%	6.9%	4.9%	5.9%	5.9%
2044AMDM	73,086	3,875	1,246	14,425	11,907	2,518	19,546	1,038,314	53	48,304	82,508	6,232	85,379	1,593	1,133	6	6
2044AMDS	78,170	3,613	850	15,640	13,127	2,513	20,103	1,181,779	59	43,602	91,342	6,378	93,826	1,702	1,164	7	7
Change	5,084	-262	-396	1,215	1,220	-5	557	143,465	6	-4,702	8,833	146	8,446	109	31	0	0
% Change	7.0%	-6.8%	-31.8%	8.4%	10.2%	-0.2%	2.9%	13.8%	10.7%	-9.7%	10.7%	2.4%	9.9%	6.9%	2.8%	4.4%	4.4%
2044PMDM	75,683	3,561	411	14,409	11,993	2,416	18,381	1,025,199	56	43,033	79,546	5,959	82,549	1,569	1,086	6	6
2044PMDS	80,976	3,612	296	15,758	13,275	2,483	19,666	1,170,149	60	36,344	89,644	6,358	92,618	1,710	1,161	7	7
Change	5,293	51	-115	1,348	1,282	66	1,285	144,950	4	-6,689	10,098	399	10,069	141	75	0	0
% Change	7.0%	1.4%	-27.9%	9.4%	10.7%	2.7%	7.0%	14.1%	6.6%	-15.5%	12.7%	6.7%	12.2%	9.0%	6.9%	7.7%	7.7%
2029IPDM	59,924	1,467	184	11,028	9,769	1,258	12,678	849,716	67	41,860	63,158	4,145	64,852	1,181	761	5	5
2029IPDS	62,067	1,327	154	11,498	10,354	1,144	12,979	924,394	71	29,417	68,179	4,247	69,807	1,229	781	5	5
Change	2,142	-139	-30	471	585	-114	301	74,678	4	-12,444	5,021	103	4,955	48	20	0	0
% Change	3.6%	-9.5%	-16.2%	4.3%	6.0%	-9.1%	2.4%	8.8%	6.3%	-29.7%	7.9%	2.5%	7.6%	4.0%	2.6%	3.3%	3.3%
2044IPDM	66,254	2,186	228	12,623	10,859	1,764	15,037	945,002	63	48,422	71,064	4,852	73,037	1,354	889	5	5
2044IPDS	70,053	2,060	234	13,530	11,791	1,739	15,823	1,055,063	67	38,266	78,668	5,112	80,646	1,448	938	6	6
Change	3,799	-126	5	907	932	-25	786	110,061	4	-10,156	7,604	260	7,609	94	49	0	0
% Change	5.7%	-5.8%	2.3%	7.2%	8.6%	-1.4%	5.2%	11.6%	6.2%	-21.0%	10.7%	5.3%	10.4%	6.9%	5.5%	6.1%	6.1%

Table D-1 DCO2v2 Updated Model Summary Statistics

Scenario	Total Trips Loaded (Pcu/Hr)	Transiet Queues (Hrs/hr)	Over-Capacity Queues (Pcu.Hrs/Hr	Link Cruise Time (Pcu.Hrs/Hr)	Free Flow (Pcu.Hrs/Hr)	Delays (Pcu.Hrs/Hr)	Total Travel Time (Pcu.Hrs/Hr)	Travel Distance (Pcu.Kms/Hr)	Overall Average Speed (KPH)	Monetary Toll (£/Hr)	Fuel Consumed during time period (1hr) (litres	Pollutants in Kg within this time period					
												CO (Kg)	CO2 (Kg)	NOX (Kg)	HC (Kg)	PB (Kg)	PM10 (Kg)
2019 Base AM	57,095	1,825	543	11,066	9,419	1,647	13,425	816,592	61	35,717	61,835	4,358	63,965	1,190	797	5	5
2019 Base IP	47,602	884	115	8,824	7,972	851	9,822	687,484	70	31,629	50,438	3,249	51,946	938	598	4	4
2019 Base PM	57,327	1,537	156	10,754	9,338	1,417	12,447	793,755	64	28,510	59,266	4,113	61,285	1,152	754	4	4
2030AMDM	71,718	3,137	849	13,755	11,545	2,210	17,741	999,171	56	45,198	77,941	5,668	80,165	1,505	1,034	6	6
2030AMDS	75,762	2,894	642	14,760	12,641	2,119	18,297	1,113,527	62	57,703	86,322	5,769	88,221	1,591	1,056	6	6
Change	4,044	-243	-206	1,005	1,095	-91	556	114,356	6	12,505	8,381	101	8,057	86	22	0	0
% Change	5.6%	-7.7%	-24.3%	7.3%	9.5%	-4.1%	3.1%	11.4%	10.1%	27.7%	10.8%	1.8%	10.1%	5.7%	2.2%	3.5%	3.5%
2030PMDM	74,447	3,002	282	13,760	11,696	2,063	17,043	991,365	58	38,745	76,182	5,546	78,731	1,495	1,013	6	6
2030PMDS	78,640	2,871	164	14,909	12,847	2,062	17,945	1,128,439	63	48,893	85,369	5,791	87,596	1,610	1,061	6	6
Change	4,193	-131	-117	1,149	1,151	-1	902	137,074	5	10,148	9,187	244	8,864	115	48	0	0
% Change	5.6%	-4.4%	-41.6%	8.4%	9.8%	-0.1%	5.3%	13.8%	8.1%	26.2%	12.1%	4.4%	11.3%	7.7%	4.7%	6.0%	6.0%
2045AMDM	77,026	4,182	1,382	15,033	12,336	2,697	20,598	1,064,297	52	48,994	85,459	6,603	88,542	1,672	1,199	7	7
2045AMDS	82,381	4,038	1,026	16,404	13,732	2,672	21,468	1,229,455	57	70,093	95,566	6,706	97,847	1,783	1,224	7	7
Change	5,355	-144	-356	1,371	1,396	-25	870	165,158	6	21,099	10,107	103	9,305	111	24	0	0
% Change	7.0%	-3.5%	-25.8%	9.1%	11.3%	-0.9%	4.2%	15.5%	10.8%	43.1%	11.8%	1.6%	10.5%	6.6%	2.0%	3.7%	3.7%
2045PMDM	80,059	4,078	558	15,210	12,546	2,665	19,846	1,061,371	54	43,844	83,733	6,492	87,141	1,677	1,181	7	7
2045PMDS	85,403	4,179	429	16,701	13,985	2,716	21,308	1,226,314	58	59,564	95,131	6,854	98,024	1,824	1,251	7	7
Change	5,344	101	-129	1,490	1,439	52	1,463	164,942	4	15,719	11,398	363	10,883	147	69	0	0
% Change	6.7%	2.5%	-23.0%	9.8%	11.5%	1.9%	7.4%	15.5%	7.7%	35.9%	13.6%	5.6%	12.5%	8.8%	5.9%	7.1%	7.1%
2030IPDM	63,137	1,684	174	11,627	10,242	1,385	13,485	882,407	65	43,058	65,879	4,407	67,695	1,248	809	5	5
2030IPDS	65,648	1,547	149	12,308	11,013	1,295	14,003	979,930	70	50,074	72,516	4,549	74,084	1,317	837	5	5
Change	2,511	-137	-25	681	771	-90	518	97,523	5	7,016	6,637	142	6,390	69	28	0	0
% Change	4.0%	-8.1%	-14.3%	5.9%	7.5%	-6.5%	3.8%	11.1%	7.0%	16.3%	10.1%	3.2%	9.4%	5.6%	3.5%	4.4%	4.4%
2045IPDM	69,336	2,459	219	13,181	11,289	1,893	15,860	972,315	61	49,673	73,495	5,116	75,604	1,417	937	5	5
2045IPDS	73,484	2,385	209	14,338	12,433	1,904	16,932	1,108,341	66	63,288	83,098	5,444	84,979	1,540	999	6	6
Change	4,149	-74	-10	1,157	1,145	12	1,072	136,026	4	13,614	9,603	328	9,375	123	62	0	0
% Change	6.0%	-3.0%	-4.7%	8.8%	10.1%	0.6%	6.8%	14.0%	6.9%	27.4%	13.1%	6.4%	12.4%	8.7%	6.6%	7.7%	7.7%

Table D-2 DCO2v1 previous Model Summary Statistics

Appendix E LTAM-wide Summary Network Statistics. DCO2v2

2030

		AM Peak				PM Peak			
		2030DM	2030DS	Diff	% Diff	2030DM	2030DS	Diff	% Diff
Simulation Network									
Transient queues	pcu. hrs	46,009	45,401	-609	-1.3%	48,046	47,606	-441	-0.9%
Over-capacity queues	pcu. hrs	16,078	15,743	-335	-2.1%	14,711	14,365	-346	-2.4%
Link cruise time	pcu. hrs	201,882	202,897	1,015	0.5%	206,298	207,548	1,250	0.6%
Total travel time	pcu. hrs	263,969	264,041	71	0.0%	269,055	269,519	464	0.2%
Travel distance	pcu. kms	13,418,735	13,556,121	137,386	1.0%	13,482,946	13,630,943	147,997	1.1%
Overall average speed	kph	50.8	51.3	0.5	1.0%	50.1	50.6	0.5	1.0%

2045

		AM Peak				PM Peak			
		2045DM	2045DS	Diff	% Diff	2045DM	2045DS	Diff	% Diff
Simulation Network									
Transient queues	pcu. hrs	58,902	58,663	-240	-0.4%	63,298	62,926	-372	-0.6%
Over-capacity queues	pcu. hrs	27,237	26,643	-594	-2.2%	27,045	26,419	-626	-2.3%
Link cruise time	pcu. hrs	230,997	232,188	1,191	0.5%	235,598	237,324	1,726	0.7%
Total travel time	pcu. hrs	317,137	317,494	357	0.1%	325,941	326,669	729	0.2%
Travel distance	pcu. kms	15,058,813	15,220,018	161,205	1.1%	15,108,208	15,296,137	187,929	1.2%
Overall average speed	kph	47.5	47.9	0.4	0.8%	46.4	46.8	0.4	0.9%

Appendix F Impact of LTC. DCO2V2 DM and DS Comparison. 2030 and 2045.

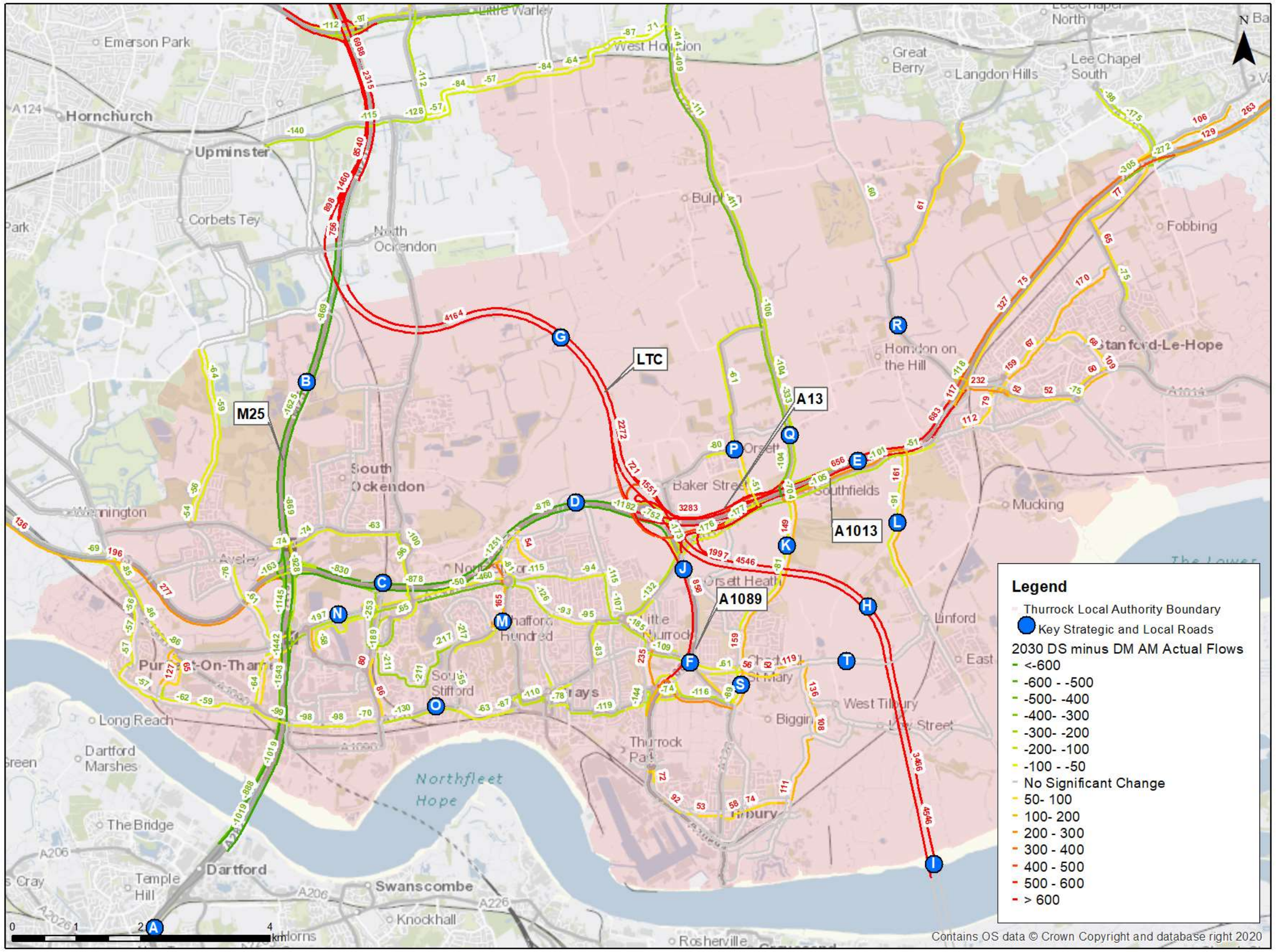


Figure F-1 2030 AM Flow changes DS – DM (DCO2v2 model)

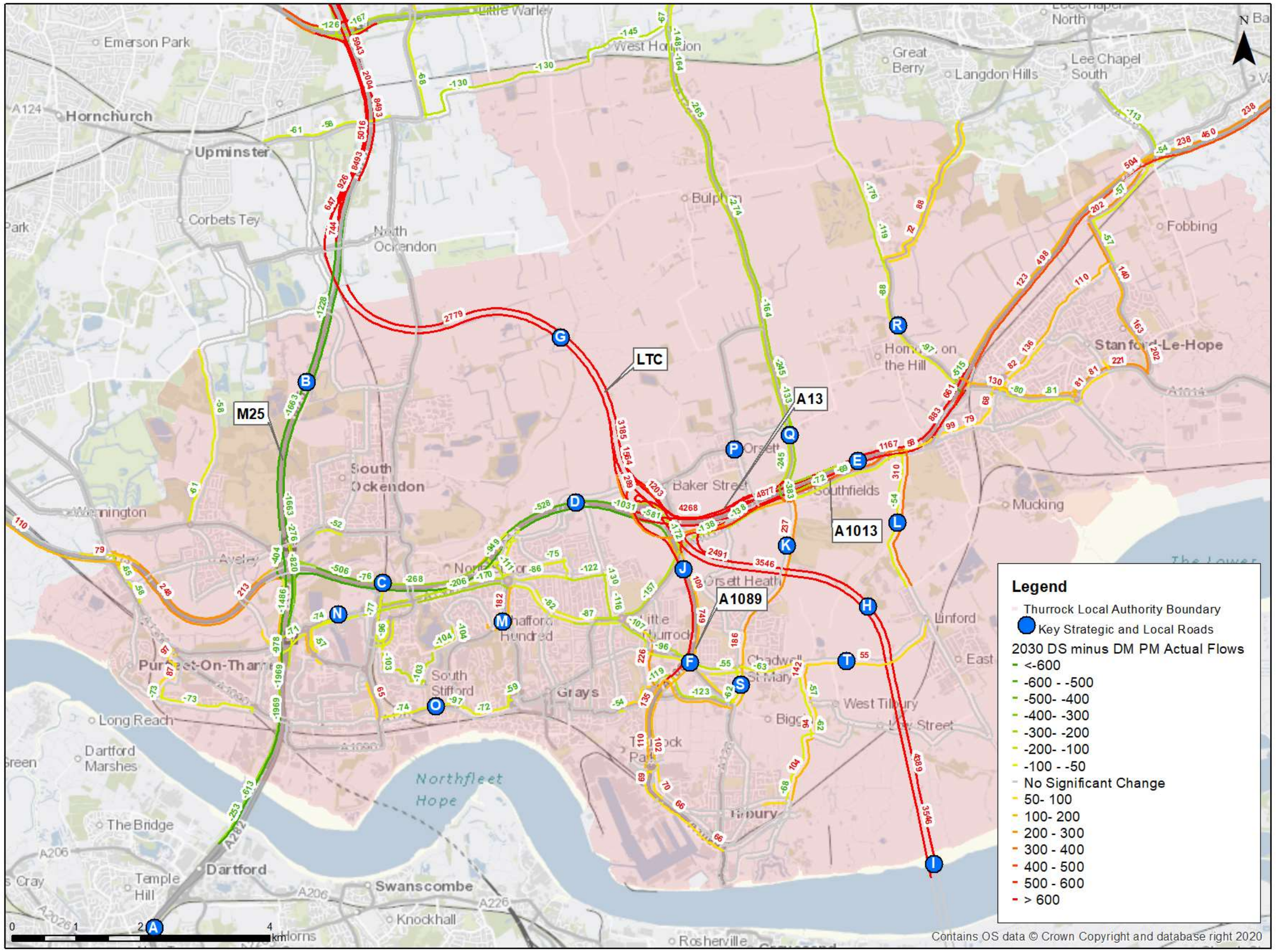


Figure F-2 2030 PM Flow changes DS – DM (DCO2v2 model)

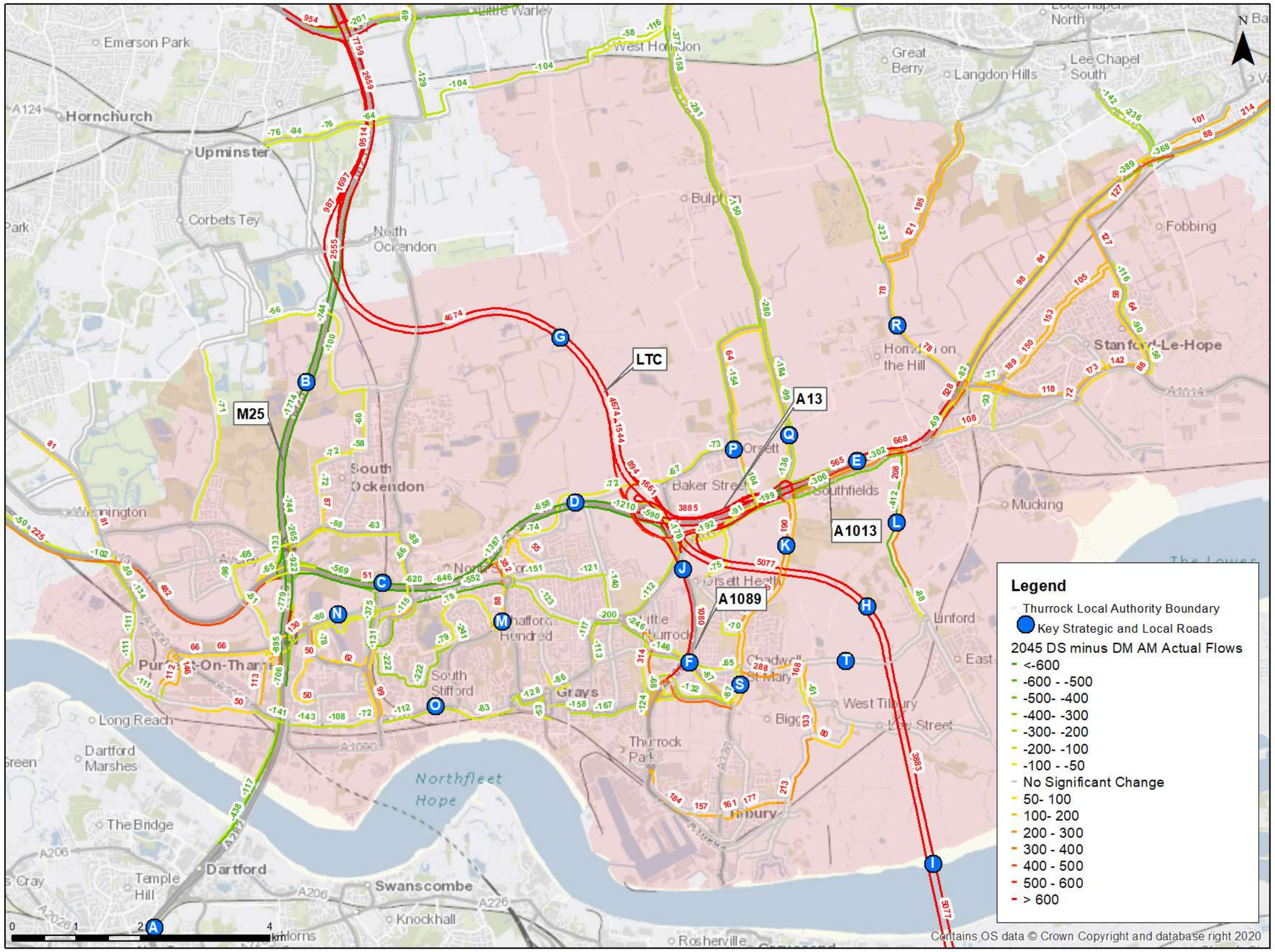


Figure F-3 2045 AM Flow changes DS – DM (DCO2v2 model)

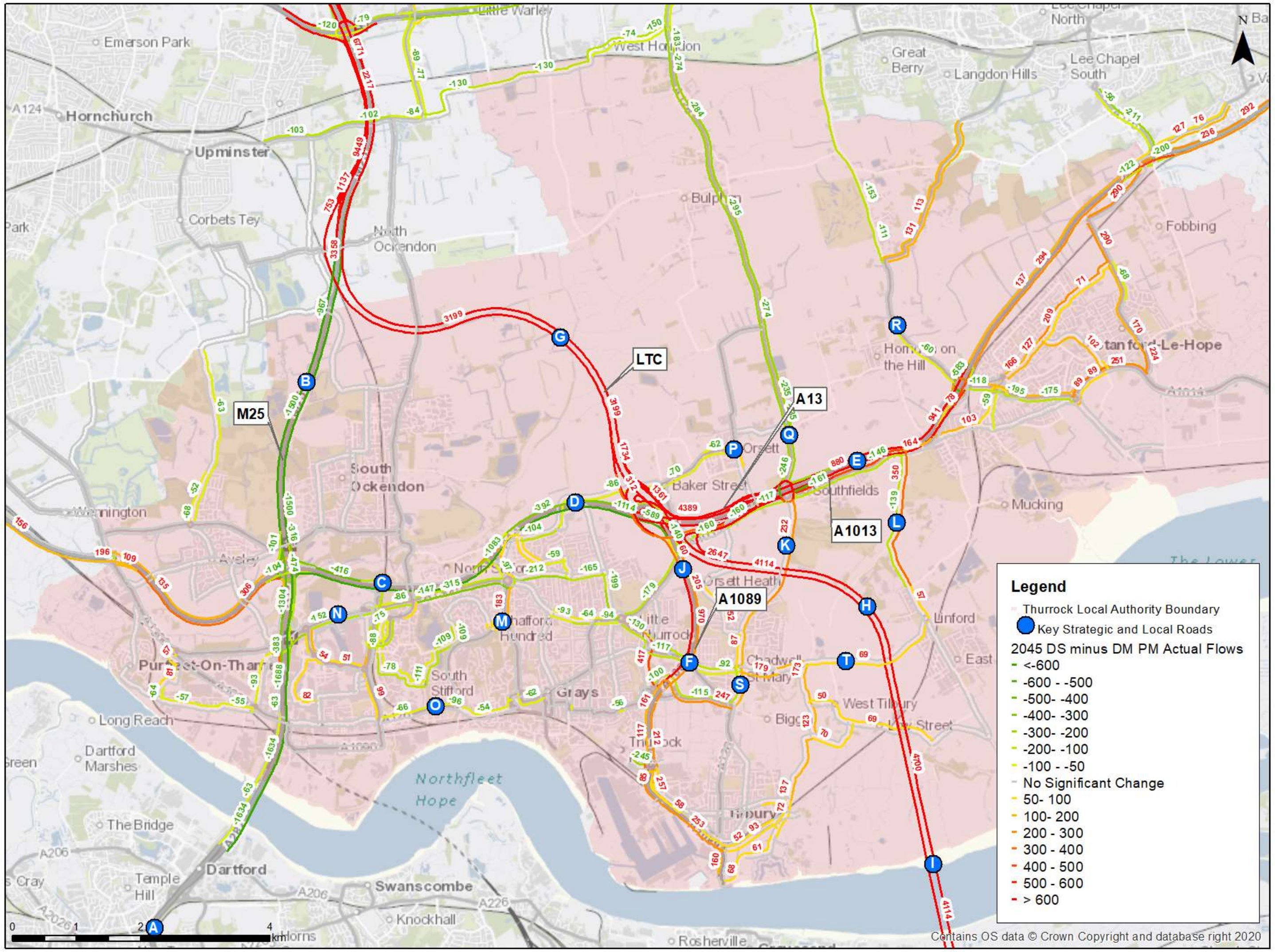


Figure F-4 2045 PM Flow changes DS – DM (DCO2V2 model)

Appendix G Link Flow Comparisons (1) DCO2v1 2029 vs DCO2v2 2030 DS Models, and (2) DCO2v1 2044 vs DCO2v2 2045 DS Models

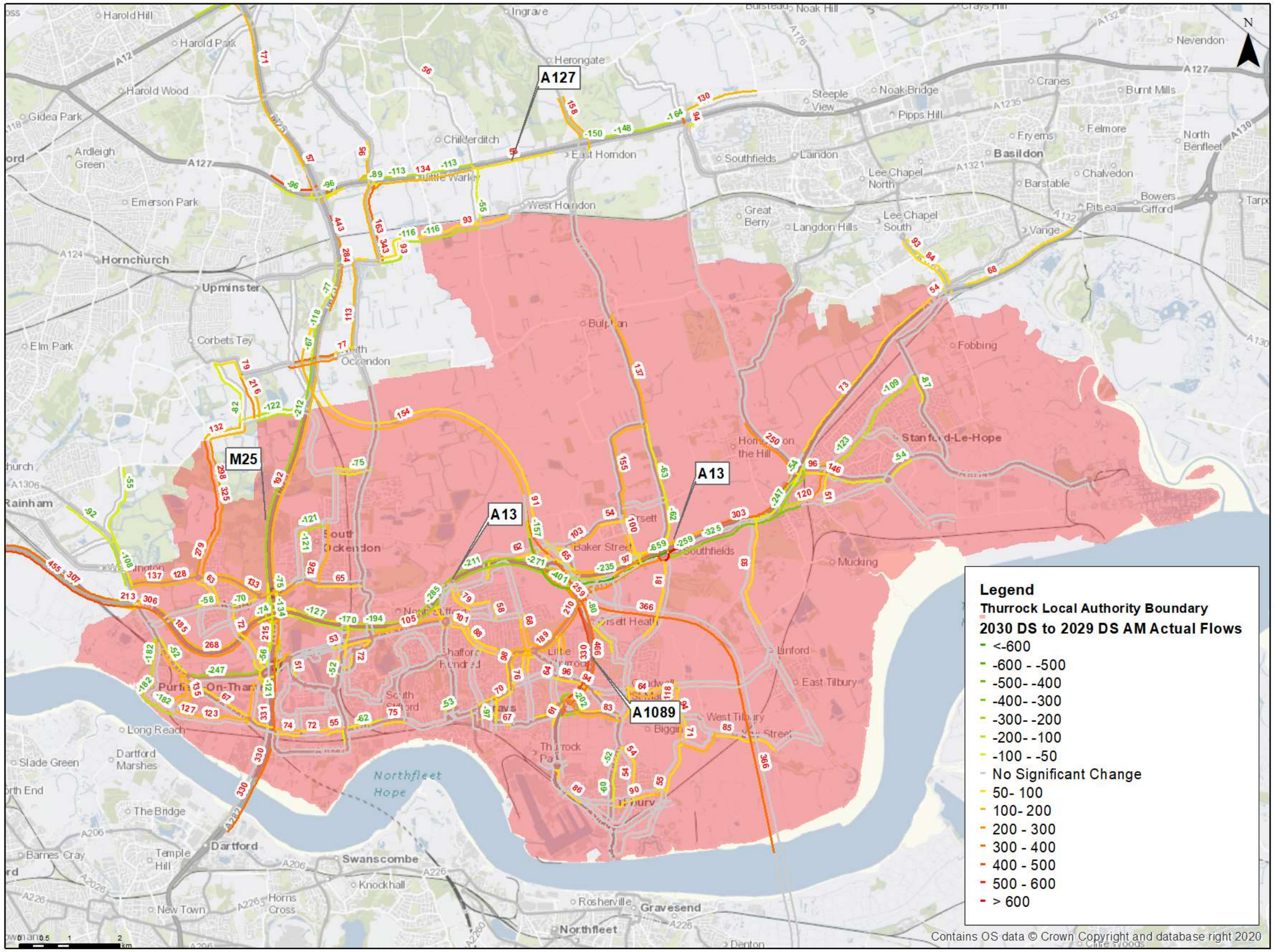


Figure G-1 DCO2v1 2029 vs DCO2v2 2030 DS AM Link Flow Difference

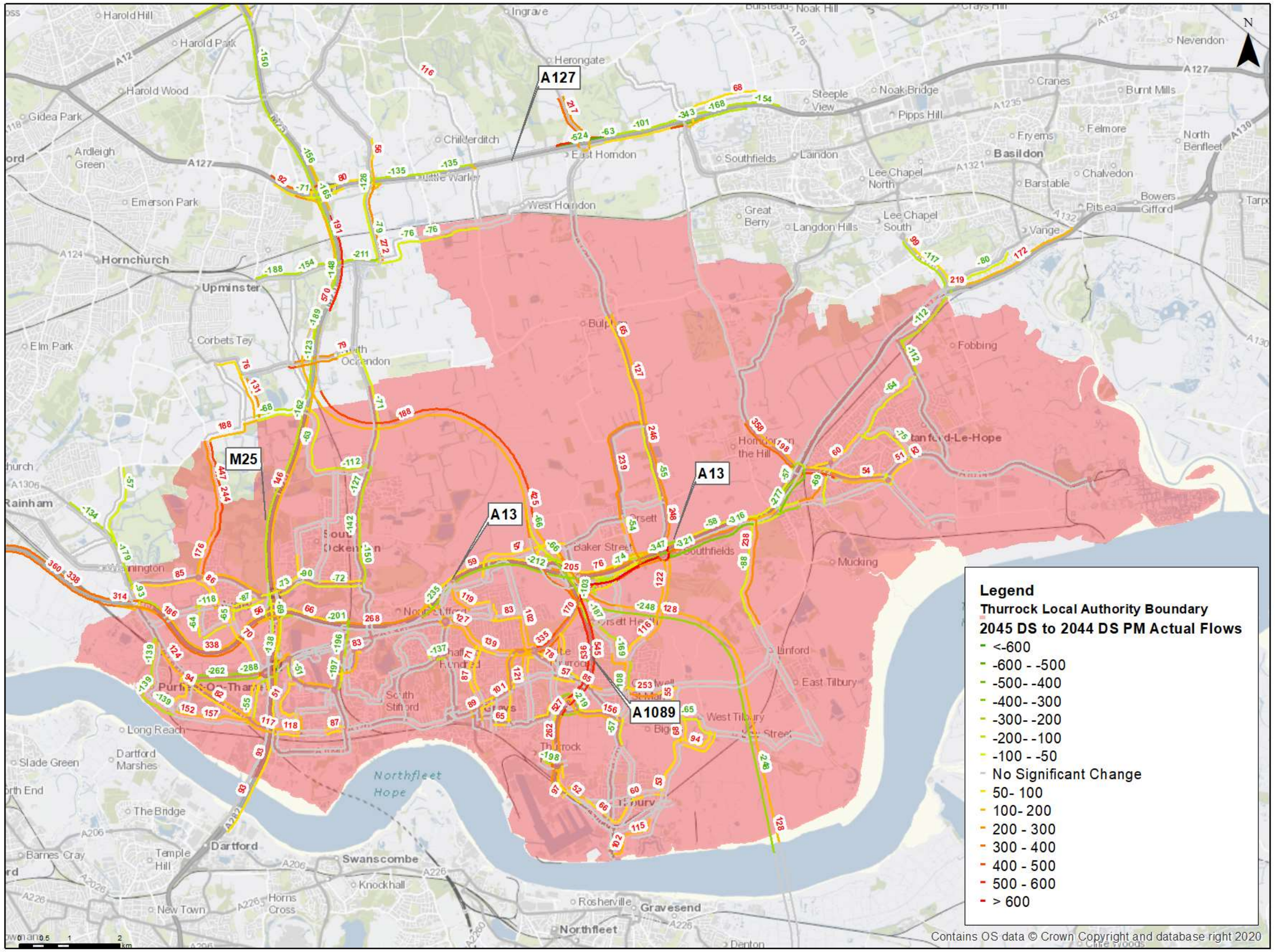


Figure G-2 DCO2v1 2029 vs DCO2v2 2030 DS PM Link Flow Difference

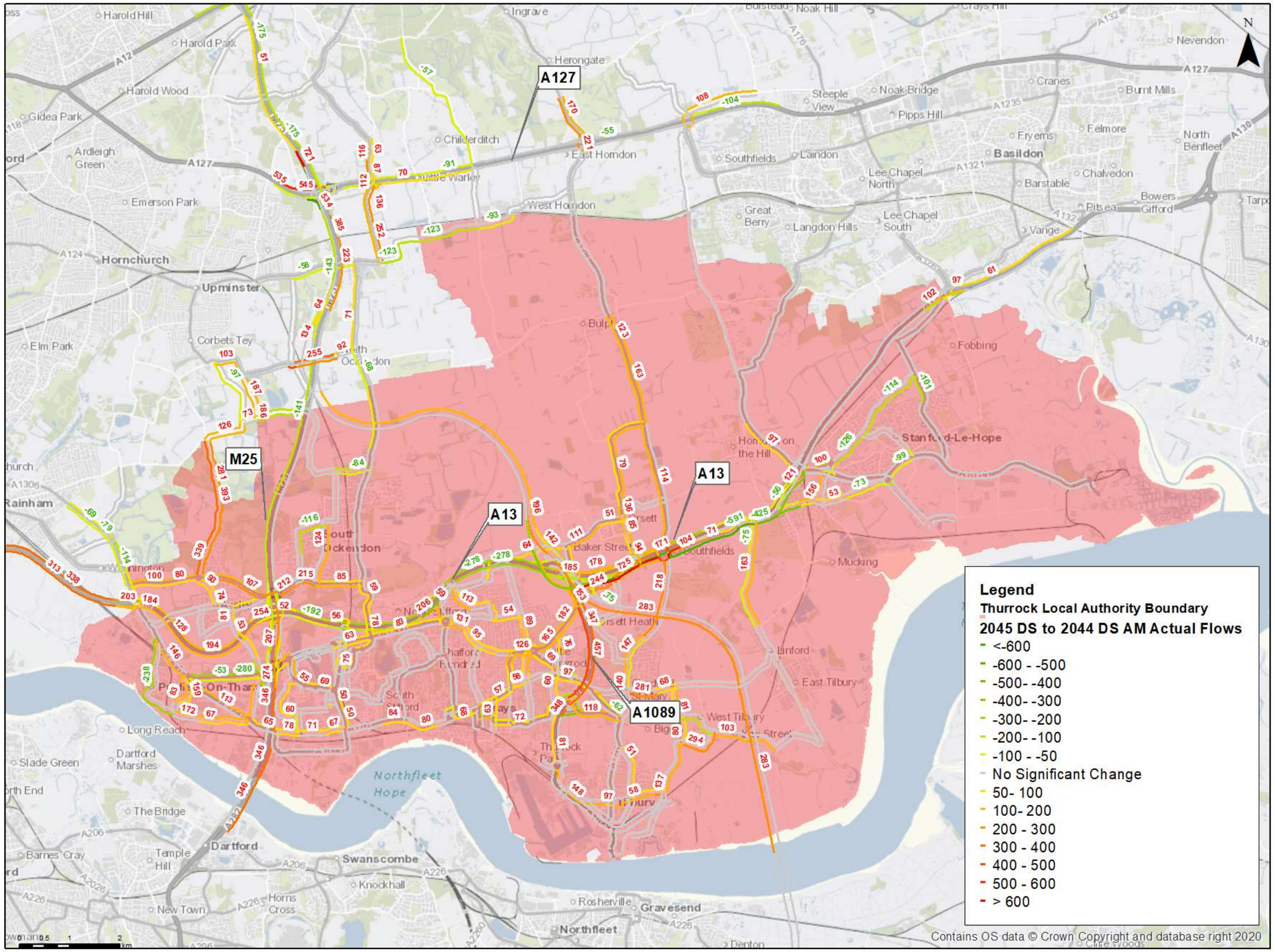


Figure G-3 DCO2v1 2044 vs DCO2v2 2045 DS AM Link Flow Difference

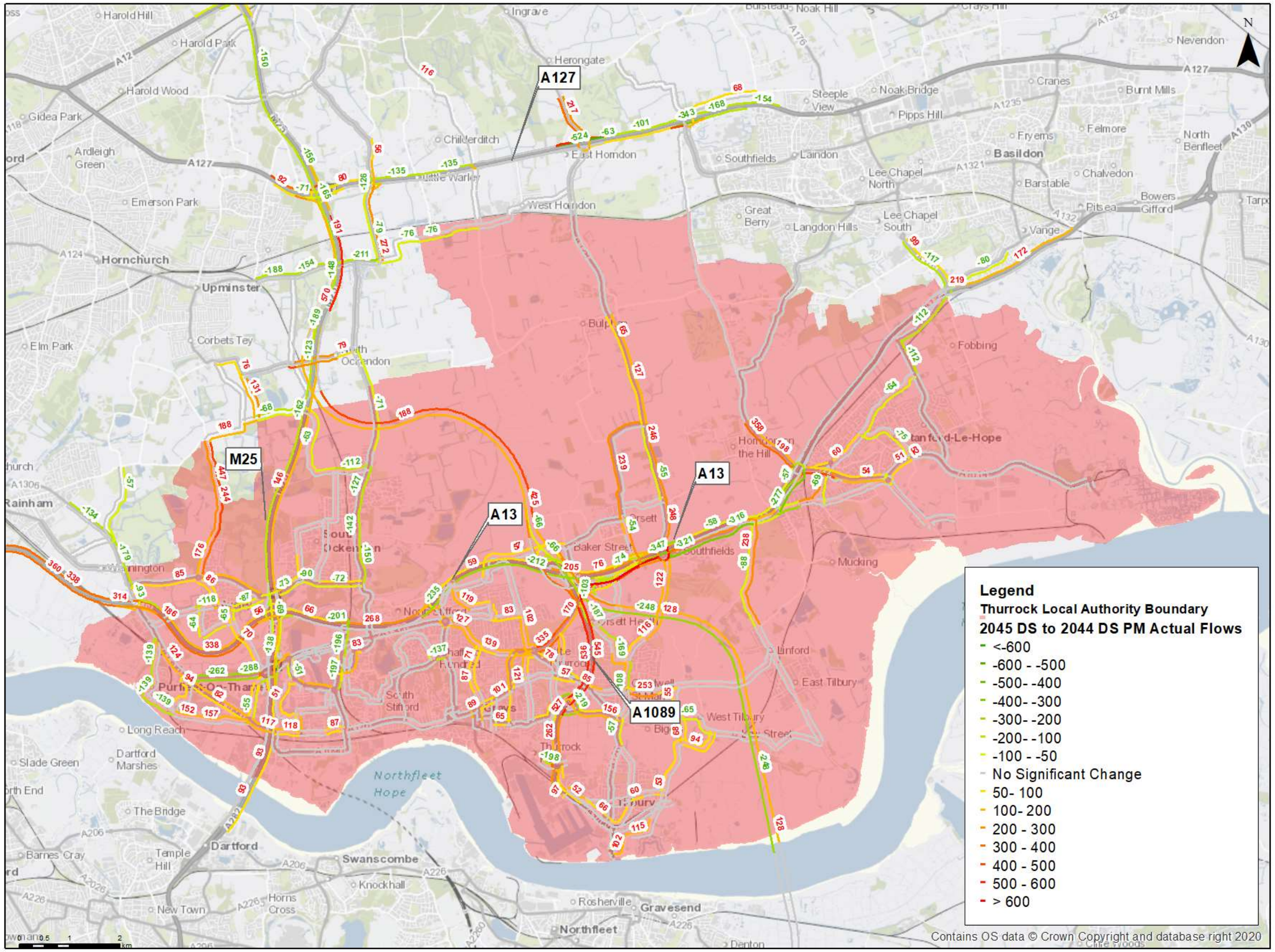


Figure G-4 DCO2v1 2044 vs DCO2v2 2045 DS PM Link Flow Difference

Appendix H Changes in Delays and V/C. DCO2v2 DM vs DCO2v2 DS

Delays Differences

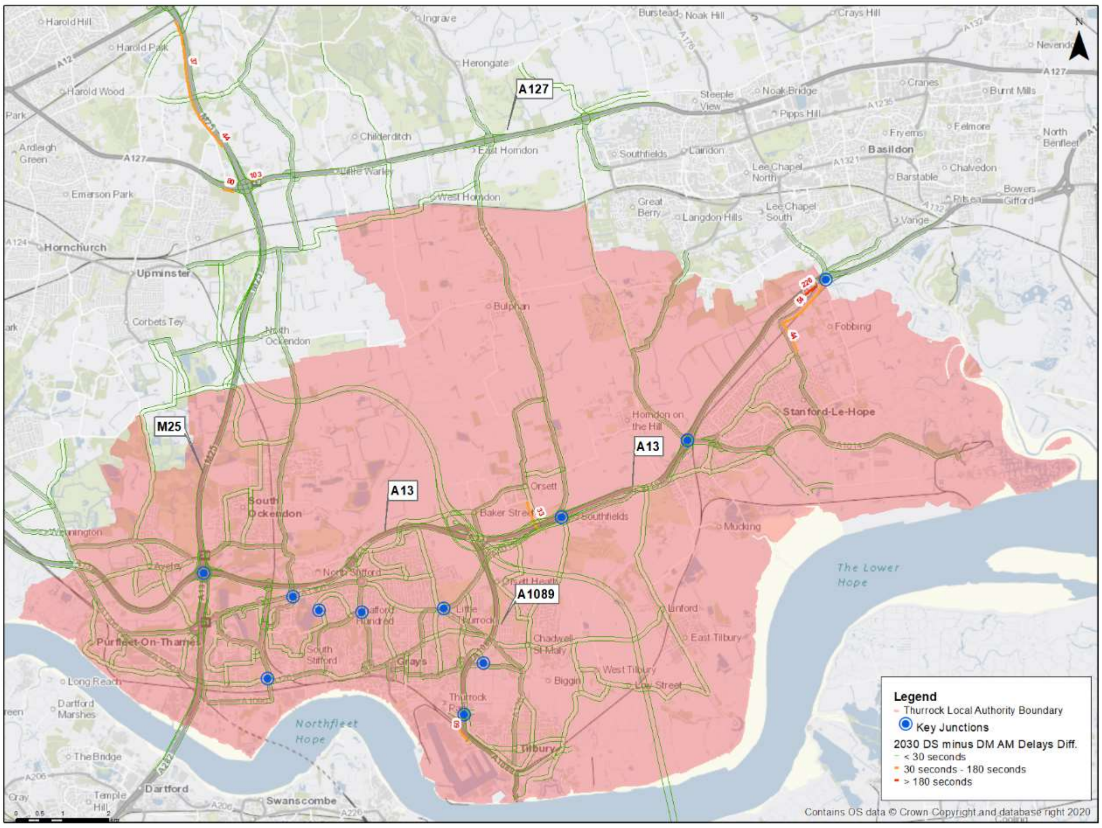


Figure H-1 Delay Difference. 2030 DCO2v2 DS minus DM. AM Peak.

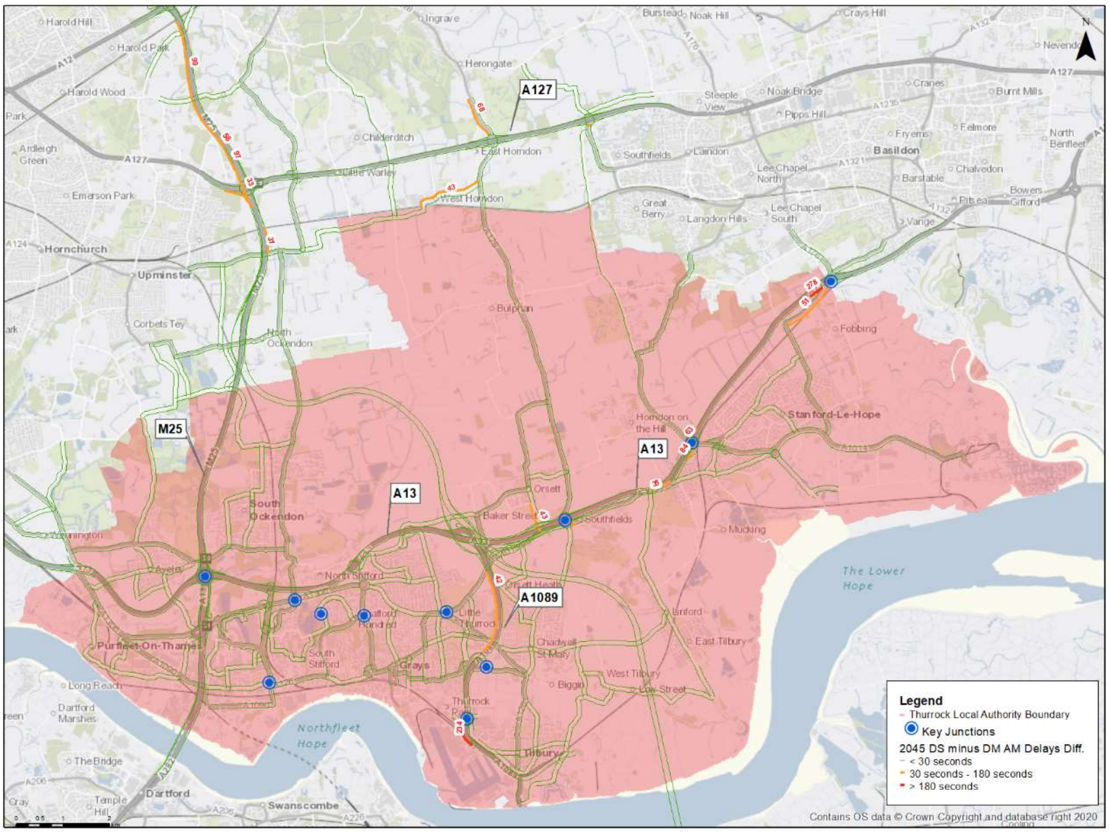


Figure H-2 Delay Difference. 2045 DCO2v2 DS minus DM. AM Peak.

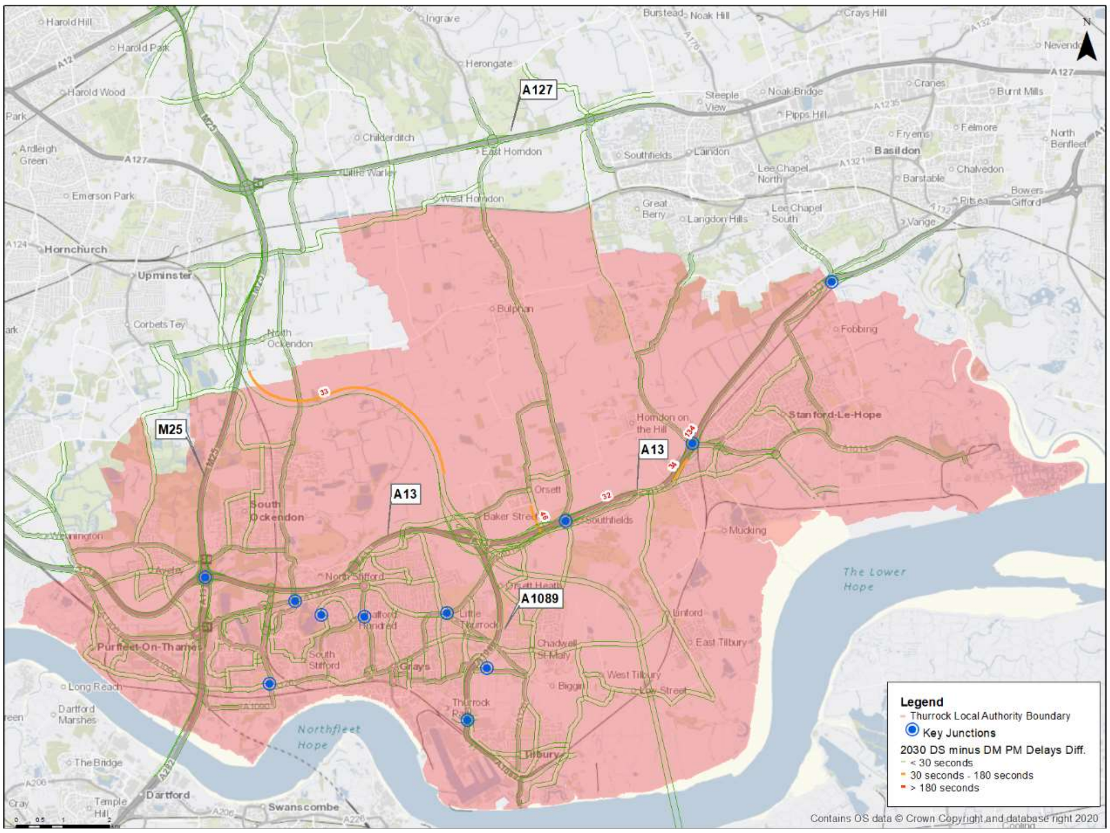


Figure H-3 Delay Difference. 2030 DCO2v2 DS minus DM. PM Peak.

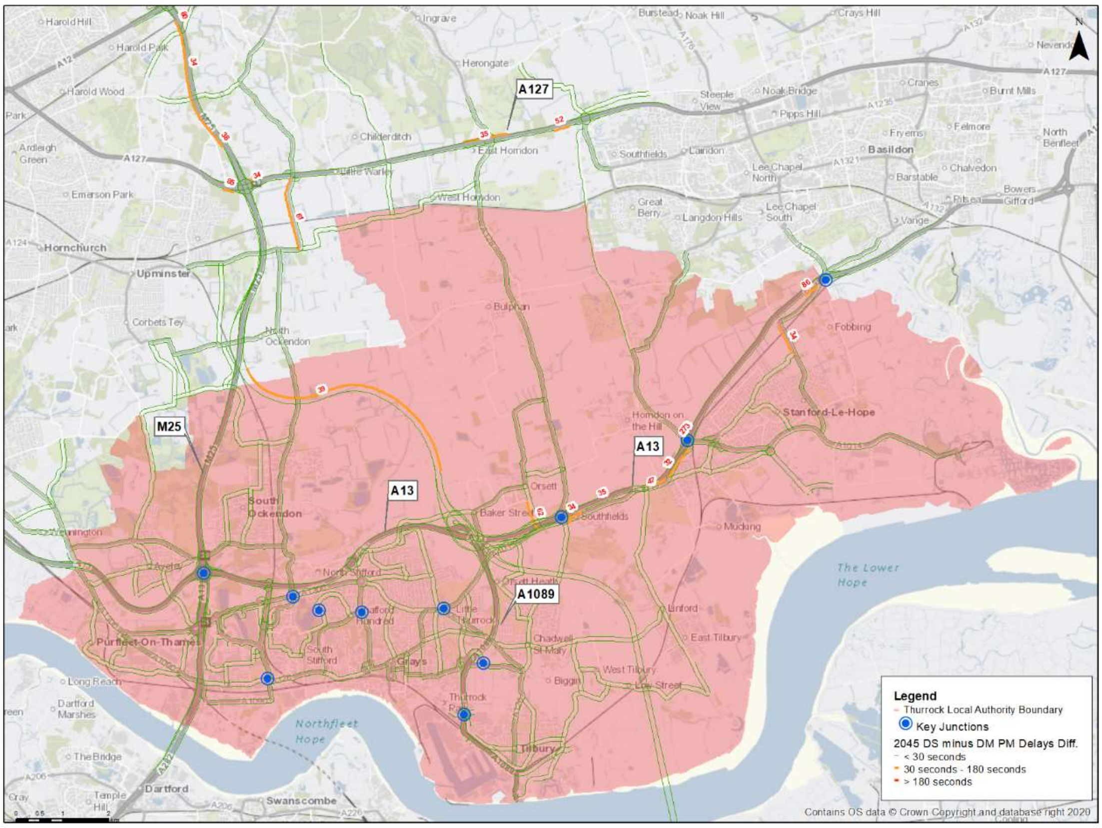


Figure H-4 Delay Difference. 2045 DCO2v2 DS minus DM. PM Peak.

Changes in V/C

* Only links with the following changes are displayed:
  - V/C is less than 100% in DM but becomes greater or equal 100% in DS
  - V/C is already greater or equal 100% in DM but further increases in DS

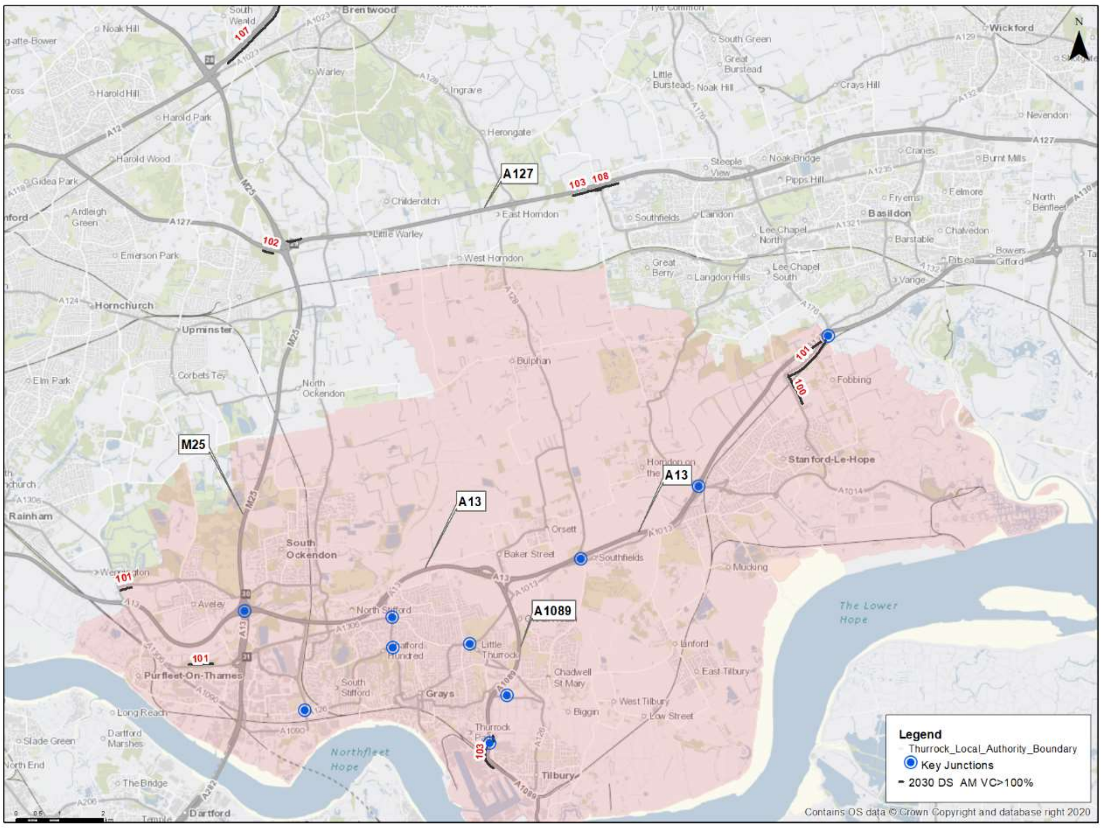


Figure H-5 V/C Difference. 2030 DCO2v2 DS minus DM. AM Peak.

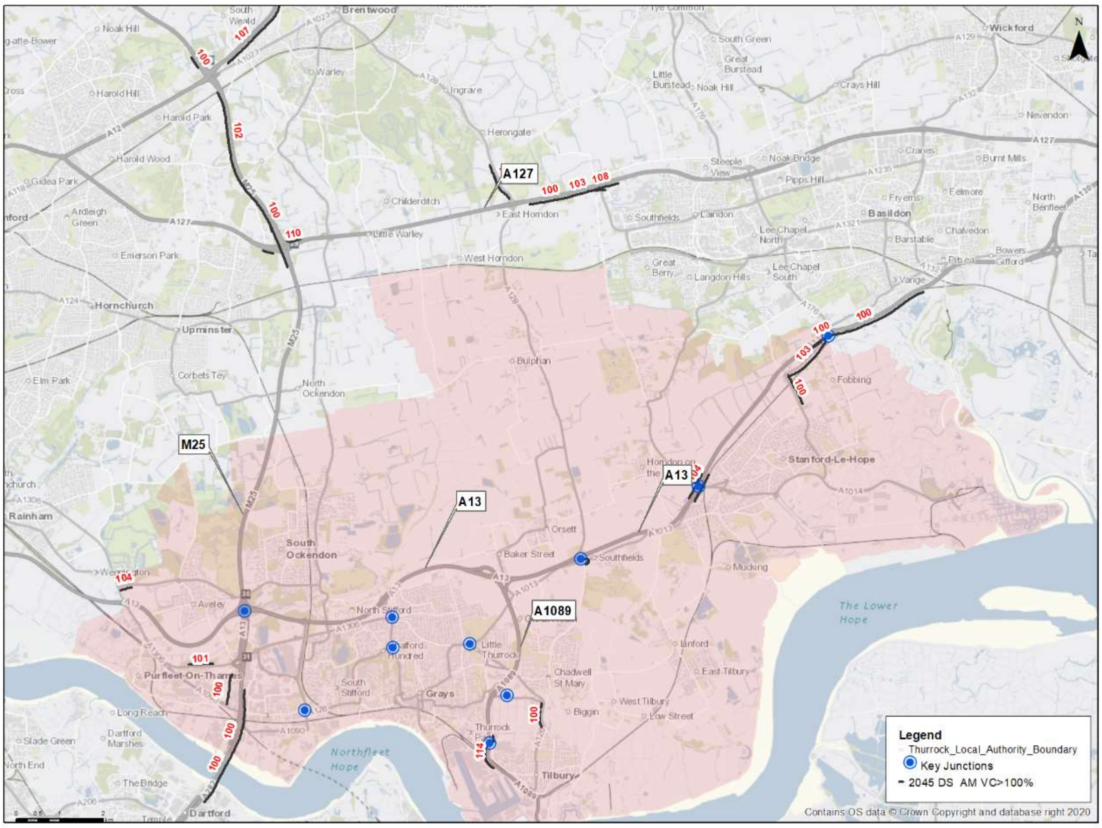


Figure H-6 V/C Difference. 2045 DCO2v2 DS minus DM. AM Peak.

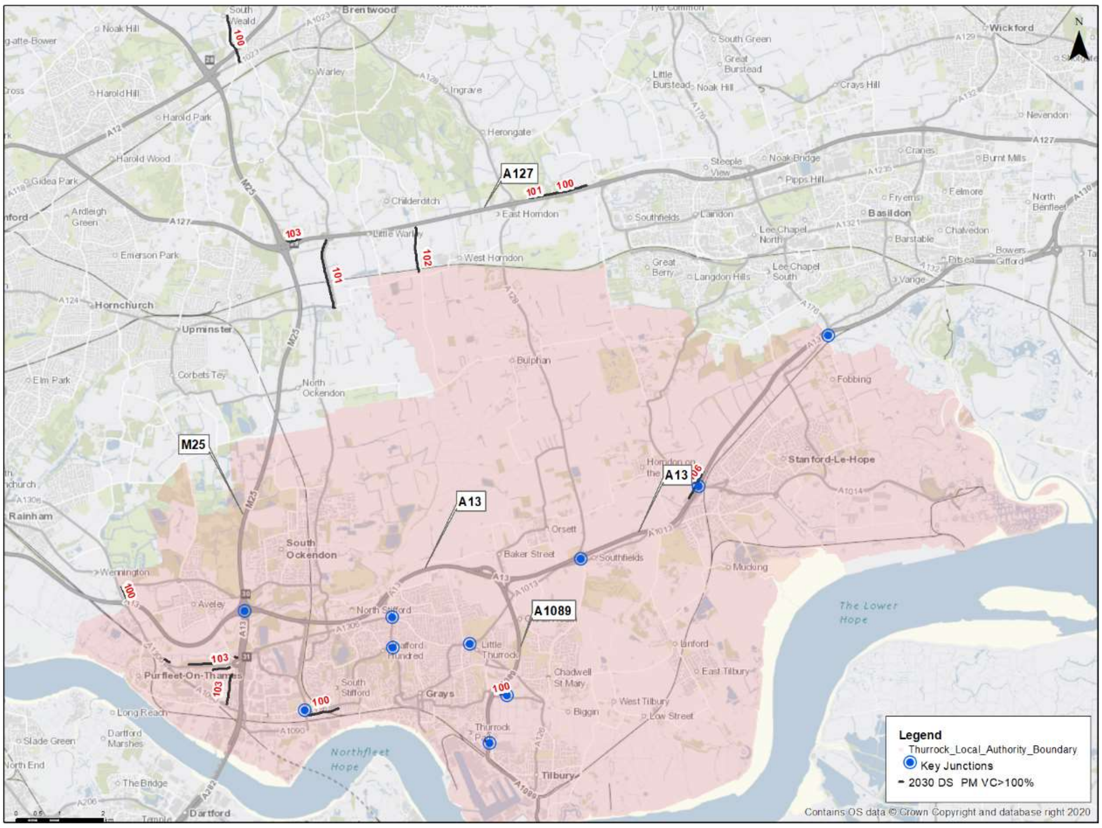


Figure H-7 V/C Difference. 2030 DCO2v2 DS minus DM. PM Peak.

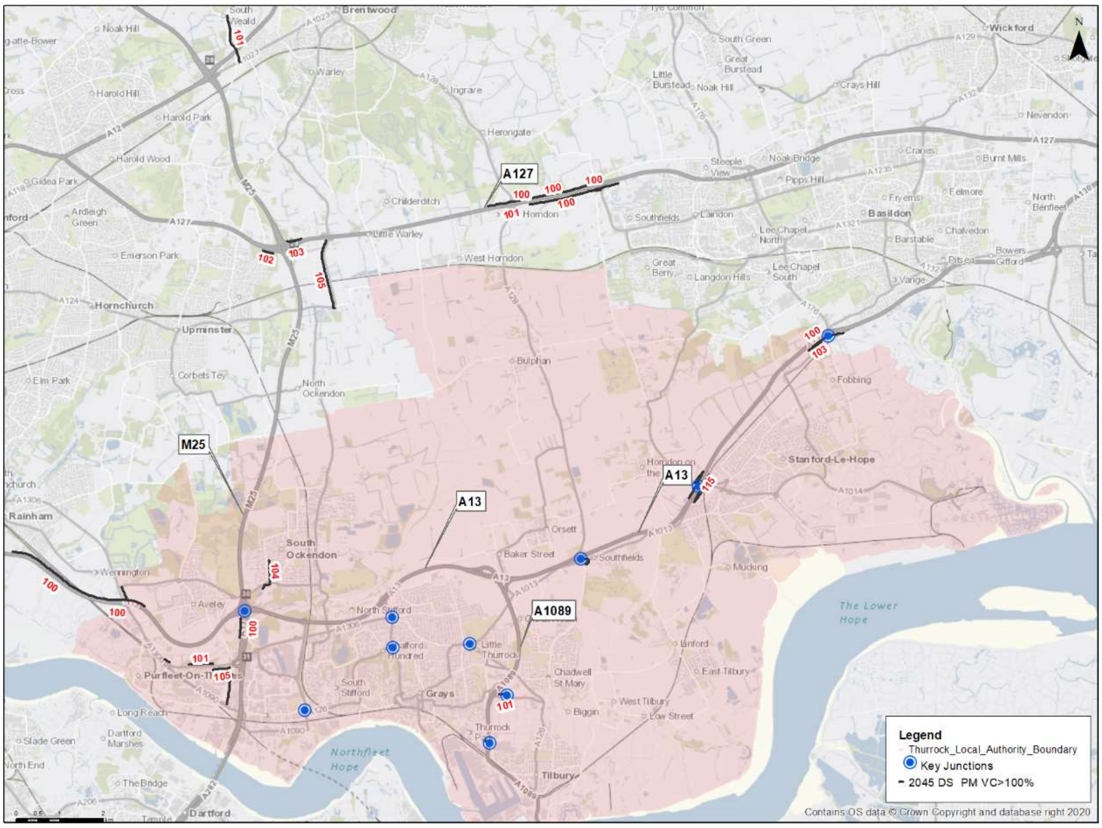


Figure H-8 V/C Difference. 2045 DCO2v2 DS minus DM. PM Peak.

Sub-annex 1.2 – Summary of Modelling Status

LTAM (Lower Thames Area Model) - Strategic Model

- Better suited to inform LTC business case, economic appraisal and strategic effects assessment
- Inadequate tool to inform and understand the operational impacts of LTC on local junctions
- Out-dated base data
- Poor local road validation
- Uses SRN peak period not LRN

Forecast Growth scenarios

- Completed based on dated guidance and assumptions

Application of Common Analytical Scenarios Framework

- Required to confirm LTC benefits/disbenefits in the context of national uncertainties

Alternative scheme layout

- Required to test adequacy of alternatives

Incident Management scenarios

- Required to substantiate resilience objective

Local Plan Growth Scenarios

- To ensure LTC does not preclude delivery of Thurrock's Local Plan

Impact arising from Thames Freeport

- To test LTC in the context of local uncertainty

Construction Impact Assessment

- To test LTC in the context of local uncertainty

Impact of Significant Events (e.g. Covid-19 pandemic)

- To confirm the assessment results are still valid

Application of the latest DfT's national travel growth forecasts using NTEM 8.0 (for car and public transport trips) and NRTP2022 (for LGV and HGV traffic)

- To confirm the assessment results are still valid

Key

- Completed and approved by the Council
- Completed but not approved
- Not completed

Local Microsimulation or Junction Modelling

- To understand operational Impacts of LTC on local junctions and local communities
- Neither of the assessment results have been agreed between NH and Thurrock

Asda Roundabout

- No modelling has been completed to assess and mitigate impacts
- Microsim modelling work is required to understand impacts of LTC

Orsett Cock

- Base Year model is complete
- Forecasts have been completed and shared with Thurrock but not signed off.
- Indicates significant capacity and safety concerns

The Manorway

- Forecast model has been produced but cannot be relied upon as it was not validated using base year flows.
- Further work is required to refine the model before the impacts can be understood

Daneholes and Marshfoot junctions

- Base Year East-West VISSIM is complete and shared with the Council.
- Forecasts have been completed but not shared with Thurrock.
- The impact of LTC on Daneholes or Marshfoot are not understood

Five Bells junction

- No modelling has been completed to assess and mitigate impacts

A1012/Devonshire Road

- No modelling has been completed to assess and mitigate impacts

Tilbury Junction

- No modelling to support future connection
- Further work is required to refine the operational junction

Known construction impacts – Local microsimulation or junction modelling is required to understand need for mitigation

The Manorway roundabout, Orsett Cock roundabout, ASDA roundabout, Daneholes roundabout, Marshfoot Road/ A1089 junction, Five Bells westbound merge with A13, A1012/Arterial Road North Stifford/Lodge Lane/ Long Lane roundabout, A1013/ Rectory Road junction, A128 Brentwood Road/ Prince Charles Avenue, A13/A1012 Gyratory in North Stifford, Grays, B149/ Chadwell Hill/ St Chads Road/ Marshfoot Road roundabout, Brentwood Road/ Heath Road, Muckingford Road/ Construction Haul Road, Southend Rd/ Lampits Hill, Station Road/ Love Lane, Stifford Road approach to B1335 Stifford Road

Sub-annex 1.3 – NH Assessment Orsett Cock Microsimulation Modelling

Attachment 1.3.1

NH document “Orsett Cock VISSIM Model Operational Assessment – 2030 & 2045 Preliminary Result”

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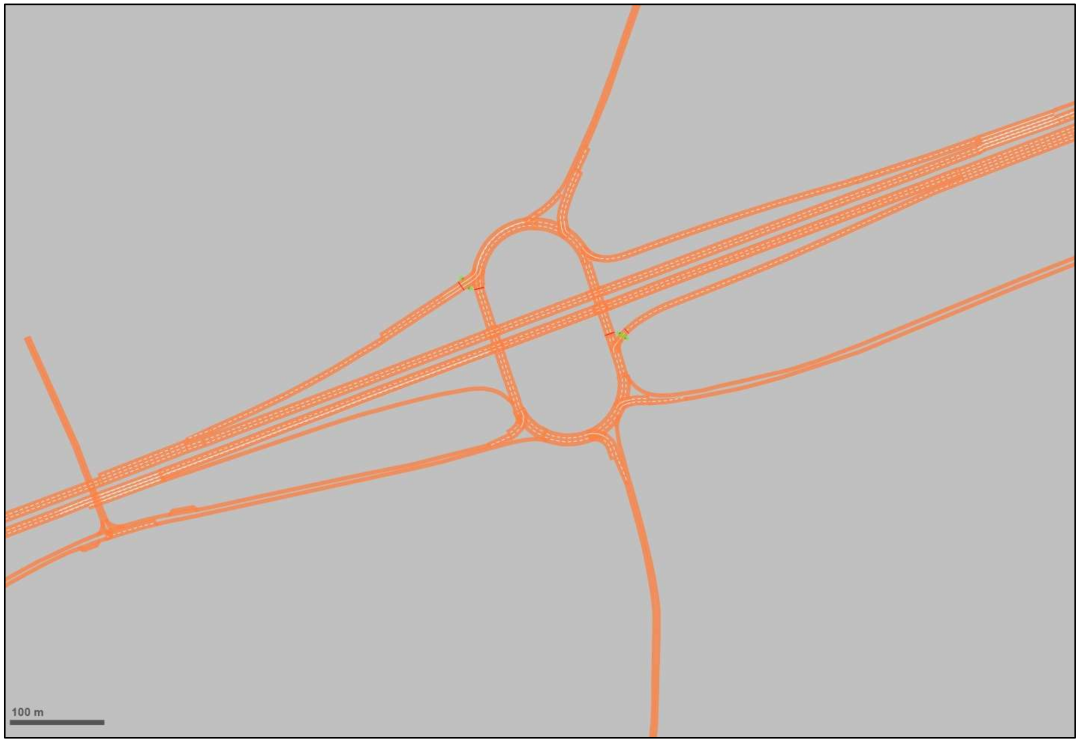
Orsett Cock VISSIM Model

Operational Assessment – 2030 & 2045 Preliminary Results

15 September 2022

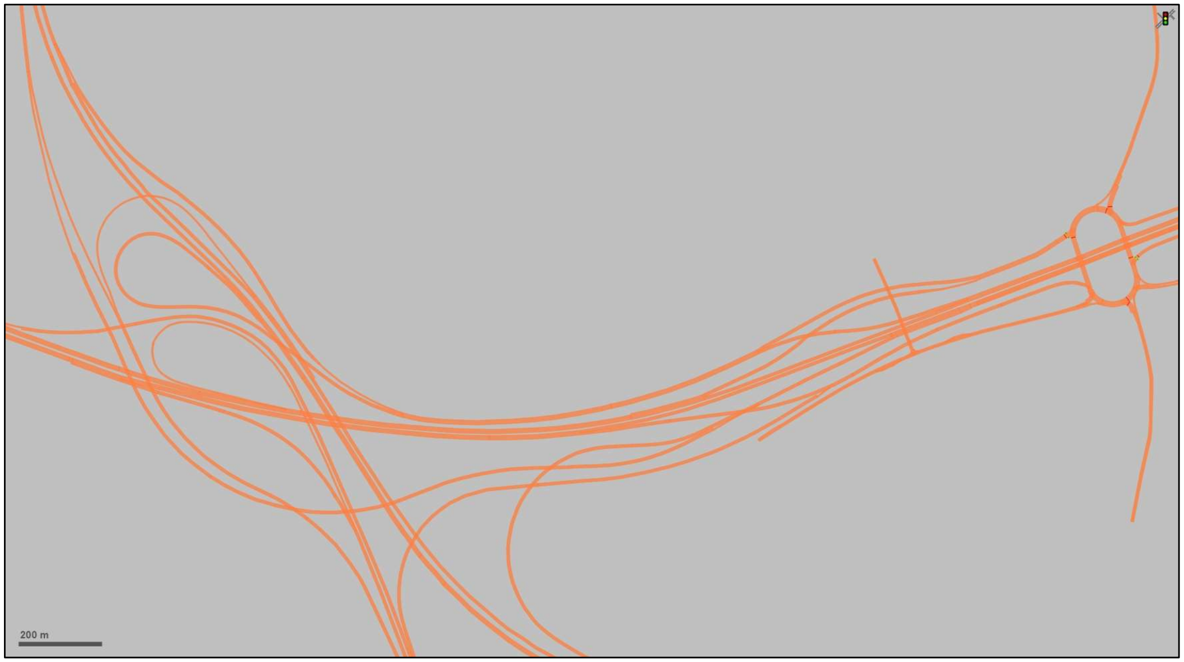
Summary of Scenarios – DM Network

- Introduction of an extra lane in both directions on the A13 east of Orsett Cock.
- Reconfiguration of the merges and diverges at the Orsett Cock junction with the A13 in both directions.
- Reconfiguration of the westbound on-slip to the A13 West with the slip road reduced to one lane.
- Reconfiguration of the A128 North approach with an extra flare lane.
- Reconfiguration of the A13 West approach (eastbound off-slip) with an extra flare lane.
- Introduction of an extra lane in the circulatory.
- Introduction of controlled pedestrian crossings and traffic signals on the A13 West and A13 East approaches.



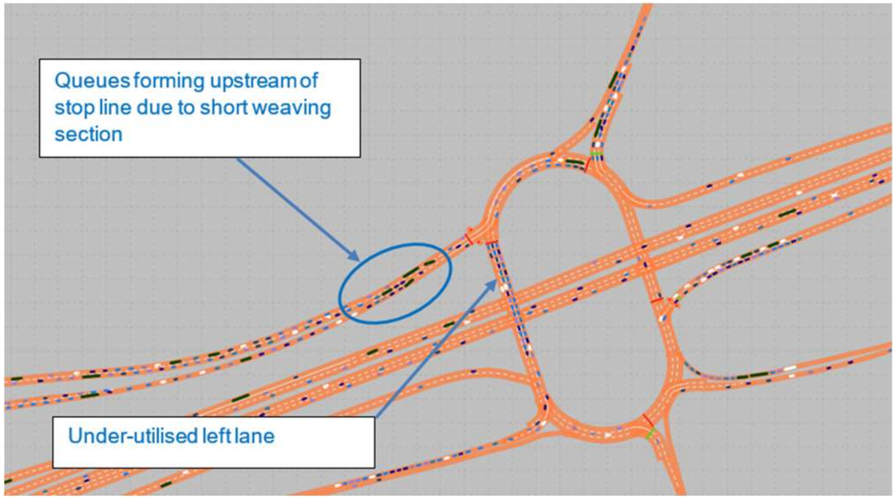
Summary of Scenarios – DS Network

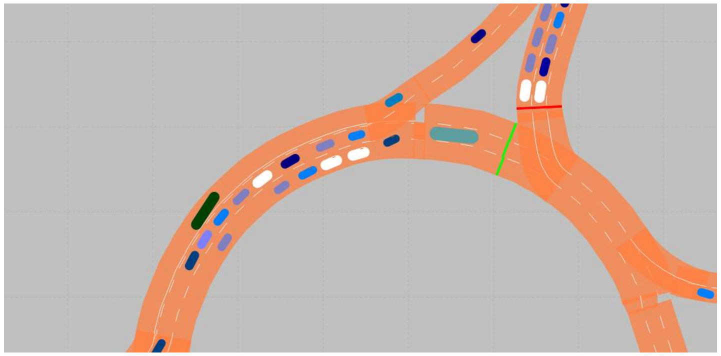
- Introduction of new LTC links around the A13/ A1089 interchange.
- Reconfiguration of A13/ A1089 interchange.
- Reconfiguration of slip roads on the A13 west of Orsett Cock.
- Realignment of A1013 (West) Stanford Road.
- Introduction of traffic signals on the A128 North and A128 South approaches at Orsett Cock.
- Reconfiguration of the A1013/ Rectory Road junction.



Initial Visual Observations

- DS models indicated that the traffic behaviour upstream of the traffic signals at the A13 West approach and the circulatory, were impacting the efficiency of these traffic signals.
- A large number of vehicles from LTC need to be in the middle and right-hand lanes, while a lot of traffic from the A13 need to use the middle and left-hand lanes for the A128 (N) exit. This causes a bottleneck upstream of the stop line, impacting the efficiency of these traffic signals with queues extending to the A13 mainline.
- The volume of traffic travelling from the circulatory to the A128 (N) is relatively low in comparison to other movements, resulting in the left lane being under-utilized.
- Traffic travelling from the right-hand lane on the western over bridge need to change to the middle lane for the A13 (E) exit. This causes delays upstream of the stop line.





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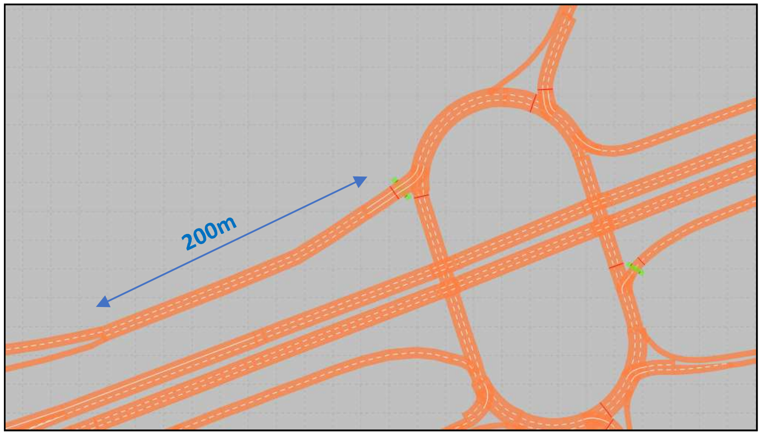
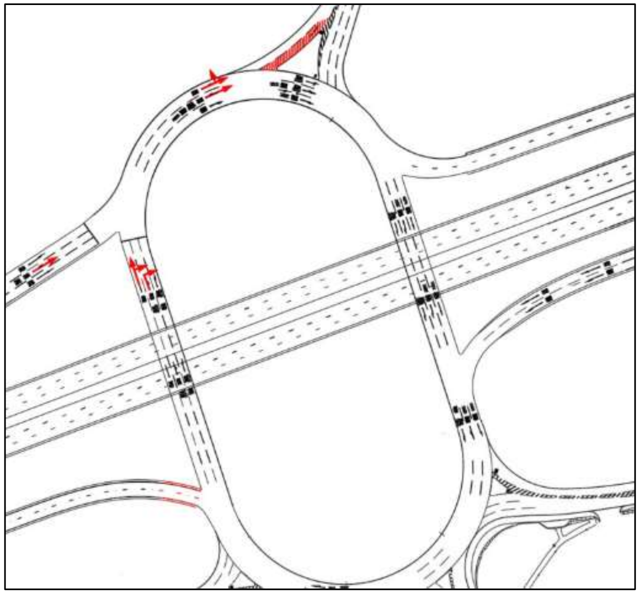
Provisional Improvements for DS



- Increased the modelled length of the section where traffic from LTC and the A13 merges on the A13 West approach, from 90m to 200m.
- Modified Lane Markings at A128 (N) exit to achieve a more even spread in lane usage on the western overbridge and avoid traffic changing lanes in the northern circulatory for the A13 (E) exit.
- The westbound on-slip on the A13 West exit is one lane in the DM network. This has been modified to two lanes in the DS network so as to tie in with the LTC design which has two lanes on the slip road.



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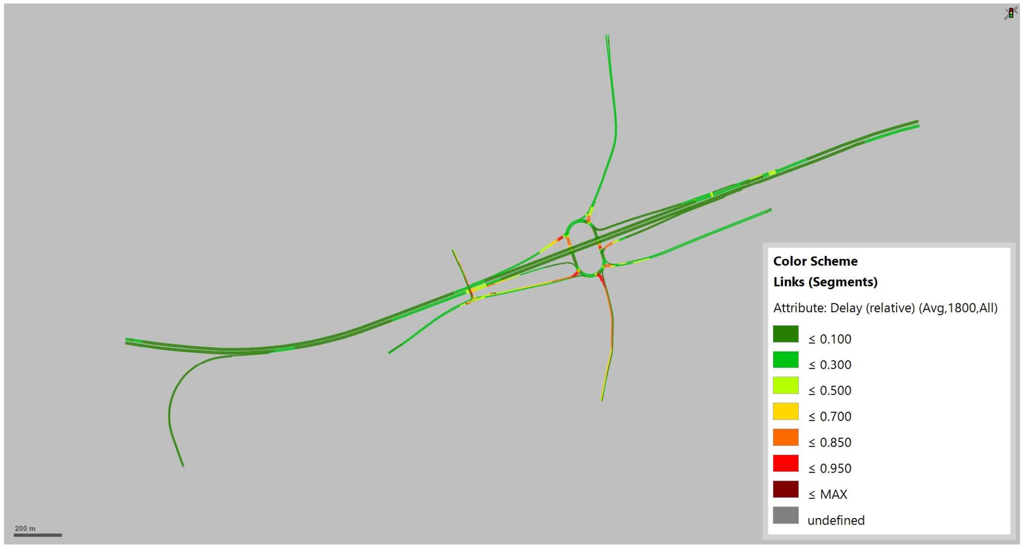
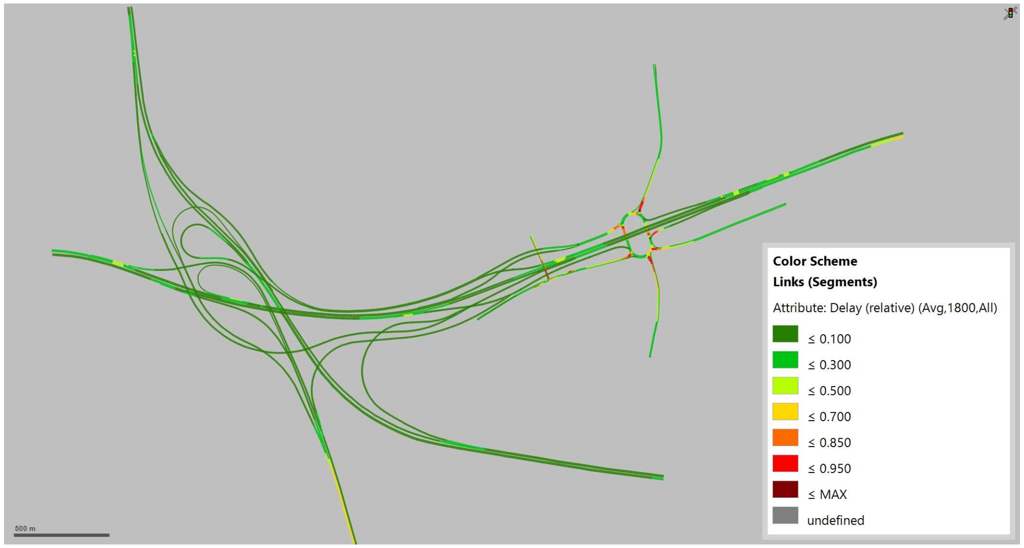
Delay Plots 2030 7.00 – 8.00

- DM



- DS



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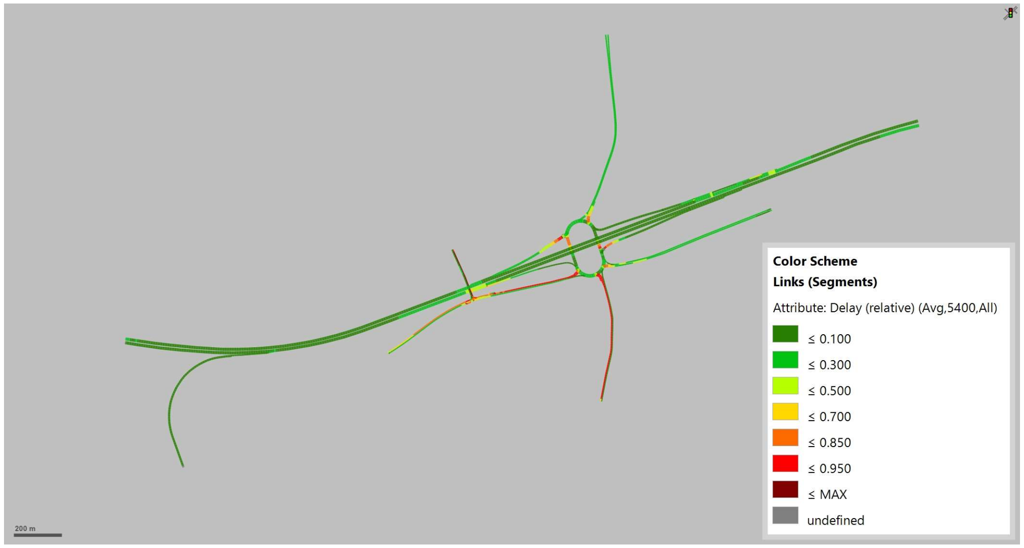
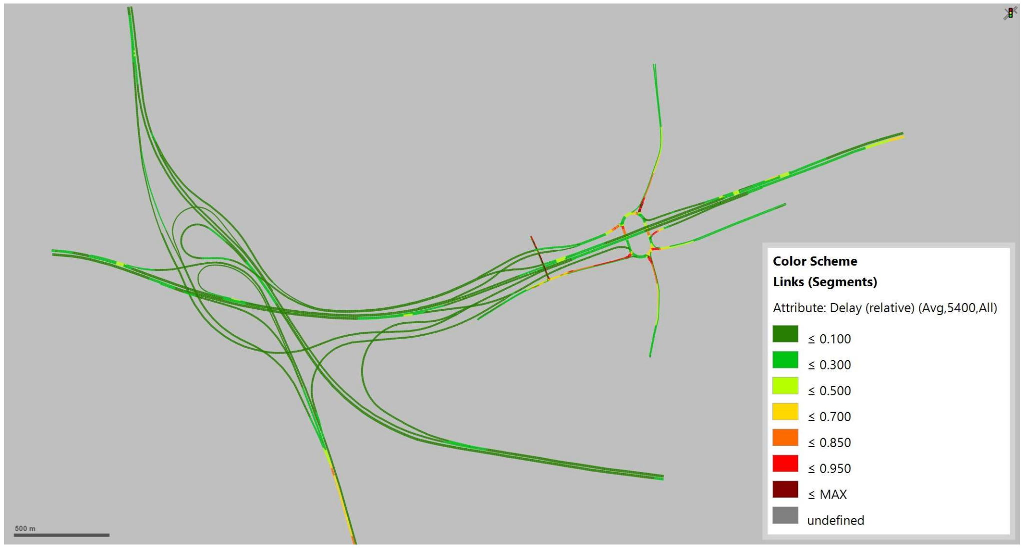
Delay Plots 2030 8.00 – 9.00

- DM



- DS



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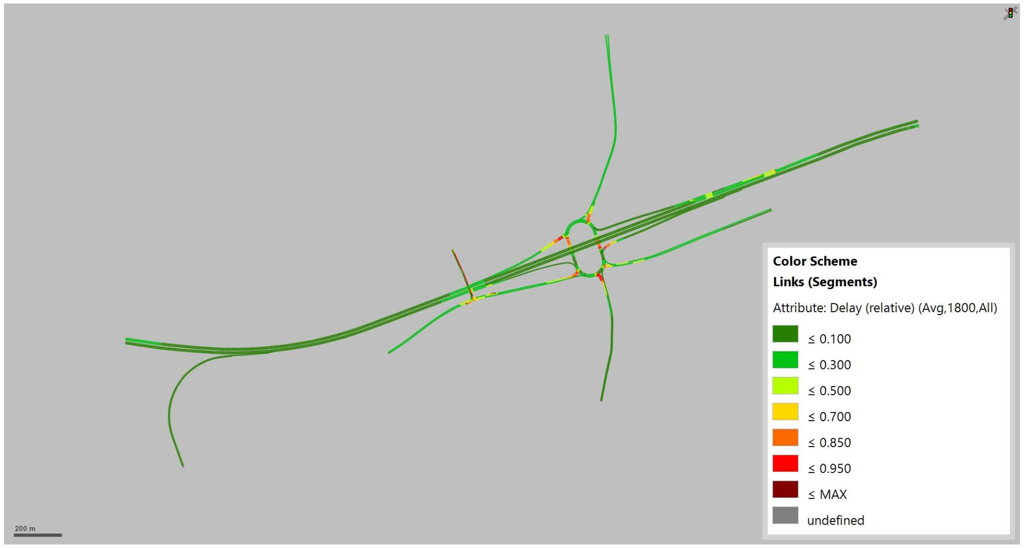
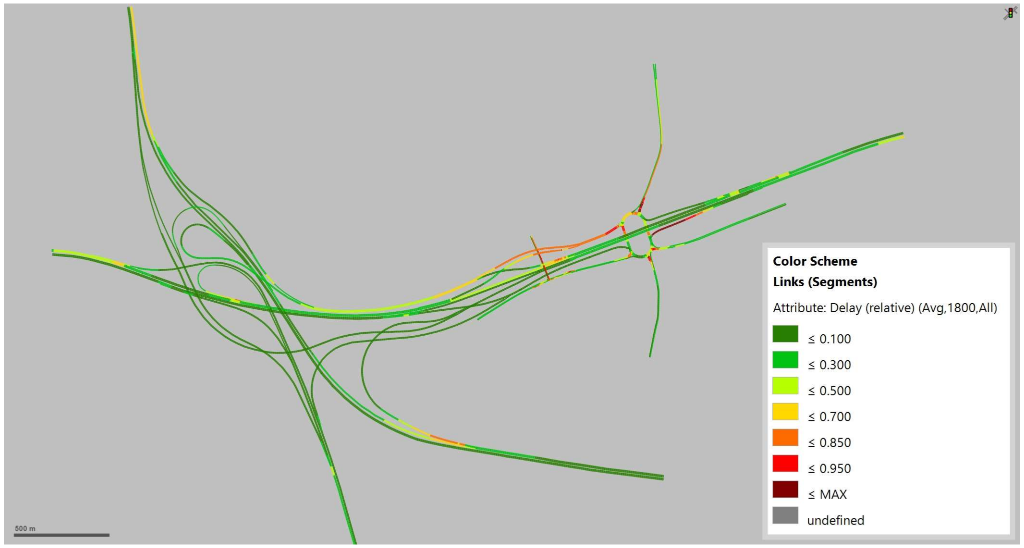
Delay Plots 2030 17.00 – 18.00

- DM



- DS



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Traffic Condition Analysis (2030)

- Average delays* and queues in AM Peak

* It is the average of all delays originating from the approach along all possible routes

AM peak 7.00 - 8.00										
Junction	Approach	Avg. Delay per veh [s]			Diff [s]	Mean Max. Queue [m]			Diff [m]
		2016 Base	2030 DM	2030 DS		2016 Base	2030 DM	2030 DS	
Orsett Cock	A128 Brentwood Rd (North)	13	22	86	65	37	25	120	94
	A13 (East)	2	4	36	32	37	59	54	-5
	A1013 Stanford Rd (East)	47	18	48	31	114	33	75	42
	A128 Brentwood Rd (South)	40	73	74	1	55	226	136	-90
	A1013 Stanford Rd (West)	46	63	70	7	97	174	84	-89
	A13 (West)	10	3	7	4	93	38	62	24
A1013 Stanford Road / Rectory Road	Rectory Rd	9	23	52	30	13	56	65	9
	Stanford Rd (East)	6	5	8	2	10	13	41	27
	Stanford Rd (West)	3	3	3	0	-	-	-	

AM peak 8.00 - 9.00									
Junction	Approach	Avg. Delay per veh [s]			Diff [s]	Mean Max. Queue [m]			Diff [m]
		2016 Base	2030 DM	2030 DS		2016 Base	2030 DM	2030 DS	
Orsett Cock	A128 Brentwood Rd (North)	23	24	144	120	51	31	285	254
	A13 (East)	6	4	37	33	47	56	55	-1
	A1013 Stanford Rd (East)	94	17	59	42	153	31	71	40
	A128 Brentwood Rd (South)	207	93	93	0	127	506	173	-333
	A1013 Stanford Rd (West)	59	104	174	71	109	473	387	-86
	A13 (West)	11	3	8	5	85	38	67	29
A1013 Stanford Road / Rectory Road	Rectory Rd	11	74	301	228	16	223	244	21
	Stanford Rd (East)	8	7	10	3	13	31	58	27
	Stanford Rd (West)	3	39	13	-26	-	-	-	

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Traffic Condition Analysis (2030)

- Average delays* and queues in PM Peak

PM peak 17.00 - 18.00										
Junction	Approach	Avg. Delay per veh [s]			Diff [s]	Mean Max. Queue [m]			Diff [m]
		2016 Base	2030 DM	2030 DS		2016 Base	2030 DM	2030 DS	
Orsett Cock	A128 Brentwood Rd (North)	51	26	156	130	88	36	383	347
	A13 (East)	10	3	295	292	87	47	222	176
	A1013 Stanford Rd (East)	22	15	42	28	34	19	40	22
	A128 Brentwood Rd (South)	13	39	57	17	19	37	43	5
	A1013 Stanford Rd (West)	30	42	64	22	135	71	46	-25
	A13 (West)	29	3	25	21	467	37	673	636
A1013 Stanford Road / Rectory Road	Rectory Rd	21	32	154	122	34	142	148	6
	Stanford Rd (East)	6	6	13	6	10	22	73	52
	Stanford Rd (West)	4	3	5	2	-	-	-	

* It is the average of all delays originating from the approach along all possible routes

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Traffic Condition Analysis (2030)

- Journey Times AM 7.00 – 8.00

Peak	Route	DM [s]	DS [s]	Diff [s]
AM 07:00-08:00	1-->2	123	189	66
	1-->3	118	182	64
	1-->4	107	172	65
	1-->5	125	195	70
	1-->6	196	242	46
	1-->8	175	244	69
	2-->1	160	184	24
	2-->3	100	111	11
	2-->4	89	101	12
	2-->5	107	124	17
	2-->6	118	120	2
	2-->8	131	173	42
	3-->1	143	180	37
	3-->2	160	210	49
	3-->4	72	97	25
	3-->5	90	119	30
	3-->6	161	167	6
	3-->8	140	169	29
	4-->1	206	180	-26
	4-->2	223	209	-13
	4-->3	218	203	-15
	4-->5	152	119	-33
	4-->6	224	167	-57
	4-->8	203	169	-34
	5-->1	167	156	-11
	5-->2	184	185	1
	5-->3	179	179	0
	5-->4	168	169	1
	5-->6	185	143	-42
	5-->8	164	145	-19
	6-->1	153	150	-4
	6-->2	122	126	4
	6-->3	165	173	7
	6-->4	155	163	8
	6-->5	172	185	13
	6-->8	222	235	12

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Traffic Condition Analysis (2030)

- Journey Times AM 8.00 – 9.00

Peak	Route	DM [s]	DS [s]	Diff [s]
AM 08:00-09:00	1-->2	125	248	123
	1-->3	121	239	118
	1-->4	109	229	119
	1-->5	128	253	125
	1-->6	190	299	109
	1-->8	169	301	133
	2-->1	161	186	26
	2-->3	100	115	14
	2-->4	89	105	16
	2-->5	108	129	21
	2-->6	117	120	3
	2-->8	130	177	48
	3-->1	142	186	44
	3-->2	159	219	59
	3-->4	71	105	34
	3-->5	90	129	39
	3-->6	151	175	24
	3-->8	130	177	47
	4-->1	274	189	-85
	4-->2	292	222	-70
	4-->3	287	213	-75
	4-->5	222	132	-90
	4-->6	283	178	-105
	4-->8	262	180	-82
	5-->1	272	259	-13
	5-->2	289	291	3
	5-->3	285	282	-2
	5-->4	273	272	-1
	5-->6	280	248	-33
	5-->8	259	250	-9
	6-->1	154	152	-1
	6-->2	122	126	4
	6-->3	167	176	9
	6-->4	155	166	11
	6-->5	174	190	16
	6-->8	215	238	24

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Traffic Condition Analysis (2030)

- Journey Times PM 17.00 – 18.00

Peak	Route	DM [s]	DS [s]	Diff [s]
PM 17:00-18:00	1-->2	134	286	152
	1-->3	131	271	140
	1-->4	116	258	143
	1-->5	134	282	148
	1-->6	185	322	138
	1-->8	164	326	162
	2-->1	161	491	330
	2-->3	103	413	309
	2-->4	88	400	312
	2-->5	107	424	317
	2-->6	114	118	4
	2-->8	127	468	342
	3-->1	139	178	39
	3-->2	163	225	62
	3-->4	66	88	22
	3-->5	85	111	27
	3-->6	135	152	17
	3-->8	114	156	41
	4-->1	136	163	27
	4-->2	160	210	50
	4-->3	157	195	37
	4-->5	82	96	14
	4-->6	132	137	4
	4-->8	111	140	29
	5-->1	130	145	14
	5-->2	155	191	37
	5-->3	152	176	25
	5-->4	136	164	27
	5-->6	127	118	-9
	5-->8	106	122	16
	6-->1	149	228	79
	6-->2	124	149	25
	6-->3	171	259	89
	6-->4	155	247	92
	6-->5	174	271	97
	6-->8	204	315	111

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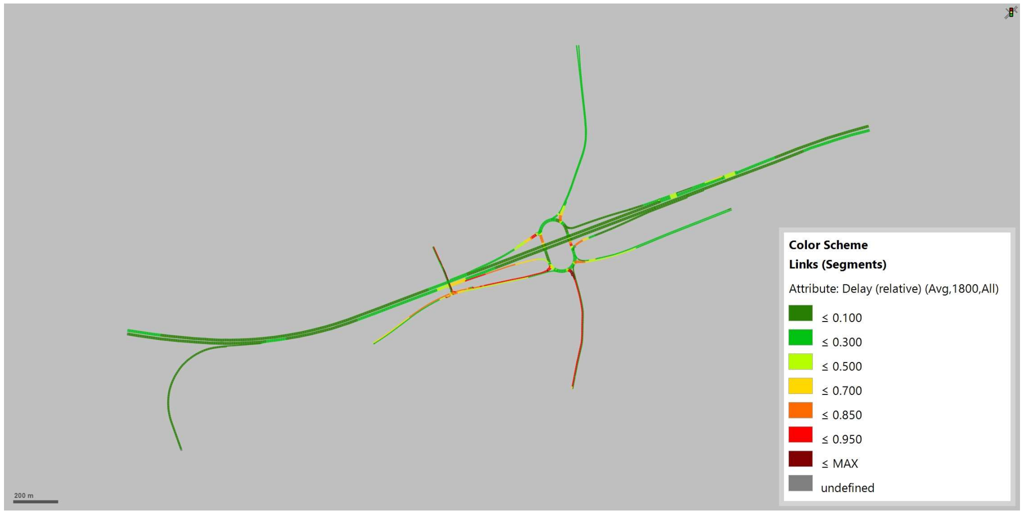
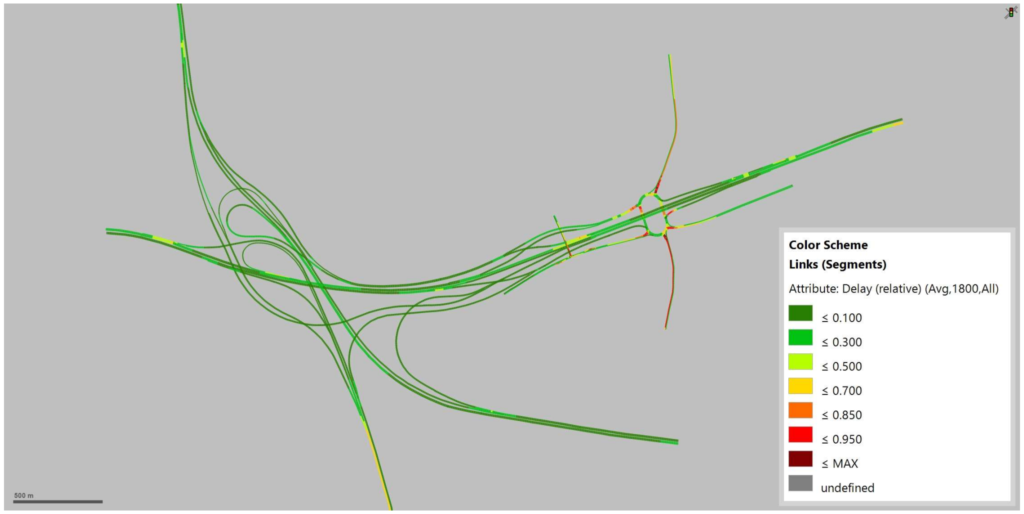
Delay Plots 2045 7.00 – 8.00

- DM



- DS



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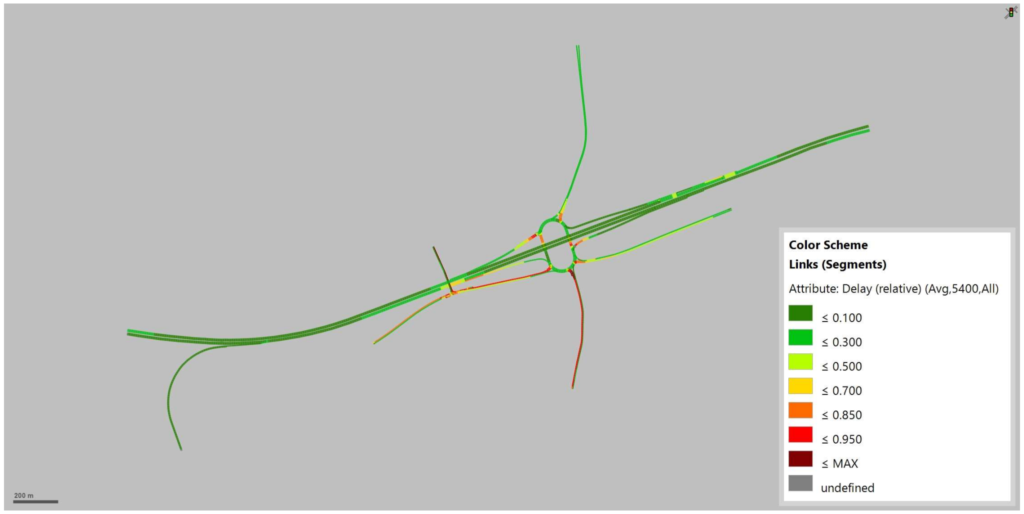
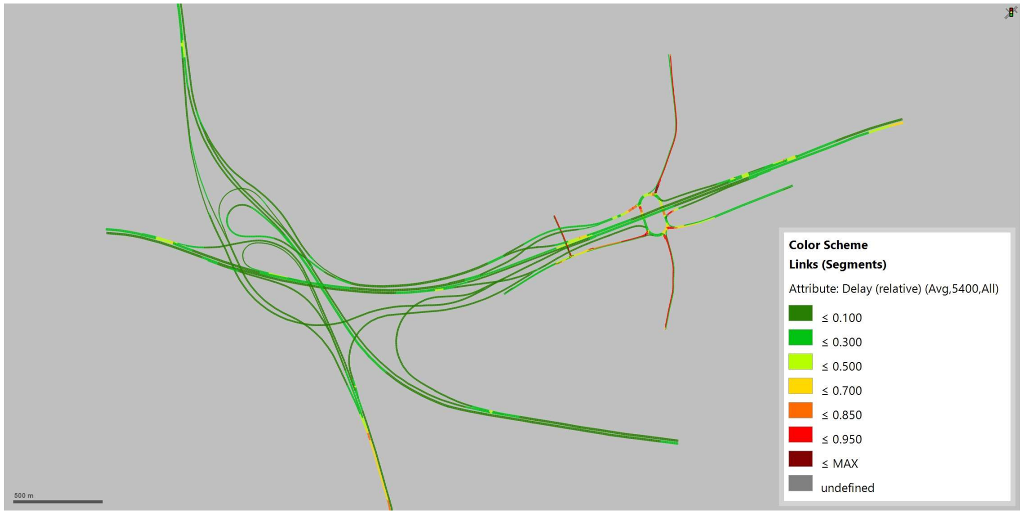
Delay Plots 2045 8.00 – 9.00

- DM



- DS



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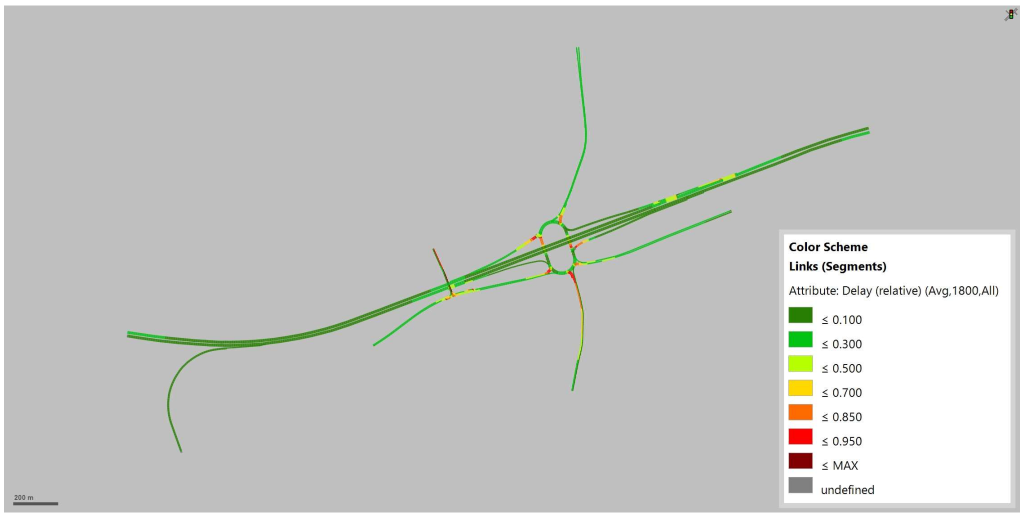
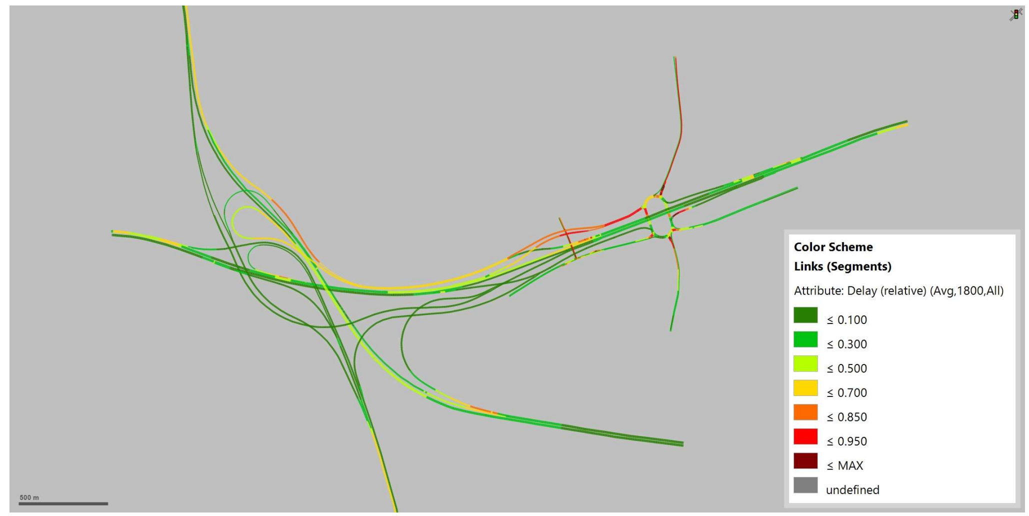
Delay Plots 2045 17.00 – 18.00

- DM



- DS



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Traffic Condition Analysis (2045)

- Average delays* and queues in AM Peak

* It is the average of all delays originating from the approach along all possible routes

AM peak 7.00 - 8.00

Junction	Approach	Avg. Delay per veh [s]			Diff [s]	Mean Max. Queue [m]			Diff [m]
		2016 Base	2045 DM	2045 DS		2016 Base	2045 DM	2045 DS	
Orsett Cock	A128 Brentwood Rd (North)	13	32	168	136	37	29	357	328
	A13 (East)	2	5	36	31	37	60	50	-11
	A1013 Stanford Rd (East)	47	42	58	16	114	79	91	12
	A128 Brentwood Rd (South)	40	269	236	-33	55	393	534	140
	A1013 Stanford Rd (West)	46	205	80	-126	97	631	93	-538
	A13 (West)	10	3	9	6	93	38	83	45
A1013 Stanford Road / Rectory Road	Rectory Rd	9	71	49	-23	13	132	60	-72
	Stanford Rd (East)	6	18	8	-10	10	96	40	-56
	Stanford Rd (West)	3	97	3	-94	-	-	-	

AM peak 8.00 - 9.00

Junction	Approach	Avg. Delay per veh [s]			Diff [s]	Mean Max. Queue [m]			Diff [m]
		2016 Base	2045 DM	2045 DS		2016 Base	2045 DM	2045 DS	
Orsett Cock	A128 Brentwood Rd (North)	23	36	279	243	51	47	794	748
	A13 (East)	6	6	36	31	47	61	51	-10
	A1013 Stanford Rd (East)	94	62	75	13	153	156	97	-58
	A128 Brentwood Rd (South)	207	430	202	-228	127	538	536	-1
	A1013 Stanford Rd (West)	59	184	175	-9	109	792	325	-467
	A13 (West)	11	4	10	7	85	39	90	51
A1013 Stanford Road / Rectory Road	Rectory Rd	11	120	270	149	16	223	233	11
	Stanford Rd (East)	8	20	9	-11	13	111	54	-57
	Stanford Rd (West)	3	114	12	-102	-	-	-	

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Traffic Condition Analysis (2045)

- Average delays* and queues in PM Peak

PM peak 17.00 - 18.00										
Junction	Approach	Avg. Delay per veh [s]			Diff [s]	Mean Max. Queue [m]			Diff [m]
		2016 Base	2045 DM	2045 DS		2016 Base	2045 DM	2045 DS	
Orsett Cock	A128 Brentwood Rd (North)	51	28	274	246	88	38	768	730
	A13 (East)	10	4	74	70	87	56	96	40
	A1013 Stanford Rd (East)	22	24	44	20	34	28	46	17
	A128 Brentwood Rd (South)	13	107	122	14	19	150	160	10
	A1013 Stanford Rd (West)	30	45	78	32	135	70	58	-11
	A13 (West)	29	3	34	31	467	37	1276	1239
A1013 Stanford Road / Rectory Road	Rectory Rd	21	45	180	135	34	169	165	-3
	Stanford Rd (East)	6	12	15	3	10	49	95	46
	Stanford Rd (West)	4	7	5	-1	-	-	-	

* It is the average of all delays originating from the approach along all possible routes

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Latent Demand (no. vehicles)

- No. of vehicles unable to enter the model network during the simulation period due to queues blocking back to the edge of the network

	AM 7-8	AM 8-9	PM 17-18
Base	31	2	59
2030 DM	68	208	2
2030 DS	376	523	669
2045 DM	336	801	48
2045 DS	896	1529	1527

Attachment 1.3.2

NH document "Lower Thames Crossing. Orsett Cock 2030 Operational Appraisal Design Release. 4.3 Operational Modelling"

Lower Thames Crossing

Orsett Cock 2030 Operational Appraisal Design Release 4.3 Operational Modelling

DATE: August 2022

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VERSION: 1.0

Lower Thames Crossing

Orsett Cock 2030 Operational Appraisal

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1. Introduction

1.1 Purpose of document

1.1.1 The purpose of this document is to present the initial findings from the traffic operation appraisal undertaken for Design Release 4.3 (DR4.3) of the network in vicinity of the Orsett Cock junction including the A13/ A1089 and the A1013 Stanford Road/ Rectory Road junction.

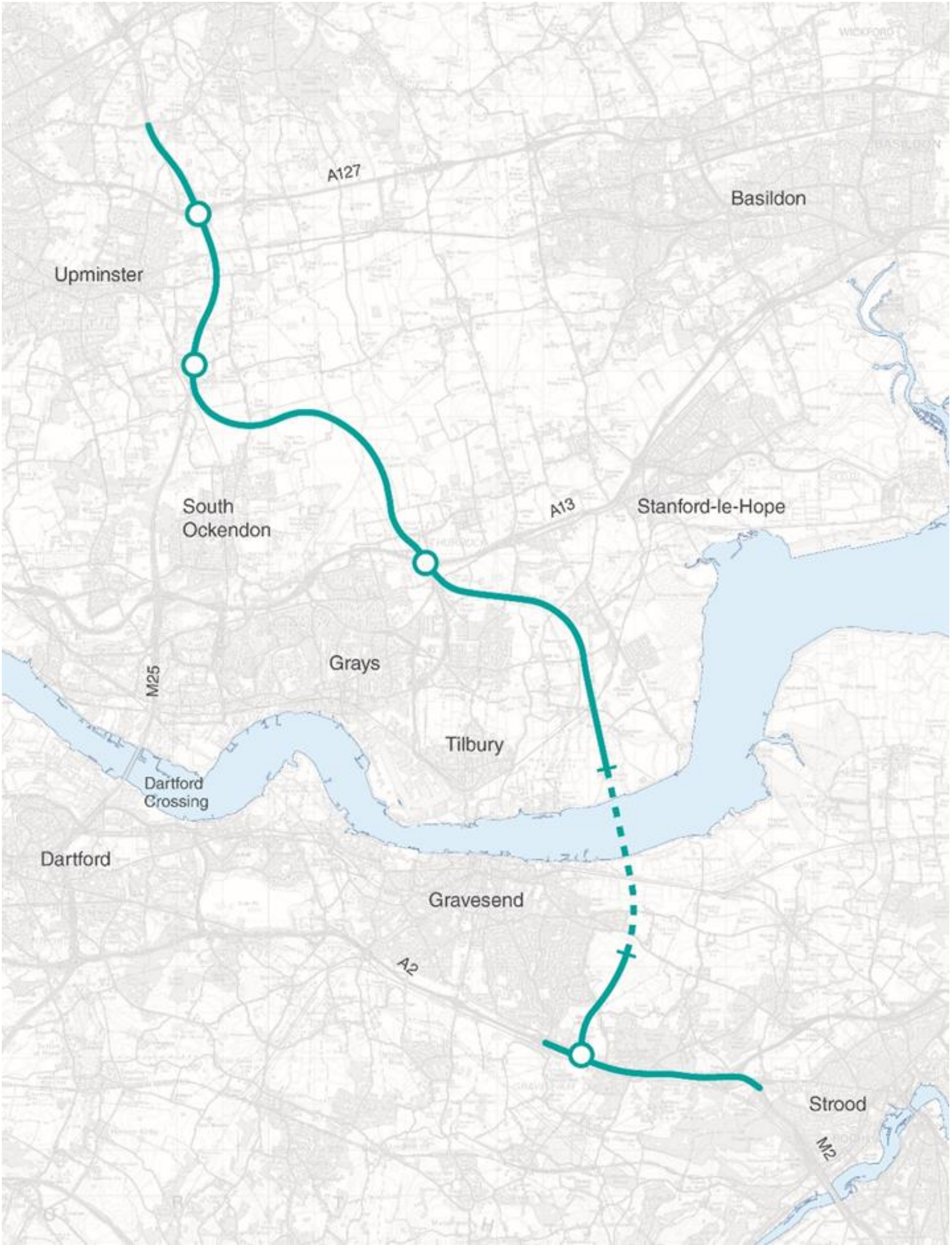
1.2 Modelling Software

1.2.1 Road traffic micro-simulation models represent individual vehicles travelling within the road network, providing realistic driver behaviour such as lane changing and overtaking. The micro-simulation software selected for the Lower Thames Crossing is VISSIM. The model has been developed in VISSIM version 2020 (SP13).

1.3 The Project

1.3.1 The A122 Lower Thames Crossing (the Project) would provide a connection between the A2 and M2 in Kent, east of Gravesend, crossing under the River Thames through a tunnel, before joining the M25 south of junction 29. The Project route is presented in Plate 1.1.

Plate 1.1 Lower Thames Crossing route



1.3.2 The A122 road would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13 and junction 29 of the M25. The tunnel entrances would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.

1.3.3 Junctions are proposed at the following locations:

- New junction with the A2 to the south-east of Gravesend
- Modified junction with the A13/ A1089 in Thurrock
- New junction with the M25 between junctions 29 and 30

1.3.4 To align with NPSNN policy and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied. Vehicles would be charged for using the new tunnel.

1.3.5 The Project route would be three lanes in both directions, except for:

- link roads
- stretches of the carriageway through junctions
- the southbound carriageway from the M25 to the junction with the A13/ A1089, which would be two lanes

1.3.6 In common with other A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. Our A122 road design outside of the tunnel includes emergency areas spaced at intervals between 800 metres and 1.6km (less than one mile). The tunnel would include a range of enhanced systems and response measures instead of emergency areas.

1.3.7 The A122 would be classified as an ‘all-purpose trunk road’ with green signs. For the benefit of safety, walkers, cyclists, horse-riders and slow-moving vehicles would be prohibited from using it.

1.3.8 The Project would include adjustment to a number of side roads. There would also be changes to a number of public rights of way, used by walkers, cyclists, and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities, including gas pipelines, overhead power lines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.

1.3.9 The Project has been developed to avoid or minimise significant effects on the environment. Some of the measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

2. Modelling Scope

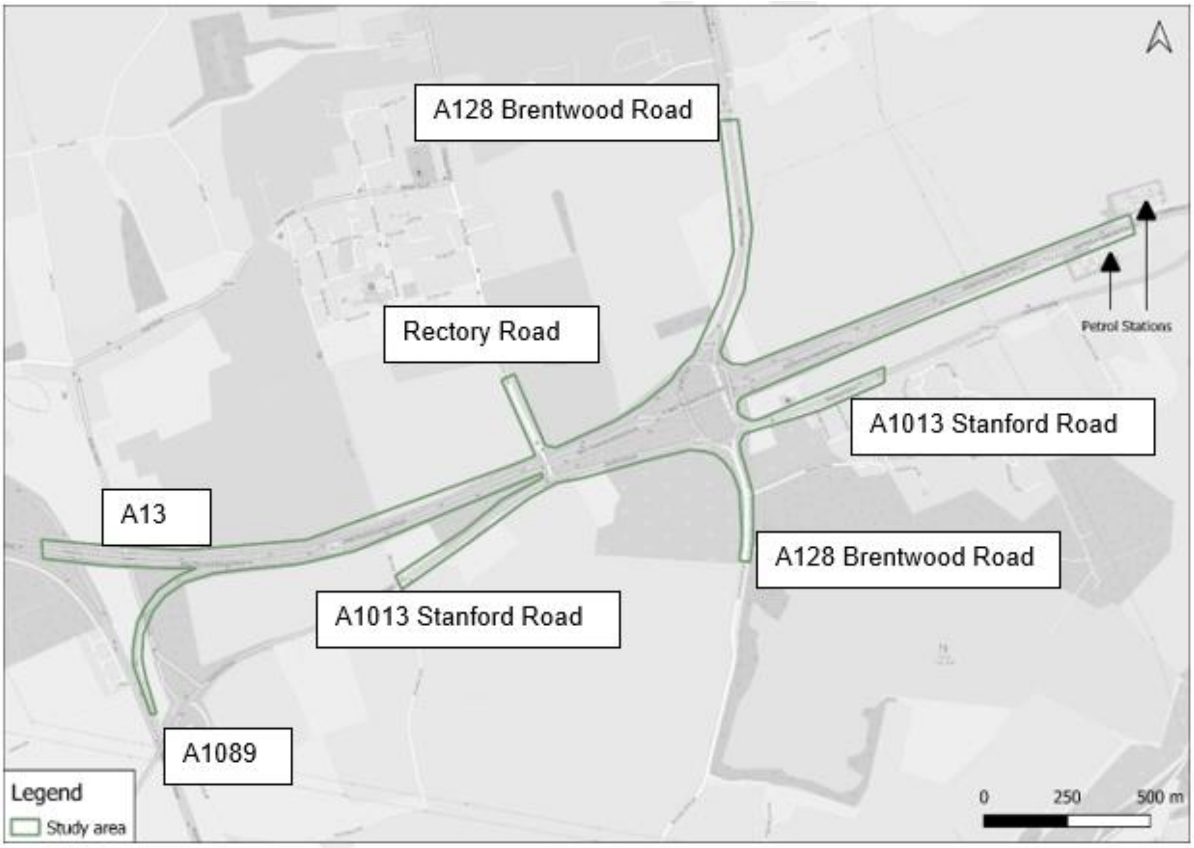
2.1.1 The traffic operation study area, modelling years and time periods have been defined based on our discussion and agreement with Thurrock Council and their consultant during a workshop on 14 December 2021.

2.1.2 The study area is located to the north-east of Grays and Plate 2.1 shows the extent of the study area covered by the VISSIM model. The section of the A13 in this area and the Orsett Cock junction recently had construction works completed as part of the A13 Widening Scheme between the Orsett Cock and the Manorway junctions, undertaken by Thurrock Council.

2.1.3 The Orsett Cock junction in 2016 was an unsignalized, grade-separated roundabout with two circulatory lanes. The A13 had three lanes in each direction west of the junction and two lanes east of Orsett Cock. The area of interest also extends to the westbound diverge from the A13 onto the A1089 in order to capture the anticipated changes proposed around the A13/ A1089 interchange in the Project.

2.1.4 The model also includes the A1013 Stanford Road/ Rectory Road unsignalized T- Junction, located just to the west of the Orsett Cock junction.

Plate 2.1 Traffic Operations Study Area



2.1.5 The VISSIM base year model was developed to reflect the road network and traffic condition in 2016, before the construction work commenced. Accordingly, a Local Model Validation Report (LMVR) was issued in June 2022 explaining how the Base Year model was developed and validated for two time periods, namely:

- AM Peak Period (07:00 - 09:00) to capture the peak hour for the A13 and strategic road network (07:00–08:00) and the peak hour of the junction and local roads (08:00–09:00); and
- PM Peak Period (17:00 - 18:00).

2.1.6 Following this, a Do Minimum model representing forecast year 2030 without LTC and a 2030 Do Something model with LTC were developed.

2.1.7 This report explains how the Do Minimum (DM) and Do Something (DS) models were developed and compares results from the 2030 DS model with the results of the 2030 DM model for understanding how network operating conditions will change from Do Minimum without LTC to a Do Something with LTC.

3. 2030 Model Development & Forecasting

3.1 Introduction

3.1.1 This section describes the development of the 2030 DM and DS VISSIM models in terms of:

- Network Development
- Forecast Traffic Demand
- Traffic Signal Optimisation
- Model Calibration
- Initial Visual Observation
- Interim Improvements in the DS scenario

3.2 Network Development – Do Minimum

3.2.1 The 2030 DM network was developed from the 2016 Base Year network by incorporating the A13 Widening Scheme between the Orsett Cock and the Manorway junctions. This scheme was recently completed by Thurrock Council.

3.2.2 The principal network changes between the 2016 Base Year and the 2030 DM were:

- Introduction of an extra lane in both directions on the A13 east of Orsett Cock.
- Reconfiguration of the merges and diverges at the Orsett Cock junction with the A13 in both directions.
- Reconfiguration of the westbound on-slip to the A13 West with the slip road reduced to one lane.
- Reconfiguration of the A128 North approach with an extra flare lane.
- Reconfiguration of the A13 West approach (eastbound off-slip) with an extra flare lane.
- Introduction of an extra lane in the circulatory.
- Introduction of controlled pedestrian crossings and traffic signals on the A13 West and A13 East approaches.

3.3 Network Development – Do Something

3.3.1 The 2030 DS network was developed from the 2030 DM network by incorporating the highway design from Design Release 4.3 within the traffic operations study area for Orsett Cock. The principal network changes between the 2030 DM and 2030 DS models were:

- Introduction of new LTC links around the A13/ A1089 interchange.
- Reconfiguration of A13/ A1089 interchange.
- Reconfiguration of slip roads on the A13 west of Orsett Cock.

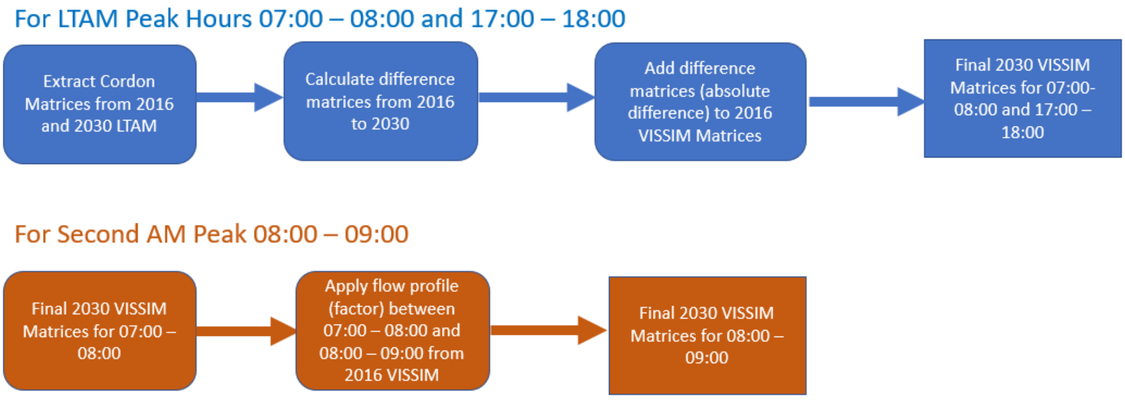
- Realignment of A1013 (West) Stanford Road.
- Introduction of traffic signals on the A128 North and A128 South approaches at Orsett Cock.
- Reconfiguration of the A1013/ Rectory Road junction.

3.3.2 The network coding for both DM and DS networks were undertaken using highway design drawings provided in AutoCAD and PDF format.

3.4 Forecast Traffic Demand

3.4.1 The forecast traffic demand matrices for each vehicle type in VISSIM were calculated as shown in Plate 3.1 and described in detail in subsequent sections.

Plate 3.1 Forecast Traffic Demand Calculation for VISSIM



3.4.2 The 2030 DM forecast traffic demand in VISSIM was determined by examining the differences in forecast traffic flows (for model zones) predicted by the 2016 Base Year and 2030 DM LTAM (CM45) models for the available hours of 07:00 – 08:00 in the AM Peak and 17:00 – 18:00 in the PM Peak.

3.4.3 The absolute differences in flows between these models were identified and then applied to the 2016 Base Year VISSIM model to develop the 2030 DM matrices. This was undertaken on the basis of origin-destination matrices so applying a matrix of 'flow differences' to the 2016 Base Year matrix to create the 2030 DM matrix.

3.4.4 Where applying absolute differences resulted in negative values, the percentage difference was used instead of the absolute difference. This was the case for the origin – destination pairs for which the LTAM forecast indicated negative growth. If the 2016 Base Year flows in VISSIM were lower than the LTAM Base flows, applying this negative flow difference would lead in some instances to a negative number, therefore it was preferred to use percentage difference instead where this occurred.

3.4.5 For the second hour in the AM (08:00 – 09:00), which is not available from LTAM, the existing flow base year profile in VISSIM (derived from count data) was used to factor the 2030 matrices from the 07:00 – 08:00 hour to the 08:00 – 09:00 hour.

3.4.6 The 2030 hourly matrices have been split into 15-minute intervals using the flow profiles from the base year VISSIM model. In summary, the comparison of the 2016 Base and 2030 DM traffic demands in Table 3.1 indicates that the overall traffic demand is forecast to increase by 30% in the AM peak hours and 26% in the PM peak hour.

Table 3.1 Traffic Volumes in Study Area by Scenario

Peak	Vehicle Type	2016 Base	2030 DM	2030 DS	
				LTC mainline flows	Total *****
AM (07:00 – 08:00)	Car	6698	8798	1807	14539
	LGV	1693	2040	599	3174
	HGV	739	1012	634	2370
	Total	9130	11850	3040	20084
AM (08:00 – 09:00)	Car	6790	8980	1807	14738
	LGV	1247	1495	599	2639
	HGV	822	1114	634	2487
	Total	8859	11589	3040	19863
PM (17:00 – 18:00)	Car	8172	10119	1784	17236
	LGV	1300	1634	418	2576
	HGV	386	655	541	1724
	Total	9858	12408	2742	21536

Note: * Total DS traffic volumes include LTC mainline flows

3.4.7 The 2030 DS forecast traffic demand matrices in VISSIM were determined using the same method as the 2030 DM, that is by examining the differences in forecast traffic flows predicted by the 2016 Base Year and 2030 DS (CS67) LTAM models.

3.4.8 There are new zones associated with the new traffic from LTC in the 2030 DS model. The new zones are shown in Plate 3.2 below. The traffic demand and the distributions for these zones were taken directly from the LTAM cordon matrices and added to the VISSIM matrices.

Plate 3.2 2030 DS VISSIM Zones

3.4.9 Similar to the 2030 DM matrices, for the second hour in the AM (08:00 – 09:00) which is not available from LTAM, flow matrices were derived using the existing base year flow profile between 07:00 – 08:00 and 08:00 – 09:00.

3.4.10 The 2030 DS hourly matrices were also split into 15-minute intervals using the existing flow profiles from the VISSIM base year model. In summary, the comparison of the 2030 DM and DS traffic demands in Table 3.1 indicates that the overall traffic demand in the study area increases by approximately 70% between the DM and DS scenarios in the AM and PM peak hours.

3.4.11 It should be noted that the 2030 DM vs 2030 DS is not a direct comparison for traffic demands at the Orsett Cock junction as the 2030 DS total volume includes the mainline traffic travelling north-south on the new LTC links. For clarity the LTC mainline traffic volumes have been shown separately in Table 3.1 above.

3.5 Public Transport

3.5.1 Bus services and location of bus stops in the DM and DS models were assumed to remain consistent with those in the Base Year model.

3.6 Traffic Signals Optimisation

3.6.1 The operation of traffic signals in the 2030 DM and DS network were initially optimised using LinSIG models and then further fine-tuned in VISSIM to reflect the small changes in demand and arrival pattern of vehicles in the 15-minute intervals.

3.6.2 A cycle time of 60 seconds was used in the 2030 DM and DS models.

3.7 DM and DS VISSIM Model Calibration

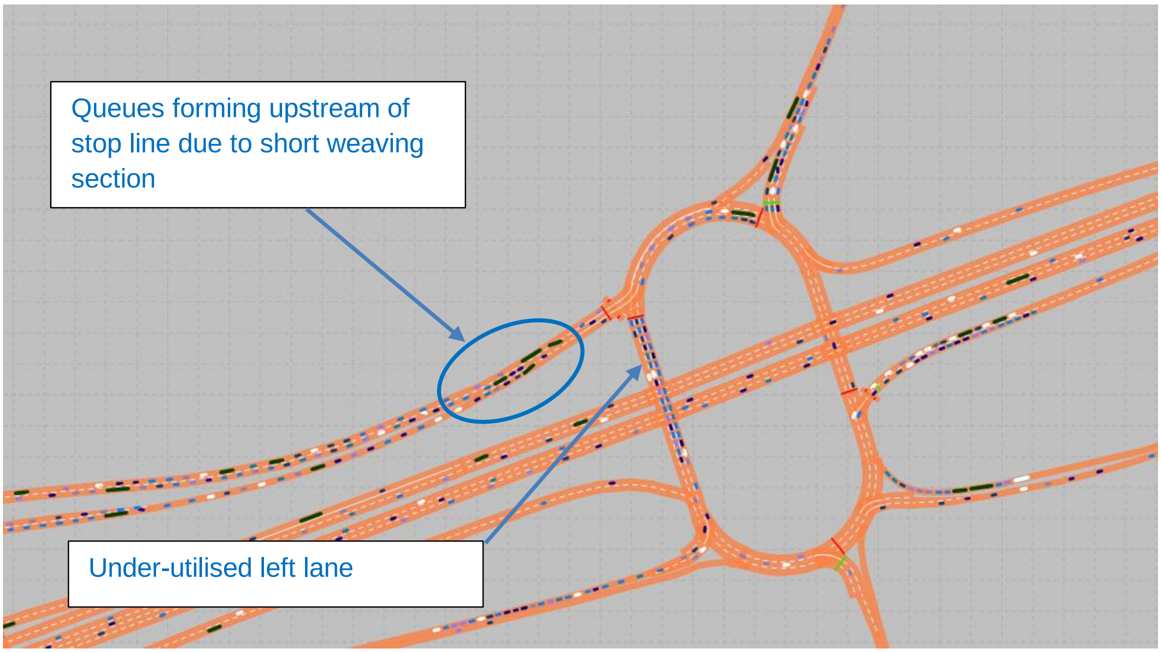
3.7.1 The network coding method and model parameters used in the DM and DS models were largely consistent with those calibrated in the base year model. However, due to changes of the network layout at the Orsett Cock junction, some parameters were adjusted in the DM and DS models to provide more realistic driving behaviours to reflect the new layout. These adjustments and the justifications for the changes are summarised below:

- The speed distributions of the desired speed and reduced speed areas on the circulatory were reduced by 10% to reflect the new circulatory carriageway lane configuration in the DM and DS models, compared to the base model.
- The circulatory has two lanes in the base model and most of the links use the standard “Urban (motorized)” link behaviour type, except for a short three-lane section just before the A1013 (W) exit which uses the “Urban (merge)” link type to allow smoother lane change behaviour, as there will be more lane changes and weaving in the three-lane section. Given the whole circulatory is widened to three lanes in the DM and DS models, all circulatory links in these models have been adjusted to use the “Urban (merge)” link type.

3.8 Initial Visual Observations

3.8.1 Visual observations during the simulation runs of the DS models indicated the traffic behaviour upstream of the traffic signals at the A13 West approach and its circulatory, were impacting the efficiency of these traffic signals. These are shown in Plate 3.3 and summarised below.

Plate 3.3 Traffic Behaviour at A13 West & Circulatory



Weaving on the A13 West approach

3.8.2 The section where traffic from LTC and the A13 merges on the A13 West approach has a modelled length of 90m. The model indicated that this merge length needs increasing as a large number of vehicles from LTC needs to be in the middle and right-hand lanes while much of the traffic from the A13 needs to use the middle and left-hand lanes for the A128 (N) exit. This causes a bottleneck upstream of the stop line with queues predicted to extend to the A13 mainline.

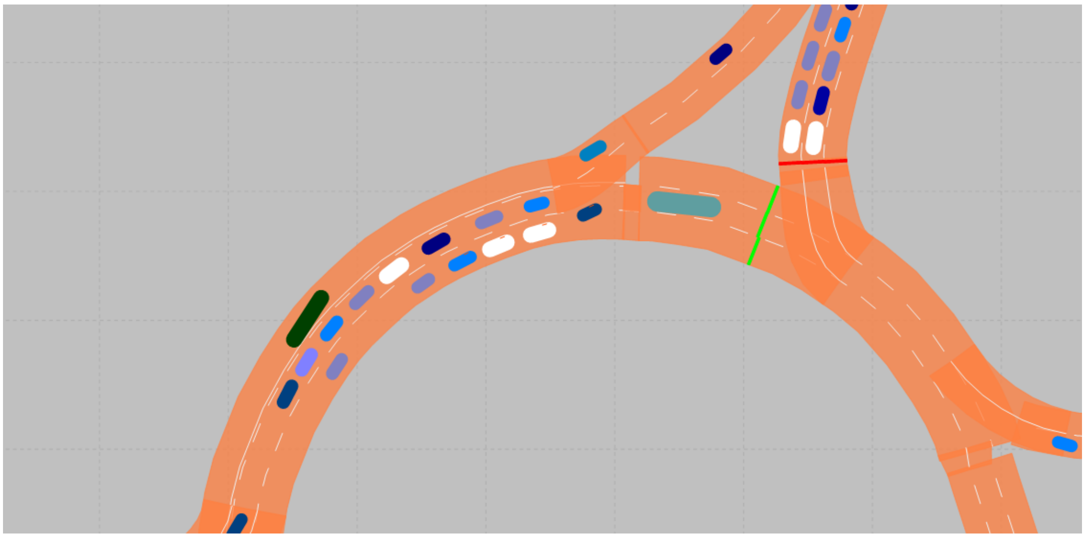
Under-utilised left lane on the western overbridge

3.8.3 The lane markings on the eastern overbridge are currently marked with the left lane dedicated for the A128 (N), middle lane for the A128 (N) & A13 (E) and right lane for the A13 (E) & A1013. The volume of traffic travelling from the circulatory to the A128 (N) is relatively low in comparison to other movements which resulted in the left lane being under-utilised.

Lane change at the northern circulatory

3.8.4 As shown in Plate 3.4, traffic travelling from the right-hand lane on the western overbridge needs to change to the middle lane for the A13 (E) exit. This causes delays upstream of the stop line.

Plate 3.4 Lane change in northern circulatory



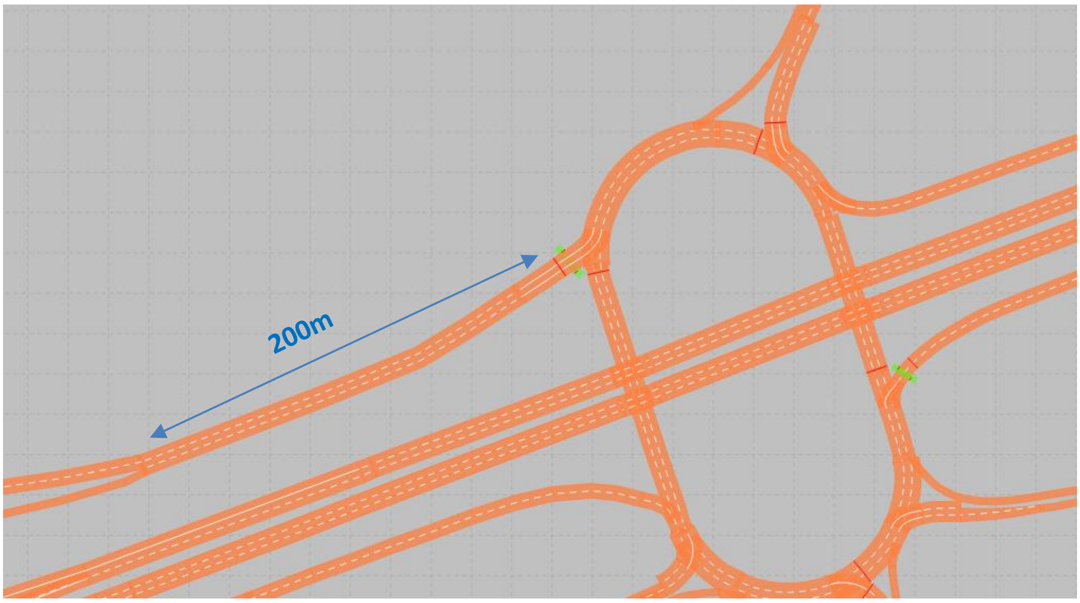
3.9 Improvements for the DS Network

3.9.1 Following discussions with the LTC team, it was agreed to implement the changes described below to the DS network in VISSIM as a provisional improvement. These are currently limited to changes on the slip roads connecting LTC to the A13 (W), and minor changes to the lane markings at the Orsett Cock junction. Any requirements for further improvements at the Orsett Cock junction will be determined following discussions with Thurrock Council based on the results from the models presented in the next chapter.

A13 West approach Improvement

3.9.2 The improved DS network increases the modelled length of the section where traffic from LTC and the A13 merges on the A13 West approach, from 90m to 200m as shown in Plate 3.5.

Plate 3.5 A13 West approach improvement

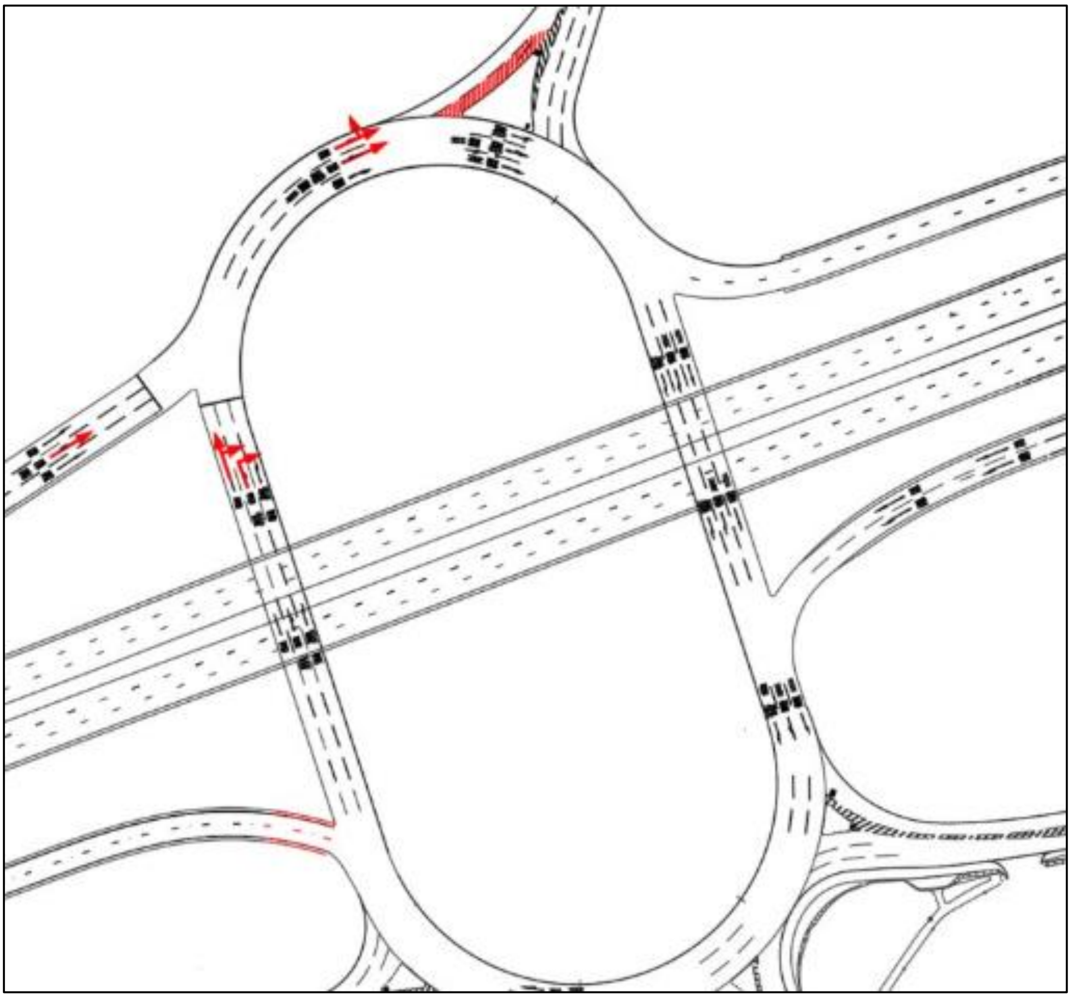


Modified Lane Markings at A128 (N) exit

3.9.3 The purpose of this modification is to achieve a more even spread in lane usage on the western overbridge and avoid traffic changing lanes in the northern circulatory for the A13 (E) exit. The modification as shown in Plate 3.6 includes the following changes:

- Reduce the A128 (N) exit to one lane
- Allow traffic to use the left lane on the western overbridge for the A13 (E) exit

Plate 3.6 Modified Lane Markings at A128(N) exit



Modified Lane Markings at A128 (N) exit

3.9.4 The westbound on-slip on the A13 West exit is one lane in the DM network. This has been modified to two lanes in the DS network so as to tie in with the LTC design which has two lanes on the slip road.

4. Traffic Condition Analysis

4.1 Introduction

4.1.1 This section compares the results of the 2030 DM and DS VISSIM models in terms of the following traffic condition indicators:

- Average delays per vehicle
- Average queues
- Predicted journey times
- Relative delays on links

4.1.2 Both AM and PM Do Something models used in this analysis includes all the improvements described in Section 3.9.

4.1.3 Consistent with the base year model validation, the results of the DM and DS models are the averages of the same 20 random seeds used in the base model.

4.2 Junctions Traffic Condition

4.2.1 The predicted traffic conditions at the Orsett Cock and A1013/ Rectory Road junctions shown in Table 4.1 to Table 4.3 have been measured in terms of the total throughput flow in vehicles, average delay per vehicle and average queue length in meters for each hour within the AM and PM peak period.

4.2.2 The total throughput flows are the sum of the flows on all movements from each approach.

4.2.3 The average delay per vehicle is calculated by taking the weighted average of the delay from all movements on each approach. It should be noted that for the Orsett Cock junction, the delays are measured for each vehicle completing the full movement from the entry to the exit, therefore including delays from the traffic signals on the circulatory.

4.2.4 The average queue lengths are calculated by taking the average of the maximum queue length in each five-minute interval. This is more reliable in comparison to taking the maximum queue length over a one-hour interval, where the maximum queue can sometimes be misleading as it may have occurred only for a very short time/ single time step during the simulation. Vehicles are defined to be in a queue when their headway and speed drops below 20 meters and 3.1mph respectively and exit the queue when their speed increases above 6.2mph.

Table 4.1 AM 07:00 – 08:00 Traffic Condition

AM peak 7.00 - 8.00										
Junction	Approach	Throughput Flow (veh)			Avg. Delay per veh (s)			Mean Max. Queue (m)		
		2016 Base	2030 DM	2030 DS	2016 Base	2030 DM	2030 DS	2016 Base	2030 DM	2030 DS
Orsett Cock	A128 Brentwood Rd (North)	632	712	683	13	22	86	37	25	120
	A13 (East)	676	942	760	2	4	36	37	59	54
	A1013 Stanford Rd (East)	655	659	685	47	18	48	114	33	75
	A128 Brentwood Rd (South)	602	717	722	40	73	74	55	226	136
	A1013 Stanford Rd (West)	599	793	643	46	63	70	97	174	84
	A13 (West)	497	479	1431	10	3	7	93	38	62
A1013 Stanford Road / Rectory Road	Rectory Rd	136	190	272	9	23	52	13	56	66
	Stanford Rd (East)	833	977	854	6	5	8	10	13	41
	Stanford Rd (West)	557	720	563	3	3	3	-	-	-

4.2.5 At the Orsett Cock junction, Table 4.1 shows that the traffic conditions in the 2030 DM scenario on the A128 (N), A13 (E), A1013 (E) and A13 (W) approaches are predicted to be in free-flowing condition with delays of less than 35 seconds and short queues during the 07:00 – 08:00 period.

4.2.6 Delays on the A128 Brentwood Road (S) and A1013 Stanford Road (West) approaches respectively, increase in the 2030 DM scenario compared to 2016, with queues on the A128 Brentwood Road (S) extending past the junction with Welling Road.

4.2.7 In general, delays at Orsett Cock junction increase on all approaches in the 2030 DS scenario compared to the 2030 DM scenario. However, the predicted queues on all approaches can be accommodated within the available safe storage space.

4.2.8 The greatest increase in delay is on the A128 Brentwood Road (N) in the 2030 DS scenario. This approach is signalised in the DS scenario and has short green times in order to prioritise the circulatory to minimise queueing on the circulating carriageway due to the short storage space available.

4.2.9 The delays on the A128 Brentwood Road (S) and A1013 Stanford Road (W) approaches increase, but the respective queues are predicted to be shorter in the 2030 DS scenario compared to 2030 DM scenario. This is because the demand flows on these approaches are higher in the 2030 DM scenario.

4.2.10 At the A1013 Stanford Road/ Rectory Road junction, traffic conditions remain free-flowing in the 2030 DM scenario. There are small increases in delays and queues on Rectory Road and Stanford Road (E) in the 2030 DS scenario. The increase in queues on Stanford Road (E) is due to the removal of the right turn pocket resulting in right turning vehicles blocking the ahead traffic.

Table 4.2 AM 08:00 – 09:00 Traffic Condition

AM peak 8.00 - 9.00										
Junction	Approach	Throughput Flow (veh)			Avg. Delay per veh (s)			Mean Max. Queue (m)		
		2016 Base	2030 DM	2030 DS	2016 Base	2030 DM	2030 DS	2016 Base	2030 DM	2030 DS
Orsett Cock	A128 Brentwood Rd (North)	695	790	792	23	24	144	51	31	285
	A13 (East)	788	892	754	6	4	37	47	56	55
	A1013 Stanford Rd (East)	637	619	654	94	17	59	153	31	71
	A128 Brentwood Rd (South)	610	824	783	207	93	93	127	506	173
	A1013 Stanford Rd (West)	722	843	795	59	104	174	109	473	387
	A13 (West)	506	478	1504	11	3	8	85	38	67
A1013 Stanford Road / Rectory Road	Rectory Rd	205	201	377	11	74	301	16	223	244
	Stanford Rd (East)	1141	980	869	8	7	10	13	31	58
	Stanford Rd (West)	620	798	622	3	39	13	-	-	-

4.2.11 In the 2030 DM 08:00 – 09:00 period, the traffic conditions on the A128 (N), A13 (E), A1013 (E) and A13 (W) approaches are similar to the 07:00 – 08:00 period and are predicted to be in free-flowing condition with delays of less than 35 seconds.

4.2.12 Both the A128 Brentwood Road (S) and A1013 Stanford Road (W) approaches are over saturated in the 2030 DM scenario with long queues. The queue on the A128 Brentwood Road (S) approach is predicted to extend past the Orsett Golf Club and the queue on the A1013 (W) approach is predicted to extend past Rectory Road.

4.2.13 Similar to the 07:00 – 08:00 period, there are increased delays on all approaches at the Orsett Cock junction in the 2030 DS scenario compared to the 2030 DM scenario. The predicted queues on most approaches can be accommodated within the available safe storage space, except for the A1013 Stanford Road (W) approach where the queue reaches just east of Rectory Road.

4.2.14 Traffic delays increase most on the A128 Brentwood Road (N) in the 2030 DS scenario compared to the DM scenario with delays increasing by 120s resulting in a 285m queue.

4.2.15 The A128 Brentwood Road (S) approach has similar delays in the 2030 DM and 2030 DS scenarios, but much shorter queues in the 2030 DS scenario due to the lower demand flow.

4.2.16 The A1013 Stanford Road (W) approach remains over saturated in the 2030 DS scenario. Delays are predicted to increase but queues are predicted to be shorter in the 2030 DS scenario compared to 2030 DM scenario due to the lower demand flow in the 2030 DS scenario.

4.2.17 At the A1013 Stanford Road/ Rectory Road junction, delays and queueing increase in both the 2030 DM and DS scenarios compared to the 2016 base year. Rectory Road is over saturated with long queues in both scenarios.

Table 4.3 PM 17:00 – 18:00 Traffic Condition

PM peak 17.00 - 18.00										
Junction	Approach	Throughput Flow (veh)			Avg. Delay per veh (s)			Mean Max. Queue (m)		
		2016 Base	2030 DM	2030 DS	2016 Base	2030 DM	2030 DS	2016 Base	2030 DM	2030 DS
Orsett Cock	A128 Brentwood Rd (North)	854	837	828	51	26	156	88	36	383
	A13 (East)	442	667	547	10	3	295	87	47	222
	A1013 Stanford Rd (East)	501	498	510	22	15	42	34	19	40
	A128 Brentwood Rd (South)	410	493	494	13	39	57	19	37	43
	A1013 Stanford Rd (West)	988	993	906	30	42	64	135	71	46
	A13 (West)	805	700	1968	29	3	25	467	37	673
A1013 Stanford Road / Rectory Road	Rectory Rd	311	314	343	21	32	154	34	142	149
	Stanford Rd (East)	680	939	846	6	6	13	10	22	73
	Stanford Rd (West)	855	979	891	4	3	5	-	-	-

4.2.18 In the PM peak, traffic conditions at the Orsett Cock junction are free-flowing in the 2030 DM scenario.

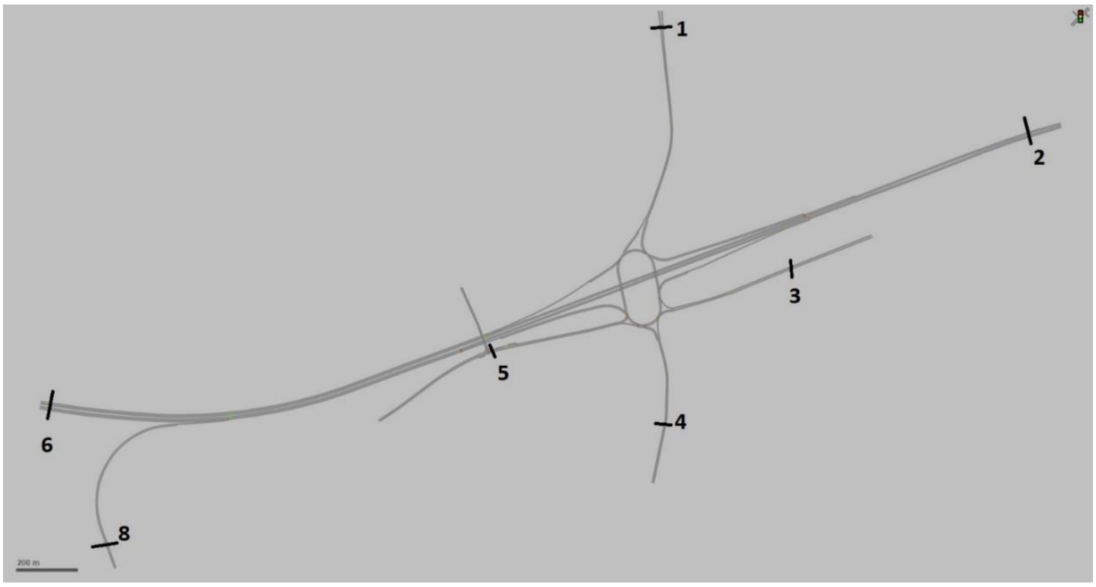
4.2.19 In the 2030 DS scenario, the Orsett Cock junction is predicted to be over-saturated in the PM peak with delays and queues on the A128 (N), A13 (E) and A13 (W) approaches.

4.2.20 At the A1013 Stanford Road/ Rectory Road junction, delays and queues on Rectory Road increase in both the 2030 DM and 2030 DS scenarios compared to the base year with long queues in both scenarios. The queues on Stanford Road (E) also increase in the 2030 DS scenario due to the removal of the right turn pocket resulting in right turning vehicles blocking the ahead traffic.

4.3 Journey Times

4.3.1 Journey time comparison has been carried out on the same routes used for the base year model validation. These cover all movements between the origins and destinations illustrated in Plate 4.1.

Plate 4.1 Journey Time Start and End Locations (DM)



4.3.2 Table 4.4 to Table 4.6 show a summary comparing the journey times for the 2016 Base Year, 2030 DM and 2030 DS for the AM and PM peak periods.

Table 4.4 Journey Time Comparison AM 07:00 – 08:00

Route	Name	2016 Base			2030 DM			2030 DS		
		Distance [m]	JT [s]	Speed [mph]	Distance [m]	JT [s]	Speed [mph]	Distance [m]	JT [s]	Speed [mph]
1-->2	A128 Brentwood Rd (North) to A13 EB mainline	2084	109	42.8	2122	123	38.6	2122	189	25.2
1-->3	A128 Brentwood Rd (North) to A1013 Stanford Rd (East)	1381	102	30.3	1396	118	26.5	1396	182	17.1
1-->4	A128 Brentwood Rd (North) to A128 Brentwood Rd (South)	1341	90	33.3	1347	107	28.1	1347	172	17.5
1-->5	A128 Brentwood Rd (North) to A1013 Stanford Rd (West)	1555	107	32.4	1533	125	27.5	1535	195	17.6
1-->6	A128 Brentwood Rd (North) to A13 WB mainline	3051	152	45.0	3025	196	34.5	3036	242	28.0
1-->8	A128 Brentwood Rd (North) to A13 WB off-slip to A1089	3189	164	43.5	2439	175	31.2	3071	244	28.1
2-->1	A13 WB mainline to A128 Brentwood Rd (North)	2343	144	36.3	2360	160	32.9	2359	184	28.6
2-->3	A13 WB mainline to A1013 Stanford Rd (East)	1629	101	36.1	1653	100	36.9	1653	111	33.3
2-->4	A13 WB mainline to A128 Brentwood Rd (South)	1588	89	39.8	1605	89	40.2	1605	101	35.5
2-->5	A13 WB mainline to A1013 Stanford Rd (West)	1803	106	37.9	1791	107	37.5	1793	124	32.5
2-->6	A13 WB mainline to A13 WB mainline	3177	119	59.7	3177	118	60.3	3178	120	59.4
2-->8	A13 WB mainline to A13 WB off-slip to A1089	3315	131	56.4	3315	131	56.7	3329	173	43.0
3-->1	A1013 Stanford Rd (East) to A128 Brentwood Rd (North)	1563	151	23.1	1590	143	24.8	1589	180	19.7
3-->2	A1013 Stanford Rd (East) to A13 EB mainline	2176	158	30.8	2215	160	30.9	2216	210	23.7
3-->4	A1013 Stanford Rd (East) to A128 Brentwood Rd (South)	808	96	18.8	835	72	25.8	835	97	19.3
3-->5	A1013 Stanford Rd (East) to A1013 Stanford Rd (West)	1022	113	20.2	1021	90	25.4	1023	119	19.2
3-->6	A1013 Stanford Rd (East) to A13 WB mainline	2517	157	35.8	2513	161	34.8	2523	167	33.8
3-->8	A1013 Stanford Rd (East) to A13 WB off-slip to A1089	2655	170	35.0	1927	140	30.8	2559	169	33.9
4-->1	A128 Brentwood Rd (South) to A128 Brentwood Rd (North)	1397	128	24.4	1431	206	15.5	1430	180	17.7
4-->2	A128 Brentwood Rd (South) to A13 EB mainline	2010	135	33.3	2056	223	20.6	2057	209	22.0
4-->3	A128 Brentwood Rd (South) to A1013 Stanford Rd (East)	1307	128	22.9	1330	218	13.6	1330	203	14.6
4-->5	A128 Brentwood Rd (South) to A1013 Stanford Rd (West)	856	90	21.3	862	152	12.6	864	119	16.2
4-->6	A128 Brentwood Rd (South) to A13 WB mainline	2351	134	39.2	2354	224	23.5	2364	167	31.7
4-->8	A128 Brentwood Rd (South) to A13 WB off-slip to A1089	2489	147	38.0	1768	203	19.5	2400	169	31.8
5-->1	A1013 Stanford Rd (West) to A128 Brentwood Rd (North)	1452	133	24.4	1465	167	19.6	1474	156	21.2
5-->2	A1013 Stanford Rd (West) to A13 EB mainline	2066	140	32.9	2090	184	25.4	2101	185	25.4
5-->3	A1013 Stanford Rd (West) to A1013 Stanford Rd (East)	1363	133	22.9	1364	179	17.0	1375	179	17.2
5-->4	A1013 Stanford Rd (West) to A128 Brentwood Rd (South)	1322	122	24.3	1315	168	17.5	1326	169	17.6
5-->6	A1013 Stanford Rd (West) to A13 WB mainline	2407	139	38.6	2387	185	28.9	2409	143	37.8
5-->8	A1013 Stanford Rd (West) to A13 WB off-slip to A1089	2545	152	37.5	1802	164	24.6	2445	145	37.8
6-->1	A13 EB mainline to A128 Brentwood Rd (North)	2767	162	38.2	2770	153	40.4	2775	150	41.4
6-->2	A13 EB mainline to A13 EB mainline	3345	121	62.0	3347	122	61.6	3347	126	59.6
6-->3	A13 EB mainline to A1013 Stanford Rd (East)	2678	162	36.9	2669	165	36.1	2676	173	34.6
6-->4	A13 EB mainline to A128 Brentwood Rd (South)	2637	150	39.2	2621	155	37.9	2627	163	36.1
6-->5	A13 EB mainline to A1013 Stanford Rd (West)	2852	168	38.1	2807	172	36.5	2815	185	34.0
6-->8	A13 EB mainline to A13 WB off-slip to A1089	4485	224	44.7	3713	222	37.3	4351	235	41.5

4.3.3 The journey time comparison between the 2030 DM scenario and the 2016 Base Year for the 07:00 – 08:00 period shows the following:

- Journey times in the DM are generally similar or slightly higher than the base year across the majority of the routes, except for those routes originating from the A128 (S) and A1013 (W) where journey times increase on average by 60s due to the delays on these approaches as described in the previous section.

4.3.4 The journey time comparison between the 2030 DS and 2030 DM scenarios for the 07:00 – 08:00 period shows the following:

- Journey times in the DS scenario are generally higher than the DM scenario across the majority of the routes, except for those routes originating from the A128 (S) and the A1013 (W) where journey times decrease in the DS scenario.
- The journey time from the A13 (E) to the A1089 increases more than the journey times from the A13 (E) to other destinations, as traffic travelling from the A13 (E) to the A1089 is required to travel through the Orsett Cock junction in the DS scenario.
- Journey times in the DS scenario on the A13 mainline are similar to the DM scenario in both directions.

Table 4.5 Journey Time Comparison AM 08:00 – 09:00

Route	Name	2016 Base			2030 DM			2030 DS		
		Distance [m]	JT [s]	Speed [mph]	Distance [m]	JT [s]	Speed [mph]	Distance [m]	JT [s]	Speed [mph]
1-->2	A128 Brentwood Rd (North) to A13 EB mainline	2084	119	39.3	2122	125	38.0	2122	248	19.2
1-->3	A128 Brentwood Rd (North) to A1013 Stanford Rd (East)	1381	112	27.6	1396	121	25.8	1396	239	13.1
1-->4	A128 Brentwood Rd (North) to A128 Brentwood Rd (South)	1341	99	30.1	1347	109	27.5	1347	229	13.2
1-->5	A128 Brentwood Rd (North) to A1013 Stanford Rd (West)	1555	119	29.3	1533	128	26.7	1535	253	13.6
1-->6	A128 Brentwood Rd (North) to A13 WB mainline	3051	161	42.3	3025	190	35.6	3036	299	22.7
1-->8	A128 Brentwood Rd (North) to A13 WB off-slip to A1089	3189	174	41.0	2439	169	32.3	3071	301	22.8
2-->1	A13 WB mainline to A128 Brentwood Rd (North)	2343	157	33.4	2360	161	32.9	2359	186	28.3
2-->3	A13 WB mainline to A1013 Stanford Rd (East)	1629	115	31.7	1653	100	36.8	1653	115	32.2
2-->4	A13 WB mainline to A128 Brentwood Rd (South)	1588	103	34.7	1605	89	40.3	1605	105	34.2
2-->5	A13 WB mainline to A1013 Stanford Rd (West)	1803	122	33.1	1791	108	37.1	1793	129	31.1
2-->6	A13 WB mainline to A13 WB mainline	3177	118	60.1	3177	117	60.8	3178	120	59.2
2-->8	A13 WB mainline to A13 WB off-slip to A1089	3315	131	56.7	3315	130	57.1	3329	177	42.0
3-->1	A1013 Stanford Rd (East) to A128 Brentwood Rd (North)	1563	187	18.7	1590	142	25.0	1589	186	19.1
3-->2	A1013 Stanford Rd (East) to A13 EB mainline	2176	196	24.8	2215	159	31.1	2216	219	22.7
3-->4	A1013 Stanford Rd (East) to A128 Brentwood Rd (South)	807	133	13.6	835	71	26.5	835	105	17.8
3-->5	A1013 Stanford Rd (East) to A1013 Stanford Rd (West)	1022	152	15.1	1021	90	25.5	1023	129	17.7
3-->6	A1013 Stanford Rd (East) to A13 WB mainline	2517	194	29.0	2513	151	37.2	2523	175	32.2
3-->8	A1013 Stanford Rd (East) to A13 WB off-slip to A1089	2655	207	28.7	1927	130	33.2	2559	177	32.3
4-->1	A128 Brentwood Rd (South) to A128 Brentwood Rd (North)	1396	265	11.8	1431	274	11.7	1430	189	16.9
4-->2	A128 Brentwood Rd (South) to A13 EB mainline	2010	274	16.4	2056	292	15.8	2057	222	20.8
4-->3	A128 Brentwood Rd (South) to A1013 Stanford Rd (East)	1307	268	10.9	1330	287	10.4	1330	213	14.0
4-->5	A128 Brentwood Rd (South) to A1013 Stanford Rd (West)	856	230	8.3	862	222	8.7	864	132	14.6
4-->6	A128 Brentwood Rd (South) to A13 WB mainline	2351	273	19.3	2353	283	18.6	2364	178	29.7
4-->8	A128 Brentwood Rd (South) to A13 WB off-slip to A1089	2489	285	19.5	1768	262	15.1	2400	180	29.8
5-->1	A1013 Stanford Rd (West) to A128 Brentwood Rd (North)	1453	133	24.4	1465	272	12.1	1474	259	12.7
5-->2	A1013 Stanford Rd (West) to A13 EB mainline	2066	143	32.4	2090	289	16.2	2101	291	16.1
5-->3	A1013 Stanford Rd (West) to A1013 Stanford Rd (East)	1363	136	22.5	1364	285	10.7	1375	282	10.9
5-->4	A1013 Stanford Rd (West) to A128 Brentwood Rd (South)	1323	123	24.0	1315	273	10.8	1326	272	10.9
5-->6	A1013 Stanford Rd (West) to A13 WB mainline	2407	141	38.2	2387	280	19.0	2409	248	21.7
5-->8	A1013 Stanford Rd (West) to A13 WB off-slip to A1089	2545	153	37.1	1802	259	15.5	2445	250	21.9
6-->1	A13 EB mainline to A128 Brentwood Rd (North)	2767	160	38.8	2770	154	40.3	2775	152	40.7
6-->2	A13 EB mainline to A13 EB mainline	3345	121	61.8	3347	122	61.6	3347	126	59.5
6-->3	A13 EB mainline to A1013 Stanford Rd (East)	2678	162	37.0	2669	167	35.8	2676	176	34.1
6-->4	A13 EB mainline to A128 Brentwood Rd (South)	2637	150	39.4	2621	155	37.7	2627	166	35.4
6-->5	A13 EB mainline to A1013 Stanford Rd (West)	2852	169	37.8	2807	174	36.0	2815	190	33.1
6-->8	A13 EB mainline to A13 WB off-slip to A1089	4485	224	44.8	3713	215	38.7	4351	238	40.8

4.3.5 The journey time comparison between the 2030 DM scenario and the 2016 Base Year for the 08:00 – 09:00 period shows the following:

- Journey times in the DM are generally similar to the base year across the majority of the routes, except for those routes originating from the A1013 (W) where journey times increase on average by 138s due to the delays on the approach.
- Journey times for those routes originating from the A1013 (E) on average decrease by 54s as the traffic signals at the A13 (E) approach assists with creating gaps in opposing traffic that contributes to the decrease in journey times.

4.3.6 The journey time comparison between the 2030 DS and 2030 DM scenarios for the 08:00 – 09:00 period shows the following:

- Journey times in the DS scenario are generally higher than the DM scenario across the majority of the routes, except for those routes originating from the A128 (S) and the A1013 (W) where journey times decrease in the DS scenario.
- The journey times originating from A128 (S) decrease on average by 84s as the introduction of traffic signals controlling the traffic contributes to the reduction in journey times.
- Journey time from the A13 (E) to the A1089 increases more than the journey times from the A13 (E) to other destinations, as traffic travelling from the A13 (E) to the A1089 are required to travel through the Orsett Cock junction in the DS scenario.
- Journey times in the DS scenario on the A13 mainline are similar to the DM scenario in both directions.

Table 4.6 Journey Time Comparison PM 17:00 – 18:00

Route	Name	2016 Base			2030 DM			2030 DS		
		Distance [m]	JT [s]	Speed [mph]	Distance [m]	JT [s]	Speed [mph]	Distance [m]	JT [s]	Speed [mph]
1-->2	A128 Brentwood Rd (North) to A13 EB mainline	2084	153	30.5	2122	134	35.5	2122	286	16.6
1-->3	A128 Brentwood Rd (North) to A1013 Stanford Rd (East)	1381	145	21.3	1396	131	23.9	1396	271	11.5
1-->4	A128 Brentwood Rd (North) to A128 Brentwood Rd (South)	1341	130	23.0	1347	116	26.1	1347	258	11.7
1-->5	A128 Brentwood Rd (North) to A1013 Stanford Rd (West)	1555	147	23.7	1533	134	25.5	1535	282	12.2
1-->6	A128 Brentwood Rd (North) to A13 WB mainline	3051	190	36.0	3025	185	36.6	3036	322	21.1
1-->8	A128 Brentwood Rd (North) to A13 WB off-slip to A1089	3189	202	35.2	2439	164	33.3	3071	326	21.1
2-->1	A13 WB mainline to A128 Brentwood Rd (North)	2343	188	27.9	2360	161	32.8	2359	491	10.8
2-->3	A13 WB mainline to A1013 Stanford Rd (East)	1628	150	24.2	1653	103	35.8	1653	413	9.0
2-->4	A13 WB mainline to A128 Brentwood Rd (South)	1588	136	26.2	1605	88	40.7	1605	400	9.0
2-->5	A13 WB mainline to A1013 Stanford Rd (West)	1803	152	26.6	1791	107	37.5	1793	424	9.5
2-->6	A13 WB mainline to A13 WB mainline	3177	113	62.8	3177	114	62.5	3178	118	60.5
2-->8	A13 WB mainline to A13 WB off-slip to A1089	3315	126	59.0	3315	127	58.6	3329	468	15.9
3-->1	A1013 Stanford Rd (East) to A128 Brentwood Rd (North)	1563	122	28.6	1590	139	25.6	1589	178	19.9
3-->2	A1013 Stanford Rd (East) to A13 EB mainline	2176	136	35.8	2215	163	30.3	2215	225	22.0
3-->4	A1013 Stanford Rd (East) to A128 Brentwood Rd (South)	807	70	25.8	835	66	28.2	835	88	21.3
3-->5	A1013 Stanford Rd (East) to A1013 Stanford Rd (West)	1022	86	26.6	1021	85	26.9	1023	111	20.5
3-->6	A1013 Stanford Rd (East) to A13 WB mainline	2517	129	43.6	2513	135	41.5	2523	152	37.1
3-->8	A1013 Stanford Rd (East) to A13 WB off-slip to A1089	2655	142	41.9	1927	114	37.6	2559	156	36.7
4-->1	A128 Brentwood Rd (South) to A128 Brentwood Rd (North)	1397	98	31.9	1431	136	23.6	1430	163	19.6
4-->2	A128 Brentwood Rd (South) to A13 EB mainline	2010	112	40.3	2056	160	28.7	2057	210	21.9
4-->3	A128 Brentwood Rd (South) to A1013 Stanford Rd (East)	1307	104	28.1	1330	157	18.9	1330	195	15.3
4-->5	A128 Brentwood Rd (South) to A1013 Stanford Rd (West)	856	62	31.1	862	82	23.6	864	96	20.1
4-->6	A128 Brentwood Rd (South) to A13 WB mainline	2351	105	50.2	2354	132	39.8	2365	137	38.7
4-->8	A128 Brentwood Rd (South) to A13 WB off-slip to A1089	2489	117	47.4	1768	111	35.5	2400	140	38.2
5-->1	A1013 Stanford Rd (West) to A128 Brentwood Rd (North)	1452	118	27.4	1465	130	25.2	1474	145	22.8
5-->2	A1013 Stanford Rd (West) to A13 EB mainline	2065	132	34.9	2090	155	30.2	2101	191	24.6
5-->3	A1013 Stanford Rd (West) to A1013 Stanford Rd (East)	1362	125	24.4	1364	152	20.1	1375	176	17.5
5-->4	A1013 Stanford Rd (West) to A128 Brentwood Rd (South)	1321	110	26.9	1315	136	21.6	1326	164	18.1
5-->6	A1013 Stanford Rd (West) to A13 WB mainline	2406	125	42.9	2387	127	42.1	2409	118	45.6
5-->8	A1013 Stanford Rd (West) to A13 WB off-slip to A1089	2544	138	41.2	1802	106	38.1	2445	122	44.8
6-->1	A13 EB mainline to A128 Brentwood Rd (North)	2768	374	16.6	2770	149	41.5	2775	228	27.3
6-->2	A13 EB mainline to A13 EB mainline	3345	267	28.1	3347	124	60.5	3347	149	50.3
6-->3	A13 EB mainline to A1013 Stanford Rd (East)	2678	380	15.8	2669	171	35.0	2676	259	23.1
6-->4	A13 EB mainline to A128 Brentwood Rd (South)	2637	365	16.2	2621	155	37.7	2627	247	23.8
6-->5	A13 EB mainline to A1013 Stanford Rd (West)	2852	381	16.7	2807	174	36.1	2815	271	23.3
6-->8	A13 EB mainline to A13 WB off-slip to A1089	4485	437	23.0	3713	204	40.8	4351	315	30.9

4.3.7 The journey time comparison between the 2030 DM scenario and 2016 Base Year for the 17:00 – 18:00 period shows the following:

- Journey times in the DM scenario are generally lower than the base year across the majority of the routes, except for those routes originating from the A128 (S) where journey times increase on average by 30s.
- Journey times for routes originating from the A13 (W) eastbound reduce significantly by over 200s due to widening of the A13 mainline in the DM scenario.

4.3.8 The journey time comparison between the 2030 DS and 2030 DM scenarios for the 17:00 – 18:00 period shows the following:

- Journey times in the DS scenario are higher than the DM scenario across all routes due to the congestion at the Orsett Cock junction.

- Journey times of routes originating from the A13 (E) and the A128 (N) increase the most due to the delay on the approach to the junction. Journey times from the A13 (E) increase by over 300s and the journey times from the A128 (N) increase by 147s on average.

4.4 Relative Delays

4.4.1 The relative delay in VISSIM is the total segment delay divided by the total segment travel time on a link, with the link made up of 10m length segments.

4.4.2 The relative delay plots on all links in the network are shown in Plate 4.2 to Plate 4.7. They provide a visual representation of the delays at the junctions and along the mainline.

Plate 4.2 Relative Delay Plot (2030 DM 07:00 – 08:00)

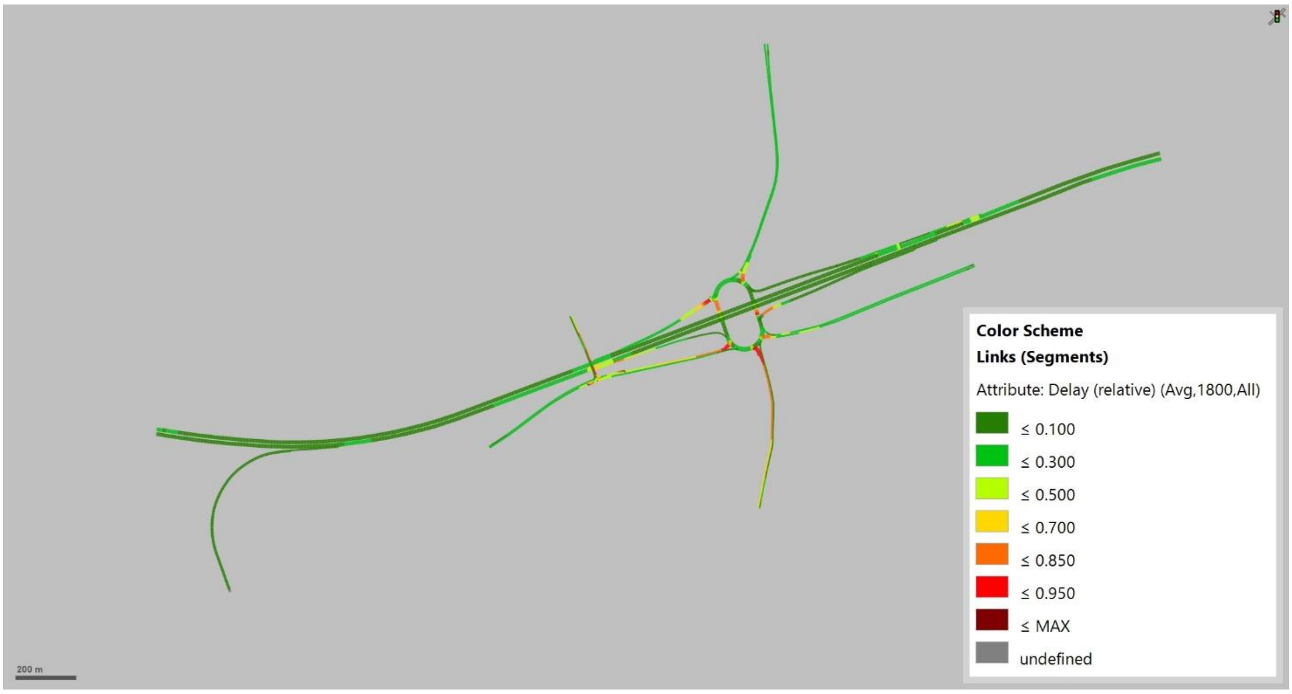


Plate 4.3 Relative Delay Plot (2030 DS 07:00 – 08:00)

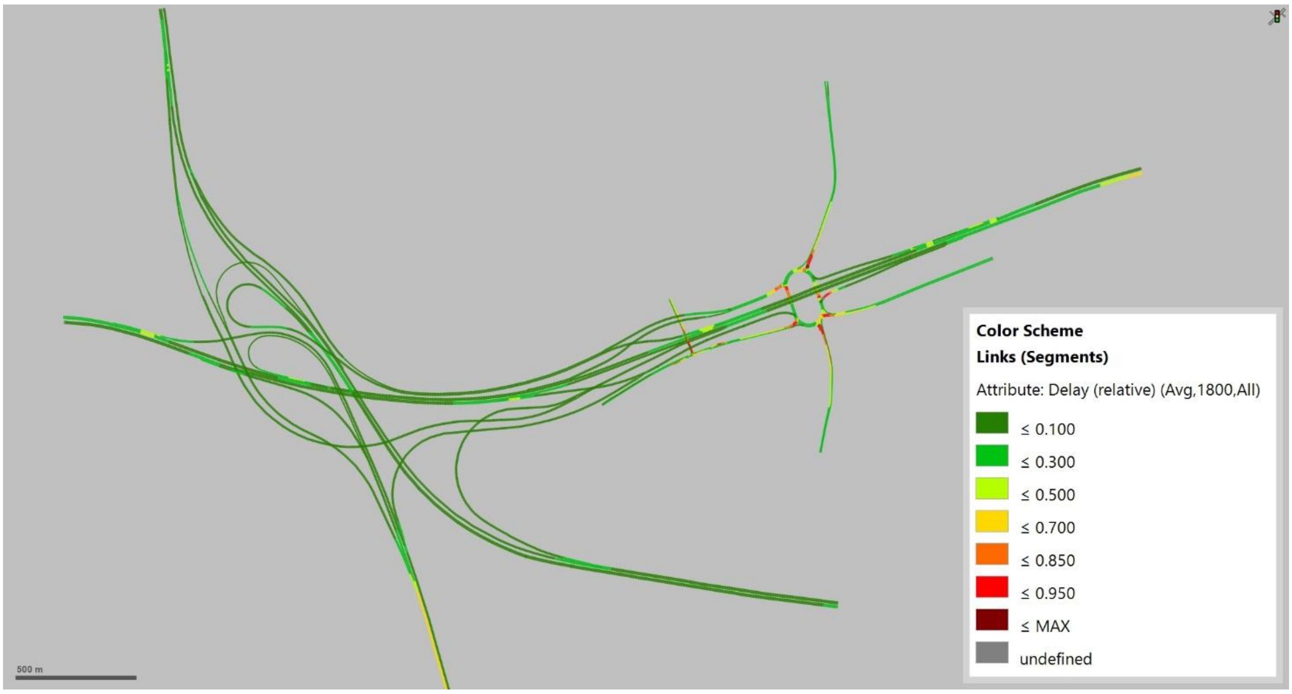


Plate 4.4 Relative Delay Plot (2030 DM 08:00 – 09:00)

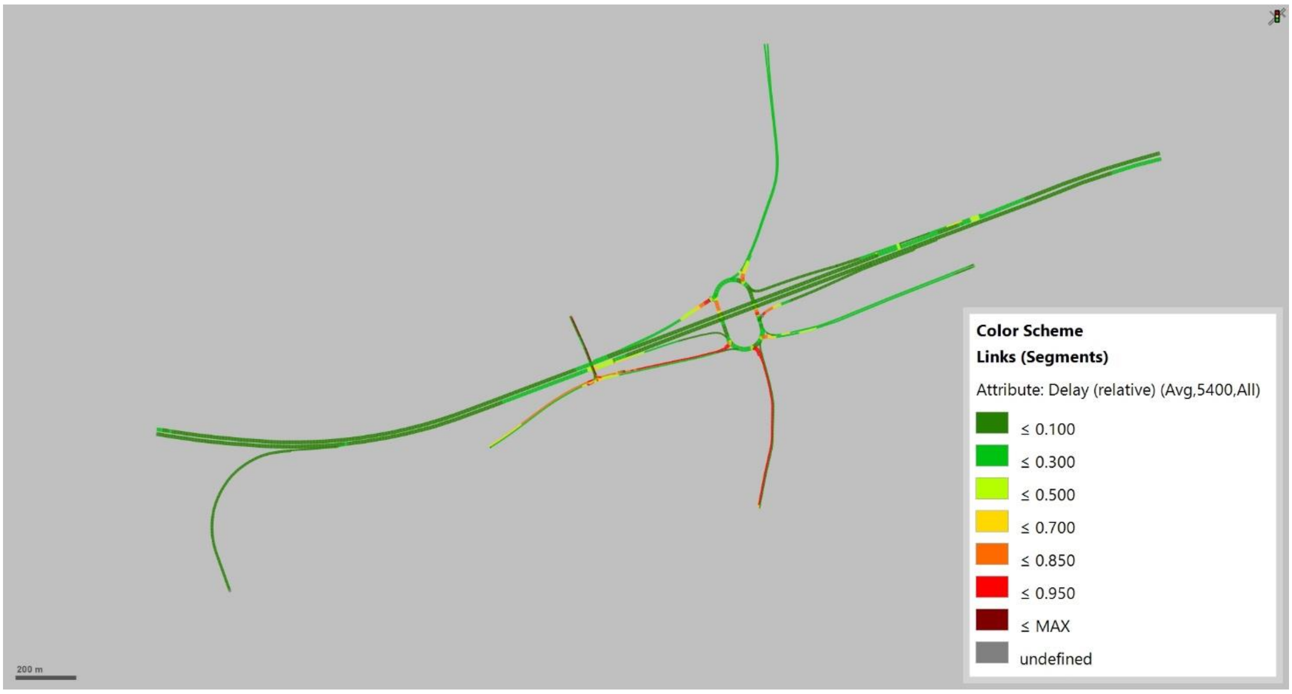


Plate 4.5 Relative Delay Plot (2030 DS 08:00 – 09:00)

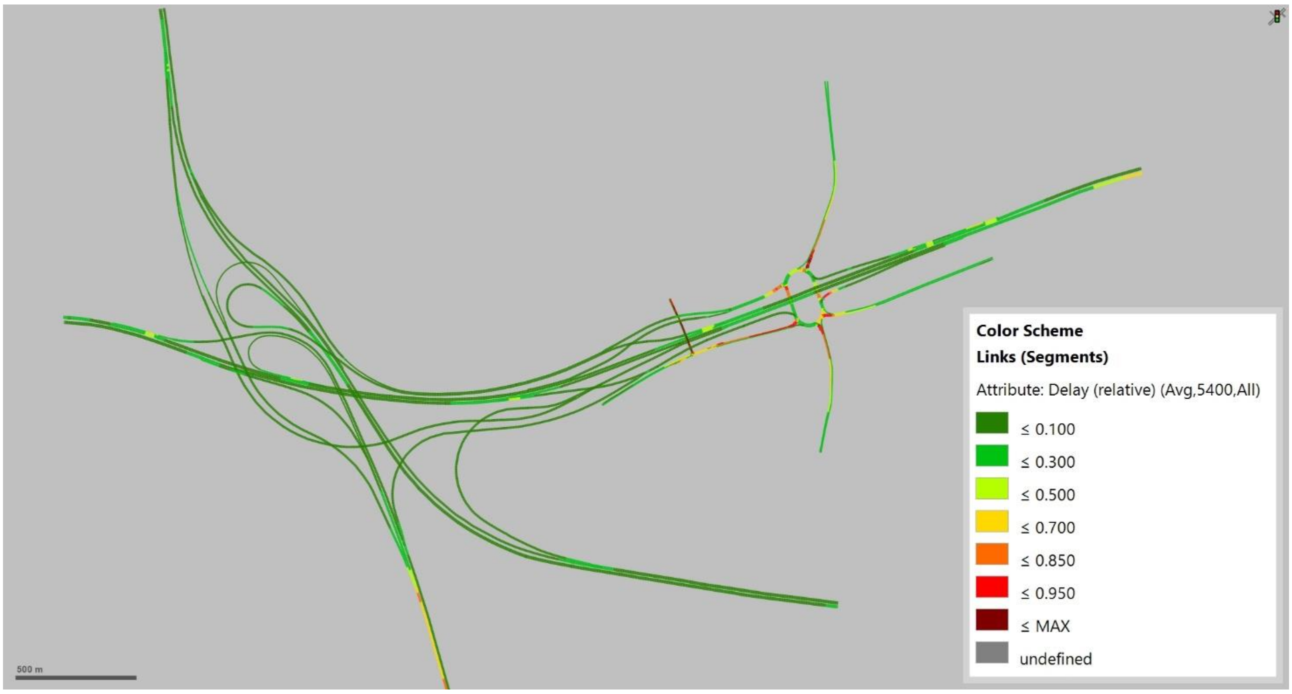


Plate 4.6 Relative Delay Plot (2030 DM 17:00 – 18:00)

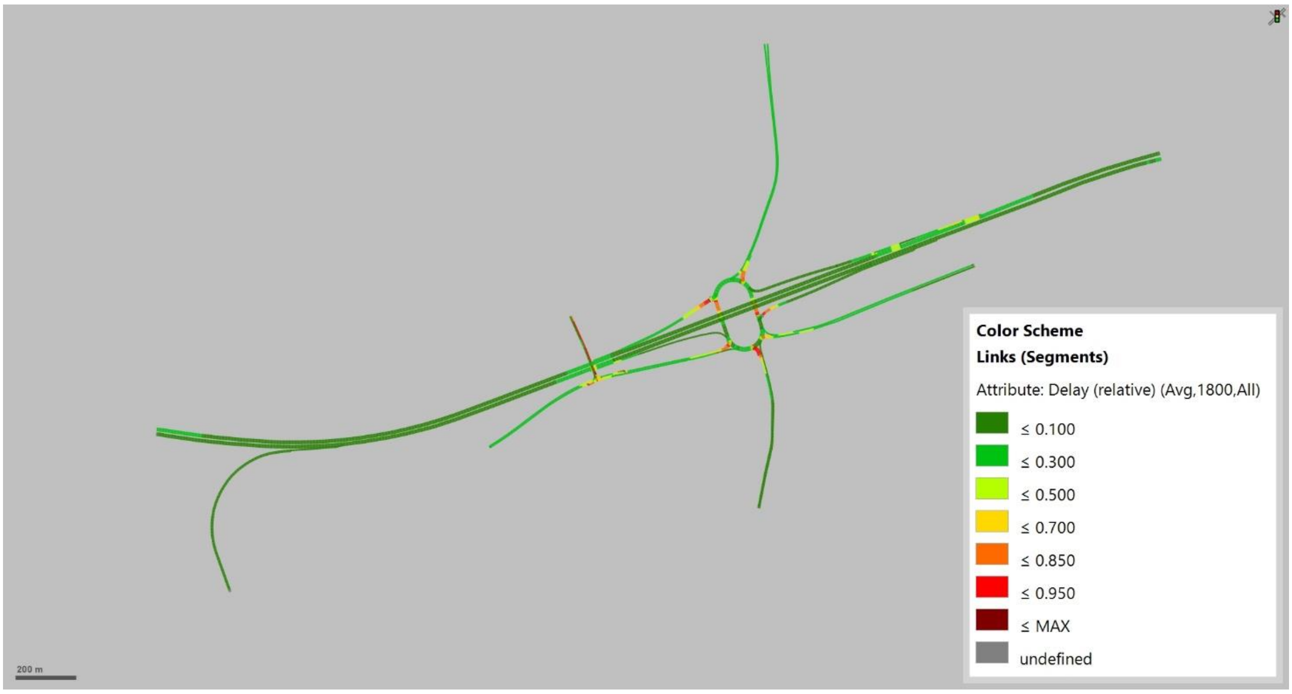
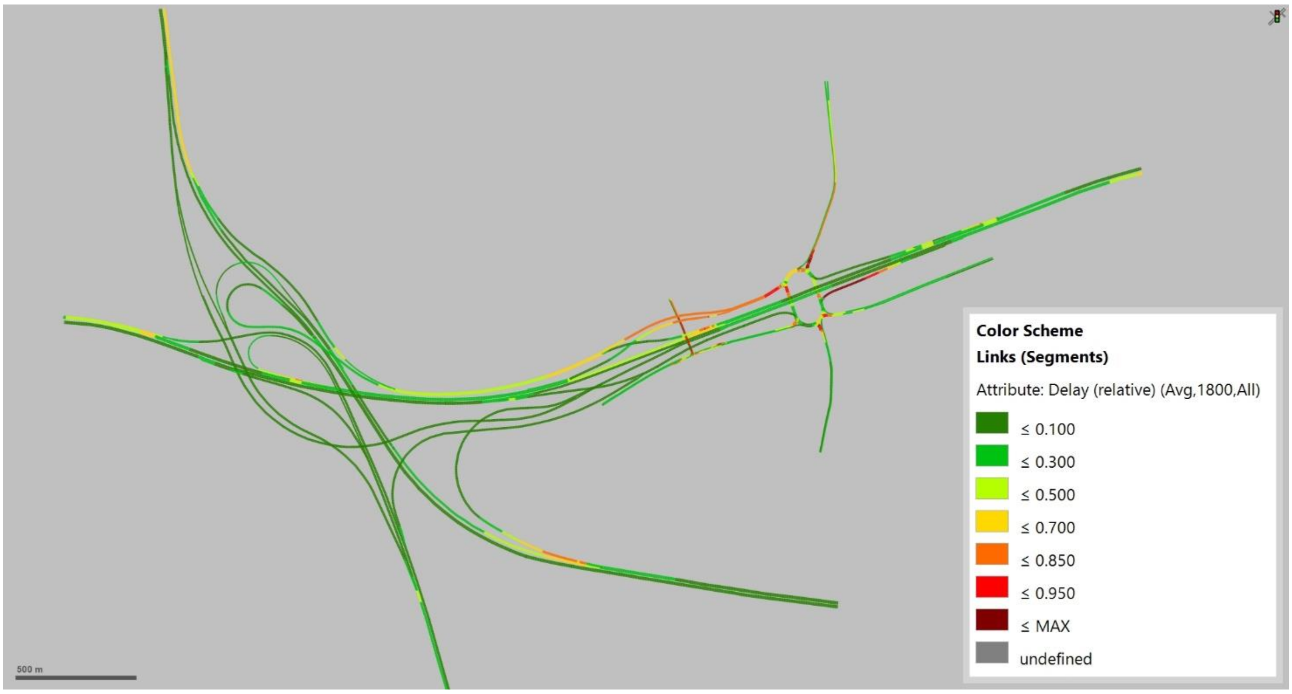


Plate 4.7 Relative Delay Plot (2030 DS 17:00 – 18:00)



4.4.3 In addition to the delays at the Orsett Cock and the A1013 Stanford Road/ Rectory Road junctions, which have been described in the previous sections, the plots also show that the traffic conditions of the A13 mainline are free-flowing in all peak periods.

4.4.4 Plate 4.3 and Plate 4.5 show that the 2030 DS scenario has some minor delays on the A1089 northbound before the diverge to LTC in the AM peak.

4.4.5 Plate 4.7 additionally shows some minor delays on the LTC southbound before the diverge to the Orsett Cock junction and at the southbound merge with the A13 mainline.

5. Conclusion

5.1.1 This report describes the development of the 2030 Do Minimum (DM) and the 2030 Do Something (DS) VISSIM models of the Orsett Cock study area that includes the Orsett Cock junction. It also compares the results between the two models.

5.1.2 The DS model contains initial ideas on changes to improve conditions at the junction. Further improvements will be developed through discussions with Thurrock Council.

5.1.3 The analysis of the traffic conditions at the Orsett Cock junction shows that the A128 (S) and the A1013 (W) approaches are predicted to be over-saturated in 2030 DM scenario (without LTC). The traffic conditions on these approaches improve slightly in 2030 DS scenario (with LTC),

5.1.4 Overall delays and queueing increase at the junction with the implementation of LTC in 2030, particularly in the PM peak period with an increase in delays and queues in the 2030 DS scenario on the A13 (W), A128 (S) and A13 (E) approaches.

5.1.5 Analysis of the traffic conditions at the A1013 Stanford Road/ Rectory Road junction shows that Rectory Road is over-saturated in the 2030 DM scenario and the delays and queues increase in the 2030 DS scenario due to the higher demand flow in the DS scenario and the removal of the right turn pocket on A1013 which reduces the gaps in traffic on the A1013 westbound for right turning vehicles from Rectory Road.

Sub-annex 1.4 – NH The Manorway Microsimulation Modelling

Lower Thames Crossing

Manorway
2030 & 2045 Operational Appraisal
Design Release 4.3 Operational Modelling

DATE: September 2022

Planning Inspectorate Scheme Ref: TR010032
Document Ref: HE540039-LTC-TTM-GEN-REP-DCO-00002

VERSION: 1.0

Lower Thames Crossing

Manorway 2030 & 2045 Operational Appraisal

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1 Introduction

1.1 Purpose of document

1.1.1 The purpose of this document is to present the findings from the traffic operation appraisal undertaken for Design Release 4.3 (DR4.3) of Manorway roundabout on the A13, A1014 The Manorway/ The Sorrells junction and Sorrells roundabout on the A1014, near DP World Gateway Port.

1.2 Modelling Software

1.2.1 Road traffic micro-simulation models represent individual vehicles travelling within the road network, providing realistic driver behaviour such as lane changing and overtaking. The micro-simulation software selected for the Lower Thames Crossing is VISSIM. The model has been developed in VISSIM version 11 (SP14).

1.3 The Project

1.3.1 The A122 Lower Thames Crossing (the Project) would provide a connection between the A2 and M2 in Kent, east of Gravesend, crossing under the River Thames through a tunnel, before joining the M25 south of junction 29. The Project route is presented in Plate 1-1.

Plate 1-1 Lower Thame Crossing route

1.3.2 The A122 road would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13 and junction 29 of the M25. The tunnel entrances would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.

1.3.3 Junctions are proposed at the following locations:

a) New junction with the A2 to the south-east of Gravesend

b) Modified junction with the A13/ A1089 in Thurrock

c) New junction with the M25 between junctions 29 and 30

1.3.4 To align with NPSNN policy and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied. Vehicles would be charged for using the new tunnel.

1.3.5 The Project route would be three lanes in both directions, except for:

a) link roads

b) stretches of the carriageway through junctions

c) the southbound carriageway from the M25 to the junction with the A13/ A1089, which would be two lanes

1.3.6 In common with other A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. Our A122 road design outside of the tunnel includes emergency areas spaced at intervals between 800 metres and 1.6km (less than one mile). The tunnel would include a range of enhanced systems and response measures instead of emergency areas.

1.3.7 The A122 would be classified as an 'all-purpose trunk road' with green signs. For the benefit of safety, walkers, cyclists, horse-riders and slow-moving vehicles would be prohibited from using it.

1.3.8 The Project would include adjustment to a number of side roads. There would also be changes to a number of public rights of way, used by walkers, cyclists, and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities, including gas pipelines, overhead power lines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.

1.3.9 The Project has been developed to avoid or minimise significant effects on the environment. Some of the measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

1.4 Structure of this report

1.4.1 The report provides the methodology of the modelling process including:

a) Chapter 2: Modelling Scope;

b) Chapter 3: VISSIM Model Development;

c) Chapter 4: Modelling Results;

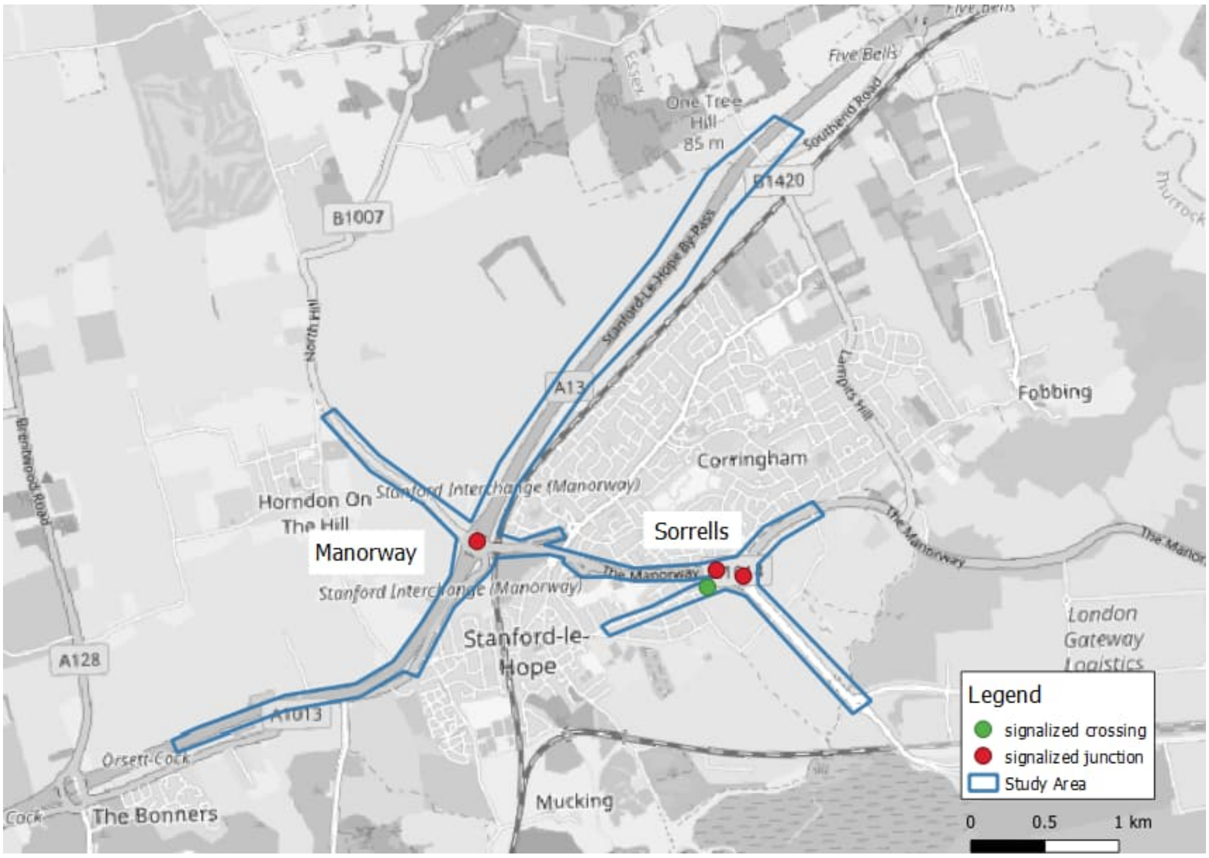
d) Chapter 5: Sensitivity Tests; and

e) Chapter 6: Conclusion.

2 Modelling Scope

2.1.1 The traffic operation study area is located north of Stanford-le-Hope and Plate 2-1 shows the extent of the study area covered by the VISSIM model. It includes three junctions and one signalised pedestrian crossing.

Plate 2-1 Traffic Operations Study Area



2.1.2 The list of junctions and the junction type included in the model is show in Table 2-1, and Table 2-2 lists the standalone signalised pedestrian crossing included the model.

Table 2-1 Modelled Junctions and Junction Type

Nr	Junction	Junction Type
1	Manorway roundabout	Signalised Roundabout
2	A1014 The Manorway/ The Sorrells	Signalised T-junction
3	Sorrells roundabout	Signalised Roundabout

Table 2-2 Modelled Signalised Pedestrian Crossings

A	Pedestrian Crossings on Corringham Rd (near Sorrells roundabout)

3 VISSIM Model Development

3.1 Technical Guidance

3.1.1 The Department for Transport's (DfT) Transport Analysis Guidance (TAG) has little guidance specific to micro-simulation models. Therefore, in accordance with industry best practice, this operational appraisal references the Transport for London (TfL) modelling guidelines which cover micro-simulation models in detail, in particular:

a) Traffic Modelling Guidelines, TfL, Version 4.0 (September 2021); and

b) Model Auditing Process (MAP) – Traffic Schemes in London Urban Network, TfL, Version 3.5.

3.2 Network Development

3.2.1 The Do Minimum (without LTC) and Do Something (with LTC) networks are the same, as there are no changes proposed to the network with LTC in operation.

3.2.2 The link structure for the network (Do Minimum and Do Something), including link lengths, connector turning movements, bus lanes and bus stop locations were coded using the latest available OS mapping, informed by Google Earth aerial photography.

3.2.3 Reduced speed areas were set up on all turning movements, with tighter turns having lower reduced speed values. Desired Speed decisions were used to set desired speeds on entry to the network and where there is a change in the posted speed limit. Vehicles attempt to travel in the model at this constant desired speed and will only adjust this speed if they approach a queue or are performing a lane change or enter a reduced speed area.

3.2.4 Priority rules have been used where one traffic movement has to give way to another traffic movement at priority junctions. The default values of a 5m headway and 3-second gap time were used.

3.2.5 Gap time and headway values were reviewed and updated as part of the model calibration process to replicate site conditions and these were then adjusted based upon considerations of geometry, position and the types of vehicles stopping. The gap times for heavy vehicles (buses and Heavy Goods Vehicles) are longer than for light vehicles (cars and Light Goods Vehicles). This reflects the fact that large vehicles have to wait for larger gaps in traffic than cars.

3.3 Signalised Junctions and Crossings

3.3.1 There are three signalised junctions in the study area and one signalised pedestrian crossing, as shown in Plate 2-1 above and listed in Table 2-1 and Table 2-2 respectively.

3.3.2 All signals within the VISSIM model were coded as fixed, apart from the one pedestrian crossing which was coded as demand dependant.

3.3.3 Intergreens were calculated and signal timings were optimised in relation to the traffic flows at the junctions.

3.3.4 All relevant PUA (interstage) files and VAP (controller logic) files accompany the VISSIM models.

3.4 Traffic Signals Optimisation

3.4.1 The operation of traffic signals in the Do Minimum and Do Something network were initially optimised using LinSIG models and then further fine-tuned in VISSIM to reflect the small changes in demand and arrival pattern of vehicles in the 15-minute intervals.

3.4.2 A cycle time of 60 seconds was used in the DM and DS models.

3.5 Traffic Demand Matrices

3.5.1 The model contains three vehicle classes:

- Cars;
- Light Goods Vehicles (LGVs); and
- Heavy Goods Vehicles (HGVs).

3.5.2 The hourly matrices for Cars, LGVs and HGVs were prepared using the actual flows directly from an LTAM cordon of the study area.

3.6 Public Transport

3.6.1 The following bus routes have been included in the model:

- 100
- 27
- Z4

3.6.2 Bus routes were coded separately from general traffic. They were coded using the VISSIM public transport lines feature, with a public transport line set up for each bus route. Bus route and frequency information was derived from bus timetable information that is publicly available on Thurrock Council website. For all bus routes and bus stops, a dwell time of 10 seconds with a 2 second standard deviation has been modelled.

3.6.3 A summary of the modelled bus routes and their frequency is presented in Table 3-1.

Table 3-1 Modelled Bus Routes and Frequency

Bus Route	AM (07:00 – 08:00)	PM (17:00 – 18:00)
100 (EB)	4 per hour	4 per hour
100 (WB)	4 per hour	4 per hour
27 (EB)	1 per hour	1 per hour
27 (WB)	1 per hour	1 per hour
Z4 (EB)	1 per hour	1 per hour
Z4 (WB)	1 per hour	1 per hour

3.7 Traffic Assignment

3.7.1 The traffic is assigned using ‘dynamic assignment’. Origin-Destination (OD) matrices are used to connect all zones in the model area. As there is no route choice in the model, each OD pair has a unique route and converging the models was not required. Each model has 10x10 matrices for the warm-up period and the peak hour.

3.8 Number of Random Seed Records

3.8.1 Traffic conditions are variable and this affects:

a) **Overall traffic volumes,** accounted for in VISSIM by selecting a representative peak hour.

b) **Random Driver Behaviours,** with traffic conditions varying day-to-day as a result of random driver behaviours such as speed selection, lane changing, route choice and bus dwell times. The stochastic micro-simulation traffic model in VISSIM attempts to replicate this day-to-day random variability by altering individual driver decisions based on random numbers. The set of random numbers is generated from an initial ‘seed’ value specified at the start of a simulation run. A single set of random numbers, generated by a single seed value, therefore represents one potential outcome, or one particular day of traffic operation. The actual value of the seed has no significance, however the seeds for different runs must be different from each other in order to produce different outcomes. Based on industry best practice and modelling guidelines, the recommended number of random seed runs is a minimum of 20 (TfL Traffic Modelling Guidelines, Version 4.0).

3.8.2 Model outputs based on 20 runs with different random seeds were considered adequate for the Manorway operational appraisal. This is also consistent with the other VISSIM models developed for LTC.

4 Modelling Results

4.1 Journey Times

4.1.1 Eight key routes were identified for which journey time results were collected. The eight routes are listed below:

1. A13 South to A13 North
2. A13 North to A13 South
3. A13 South to Port Access
4. Port Access to A13 South
5. A13 North to Port Access
6. Port Access to A13 North
7. B1007 to Port Access
8. Port Access to B1007

4.1.2 The routes are shown schematically in the maps in Plate 4-1 to Plate 4-4.

Plate 4-1 Journey time routes 1 and 2

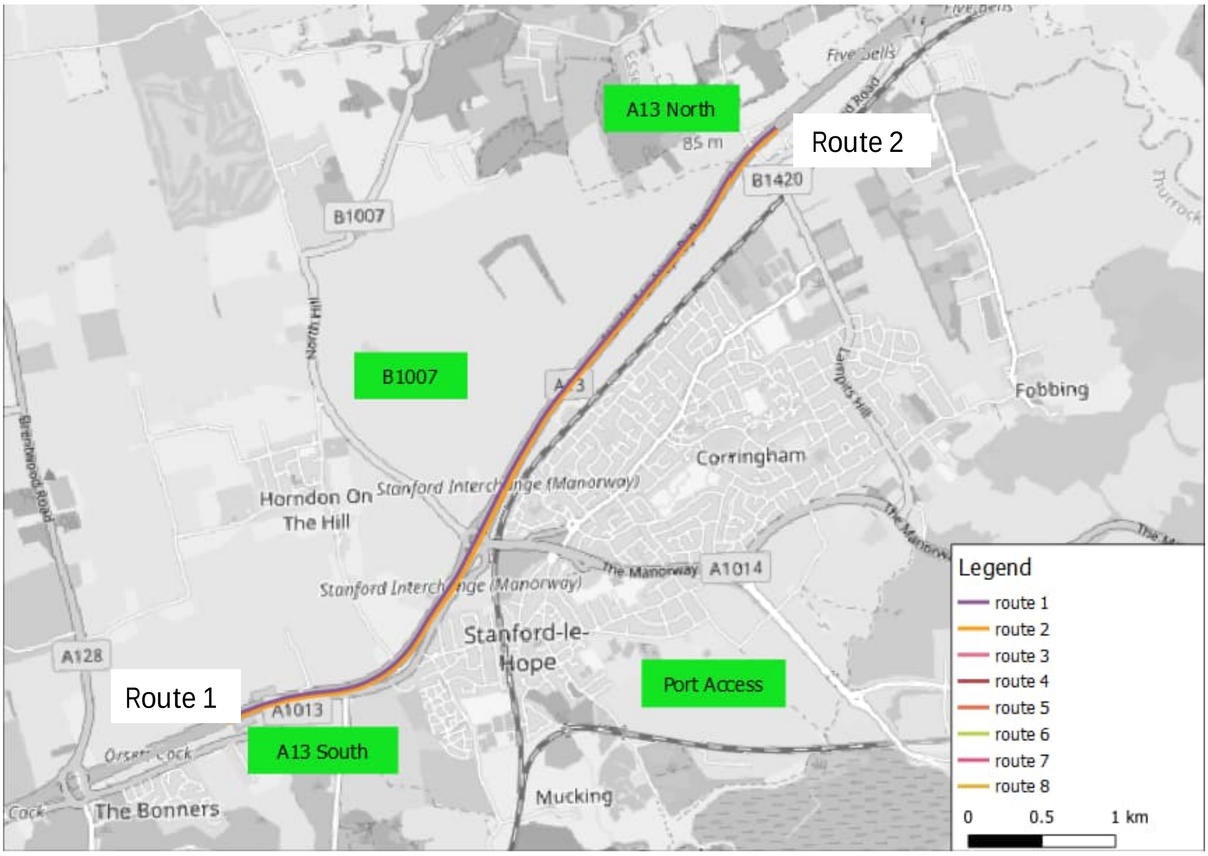


Plate 4-2 Journey time routes 3 and 4

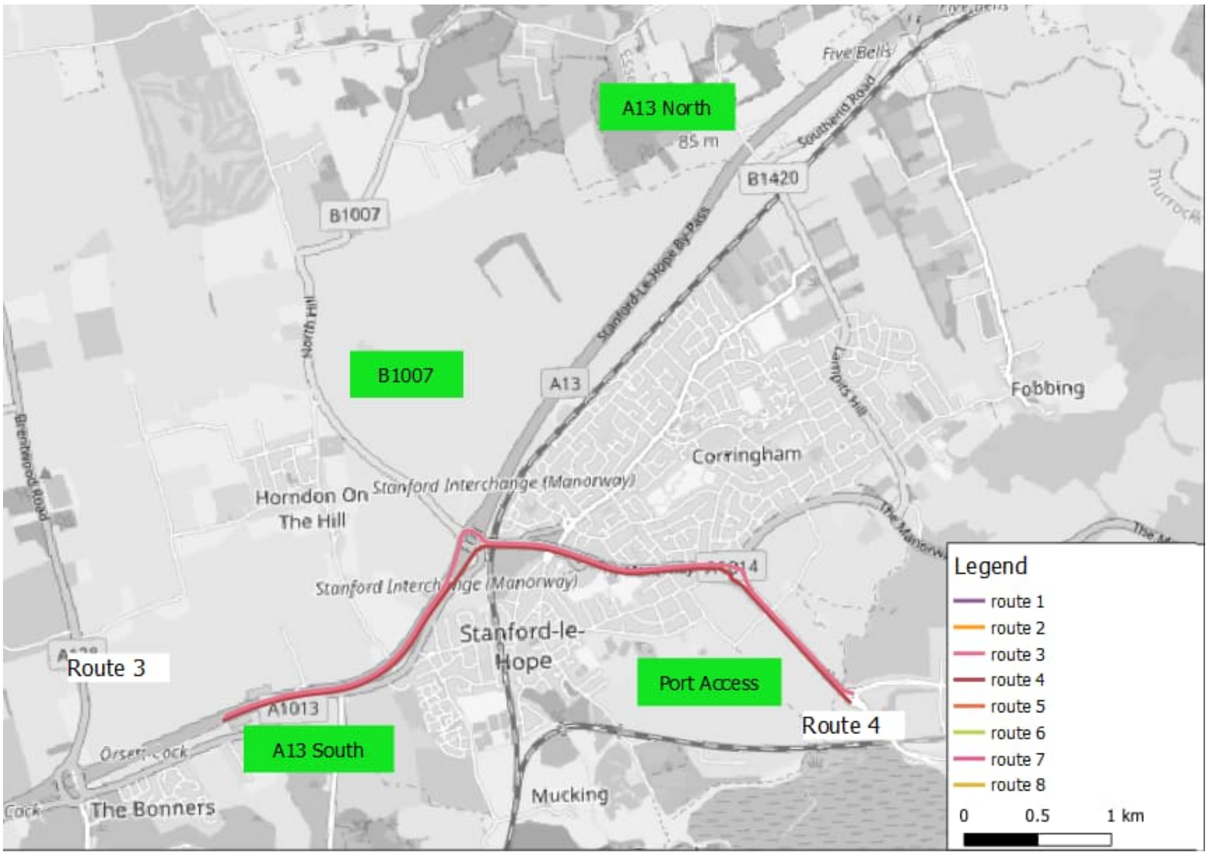


Plate 4-3 Journey time routes 5 and 6

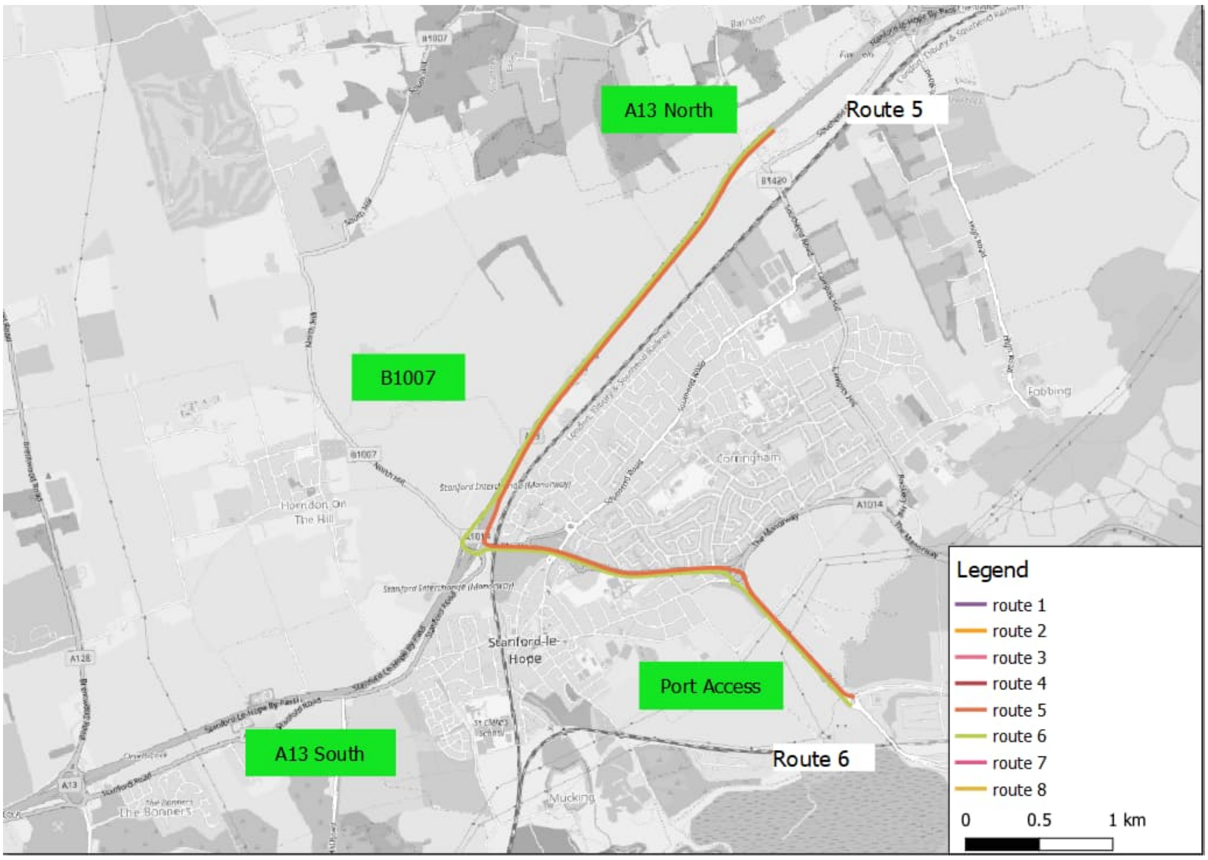
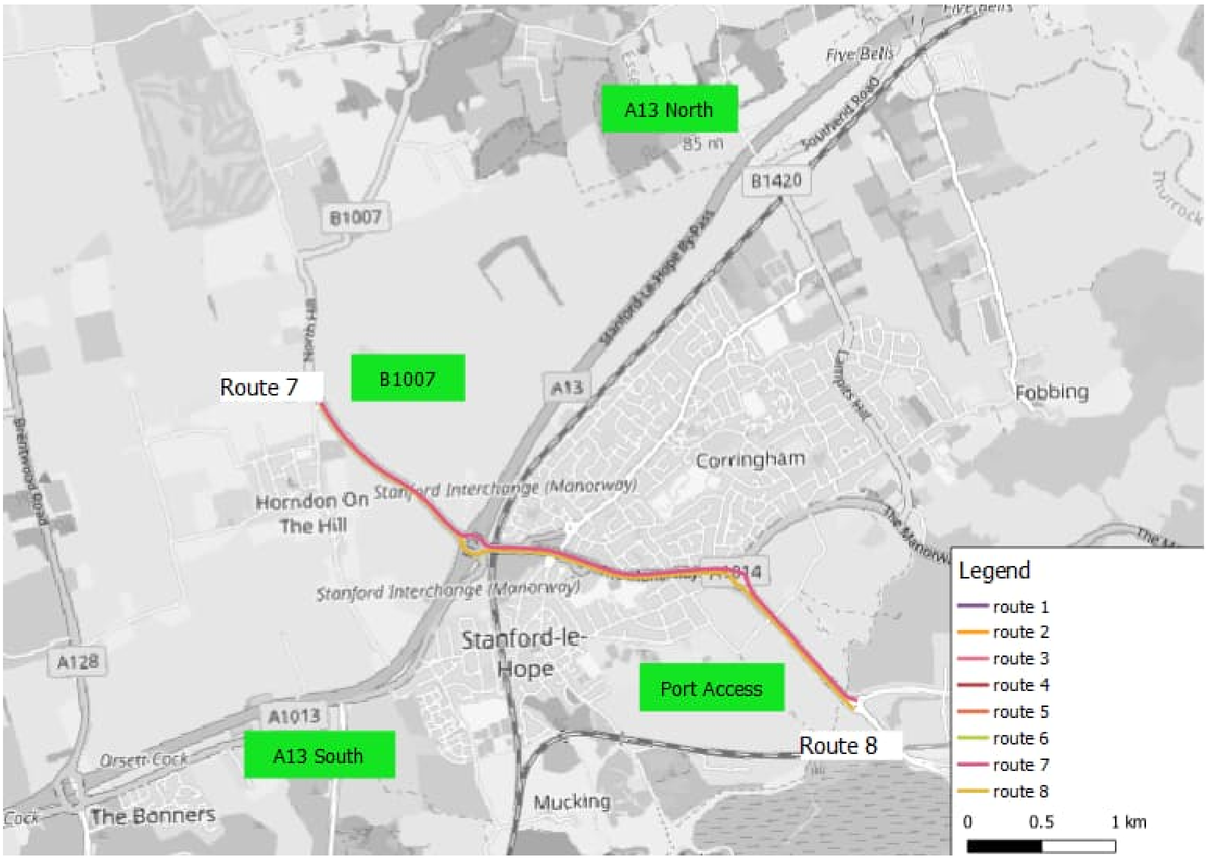


Plate 4-4 Journey time routes 7 and 8



4.1.3 The journey time comparisons between the Do Minimum (without LTC) and Do Something (with LTC) scenarios for the opening year 2030 and design year 2045 in the AM and PM peaks, are presented in Table 4-1 and Table 4-2 respectively.

Table 4-1 Journey times DM v DS – AM Peak

	Journey Times [s]					
	Do-Minimum		Do-Something		Difference (DS-DM)	
Route	2030 AM	2045 AM	2030 AM	2045 AM	2030 AM	2045 AM
1. A13 South to A13 North	103	105	104	106	2	1
2. A13 North to A13 South	111	114	126	135	15	21
3. A13 South to Port Access	238	240	244	242	7	2
4. Port Access to A13 South	225	221	231	239	5	18
5. A13 North to Port Access	205	206	207	213	2	7
6. Port Access to A13 North	258	265	258	264	-1	-2
7. B1007 to Port Access	205	208	209	207	4	0
8. Port Access to B1007	207	202	204	207	-2	5

4.1.4 In the AM peak the model predicts a journey time increase on the A13 southbound of 15 seconds in 2030 and 21 seconds in 2045. The journey time from the Port Access to the A13 South is also predicted to increase by 18 seconds in 2045. The rest of the routes show journey time differences of less than 10 seconds.

Table 4-2 Journey times DM v DS – PM Peak

	Journey Times [s]					
	Do-Minimum		Do-Something		Difference (DS-DM)	
Route	2030 PM	2045 PM	2030 PM	2045 PM	2030 PM	2045 PM
1. A13 South to A13 North	105	105	106	110	2	5
2. A13 North to A13 South	104	109	116	140	13	31
3. A13 South to Port Access	240	242	238	246	-2	3
4. Port Access to A13 South	217	224	232	246	15	22
5. A13 North to Port Access	204	206	207	221	3	15
6. Port Access to A13 North	282	290	276	281	-6	-9
7. B1007 to Port Access	206	211	203	203	-4	-8
8. Port Access to B1007	210	213	216	220	6	7

4.1.5 In the PM peak the model predicts a journey time increase on the A13 southbound of 13 seconds in 2030 and 31 seconds in 2045. The journey time from the Port Access to the A13 South is also predicted to increase by 15 seconds and 22 seconds in 2030 and 2045 respectively. Additionally, the journey time from the A13 North to the Port Access increase by 15 seconds. The rest of the routes show journey time differences of less than 10 seconds.

4.2 Queue Length Results

4.2.1 Queue length results have been collected for all junction approaches. The locations of queue counters at the Manorway roundabout are shown in Plate 4-5, and Plate 4-6 shows the locations of queue counters on the A1014 The Manorway and at Sorrells roundabout.

Plate 4-5 Queue counters – Manorway roundabout

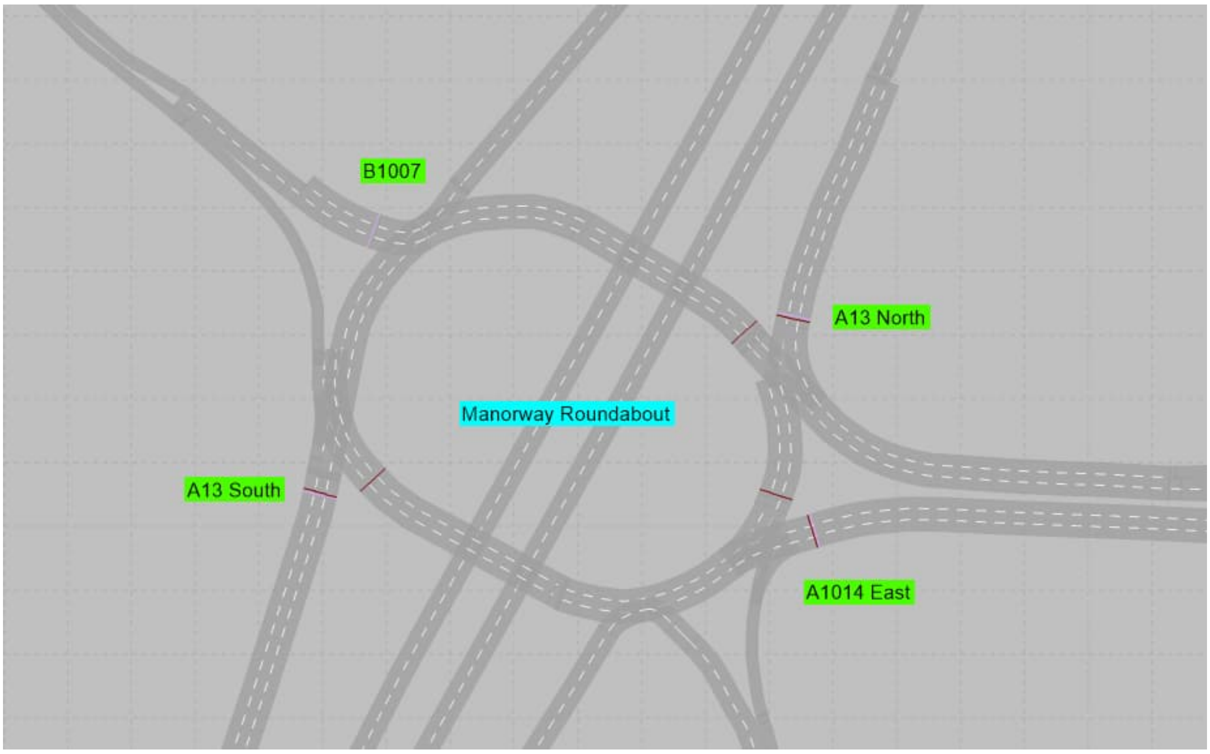
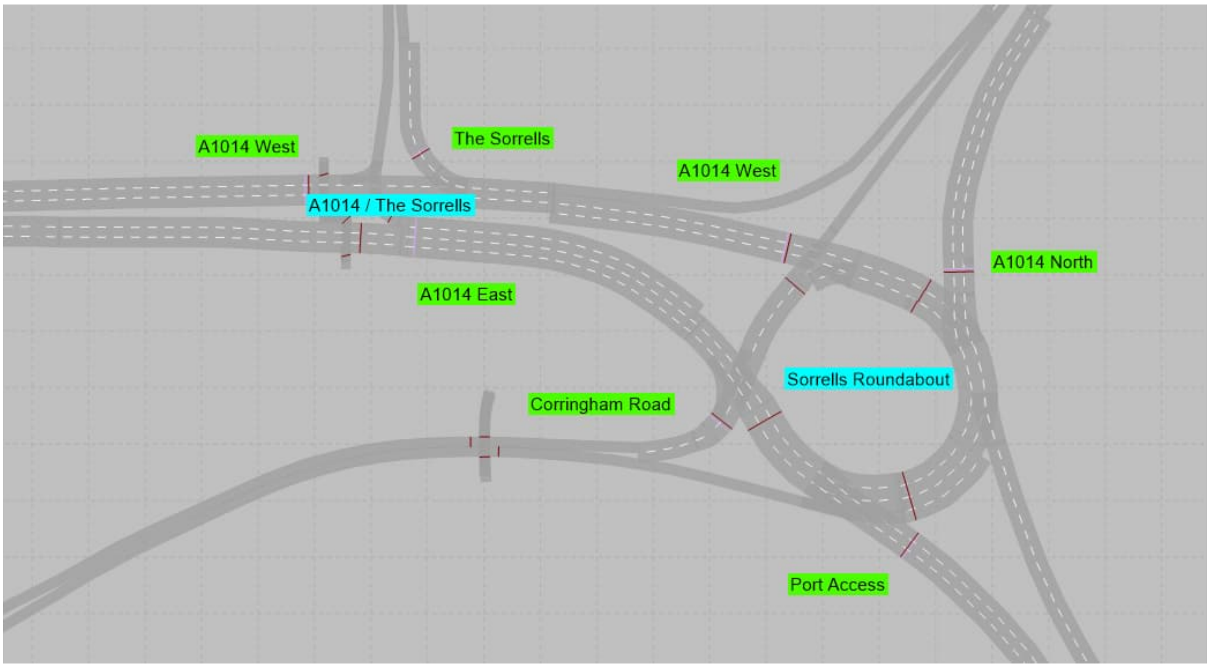


Plate 4-6 Queue counters – A1014 The Manorway, The Sorrels & Sorrells roundabout



4.2.2 Queue counters have been located at the stop lines of each approach in the model. VISSIM considers a vehicle to be in a queue when its speed drops below 5kph and to have left a queue when its speed increases above 10kph and stops measuring the queue when there is a gap of more than 20m between two individual vehicles.

4.2.3 The queue length results from the 2030 and 2045 model runs are presented in Plate 4-7 and Plate 4-8 respectively. The graphs show the Mean Max Queue (MMQ) results which is the average of the maximum queue on each approach in 5-minute intervals.

4.2.4 The results indicate similar levels of queuing between Do Minimum (without LTC) and Do Something (with LTC) scenarios, with differences of less than four vehicles predicted at each of the individual approaches of all the three modelled junctions.

Plate 4-7 Mean Max Queue - 2030

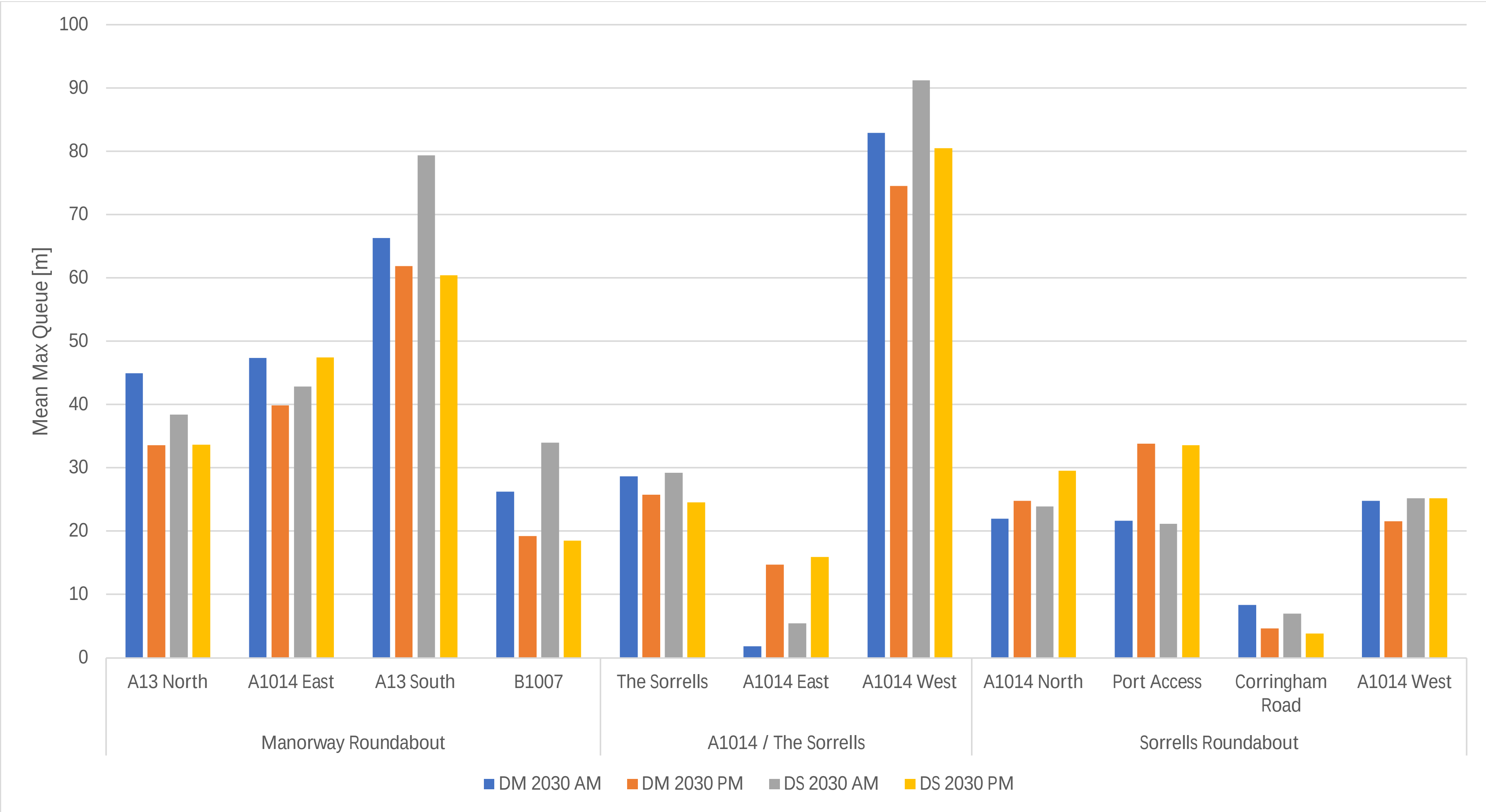
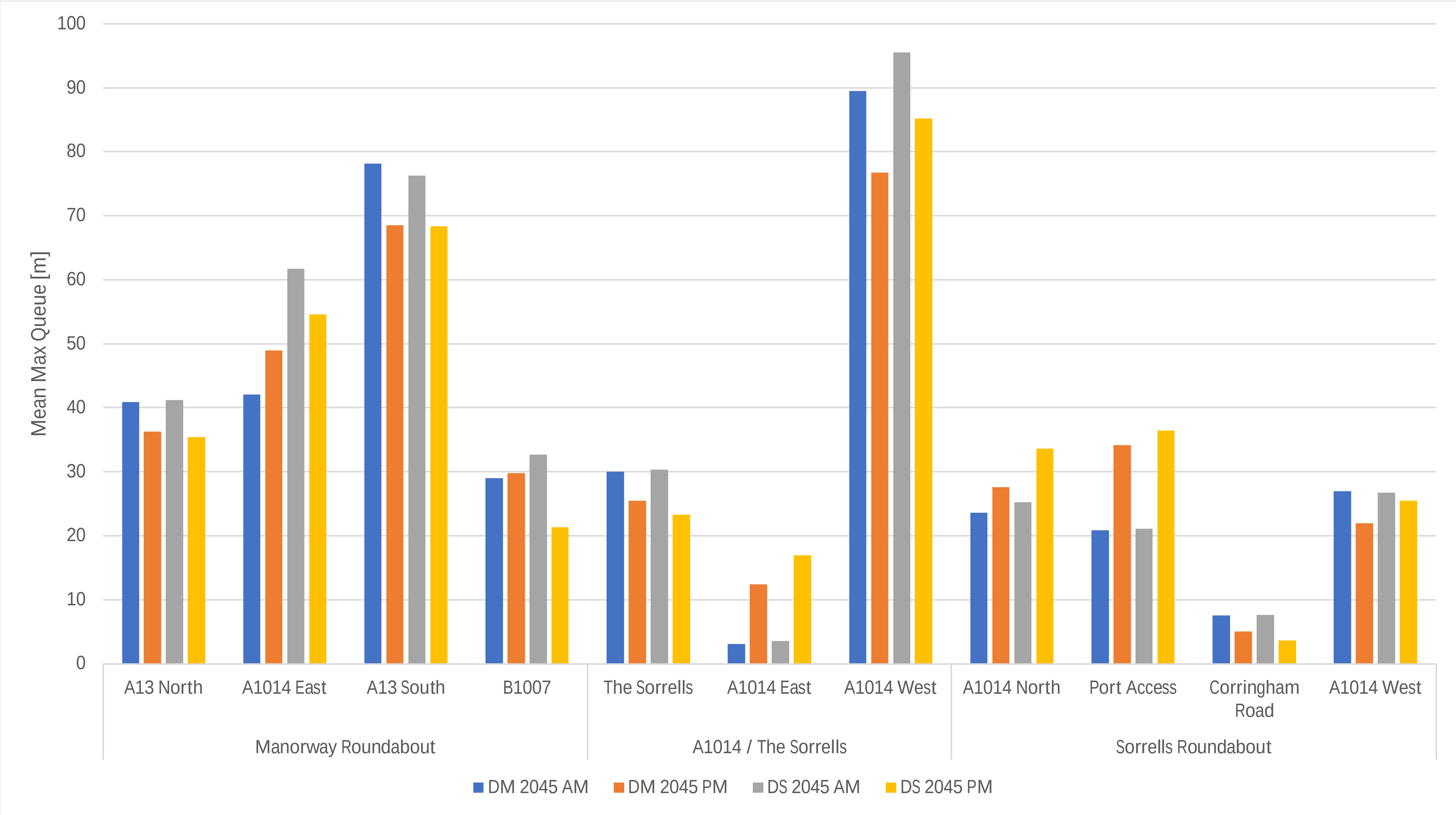


Plate 4-8 Mean Max Queue - 2045



4.3 Junction Results

4.3.1 The node evaluation or predicted performance results at junctions for the 2030 Do Minimum and Do Something, and 2045 Do Minimum and Do Something scenarios, are shown in Table 4-3 and Table 4-4 respectively, and have been measured in terms of the difference (with LTC minus without LTC) of the following:

- Predicted total hourly throughput flow in vehicles;
- Average delay in seconds for each route from an approach; and
- Average approach delay which is the average of all delays originating from the approach along all possible routes.

4.3.2 The average values for flows and delays are the weighted average of all 20 random seed runs.

Table 4-3 Flows and Delays for 2030

			DM 2030 AM		DM 2030 PM		DS 2030 AM		DS 2030 PM		AM Difference		PM Difference	
Junction	Approach	To	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)
Manorway Roundabout	A13 North (off-slip)	A13 North (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 East	371	21.7	353	19.4	313	20.7	294	21.7	-58	-1.0	-59	2.3
		A1013 South	71	30.2	91	30.7	86	37.0	106	33.6	15	6.8	15	2.9
		B1007 West	15	48.6	11	50.5	11	49.2	10	55.8	-4	0.6	-1	5.3
		Average approach delay										2.2		3.5
	A1014 East	A1014 East	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1013 South	34	7.7	77	4.8	33	6.3	72	5.2	-1	-1.5	-5	0.5
		A13 South (on-slip)	1012	7.8	1206	4.6	1295	6.3	1628	5.7	283	-1.4	422	1.1
		B1007 West	81	12.1	428	14.6	75	12.8	351	19.5	-6	0.7	-77	4.9
		A13 North (on-slip)	418	14.0	563	13.9	365	13.1	228	16.0	-53	-0.9	-335	2.1
		Average approach delay										-0.8		2.1

			DM 2030 AM		DM 2030 PM		DS 2030 AM		DS 2030 PM		AM Difference		PM Difference	
Junction	Approach	To	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)
	A1013 South	A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 South (on-slip)	0	0.0	0	0.0	83	7.9	120	10.2	83	7.9	120	10.2
		B1007 West	38	17.5	74	24.5	31	20.7	107	33.7	-7	3.2	33	9.2
		A13 North (on-slip)	255	24.9	176	30.6	199	31.5	47	33.2	-56	6.6	-129	2.6
		A1014 East	77	29.9	31	34.1	80	35.2	46	35.1	3	5.2	15	1.0
		Average approach delay										5.7		5.7
	A13 South (off-slip)	A13 South (on-slip)	0	0.0	0	0.0	35	48.3	27	41.9	35	48.3	27	41.9
		B1007 West	408	13.9	452	14.5	415	13.9	408	10.2	7	-0.1	-44	-4.3
		A1014 East	1101	17.9	1012	17.6	1266	22.4	1197	13.8	165	4.5	185	-3.8
		A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Average approach delay										17.6		11.2
	B1007 West	B1007 West	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 North (on-slip)	24	4.9	25	5.3	23	4.8	18	3.7	-1	-0.1	-7	-1.6
		A1014 East	184	11.9	257	12.4	69	12.1	225	8.9	-115	0.1	-32	-3.5
		A1013 South	50	42.3	30	41.2	41	48.7	45	36.6	-9	6.5	15	-4.5
		A13 South (on-slip)	318	39.8	209	40.3	443	45.3	237	34.7	125	5.5	28	-5.6
		Average approach delay										3.0		-3.8
A1014 / The Sorrells	The Sorrels	A1014 East	191	21.7	171	20.4	198	20.6	175	19.3	7	-1.2	4	-1.1
		Average approach delay										-1.2		-1.1
	A1014 East	A1014 West	907	1.2	1727	4.9	965	3.6	1671	5.0	58	2.4	-56	0.1
		The Sorrels	15	19.1	66	18.6	14	18.2	88	18.7	-1	-0.9	22	0.1
		Average approach delay										0.8		0.1
	A1014 West	The Sorrels	59	13.1	189	14.1	60	14.4	163	15.5	1	1.3	-26	1.4
		A1014 East	1347	10.4	739	11.2	1354	11.3	865	12.8	7	0.9	126	1.6
		Average approach delay										1.1		1.5

Junction	Approach	To	DM 2030 AM Flow (veh)	DM 2030 AM Delay (s)	DM 2030 PM Flow (veh)	DM 2030 PM Delay (s)	DS 2030 AM Flow (veh)	DS 2030 AM Delay (s)	DS 2030 PM Flow (veh)	DS 2030 PM Delay (s)	AM Difference Flow (veh)	AM Difference Delay (s)	PM Difference Flow (veh)	PM Difference Delay (s)
Sorrells Roundabout	A1014 North	A1014 North	15	14.8	32	22.4	15	20.8	104	27.4	0	6.0	72	5.0
		Port Access	66	9.5	15	8.0	123	10.1	14	8.7	57	0.6	-1	0.8
		Corringham Rd	19	9.0	29	10.8	18	11.8	27	12.3	-1	2.8	-2	1.5
		A1014 West	487	10.7	773	19.3	547	18.4	796	20.6	60	7.7	23	1.3
		Average approach delay										4.3		2.1
	Port Access	Port Access	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Corringham Rd	4	8.3	29	8.3	4	8.1	28	8.1	0	-0.2	-1	-0.2
		A1014 West	283	16.9	861	11.4	283	10.2	812	11.5	0	-6.7	-49	0.1
		A1014 North	16	28.7	40	24.4	16	24.2	87	26.4	0	-4.5	47	2.0
		Average approach delay										-3.8		0.6
	Corringham Rd	Corringham Rd	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 West	9	10.2	13	9.8	9	9.5	10	8.4	0	-0.7	-3	-1.4
		A1014 North	37	21.8	13	22.6	37	21.0	12	19.9	0	-0.9	-1	-2.7
		Port Access	22	29.6	2	33.5	20	33.3	2	32.4	-2	3.7	0	-1.1
		Average approach delay										0.7		-1.7
	A1014 West	A1014 West	144	24.7	149	38.6	140	33.4	144	38.9	-4	8.7	-5	0.4
		A1014 North	618	0.9	400	0.6	689	0.9	527	0.8	71	0.1	127	0.1
		Port Access	763	5.0	313	5.0	710	5.1	316	5.0	-53	0.1	3	-0.1
		Corringham Rd	13	28.6	47	18.0	12	29.8	52	18.8	-1	1.1	5	0.9
		Average approach delay										2.5		0.3

Table 4-4 Flows and Delays for 2045

Junction	Approach	To	DM 2045 AM Flow (veh)	DM 2045 AM Delay (s)	DM 2045 PM Flow (veh)	DM 2045 PM Delay (s)	DS 2045 AM Flow (veh)	DS 2045 AM Delay (s)	DS 2045 PM Flow (veh)	DS 2045 PM Delay (s)	AM Difference Flow (veh)	AM Difference Delay (s)	PM Difference Flow (veh)	PM Difference Delay (s)
Manorway Roundabout	A13 North (off-slip)	A13 North (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 East	386	21.2	387	19.3	301	23.6	228	25.8	-85	2.5	-159	6.6
		A1013 South	89	32.0	108	32.6	106	31.8	98	33.1	17	-0.2	-10	0.6
		B1007 West	16	50.1	13	50.8	8	48.1	8	49.5	-8	-2.0	-5	-1.3
		Average approach delay										0.1		2.0
	A1014 East	A1014 East	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1013 South	41	6.0	100	5.7	47	8.9	109	6.5	6	2.8	9	0.8
		A13 South (on-slip)	1136	6.1	1300	5.7	1436	8.3	1704	6.9	300	2.2	404	1.2
		B1007 West	112	12.8	508	16.6	139	15.2	448	20.8	27	2.4	-60	4.2
		A13 North (on-slip)	397	13.4	558	15.4	233	13.3	93	17.5	-164	-0.1	-465	2.1
		Average approach delay										1.8		2.1
	A1013 South	A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 South (on-slip)	0	0.0	0	0.0	86	9.0	95	11.4	86	9.0	95	11.4
		B1007 West	51	17.6	91	27.1	58	26.2	111	32.3	7	8.6	20	5.1
		A13 North (on-slip)	307	31.2	119	32.0	154	32.2	41	29.7	-153	1.0	-78	-2.3
		A1014 East	98	37.6	39	34.7	86	34.7	80	30.8	-12	-2.9	41	-3.9
		Average approach delay										3.9		2.6
	A13 South (off-slip)	A13 South (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		B1007 West	481	14.5	438	14.4	360	11.4	416	11.8	-121	-3.1	-22	-2.6
		A1014 East	1196	19.3	1123	19.2	1381	20.2	1258	16.6	185	0.9	135	-2.7
		A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Average approach delay										-1.1		-2.6

Junction	Approach	To	DM 2045 AM Flow (veh)	DM 2045 AM Delay (s)	DM 2045 PM Flow (veh)	DM 2045 PM Delay (s)	DS 2045 AM Flow (veh)	DS 2045 AM Delay (s)	DS 2045 PM Flow (veh)	DS 2045 PM Delay (s)	AM Difference Flow (veh)	AM Difference Delay (s)	PM Difference Flow (veh)	PM Difference Delay (s)
	B1007 West	B1007 West	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 North (on-slip)	29	5.8	28	6.1	23	4.2	17	3.5	-6	-1.6	-11	-2.6
		A1014 East	126	12.1	237	14.2	76	10.8	312	7.9	-50	-1.2	75	-6.3
		A1013 South	48	43.8	39	45.2	53	41.3	75	31.1	5	-2.5	36	-14.1
		A13 South (on-slip)	352	41.7	237	43.3	464	39.1	229	30.6	112	-2.7	-8	-12.8
		Average approach delay										-2.0		-8.9
A1014 / The Sorrells	The Sorrells	A1014 East	205	21.0	171	20.0	212	20.9	171	19.1	7	-0.1	0	-0.9
		Average approach delay										-0.1		-0.9
	A1014 East	A1014 West	950	3.0	1810	4.6	983	3.0	1654	5.1	33	0.0	-156	0.4
		The Sorrells	14	17.9	63	18.9	13	18.7	97	18.4	-1	0.8	34	-0.5
		Average approach delay										0.4		0.0
	A1014 West	The Sorrells	60	13.0	190	14.5	60	11.1	153	16.7	0	-2.0	-37	2.2
		A1014 East	1375	10.5	841	11.6	1488	9.5	1016	13.9	113	-1.0	175	2.3
		Average approach delay										-1.5		2.2
Sorrells Roundabout	A1014 North	A1014 North	16	20.1	33	25.6	44	21.1	158	27.6	28	1.0	125	2.0
		Port Access	86	9.5	15	8.0	107	9.7	14	9.0	21	0.2	-1	1.0
		Corringham Rd	22	11.5	31	12.4	19	11.8	28	11.6	-3	0.3	-3	-0.8
		A1014 West	532	17.6	854	20.2	559	17.6	842	19.9	27	0.1	-12	-0.3
		Average approach delay										0.4		0.5
	Port Access	Port Access	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Corringham Rd	4	8.1	28	8.6	3	9.4	28	8.5	-1	1.2	0	-0.1
		A1014 West	282	10.0	858	11.7	284	10.8	768	12.8	2	0.7	-90	1.1
		A1014 North	16	20.6	41	17.9	15	20.7	128	29.3	-1	0.1	87	11.4
		Average approach delay										0.7		4.1

Junction	Approach	To	DM 2045 AM Flow (veh)	DM 2045 AM Delay (s)	DM 2045 PM Flow (veh)	DM 2045 PM Delay (s)	DS 2045 AM Flow (veh)	DS 2045 AM Delay (s)	DS 2045 PM Flow (veh)	DS 2045 PM Delay (s)	AM Difference Flow (veh)	AM Difference Delay (s)	PM Difference Flow (veh)	PM Difference Delay (s)
	Corringham Rd	Corringham Rd	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 West	9	8.9	13	8.6	9	10.4	9	9.4	0	1.6	-4	0.7
		A1014 North	39	22.8	16	24.6	37	23.3	9	20.9	-2	0.5	-7	-3.7
		Port Access	21	33.1	2	39.0	20	33.4	2	32.5	-1	0.2	0	-6.5
		Average approach delay										0.8		-3.2
	A1014 West	A1014 West	141	34.6	150	37.1	145	34.6	136	39.1	4	0.0	-14	2.0
		A1014 North	697	1.0	439	0.7	803	1.0	613	0.9	106	0.1	174	0.2
		Port Access	729	5.9	303	6.5	706	6.1	307	5.0	-23	0.2	4	-1.5
		Corringham Rd	13	29.4	119	16.6	45	17.4	131	17.6	32	-12.0	12	1.0
		Average approach delay										-2.9		0.4

4.3.3 The junction results indicate similar levels of delay between the Do Minimum and Do Something scenarios for the 2030 and 2045 future years, in the AM and PM peak periods for the listed routes at the junctions.

4.3.4 In 2030 the modelling predicts that at the Manorway roundabout the A13 South approach (off-slip) would experience an increase in average approach delay of approx. 18 seconds in the AM and approx. 12 seconds in the PM. The respective average approach delays on all the other approaches vary between a maximum increase of approx. 6 seconds and a maximum reduction of approx. 4 seconds.

4.3.5 At the A1014 The Manorway/ The Sorrells junction in 2030, the respective average approach delays vary between a maximum increase of approx. 2 seconds and a maximum reduction of approx. 2 seconds. At Sorrells roundabout it varies between a maximum of 5 seconds increase and a maximum of 4 seconds reduction.

4.3.6 In 2045 the modelling predicts that at the Manorway roundabout the A1013 approach would experience an increase in average approach delay of approx. 4 seconds in the AM and approx. 3 seconds in the PM. The respective average approach delays on all the other approaches vary between a maximum increase of approx. 2-3 seconds and a maximum reduction of approx. 8-9 seconds.

4.3.7 At the A1014 The Manorway/ The Sorrells junction in 2045, the respective average approach delays vary between a maximum increase of approx. 3 seconds and a maximum reduction of approx. 2 seconds. At Sorrells roundabout it varies between a maximum of 5 seconds increase and a maximum of 4 seconds reduction.

5 Sensitivity Tests

5.1 Introduction

5.1.1 As shown in the modelling results analysis in the previous chapter, the VISSIM modelling is not predicting any noticeable changes to the delays with the introduction of the LTC scheme. Particularly in 2045 on the A13 North on-slip (northbound on-slip) the model predicts free-flow conditions both in the Do Minimum (without LTC) and Do Something (with LTC) scenarios, as shown in the relative delay plots in Plate A.7 and Plate A.8 in Appendix A.

5.1.2 LTAM in 2045 however, as shown in Plate 5-1 and Plate 5-2 respectively, predicts additional delays of 65s in the AM Peak and 210s in the PM Peak with the introduction of LTC compared to without LTC.

Plate 5-1 LTAM 2045 DS v DM Delay Difference – AM Peak

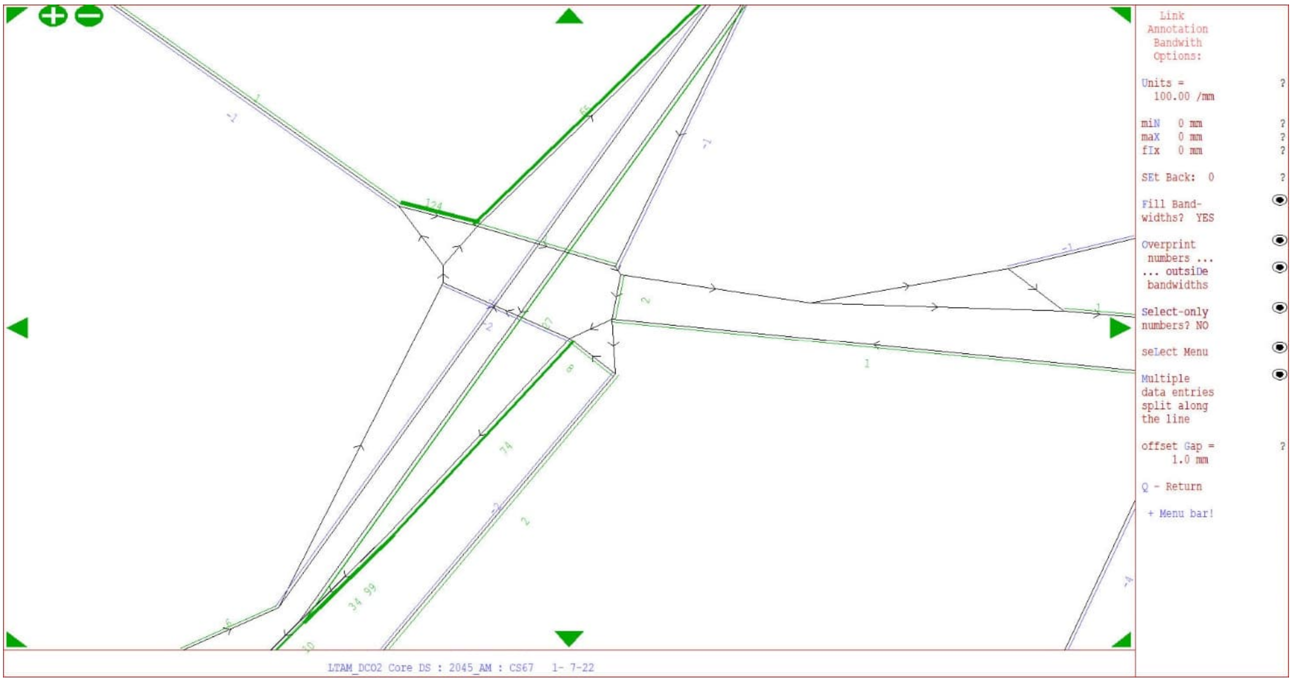
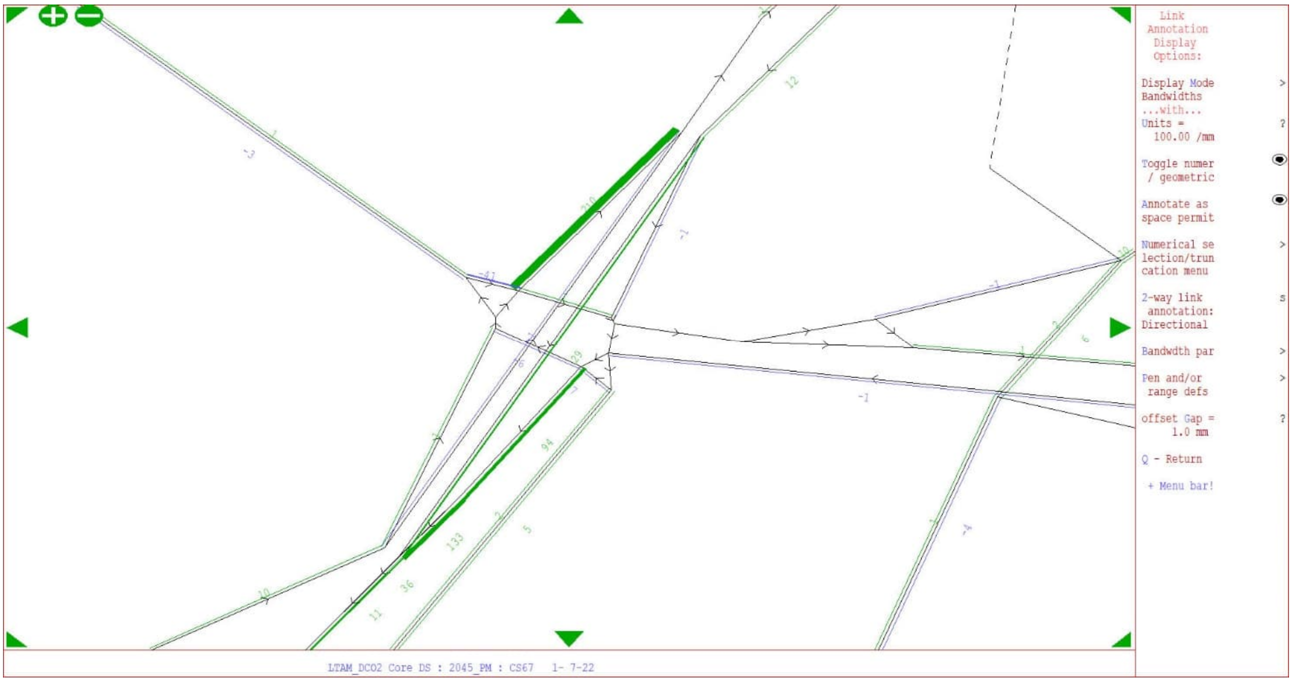


Plate 5-2 LTAM 2045 DS v DM Delay Difference – PM Peak



5.1.3 These delays on the A13 North on-slip suppress the flows accessing the A13 northbound via the slip road. Plate 5-3 and Plate 5-4 show the flow differences between Do Minimum and Do Something scenarios on A13 North on-slip specifically – the LTAM 2045 forecast shows approx. 400 less Passenger Car Units (PCU) in the AM peak and approx. 550 less PCUs in the PM peak in the Do Something model compared to the Do Minimum model.

Plate 5-3 LTAM 2045 DS v DM Flow Difference – AM Peak

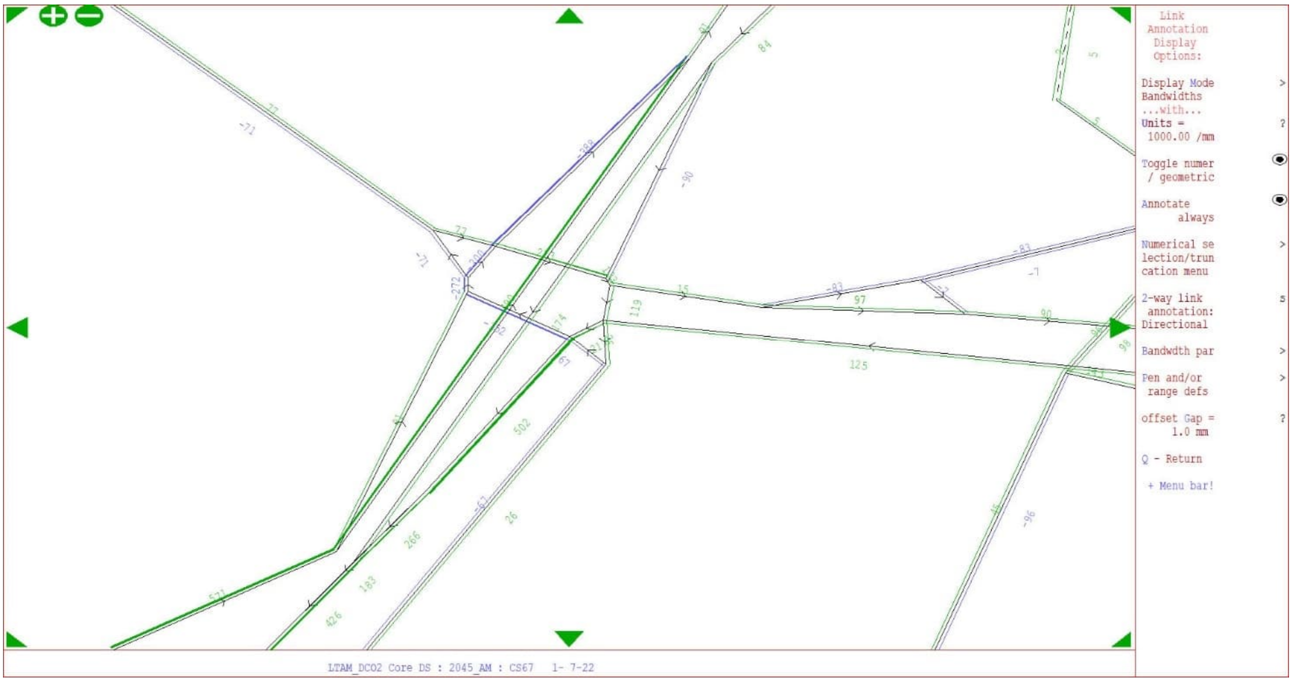
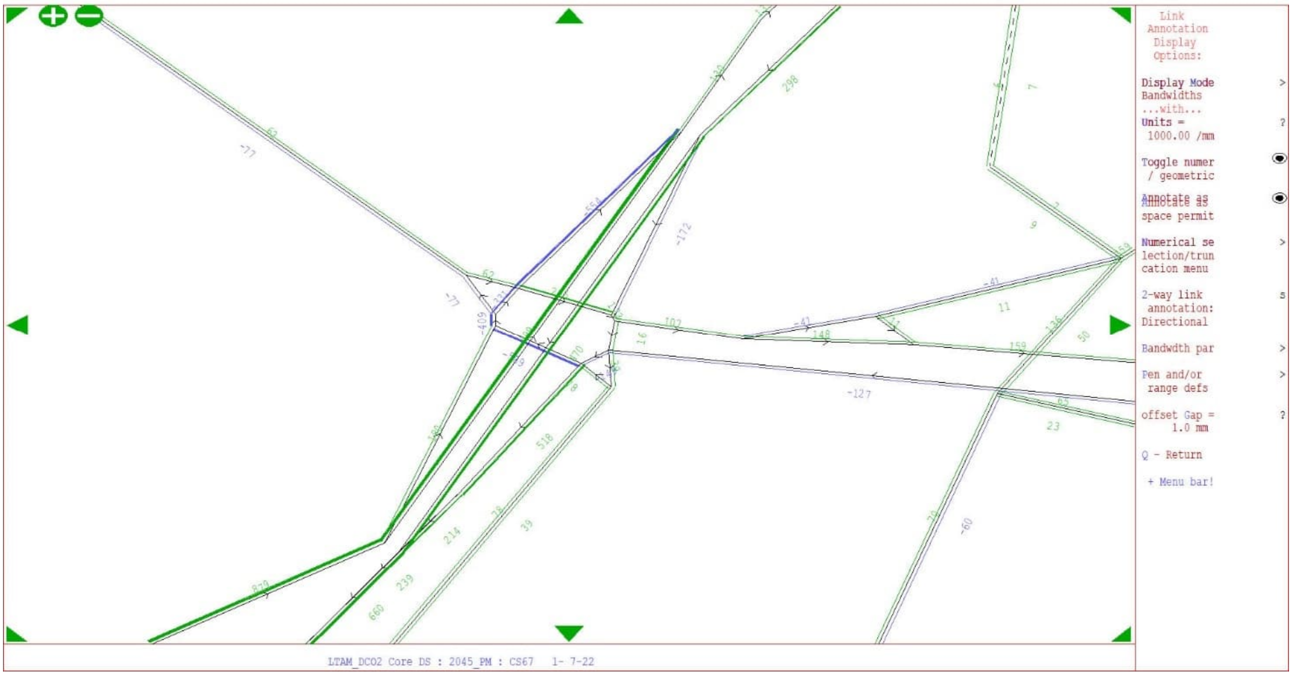


Plate 5-4 LTAM 2045 DS v DM Flow Difference – PM Peak



5.1.4 The traffic suppression in LTAM is caused by the delays observed on the A13 North on-slip, which leads to traffic seeking alternative routes. Since VISSIM is not predicting similar delays on the slip road, it can be anticipated that more traffic would use the slip road to access the A13 northbound.

5.1.5 Therefore, a number of sensitivity tests were carried out, incrementally increasing the traffic volume on the A13 North on-slip. The additional flows were applied as a proportion of the flow difference between the Do Minimum and Do Something scenarios on the A13 North on-slip, distributed to originate proportionally from all zones.

5.1.6 The additional traffic was implemented only for Cars as the flow differences in LGVs and HGVs between the Do Minimum and Do Something scenarios were negligible, indicating that it is the cars that mainly reroute to avoid the delay on the A13 North on-slip.

5.1.7 The sensitivity modelling scenarios tested are summarised below:

- DS 2045 AM +35% (approx. +130 PCUs)
- DS 2045 AM +70% (approx. +275 PCUs)
- DS 2045 PM +25% (approx. +150 PCUs)
- DS 2045 PM +50% (approx. +250 PCUs)
- DS 2045 PM +70% (approx. +400 PCUs)

5.1.8 This analysis has only been carried out for the design year 2045 as the forecast flows are higher, giving an upper limit.

5.2 Journey Time Results

5.2.1 The journey time results for the 8 key routes as defined in Section 4.1 and shown in Plate 5-5 below, are summarised in Table 5-1 and Table 5-2 for the AM and PM peaks respectively.

Plate 5-5 Key 8 Journey Time Routes

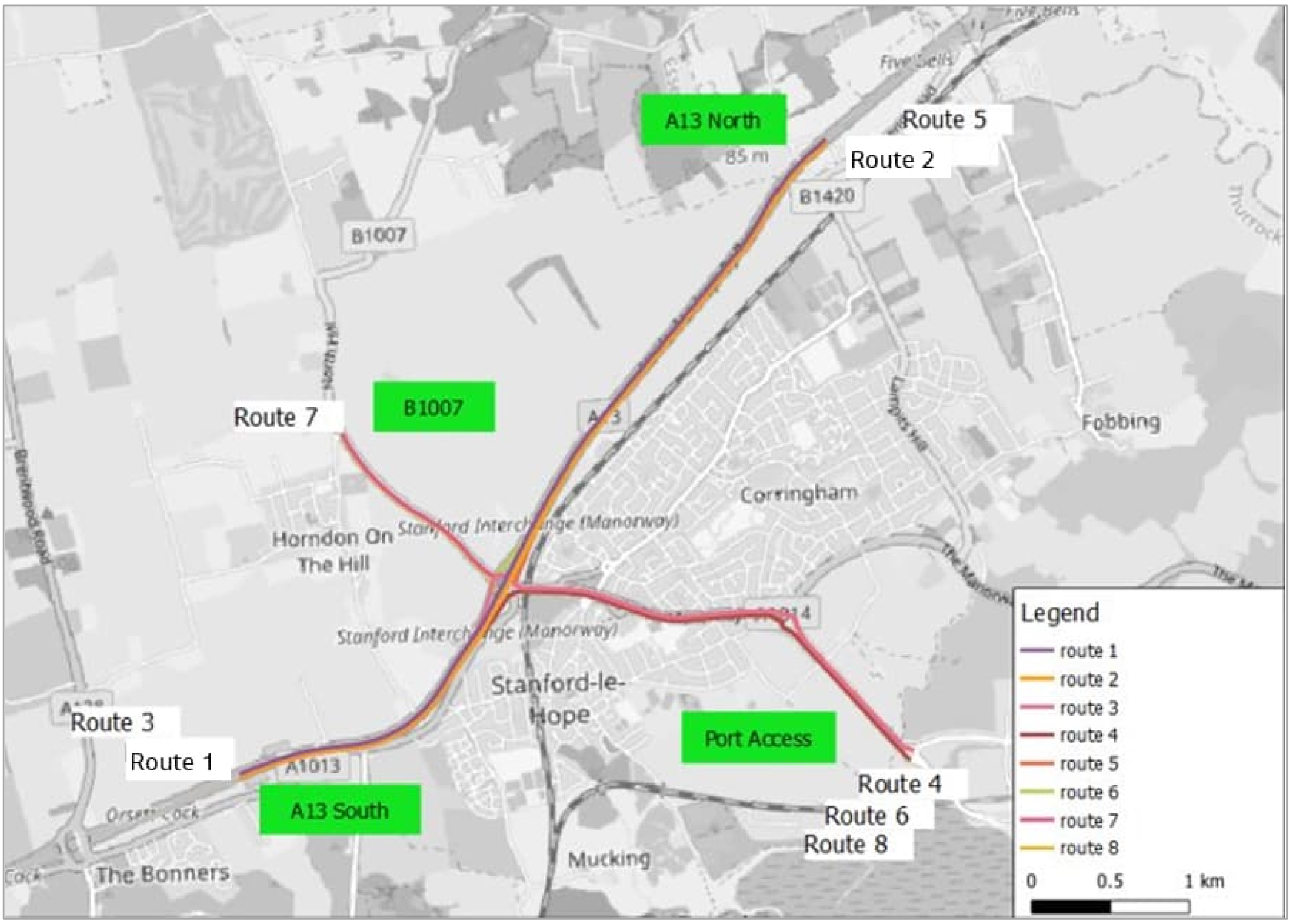


Table 5-1 Journey times – 2045 AM

Route	Journey Times [s]						
	Core Scenarios		Sensitivity Test		Difference		
	DM 2045 AM	DS 2045 AM	DS 2045 AM +35%	DS 2045 AM +70%	DS 2045 AM	DS 2045 AM +35%	DS 2045 AM +70%
1. A13 South to A13 North	105	106	106	108	1	1	3
2. A13 North to A13 South	114	135	135	131	21	21	17
3. A13 South to Port Access	240	242	243	246	2	2	6
4. Port Access to A13 South	221	239	239	240	18	18	19
5. A13 North to Port Access	206	213	213	211	7	7	6
6. Port Access to A13 North	265	264	262	386	-2	-4	121
7. B1007 to Port Access	208	207	208	259	0	0	52
8. Port Access to B1007	202	207	207	215	5	5	13

5.2.2 Table 5-1 shows the journey time results in the AM peak comparing the Do Minimum with the core Do Something, with the +35% Do Something sensitivity test and with the +70% Do Something sensitivity test.

5.2.3 The results indicate that the addition of the approx. 130 PCUs (in the Do Something +35% modelling scenario) has negligible changes to the journey times.

5.2.4 Doubling the amount of additional traffic (in the Do Something +70% modelling scenario) the journey time increases noticeably on route 6 (from the Port Access to the A13 North on-slip) by approx. 2 minutes, as vehicles are queueing on A13 North on-slip to access the A13 northbound. This is shown in the relative delay plot in Plate A.9. Noticeable delay is also observed on route 7 (from the B1007 to the Port Access) as the queue on A13 North on-slip is blocking back to the Manorway roundabout.

Table 5-2 Journey times – 2045 PM

	Journey Times [s]								
	Core Scenarios		Sensitivity Test			Difference			
Route	DM 2045 PM	DS 2045 PM	DS 2045 PM +25%	DS 2045 PM +50%	DS 2045 PM +70%	DS 2045 PM	DS 2045 PM +25%	DS 2045 PM +50%	DS 2045 PM +70%
1. A13 South to A13 North	105	110	109	111	112	5	4	6	7
2. A13 North to A13 South	109	140	133	133	131	31	24	25	22
3. A13 South to Port Access	242	246	244	246	257	3	2	4	15
4. Port Access to A13 South	224	246	247	248	328	22	24	25	104
5. A13 North to Port Access	206	221	218	219	215	15	12	13	9
6. Port Access to A13 North	290	281	289	423	726	-9	-1	133	436
7. B1007 to Port Access	211	203	204	225	304	-8	-8	14	93
8. Port Access to B1007	213	220	221	223	332	7	8	10	119

5.2.5 In the PM peak, three sensitivity tests have been carried out, adding approx. 150, 250 and 400 PCUs respectively to the core Do Something flows.

5.2.6 In the Do Something +25% modelling scenario the results are similar to the core Do Something scenario, while in the Do Something +50% modelling scenario there is a noticeable journey time increase in route 6 of more than 2 minutes. Similar to the AM peak the additional traffic on the A13 North on-slip is causing the delay. This is shown in the relative delay plot in Appendix A.

5.2.7 In the final sensitivity test, the Do Something +70% modelling scenario, the delay increases considerably, with route 6 showing an increase in journey time compared to the Do Minimum scenario of over 7 minutes, while routes 7 and 8 (from the Port Access to the B1007 and vice versa) also show journey time increases of approx. 1.5 minutes and approx. 2 minutes respectively. This occurs as the queue on the A13 North on-slip blocks back to Manorway roundabout. This is demonstrated in the relative delay plot in Plate A.13.

5.2.8 The queue and delay results for all the sensitivity tests are shown in Appendix B.

6 Conclusion

6.1.1 This report describes the development of the 2030 and 2045 Do Minimum (without LTC) and Do Something (with LTC) VISSIM operational assessment of the Manorway study area, which includes the Manorway roundabout.

6.1.2 The results of the models are analysed in comparison, evaluating the impact of the introduction of the LTC scheme on the network traffic conditions.

6.1.3 The journey time results show modest journey time increases on the A13 southbound mainline and the A13 South on-slip (southbound on-slip) in 2030 and 2045, in both the AM and PM peak hours. The journey time from the A13 South off-slip to the Port Access also increases in 2045 in the PM peak by 15 seconds. All other routes show little journey time changes.

6.1.4 The LTAM model suppress traffic using the A13 North on-slip to access the A13 northbound mainline due to predicted congestion on the slip road in the model – the LTAM 2045 forecast diverts approx. 400 Passenger Car Units (PCUs) or cars in the AM peak and approx. 550 PCUs (cars) in the PM peak away from the A13 North on-slip. The remaining PCUs on the A13 North on-slip are HGVs.

6.1.5 However, the VISSIM modelling predicts that the slip road is not congested and can accommodate more traffic using the slip road to access the A13 northbound mainline.

6.1.6 A series of sensitivity tests (in VISSIM) have been carried out to introduce additional traffic on the A13 North on-slip in the Do Something scenario.

6.1.7 The sensitivity tests carried out (for 2045 only) show that adding 275 PCUs in the AM peak and 250 PCUs in the PM peak results in the slip road operating at capacity with delays of similar magnitude as suggested in LTAM. This is less than the LTAM predicted diverted traffic from the A13 North on-slip (LTAM 2045 Do Minimum – Do Something forecast).

Appendix A – Relative Delay Plots

Plate A.1 DM 2030 AM

Plate A.2 DM 2030 PM

Plate A.3 DM 2045 AM

Plate A.4 DM 2045 PM

Plate A.5 DS 2030 AM

Plate A.6 DS 2030 PM

Plate A.7 DS 2045 AM

Plate A.8 DS 2045 PM

Plate A.9 Sensitivity Test DS 2045 AM +35%

Plate A.10 Sensitivity Test DS 2045 AM +70%

Plate A.11 Sensitivity Test DS 2045 PM +25%

Plate A.12 Sensitivity Test DS 2045 PM +50%

Plate A.13 Sensitivity Test DS 2045 PM +70%

Appendix B – Sensitivity Tests Queue and Junction Results

Plate B.1 Sensitivity Tests – Mean Max Queue AM Peak

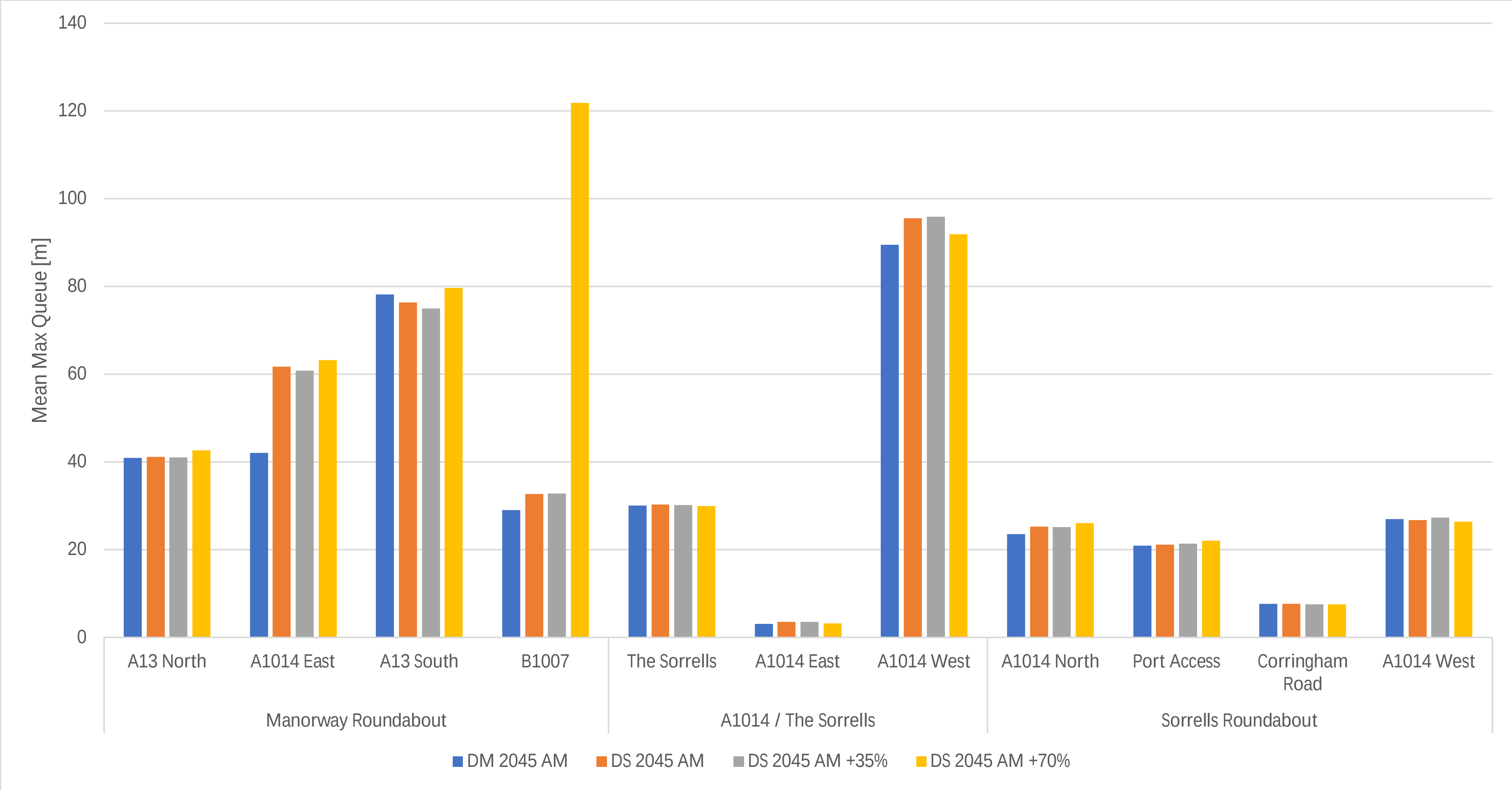


Plate B.2 Sensitivity Tests – Mean Max Queue PM Peak

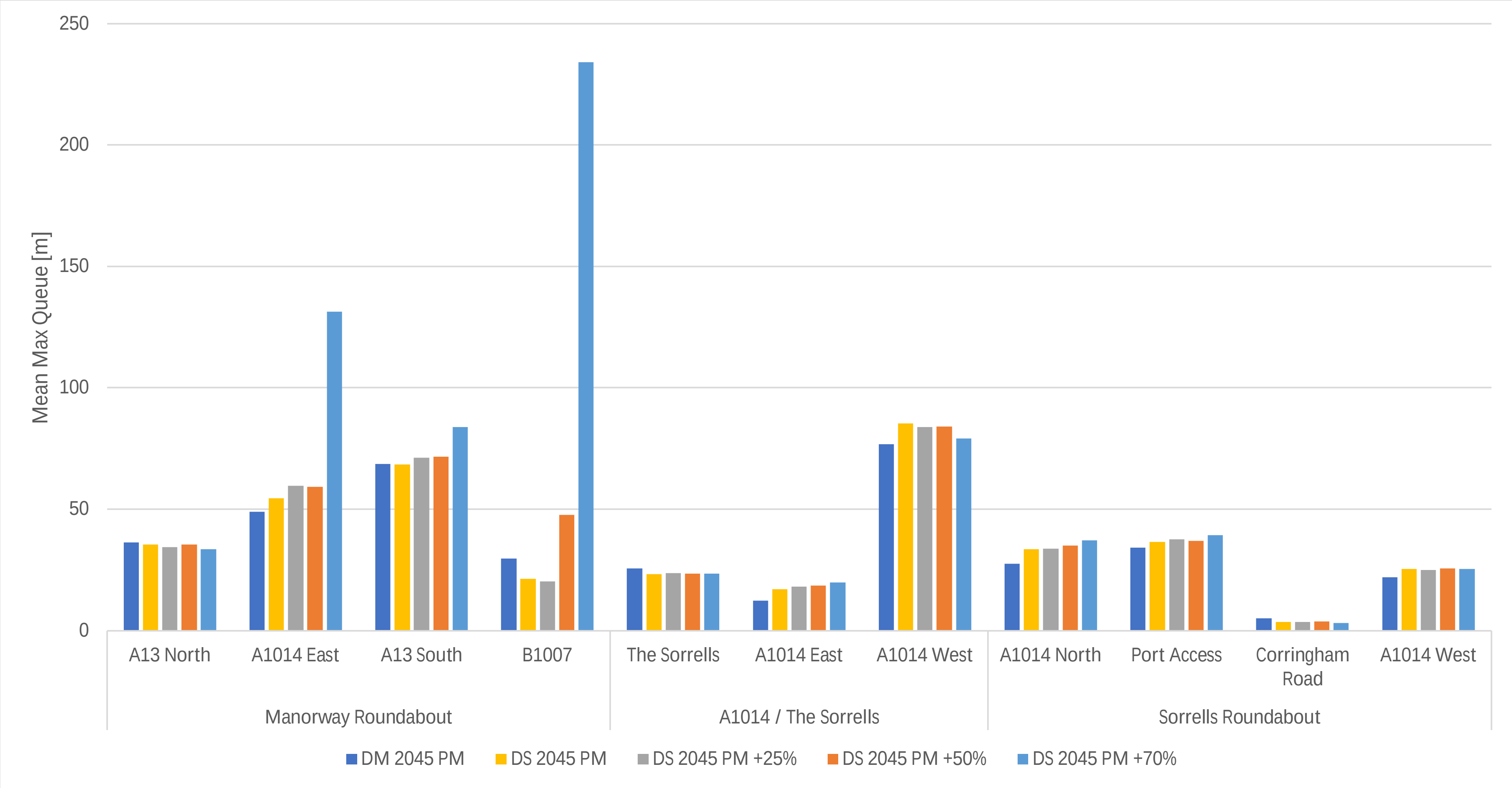


Table B.1 Sensitivity Tests Flows and Delays – 2045 AM

											Difference with DM					
			DM 2045 AM		DS 2045 AM		DS 2045 AM +35%		DS 2045 AM +70%		DS 2045 AM		DS 2045 AM +35%		DS 2045 AM +70%	
Junction	Approach	To	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)
Manorway Roundabout	A13 North (off-slip)	A13 North (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 East	386	21.2	301	23.6	301	23.6	302	24.1	-85	2.5	-85	2.4	-84	2.9
		A1013 South	89	32.0	106	31.8	106	31.5	107	32.0	17	-0.2	17	-0.5	18	-0.1
		B1007 West	16	50.1	8	48.1	8	48.5	8	42.0	-8	-2.0	-8	-1.6	-8	-8.1
	A1014 East	A1014 East	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1013 South	41	6.0	47	8.9	47	8.7	47	9.3	6	2.8	6	2.6	6	3.3
		A13 South (on-slip)	1136	6.1	1436	8.3	1436	8.3	1426	9.7	300	2.2	300	2.2	290	3.6
		B1007 West	112	12.8	139	15.2	139	15.1	139	21.9	27	2.4	27	2.3	27	9.1
		A13 North (on-slip)	397	13.4	233	13.3	232	13.4	352	50.1	-164	-0.1	-165	0.1	-45	36.8
	A1013 South	A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 South (on-slip)	0	0.0	86	9.0	85	8.9	86	10.3	86	9.0	85	8.9	86	10.3
		B1007 West	51	17.6	58	26.2	58	26.8	57	28.6	7	8.6	7	9.3	6	11.0
		A13 North (on-slip)	307	31.2	154	32.2	154	32.4	288	70.7	-153	1.0	-153	1.2	-19	39.5
		A1014 East	98	37.6	86	34.7	86	34.6	84	63.1	-12	-2.9	-12	-3.0	-14	25.5
	A13 South (off-slip)	A13 South (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		B1007 West	481	14.5	360	11.4	360	11.5	362	12.0	-121	-3.1	-121	-3.0	-119	-2.5
		A1014 East	1196	19.3	1381	20.2	1381	20.4	1369	24.8	185	0.9	185	1.1	173	5.5
		A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	B1007 West	B1007 West	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 North (on-slip)	29	5.8	23	4.2	23	4.4	22	28.7	-6	-1.6	-6	-1.4	-7	22.9
		A1014 East	126	12.1	76	10.8	76	11.0	60	28.2	-50	-1.2	-50	-1.0	-66	16.2
		A1013 South	48	43.8	53	41.3	53	41.6	39	64.8	5	-2.5	5	-2.3	-9	20.9

Junction	Approach	To	DM 2045 AM Flow (veh)	DM 2045 AM Delay (s)	DS 2045 AM Flow (veh)	DS 2045 AM Delay (s)	DS 2045 AM +35% Flow (veh)	DS 2045 AM +35% Delay (s)	DS 2045 AM +70% Flow (veh)	DS 2045 AM +70% Delay (s)	Difference with DM: DS 2045 AM Flow (veh)	Difference with DM: DS 2045 AM Delay (s)	Difference with DM: DS 2045 AM +35% Flow (veh)	Difference with DM: DS 2045 AM +35% Delay (s)	Difference with DM: DS 2045 AM +70% Flow (veh)	Difference with DM: DS 2045 AM +70% Delay (s)
		A13 South (on-slip)	352	41.7	464	39.1	463	39.3	359	79.7	112	-2.7	111	-2.5	7	37.9
A1014 / The Sorrells	The Sorrels	A1014 East	205	21.0	212	20.9	211	21.0	211	20.7	7	-0.1	6	0.0	6	-0.3
	A1014 East	A1014 West	950	3.0	983	3.0	983	3.0	1020	3.0	33	0.0	33	0.0	70	0.0
		The Sorrels	14	17.9	13	18.7	13	18.8	13	18.9	-1	0.8	-1	0.8	-1	0.9
	A1014 West	The Sorrels	60	13.0	60	11.1	59	11.1	59	10.6	0	-2.0	-1	-1.9	-1	-2.4
		A1014 East	1375	10.5	1488	9.5	1488	9.6	1471	9.3	113	-1.0	113	-0.9	96	-1.2
Sorrells Roundabout	A1014 North	A1014 North	16	20.1	44	21.1	44	21.5	45	21.5	28	1.0	28	1.4	29	1.4
		Port Access	86	9.5	107	9.7	107	9.8	108	10.0	21	0.2	21	0.3	22	0.5
		Corringham Rd	22	11.5	19	11.8	19	11.6	20	12.0	-3	0.3	-3	0.1	-2	0.5
		A1014 West	532	17.6	559	17.6	559	17.6	590	17.8	27	0.1	27	0.1	58	0.2
	Port Access	Port Access	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Corringham Rd	4	8.1	3	9.4	3	8.7	3	10.0	-1	1.2	-1	0.6	-1	1.8
		A1014 West	282	10.0	284	10.8	284	10.8	290	11.1	2	0.7	2	0.8	8	1.1
		A1014 North	16	20.6	15	20.7	15	21.3	16	20.9	-1	0.1	-1	0.6	0	0.2
	Corringham Rd	Corringham Rd	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 West	9	8.9	9	10.4	9	10.2	9	9.6	0	1.6	0	1.3	0	0.7
		A1014 North	39	22.8	37	23.3	37	23.3	37	23.3	-2	0.5	-2	0.5	-2	0.5
		Port Access	21	33.1	20	33.4	20	33.4	20	33.4	-1	0.2	-1	0.3	-1	0.3
	A1014 West	A1014 West	141	34.6	145	34.6	144	34.3	145	34.4	4	0.0	3	-0.3	4	-0.2
		A1014 North	697	1.0	803	1.0	803	1.1	795	1.0	106	0.1	106	0.1	98	0.0
		Port Access	729	5.9	706	6.1	706	6.2	695	6.1	-23	0.2	-23	0.3	-34	0.2
		Corringham Rd	13	29.4	45	17.4	44	17.7	43	17.5	32	-12.0	31	-11.7	30	-11.9

Table B.2 Sensitivity Tests Flows and Delays – 2045 PM

													Difference with DM							
			DM 2045 PM		DS 2045 PM		DS 2045 PM +25%		DS 2045 PM +50%		DS 2045 PM +70%		DS 2045 PM		DS 2045 PM +25%		DS 2045 PM +50%		DS 2045 PM +70%	
Junction	Approach	To	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)
Manorway Roundabout	A13 North (off-slip)	A13 North (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 East	387	19.3	228	25.8	229	25.8	229	26.2	229	24.9	-159	6.6	-158	6.5	-158	7.0	-158	5.6
		A1013 South	108	32.6	98	33.1	98	32.2	98	32.8	99	34.0	-10	0.6	-10	-0.3	-10	0.3	-9	1.5
		B1007 West	13	50.8	8	49.5	8	44.6	9	47.7	8	86.9	-5	-1.3	-5	-6.2	-4	-3.0	-5	36.2
	A1014 East	A1014 East	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1013 South	100	5.7	109	6.5	109	6.8	109	6.9	96	15.5	9	0.8	9	1.1	9	1.2	-4	9.7
		A13 South (on-slip)	1300	5.7	1704	6.9	1704	7.3	1703	7.4	1497	20.0	404	1.2	404	1.6	403	1.7	197	14.4
		B1007 West	508	16.6	448	20.8	449	21.2	448	21.9	375	72.6	-60	4.2	-59	4.7	-60	5.4	-133	56.0
		A13 North (on-slip)	558	15.4	93	17.5	206	18.7	312	35.3	344	187.8	-465	2.1	-352	3.3	-246	19.9	-214	172.4
	A1013 South	A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A13 South (on-slip)	0	0.0	95	11.4	95	12.1	94	13.0	94	18.4	95	11.4	95	12.1	94	13.0	94	18.4
		B1007 West	91	27.1	111	32.3	112	32.4	112	33.0	109	50.5	20	5.1	21	5.2	21	5.9	18	23.4
		A13 North (on-slip)	119	32.0	41	29.7	40	30.0	64	46.5	75	208.8	-78	-2.3	-79	-2.0	-55	14.5	-44	176.8
		A1014 East	39	34.7	80	30.8	80	31.1	80	38.8	69	167.7	41	-3.9	41	-3.6	41	4.1	30	132.9
	A13 South (off-slip)	A13 South (on-slip)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		B1007 West	438	14.4	416	11.8	418	11.8	418	12.0	416	13.4	-22	-2.6	-20	-2.6	-20	-2.4	-22	-1.0
		A1014 East	1123	19.2	1258	16.6	1263	16.7	1260	19.1	1252	31.7	135	-2.7	140	-2.6	137	-0.1	129	12.5
		A1013 South	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	B1007 West	B1007 West	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

			DM 2045 PM		DS 2045 PM		DS 2045 PM +25%		DS 2045 PM +50%		DS 2045 PM +70%		Difference with DM: DS 2045 PM		Difference with DM: DS 2045 PM +25%		Difference with DM: DS 2045 PM +50%		Difference with DM: DS 2045 PM +70%	
Junction	Approach	To	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)	Flow (veh)	Delay (s)
		A13 North (on-slip)	28	6.1	17	3.5	10	3.8	15	25.7	10	111.8	-11	-2.6	-18	-2.3	-13	19.6	-18	105.7
		A1014 East	237	14.2	312	7.9	313	8.3	288	20.0	152	66.3	75	-6.3	76	-5.8	51	5.8	-85	52.1
		A1013 South	39	45.2	75	31.1	75	32.6	68	44.7	34	80.7	36	-14.1	36	-12.5	29	-0.4	-5	35.5
		A13 South (on-slip)	237	43.3	229	30.6	229	32.2	209	42.7	108	97.3	-8	-12.8	-8	-11.1	-28	-0.7	-129	53.9
A1014 / The Sorrells	The Sorrels	A1014 East	171	20.0	171	19.1	172	19.1	173	19.3	174	19.0	0	-0.9	1	-0.9	2	-0.8	3	-1.0
	A1014 East	A1014 West	1810	4.6	1654	5.1	1734	5.2	1814	5.4	1891	5.8	-156	0.4	-76	0.6	4	0.7	81	1.1
		The Sorrels	63	18.9	97	18.4	97	18.5	96	17.8	97	18.5	34	-0.5	34	-0.4	33	-1.1	34	-0.5
	A1014 West	The Sorrels	190	14.5	153	16.7	153	16.2	149	16.0	143	14.7	-37	2.2	-37	1.7	-41	1.5	-47	0.2
		A1014 East	841	11.6	1016	13.9	1017	13.8	1013	13.6	968	12.4	175	2.3	176	2.2	172	2.1	127	0.8
Sorrells Roundabout	A1014 North	A1014 North	33	25.6	158	27.6	159	28.3	160	30.2	161	32.1	125	2.0	126	2.7	127	4.6	128	6.5
		Port Access	15	8.0	14	9.0	15	9.1	15	9.4	15	9.2	-1	1.0	0	1.1	0	1.3	0	1.2
		Corringham Rd	31	12.4	28	11.6	28	12.2	28	12.0	28	12.2	-3	-0.8	-3	-0.2	-3	-0.4	-3	-0.2
		A1014 West	854	20.2	842	19.9	888	20.2	933	20.7	978	21.6	-12	-0.3	34	0.0	79	0.6	124	1.5
	Port Access	Port Access	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Corringham Rd	28	8.6	28	8.5	27	9.0	28	8.9	27	9.0	0	-0.1	-1	0.4	0	0.3	-1	0.4
		A1014 West	858	11.7	768	12.8	802	13.2	835	13.7	869	14.6	-90	1.1	-56	1.5	-23	2.0	11	2.9
		A1014 North	41	17.9	128	29.3	128	30.0	128	30.3	128	30.6	87	11.4	87	12.1	87	12.3	87	12.7
	Corringham Rd	Corringham Rd	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		A1014 West	13	8.6	9	9.4	8	9.7	8	8.7	8	9.4	-4	0.7	-5	1.1	-5	0.0	-5	0.8
		A1014 North	16	24.6	9	20.9	10	22.4	10	21.3	10	20.1	-7	-3.7	-6	-2.2	-6	-3.3	-6	-4.5

Sub-annex 1.5 – Thurrock Council Model - Asda Roundabout Results

Junctions 10

ARCADY 10 - Roundabout Module

Version: 10.0.4.1693

For sales and distribution information, program advice and maintenance, contact TRL Software:
+44 (0)1344 379777 software@trl.co.uk trlsoftware.com

Filename: Asda Roundabout JH.j10
Path: J:\332610234_LTC\Junctions 10
Report generation date: 10/07/2023 12:07:01

Summary of junction performance

	7-8am					8-9am					5-6pm				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	2019 Base Year														
Arm A		4.0	8.63	0.76	A		4.2	8.96	0.77	A		3.0	7.27	0.73	A
Arm B		0.0	4.37	0.02	A		0.0	4.42	0.02	A		0.0	4.11	0.03	A
Arm C	D1	1.4	8.10	0.53	A	D2	1.5	8.31	0.54	A	D3	0.8	4.93	0.40	A
Arm D		0.4	3.10	0.24	A		0.4	3.12	0.24	A		1.2	4.15	0.51	A
Arm E		0.4	3.84	0.26	A		0.4	3.87	0.26	A		3.4	11.81	0.75	B
	2030 DM (without LTC)														
Arm A		358.8	567.40	1.27	F		385.3	605.04	1.29	F		93.5	132.61	1.08	F
Arm B		0.3	6.39	0.17	A		0.3	6.42	0.18	A		0.3	6.44	0.20	A
Arm C	D4	2.1	10.17	0.63	B	D5	2.2	10.36	0.64	B	D6	1.8	9.38	0.61	A
Arm D		1.3	4.85	0.50	A		1.3	4.93	0.51	A		3.0	8.08	0.72	A
Arm E		0.8	5.88	0.39	A		0.8	5.99	0.39	A		41.5	120.79	1.05	F
	2030 DS (with LTC)														
Arm A		370.1	583.29	1.28	F		396.7	621.20	1.29	F		120.9	172.96	1.10	F
Arm B		0.3	6.39	0.17	A		0.3	6.41	0.18	A		0.3	6.36	0.20	A
Arm C	D7	2.9	12.73	0.71	B	D8	3.0	13.10	0.71	B	D9	2.1	10.15	0.65	B
Arm D		1.3	5.04	0.51	A		1.3	5.13	0.51	A		3.9	10.11	0.78	B
Arm E		0.8	6.14	0.40	A		0.8	6.27	0.41	A		72.9	202.41	1.12	F
	2045 DM (without LTC)														
Arm A		385.2	604.65	1.29	F		412.0	642.91	1.30	F		186.2	303.35	1.16	F
Arm B		0.3	6.41	0.17	A		0.3	6.44	0.18	A		0.3	6.42	0.20	A
Arm C	D10	2.9	12.70	0.71	B	D11	3.0	13.03	0.71	B	D12	2.4	11.27	0.68	B
Arm D		1.2	4.91	0.49	A		1.2	4.99	0.50	A		3.3	8.95	0.75	A
Arm E		0.9	6.33	0.42	A		0.9	6.48	0.43	A		86.9	232.63	1.15	F
	2045 DS (with LTC)														
Arm A		390.7	612.50	1.29	F		418.6	652.25	1.31	F		295.0	495.25	1.24	F
Arm B		0.3	6.35	0.17	A		0.3	6.37	0.18	A		0.3	6.41	0.20	A
Arm C	D13	7.6	27.96	0.87	D	D14	8.1	29.84	0.88	D	D15	4.0	16.65	0.79	C
Arm D		1.2	5.24	0.49	A		1.2	5.34	0.50	A		13.6	31.65	0.94	D
Arm E		1.0	7.05	0.45	A		1.0	7.23	0.46	A		52.0	180.04	1.11	F

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	Asda Roundabout
Location	Thurrock
Site number	
Date	20/06/2023
Version	
Status	(new file)
Identifier	
Client	Thurrock Council
Jobnumber	332610234
Enumerator	CORP\thochkins
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2019 Base Year	7-8am	ONE HOUR	06:45	08:15	15
D2	2019 Base Year	8-9am	ONE HOUR	07:45	09:15	15
D3	2019 Base Year	5-6pm	ONE HOUR	16:45	18:15	15
D4	2030 DM (without LTC)	7-8am	ONE HOUR	06:45	08:15	15
D5	2030 DM (without LTC)	8-9am	ONE HOUR	07:45	09:15	15
D6	2030 DM (without LTC)	5-6pm	ONE HOUR	16:45	18:15	15
D7	2030 DS (with LTC)	7-8am	ONE HOUR	06:45	08:15	15
D8	2030 DS (with LTC)	8-9am	ONE HOUR	07:45	09:15	15
D9	2030 DS (with LTC)	5-6pm	ONE HOUR	16:45	18:15	15
D10	2045 DM (without LTC)	7-8am	ONE HOUR	06:45	08:15	15
D11	2045 DM (without LTC)	8-9am	ONE HOUR	07:45	09:15	15
D12	2045 DM (without LTC)	5-6pm	ONE HOUR	16:45	18:15	15
D13	2045 DS (with LTC)	7-8am	ONE HOUR	06:45	08:15	15
D14	2045 DS (with LTC)	8-9am	ONE HOUR	07:45	09:15	15
D15	2045 DS (with LTC)	5-6pm	ONE HOUR	16:45	18:15	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2019 Base Year, 7-8am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	7.09	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	7.09	A

Arms

Arms

Arm	Name	Description	No give-way line
A	A1089 (N)		
B	Amazon Fulfilment		
C	A126 (S)		
D	A1089 (S)		
E	Thurrock Park Way		

Roundabout Geometry

Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Entry only	Exit only
A	6.87	7.02	1.8	140.8	111.0	14.9		
B	3.90	8.92	12.2	48.0	111.0	14.3		
C	3.55	7.22	22.0	21.5	111.0	21.7		
D	7.80	9.16	4.6	38.7	111.0	41.3		
E	3.58	8.96	16.9	49.0	111.0	14.2		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Arm	Final slope	Final intercept (PCU/hr)
A	0.553	2317
B	0.505	1991
C	0.476	1859
D	0.560	2534
E	0.513	2051

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2019 Base Year	7-8am	ONE HOUR	06:45	08:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	1527	100.000
B		✓	23	100.000
C		✓	579	100.000
D		✓	418	100.000
E		✓	373	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	34	348	627	518
	B	11	0	5	6	1
	C	417	2	0	134	26
	D	351	5	10	0	52
	E	214	8	58	93	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	27	27	27	27	27
	B	27	27	27	27	27
	C	27	27	27	27	27
	D	27	27	27	27	27
	E	27	27	27	27	27

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	0.76	8.63	4.0	A
B	0.02	4.37	0.0	A
C	0.53	8.10	1.4	A
D	0.24	3.10	0.4	A
E	0.26	3.84	0.4	A

Main Results for each time segment

06:45 - 07:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1150	132	2244	0.512	1144	1.3	4.137	A
B	17	1240	1365	0.013	17	0.0	3.391	A
C	436	941	1411	0.309	434	0.6	4.666	A
D	315	730	2125	0.148	314	0.2	2.522	A
E	281	597	1745	0.161	280	0.2	3.119	A

07:00 - 07:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1373	158	2230	0.616	1370	2.0	5.300	A
B	21	1484	1242	0.017	21	0.0	3.743	A
C	521	1127	1323	0.393	520	0.8	5.683	A
D	376	875	2044	0.184	376	0.3	2.739	A
E	335	715	1684	0.199	335	0.3	3.388	A

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1681	194	2210	0.761	1674	3.9	8.404	A
B	25	1814	1075	0.024	25	0.0	4.353	A
C	637	1377	1204	0.529	635	1.4	8.003	A
D	460	1069	1936	0.238	460	0.4	3.098	A
E	411	874	1602	0.256	410	0.4	3.832	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1681	194	2210	0.761	1681	4.0	8.627	A
B	25	1821	1072	0.024	25	0.0	4.369	A
C	637	1383	1201	0.531	637	1.4	8.104	A
D	460	1073	1933	0.238	460	0.4	3.103	A
E	411	876	1601	0.256	411	0.4	3.838	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1373	158	2230	0.616	1380	2.1	5.431	A
B	21	1495	1236	0.017	21	0.0	3.762	A
C	521	1135	1319	0.395	523	0.8	5.759	A
D	376	881	2041	0.184	376	0.3	2.746	A
E	335	718	1683	0.199	336	0.3	3.397	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1150	133	2244	0.512	1152	1.3	4.199	A
B	17	1248	1361	0.013	17	0.0	3.404	A
C	436	948	1408	0.310	437	0.6	4.713	A
D	315	736	2122	0.148	315	0.2	2.531	A
E	281	600	1743	0.161	281	0.2	3.127	A

2019 Base Year, 8-9am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	7.31	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	7.31	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2019 Base Year	8-9am	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	1544	100.000
B		✓	24	100.000
C		✓	585	100.000
D		✓	422	100.000
E		✓	377	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	35	352	634	523
	B	12	0	5	6	1
	C	421	2	0	136	26
	D	354	5	10	0	53
	E	216	8	59	94	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	27	27	27	27	27
	B	27	27	27	27	27
	C	27	27	27	27	27
	D	27	27	27	27	27
	E	27	27	27	27	27

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	0.77	8.96	4.2	A
B	0.02	4.42	0.0	A
C	0.54	8.31	1.5	A
D	0.24	3.12	0.4	A
E	0.26	3.87	0.4	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1162	134	2243	0.518	1157	1.4	4.187	A
B	18	1253	1358	0.013	18	0.0	3.410	A
C	440	952	1406	0.313	438	0.6	4.707	A
D	318	738	2121	0.150	317	0.2	2.532	A
E	284	603	1742	0.163	283	0.2	3.132	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1388	160	2229	0.623	1385	2.1	5.400	A
B	22	1500	1234	0.017	22	0.0	3.771	A
C	526	1139	1317	0.399	525	0.8	5.764	A
D	379	884	2039	0.186	379	0.3	2.753	A
E	339	722	1681	0.202	339	0.3	3.406	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1700	196	2209	0.770	1692	4.1	8.706	A
B	26	1833	1066	0.025	26	0.0	4.399	A
C	644	1392	1197	0.538	642	1.5	8.198	A
D	465	1080	1930	0.241	464	0.4	3.120	A
E	415	883	1598	0.260	415	0.4	3.862	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1700	196	2209	0.770	1700	4.2	8.961	A
B	26	1841	1062	0.025	26	0.0	4.415	A
C	644	1398	1194	0.539	644	1.5	8.310	A
D	465	1084	1927	0.241	465	0.4	3.125	A
E	415	885	1597	0.260	415	0.4	3.868	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1388	160	2229	0.623	1396	2.1	5.545	A
B	22	1511	1228	0.018	22	0.0	3.788	A
C	526	1148	1313	0.401	528	0.9	5.843	A
D	379	890	2036	0.186	380	0.3	2.761	A
E	339	725	1679	0.202	339	0.3	3.413	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1162	134	2243	0.518	1165	1.4	4.253	A
B	18	1262	1354	0.013	18	0.0	3.424	A
C	440	958	1403	0.314	442	0.6	4.758	A
D	318	743	2118	0.150	318	0.2	2.539	A
E	284	606	1740	0.163	284	0.2	3.142	A

2019 Base Year, 5-6pm

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	7.29	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	7.29	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2019 Base Year	5-6pm	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	1389	100.000
B		✓	32	100.000
C		✓	502	100.000
D		✓	952	100.000
E		✓	951	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	21	560	388	420
	B	18	0	8	3	3
	C	330	0	0	136	36
	D	750	12	54	0	136
	E	649	0	227	75	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	14	14	14	14	14
	B	14	14	14	14	14
	C	14	14	14	14	14
	D	14	14	14	14	14
	E	14	14	14	14	14

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	0.73	7.27	3.0	A
B	0.03	4.11	0.0	A
C	0.40	4.93	0.8	A
D	0.51	4.15	1.2	A
E	0.75	11.81	3.4	B

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1046	276	2165	0.483	1041	1.1	3.640	A
B	24	1292	1339	0.018	24	0.0	3.121	A
C	378	680	1536	0.246	376	0.4	3.535	A
D	717	605	2195	0.326	715	0.6	2.768	A
E	716	873	1603	0.447	712	0.9	4.590	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1249	330	2135	0.585	1247	1.6	4.609	A
B	29	1547	1210	0.024	29	0.0	3.473	A
C	451	814	1472	0.307	451	0.5	4.017	A
D	856	724	2129	0.402	855	0.8	3.221	A
E	855	1045	1515	0.564	853	1.5	6.181	A

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1529	403	2095	0.730	1524	3.0	7.116	A
B	35	1890	1037	0.034	35	0.0	4.097	A
C	553	995	1386	0.399	552	0.7	4.913	A
D	1048	886	2038	0.514	1046	1.2	4.130	A
E	1047	1279	1394	0.751	1040	3.3	11.347	B

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1529	405	2093	0.731	1529	3.0	7.266	A
B	35	1898	1033	0.034	35	0.0	4.113	A
C	553	998	1384	0.399	553	0.8	4.935	A
D	1048	888	2037	0.515	1048	1.2	4.151	A
E	1047	1282	1393	0.752	1047	3.4	11.811	B

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1249	333	2133	0.585	1254	1.6	4.699	A
B	29	1558	1204	0.024	29	0.0	3.492	A
C	451	819	1469	0.307	452	0.5	4.038	A
D	856	728	2127	0.402	858	0.8	3.240	A
E	855	1049	1513	0.565	862	1.5	6.380	A

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1046	278	2164	0.483	1048	1.1	3.684	A
B	24	1301	1334	0.018	24	0.0	3.134	A
C	378	684	1534	0.246	378	0.4	3.553	A
D	717	609	2193	0.327	718	0.6	2.781	A
E	716	877	1601	0.447	718	0.9	4.663	A

2030 DM (without LTC), 7-8am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	314.64	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	314.64	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2030 DM (without LTC)	7-8am	ONE HOUR	06:45	08:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2558	100.000
B		✓	134	100.000
C		✓	688	100.000
D		✓	847	100.000
E		✓	432	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	137	1090	783	548
	B	122	0	5	6	1
	C	526	2	0	134	26
	D	780	5	10	0	52
	E	273	8	58	93	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	24	24	24	24	24
	B	24	24	24	24	24
	C	24	24	24	24	24
	D	24	24	24	24	24
	E	24	24	24	24	24

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.27	567.40	358.8	F
B	0.17	6.39	0.3	A
C	0.63	10.17	2.1	B
D	0.50	4.85	1.3	A
E	0.39	5.88	0.8	A

Main Results for each time segment

06:45 - 07:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1926	132	2244	0.858	1899	6.8	12.100	B
B	101	1918	1023	0.099	100	0.1	4.837	A
C	518	1154	1310	0.395	515	0.8	5.590	A
D	638	913	2023	0.315	635	0.6	3.211	A
E	325	1083	1495	0.218	324	0.3	3.808	A

07:00 - 07:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2300	158	2230	1.031	2177	37.6	46.468	E
B	120	2205	878	0.137	120	0.2	5.890	A
C	618	1332	1226	0.505	617	1.2	7.312	A
D	761	1073	1933	0.394	761	0.8	3.802	A
E	388	1297	1386	0.280	388	0.5	4.472	A

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2816	193	2210	1.274	2209	189.5	191.313	F
B	148	2267	846	0.174	147	0.3	6.384	A
C	758	1393	1196	0.633	754	2.1	10.017	B
D	933	1216	1854	0.503	931	1.2	4.828	A
E	476	1587	1237	0.385	474	0.8	5.848	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2816	194	2210	1.274	2210	341.1	435.061	F
B	148	2269	845	0.175	148	0.3	6.395	A
C	758	1394	1196	0.633	757	2.1	10.174	B
D	933	1219	1852	0.504	933	1.3	4.855	A
E	476	1591	1234	0.385	476	0.8	5.882	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2300	159	2230	1.031	2229	358.8	567.396	F
B	120	2255	853	0.141	121	0.2	6.102	A
C	618	1360	1212	0.510	622	1.3	7.601	A
D	761	1089	1925	0.396	763	0.8	3.850	A
E	388	1303	1382	0.281	389	0.5	4.503	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1926	133	2244	0.858	2236	281.3	515.644	F
B	101	2238	861	0.117	101	0.2	5.876	A
C	518	1331	1226	0.423	520	0.9	6.335	A
D	638	990	1980	0.322	639	0.6	3.329	A
E	325	1090	1492	0.218	326	0.3	3.832	A

2030 DM (without LTC), 8-9am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	335.37	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	335.37	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2030 DM (without LTC)	8-9am	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2585	100.000
B		✓	136	100.000
C		✓	694	100.000
D		✓	856	100.000
E		✓	437	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	139	1101	791	554
	B	124	0	5	6	1
	C	531	2	0	135	26
	D	788	5	10	0	53
	E	276	8	59	94	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	24	24	24	24	24
	B	24	24	24	24	24
	C	24	24	24	24	24
	D	24	24	24	24	24
	E	24	24	24	24	24

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.29	605.04	385.3	F
B	0.18	6.42	0.3	A
C	0.64	10.36	2.2	B
D	0.51	4.93	1.3	A
E	0.39	5.99	0.8	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1946	133	2243	0.867	1917	7.3	12.723	B
B	102	1936	1013	0.101	102	0.1	4.893	A
C	522	1166	1304	0.401	519	0.8	5.661	A
D	644	923	2018	0.319	642	0.6	3.239	A
E	329	1094	1490	0.221	328	0.3	3.837	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2324	160	2229	1.043	2184	42.3	50.727	F
B	122	2213	874	0.140	122	0.2	5.936	A
C	624	1338	1223	0.510	622	1.3	7.411	A
D	770	1081	1929	0.399	769	0.8	3.844	A
E	393	1310	1379	0.285	392	0.5	4.524	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2846	195	2209	1.288	2208	202.0	205.189	F
B	150	2268	846	0.177	149	0.3	6.409	A
C	764	1396	1195	0.639	761	2.1	10.194	B
D	942	1223	1849	0.510	941	1.3	4.902	A
E	481	1603	1228	0.392	480	0.8	5.955	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2846	196	2209	1.288	2209	361.3	461.595	F
B	150	2269	845	0.177	150	0.3	6.418	A
C	764	1397	1195	0.640	764	2.2	10.357	B
D	942	1226	1848	0.510	942	1.3	4.931	A
E	481	1607	1226	0.392	481	0.8	5.992	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2324	160	2229	1.043	2228	385.3	605.040	F
B	122	2255	852	0.143	122	0.2	6.117	A
C	624	1362	1211	0.515	627	1.3	7.686	A
D	770	1095	1921	0.401	771	0.8	3.888	A
E	393	1317	1375	0.286	394	0.5	4.557	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1946	134	2243	0.868	2236	312.8	562.340	F
B	102	2239	861	0.119	103	0.2	5.890	A
C	522	1333	1225	0.427	524	0.9	6.383	A
D	644	996	1977	0.326	645	0.6	3.354	A
E	329	1101	1486	0.221	330	0.4	3.862	A

2030 DM (without LTC), 5-6pm

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	81.40	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	81.40	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2030 DM (without LTC)	5-6pm	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2054	100.000
B		✓	146	100.000
C		✓	641	100.000
D		✓	1219	100.000
E		✓	1048	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	127	694	739	494
	B	130	0	8	4	4
	C	469	0	0	136	36
	D	1017	12	54	0	136
	E	746	0	227	75	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	16	16	16	16	16
	B	16	16	16	16	16
	C	16	16	16	16	16
	D	16	16	16	16	16
	E	16	16	16	16	16

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.08	132.61	93.5	F
B	0.20	6.44	0.3	A
C	0.61	9.38	1.8	A
D	0.72	8.08	3.0	A
E	1.05	120.79	41.5	F

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1546	275	2165	0.714	1535	2.8	6.515	A
B	110	1706	1130	0.097	109	0.1	4.092	A
C	483	1081	1345	0.359	480	0.6	4.813	A
D	918	848	2060	0.446	914	0.9	3.633	A
E	789	1261	1404	0.562	783	1.5	6.664	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1847	329	2136	0.865	1831	6.7	13.082	B
B	131	2036	963	0.136	131	0.2	5.017	A
C	576	1290	1245	0.463	575	1.0	6.214	A
D	1096	1014	1967	0.557	1094	1.4	4.772	A
E	942	1509	1276	0.738	936	3.1	12.018	B

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2261	379	2108	1.073	2078	52.7	60.932	F
B	161	2315	822	0.196	160	0.3	6.306	A
C	706	1475	1157	0.610	703	1.8	9.118	A
D	1342	1200	1862	0.721	1336	2.9	7.854	A
E	1154	1844	1104	1.045	1065	25.3	61.675	F

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2261	386	2104	1.075	2098	93.5	132.612	F
B	161	2342	809	0.199	161	0.3	6.444	A
C	706	1489	1151	0.613	706	1.8	9.376	A
D	1342	1208	1858	0.722	1342	3.0	8.083	A
E	1154	1852	1101	1.048	1089	41.5	120.794	F

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1847	375	2110	0.875	2084	34.1	113.146	F
B	131	2319	820	0.160	132	0.2	6.069	A
C	576	1454	1168	0.494	579	1.1	7.125	A
D	1096	1078	1931	0.568	1102	1.5	5.070	A
E	942	1519	1271	0.741	1094	3.6	40.730	E

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1546	280	2163	0.715	1671	3.0	10.810	B
B	110	1838	1063	0.103	110	0.1	4.386	A
C	483	1164	1305	0.370	484	0.7	5.100	A
D	918	885	2039	0.450	920	1.0	3.739	A
E	789	1270	1399	0.564	797	1.5	7.030	A

2030 DS (with LTC), 7-8am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	321.07	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	321.07	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2030 DS (with LTC)	7-8am	ONE HOUR	06:45	08:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2570	100.000
B		✓	134	100.000
C		✓	759	100.000
D		✓	823	100.000
E		✓	437	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	140	1067	778	585
	B	122	0	5	6	1
	C	597	2	0	134	26
	D	756	5	10	0	52
	E	278	8	58	93	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	24	24	24	24	24
	B	24	24	24	24	24
	C	24	24	24	24	24
	D	24	24	24	24	24
	E	24	24	24	24	24

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.28	583.29	370.1	F
B	0.17	6.39	0.3	A
C	0.71	12.73	2.9	B
D	0.51	5.04	1.3	A
E	0.40	6.14	0.8	A

Main Results for each time segment

06:45 - 07:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1935	132	2244	0.862	1907	7.0	12.357	B
B	101	1924	1020	0.099	100	0.1	4.853	A
C	571	1178	1299	0.440	568	1.0	6.072	A
D	620	994	1978	0.313	617	0.6	3.275	A
E	329	1118	1477	0.223	328	0.4	3.877	A

07:00 - 07:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2310	158	2230	1.036	2180	39.6	48.247	E
B	120	2206	877	0.137	120	0.2	5.896	A
C	682	1355	1214	0.562	680	1.6	8.318	A
D	740	1167	1881	0.393	739	0.8	3.905	A
E	393	1338	1364	0.288	392	0.5	4.590	A

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2830	193	2210	1.280	2209	194.8	197.112	F
B	148	2265	847	0.174	147	0.3	6.376	A
C	836	1415	1186	0.705	831	2.8	12.387	B
D	906	1322	1794	0.505	904	1.3	5.006	A
E	481	1637	1211	0.397	480	0.8	6.097	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2830	194	2210	1.280	2210	349.7	446.210	F
B	148	2267	846	0.174	148	0.3	6.386	A
C	836	1416	1185	0.705	835	2.9	12.733	B
D	906	1326	1792	0.506	906	1.3	5.040	A
E	481	1642	1208	0.398	481	0.8	6.141	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2310	159	2230	1.036	2229	370.1	583.287	F
B	120	2253	854	0.141	121	0.2	6.091	A
C	682	1382	1202	0.568	687	1.7	8.761	A
D	740	1184	1871	0.395	742	0.8	3.959	A
E	393	1347	1360	0.289	394	0.5	4.628	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1935	133	2244	0.862	2236	294.7	535.411	F
B	101	2236	862	0.117	101	0.2	5.866	A
C	571	1353	1215	0.470	574	1.1	6.982	A
D	620	1074	1933	0.321	621	0.6	3.405	A
E	329	1126	1473	0.223	330	0.4	3.906	A

2030 DS (with LTC), 8-9am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	341.69	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	341.69	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2030 DS (with LTC)	8-9am	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2597	100.000
B		✓	136	100.000
C		✓	767	100.000
D		✓	832	100.000
E		✓	442	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	142	1078	786	591
	B	124	0	5	6	1
	C	604	2	0	135	26
	D	764	5	10	0	53
	E	281	8	59	94	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	24	24	24	24	24
	B	24	24	24	24	24
	C	24	24	24	24	24
	D	24	24	24	24	24
	E	24	24	24	24	24

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.29	621.20	396.7	F
B	0.18	6.41	0.3	A
C	0.71	13.10	3.0	B
D	0.51	5.13	1.3	A
E	0.41	6.27	0.8	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1955	133	2244	0.871	1925	7.5	13.004	B
B	102	1942	1010	0.101	102	0.1	4.909	A
C	577	1189	1293	0.446	573	1.0	6.168	A
D	626	1004	1972	0.318	624	0.6	3.306	A
E	333	1130	1471	0.226	331	0.4	3.912	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2335	160	2229	1.047	2187	44.5	52.621	F
B	122	2213	873	0.140	122	0.2	5.939	A
C	690	1361	1211	0.569	687	1.6	8.471	A
D	748	1176	1876	0.399	747	0.8	3.951	A
E	397	1353	1356	0.293	397	0.5	4.648	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2859	195	2209	1.294	2208	207.4	211.254	F
B	150	2266	847	0.177	149	0.3	6.400	A
C	844	1418	1185	0.713	839	2.9	12.724	B
D	916	1331	1789	0.512	914	1.3	5.091	A
E	487	1655	1201	0.405	485	0.8	6.222	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2859	196	2209	1.294	2209	370.0	473.014	F
B	150	2267	846	0.177	150	0.3	6.409	A
C	844	1419	1184	0.713	844	3.0	13.104	B
D	916	1336	1786	0.513	916	1.3	5.128	A
E	487	1661	1198	0.406	487	0.8	6.271	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2335	161	2229	1.048	2228	396.7	621.198	F
B	122	2253	853	0.143	122	0.2	6.111	A
C	690	1384	1201	0.574	695	1.7	8.913	A
D	748	1192	1867	0.401	750	0.8	4.004	A
E	397	1363	1352	0.294	399	0.5	4.689	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1955	134	2243	0.872	2236	326.4	582.403	F
B	102	2237	862	0.119	103	0.2	5.883	A
C	577	1355	1214	0.476	580	1.1	7.060	A
D	626	1081	1929	0.325	627	0.6	3.430	A
E	333	1139	1467	0.227	333	0.4	3.942	A

2030 DS (with LTC), 5-6pm

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	113.46	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	113.46	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2030 DS (with LTC)	5-6pm	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2116	100.000
B		✓	146	100.000
C		✓	689	100.000
D		✓	1288	100.000
E		✓	1057	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	129	751	726	510
	B	130	0	8	4	4
	C	517	0	0	136	36
	D	1086	12	54	0	136
	E	756	0	227	74	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	15	15	15	15	15
	B	15	15	15	15	15
	C	15	15	15	15	15
	D	15	15	15	15	15
	E	15	15	15	15	15

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.10	172.96	120.9	F
B	0.20	6.36	0.3	A
C	0.65	10.15	2.1	B
D	0.78	10.11	3.9	B
E	1.12	202.41	72.9	F

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1593	274	2166	0.736	1581	3.1	6.938	A
B	110	1750	1108	0.099	109	0.1	4.145	A
C	519	1082	1344	0.386	516	0.7	4.979	A
D	970	895	2033	0.477	966	1.0	3.864	A
E	796	1348	1359	0.586	789	1.6	7.189	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1902	327	2136	0.890	1882	8.1	15.208	C
B	131	2084	939	0.140	131	0.2	5.124	A
C	619	1289	1246	0.497	618	1.1	6.574	A
D	1158	1070	1935	0.598	1155	1.7	5.289	A
E	950	1614	1223	0.777	942	3.7	14.298	B

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2330	363	2117	1.101	2096	66.5	73.051	F
B	161	2318	821	0.196	160	0.3	6.268	A
C	759	1447	1171	0.648	755	2.1	9.871	A
D	1418	1258	1830	0.775	1410	3.8	9.668	A
E	1164	1970	1040	1.119	1019	39.9	90.498	F

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2330	366	2115	1.102	2112	120.9	166.357	F
B	161	2336	811	0.198	161	0.3	6.362	A
C	759	1458	1166	0.651	758	2.1	10.154	B
D	1418	1265	1826	0.777	1418	3.9	10.114	B
E	1164	1980	1035	1.125	1032	72.9	202.405	F

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1902	401	2096	0.908	2076	77.5	172.960	F
B	131	2339	810	0.162	131	0.2	6.106	A
C	619	1421	1183	0.523	623	1.3	7.427	A
D	1158	1121	1907	0.607	1166	1.8	5.652	A
E	950	1627	1216	0.782	1197	11.3	132.471	F

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1593	287	2158	0.738	1889	3.4	36.752	E
B	110	2052	955	0.115	110	0.2	4.903	A
C	519	1266	1257	0.413	521	0.8	5.636	A
D	970	974	1989	0.488	972	1.1	4.086	A
E	796	1359	1354	0.588	834	1.7	8.546	A

2045 DM (without LTC), 7-8am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	332.93	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	332.93	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2045 DM (without LTC)	7-8am	ONE HOUR	06:45	08:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2586	100.000
B		✓	134	100.000
C		✓	765	100.000
D		✓	796	100.000
E		✓	468	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	134	1099	758	595
	B	122	0	5	6	1
	C	603	2	0	134	26
	D	729	5	10	0	52
	E	309	8	58	93	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	24	24	24	24	24
	B	24	24	24	24	24
	C	24	24	24	24	24
	D	24	24	24	24	24
	E	24	24	24	24	24

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.29	604.65	385.2	F
B	0.17	6.41	0.3	A
C	0.71	12.70	2.9	B
D	0.49	4.91	1.2	A
E	0.42	6.33	0.9	A

Main Results for each time segment

06:45 - 07:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1947	132	2244	0.867	1918	7.3	12.719	B
B	101	1939	1012	0.100	100	0.1	4.893	A
C	576	1170	1303	0.442	572	1.0	6.079	A
D	599	1005	1971	0.304	597	0.5	3.248	A
E	352	1102	1486	0.237	351	0.4	3.929	A

07:00 - 07:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2325	158	2230	1.043	2185	42.3	50.697	F
B	120	2216	872	0.138	120	0.2	5.935	A
C	688	1342	1221	0.563	685	1.6	8.300	A
D	716	1178	1875	0.382	715	0.8	3.846	A
E	421	1319	1374	0.306	420	0.5	4.677	A

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2847	193	2210	1.288	2209	201.9	205.027	F
B	148	2271	844	0.175	147	0.3	6.404	A
C	842	1400	1193	0.706	837	2.8	12.356	B
D	876	1334	1787	0.490	875	1.2	4.882	A
E	515	1614	1223	0.421	514	0.9	6.284	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2847	194	2210	1.288	2210	361.2	461.262	F
B	148	2273	843	0.175	148	0.3	6.413	A
C	842	1401	1193	0.706	842	2.9	12.700	B
D	876	1338	1785	0.491	876	1.2	4.913	A
E	515	1619	1220	0.422	515	0.9	6.335	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2325	159	2230	1.043	2229	385.2	604.653	F
B	120	2259	851	0.142	121	0.2	6.119	A
C	688	1366	1209	0.569	693	1.7	8.725	A
D	716	1195	1865	0.384	717	0.8	3.893	A
E	421	1328	1369	0.307	422	0.6	4.718	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1947	133	2244	0.868	2237	312.7	561.967	F
B	101	2242	859	0.117	101	0.2	5.893	A
C	576	1338	1223	0.471	578	1.1	6.950	A
D	599	1084	1927	0.311	600	0.6	3.367	A
E	352	1110	1481	0.238	353	0.4	3.959	A

2045 DM (without LTC), 8-9am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	353.74	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	353.74	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2045 DM (without LTC)	8-9am	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2613	100.000
B		✓	136	100.000
C		✓	772	100.000
D		✓	805	100.000
E		✓	474	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	135	1111	766	601
	B	124	0	5	6	1
	C	609	2	0	135	26
	D	737	5	10	0	53
	E	313	8	59	94	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	24	24	24	24	24
	B	24	24	24	24	24
	C	24	24	24	24	24
	D	24	24	24	24	24
	E	24	24	24	24	24

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.30	642.91	412.0	F
B	0.18	6.44	0.3	A
C	0.71	13.03	3.0	B
D	0.50	4.99	1.2	A
E	0.43	6.48	0.9	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1967	133	2244	0.877	1936	7.8	13.397	B
B	102	1958	1002	0.102	102	0.1	4.953	A
C	581	1181	1297	0.448	577	1.0	6.168	A
D	606	1015	1966	0.308	604	0.5	3.271	A
E	357	1114	1479	0.241	355	0.4	3.965	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2349	160	2229	1.054	2190	47.5	55.216	F
B	122	2224	868	0.141	122	0.2	5.980	A
C	694	1348	1218	0.570	692	1.6	8.440	A
D	724	1187	1870	0.387	723	0.8	3.888	A
E	426	1334	1366	0.312	425	0.6	4.741	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2877	195	2209	1.302	2208	214.7	219.509	F
B	150	2273	843	0.178	149	0.3	6.432	A
C	850	1402	1192	0.713	845	2.9	12.656	B
D	886	1342	1783	0.497	885	1.2	4.962	A
E	522	1631	1214	0.430	520	0.9	6.425	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2877	196	2209	1.302	2209	381.8	488.410	F
B	150	2274	843	0.178	150	0.3	6.440	A
C	850	1403	1192	0.713	850	3.0	13.030	B
D	886	1347	1780	0.498	886	1.2	4.993	A
E	522	1637	1211	0.431	522	0.9	6.479	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2349	161	2229	1.054	2228	412.0	642.907	F
B	122	2260	850	0.144	122	0.2	6.138	A
C	694	1368	1208	0.574	699	1.7	8.860	A
D	724	1202	1861	0.389	725	0.8	3.937	A
E	426	1343	1362	0.313	428	0.6	4.784	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1967	134	2243	0.877	2236	344.7	609.328	F
B	102	2244	858	0.119	103	0.2	5.908	A
C	581	1340	1222	0.476	583	1.1	7.017	A
D	606	1090	1924	0.315	607	0.6	3.393	A
E	357	1122	1475	0.242	358	0.4	3.996	A

2045 DM (without LTC), 5-6pm

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	175.76	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	175.76	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2045 DM (without LTC)	5-6pm	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2235	100.000
B		✓	146	100.000
C		✓	708	100.000
D		✓	1238	100.000
E		✓	1099	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	1	123	765	829	517
	B	130	0	8	4	4
	C	536	0	0	136	36
	D	1036	12	54	0	136
	E	798	0	227	74	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	15	15	15	15	15
	B	15	15	15	15	15
	C	15	15	15	15	15
	D	15	15	15	15	15
	E	15	15	15	15	15

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.16	303.35	186.2	F
B	0.20	6.42	0.3	A
C	0.68	11.27	2.4	B
D	0.75	8.95	3.3	A
E	1.15	232.63	86.9	F

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1683	274	2166	0.777	1667	3.8	8.074	A
B	110	1841	1062	0.104	109	0.1	4.346	A
C	533	1163	1306	0.408	530	0.8	5.315	A
D	932	915	2022	0.461	928	1.0	3.770	A
E	827	1325	1371	0.604	821	1.7	7.436	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2009	327	2136	0.940	1973	12.8	21.734	C
B	131	2181	890	0.148	131	0.2	5.455	A
C	636	1379	1203	0.529	635	1.3	7.257	A
D	1113	1090	1924	0.579	1111	1.6	5.077	A
E	988	1587	1237	0.799	978	4.2	15.435	C

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2461	357	2120	1.161	2111	100.3	104.453	F
B	161	2339	810	0.198	160	0.3	6.368	A
C	780	1494	1148	0.679	775	2.3	10.966	B
D	1363	1263	1827	0.746	1356	3.3	8.667	A
E	1210	1938	1056	1.146	1040	46.8	101.280	F

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2461	360	2118	1.162	2117	186.2	249.109	F
B	161	2348	806	0.200	161	0.3	6.418	A
C	780	1499	1146	0.680	779	2.4	11.269	B
D	1363	1268	1824	0.747	1363	3.3	8.954	A
E	1210	1947	1052	1.151	1050	86.9	232.631	F

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2009	392	2100	0.957	2088	166.6	303.353	F
B	131	2354	802	0.164	131	0.2	6.174	A
C	636	1464	1163	0.547	640	1.4	7.986	A
D	1113	1122	1906	0.584	1120	1.6	5.308	A
E	988	1600	1230	0.803	1214	30.4	177.045	F

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1683	308	2147	0.784	2132	54.1	188.437	F
B	110	2314	823	0.134	110	0.2	5.810	A
C	533	1453	1168	0.456	535	1.0	6.557	A
D	932	1027	1959	0.476	934	1.1	4.050	A
E	827	1336	1366	0.606	942	1.8	12.757	B

2045 DS (with LTC), 7-8am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	331.88	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	331.88	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D13	2045 DS (with LTC)	7-8am	ONE HOUR	06:45	08:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2592	100.000
B		✓	134	100.000
C		✓	936	100.000
D		✓	751	100.000
E		✓	474	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	138	1069	769	616
	B	122	0	5	6	1
	C	774	2	0	134	26
	D	684	5	10	0	52
	E	315	8	58	93	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	23	23	23	23	23
	B	23	23	23	23	23
	C	23	23	23	23	23
	D	23	23	23	23	23
	E	23	23	23	23	23

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.29	612.50	390.7	F
B	0.17	6.35	0.3	A
C	0.87	27.96	7.6	D
D	0.49	5.24	1.2	A
E	0.45	7.05	1.0	A

Main Results for each time segment

06:45 - 07:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1951	132	2244	0.869	1922	7.3	12.769	B
B	101	1940	1011	0.100	100	0.1	4.857	A
C	705	1193	1291	0.546	699	1.5	7.403	A
D	565	1148	1892	0.299	563	0.5	3.334	A
E	357	1195	1438	0.248	355	0.4	4.085	A

07:00 - 07:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2330	158	2230	1.045	2186	43.3	51.451	F
B	120	2214	873	0.138	120	0.2	5.881	A
C	841	1367	1209	0.696	836	2.7	11.739	B
D	675	1347	1780	0.379	674	0.7	4.000	A
E	426	1430	1317	0.324	425	0.6	4.963	A

07:15 - 07:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2854	193	2210	1.291	2209	204.5	207.802	F
B	148	2268	846	0.174	147	0.3	6.338	A
C	1031	1424	1182	0.872	1014	7.0	24.193	C
D	827	1529	1678	0.493	825	1.2	5.178	A
E	522	1742	1157	0.451	520	1.0	6.939	A

07:30 - 07:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2854	194	2210	1.291	2210	365.4	466.715	F
B	148	2270	845	0.175	148	0.3	6.347	A
C	1031	1425	1181	0.873	1028	7.6	27.956	D
D	827	1542	1671	0.495	827	1.2	5.243	A
E	522	1756	1150	0.454	522	1.0	7.054	A

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2330	159	2229	1.045	2229	390.7	612.500	F
B	120	2256	852	0.141	121	0.2	6.054	A
C	841	1391	1197	0.703	860	3.0	13.746	B
D	675	1377	1763	0.383	677	0.8	4.081	A
E	426	1452	1306	0.326	428	0.6	5.053	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1951	133	2244	0.870	2237	319.4	571.767	F
B	101	2239	860	0.117	101	0.2	5.831	A
C	705	1363	1211	0.582	710	1.8	8.925	A
D	565	1233	1844	0.307	566	0.5	3.469	A
E	357	1208	1431	0.249	358	0.4	4.128	A

2045 DS (with LTC), 8-9am

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	353.40	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	353.40	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D14	2045 DS (with LTC)	8-9am	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2620	100.000
B		✓	136	100.000
C		✓	945	100.000
D		✓	759	100.000
E		✓	479	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	140	1080	777	623
	B	124	0	5	6	1
	C	782	2	0	135	26
	D	691	5	10	0	53
	E	318	8	59	94	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	23	23	23	23	23
	B	23	23	23	23	23
	C	23	23	23	23	23
	D	23	23	23	23	23
	E	23	23	23	23	23

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.31	652.25	418.6	F
B	0.18	6.37	0.3	A
C	0.88	29.84	8.1	D
D	0.50	5.34	1.2	A
E	0.46	7.23	1.0	A

Main Results for each time segment

07:45 - 08:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1972	133	2244	0.879	1941	7.9	13.483	B
B	102	1959	1002	0.102	102	0.1	4.917	A
C	711	1206	1286	0.553	705	1.5	7.558	A
D	571	1160	1885	0.303	569	0.5	3.359	A
E	361	1208	1431	0.252	359	0.4	4.124	A

08:00 - 08:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2355	160	2229	1.057	2192	48.7	56.192	F
B	122	2221	869	0.141	122	0.2	5.923	A
C	850	1373	1206	0.705	844	2.8	12.071	B
D	682	1357	1774	0.385	681	0.8	4.047	A
E	431	1446	1309	0.329	430	0.6	5.032	A

08:15 - 08:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2885	195	2209	1.306	2208	217.8	222.937	F
B	150	2269	845	0.177	149	0.3	6.362	A
C	1040	1427	1180	0.882	1022	7.4	25.428	D
D	836	1538	1673	0.500	834	1.2	5.265	A
E	527	1760	1148	0.460	526	1.0	7.098	A

08:30 - 08:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2885	196	2209	1.306	2209	386.8	494.965	F
B	150	2270	845	0.177	150	0.3	6.370	A
C	1040	1428	1180	0.882	1038	8.1	29.838	D
D	836	1552	1665	0.502	836	1.2	5.337	A
E	527	1775	1140	0.463	527	1.0	7.225	A

08:45 - 09:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2355	161	2228	1.057	2228	418.6	652.246	F
B	122	2256	852	0.144	122	0.2	6.072	A
C	850	1393	1196	0.710	869	3.2	14.287	B
D	682	1388	1757	0.388	684	0.8	4.132	A
E	431	1469	1297	0.332	432	0.6	5.133	A

09:00 - 09:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1972	134	2243	0.879	2236	352.6	620.961	F
B	102	2240	860	0.119	103	0.2	5.848	A
C	711	1365	1210	0.588	717	1.8	9.078	A
D	571	1241	1840	0.311	572	0.6	3.495	A
E	361	1221	1425	0.253	361	0.4	4.167	A

2045 DS (with LTC), 5-6pm

Data Errors and Warnings

No errors or warnings

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	Asda Roundabout	Standard Roundabout		A, B, C, D, E	244.82	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	244.82	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D15	2045 DS (with LTC)	5-6pm	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Demand overview (Traffic)

Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
A		✓	2385	100.000
B		✓	146	100.000
C		✓	821	100.000
D		✓	1502	100.000
E		✓	848	100.000

Origin-Destination Data

Demand (PCU/hr)

		To				
		A	B	C	D	E
From	A	0	127	825	893	540
	B	130	0	8	4	4
	C	649	0	0	136	36
	D	1300	12	54	0	136
	E	547	0	227	74	0

Vehicle Mix

Heavy Vehicle Percentages

		To				
		A	B	C	D	E
From	A	14	14	14	14	14
	B	14	14	14	14	14
	C	14	14	14	14	14
	D	14	14	14	14	14
	E	14	14	14	14	14

Results

Results Summary for whole modelled period

Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
A	1.24	495.25	295.0	F
B	0.20	6.41	0.3	A
C	0.79	16.65	4.0	C
D	0.94	31.65	13.6	D
E	1.11	180.04	52.0	F

Main Results for each time segment

16:45 - 17:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1796	274	2166	0.829	1775	5.2	10.029	B
B	110	1946	1009	0.109	109	0.1	4.560	A
C	618	1225	1276	0.484	614	1.1	6.155	A
D	1131	1014	1966	0.575	1125	1.5	4.842	A
E	638	1605	1227	0.520	634	1.2	6.860	A

17:00 - 17:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2144	328	2136	1.004	2061	25.8	36.199	E
B	131	2268	846	0.155	131	0.2	5.743	A
C	738	1428	1180	0.626	735	1.9	9.162	A
D	1350	1200	1862	0.725	1345	2.9	7.843	A
E	762	1920	1065	0.716	756	2.7	13.032	B

17:15 - 17:30

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2626	367	2115	1.242	2112	154.3	160.190	F
B	161	2353	803	0.200	160	0.3	6.385	A
C	904	1493	1149	0.787	896	3.9	15.725	C
D	1654	1373	1766	0.937	1619	11.7	23.759	C
E	934	2323	858	1.088	832	28.1	82.065	F

17:30 - 17:45

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2626	370	2113	1.243	2113	282.7	377.364	F
B	161	2357	801	0.201	161	0.3	6.408	A
C	904	1494	1148	0.787	903	4.0	16.654	C
D	1654	1380	1762	0.939	1646	13.6	31.651	D
E	934	2354	843	1.108	838	52.0	180.036	F

17:45 - 18:00

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	2144	400	2096	1.023	2095	295.0	495.247	F
B	131	2373	793	0.166	131	0.2	6.204	A
C	738	1466	1162	0.635	746	2.0	10.062	B
D	1350	1217	1853	0.729	1392	3.2	9.679	A
E	762	1973	1038	0.734	956	3.7	85.477	F

18:00 - 18:15

Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
A	1796	280	2163	0.830	2154	205.3	418.641	F
B	110	2310	824	0.133	110	0.2	5.746	A
C	618	1455	1167	0.530	621	1.3	7.557	A
D	1131	1107	1914	0.591	1137	1.7	5.316	A
E	638	1623	1218	0.524	648	1.3	7.314	A

Lower Thames Crossing

Thurrock Council Local Impact Report

Appendix C Annex 2 – Key Scheme Amendments required to LTC

Contents

C2.1 A13/A1089/Orsett Cock/LTC interchange

C2.1.1. Consideration of the absence of appraisal of alternative layouts for the A13/A1089/Orsett Cock/LTC interchange is covered within Section 8 of the LIR.

C2.1.2. The Council has further commented on the flaws and inadequacies of the modelled operation of the proposed interface between LTC and the LRN at Orsett Cock. Appendix C Annex 1 Sub-annex 1.1 and Section 9.4 of the LIR summarise the deficiencies in the modelling of the junction, both through the strategic LTAM, which is reported within the DCO evidence base and through emerging microsimulation modelling, which is not contained within the DCO application.

C2.1.3. Notwithstanding the Council's view of the inappropriateness of the interchange between LTC and A13/A1089 at Orsett Cock or the robustness of the modelling of the proposals, the Council has consistently raised its concerns over the safe configuration of the proposed complex, confusing and convoluted interchange. These are captured largely through SoCG Matters 2.1.91 and 2.1.92.

C2.1.4. The configuration of the interchange is shown at General Arrangement Plans Volume C Sheets 29, 32 and 33 (APP-017) and the associated Authorised Development works are set out at Schedule 1 Part 1 of the dDCO (AS-038) and illustrated in the Works Plans (AS-026). The Rights of Way and Access Plans Volume C (AS-032) sheets 29, 32 and 33 indicate the sections of route to be stopped up or amended and cross reference to the works descriptions of the dDCO (AS-038).

C2.1.5. There are discrepancies between some points within those documents including references to works that have been largely already carried out – such as Works No 7F(i) and Work No. 7H. The description of works to the Orsett Cock roundabout further indicate works within the circulation (Work No 7F (iii)) whilst the General Arrangement, Works Plans and Rights of Way and Access Plans do not indicate any proposed works within the Orsett Cock junction. Plates C2.1 to C2.4 illustrate some of the inconsistencies and misleading works descriptions that are provided within the dDCO (AS-038) and wider evidence base.

C2.1.6. The proposed General Arrangements stop short of the Orsett Cock junction and do not demonstrate appropriate tie-ins to the current layout of the LRN junction. The proposals do not demonstrate how robust signing and notification to road users is provided to assist with safely and efficiently navigating the confusing configuration of the interchange. The consequence is one of likely disruption to the Council's network, potential safety issues and with further design refinement which could require works outside of the Order Limits and the indicated works e.g. signs and road markings on the LRN.

Plate C2.1 – Extract from dDCO (AS038) Schedule 1 Part 1 Works 7H description.

(h) **Work No. 7H** – as shown on sheet 29 and 32 of the works plans and being the construction of a new link road between Orsett Cock roundabout and A13, to include—

(i) the construction of the new two-lane link road, between the improved Orsett Cock roundabout (Work No. 7F) and the westbound carriageway of the improved A13 (Work No. 7F), approximately 1,200 metres in length, as shown on sheets 29 and 32 of the rights of way and access plans (reference points 29/7 and 29/6); and

(ii) the construction of a new bridge to carry the new link road between the existing Orsett Cock roundabout and the westbound carriageway of A13 over the new link road between the westbound carriageway of A13 and the new A122 Lower Thames Crossing (Work No. 7E).

Plate C2.2 – Extract from dDCO (AS038) Schedule 1 Part 1 Works 7F description.

(f) **Work No. 7F** – as shown on sheets 29, 31, 32 and 33 of the works plans and being the construction of an improved section of the A13, to include—

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(i) the improvement of the existing dual carriageway A13 for approximately 4,300 metres in length, as shown on sheets 29 and 32 of the rights of way and access plans (reference points 29/3 to 29/4 and 29/2 to 29/1);

(ii) the construction of a new bridge to carry the existing A13 over the link road between the northbound carriageway of the improved A1089 and the northbound carriageway of the new A122 Lower Thames Crossing (Work No. 7Z) and the link road between the westbound carriageway of the improved A13 and the northbound carriageway of the new A122 Lower Thames Crossing(Work No. 7E);

(iii) the improvement of the existing Orsett Cock roundabout, as shown on sheet 32 of the rights of way and access plans (reference points 29/6 and 30/2); and

(iv) the construction of a new public right of way from Long Lane to south of the A13 road, as shown on sheets 29 and 33 of the rights of way and access plans (reference points 28/6 and 28/7).

Plate C2.3 – Extract from General Arrangement Plans Volume C (sheets21 to 49) (APP-017) Orsett Cock scheme interface.

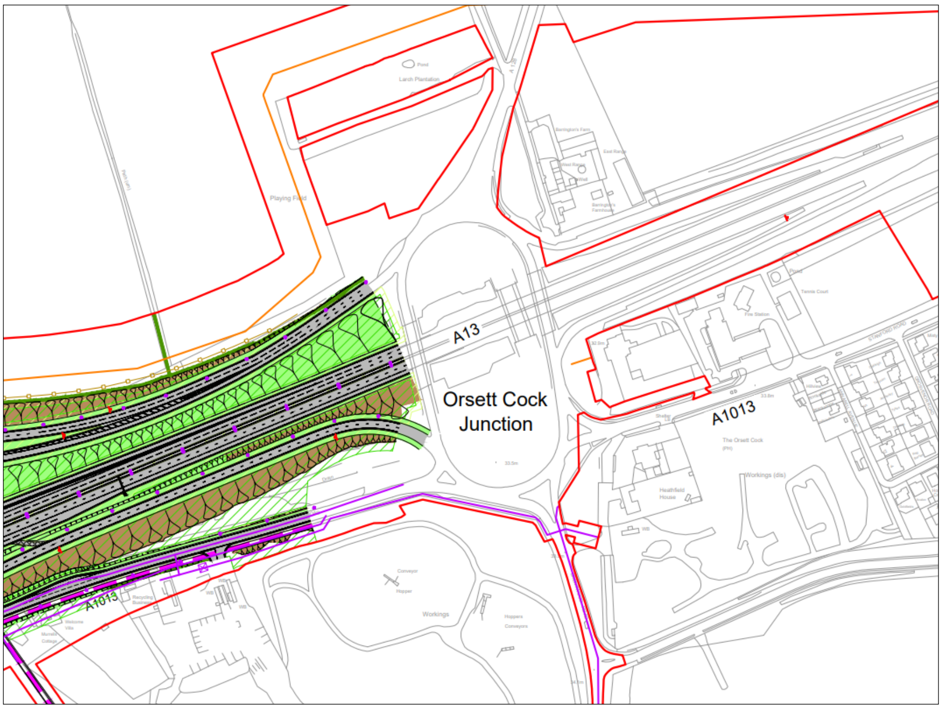
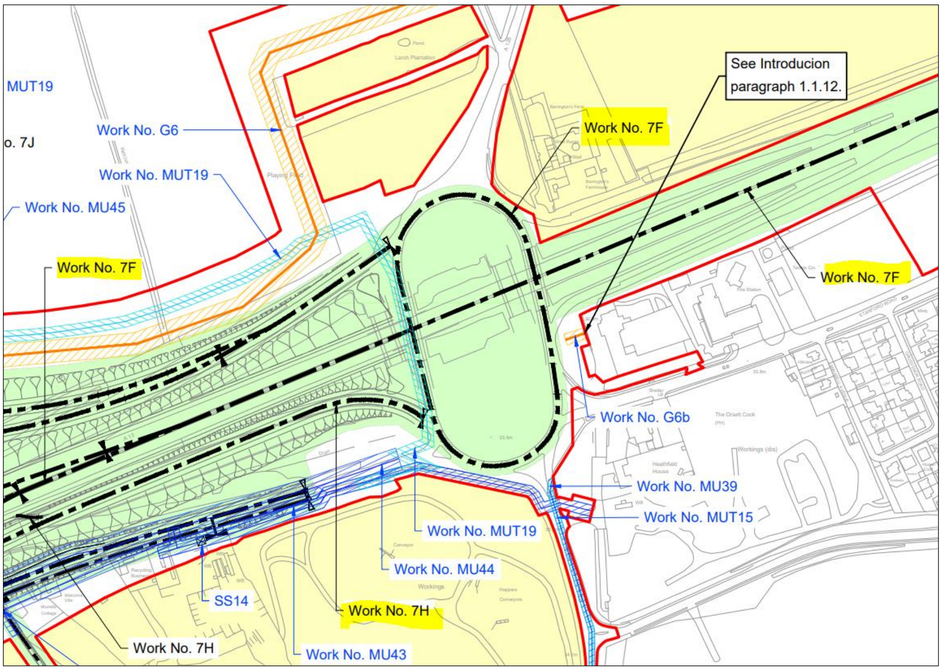


Plate C2.4 – Extract from Works Plans Volume C Composite (sheets21 to 49) (AS-026) Orsett Cock Works.



C2.2 Pegasus Crossing on A1013

C2.2.1. An example of unresolved design challenges within the proposed works that could have cumulative significant effects on the wider layout is the proposal of a 'Pegasus' crossing of A1013 to the immediate west of the new Rectory Road bridge. That facility is referenced across a series of document, including paragraph 7.12.33 of the Transport Assessment (APP-529), however that facility is not committed to through the dDCO (AS-038) or referenced on any plans or drawing.

C2.2.2. The Council is concerned that the indicative location of the crossing does not allow sufficient space for an appropriate crossing to be included within the scheme and that the consequences on the adjoining infrastructure would cause substantive challenges that could be extremely contentious. It can be foreseen that the contractor would resolve not to provide the crossing and NH would therefore renege on part of the strategy for Active Travel and equestrian facilities. It is the Council's concern that the incredibly intricate and fragile design of the interchange could quickly unravel and lead to a cascade of problems and under-performance as a consequence of an apparently minor change – such as seeking to relocate the Pegasus crossing; leading to the need to relocating the A1013 realignment and the associated bus laybys; leading to the need to review the demolition of properties adjacent to the current A1013.

C2.2.3. NH considers that issues relating to detail are not to be resolved as part of the DCO examination, however, the Council requires that certainty of delivery must be tested before DCO is granted. NPSNN requires that LTC must "*take opportunities to improve road safety*" (NPSNN paragraph 3.10 and 4.60) and at the same time should not introduce safety problems. Furthermore, at paragraph 3.17 NPSNN acknowledges "*There is a direct role for the national road network to play in helping pedestrians and cyclists. The Government expects applicants to use reasonable endeavours to address the needs of cyclists and pedestrians in the design of the new scheme. The Government also expects applicants to identify opportunities to invest in infrastructure in locations where the national road network severs communities and acts as a barrier to cyclists and walking, by correcting historic problems, retrofitting the latest solutions and ensuring that it is easy and safe for cyclists to use junctions.*" By overlooking the detail associated with what is on first inspection a relatively minor point, NH is not responding to the requirements of NPSNN.

C2.3 Use of Orsett Cock as part of the SRN

C2.3.1. The junction at Orsett Cock will remain the responsibility of Thurrock Council to manage and maintain following the opening of the LTC. The Council considers it unacceptable for NH to use the LRN to link sections of the SRN and to create deficiencies in the operation of the LRN as a consequence of changed movement patterns and induced traffic travelling to LTC through the Orsett Cock junction.

C2.4 Design Concerns

C2.4.1. As part of its review of the design of the interchange and connections to the LRN, a technical note setting out the Council's observations of the proposed outline layout was issued to NH in January 2022 and was the subject of discussions during a series of meetings. The technical note is provided at Sub-annex 2.1 of this Annex 2 and identifies a series of ten concerns. All are important and would need to be resolved.

C2.4.2. The Council acknowledges that most are contained within the network for which NH would be responsible, however, the poor layout of the interchange is anticipated to result in a high rate of collisions. Those safety concerns could result in injury to the Council's residents and so have a direct effect on harm to its communities irrespective of the location of. In addition, a collision at the A13/A1089 interchange would likely result in congestion on the LRN during the management of the incident.

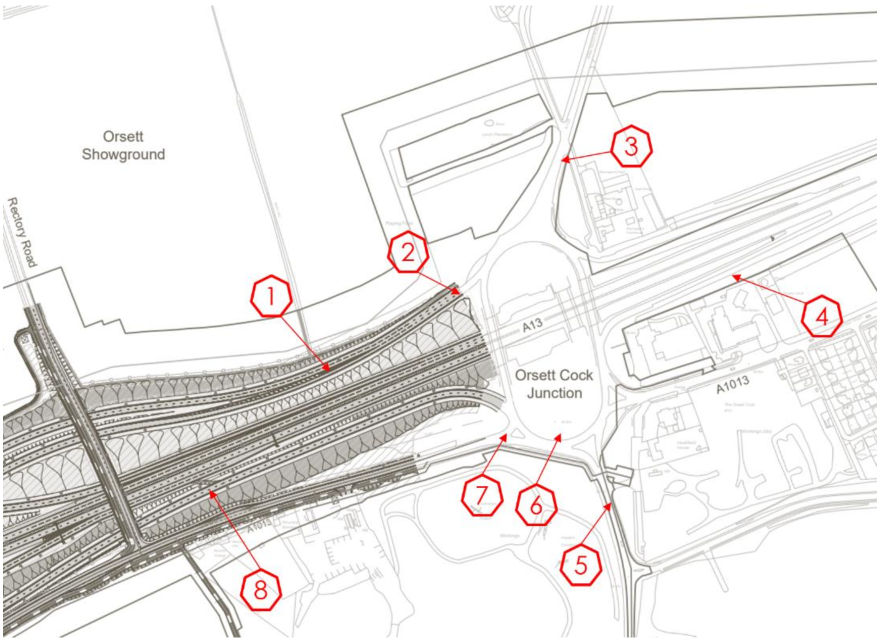
C2.4.3. Two of the concerns are considered to be of direct impact to the safe operation of the Orsett Cock junction for which the Council would be the Highway Authority. These would be:

1 The difficult and dangerous movement from A1013 Stanford Road eastbound into the westbound link to A13/A1089 (Point 4 within the appended technical note); and

2 Unsafe weaving arrangements on the eastbound approach to Orsett Cock (Point 5 within the appended technical note).

C2.4.4. The image at Plate C2.5 indicates the Council's areas of concern relating to the operation of the Orsett Cock junction:

Plate C2.5 – Points of concern at Orsett Cock interchange.



C2.4.5. Point 1: The weaving length on the approach to the Orsett Cock junction requires vehicles leaving LTC and access the LRN to merge with traffic leaving A13 eastbound. The two streams of traffic would seek to cross as they join the Orsett Cock circulation. Both links at that point are the subject of the national speed limit. This is a serious safety concern that will be introduced and has not been adequately reviewed by NH and not mitigated. Notwithstanding the concern over the harm to the local communities and drivers in the LRN, the problem will become a problem for the Council to manage as the link between A13 and Orsett Cock will be part of the LRN/MRN.

C2.4.6. Point 2: The weaving from point 1 occurs through a signal-controlled junction which modelling has shown to be heavily congested and with significant queuing.

C2.4.7. Point 3: Analysis of the microsimulation model shows extensive queues are predicted to occur southbound on A128 Brentwood Road in both peak period – LTAM indicates delays but not to the extent of the microsimulation. That congestion on the approach to the junction has been shown to result in traffic reassigning to parallel corridors, such as through Orsett Village.

C2.4.8. Point 4: Queues are predicted to occur on the westbound off-slip from A13 to Orsett Cock as a consequence of the alterations to the connection between A13 westbound and A1089 southbound. It is a concern that those queues could impact on safe flow of traffic westbound on A13.

C2.4.9. Point 5: Queues are predicted within the microsimulation models to occur northbound in Brentwood Road where that traffic struggles to enter the circulation – LTAM indicates delays but not to the extent of the microsimulation.

C2.4.10. Point 6: Active Travel and public transport connection opportunities through the junction are severely hampered by the increased traffic induced within the junction.

C2.4.11. Point 7: The reverse turn from A1013 Stanford Road to the westbound A13 and A1089 link which has been modified in 2022 as part of the Council funded A13 improvement as a single lane connector with hard shoulder along the link. NH proposes that the link will be reformatted to a narrow two-lane carriageway with narrow edge margins. Long vehicles turning into the link will need to cross lanes within the roundabout circulation and to enter the link. With the significant increase in traffic through the junction, this manoeuvre will cause disruption to traffic flow and can be dangerous for other traffic, especially cyclists.

C2.4.12. Point 8: An emergency service connector has been introduced to resolve connectivity for emergency services between its depot on A1013 and LTC northbound and southbound. This connection would need to be secured to protect against general traffic using it to access LTC. In securing the link this will put emergency services at risk when they are required to open the link whilst in live traffic. This link is required due to the changes in connection between A13 and LTC.

C2.4.13. Paragraphs 4.64 and 4.65 of NPSNN stipulates that NH must demonstrate that the proposed layout is safe. Importantly paragraph 4.66 states that "*The Secretary of State should not grant development consent unless satisfied that all reasonable steps have been taken …..to minimise the risk of road casualties arising from the scheme.*.". NH reports in the Transport Assessment (APP-529) at paragraph 9.2.5 that there are several departures from standards that are being reviewed by its design specialists. It does not report that those departures are resolvable or acceptable or where they occur. The Council has requested the departures report but NH has rejected that request.

C2.4.14. NH goes on to report in that section of the TA (APP-529, section 9) that LTC has been the subject of an independent Stage 1 Road Safety Audit. The Council has reviewed that audit and noted that it was carried out as virtual safety audit in May/June 2020, during the COVID pandemic, without the benefit of a site visit and on a preliminary iteration of the design. The design information provided to the Audit team did not have the interface between the current Orsett Cock junction and LTC. Amongst other points, the auditors did note at point 3.5.1 of the audit the complexity of the interfaces including between LTC and A13 and that that complexity could lead to driver confusion and late lane changes. The Council is extremely concerned about the linkage between LTC and Orsett Cock and the short weaving section. The Auditor recommended at point 3.5.1 of the audit the early creation of a signing strategy for LTC. NH responded to that recommendation that signing had been developed and would be refined through detailed design i.e. post DCO.

C2.4.15. A copy of the Road Safety Audit and NH's Designer's Response are provided at Attachment 2.2.1 and Attachment 2.2.2 respectively of Sub-annex 2.2 of this Annex 2. NH reports in the Transport Assessment that a further Stage 1 Road Safety Audit has been carried out in August 2022. Neither Safety Audit is included with the DCOv2 submission and so the latter audit cannot be reviewed. The Council requires the updated Stage 1 Road Safety Audit to be made available to the DCO examination. The Council is of the opinion that NH has not provided sufficient evidence of the safety review or that the proposed layout minimises the risk of road casualties.

C2.4.16. In addition to concerns over the safe operation of the interchange, the Council has significant concerns that the flawed operation of the junction at Orsett Cock will deliver a junction that will be congested for large periods of the day.

C2.4.17. The LTAM strategic modelling has given a broad indication of the effects on the operation of the Orsett Cock junction but that modelling is too coarse to provide a robust appraisal. As recognised by Government within the NPSNN at paragraph 4.6, this DCO should be supported by transport modelling "*to provide sufficiently accurate detail of the impacts*". The Council has proposed that NH undertakes local microsimulation modelling better to inform and understand the capacity, congestion, severance and safety of the junction and wider interchange.

C2.4.18. The Council has been provided with a baseline microsimulation model but neither that nor any forecast model has been presented as evidence to the Examination. A review of the emerging micro-simulation results has been carried out by the Council, outside of the Examination. That review is reported at section 9.4 of this LIR.

C2.4.19. The modelling provided to the Council has indicated that substantial queuing and complex traffic weaving occurs on the eastbound approach to the Orsett Cock junction during both modelled peak periods. As well as being inappropriate it would be unsafe as drivers seek to take chances or in the absence of peak period queues may suffer higher speed incidents which will also further disrupt the operation of the network.

C2.5 Tilbury Junction

C2.5.1. If LTC is to be imposed on the borough, the Council has sought to achieve local benefit by introducing viable local connections. The interchange at A13 brings no enhanced connectivity and stifles development growth. Through the stakeholder engagement process the Council has therefore proposed two local connections. That approach is supported at a number of places in the NPSNN, such as at paragraphs 3.20, 5.205, 5.215 and 5.216. Those sections of NPSNN propose that new road schemes must promote connectivity and sustainable development with an emphasis on non-motorised users. The inclusion of local linkage will assist with permeability for public transport and if co-ordinated correctly would facilitate active travel modes as part of future development growth.

C2.5.2. To the south of the borough it has been proposed that a link should be created to the Port of Tilbury and to possible development growth to the east of the borough. That connection could be created via a junction between the north tunnel portal and the Tilbury Loop railway.

C2.5.3. NH had provided the Council with indicative arrangements for a junction in that zone which have not been progressed. The Council notes, however, the introduction of the operational access immediately north of the tunnel portal. That proposal is indicated in the General Arrangement Plans Volume B Sheet 20 (APP-016, Sheet 20) and is referenced in the Transport Assessment (APP-529, paragraph 3.1.11 and Glossary) as an emergency access and vehicle turn-around facility. That layout reflects the early discussion between the Council and NH but it does not provide a local network function.

C2.5.4. The Council has undertaken a preliminary appraisal of the prospect of transforming the operational access into an interchange such that it would then benefit local communities and businesses. That appraisal is set out in the technical note at Sub-annex 2.3 of this Annex 2.

C2.5.5. Overall, it was found that:

3 The proposed NH junction design cannot accommodate the traffic from any of the demand scenarios. This indicates that NH's configuration of the junction does not provide adequate capacity to support traffic demand associated with future delivery of a Tilbury Link Road and committed future development across the area. It would therefore also not support future growth aspirations and movement demands associated with the Port of Tilbury or development sites proposed as part of the emerging Thurrock Local Plan.

4 The proposed NH junction design cannot accommodate the levels of demand forecast at this junction in the strategic modelling of alternative LTC options (undertaken by NH for the Council) which include different LTC/A13/A1089 junction configurations and result in different level of traffic using the Tilbury Link Road.

5 With roundabout and slip-road widening, both the 'high' and 'low' demand scenarios on the TLR can be accommodated but only if a general traffic connection to East Tilbury is not provided (i.e. allowing public transport and active travel connection only).

6 The proposed NH layout for Tilbury Junction does not include dedicated facilities for public transport or active travel. Space would need to be provided on the road linking the two roundabouts to provide flexibility to reallocate road space to public transport in the future. Additionally, a combined 5 metre active travel route should be provided on the southern side of the road between the East Tilbury connecting corridor and the Tilbury Link Road.

C2.5.6. In summary the indicated operational access does not provided for future adaptation to an interchange that would benefit the communities within Thurrock. The currently indicated junction is therefore entirely over engineered for the function it would provide i.e. access to the tunnel control facilities; operational maintenance access, emergency service access and vehicle turn-around.

C2.6 Public Transport Access to LTC

C2.6.1. The Council acknowledges the objective of LTC to open out opportunities to public transport and that LTC should leave a legacy of facilitating environmentally sound connections across the River Thames. This aspiration is not achieved.

C2.6.2. A technical note has been prepared by the Council encouraging NH to amend the proposals to achieve connectivity such that Local Buses (as defined in the Traffic Signs Regulations and General Directions 2016 Schedule 1 Definitions) could benefit from the cross-river connection. That technical note was prepared in May 2021 and is included at Sub-annex 2.4 of this Annex 2.

C2.6.3. The Council suggested options to remodel the then proposed emergency service access points to LTC and to establish appropriate connections to the local roads. The two locations shown were at Brentwood Road and at the then proposed emergency and operational interface at Station Road to the north of the north portal, which has since been amended by the Tilbury operational access. Reciprocal connections would also be required south of the river to allow robust connections to local roads within Gravesham and into Kent.

C2.6.4. This strategy would allow the current Fastrack services, operating between Dartford and Gravesend, or similar, to extend into Thurrock and Essex or Thurrock services to open out employment and community linkages across the river. With appropriate adaptation the scheme adjustments would present opportunities for active travel interchange. Importantly giving strong connections to the Port of Tilbury and the emerging Freeport.

C2.6.5. The Council will enhance local public transport connectivity within the Borough as part of the delivery of local growth and further business and port expansions. Those intentions would be better realised with complementary strategic services. The Council has corresponded with NH over the proposals to facilitate robust connections across LTC for buses and walking, cycling and horse-riding through the provision of sufficient width at the bridge structures to allow for strong current connections and to allow full future connections. NH has reflected these widths in some but not all crossings. A summary of the comparison between the Council's requirements and NH proposals is provided at Sub-annex 2.5 to this Annex 2.

C2.6.6. The Council requires that NH collaborates with the Council and bus operators to incorporate public transport connectivity into LTC. That connectivity would start to achieve one of its stated objectives and make some progress to ameliorating one of the Council's objections and would help to comply with the NPSNN.

C2.7 Passive Provision at Ockendon

C2.7.1. The Council has indicated to NH that the emerging Local Plan for Thurrock is anticipated to require significant residential and employment growth around South Ockendon and that such development should be balanced with access to the SRN. If LTC is to be delivered it offers the opportunity for a connection to be formed to the north of South Ockendon. Through engagement with NH, the Council has sought to develop that concept and initially to seek the provision of a connection – reflecting the stated objective of LTC to facilitate local growth. NH has stated that a connection will not be included within the proposals, but it would as a minimum ensure that nothing within the design of LTC and the associated utilities, alignment and earthworks would not preclude an interchange being delivered by others in the future.

C2.7.2. The indicative General Arrangements Volume C (sheets21 to 49) (APP-017) and the Works Plans Volume C Composite (sheets21 to 49) (AS-026) indicate a utilities tunnel to the immediate west of the North Rad crossing and does not commit to ensuring that that utility crossing will be sufficiently low to allow for a future interchange without substantive realignment.

C2.7.3. The safeguarding for the Ockendon interchange should be captured within the consented DCO and the zone of safeguarding indicated on the associated plans.

Sub-annex 2.1 – LTC-A13 Interchange - Design Consultation Scheme - Thurrock Council Safety and Operation Comments

TECHNICAL NOTE

Job Name: Thurrock LTC

Job No: 332510754

Date: 11 January 2022

Prepared By: Adrian Neve

Subject: **LTC/A13/A1089/Orsett Cock Interchange – Safety and Operation Comments – Thurrock Council**

1. Introduction

1.1. This Technical Note captures the review, on behalf of Thurrock Council (the Council), of the layout proposed by National Highways (NH) for the interchange between Lower Thames Crossing (LTC), A13, A1089, A1013 and A128. The interchange is focused on the Orsett Cock junction and the A13/A1089 junction.

1.2. This review is notwithstanding the Council's concerns regarding the absence of an Options Appraisal for the interchange and wider configuration of the LTC scheme north of the river which is subject to outstanding discussions.

1.3. The proposed layout, which is the subject of this note, is as presented by NH at the Community Impacts Consultation July 2021. The only exceptions are comments relating to the proposal for an additional lane on the LTC to Orsett Cock link, which has been alluded to within the consultation material, and the prospective reconfiguration of the link between Orsett Cock and the LTC/A1089 links, which has been briefly outlined in recent engagement with NH and is subject to ongoing microsimulation modelling we understand will report back in Spring /Summer 2022.

1.4. The Council has consistently expressed its view that the interchange, as proposed, is unnecessarily complex, land hungry and convoluted. This opinion is expected to be stronger once associated roadside and network management signing and infrastructure are superimposed onto the early concept designs. The Council cannot comment on that detail at this stage.

1.5. Although the Council's view on the inappropriateness of the interchange is maintained, this note provides feedback only on the concerns regarding perceived safety and operational challenges. The Council has been provided with a Stage 1 Road Safety Audit dated 13 July 2020 reference 678379CH.TO.12.SO.OE/RSA1 revision P02, carried out by Jacobs. That Audit considered the entire LTC scheme and included the interchange between LTC and A13. The Council notes that the Audit Team had not visited the site at the time of the Audit. NH has provided the Designer's Response document to the Road Safety Audit, reference HE540039-CJV-GEN-GEN-REP-DES-00101 revision P01 dated 11 August 2020 in which it is proposed that many of the comments raised by the Audit Team are left to be resolved through the detailed design of the proposals.

1.6. The Council requests details of the records of departures that have been adopted within the design of the interchange. This will help to inform its understanding of those departures that have been included and accepted within the design.

1.7. The comments made in this note are informed by the Council's review of the PCF stage 3 developed drawings contained within the Design Refinement Consultation Map Book 1 - General Arrangement drawings – specifically sheets 26, 29 and 30. In preparing its view on the configuration, prospective safety and operation of the A13 / LTC interchange, the Council has taken into account the concerns and comments raised through the Road Safety Audit and the responses made by NH in the Designer's Response. The Council notes that many comments made within the Stage 1 Road Safety Audit cover general topics across the LTC proposals (e.g. intervisibility at structure) and that there are specific points relating to sections of the infrastructure (e.g. the location, configuration and management of the Emergency Areas or the Emergency Access corridors). The Council does not comment on these matters here as these are generally matters for NH's operations of its network. It is noted however that the safe and efficient management of Emergency Access routes is important to the Council such that misuse could create problems on the Council's network. The resolution of this matter is therefore extremely important to the Council.

1.8. The following concerns are raised over and above the comments made within the Road Safety Audit, albeit the Council notes the general tone of the Road Safety Audit where the complexity of the A13 / LTC interchange and potential for driver confusion and conflict points are cited. The Council welcomes a detailed response from NH on the concerns raised in this note.

2. Areas of Concern General Arrangement Drawings Sheet 26

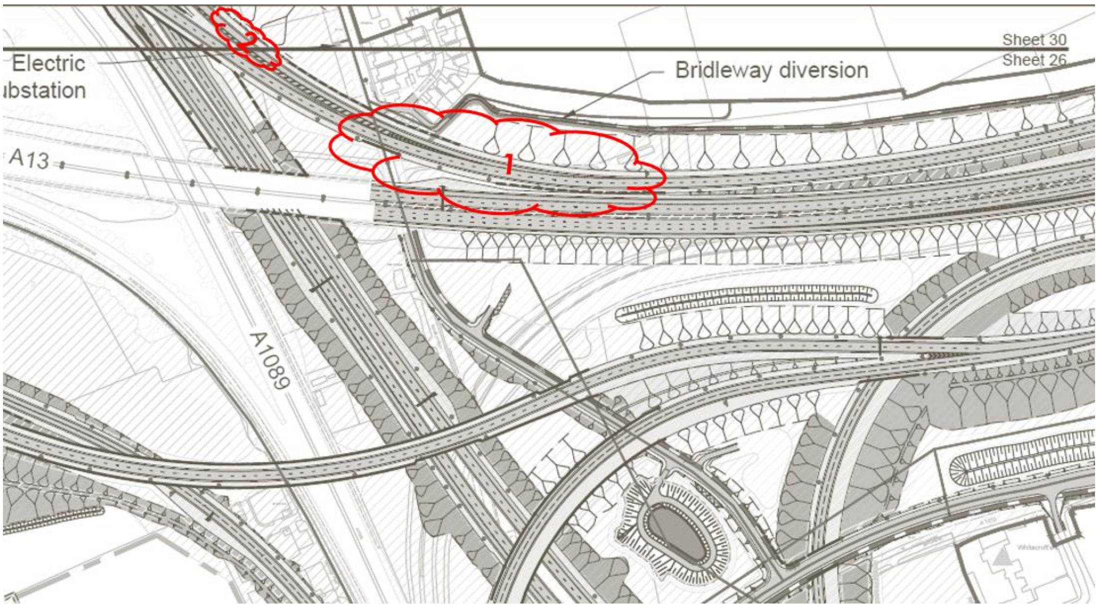


Figure 2.1: GA Sheet 26 – LTC off slips merge point

Points 1 and 2 - LTC off slips to A13/Orsett connection:

2.1. The angle of merge has drivers approaching from behind the joining driver's eye line i.e. over their shoulder. Merging drivers will have just been through a lane drop and then, within circa 350m, are faced with a priority connection with high speed traffic approaching from over their shoulder. The sight lines appear to be very poor and may result in clashes at the merge point where drivers are not able to adapt sufficiently quickly to the speeds of vehicles on the priority through lanes.

2.2. Shortly after this merge point drivers will then need to make a decision to cross to the A13 access slip or to continue to Orsett Cock. This pending decision could further distract drivers whilst they negotiate the priority merge. There are therefore many decisions being made immediately before and after a point of poor visibility.

2.3. The Council requests confirmation from NH that this issue has been appraised and that it is content with the proposed arrangement or whether it intends to provide further information on how the scheme design can be modified to address this issue. Is the design in accordance with CD122 or have any departures been assumed?

3. Areas of Concern General Arrangement Drawings Sheet 29

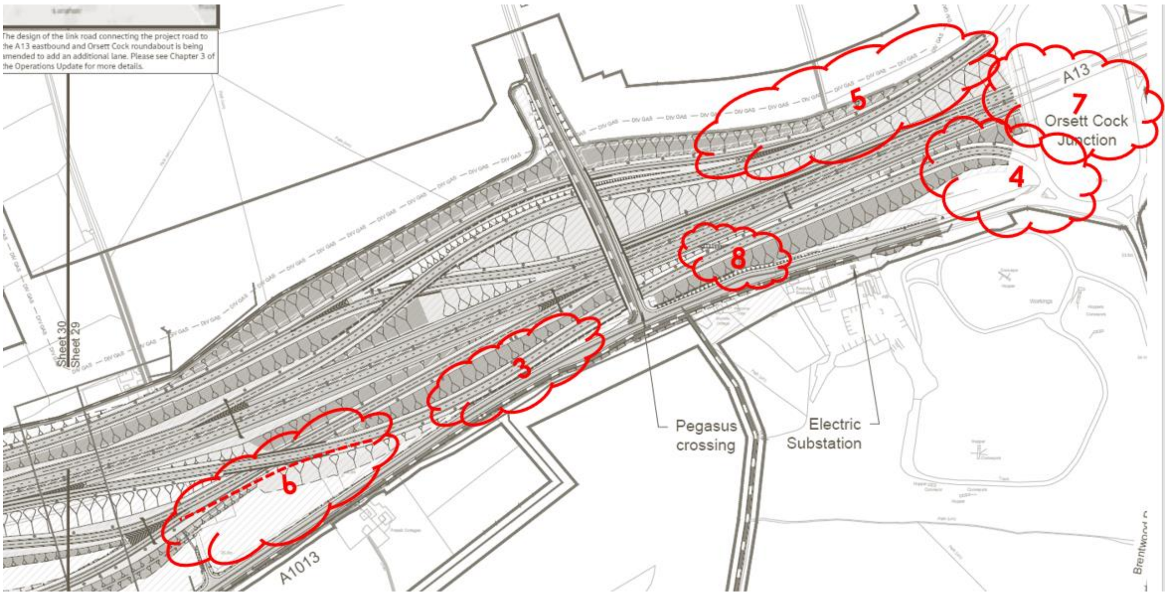


Figure 3.1: GA Sheet 29– Orsett Cock junction, A13 and LTC slips

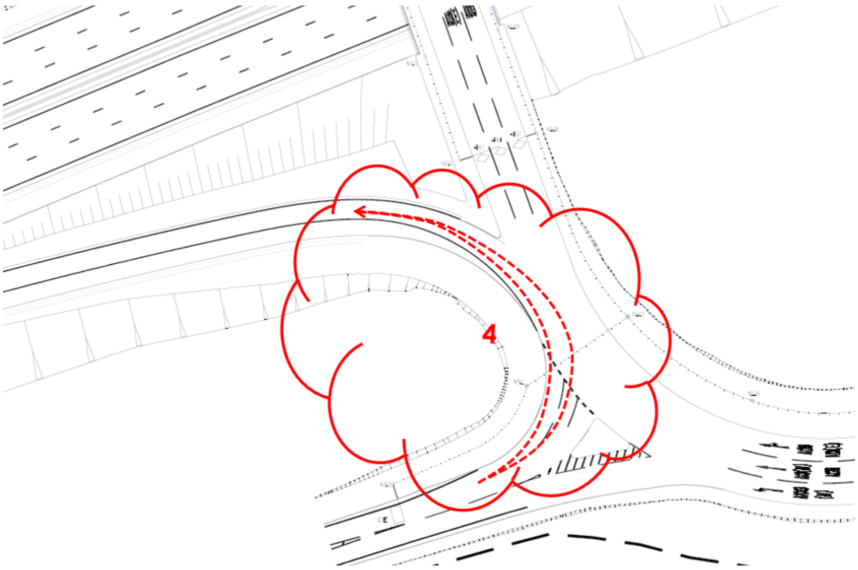


Figure 3.2: Large vehicle tight radius turn from A1013 to LTC link
[Excerpt source: Atkins / SNC Lavalin drawing reference A13WIDTC-ATK-HTS-XX-DR-CH-000001 Rev G Sht 1 of 3]

Figure 3.3: Nearside to nearside glare and possible distraction between A1013 and LTC link

Point 3 - Orsett Cock to A13 and LTC connection link:

3.1. Traffic westbound on the LTC link will be running nearside to nearside with eastbound A1013 traffic. These carriageways appear to be at similar levels with minimal separation. Drivers on LTC link will be going through a decision point and drivers on A1013 will be approaching the junction with Rectory Road; the new Pegasus crossing; and traffic queuing to enter the Orsett Cock junction. Any additional distractions or confusion would impact on the safe operation of the links. This type of nearside to nearside running was raised as an issue within the Road Safety Audit and does not appear to have been adequately addressed.

3.2. The Council requests that NH provides further information on the lighting masking and safety segregation measures that are proposed to stop headlight blinding and confusion between these two opposing traffic movements.

Point 4 - A1013 to A13/A1089/LTC link turn at Orsett Cock:

3.3. The amended link to A13 and A1089 will experience a substantive increase in demand, including by large vehicles, due to the link now being used to access A1089 southbound from A13 westbound and LTC and from A1013 to LTC northbound. These changes increase the traffic flow on that link which increases the level of conflict and reduces the safety of the turn from A1013 to the link road.

3.4. Traffic turning from A1013 Stanford Road into the link will be slow moving and will turn across a number of lanes to make the turn. Swept-path analysis of that movement has not been provided by NH but it is considered that, due to the tight internal radius between Stanford Road (A1013) and the westbound link road, vehicles will be required to turn across a number of lanes within the Orsett Cock junction circulation in order to access the reconfigured link. The Council requests that NH confirms that this issue has been assessed and whether it is either content with the proposed arrangement or provides further information on how the scheme design can be modified to address this issue.

3.5. Under the A13 Improvement scheme that is currently being constructed by Keir on behalf of the Council, the link to A13 is narrowed to a single lane. This change in network configuration needs also to be reflected in the NH proposals, which currently show this link as a two lane connection. The configuration of the connection to the Orsett Cock junction and the associated link to LTC and A13 have changed since the virtual Road Safety Audit was carried out. The Audit Team will also not have had the advantage of attending site to note the operation of this junction. The Council requests that the implications of that single lane connection be considered further by NH in relation to connectivity during incidents and the absence of resilience within the network.

Point 5 - LTC to Orsett Cock link:

3.6. As stated by NH in the Design Refinement Consultation this link has been widened to 2 lanes and joins very close to the approach to the Orsett Cock junction, which in turn flares to 3 lanes under the scheme which is currently under construction. These changes are not shown on the consultation scheme and should be reflected in the assessment of the safety and operation of the link to Orsett Cock. It is the Council's opinion that this merge is too close to the new Orsett Cock signal controls (circa 150-200m), and in conflict with the point that A13 off slip traffic is lane changing to go north or south e.g. A128, A1013 or Brentwood Road.

3.7. Traffic from LTC will be split across all three lanes at Orsett Cock as will traffic from A13. The significant amount of driver lane changing will be dangerous when mixed with the slowing traffic and storage for the new signal controls.

3.8. The Council requests that NH confirms and provides evidence that these merges and conflicts are acceptable and will not create accident problems and affect the suitable operation of the junction. Alternatively, that NH provides further information on how the scheme design can be modified to address this issue.

Point 6 - Orsett Cock to A13 westbound, A1089 southbound and LTC:

3.9. The proposed revision to the link between Orsett Cock and A13 on slip gives a new decision diverge point with the A1089 southbound link road. The Council has not been informed whether the proposed revised link will be single or double lane and so cannot comment on the complexity that it might represent. Furthermore, the A13 link to LTC southbound runs immediately adjacent to the revised link and could add confusion to drivers if there is no clear separation between the links.

3.10. The Council reserves comment on the performance of the amended link with regards to traffic flow. That aspect will be considered as part of the further traffic modelling that is being carried out by NH. The performance of the link could impact on the safety of the interchange and as such the Council may wish to comment on that point in due course. It is noted that the amended link removes the connection between the Orsett Cock roundabout and access to LTC northbound and southbound. The amended link also brings A1089 southbound traffic through the Orsett Cock roundabout. These amendments need to be reflected within the modelling exercise and conclusions drawn on the operation effects and the safety of the junction and wider interchange.

3.11. The Council requests that NH provides further evidence as to how this link, and the decision points along it, would be set out and clearly signed to avoid off-side diverges, late decisions and lane changes and conflicts. The Council also request evidence on the appraisal of the effects on the safe and efficient operation of the Orsett Cock junction – should include robust micro-simulation modelling of the network and a reflection on how that relates to the design and layout of the interchange.

Point 7 – Amended layout of Orsett Cock junction and active travel facilities:

3.12. The revised configuration of the Orsett Cock junction must be reflected in the layout of the interchange. This will inform consideration of the safety operation of the junction and how that will affect the capacity operation of the junction. The latter must be appraised through comprehensive micro-simulation modelling of the interchange. The proposals included within the Stage 1 Road Safety Audit did not include the revised arrangement at the Orsett Cock junction.

The scheme as currently being implemented has limited new facilities for pedestrians and cyclists. This has been raised with the current designers but must also be reflected in NH's designs and appraisal. It is expected that in line with the Councils' proposals to increase active travel, additional facilities for safe crossing of the slip roads and other junction arms will need to be provided in any LTC configuration that utilises Orsett Cock as a key part of its connectivity with the A1089. If NH is proactively to encourage active travel then the interchange must allow for suitable facilities and assess the effects of those facilities on the safety and operation at the Orsett Cock junction.

Point 8 - Emergency service connections:

3.13. It is understood from NH that there is to be an emergency service connection point located within the interchange to allow permeability for the emergency services such that those services can achieve safe response times. It is not clear from the General Arrangement drawing within the consultation material how it might be used under a general free-flow situation. The Council can therefore not comment on the appropriateness of that infrastructure; how the use of the connection point could impact on the safe operation of the network; and also, on the network management burden that the Council will have to take on. This connection was not included within the design which has been the subject of the Stage 1 Road Safety Audit.

3.14. The Council requests that NH provides details of the emergency services connection point and how it will be used and managed. An assessment of its effect on the safe operation of the network should also be provided.

4. Areas of Concern General Arrangement Drawings Sheet 14

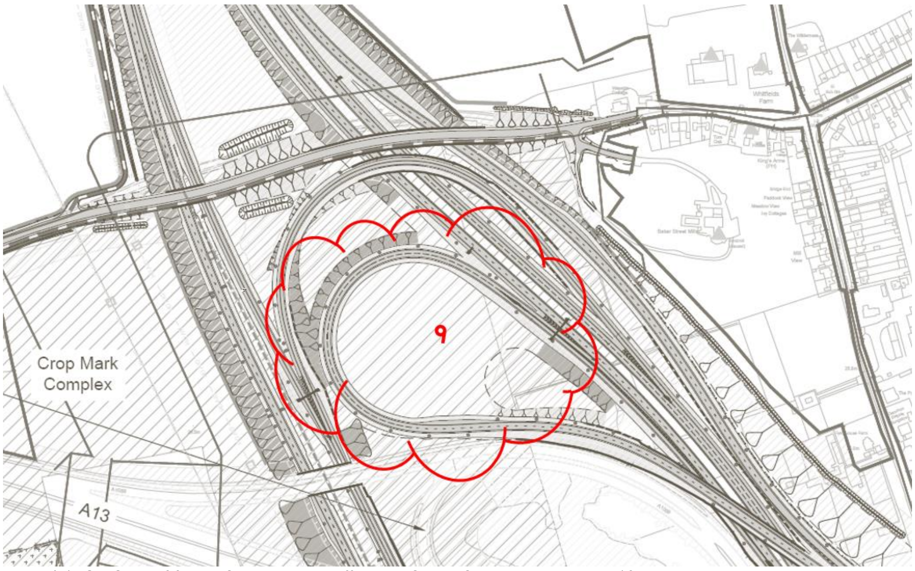


Figure 4.1: GA Sheet 30 – LTC northbound off slip to Orsett Cock junction and A13 eastbound

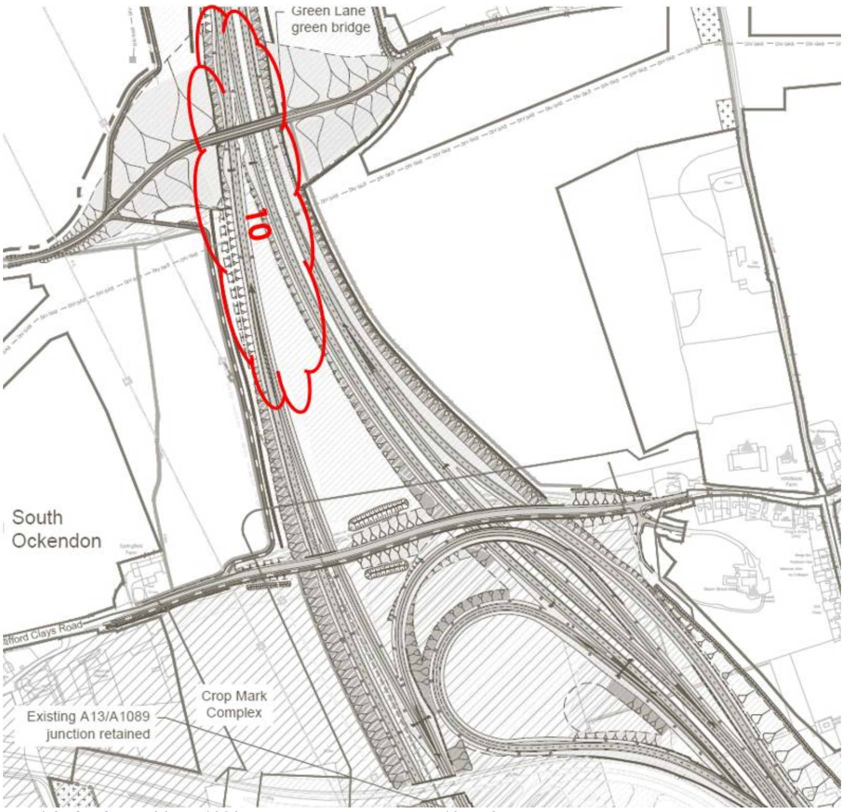


Figure 4.2: GA Sheet 30 – A1089 northbound merge with A13-LTC northbound link and on-slip

Point 9 - Link LTC northbound to A13 eastbound / Orsett Cock:

4.1. This link has an internal radius of circa 90-100m. The Council is cognisant of the poor safety record of similar sweeping links, such as that between A1089 northbound to A13 eastbound and the need to introduce retrospective speed restrictions to manage down the incidence of crashes and loss of control accidents. The propensity for loss of control incidents on sweeping links is recognised within the Road Safety Audit.

4.2. The Council requests that NH confirms the design speed that has been assumed for this link and whether there is to be a signed reduced speed on the link.

Point 10 - A1089 northbound merge with LTC northbound link and LTC on slip:

4.3. Traffic travelling from A1089 towards LTC to join northbound first merges with traffic from A13 which is also seeking to join LTC northbound. This is in effect an off-side merge, contrary to CD122 Section 3.

4.4. Traffic leaving A1089 will have a high percentage of slow-moving HGV traffic which will need to move across after the merge point to the nearside lane to access the long slip lane, safely to join LTC northbound. Faster moving traffic, joining LTC from the A13 eastbound link, will seek to join LTC northbound at the short slip lane using the offside lane after the merge point. These two flows of traffic will cross in the 300m between the merge and diverge points creating a dangerous conflict point.

4.5. The Council requests that NH provides evidence as to how this configuration and conflict is acceptable; whether a departure has been included; or provide further information on how the scheme design can be modified to address this issue.

5. Summary

5.1. The Council has previously expressed and continues to have concerns about the suitability and configuration of the LTC/A13/A1089/A128 interchange. This note raises ten points of specific concern associated with the safety of the proposed configuration.

5.2. Further to the specific concerns raised in the note, it is the Council's opinion that the convoluted and confusing nature of the proposed interchange would likely result in considerable driver confusion and indecision and potentially presents many conflict points. This view is supported in the Road Safety Audit, provided by NH.

5.3. The Council has reviewed the Road Safety Audit that has been completed on the proposed junction design (and includes the wider LTC scheme). The Audit does little to provide reassurance to the Council regarding the safety of the proposed interchange. Some of the concerns, identified in this note, have been raised in the early phase Stage 1 Road Safety Audit, however resolution of those problems have been typically postponed to be taken on board in the detailed design stage. Further safety detailed concerns are expressed by the Council in this note which should be considered by NH and suitable resolution should be put forward prior to submission of the scheme to DCO Examination.

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Stantec UK Ltd, Caversham Bridge House, Waterman Place, Reading, RG1 8DN

T: +44 (0)118 950 0761

Sub-annex 2.2 –LTC Preliminary Design Stage 1 Road Safety Audit

Attachment 2.2.1 – NH Commissioned LTC Stage 1 RSA

Lower Thames Crossing

GG 119 Stage 1 Road Safety Audit

678379CH.TO.12.SO.OE/RSA1 | P02

13.07.2020

Highways England

Engineering Design Release (DR3.0) SGAR3

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Jacobs U.K. Limited

1 The Square
Temple Quay
Bristol BS1 6DG

+44 (0)117 457 0980

www.jacobs.com

Document history and status

Revision	Date	Description	Authors	Checked	Reviewed	Approved
P01	26 June 2020	Final Issue The RSA report was written in sections by the audit team for efficient delivery of the audit; check/review of each section was undertaken by a different auditor to the author of that section.	Kate Carpenter Alison Foale Daniel Harris	Alison Foale/ Daniel Harris	Alison Foale/ Daniel Harris	Kate Carpenter
P02	13 July 2020	Final Issue Minor alterations following Overseeing Organisation comments.	Kate Carpenter Alison Foale Daniel Harris	Alison Foale/ Daniel Harris	Alison Foale/ Daniel Harris	Kate Carpenter

Contents

1 Introduction

1.1 Road Safety Audit Team

1.1.1 This report results from a Stage 1 Road Safety Audit (RSA) carried out on the Lower Thames Crossing Scheme (LTC) engineering design release 3.0 (DR 3.0), in accordance with the Project Control Framework (PCF) (Stage 3) and Design Manual for Roads and Bridges (DMRB) General Principles and Scheme Governance General Information GG 119.

1.1.2 The RSA has been undertaken at the request of Mark Bottomley the LTC Deputy Project Director, who issued an approved brief to the RSA team on Monday 1st June 2020.

1.1.3 The Audit was carried out during May and June 2020.

1.1.4 The RSA team membership approved by Matthew Pilsbury, the Highways England Road Safety Lead, was as follows:

Alison Foale BEng (Hons) MSc MCIHT MSoRSA
Highways England Approved Certificate of Competency
Road Safety Team Leader, Jacobs

Daniel Harris BA (Hons) MCIHT MSoRSA RegRSA (IHE)
Highways England Approved Certificate of Competency
Road Safety Team Member, Jacobs

Kate Carpenter BEng CEng MICE FCIHT FSoRSA
Highways England Approved Certificate of Competency
Road Safety Team Member, Jacobs

1.2 Scheme Summary

1.2.1 The LTC is a proposed new GD 300 Level 3 scheme connecting the A2 in Kent, Thurrock (at the A13) and the M25 in Essex through a tunnel beneath the River Thames with the following strategic objectives:

- to support sustainable local development and regional economic growth in the medium to long term;
- to be affordable to government and users;
- to achieve value for money;
- to minimise adverse impacts on health and the environment;
- to relieve the congested A282 Dartford Crossings and approach roads, and improve their performance by providing free-flowing, north-south capacity;

- to improve resilience of the Thames crossings and the strategic road network; and
- to improve safety.

1.2.2 The route will form part of the English strategic road network (SRN) and will be coordinated with the wider Lower Thames Area Network (LTAN) as illustrated in Figure 1-1.

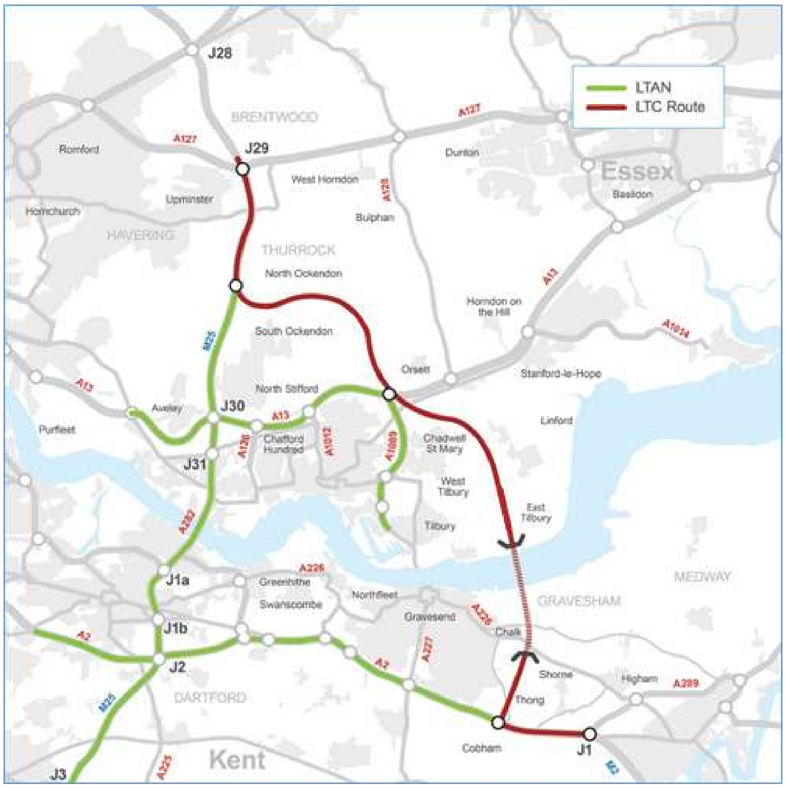

FIGURE 1-1 - LOWER THAMES AREA NETWORK

1.2.3 The LTC route is approximately 14.5 miles (23km) in length including the longest twin bore road tunnel (4.27km) on the SRN. The tunnel has one of the world's largest bore diameters. The tunnel will pass beneath the River Thames with its southern portal located to the east of the village of Chalk, and its northern portal to the west of East Tilbury.

1.2.4 On the south side of the Thames, the new road will link the tunnel to the A2, M2 and local road network in Kent via a multi-level interchange with connector link roads.

1.2.5 At the northern extent of the scheme the new road will link with the M25 to the south of the existing J29 at a new motorway junction (J29a) with south facing slip road only. The creation of the new J29a will modify the existing M25 between J29 and J30. This link will retain its operating regime as controlled motorway and will be widened from 4 to 5 southbound lanes between J29 and a new J29a.

1.2.6 On the north side of the Thames the new road will link to the existing A13 via a multi-level interchange. The A13 interchange will provide access to the local road network.

1.2.7 Due to the LTC route crossing tidal and fluvial flood plains the route to the north of the river will be elevated above ground level by use of embankments and viaducts. Additional flood defences are proposed at the tunnel portals and approaches.

1.2.8 The LTC route and associated infrastructure works impact on existing WCH (walking cycling horse-riding) routes. The scheme provides for pedestrians, cyclists and equestrians through the provision of green bridges, overbridges, underpasses and diverted routes.

1.3 Operating regimes

1.3.1 LTC from J29a M25 to the LTC / A2 / M2 interchange will be designated as an all-purpose trunk road (APTR) and will operate as a GD 300 Level 3 scheme with a controlled environment including:

LTC Mainline:

- dual 3 lane (LTC/A2 junction to A13)
- 3 lanes northbound (A13-M25)
- 2 lanes southbound (M25-A13)
- no hard shoulders
- stationary vehicle detection (SVD)
- variable mandatory speed limits (VMSL)
- Red-X
- provision of places of relative safety (PRS) including 22 mainline emergency areas (EA) and sections of hard shoulder through the A13 junction, approaches to J29 M25 and the A2 interchanges
- variable message signs (VMS) and control signalling
- formal surveillance (CCTV)

LTC main crossing (Tunnel):

- 3 lanes in each bore
- no hard shoulders
- emergency walkways in accordance with BD78 to nearside and offside carriageway in each tunnel bore

- stationary vehicle detection (SVD)
- video automatic incident detection (VAID)
- average speed enforcement
- Red-X
- provision of places of relative safety (PRS) – the design and enhanced operating procedures will create a safe area at the specific location where a road user has encountered difficulties (i.e break-down, live lane stop)
- variable message signs (VMS) and control signalling
- stop system at the tunnel portals
- formal surveillance (CCTV)
- emergency telephones
- cross-bore passages.

1.3.2 For operational purposes the design of the tunnel portal areas incorporates:

- carriageway cross-overs
- works access junctions with the LTC mainline
- emergency / maintenance loop roads
- emergency services access links with the local road network (A226 at the southern portal, Station Road at the northern portal)
- authorised vehicle (i.e. Traffic Officer Service) turnaround areas
- tunnel stop system at both northern and southern tunnel portals.

1.3.3 The LTC route is designed to operate without restrictions to heavy goods vehicles (HGV) and dangerous goods vehicles (DGV), other than for the carriage of abnormal loads. It is proposed that the LTC route will operate as a GD 300 Level 3 scheme and will be subject to prohibitions:

- prohibition of pedestrians, cyclists, equestrians.
- prohibition of slow-moving vehicles (i.e. agricultural vehicles, motorcycles less than 50cc).
- prohibition of HGVs in lane 3.

1.3.4 A free-flowing charging system for passage through the tunnel is proposed, where drivers do not need to stop but pay remotely, similar to that at the Dartford Crossing.

1.3.5 Additional emergency access provision and authorised vehicle turnaround facilities are provided to the LTC mainline from the local road network from Brentwood Road located to the north of the Thames.

1.4 Design speeds

1.4.1 The design speed for the LTC mainline and the improved sections of M2 / A2 and M25 is 120km/h (70mph speed limit).

1.4.2 The design speeds of connector roads (a collective term for interchange link, slip roads and link roads) are:

- Interchange links (free flow links within an interchange) - 85km/h
- Slip roads - 70km/h
- Link roads (one-way connector roads adjacent to but separate from the mainline carriageway) - 120km/h or 100km/h.

1.5 Site Visits

1.5.1 The RSA took place during the Covid-19 pandemic. The RSA was undertaken by the audit team utilising remote working, including video calls, screen sharing and shared documents.

1.5.2 In line with Highways England guidance at the time, a physical site visit was not undertaken as part of this RSA. In relation to Stage 1 RSAs the Highways England (GG 119) requirement for a physical site visit was relaxed and teams encouraged to utilise digital resources to assist with the process. It is noted that there is still a requirement for a fully compliant Stage 1 Road Safety Audit to be undertaken if the project has not moved beyond this stage after the pandemic is over.

1.5.3 In lieu of a physical site visit, the audit team members undertook collaborative online reviews of the brief, design drawings and supplementary materials as follows:

Table 1.1 RSA team collaborative reviews

Date	Purpose
27.05.2020	Introduction ‘walk through briefing’ provided by the Design Organisation (DO)
02.06.2020	Review of supplied documents
05.06.2020	Collaborative review of General Arrangement drawings – 1 of 2
08.06.2020	Collaborative review of General Arrangement drawings – 2 of 2
12.06.2020	Collaborative discussion regarding problems identified during individual reviews of drawings and documents

Date	Purpose
17.06.2020	Collaborative discussion regarding problems identified during individual reviews of drawings and documents
19.06.2020	Collaborative review of Drainage drawings
24.06.2020	Collaborative discussion regarding problems identified during individual reviews of drawings and documents
26.06.2020	Collaborative review and discussion regarding identified issues, finalisation of the report and covering letter

1.5.4 During the online reviews digital resources including Ordnance Survey mapping and Google Streetview were utilised to help inform the RSA. A limitation of the online process relates to identification of vertical and horizontal alignment issues, although these have been reported where a combination of the supplied information and online resources have allowed.

1.6 This Report

1.6.1 This report is presented based upon the checklist contained in Appendix B of GG 119 for RSA. The terms of reference of the Road Safety Audit are as described in GG 119. The Road Safety Audit Team has examined and reported only on the road safety implications of the scheme as presented and has not examined or verified the compliance of the designs to any other criteria. However, in order to clearly explain a safety problem or the recommendation to resolve a problem, the Audit Team may on occasion have referred to a Design Standard for information only. Observations made should not be construed as implying that a technical audit has been undertaken in any respect.

1.6.2 This RSA has examined the road safety implications of the scheme as presented, based on the normal operating state. It has not considered or investigated road safety with regards to incident management, maintenance, temporary traffic management and emergency state operating regimes within the extents of the scheme.

1.6.3 The drawings and documents provided as part of this RSA are shown in the List of Drawings and Documents Supplied in Appendix A.

1.6.4 The documents provided also include a departures from standard spreadsheet. The departures are still in development and a full assessment has not been possible at the present stage.

1.6.5 Three years of personal injury collision (PIC) data was supplied to the audit team. The data indicated that, while PICs occur on the existing network which will tie into the LTC scheme, the rate and severity of collisions was broadly as expected for the types of carriageway and junctions. Three locations of note where collisions occur in clusters or above expected rates were:

- M25 junction 29 – two small clusters of PICs (four to six in each) at the A127 eastbound and M25 junction 29 clockwise diverge give way lines and immediate circulatory. A cluster of eight collisions at the M25 junction anti-clockwise diverge give way line. The PICs were typical of the location, including rear shunt type collisions often resulting from following too closely and moving off/restart movements.

- A13 Orsett Cock Roundabout – nineteen PICs (two serious, seventeen slight) during the last three years of available data. The collisions are typical of those found at large grade separated roundabouts.

- M2 junction with the A2 and A289 – a cluster of eleven PICs (one serious, ten slight) in three years on the outside of the merge loop that provides for movements from the A289 southbound to the M2 southbound. These collisions are largely due to a loss of control, with more than half occurring on a wet/damp road surface.

1.6.6 A location plan is supplied in Appendix B. Each of the problems identified by the Audit Team has been allocated a unique reference number and is shown on the plan extracts contained within Appendix C.

1.6.7 Appendix D includes records of meetings between the RSA team and the project team, and Appendix E any clarifications provided by the design organisation.

1.7 What happens next?

1.7.1 This audit report has been submitted to the Project Sponsor. The design organisation is required to manage the production of the RSA response report, as detailed in GG 119, in collaboration with the Overseeing Organisation. The response report should reach one of the conclusions set out below, namely:

- accept the RSA problem and recommendation made by the RSA team;

- accept the RSA problem raised, but suggest an alternative solution, giving appropriate reasoning; or

- disagree with the RSA problem and recommendation raised, giving appropriate reasoning for rejecting both.

1.7.2 In addition, the RSA response report shall contain a response from the Overseeing Organisation and a RSA action for each problem agreed between the Design Organisation and Overseeing Organisation.

1.7.3 Safety issues identified during the audit which the Terms of Reference exclude from this report, but which the audit team wishes to draw to the attention of the Project Sponsor, will be set out in a separate covering correspondence. These issues could include but not be limited to maintenance items and operational issues.

2 Items raised in previous Road Safety Audits

2.1 Summary

2.1.1 The road safety aspects of Lower Thames Crossing have not been subject to any previous RSAs.

3 Items Raised at this Stage 1 Road Safety Audit

3.1 Local Alignment

Visibility

3.1.1 Problem

Location: Various

Summary: Bridge structures/piers restricting visibility

The bridge structure information provided for this RSA does not include details regarding the piers. At some locations, such as (but not limited to) the merges under the Thong Lane overbridge, the bridge piers and carriageway alignment may combine to restrict forward visibility to merges or vehicles downstream.

RECOMMENDATION

It is recommended that suitable forward visibility is provided around all bridge piers and that full details of bridge structures are provided for the Stage 2 RSA.

3.1.2 Problem

Location: Various

Summary: Embankments and fencing restricting visibility

Visibility from access roads may be restricted by the profile of adjacent embankments, restraint systems and fencing. An example of this is the access to the pond off Muckingford Road which runs parallel to the carriageway before joining it at a priority junction. Drivers on the access road may not be able to see a vehicle on Muckingford Road as they travel east off the overbridge increasing the risk of failure to giveway collisions. A further example of this is on the west side of Green Lane overbridge at Ch 14 700.

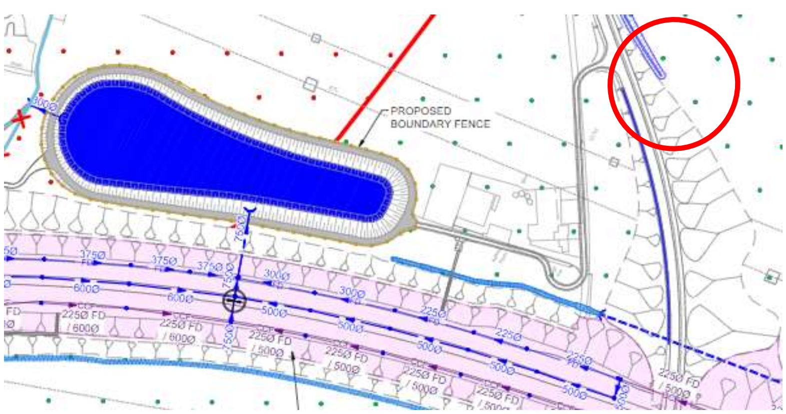

FIGURE 3-1 – EXTRACT FROM PROPOSED DRAINAGE PLAN HE540039-CJV-HDG-SZP_DN000000_Z-DR-CD-00007

RECOMMENDATION

It is recommended that suitable forward visibility is provided from access roads where they connect to the local road network.

Vertical alignment

3.1.3 Problem

Location: Various

Summary: Vertical alignment and general layout combine to create problems

At some locations a combination of the vertical alignment and the general road layout combine in a way that could increase the risk of collisions. This includes, but is not limited to:

- LTC southbound to M2 eastbound interchange link where a 5-6% gradient incline is provided on approach to the merge with the M2 eastbound. The merge taper starts under Thong Lane bridge and a combination of the gradient, structure, approach angle, signing (including a gantry east of the structure) and general complexity of the layout may increase the potential for confusion, late lane changes and collisions at the merge.
- LTC southbound to A2 eastbound collector road, where the approach is on an extended 4% gradient to a merge on a crest just beyond the Thong Lane overbridge.

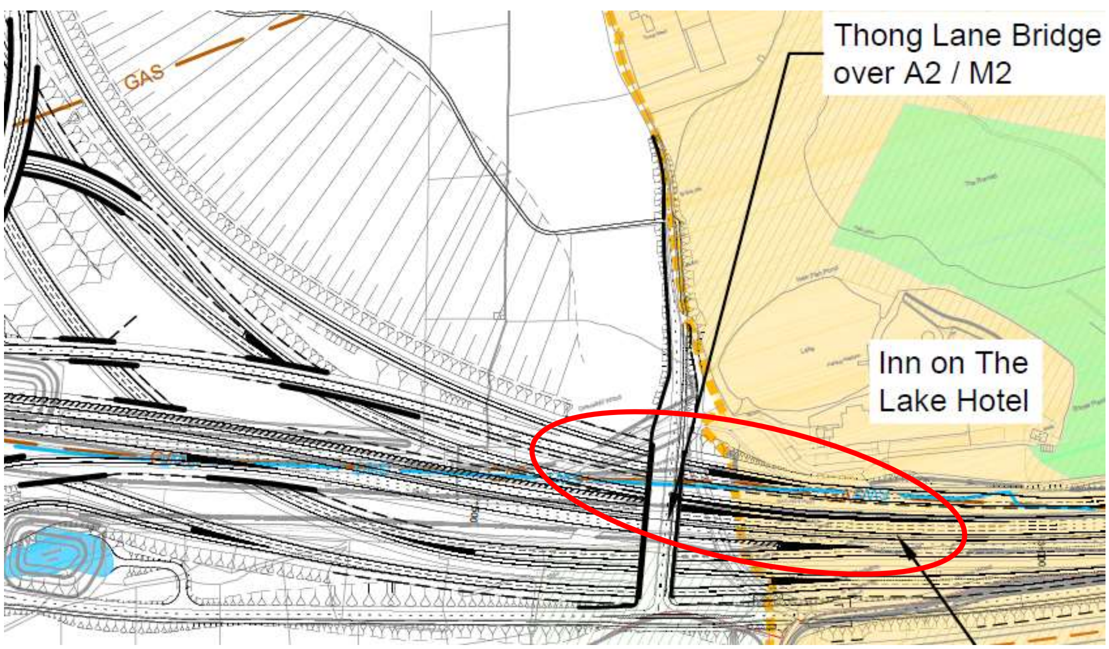

FIGURE 3-2 – EXTRACT FROM GENERAL ARRANGEMENT DRAWING HE540039-CJV-HML-S02_ML000000_Z-DR-CH-00050

RECOMMENDATION

It is recommended that detailed modelling of visibility envelopes is undertaken to ensure that all drivers will have adequate visibility of manoeuvres and anticipate vehicle movements.

3.1.4 Problem

Location: New roundabout south of the M2/A2/LTC junction

Summary: Retaining structure restricting visibility

Retaining structure RWN00000022 is located between the west and north arms of the new roundabout south of the M2/A2/LTC junction. From the information provided it is not clear if the retaining structure will restrict visibility to/from the two adjacent arms. Restricted visibility on approach to the roundabout and at the give way lines increases the risk of failure to give way and side impact collisions involving vehicles emerging onto the circulatory.

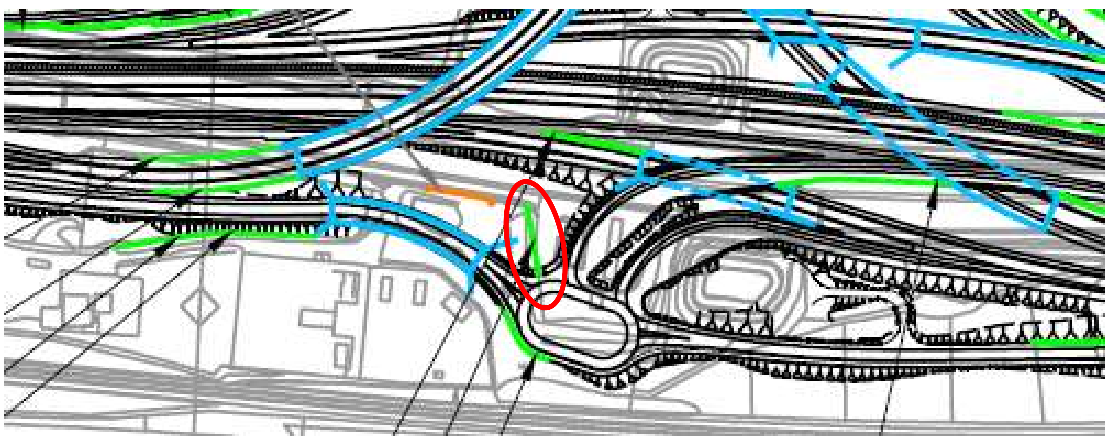

FIGURE 3-3 – EXTRACT FROM RETAINING WALL STRUCTURES DRAWING HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28072

RECOMMENDATION

It is recommended that suitable forward visibility is provided around all retaining structures and that full details are provided for the Stage 2 RSA.

3.1.5 Problem

Location: Harlex Haulage access road and Park Pale Overbridge

Summary: Vertical alignment of the access approach and overbridge impact visibility

A new access road to Harlex Haulage is proposed on the outside of the bend to the north side of Park Pale overbridge. The approach road incorporates a 6% gradient. At the junction, visibility to vehicles travelling northbound over the bridge may be reduced due to the vertical alignment.

The combination of approach gradient and reduced visibility could result in collisions at the junction involving vehicles emerging from the Harlex Haulage access road.

RECOMMENDATION

It is recommended that detailed modelling of visibility envelopes is undertaken to ensure that all drivers will have adequate visibility of manoeuvres and of the access location so they can anticipate vehicle movements.

3.1.6 Problem

Location: Emergency access road off Brentwood Road

Summary: Vertical alignment of the access approach

An emergency access onto the LTC southbound carriageway is provided off Brentwood overbridge. The gradient of the access road is 7.8%. Given the gradient and the potentially time dependent nature of those using the access there is an increased risk of loss of control and potential for vehicles to leave the carriageway where there is no restraint system resulting in collisions with LTC traffic. The access controls are not yet known in terms of location and form. They must be set back from the carriageway to allow eastbound vehicles on LTC to pull clear of the carriageway and stop before passing through the access control. This may place them in a location where they present a hazard to vehicle users on the access approaching LTC, or those travelling to the private properties on High House Lane.

FIGURE 3-4 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6

RECOMMENDATION

It is recommended that the location of and form of access controls to the emergency accesses are provided at stage 2 RSA.

Horizontal Alignment

3.1.7 Problem

Location: A289/local collector road south of the A2 merge with LTC northbound

Summary: Offside diverge

An offside diverge is provided from the A289/local collector road, south of the A2, to the LTC northbound. Offside diverges are generally not recommended for safety reasons. Given the complexity of the junction the provision of an offside diverge increases the risk of lane change side impact collisions (particularly involving heavy goods vehicles moving to the offside lane) and collisions at the nosing.

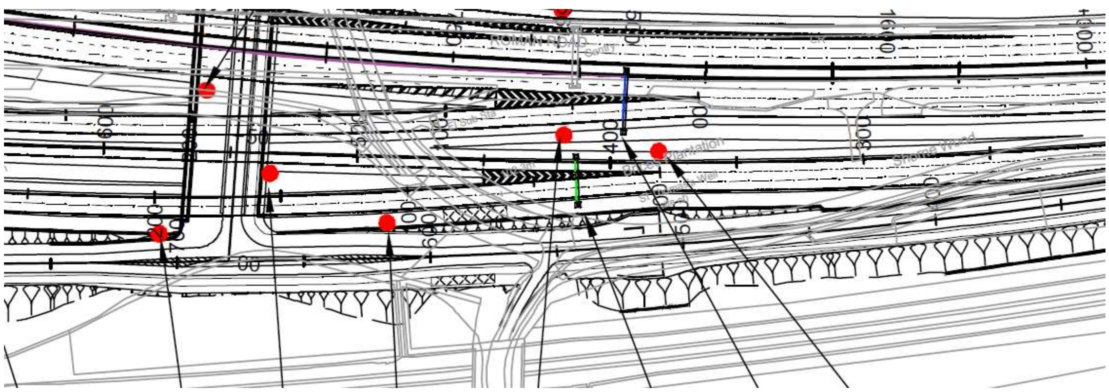

FIGURE 3-5 – EXTRACT FROM DRAWING HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00151

RECOMMENDATION

It is recommended that the requirement for an offside diverge is reviewed and modelled. If the offside diverge is required, additional mitigation measures such as road markings, general signing and lane designation signing should be provided on the approach.

3.1.8 Problem

Location: M25 clockwise entry slip at junction 29

Summary: Potential weaving manoeuvres on the entry slip road

A segregated left slip lane from the A127 onto the M25 clockwise has been provided at junction 29. The segregated left slip then develops into a lane gain while the off side lane merges onto the M25. Drivers exiting the roundabout using the off side lane may prefer to use the lane gain for ease of joining the M25 creating a short weaving section as drivers change lane, potentially resulting in side swipe collisions.

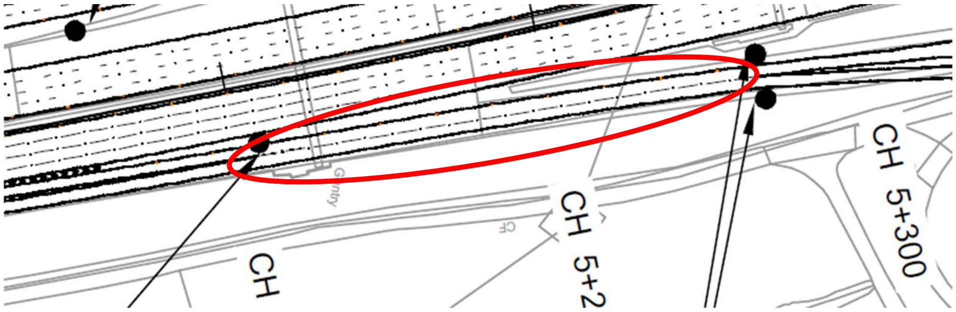

FIGURE 3-6 – EXTRACT FROM DIRECTION SIGNS LOCATION PLAN HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00164

RECOMMENDATION

It is recommended that the requirements associated with segregated left slip lanes, in combination with merge requirements and modelling information of the slip road, are used to minimise the risk of lane changing on the entry slip road.

3.1.9 Problem

Location: Various

Summary: Alignment of lane bifurcation

There are a number of locations where the bifurcation of lanes appears to be more severe than expected which could result in more serious consequences in the event of late lane changing near the nosing. Examples of this are where the junction 29 link road diverges from LTC northbound and the A2 eastbound to LTC northbound.

RECOMMENDATION

It is recommended that the alignment of diverges and merges is revised to remove any sudden changes in alignment.

Horizontal and Vertical Alignment

3.1.10 Problem

Location: Tunnel, EA, crossover and A2 junction proximity

Summary: Close feature spacing may result in late southbound lane changing between tunnel and A2, or within the tunnel.

In the area between the southern portal and A2 junction a large number of potential conflicts occurs:

- The absence of EAs in the tunnel maximises the likely discretionary use of the EA immediately south of the tunnel; this may cause drivers to brake to enter the EA and/or change lane to the nearside without warning, potentially colliding with other vehicles in shunts or side-swipes.

- Drivers have a relatively short distance to make lane changing manoeuvres between the tunnel and A2 junction, especially if they were not guided before the tunnel as to lane use. In addition, HGVs are likely to use nearside lanes regardless of downstream destinations, so will make lane changes to the offside between the portal and A2 junction. Left hand drive HGVs are impeded in visibility moving to offside lanes, and present a specific hazard increasing the likelihood of side-swipe collisions.

- The rising longitudinal alignment rising from the tunnel and southbound alignment increases the likelihood of being dazzled by low sun especially in winter. In wet conditions, lane lines and any lane marking of lane designations will not be visible, and a film of water would add to the dazzle risk. This may lead drivers to drift out of their lane resulting in side-swipe collisions, and/or shunt vehicles ahead which slow suddenly due to flow breakdown.

- When the crossover is in operation, and contraflow traffic is in the west bore, the crossover chicane positioned immediately south of the portal creates additional challenge for drivers. This may lead them to drift out of their lane resulting in side swipes, and/or be dazzled leading to shunt collisions while attending to route signs on gantries or nearside.

- If a breakdown occurs in this section, queues are likely to extend back into the tunnel, which may lead to sudden lane changing to gain progress if queues are longer in some lanes than others. The uphill gradient on tunnel exit, combined with drivers emerging into bright sunlight after the relatively darker tunnel may result in misjudgement and side-swipe collisions. Lighting specification is to match external lighting but a disparity is still likely in bright sunlight. This is an additional issue for larger slower moving vehicles including left hand drive vehicles changing lane to the offside for A2/M2 east due their poorer visibility. Drivers changing lane in the tunnel (where direction signs are not included) may not remember the counter-intuitive arrangement where the right-hand lane turns left (to the west) and the left-hand lane turns right (to the east). They may therefore change lanes again when they see the first signs (verge mounted or gantry mounted) downstream of the tunnel portal increasing the likelihood of shunts and side-swipes.

Sign designs, destinations and lane designations are not yet known; careful design including liaising with local highway authorities will be essential to mitigate these hazards. Signing upstream of the tunnel may be able to provide lane use information for destinations downstream of the tunnel, but HGVs are likely to remain in nearside lanes and change lanes downstream of the tunnel section.

RECOMMENDATION

It is recommended that all of these aspects are specifically included in the detailed design of alignment; EA positions and forms; gantries; signs, lane markings and lane designations. Operational regimes, including lane control in the tunnel and link downstream, should also address these scenarios, aiming to minimise lane changing in the tunnel. Any collision in this location may cause extensive delays increase the likelihood of shunts further upstream and any resultant fire may have an additional adverse safety and accessibility impact on all users especially those with restricted mobility or visual impairment.

3.2 General

Basic design principles

3.2.1 Problem

Location: Scheme wide

Summary: Stopped up roads

In order to construct the LTC scheme there are existing roads that need to be stopped up, such as Hornsby Lane. If stopped up roads are not clearly signed and turning heads provided (for drivers following outdated satellite navigation systems) it could increase the potential for collisions involving turning vehicles and result in large vehicles on inappropriate roads as they navigate around the LTC carriageway.

RECOMMENDATION

It is recommended that all stopped up roads are clearly and widely signed (provide full signing details for the Stage 2 RSA) and that turning heads are provided.

3.2.2 Problem

Location: Overbridges

Summary: Vehicles stopping on bridges

Overbridges are provided throughout the scheme. There is potential that these bridges, particularly those with views of interest to the public (such as the tunnel portals) and large green spaces (such as the wide ‘green bridges’) could result in vehicles stopping on the overbridge carriageways. This increases the risk of rear shunt type collisions and collisions involving vehicles re-entering the carriageway if they are able to park on the adjacent verges/hard standings.

RECOMMENDATION

It is recommended that suitable parking or clearway restrictions are incorporated on the overbridges and that these are adequately marked and signed. Highways England should request that enforcement is undertaken.

Cross sections

3.2.3 Problem

Location: Various

Summary: Opposing headlights

There are a number of locations where farm/maintenance access tracks run parallel to the LTC, for example the access track from North Road, or the A13 interchange loops. During the hours of darkness or low visibility a vehicle using a parallel route in the opposite direction to the adjacent LTC carriageway may result in drivers being dazzled or confused, increasing the risk of sudden braking and rear shunt type collisions or loss of control.

RECOMMENDATION

It is recommended that screening is provided to minimise glare from opposing headlights.

3.2.4 Problem

Location: A289 southbound merge with M2 southbound at Junction 1

Summary: Level differences

At present there is a substantial, unprotected level difference between the A289 southbound merge carriageway and the M2 southbound carriageway. The proposed scheme includes four lanes and no hard shoulder adjacent to the level difference at the merge on the M2. If the level difference remains there is an increased risk of vehicles overturning into the A289 southbound merge if they leave the M2 carriageway from the nearside lane at this location.

RECOMMENDATION

It is recommended that the current unprotected level difference is removed and road restraint provided.

Landscaping

3.2.5 Problem

Location: Landscaped areas

Summary: Accessing landscaped areas

Throughout the scheme there are areas that are likely to be landscaped but are enclosed by carriageways, for example at the A13 and A2 interchanges and where the LTC splits to join the M25. No obvious access arrangements have been identified for some of these areas which may result in operatives stopping on verges increasing the risk of rear shunt collisions as they slow to negotiate kerbs or as they re-join carriageways.

There is also a risk that landscaped areas are not maintained and over time encroach into visibility splays. This may result in failure to give way or rear shunt type collisions if full visibility splays are not achieved.

RECOMMENDATION

It is recommended that accesses to landscaped areas are provided and the landscaping details provided at stage 2 RSA.

Emergency Areas

3.2.6 Problem

Location: Emergency areas (EAs)

Summary: Restricted forward visibility to and from EAs

Forward visibility to a number of the EAs appears to be restricted by preceding structures, embankments and carriageway alignment. Reduced forward visibility could result in drivers missing the provision entirely, potentially resulting in a live lane stop, and an increased risk of rear shunts. Examples of this include:

- An EA is provided on the northbound LTC diverge loop road. The tight horizontal alignment may result in drivers not having sufficient forward visibility to locate and negotiate into the EA.

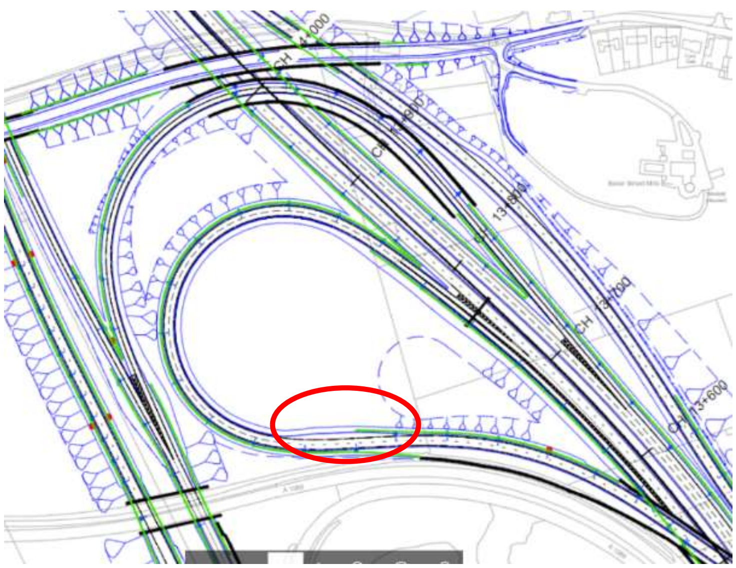

FIGURE 3-7 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042 LAYOUT 7

- The EA provided on the LTC northbound carriageway (Ch 19 000) may be obstructed by the preceding North Road overbridge structure and embankments.

RECOMMENDATION

Undertake detailed modelling of visibility to determine drivers' view on approach, both physical sightlines to EAs and to assess whether bridge structure will reduce conspicuity of the EA. For example, in early morning on sunny days whether the bridge would cast a shadow affecting conspicuity of the EA. It is recommended that the position of the EA on the loop road at the A13/LTC interchange is relocated downstream of the loop, maintaining the required spacing between EAs.

It is recommended that where EAs are located behind features that obscure forward visibility that they are relocated to where appropriate forward visibility is achieved.

3.2.7 Problem

Location: Emergency areas (EAs)

Summary: EA specification

There are some inconsistencies in EA layout throughout the scheme. For example the EA at the southern tunnel portal is the only one to incorporate orange surfacing. This inconsistency could result in driver indecision, sudden braking and rear end shunts and side swipe type collisions.

RECOMMENDATION

It is recommended that the EA specification is consistent across the scheme and with the rest of the network particularly as revisions to EA requirements occur.

3.2.8 Problem

Location: Emergency areas (EAs)

Summary: Areas of hardstanding within EAs

Some of the EA layouts incorporate an area of hardstanding. The drawing extract below (Ch 11+100) illustrates an area of hardstanding that appears to be associated with access steps to the adjacent drainage ditch. If this is for maintenance purposes then this is likely to increase the usage of the EA. There is an increased risk of conflict with other vehicles as drivers decelerate to enter the EA and as they merge to re-join the carriageway resulting in rear shunts and late lane changing type collisions.

FIGURE 3-8 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6

RECOMMENDATION

Ensure that the relative risks for road users and workers is not increased due to the hazards associated with vehicles entering and leaving the EA. This may include the provision of alternative maintenance access using the local road network.

3.2.9 Problem

Location: Emergency areas (EAs)

Summary: EAs close to conflict points

Several EAs are located on slips close to merge points, creating potential for conflict between vehicles leaving an EA and passing vehicles; any incident may result in vehicles and/or debris entering the mainline carriageway

An example is the slip road from A13 westbound to LTC southbound, on which the downstream end of the EA is downstream of the merge nose where the slip meets LTC.

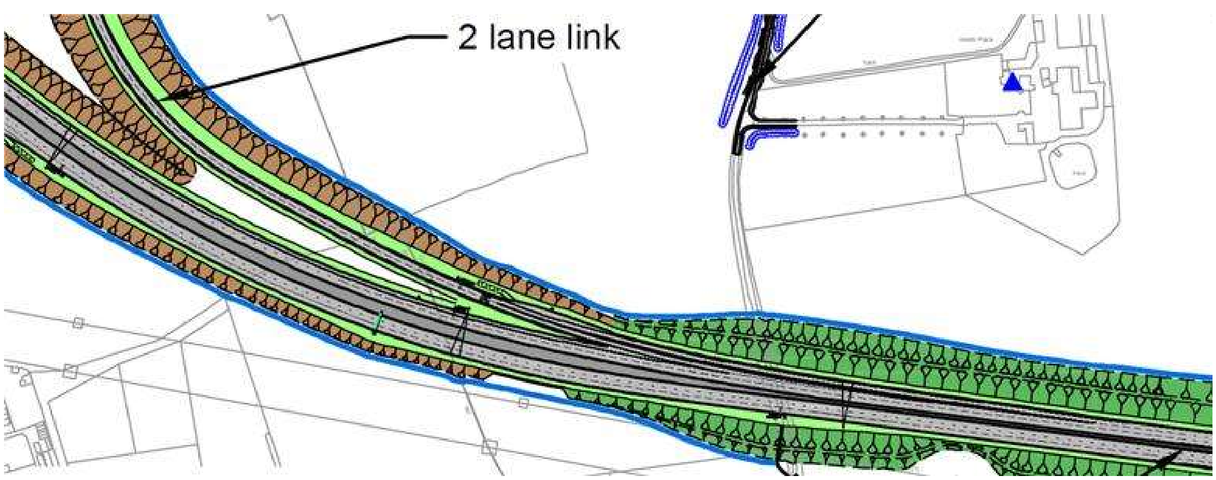

FIGURE 3-9 – EXTRACT FROM GENERAL ARRANGEMENT DRAWING HE540039-CJV-HML-S11_ML000000_Z-DR-CH-00010

RECOMMENDATION

It is recommended that EAs are positioned away from conflict points.

Access

3.2.10 Problem

Location: Emergency accesses

Summary: Connections from private means of accesses which have diverge/merge tapers

The emergency access on the west side of Brentwood overbridge is in close proximity to an EA increasing the scope for uncertainty e.g. a vehicle indicating left to enter the access may appear to be indicating to enter the EA, especially as at this location cutting slope adjacent to the access appears to constrain access to and from mainline.

FIGURE 3-10 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6

RECOMMENDATION

It is recommended that emergency and maintenance accesses don't look like junctions and that the mainline drivers' view through structures to access points is checked to ensure that visibility to/from the access is not constrained by cutting slope.

3.2.11 Problem

Location: Emergency accesses

Summary: Mis-use of maintenance accesses as short cuts to LTC

Without suitable security measures the emergency accesses throughout the scheme could be used as short cuts to join the LTC. Vehicles would then join the mainline carriageway via short merge tapers resulting in late lane changing, sudden braking and rear shunt type collisions. This also applies to the access off the A226 to the top of the southern tunnel portal.

RECOMMENDATION

It is recommended that suitable measures such as CCTV, signing and access control to discourage general access are provided, while maintaining access for authorised vehicles.

Emergency and maintenance access

3.2.12 Problem

Location: North of northern portal

Summary: Potential for illegal access and/or collisions involving authorised vehicles.

In addition to the general issue of emergency access described above, a combination issue exists regarding the turnaround facility at the northern end of the tunnel. This combines access and egress to both LTC carriageways; access to the tunnel service building; maintenance access to a pond and possibly farmland (different details on different drawing sets).

Details of access control, from LTC route to and from Station Road, is not yet finalised so it is unclear how unlawful access will be prevented and authorised access made effective. This location contains a number of interconnected hazards:

- Gaps in VRS at apparent high level differences may result in injury to occupants of authorised or other vehicles;
- Potential for deliberate or unintentional access between LTC and Station Road, to bypass tolling points (unknown location); correct error in route or other reasons may result in collisions at connections to LTC route;
- Cutting slopes conceal access to southbound carriageway which may cause shunts when vehicles slow to enter, or side impacts when they emerge;
- Dual loop for turnaround/tunnel service but visibility and detailed layout including VRS is not yet known. Potential for poor visibility for vehicles emerging at junction between the northern part of the loop and vehicles on the southern part may result in collisions between authorised or other vehicles;
- Accesses to drainage/farm land may prevent control of public access (note apparent difference between drawing sets)

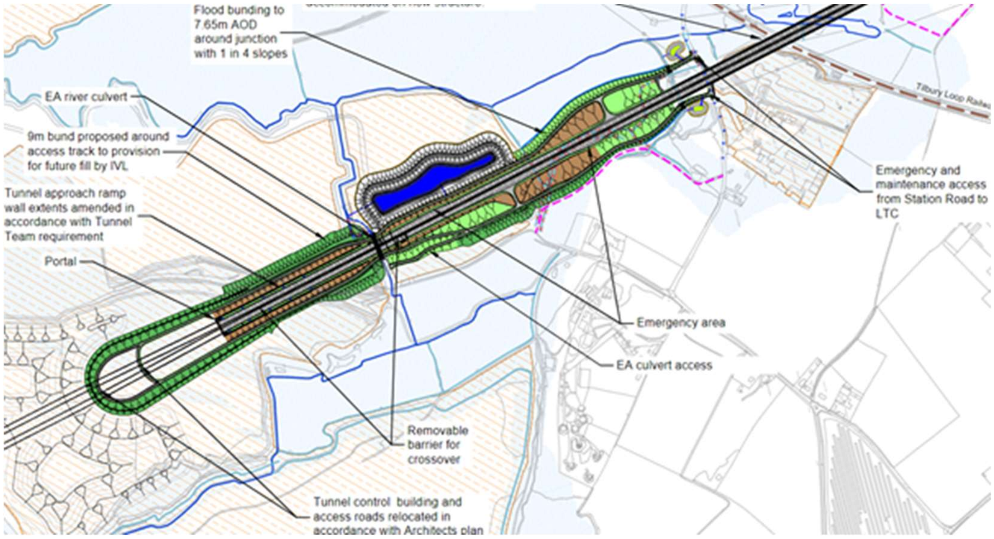

FIGURE 3-11 – EXTRACT FROM GA DRAWING HE540039-CJV-HML-S09_ML000000_Z-DR-CH-00010

RECOMMENDATION

It is recommended that all of these aspects are specifically addressed in the detailed design of alignment; tracks and junctions; gantries; signs, lane markings and lane designations.

3.2.13 Problem

Location: Maintenance accesses

Summary: Lack of turnaround facility

There are a number of access tracks to ponds, structures and technology assets that don't incorporate a turnaround facility, for example immediately south of the LTC/A2 interchange and the access off the A226 to the tunnel southern portal. This increases the risk of conflict between vehicles trying to manoeuvre in confined areas resulting in low impact collisions.

RECOMMENDATION

It is recommended that turnaround areas that can accommodate the largest expected vehicle to the asset/feature are provided.

3.2.14 Problem

Location: Maintenance access areas

Summary: Mis-use of maintenance areas

There are a number of areas of hardstanding throughout the scheme that appear to be maintained. These could be abused by drivers, increasing the risk of collisions as vehicles slow to access them and when they merge back into the carriageway resulting in late braking, rear shunts and side swipe type collisions. An existing example of this is on the northside of junction 29 of the M25 as shown in the photo below.

FIGURE 3-12 – GOOGLE STREETVIEW IMAGE

RECOMMENDATION

It is recommended that where these are not necessary they are removed or that they are amended to avoid looking like laybys or junctions.

3.2.15 Problem

Location: Access to ponds

Summary: Position of gates

Access to the pond located between Henhurst Road and the LTC/A2 interchange is off the circulatory carriageway of the Henhurst Road roundabout. No information is provided regarding access arrangements. If gates are located close to the back of the footway there is a risk that vehicles intending to enter the site will extend out into the circulatory carriageway while operating the access controls, resulting in rear shunts and late lane changing collisions. This situation occurs at a number of other locations including the pond access in problem 3.2.21 where the position of the gates will result in a vehicle extending onto the carriageway and across the footway.

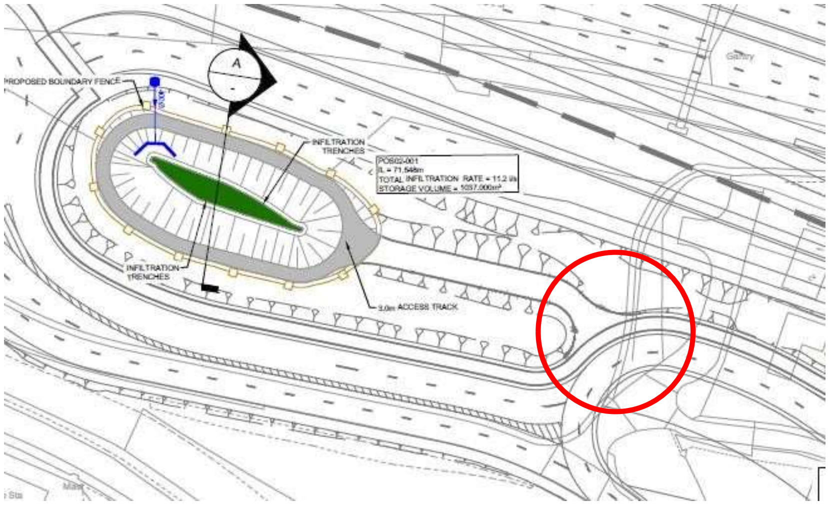

FIGURE 3-13 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S02_PON0000001-DR-CD-00001

RECOMMENDATION

It is recommended that sufficient room is provided for vehicles to pull into the access to avoid blocking the carriageway or footway.

3.2.16 Problem

Location: Public footpath FR 136 (Ch 17+300)

Summary: Suitability of access to pond

Public footpath FR 136 appears to provide access to a pond on the west side of LTC. It is not clear if the public right of way (PRoW), which passes over the LTC via an overbridge, is suitable for vehicular access in terms of vehicle restraint and vertical profile. A maintenance bay is proposed at the top of the embankment in close proximity to the bridge structure which could result in vehicles trying to manoeuvre in a confined area resulting in low impact collisions and potentially in conflict with pedestrians, cyclists and equestrians.

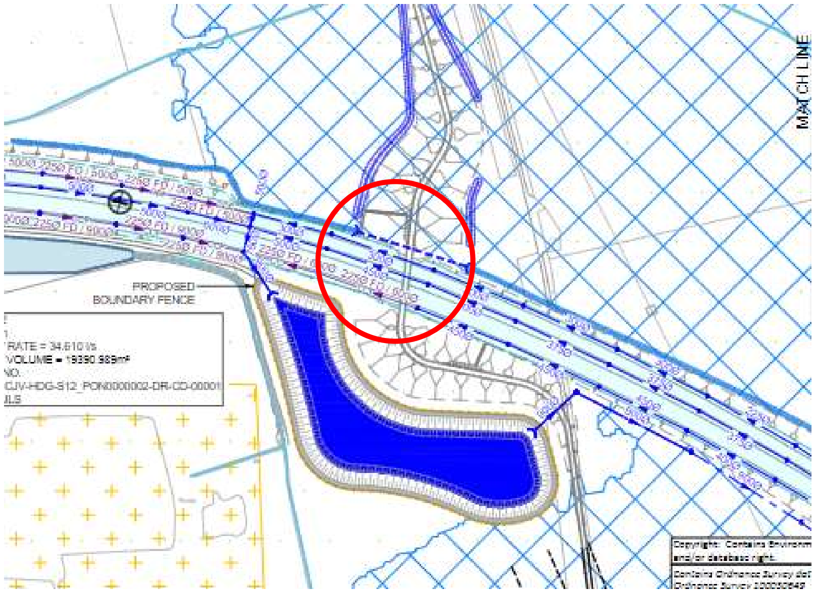

FIGURE 3-14 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S12_PON0000002-DR-CD-00002

RECOMMENDATION

It is recommended that the suitability of the PRoW as a form of access for the pond is clarified or an alternative provided.

3.2.17 Problem

Location: Various

Summary: Access to ditches

There are a number of ditches indicated on the drainage drawings but it is not clear how these will be maintained, particularly where they are behind vehicle restraint, eg near North Road and at the LTC/A13 junction. If maintenance access is not provided there is an increased risk of collisions involving maintenance vehicles slowing down to leave the carriageway or if parking in verges or other unsuitable locations.

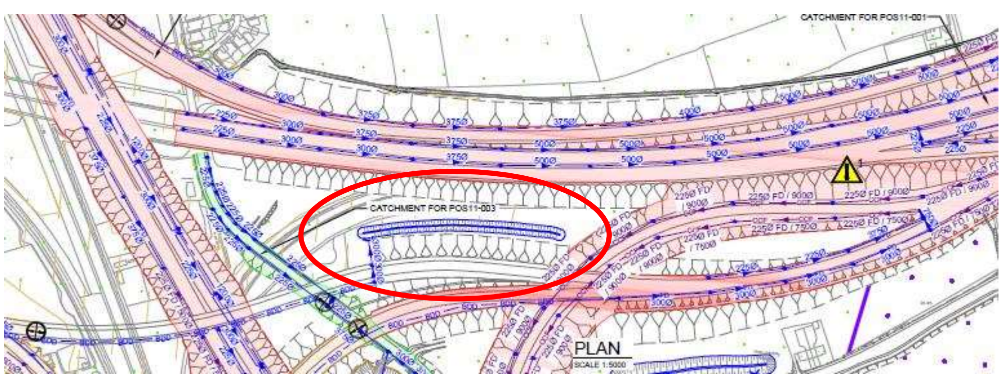

FIGURE 3-15 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-SZP_DN000000_Z-DR-CD-00009

RECOMMENDATION

It is recommended that maintenance access is provided to ditches where required, avoiding any gap where a vehicle might enter the ditch if they leave the carriageway, for example swerving to avoid another vehicle changing lane without warning. If vehicular access is provided, incorporate turnaround areas that can accommodate the largest expected vehicle to the asset/feature.

3.2.18 Problem

Location: Maintenance access roads to ponds

Summary: Proximity to Hever Court Road roundabout

The increased size of the Hever Court Road roundabout has resulted in the access to an existing pond being located closer to the roundabout. This reduces the available forward visibility for drivers of vehicles exiting the roundabout to observe the access and vehicles entering or leaving it. There is an increased risk of rear shunts as vehicles slow to turn into the access and failure to give way collisions as vehicles re-join the carriageway.

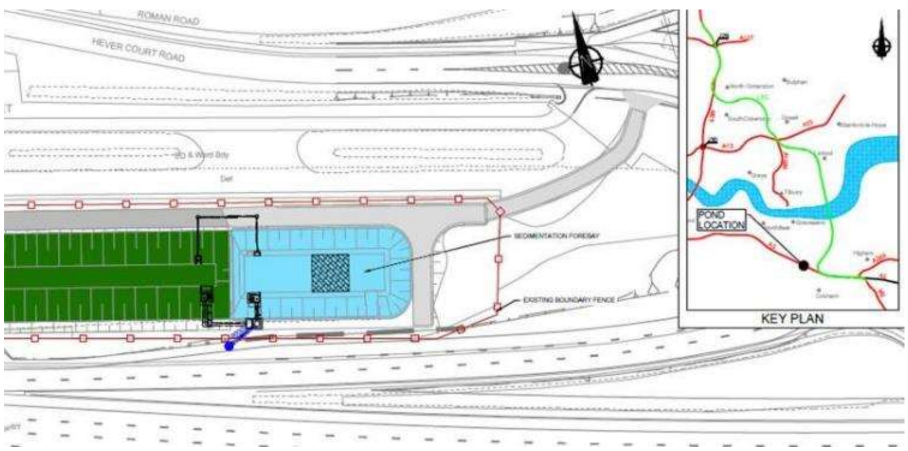

FIGURE 3-16 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S02_POE000001-DR-CD-000001

RECOMMENDATION

It is recommended that an alternative design for the access is provided which has appropriate visibility for approaching drivers.

3.2.19 Problem

Location: Access roads to ponds, culverts and ditches

Summary: Mis-use of maintenance areas

There are a number of maintenance accesses to ponds, culverts and ditches off connector roads and hard shoulders and these may be seen as additional refuge areas by drivers either in the event of an emergency or for a discretionary stop.

This increases scope for rear shunt type collisions when vehicles slow to use the access and re-join the carriageway and general mis-use in the event of a breakdown. Examples include:

- LTC CH 3 300

FIGURE 3-17 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S12_PON000001-DR-CD-000001

- Access to Culvert MNN0000001 from the connector road north of the east-west A2 carriageway.

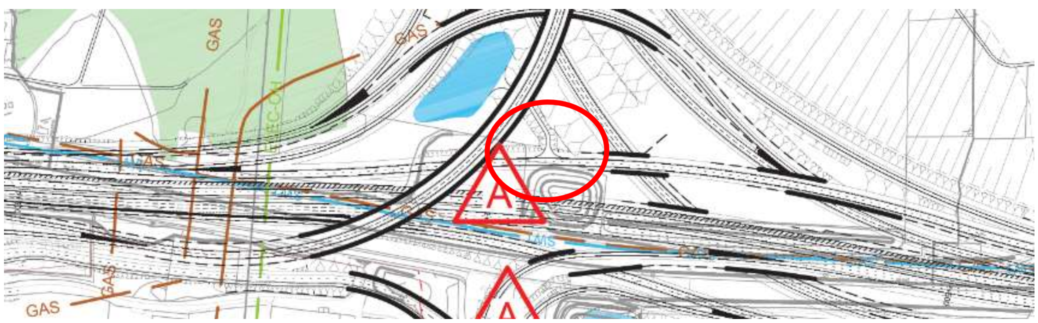

FIGURE 3-18 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S02_POE000001-DR-CD-000001

RECOMMENDATION

It is recommended that detailed modelling of visibility envelopes is undertaken to ensure that all drivers will have adequate visibility of manoeuvres and of the access location so they can anticipate vehicle movements.

3.2.20 Problem

Location: Access tracks at proposed ponds

Summary: Width and alignment of access tracks

Access tracks are shown alongside or around the perimeter of a number of the proposed ponds. The tracks vary in width, can have relatively tortuous alignments and are bounded to the rear by fencing. It is not clear if maintenance vehicles will be able to negotiate these tracks, potentially resulting in an incursion into the water feature and injury. If no access controls are provided they may also be used by public vehicles seeking a convenient off road stopping location for a rest break.

This may similarly result in incursion, particularly at night and especially for drivers unfamiliar with the location which will not be lit.

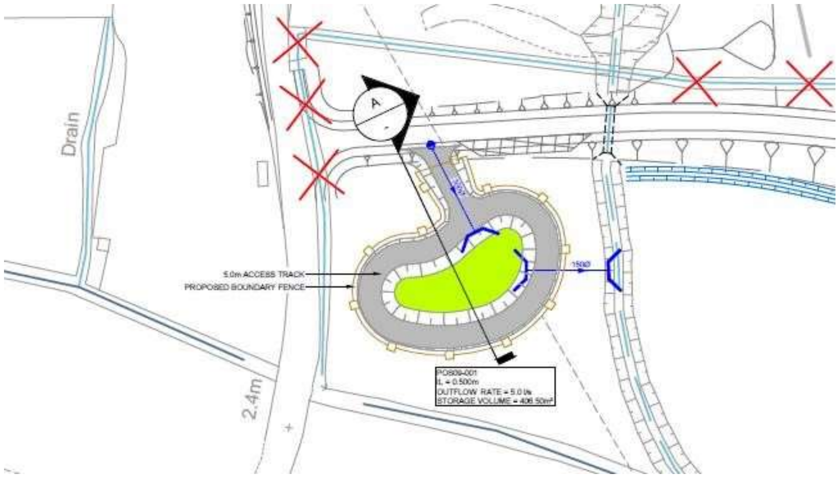

FIGURE 3-19 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S09_PON0000001-DR-CD-00001

RECOMMENDATIONS

It is recommended that access by the largest anticipated vehicle is assessed, that any fencing does not impact on the usable width and access controls are provided to prevent use by unauthorised vehicles.

Skid Resistance

3.2.21 Problem

Location: Scheme wide

Summary: Suitability of proposed pavement surface skid resistance

There are locations where the suitability of the proposed pavement surface skid resistance may not be adequate or is unclear. This includes, but is not limited to:

- Horford Road overbridge, which includes gradients of 8% and has a proposed pavement surface PSV of 50; and
- tie in locations to existing carriageways, where the existing pavement surface PSV is unknown.

The provision of pavement surface with inadequate PSV or an unsuitable tie in arrangement increases the potential for differing skid resistance and loss of control collisions, particularly if the road surface is wet. See covering letter for further explanation of this issue and drawing inconsistencies regarding pavement proposals.

RECOMMENDATION

It is recommended that pavement surfaces with adequate skid resistance are provided throughout and full details of pavement surface tie in arrangements are provided for the Stage 2 RSA. No diagonal joints, or longitudinal joints within lanes should be provided. Position transverse joints away from locations of heavy braking and steering, for example at junctions.

3.2.22 Problem

Location: Brentwood Road overbridge emergency access links

Summary: Pavements with differing skid resistance properties in braking areas

Pavements with differing skid resistance are provided on the LTC mainline carriageway (PSV 63) and the Brentwood Road overbridge emergency access loop diverges. While these areas are not designed as EAs, it is likely they could be used by motorists in the event of an incident.

Pavement surfacing with differing skid resistance, in a location that could be subject to heavy braking with vehicles straddled across different pavement types, increases the risk of loss of control collisions. This is exacerbated when the carriageway is wet.

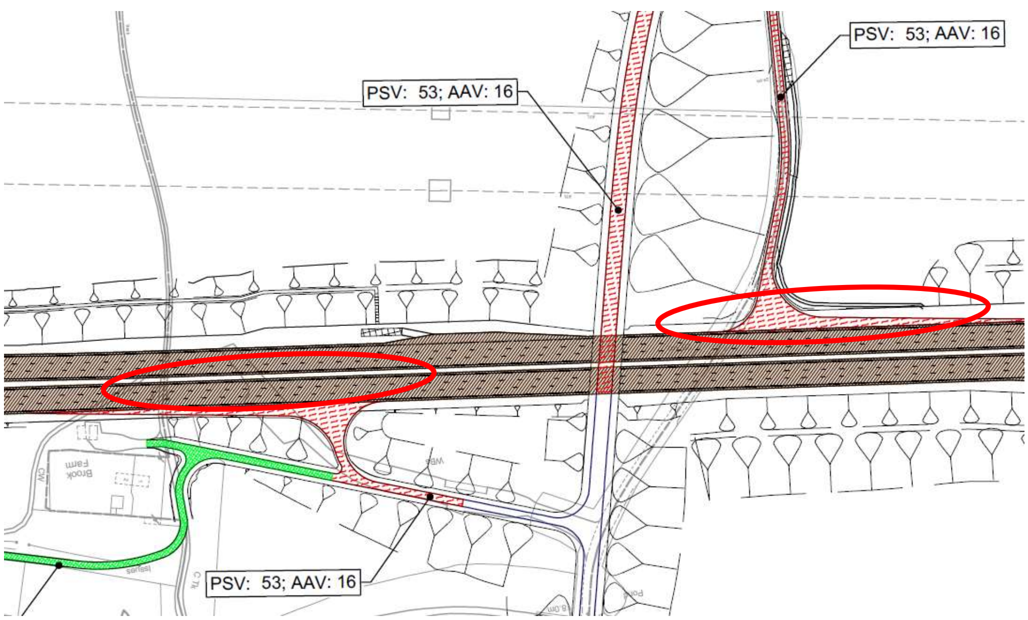

FIGURE 3-20 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00023

RECOMMENDATION

It is recommended that pavements with consistent skid resistance properties are provided in all locations where heavy braking may occur.

3.2.23 Problem

Location: Various

Summary: Pavement surface skid resistance

Pavement surfaces with lower skid resistance, compared to other sections, are provided on some of the junction loops/connector roads. This includes, but is not limited to the:

- loop between the A1089 and LTC southbound carriageways, where a pavement with a PSV value of 55 is provided. This compares to a PSV value of 65 on the LTC northbound to A13 eastbound loop;

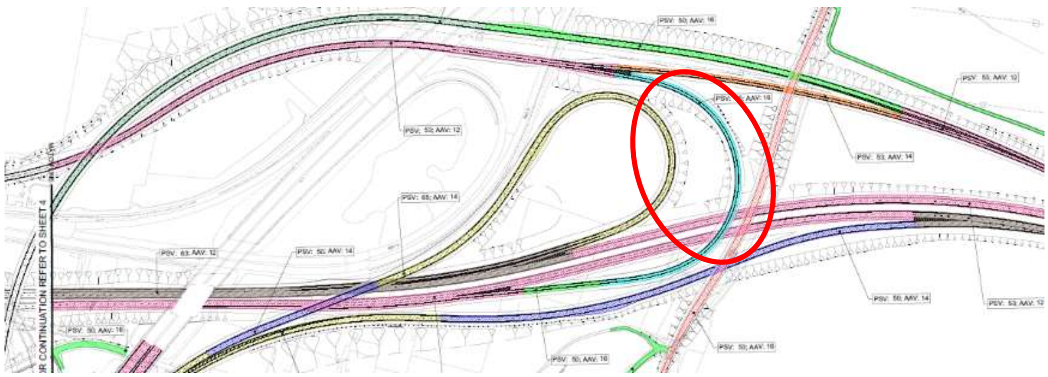

FIGURE 3-21 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00026 SHOWING THE A1089 AND LTC SOUTHBOUND LOOP

- The connecting link between the Gravesend local road and the A2 eastbound carriageway, where a pavement with a PSV value of 50 is provided; and

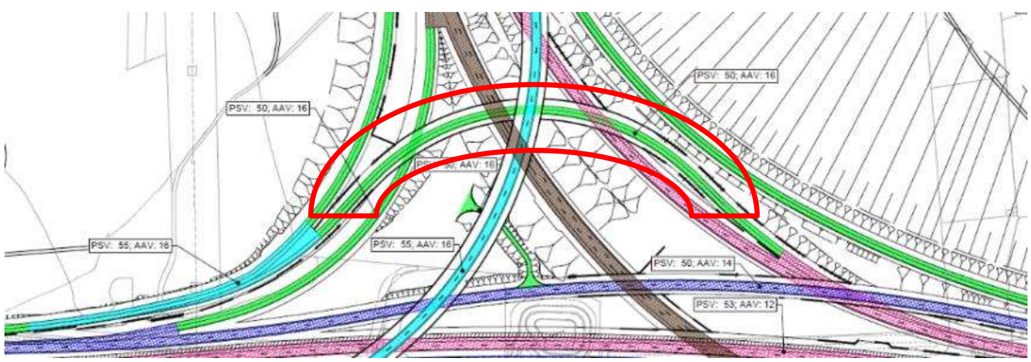

FIGURE 3-22 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00023 SHOWING THE CONNECTING LINK BETWEEN THE GRAVESEND LOCAL ROAD AND THE A2 EASTBOUND

- The new/revised approach to the Brewers Road/Thong Lane/Halfpence Lane roundabout which includes 65 PSV pavement surface that reduces to 50 PSV pavement surface at the tightest radii.

While the above radii are not as tight as others, the long sweeping nature, ability to carry speed and change in skid resistance increases the risk of loss of control collisions and vehicles leaving the carriageway. This is particularly relevant to motorcycles and could be exacerbated when the surface is wet.

RECOMMENDATION

It is recommended that pavement surfaces with adequate and consistent skid resistance for the carriageway radii/movement are provided throughout.

3.2.24 Problem

Location: M25 Junction 29

Summary: Poor condition of existing pavement surface

New pavement is not specified where the northbound merge and diverge arms join the M25 Junction 29 circulatory. Street view mapping indicates these areas are worn and likely to have a reduced skid resistance at present. At these locations this could result in loss of control collisions, particularly when the surface is wet.

The southbound diverge approach is of particular concern given the volume of vehicles, downhill gradient on approach to the stop line and close proximity of the new access/egress for the industrial area.

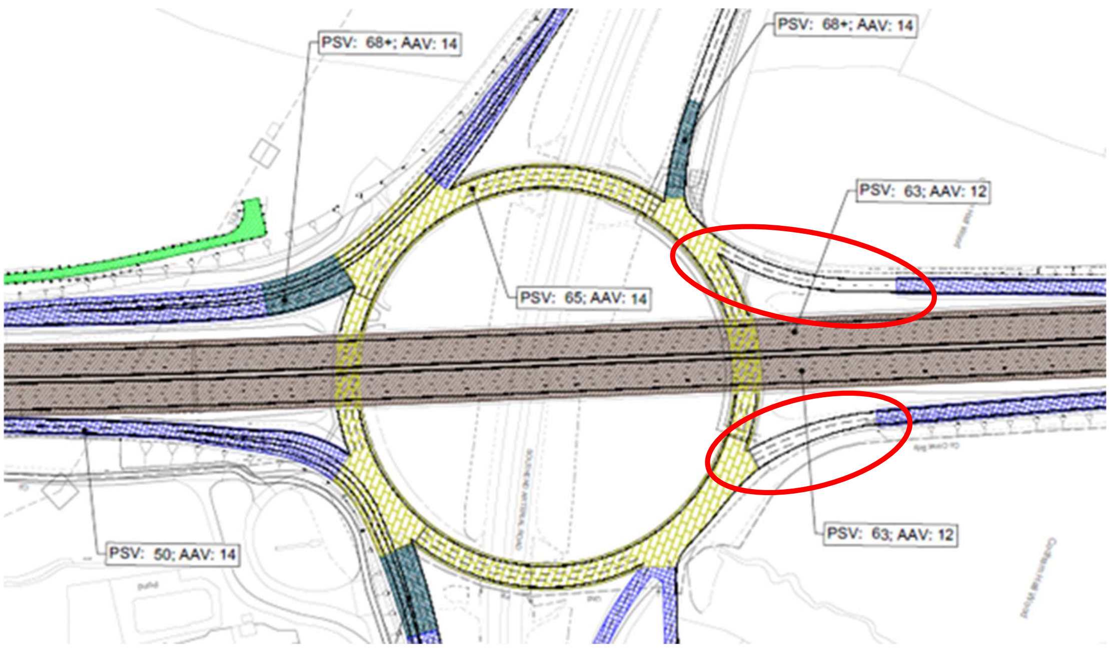

FIGURE 3-23 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00033

RECOMMENDATION

It is recommended that pavement surfaces with adequate skid resistance are provided where the northbound merge and diverge arms join the M25 Junction 29 circulatory.

3.2.25 Problem

Location: M25 Junction 29 dedicated left turn lanes

Summary: High PSV (68+) pavement surface provided

Dedicated left turn lanes are provided for movements from the A127 westbound to M25 Southbound and M25 northbound to A127 westbound. It is proposed that high PSV (68+) pavement surface is provided on the diverge arm approaches to signal stop lines and the equivalent length of the dedicated left turn lane.

If the high PSV pavement surface is a contrasting colour (as per the existing arrangement), this could result in hesitation, braking and rear end shunts as vehicles slow or stop for a non-existent stop line within the dedicated left turn lane.

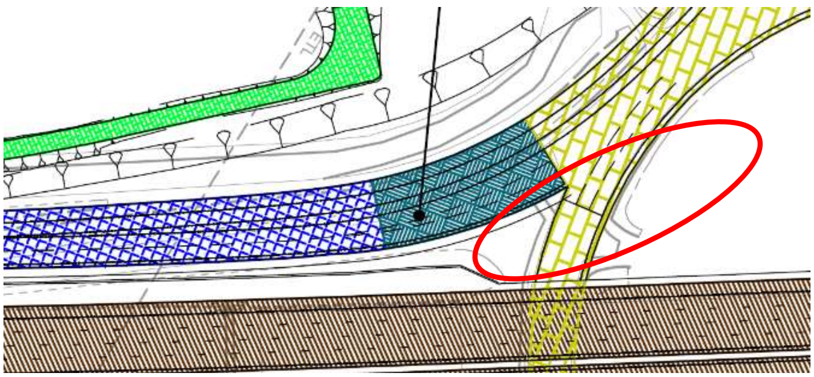

FIGURE 3-24 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00033

RECOMMENDATION

It is recommended that pavements with adequate skid resistance and consistent appearance are provided through the dedicated left turn lanes.

3.2.26 Problem

Location: Crossovers on tunnel approaches

Summary: Differential skid resistance may exist at crossovers, where detritus could further induce skidding.

Crossovers are proposed at each end of the tunnel for major maintenance events, and drivers are intended to be able to negotiate these at high speed (50mph). The pavement areas will not be in normal trafficked use and this may result in differential skid resistance (higher or lower than adjacent running lanes). This may induce vehicle instability as vehicles enter the crossover resulting in collisions with restraints or other vehicles. See also problem 3.2.28 related to VRS at this location. The accumulation of loose material in this area is also likely, and could further increase the likelihood of skidding-related collisions.

RECOMMENDATION

Provide and manage crossover surfacing to minimise the likelihood of loss of control when in use.

Fences and road restraint systems

3.2.27 Problem

Location: Road restraint system tie in locations

Summary: Transition from proposed to existing road restraint systems

At locations where the proposed road restraint systems reach the extents of the scheme boundaries, it is unclear how these will tie into the existing provisions. An example of this is the A2/M2 junction where the proposed concrete central barrier ends at a location where the existing provision is single sided restraint system within a wide central reservation.

FIGURE 3-25 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042

At the western extent of the A2 it is also unclear how the proposed concrete central barrier will tie into the existing restraint system and large concrete footings for retained gantries.

Restraint systems that do not tie in/transition correctly can result in additional points of conflict and layouts that could increase the severity of a collision should a vehicle leave the carriageway. A vehicle may be directed towards a hazard or be able to crossover into the opposing carriageway.

RECOMMENDATION

It is recommended that road restraint systems tie into/transition with existing provisions, with full details provided for the stage 2 RSA.

3.2.28 Problem

Location: Crossover points at the tunnel portals

Summary: Protection of exposed ends of VRS at crossovers

The details of the protection for exposed ends of central VRS are not yet known. These need to provide energy absorption for vehicles whose drivers misjudge the chicane manoeuvre and/or pass through at excessive speed.

RECOMMENDATION

It is recommended that the design incorporates lateral protection for vehicles failing to make the crossover and impact the VRS side-on and for those who impact the nose at the crossover, end-on or side-on as they pass through. Motorcyclist protection should also be included in the design details.

3.2.29 Problem

Location: Turnaround facilities adjacent to water courses/ponds

Summary: Lack of vehicle restraint

There are a number of turnaround facilities at the end of access tracks which are located adjacent to water courses and ponds. No vehicle restraint has been provided at these locations increasing the risk that vehicles could enter the watercourse when turning around. Note that the design of access tracks in this location is inconsistent between drawing sets; Plan and Profile Sheet 13 HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-00014 does not show the route passing beneath the end of the embankment which is shown at the top of the extract below (Ch 16 520 approximately).

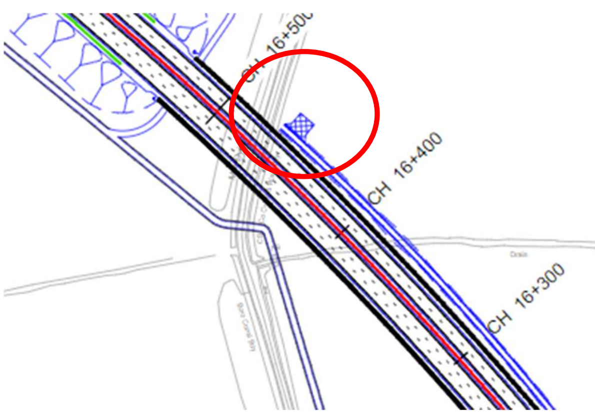

FIGURE 3-26 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 8

RECOMMENDATION

It is recommended that vehicle restraint is provided at all locations where necessary to prevent vehicle incursions and eliminate inconsistency in scheme design between drawing sets.

3.2.30 Problem

Location: Tight radii and interchanges

Summary: Provision for motorcyclists

There are a number of locations where the horizontal alignment of the carriageway is tight, for example the loops at the A13/LTC interchange. This is an area where motorcyclists are more vulnerable to injury in the event that they lose control on the bend, or take action to avoid another vehicle that has misjudged the alignment. When motorcyclists strike metal VRS the gap beneath the barrier can allow a motorcyclist to slide through and come into contact with the unprotected safety barrier posts, increasing the risk of serious injury.

In some locations it is unclear what the VRS is provided to protect, for example where it is at the toe of a cutting slope. If not essential, it presents a hazard especially to motorcycles without a benefit to other users

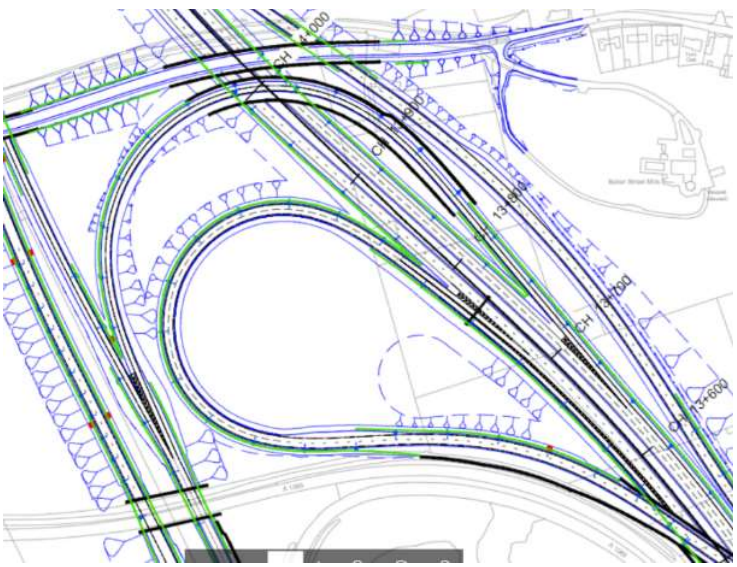

FIGURE 3-27 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042

RECOMMENDATION

It is recommended that any VRS that represents a net hazard is omitted and provision is included for motorcycles on tight radii in the vehicle restraint specification.

3.2.31 Problem

Location: Numerous overbridges and other locations

Summary: Short or missing road restraint may result in fall from height and/or incursion onto roads beneath

There are numerous overbridges and other locations where there appears to be inadequate protection to prevent road users falling onto lower levels and/or into roads or other hazards below. Further complications are presented where junctions occur close to these locations because this adds conflict at locations of possible incursion, and because accesses prevent continuous restraint provision. See example below where the B1421 Ockendon Road passes over the M25.

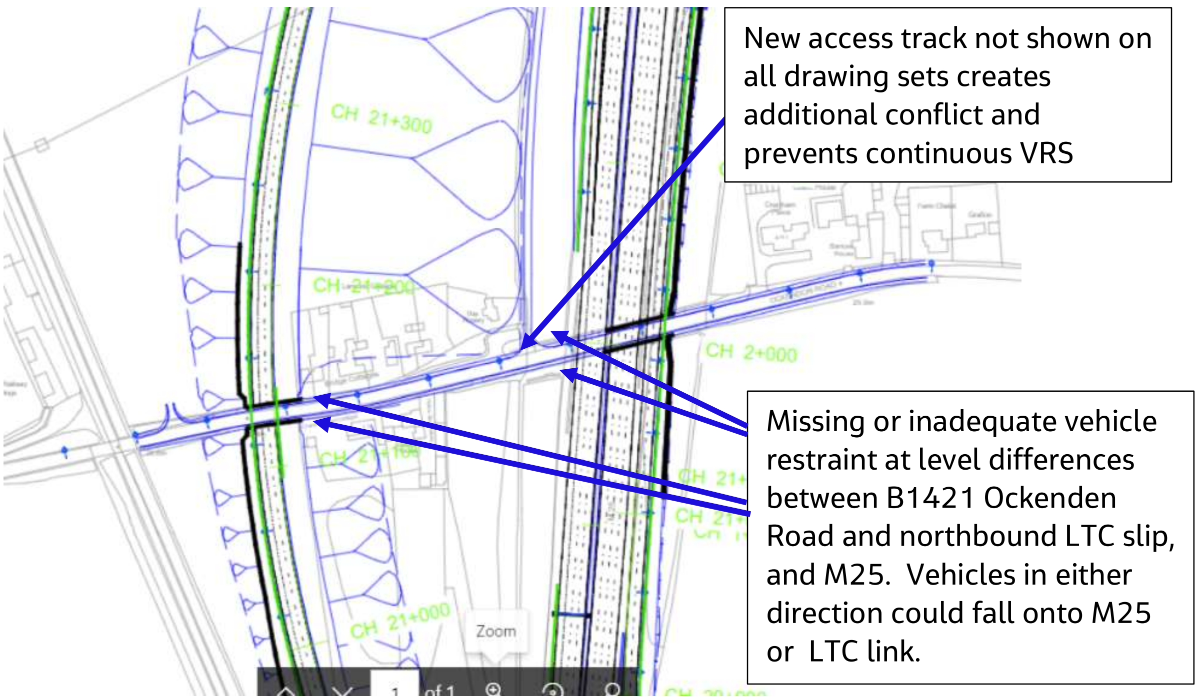

FIGURE 3-28 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 10

This is in part an existing hazard (see image below from Google Streetview looking east over M25 bridge) but the proposals add an additional overbridge, and the new access increases conflict and therefore the hazard at this location.

FIGURE 3-29 – GOOGLE STREETVIEW IMAGE

Similar hazards are presented over the A13 interchange where A1013 passes over A1089; LTC mainline and the slip from A13 westbound to LTC southbound, with no VRS shown see HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 7.

At some overbridge locations there are also short gaps between VRS sections, which present two terminal impact locations where vehicle users could be injured by trauma/deceleration. This is in addition to the hazard of an unprotected gap such as the example at Brentwood overbridge shown below. Motor vehicle users, pedestrians, cyclists or equestrians could be injured by the unprotected level difference.

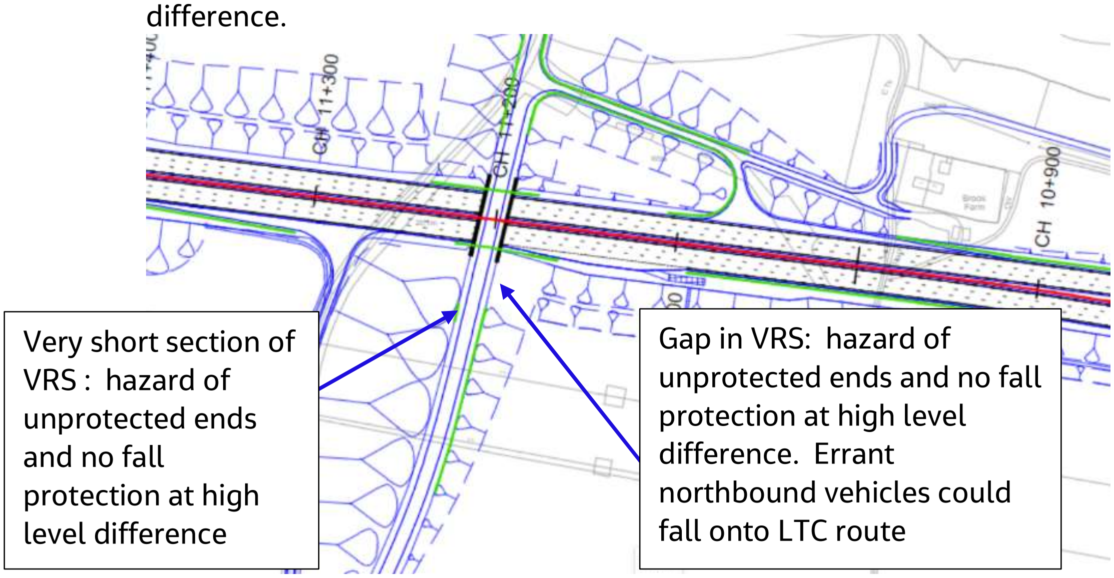

FIGURE 3-30 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6.

RECOMMENDATION

Assess all overbridges and other level differences to provide fall protection to motor vehicle users, pedestrians, cyclists and equestrians.

3.3 Junctions

Layout

3.3.1 Problem

Location: M25 Junction 29/A127 access to Codham Hall

Summary: Concentration of traffic movements to/from Codham Hall at the A127/M25 junction

At junction 29 of the M25 there are currently two accesses to Codham Hall, an industrial area located on the north and south sides of the A127 to the east of motorway junction. The signal-controlled access between the A127 westbound exit slip and the M25 clockwise entry slip is not shown on the LTC proposal drawings suggesting it will no longer be available. The removal of this access will result in all traffic related to Codham Hall using the uncontrolled access off the circulatory carriageway between the M25 clockwise exit slip and the A127 eastbound entry slip.

It is likely that there will be an increase in traffic movements at junction 29 due to LTC which may make it increasingly difficult for traffic from Codham Hall to join the roundabout. The circulatory carriageway at the Codham Hall approach is four lanes wide; drivers have to cross the two nearside lanes (for the A127 eastbound) to continue on to the roundabout and the access is orientated like a priority T junction which could result in drivers turning the wrong way onto the roundabout. The combination of these factors increases the risk of failure to giveway and side impact collisions at this location.

Google Streetview images show that a lamp column on the nose between the A127 eastbound merge and the junction 29 circulatory carriageway had been demolished suggesting there may be existing problems with drivers misjudging this part of the junction.

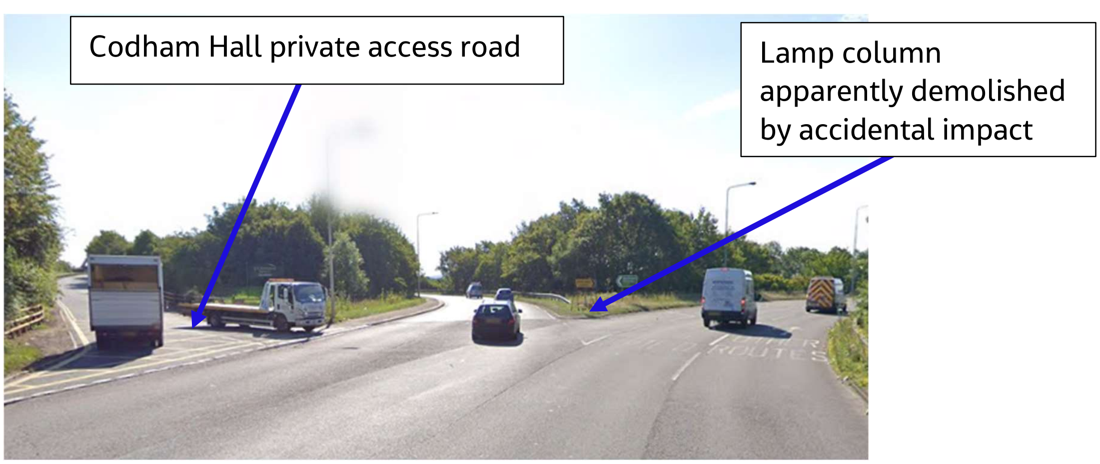

FIGURE 3-31 – GOOGLE STREETVIEW IMAGE OF CODHAM HALL ENTRY

There is no clear signing of the current accesses to Codham Hall estate and the amalgamation of the two accesses into one could increase driver confusion resulting in late braking, lane changing and rear shunts.

RECOMMENDATION

It is recommended that modelling of the junction includes the changes in vehicle movements associated with Codham Hall and any necessary changes to the control of the roundabout are incorporated into the design along with a signing strategy. Provide details of access and egress for this facility for audit, including route signing.

3.3.2 Problem

Location: M25 Junction 29/A127

Summary: Internal access within Codham Hall estate

The closure of the signal-controlled access to Codham Hall will result in drivers who want to access the southside of the estate using the existing overbridge which links the two sides. It is not clear if this structure or the road layout is suitable for an increase in use, potentially by large commercial vehicles, which could result in head on and side swipe collisions. It is also not clear how emergency access to the southside of the estate will be achieved in the event that the overbridge is closed.

As in other locations, the design proposals for this area are different between drawing sets.

RECOMMENDATION

Provide details of internal access proposals for this facility for audit, including route signing. While this is a private road, it is likely to be perceived as public highway by drivers and its safe operation will have an impact on the adjacent public highway network.

3.4 Walking, cycling and horse riding

All users

3.4.1 Problem

Location: Various

Summary: Ability of cross sections to safely accommodate walking, cycling and horse riding routes

The General Arrangement drawings indicate a number of walking, cycling and horse riding routes, many of which include over or under bridges. It is unclear if the available carriageway and structure cross sections are able to accommodate the proposed routes.

As an example, the Muckingford Road 'NMU' (sic) proposed shared route is expected to be at least three metres wide. It is unclear if this can be accommodated within the existing carriageway/highway extents or within the proposed bridge cross section where the route passes over the LTC.

The provision of routes that are not consistent, are sub-standard or variable, or terminate if not able to be accommodated increases the potential for users to enter the carriageway and be involved in collisions with vehicles.

RECOMMENDATION

It is recommended that all walking, cycling and horse riding routes are provided in accordance with current design guidance and that cross sections are provided (including for under and overbridges) for the Stage 2 RSA to confirm these can be accommodated within the available carriageway, highway and structure extents.

3.4.2 Problem

Location: Various

Summary: Connectivity and signing of the proposed network

There are a number of locations where it is unclear how the proposed walking, cycling and horse riding network will be accommodated, how it will connect with existing provisions and how it will be clearly signed.

This includes, but is not limited to:

- Muckingford Road, where the east-west route does not appear to connect to any existing network and will result in users having to enter the carriageway to join or leave the WCH route;
- the east-west route across Brentwood Road, which connects into unbound farm tracks likely to be unsuitable for a large number of users;

- the routes around the LTC junctions with the A13 and A1013;
- the accommodation of the existing PRoW at High House Lane;
- whether the existing Green Lane bridleway is being maintained; and
- how the existing Ockendon Road PRoW is being accommodated.

Poor route connectivity, onward connections and a lack of signage can result in user hesitation, users in the carriageway and users tripping/falling or being unseated on unsuitable surfaces.

RECOMMENDATION

It is recommended that all walking, cycling and horse riding routes are provided in accordance with current design guidance and that they tie in at suitable locations, allowing for safe, connected, onward journeys by all types of user. All routes and onward connections should be clearly signed, with full signing details provided for the Stage 2 RSA.

3.4.3 Problem

Location: Overbridges that include provision for pedestrians, cyclists and equestrians

Summary: Provision of adequate parapets

The General Arrangement drawings indicate a number of walking, cycling and horse riding routes, many of which include carriageway crossings on overbridges. It is unclear if the bridge structures incorporate the correct parapets for the users of each route.

The provision of parapets not suitable for the intended users of the routes increases the potential for cyclists and equestrian falls in the event of a rider being unseated. Specific to equestrians, the provision of incorrect parapets can result in horses becoming startled, increasing the risk of riders being unseated.

RECOMMENDATION

It is recommended that suitable parapets are provided for the intended users of the overbridge routes and that full bridge cross section and parapet details are provided for the Stage 2 RSA.

Pedestrians and Cyclists

3.4.4 Problem

Location: Shared path south of the A2

Summary: Carriageway crossings

The existing pedestrian and cycle route that runs east-west parallel to the A2 is to be modified as part of the LTC project. The modified route includes additional carriageway crossings, including a three lane crossing on the bend where the LTC southbound diverge approaches the Henhurst Road/A2 overbridge roundabout south of the A2.

From the information provided it is unclear if the pedestrian/cycle carriageway crossings are signalised. See Figure below.

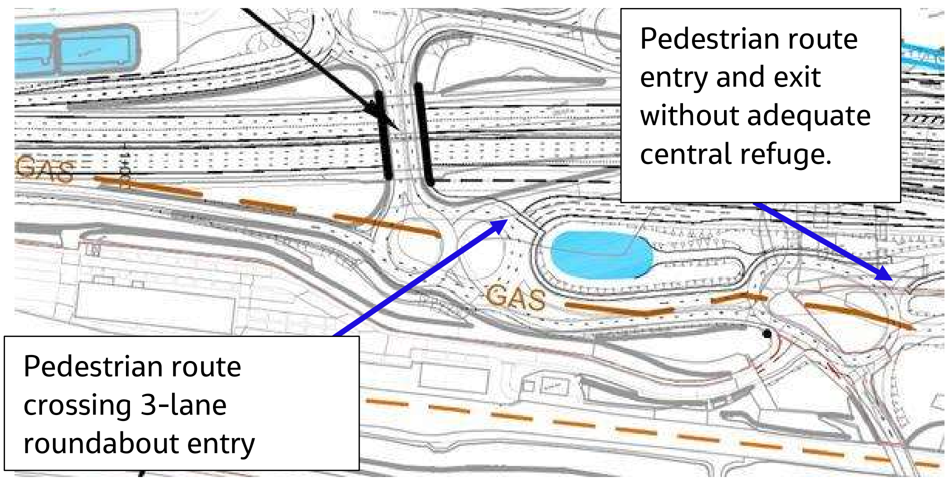

FIGURE 3-32 – HE540039-CJV-HML-S02_ML000000_Z-DR-CH-00050

Additional crossings, circuitous routes and crossings of excessive length increase the risk of collisions involving crossing pedestrians and cyclists with vehicles.

RECOMMENDATION

It is recommended that the number of shared route carriageway crossings is minimised and that signalised crossings are provided. Signal details should be provided for the Stage 2 RSA.

3.4.5 Problem

Location: M25 junction 29 pedestrian and cycle route

Summary: Length of route

The General Arrangement drawings indicate the proposed NMU (sic) route around M25 junction 29 and the onwards movements south of the junction. If travelling across the junction the route includes four separate signalised crossings. If the user then wishes to travel southbound on the east side of the M25, they are required to follow a 1.5km diversion via a bridge over the A127.

Given that the signalised crossings are not on desire lines and include multiple stages, plus the length of the diversion, this could result in pedestrians and cyclists entering the carriageway away from signals or following desire lines through areas of grass verge. This increases the risk of pedestrian and cyclist collisions with vehicles.

FIGURE 3-33 – EXTRACT FROM GENERAL ARRANGEMENT DRAWING HE540039-CJV-HML-S14_ML000000_Z-DR-CH-00010

RECOMMENDATION

It is recommended that more direct routes for pedestrians and cyclists are provided across M25 junction 29 and across the A127 eastern arm and that destination signing is provided to minimise short cuts across unsafe alternatives.

Equestrians

3.4.6 Problem

Location: North Ockendon

Summary: Route connectivity

The proposed overbridge to the south of North Ockendon accommodates a bridleway, but there are no onward connections for equestrians.

Poor route connectivity and onward connections can result in user hesitation, horses on unsuitable routes and riders being unseated.

RECOMMENDATION

It is recommended that the proposed bridleway connects to an existing provision/route suitable for horses and that the route is clearly signed, with full signing details provided for the Stage 2 RSA.

3.5 Road signs, carriageway markings and lighting

Road signs

3.5.1 Problem

Location: Scheme wide

Summary: Route signing strategy

A clear route signing strategy is needed to ensure that drivers understand the complexity of the interchanges and are able to make the right decisions based on sign information, this includes relevant prohibition signs for the LTC. The layout of all three of the LTC interchanges with the M25, A13 and A2 respectively, provides scope for driver confusion increasing the risk of late lane changing and sudden braking, resulting in side swipes and rear shunts. This is particularly apparent where:

- there is a need to make a number of decisions in quick succession, e.g. A2 westbound there are three merges over a 500m length, or
- the layout is unusual, e.g. Junction 29 of the M25 where there is a long parallel link road from the LTC to the junction which may be unfamiliar to drivers.

RECOMMENDATION

It is recommended that the LTC route signing strategy is included in an Interim RSA to ensure that the complexity of the three interchanges in terms of driver understanding and decision making is fully assessed before stage 2 RSA.

3.5.2 Problem

Location: Various

Summary: Potential for signs to be visible to traffic on adjacent links/roads

There are a number of locations where signs located between parallel routes may result in driver confusion and potentially sudden braking increasing the risk of rear shunt type collisions. An example of this is at the A2/LTC interchange, see figure below.

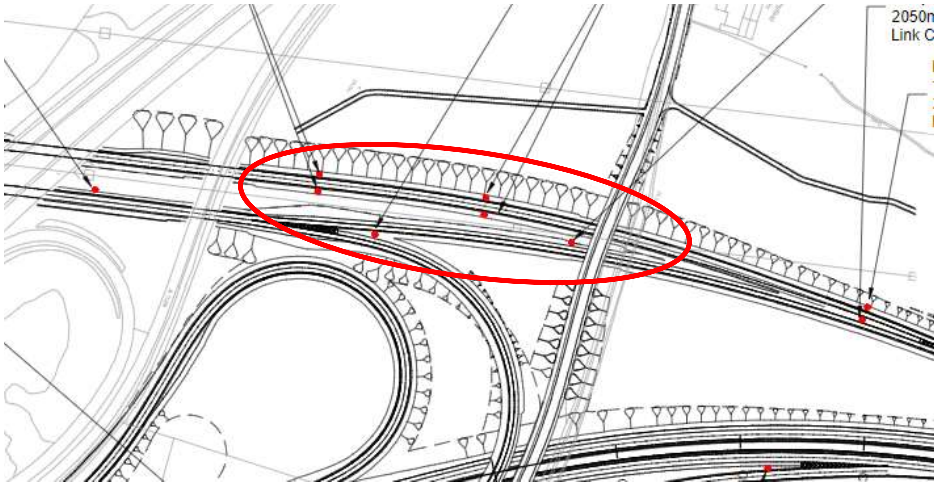

FIGURE 3-34 – EXTRACT FROM DIRECTION SIGNS LOCATION PLAN SECTION 13 HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00157

RECOMMENDATION

It is recommended that where signs would cause confusion to drivers on adjacent links screening is provided.

3.5.3 Problem

Location: Various

Summary: Potential for signs and gantries to be obscured by overbridges and other features

There are a number of locations where signs and gantries are shown behind over bridges and are potentially obscured by embankments/wing walls. Reduced visibility to signs and gantries can result in drivers having insufficient time to process the information increasing hesitation and late decision making.

Where signs and gantries are located with sufficient forward visibility but through overbridges, processing time for drivers can be reduced as their focus is initially not on the sign.

RECOMMENDATION

It is recommended that appropriate clear forward visibility to signs and gantries is provided taking into account the effect that viewing signs through structures can reduce available processing time for drivers.

3.5.4 Problem

Location: Various

Summary: Gantries spanning across the LTC mainline and parallel roads

There are a number of gantries shown extending over parallel roads and the mainline, e.g. A2 WB Ch 3854 and 4100 and A2 EB Ch 4500. These gantries incorporate strategic VMS/MS signs, lane AMIs or a combination of these. It is unclear who the VMS/MS signs are for at these locations but it is likely that the messages will be visible from both the parallel link road and mainline, potentially resulting in confusion.

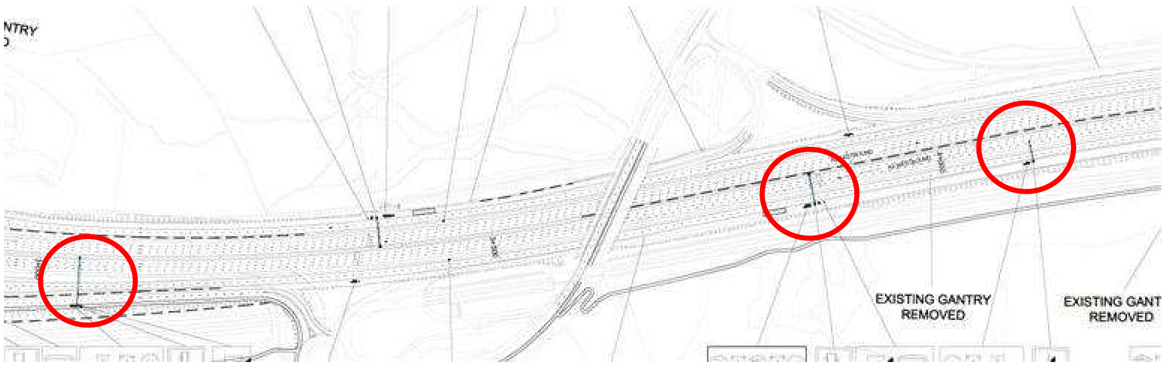

FIGURE 3-35 – EXTRACT FROM TECHNOLOGY DRAWING HE540039-CJV-HMC-A2_HC000000_Z-DR-EC-00003

RECOMMENDATION

Design signs and signals to minimise visibility by those not the intended viewers and provide sign details at Stage 2 RSA.

3.5.5 Problem

Location: Scheme wide

Summary: Lack of direction signing

There are a number of areas of altered road network where no direction signs are proposed. Examples of this include the A127 approaches to junction 29 of the M25 and the three roundabouts (two north of the A2 and one south). The roundabout shape, destinations from some arms and permitted movements are being altered but no signs are proposed to reflect these changes increasing the risk of driver confusion, hesitation and resulting in side swipes and rear shunts.

RECOMMENDATION

It is recommended that full sign details are provided at Stage 2 RSA including any TTM signing.

3.5.6 Problem

Location: LTC route

Summary: Need for junction numbering and optimal direction signing.

The scheme includes complex new junctions with sweeping loops and layouts where drivers may become confused as to which direction they are facing. This may result in sudden braking if they are late to observe their exit or are fearful of entering the tunnel in error and paying the associated charge. This can be exacerbated by satellite navigation systems which have not been updated and exclude new links and junctions.

A further complication relates to manoeuvres that are not specifically provided, for example eastbound A13 traffic wishing to travel north or south on LTC must continue to Orsett Cock Roundabout, make a U-turn and return to take the link to southbound LTC. If they are not familiar with the new layout, drivers may take the diverge to southbound A1089 in error.

GD 300 Expressways design guidance includes junction numbering as a mandatory feature of Level 3 Expressways and this may assist with navigation in some respects. However, it could add to confusion because LTC junctions could be given numbers but they would also have a different junction number from the connection major route.

GD 300 also states that "*Liaison with adjacent local highway authorities shall commence in HE PCF [Ref 14.N] stage 1 to identify changes that are required to their road signing*". It is understood that liaison with local highway authorities has not yet commenced; this is important in order to understand the destinations that drivers are likely to be seeking for various route permutations.

If direction signing throughout the scheme and its connections does not reflect scope for driver error, and the destinations they are likely to be looking for, there is potential for late lane changing, sudden braking and distraction from driving conditions, which may result in shunt or side-swipe collisions.

Signing for permitted vehicle groups similarly needs to reflect existing and likely future road users' needs, to avoid illegal use. Appropriate signing can minimise sudden braking or lane changing and resulting side swipe and shunt collisions which could occur if good advance signing of prohibitions is not made.

RECOMMENDATION

Liaise with local highway authorities to identify appropriate destinations and determine whether route numbering will be provided for LTC. Develop direction signs and prohibition signing proposals to address the navigational challenges described above.

3.5.7 Problem

Location: Scheme wide

Summary: Marker posts

It is not clear if marker posts are going to be provided as part of the scheme and if these will indicate the nearest ERT from that location. Without these, stranded drivers could be exposed for longer on the live carriageway if they walk in the wrong direction. Near junctions, drivers walking to get assistance may cross slip roads if they do not walk in the correct direction.

It is not known whether network referencing signs will be shown, but this would be expected; these signs can enable drivers who have broken down to give their location to emergency services and/or breakdown service suppliers.

RECOMMENDATION

It is recommended that full sign and marker post proposal details are provided at Stage 2 RSA.

3.5.8 Problem

Location: Scheme wide

Summary: Position of signs in verges

There are a number of proposed signs located in verges, at nosings or within steep embankments where there appears to be inadequate room to accommodate the signs. This could result in:

- insufficient clearance to the edge of carriageway and a risk of vehicle strikes,
- reduced performance of a road restraint system if positioned within the working width increasing the severity of a collision in the event that a vehicle leaves the carriageway ,and
- complications in terms of maintenance if located adjacent to significant drops.

RECOMMENDATION

It is recommended that full sign details are provided at Stage 2 RSA ensuring that all signs are located and protected appropriately.

3.5.9 Problem

Location: Scheme wide

Summary: Unprotected signs

There are a number of proposed signs located in verges and at nosings which do not appear to be protected. This is likely to increase the severity of collisions in the event of a vehicle leaving the carriageway at these locations. For example the direction sign located in the wide verge adjacent to the A13 westbound slip onto A1089 southbound.

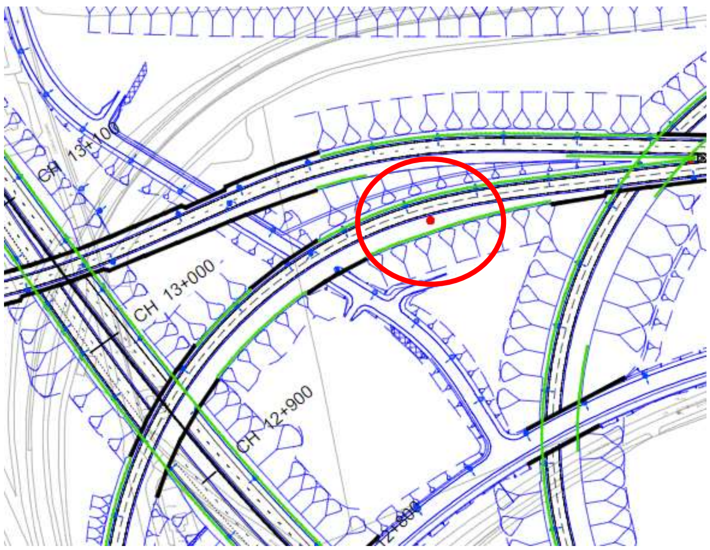

FIGURE 3-36 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-ML000000_Z-DR-CH-20042

RECOMMENDATION

It is recommended that the roadside risks for all road users are managed and signs are protected accordingly.

Carriageway markings

3.5.10 Problem

Location: Various merges

Summary: Inconsistent use of warning road markings at merges

There is an inconsistent use of warning lane markings at merges, for example the southbound merge from LTC to the eastbound A2. This can result in drivers being less aware of the potential for drivers changing lanes increasing the risk of side swipe collisions.

RECOMMENDATION

It is recommended that warning road markings are provided in accordance with the Traffic Signs Manual Chapter 5.

Lighting

3.5.11 Problem

Location: Scheme wide

Summary: Use of uni-directional road studs where contraflow is likely

Road studs appear to be unidirectional throughout – given that maintenance/ emergency routing will involve crossover/contraflow running this could cause issues regarding lane discipline and definition resulting in side impact collisions.

RECOMMENDATION

It is recommended that bi-directional studs are used where regular contra flow arrangements are anticipated.

3.5.12 Problem

Location: Scheme wide

Summary: Lighting columns vulnerable to vehicle strikes

There are some locations where lighting columns are positioned in front of maintenance bays or accesses increasing the risk of being struck by vehicles, resulting in injury.

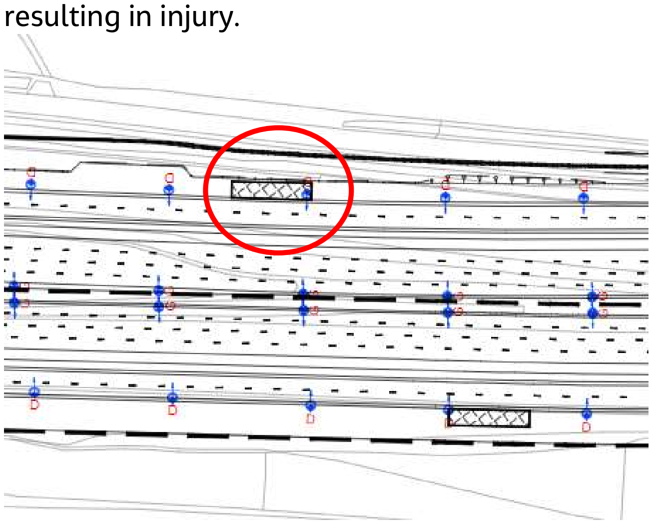

FIGURE 3-37 – EXTRACT FROM LIGHTING DRAWING HE540039-CJV-HLG-RL000000_Z-DR-EO-00002

RECOMMENDATION

It is recommended that lighting columns are located with sufficient clearance to the edge of the carriageway/maintenance areas and protected where necessary.

3.5.13 Problem

Location: M25 south of junction 29

Summary: Lighting provision

The M25 south of junction 29 is proposed to be eleven lanes wide with lighting in the nearside of both the clockwise and anticlockwise carriageways. This section includes the LTC merge and diverge where drivers will be making route choices and changing lanes which under potentially lower lighting levels increases the risk of night time collisions. Motorcyclists are especially vulnerable injury in lower lighting if drivers are less able to see a motorcycle due to its smaller size and/or form meaning it is not anticipated.

RECOMMENDATION

Check that the lighting design will provide appropriate lighting levels on all lanes.

3.5.14 Problem

Location: Scheme wide

Summary: Lighting provision

The LTC Lighting report states that, '*lighting levels will be linked to the live traffic flow, so that during quiet periods the lighting will be dimmed to reduce energy consumption*.' It is not clear if this will have an impact on the transition from one lighting level to another resulting in issues as eyes adjust and potentially resulting in collisions such as rear shunts in slowing traffic or as a vehicle changes lane.

RECOMMENDATION

It is recommended that the effect of the proposal to dim the lighting does not create differences in lighting levels, particularly in relation to the tunnel.

3.5.15 Problem

Location: Scheme wide

Summary: Green studs used at appropriate locations.

Green studs are proposed on auxiliary lanes in accordance with TSM Chapter 5 4.4.1. However, that document does not reflect the possibility of an EA within that lane e.g. Ch 12 358-Ch 13 400 at A13 junction with EA at Ch 12 700m. Drivers in through-lanes may not anticipate an EA at this location and make a sudden lane change to enter it, in conflict with vehicles in the lane-drop nearside lane and resulting in side swipe and rear shunt collisions.

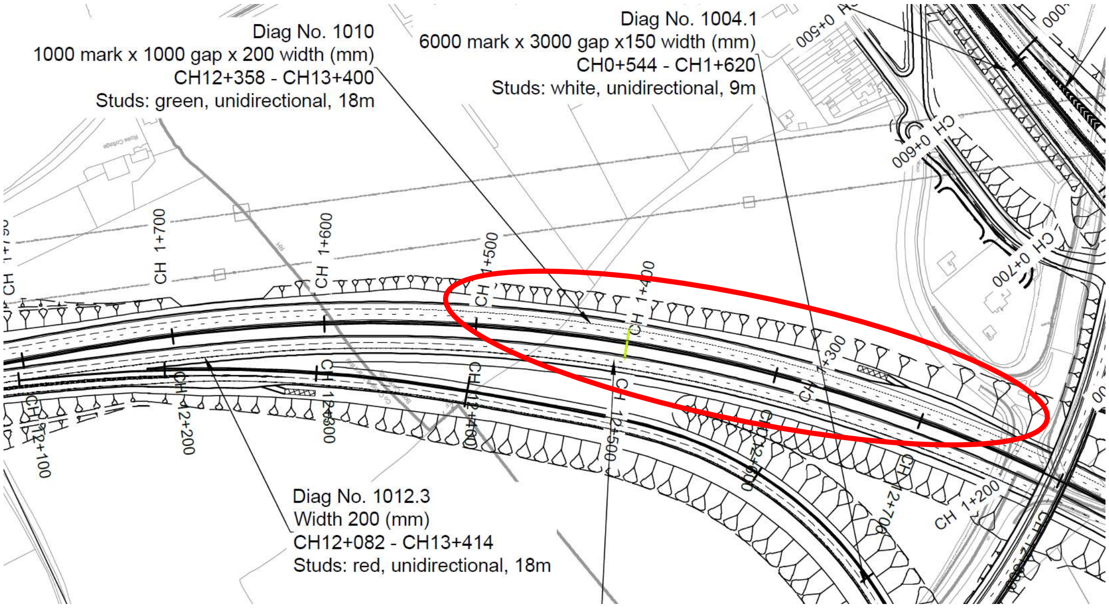

FIGURE 3-38 – EXTRACT FROM ROAD MARKINGS DRAWING HE540039-CJV-HMK-SZP_RG000000_Z-DR-CH-00158

RECOMMENDATION

Review EA positions and stud designs to minimise drivers making sudden lane changes at these locations.

4 Road Safety Audit Team Statement

4.1 Audit Team Statement

4.1.1 We certify that we have examined the documents listed in this report. The examination has been carried out with the sole purpose of identifying any features of the design that could be removed or modified in order to improve the safety of the scheme. The problems identified in this report together with associated safety improvement suggestions that we recommend should be studied for implementation. No member of the audit team has been involved with the scheme design.

4.1.2 We certify that this Road Safety Audit has been carried out in accordance with GG 119. This includes the Covid-19 Pandemic relaxation on site visits, as detailed in Section 1.

4.1.3 Signed on behalf of Jacobs

Road Safety Audit Team Leader	
Name:	Alison Foale
Signed:	
Position:	Senior Road Safety Engineer
Organisation:	Jacobs
Address:	The Square, Temple Quay, Redcliffe, Bristol, BS1 6DG
Date:	13.07.2020
Road Safety Audit Team Members	
Name:	Daniel Harris
Signed:	
Position:	Senior Road Safety Engineer
Organisation:	Jacobs
Address:	The Square, Temple Quay, Redcliffe, Bristol, BS1 6DG
Date	13.07.2020
Name:	Kate Carpenter
Signed:	
Position:	Senior Associate Director of Operational Safety and Traffic Engineering
Organisation:	Jacobs
Address:	Cottons Centre, 2nd Floor, Cottons Lane, London, SE1 2QG
Date:	13.07.2020

Appendix A. Drawings & Documents Provided for Road Safety Audit

Table A.1 – Supplied Documents

Document Number / Reference	Date / Version	Title
General / Highways		
HE540039-CJV-GEN-GEN-REP-OPS-00053	-	Lower Thames Crossing Stage 1 Road Safety Audit Brief
HE540039-CJV-GEN-GEN-REP-HWY-00153	2.0	Design Basis - Highways
HE540039-CJV-HGN-GEN-STD-DES-00001.xls	1.1	Departures from Standards Checklist
HE540039-CJV-GEN-GEN-REP-DEL-00006.pdf	-	NMU (WCH) Strategy
Email dated 13 December 2019 sent by Highways England Safety Risk Requirements Team	-	SRN Safety Risk Model – collision data.pdf
Essex CC Local Road Network STATS19 data	-	Essex CC Local Road Network STATS19 data
3e Orsett Cock RBT_21012020_134838.pdf 3e Orsett Cock RBT_21012020_134838_001.pdf A13 - 1 of 4_21012020_131113.pdf A13 - 2 of 4_21012020_131203.pdf A13 - 3 of 4_21012020_131246.pdf A13 - 4 of 4_21012020_131329.pdf Area 1_21012020_125025.pdf Area 2_21012020_125412.pdf Area 3a Stifford Clays Road & Baker Street_21012020_130143.pdf Area 3b Stanford Road_21012020_125936.pdf Area 3c Brentwood Road_21012020_130644.pdf Area 3d A128_21012020_130336.pdf Area 4_21012020_125639.pdf	-	Thurrock STATS19 Collision Data zip
Area 1 - A226 Gravesend Road, Gravesend 3yr PIC D Report Area 1 - A226 Gravesend Road, Gravesend 3yr PIC Plot Area 2 - Gravesend East, Gravesend 3yr PIC D Report Area 2 - Gravesend East, Gravesend 3yr PIC Plot Area 3 - A289, M2, A2 Gravesend 3yr PIC D Report Area 3 - A289, M2, A2 Gravesend 3yr PIC Excel Area 3 - A289, M2, A2 Gravesend 3yr PIC Plot Area 4 - Thong Lane, Gravesend 3yr PIC plot Area 5 - Thong Lane, Brewers Rd, Gravesend 3yr PIC D Report Area 5 - Thong Lane, Brewers Rd, Gravesend 3yr PIC Plot	-	Kent CC Stats_19_Data.zip
A127 Jc29 Attendant and Casualty Variables ReportInterpretedListing ReportStic	-	TfL A127 Jct 29.zip (Transport for London)
Tunnels		
HE540039-CJV-GEN-GEN-REP-TUN-00025	0.7	Tunnel Operational Risk Assessment
HE540039-CJV-GEN-GEN-REP-TUN-00024	1.0	Tunnel Safety Consultation Document
HE540039-CJV-STU-GEN-RPT-TUN-00001	2.1	Tunnel Design Authority Report
HE540039-CJV-GEN-GEN-REP-TUN-00016	3.1	Main Crossing Bored Tunnels Space Proofing Report (including space proofing drawings for the tunnel, low point sump and cross passages)
Technology		

Document Number / Reference	Date / Version	Title
HE540039-CJV-GEN-GEN-REP-HWY-00134.pdf	2.0	Cross-Scheme Highway Technology Design Report
Signing and Road Markings		
HE540039-CJV-HSN-GEN-REP-HWY-00134_Rev3.pdf	3.0	Scheme-Wide Signage Strategy
HE540039-CJV-HSN-SNA-REP-HWY-00001-rev2_0.pdf	2.0	Traffic Signs and Road Markings Design - North of the Tunnel
HE540039-CJV-HSN-SSA-REP-HWY-00001-rev2_0.pdf	2.0	Traffic Signs and Road Markings Design - South of the Tunnel
Lighting		
HE540039-CJV-GEN-GEN-REP-HWY-00144 Lighting Design Report North.pdf	2.0	Highway Design Lighting Report - North of the Tunnel
HE540039-CJV-GEN-GEN-REP-HWY-00151 Lighting Design Report South.pdf	-	Highway Design Lighting Report - South of the Tunnel

Note: Many of the reports set out above were produced as part of Design Release DR2.14 and contain links to DR2.14 drawings. The drawings to be referenced in this audit are those listed below.

Table A.2 – Supplied Drawings

Drawing Number / Reference	Title	Revision
Highways General Arrangement Drawings		
HE540039-CJV-HML-S01_ML000000_Z-DR-CH-00050	Section 1 A2 / M2 General Arrangement	P01
HE540039-CJV-HML-S02_ML000000_Z-DR-CH-00050	Section 2 LTC A2 Junction General Arrangement	P01
HE540039-CJV-HML-S03_ML000000_Z-DR-CH-00050	Section 3 and 6 (South) Gravesend Link General Arrangement	P01
HE540039-CJV-HML-S09_ML000000_Z-DR-CH-00010	Sections 6,7,8,and 9 - Tilbury Link General Arrangement	P05
HE540039-CJV-HML-S10_ML000000_Z-DR-CH-00003	Section 10 - Chadwell Link General Arrangement	P05
HE540039-CJV-HML-S11_ML000000_Z-DR-CH-00010	Section 11 - A13 Junction General Arrangement	P05
HE540039-CJV-HML-S12_ML000000_Z-DR-CH-00010	Section 12 - Ockendon Link General Arrangement	P04
HE540039-CJV-HML-S13_ML000000_Z-DR-CH-00010	Section 13 - LTC/M25 Junction General Arrangement	P05
HE540039-CJV-HML-S14_ML000000_Z-DR-CH-00010	Section 14 - M25 Junction 29 General Arrangement	P05
Highways – A13 Junction Plan & Profile		
HE540039-CJV-HML-A13_JN100012_Z-DR-CH-00001.pdf	A13 JUNCTION (LINK ROAD 12) A13 WB TO ORSETT COCK RDBT PLAN & PROFILE	P06

Drawing Number / Reference	Title	Revision
HE540039-CJV-HML-A13_JN100007_Z-DR-CH-00002.pdf	A13 JUNCTION (LINK ROAD 7) A1089 NB TO LTC SB PLAN & PROFILE	P07
HE540039-CJV-HML-A13_JN100006_Z-DR-CH-00001.pdf	A13 JUNCTION (LINK ROAD 6) A1089 NB TO LTC NB PLAN & PROFILE SHEET 1 OF 2	P07
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HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28101	FIELD BRIDGE STRUCTURES KEY PLAN Sheet 11 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28102	FIELD BRIDGE STRUCTURES KEY PLAN Sheet 12 of 12	P02
HE540039-CJV-SGN-SNZ-PRG-STR-00006	Field Bridge Schedule	1.0
Sign / Signal Gantries		
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28021	GANTRY & MAST STRUCTURES KEY PLAN Sheet 1 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28022	GANTRY & MAST STRUCTURES KEY PLAN Sheet 2 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28023	GANTRY & MAST STRUCTURES KEY PLAN Sheet 3 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28025	GANTRY & MAST STRUCTURES KEY PLAN Sheet 5 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28027	GANTRY & MAST STRUCTURES KEY PLAN Sheet 7 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28028	GANTRY & MAST STRUCTURES KEY PLAN Sheet 8 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28029	GANTRY & MAST STRUCTURES KEY PLAN Sheet 9 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28030	GANTRY & MAST STRUCTURES KEY PLAN Sheet 10 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28031	GANTRY & MAST STRUCTURES KEY PLAN Sheet 11 of 12	P02
HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28032	GANTRY & MAST STRUCTURES KEY PLAN Sheet 12 of 12	P02
HE540039-CJV-SGN-GEN-REG-STR-00101	Ancillary Structures Schedule - Gantries and Masts South Section	DR 3.0
HE540039-CJV-SGN-SNZ-PRG-STR-00004	Ancillary Structures Schedule - Gantries & Masts North of the River Thames	DR 3.0

Table A.3 – Additional materials, not detailed in the brief, supplied to the RSA team through the audit process

Drawing Number / Reference	Title	Date / Revision
Scheme Overview Plan	Scheme Overview Plan	May 2020
Vehicle Restraint Systems Models		

HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 1	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 2	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 3	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 4	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 5	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 6	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 7	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 8	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 9	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 10	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 11	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 12	DR3.0 Whole scheme – RSA VRS layout	P01.1
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 13	DR3.0 Whole scheme – RSA VRS layout	P01.1
PSV-AAV-DR4 Drawings		
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00021	Pavements Layout North 1 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00022	Pavements Layout North 2 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00023	Pavements Layout North 3 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00024	Pavements Layout North 4 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00025	Pavements Layout North 5 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00026	Pavements Layout North 6 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00027	Pavements Layout North 7 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00028	Pavements Layout North 8 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00029	Pavements Layout North 9 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00030	Pavements Layout North 10 of 14	P02

HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00031	Pavements Layout North 11 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00032	Pavements Layout North 12 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00033	Pavements Layout North 13 of 14	P02
HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00034	Pavements Layout North 14 of 14	P02
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00021	Pavements Layout South 1 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00022	Pavements Layout South 2 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00023	Pavements Layout South 3 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00024	Pavements Layout South 4 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00025	Pavements Layout South 5 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00026	Pavements Layout South 6 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00031	Pavements Layout South 7 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00028	Pavements Layout South 8 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00029	Pavements Layout South 9 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00030	Pavements Layout South 10 of 11	P03
HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00031	Pavements Layout South 11 of 11	P03
HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042	DR3.0 Whole scheme – RSA VRS layout	P01.1

Appendix B. Location Plan

Figure A.1 – Location Plan

Appendix C. Problem Location Plans

Not all problems detailed within the Road Safety Audit occur at specific locations. Where this is the case the type of problem is outlined and an example given within the problem text. The following problems occur at more than one location:

- 3.1.1 – 3.1.3
- 3.1.9
- 3.2.1 – 3.2.3
- 3.2.5 – 3.2.9
- 3.2.11
- 3.2.13 – 3.2.15
- 3.2.17
- 3.2.19 – 3.2.21
- 3.2.23
- 3.2.26 – 3.2.31
- 3.4.1 – 3.4.3
- 3.5.1 – 3.5.12
- 3.5.14 – 3.5.15

Figure A.2 Problem location plan based on GA drawing HE540039-CJV-HML-S14_ML000000_Z-DR-CH-00010

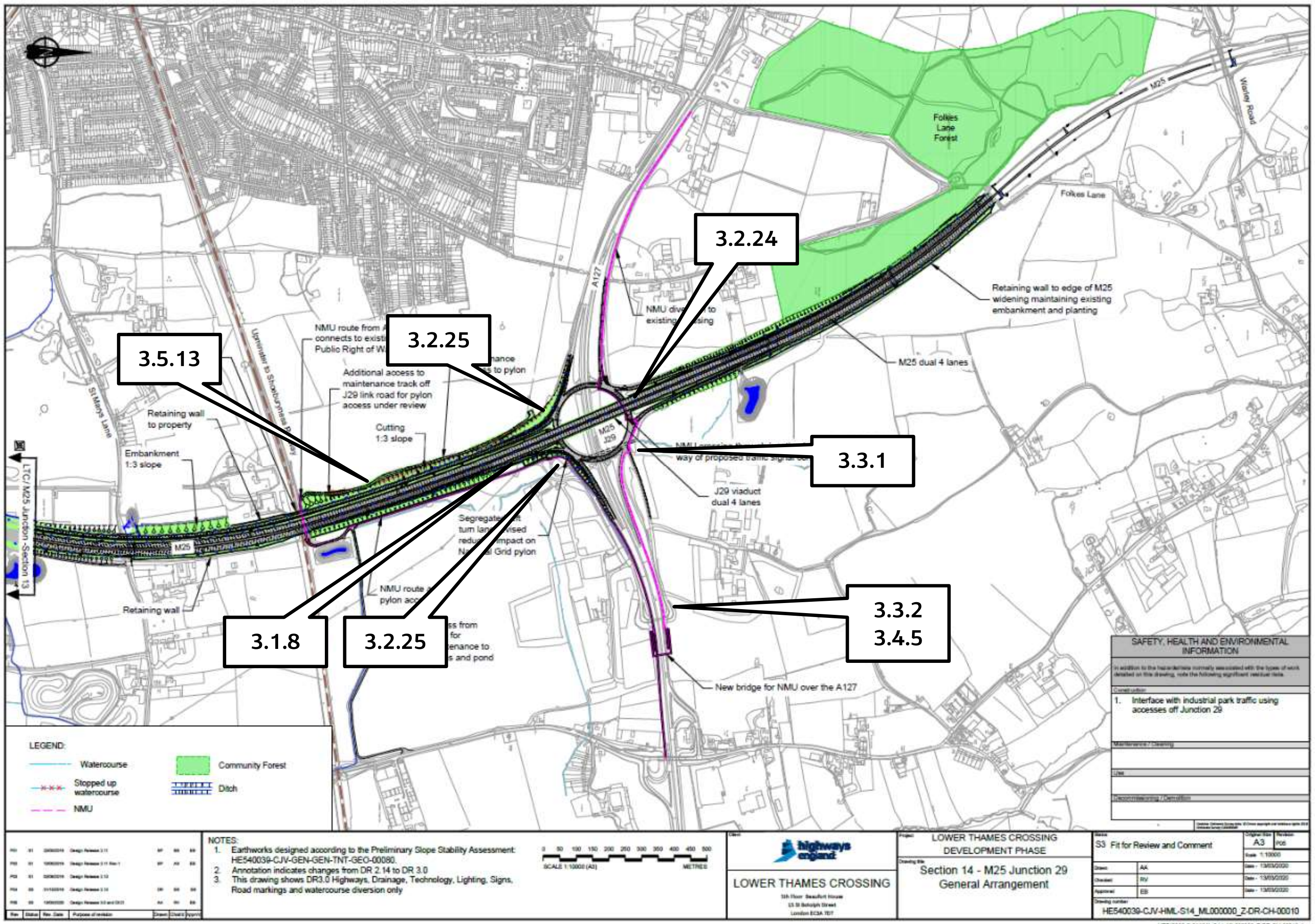


Figure A.3 Problem location plan based on GA drawing HE540039-CJV-HML-S13_ML000000_Z-DR-CH-00010

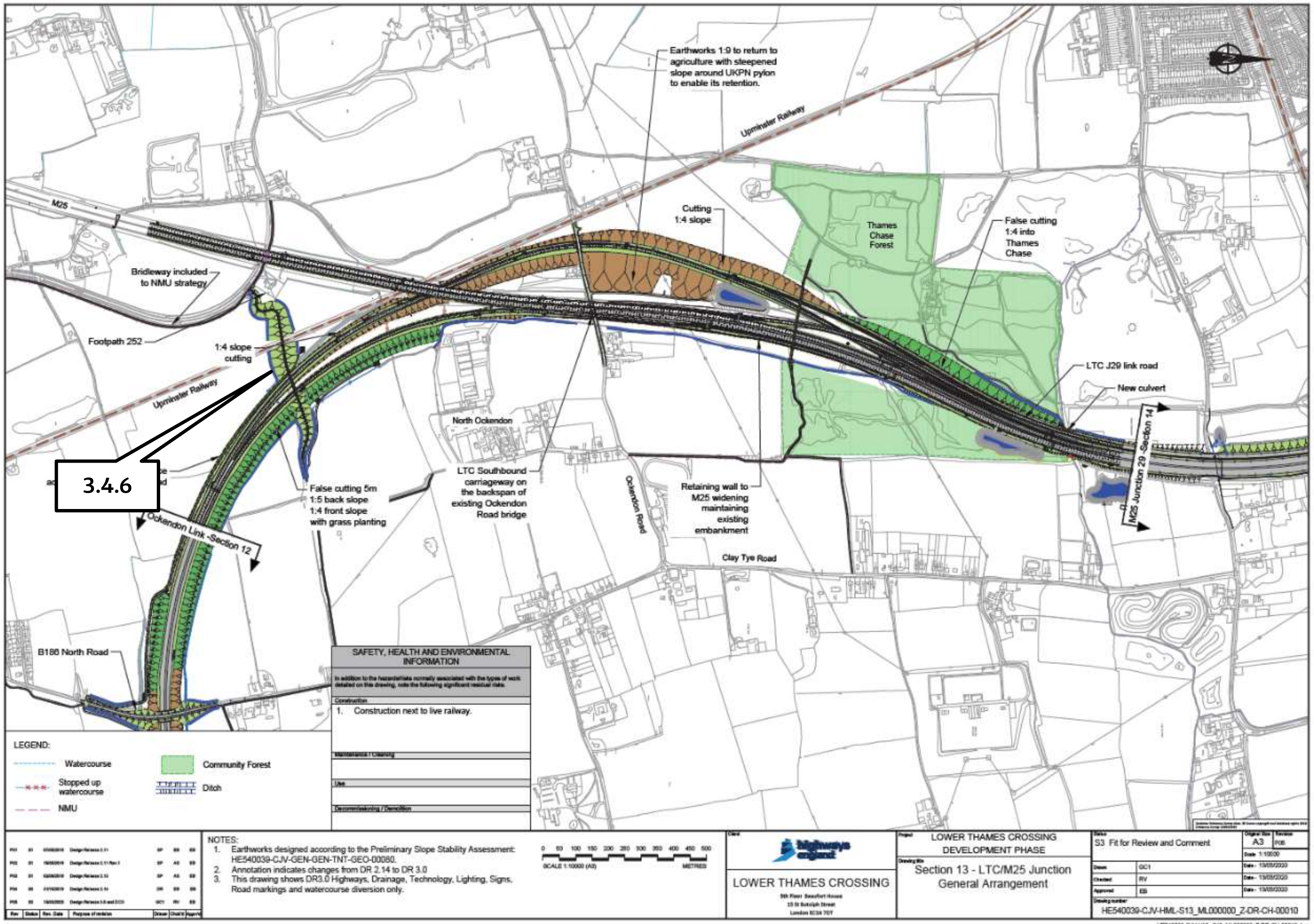


Figure A.4 Problem location plan based on GA drawing HE540039-CJV-HML-S12_ML000000_Z-DR-CH-00010

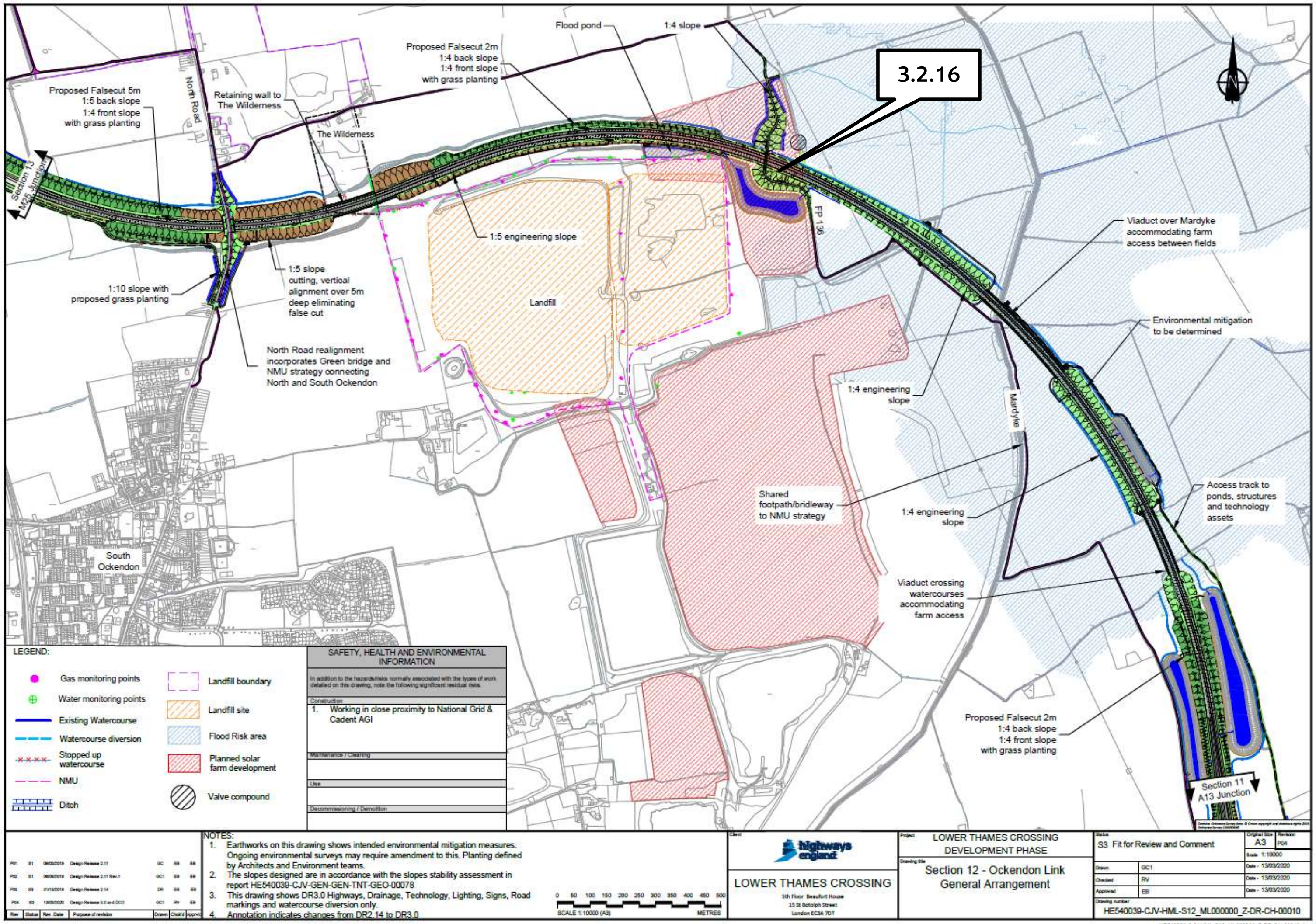


Figure A.5 Problem location plan based on GA drawing HE540039-CJV-HML-S11_ML000000_Z-DR-CH-00010

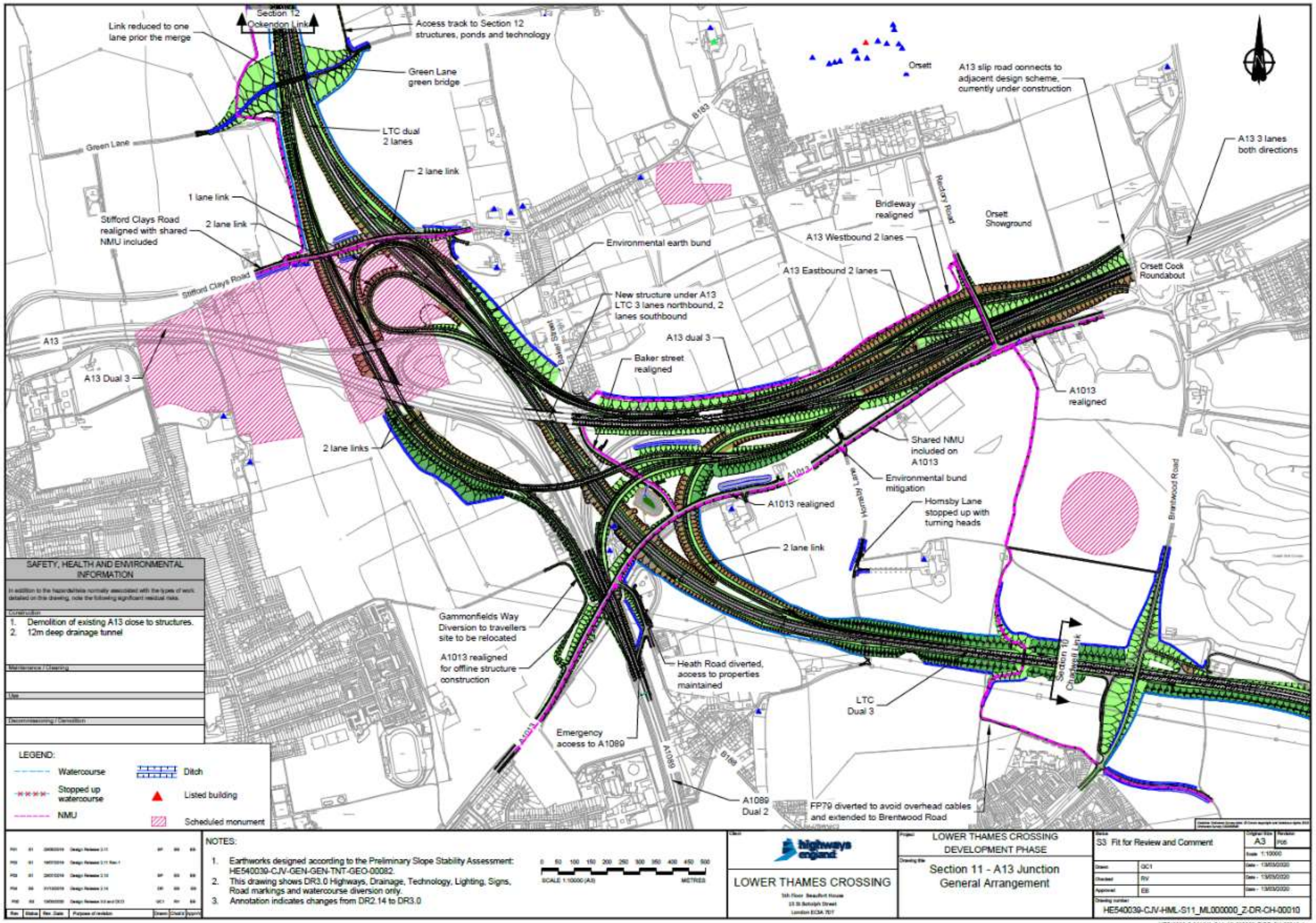


Figure A.6 Problem location plan based on GA drawing HE540039-CJV-HML-S10_ML000000_Z-DR-CH-00003

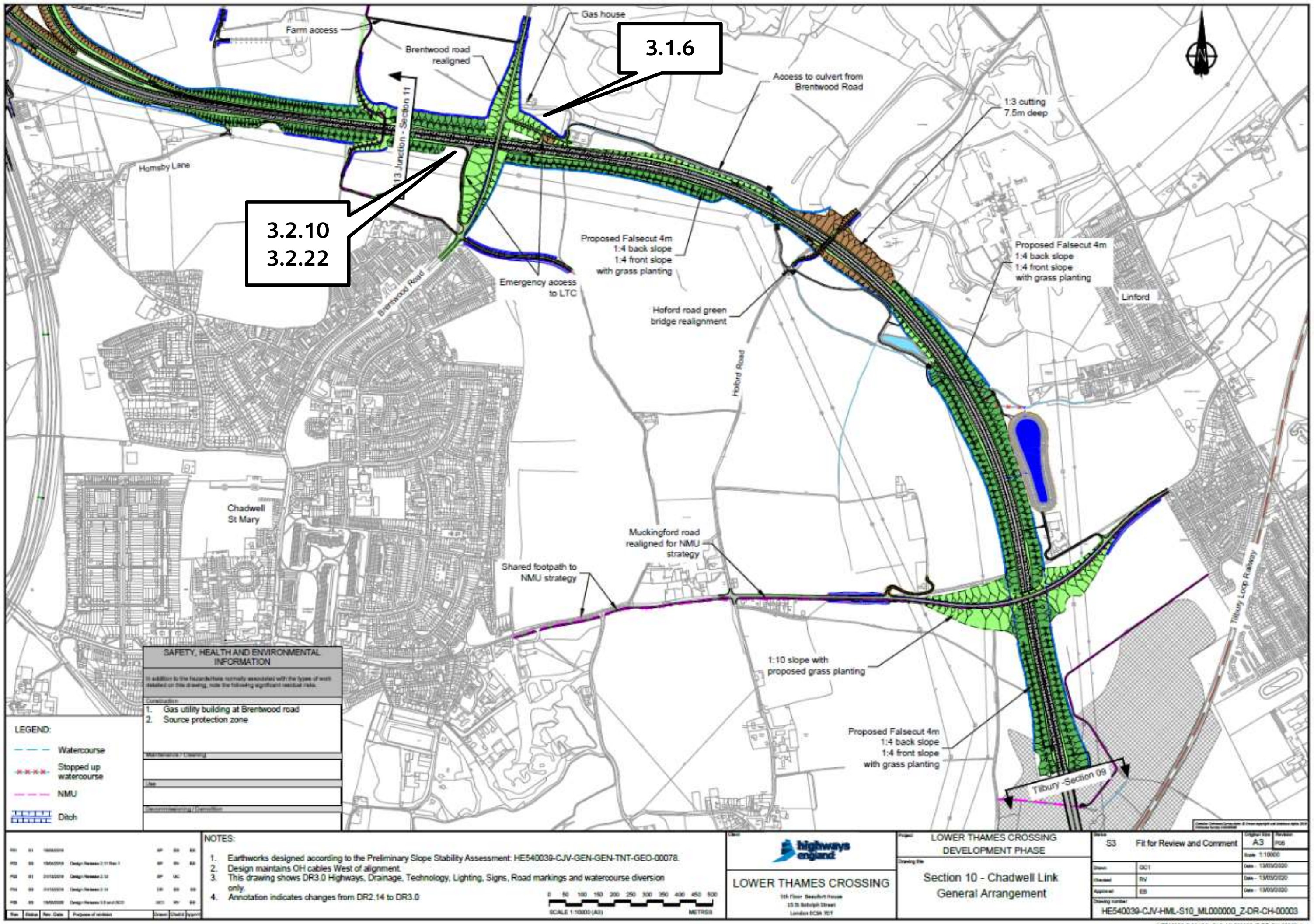


Figure A.7 Problem location plan based on GA drawing HE540039-CJV-HML-S09_ML000000_Z-DR-CH-00010

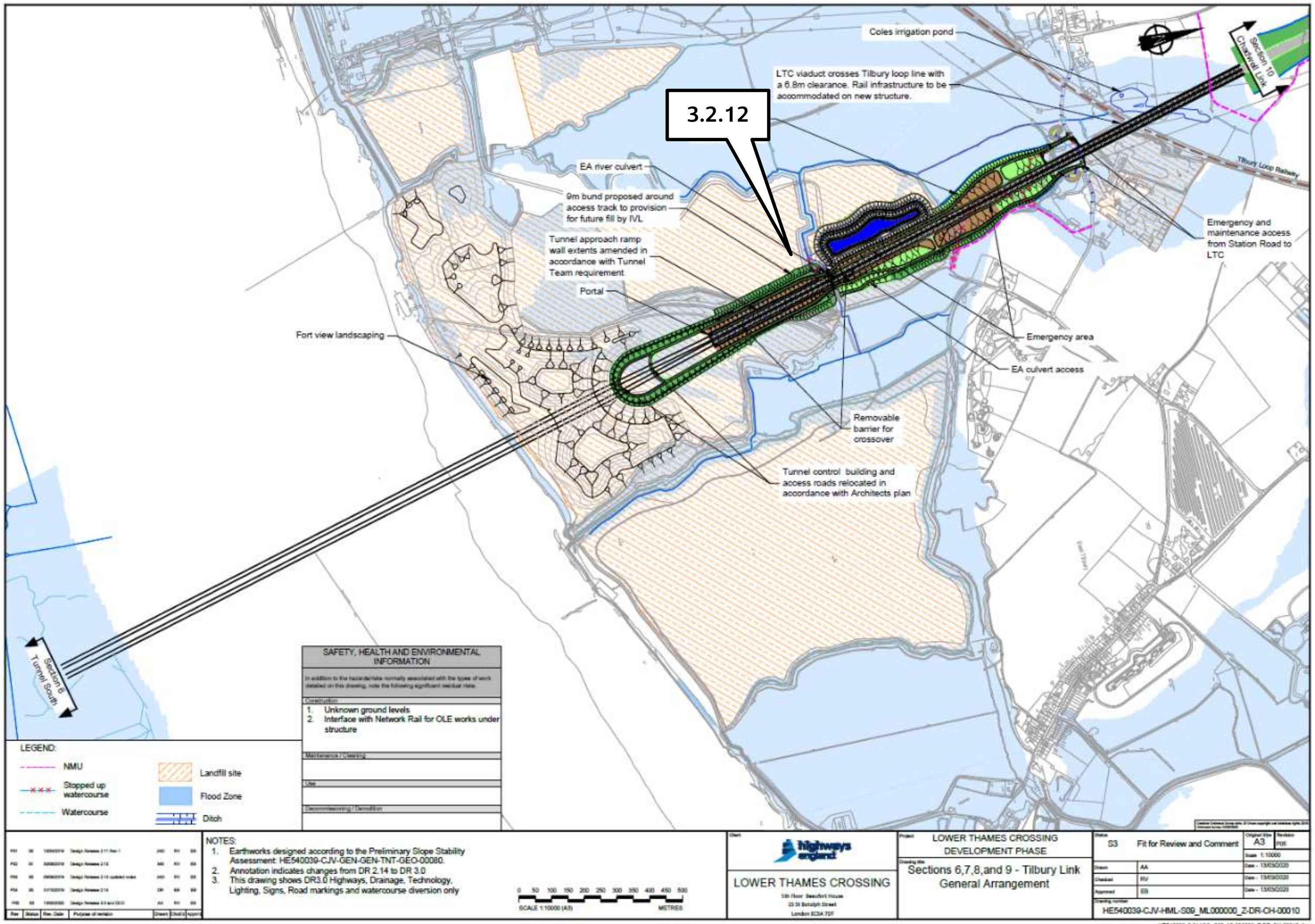


Figure A.8 Problem location plan based on GA drawing HE540039-CJV-HML-S03_ML000000_Z-DR-CH-00050

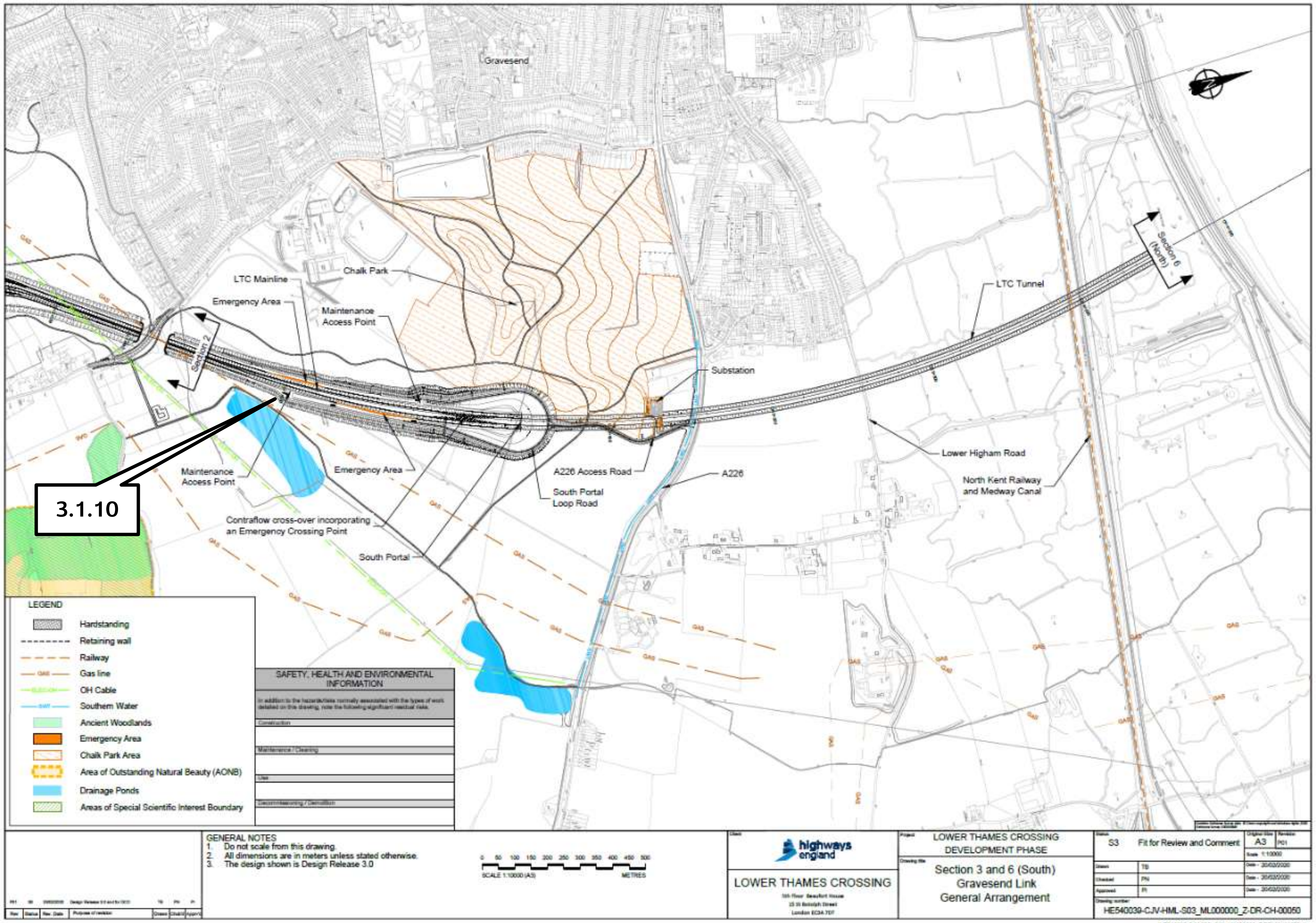


Figure A.9 Problem location plan based on GA drawing HE540039-CJV-HML-S02_ML000000_Z-DR-CH-00050

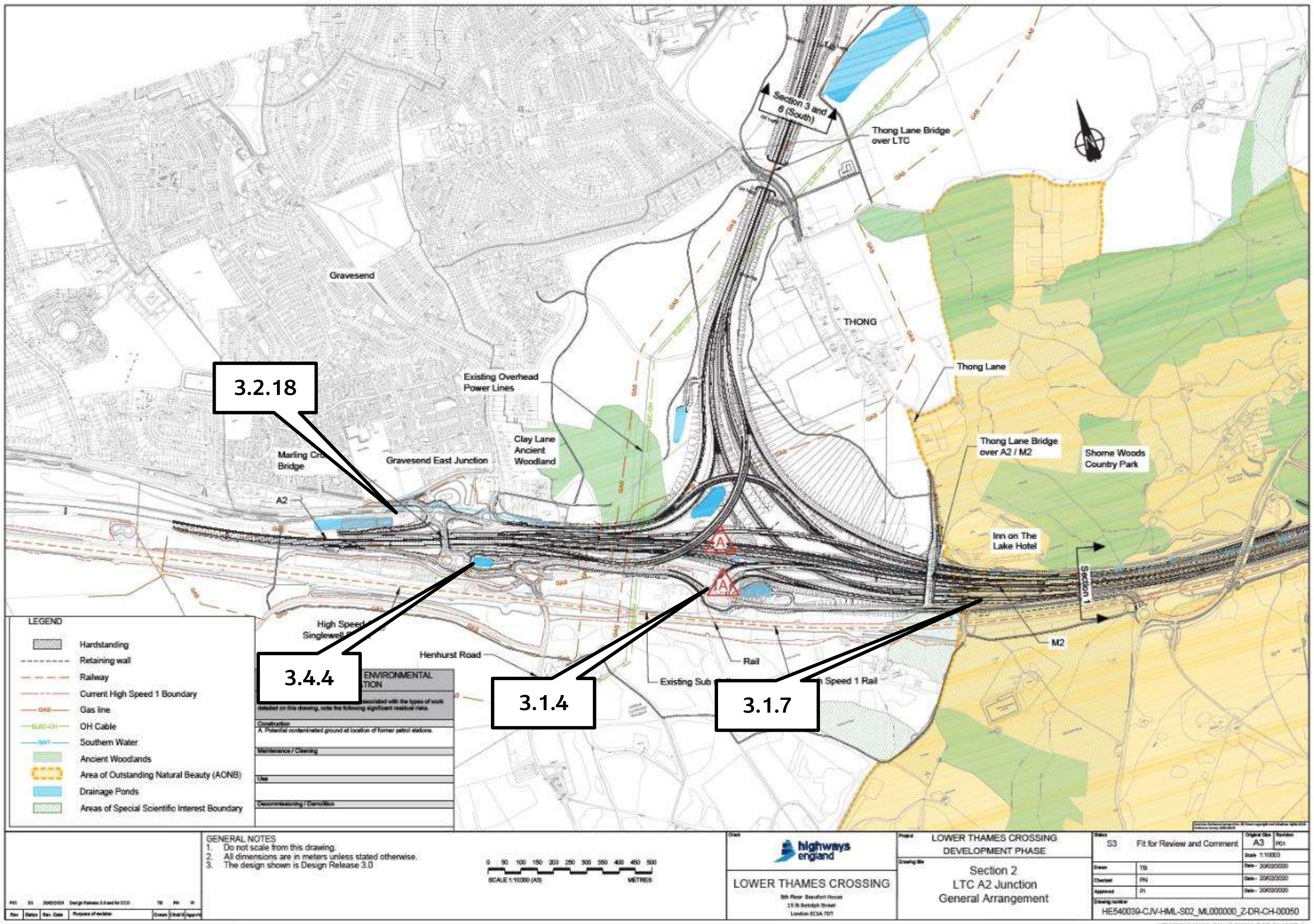
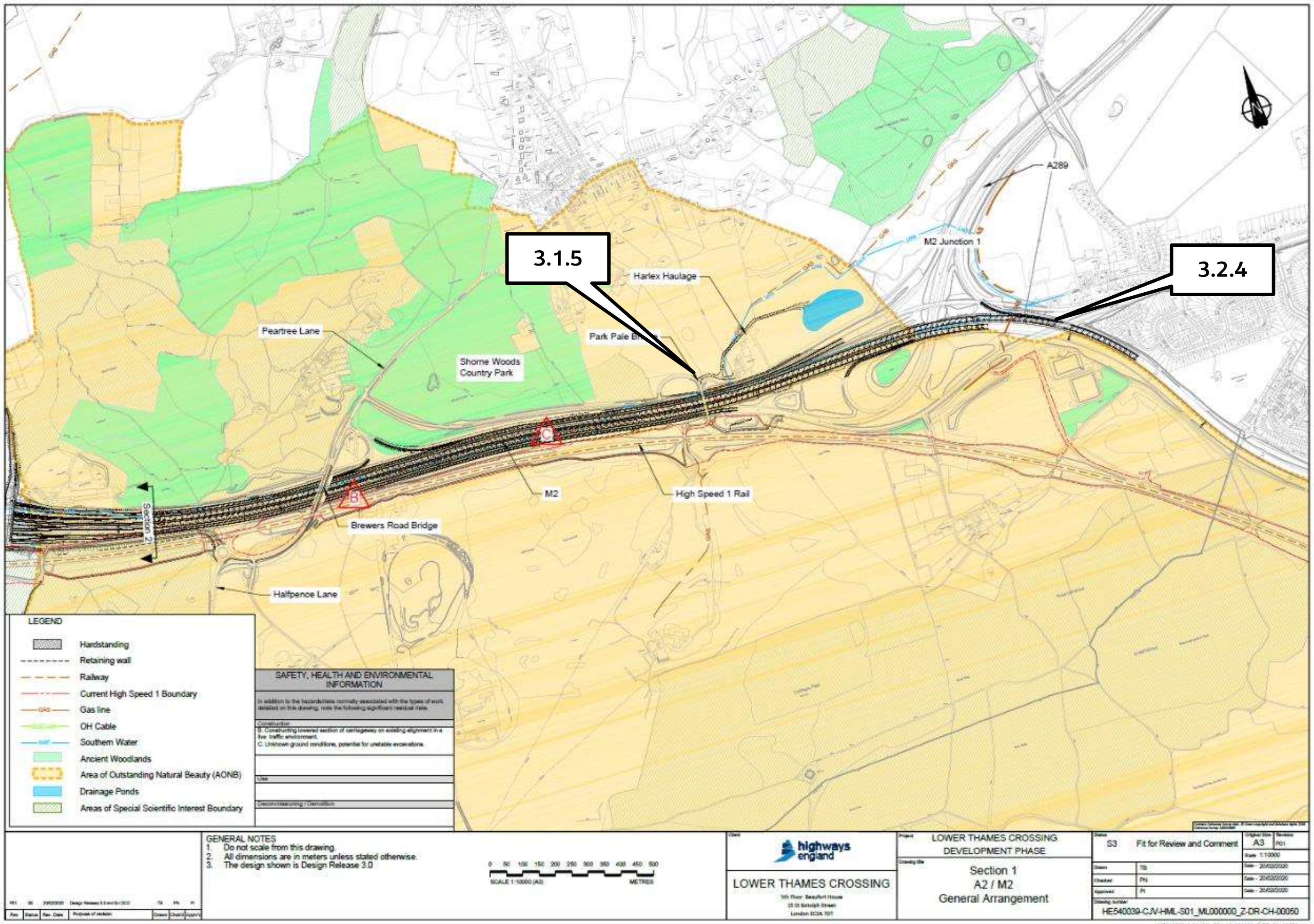


Figure A.10 Problem location plan based on GA drawing HE540039-CJV-HML-S01_ML000000_Z-DR-CH-00050



Appendix D. Meeting Minutes

D.1 Meeting Minutes

D.1.1 Meeting Reference 001

Subject	LTC 'Walk Through'		
Project	LTC Stage 1 RSA		
Project No.	Meeting ref 001 v 1	File	
Prepared by	Alison Foale	Phone No.	
Location	Teams meeting	Date/Time	27/05/2020
Participants	Adam Oredecki, Lower Thames Crossing		
	Philip Patterson, Lower Thames Crossing		
	Kate Carpenter, Jacobs		
	Daniel Harris, Jacobs		
	Alison Foale, Jacobs		
Copies to	David Cook, Lower Thames Crossing	Apologies	

Notes		Action
General	Purpose of the meeting was for the Design Organisation to provide a 'walk through' briefing to assist the road safety audit team with an appreciation of the scheme.	
	AO presented a useful plan of the entire scheme colour coded to help distinguish between the various routes through the three major junctions. The RSA team have requested a copy of the plan. **Post meeting note:** *AO has provided this information since the meeting.*	AO
	PP confirmed that the standards used in the design of the scheme are as of July 1 2019. This includes Smart Motorway standards/IANs.	
DfS	The departures associated with the scheme have been reviewed since the Brief was prepared. PP to provide an updated departures schedule. **Post meeting note:** *PP has provided an updated schedule to the RSA team.*	PP

Tunnel	The tunnel operational risk assessment has been endorsed by SCRG. Tunnel maintenance activities will be coordinated with the operation of the Dartford river crossings. The LTC mainline from the LTC / A2 junction to the southern portal has a negative 4% gradient that continues for a further 1km within the tunnel, then transitioning to a 1.6% negative gradient through to the tunnel low point, and thereafter an approximately 3% positive gradient toward the exit portal. Lane control will be provided inside the tunnel by extending the external lane control system through the tunnel, using AMI-type signals above each lane. This approach is used instead of ‘green arrow / red cross’ lane control. The AMIs through the tunnel are spaced at 270m intervals and the VMS at 540m intervals. A tunnel STOP system will also be in place whereby VMS, VMSL and red-X will be used to stop traffic entering the tunnel if required. There are no EAs through the tunnel but PRS created around the incident using VAID (video automatic incident detection), SVD (stopped vehicle detection), 100% CCTV coverage and lane closures. A dedicated LTC 24/7 TOS is to be provided with 1 crew stationed at the northern tunnel portal service building and 1 crew stationed at the southern portal service building. The tunnel will be controlled by the Tunnel Control Station (TCS) that will form part of the Regional Operating Centre (ROC) with dedicated operatives that will monitor and employ specific traffic and incident management plans. For information pedestrian crossovers are provided in the tunnels between bores. Doors locked unless remotely operated in the event of an incident. **Post meeting information provided by AO:** *The network performance criteria for detecting an incident in the tunnel and alerting the ROC is 10 seconds within the tunnel and 20 seconds on the wider LTC.*

	A free vehicle recovery service is to be provided for the tunnel that will cover NB LTC (EA1-NB to EA2-NB approx. 3.7miles) and SB LTC (EA21-SB to EA-22 approx. 3.5 miles). Bore closures may also be required. Public Announcement System (PAS) and radio-break-in broadcast are to be provided. *Subsequent to the meeting the tunnel team have confirmed that emergency telephone panels (EPs) are to be installed at 50m centres in the tunnel wall adjacent to lane 1. Additional telephones are to be installed at the cross-passage doors. The cross-passage doors are spaced at 150m centres – endorsed by SCRG*
General	The protocol around using the crossovers either side of the tunnel bores has not been established however the crossovers at the tunnel portal areas will be used for incident management and contraflow. Contraflow will only be operated in exceptional scenarios All accesses to LTC will have prohibition signing to prevent access for prohibited users. There are no restrictions on large and other authorized vehicles using LTC. The structures along the LTC route are designed to accommodate vehicles that comply with The Road Vehicles (Authorisation of Special Types) (General) Order (STGO): SV 80 (CAT 1 50 tonnes) SV 100 (CAT 2 80 tonnes) SV 196 (150 tonnes) The passage of Special Order vehicles on the LTC will be subject to existing SRN and local road Form of Notice to the Police, Highway and Bridge Authorities. Maintenance/traffic officer accesses will all be gated with provision to stop off carriageway in order to access them. Signs incorporated into Design Release 3.0 (the scheme being audited) only indicate the type of sign and location not the specific wording/destinations etc. LTC team have confirmed that they are satisfied that they can

	accommodate the signs. PP confirmed that the signing strategy has had no input from local authorities to date. A13/LTC junction does not cater for all movements. LTC SB to A13 WB; A13 EB to LTC NB; no west facing link roads. There are also some advisory speed limits.	
Lighting	Lighting inside the tunnel replicates the lighting conditions outside the tunnel to avoid sudden differences in illumination levels. **Post meeting information from AO – extract from the Combined Operations PCF:** *Light conditions outside the tunnel portals will be continuously monitored. The intensity of lighting within the tunnel will be automatically adjusted in accordance with the ambient light conditions outside the tunnel. The highest intensity of lighting in the tunnel will be provided during the daytime and the lowest intensity at night-time. The luminance level of light provided in the transition zone is gradually reduced to the required level in the interior zone* *The tunnel lighting system will be designed to minimise the contrast in lighting levels between the open road and the tunnel environment, regardless of time of day.* *Emergency lighting is to be provided in the tunnel that will provide a period of 2 hours of lighting in the event of a power failure.* *Strip lighting will be provided on the tunnel walls to assist evacuating tunnel users in finding their way towards an emergency exit door in reduced visibility conditions. The strip lighting will be illuminated in emergency incident conditions.*	
Road restraint	Road restraint details are not included in the drawings. PP confirmed that the road restraint modelling had just been completed and access to the CAD model would be provided to the RSA team.	PP
Printing	RSA team requested access to hard copies of some of the scheme drawings to minimize screen fatigue and help the team assimilate the varies elements of the scheme and	AO

	their interaction. AO confirmed that this would need LTC approval and to make enquiries.	
RSA Brief	The RSA Brief has not been signed off by Mark Bottomley but AO confirmed that MB happy to proceed at risk following discussions with David Cook.	
RSA CVs	AO confirmed that Mark Bottomley – Highways England Deputy Project Director and Matt Pilsbury approved the audit team's CVs.	
RSA report	RSA team requested access to the current report template. AO to upload this onto Teams. **Post meeting note**: *AO has uploaded the report template onto Teams*.	AO

Appendix E. Clarifications

E.1 Clarifications

E.1.1 Clarification 001

Clarification was sought regarding vehicle restraint systems. The digital models originally supplied did not include detail suitable for a stage 1 Road Safety Audit. Additional vehicle restraint system drawings, including suitable information, were supplied. The additional drawings are detailed in Appendix A Table A.3.

E.1.2 Clarification 002

Clarification was sought regarding pavements. The drawings supplied did not include information relating to skid resistance. While the drawings referred to either Appendix 7/1 and/or the 0700 (HPV) series contract specification, neither of these documents had been provided to the audit team.

In order to address the clarification, additional pavements drawings were supplied showing the surface PSV and AAV. The additional drawings are detailed in Appendix A Table A.3.

E.1.3 Clarification 003

Clarification was sought regarding potential missing road signing drawings. The drawings provided jump from HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00152 to HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00155. While a link to the drawing sets was supplied, this did not include signing details for the 'missing' section, immediately north of the northern tunnel portal.

It is understood that at the current stage of design no direction signs are proposed within the 'missing' section. This may be subject to change. All sign faces will be subject to detailed assessment as part of the Stage 2 Road Safety Audit.

Attachment 2.2.2 – RSA1 NH Designers Response

Lower Thames Crossing

Road Safety Audit Response Report

Stage 1 Road Safety Audit Design Release 3.0

DATE: 11/08/2020

VERSION: P01

Document control

Document no	HE540039-CJV-GEN-GEN-REP-DES-00101
Authors	Philip Paterson on behalf of the Design Organisation Adam Oredecki on behalf of the Overseeing Organisation
Owner	Philip Paterson
Distribution	Sandra Brown – Safer Roads Design Team, SES Mark Howes - Safer Road Design Team, SES Thomas Davies - A-road Concept Development Team, SES Matthew Rowdon - A-road Concept Development Team, SES Ron Thompson – Safety Risk Requirements Group, SES Matthew Pilsbury – Safer Roads Design Team, SES Eamonn Colgan – Tunnels Team, SES Gareth Protheroe – CASCADE Development Director Simon Beaney – CASCADE Delivery Director Highways South Jim Guild – CASCADE Delivery Director Highways North Keith Bowers – CASCADE Tunnels Director Brian Kenrick – CASCADE Tunnel Operations Lead Paviter Singh Phull – CDM Principal Designer Manager LTC Pre-Construction Information Tracker - PCI Tracker Alison Foale – Road Safety Audit Team Leader (Jacobs)
Document Status	SGAR3

Revision history

Version	Date	Description	Author

Reviewer list

Name	Role
Peter Franklin	LTC Operational Safety Lead
David Cook	LTC Head of Network Operations
Amelia Yeodal	Senior User Operations Directorate, South East
Sandra Brown	Safer Roads Design Team, SES
Mark Howes	Safer Roads Design Team, SES
Matthew Pilsbury	Safer Roads Design Team, SES
Ron Thompson	Safety Risk Requirements Group, SES
Matthew Rowdon	A-road Concept Development Team, SES

Approvals

Name	Signature	Title	Date of issue	Version
Mark Bottomley		Highways England LTC Deputy Project Director		P01

Lower Thames Crossing

Road Safety Audit Response Report

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1 Introduction

1.1 Project details

Table 1.1- Project details

Report title:	Road safety audit response report Stage 1 road safety audit design release 3.0
Date:	23/07/2020
Document reference and revision	HE540039-CJV-GEN-GEN-REP-DES-00101 Rev P01
Prepared by:	CASCADE
On behalf of:	Highways England

Table 1.2- Authorisation sheet

Project:	Lower Thames Crossing
Report title:	Road safety audit response report Stage 1 road safety audit design release 3.0
Prepared by:	
Name	Philip Paterson
Position	Highways Lead
Signed	[redacted]
Organisation	CASCADE
Date	23/07/20
Approved by:	
Name	Gareth Protheroe
Position	Development Director
Signed	[redacted]
Organisation	CASCADE
Date	11/08/2020

1.2 Stage 1 road safety audit

1.2.1 In accordance with the Project Control Framework (PCF) (Stage 3) and Design Manual for Roads and Bridges (DMRB) General Principles and Scheme Governance General Information GG 119 [1] a stage 1 RSA has been carried out for the Lower Thames Crossing (LTC) scheme engineering design release 3.0 (DR3.0).

1.2.2 The stage 1 RSA was carried out by independent auditors from Jacobs, May and June 2020. The stage 1 road safety audit report (document number 678379CH.TO.12.SO.OE/RSA1/P02 dated 13/07/2020) was submitted to the Overseeing Organisation 13/07/2020.

1.3 Road safety audit response report

1.3.1 This road safety audit (RSA) response report is based on the outlined template in appendix F GG 119 [1].

1.3.2 The representatives from the design organisation who prepared this road safety audit response report are listed in table 1.3.

Table 1.3 - Design Organisation key personnel

Name	Role
Gareth Protheroe	Development Director
Philip Paterson	Highways Lead

1.4 Key personnel to the road safety audit process

Table 1.4- Key personnel

Organisation	Personnel
Overseeing Organisation	Mark Bottomley – LTC Deputy Project Director David Cook – Head of Network Operations on behalf of the Overseeing Organisation Adam Oredecki – Operations Lead on behalf of the Overseeing Organisation Peter Franklin – Operational Safety Lead on behalf of the Overseeing Organisation Matthew Pilsbury - Senior Technical Advisor, Safer Roads Design, SES
Road safety audit team	Alison Foale – Team Leader (Jacobs) Kate Carpenter – Team Member (Jacobs) Daniel Harris – Team Member (Jacobs)
Design Organisation	Gareth Protheroe – Development Director Philip Paterson – Highways Lead

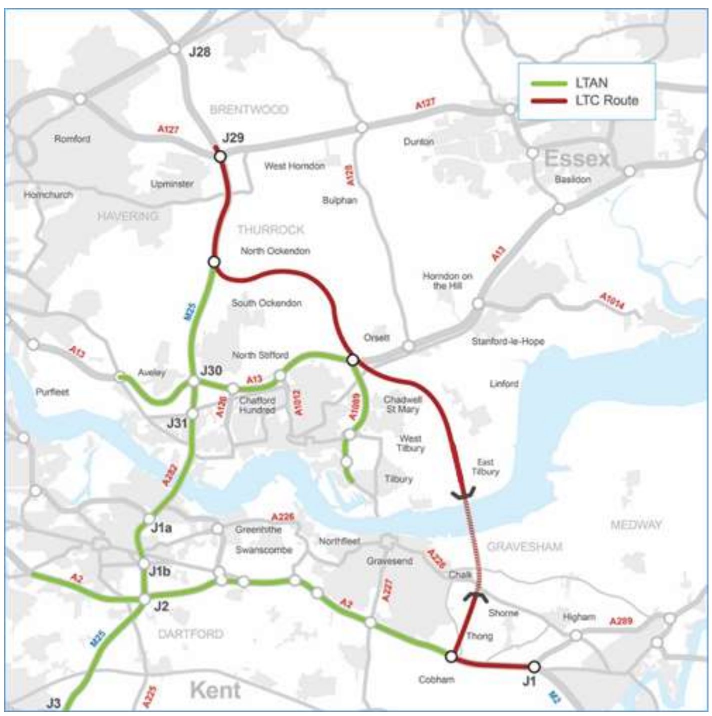
1.5 Project summary

1.5.1 The LTC is a proposed new GD 300 Level 3 scheme [2] connecting the A2 in Kent, Thurrock and the M25 in Essex through a tunnel beneath the River Thames with the following strategic objectives:

- to support sustainable local development and regional economic growth in the medium to long term
- to be affordable to government and users
- to achieve value for money
- to minimise adverse impacts on health and the environment
- to relieve the congested A282 Dartford Crossings and approach roads, and improve their performance by providing free-flowing, north-south capacity
- to improve resilience of the Thames crossings and the strategic road network
- to improve safety.

1.5.2 The route will form part of the English strategic road network (SRN) and will be coordinated with the wider Lower Thames Area Network (LTAN) as illustrated in Figure 1.1.

Figure 1.1 – LTC & LTAN



1.5.3 The LTC route is approximately 14.5 miles (23km) in length including the longest twin bore road tunnel (4.27km) on the SRN. The tunnel has one of the world's largest bore diameters.

1.5.4 The tunnel will pass beneath the River Thames with its southern portal located to the east of the village of Chalk, and its northern portal to the west of East Tilbury.

1.5.5 On the south side of the Thames, the new road will link the tunnel to the A2, M2 and local road network in Kent via a multi-level interchange with connector link roads.

1.5.6 At the northern extent of the scheme the new road will link with the M25 to the south of the existing J29 at a new motorway junction (J29a) with south facing slip road only. The creation of the new J29a will modify the existing M25 between J29 and J30. This link will retain its operating regime as controlled motorway and will be widened from 4 to 5 southbound lanes between J29 and a new J29a.

1.5.7 On the north side of the Thames the new road will link to the existing A13 via a multi-level interchange.

1.5.8 The A13 interchange will provide access to the local road network.

1.5.9 Due to the LTC route crossing tidal and fluvial flood plains the route to the north of the river will be elevated above ground level by use of embankments and viaducts.

1.5.10 Additional flood defences are proposed at the tunnel portals and approaches.

1.5.11 The LTC route and associated infrastructure works impact on existing WCH (walking cycling equestrian) routes. The scheme retains and improves WCH routes through the provision of green bridges, overbridges, underpasses and diverted routes.

1.5.12 LTC from J29a M25 to the LTC / A2 / M2 interchange will be designated as an all-purpose trunk road (APTR) and will operate as a GD 300 Level 3 scheme [2] with a controlled environment including:

LTC Mainline:

- Dual 3 lane (LTC/A2 junction to A13)
- 3 lanes northbound (A13-M25)
- 2 lanes southbound (M25-A13)
- no hard shoulders
- stationary vehicle detection (SVD)
- variable mandatory speed limits (VMSL)
- Red-X
- Provision of places of relative safety (PRS) including 22 mainline emergency areas
- variable message signs (VMS) and control signaling
- formal surveillance (CCTV)

LTC main crossing (Tunnel):

- 3 lanes in each bore
- no hard shoulders

- emergency walkways to nearside and offside carriageway in each tunnel bore
- stationary vehicle detection (SVD)
- variable mandatory speed limits (VMSL)
- Red-X
- provision of places of relative safety (PRS) – the design and operating procedures propose to create a PRS at the specific location where a road user has encountered difficulties (i.e. break-down, live lane stop)
- variable message signs (VMS) and control signaling
- stop system at the tunnel portals
- formal surveillance (CCTV)
- emergency telephones and
- cross bore passages

1.5.13 For operational purposes the design of the tunnel portal areas incorporates:

- carriageway cross-overs
- works access junctions with the LTC mainline
- places of relative safety (PRS)
- emergency / maintenance loop roads
- emergency services access links with the local road network (A226 at the southern portal, Station Road at the northern portal)
- authorised vehicle (i.e. Traffic Officer Service) turnaround areas and
- tunnel stop system at both northern and southern tunnel portals.

Traffic prohibitions (LTC mainline)

1.5.14 The LTC route is designed to operate without any heavy goods vehicle and dangerous goods vehicle (DGV) restrictions other than for the passage of abnormal loads.

1.5.15 Although it is proposed that the LTC route will operate as a GD 300 Level 3 scheme [2], the route will be subject to prohibitions:

- Prohibition of pedestrians, cyclists, equestrians
- Prohibition of slow-moving vehicles (i.e. agricultural vehicles, motorcycles less than 50cc)
- Prohibition of HGVs in Lane 3

1.5.16 A free-flowing charging system for passage through the tunnel is proposed, where drivers do not need to stop but pay remotely, similar to that at Dartford Crossing.

1.5.17 Additional emergency access provision and authorised vehicle turnaround facilities are provided to the LTC mainline from the local road network from Brentwood Road located to the north of the Thames.

1.5.18 WCH (walking cycling equestrian) routes are located in the vicinity of the LTC. The scheme retains these routes through the provision of green bridges, overbridges, underpass and diverted routes.

2 Road safety audit decision log

2.1 Road safety audit decision log

2.1.1 The decision log is provided at appendix A.

3 Design organisation and Overseeing Organisation statements

3.1 Design organisation statement

On behalf of the design organisation I certify that: 1) **the RSA actions identified in response to the road safety audit problems in this road safety audit have been discussed and agreed with the Overseeing Organisation.**	
Name:	Gareth Protheroe
Signed	
Position:	Development Director
Organisation:	CASCADE
Date:	11/08/2020

3.2 Overseeing Organisation statement

On behalf of the Overseeing Organisation I certify that: 1) **the RSA actions identified in response to the road safety audit problems in this road safety audit have been discussed and agreed with the design organisation.** 2) **the agreed RSA actions will be progressed.**	
Name:	Mark Bottomley
Signed	
Position:	LTC Deputy Project Director
Organisation:	Highways England
Date:	

References

Include all references shown in the document or delete this section if none

Title	Document number or date
Lower Thames Crossing GG 119 Stage 1 Road Safety Audit Report	678379CH.TO.12.SE.OE/RSA1/P02 (13/07/2020)
Design Manual for Roads and Bridges (DMRB) General Principles and Scheme Governance General Information GG 119 Road Safety Audit	Revision 2 January 2020
Design Manual for Roads and Bridges (DMRB) General Principles and Scheme Governance GD 300 Requirements for new and upgraded all-purpose trunk roads (expressways)	Standards current as at 1 June 2019

Abbreviations

Term	Explanation
ADS	Advance direction sign
ALARP	As low as is reasonably practicable
CCTV	Closed-circuit television.
Ch	Chainage
DCO	Development Consent Order
DfT	Department for Transport
DMRB	Highways England Design Manual for Roads and Bridges
DGV	Dangerous goods vehicle
EA	Emergency area
ERT	Emergency response telephone
FTP	Fixed taper point
HGV	Heavy goods vehicle
LTC	Lower Thames Crossing
LTAN	Lower Thames Area Network
MRS	Maintenance & Repair Statement
NSCRG	National safety control review group
ORA	Operational risk assessment
PCF	Highways England project control framework
PRS	Places of relative safety
PSV	Polished stone value
RAG	Red Amber Green coding
RSA	Road safety audit
SCRG	Safety control review group
SES	Safety Engineering Standards
SfR	Signaling for Roadworks
SGAR	Stage gate assessment review

Term	Explanation
SRN	Strategic road network
SVD	Stationary vehicle detection
TDSCG	Tunnel design safety consultation group
TRO	Traffic Regulation Order
TSRGD	The Traffic Signs Regulations and General Directions
TSM	Traffic signs manual
TTM	Temporary traffic management
VAID	Video automatic incident detection
VMSL	Variable mandatory speed limit
VMS	Variable message sign and control signaling
VRS	Vehicle restraint system
WCH	Walking cycling and horse-riding

Appendix A - Road safety audit decision log

Tables A.1 and A.2 uses a Red Amber Green (RAG) colour code to denote the status of a road audit problem:

RAG	Status
(Green)	RSA problem and recommendation accepted
(Amber)	RSA problem accepted with alternative recommendation / mitigation
(Red)	RSA problem rejected

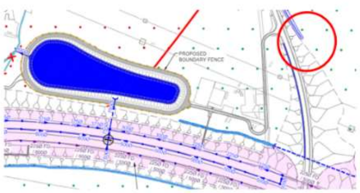
Table A.1 Road safety audit decision log summary

RAG	Status	Number
(Green)	RSA problem and recommendation accepted	55
(Amber)	RSA problem accepted with alternative recommendation / mitigation	6
(Red)	RSA problem rejected	2

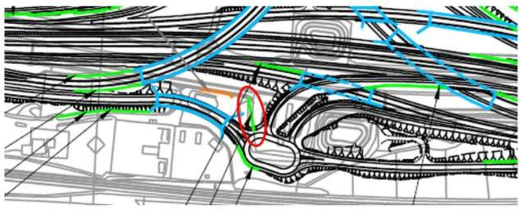
Table A.2 Road safety audit decision log

Note: Where, under the Agreed RSA actions, reference is made to the Design Organisation, this is the Design Organisation that will be engaged to undertake the detailed design.

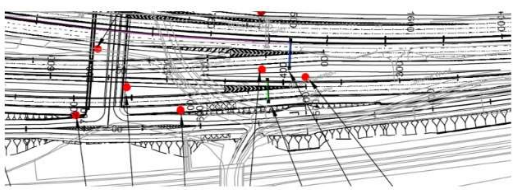
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
3.1.1 Visibility **Location**: Various **Summary**: Bridge structures/piers restricting visibility The bridge structure information provided for this RSA does not include details regarding the piers. At some locations, such as (but not limited to) the merges under the Thong Lane overbridge, the bridge piers and carriageway alignment may combine to restrict forward visibility to merges or vehicles downstream.	It is recommended that suitable forward visibility is provided around all bridge piers and that full details of bridge structures are provided for the Stage 2 RSA.	Accept the RSA problem and recommendation. The issue of forward visibility at bridge structures will be fully considered as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design • engage with the Overseeing Organisation in respect of the detailed design	
3.1.2 Visibility **Location**: Various **Summary**: Embankments and fencing restricting visibility	It is recommended that suitable forward visibility is provided from access roads where they connect to the local road network.	Accept the RSA problem and recommendation. The issue of forward visibility from access roads will be fully considered as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

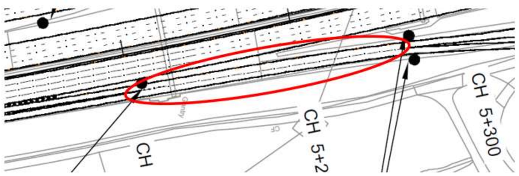
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Visibility from access roads may be restricted by the profile of adjacent embankments, restraint systems and fencing. An example of this is the access to the pond off Muckingford Road which runs parallel to the carriageway before joining it at a priority junction. Drivers on the access road may not be able to see a vehicle on Muckingford Road as they travel east off the overbridge increasing the risk of failure to giveway collisions. A further example of this is on the west side of Green Lane overbridge Ch 14 700.  FIGURE 3-1 – EXTRACT FROM PROPOSED DRAINAGE PLAN HE540039-CJV-HDG-SZP_DN000000_Z-DR-CD-00007					
3.1.3 Vertical alignment **Location**: Various **Summary**: Vertical alignment and general layout combine to create problems At some locations a combination of the vertical alignment and the general road layout combine in a way that could increase the risk of collisions. This includes, but is not limited to: • LTC southbound to M2 eastbound interchange link where a 5-6% gradient incline is provided on approach to the merge with the M2 eastbound. The merge taper starts under Thong Lane bridge and a combination of the	It is recommended that detailed modelling of visibility envelopes is undertaken to ensure that all drivers will have adequate visibility of manoeuvres and anticipate vehicle movements.	Accept the RSA problem and recommendation. Modelling commensurate with the preliminary design stage has been undertaken. Detailed modelling of visibility envelopes will be undertaken as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
gradient, structure, approach angle, signing (including a gantry east of the structure) and general complexity of the layout may increase the potential for confusion, late lane changes and collisions at the merge. • LTC southbound to A2 eastbound collector road, where the approach is on an extended 4% gradient to a merge on a crest just beyond the Thong Lane overbridge.  FIGURE 3-2 – EXTRACT FROM GENERAL ARRANGEMENT DRAWING HE540039-CJV-HML-S02_ML000000_Z-DR-CH-00050					
3.1.4 Vertical alignment **Location**: New roundabout south of the M2/A2/LTC junction **Summary**: Retaining structure restricting visibility Retaining structure RWN00000022 is located between the west and north arms of the new roundabout south of the M2/A2/LTC junction. From the information provided it is not clear if the retaining structure will restrict visibility to/from the two adjacent arms. Restricted	It is recommended that suitable forward visibility is provided around all retaining structures and that full details are provided for the Stage 2 RSA.	Accept the RSA problem and recommendation. The issue of forward visibility around retaining structures will be fully considered as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
visibility on approach to the roundabout and at the give way lines increases the risk of failure to give way and side impact collisions involving vehicles emerging onto the circulatory.  FIGURE 3-3 – EXTRACT FROM RETAINING WALL STRUCTURES DRAWING HE540039-CJV-SGN-SZP_STZZZZZZZZ-DR-CB-28072				respect of the detailed design	
3.1.5 Vertical alignment **Location**: Harlex Haulage access road and Park Pale Overbridge **Summary**: Vertical alignment of the access approach and overbridge impact visibility A new access road to Harlex Haulage is proposed on the outside of the bend to the north side of Park Pale overbridge. The approach road incorporates a 6% gradient. At the junction, visibility to vehicles travelling northbound over the bridge may be reduced due to the vertical alignment. The combination of approach gradient and reduced visibility could result in collisions at the junction involving vehicles emerging from the Harlex Haulage access road.	It is recommended that detailed modelling of visibility envelopes is undertaken to ensure that all drivers will have adequate visibility of manoeuvres and of the access location so they can anticipate vehicle movements.	Accept the RSA problem and recommendation. Modelling commensurate with the preliminary design stage has been undertaken. Detailed modelling of visibility envelopes will be undertaken as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
3.1.6 Vertical alignment **Location**: Emergency access road off Brentwood Road **Summary**: Vertical alignment of the access approach An emergency access onto the LTC southbound carriageway is provided off Brentwood overbridge. The gradient of the access road is 7.8%. Given the gradient and the potentially time dependent nature of those using the access there is an increased risk of loss of control and potential for vehicles to leave the carriageway where there is no restraint system resulting in collisions with LTC traffic. The access controls are not yet known in terms of location and form. They must be set back from the carriageway to allow eastbound vehicles on LTC to pull clear of the carriageway and stop before passing through the access control. This may place them in a location where they present a hazard to vehicle users on the access approaching LTC, or those travelling to the private properties on High House Lane.  FIGURE 3-4 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6	It is recommended that the location of and form of access controls to the emergency accesses are provided at stage 2 RSA.	Accept the RSA problem and recommendation. Access control details will be developed as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. Access controls affect core-responder target response times. Therefore, the development of the access control specification requires a consistent approach across the project.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
3.1.7 Horizontal alignment **Location**: A289/local collector road south of the A2 merge with LTC northbound **Summary**: Offside diverge An offside diverge is provided from the A289/local collector road, south of the A2, to the LTC northbound. Offside diverges are generally not recommended for safety reasons. Given the complexity of the junction the provision of an offside diverge increases the risk of lane change side impact collisions (particularly involving heavy goods vehicles moving to the offside lane) and collisions at the nosing.  FIGURE 3-5 – EXTRACT FROM DRAWING HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00151	It is recommended that the requirement for an offside diverge is reviewed and modelled. If the offside diverge is required, additional mitigation measures such as road markings, general signing and lane designation signing should be provided on the approach	Disagree with the RSA problem. Do not agree that an offside diverge has been provided. The diverge layout has been designed as a Type D2 (lane drop at parallel diverge) in accordance with TD22/06 with connection to the LTC being ahead and the A2 being the diverging carriageway. Although the predominant flow will be to the left vehicles have approaching 2km to get into the correct lane for the junction. There is no scope for reconfiguring the layout to provide the NB alignment from the left side. Additional mitigation measures can be provided at the detailed design stage if considered necessary.	Agree with the Design organisation that the proposed layout is not an offside diverge. Whilst the Type D2 is not a preferred option it is a permitted design in accordance with TD22/06. Advance direction signs with lane designation commencing at a distance of 1 mile upstream of the lane drop are being developed. This provides road users with instruction to follow the correct lane. Notwithstanding the above, the detailed design should consider the provision of any other proportionate mitigation. The detailed design for the A289/Local collector road south to LTC northbound and A2 westbound shall be submitted to stage 2 RSA.	The Design organisation shall: • be responsible for developing the design to current standards as part of detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.1.8 Horizontal alignment **Location**: M25 clockwise entry slip at junction 29 **Summary**: Potential weaving manoeuvres on the entry slip road	It is recommended that the requirements associated with segregated left slip lanes, in combination with merge requirements and	Accept the RSA problem and recommendation. The arrangements of the segregated slip road and the subsequent merge will be developed	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
A segregated left slip lane from the A127 onto the M25 clockwise has been provided at junction 29. The segregated left slip then develops into a lane gain while the off side lane merges onto the M25. Drivers exiting the roundabout using the off side lane may prefer to use the lane gain for ease of joining the M25 creating a short weaving section as drivers change lane, potentially resulting in side swipe collisions.  FIGURE 3-6 – EXTRACT FROM DIRECTION SIGNS LOCATION PLAN HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00164	modelling information of the slip road, are used to minimise the risk of lane changing on the entry slip road.	as part of the detailed design.	RSA.	design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.1.9 Horizontal alignment **Location**: Various **Summary**: Alignment of lane bifurcation There are a number of locations where the bifurcation of lanes appears to be more severe than expected which could result in more serious consequences in the event of late lane changing near the nosing. Examples of this are where the junction 29 link road diverges from LTC northbound and the A2 eastbound to LTC northbound.	It is recommended that the alignment of diverges and merges is revised to remove any sudden changes in alignment.	Disagree with the RSA problem. Bifurcations at junctions have been designed in compliance with TD22/06 Table 4/4 and TD39/94. Bifurcations at some locations require larger ratios due to site constraints. These layouts will, however, be reviewed and developed as part of the detailed design process.	The Overseeing Organisation concurs with the comments made by the Design organisation. The recommendation states “that the alignment of the diverges and merges is revised to remove any sudden changes in alignment”. However, the problem description states that “the bifurcation of lanes	The Design organisation shall: • be responsible for implementing a review with further development as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			appears to be more severe than expected ..” Although the Overseeing Organisation is unable to accept the recommendation based on an unqualified problem, the design of the merges and diverges should be reviewed and developed at the detailed design stage. The detailed design shall be submitted to a stage 2 RSA.		
3.1.10 Horizontal and vertical alignment **Location**: Tunnel, EA, crossover and A2 junction proximity **Summary**: Close feature spacing may result in late southbound lane changing between tunnel and A2, or within the tunnel. In the area between the southern portal and A2 junction a large number of potential conflicts occurs: • The absence of EAs in the tunnel maximises the likely discretionary use of the EA immediately south of the tunnel; this may cause drivers to brake to enter the EA and/or change lane to the nearside without warning, potentially colliding with other vehicles in shunts or side-swipes. • Drivers have a relatively short distance to make lane changing manoeuvres between	It is recommended that all of these aspects are specifically included in the detailed design of alignment; EA positions and forms; gantries; signs, lane markings and lane designations. Operational regimes, including lane control in the tunnel and link downstream, should also address these scenarios, aiming to minimise lane changing in the tunnel. Any collision in this location may cause extensive delays increase the likelihood of shunts	Accept the RSA problem and recommendation. All of the identified issues will be considered as part of the detailed design.	The Overseeing Organisation agrees with the problem associated with the proximity between the southern tunnel portal and the LTC / A2 e/b and w/b split. Operating regimes and incident management plans are being developed that will be integrated with the detailed design. The following comments are made in relation to each bullet point listed in the RSA problem description.	The Design organisation shall: • be responsible for developing the design as part of detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design The Overseeing Organisation and Design organisation shall be jointly responsible for developing associated	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
the tunnel and A2 junction, especially if they were not guided before the tunnel as to lane use. In addition, HGVs are likely to use nearside lanes regardless of downstream destinations, so will make lane changes to the offside between the portal and A2 junction. Left hand drive HGVs are impeded in visibility moving to offside lanes, and present a specific hazard increasing the likelihood of side-swipe collisions. • The rising longitudinal alignment rising from the tunnel and southbound alignment increases the likelihood of being dazzled by low sun especially in winter. In wet conditions, lane lines and any lane marking of lane designations will not be visible, and a film of water would add to the dazzle risk. This may lead drivers to drift out of their lane resulting in side-swipe collisions, and/or shunt vehicles ahead which slow suddenly due to flow breakdown. • When the crossover is in operation, and contraflow traffic is in the west bore, the crossover chicane positioned immediately south of the portal creates additional challenge for drivers. This may lead them to drift out of their lane resulting in side swipes, and/or be dazzled leading to shunt collisions while attending to route signs on gantries or nearside. • If a breakdown occurs in this section, queues are likely to extend back into the tunnel, which may lead to sudden lane changing to gain progress if queues are longer in some lanes than others. The uphill	further upstream and any resultant fire may have an additional adverse safety and accessibility impact on all users especially those with restricted mobility or visual impairment.		**First bullet point:** Whilst there are no formal EAs in the tunnel the Combined Operations PCF and tunnel operational risk assessment (ORA) introduce enhanced operating procedures and systems (e.g. vehicle detection, VAID plus secondary incident detection system (e.g. radar), CCTV, VMSL, lane signalling on approach to and through the tunnel, lane and bore closure protocols, public announcement, ventilation system, ERTs, dedicated Traffic Officer service and free vehicle recovery between portal to portal). The ORA has been developed in consultation with the TDSCG. Engagement with the TDSCG will continue during detailed design and handover into operation and maintenance. The ORA (v0.7) was endorsed by SCRG at	operating procedures and systems.	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
gradient on tunnel exit, combined with drivers emerging into bright sunlight after the relatively darker tunnel may result in misjudgement and side-swipe collisions. Lighting specification is to match external lighting but a disparity is still likely in bright sunlight. This is an additional issue for larger slower moving vehicles including left hand drive vehicles changing lane to the offside for A2/M2 east due their poorer visibility. Drivers changing lane in the tunnel (where direction signs are not included) may not remember the counter-intuitive arrangement where the right-hand lane turns left (to the west) and the left-hand lane turns right (to the east). They may therefore change lanes again when they see the first signs (verge mounted or gantry mounted) downstream of the tunnel portal increasing the likelihood of shunts and side-swipes. Sign designs, destinations and lane designations are not yet known; careful design including liaising with local highway authorities will be essential to mitigate these hazards. Signing upstream of the tunnel may be able to provide lane use information for destinations downstream of the tunnel, but HGVs are likely to remain in nearside lanes and change lanes downstream of the tunnel section.			meeting #19 07 April 2020. Development is ongoing in respect of informing road users how to drive through the tunnel and what to do in the event of an incident. The EAs located to the south of the tunnel portal are located on a gradient greater than 2% and were endorsed by SCRG at meeting #22 02 July 2020. **Second bullet point:** The RSA team refer to HGVs making lane changes to the offside. Where LTC operates with three lanes the third lane will be subject to a HGV prohibition. HGVs would only travel in lanes 1 and 2. Due to forecast LTC to A2 e/b and LTC to w/b traffic flows the operating regime is to: • ensure that traffic is permitted to use all three lanes in the tunnel (apart from HGVs in lane 3)		

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			• minimise overtaking in the tunnel and therefore it is not proposed to provide: ○ ADS and lane designation signs within the tunnel ○ lane designation signs upstream of the tunnel portal (except in incident conditions) The current proposals provide a lane drop with lane designation commencing after the southern portal exit. It is understood from the Design organisation that the proposed configuration is design compliant. In respect to the RSA comment relating to left hand drive vehicles changing lanes, this would apply to all links / junctions on the LTC and wider SRN. However, the RSA report did not raise this as a problem at any other location where lane changing may occur.		

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			Third bullet point: Agree with the Design organisation as the detailed alignment will determine required mitigation. **Fourth bullet point:** The contraflow will only operate during exceptional events where a tunnel bore is closed for a long duration of time. The cross over will operate as a single lane under temporary traffic management measures supported by a controlled environment (reduced speed limits, lane signalling) that includes both northbound and southbound carriageways on approach to and through the tunnel. During contra flow running the operating regime proposes a single lane in each direction with the middle lane (lane 2) functioning as a safety buffer zone. The development of the operating regime is ongoing.		

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			Fifth bullet point: The operational safety regime for the tunnel is to minimise the probability of queues extending back into the tunnel and to avoid traffic congestion in the tunnel. LTC operates within a controlled environment that will be used to manage and respond to live lane stops including lane and tunnel bore closure. The detailed design shall be submitted to a stage 2 RSA.		
3.2.1 General **Location**: Scheme wide **Summary**: Stopped up roads In order to construct the LTC scheme there are existing roads that need to be stopped up, such as Hornsby Lane. If stopped up roads are not clearly signed and turning heads provided (for drivers following outdated satellite navigation systems) it could increase the potential for collisions involving turning vehicles and result in large vehicles on inappropriate roads as they navigate around the LTC carriageway.	It is recommended that all stopped up roads are clearly and widely signed (provide full signing details for the Stage 2 RSA) and that turning heads are provided.	Accept the RSA problem and recommendation. Stopped up roads will be signed as part of the detailed design and where appropriate turning heads provided.	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design • engage with the Overseeing Organisation in respect of the detailed design	
3.2.2 General **Location:** Overbridges **Summary:** Vehicles stopping on bridges	It is recommended that suitable parking or clearway restrictions are incorporated on the	Accept the RSA problem and recommendation. Appropriate restrictions will be incorporated	The DCO powers include the provision for restrictions (e.g. clearway, stopping restrictions	**Design:** The Design organisation shall be responsible for incorporating	

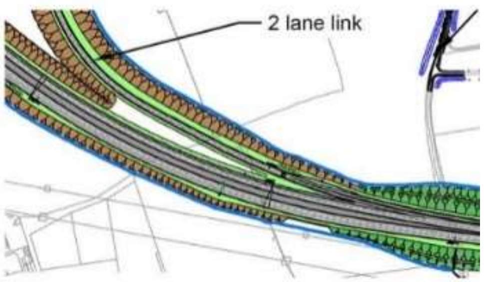
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Overbridges are provided throughout the scheme. There is potential that these bridges, particularly those with views of interest to the public (such as the tunnel portals) and large green spaces (such as the wide 'green bridges') could result in vehicles stopping on the overbridge carriageways. This increases the risk of rear shunt type collisions and collisions involving vehicles re-entering the carriageway if they are able to park on the adjacent verges/hard standings.	overbridges and that these are adequately marked and signed. Highways England should request that enforcement is undertaken.	within the detailed design.	within emergency areas) on the LTC route. The DCO powers, at this stage, do not include powers for restrictions / prohibitions on local road network overbridges apart from Thong Lane over the A2. Due to the proposed DCO submission date there may not be an opportunity to assess and incorporate additional powers prior to DCO as agreement with local highway authorities would need to be obtained. The LTC DCO & Planning Team has confirmed that there would be an opportunity to introduce restrictions post-DCO, using traffic regulation powers in the DCO, prior to the expiry of 24 months from the opening of the authorised development (i.e. the project). The second part of the RSA recommendation relates to Highways England requesting that enforcement is	appropriate restrictions within the detailed design with subsequent submission to stage 2 RSA. **Enforcement:** The Overseeing Organisation shall be responsible for including a protocol to request that enforcement is carried out on the SRN within the Combined Operations (PCF) Compliance Strategy. **Post-DCO processing of traffic regulation orders:** If traffic regulation orders are required on the local road network post-DCO (within 24 months of opening of the project road), the Overseeing Organisation will have powers to implement the appropriate orders subject to consultation with the relevant local highway authority.	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			undertaken. Whilst Highways England may request that enforcement is undertaken this would only apply to the SRN and not the local road network. The detailed design shall be submitted to a stage 2 RSA.		
3.2.3 Cross section **Location**: Various **Summary**: Opposing headlights. There are a number of locations where farm/maintenance access tracks run parallel to the LTC, for example the access track from North Road, or the A13 interchange loops. During the hours of darkness or low visibility a vehicle using a parallel route in the opposite direction to the adjacent LTC carriageway may result in drivers being dazzled or confused, increasing the risk of sudden braking and rear shunt type collisions or loss of control.	It is recommended that screening is provided to minimise glare from opposing headlights.	Accept the RSA problem and recommendation. Appropriate screening will be developed as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design.	
3.2.4 Cross section **Location**: A289 southbound merge with M2 southbound at Junction 1 **Summary**: Level differences At present there is a substantial, unprotected level difference between the A289 southbound merge carriageway and the M2 southbound carriageway. The proposed scheme includes four lanes and no hard shoulder adjacent to the	It is recommended that the current unprotected level difference is removed and road restraint provided.	Accept the RSA problem and recommendation. This issue has subsequently been resolved. The alignment of the on-slip has been revised to minimise this level difference with any residual level difference	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
level difference at the merge on the M2. If the level difference remains there is an increased risk of vehicles overturning into the A289 southbound merge if they leave the M2 carriageway from the nearside lane at this location.		behind the nose being accommodated with sections of concrete barrier / smooth faced retaining wall.		• engage with the Overseeing Organisation in respect of the detailed design	
3.2.5 Landscaping **Location:** Landscaped areas **Summary:** Accessing landscaped areas. Throughout the scheme there are areas that are likely to be landscaped but are enclosed by carriageways, for example at the A13 and A2 interchanges and where the LTC splits to join the M25. No obvious access arrangements have been identified for some of these areas which may result in operatives stopping on verges increasing the risk of rear shunt collisions as they slow to negotiate kerbs or as they re-join carriageways. There is also a risk that landscaped areas are not maintained and over time encroach into visibility splays. This may result in failure to give way or rear shunt type collisions if full visibility splays are not achieved.	It is recommended that accesses to landscaped areas are provided and the landscaping details provided at stage 2 RSA.	Accept the RSA problem and recommendation. Access arrangements to all landscaped areas will be developed as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design • engage with the Overseeing Organisation in respect of the detailed design	
3.2.6 Emergency Areas **Location:** Emergency areas (EAs) **Summary:** Restricted forward visibility to and from EAs. Forward visibility to a number of the EAs appears to be restricted by preceding structures, embankments and carriageway alignment. Reduced forward visibility could result in drivers missing the provision entirely, potentially	Undertake detailed modelling of visibility to determine drivers' view on approach, both physical sightlines to EAs and to assess whether bridge structure will reduce conspicuity of the EA. For example, in early morning	Disagree with the RSA problem. Modelling has been carried out to ensure sufficient visibility to and from EA locations throughout the scheme. Verge and central reserve widening have	Whilst the Overseeing organisation agrees with the problem, the Design organisation response confirms that the problem has now been resolved.	The Design organisation shall: • be responsible for implementing a review of the proposals as part of the detailed design including submission to stage 2 RSA	

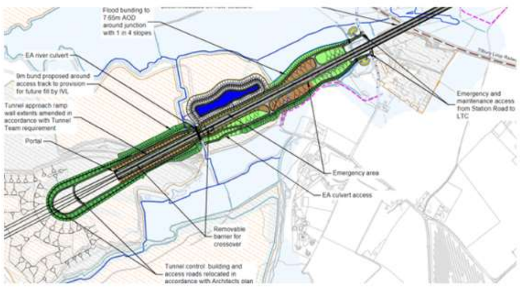
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
resulting in a live lane stop, and an increased risk of rear shunts. Examples of this include: • An EA is provided on the northbound LTC diverge loop road. The tight horizontal alignment may result in drivers not having sufficient forward visibility to locate and negotiate into the EA.  • The EA provided on the LTC northbound carriageway (Ch 19 000) may be obstructed by the preceding North Road overbridge structure and embankments.	on sunny days whether the bridge would cast a shadow affecting conspicuity of the EA. It is recommended that the position of the EA on the loop road at the A13/LTC interchange is relocated downstream of the loop, maintaining the required spacing between EAs. It is recommended that where EAs are located behind features that obscure forward visibility that they are relocated to where appropriate forward visibility is achieved.	been implemented on tight radii to ensure visibility is maintained. On loop link roads the internal area has been flattened and landscaping restricted to ensure full visibility around the loop for drivers. Having said this, the issue is one that will be revisited as part of the detailed design.		• engage with the Overseeing Organisation in respect of the detailed design	
3.2.7 Emergency areas **Location:** Emergency areas (EAs) **Summary:** EA specification There are some inconsistencies in EA layout throughout the scheme. For example, the EA at the southern tunnel portal is the only one to incorporate orange surfacing. This inconsistency could result in driver indecision, sudden braking and rear end shunts and side swipe type collisions.	It is recommended that the current EA specification is used and that details of the proposed EAs are provided at Stage 2 RSA to demonstrate clarity and consistency to drivers	Accept the RSA problem and recommendation. Any inconsistencies shown will be addressed in the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. LTC is designed as a GD 300 Level 3 scheme. Further to discussions with A-road Concept Development Team, SES, all EAs shall have	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design • engage with the Overseeing Organisation in	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			standard black/grey surfacing.	respect of the detailed design	
 FIGURE 3-8 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6 **3.2.8 Emergency areas** **Location:** Emergency areas (EAs) **Summary:** Areas of hardstanding within EAs. Some of the EA layouts incorporate an area of hardstanding. The drawing extract below (Ch 11+100) illustrates an area of hardstanding that appears to be associated with access steps to the adjacent drainage ditch. If this is for maintenance purposes then this is likely to increase the usage of the EA. There is an increased risk of conflict with other vehicles as drivers decelerate to enter the EA and as they merge to re-join the carriageway resulting in rear end shunts and late lane changing type collisions.	Ensure that the relative risks for road users and workers is not increased due to the hazards associated with vehicles entering and leaving the EA. This may include the provision of alternative maintenance access using the local road network.	Accept the RSA problem and recommendation. The interaction between use of these areas as an EA and for maintenance purposes will be considered as part of the detailed design.	The use of combined emergency areas (EA) /maintenance hard standings (MHS) is an accepted design solution (MPI-11, MPI-66). MPI-11 sets out the safety benefits associated with the provision of combined EA/MHS. In the context LTC the MHS element of the combined EA/MHS will be primarily used for planned maintenance activities. Access and egress by maintenance vehicles will be undertaken in a controlled manner that may include support from the Regional Control Centre (ROC) – lane signalling, VMSL, EA-VMS, lane closures. Maintenance vehicles accessing the combined EA/MHS are required to activate flashing beacons in advance of the accessing the EA/MHS. Authorised use of the MHS will be subject to risk assessment.	The Design organisation shall: • be responsible for developing maintenance access provision as part of the detailed design having due regard to prevailing design standards & guidance (notably MPI-11 and MPI-66). The detailed design to be submitted to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design The Overseeing Organisation shall further develop maintenance access protocols.	

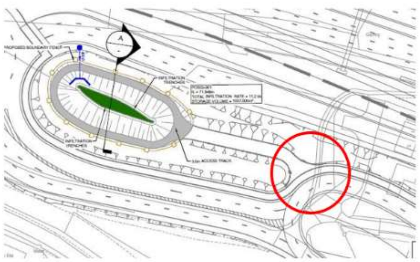
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			Development of maintenance access protocols is ongoing. The detailed design shall be submitted to a stage 2 RSA.		
3.2.9 Emergency areas **Location:** Emergency areas (EAs) **Summary:** EAs close to conflict points  Several EAs are located on slips close to merge points, creating potential for conflict between vehicles leaving an EA and passing vehicles; any incident may result in vehicles and/or debris entering the mainline carriageway. An example is the slip road from A13 westbound to LTC southbound, on which the downstream end of the EA is downstream of the merge nose where the slip meets LTC.	It is recommended that EAs are positioned away from conflict points.	Accept the RSA problem and recommendation. The final positions of all EAs will be determined during detailed design with a view to avoiding conflict points. The preliminary positioning of the EAs on slip roads has been provided in accordance with GD 300 and IAN 161/17.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.10 Access **Location:** Emergency accesses	It is recommended that emergency and maintenance accesses	Accept the RSA problem and recommendation.	The Overseeing Organisation concurs with	The Design organisation shall:	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
 FIGURE 3-10 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 6 **Summary:** Connections from private means of accesses which have diverge/merge tapers. The emergency access on the west side of Brentwood overbridge is in close proximity to an EA increasing the scope for uncertainty e.g. a vehicle indicating left to enter the access may appear to be indicating to enter the EA, especially as at this location cutting slope adjacent to the access appears to constrain access to and from mainline.	don't look like junctions and that the mainline drivers' view through structures to access points is checked to ensure that visibility to/from the access is not constrained by cutting slope.	These accesses will be detailed not to look like junctions and visibility will be considered as part of the detailed design.	the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	• be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.11 Access **Location:** Emergency accesses **Summary:** Mis-use of maintenance accesses as short cuts to LTC Without suitable security measures the emergency accesses throughout the scheme could be used as short cuts to join the LTC. Vehicles would then join the mainline carriageway via short merge tapers resulting in late lane changing, sudden braking and rear shunt type collisions. This also applies to the access off the A226 to the top of the southern tunnel portal.	It is recommended that suitable measures such as CCTV, signing and access control to discourage general access are provided, while maintaining access for authorised vehicles.	Accept the RSA problem and recommendation. Access control will be included and will be developed as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. Access controls affect core-responder target response times. Therefore, the development of the access control specification requires a consistent approach across the project.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in	

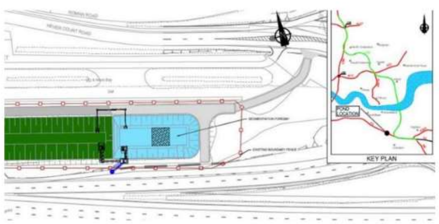
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
				respect of the detailed design	
3.2.12 Emergency and maintenance access **Location:** North of northern portal **Summary:** Potential for illegal access and/or collisions involving authorised vehicles. In addition to the general issue of emergency access described above, a combination issue exists regarding the turnaround facility at the northern end of the tunnel. This combines access and egress to both LTC carriageways; access to the tunnel service building; maintenance access to a pond and possibly farmland (different details on different drawing sets). Details of access control, from LTC route to and from Station Road, is not yet finalised so it is unclear how unlawful access will be prevented and authorised access made effective. This location contains a number of interconnected hazards: • Gaps in VRS at apparent high level differences may result in injury to occupants of authorised or other vehicles; • Potential for deliberate or unintentional access between LTC and Station Road, to bypass tolling points (unknown location); correct error in route or other reasons may result in collisions at connections to LTC route; • Cutting slopes conceal access to southbound carriageway which may cause	It is recommended that all of these aspects are specifically considered in the detailed design of alignment; tracks and junctions; gantries; signs, lane markings and lane designations.	Accept the RSA problem and recommendation. All of these issues will be considered in the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The development of operating regimes / protocols associated with the northern tunnel portal loop road including the Station Road emergency access is ongoing. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
shunts when vehicles slow to enter, or side impacts when they emerge; • Dual loop for turnaround/tunnel service but visibility and detailed layout including VRS is not yet known. Potential for poor visibility for vehicles emerging at junction between the northern part of the loop and vehicles on the southern part may result in collisions between authorised or other vehicles;  FIGURE 3-11 – EXTRACT FROM GA DRAWING HE540039-CJV-HML-S09_ML000000_Z-DR-CH-00010 • Accesses to drainage/farm land may prevent control of public access (note apparent difference between drawing sets)					
3.2.13 Emergency and maintenance access **Location:** Maintenance accesses **Summary:** Lack of turnaround facility. There are a number of access tracks to ponds, structures and technology assets that don't incorporate a turnaround facility, for example immediately south of the LTC/A2 interchange and the access off the A226 to the tunnel southern portal. This increases the risk of	It is recommended that turnaround areas that can accommodate the largest expected vehicle to the asset/feature are provided.	Accept the RSA problem and recommendation. Turnaround facilities have been identified within the preliminary design where there could be an impact on the Order Limits. Detailing of all of these facilities will be	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA	

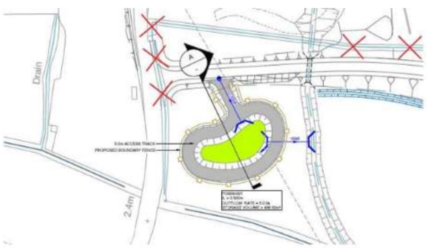
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
conflict between vehicles trying to manoeuvre in confined areas resulting in low impact collisions.		undertaken as part of the detailed design.		• engage with the Overseeing Organisation in respect of the detailed design	
3.2.14 Maintenance access areas **Location:** Maintenance access areas **Summary:** Mis-use of maintenance areas. There are a number of areas of hardstanding throughout the scheme that appear to be maintained. These could be abused by drivers, increasing the risk of collisions as vehicles slow to access them and when they merge back into the carriageway resulting in late braking, rear shunts and side swipe type collisions. An existing example of this is on the northside of junction 29 of the M25 as shown in the photo below. 	It is recommended that where these are not necessary they are removed or that they are amended to avoid looking like laybys or junctions.	Accept the RSA problem and recommendation. These locations will be considered as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.15 Maintenance access areas **Location:** Access to ponds **Summary:** Position of gates.	It is recommended that sufficient room is provided for vehicles to pull into the access to avoid blocking	Accept the RSA problem and recommendation. The detailed design will make adequate provision for vehicles to	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA recommendation as	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Access to the pond located between Henhurst Road and the LTC/A2 interchange is off the circulatory carriageway of the Henhurst Road roundabout. No information is provided regarding access arrangements. If gates are located close to the back of the footway there is a risk that vehicles intending to enter the site will extend out into the circulatory carriageway while operating the access controls, resulting in rear shunts and late lane changing collisions. This situation occurs at a number of other locations including the pond access in problem 3.2.21 where the position of the gates will result in a vehicle extending onto the carriageway and across the footway.  FIGURE 3-13 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S02_PON0000001-DR-CD-00001	the carriageway or footway.	pull off the main carriageway at gates or other control measures.	The detailed design shall be submitted to a stage 2 RSA.	part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.16 Maintenance access areas **Location:** Public footpath FR 136 (Ch 17+300) **Summary:** Suitability of access to pond. Public footpath FR 136 appears to provide access to a pond on the west side of LTC. It is not clear if the public right of way (PRoW), which passes over the LTC via an overbridge, is	It is recommended that the suitability of the PRoW as a form of access for the pond is clarified or an alternative provided.	Accept the RSA problem and recommendation. However, this PRoW is also a proposed farm access track across LTC and suitable for vehicle access. It has been	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including	

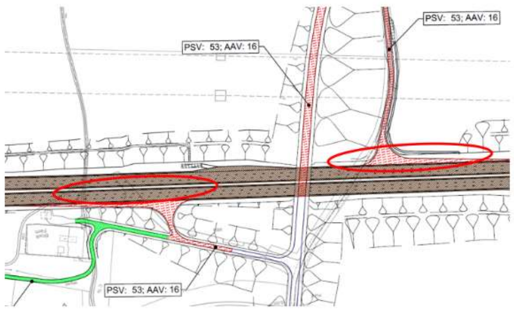
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
suitable for vehicular access in terms of vehicle restraint and vertical profile. A maintenance bay is proposed at the top of the embankment in close proximity to the bridge structure which could result in vehicles trying to manoeuvre in a confined area resulting in low impact collisions and potentially in conflict with pedestrians, cyclists and equestrians.  FIGURE 3-14 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S12_PON0000002-DR-CD 00002		assessed and designed to be used by National Grid to access their pylons with large vehicles and is considered to be a suitable access road. The location of maintenance bays will be further refined at detailed design.		submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.17 Maintenance access areas **Location:** Various **Summary:** Access to ditches. There are a number of ditches indicated on the drainage drawings but it is not clear how these will be maintained, particularly where they are behind vehicle restraint, e.g. near North Road and at the LTC/A13 junction. If maintenance access is not provided there is an increased risk of collisions involving maintenance vehicles	It is recommended that maintenance access is provided to ditches where required, avoiding any gap where a vehicle might enter the ditch if they leave the carriageway, for example swerving to avoid another vehicle changing lane without warning. If vehicular access is provided, incorporate turnaround	Accept the RSA problem and recommendation. Maintenance access to ditches will be provided in the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in	

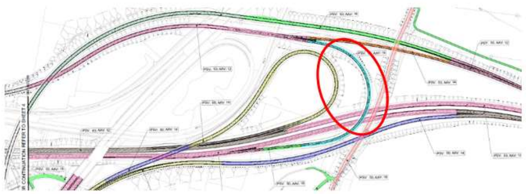
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
slowing down to leave the carriageway or if parking in verges or other unsuitable locations.  FIGURE 3-15 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-SZP_DN000000_Z-DR-CD-00009	areas that can accommodate the largest expected vehicle to the asset/feature.			respect of the detailed design	
3.2.18 Maintenance access areas **Location:** Maintenance access roads to ponds **Summary:** Proximity to Hever Court Road roundabout.  FIGURE 3-16 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S02_POE000001-DR-CD-000001 The increased size of the Hever Court Road roundabout has resulted in the access to an existing pond being located closer to the roundabout. This reduces the available forward visibility for drivers of vehicles exiting the roundabout to observe the access and vehicles entering or leaving it. There is an increased risk of rear shunts as vehicles slow to turn into the access and failure to give way collisions as vehicles re-join the carriageway.	It is recommended that an alternative design for the access is provided which has appropriate visibility for approaching drivers.	Accept the RSA problem and recommendation. Agree that the distance between the roundabout exit and the access point has reduced. The likelihood of this risk being realised is very low due to the very infrequent use of the access. The access point could be modified during detailed design and relocated to the west and combined with the other existing dropped crossing.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

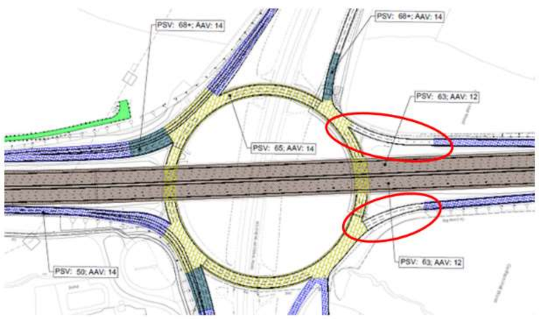
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
3.2.19 Maintenance access areas **Location:** Access roads to ponds, culverts and ditches. **Summary:** Mis-use of maintenance areas There are a number of maintenance accesses to ponds, culverts and ditches off connector roads and hard shoulders and these may be seen as additional refuge areas by drivers either in the event of an emergency or for a discretionary stop. This increases scope for rear shunt type collisions when vehicles slow to use the access and re-join the carriageway and general mis-use in the event of a breakdown. Examples include: • LTC CH 3 300  FIGURE 3-17 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S12_PON000001-DR-CD-000001 • Access to Culvert MNN0000001 from the connector road north of the east-west A2 carriageway.  FIGURE 3-18 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S02_POE000001-DR-CD-000001	It is recommended that detailed modelling of visibility envelopes is undertaken to ensure that all drivers will have adequate visibility of manoeuvres and of the access location so they can anticipate vehicle movements.	Accept the RSA problem and recommendation. Modelling commensurate with the preliminary design stage has been undertaken. Detailed modelling of visibility envelopes will be undertaken as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.20 Maintenance access areas **Location:** Access tracks at proposed ponds	It is recommended that access by the largest anticipated vehicle is	Accept the RSA problem and recommendation.	The Overseeing Organisation concurs with	The Design organisation shall:	

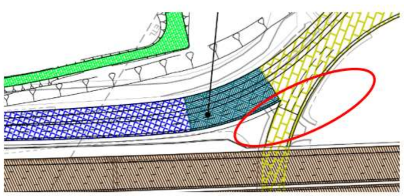
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Summary: Width and alignment of access tracks. Access tracks are shown alongside or around the perimeter of a number of the proposed ponds. The tracks vary in width, can have relatively tortuous alignments and are bounded to the rear by fencing. It is not clear if maintenance vehicles will be able to negotiate these tracks, potentially resulting in an incursion into the water feature and injury. If no access controls are provided they may also be used by public vehicles seeking a convenient off road stopping location for a rest break. This may similarly result in incursion, particularly at night and especially for drivers unfamiliar with the location which will not be lit.  FIGURE 3-19 – EXTRACT FROM DRAINAGE DRAWING HE540039-CJV-HDG-S09_PON0000001-DR-CD-00001	assessed, that any fencing does not impact on the usable width and access controls are provided to prevent use by unauthorised vehicles.	Access tracks will be designed to cater for the largest anticipated vehicles in detailed design, with appropriate fencing and control measures.	the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	• be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.21 Skid Resistance **Location:** Scheme wide **Summary:** Suitability of proposed pavement surface skid resistance. There are locations where the suitability of the proposed pavement surface skid resistance may	It is recommended that pavement surfaces with adequate skid resistance are provided throughout and full details of pavement surface tie in	Accept the RSA problem and recommendation. Pavement surfaces with adequate skid resistance will be developed in the	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed	

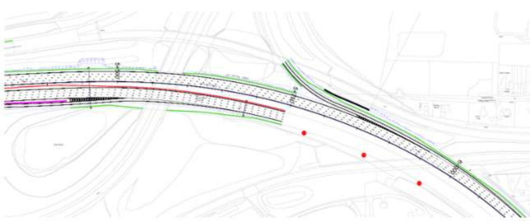
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
not be adequate or is unclear. This includes, but is not limited to: • Horford Road overbridge, which includes gradients of 8% and has a proposed pavement surface PSV of 50; and • tie in locations to existing carriageways, where the existing pavement surface PSV is unknown. The provision of pavement surface with inadequate PSV or an unsuitable tie in arrangement increases the potential for differing skid resistance and loss of control collisions, particularly if the road surface is wet. See covering letter for further explanation of this issue and drawing inconsistencies regarding pavement proposals.	arrangements are provided for the Stage 2 RSA. No diagonal joints, or longitudinal joints within lanes should be provided. Position transverse joints away from locations of heavy braking and steering, for example at junctions.	detailed design and joints detailed in accordance with good practice.	RSA.	design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.22 Skid Resistance **Location:** Brentwood Road overbridge emergency access links **Summary:** Pavements with differing skid resistance properties in braking areas Pavements with differing skid resistance are provided on the LTC mainline carriageway (PSV 63) and the Brentwood Road overbridge emergency access loop diverges. While these areas are not designed as EAs, it is likely they could be used by motorists in the event of an incident.	It is recommended that pavements with consistent skid resistance properties are provided in all locations where heavy braking may occur.	Accept the RSA problem and recommendation. Pavements with consistent skid resistance properties will be included within the detailed design in areas where they may be heavy braking.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Pavement surfacing with differing skid resistance, in a location that could be subject to heavy braking with vehicles straddled across different pavement types, increases the risk of loss of control collisions. This is exacerbated when the carriageway is wet.  FIGURE 3-20 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00023					
3.2.23 Skid Resistance **Location:** Various **Summary:** Pavement surface skid resistance. Pavement surfaces with lower skid resistance, compared to other sections, are provided on some of the junction loops/connector roads. This includes, but is not limited to the: • loop between the A1089 and LTC southbound carriageways, where a pavement with a PSV value of 55 is provided. This compares to a PSV value of 65 on the LTC northbound to A13 eastbound loop;	It is recommended that pavement surfaces with adequate and consistent skid resistance for the carriageway radii/movement are provided throughout.	Accept the RSA problem and recommendation. Pavement surfaces with adequate and consistent skid resistance properties will be included within the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

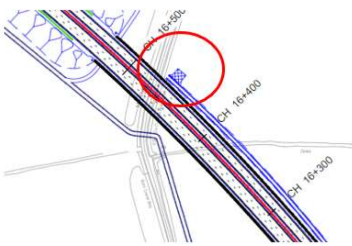
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
 FIGURE 3-21 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00026 SHOWING THE A1089 AND LTC SOUTHBOUND LOOP • The connecting link between the Gravesend local road and the A2 eastbound carriageway, where a pavement with a PSV value of 50 is provided; and  FIGURE 3-22 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SSP_ML000000_Z-DR-CH-00023 SHOWING THE CONNECTING LINK BETWEEN THE GRAVESEND LOCAL ROAD AND THE A2 EASTBOUND • The new/revised approach to the Brewers Road/Thong Lane/Halfpence Lane roundabout which includes 65 PSV pavement surface that reduces to 50 PSV pavement surface at the tightest radii. While the above radii are not as tight as others, the long sweeping nature, ability to carry speed and change in skid resistance increases the risk of loss of control collisions and vehicles leaving the carriageway. This is particularly relevant to motorcycles and could be exacerbated when the surface is wet.					

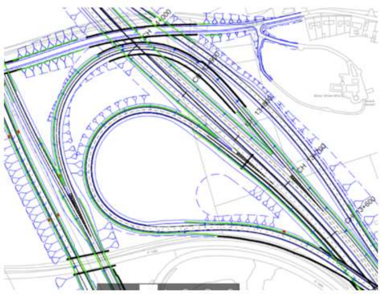
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
3.2.24 Skid Resistance **Location:** M25 Junction 29 **Summary:** Poor condition of existing pavement surface. New pavement is not specified where the northbound merge and diverge arms join the M25 Junction 29 circulatory. Street view mapping indicates these areas are worn and likely to have a reduced skid resistance at present. At these locations this could result in loss of control collisions, particularly when the surface is wet. The southbound diverge approach is of particular concern given the  FIGURE 3-23 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00033 volume of vehicles, downhill gradient on approach to the stop line and close proximity of the new access/egress for the industrial area.	It is recommended that pavement surfaces with adequate skid resistance are provided where the northbound merge and diverge arms join the M25 Junction 29 circulatory.	Accept the RSA problem and recommendation. Pavement surfaces with adequate and consistent skid resistance properties will be included within the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.25 Skid Resistance **Location:** M25 Junction 29 dedicated left turn lanes	It is recommended that pavements with adequate skid resistance and consistent appearance	Accept the RSA problem and recommendation. Pavement surfaces with adequate skid	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Summary: High PSV (68+) pavement surface provided. Dedicated left turn lanes are provided for movements from the A127 westbound to M25 Southbound and M25 northbound to A127 westbound. It is proposed that high PSV (68+) pavement surface is provided on the diverge arm approaches to signal stop lines and the equivalent length of the dedicated left turn lane. If the high PSV pavement surface is a contrasting colour (as per the existing arrangement), this could result in hesitation, braking and rear end shunts as vehicles slow or stop for a non-existent stop line within the dedicated left turn lane.  FIGURE 3-24 – EXTRACT FROM PAVEMENT PSV DRAWING HE540039-CJV-HPV-SNP_ML000000_Z-DR-CH-00033	are provided through the dedicated left turn lanes.	resistance and consistent appearance will be included within the detailed design.	The detailed design shall be submitted to a stage 2 RSA.	recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.26 Skid Resistance **Location:** Crossovers on tunnel approaches **Summary:** Differential skid resistance may exist at crossovers, where detritus could further induce skidding. Crossovers are proposed at each end of the tunnel for major maintenance events, and	Provide and manage crossover surfacing to minimise the likelihood of loss of control when in use.	Accept the RSA problem and recommendation. Crossover surfacing to minimise the likelihood of loss of control when in use will be included in the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including	

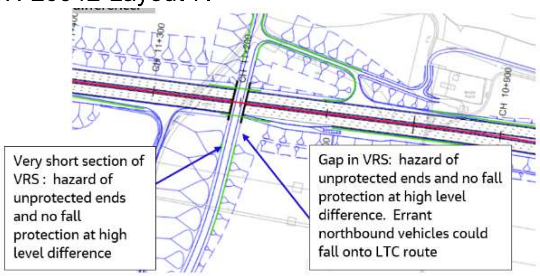
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
drivers are intended to be able to negotiate these at high speed (50mph). The pavement areas will not be in normal trafficked use and this may result in differential skid resistance (higher or lower than adjacent running lanes). This may induce vehicle instability as vehicles enter the crossover resulting in collisions with restraints or other vehicles. See also problem 3.2.28 related to VRS at this location. The accumulation of loose material in this area is also likely and could further increase the likelihood of skidding-related collisions.				submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.27 Fences and road restraint systems **Location:** Road restraint system tie in locations **Summary:** Transition from proposed to existing road restraint systems At locations where the proposed road restraint systems reach the extents of the scheme boundaries, it is unclear how these will tie into the existing provisions. An example of this is the A2/M2 junction where the proposed concrete central barrier ends at a location where the existing provision is single sided restraint system within a wide central reservation.  FIGURE 3-25 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042	It is recommended that road restraint systems tie into/transition with existing provisions, with full details provided for the stage 2 RSA.	Accept the RSA problem and recommendation. The tie-in of proposed road restraint systems to existing provision will be fully detailed as part of the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
At the western extent of the A2 it is also unclear how the proposed concrete central barrier will tie into the existing restraint system and large concrete footings for retained gantries. Restraint systems that do not tie in/transition correctly can result in additional points of conflict and layouts that could increase the severity of a collision should a vehicle leave the carriageway. A vehicle may be directed towards a hazard or be able to crossover into the opposing carriageway.					
3.2.28 Fences and road restraint systems **Location:** Crossover points at the tunnel portals **Summary:** Protection of exposed ends of VRS at crossovers The details of the protection for exposed ends of central VRS are not yet known. These need to provide energy absorption for vehicles whose drivers misjudge the chicane manoeuvre and/or pass through at excessive speed.	It is recommended that the design incorporates lateral protection for vehicles failing to make the crossover and impact the VRS side-on and for those who impact the nose at the crossover, end-on or side-on as they pass through. Motorcyclist protection should also be included in the design details.	Accept the RSA problem and recommendation. Protection of the type recommended will be incorporated within the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.29 Fences and road restraint systems **Location:** Turnaround facilities adjacent to water courses/ponds **Summary:** Lack of vehicle restraint	It is recommended that vehicle restraint is provided at all locations where necessary to prevent vehicle incursions and eliminate inconsistency in scheme	Accept the RSA problem and recommendation. Appropriate vehicle restraint will be incorporated within the detailed design at all locations necessary to	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including	

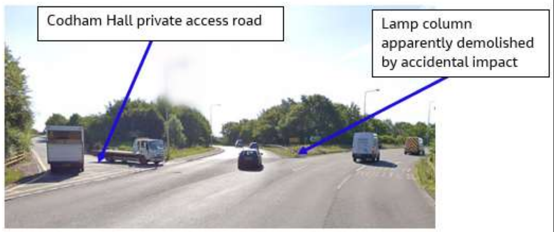
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
There are a number of turnaround facilities at the end of access tracks which are located adjacent to water courses and ponds. No vehicle restraint has been provided at these locations increasing the risk that vehicles could enter the watercourse when turning around. Note that the design of access tracks in this location is inconsistent between drawing sets; Plan and Profile Sheet 13 HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-00014 does not show the route passing beneath the end of the embankment which is shown at the top of the extract below (Ch 16 520 approximately).  FIGURE 3-26 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 8	design between drawing sets.	prevent vehicle incursions.		submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.2.30 Fences and road restraint systems **Location:** Tight radii and interchanges **Summary:** Provision for motorcyclists. There are a number of locations where the horizontal alignment of the carriageway is tight, for example the loops at the A13/LTC interchange. This is an area where motorcyclists are more vulnerable to injury in the event that they lose control on the bend or take	It is recommended that any VRS that represents a net hazard is omitted and provision is included for motorcycles on tight radii in the vehicle restraint specification.	Accept the RSA problem and recommendation. VRS will be fully detailed as part of the detailed design and will not be included if it represents a net hazard.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
action to avoid another vehicle that has misjudged the alignment. When motorcyclists strike metal VRS the gap beneath the barrier can allow a motorcyclist to slide through and come into contact with the unprotected safety barrier posts, increasing the risk of serious injury. In some locations it is unclear what the VRS is provided to protect, for example where it is at the toe of a cutting slope. If not essential, it presents a hazard especially to motorcycles  FIGURE 3-27 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042 without a benefit to other users.				• engage with the Overseeing Organisation in respect of the detailed design	
3.2.31 Fences and road restraint systems **Location:** Numerous overbridges and other locations **Summary**: Short or missing road restraint may result in fall from height and/or incursion onto roads beneath.	Assess all overbridges and other level differences to provide fall protection to motor vehicle users, pedestrians, cyclists and equestrians.	Accept the RSA problem and recommendation. VRS will be fully detailed as part of the detailed design and will provide adequate fall protection.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
There are numerous overbridges and other locations where there appears to be inadequate protection to prevent road users falling onto lower levels and/or into roads or other hazards below. Further complications are presented where junctions occur close to these locations because this adds conflict at locations of possible incursion, and because accesses prevent continuous restraint provision. See example below where the B1421 Ockendon Road passes over the M25.  FIGURE 3-28 – EXTRACT FROM VEHICLE RESTRAINT DRAWING HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-LAYOUT 10 This is in part an existing hazard (see image below from Google Streetview looking east over M25 bridge) but the proposals add an additional overbridge, and the new access increases conflict and therefore the hazard at this location.				• engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
 Similar hazards are presented over the A13 interchange where A1013 passes over A1089; LTC mainline and the slip from A13 westbound to LTC southbound, with no VRS shown see HE540039-CJV-HML-SZP_ML000000_Z-DR-CH-20042-Layout 7.  At some overbridge locations there are also short gaps between VRS sections, which present two terminal impact locations where vehicle users could be injured by trauma/deceleration. This is in addition to the hazard of an unprotected gap such as the example at Brentwood overbridge shown below. Motor vehicle users, pedestrians, cyclists or					

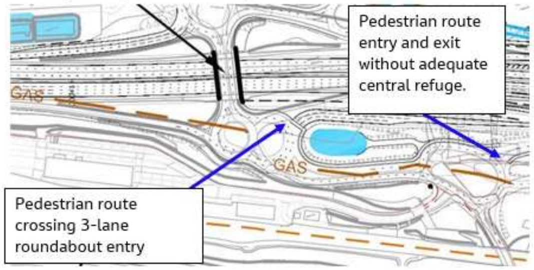
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
equestrians could be injured by the unprotected level difference.					
3.3.1 Junction **Location:** M25 Junction 29/A127 access to Codham Hall **Summary**: Concentration of traffic movements to/from Codham Hall at the A127/M25 junction. At junction 29 of the M25 there are currently two accesses to Codham Hall, an industrial area located on the north and south sides of the A127 to the east of motorway junction. The signal-controlled access between the A127 westbound exit slip and the M25 clockwise entry slip is not shown on the LTC proposal drawings suggesting it will no longer be available. The removal of this access will result in all traffic related to Codham Hall using the uncontrolled access off the circulatory carriageway between the M25 clockwise exit slip and the A127 eastbound entry slip. It is likely that there will be an increase in traffic movements at junction 29 due to LTC which may make it increasingly difficult for traffic from Codham Hall to join the roundabout. The circulatory carriageway at the Codham Hall approach is four lanes wide; drivers have to cross the two nearside lanes (for the A127 eastbound) to continue on to the roundabout and the access is orientated like a priority T junction which could result in drivers turning the wrong way onto the roundabout. The combination of these factors increases the risk of failure to giveway and side impact collisions at this location.	It is recommended that modelling of the junction includes the changes in vehicle movements associated with Codham Hall and any necessary changes to the control of the roundabout are incorporated into the design along with a signing strategy. Provide details of access and egress for this facility for audit, including route signing.	Accept the RSA problem and recommendation. The detailed design modelling will include the changes associated with Codham Hall and the roundabout control and signing will be developed accordingly. It is also noted that there are ongoing discussions with third parties about access to these areas.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
 FIGURE 3-31 – GOOGLE STREETVIEW IMAGE OF CODHAM HALL ENTRY Google Streetview images show that a lamp column on the nose between the A127 eastbound merge and the junction 29 circulatory carriageway had been demolished suggesting there may be existing problems with drivers misjudging this part of the junction. There is no clear signing of the current accesses to Codham Hall estate and the amalgamation of the two accesses into one could increase driver confusion resulting in late braking, lane changing and rear shunts.					
3.3.2 Junction **Location:** M25 Junction 29/A127 **Summary**: Internal access within Codham Hall estate. The closure of the signal-controlled access to Codham Hall will result in drivers who want to access the southside of the estate using the existing overbridge which links the two sides. It is not clear if this structure or the road layout is suitable for an increase in use, potentially by large commercial vehicles, which could result in head on and side swipe collisions. It is also not	Provide details of internal access proposals for this facility for audit, including route signing. While this is a private road, it is likely to be perceived as public highway by drivers and its safe operation will have an impact on the adjacent public highway network.	Accept the RSA problem and recommendation. The detailed design will consider all relevant aspects of the interface with this access road.	The Overseeing Organisation concurs with the comments made by the Design organisation. Discussions are ongoing regarding a possible alternative access. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
clear how emergency access to the southside of the estate will be achieved in the event that the overbridge is closed. As in other locations, the design proposals for this area are different between drawing sets.				respect of the detailed design	
3.4.1 Walking, cycling and horse riding **Location:** Various **Summary:** ability of cross sections to safely accommodate walking, cycling and horse riding routes. The General Arrangement drawings indicate a number of walking, cycling and horse riding routes, many of which include over or under bridges. It is unclear if the available carriageway and structure cross sections are able to accommodate the proposed routes. As an example, the Muckingford Road 'NMU' (sic) proposed shared route is expected to be at least three metres wide. It is unclear if this can be accommodated within the existing carriageway/highway extents or within the proposed bridge cross section where the route passes over the LTC. The provision of routes that are not consistent, are sub-standard or variable, or terminate if not able to be accommodated increases the potential for users to enter the carriageway and be involved in collisions with vehicles.	It is recommended that all walking, cycling and horse riding routes are provided in accordance with current design guidance and that cross sections are provided (including for under and overbridges) for the Stage 2 RSA to confirm these can be accommodated within the available carriageway, highway and structure extents.	Accept the RSA problem and recommendation. All walking, cycling and horse riding routes will be provided in detailed design in accordance with current design guidance and cross sections will be provided (including for under and overbridges) for the Stage 2 RSA to confirm these can be accommodated within the available carriageway, highway and structure extents.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.4.2 Walking, cycling and horse riding **Location:** Various **Summary:** Connectivity and signing of the proposed network.	It is recommended that all walking, cycling and horse riding routes are provided in accordance with current design guidance and that	Accept the RSA problem and recommendation. All walking, cycling and horse riding routes will be provided in detailed	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall	The Design organisation shall: • be responsible for implementing the RSA recommendation as	

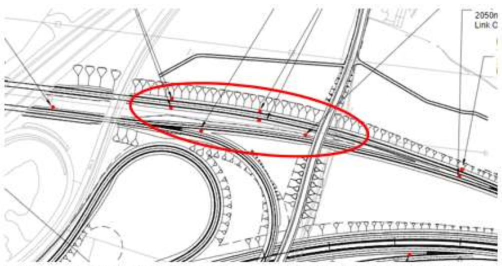
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
There are a number of locations where it is unclear how the proposed walking, cycling and horse riding network will be accommodated, how it will connect with existing provisions and how it will be clearly signed. This includes, but is not limited to: • Muckingford Road, where the east-west route does not appear to connect to any existing network and will result in users having to enter the carriageway to join or leave the WCH route; • the east-west route across Brentwood Road, which connects into unbound farm tracks likely to be unsuitable for a large number of users; • the routes around the LTC junctions with the A13 and A1013; • the accommodation of the existing PRoW at High House Lane; • whether the existing Green Lane bridleway is being maintained; and • how the existing Ockendon Road PRoW is being accommodated. Poor route connectivity, onward connections and a lack of signage can result in user hesitation, users in the carriageway and users tripping/falling or being unseated on unsuitable surfaces.	they tie in at suitable locations, allowing for safe, connected, onward journeys by all types of user. All routes and onward connections should be clearly signed, with full signing details provided for the Stage 2 RSA.	design in accordance with current design guidance and they will tie into existing facilities at suitable locations with appropriate signage.	be submitted to a stage 2 RSA.	part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.4.3 Walking, cycling and horse riding **Location:** Overbridges that include provision for pedestrians, cyclists and equestrians **Summary:** Provision of adequate parapets.	It is recommended that suitable parapets are provided for the intended users of the overbridge routes and that full bridge	Accept the RSA problem and recommendation. Suitable parapets will be provided for the	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA	

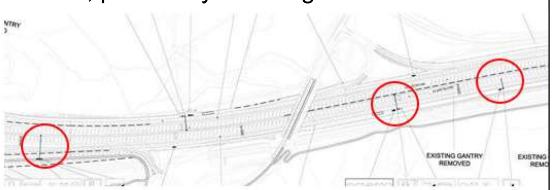
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
The General Arrangement drawings indicate a number of walking, cycling and horse riding routes, many of which include carriageway crossings on overbridges. It is unclear if the bridge structures incorporate the correct parapets for the users of each route. The provision of parapets not suitable for the intended users of the routes increases the potential for cyclists and equestrian falls in the event of a rider being unseated. Specific to equestrians, the provision of incorrect parapets can result in horses becoming startled, increasing the risk of riders being unseated.	cross section and parapet details are provided for the Stage 2 RSA.	intended users of the overbridge routes.	The detailed design shall be submitted to a stage 2 RSA.	recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.4.4 Pedestrians and Cyclists **Location:** Shared path south of the A2 - carriageway crossings. **Summary:** The existing pedestrian and cycle route that runs east-west parallel to the A2 is to be modified as part of the LTC project. The modified route includes additional carriageway crossings, including a three lane crossing on the bend where the LTC southbound diverge approaches the Henhurst Road/A2 overbridge roundabout south of the A2. From the information provided it is unclear if the pedestrian/cycle carriageway crossings are signalised. See Figure below.	It is recommended that the number of shared route carriageway crossings is minimised and that signalised crossings are provided. Signal details should be provided for the Stage 2 RSA.	Accept the RSA problem and recommendation. The location of the 3-lane crossing will be controlled by signals. The central refuge / splitter island referred to is 4m deep at the crossing location shown and is considered adequate. If this is deemed to be insufficient then there is scope to modify the roundabout exit at the detailed design stage to provide a larger island. Attempts have been made to reduce the number of carriageway	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
 FIGURE 3-32 – HE540039-CJV-HML-S02_ML000000_Z-DR-CH-00050 Additional crossings, circuitous routes and crossings of excessive length increase the risk of collisions involving crossing pedestrians and cyclists with vehicles		crossing points along the NMU route and providing a crossing at the refuge / splitter island enables pedestrians to concentrate of one traffic direction at a time therefore reducing the potential for accidents through judgemental errors or confusion.			
3.4.5 Pedestrians and Cyclists **Location:** M25 junction 29 pedestrian and cycle route **Summary**: Length of route. The General Arrangement drawings indicate the proposed NMU (sic) route around M25 junction 29 and the onwards movements south of the junction. If travelling across the junction the route includes four separate signalised crossings. If the user then wishes to travel southbound on the east side of the M25, they are required to follow a 1.5km diversion via a bridge over the A127. Given that the signalised crossings are not on desire lines and include multiple stages, plus the length of the diversion, this could result in pedestrians and cyclists entering the carriageway away from signals or following desire lines through areas of grass verge. This increases the risk of pedestrian and	It is recommended that more direct routes for pedestrians and cyclists are provided across M25 junction 29 and across the A127 eastern arm and that destination signing is provided to minimise short cuts across unsafe alternatives.	Accept the RSA problem and recommendation. It is considered that the routing developed as part of the preliminary design is compatible with the constraints identified but this will be considered further during the detailed design with a view to establishing the most direct routes. Signage to minimise short cuts across unsafe alternatives will be incorporated within the detailed design.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
cyclist collisions with vehicles.  FIGURE 3-33 – EXTRACT FROM GENERAL ARRANGEMENT DRAWING HE540039-CJV-HML-S14_ML000000_Z-DR-CH-00010					
3.4.6 Equestrians **Location:** North Ockendon. **Summary:** Route connectivity The proposed overbridge to the south of North Ockendon accommodates a bridleway, but there are no onward connections for equestrians. Poor route connectivity and onward connections can result in user hesitation, horses on unsuitable routes and riders being unseated.	It is recommended that the proposed bridleway connects to an existing provision/route suitable for horses and that the route is clearly signed, with full signing details provided for the Stage 2 RSA.	Accept the RSA problem and recommendation. Within the design there are proposals to provide new shared facility links connecting into the local PRoW network in the area.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.1 Road sign **Location:** Scheme wide **Summary:** Route signing strategy. A clear route signing strategy is needed to ensure that drivers understand the complexity of the interchanges and are able to make the right decisions based on sign information, this	It is recommended that the LTC route signing strategy is included in an Interim RSA to ensure that the complexity of the three interchanges in terms of driver understanding and	Accept the RSA problem. The signage strategy has been developed since the issue of DR3.0 and sign face details are now available. Full signage details and the	It is accepted that signing is required to ensure that drivers understand the complexity of the interchanges and are able to make the right decisions based on sign information.	The Design organisation shall: • be responsible for developing the signing strategy and detailed design including submission to stage 2 RSA unless otherwise	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
includes relevant prohibition signs for the LTC. The layout of all three of the LTC interchanges with the M25, A13 and A2 respectively, provides scope for driver confusion increasing the risk of late lane changing and sudden braking, resulting in side swipes and rear shunts. This is particularly apparent where: • there is a need to make a number of decisions in quick succession, e.g. A2 westbound there are three merges over a 500m length, or • the layout is unusual, e.g. Junction 29 of the M25 where there is a long parallel link road from the LTC to the junction which may be unfamiliar to drivers.	decision making is fully assessed before stage 2 RSA.	associated signage strategy will be developed as part of the detailed design. It is not considered appropriate for the design organisation to comment on the recommendation for an interim RSA before the Stage 2 RSA.	As stated by the Design organisation the signing strategy has been developed since the issue of DR3.0 with input from the Overseeing Organisation. Full signing details are to be developed as part of the detailed design. Following the appointment of the main Design & Build Contractors it may be necessary to undertake repeat stage 1 RSAs that may include signing. It is not considered appropriate at this stage to submit a signing strategy to an interim road safety audit as the outcomes for the project can be achieved by submitting the details to a repeat stage 1 (if required) and stage 2 RSAs. In accordance with GG 119 the requirement to carry out an interim road safety audit is at the discretion of the Overseeing Organisation who may opt, at the	requested by the Overseeing Organisation to submit another audit stage • engage with the Overseeing Organisation in respect of the detailed design The Overseeing Organisation shall be responsible for assuring that the appropriate audit types specified in GG 119 'Road Safety Audit' are implemented.	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			appropriate time, to submit the signing details to an interim audit.		
3.5.2 Road sign **Location:** Various Summary: Potential for signs to be visible to traffic on adjacent links/roads. There are a number of locations where signs located between parallel routes may result in driver confusion and potentially sudden braking increasing the risk of rear shunt type collisions. An example of this is at the A2/LTC interchange, see figure below.  FIGURE 3-34 – EXTRACT FROM DIRECTION SIGNS LOCATION PLAN SECTION 13 HE540039-CJV-HSN-SZP_SG000000_Z-DR-CH-00157	It is recommended that where signs would cause confusion to drivers on adjacent links screening is provided.	Accept the RSA problem and recommendation. Screening for signage will be incorporated within the detailed design as necessary.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.3 Road sign **Location:** Various **Summary:** Potential for signs and gantries to be obscured by overbridges and other features. There are a number of locations where signs and gantries are shown behind over bridges and are potentially obscured by embankments/wing walls. Reduced visibility to signs and gantries	It is recommended that appropriate clear forward visibility to signs and gantries is provided taking into account the effect that viewing signs through structures can reduce available processing time for drivers.	Accept the RSA problem and recommendation. Modelling commensurate with the preliminary design phase has been undertaken. The detailed design will ensure that appropriate	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
can result in drivers having insufficient time to process the information increasing hesitation and late decision making. Where signs and gantries are located with sufficient forward visibility but through overbridges, processing time for drivers can be reduced as their focus is initially not on the sign.		clear forward visibility to signs and gantries is provided.		submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.4 Road sign **Location:** Various **Summary:** Gantries spanning across the LTC mainline and parallel roads. There are a number of gantries shown extending over parallel roads and the mainline, e.g. A2 WB Ch 3854 and 4100 and A2 EB Ch 4500. These gantries incorporate strategic VMS/MS signs, lane AMIs or a combination of these. It is unclear who the VMS/MS signs are for at these locations but it is likely that the messages will be visible from both the parallel link road and mainline, potentially resulting in confusion.  FIGURE 3-35 – EXTRACT FROM TECHNOLOGY DRAWING HE540039-CJV-HMC-A2_HC000000_Z-DR-EC-00003	Design signs and signals to minimise visibility by those not the intended viewers and provide sign details at Stage 2 RSA.	Accept the RSA problem and recommendation. The detailed design will ensure that signs and signals are detailed to minimise visibility by those not intended to view them.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.5 Road sign **Location:** Scheme wide **Summary:** Lack of direction signing. There are a number of areas of altered road network where no direction signs are proposed.	It is recommended that full sign details are provided at Stage 2 RSA including any TTM signing.	Accept the RSA problem and recommendation. The preliminary design has only considered major advanced	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for developing full signing details including	

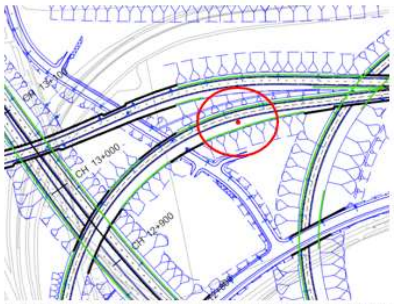
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Examples of this include the A127 approaches to junction 29 of the M25 and the three roundabouts (two north of the A2 and one south). The roundabout shape, destinations from some arms and permitted movements are being altered but no signs are proposed to reflect these changes increasing the risk of driver confusion, hesitation and resulting in side swipes and rear shunts.		directional signage. Full signage details will be incorporated within the detailed design.	In respect of TTM signing this should only relate to diversion routes. TTM will be required across the scheme taking into account: • Project Maintenance Repair Statement (MRS) PCF product • Duration of planned and unplanned maintenance • Incident management TTM requirements • Lengths of TTM scheme • Measures required to achieve ALARP • DfT TSM Chapter 8. (Note: GD 300 Rev 2 states that *The aspiration is to eventually replace Chapter 8 Traffic Sign Manual TSM Chapter 8 [Ref 36.N] approach signing for relaxed works with TTM signing provided by the permanent VMS and control signals)* • Maintenance service provider working methods.	diversion route signs / symbols as part of the detailed design with submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

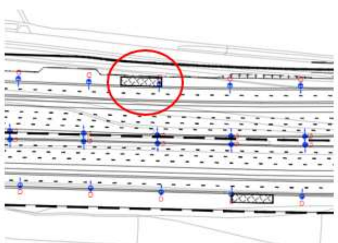
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
			• Compliance • The project is also likely to use the Signalling for Roadworks (SfR) technique as part of an overall TTM scheme. Whilst VMS have been location to enable SfR the proposal currently requires endorsement by the National Safety Control Review Group (NSCRG). Taking into account the above variables and the duration of time between the Stage 2 RSA and scheme opening it is not considered viable to submit all TTM signing to a Stage 2 RSA.		
3.5.6 Road sign **Location:** LTC route **Summary:** Need for junction numbering and optimal direction signing. The scheme includes complex new junctions with sweeping loops and layouts where drivers may become confused as to which direction they are facing. This may result in sudden braking if they are late to observe their exit or are fearful of entering the tunnel in error and paying the associated charge. This can be exacerbated by	Liaise with local highway authorities to identify appropriate destinations and determine whether route numbering will be provided for LTC. Develop direction signs and prohibition signing proposals in consideration of the navigational challenges described above.	Accept the RSA problem and recommendation. The detailed design process will include liaison with local highway authorities to identify appropriate destinations and determine whether route numbering will be provided for LTC. Direction signs and	The Overseeing Organisation concurs with the comments made by the Design organisation. Full signing details had not been developed for the stage 1 RSA. Signing details have since been developed further including road user charging signs, prohibition signs and direction signs.	The Design organisation shall: • be responsible for developing full signing details as part of the detailed design with submission to stage 2 RSA • engage with the Overseeing Organisation in	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
satellite navigation systems which have not been updated and exclude new links and junctions. A further complication relates to manoeuvres that are not specifically provided, for example eastbound A13 traffic wishing to travel north or south on LTC must continue to Orsett Cock Roundabout, make a U-turn and return to take the link to southbound LTC. If they are not familiar with the new layout, drivers may take the diverge to southbound A1089 in error. GD 300 Expressways design guidance includes junction numbering as a mandatory feature of Level 3 Expressways and this may assist with navigation in some respects. However, it could add to confusion because LTC junctions could be given numbers but they would also have a different junction number from the connection major route. GD 300 also states that "Liaison with adjacent local highway authorities shall commence in HE PCF [Ref 14.N] stage 1 to identify changes that are required to their road signing". It is understood that liaison with local highway authorities has not yet commenced; this is important in order to understand the destinations that drivers are likely to be seeking for various route permutations. If direction signing throughout the scheme and its connections does not reflect scope for driver error, and the destinations they are likely to be looking for, there is potential for late lane changing, sudden braking and distraction from		prohibition signing proposals will be developed in consideration of the navigational challenges described in the problem.	The detailed design shall be submitted to a stage 2 RSA. The project has and continues to consult with local authorities. It should be noted that GD 300 was only published at PCF Stage 3.	respect of the detailed design	

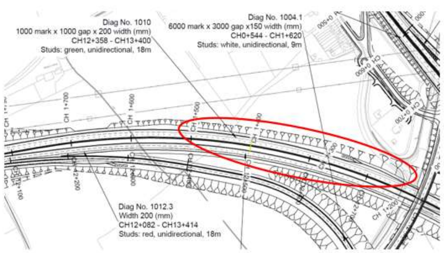
RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
driving conditions, which may result in shunt or side-swipe collisions. Signing for permitted vehicle groups similarly needs to reflect existing and likely future road users' needs, to avoid illegal use. Appropriate signing can minimise sudden braking or lane changing and resulting side swipe and shunt collisions which could occur if good advance signing of prohibitions is not made.					
3.5.7 Road sign **Location:** Scheme wide **Summary:** Marker posts. It is not clear if marker posts are going to be provided as part of the scheme and if these will indicate the nearest ERT from that location. Without these, stranded drivers could be exposed for longer on the live carriageway if they walk in the wrong direction. Near junctions, drivers walking to get assistance may cross slip roads if they do not walk in the correct direction. It is not known whether network referencing signs will be shown, but this would be expected; these signs can enable drivers who have broken down to give their location to emergency services and/or breakdown service suppliers.	It is recommended that full sign and marker post proposal details are provided at Stage 2 RSA.	Accept the RSA problem and recommendation. Full sign and marker post details will be incorporated within the detailed design	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.8 Road sign **Location:** Scheme wide **Summary:** Position of signs in verges. There are a number of proposed signs located in verges, at nosings or within steep embankments where there appears to be inadequate room to accommodate the signs. This could result in:	It is recommended that full sign details are provided at Stage 2 RSA ensuring that all signs are located and protected appropriately.	Accept the RSA problem and recommendation. Full signage details will be developed as part of the detailed design to ensure that all signs are located and protected appropriately.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA..	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
• insufficient clearance to the edge of carriageway and a risk of vehicle strikes, • reduced performance of a road restraint system if positioned within the working width increasing the severity of a collision in the event that a vehicle leaves the carriageway ,and • complications in terms of maintenance if located adjacent to significant drops.				submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.9 Road sign Location: Scheme wide **Summary:** Unprotected signs. There are a number of proposed signs located in verges and at nosings which do not appear to be protected. This is likely to increase the severity of collisions in the event of a vehicle leaving the carriageway at these locations. For example, the direction sign located in the wide verge adjacent to the A13 westbound slip onto A1089 southbound.	It is recommended that the roadside risks for all road users are managed and signs are protected accordingly.	Accept the RSA problem and recommendation. Full signage details will be developed as part of the detailed design to ensure that all signs are located and protected appropriately.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
 FIGURE 3-36 – EXTRACT FROM VRS DRAWING HE540039-CJV-HML-ML000000_Z-DR-CH-20042					
3.5.10 Carriageway markings **Location:** Various verges **Summary:** Inconsistent use of warning road markings at merges. There is an inconsistent use of warning lane markings at merges, for example the southbound merge from LTC to the eastbound A2. This can result in drivers being less aware of the potential for drivers changing lanes increasing the risk of side swipe collisions.	It is recommended that warning road markings are provided in accordance with the Traffic Signs Manual Chapter 5.	Accept the RSA problem and recommendation. Warning road markings will be incorporated within the detailed design in accordance with the Traffic Signs Manual Chapter 5.	Whilst Overseeing Organisation concurs with the comments made by the Design organisation, due regard must be given to The Traffic Signs Regulations and General Directions (TSRGD) 2016 and any subsequent updates. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including due cognisance to TSRGD and submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.11 Lighting **Location:** Scheme wide **Summary:** Use of uni-directional road studs where contraflow is likely.	It is recommended that bi-directional studs are used where regular contra flow arrangements are anticipated.	Accept the RSA problem and recommendation. Bi-directional studs will be incorporated within the detailed design	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall	The Design organisation shall: • be responsible for implementing the RSA recommendation as	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
Road studs appear to be unidirectional throughout – given that maintenance/ emergency routing will involve crossover/contraflow running this could cause issues regarding lane discipline and definition resulting in side impact collisions.		where regular contra flow arrangements are anticipated.	be submitted to a stage 2 RSA.	part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design.	
3.5.12 Lighting **Location:** Scheme wide **Summary:** Lighting columns vulnerable to vehicle strikes. There are some locations where lighting columns are positioned in front of maintenance bays or accesses increasing the risk of being struck by vehicles, resulting in injury.  FIGURE 3-37 – EXTRACT FROM LIGHTING DRAWING HE540039-CJV-HLG-RL000000_Z-DR-EO-00002	It is recommended that lighting columns are located with sufficient clearance to the edge of the carriageway/maintenance areas and protected where necessary.	Accept the RSA problem and recommendation. Lighting columns will be incorporated within the detailed design with sufficient clearance to the edge of the carriageway/ maintenance areas and will be protected where necessary.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.13 Lighting **Location:** M25 south of junction 29 **Summary:** Lighting provision.	Check that the lighting design will provide appropriate lighting levels on all lanes.	Accept the RSA problem and recommendation. The detailed design will ensure that appropriate	The Overseeing Organisation concurs with the comments made by the Design organisation.	The Design organisation shall: • be responsible for implementing the RSA	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
The M25 south of junction 29 is proposed to be eleven lanes wide with lighting in the nearside of both the clockwise and anticlockwise carriageways. This section includes the LTC merge and diverge where drivers will be making route choices and changing lanes which under potentially lower lighting levels increases the risk of night time collisions. Motorcyclists are especially vulnerable injury in lower lighting if drivers are less able to see a motorcycle due to its smaller size and/or form meaning it is not anticipated.		lighting levels are provided on all lanes.	The detailed design shall be submitted to a stage 2 RSA.	recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	
3.5.14 Lighting **Location:** Scheme wide **Summary:** Lighting provision. The LTC Lighting report states that, 'lighting levels will be linked to the live traffic flow, so that during quiet periods the lighting will be dimmed to reduce energy consumption.' It is not clear if this will have an impact on the transition from one lighting level to another resulting in issues as eyes adjust and potentially resulting in collisions such as rear shunts in slowing traffic or as a vehicle changes lane.	It is recommended that the effect of the proposal to dim the lighting does not create differences in lighting levels, particularly in relation to the tunnel.	Accept the RSA problem and recommendation. The detailed design will ensure that any proposals to dim the lighting does not create differences in lighting levels, particularly in relation to the tunnel. It should be noted that the proposal to vary traffic lighting levels in response to live traffic flows (vehicle numbers) does not apply to the enclosed road tunnel lighting design. Within the tunnel lighting design, lighting levels at the tunnel portals/entry zones will vary in response to signals from	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

RSA problem	RSA recommendation	Design organisation response	Overseeing Organisation response	Agreed RSA actions	RAG Status
		photometers located on the tunnel approaches / exits, specifically for the purpose of helping motorists eyes to adjust more readily to the transition from open road to enclosed tunnel and vice versa.			
3.5.15 Lighting **Location:** Scheme wide Summary: Green studs used at appropriate locations. Green studs are proposed on auxiliary lanes in accordance with TSM Chapter 5 4.4.1. However, that document does not reflect the possibility of an EA within that lane e.g. Ch 12 358-Ch 13 400 at A13 junction with EA at Ch 12 700m. Drivers in through-lanes may not anticipate an EA at this location and make a sudden lane change to enter it, in conflict with vehicles in the lane-drop nearside lane and resulting in side swipe and rear shunt collisions.  FIGURE 3-38 – EXTRACT FROM ROAD MARKINGS DRAWING HE540039-CJV-HMK-SZP_RG000000_Z-DR-CH-00158	Review EA positions and stud designs to minimise drivers making sudden lane changes at these locations.	Accept the RSA problem and recommendation. The detailed design will be developed to minimise the likelihood of drivers making sudden lane changes at these locations.	The Overseeing Organisation concurs with the comments made by the Design organisation. The detailed design shall be submitted to a stage 2 RSA.	The Design organisation shall: • be responsible for implementing the RSA recommendation as part of the detailed design including submission to stage 2 RSA • engage with the Overseeing Organisation in respect of the detailed design	

Sub-annex 2.3 – Tilbury Junction Commentary and Appraisal

TECHNICAL NOTE

Job Name: Lower Thames Crossing (Thurrock Borough Council)

Job No: 33251075

Note No: 02

Date: 04/01/2023

Prepared By: Nick Blades, Kieran Mann, Morteza Nejad & Gwen Protheroe

Reviewed By: Adrian Neve

Subject: **Tilbury Junction Capacity Assessment and Configuration Appraisal**

1. Non-Technical Summary

1.1. As part of the Lower Thames Crossing (LTC) Scheme Development Consent Order (DCO) (November 2022), a grade-separated access junction (hereafter referred to as the Tilbury Junction) and associated operational access roads are proposed at Tilbury. The Tilbury junction is located approximately 500 metres to the north of the tunnel entrance on the northern side of the river.

1.2. National Highways' (NH's) have stated in their consultation material that the Tilbury Junction would not provide public traffic with access on or off LTC at this location and is instead proposed to provide operational access only so that maintenance and emergency vehicles can access the LTC. It is also proposed to give emergency services the flexibility to turn vehicles around in the event of incidents in the tunnel. NH have also stated that the operational access junction could potentially accommodate further development in the future, helping avoid potentially disruptive re-work at a future date.

1.3. The provision of a new junction at Tilbury is supported in principle by Thurrock Council (the Council) if it is accompanied by delivery (or a commitment to future delivery) of the Tilbury Link Road (TLR) it is intended to facilitate. In the absence of this commitment, the Council's view is that the junction is over-specified for an operational and emergency access only. Simply provided as an operational and emergency access it is an expensive and unnecessary luxury in the context of the LTC scheme as currently proposed.

1.4. It is also the Council's view that delivery of the Tilbury junction alongside the TLR could also enable the rationalisation of NH's currently proposed interchange between LTC, A13 and A1089 – in turn enhancing connection to LTC for current and future communities in Thurrock; relieving pressure on the A13 Orsett Cock roundabout; reducing land and severance impacts of the proposed convoluted LTC interchange; and providing opportunities for effective cross-river connections for public transport services.

1.5. The Council agrees that the junction should be designed with the future delivery of a TLR and future development in mind to avoid potentially disruptive re-work at a later date. The Council therefore expects NH to demonstrate that the proposed junction design is capable of providing the vital capacity, connectivity, configuration and operational performance required to accommodate future traffic, public transport and walking, cycling and horse-riding (WCH) movement demands arising as a result of the proposed LTC scheme configuration with a TLR in place and with local growth aspirations for the area (e.g. Thames Freeport expansion and the Thurrock emerging Local Plan). This evidence has not been provided by NH.

1.6. This Technical Note provides an assessment of the proposed 2022 DCO Tilbury junction arrangement at Tilbury as the Council wishes to understand whether the junction arrangement proposed would support delivery of the TLR and help deliver future local economic growth aspirations.

1.7. This note reviews the design characteristics and standards, the appropriateness of the layout and configuration of NH's proposal for the Tilbury Junction. An assessment is made of the capacity of the junction roundabouts under a range of traffic demand scenarios which align with the potential traffic demand and growth predicted to occur in the vicinity of the junction.

1.8. To inform the Tilbury Junction capacity assessment three potential 2030 traffic demand scenarios (low, high and port only) at the junction related to the Tilbury Link Road (TLR) have been extracted from the Lower Thames Area Model (LTAM) model runs of alternative LTC options (with the TLR in place) that were provided to the Council by NH. Additionally, three traffic demand scenarios related to traffic demand from East Tilbury have been used based on data from some preliminary Thurrock Local Plan strategic modelling completed in 2020. This results in a combination of 7 different traffic demand scenarios at the Tilbury Junction which have been included as part of this assessment and are indicated by Table 2 of the note.

1.9. An assessment of the capacity of the merge and diverge slip-roads between the LTC and Tilbury Junction has also been undertaken to determine the merge/ diverge requirements for each traffic demand scenario and to confirm that the adopted design standards would suit an all-purpose and all movements grade-separated junction. The merge/diverge assessment shows that the current NH design would only facilitate additional traffic under the 'port only' and 'low' TLR forecast traffic demand scenarios and with a public transport and active travel only connection to East Tilbury.

1.10. A junction improvement package was also developed and tested to determine whether widening on specific roundabout arms and modifications to the merge diverge arrangements could help accommodate higher traffic demand scenarios at the Tilbury Junction.

1.11. In summary it was found that:

i. The currently proposed NH Tilbury junction design would only accommodate the 'port only' 2030 forecast traffic demand scenario. NH's configuration of the junction does not provide adequate capacity to support the 'low' and 'high' 2030 forecast traffic demand scenarios along the TLR. It would therefore not provide adequate capacity to fully support future growth aspirations and movement demands associated with Freeport proposals at the Port of Tilbury and developments sites proposed as part of the emerging Thurrock Local Plan.

ii. With an improvement package including junction design changes and slip-road modifications, both the 'low' and 'high' demand scenarios on the TLR can be accommodated but only if a public transport and active travel only connection to East Tilbury is provided (i.e. not a full general traffic access).

iii. The proposed NH layout for Tilbury Junction does not include dedicated facilities for public transport or active travel. Space should be provided on the road linking the two roundabouts to provide flexibility to reallocate road space to public transport in the future. Additionally, a combined 5 metre active travel route should be provided on the southern side of the road between the East Tilbury connecting corridor and the Tilbury Link Road.

1.12. Alternative junction improvements or configurations could be assessed as part of future studies to determine whether Tilbury Junction could facilitate higher levels of traffic demand from the TLR and East Tilbury

TECHNICAL NOTE

2. Introduction

LTC Tilbury Operational Access Junction and Arrangement

2.1. As part of the Lower Thames Crossing (LTC) Development Consent Order (DCO) scheme (November 2022), a grade-separated access junction (hereafter referred to as the Tilbury Junction) and associated operational access roads are proposed at Tilbury, approximately 500 metres to the north of the tunnel entrance on the northern side of the river.

2.2. National Highways' (NH's) have stated in their consultation material (Local Refinement Consultation – May 2022) that the Tilbury Junction would not provide public traffic with access on or off LTC at this location and is instead proposed to provide operational access only so that maintenance and emergency vehicles can access the LTC. The proposed operational access arrangement is also proposed to give emergency services the flexibility to turn vehicles around in the event of incidents in the tunnel.

2.3. NH stated in their consultation material that the operational access could potentially accommodate further development in the future, helping avoid potentially disruptive re-work at a future date. However, NH also stated that any road connecting to the LTC at this point would have to follow the relevant planning process at the appropriate time.

2.4. The *current design and the previous design of the operational access arrangements are shown in*

2.5.

2.6.

2.7. Figure 1 *and are taken from the 2020 design consultation 'LTC-Design-Consultation-2020-10k-General-Arrangement-maps-1-6-sm-2 and TR010032-001369-2.9 Engineering Drawings' and 2022 DCO application 'Sections Volume E (South portal and Tilbury plan and profiles)'.*

Council's Position

2.8. The provision of a new junction at Tilbury is supported in principle by the Council if it is accompanied by delivery (or a commitment to future delivery) of the TLR it is intended to facilitate. In the absence of this commitment, the junction is over-specified for an operational and emergency access only. Simply provided as an operational and emergency access it is an expensive and unnecessary luxury in the context of the LTC scheme as currently proposed.

2.9. The Council agrees that the junction should be designed with the future delivery of a TLR and future development in mind to avoid potentially disruptive re-work at a later date. However, it is the Council's view that NH has not to date completed adequate option assessment, traffic modelling and design development work in relation to the LTC scheme overall, at the A13 Orsett Cock junction or at the proposed Tilbury junction to enable it to make fully informed judgements and comments on this element of the LTC scheme.

2.10. The Council expects NH to demonstrate that the proposed junction design is capable of providing the capacity, connectivity, configuration and operational performance required to accommodate future traffic, public transport and walking, cycling and horse-riding (WCH) movement demands arising from the proposed LTC scheme configuration with a TLR in place and with local growth aspirations for Tilbury and the wider Thurrock area (e.g. Thames Freeport expansion and the Thurrock emerging Local Plan). This evidence has not been provided thereby making it impossible for the Council to take a reasonably informed position on this junction proposal and design.

Purpose of this Note

2.11. This Technical Note provides an assessment of the proposed 2022 DCO Tilbury junction arrangement. The Council wishes to understand whether the junction arrangement proposed would can help provide efficient general public access between LTC; the Port of Tilbury and the emerging Freeport; the wider Tilbury and Grays area; and East Tilbury and surrounding area. It is the Council's view that the junction should be capable of supporting forecast traffic and movement demands for all modes of travel to those areas.

2.12. It is also the Council's view that delivery of the Tilbury junction alongside the TLR could also enable the rationalisation of NH's currently proposed interchange between LTC, A13 and A1089 – in turn enhancing connection to LTC for current and future communities in Thurrock; relieving pressure on the A13Orsett Cock roundabout; reducing land and severance impacts of the proposed convoluted LTC interchange; and providing opportunities for effective cross-river connections for public transport services.

2.13. The Council expects NH to demonstrate that the proposed junction design can accommodate future movement demands arising as a result of the proposed LTC scheme configuration with a TLR in place and with local growth aspirations for the area e.g. Thames Freeport expansion and the Thurrock emerging Local Plan. It is the Council's opinion that demonstrating this is critical given NH's acknowledged that the *'access arrangement at Tilbury has been designed…with possible future development in mind, helping to avoid potentially disruptive re-work at a later date…'* and relates directly to the stated objective for LTC '*to support sustainable local development and regional economic growth*…'.

2.14. This Technical Note provides an assessment of the capacity and suitability of the Tilbury Junction and its associated roundabout junctions under various traffic demand scenarios (assuming a future TLR and a potential connection with East Tilbury from the east of the junction, to facilitate local connection and prospective growth).

2.15. The key aims and objectives of this assessment are to determine:

i. Whether the proposed NH design will provide capacity to help facilitate future port and Local Plan aspirations;

ii. What levels of future traffic demand on the Tilbury Link Road and from East Tilbury can the junction accommodate;

iii. Whether the junction can accommodate the levels of demand forecast at this junction in the strategic modelling of alternative LTC options (undertaken by NH for the Council) which include different LTC/A13/A1089 junction configurations and result in different level of traffic using the Tilbury Link Road;

iv. If junction improvements and/or LTC merge/diverge modifications would be required to better meet future growth ambitions and facilitate alternative LTC/A13 junction configurations;

v. If the junction design meets design guidance and facilitates future public transport and active travel uses;

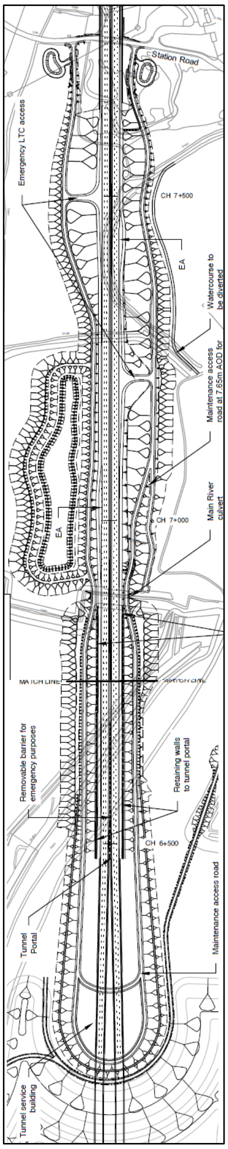
vi. What measures could be implemented to limit access to the junction for a 'Port Only' traffic scenario; and

vii. If the junction design can accommodate appropriate vehicle swept paths e.g. HGV, buses.

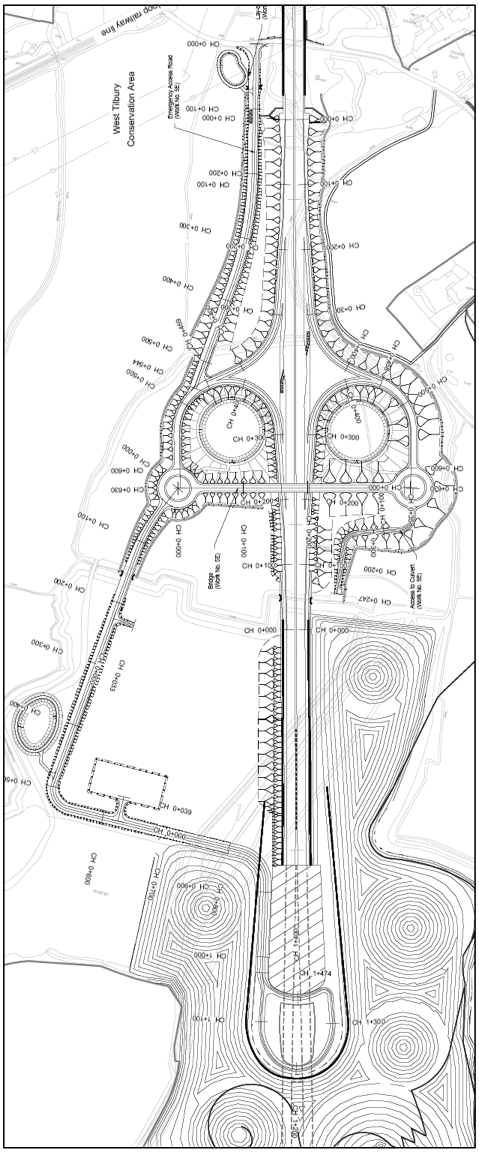
Figure 1: Tilbury Junction Design Options

July 2021 CIC Design

November 2022 DCO Design



Station Road
Emergency LTC access
CH 7+500
EA
Watercourse to be diverted
Maintenance access road at 7.65m AOD for
Main River culvert
CH 7+000
EA
Removable barrier for emergency purposes
Retaining walls to tunnel portal
CH 6+500
Maintenance access road
Tunnel Portal
Tunnel service building



West Tilbury Conservation Area
CH 0+300
CH 0+000
CH 0+039
CH 1+474

3. Potential Tilbury Junction Demand Scenarios

3.1. Seven different potential future traffic demand scenarios at the Tilbury Junction have been estimated based on:

- Three different Tilbury Link Road demand scenarios (based on two different LTC/A13 junction configurations); and
- Three different levels of traffic demand from Local Plan growth at East Tilbury.

The matrix of scenarios analysed in this note is represented by Table 1 below.

Table 1: Summary of Traffic Demand Scenarios Included in this Assessment

Traffic Demand Scenarios		Tilbury Link Road Demand		
		1 - Low TLR Demand **(Current LTC Scheme and LTC / A13 / A1089 Connections)**	**2 – High TLR Demand** **(Alternative LTC Scheme Without LTC / A13 / A1089 Connections)**	**3 – Port Only TLR Demand** **(Current LTC Scheme and LTC / A13 / A1089 Connections)**
East Tilbury Demand	**A- PT/Active Travel Only**	Scenario 1A	Scenario 2A	Scenario 3A
	B- Low Demand	Scenario 1B	Scenario 2B	N/A
	C- High Demand	Scenario 1C	Scenario 2C	N/A

3.2. This section of the note sets out how the traffic demand scenarios have been established and the data sources used.

Tilbury Link Road Demand

3.3. As part of ongoing work testing the impact of TLR as part of the LTC proposals, the Council have specified alternative LTC option runs on the Lower Thames Area Model (LTAM). These alternative LTC option model runs all include the TLR and the Tilbury Junction based on the current NH proposals (Local Refinement Consultation) but do not include a connection to East Tilbury. The alternative options each have different LTC/A13/A1089 junction configurations and result in different levels of traffic using the Tilbury Link Road.

3.4. Three forecast traffic demand scenarios on the TLR and at the Tilbury Junction have been extracted from the LTAM alternative option models, based on the NH DCO model year of 2030:

- **Scenario 1 ('Low' TLR Demand)**: LTC scheme configuration includes TLR and with all the connections currently proposed by NH between the LTC, A13 and A1089 (reflecting the LTC DCO design). This scenario is identified as the 'CTL01' model run of the LTAM. This scenario results in two-way demand along TLR of 1,636 passenger car equivalents (PCUs) during the AM peak hour and 1,793 PCUs during the PM peak hour.
- **Scenario 2 ('High' TLR Demand):** LTC scheme configuration includes TLR but without any connections between the LTC, A13 and A1089. This scenario is identified as the 'CTL02' model run of the LTAM. This scenario results in two-way demand along TLR of 2,499 PCUs during the AM peak hour and 2,566 PCUs during the PM peak hour.

- **Scenario 3 ('Port Only' TLR Demand):** LTC scheme configuration includes TLR with only port vehicles accessing the Port of Tilbury on the TLR and with all the connections currently proposed by NH between the LTC, A13 and A1089 (reflecting the LTC DCO design). This demand scenario is identified as the 'CTL01' model run of LTAM and through link analysis extracts only the vehicle traffic flows accessing the existing Port of Tilbury and Tilbury 2 and then assigning to use the TLR and the proposed Tilbury Junction. This scenario results in two-way demand along TLR of 387 PCUs during the AM peak hour and 204 PCUs during the PM peak hour.

3.5. In terms of the relative difference in traffic flows between the three LTC configurations, Scenario 2 results in higher traffic flows on the TLR and the LTC Tilbury Junction on/off-slip roads, and therefore results in higher overall traffic flows at the Tilbury Junction roundabouts. Scenario 1 results in higher traffic flows on the LTC mainline at this location as it results in a higher traffic demand for the LTC due to the presence of the A13 and A1089 connections further north. Scenario 3 results in the lowest flows on the TLR and flows between Scenario 1 and Scenario 2 for the LTC mainline and on A1089 to the north.

3.6. It should be noted that the LTAM forecast model scenarios have been developed using general Tempro 7.2 traffic growth forecasts. LTAM does also account for consented and committed developments across the modelled area as recorded in the model uncertainty log (with equivalent growth removed from Tempro). Between 2016 and 2030 Tempro forecasts assume an additional 18,700 new homes and 3,666 new jobs in Thurrock. As a result the 2030 LTAM forecasts used in this assessment of the Tilbury Junction do not represent a full Local Plan growth (at least 24,000 new homes by 2040) scenario with the correct spatial distribution of growth sites across Thurrock. It also does not fully represent the future demand associated with Freeport growth aspirations in Thurrock at the Port of Tilbury and London Gateway/DP World.

East Tilbury Connection Demand

3.7. As part of continual work between the Council's Local Plan development and the LTC project, Stantec was commissioned in 2020 to develop high level transport demand scenarios to account for indicative emerging Local Plan development and associated highway network improvements. These preliminary Local Plan scenarios were provided to NH to allow its modelling team to run and assess the impact of Local Plan development and highway network adjustments in the full LTAM as well as the Variable Demand Modelling (VDM) element of the model that allows for trip adjustments as part of the development of the matrix input for LTAM. Some preliminary model runs were undertaken and shared with the Council.

3.8. The networks for this 2020 work were developed based on initial assumptions of potential new connections between the LTC and the local network within Thurrock. A new connection between the LTC and the Port of Tilbury to the west (the Tilbury Link Road) was included. A small connection to the urban conurbation of East Tilbury was also assumed. Both connected to a new grade-separated roundabout junction on the LTC just immediately to the north of the LTC's northern portal. The grade-separated junction modelled within the scenario allowed all movements, but was coded only within the strategic transport model, no further assessment on design or viability was been undertaken.

3.9. The version of the model used for the extraction of data for input into the current Tilbury Junction assessment was what is referred to as the 'With LTC and TLR model'. It included residential development at East Tilbury of a total of 3,075 dwellings, 51,459 m2 of a mixture of B1, B2 and B8 uses, and the development at Port of Tilbury associated with what is known as Tilbury 2.

3.10. Traffic demand for future expected Local Plan growth at East Tilbury only has been extracted from the 'With LTC and TLR model' which includes the Tilbury Junction grade-separated junction (based on different arrangement to the current NH layout) and the TLR, based on a modelled forecast year of 2030. Origin-Destination flows at the Tilbury Junction were extracted but only the traffic demand to/from East Tilbury was used as part of this assessment. The resulting traffic demand for East Tilbury is shown on Table 2.

Table 2: Traffic Demand for East Tilbury, Extracted from 'With LTC and TLR model'

	From East Tilbury		To East Tilbury	
	AM Peak Hour	**PM Peak Hour**	**AM Peak Hour**	**PM Peak Hour**
To/ From LTC (South)	969	992	915	1230
To/ From LTC (North)	167	159	113	225
To/From Tilbury Link Road	62	33	214	234
Total	**1198**	**1184**	**1242**	**1689**

3.11. Based on the traffic demand shown on Table 2, the following three scenarios have been tested as part of this assessment:

- **Scenario A (PT/ Active Travel Only)**: Assumes no general vehicle traffic connection between East Tilbury and the Tilbury Junction. A public transport and active travel connection to East Tilbury could still be provided as part of this scenario.
- **Scenario B (Low Demand):** Includes 50% of the traffic flows exported from the strategic model. This option tests the scenario of a lower level of growth at East Tilbury or a scenario where direct access between the Tilbury Junction and Princess Margaret Road is restricted which would result in no background traffic (other than Local Plan development traffic) using the Tilbury Junction to access East Tilbury and further afield.
- **Scenario C (High Demand)**: Includes 100% of traffic flows exported from the strategic model. This assumes the full level of growth and background traffic included in the 'With LTC and TLR model' model.

4. Junction Merge/ Diverge - Assessment

4.1. A merge/ diverge assessment has been undertaken for the merges and diverges between the LTC and Tilbury Junction, based on Design Manual for Roads and Bridges (DMRB) CD 122 Version 1.1.1. The assessment is based on a review of traffic flows on the merge and diverge slip roads from the Tilbury junction and the traffic flows on the LTC mainline, upstream and downstream of the merge and diverge points. The resulting merge/diverge requirements for each traffic demand scenario have been compared against the current NH design for Tilbury Junction to ascertain whether the design satisfies the requirements.

4.2. Table 3 provides a summary of the merge/diverge assessment and the detailed assessment results are included in Appendix B. The current NH design for Tilbury Junction satisfies the requirements for traffic demand associated with Scenarios 1A and 3A only.

4.3. Scenario 1B and 1C would require an additional lane on the LTC to the south of Tilbury Junction due to a combination of the volumes of East Tilbury traffic going to / coming from south of the river and also due to the large volumes of traffic already on the LTC associated with Scenario 1 (as discussed in Paragraph 3.5).

TECHNICAL NOTE

4.4. Scenario 2A requires two lanes on the southbound merge on-slip due to the level of traffic routing from the Tilbury Link Road to the south on the LTC. Scenarios 2B and 2C would also require two lanes on the northbound diverge off-slip to accommodate the traffic flows going to East Tilbury from the south of the LTC.

Table 3: Merge / Diverge Assessment Results

Merge Diverge Assessment		**Tilbury Link Road Demand**		
		1 - Low TLR Demand (Current LTC Scheme with LTC / A13 / A1089 Connections)	**2 - High TLR Demand (Alternative LTC without LTC / A13 / A1089 Connections)**	**3 – Port Only TLR Demand (Current LTC Scheme with LTC / A13 / A1089 Connections)**
East Tilbury Connection Demand	**A- PT / Active Travel Only**	Scenario 1A: ✓ • Current NH design satisfies the merge/ diverge requirements	Scenario 2A: ✗ • Southbound Merge Requires a 2-lane on-slip	Scenario 3A: ✓ • Current NH design satisfies the merge/ diverge requirements
	B- Low Demand	Scenario 1B: ✗ • Southbound merge requires 4 lanes downstream on the LTC & a 2 lane on-slip • Northbound diverge requires 4 lanes upstream on the LTC & a 2 lane off-slip	Scenario 2B: ✗ • Southbound merge requires a 2 lane on-slip • Northbound diverge requires a 2 lane off-slip	N/A
	C- High Demand	Scenario 1C: ✗ • Not tested as it would have the same issues as Scenario 1B or worse	Scenario 2C: ✗ • Not tested as it would have the same issues as Scenario 2B or worse	N/A

Note: ✓ represents scenarios where the NH design satisfies the merge/ diverge requirements and an ✗ represents scenarios where different merge/ diverge configurations are required

5. Junction Roundabouts - Capacity Assessment

5.1. Junction capacity assessments were undertaken for the two priority roundabouts of the Tilbury Junction based on the current NH layout (including connections with Tilbury Link Road and East Tilbury), for all seven traffic demand scenarios identified in Section 2 of this note. Subsequently, where the initial modelling indicated that the junction was predicted to be over theoretical capacity, junction widening/design adjustments were tested to determine whether the capacity constraints, under the different traffic demand scenarios, could be mitigated.

5.2. The DfT approved Junctions 10 (ARCADY) software has been used for the assessment of the roundabout junctions. The assessment results are given in terms of queueing, delays, and Ratio of Flow to Capacity (RFC). Queues are reported in terms of passenger car unit (PCU) equivalent, where 1 PCU equates to a typical mid-sized car. Although the theoretical capacity of a junction arm is 1.0 RFC, the upper threshold for desirable RFC values is 0.85 and junction arms with higher RFC values are expected to likely have capacity / performance issues.

Current NH layout (Including Connections with Tilbury Link Road and East Tilbury)

5.3. The current NH design for the Tilbury Junction roundabouts includes single-lane approach and exit lanes, without significant flaring, for all roundabout arms. As part of this assessment, the south arm of the western roundabout was assumed to be the TLR which would also provide access to the tunnel servicing area via a priority junction further south of the roundabout. Additionally, a connection with East Tilbury has been included as part of the assessment, assuming a single lane entry and exit roundabout arm on the eastern roundabout. Drawing 100, within Appendix C, provides a high-level illustration of this layout for the purpose of capacity assessment only.

5.4. A summary of the capacity assessment results for the two Tilbury Junction roundabouts based on the current NH design (including connections with Tilbury Link Road and East Tilbury), is shown on Table 4. The full detailed Junctions 10 outputs are included in Appendix D.

5.5. The results show that Scenarios 1A – 1C & 2A – 2C tested exceed the desirable RFC of 0.85 on at least one roundabout arm with the exception of Scenario 3A. Additionally, with the exception of Scenario 1A (during the AM Peak hour) & 3A, the other scenarios exceed the maximum theoretical RFC of 1.0 on at least one roundabout arm.

5.6. Scenarios which include a connection to East Tilbury perform significantly worse than those without a connection due to the increased traffic demand at the roundabouts. Similarly, the high TLR demand scenarios (where the LTC configuration does not include a connection with the A13 and A1089) perform worse due to the increased traffic demand along TLR and at the Tilbury Junction (as discussed in Paragraphs 3.4 and 3.5).

5.7. At the western roundabout, the critical roundabout arms are the north arm (traffic from the south on the LTC) and the south arm (TLR). The eastern roundabout generally performs better than the western roundabout and only operates above maximum theoretical capacity in scenarios with the East Tilbury connection. At the eastern roundabout, the critical roundabout arms are the west arm (traffic from the TLR) and the east arm (East Tilbury traffic).

5.8. Overall, it is evident that the unmodified current NH design for the Tilbury Junction cannot accommodate either the low or high traffic levels forecast along TLR or with any of the general traffic demand scenarios associated with an East Tilbury connection / development. Modifications to the proposed layout would be required to achieve a suitable layout.

Table 4: Tilbury Junction Roundabout Capacity Assessment Results - NH Layout + East Tilbury Link

Junction Capacity Assessment		Tilbury Link Road Demand		
		1 - Low TLR Demand (Current LTC scheme with LTC / A13 / A1089 Connections)	**2 - High TLR Demand (Current LTC scheme without LTC / A13 / A1089 Connections)**	**3 – Port Only TLR Demand (Current LTC scheme with LTC / A13 / A1089 Connections)**
East Tilbury Connection Demand	**A- PT / Active Travel Only**	Scenario 1A: ✗ • Junction operates over capacity	Scenario 2A: ✗ • Junction operates over capacity	Scenario 3A: ✓ • Junction operates within capacity
	B- Low Demand	Scenario 1B: ✗ • Junction operates over capacity	Scenario 2B: ✗ • Junction operates over capacity	N/A
	C- High Demand	Scenario 1C: ✗ • Junction operates over capacity	Scenario 2C: ✗ • Junction operates over capacity	N/A

Note: ✓ represents scenarios where the NH design satisfies the junction capacity requirements and an ✗ represents scenarios where the junction operates above desirable levels of capacity, or the maximum capacity is exceeded

Junction Improvements

5.9. A junction improvement package was tested to determine whether design modifications such as lane widening could accommodate additional traffic at Tilbury Junction associated with future growth ambitions at the Port of Tilbury, East Tilbury Local Plan sites and / or alternative LTC/A13/A1089 junction configurations. In the first instance, widening of all roundabout approach arms to two lanes was tested. However, it was found that targeted widening on specific roundabout arms would yield similar outcomes as uniform widening across all arms.

5.10. The targeted junction improvements identified and assessed include:

Western Roundabout

- North Arm: entry lane widened to two lanes (with additional flaring) for approximately 60m
- South Arm: entry and exit lanes widening to two lanes for approximately 60m
- East Arm: entry and exit lanes widening to two lanes, through to the eastern roundabout (requiring widening of the bridge over LTC between the two roundabouts)

Eastern Roundabout

- West arm: entry lane widening to two lanes (with additional flaring), through to the western roundabout
- North Arm: exit lane widened to two lanes through to the LTC

5.11. The junction improvements at the western and eastern roundabouts of Tilbury Junction are highlighted in green on Figure 2 (and shown in Appendix C drawing 102) and include widening the bridge over LTC between the two roundabouts to facilitate the two running lanes in each direction. Commentary in the provision for active travel and public transport facilities is given later in this note.

Commented [BN1]: Is the junction improvement package shown on a plan in Appendix C? Add reference to Appendix C and Dwg No.

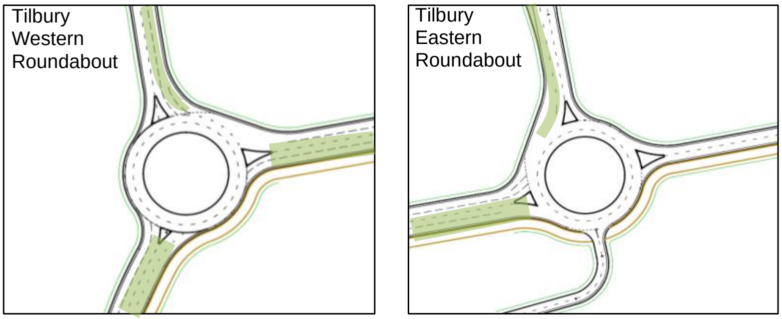


Figure 2: Junction Improvements at the Tilbury Junction

5.12. The capacity assessment results for the two Tilbury Junction roundabouts, including the improvement package described above, is shown on Table 5. The results show that Tilbury Junction operates within desirable RFC levels with no queuing or delay issues under Scenarios 1A, 1B, 2A and 3A across both the AM and PM peak hours.

5.13. In Scenario 2B, during the AM peak hour, the roundabouts operate within capacity but with the north arm of the western roundabout is forecast to operate above the desirable RFC of 0.85. In all other scenarios, one or more roundabout arms are forecast to operate over maximum theoretical capacity with significant delays and queuing. The critical roundabout arms under this improvement package are the north arm of the western roundabout and the west and east arms of the east roundabout.

5.14. Overall, the junction improvement package tested facilitates the high TLR demand scenario (associated with an alternative LTC/A13 junction configuration) with a public transport and active travel only connection to East Tilbury (Scenarios 1A and 2A). The junction improvements also facilitate low TLR traffic demand scenario (under the current NH LTC/A13 configuration) combined with a 'low demand' traffic demand at East Tilbury. However, all other scenarios operate over desirable levels of capacity and therefore indicate that the suggested improvements tested cannot accommodate the combined traffic demand associated with future growth ambitions at East Tilbury and a high TLR demand scenario (alternative LTC scheme and LTC/A13 junction configuration).

Table 5: Tilbury Junction Roundabout Capacity Assessment Results (Improvement Package)

Junction Capacity Assessment		**Tilbury Link Road Demand**		
		1 - Low TLR Demand (With LTC / A13 / A1089 Connections)	**2 - High TLR Demand (Without LTC / A13 / A1089 Connections)**	**3 – Port Only TLR Demand (Only Port of Tilbury Traffic accessing Junction)**
East Tilbury Connection Demand	**A- PT / Active Travel Only**	Scenario 1A: ✓ • Junction improvements tested accommodates traffic flows	Scenario 2A: ✓ • Junction improvements tested accommodates traffic flows	Scenario 3A: ✓ • Junction operates within capacity
	B- Low Demand	Scenario 1B: ✓ • Junction improvements tested accommodates traffic flows	Scenario 2B: ✗ • Junction operates slightly over capacity with the improvements tested • More comprehensive improvements expected to resolve issues	N/A
	C- High Demand	Scenario 1C: ✗ • Junction operates over capacity with the improvements tested • More comprehensive improvements expected to resolve issues	Scenario 2C: ✗ • Junction operates over capacity with the improvements tested • More comprehensive improvements could potentially resolve issues	N/A

Note: ✓ represents scenarios where the improvements satisfy the junction capacity requirements and an ✗ represents scenarios where the junction operates above desirable levels of capacity, or the maximum capacity is exceeded

Tilbury Junction - Capacity Assessment Summary

5.15. Junction capacity assessments were undertaken for the two priority roundabouts of the Tilbury Junction, for all seven traffic demand scenarios which include the Tilbury Link Road, alternative LTC/ A13 configurations and different levels of traffic demand associated with growth at East Tilbury.

5.16. The assessment results highlight that the current NH design for the Tilbury Junction cannot accommodate the 'low' and 'high' traffic forecasts associated with a Tilbury Link Road or traffic associated with an East Tilbury connection. The current NH design could only accommodate Scenario 3A (Port only traffic).

5.17. A junction improvement package was tested which included widening at specific roundabout arms. This would facilitate the 'high' traffic demand scenarios on the TLR (under alternative LTC/A13/A1089 junction configurations) and with a public transport and active travel only connection to East Tilbury (Scenarios 1A, 2A and 3A). The junction improvements also facilitate the 'low' traffic demand scenario from the Tilbury Link Road (with the current NH LTC/A13/A1089 configuration) combined with a 'low demand' traffic demand at East Tilbury. The improvements cannot accommodate the combined traffic demand associated with 'high' future growth demand at East Tilbury and 'high' traffic demand on the Tilbury Link Road (alternative LTC/A13/A1089 junction configuration).

6. 'Port Only' TLR Control Mechanisms

6.1. NH and Thurrock Council would need to review and agree the mechanism for control on enforcement for a 'Port Only' traffic access arrangement on the TLR. It is anticipated that free-flow access and egress would be favoured and provided with 'HGV only' or 'Port Only' lane enforcement. Physical measures would need to be assessed against the safety implications and are likely to be limited to TLR. Various details have been considered below to understand how this mechanism may look:

- Advanced warning signage and in-lane line marking distinguishing the exits on the LTC mainline and at the junction. This signage would be aimed at ensuring traffic in both directions on the mainline are adequately informed that no local access is available from Tilbury Junction, and that 'Port Only' traffic should use the slips; and

- Number plate recognition strategies - this may involve the installation of number plate recognition cameras on the slips that implement variable message signage messages when a vehicle that is not recognised accesses the slip. This message may present a message indicating to return to LTC at the junction. In addition to the message, a number plate recognition camera may be located on TLR and should the vehicle ignore the signage, a penalty may be issued to the driver as a further deterrent (although, this will result in the vehicle still accessing TLR). A different solution may involve installation of number plate recognition cameras on TLR, west of Tilbury Junction. This may also include a motorised barrier that only permits one vehicle at a time to pass when entering TLR. This may also include a turnaround area to enable vehicles entering the port to return to Tilbury Junction and then LTC.

6.2 Strategies to manage Tilbury Junction could be similar to solutions implemented previously at the M11 traffic control centre access. During the 2012 Olympics the facility acted as a temporary logistics freight hub, with non-HGV vehicle restrictions enforced through the use of signage as shown in Figure 5. Standard operations of this facility still include restrictions to only permit access to vehicles accessing the traffic control centre as shown in Figure 4.

Figure 3: Logistics Centre HGV Signage on the M11 (Source: Google Maps, 2012)

Figure 4: Traffic Control Centre Signage on the M11 (Source: Google Maps, 2012)

6.3 Another example is the proposed Interstate 75 Truck only lane in Georgia, with the control treatment shown in Figure 5.

Figure 5: Truck Only Lane Signage (Source: https://0014203-gdot.hub.arcgis.com/)

7. Junction Design Review and Potential Improvements

Standards and Safety

7.1. The geometry of the proposed junction meets the minimum requirements of DMRB CD 122 regarding grade separated junctions. The connector road loops are approximately 75m radius as specified by CD 122 Section 5.10. The diverge layout meets the requirements of layout A shown in figure 3.30a of CD 122. The merge layout meets the requirements of layout A in figure 3.14a of CD 122. The geometry of the design is therefore only appropriate for Scenarios 1A and 3A and is inadequate for all other traffic demand scenarios as detailed under Section 3 of this note.

7.2. DMRB CD 116 gives guidance regarding the design of roundabouts. Upon review, the proposed design may reduce capacity. From section 3.19.2, a kerb entry radius of 15m or less reduces capacity, the proposals show entry kerb radii between 16.5 and 17.5m. Exit kerb radii are undersized, shown as around 17.5m radii; section 3.29.2 states that exit kerb radii should be 40m. A full analysis of the roundabouts including deflection angles has not been undertaken at this stage. Notwithstanding capacity considerations of the roundabout which are covered in Section 4, it is expected that a roundabout design which meets the required geometrical standards can be delivered within the overall Tilbury Junction footprint proposed by NH.

7.3. To consider the potential future largest vehicles accessing Tilbury junction, swept path analysis has been conducted for three vehicle types. The vehicles are:

- 12.5m Bus
- 16.5m HGV
- 18.5m HGV

7.4. These vehicle types are expected to be the largest vehicles that will access Tilbury Junction when considering a potential future MRT service and port uses. The drawings are presented in Appendix E.

7.5. The swept path tracking indicates that the proposed junction is adequate to cater for 12.5m buses and 16.5m HGV. The western roundabout at the junction is unable to cater for westbound left turning 18.5 HGV with vehicles passing over the outside kerb when manoeuvring through the junction.

Public Transport and Active Travel Provision

7.6. The current NH layout for Tilbury Junction does not include dedicated priority facilities or road space for public transport such as bus lanes. If an additional traffic lane is provided in both directions on the road linking the two roundabouts, it would provide flexibility to reallocate road space to public transport in the future.

7.7. The current NH layout for Tilbury Junction also does not currently include dedicated facilities for active travel modes. Given the aspirations for future growth at East Tilbury and also at the Port of Tilbury, it is essential that adequate active travel provision is included as part of any Tilbury Junction layout.

7.8. A potential solution would be to provide a combined 5 metre active travel corridor (2 metres for pedestrians and 3 metres for cyclists), on the southern side of the road between the East Tilbury connecting road and the Tilbury Link Road. At the Tilbury Link Road, the active travel corridor would stay on the eastern side of the carriageway and continue southwards until a point where a suitable crossing location could be provided. This solution would limit the number crossings on the roundabout arms to only the south arm of the east roundabout which is a servicing road and is not expected to have frequent or high volumes of traffic.

7.9. The typical cross-section of a 5 metre active travel corridor, on the bridge linking two roundabouts, is shown on Drawing 110 within Appendix C.

Tilbury Junction Improvement Package

7.10. An improvement package for Tilbury Junction arrangement as a whole has been prepared which includes active travel provision and facilitates the 'port only', 'low' and 'high' traffic demand forecasts for the Tilbury Link Road. The improvement package includes the following improvements:

- Roundabout junction improvement measures set out under Paragraph 5.10. As part of this, two traffic lanes are provided in both directions on the road linking the two roundabouts (requiring bridge widening) which would provide flexibility to reallocate road space to public transport in the future.
- Southbound on-slip road (merge) onto the LTC widened to two lanes without a lane gain on the LTC.
- 5 metre wide active travel corridor on the southern side of the road between the East Tilbury connecting road and the Tilbury Link Road, as set out under Paragraph 7.8.

7.11. An indicative drawing showing the layout of the improvement package is shown on Drawing 102 in Appendix C. It should be noted that this drawing is not a developed design but is instead an indicative layout of high-level improvement measures, prepared to inform the capacity assessment undertaken as part of the work set out in this note.

7.12. The overall merge/ diverge and junction capacity assessment results for the Tilbury Junction improvement package are shown in Table 6.

Table 6: Tilbury Junction Improvement Package Merge/ Diverge and Junction Capacity Results

Merge/ Diverge and Junction Capacity Assessment		Tilbury Link Road Demand		
		1 - Low TLR Demand (With LTC / A13 / A1089 Connections)	**2 - High TLR Demand (Without LTC / A13 / A1089 Connections)**	**3 – Port Only TLR Demand (Only Port of Tilbury Traffic accessing Junction)**
East Tilbury Demand	**A- PT/ Active Travel Only**	Scenario 1A • Merge/ diverge: ✓ Improvements satisfy the merge/ diverge requirements • Junction Capacity: ✓ Improvements tested accommodates traffic flows	Scenario 2A • Merge/ diverge: ✓ Improvements satisfy the merge/ diverge requirements • Junction Capacity: ✓ Improvements tested accommodates traffic flows	Scenario 3A • Merge/ diverge: ✓ Improvements satisfy the merge/ diverge requirements • Junction Capacity: ✓ Improvements tested accommodates traffic flows
	B- Low Demand	Scenario 1B • Merge/ diverge: ✗ 4 lanes required on LTC south of junction • Junction Capacity: ✓ Improvements tested accommodates traffic flows	Scenario 2B • Merge/ diverge: ✗ Northbound diverge requires a 2-lane on-slip • Junction Capacity: ✗ Operates slightly over capacity with the improvements tested	N/A
	C- High Demand	Scenario 1C • Merge/ diverge: ✗ 4 lanes required on LTC south of junction • Junction Capacity: ✗ Operates over capacity with the improvements tested	Scenario 2C • Merge/ diverge: ✗ Southbound Merge and northbound diverge requires a 2-lane on-slip • Junction Capacity: ✗ Operates over capacity with the improvements tested	N/A

Note: ✓ represents scenarios which satisfy the merge diverge or junction capacity requirements

✗ represents scenarios where different merge/ diverge configurations are needed or the junction operates above desirable levels of capacity, or the maximum capacity is exceeded

7.13. The results show that with the junction improvement package proposed, Tilbury Junction accommodates the 'port only', 'low' and 'high' traffic demand forecasts for the Tilbury Link Road but only if a general traffic connection to East Tilbury is not provided (i.e. allowing public transport and active travel connection only).

7.14. Scenario 2B (high TLR demand and low East Tilbury demand) could also potentially be accommodated with additional roundabout improvements such as left-turn bypass lanes on specific roundabout entry arms (these improvements have not been tested as part of this assessment).

7.15. Under Scenarios 1B and 1C ('low' TLR scenario and a general traffic connection to East Tilbury) the traffic demand tested would require four lanes on the mainline LTC.

Alternative Junction Improvements

7.16. Alternative Junction Improvements or configurations which could be assessed as part of future studies include the following:

- Junction widening with segregated left-turn bypass lanes
- Signal controlled or partially signal controlled roundabouts based on a similar design to the current NH layout
- Signal controlled junctions (three-arm) including bus priority and active travel provision

8. Summary and Conclusions

8.1. This note reviews the design characteristics and standards; the appropriateness of the layout and configuration of NH's proposal for the Tilbury Junction. An assessment is made of the capacity of Tilbury Junction (and its associated roundabout junctions) under a number of traffic demand scenarios which consider the potential traffic demand and growth predicted to occur in the vicinity of the junction. It also considers the capacity of the merge / diverge arrangement between the mainline LTC and Tilbury junction.

8.2. Seven different traffic demand scenarios at the Tilbury Junction have been estimated based on two different LTC configurations (with the TLR in place) and three different levels of potential traffic demand from Local Plan growth at East Tilbury.

8.3. An assessment has been undertaken of the merges and diverges between the LTC and Tilbury Junction. The merge/diverge assessment shows that the current NH design would only facilitate additional traffic under the 'port only' and 'low' TLR forecast traffic demand scenarios and with a public transport and active travel only connection to East Tilbury (Scenarios 1A and 3A).

8.4. A junction improvement package was developed and tested to determine whether additional lanes / widening on specific roundabout arms and modifications to the merge/diverge arrangements could help accommodate higher traffic demand scenarios at the Tilbury Junction.

8.5. Overall, it was found that:

i. The currently proposed NH Tilbury junction design would only accommodate the 'port only' 2030 forecast traffic demand scenario. NH's configuration of the junction does not provide adequate capacity to support the 'low' and 'high' 2030 forecast traffic demand scenarios along the TLR. It would therefore not provide adequate capacity to fully support future growth aspirations and movement demands associated with Freeport proposals at the Port of Tilbury and developments sites proposed as part of the emerging Thurrock Local Plan.

ii. With an improvement package including junction design changes and slip-road modifications, both the 'low' and 'high' demand scenarios on the TLR can be accommodated but only if a public transport and active travel only connection to East Tilbury is provided (i.e. not a full general traffic access).

iii. The proposed NH layout for Tilbury Junction does not include dedicated facilities for public transport or active travel. Space should be provided on the road linking the two roundabouts to provide flexibility to reallocate road space to public transport in the future. Additionally, a combined 5 metre active travel route should be provided on the southern side of the road between the East Tilbury connecting corridor and the Tilbury Link Road.

8.6. Alternative junction improvements or configurations could be assessed as part of future studies to determine whether Tilbury Junction could facilitate higher levels of traffic demand from the TLR and East Tilbury.

Appendix A – LTC General Arrangement Plan for Tilbury Junction (LTC Local Refinement Consultation May 2022)

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P01	S8	19/10/2022	DCO Application	GP	RO	ASB

NOTES:

1. The proposed arrangement of the Scheme is illustrative only and will be subject to change as part of detailed design development. Any changes will be limited to being within the constraints included in the Development Consent Order (application document reference TR010032/APP/3.1).
2. These plans should be read in conjunction with the Development Consent Order (application document reference TR010032/APP/3.1).
3. For Environmental details refer to the Environmental Masterplan (application document reference TR010032/APP/6.2 Fig 2.4) and Environmental Constraints Plan (application document reference TR010032/APP/6.2 Fig 2.3) and associated drawings and documents.

BOUNDARIES

- Order Limits
- Local Authority boundary
- Proposed replacement travellers site

PROPOSED ENGINEERING AND CONSTRUCTION

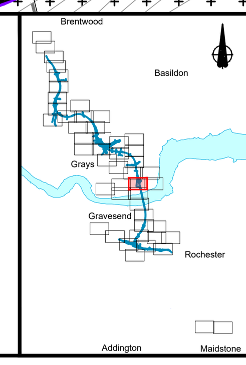
- New carriageway
- Overbridge
- Underpass
- Culvert
- Traffic sign
- Gantry
- Lighting
- Infiltration basin, detention basin or retention pond
- Walking, cycling and horse-riding routes
- Green Roof for Tunnel Service Building
- Tunnel
- Ground protection tunnel
- Earthworks - Cutting
- Earthworks - Embankment
- Earthworks - False cutting and landscaping
- Verge
- Retaining wall
- Water pipe & self-regulating valve
- Maintenance access
- Car park
- Rendezvous point

PROPOSED UTILITIES

- Underground gas diversion
- Realigned or modified overhead electricity line
- Underground multiutility alignment
- Diversion ties into existing network
- Utility compound or substation

PROPOSED ENVIRONMENTAL WORKS

- Woodland planting
- Grassland planting
- Ecological habitat creation and receptor site for protected species
- Temporary ecological habitat
- Bat Barn structure
- Ecological pond
- Flood Compensation Area
- Open space provision, replacement open space or replacement common land
- Hedgerow
- Watercourse diversion
- Ecological fencing (badger)
- Acoustic barrier
- Fencing



Client: National Highways

Project: LOWER THAMES CROSSING

Status: DCO Application

Application Document Number: TR010032/APP/2.5

Original Size: A1

Revision: P01

Scale: 1:2500

Drawing title: GENERAL ARRANGEMENT REGULATION 5(2)(o) SHEET 20

Drawing Number: HE540039-CJV-BOP-SZZ_GN000000_-DR-CX-10017

HE540039-CJV-BOP-SZZ_GN000000_-DR-CX-10017.dwg

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P01	S8	19/10/2022	DCO Application	GP	RO	ASB

NOTES:

1. The proposed arrangement of the Scheme is illustrative only and will be subject to change as part of detailed design development. Any changes will be limited to being within the constraints included in the Development Consent Order (application document reference TR010032/APP/3.1).
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- Water pipe & self-regulating valve
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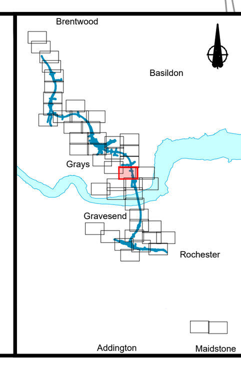


Client

national highways

Project

LOWER THAMES CROSSING

Status: DCO Application

Original Size: A1

Revision: P01

Application Document Number: TR010032/APP/2.5

Scale: 1:2500

Drawing title

GENERAL ARRANGEMENT REGULATION 5(2)(o) SHEET 23

Drawing Number: HE540039-CJV-BOP-SZZ_GN000000_-DR-CX-10020

HE540039-CJV-BOP-SZZ_GN000000_-DR-CX-10020.dwg

TECHNICAL NOTE

Appendix B – Merge / Diverge Assessment Results

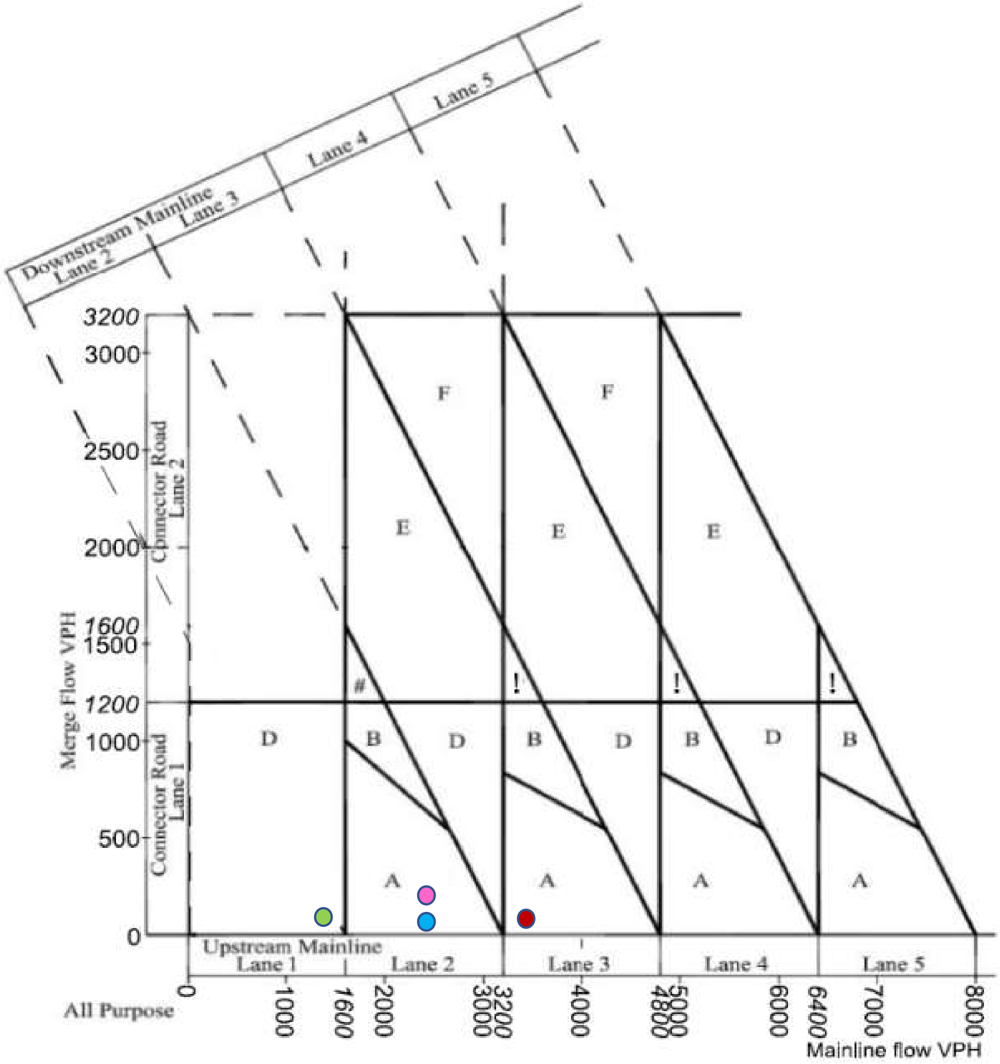
Northbound Merge

Flows in Vehicles

S1A	Upst. Main	Merge	
AM Peak	3427.55	25.408	A 3>3
PM Peak	2514.404	25.352	

S2A			
AM Peak	2518.512	152.234	A 2>2
PM Peak	1447.674	24.026	

Figure 3.12a All-purpose road merging diagram

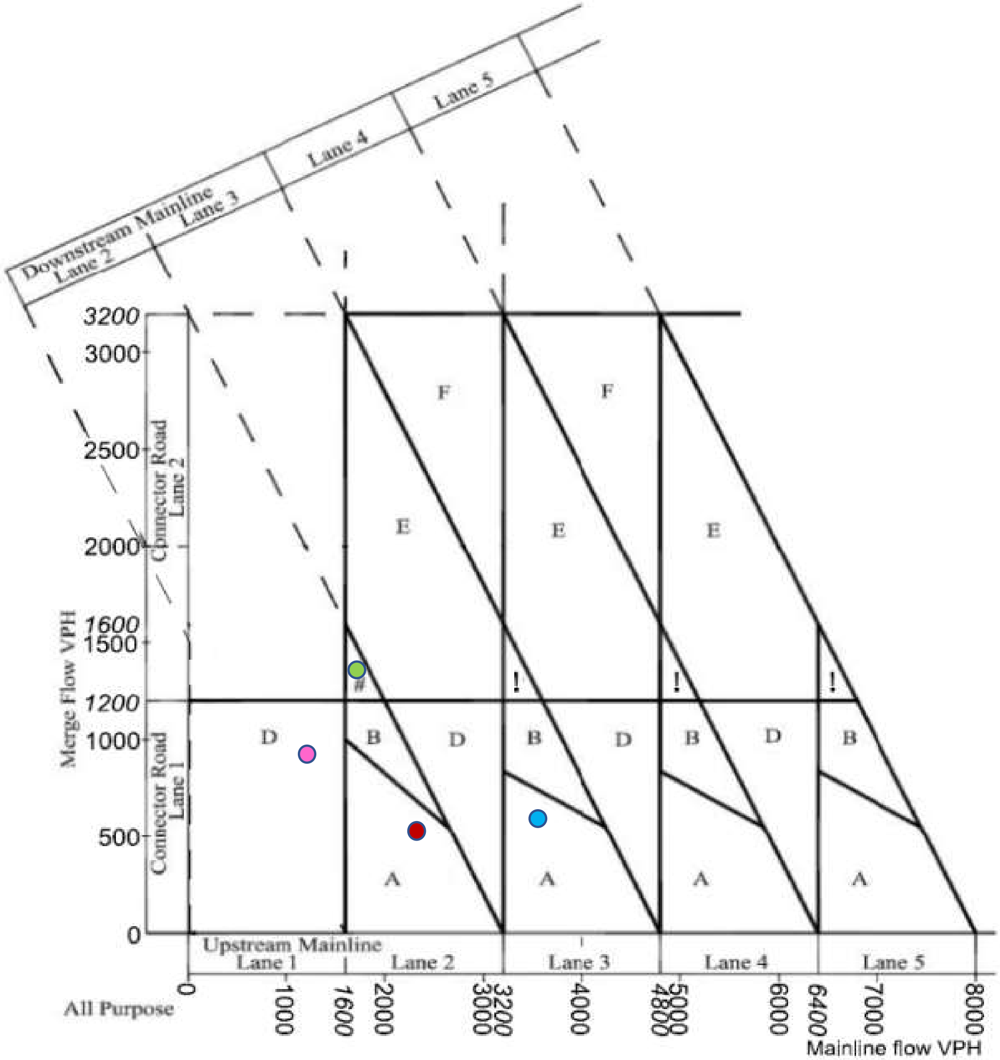


Southbound Merge
Flows in Vehicles

S1A	Upst. Main	Merge		
AM Peak	2476.026	521.544	(red)	A 3>3
PM Peak	3464.076	686.1	(blue)	

S2A				
AM Peak	1390.49	921.382	(pink)	B* 2>2
PM Peak	1864.85	1357.562	(green)	

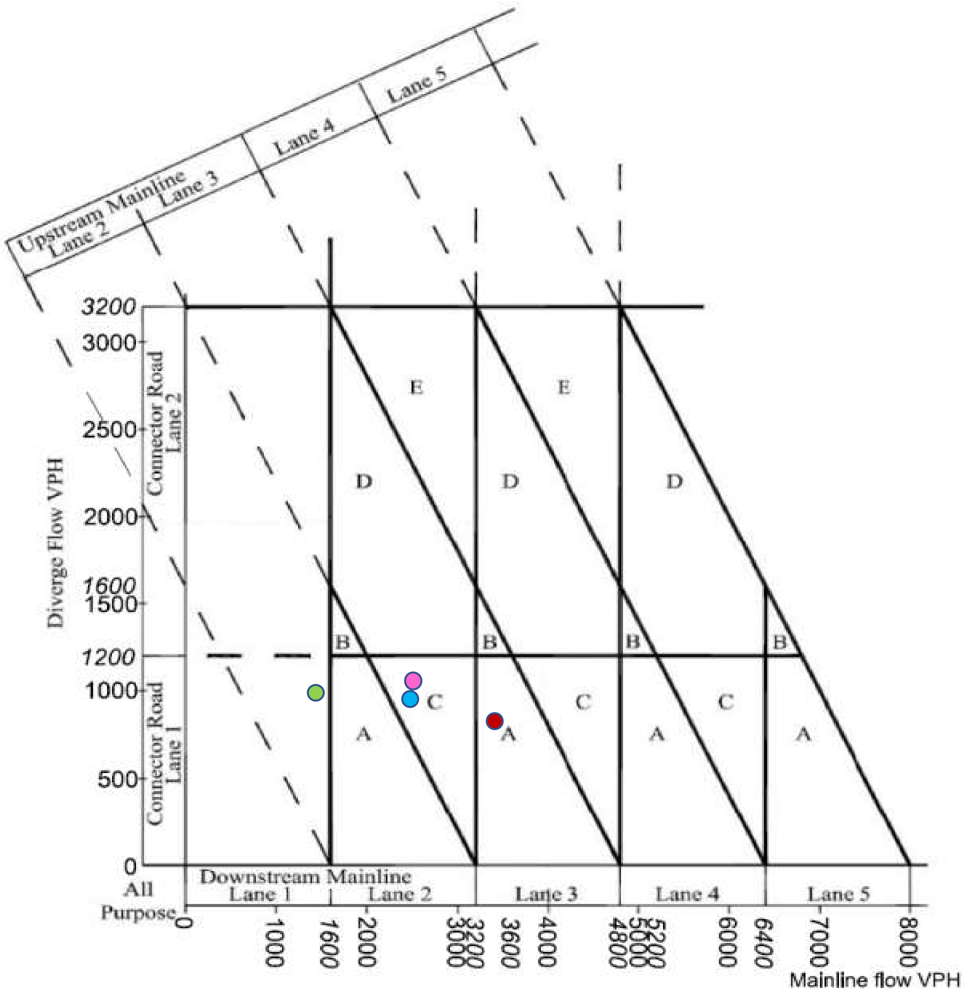
Figure 3.12a All-purpose road merging diagram



Northbound Diverge
Flows in Vehicles

S1A	Dwnst. Main	Diverge		
AM Peak	3427.55	765.616	● (red)	
PM Peak	2514.404	949.15	● (blue)	A 3>3
S2A				
AM Peak	2518.512	1024.824	● (pink)	C 3>2
PM Peak	1447.674	983.652	● (green)	

Figure 3.26a All-purpose road diverging diagram

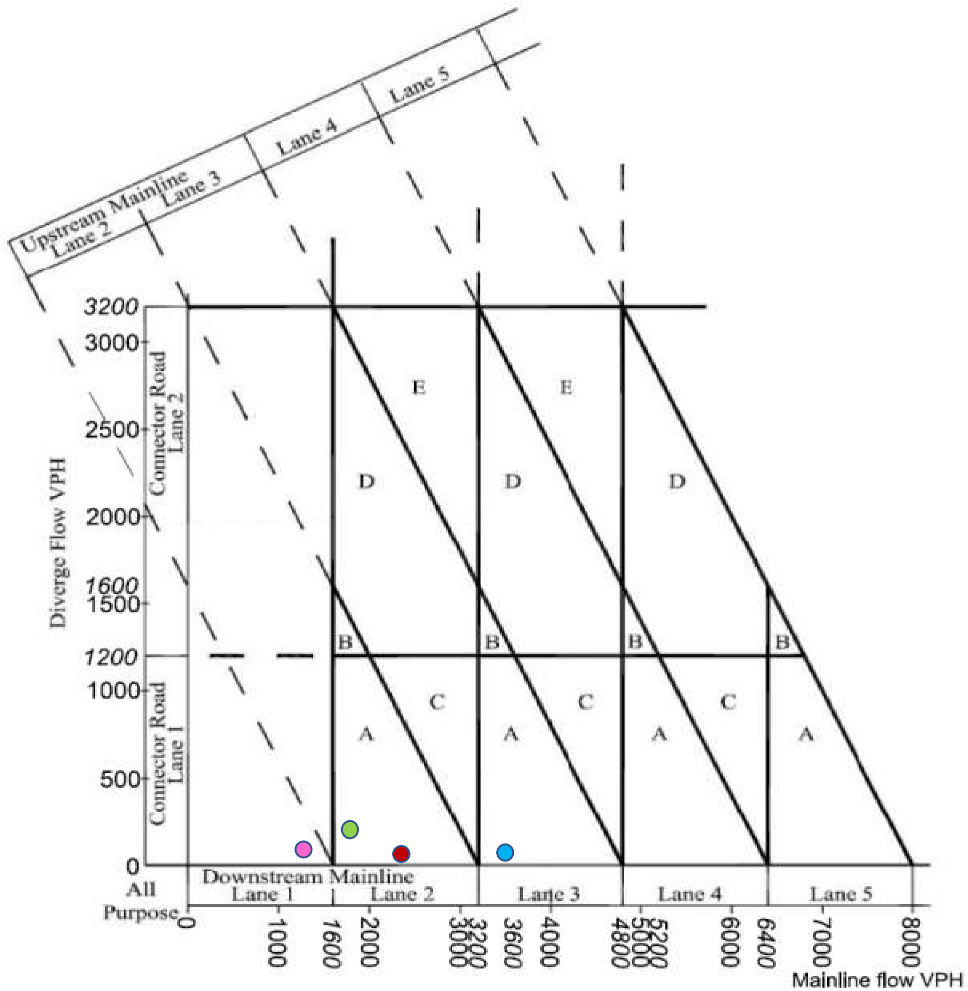


Southbound Diverge

Flows in Vehicles

S1A	Dwnst. Main	Diverge		
AM Peak	2476.026	55.73	● (red)	A 3>3
PM Peak	3464.076	23.55	● (blue)	
S2A				
AM Peak	1390.49	71.834	● (pink)	A 2>2
PM Peak	1864.85	170.31	● (green)	

Figure 3.26a All-purpose road diverging diagram



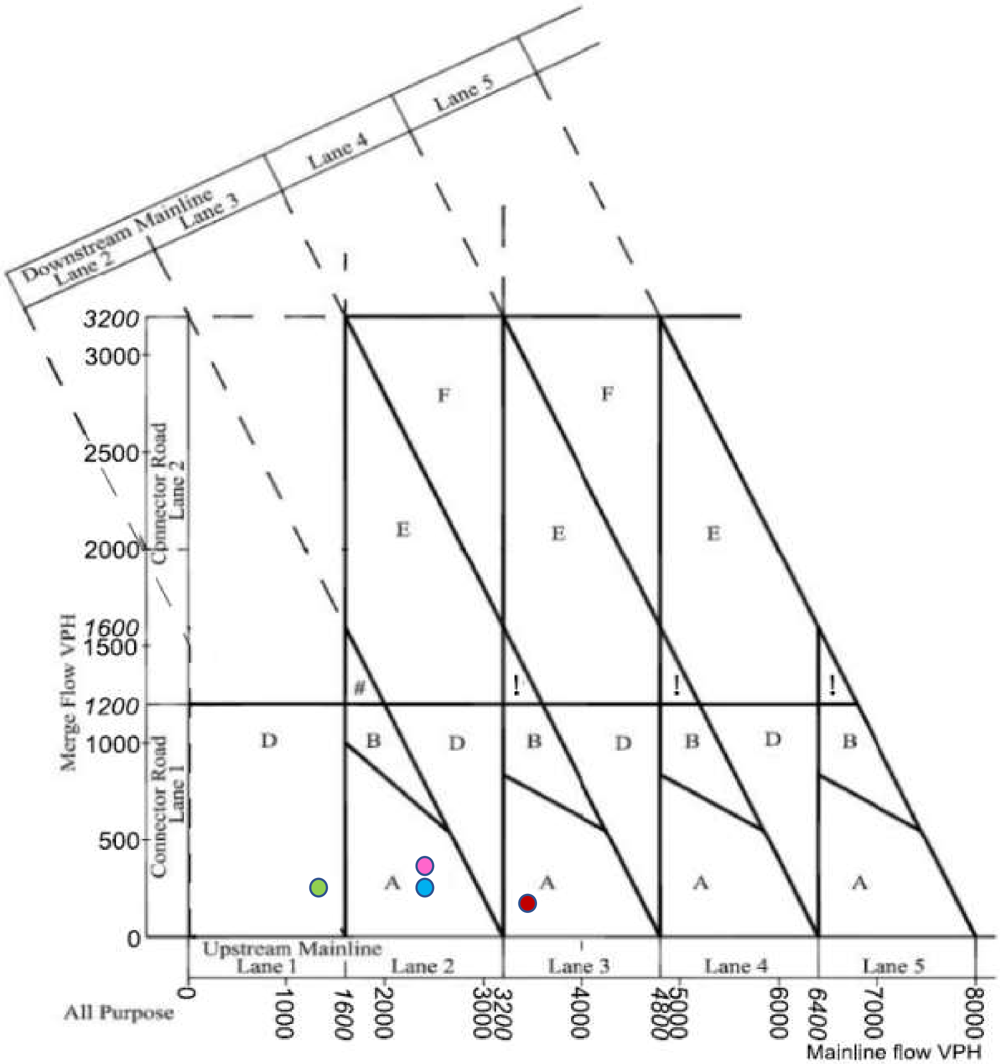
Northbound Merge

Flows in Vehicles

S1B	Upst. Main	Merge		
AM Peak	3427.55	183.708	● (red)	A 3>3
PM Peak	2514.404	264.452	● (blue)	

S2B				
AM Peak	2518.512	310.534	● (pink)	A 2>2
PM Peak	1447.674	263.126	● (green)	

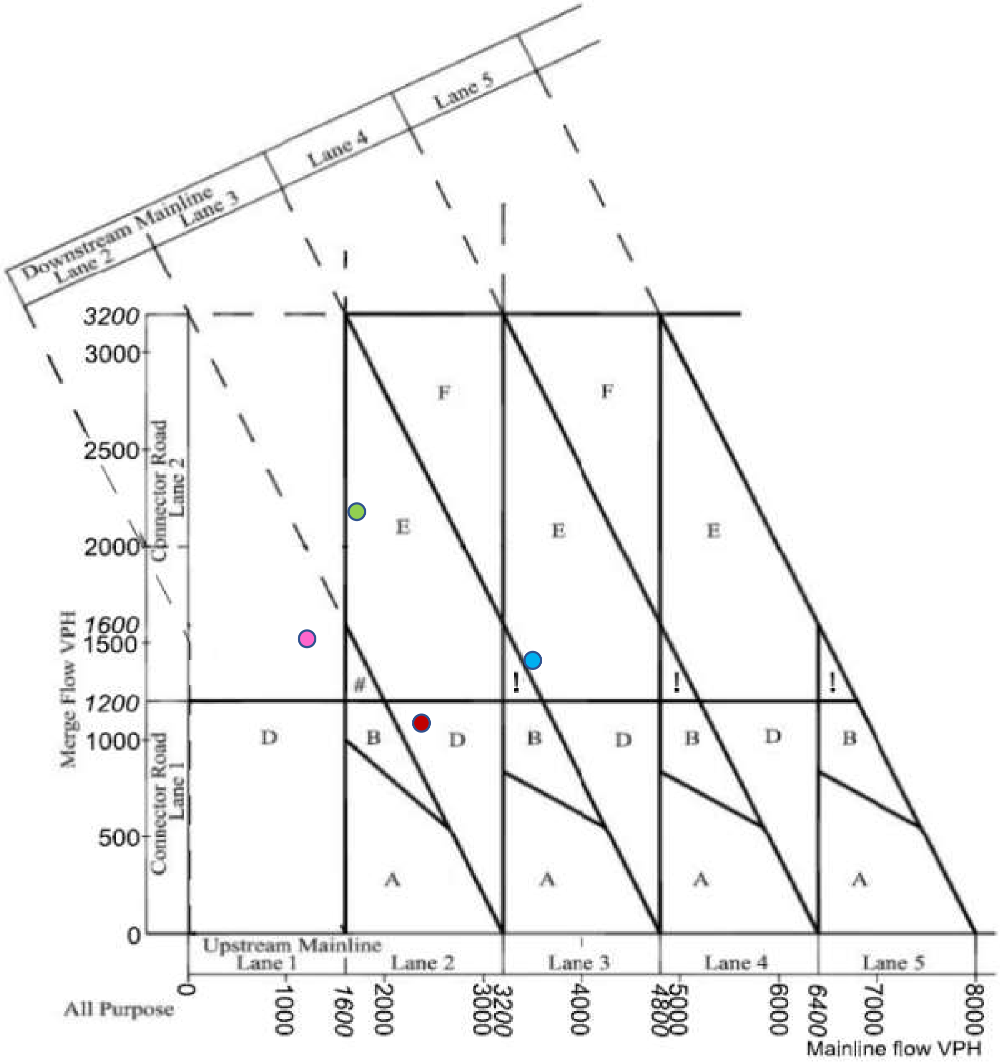
Figure 3.12a All-purpose road merging diagram



Southbound Merge
Flows in Vehicles

S1B	Upst. Main	Merge		
AM Peak	2476.026	1116.844	●	E 3>4
PM Peak	3464.076	1436.4	●	
S2B				
AM Peak	1390.49	1516.682	●	E 2>3
PM Peak	1864.85	2107.862	●	

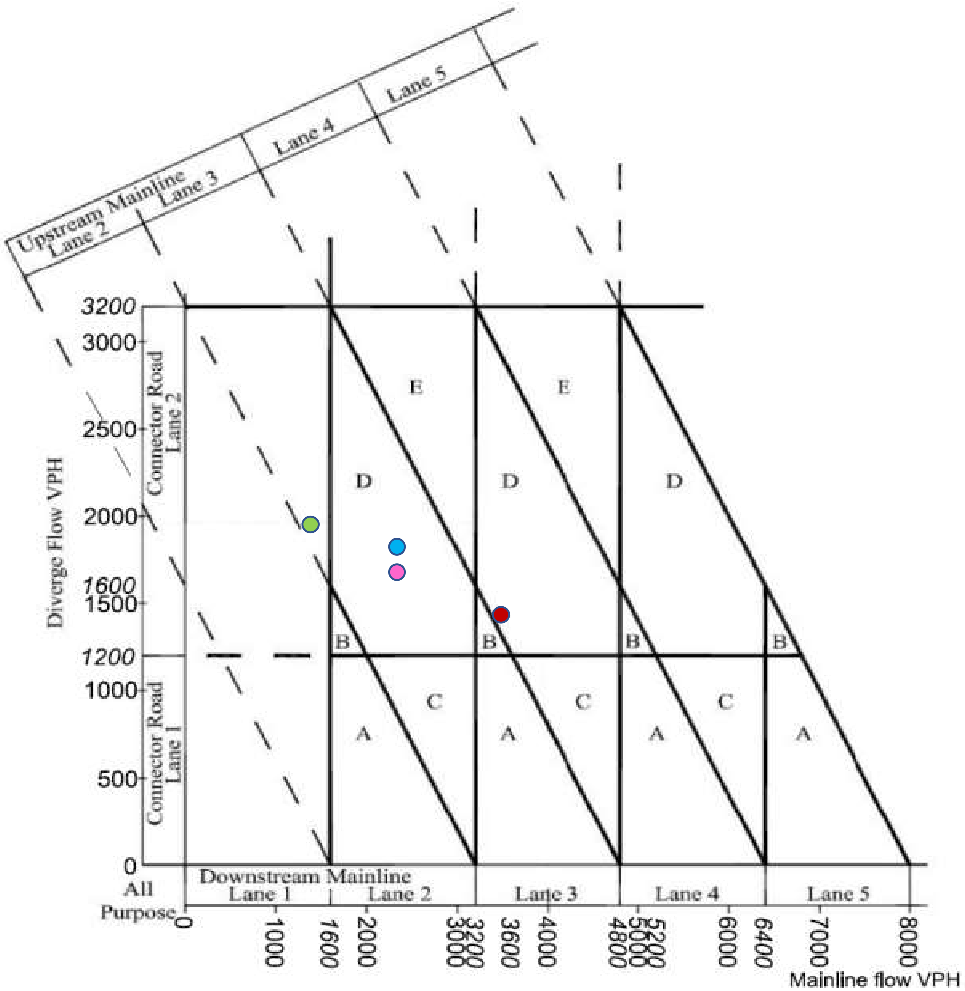
Figure 3.12a All-purpose road merging diagram



Northbound Diverge
Flows in Vehicles

S1B	Dwnst. Main	Diverge		
AM Peak	3427.55	1437.616	(red)	
PM Peak	2514.404	1807.35	(blue)	D 4>3
S2B				
AM Peak	2518.512	1696.824	(pink)	D 3>2
PM Peak	1447.674	1841.852	(green)	

Figure 3.26a All-purpose road diverging diagram



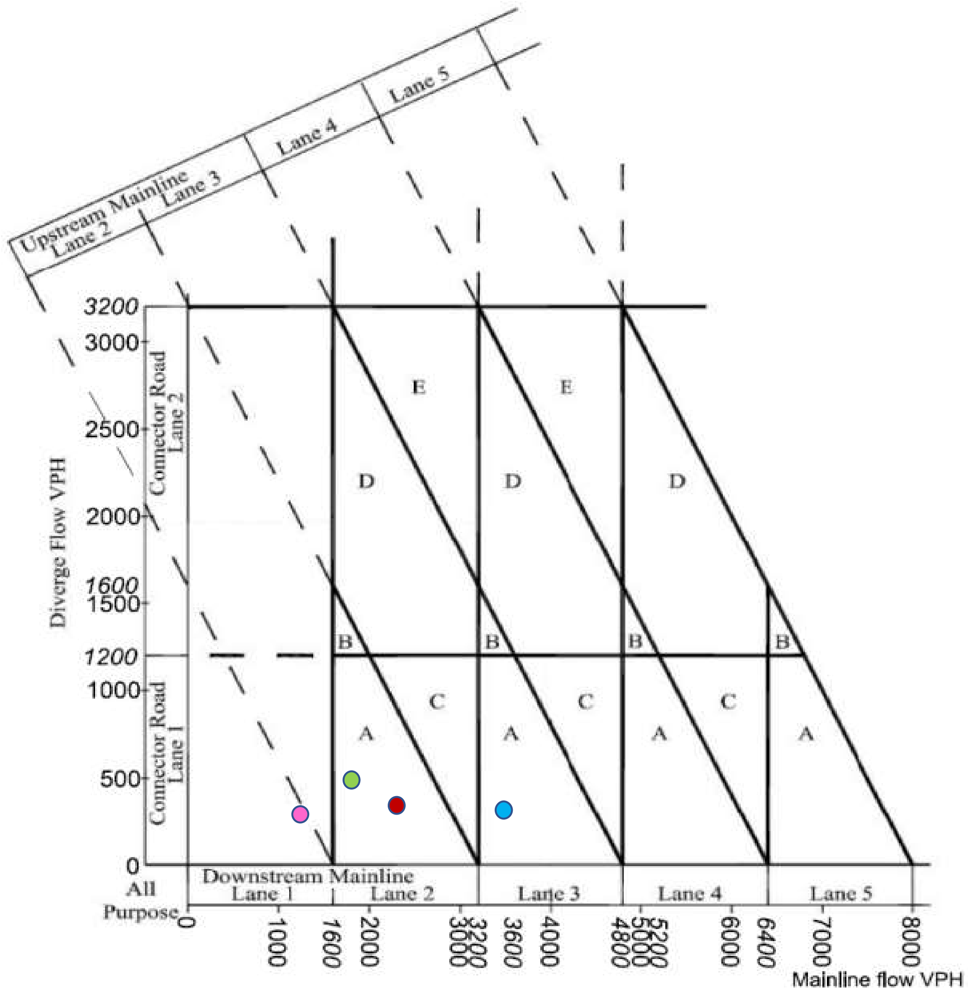
Southbound Diverge

Flows in Vehicles

S1B	Dwnst. Main	Diverge	
AM Peak	2476.026	316.43	A 3>3
PM Peak	3464.076	235.85	

S2B			
AM Peak	1390.49	332.534	A 2>2
PM Peak	1864.85	382.61	

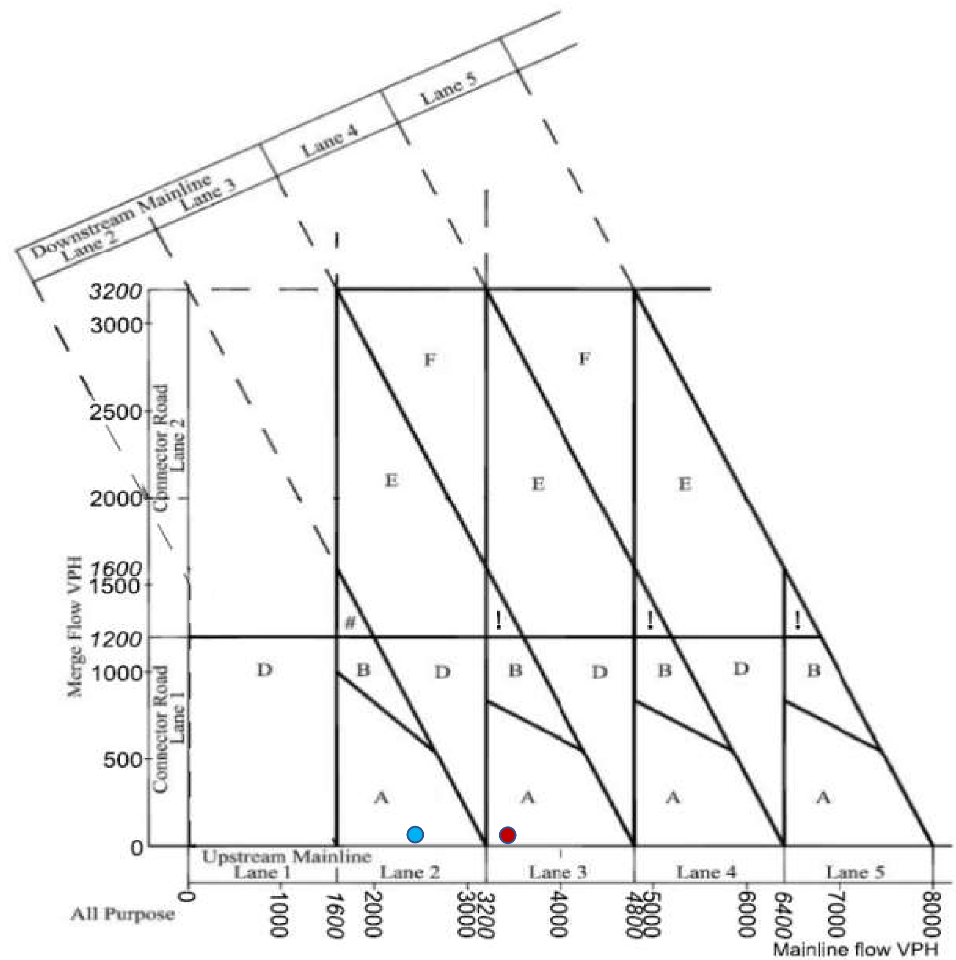
Figure 3.26a All-purpose road diverging diagram



Northbound Merge
Flows in Vehicles

3A	Upst. Main	Merge		
AM Peak	3427.55	63	● (red)	A 3>3
PM Peak	2514.404	44	● (blue)	

Figure 3.12a All-purpose road merging diagram

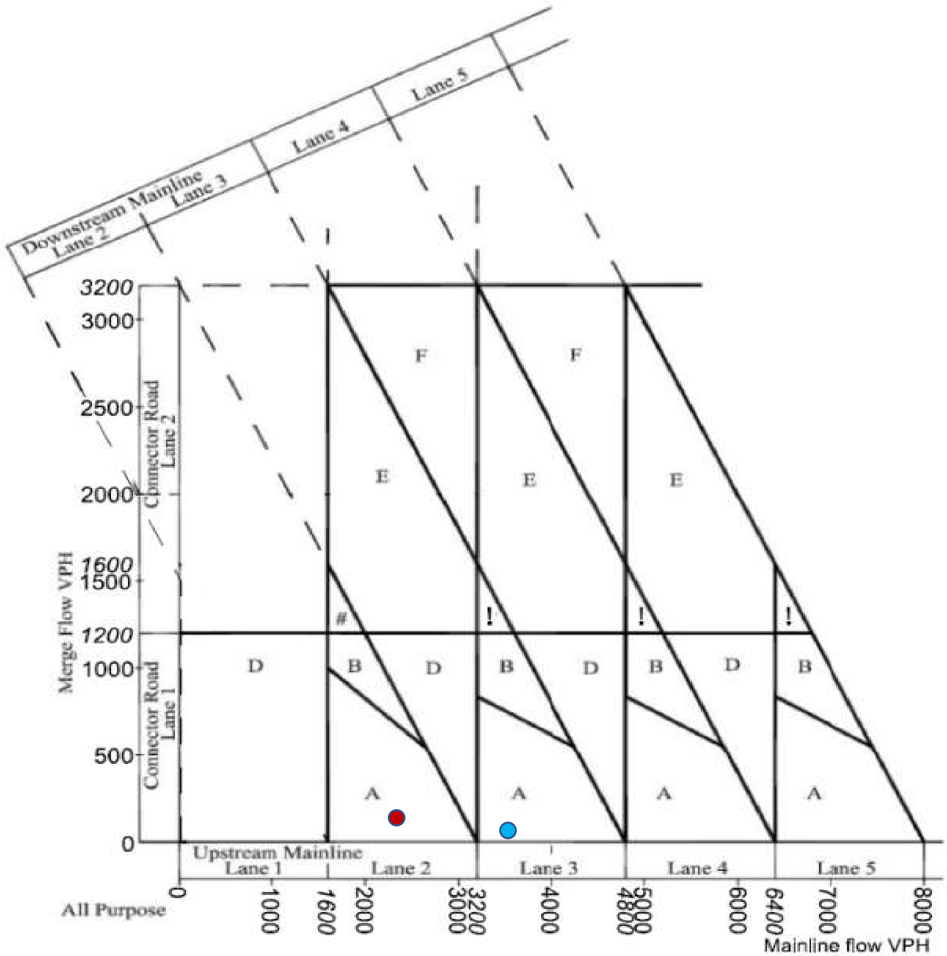


Southbound Merge
Flows in Vehicles

3A	Upst. Main	Merge
AM Peak	2476.026	139
PM Peak	3464.076	49

A 3>3

Figure 3.12a All-purpose road merging diagram

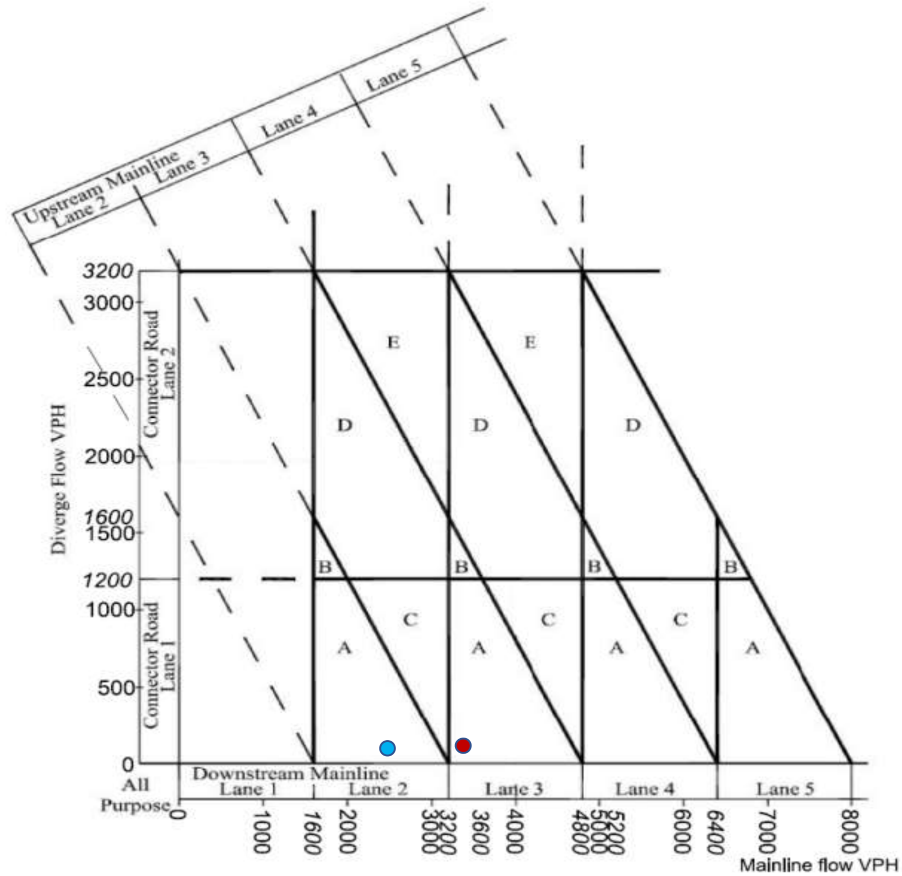


Northbound Diverge

Flows in Vehicles

3A	Dwnst. Main	Diverge		
AM Peak	3427.55	138		
PM Peak	2514.404	82		A 3>3

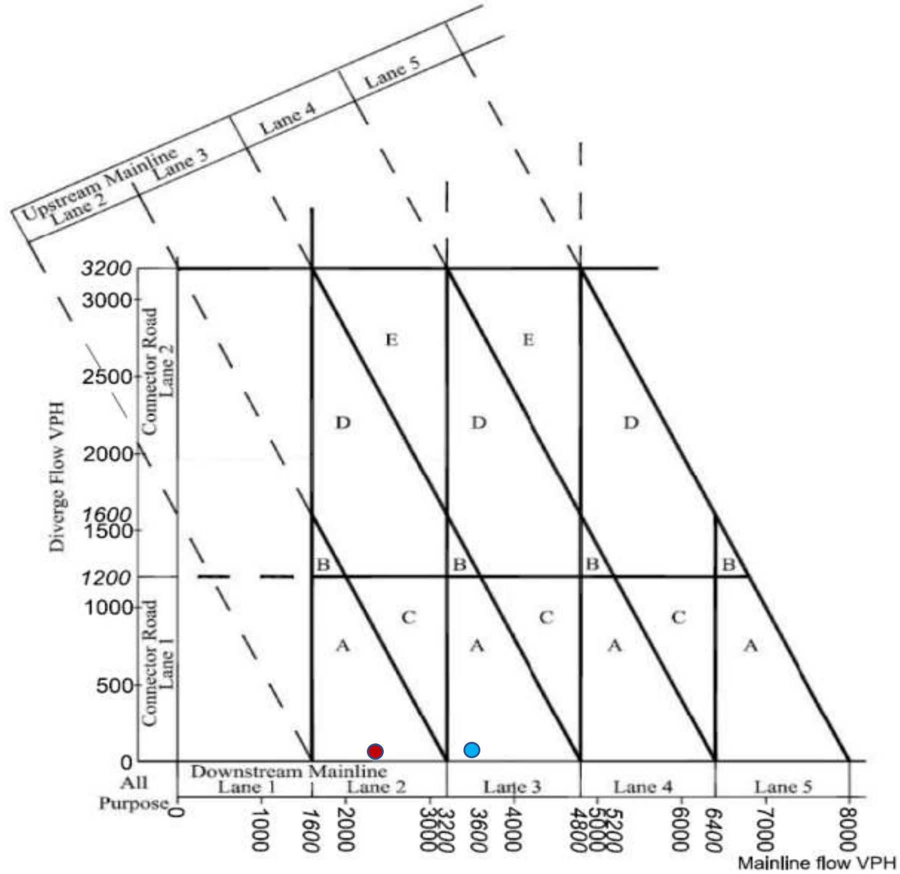
Figure 3.26a All-purpose road diverging diagram



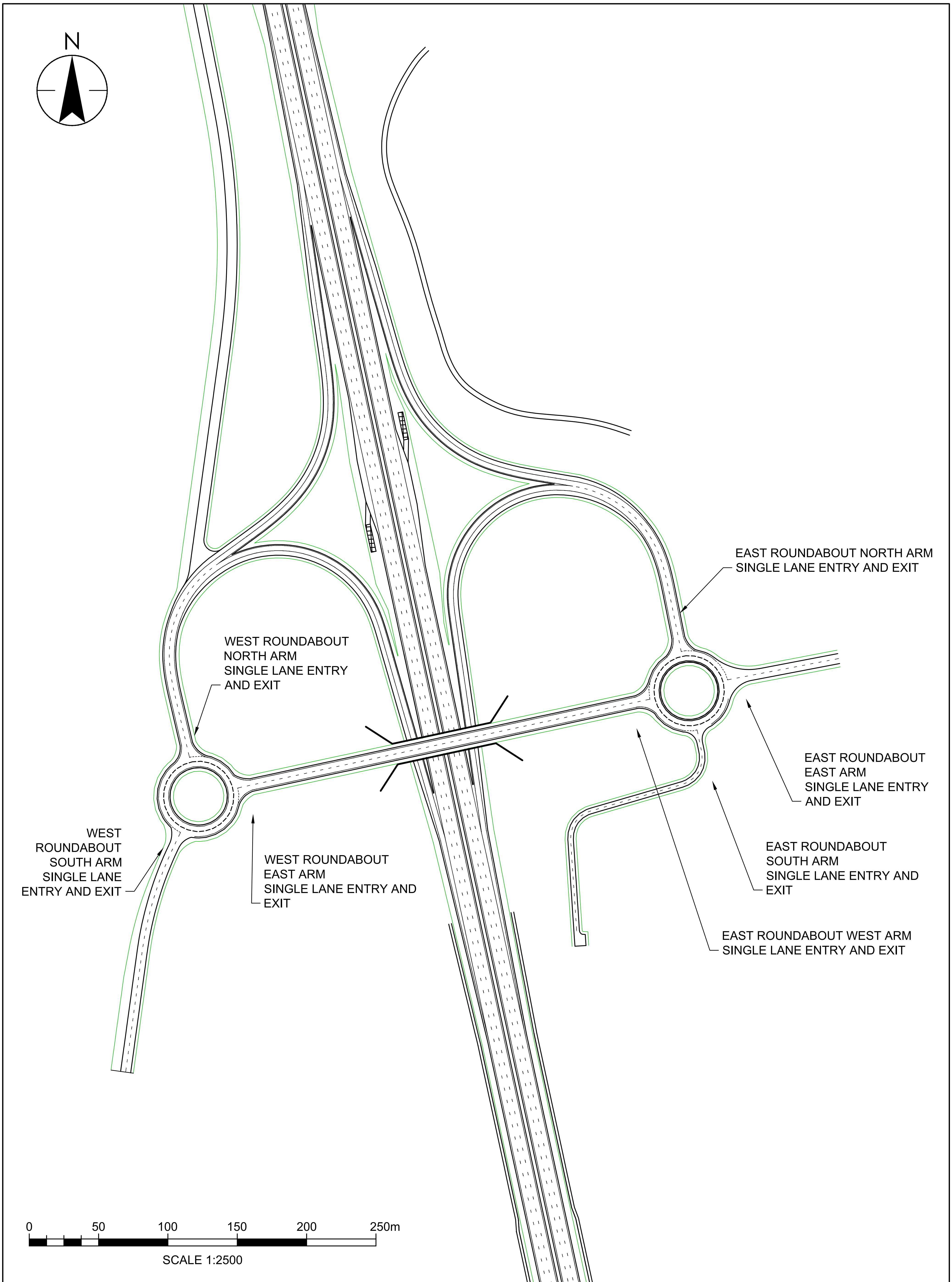
Southbound Diverge
Flows in Vehicles

3A	Dwnst. Main	Diverge		
AM Peak	2476.026	47	●	A 3>3
PM Peak	3464.076	28	●	

Figure 3.26a All-purpose road diverging diagram



Appendix C – NH Proposed and Adjusted Tilbury Junction Layout and Cross-Sections



Stantec

Stantec UK Limited
Unit 10, Connect 38, 1 Dover Place
Ashford
TN23 1FB
Tel. +44 1233 527 250
www.stantec.com/uk

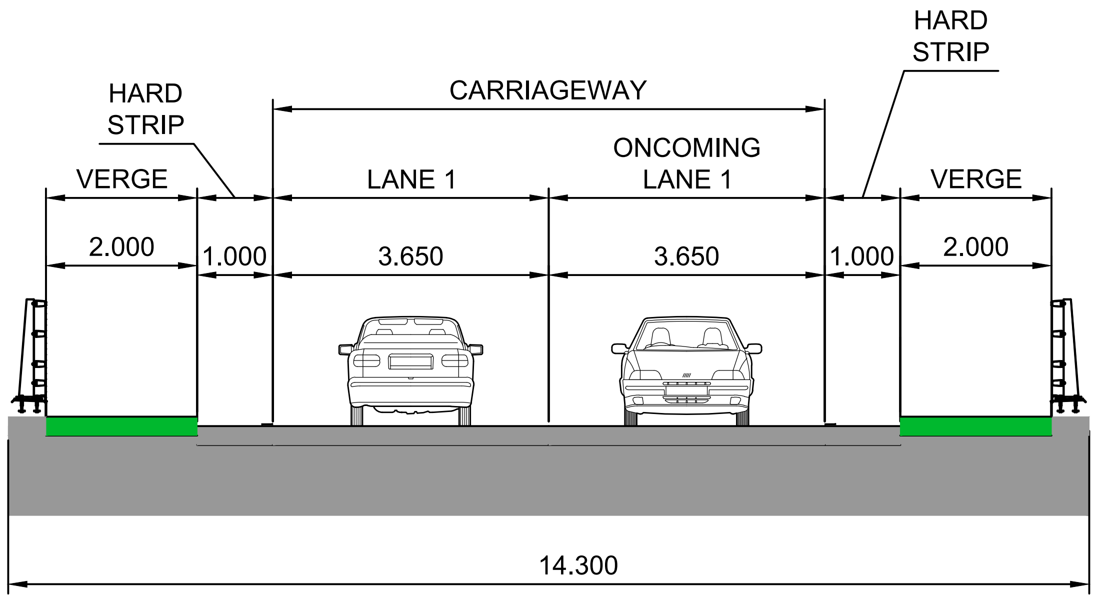
Client/Project:
Tilbury Link Road

TILBURY LINK ROAD

Project No.:
332510754

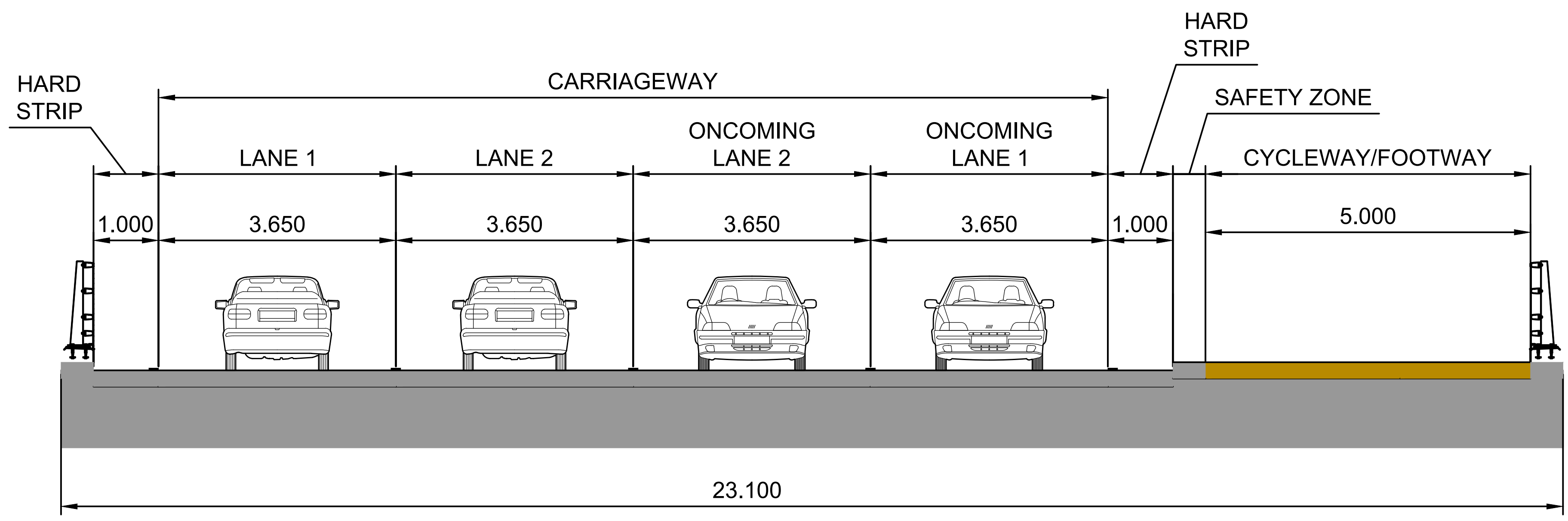
Title
JUNCTION ARRANGEMENT
NATIONAL HIGHWAYS
LAYOUT WITH EAST TILBURY
LINK & TILBURY LINK ROAD

Revision:	Date:	Drawing No.
P01	2202.08.26	100



NATIONAL HIGHWAYS BRIDGE
TYPICAL SECTION

SCALE 1:100



PROPOSED BRIDGE
TYPICAL SECTION

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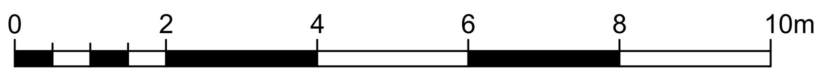


SCALE 1:100

Stantec

Stantec UK Limited
Unit 10, Connect 38, 1 Dover Place
Ashford
TN23 1FB
Tel. +44 1233 527 250
www.stantec.com/uk

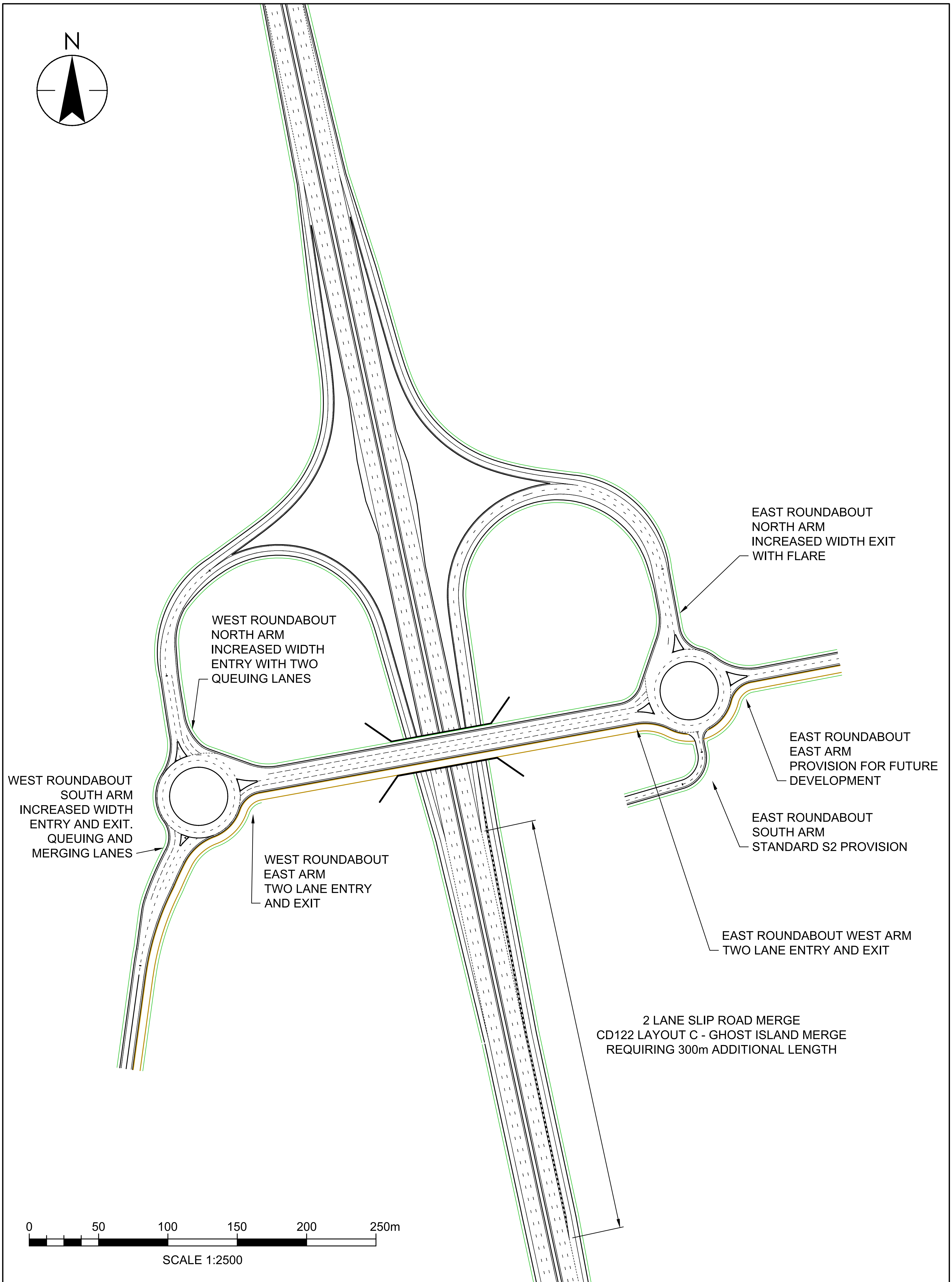
Client/Project:
Tilbury Link Road

TILBURY LINK ROAD

Project No.:
332510754

Title
TYPICAL CROSS SECTIONS

Revision:	Date:	Drawing No.
P01	2202.08.26	110



Stantec

Stantec UK Limited
Unit 10, Connect 38, 1 Dover Place
Ashford
TN23 1FB
Tel. +44 1233 527 250
www.stantec.com/uk

Client/Project:
Tilbury Link Road

TILBURY LINK ROAD

Project No.:
332510754

Title
JUNCTION ARRANGEMENT
OPTION 2

Revision:	Date:	Drawing No.
P01	2202.08.26	102

Plotted: 30.08.2022 2022.08.30 5:31:13 PM By: Protheroe, Gwen
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Appendix D – Junctions 10 Results

Tilbury Junction Roundabout Capacity Assessment Results - National Highways Layout + East Tilbury Link

Roundabout - Arm	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Scenario 1A - AM Peak Hr				Scenario 1A - PM Peak Hr				Scenario 2A - AM Peak Hr				Scenario 2A - PM Peak Hr			
West Rbt - North Arm	11	44.65	0.92	E	68.7	204.21	1.12	F	267.7	1109.4	1.46	F	182.8	830.48	1.36	F
West Rbt - East Arm	0.2	6.83	0.1	A	0.1	7.8	0.05	A	0.2	6.83	0.12	A	0.4	6.1	0.23	A
West Rbt - South Arm	2	9.69	0.61	A	2	8.77	0.65	A	88.9	225.79	1.12	F	182.3	518.14	1.25	F
East Rbt - North Arm	0.1	4.33	0.07	A	0.1	4.79	0.03	A	0.1	4.56	0.09	A	0.2	4.1	0.17	A
East Rbt - East Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - South Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - West Arm	1.3	7	0.51	A	1.4	6.41	0.57	A	4.4	15.27	0.79	C	8.5	26.11	0.9	D
	Scenario 1B - AM Peak Hr				Scenario 1B - PM Peak Hr				Scenario 2B - AM Peak Hr				Scenario 2B - PM Peak Hr			
West Rbt - North Arm	326.6	1062.6	1.5	F	737.1	2427.2	1.93	F	860.7	3453.4	2.01	F	954.8	4170.7	2.17	F
West Rbt - East Arm	0.7	8.42	0.3	A	0.5	8.07	0.23	A	0.8	8.62	0.32	A	0.9	7.52	0.38	A
West Rbt - South Arm	3.6	15.04	0.74	C	4.6	17.87	0.8	C	200	586.35	1.27	F	344.6	996.64	1.41	F
East Rbt - North Arm	0.3	6.38	0.14	A	0.4	7.71	0.16	A	0.3	6.14	0.16	A	0.6	6.59	0.31	A
East Rbt - East Arm	2.4	11.51	0.57	B	2.4	11.74	0.55	B	2.4	11.8	0.58	B	2.8	13.72	0.59	B
East Rbt - South Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - West Arm	46.2	138.94	1.05	F	100.6	321.82	1.15	F	206.2	594.42	1.17	F	516.5	1466.4	1.36	F
	Scenario 1C - AM Peak Hr				Scenario 1C - PM Peak Hr				Scenario 2C - AM Peak Hr				Scenario 2C - PM Peak Hr			
West Rbt - North Arm	969.2	3187.4	2.15	F	1658.7	5561.3	2.85	F	1493.2	5925.4	2.59	F	1791.1	7676.8	2.98	F
West Rbt - East Arm	0.7	7.93	0.3	A	0.5	7.48	0.22	A	0.8	8.34	0.33	A	0.8	7.29	0.36	A
West Rbt - South Arm	6.9	26.36	0.85	D	10.8	38.57	0.92	E	328.2	964.69	1.4	F	511.9	1521.6	1.55	F
East Rbt - North Arm	0.4	7.28	0.2	A	0.7	9.22	0.28	A	0.5	7.04	0.22	A	1.1	8.82	0.43	A
East Rbt - East Arm	35.4	97.78	1	F	28.4	81.74	0.98	F	39.3	107.21	1.01	F	52.4	140.98	1.04	F
East Rbt - South Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - West Arm	549.3	1915.7	1.65	F	707.4	2464.8	1.81	F	727.7	2456.5	1.66	F	1040.3	3553.6	1.88	F
	Scenario 3A - AM Peak Hr				Scenario 3A - PM Peak Hr											
West Rbt - North Arm	0.1	2.73	0.1	A	0.2	2.75	0.15	A								
West Rbt - East Arm	0	2.55	0.04	A	0	2.6	0.03	A								
West Rbt - South Arm	0.2	353	0.18	A	0.1	3.18	0.1	A								
East Rbt - North Arm	0	2.34	0.03	A	0	2.33	0.03	A								
East Rbt - East Arm	0	0	0	A	0	0	0	A								
East Rbt - South Arm	0	0	0	A	0	0	0	A								
East Rbt - West Arm	0.1	2.63	0.11	A	0	2.42	0.03	A								

Tilbury Junction Roundabout Capacity Assessment Results (Improvement Package)

	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Scenario 1A - AM Peak Hr				Scenario 1A - PM Peak Hr				Scenario 2A - AM Peak Hr				Scenario 2A - PM Peak Hr			
West Rbt - North Arm	1.1	4.21	0.48	A	1.5	4.87	0.58	A	3.7	10.94	0.76	B	3.3	11.7	0.75	B
West Rbt - East Arm	0.1	3.36	0.05	A	0	4.01	0.03	A	0.1	4	0.08	A	0.2	3.23	0.14	A
West Rbt - South Arm	0.6	2.97	0.32	A	0.6	2.46	0.35	A	1.8	4.68	0.59	A	2	4.62	0.66	A
East Rbt - North Arm	0.1	4.44	0.07	A	0.1	4.9	0.03	A	0.1	4.67	0.09	A	0.3	4.22	0.17	A
East Rbt - East Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - South Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - West Arm	0.6	2.98	0.31	A	0.5	2.54	0.34	A	1.4	4.27	0.53	A	2.1	5.09	0.68	A
	Scenario 1B - AM Peak Hr				Scenario 1B - PM Peak Hr				Scenario 2B - AM Peak Hr				Scenario 2B - PM Peak Hr			
West Rbt - North Arm	2.2	5.59	0.62	A	4.8	9.84	0.79	A	10.1	22.2	0.9	C	46.3	92.07	1.03	F
West Rbt - East Arm	0.4	4.5	0.19	A	0.3	5.05	0.16	A	0.5	5.32	0.23	A	0.5	4.23	0.26	A
West Rbt - South Arm	0.8	3.37	0.39	A	0.8	3.07	0.42	A	2.5	5.92	0.67	A	3	6.45	0.74	A
East Rbt - North Arm	0.3	7.09	0.15	A	0.4	9.5	0.19	A	0.4	7.37	0.18	A	0.9	9.5	0.39	A
East Rbt - East Arm	2.8	13.72	0.61	B	2.8	13.86	0.59	B	2.9	14.15	0.62	B	3.4	16.73	0.64	C
East Rbt - South Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - West Arm	1.9	5.22	0.56	A	2.8	6.51	0.68	A	4.7	9.61	0.78	A	30.1	47.65	0.99	E
	Scenario 1C - AM Peak Hr				Scenario 1C - PM Peak Hr				Scenario 2C - AM Peak Hr				Scenario 2C - PM Peak Hr			
West Rbt - North Arm	9.5	18.28	0.87	C	164.8	215.63	1.14	F	208.5	320.89	1.21	F	491.9	940.22	1.53	F
West Rbt - East Arm	0.4	4.69	0.19	A	0.3	4.9	0.15	A	0.5	5.11	0.22	A	0.4	3.98	0.22	A
West Rbt - South Arm	1	3.74	0.44	A	1.1	3.66	0.48	A	3.3	7.33	0.73	A	4.5	9.14	0.8	A
East Rbt - North Arm	0.8	13.34	0.32	B	1.7	21.24	0.48	C	0.8	11.43	0.31	B	2.4	18.92	0.62	C
East Rbt - East Arm	68	176.27	1.08	F	54.6	146.55	1.05	F	74.1	191.41	1.09	F	92.2	255.38	1.13	F
East Rbt - South Arm	0	0	0	A	0	0	0	A	0	0	0	A	0	0	0	A
East Rbt - West Arm	24.6	47.72	0.97	E	171.2	284.91	1.13	F	162	276.32	1.13	F	642.3	1073.7	1.32	F
	Scenario 3A - AM Peak Hr				Scenario 3A - PM Peak Hr											
West Rbt - North Arm	0.1	1.34	0.05	A	0.1	1.33	0.08	A								
West Rbt - East Arm	0	1.7	0.02	A	0	1.74	0.02	A								
West Rbt - South Arm	0.1	1.69	0.09	A	0.1	1.6	0.05	A								
East Rbt - North Arm	0	2.94	0.04	A	0	2.92	0.04	A								
East Rbt - East Arm	0	0	0	A	0	0	0	A								
East Rbt - South Arm	0	0	0	A	0	0	0	A								
East Rbt - West Arm	0.1	1.4	0.06	A	0	1.34	0.02	A								

Proposed NH Junction Layout Testing

Junctions 10

ARCADY 10 - Roundabout Module

Version: 10.0.4.1693

For sales and distribution information, program advice and maintenance, contact TRL Software:
+44 (0)1344 379777 software@trl.co.uk trlsoftware.com

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Filename: TILBURY JUNCTION INC EAST ARM AM-PM OPTION 0.j10
Path: \\bgl-vfps-001\bgl\Home\mnejad\Tilbury Junction\Modelling\220826
Report generation date: 30/08/2022 14:53:34

Summary of junction performance

	S1: CTL01 AM					S1: CTL01 PM					S2: CTL02 AM					S2: CTL02 PM				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	2030 [NO E.TIL]																			
Junction 1 - Arm 1		11.0	44.65	0.92	E		68.7	204.21	1.12	F		267.7	1109.39	1.46	F		182.8	830.48	1.36	F
Junction 1 - Arm 2		0.2	6.83	0.10	A		0.1	7.80	0.05	A		0.2	6.83	0.12	A		0.4	6.10	0.23	A
Junction 1 - Arm 3		2.0	9.69	0.61	A		2.0	8.77	0.65	A		88.9	225.79	1.12	F		182.3	518.14	1.25	F
Junction 2 - Arm 1	D1	0.1	4.33	0.07	A	D2	0.1	4.79	0.03	A	D3	0.1	4.56	0.09	A	D4	0.2	4.10	0.17	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		1.3	7.00	0.51	A		1.4	6.41	0.57	A		4.4	15.27	0.79	C		8.5	26.11	0.90	D
	2030 [50% E.TIL]																			
Junction 1 - Arm 1		326.6	1062.64	1.50	F		737.1	2427.22	1.93	F		860.7	3453.37	2.01	F		954.8	4170.74	2.17	F
Junction 1 - Arm 2		0.7	8.42	0.30	A		0.5	8.07	0.23	A		0.8	8.62	0.32	A		0.9	7.52	0.38	A
Junction 1 - Arm 3		3.6	15.04	0.74	C		4.6	17.87	0.80	C		200.0	586.35	1.27	F		344.6	996.64	1.41	F
Junction 2 - Arm 1	D5	0.3	6.38	0.14	A	D6	0.4	7.71	0.16	A	D7	0.3	6.14	0.16	A	D8	0.6	6.59	0.31	A
Junction 2 - Arm 2		2.4	11.51	0.57	B		2.4	11.74	0.55	B		2.4	11.80	0.58	B		2.8	13.72	0.59	B
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		46.2	138.94	1.05	F		100.6	321.82	1.15	F		206.2	594.42	1.17	F		516.5	1466.39	1.36	F
	2030 [100% E.TIL]																			
Junction 1 - Arm 1		969.2	3187.44	2.15	F		1658.7	5561.28	2.85	F		1493.2	5925.37	2.59	F		1791.1	7676.81	2.98	F
Junction 1 - Arm 2		0.7	7.93	0.30	A		0.5	7.48	0.22	A		0.8	8.34	0.33	A		0.8	7.29	0.36	A
Junction 1 - Arm 3		6.9	26.36	0.85	D		10.8	38.57	0.92	E		328.2	964.69	1.40	F		511.9	1521.55	1.55	F
Junction 2 - Arm 1	D9	0.4	7.28	0.20	A	D10	0.7	9.22	0.28	A	D11	0.5	7.04	0.22	A	D12	1.1	8.82	0.43	A
Junction 2 - Arm 2		35.4	97.78	1.00	F		28.4	81.74	0.98	F		39.3	107.21	1.01	F		52.4	140.98	1.04	F
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		549.3	1915.73	1.65	F		707.4	2464.80	1.81	F		727.7	2456.52	1.66	F		1040.3	3553.55	1.88	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

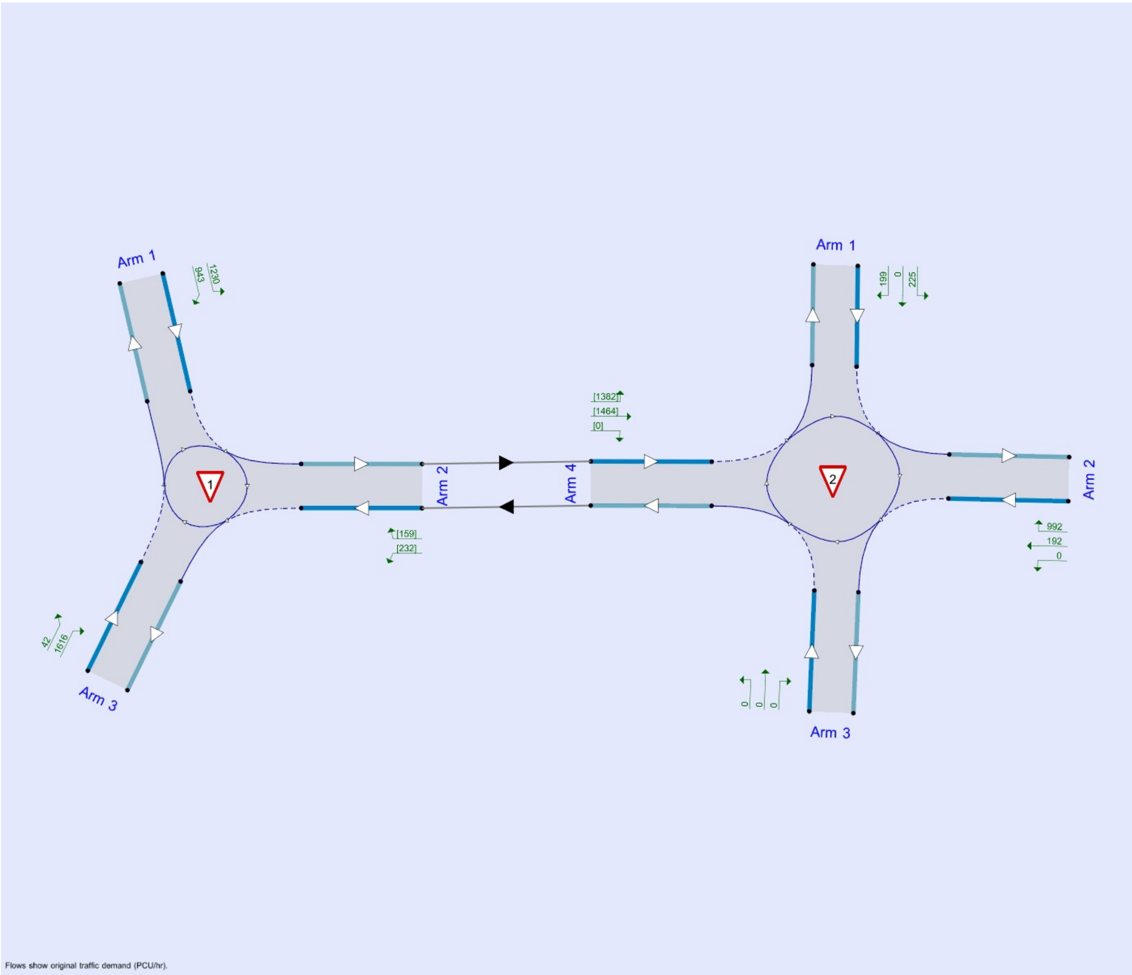
File Description

Title	
Location	
Site number	
Date	12/07/2022
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	

Enumerator	CORP\mgilder
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2030 [NO E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D2	2030 [NO E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D3	2030 [NO E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D4	2030 [NO E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15
D5	2030 [50% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D6	2030 [50% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D7	2030 [50% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D8	2030 [50% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15
D9	2030 [100% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D10	2030 [100% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D11	2030 [100% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D12	2030 [100% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2030 [NO E.TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	28.02	D
2	untitled	Standard Roundabout		1, 2, 3, 4	6.71	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	21.58	C

Arms

Arms

Junction	Arm	Name	Description	No give-way line
1	1	untitled		
	2	untitled		
	3	untitled		
2	1	untitled		
	2	untitled		
	3	untitled		
	4	untitled		

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Entry only	Exit only
1	1	3.65	6.67	4.0	16.7	60.0	26.0		
	2	3.65	6.81	2.7	16.5	60.0	22.0		
	3	3.65	5.91	2.2	17.8	60.0	30.0		
2	1	3.65	6.88	2.7	17.7	60.0	28.0		
	2	3.65	6.77	4.2	15.6	60.0	32.0		
	3	2.00	4.55	1.7	10.0	60.0	34.0		
	4	3.65	6.77	4.2	15.6	60.0	32.0		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
1	1	0.502	1379
	2	0.498	1331
	3	0.479	1259
2	1	0.489	1306
	2	0.492	1357
	3	0.366	695
	4	0.492	1358

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2030 [NO E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	864	100.000
	2	✓			
	3		✓	694	100.000
2	1		✓	78	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	864
	2	0	0	78
	3	63	631	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	78
	2	0	0	0	0
	3	0	0	0	0
	4	631	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	19
	2	0	0	47
	3	100	29	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	47
	2	0	0	0	0
	3	0	0	0	0
	4	29	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.92	44.65	11.0	E
	2	0.10	6.83	0.2	A
	3	0.61	9.69	2.0	A
2	1	0.07	4.33	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.51	7.00	1.3	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	650	472	1142	0.570	644	1.5	8.509	A
	2	58	644	1010	0.058	58	0.1	5.555	A
	3	522	0	1259	0.415	519	0.9	6.449	A
2	1	59	0	1306	0.045	58	0.1	4.239	A
	2	0	58	1328	0.000	0	0.0	0.000	A
	3	0	58	674	0.000	0	0.0	0.000	A
	4	472	0	1358	0.347	469	0.7	5.208	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	777	566	1095	0.710	772	2.8	13.071	B
	2	70	772	947	0.074	70	0.1	6.033	A
	3	624	0	1259	0.495	622	1.3	7.520	A
2	1	70	0	1306	0.054	70	0.1	4.280	A
	2	0	70	1323	0.000	0	0.0	0.000	A
	3	0	70	670	0.000	0	0.0	0.000	A
	4	566	0	1358	0.417	565	0.9	5.849	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	951	692	1031	0.923	925	9.4	33.996	D
	2	86	925	871	0.099	86	0.2	6.737	A
	3	764	0	1259	0.607	761	2.0	9.581	A
2	1	86	0	1306	0.066	86	0.1	4.335	A
	2	0	86	1315	0.000	0	0.0	0.000	A
	3	0	86	664	0.000	0	0.0	0.000	A
	4	692	0	1358	0.510	691	1.3	6.941	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	951	695	1030	0.924	945	11.0	44.652	E
	2	86	945	861	0.100	86	0.2	6.827	A
	3	764	0	1259	0.607	764	2.0	9.685	A
2	1	86	0	1306	0.066	86	0.1	4.335	A
	2	0	86	1315	0.000	0	0.0	0.000	A
	3	0	86	664	0.000	0	0.0	0.000	A
	4	695	0	1358	0.512	695	1.3	7.001	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	777	570	1093	0.711	808	3.1	16.573	C
	2	70	808	929	0.076	70	0.1	6.167	A
	3	624	0	1259	0.495	627	1.3	7.623	A
2	1	70	0	1306	0.054	70	0.1	4.282	A
	2	0	70	1323	0.000	0	0.0	0.000	A
	3	0	70	670	0.000	0	0.0	0.000	A
	4	570	0	1358	0.420	571	0.9	5.915	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	650	476	1140	0.571	656	1.6	8.969	A
	2	59	656	1004	0.059	59	0.1	5.596	A
	3	522	0	1259	0.415	524	1.0	6.540	A
2	1	59	0	1306	0.045	59	0.1	4.243	A
	2	0	59	1328	0.000	0	0.0	0.000	A
	3	0	59	674	0.000	0	0.0	0.000	A
	4	476	0	1358	0.351	477	0.7	5.279	A

2030 [NO E.TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	118.40	F
2	untitled	Standard Roundabout		1, 2, 3, 4	6.32	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	85.58	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2030 [NO E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1006	100.000
	2	✓			
	3		✓	747	100.000
2	1		✓	40	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	1006
	2	0	0	40
	3	44	703	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	40
	2	0	0	0	0
	3	0	0	0	0
	4	703	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	9
	2	0	0	68
	3	70	4	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	68
	2	0	0	0	0
	3	0	0	0	0
	4	4	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.12	204.21	68.7	F
	2	0.05	7.80	0.1	A
	3	0.65	8.77	2.0	A
2	1	0.03	4.79	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.57	6.41	1.4	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	757	526	1115	0.680	748	2.2	10.480	B
	2	30	748	959	0.031	30	0.1	6.509	A
	3	562	0	1259	0.447	559	0.8	5.447	A
2	1	30	0	1306	0.023	30	0.0	4.738	A
	2	0	30	1342	0.000	0	0.0	0.000	A
	3	0	30	684	0.000	0	0.0	0.000	A
	4	526	0	1358	0.387	523	0.7	4.474	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	904	631	1062	0.852	892	5.4	21.565	C
	2	36	892	887	0.040	36	0.1	7.102	A
	3	672	0	1259	0.533	670	1.2	6.489	A
2	1	36	0	1306	0.028	36	0.0	4.760	A
	2	0	36	1339	0.000	0	0.0	0.000	A
	3	0	36	682	0.000	0	0.0	0.000	A
	4	631	0	1358	0.464	630	0.9	5.135	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1108	771	991	1.117	975	38.6	95.085	F
	2	44	975	846	0.052	44	0.1	7.540	A
	3	822	0	1259	0.653	819	2.0	8.654	A
2	1	44	0	1306	0.034	44	0.1	4.790	A
	2	0	44	1335	0.000	0	0.0	0.000	A
	3	0	44	679	0.000	0	0.0	0.000	A
	4	771	0	1358	0.568	769	1.3	6.343	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1108	774	990	1.119	987	68.7	204.207	F
	2	44	987	840	0.052	44	0.1	7.598	A
	3	822	0	1259	0.653	822	2.0	8.767	A
	1	44	0	1306	0.034	44	0.1	4.790	A
	2	0	44	1335	0.000	0	0.0	0.000	A

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	44	679	0.000	0	0.0	0.000	A
	4	774	0	1358	0.570	774	1.4	6.407	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	904	635	1060	0.853	1043	34.0	179.936	F
	2	36	1043	812	0.044	36	0.1	7.797	A
	3	672	0	1259	0.533	675	1.2	6.588	A
2	1	36	0	1306	0.028	36	0.0	4.762	A
	2	0	36	1339	0.000	0	0.0	0.000	A
	3	0	36	682	0.000	0	0.0	0.000	A
	4	635	0	1358	0.467	637	0.9	5.202	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	757	531	1112	0.681	883	2.5	27.558	D
	2	30	883	891	0.034	30	0.1	7.022	A
	3	562	0	1259	0.447	564	0.9	5.524	A
2	1	30	0	1306	0.023	30	0.0	4.740	A
	2	0	30	1342	0.000	0	0.0	0.000	A
	3	0	30	684	0.000	0	0.0	0.000	A
	4	531	0	1358	0.391	532	0.7	4.538	A

2030 [NO E.TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	611.73	F
2	untitled	Standard Roundabout		1, 2, 3, 4	14.34	B

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	419.49	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2030 [NO E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1117	100.000
	2	✓			
	3		✓	1279	100.000
2	1		✓	103	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	1117
	2	0	0	103
	3	193	1086	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	103
	2	0	0	0	0
	3	0	0	0	0
	4	1086	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	17
	2	0	0	51
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	51
	2	0	0	0	0
	3	0	0	0	0
	4	25	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.46	1109.39	267.7	F
	2	0.12	6.83	0.2	A
	3	1.12	225.79	88.9	F
2	1	0.09	4.56	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.79	15.27	4.4	C

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	841	805	975	0.863	817	6.1	23.913	C
	2	77	817	925	0.083	77	0.1	6.406	A
	3	963	0	1259	0.765	948	3.8	13.991	B
2	1	78	0	1306	0.059	77	0.1	4.421	A
	2	0	77	1319	0.000	0	0.0	0.000	A
	3	0	77	667	0.000	0	0.0	0.000	A
	4	805	0	1358	0.592	797	1.8	7.933	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1004	956	898	1.118	882	36.6	103.271	F
	2	93	882	892	0.104	92	0.2	6.796	A
	3	1150	0	1259	0.913	1126	9.7	29.910	D
2	1	93	0	1306	0.071	93	0.1	4.477	A
	2	0	93	1312	0.000	0	0.0	0.000	A
	3	0	93	661	0.000	0	0.0	0.000	A
	4	956	0	1358	0.704	952	2.9	10.967	B

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1230	1056	848	1.450	848	132.2	369.676	F
	2	113	848	909	0.125	113	0.2	6.825	A
	3	1408	0	1259	1.118	1244	50.8	100.736	F
2	1	113	0	1306	0.087	113	0.1	4.556	A
	2	0	113	1301	0.000	0	0.0	0.000	A
	3	0	113	654	0.000	0	0.0	0.000	A
	4	1056	0	1358	0.778	1051	4.1	14.404	B

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1230	1067	843	1.459	843	228.9	776.165	F
	2	113	843	912	0.124	113	0.2	6.809	A
	3	1408	0	1259	1.118	1256	88.9	209.941	F
	1	113	0	1306	0.087	113	0.1	4.556	A
	2	0	113	1301	0.000	0	0.0	0.000	A

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	113	654	0.000	0	0.0	0.000	A
	4	1067	0	1358	0.785	1065	4.4	15.274	C

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1004	1054	849	1.182	849	267.7	1056.845	F
	2	93	849	909	0.102	93	0.2	6.667	A
	3	1150	0	1259	0.913	1241	65.9	225.792	F
2	1	93	0	1306	0.071	93	0.1	4.480	A
	2	0	93	1312	0.000	0	0.0	0.000	A
	3	0	93	661	0.000	0	0.0	0.000	A
	4	1054	0	1358	0.776	1054	4.4	14.827	B

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	841	1024	864	0.973	861	262.8	1109.393	F
	2	78	861	903	0.086	78	0.1	6.589	A
	3	963	0	1259	0.765	1206	5.2	102.183	F
2	1	78	0	1306	0.059	78	0.1	4.425	A
	2	0	78	1319	0.000	0	0.0	0.000	A
	3	0	78	667	0.000	0	0.0	0.000	A
	4	1024	0	1358	0.754	1025	4.0	13.626	B

2030 [NO E.TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	593.24	F
2	untitled	Standard Roundabout		1, 2, 3, 4	23.16	C

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	384.33	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2030 [NO E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	943	100.000
	2	✓			
	3		✓	1424	100.000
2	1		✓	199	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	943
	2	0	0	199
	3	42	1382	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	199
	2	0	0	0	0
	3	0	0	0	0
	4	1382	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	12
	2	0	0	24
	3	70	3	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	24
	2	0	0	0	0
	3	0	0	0	0
	4	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.36	830.48	182.8	F
	2	0.23	6.10	0.4	A
	3	1.25	518.14	182.3	F
2	1	0.17	4.10	0.2	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.90	26.11	8.5	D

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	710	1020	866	0.819	692	4.4	21.377	C
	2	149	692	987	0.151	148	0.2	5.319	A
	3	1072	0	1259	0.851	1051	5.3	16.650	C
2	1	150	0	1306	0.115	149	0.2	3.856	A
	2	0	149	1284	0.000	0	0.0	0.000	A
	3	0	149	641	0.000	0	0.0	0.000	A
	4	1020	0	1358	0.751	1008	3.0	10.281	B

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	848	1179	786	1.078	764	25.5	87.286	F
	2	179	764	951	0.188	178	0.3	5.776	A
	3	1280	0	1259	1.017	1215	21.6	51.547	F
2	1	179	0	1306	0.137	179	0.2	3.958	A
	2	0	179	1269	0.000	0	0.0	0.000	A
	3	0	179	630	0.000	0	0.0	0.000	A
	4	1179	0	1358	0.868	1167	5.9	18.341	C

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1038	1220	766	1.355	765	93.9	293.196	F
	2	219	765	950	0.230	219	0.4	6.096	A
	3	1568	0	1259	1.245	1257	99.4	182.350	F
2	1	219	0	1306	0.168	219	0.2	4.103	A
	2	0	219	1249	0.000	0	0.0	0.000	A
	3	0	219	615	0.000	0	0.0	0.000	A
	4	1220	0	1358	0.898	1213	7.7	23.939	C

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1038	1222	765	1.357	765	162.2	611.361	F
	2	219	765	950	0.231	219	0.4	6.102	A
	3	1568	0	1259	1.245	1259	176.7	400.792	F
	1	219	0	1306	0.168	219	0.2	4.105	A
	2	0	219	1249	0.000	0	0.0	0.000	A

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	219	615	0.000	0	0.0	0.000	A
	4	1222	0	1358	0.900	1219	8.2	25.715	D

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	848	1221	766	1.107	765	182.8	817.877	F
	2	179	765	950	0.188	179	0.3	5.793	A
	3	1280	0	1259	1.017	1258	182.3	518.142	F
2	1	179	0	1306	0.137	179	0.2	3.960	A
	2	0	179	1269	0.000	0	0.0	0.000	A
	3	0	179	630	0.000	0	0.0	0.000	A
	4	1221	0	1358	0.899	1220	8.5	26.113	D

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	710	1215	768	0.924	764	169.4	830.478	F
	2	150	764	951	0.158	150	0.2	5.577	A
	3	1072	0	1259	0.851	1252	137.3	460.205	F
2	1	150	0	1306	0.115	150	0.2	3.861	A
	2	0	150	1283	0.000	0	0.0	0.000	A
	3	0	150	640	0.000	0	0.0	0.000	A
	4	1215	0	1358	0.895	1215	8.5	25.687	D

2030 [50% E.TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	591.65	F
2	untitled	Standard Roundabout		1, 2, 3, 4	84.77	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	365.19	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2030 [50% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1322	100.000
	2	✓			
	3		✓	801	100.000
2	1		✓	135	100.000
	2		✓	683	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	458	864
	2	84	0	109
	3	63	738	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	57	0	78
	2	485	0	0	198
	3	0	0	0	0
	4	631	565	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	19
	2	92	0	51
	3	100	28	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	47
	2	79	0	0	83
	3	0	0	0	0
	4	29	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.50	1062.64	326.6	F
	2	0.30	8.42	0.7	A
	3	0.74	15.04	3.6	C
2	1	0.14	6.38	0.3	A
	2	0.57	11.51	2.4	B
	3	0.00	0.00	0.0	A
	4	1.05	138.94	46.2	F

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	995	551	1102	0.903	959	9.1	29.282	D
	2	206	627	1019	0.202	204	0.4	7.340	A
	3	603	89	1217	0.496	598	1.3	7.606	A
2	1	102	409	1106	0.092	101	0.2	5.760	A
	2	514	58	1328	0.387	510	1.1	7.878	A
	3	0	568	487	0.000	0	0.0	0.000	A
	4	883	362	1180	0.749	867	4.1	16.234	C

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1188	661	1047	1.135	1032	48.2	116.467	F
	2	248	674	995	0.249	247	0.5	8.001	A
	3	720	108	1208	0.596	718	1.9	9.625	A
2	1	121	472	1076	0.113	121	0.2	6.070	A
	2	614	70	1323	0.464	612	1.5	9.107	A
	3	0	682	445	0.000	0	0.0	0.000	A
	4	1019	435	1144	0.891	998	9.2	32.538	D

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1456	807	974	1.495	973	168.9	412.114	F
	2	303	636	1015	0.298	302	0.7	8.403	A
	3	882	132	1196	0.737	876	3.5	14.502	B
2	1	149	502	1061	0.140	148	0.3	6.347	A
	2	752	86	1315	0.572	749	2.3	11.386	B
	3	0	835	389	0.000	0	0.0	0.000	A
	4	1144	532	1096	1.043	1062	29.5	81.326	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1456	812	971	1.499	971	290.1	828.535	F
	2	304	634	1015	0.299	304	0.7	8.421	A
	3	882	132	1196	0.738	882	3.6	15.037	C
	1	149	511	1057	0.141	149	0.3	6.381	A
	2	752	86	1315	0.572	752	2.4	11.511	B

2	3	0	838	388	0.000	0	0.0	0.000	A
	4	1148	534	1095	1.049	1082	46.2	138.945	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1188	669	1043	1.140	1042	326.6	1062.637	F
	2	249	681	992	0.251	250	0.6	8.080	A
	3	720	109	1207	0.597	726	2.0	9.995	A
2	1	121	524	1050	0.116	122	0.2	6.243	A
	2	614	70	1323	0.464	617	1.6	9.233	A
	3	0	687	443	0.000	0	0.0	0.000	A
	4	1030	438	1142	0.902	1109	26.5	123.241	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	995	558	1098	0.906	1094	301.9	1034.516	F
	2	208	715	975	0.214	209	0.5	7.822	A
	3	603	91	1216	0.496	606	1.3	7.810	A
2	1	102	480	1071	0.095	102	0.2	5.978	A
	2	514	59	1328	0.387	516	1.2	8.001	A
	3	0	575	485	0.000	0	0.0	0.000	A
	4	937	366	1178	0.796	1017	6.6	42.041	E

2030 [50% E.TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1463.20	F
2	untitled	Standard Roundabout		1, 2, 3, 4	197.08	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	915.97	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2030 [50% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1621	100.000
	2	✓			
	3		✓	864	100.000
2	1		✓	153	100.000
	2		✓	672	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	615	1006
	2	80	0	56
	3	44	820	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	40
	2	496	0	0	176
	3	0	0	0	0
	4	703	732	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	9
	2	96	0	63
	3	70	19	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	68
	2	96	0	0	90
	3	0	0	0	0
	4	4	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.93	2427.22	737.1	F
	2	0.23	8.07	0.5	A
	3	0.80	17.87	4.6	C
2	1	0.16	7.71	0.4	A
	2	0.55	11.74	2.4	B
	3	0.00	0.00	0.0	A
	4	1.15	321.82	100.6	F

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1220	612	1071	1.139	1041	44.9	89.861	F
	2	161	646	1010	0.160	160	0.3	7.651	A
	3	650	94	1214	0.536	645	1.4	7.598	A
2	1	115	500	1062	0.108	114	0.2	7.051	A
	2	506	30	1342	0.377	501	1.2	8.275	A
	3	0	531	501	0.000	0	0.0	0.000	A
	4	1007	370	1176	0.857	980	6.8	22.442	C

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1457	734	1010	1.443	1009	156.9	380.242	F
	2	194	626	1019	0.190	193	0.4	7.878	A
	3	777	114	1205	0.645	774	2.1	10.021	B
2	1	138	548	1038	0.132	137	0.3	7.419	A
	2	604	36	1339	0.451	602	1.6	9.473	A
	3	0	638	461	0.000	0	0.0	0.000	A
	4	1117	445	1139	0.981	1074	17.4	53.230	F

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1785	894	930	1.920	929	370.7	1024.539	F
	2	237	577	1044	0.227	237	0.5	8.061	A
	3	951	139	1192	0.798	942	4.4	16.853	C
2	1	168	552	1037	0.163	168	0.4	7.698	A
	2	740	44	1336	0.554	737	2.3	11.624	B
	3	0	781	409	0.000	0	0.0	0.000	A
	4	1247	544	1090	1.144	1082	58.7	140.976	F

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1785	902	926	1.928	926	585.5	1865.728	F
	2	238	574	1045	0.227	238	0.5	8.065	A
	3	951	140	1192	0.798	951	4.6	17.867	C
	1	168	555	1035	0.163	168	0.4	7.715	A
	2	740	44	1335	0.554	740	2.4	11.740	B

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	784	408	0.000	0	0.0	0.000	A
	4	1253	546	1089	1.151	1087	100.3	271.448	F

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1457	746	1004	1.451	1004	698.8	2224.677	F
	2	195	623	1021	0.191	195	0.4	7.894	A
	3	777	115	1204	0.645	786	2.3	10.622	B
2	1	138	574	1026	0.134	138	0.3	7.534	A
	2	604	36	1339	0.451	607	1.6	9.597	A
	3	0	643	460	0.000	0	0.0	0.000	A
	4	1127	448	1137	0.991	1126	100.6	321.815	F

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1220	621	1067	1.144	1067	737.1	2427.220	F
	2	163	662	1002	0.163	163	0.4	7.773	A
	3	650	96	1213	0.536	654	1.4	7.825	A
2	1	115	591	1018	0.113	115	0.2	7.416	A
	2	506	30	1342	0.377	508	1.2	8.402	A
	3	0	538	498	0.000	0	0.0	0.000	A
	4	1025	375	1173	0.874	1158	67.5	263.019	F

2030 [50% E.TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1917.53	F
2	untitled	Standard Roundabout		1, 2, 3, 4	372.07	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1292.81	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2030 [50% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1575	100.000
	2	✓			
	3		✓	1386	100.000
2	1		✓	160	100.000
	2		✓	683	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	458	1117
	2	84	0	134
	3	193	1193	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	57	0	103
	2	485	0	0	198
	3	0	0	0	0
	4	1086	565	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	17
	2	92	0	54
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	51
	2	79	0	0	83
	3	0	0	0	0
	4	25	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	2.01	3453.37	860.7	F
	2	0.32	8.62	0.8	A
	3	1.27	586.35	200.0	F
2	1	0.16	6.14	0.3	A
	2	0.58	11.80	2.4	B
	3	0.00	0.00	0.0	A
	4	1.17	594.42	206.2	F

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1186	876	939	1.263	920	66.3	141.851	F
	2	225	653	1006	0.223	223	0.5	7.644	A
	3	1043	86	1218	0.857	1018	6.4	20.640	C
2	1	120	370	1125	0.107	120	0.2	5.781	A
	2	514	77	1319	0.390	510	1.1	7.967	A
	3	0	587	480	0.000	0	0.0	0.000	A
	4	1144	362	1180	0.969	1082	15.4	39.158	E

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1416	1006	874	1.621	873	202.0	565.794	F
	2	270	619	1023	0.264	270	0.6	7.961	A
	3	1246	104	1209	1.030	1168	25.8	63.282	F
2	1	144	387	1117	0.129	144	0.2	5.974	A
	2	614	92	1312	0.468	612	1.6	9.250	A
	3	0	705	437	0.000	0	0.0	0.000	A
	4	1260	435	1144	1.101	1130	47.9	115.995	F

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1734	1029	862	2.012	862	420.1	1308.611	F
	2	330	611	1027	0.322	330	0.8	8.595	A
	3	1526	127	1198	1.273	1196	108.3	212.427	F
2	1	176	374	1123	0.157	176	0.3	6.137	A
	2	752	113	1301	0.578	749	2.4	11.657	B
	3	0	862	379	0.000	0	0.0	0.000	A
	4	1280	532	1096	1.168	1094	94.4	245.520	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1734	1031	861	2.014	861	638.4	2219.599	F
	2	331	611	1027	0.323	331	0.8	8.624	A
	3	1526	128	1198	1.274	1198	190.5	455.049	F
	1	176	374	1123	0.157	176	0.3	6.140	A
	2	752	113	1301	0.578	752	2.4	11.795	B

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	865	378	0.000	0	0.0	0.000	A
	4	1281	534	1095	1.170	1094	141.2	392.173	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1416	1039	857	1.653	857	778.2	2985.070	F
	2	272	607	1029	0.264	272	0.6	7.942	A
	3	1246	105	1209	1.031	1208	200.0	586.353	F
2	1	144	391	1115	0.129	144	0.2	5.991	A
	2	614	93	1311	0.468	617	1.6	9.386	A
	3	0	710	435	0.000	0	0.0	0.000	A
	4	1289	438	1142	1.128	1141	177.9	506.091	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1186	1041	856	1.386	856	860.7	3453.369	F
	2	227	607	1029	0.221	228	0.5	7.493	A
	3	1043	88	1217	0.857	1209	158.5	534.386	F
2	1	120	403	1109	0.109	121	0.2	5.882	A
	2	514	78	1319	0.390	516	1.2	8.094	A
	3	0	594	478	0.000	0	0.0	0.000	A
	4	1290	366	1178	1.095	1177	206.2	594.419	F

2030 [50% E.TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2313.65	F
2	untitled	Standard Roundabout		1, 2, 3, 4	913.84	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1715.60	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2030 [50% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1558	100.000
	2	✓			
	3		✓	1541	100.000
2	1		✓	312	100.000
	2		✓	672	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	615	943
	2	80	0	216
	3	42	1499	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	199
	2	496	0	0	176
	3	0	0	0	0
	4	1382	732	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	12
	2	96	0	29
	3	70	12	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	24
	2	96	0	0	90
	3	0	0	0	0
	4	3	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	2.17	4170.74	954.8	F
	2	0.38	7.52	0.9	A
	3	1.41	996.64	344.6	F
2	1	0.31	6.59	0.6	A
	2	0.59	13.72	2.8	B
	3	0.00	0.00	0.0	A
	4	1.36	1466.39	516.5	F

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1173	1084	834	1.406	822	87.8	204.598	F
	2	280	497	1084	0.258	278	0.5	6.337	A
	3	1160	75	1223	0.949	1114	11.5	30.026	D
2	1	235	399	1111	0.211	233	0.4	5.833	A
	2	506	149	1284	0.394	501	1.2	8.884	A
	3	0	650	457	0.000	0	0.0	0.000	A
	4	1408	370	1176	1.197	1154	63.6	108.737	F

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1401	1173	790	1.774	789	240.6	758.252	F
	2	336	478	1093	0.308	336	0.6	6.750	A
	3	1385	91	1216	1.140	1206	56.4	113.719	F
2	1	280	394	1114	0.252	280	0.5	6.149	A
	2	604	179	1269	0.476	602	1.7	10.459	B
	3	0	781	409	0.000	0	0.0	0.000	A
	4	1485	444	1139	1.303	1138	150.1	350.730	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1715	1173	790	2.172	790	472.0	1632.218	F
	2	411	478	1093	0.376	411	0.8	7.486	A
	3	1697	111	1206	1.407	1205	179.2	359.159	F
2	1	344	378	1122	0.306	343	0.6	6.580	A
	2	740	219	1249	0.592	736	2.7	13.517	B
	3	0	955	345	0.000	0	0.0	0.000	A
	4	1484	543	1090	1.361	1090	248.6	665.226	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1715	1173	790	2.172	790	703.5	2699.159	F
	2	413	478	1093	0.378	413	0.9	7.518	A
	3	1697	112	1206	1.407	1206	302.0	721.310	F
	1	344	377	1122	0.306	344	0.6	6.586	A
	2	740	219	1249	0.592	740	2.8	13.717	B

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	959	344	0.000	0	0.0	0.000	A
	4	1484	546	1089	1.363	1089	347.5	967.618	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1401	1182	785	1.784	785	857.4	3591.545	F
	2	338	475	1095	0.309	339	0.6	6.781	A
	3	1385	92	1215	1.140	1215	344.6	959.545	F
2	1	280	394	1114	0.252	281	0.5	6.160	A
	2	604	179	1269	0.476	608	1.8	10.649	B
	3	0	787	407	0.000	0	0.0	0.000	A
	4	1492	449	1137	1.312	1137	436.2	1235.191	F

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1173	1185	783	1.497	783	954.8	4170.742	F
	2	283	474	1095	0.259	284	0.5	6.311	A
	3	1160	77	1222	0.949	1218	330.0	996.636	F
2	1	235	406	1108	0.212	235	0.4	5.881	A
	2	506	150	1283	0.394	508	1.3	9.050	A
	3	0	658	454	0.000	0	0.0	0.000	A
	4	1494	375	1173	1.274	1173	516.5	1466.389	F

2030 [100% E.TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1902.97	F
2	untitled	Standard Roundabout		1, 2, 3, 4	1003.35	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1469.34	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2030 [100% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1779	100.000
	2	✓			
	3		✓	909	100.000
2	1		✓	191	100.000
	2		✓	1198	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	915	864
	2	167	0	140
	3	63	845	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	78
	2	969	0	0	229
	3	0	0	0	0
	4	631	1129	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	19
	2	92	0	53
	3	100	28	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	47
	2	79	0	0	83
	3	0	0	0	0
	4	29	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	2.15	3187.44	969.2	F
	2	0.30	7.93	0.7	A
	3	0.85	26.36	6.9	D
2	1	0.20	7.28	0.4	A
	2	1.00	97.78	35.4	F
	3	0.00	0.00	0.0	A
	4	1.65	1915.73	549.3	F

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1339	630	1062	1.261	1042	74.4	140.249	F
	2	228	506	1079	0.211	226	0.5	7.241	A
	3	684	123	1200	0.570	677	1.7	8.928	A
2	1	143	624	1001	0.143	142	0.3	7.007	A
	2	902	58	1329	0.679	887	3.6	14.242	B
	3	0	945	349	0.000	0	0.0	0.000	A
	4	1166	718	1005	1.161	973	48.2	103.534	F

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1599	756	999	1.601	999	224.5	568.407	F
	2	273	485	1090	0.250	272	0.6	7.574	A
	3	817	148	1188	0.688	813	2.8	12.442	B
2	1	171	598	1014	0.169	171	0.3	7.149	A
	2	1077	70	1323	0.814	1064	7.0	23.753	C
	3	0	1133	280	0.000	0	0.0	0.000	A
	4	1270	860	934	1.359	933	132.4	370.202	F

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1959	917	918	2.133	918	484.6	1382.963	F
	2	323	446	1109	0.292	323	0.7	7.869	A
	3	1000	176	1175	0.852	986	6.4	23.324	C
2	1	210	553	1036	0.202	209	0.4	7.284	A
	2	1319	85	1315	1.003	1246	25.2	61.347	F
	3	0	1331	207	0.000	0	0.0	0.000	A
	4	1389	1008	862	1.612	862	264.3	844.202	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1959	929	912	2.147	912	746.2	2282.868	F
	2	330	443	1111	0.297	330	0.7	7.927	A
	3	1000	180	1173	0.853	998	6.9	26.358	D
	1	210	544	1040	0.202	210	0.4	7.255	A
	2	1319	85	1315	1.003	1278	35.4	97.777	F

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	1363	196	0.000	0	0.0	0.000	A
	4	1398	1034	849	1.647	849	401.7	1420.759	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1599	774	990	1.616	990	898.6	2864.688	F
	2	296	481	1092	0.271	296	0.6	7.783	A
	3	817	161	1182	0.691	832	3.1	14.068	B
2	1	171	569	1028	0.167	172	0.3	7.040	A
	2	1077	70	1323	0.814	1181	9.4	56.557	F
	3	0	1251	237	0.000	0	0.0	0.000	A
	4	1284	955	888	1.446	888	500.7	1740.672	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1339	641	1057	1.267	1057	969.2	3187.441	F
	2	235	513	1076	0.218	236	0.5	7.376	A
	3	684	128	1198	0.571	689	1.8	9.386	A
2	1	143	635	996	0.144	144	0.3	7.074	A
	2	902	58	1328	0.679	923	4.0	16.740	C
	3	0	982	335	0.000	0	0.0	0.000	A
	4	1185	747	990	1.197	990	549.3	1915.726	F

2030 [100% E.TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3617.43	F
2	untitled	Standard Roundabout		1, 2, 3, 4	1288.45	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2543.32	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2030 [100% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	2236	100.000
	2	✓			
	3		✓	981	100.000
2	1		✓	265	100.000
	2		✓	1184	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	1230	1006
	2	159	0	73
	3	44	937	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	225	0	40
	2	992	0	0	192
	3	0	0	0	0
	4	703	1464	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	**2**	**3**
From	**1**	0	94	9
	2	96	0	63
	3	70	19	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	**2**	**3**	**4**
From	**1**	0	93	0	68
	2	96	0	0	90
	3	0	0	0	0
	4	4	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	2.85	5561.28	1658.7	F
	2	0.22	7.48	0.5	A
	3	0.92	38.57	10.8	E
2	1	0.28	9.22	0.7	A
	2	0.98	81.74	28.4	F
	3	0.00	0.00	0.0	A
	4	1.81	2464.80	707.4	F

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1683	698	1028	1.637	1019	166.0	307.856	F
	2	172	459	1103	0.156	171	0.3	7.105	A
	3	739	117	1203	0.614	731	1.9	9.064	A
2	1	200	659	984	0.203	198	0.5	8.620	A
	2	891	30	1342	0.664	877	3.7	14.650	B
	3	0	907	363	0.000	0	0.0	0.000	A
	4	1259	735	996	1.264	976	70.8	143.518	F

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2010	837	958	2.098	958	429.0	1195.519	F
	2	206	431	1117	0.185	206	0.4	7.285	A
	3	882	141	1191	0.740	876	3.3	13.537	B
2	1	238	624	1001	0.238	238	0.6	8.893	A
	2	1064	36	1339	0.795	1052	6.8	23.415	C
	3	0	1088	297	0.000	0	0.0	0.000	A
	4	1364	881	924	1.476	923	181.0	519.360	F

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2462	1008	872	2.822	872	826.4	2563.299	F
	2	246	392	1136	0.216	245	0.5	7.445	A
	3	1080	168	1179	0.916	1056	9.4	30.462	D
2	1	292	571	1027	0.284	291	0.7	9.221	A
	2	1304	44	1336	0.976	1244	21.6	55.403	F
	3	0	1288	223	0.000	0	0.0	0.000	A
	4	1488	1042	845	1.762	845	341.8	1127.094	F

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2462	1026	863	2.852	863	1226.1	3832.593	F
	2	251	388	1138	0.221	251	0.5	7.479	A
	3	1080	172	1177	0.918	1074	10.8	38.570	E
	1	292	562	1032	0.283	292	0.7	9.182	A
	2	1304	44	1335	0.976	1277	28.4	81.737	F

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	3	0	1321	211	0.000	0	0.0	0.000	A
	4	1501	1070	831	1.806	831	509.3	1850.854	F

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2010	869	942	2.134	942	1493.1	4868.520	F
	2	221	424	1120	0.198	222	0.5	7.383	A
	3	882	152	1186	0.743	910	3.7	17.133	C
2	1	238	599	1014	0.235	239	0.6	8.779	A
	2	1064	36	1339	0.795	1143	8.6	43.418	E
	3	0	1179	263	0.000	0	0.0	0.000	A
	4	1388	958	886	1.566	886	634.6	2190.221	F

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1683	712	1021	1.649	1021	1658.7	5561.282	F
	2	178	459	1102	0.161	178	0.4	7.181	A
	3	739	122	1201	0.615	745	2.0	9.678	A
2	1	200	664	982	0.203	200	0.5	8.696	A
	2	891	30	1342	0.664	910	4.0	16.858	C
	3	0	940	351	0.000	0	0.0	0.000	A
	4	1274	762	983	1.296	983	707.4	2464.803	F

2030 [100% E.TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3495.86	F
2	untitled	Standard Roundabout		1, 2, 3, 4	1320.46	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2554.13	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2030 [100% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	2032	100.000
	2	✓			
	3		✓	1493	100.000
2	1		✓	216	100.000
	2		✓	1198	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	915	1117
	2	167	0	165
	3	193	1300	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	103
	2	969	0	0	229
	3	0	0	0	0
	4	1086	1129	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	17
	2	92	0	54
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	51
	2	79	0	0	83
	3	0	0	0	0
	4	25	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	2.59	5925.37	1493.2	F
	2	0.33	8.34	0.8	A
	3	1.40	964.69	328.2	F
2	1	0.22	7.04	0.5	A
	2	1.01	107.21	39.3	F
	3	0.00	0.00	0.0	A
	4	1.66	2456.52	727.7	F

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1530	939	907	1.687	899	157.7	328.770	F
	2	247	494	1085	0.227	245	0.5	7.314	A
	3	1124	123	1200	0.937	1079	11.2	30.716	D
2	1	163	504	1060	0.154	162	0.3	6.685	A
	2	902	77	1319	0.684	887	3.7	14.528	B
	3	0	964	342	0.000	0	0.0	0.000	A
	4	1344	718	1005	1.338	988	89.0	174.366	F

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1827	1023	865	2.112	865	398.2	1164.683	F
	2	296	475	1095	0.270	295	0.6	7.699	A
	3	1342	148	1188	1.130	1175	52.9	111.902	F
2	1	195	476	1074	0.181	194	0.4	6.837	A
	2	1077	93	1311	0.821	1063	7.2	24.659	C
	3	0	1156	272	0.000	0	0.0	0.000	A
	4	1413	860	935	1.511	934	208.6	602.495	F

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2237	1022	865	2.585	865	741.1	2379.189	F
	2	351	476	1094	0.320	350	0.8	8.260	A
	3	1644	176	1175	1.399	1174	170.4	350.850	F
2	1	238	441	1091	0.218	238	0.5	7.045	A
	2	1319	114	1301	1.014	1239	27.2	65.361	F
	3	0	1353	199	0.000	0	0.0	0.000	A
	4	1412	1002	864	1.633	864	345.4	1168.608	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2237	1021	866	2.584	866	1083.9	3825.292	F
	2	357	476	1094	0.326	357	0.8	8.344	A
	3	1644	179	1173	1.401	1173	288.1	707.341	F
	1	238	434	1094	0.218	238	0.5	7.025	A
	2	1319	114	1301	1.014	1270	39.3	107.209	F

2	3	0	1384	188	0.000	0	0.0	0.000	A
	4	1411	1028	852	1.656	852	485.2	1762.732	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1827	1029	862	2.119	862	1325.1	5060.643	F
	2	321	474	1095	0.293	322	0.7	7.962	A
	3	1342	162	1182	1.136	1182	328.2	937.855	F
2	1	195	450	1086	0.179	195	0.4	6.746	A
	2	1077	93	1311	0.821	1194	10.1	66.083	F
	3	0	1287	224	0.000	0	0.0	0.000	A
	4	1417	966	883	1.605	882	618.8	2112.569	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1530	1039	857	1.785	857	1493.2	5925.371	F
	2	255	471	1097	0.232	256	0.5	7.326	A
	3	1124	128	1198	0.939	1193	311.0	964.688	F
2	1	163	504	1060	0.154	163	0.3	6.709	A
	2	902	78	1319	0.684	926	4.1	17.372	C
	3	0	1004	327	0.000	0	0.0	0.000	A
	4	1425	749	989	1.440	989	727.7	2456.525	F

2030 [100% E.TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	4550.18	F
2	untitled	Standard Roundabout		1, 2, 3, 4	1901.25	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	3377.15	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2030 [100% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	2173	100.000
	2	✓			
	3		✓	1658	100.000
2	1		✓	424	100.000
	2		✓	1184	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	1230	943
	2	159	0	232
	3	42	1616	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	225	0	199
	2	992	0	0	192
	3	0	0	0	0
	4	1382	1464	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	12
	2	96	0	29
	3	70	12	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	24
	2	96	0	0	90
	3	0	0	0	0
	4	3	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	2.98	7676.81	1791.1	F
	2	0.36	7.29	0.8	A
	3	1.55	1521.55	511.9	F
2	1	0.43	8.82	1.1	A
	2	1.04	140.98	52.4	F
	3	0.00	0.00	0.0	A
	4	1.88	3553.55	1040.3	F

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1636	1121	816	2.006	810	206.5	470.863	F
	2	290	351	1156	0.251	288	0.5	6.202	A
	3	1248	117	1203	1.038	1150	24.6	50.499	F
2	1	319	508	1058	0.302	317	0.7	7.407	A
	2	891	149	1284	0.694	875	4.2	16.546	C
	3	0	1023	320	0.000	0	0.0	0.000	A
	4	1579	733	997	1.584	988	147.8	283.261	F

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1953	1159	797	2.452	797	495.7	1595.539	F
	2	348	346	1159	0.301	348	0.6	6.644	A
	3	1491	141	1191	1.251	1189	99.9	198.800	F
2	1	381	476	1074	0.355	380	0.8	7.941	A
	2	1064	179	1269	0.839	1047	8.5	29.394	D
	3	0	1226	246	0.000	0	0.0	0.000	A
	4	1610	877	926	1.738	926	318.7	952.068	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2393	1149	802	2.984	802	893.4	3126.649	F
	2	413	348	1158	0.357	413	0.8	7.228	A
	3	1825	168	1179	1.549	1179	261.7	558.577	F
2	1	467	444	1090	0.428	466	1.1	8.816	A
	2	1304	219	1250	1.043	1202	34.0	80.886	F
	3	0	1420	175	0.000	0	0.0	0.000	A
	4	1603	1007	862	1.858	862	503.8	1720.141	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2393	1148	802	2.982	802	1291.0	4956.898	F
	2	419	348	1158	0.361	418	0.8	7.294	A
	3	1825	170	1178	1.550	1178	423.6	1047.638	F
	1	467	438	1092	0.427	467	1.1	8.805	A
	2	1304	219	1249	1.043	1230	52.4	140.978	F

2	3	0	1449	164	0.000	0	0.0	0.000	A
	4	1602	1031	851	1.883	851	691.6	2437.868	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1953	1156	798	2.447	798	1579.8	6531.091	F
	2	377	346	1159	0.325	377	0.7	6.903	A
	3	1491	153	1186	1.257	1186	499.9	1400.342	F
2	1	381	441	1091	0.349	382	0.8	7.789	A
	2	1064	179	1269	0.839	1216	14.6	105.406	F
	3	0	1395	184	0.000	0	0.0	0.000	A
	4	1607	1019	856	1.877	856	879.4	3017.805	F

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1636	1170	791	2.068	791	1791.1	7676.810	F
	2	301	343	1160	0.260	302	0.5	6.291	A
	3	1248	123	1200	1.040	1200	511.9	1521.546	F
2	1	319	501	1061	0.301	320	0.7	7.435	A
	2	891	150	1283	0.695	931	4.7	21.827	C
	3	0	1081	299	0.000	0	0.0	0.000	A
	4	1618	780	974	1.661	974	1040.3	3553.552	F

Improvement Package Testing for Scenario 1A and 2A (un-even lane usage adjustment applied to West Rbt, North Arm)

Junctions 10
ARCADY 10 - Roundabout Module
Version: 10.0.4.1693 © Copyright TRL Software Limited, 2021
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Filename: TILBURY JUNCTION INC EAST ARM AM-PM option 2 uneven lanes.j10
Path: \\bgl-vfps-001\bgl\Home\mnejad\Tilbury Junction\Modelling\220831
Report generation date: 31/08/2022 17:24:11

»2030 [NO E. TIL], S1: CTL01 AM
»2030 [NO E. TIL], S1: CTL01 PM
»2030 [NO E. TIL], S2: CTL02 AM
»2030 [NO E. TIL], S2: CTL02 PM

Summary of junction performance

	S1: CTL01 AM					S1: CTL01 PM					S2: CTL02 AM					S2: CTL02 PM				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	2030 [NO E. TIL]																			
Junction 1 - Arm 1	D1	1.1	4.21	0.48	A	D2	1.5	4.87	0.58	A	D3	3.7	10.94	0.76	B	D4	3.3	11.70	0.75	B
Junction 1 - Arm 2		0.1	3.36	0.05	A		0.0	4.01	0.03	A		0.1	4.00	0.08	A		0.2	3.23	0.14	A
Junction 1 - Arm 3		0.6	2.97	0.32	A		0.6	2.46	0.35	A		1.8	4.68	0.59	A		2.0	4.62	0.66	A
Junction 2 - Arm 1		0.1	4.44	0.07	A		0.1	4.90	0.03	A		0.1	4.67	0.09	A		0.3	4.22	0.17	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		0.6	2.98	0.31	A		0.5	2.54	0.34	A		1.4	4.27	0.53	A		2.1	5.09	0.68	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

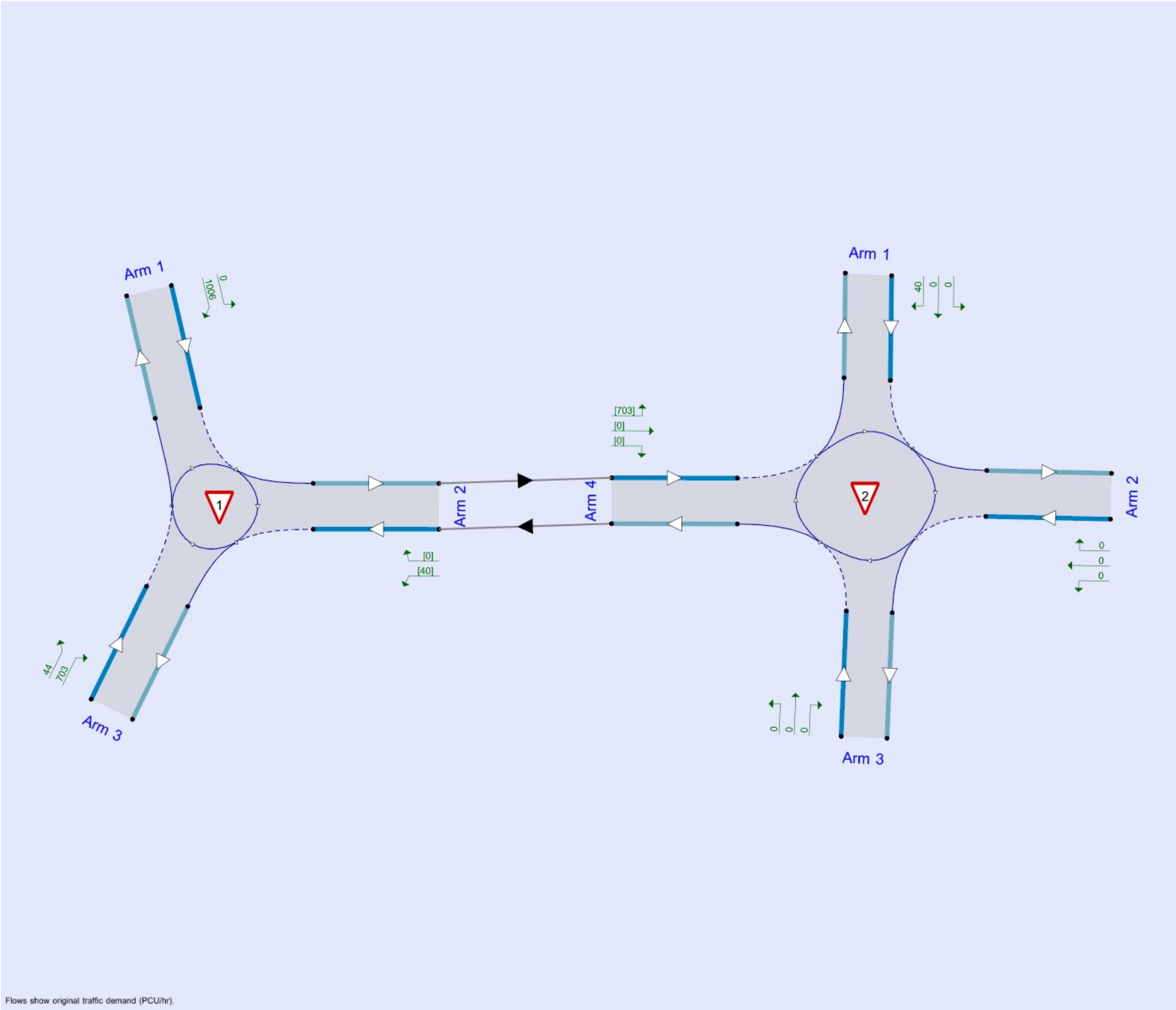
File summary

File Description

Title	
Location	
Site number	
Date	12/07/2022
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	CORP\mgilder
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2030 [NO E. TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D2	2030 [NO E. TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D3	2030 [NO E. TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D4	2030 [NO E. TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2030 [NO E. TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3.64	A
2	untitled	Standard Roundabout		1, 2, 3, 4	3.14	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	3.49	A

Arms

Arms

Junction	Arm	Name	Description	No give-way line
1	1	untitled		
	2	untitled		
	3	untitled		
2	1	untitled		
	2	untitled		
	3	untitled		
	4	untitled		

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Entry only	Exit only
1	1	7.30	7.54	4.7	20.0	60.0	6.0		
	2	7.30	7.30	0.0	20.0	60.0	19.0		
	3	7.30	8.00	4.7	20.0	60.0	27.0		
2	1	3.65	4.40	1.5	20.0	60.0	10.0		
	2	3.65	4.40	1.6	20.0	60.0	13.0		
	3	2.00	4.00	2.2	10.0	60.0	17.0		
	4	7.30	7.30	0.0	20.0	60.0	25.0		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
1	1	0.711	2464
	2	0.670	2296
	3	0.678	2380
2	1	0.502	1277
	2	0.497	1266
	3	0.393	758
	4	0.657	2250

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2030 [NO E. TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	864	100.000
	2	✓			
	3		✓	694	100.000
2	1		✓	78	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	864
	2	0	0	78
	3	63	631	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	78
	2	0	0	0	0
	3	0	0	0	0
	4	631	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	19
	2	0	0	47
	3	100	29	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	47
	2	0	0	0	0
	3	0	0	0	0
	4	29	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.48	4.21	1.1	A
	2	0.05	3.36	0.1	A
	3	0.32	2.97	0.6	A
	1	0.07	4.44	0.1	A
	2	0.00	0.00	0.0	A

2	3	0.00	0.00	0.0	A
	4	0.31	2.98	0.6	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	650	474	2127	0.306	648	0.5	2.894	A
	2	58	648	1862	0.031	58	0.0	2.934	A
	3	522	0	2380	0.220	521	0.4	2.578	A
2	1	59	0	1277	0.046	58	0.1	4.342	A
	2	0	58	1237	0.000	0	0.0	0.000	A
	3	0	58	735	0.000	0	0.0	0.000	A
	4	474	0	2250	0.211	472	0.3	2.611	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	777	567	2061	0.377	776	0.7	3.333	A
	2	70	776	1776	0.039	70	0.1	3.101	A
	3	624	0	2380	0.262	623	0.5	2.731	A
2	1	70	0	1277	0.055	70	0.1	4.384	A
	2	0	70	1231	0.000	0	0.0	0.000	A
	3	0	70	731	0.000	0	0.0	0.000	A
	4	567	0	2250	0.252	567	0.4	2.758	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	951	694	1970	0.483	950	1.1	4.192	A
	2	86	950	1660	0.052	86	0.1	3.361	A
	3	764	0	2380	0.321	763	0.6	2.968	A
2	1	86	0	1277	0.067	86	0.1	4.442	A
	2	0	86	1223	0.000	0	0.0	0.000	A
	3	0	86	724	0.000	0	0.0	0.000	A
	4	694	0	2250	0.308	694	0.6	2.983	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	951	695	1970	0.483	951	1.1	4.205	A
	2	86	951	1659	0.052	86	0.1	3.364	A
	3	764	0	2380	0.321	764	0.6	2.968	A
2	1	86	0	1277	0.067	86	0.1	4.442	A
	2	0	86	1223	0.000	0	0.0	0.000	A
	3	0	86	724	0.000	0	0.0	0.000	A
	4	695	0	2250	0.309	695	0.6	2.984	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	777	568	2060	0.377	778	0.7	3.345	A
	2	70	778	1775	0.040	70	0.1	3.104	A
	3	624	0	2380	0.262	625	0.5	2.733	A
2	1	70	0	1277	0.055	70	0.1	4.385	A
	2	0	70	1231	0.000	0	0.0	0.000	A
	3	0	70	731	0.000	0	0.0	0.000	A
	4	568	0	2250	0.252	568	0.4	2.763	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	650	475	2126	0.306	651	0.5	2.908	A
	2	59	651	1860	0.032	59	0.0	2.937	A
	3	522	0	2380	0.220	523	0.4	2.585	A
2	1	59	0	1277	0.046	59	0.1	4.344	A
	2	0	59	1237	0.000	0	0.0	0.000	A
	3	0	59	735	0.000	0	0.0	0.000	A

	4	475	0	2250	0.211	476	0.3	2.617	A

2030 [NO E. TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3.85	A
2	untitled	Standard Roundabout		1, 2, 3, 4	2.66	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	3.50	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2030 [NO E. TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1006	100.000
	2	✓			
	3		✓	747	100.000
2	1		✓	40	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	1006
	2	0	0	40
	3	44	703	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
	1	0	0	0	40

From	2	0	0	0	0
	3	0	0	0	0
	4	703	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	9
	2	0	0	68
	3	70	4	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	68
	2	0	0	0	0
	3	0	0	0	0
	4	4	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.58	4.87	1.5	A
	2	0.03	4.01	0.0	A
	3	0.35	2.46	0.6	A
2	1	0.03	4.90	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.34	2.54	0.5	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	757	528	2088	0.363	755	0.6	2.938	A
	2	30	755	1790	0.017	30	0.0	3.434	A
	3	562	0	2380	0.236	561	0.3	2.106	A
2	1	30	0	1277	0.024	30	0.0	4.850	A
	2	0	30	1251	0.000	0	0.0	0.000	A
	3	0	30	746	0.000	0	0.0	0.000	A
	4	528	0	2250	0.235	527	0.3	2.171	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	904	632	2015	0.449	903	0.9	3.527	A
	2	36	903	1691	0.021	36	0.0	3.653	A
	3	672	0	2380	0.282	671	0.4	2.242	A
2	1	36	0	1277	0.028	36	0.0	4.873	A
	2	0	36	1248	0.000	0	0.0	0.000	A
	3	0	36	744	0.000	0	0.0	0.000	A
	4	632	0	2250	0.281	631	0.4	2.312	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1108	773	1914	0.579	1105	1.5	4.838	A
	2	44	1105	1555	0.028	44	0.0	4.001	A
	3	822	0	2380	0.346	822	0.6	2.459	A
	1	44	0	1277	0.034	44	0.1	4.905	A

	2	0	44	1244	0.000	0	0.0	0.000	A
2	3	0	44	741	0.000	0	0.0	0.000	A
	4	773	0	2250	0.344	773	0.5	2.534	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1108	774	1913	0.579	1108	1.5	4.869	A
	2	44	1108	1554	0.028	44	0.0	4.005	A
	3	822	0	2380	0.346	822	0.6	2.459	A
2	1	44	0	1277	0.034	44	0.1	4.905	A
	2	0	44	1244	0.000	0	0.0	0.000	A
	3	0	44	741	0.000	0	0.0	0.000	A
	4	774	0	2250	0.344	774	0.5	2.535	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	904	633	2014	0.449	907	0.9	3.550	A
	2	36	907	1688	0.021	36	0.0	3.662	A
	3	672	0	2380	0.282	672	0.4	2.243	A
2	1	36	0	1277	0.028	36	0.0	4.873	A
	2	0	36	1248	0.000	0	0.0	0.000	A
	3	0	36	744	0.000	0	0.0	0.000	A
	4	633	0	2250	0.281	633	0.4	2.315	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	757	530	2087	0.363	758	0.6	2.957	A
	2	30	758	1788	0.017	30	0.0	3.440	A
	3	562	0	2380	0.236	563	0.3	2.110	A
2	1	30	0	1277	0.024	30	0.0	4.850	A
	2	0	30	1251	0.000	0	0.0	0.000	A
	3	0	30	746	0.000	0	0.0	0.000	A
	4	530	0	2250	0.235	530	0.3	2.178	A

2030 [NO E. TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	7.45	A
2	untitled	Standard Roundabout		1, 2, 3, 4	4.30	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	6.44	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2030 [NO E. TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1117	100.000
	2	✓			
	3		✓	1279	100.000
2	1		✓	103	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	1117
	2	0	0	103
	3	193	1086	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
	1	0	0	0	103

	2	0	0	0	0
From	3	0	0	0	0
	4	1086	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	17
	2	0	0	51
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	51
	2	0	0	0	0
	3	0	0	0	0
	4	25	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.76	10.94	3.7	B
	2	0.08	4.00	0.1	A
	3	0.59	4.68	1.8	A
2	1	0.09	4.67	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.53	4.27	1.4	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	841	815	1884	0.446	837	0.9	4.007	A
	2	77	837	1735	0.044	77	0.1	3.278	A
	3	963	0	2380	0.405	959	0.9	3.195	A
2	1	78	0	1277	0.061	77	0.1	4.530	A
	2	0	77	1228	0.000	0	0.0	0.000	A
	3	0	77	728	0.000	0	0.0	0.000	A
	4	815	0	2250	0.362	812	0.7	3.124	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1004	975	1770	0.567	1002	1.5	5.465	A
	2	93	1002	1625	0.057	92	0.1	3.547	A
	3	1150	0	2380	0.483	1149	1.2	3.692	A
2	1	93	0	1277	0.073	93	0.1	4.589	A
	2	0	93	1220	0.000	0	0.0	0.000	A
	3	0	93	722	0.000	0	0.0	0.000	A
	4	975	0	2250	0.433	974	0.9	3.525	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1230	1194	1615	0.762	1222	3.6	10.496	B
	2	113	1222	1477	0.077	113	0.1	3.984	A
	3	1408	0	2380	0.592	1406	1.8	4.658	A
	1	113	0	1277	0.089	113	0.1	4.671	A

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	2	0	113	1210	0.000	0	0.0	0.000	A
	3	0	113	714	0.000	0	0.0	0.000	A
	4	1194	0	2250	0.530	1192	1.4	4.244	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1230	1196	1613	0.762	1229	3.7	10.939	B
	2	113	1229	1472	0.077	113	0.1	4.000	A
	3	1408	0	2380	0.592	1408	1.8	4.682	A
2	1	113	0	1277	0.089	113	0.1	4.671	A
	2	0	113	1210	0.000	0	0.0	0.000	A
	3	0	113	714	0.000	0	0.0	0.000	A
	4	1196	0	2250	0.531	1196	1.4	4.266	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1004	978	1768	0.568	1013	1.6	5.637	A
	2	93	1013	1618	0.057	93	0.1	3.564	A
	3	1150	0	2380	0.483	1152	1.2	3.713	A
2	1	93	0	1277	0.073	93	0.1	4.590	A
	2	0	93	1220	0.000	0	0.0	0.000	A
	3	0	93	722	0.000	0	0.0	0.000	A
	4	978	0	2250	0.435	980	1.0	3.547	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	841	819	1882	0.447	843	1.0	4.067	A
	2	78	843	1731	0.045	78	0.1	3.290	A
	3	963	0	2380	0.405	964	0.9	3.218	A
2	1	78	0	1277	0.061	78	0.1	4.534	A
	2	0	78	1227	0.000	0	0.0	0.000	A
	3	0	78	728	0.000	0	0.0	0.000	A
	4	819	0	2250	0.364	820	0.7	3.149	A

2030 [NO E. TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	7.11	A
2	untitled	Standard Roundabout		1, 2, 3, 4	4.98	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	6.30	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2030 [NO E. TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	943	100.000
	2	✓			
	3		✓	1424	100.000
2	1		✓	199	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	943
	2	0	0	199
	3	42	1382	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
	1	0	0	0	199

From	2	0	0	0	0
	3	0	0	0	0
	4	1382	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	12
	2	0	0	24
	3	70	3	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	24
	2	0	0	0	0
	3	0	0	0	0
	4	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.75	11.70	3.3	B
	2	0.14	3.23	0.2	A
	3	0.66	4.62	2.0	A
2	1	0.17	4.22	0.3	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.68	5.09	2.1	A

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	710	1037	1726	0.411	707	0.8	3.943	A
	2	149	707	1822	0.082	149	0.1	2.667	A
	3	1072	0	2380	0.450	1069	0.8	2.854	A
2	1	150	0	1277	0.117	149	0.2	3.957	A
	2	0	149	1192	0.000	0	0.0	0.000	A
	3	0	149	700	0.000	0	0.0	0.000	A
	4	1037	0	2250	0.461	1034	0.9	3.039	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	848	1241	1581	0.536	846	1.3	5.465	A
	2	179	846	1729	0.103	179	0.1	2.878	A
	3	1280	0	2380	0.538	1279	1.2	3.401	A
2	1	179	0	1277	0.140	179	0.2	4.065	A
	2	0	179	1177	0.000	0	0.0	0.000	A
	3	0	179	688	0.000	0	0.0	0.000	A
	4	1241	0	2250	0.551	1239	1.3	3.664	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1038	1519	1384	0.750	1031	3.2	11.178	B
	2	219	1031	1605	0.136	219	0.2	3.218	A
	3	1568	0	2380	0.659	1565	2.0	4.584	A
	1	219	0	1277	0.172	219	0.3	4.217	A

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
2	2	0	219	1157	0.000	0	0.0	0.000	A
	3	0	219	672	0.000	0	0.0	0.000	A
	4	1519	0	2250	0.675	1515	2.1	5.021	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1038	1522	1382	0.751	1038	3.3	11.697	B
	2	219	1038	1601	0.137	219	0.2	3.230	A
	3	1568	0	2380	0.659	1568	2.0	4.618	A
2	1	219	0	1277	0.172	219	0.3	4.219	A
	2	0	219	1157	0.000	0	0.0	0.000	A
	3	0	219	672	0.000	0	0.0	0.000	A
	4	1522	0	2250	0.676	1521	2.1	5.085	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	848	1245	1578	0.537	856	1.3	5.642	A
	2	179	856	1723	0.104	179	0.1	2.894	A
	3	1280	0	2380	0.538	1283	1.2	3.431	A
2	1	179	0	1277	0.140	179	0.2	4.068	A
	2	0	179	1177	0.000	0	0.0	0.000	A
	3	0	179	688	0.000	0	0.0	0.000	A
	4	1245	0	2250	0.553	1249	1.3	3.713	A

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	710	1042	1723	0.412	712	0.8	3.996	A
	2	150	712	1819	0.082	150	0.1	2.676	A
	3	1072	0	2380	0.450	1074	0.9	2.876	A
2	1	150	0	1277	0.117	150	0.2	3.961	A
	2	0	150	1191	0.000	0	0.0	0.000	A
	3	0	150	699	0.000	0	0.0	0.000	A
	4	1042	0	2250	0.463	1043	0.9	3.078	A

Improvement Package Testing (Results for Scenarios 1A and 2A should be disregarded as an un-even lane adjustment applied and included before this set of results for S1A and S2A)

Junctions 10
ARCADY 10 - Roundabout Module
Version: 10.0.4.1693 © Copyright TRL Software Limited, 2021
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Filename: TILBURY JUNCTION INC EAST ARM AM-PM option 2.j10
Path: \\bgl-vfps-001\bgl\Home\mnejad\Tilbury Junction\Modelling\220831
Report generation date: 31/08/2022 17:13:43

Summary of junction performance

	S1: CTL01 AM					S1: CTL01 PM					S2: CTL02 AM					S2: CTL02 PM				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	2030 [NO E.TIL]																			
Junction 1 - Arm 1		0.8	2.90	0.39	A		1.0	3.12	0.47	A		1.8	5.27	0.61	A		1.6	5.50	0.59	A
Junction 1 - Arm 2		0.1	3.41	0.05	A		0.0	4.06	0.03	A		0.1	4.06	0.08	A		0.2	3.28	0.14	A
Junction 1 - Arm 3		0.6	2.97	0.32	A		0.6	2.46	0.35	A		1.8	4.68	0.59	A		2.0	4.62	0.66	A
Junction 2 - Arm 1	D1	0.1	4.44	0.07	A	D2	0.1	4.90	0.03	A	D3	0.1	4.67	0.09	A	D4	0.3	4.22	0.17	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		0.4	2.28	0.25	A		0.4	1.91	0.28	A		1.0	2.93	0.44	A		1.3	3.06	0.56	A
	2030 [50% E.TIL]																			
Junction 1 - Arm 1		2.2	5.59	0.62	A		4.8	9.84	0.79	A		10.1	22.20	0.90	C		46.3	92.07	1.03	F
Junction 1 - Arm 2		0.4	4.50	0.19	A		0.3	5.05	0.16	A		0.5	5.32	0.23	A		0.5	4.23	0.26	A
Junction 1 - Arm 3		0.8	3.37	0.39	A		0.8	3.07	0.42	A		2.5	5.92	0.67	A		3.0	6.45	0.74	A
Junction 2 - Arm 1	D5	0.3	7.09	0.15	A	D6	0.4	9.50	0.19	A	D7	0.4	7.37	0.18	A	D8	0.9	9.50	0.39	A
Junction 2 - Arm 2		2.8	13.72	0.61	B		2.8	13.86	0.59	B		2.9	14.15	0.62	B		3.4	16.73	0.64	C
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		1.9	5.22	0.56	A		2.8	6.51	0.68	A		4.7	9.61	0.78	A		30.1	47.65	0.99	E
	2030 [100% E.TIL]																			
Junction 1 - Arm 1		9.5	18.28	0.87	C		164.8	215.63	1.14	F		208.5	320.89	1.21	F		491.9	940.22	1.53	F
Junction 1 - Arm 2		0.4	4.69	0.19	A		0.3	4.90	0.15	A		0.5	5.11	0.22	A		0.4	3.98	0.22	A
Junction 1 - Arm 3		1.0	3.74	0.44	A		1.1	3.66	0.48	A		3.3	7.33	0.73	A		4.5	9.14	0.80	A
Junction 2 - Arm 1	D9	0.8	13.34	0.32	B	D10	1.7	21.24	0.48	C	D11	0.8	11.43	0.31	B	D12	2.4	18.92	0.62	C
Junction 2 - Arm 2		68.0	176.27	1.08	F		54.6	146.55	1.05	F		74.1	191.41	1.09	F		92.2	255.38	1.13	F
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		24.6	47.72	0.97	E		171.2	284.91	1.13	F		162.0	276.32	1.13	F		642.3	1073.70	1.32	F

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

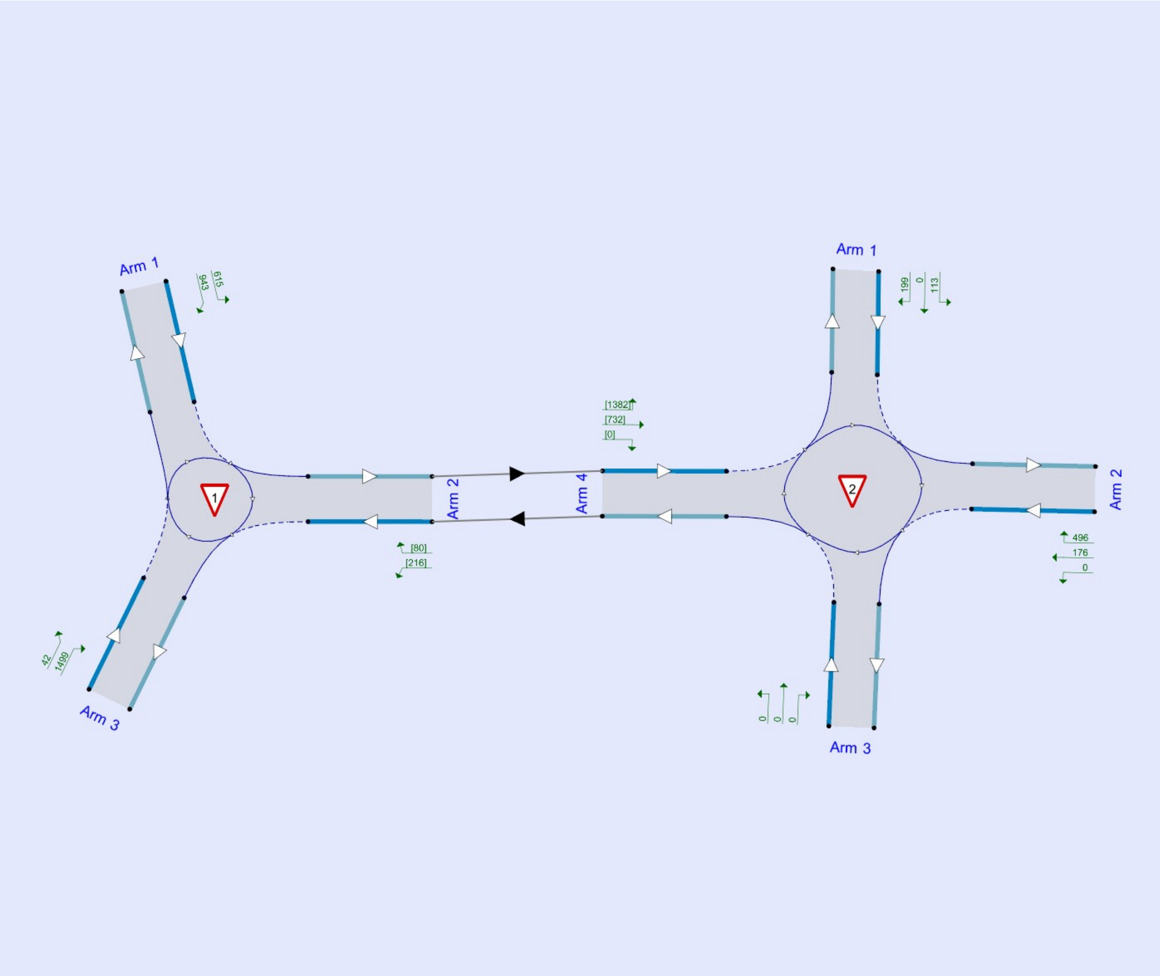
File Description

Title	
Location	
Site number	
Date	12/07/2022
Version	
Status	(new file)
Identifier	

Client	
Jobnumber	
Enumerator	CORP\mgilder
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



Flows show original traffic demand (PCU/hr).

The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2030 [NO E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D2	2030 [NO E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D3	2030 [NO E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D4	2030 [NO E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15
D5	2030 [50% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D6	2030 [50% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D7	2030 [50% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D8	2030 [50% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15
D9	2030 [100% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15
D10	2030 [100% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15
D11	2030 [100% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15
D12	2030 [100% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

2030 [NO E.TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.96	A
2	untitled	Standard Roundabout		1, 2, 3, 4	2.52	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.82	A

Arms

Arms

Junction	Arm	Name	Description	No give-way line
1	1	untitled		
	2	untitled		
	3	untitled		
2	1	untitled		
	2	untitled		
	3	untitled		
	4	untitled		

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Entry only	Exit only
1	1	7.30	11.90	11.7	20.0	60.0	15.0		
	2	7.30	7.30	0.0	20.0	60.0	23.0		
	3	7.30	8.00	4.7	20.0	60.0	27.0		
2	1	3.65	4.40	1.5	20.0	60.0	10.0		
	2	3.65	4.40	1.6	20.0	60.0	13.0		
	3	2.00	4.00	2.2	10.0	60.0	17.0		
	4	7.30	10.90	7.2	20.0	60.0	19.0		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
1	1	0.792	2976
	2	0.661	2266
	3	0.678	2380
2	1	0.502	1277
	2	0.497	1266
	3	0.393	758
	4	0.746	2732

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	2030 [NO E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)

HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	864	100.000
	2	✓			
	3		✓	694	100.000
2	1		✓	78	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	864
	2	0	0	78
	3	63	631	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	78
	2	0	0	0	0
	3	0	0	0	0
	4	631	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	19
	2	0	0	47
	3	100	29	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	47
	2	0	0	0	0
	3	0	0	0	0
	4	29	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.39	2.90	0.8	A
	2	0.05	3.41	0.1	A
	3	0.32	2.97	0.6	A
2	1	0.07	4.44	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.25	2.28	0.4	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	650	474	2601	0.250	649	0.4	2.192	A
	2	58	649	1836	0.032	58	0.0	2.975	A
	3	522	0	2380	0.220	521	0.4	2.578	A
2	1	59	0	1277	0.046	58	0.1	4.342	A
	2	0	58	1237	0.000	0	0.0	0.000	A
	3	0	58	735	0.000	0	0.0	0.000	A
	4	474	0	2732	0.173	473	0.3	2.054	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	777	567	2527	0.307	776	0.5	2.446	A
	2	70	776	1752	0.040	70	0.1	3.145	A
	3	624	0	2380	0.262	623	0.5	2.731	A
2	1	70	0	1277	0.055	70	0.1	4.384	A
	2	0	70	1231	0.000	0	0.0	0.000	A
	3	0	70	731	0.000	0	0.0	0.000	A
	4	567	0	2732	0.207	567	0.3	2.144	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	951	694	2427	0.392	950	0.8	2.900	A
	2	86	950	1637	0.052	86	0.1	3.410	A
	3	764	0	2380	0.321	763	0.6	2.968	A
2	1	86	0	1277	0.067	86	0.1	4.442	A
	2	0	86	1223	0.000	0	0.0	0.000	A
	3	0	86	724	0.000	0	0.0	0.000	A
	4	694	0	2732	0.254	694	0.4	2.278	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	951	695	2426	0.392	951	0.8	2.903	A
	2	86	951	1636	0.052	86	0.1	3.412	A
	3	764	0	2380	0.321	764	0.6	2.968	A
2	1	86	0	1277	0.067	86	0.1	4.442	A
	2	0	86	1223	0.000	0	0.0	0.000	A
	3	0	86	724	0.000	0	0.0	0.000	A
	4	695	0	2732	0.254	695	0.4	2.278	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	777	568	2527	0.307	778	0.5	2.450	A
	2	70	778	1751	0.040	70	0.1	3.150	A
	3	624	0	2380	0.262	625	0.5	2.733	A
2	1	70	0	1277	0.055	70	0.1	4.385	A
	2	0	70	1231	0.000	0	0.0	0.000	A
	3	0	70	731	0.000	0	0.0	0.000	A
	4	568	0	2732	0.208	568	0.3	2.147	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	650	475	2600	0.250	651	0.4	2.200	A
	2	59	651	1835	0.032	59	0.0	2.978	A
	3	522	0	2380	0.220	523	0.4	2.585	A
2	1	59	0	1277	0.046	59	0.1	4.344	A
	2	0	59	1237	0.000	0	0.0	0.000	A
	3	0	59	735	0.000	0	0.0	0.000	A
	4	475	0	2732	0.174	476	0.3	2.057	A

2030 [NO E.TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.87	A
2	untitled	Standard Roundabout		1, 2, 3, 4	2.07	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.63	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	2030 [NO E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1006	100.000
	2	✓			
	3		✓	747	100.000
2	1		✓	40	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	1006
	2	0	0	40
	3	44	703	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	40
	2	0	0	0	0
	3	0	0	0	0
	4	703	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	9
	2	0	0	68
	3	70	4	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	68
	2	0	0	0	0
	3	0	0	0	0
	4	4	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.47	3.12	1.0	A
	2	0.03	4.06	0.0	A
	3	0.35	2.46	0.6	A
2	1	0.03	4.90	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.28	1.91	0.4	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	757	528	2558	0.296	756	0.5	2.175	A
	2	30	756	1766	0.017	30	0.0	3.483	A
	3	562	0	2380	0.236	561	0.3	2.106	A
2	1	30	0	1277	0.024	30	0.0	4.850	A
	2	0	30	1251	0.000	0	0.0	0.000	A
	3	0	30	746	0.000	0	0.0	0.000	A
	4	528	0	2732	0.193	527	0.2	1.697	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	904	632	2476	0.365	904	0.6	2.494	A
	2	36	904	1668	0.022	36	0.0	3.705	A
	3	672	0	2380	0.282	671	0.4	2.242	A
2	1	36	0	1277	0.028	36	0.0	4.873	A
	2	0	36	1248	0.000	0	0.0	0.000	A
	3	0	36	744	0.000	0	0.0	0.000	A
	4	632	0	2732	0.231	631	0.3	1.781	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1108	773	2364	0.469	1106	1.0	3.117	A
	2	44	1106	1534	0.029	44	0.0	4.059	A
	3	822	0	2380	0.346	822	0.6	2.459	A
2	1	44	0	1277	0.034	44	0.1	4.905	A
	2	0	44	1244	0.000	0	0.0	0.000	A
	3	0	44	741	0.000	0	0.0	0.000	A
	4	773	0	2732	0.283	773	0.4	1.910	A

17:30 - 17:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1108	774	2363	0.469	1108	1.0	3.123	A
	2	44	1108	1533	0.029	44	0.0	4.061	A
	3	822	0	2380	0.346	822	0.6	2.459	A
2	1	44	0	1277	0.034	44	0.1	4.905	A
	2	0	44	1244	0.000	0	0.0	0.000	A
	3	0	44	741	0.000	0	0.0	0.000	A
	4	774	0	2732	0.283	774	0.4	1.910	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	904	633	2476	0.365	906	0.6	2.503	A
	2	36	906	1667	0.022	36	0.0	3.708	A
	3	672	0	2380	0.282	672	0.4	2.243	A
2	1	36	0	1277	0.028	36	0.0	4.873	A
	2	0	36	1248	0.000	0	0.0	0.000	A
	3	0	36	744	0.000	0	0.0	0.000	A
	4	633	0	2732	0.232	633	0.3	1.782	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	757	530	2557	0.296	758	0.5	2.183	A
	2	30	758	1764	0.017	30	0.0	3.487	A
	3	562	0	2380	0.236	563	0.3	2.110	A
2	1	30	0	1277	0.024	30	0.0	4.850	A
	2	0	30	1251	0.000	0	0.0	0.000	A
	3	0	30	746	0.000	0	0.0	0.000	A
	4	530	0	2732	0.194	530	0.3	1.701	A

2030 [NO E.TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	4.92	A
2	untitled	Standard Roundabout		1, 2, 3, 4	3.08	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	4.32	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	2030 [NO E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1117	100.000
	2	✓			
	3		✓	1279	100.000
2	1		✓	103	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	1117
	2	0	0	103
	3	193	1086	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	103
	2	0	0	0	0
	3	0	0	0	0
	4	1086	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	17
	2	0	0	51
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	51
	2	0	0	0	0
	3	0	0	0	0
	4	25	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.61	5.27	1.8	A
	2	0.08	4.06	0.1	A
	3	0.59	4.68	1.8	A
2	1	0.09	4.67	0.1	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.44	2.93	1.0	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	841	815	2331	0.361	838	0.7	2.816	A
	2	77	838	1711	0.045	77	0.1	3.326	A
	3	963	0	2380	0.405	959	0.9	3.195	A
2	1	78	0	1277	0.061	77	0.1	4.530	A
	2	0	77	1228	0.000	0	0.0	0.000	A
	3	0	77	728	0.000	0	0.0	0.000	A
	4	815	0	2732	0.298	813	0.5	2.342	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1004	975	2204	0.456	1003	1.0	3.503	A
	2	93	1003	1602	0.058	92	0.1	3.599	A
	3	1150	0	2380	0.483	1149	1.2	3.692	A
2	1	93	0	1277	0.073	93	0.1	4.589	A
	2	0	93	1220	0.000	0	0.0	0.000	A
	3	0	93	722	0.000	0	0.0	0.000	A
	4	975	0	2732	0.357	975	0.7	2.560	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1230	1194	2031	0.605	1227	1.8	5.214	A
	2	113	1227	1454	0.078	113	0.1	4.053	A
	3	1408	0	2380	0.592	1406	1.8	4.658	A
2	1	113	0	1277	0.089	113	0.1	4.671	A
	2	0	113	1210	0.000	0	0.0	0.000	A
	3	0	113	714	0.000	0	0.0	0.000	A
	4	1194	0	2732	0.437	1192	1.0	2.921	A

08:30 - 08:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1230	1196	2030	0.606	1230	1.8	5.266	A
	2	113	1230	1452	0.078	113	0.1	4.060	A
	3	1408	0	2380	0.592	1408	1.8	4.682	A
2	1	113	0	1277	0.089	113	0.1	4.671	A
	2	0	113	1210	0.000	0	0.0	0.000	A
	3	0	113	714	0.000	0	0.0	0.000	A
	4	1196	0	2732	0.438	1196	1.0	2.927	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1004	978	2202	0.456	1007	1.0	3.538	A
	2	93	1007	1599	0.058	93	0.1	3.607	A
	3	1150	0	2380	0.483	1152	1.2	3.713	A
2	1	93	0	1277	0.073	93	0.1	4.590	A
	2	0	93	1220	0.000	0	0.0	0.000	A
	3	0	93	722	0.000	0	0.0	0.000	A
	4	978	0	2732	0.358	980	0.7	2.568	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	841	819	2328	0.361	842	0.7	2.836	A
	2	78	842	1709	0.045	78	0.1	3.335	A
	3	963	0	2380	0.405	964	0.9	3.218	A
2	1	78	0	1277	0.061	78	0.1	4.534	A
	2	0	78	1227	0.000	0	0.0	0.000	A
	3	0	78	728	0.000	0	0.0	0.000	A
	4	819	0	2732	0.300	819	0.5	2.352	A

2030 [NO E.TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	4.84	A
2	untitled	Standard Roundabout		1, 2, 3, 4	3.21	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	4.22	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	2030 [NO E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	943	100.000
	2	✓			
	3		✓	1424	100.000
2	1		✓	199	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	943
	2	0	0	199
	3	42	1382	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	199
	2	0	0	0	0
	3	0	0	0	0
	4	1382	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	12
	2	0	0	24
	3	70	3	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	24
	2	0	0	0	0
	3	0	0	0	0
	4	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.59	5.50	1.6	A
	2	0.14	3.28	0.2	A
	3	0.66	4.62	2.0	A
2	1	0.17	4.22	0.3	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.56	3.06	1.3	A

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	710	1037	2155	0.329	708	0.5	2.782	A
	2	149	708	1797	0.083	149	0.1	2.707	A
	3	1072	0	2380	0.450	1069	0.8	2.854	A
2	1	150	0	1277	0.117	149	0.2	3.957	A
	2	0	149	1192	0.000	0	0.0	0.000	A
	3	0	149	700	0.000	0	0.0	0.000	A
	4	1037	0	2732	0.380	1035	0.6	2.181	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	848	1241	1994	0.425	847	0.8	3.512	A
	2	179	847	1706	0.105	179	0.1	2.922	A
	3	1280	0	2380	0.538	1279	1.2	3.401	A
2	1	179	0	1277	0.140	179	0.2	4.065	A
	2	0	179	1177	0.000	0	0.0	0.000	A
	3	0	179	688	0.000	0	0.0	0.000	A
	4	1241	0	2732	0.454	1240	0.9	2.484	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1038	1519	1774	0.585	1035	1.6	5.437	A
	2	219	1035	1581	0.138	219	0.2	3.276	A
	3	1568	0	2380	0.659	1565	2.0	4.584	A
2	1	219	0	1277	0.172	219	0.3	4.217	A
	2	0	219	1157	0.000	0	0.0	0.000	A
	3	0	219	672	0.000	0	0.0	0.000	A
	4	1519	0	2732	0.556	1517	1.3	3.047	A

08:45 - 09:00

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1038	1522	1772	0.586	1038	1.6	5.498	A
	2	219	1038	1579	0.139	219	0.2	3.282	A
	3	1568	0	2380	0.659	1568	2.0	4.618	A
2	1	219	0	1277	0.172	219	0.3	4.219	A
	2	0	219	1157	0.000	0	0.0	0.000	A
	3	0	219	672	0.000	0	0.0	0.000	A
	4	1522	0	2732	0.557	1522	1.3	3.062	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	848	1245	1990	0.426	851	0.8	3.549	A
	2	179	851	1703	0.105	179	0.1	2.929	A
	3	1280	0	2380	0.538	1283	1.2	3.431	A
2	1	179	0	1277	0.140	179	0.2	4.068	A
	2	0	179	1177	0.000	0	0.0	0.000	A
	3	0	179	688	0.000	0	0.0	0.000	A
	4	1245	0	2732	0.456	1247	0.9	2.499	A

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	710	1042	2151	0.330	711	0.6	2.801	A
	2	150	711	1795	0.084	150	0.1	2.713	A
	3	1072	0	2380	0.450	1074	0.9	2.876	A
2	1	150	0	1277	0.117	150	0.2	3.961	A
	2	0	150	1191	0.000	0	0.0	0.000	A
	3	0	150	699	0.000	0	0.0	0.000	A
	4	1042	0	2732	0.381	1043	0.6	2.197	A

2030 [50% E.TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	4.72	A
2	untitled	Standard Roundabout		1, 2, 3, 4	8.23	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	6.32	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	2030 [50% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1322	100.000
	2	✓			
	3		✓	801	100.000
2	1		✓	135	100.000
	2		✓	683	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	458	864
	2	84	0	109
	3	63	738	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	57	0	78
	2	485	0	0	198
	3	0	0	0	0
	4	631	565	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	19
	2	92	0	51
	3	100	28	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	47
	2	79	0	0	83
	3	0	0	0	0
	4	29	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.62	5.59	2.2	A
	2	0.19	4.50	0.4	A
	3	0.39	3.37	0.8	A
2	1	0.15	7.09	0.3	A
	2	0.61	13.72	2.8	B
	3	0.00	0.00	0.0	A
	4	0.56	5.22	1.9	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	995	554	2538	0.392	992	0.9	3.168	A
	2	206	648	1837	0.112	205	0.2	3.670	A
	3	603	89	2320	0.260	601	0.5	2.757	A
2	1	101	422	1065	0.095	101	0.2	6.002	A
	2	514	58	1237	0.415	509	1.3	8.846	A
	3	0	567	535	0.000	0	0.0	0.000	A
	4	898	361	2463	0.364	894	0.8	3.380	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1188	663	2451	0.485	1187	1.3	3.876	A
	2	247	776	1753	0.141	247	0.3	3.981	A
	3	720	108	2307	0.312	720	0.6	2.987	A
2	1	121	507	1023	0.118	121	0.2	6.420	A
	2	614	70	1231	0.498	612	1.8	10.431	B
	3	0	682	490	0.000	0	0.0	0.000	A
	4	1074	434	2408	0.446	1073	1.2	3.974	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1456	812	2334	0.624	1452	2.2	5.541	A
	2	303	949	1638	0.185	302	0.4	4.485	A
	3	882	131	2291	0.385	881	0.8	3.362	A
2	1	148	620	966	0.153	148	0.3	7.078	A
	2	751	86	1223	0.614	747	2.8	13.504	B
	3	0	833	431	0.000	0	0.0	0.000	A
	4	1315	531	2336	0.563	1312	1.9	5.175	A

08:30 - 08:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1456	813	2333	0.624	1455	2.2	5.593	A
	2	304	951	1636	0.186	304	0.4	4.496	A
	3	882	132	2290	0.385	882	0.8	3.365	A
2	1	148	622	965	0.154	148	0.3	7.091	A
	2	751	86	1223	0.614	751	2.8	13.722	B
	3	0	837	429	0.000	0	0.0	0.000	A
	4	1317	533	2334	0.564	1317	1.9	5.221	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1188	664	2450	0.485	1192	1.3	3.914	A
	2	249	779	1750	0.143	250	0.3	3.995	A
	3	720	109	2306	0.312	721	0.6	2.992	A
2	1	121	510	1021	0.118	121	0.2	6.441	A
	2	614	70	1231	0.498	617	1.8	10.638	B
	3	0	688	488	0.000	0	0.0	0.000	A
	4	1077	438	2405	0.448	1080	1.2	4.019	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	995	556	2536	0.392	997	0.9	3.191	A
	2	209	652	1835	0.114	209	0.2	3.688	A
	3	603	91	2318	0.260	604	0.5	2.765	A
2	1	101	427	1063	0.095	101	0.2	6.024	A
	2	514	59	1237	0.415	516	1.3	9.023	A
	3	0	575	532	0.000	0	0.0	0.000	A
	4	901	366	2459	0.367	903	0.9	3.417	A

2030 [50% E.TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	7.29	A
2	untitled	Standard Roundabout		1, 2, 3, 4	8.90	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	8.02	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	2030 [50% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1621	100.000
	2	✓			
	3		✓	864	100.000
2	1		✓	153	100.000
	2		✓	672	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	615	1006
	2	80	0	56
	3	44	820	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	40
	2	496	0	0	176
	3	0	0	0	0
	4	703	732	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	9
	2	96	0	65
	3	70	12	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	68
	2	96	0	0	90
	3	0	0	0	0
	4	4	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.79	9.84	4.8	A
	2	0.16	5.05	0.3	A
	3	0.42	3.07	0.8	A
2	1	0.19	9.50	0.4	A
	2	0.59	13.86	2.8	B
	3	0.00	0.00	0.0	A
	4	0.68	6.51	2.8	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1220	616	2489	0.490	1215	1.2	3.683	A
	2	161	754	1767	0.091	160	0.2	4.075	A
	3	650	94	2316	0.281	649	0.4	2.459	A
2	1	115	547	1002	0.115	114	0.2	7.523	A
	2	506	30	1251	0.404	501	1.3	9.263	A
	3	0	531	550	0.000	0	0.0	0.000	A
	4	1077	370	2457	0.438	1073	1.0	3.501	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1457	737	2393	0.609	1454	2.0	4.997	A
	2	194	902	1669	0.116	193	0.2	4.439	A
	3	777	114	2303	0.337	776	0.6	2.687	A
2	1	138	656	948	0.145	137	0.3	8.251	A
	2	604	36	1248	0.484	602	1.8	10.799	B
	3	0	638	507	0.000	0	0.0	0.000	A
	4	1288	444	2401	0.537	1286	1.5	4.352	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1785	902	2262	0.789	1774	4.7	9.443	A
	2	237	1101	1537	0.154	236	0.3	5.032	A
	3	951	139	2286	0.416	950	0.8	3.071	A
2	1	168	801	875	0.193	168	0.4	9.453	A
	2	740	44	1244	0.595	736	2.8	13.662	B
	3	0	780	452	0.000	0	0.0	0.000	A
	4	1575	543	2327	0.677	1570	2.8	6.379	A

17:30 - 17:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1785	903	2261	0.789	1784	4.8	9.837	A
	2	238	1107	1533	0.155	238	0.3	5.055	A
	3	951	140	2285	0.416	951	0.8	3.075	A
2	1	168	806	872	0.193	168	0.4	9.499	A
	2	740	44	1244	0.595	740	2.8	13.859	B
	3	0	784	450	0.000	0	0.0	0.000	A
	4	1580	546	2325	0.679	1580	2.8	6.513	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1457	738	2392	0.609	1468	2.1	5.151	A
	2	195	911	1663	0.117	196	0.2	4.464	A
	3	777	115	2302	0.337	778	0.6	2.694	A
2	1	138	663	944	0.146	138	0.3	8.301	A
	2	604	36	1248	0.484	608	1.9	10.996	B
	3	0	644	505	0.000	0	0.0	0.000	A
	4	1295	449	2398	0.540	1300	1.6	4.447	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1220	618	2487	0.491	1224	1.3	3.733	A
	2	163	759	1763	0.093	163	0.2	4.095	A
	3	650	96	2315	0.281	651	0.4	2.468	A
2	1	115	553	999	0.115	115	0.2	7.568	A
	2	506	30	1251	0.404	508	1.3	9.445	A
	3	0	538	547	0.000	0	0.0	0.000	A
	4	1082	375	2453	0.441	1084	1.1	3.558	A

2030 [50% E.TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	13.73	B
2	untitled	Standard Roundabout		1, 2, 3, 4	10.71	B

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	12.42	B

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	2030 [50% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1575	100.000
	2	✓			
	3		✓	1386	100.000
2	1		✓	160	100.000
	2		✓	683	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	458	1117
	2	84	0	134
	3	193	1193	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	57	0	103
	2	485	0	0	198
	3	0	0	0	0
	4	1086	565	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	17
	2	92	0	53
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	51
	2	79	0	0	83
	3	0	0	0	0
	4	25	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.90	22.20	10.1	C
	2	0.23	5.32	0.5	A
	3	0.67	5.92	2.5	A
2	1	0.18	7.37	0.4	A
	2	0.62	14.15	2.9	B
	3	0.00	0.00	0.0	A
	4	0.78	9.61	4.7	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1186	895	2268	0.523	1180	1.4	4.327	A
	2	225	837	1712	0.131	224	0.2	4.012	A
	3	1043	86	2322	0.449	1039	1.0	3.534	A
2	1	120	422	1065	0.113	120	0.2	6.146	A
	2	514	77	1228	0.419	509	1.3	8.962	A
	3	0	586	528	0.000	0	0.0	0.000	A
	4	1238	362	2463	0.503	1232	1.4	4.043	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1416	1071	2128	0.665	1411	2.6	6.557	A
	2	270	1001	1604	0.168	270	0.3	4.478	A
	3	1246	104	2310	0.539	1244	1.5	4.260	A
2	1	144	506	1023	0.141	144	0.3	6.612	A
	2	614	92	1220	0.503	612	1.8	10.627	B
	3	0	704	481	0.000	0	0.0	0.000	A
	4	1481	435	2408	0.615	1478	2.2	5.354	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1734	1310	1939	0.894	1707	9.3	18.621	C
	2	330	1211	1465	0.225	329	0.5	5.261	A
	3	1526	127	2294	0.665	1522	2.5	5.859	A
2	1	176	615	968	0.182	176	0.4	7.337	A
	2	752	113	1210	0.622	748	2.8	13.904	B
	3	0	861	420	0.000	0	0.0	0.000	A
	4	1807	531	2336	0.773	1797	4.5	9.110	A

08:30 - 08:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1734	1313	1936	0.896	1731	10.1	22.199	C
	2	331	1227	1454	0.228	331	0.5	5.323	A
	3	1526	128	2294	0.665	1526	2.5	5.920	A
2	1	176	621	965	0.183	176	0.4	7.373	A
	2	752	113	1210	0.622	752	2.9	14.146	B
	3	0	865	418	0.000	0	0.0	0.000	A
	4	1817	534	2334	0.778	1816	4.7	9.610	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1416	1076	2124	0.666	1446	2.7	7.262	A
	2	272	1025	1588	0.171	273	0.3	4.547	A
	3	1246	105	2309	0.540	1250	1.5	4.311	A
2	1	144	515	1018	0.141	144	0.3	6.657	A
	2	614	93	1220	0.503	618	1.9	10.851	B
	3	0	711	479	0.000	0	0.0	0.000	A
	4	1496	439	2405	0.622	1506	2.3	5.614	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1186	900	2264	0.524	1191	1.5	4.429	A
	2	227	844	1707	0.133	228	0.3	4.041	A
	3	1043	88	2321	0.450	1045	1.0	3.569	A
2	1	120	428	1062	0.113	121	0.2	6.178	A
	2	514	78	1227	0.419	516	1.3	9.151	A
	3	0	594	525	0.000	0	0.0	0.000	A
	4	1246	367	2459	0.507	1249	1.4	4.142	A

2030 [50% E.TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	44.62	E
2	untitled	Standard Roundabout		1, 2, 3, 4	37.10	E

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	41.07	E

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	2030 [50% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1558	100.000
	2	✓			
	3		✓	1541	100.000
2	1		✓	312	100.000
	2		✓	672	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	615	943
	2	80	0	216
	3	42	1499	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	199
	2	496	0	0	176
	3	0	0	0	0
	4	1382	732	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	12
	2	96	0	27
	3	70	8	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	24
	2	96	0	0	90
	3	0	0	0	0
	4	3	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.03	92.07	46.3	F
	2	0.26	4.23	0.5	A
	3	0.74	6.45	3.0	A
2	1	0.39	9.50	0.9	A
	2	0.64	16.73	3.4	C
	3	0.00	0.00	0.0	A
	4	0.99	47.65	30.1	E

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1173	1124	2086	0.562	1166	1.7	5.222	A
	2	280	706	1799	0.156	279	0.3	3.322	A
	3	1160	75	2329	0.498	1156	1.1	3.335	A
2	1	235	546	1003	0.234	233	0.4	6.646	A
	2	506	149	1192	0.424	500	1.4	10.037	B
	3	0	649	503	0.000	0	0.0	0.000	A
	4	1585	369	2457	0.645	1576	2.2	4.949	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1401	1346	1911	0.733	1393	3.6	9.218	A
	2	336	843	1708	0.197	336	0.3	3.682	A
	3	1385	91	2319	0.597	1383	1.6	4.189	A
2	1	280	653	949	0.296	280	0.6	7.657	A
	2	604	178	1177	0.513	602	2.0	12.107	B
	3	0	780	452	0.000	0	0.0	0.000	A
	4	1895	444	2401	0.789	1887	4.4	8.414	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1715	1645	1674	1.025	1612	29.5	48.564	E
	2	411	975	1620	0.254	410	0.5	4.173	A
	3	1697	111	2305	0.736	1691	3.0	6.342	A
2	1	344	767	892	0.385	342	0.9	9.310	A
	2	740	218	1157	0.639	735	3.3	16.350	C
	3	0	953	384	0.000	0	0.0	0.000	A
	4	2281	542	2328	0.980	2215	21.1	29.026	D

08:45 - 09:00

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1715	1650	1670	1.027	1648	46.3	92.074	F
	2	413	998	1606	0.257	413	0.5	4.234	A
	3	1697	112	2304	0.736	1697	3.0	6.455	A
2	1	344	784	883	0.389	343	0.9	9.495	A
	2	740	219	1157	0.639	740	3.4	16.729	C
	3	0	959	382	0.000	0	0.0	0.000	A
	4	2301	546	2325	0.990	2265	30.1	47.650	E

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1401	1353	1905	0.735	1570	3.9	22.264	C
	2	339	950	1637	0.207	340	0.4	3.895	A
	3	1385	92	2318	0.598	1391	1.6	4.260	A
2	1	280	716	917	0.306	282	0.6	8.078	A
	2	604	180	1177	0.513	609	2.1	12.437	B
	3	0	789	448	0.000	0	0.0	0.000	A
	4	1973	450	2397	0.823	2069	6.1	16.766	C

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1173	1131	2081	0.564	1182	1.8	5.431	A
	2	283	715	1793	0.158	284	0.3	3.349	A
	3	1160	77	2328	0.498	1162	1.1	3.376	A
2	1	235	558	997	0.236	236	0.4	6.744	A
	2	506	150	1191	0.425	508	1.5	10.288	B
	3	0	659	499	0.000	0	0.0	0.000	A
	4	1597	375	2452	0.651	1612	2.3	5.330	A

2030 [100% E.TIL], S1: CTL01 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	12.48	B
2	untitled	Standard Roundabout		1, 2, 3, 4	94.55	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	54.55	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	2030 [100% E.TIL]	S1: CTL01 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	1779	100.000
	2	✓			
	3		✓	908	100.000
2	1		✓	191	100.000
	2		✓	1198	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	915	864
	2	167	0	140
	3	63	845	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	78
	2	969	0	0	229
	3	0	0	0	0
	4	631	1129	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	19
	2	92	0	53
	3	100	28	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	47
	2	79	0	0	83
	3	0	0	0	0
	4	29	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.87	18.28	9.5	C
	2	0.19	4.69	0.4	A
	3	0.44	3.74	1.0	A
2	1	0.32	13.34	0.8	B
	2	1.08	176.27	68.0	F
	3	0.00	0.00	0.0	A
	4	0.97	47.72	24.6	E

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1339	634	2474	0.541	1332	1.7	4.598	A
	2	227	647	1838	0.124	226	0.2	3.840	A
	3	684	123	2297	0.298	681	0.6	2.922	A
2	1	144	840	855	0.168	142	0.3	8.439	A
	2	902	58	1237	0.729	884	4.5	17.539	C
	3	0	942	388	0.000	0	0.0	0.000	A
	4	1319	715	2199	0.600	1310	2.3	6.244	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1599	759	2375	0.673	1594	3.0	6.718	A
	2	272	774	1753	0.155	271	0.3	4.176	A
	3	816	148	2280	0.358	816	0.7	3.225	A
2	1	172	1007	771	0.223	171	0.5	10.027	B
	2	1077	70	1231	0.875	1056	9.8	33.223	D
	3	0	1126	316	0.000	0	0.0	0.000	A
	4	1579	854	2095	0.754	1570	4.6	10.488	B

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1959	929	2241	0.874	1935	8.9	16.155	C
	2	313	940	1644	0.191	313	0.4	4.650	A
	3	1000	170	2265	0.441	999	1.0	3.729	A
2	1	210	1199	675	0.312	209	0.7	12.896	B
	2	1319	85	1224	1.078	1192	41.6	94.531	F
	3	0	1277	256	0.000	0	0.0	0.000	A
	4	1924	964	2013	0.956	1870	18.2	31.221	D

08:30 - 08:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	1959	930	2240	0.875	1956	9.5	18.279	C
	2	318	950	1637	0.194	318	0.4	4.693	A
	3	1000	173	2263	0.442	1000	1.0	3.740	A
2	1	210	1226	662	0.318	210	0.8	13.339	B
	2	1319	86	1223	1.078	1214	68.0	176.271	F
	3	0	1299	248	0.000	0	0.0	0.000	A
	4	1937	982	2000	0.968	1911	24.6	47.716	E

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1599	761	2374	0.674	1625	3.1	7.278	A
	2	300	789	1744	0.172	300	0.4	4.289	A
	3	816	163	2269	0.360	817	0.7	3.259	A
2	1	172	1071	740	0.232	173	0.5	10.646	B
	2	1077	71	1231	0.875	1199	37.4	162.298	F
	3	0	1270	259	0.000	0	0.0	0.000	A
	4	1596	970	2009	0.795	1669	6.5	19.369	C

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1339	637	2472	0.542	1345	1.8	4.707	A
	2	256	653	1834	0.140	256	0.3	3.927	A
	3	684	139	2286	0.299	684	0.6	2.952	A
2	1	144	862	844	0.170	144	0.3	8.617	A
	2	902	59	1237	0.729	1030	5.4	44.846	E
	3	0	1089	330	0.000	0	0.0	0.000	A
	4	1328	833	2111	0.629	1344	2.7	7.442	A

2030 [100% E.TIL], S1: CTL01 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	141.19	F
2	untitled	Standard Roundabout		1, 2, 3, 4	220.25	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	181.65	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D10	2030 [100% E.TIL]	S1: CTL01 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	2236	100.000
	2	✓			
	3		✓	981	100.000
2	1		✓	265	100.000
	2		✓	1184	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	1230	1006
	2	159	0	73
	3	44	937	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	225	0	40
	2	992	0	0	192
	3	0	0	0	0
	4	703	1464	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	9
	2	96	0	63
	3	70	19	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	68
	2	96	0	0	90
	3	0	0	0	0
	4	4	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.14	215.63	164.8	F
	2	0.15	4.90	0.3	A
	3	0.48	3.66	1.1	A
2	1	0.48	21.24	1.7	C
	2	1.05	146.55	54.6	F
	3	0.00	0.00	0.0	A
	4	1.13	284.91	171.2	F

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1683	703	2420	0.696	1671	3.2	6.792	A
	2	171	752	1768	0.097	171	0.2	4.149	A
	3	739	117	2301	0.321	736	0.6	2.772	A
2	1	200	1085	732	0.272	197	0.7	12.623	B
	2	891	30	1251	0.712	873	4.5	17.825	C
	3	0	903	403	0.000	0	0.0	0.000	A
	4	1622	732	2186	0.742	1606	4.1	9.023	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2010	842	2310	0.870	1989	8.5	15.179	C
	2	205	895	1674	0.123	205	0.3	4.516	A
	3	882	141	2285	0.386	881	0.8	3.092	A
2	1	238	1280	634	0.376	237	1.1	17.019	C
	2	1064	36	1248	0.853	1045	9.2	31.838	D
	3	0	1081	333	0.000	0	0.0	0.000	A
	4	1936	876	2079	0.931	1895	14.2	25.107	D

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2462	1030	2160	1.140	2141	88.6	91.203	F
	2	238	963	1628	0.146	238	0.3	4.771	A
	3	1080	163	2270	0.476	1079	1.1	3.644	A
2	1	292	1327	611	0.478	290	1.7	21.007	C
	2	1304	44	1244	1.048	1199	35.3	84.038	F
	3	0	1243	270	0.000	0	0.0	0.000	A
	4	2208	1005	1983	1.114	1965	75.1	92.963	F

17:30 - 17:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	2462	1032	2159	1.140	2157	164.8	215.633	F
	2	243	971	1624	0.150	243	0.3	4.803	A
	3	1080	166	2267	0.476	1080	1.1	3.656	A
2	1	292	1326	611	0.477	292	1.7	21.237	C
	2	1304	44	1244	1.048	1226	54.6	146.552	F
	3	0	1270	259	0.000	0	0.0	0.000	A
	4	2218	1028	1966	1.129	1963	139.0	204.029	F

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2010	844	2308	0.871	2288	95.2	205.297	F
	2	232	1030	1585	0.147	232	0.3	4.905	A
	3	882	159	2272	0.388	883	0.8	3.128	A
2	1	238	1333	608	0.392	240	1.3	18.575	C
	2	1064	36	1248	0.853	1210	18.2	118.302	F
	3	0	1246	269	0.000	0	0.0	0.000	A
	4	2102	1014	1976	1.064	1974	171.2	284.909	F

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1683	706	2417	0.696	2050	3.5	34.880	D
	2	183	922	1655	0.111	184	0.2	4.507	A
	3	739	126	2295	0.322	739	0.6	2.792	A
2	1	200	1435	557	0.358	200	1.1	19.111	C
	2	891	30	1251	0.713	943	5.2	25.937	D
	3	0	973	376	0.000	0	0.0	0.000	A
	4	1834	790	2143	0.856	2124	98.7	230.226	F

2030 [100% E.TIL], S2: CTL02 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	172.36	F
2	untitled	Standard Roundabout		1, 2, 3, 4	232.47	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	201.50	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D11	2030 [100% E.TIL]	S2: CTL02 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	2032	100.000
	2	✓			
	3		✓	1493	100.000
2	1		✓	216	100.000
	2		✓	1198	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	915	1117
	2	167	0	165
	3	193	1300	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	113	0	103
	2	969	0	0	229
	3	0	0	0	0
	4	1086	1129	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	88	17
	2	92	0	54
	3	35	25	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	85	0	51
	2	79	0	0	83
	3	0	0	0	0
	4	25	76	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.21	320.89	208.5	F
	2	0.22	5.11	0.5	A
	3	0.73	7.33	3.3	A
2	1	0.31	11.43	0.8	B
	2	1.09	191.41	74.1	F
	3	0.00	0.00	0.0	A
	4	1.13	276.32	162.0	F

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1530	975	2205	0.694	1517	3.1	7.260	A
	2	246	834	1714	0.144	245	0.3	4.189	A
	3	1124	123	2297	0.489	1119	1.2	3.844	A
2	1	163	836	857	0.190	161	0.4	8.623	A
	2	902	77	1228	0.735	883	4.6	17.958	C
	3	0	961	381	0.000	0	0.0	0.000	A
	4	1658	715	2199	0.754	1641	4.3	9.189	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1827	1167	2053	0.890	1801	9.6	18.515	C
	2	294	990	1611	0.183	294	0.4	4.673	A
	3	1342	148	2280	0.589	1340	1.8	4.821	A
2	1	195	985	783	0.249	194	0.5	10.202	B
	2	1077	93	1220	0.883	1054	10.3	34.795	D
	3	0	1147	308	0.000	0	0.0	0.000	A
	4	1978	853	2096	0.943	1932	15.7	26.770	D

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2237	1426	1847	1.211	1837	109.8	126.360	F
	2	339	1010	1598	0.212	339	0.5	4.890	A
	3	1644	171	2265	0.726	1638	3.3	7.184	A
2	1	238	1021	764	0.312	237	0.7	11.393	B
	2	1319	113	1210	1.091	1182	44.7	100.730	F
	3	0	1295	249	0.000	0	0.0	0.000	A
	4	2253	956	2019	1.116	2003	78.3	95.190	F

08:30 - 08:45

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	2237	1431	1843	1.214	1842	208.5	309.476	F
	2	343	1013	1596	0.215	343	0.5	4.916	A
	3	1644	173	2263	0.726	1644	3.3	7.328	A
2	1	238	1022	764	0.312	238	0.8	11.433	B
	2	1319	114	1209	1.091	1201	74.1	191.413	F
	3	0	1315	241	0.000	0	0.0	0.000	A
	4	2261	972	2007	1.126	2005	142.3	205.418	F

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1827	1174	2047	0.892	2033	156.9	320.894	F
	2	321	1118	1526	0.210	321	0.5	5.109	A
	3	1342	161	2271	0.591	1348	1.8	4.956	A
2	1	195	1025	763	0.255	195	0.6	10.611	B
	2	1077	93	1220	0.883	1191	45.6	184.165	F
	3	0	1284	254	0.000	0	0.0	0.000	A
	4	2089	963	2014	1.037	2010	162.0	276.320	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1530	981	2200	0.695	2141	4.0	130.006	F
	2	281	1177	1487	0.189	281	0.4	5.106	A
	3	1124	141	2284	0.492	1126	1.2	3.932	A
2	1	163	1057	747	0.218	163	0.5	10.319	B
	2	902	78	1227	0.735	1062	5.6	59.637	F
	3	0	1140	310	0.000	0	0.0	0.000	A
	4	1945	859	2092	0.930	2073	130.0	254.269	F

2030 [100% E.TIL], S2: CTL02 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	488.03	F
2	untitled	Standard Roundabout		1, 2, 3, 4	743.50	F

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	616.78	F

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D12	2030 [100% E.TIL]	S2: CTL02 PM	ONE HOUR	08:00	09:30	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	2173	100.000
	2	✓			
	3		✓	1658	100.000
2	1		✓	424	100.000
	2		✓	1184	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	1230	943
	2	159	0	234
	3	42	1616	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	225	0	199
	2	992	0	0	192
	3	0	0	0	0
	4	1382	1464	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	94	12
	2	96	0	29
	3	70	12	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	93	0	24
	2	96	0	0	90
	3	0	0	0	0
	4	3	89	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	1.53	940.22	491.9	F
	2	0.22	3.98	0.4	A
	3	0.80	9.14	4.5	A
2	1	0.62	18.92	2.4	C
	2	1.13	255.38	92.2	F
	3	0.00	0.00	0.0	A
	4	1.32	1073.70	642.3	F

Main Results for each time segment

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1636	1211	2017	0.811	1612	5.9	12.465	B
	2	289	700	1803	0.160	288	0.3	3.556	A
	3	1248	116	2301	0.542	1243	1.3	3.824	A
2	1	319	1053	748	0.426	315	1.1	12.579	B
	2	891	148	1193	0.747	870	5.3	20.633	C
	3	0	1018	358	0.000	0	0.0	0.000	A
	4	2124	729	2188	0.971	2047	19.4	26.534	D

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1953	1450	1828	1.068	1788	47.3	66.071	F
	2	346	776	1752	0.197	346	0.4	3.830	A
	3	1491	140	2285	0.652	1487	2.1	5.078	A
2	1	381	1069	740	0.515	379	1.6	15.175	C
	2	1064	178	1177	0.904	1035	12.5	42.293	E
	3	0	1213	281	0.000	0	0.0	0.000	A
	4	2462	867	2085	1.181	2078	115.4	126.066	F

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	2393	1770	1575	1.519	1574	251.9	349.989	F
	2	402	683	1814	0.222	402	0.4	3.816	A
	3	1825	163	2270	0.804	1816	4.4	8.784	A
2	1	467	1040	755	0.618	464	2.4	18.694	C
	2	1304	218	1158	1.126	1137	54.2	123.780	F
	3	0	1354	226	0.000	0	0.0	0.000	A
	4	2661	952	2022	1.316	2021	275.3	353.617	F

08:45 - 09:00

Junction	Arm	Total Demand	Circulating flow	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	(PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	2393	1779	1568	1.526	1568	458.1	764.328	F
	2	406	680	1816	0.224	406	0.4	3.821	A
	3	1825	164	2269	0.805	1825	4.5	9.141	A
2	1	467	1035	757	0.616	467	2.4	18.918	C
	2	1304	219	1157	1.127	1152	92.2	242.310	F
	3	0	1371	220	0.000	0	0.0	0.000	A
	4	2666	965	2012	1.325	2012	438.8	642.765	F

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1953	1462	1819	1.074	1818	491.9	940.218	F
	2	367	789	1744	0.211	367	0.4	3.917	A
	3	1491	149	2279	0.654	1500	2.2	5.281	A
2	1	381	1035	757	0.503	384	1.6	14.897	B
	2	1064	180	1176	0.905	1152	70.3	255.381	F
	3	0	1332	235	0.000	0	0.0	0.000	A
	4	2491	965	2012	1.238	2012	558.5	894.072	F

09:15 - 09:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	1636	1220	2011	0.814	2005	399.7	801.003	F
	2	336	870	1690	0.199	336	0.4	3.980	A
	3	1248	136	2288	0.546	1251	1.4	3.936	A
2	1	319	1039	756	0.423	321	1.1	12.733	B
	2	891	151	1191	0.748	1141	8.0	126.141	F
	3	0	1291	251	0.000	0	0.0	0.000	A
	4	2354	956	2019	1.166	2019	642.3	1073.704	F

Junctions 10

ARCADY 10 - Roundabout Module

Version: 10.0.4.1693

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Filename: TILBURY JUNCTION INC EAST ARM AM-PM Additional Modelling.j10
Path: \\bgl-vfps-001\bgl\Home\mnejad\Tilbury Junction\Modelling
Report generation date: 06/12/2022 15:01:44

Summary of junction performance

	2022 AM					2022 PM					2022 IP				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	Port of Tilbury 1														
Junction 1 - Arm 1		0.0	1.28	0.03	A		0.0	1.24	0.02	A		0.0	1.32	0.05	A
Junction 1 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 1 - Arm 3		0.0	1.56	0.03	A		0.0	1.53	0.02	A		0.1	1.63	0.08	A
Junction 2 - Arm 1	D1	0.0	0.00	0.00	A	D4	0.0	0.00	0.00	A	D7	0.0	0.00	0.00	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		0.0	1.36	0.03	A		0.0	1.33	0.01	A		0.1	1.39	0.06	A
	Port of Tilbury 2														
Junction 1 - Arm 1		0.0	1.26	0.02	A		0.0	1.23	0.01	A		0.0	1.30	0.03	A
Junction 1 - Arm 2		0.0	1.65	0.02	A		0.0	1.63	0.01	A		0.0	1.67	0.02	A
Junction 1 - Arm 3		0.1	1.62	0.06	A		0.0	1.55	0.03	A		0.1	1.67	0.10	A
Junction 2 - Arm 1	D2	0.0	2.94	0.04	A	D5	0.0	2.89	0.02	A	D8	0.0	2.92	0.04	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		0.0	1.36	0.03	A		0.0	1.33	0.01	A		0.1	1.39	0.06	A
	Port of Tilbury Total														
Junction 1 - Arm 1		0.1	1.34	0.05	A		0.0	1.27	0.03	A		0.1	1.33	0.08	A
Junction 1 - Arm 2		0.0	1.70	0.02	A		0.0	1.65	0.01	A		0.0	1.74	0.02	A
Junction 1 - Arm 3		0.1	1.69	0.09	A		0.0	1.58	0.04	A		0.1	1.60	0.05	A
Junction 2 - Arm 1	D3	0.0	2.94	0.04	A	D6	0.0	2.89	0.02	A	D9	0.0	2.92	0.04	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 4		0.1	1.40	0.06	A		0.0	1.34	0.02	A		0.0	1.34	0.02	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

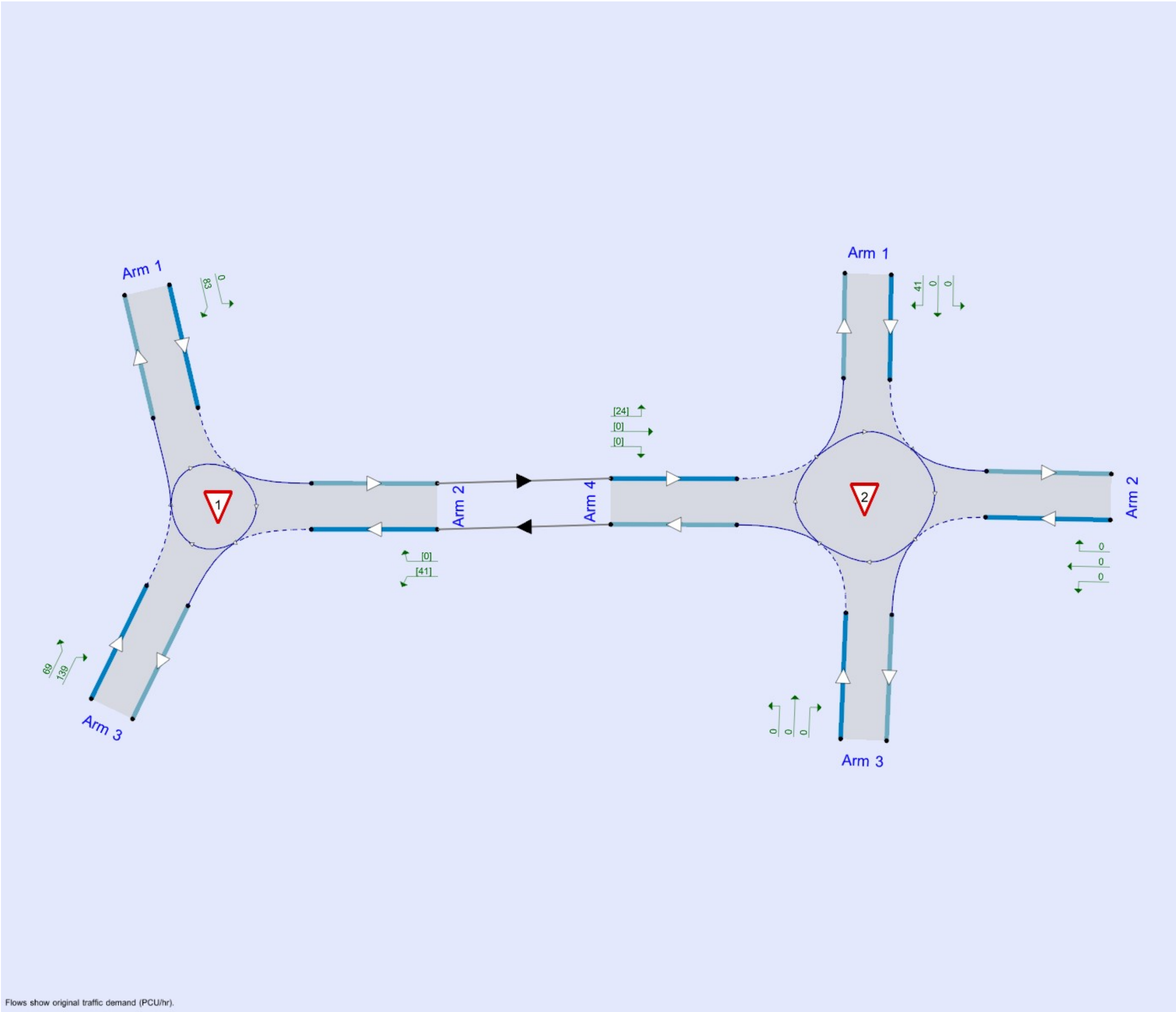
File Description

Title	
Location	
Site number	
Date	12/07/2022
Version	
Status	(new file)

Identifier	
Client	
Jobnumber	
Enumerator	CORP\mgilder
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin



The junction diagram reflects the last run of Junctions.

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	Port of Tilbury 1	2022 AM	ONE HOUR	07:45	09:15	15
D2	Port of Tilbury 2	2022 AM	ONE HOUR	07:45	09:15	15
D3	Port of Tilbury Total	2022 AM	ONE HOUR	07:45	09:15	15
D4	Port of Tilbury 1	2022 PM	ONE HOUR	16:45	18:15	15
D5	Port of Tilbury 2	2022 PM	ONE HOUR	16:45	18:15	15
D6	Port of Tilbury Total	2022 PM	ONE HOUR	16:45	18:15	15
D7	Port of Tilbury 1	2022 IP	ONE HOUR	12:15	13:45	15
D8	Port of Tilbury 2	2022 IP	ONE HOUR	12:15	13:45	15
D9	Port of Tilbury Total	2022 IP	ONE HOUR	12:15	13:45	15

Analysis Set Details

ID	Network flow scaling factor (%)

A1	100.000

Port of Tilbury 1, 2022 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.41	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.36	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.39	A

Arms

Arms

Junction	Arm	Name	Description	No give-way line
1	1	untitled		
	2	untitled		
	3	untitled		
2	1	untitled		
	2	untitled		
	3	untitled		
	4	untitled		

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Entry only	Exit only
1	1	7.30	11.90	11.7	20.0	60.0	15.0		
	2	7.30	7.30	0.0	20.0	60.0	23.0		
	3	7.30	8.00	4.7	20.0	60.0	27.0		
2	1	3.65	4.40	1.5	20.0	60.0	10.0		
	2	3.65	4.40	1.6	20.0	60.0	13.0		
	3	2.00	4.00	2.2	10.0	60.0	17.0		
	4	7.30	10.90	7.2	20.0	60.0	19.0		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
1	1	0.792	2976
	2	0.661	2266
	3	0.678	2380
2	1	0.502	1276
	2	0.498	1267
	3	0.393	758
	4	0.746	2732

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	Port of Tilbury 1	2022 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	90	100.000
	2	✓			
	3		✓	74	100.000
2	1		✓	0	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	90
	2	0	0	0
	3	0	74	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	74	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS

1	1	0.03	1.28	0.0	A
	2	0.00	0.00	0.0	A
	3	0.03	1.56	0.0	A
2	1	0.00	0.00	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.03	1.36	0.0	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	68	56	2932	0.023	68	0.0	1.256	A
	2	0	68	2221	0.000	0	0.0	0.000	A
	3	56	0	2380	0.023	56	0.0	1.548	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	56	0	2732	0.020	56	0.0	1.344	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	81	67	2924	0.028	81	0.0	1.265	A
	2	0	81	2212	0.000	0	0.0	0.000	A
	3	67	0	2380	0.028	67	0.0	1.555	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	67	0	2732	0.024	66	0.0	1.350	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	99	81	2912	0.034	99	0.0	1.279	A
	2	0	99	2200	0.000	0	0.0	0.000	A
	3	81	0	2380	0.034	81	0.0	1.565	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	81	0	2732	0.030	81	0.0	1.357	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	99	81	2912	0.034	99	0.0	1.279	A
	2	0	99	2200	0.000	0	0.0	0.000	A
	3	81	0	2380	0.034	81	0.0	1.565	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	81	0	2732	0.030	81	0.0	1.357	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	81	67	2924	0.028	81	0.0	1.265	A
	2	0	81	2212	0.000	0	0.0	0.000	A
	3	67	0	2380	0.028	67	0.0	1.557	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	67	0	2732	0.024	67	0.0	1.350	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service

1	**1**	68	56	2932	0.023	68	0.0	1.258	A
	2	0	68	2221	0.000	0	0.0	0.000	A
	3	56	0	2380	0.023	56	0.0	1.548	A
2	**1**	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	56	0	2732	0.020	56	0.0	1.344	A

Port of Tilbury 2, 2022 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.55	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.94	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.69	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	Port of Tilbury 2	2022 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	48	100.000
	2	✓			
	3		✓	128	100.000
2	1		✓	47	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	48
	2	0	0	0
	3	63	65	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	47
	2	0	0	0	0
	3	0	0	0	0
	4	65	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.02	1.26	0.0	A
	2	0.02	1.65	0.0	A
	3	0.06	1.62	0.1	A
2	1	0.04	2.94	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.03	1.36	0.0	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	36	61	2928	0.012	36	0.0	1.244	A
	2	35	36	2242	0.016	35	0.0	1.630	A
	3	96	23	2364	0.041	96	0.0	1.586	A
2	1	35	0	1276	0.028	35	0.0	2.900	A
	2	0	35	1250	0.000	0	0.0	0.000	A
	3	0	35	744	0.000	0	0.0	0.000	A
	4	61	0	2732	0.022	60	0.0	1.347	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	72	2919	0.015	43	0.0	1.251	A
	2	42	43	2237	0.019	42	0.0	1.639	A
	3	115	28	2361	0.049	115	0.1	1.602	A
2	1	42	0	1276	0.033	42	0.0	2.916	A
	2	0	42	1246	0.000	0	0.0	0.000	A
	3	0	42	742	0.000	0	0.0	0.000	A
	4	72	0	2732	0.027	72	0.0	1.353	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	53	89	2906	0.018	53	0.0	1.261	A
	2	52	53	2231	0.023	52	0.0	1.651	A
	3	141	34	2357	0.060	141	0.1	1.623	A
2	1	52	0	1276	0.041	52	0.0	2.939	A
	2	0	52	1242	0.000	0	0.0	0.000	A
	3	0	52	738	0.000	0	0.0	0.000	A
	4	89	0	2732	0.033	89	0.0	1.361	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	53	89	2906	0.018	53	0.0	1.261	A
	2	52	53	2231	0.023	52	0.0	1.651	A
	3	141	34	2357	0.060	141	0.1	1.623	A
2	1	52	0	1276	0.041	52	0.0	2.939	A
	2	0	52	1242	0.000	0	0.0	0.000	A
	3	0	52	738	0.000	0	0.0	0.000	A
	4	89	0	2732	0.033	89	0.0	1.361	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	73	2919	0.015	43	0.0	1.251	A
	2	42	43	2237	0.019	42	0.0	1.639	A
	3	115	28	2361	0.049	115	0.1	1.604	A
2	1	42	0	1276	0.033	42	0.0	2.917	A
	2	0	42	1246	0.000	0	0.0	0.000	A
	3	0	42	742	0.000	0	0.0	0.000	A
	4	73	0	2732	0.027	73	0.0	1.353	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	36	61	2928	0.012	36	0.0	1.244	A
	2	35	36	2242	0.016	35	0.0	1.630	A
	3	96	24	2364	0.041	96	0.0	1.586	A
2	1	35	0	1276	0.028	35	0.0	2.900	A
	2	0	35	1250	0.000	0	0.0	0.000	A
	3	0	35	744	0.000	0	0.0	0.000	A
	4	61	0	2732	0.022	61	0.0	1.347	A

Port of Tilbury Total, 2022 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.56	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.76	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.63	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	Port of Tilbury Total	2022 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	138	100.000
	2	✓			
	3		✓	202	100.000
2	1		✓	47	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	138
	2	0	0	0
	3	63	139	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	47
	2	0	0	0	0
	3	0	0	0	0
	4	139	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.05	1.34	0.1	A
	2	0.02	1.70	0.0	A
	3	0.09	1.69	0.1	A
2	1	0.04	2.94	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.06	1.40	0.1	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	104	116	2884	0.036	104	0.0	1.294	A
	2	35	104	2197	0.016	35	0.0	1.664	A
	3	152	23	2364	0.064	152	0.1	1.626	A
2	1	35	0	1276	0.028	35	0.0	2.900	A
	2	0	35	1250	0.000	0	0.0	0.000	A
	3	0	35	744	0.000	0	0.0	0.000	A
	4	116	0	2732	0.043	116	0.0	1.375	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	124	139	2866	0.043	124	0.0	1.312	A
	2	42	124	2184	0.019	42	0.0	1.680	A
	3	182	28	2361	0.077	182	0.1	1.651	A
2	1	42	0	1276	0.033	42	0.0	2.916	A
	2	0	42	1246	0.000	0	0.0	0.000	A
	3	0	42	742	0.000	0	0.0	0.000	A
	4	139	0	2732	0.051	139	0.1	1.387	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	152	170	2842	0.053	152	0.1	1.337	A
	2	52	152	2165	0.024	52	0.0	1.702	A
	3	222	34	2357	0.094	222	0.1	1.685	A
2	1	52	0	1276	0.041	52	0.0	2.939	A
	2	0	52	1242	0.000	0	0.0	0.000	A
	3	0	52	738	0.000	0	0.0	0.000	A
	4	170	0	2732	0.062	170	0.1	1.404	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	152	170	2842	0.053	152	0.1	1.337	A
	2	52	152	2165	0.024	52	0.0	1.702	A
	3	222	34	2357	0.094	222	0.1	1.685	A
2	1	52	0	1276	0.041	52	0.0	2.939	A
	2	0	52	1242	0.000	0	0.0	0.000	A
	3	0	52	738	0.000	0	0.0	0.000	A
	4	170	0	2732	0.062	170	0.1	1.404	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	124	139	2866	0.043	124	0.0	1.314	A
	2	42	124	2184	0.019	42	0.0	1.680	A
	3	182	28	2361	0.077	182	0.1	1.653	A
2	1	42	0	1276	0.033	42	0.0	2.917	A
	2	0	42	1246	0.000	0	0.0	0.000	A
	3	0	42	742	0.000	0	0.0	0.000	A
	4	139	0	2732	0.051	139	0.1	1.387	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	104	116	2884	0.036	104	0.0	1.294	A
	2	35	104	2197	0.016	35	0.0	1.667	A
	3	152	24	2364	0.064	152	0.1	1.629	A
2	1	35	0	1276	0.028	35	0.0	2.900	A
	2	0	35	1250	0.000	0	0.0	0.000	A
	3	0	35	744	0.000	0	0.0	0.000	A
	4	116	0	2732	0.043	117	0.0	1.375	A

Port of Tilbury 1, 2022 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.37	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.33	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.36	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	Port of Tilbury 1	2022 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	43	100.000
	2	✓			
	3		✓	33	100.000
2	1		✓	0	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	43
	2	0	0	1
	3	0	33	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	33	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.02	1.24	0.0	A
	2	0.00	0.00	0.0	A
	3	0.02	1.53	0.0	A
2	1	0.00	0.00	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.01	1.33	0.0	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	32	25	2957	0.011	32	0.0	1.230	A
	2	0	32	2244	0.000	0	0.0	0.000	A
	3	25	0	2380	0.010	25	0.0	1.527	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	25	0	2732	0.009	25	0.0	1.329	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	39	30	2953	0.013	39	0.0	1.234	A
	2	0	39	2240	0.000	0	0.0	0.000	A
	3	30	0	2380	0.012	30	0.0	1.530	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	30	0	2732	0.011	30	0.0	1.331	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	47	36	2948	0.016	47	0.0	1.240	A
	2	0	47	2234	0.000	0	0.0	0.000	A
	3	36	0	2380	0.015	36	0.0	1.535	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	36	0	2732	0.013	36	0.0	1.334	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	47	36	2948	0.016	47	0.0	1.240	A
	2	0	47	2234	0.000	0	0.0	0.000	A
	3	36	0	2380	0.015	36	0.0	1.535	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	36	0	2732	0.013	36	0.0	1.334	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	39	30	2953	0.013	39	0.0	1.234	A
	2	0	39	2240	0.000	0	0.0	0.000	A
	3	30	0	2380	0.012	30	0.0	1.533	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	30	0	2732	0.011	30	0.0	1.333	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	32	25	2957	0.011	32	0.0	1.232	A
	2	0	32	2244	0.000	0	0.0	0.000	A
	3	25	0	2380	0.010	25	0.0	1.530	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	25	0	2732	0.009	25	0.0	1.331	A

Port of Tilbury 2, 2022 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.47	A
2	untitled	Standard Roundabout		1, 2, 3, 4	2.32	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.69	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	Port of Tilbury 2	2022 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	39	100.000
	2	✓			
	3		✓	60	100.000
2	1		✓	28	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	39
	2	0	0	28
	3	44	16	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	28
	2	0	0	0	0
	3	0	0	0	0
	4	16	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.01	1.23	0.0	A
	2	0.01	1.63	0.0	A
	3	0.03	1.55	0.0	A
2	1	0.02	2.89	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.01	1.33	0.0	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	29	12	2967	0.010	29	0.0	1.225	A
	2	21	29	2246	0.009	21	0.0	1.617	A
	3	45	0	2380	0.019	45	0.0	1.541	A
2	1	21	0	1276	0.017	21	0.0	2.867	A
	2	0	21	1257	0.000	0	0.0	0.000	A
	3	0	21	750	0.000	0	0.0	0.000	A
	4	12	0	2732	0.004	12	0.0	1.323	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	35	14	2965	0.012	35	0.0	1.228	A
	2	25	35	2242	0.011	25	0.0	1.622	A
	3	54	0	2380	0.023	54	0.0	1.546	A
2	1	25	0	1276	0.020	25	0.0	2.877	A
	2	0	25	1255	0.000	0	0.0	0.000	A
	3	0	25	748	0.000	0	0.0	0.000	A
	4	14	0	2732	0.005	14	0.0	1.324	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	18	2962	0.014	43	0.0	1.232	A
	2	31	43	2237	0.014	31	0.0	1.630	A
	3	66	0	2380	0.028	66	0.0	1.555	A
2	1	31	0	1276	0.024	31	0.0	2.890	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	18	0	2732	0.006	18	0.0	1.325	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	18	2962	0.014	43	0.0	1.232	A
	2	31	43	2237	0.014	31	0.0	1.630	A
	3	66	0	2380	0.028	66	0.0	1.555	A
2	1	31	0	1276	0.024	31	0.0	2.890	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	18	0	2732	0.006	18	0.0	1.325	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	35	14	2965	0.012	35	0.0	1.228	A
	2	25	35	2242	0.011	25	0.0	1.622	A
	3	54	0	2380	0.023	54	0.0	1.549	A
2	1	25	0	1276	0.020	25	0.0	2.879	A
	2	0	25	1255	0.000	0	0.0	0.000	A
	3	0	25	748	0.000	0	0.0	0.000	A
	4	14	0	2732	0.005	14	0.0	1.324	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	29	12	2967	0.010	29	0.0	1.227	A
	2	21	29	2246	0.009	21	0.0	1.619	A
	3	45	0	2380	0.019	45	0.0	1.543	A
2	1	21	0	1276	0.017	21	0.0	2.870	A
	2	0	21	1257	0.000	0	0.0	0.000	A
	3	0	21	750	0.000	0	0.0	0.000	A
	4	12	0	2732	0.004	12	0.0	1.323	A

Port of Tilbury Total, 2022 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.46	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.91	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.58	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	Port of Tilbury Total	2022 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	82	100.000
	2	✓			
	3		✓	93	100.000
2	1		✓	28	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	82
	2	0	0	29
	3	44	49	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	28
	2	0	0	0	0
	3	0	0	0	0
	4	49	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.03	1.27	0.0	A
	2	0.01	1.65	0.0	A
	3	0.04	1.58	0.0	A
2	1	0.02	2.89	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.02	1.34	0.0	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	37	2947	0.021	62	0.0	1.247	A
	2	21	62	2225	0.009	21	0.0	1.632	A
	3	70	0	2380	0.029	70	0.0	1.557	A
2	1	21	0	1276	0.017	21	0.0	2.867	A
	2	0	21	1257	0.000	0	0.0	0.000	A
	3	0	21	750	0.000	0	0.0	0.000	A
	4	37	0	2732	0.013	37	0.0	1.335	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	74	44	2942	0.025	74	0.0	1.254	A
	2	25	74	2217	0.011	25	0.0	1.641	A
	3	84	0	2380	0.035	84	0.0	1.566	A
2	1	25	0	1276	0.020	25	0.0	2.877	A
	2	0	25	1255	0.000	0	0.0	0.000	A
	3	0	25	748	0.000	0	0.0	0.000	A
	4	44	0	2732	0.016	44	0.0	1.338	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	90	54	2934	0.031	90	0.0	1.265	A
	2	31	90	2206	0.014	31	0.0	1.654	A
	3	102	0	2380	0.043	102	0.0	1.579	A
2	1	31	0	1276	0.024	31	0.0	2.890	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	54	0	2732	0.020	54	0.0	1.343	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	90	54	2934	0.031	90	0.0	1.265	A
	2	31	90	2206	0.014	31	0.0	1.654	A
	3	102	0	2380	0.043	102	0.0	1.579	A
2	1	31	0	1276	0.024	31	0.0	2.890	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	54	0	2732	0.020	54	0.0	1.343	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	74	44	2941	0.025	74	0.0	1.256	A
	2	25	74	2217	0.011	25	0.0	1.644	A
	3	84	0	2380	0.035	84	0.0	1.569	A
2	1	25	0	1276	0.020	25	0.0	2.879	A
	2	0	25	1255	0.000	0	0.0	0.000	A
	3	0	25	748	0.000	0	0.0	0.000	A
	4	44	0	2732	0.016	44	0.0	1.338	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	37	2947	0.021	62	0.0	1.247	A
	2	21	62	2225	0.009	21	0.0	1.632	A
	3	70	0	2380	0.029	70	0.0	1.560	A
2	1	21	0	1276	0.017	21	0.0	2.870	A
	2	0	21	1257	0.000	0	0.0	0.000	A
	3	0	21	750	0.000	0	0.0	0.000	A
	4	37	0	2732	0.014	37	0.0	1.335	A

Port of Tilbury 1, 2022 IP

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.50	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.39	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.47	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	Port of Tilbury 1	2022 IP	ONE HOUR	12:15	13:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	121	100.000
	2	✓			
	3		✓	163	100.000
2	1		✓	0	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	121
	2	0	0	0
	3	24	139	0

Demand (PCU/hr)

Junction 2

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	24	0	0	0

Vehicle Mix

Heavy Vehicle Percentages

Junction 1

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Heavy Vehicle Percentages

Junction 2

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.05	1.32	0.0	A
	2	0.00	0.00	0.0	A
	3	0.08	1.63	0.1	A
2	1	0.00	0.00	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.06	1.39	0.1	A

Main Results for each time segment

12:15 - 12:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	104	2894	0.031	91	0.0	1.284	A
	2	0	91	2205	0.000	0	0.0	0.000	A
	3	123	0	2380	0.052	122	0.1	1.594	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	104	0	2732	0.038	104	0.0	1.369	A

12:30 - 12:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	109	125	2877	0.038	109	0.0	1.299	A
	2	0	109	2194	0.000	0	0.0	0.000	A
	3	147	0	2380	0.062	146	0.1	1.611	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	125	0	2732	0.046	125	0.0	1.380	A

12:45 - 13:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	133	153	2855	0.047	133	0.0	1.322	A
	2	0	133	2178	0.000	0	0.0	0.000	A
	3	179	0	2380	0.075	179	0.1	1.635	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	153	0	2732	0.056	153	0.1	1.395	A

13:00 - 13:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	133	153	2855	0.047	133	0.0	1.322	A
	2	0	133	2178	0.000	0	0.0	0.000	A
	3	179	0	2380	0.075	179	0.1	1.635	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	153	0	2732	0.056	153	0.1	1.395	A

13:15 - 13:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	109	125	2877	0.038	109	0.0	1.301	A
	2	0	109	2194	0.000	0	0.0	0.000	A
	3	147	0	2380	0.062	147	0.1	1.613	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	125	0	2732	0.046	125	0.0	1.382	A

13:30 - 13:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	105	2893	0.031	91	0.0	1.284	A
	2	0	91	2205	0.000	0	0.0	0.000	A
	3	123	0	2380	0.052	123	0.1	1.596	A
2	1	0	0	1276	0.000	0	0.0	0.000	A
	2	0	0	1267	0.000	0	0.0	0.000	A
	3	0	0	758	0.000	0	0.0	0.000	A
	4	105	0	2732	0.038	105	0.0	1.369	A

Port of Tilbury 2, 2022 IP

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.58	A
2	untitled	Standard Roundabout		1, 2, 3, 4	1.74	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.64	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	Port of Tilbury 2	2022 IP	ONE HOUR	12:15	13:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	83	100.000
	2	✓			
	3		✓	208	100.000
2	1		✓	41	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	83
	2	0	0	41
	3	69	139	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	41
	2	0	0	0	0
	3	0	0	0	0
	4	24	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.03	1.30	0.0	A
	2	0.02	1.67	0.0	A
	3	0.10	1.67	0.1	A
2	1	0.04	2.92	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.06	1.39	0.1	A

Main Results for each time segment

12:15 - 12:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	104	2894	0.022	62	0.0	1.271	A
	2	31	62	2224	0.014	31	0.0	1.640	A
	3	157	0	2380	0.066	156	0.1	1.618	A
2	1	31	0	1276	0.024	31	0.0	2.890	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	104	0	2732	0.038	104	0.0	1.369	A

12:30 - 12:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	75	125	2877	0.026	75	0.0	1.283	A
	2	37	75	2216	0.017	37	0.0	1.651	A
	3	187	0	2380	0.079	187	0.1	1.640	A
2	1	37	0	1276	0.029	37	0.0	2.904	A
	2	0	37	1249	0.000	0	0.0	0.000	A
	3	0	37	744	0.000	0	0.0	0.000	A
	4	125	0	2732	0.046	125	0.0	1.380	A

12:45 - 13:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	153	2855	0.032	91	0.0	1.302	A
	2	45	91	2205	0.020	45	0.0	1.665	A
	3	229	0	2380	0.096	229	0.1	1.672	A
2	1	45	0	1276	0.035	45	0.0	2.923	A
	2	0	45	1245	0.000	0	0.0	0.000	A
	3	0	45	740	0.000	0	0.0	0.000	A
	4	153	0	2732	0.056	153	0.1	1.395	A

13:00 - 13:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	153	2855	0.032	91	0.0	1.302	A
	2	45	91	2205	0.020	45	0.0	1.665	A
	3	229	0	2380	0.096	229	0.1	1.672	A
2	1	45	0	1276	0.035	45	0.0	2.923	A
	2	0	45	1245	0.000	0	0.0	0.000	A
	3	0	45	740	0.000	0	0.0	0.000	A
	4	153	0	2732	0.056	153	0.1	1.395	A

13:15 - 13:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	75	125	2877	0.026	75	0.0	1.285	A
	2	37	75	2216	0.017	37	0.0	1.651	A
	3	187	0	2380	0.079	187	0.1	1.643	A
2	1	37	0	1276	0.029	37	0.0	2.904	A
	2	0	37	1249	0.000	0	0.0	0.000	A
	3	0	37	744	0.000	0	0.0	0.000	A
	4	125	0	2732	0.046	125	0.0	1.382	A

13:30 - 13:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	105	2893	0.022	63	0.0	1.273	A
	2	31	63	2224	0.014	31	0.0	1.640	A
	3	157	0	2380	0.066	157	0.1	1.620	A
2	1	31	0	1276	0.024	31	0.0	2.892	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	105	0	2732	0.038	105	0.0	1.369	A

Port of Tilbury Total, 2022 IP

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 4	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	1.46	A
2	untitled	Standard Roundabout		1, 2, 3, 4	2.07	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	1.58	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	Port of Tilbury Total	2022 IP	ONE HOUR	12:15	13:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	4	Simple (vertical queueing)	Normal	0	100.00	
2	4	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	204	100.000
	2	✓			
	3		✓	117	100.000
2	1		✓	41	100.000
	2		✓	0	100.000
	3		✓	0	100.000
	4	✓			

Origin-Destination Data

Demand (PCU/hr)

Junction 1

		To		
		1	2	3
From	1	0	0	204
	2	0	0	41
	3	69	48	0

Junction 2

Demand (PCU/hr)

		To			
		1	2	3	4
From	1	0	0	0	41
	2	0	0	0	0
	3	0	0	0	0
	4	48	0	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To			
		1	2	3	4
From	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.08	1.33	0.1	A
	2	0.02	1.74	0.0	A
	3	0.05	1.60	0.1	A
2	1	0.04	2.92	0.0	A
	2	0.00	0.00	0.0	A
	3	0.00	0.00	0.0	A
	4	0.02	1.34	0.0	A

Main Results for each time segment

12:15 - 12:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	154	36	2948	0.052	153	0.1	1.287	A
	2	31	153	2164	0.014	31	0.0	1.686	A
	3	88	0	2380	0.037	88	0.0	1.569	A
2	1	31	0	1276	0.024	31	0.0	2.890	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	36	0	2732	0.013	36	0.0	1.334	A

12:30 - 12:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	183	43	2942	0.062	183	0.1	1.304	A
	2	37	183	2144	0.017	37	0.0	1.707	A
	3	105	0	2380	0.044	105	0.0	1.581	A
2	1	37	0	1276	0.029	37	0.0	2.904	A
	2	0	37	1249	0.000	0	0.0	0.000	A
	3	0	37	744	0.000	0	0.0	0.000	A
	4	43	0	2732	0.016	43	0.0	1.338	A

12:45 - 13:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	225	53	2935	0.077	225	0.1	1.327	A
	2	45	225	2117	0.021	45	0.0	1.736	A
	3	129	0	2380	0.054	129	0.1	1.598	A
2	1	45	0	1276	0.035	45	0.0	2.923	A
	2	0	45	1245	0.000	0	0.0	0.000	A
	3	0	45	740	0.000	0	0.0	0.000	A
	4	53	0	2732	0.019	53	0.0	1.343	A

13:00 - 13:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	225	53	2935	0.077	225	0.1	1.327	A
	2	45	225	2117	0.021	45	0.0	1.736	A
	3	129	0	2380	0.054	129	0.1	1.598	A
2	1	45	0	1276	0.035	45	0.0	2.923	A
	2	0	45	1245	0.000	0	0.0	0.000	A
	3	0	45	740	0.000	0	0.0	0.000	A
	4	53	0	2732	0.019	53	0.0	1.343	A

13:15 - 13:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	183	43	2942	0.062	183	0.1	1.304	A
	2	37	183	2144	0.017	37	0.0	1.707	A
	3	105	0	2380	0.044	105	0.0	1.584	A
2	1	37	0	1276	0.029	37	0.0	2.904	A
	2	0	37	1249	0.000	0	0.0	0.000	A
	3	0	37	744	0.000	0	0.0	0.000	A
	4	43	0	2732	0.016	43	0.0	1.340	A

13:30 - 13:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	154	36	2948	0.052	154	0.1	1.287	A
	2	31	154	2164	0.014	31	0.0	1.686	A
	3	88	0	2380	0.037	88	0.0	1.572	A
2	1	31	0	1276	0.024	31	0.0	2.892	A
	2	0	31	1252	0.000	0	0.0	0.000	A
	3	0	31	746	0.000	0	0.0	0.000	A
	4	36	0	2732	0.013	36	0.0	1.334	A

Junctions 10

ARCADY 10 - Roundabout Module

For sales and distribution information, program advice and maintenance, contact TRL Software:
+44 (0)1344 379777 software@trl.co.uk trlsoftware.com

Filename: TILBURY JUNCTION Additional Modelling.j10
Path: \\bgl-vfps-001\bgl\Home\mnejad\Tilbury Junction\Modelling
Report generation date: 06/12/2022 14:45:42

Summary of junction performance

	2022 AM					2022 PM					2022 IP				
	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS	Set ID	Queue (PCU)	Delay (s)	RFC	LOS
	Port of Tilbury 1														
Junction 1 - Arm 1	D1	0.1	2.53	0.07	A	D4	0.0	2.41	0.03	A	D7	0.1	2.67	0.09	A
Junction 1 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 1 - Arm 3		0.1	3.06	0.06	A		0.0	2.94	0.03	A		0.2	3.33	0.14	A
Junction 2 - Arm 1		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.1	2.47	0.05	A		0.0	2.39	0.02	A		0.1	2.60	0.10	A
	Port of Tilbury 2														
Junction 1 - Arm 1	D2	0.0	2.46	0.03	A	D5	0.0	2.38	0.03	A	D8	0.1	2.59	0.06	A
Junction 1 - Arm 2		0.0	2.46	0.03	A		0.0	2.41	0.02	A		0.0	2.48	0.03	A
Junction 1 - Arm 3		0.1	3.27	0.11	A		0.1	3.02	0.05	A		0.2	3.49	0.18	A
Junction 2 - Arm 1		0.0	2.34	0.03	A		0.0	2.31	0.02	A		0.0	2.33	0.03	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.1	2.48	0.06	A		0.0	2.37	0.01	A		0.1	2.60	0.10	A
	Port of Tilbury Total														
Junction 1 - Arm 1	D3	0.1	2.73	0.10	A	D6	0.1	2.49	0.06	A	D9	0.2	2.75	0.15	A
Junction 1 - Arm 2		0.0	2.55	0.04	A		0.0	2.45	0.02	A		0.0	2.60	0.03	A
Junction 1 - Arm 3		0.2	3.53	0.18	A		0.1	3.11	0.08	A		0.1	3.18	0.10	A
Junction 2 - Arm 1		0.0	2.34	0.03	A		0.0	2.31	0.02	A		0.0	2.33	0.03	A
Junction 2 - Arm 2		0.0	0.00	0.00	A		0.0	0.00	0.00	A		0.0	0.00	0.00	A
Junction 2 - Arm 3		0.1	2.63	0.11	A		0.0	2.42	0.04	A		0.0	2.42	0.03	A

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle.

File summary

File Description

Title	
Location	
Site number	
Date	12/07/2022
Version	
Status	(new file)
Identifier	
Client	
Jobnumber	
Enumerator	CORP\mgilder
Description	

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	PCU	PCU	perHour	s	-Min	perMin

Analysis Options

Calculate Queue Percentiles	Calculate residual capacity	RFC Threshold	Average Delay threshold (s)	Queue threshold (PCU)
		0.85	36.00	20.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	Port of Tilbury 1	2022 AM	ONE HOUR	07:45	09:15	15
D2	Port of Tilbury 2	2022 AM	ONE HOUR	07:45	09:15	15
D3	Port of Tilbury Total	2022 AM	ONE HOUR	07:45	09:15	15
D4	Port of Tilbury 1	2022 PM	ONE HOUR	16:45	18:15	15
D5	Port of Tilbury 2	2022 PM	ONE HOUR	16:45	18:15	15
D6	Port of Tilbury Total	2022 PM	ONE HOUR	16:45	18:15	15
D7	Port of Tilbury 1	2022 IP	ONE HOUR	12:15	13:45	15
D8	Port of Tilbury 2	2022 IP	ONE HOUR	12:15	13:45	15
D9	Port of Tilbury Total	2022 IP	ONE HOUR	12:15	13:45	15

Analysis Set Details

ID	Network flow scaling factor (%)
A1	100.000

Port of Tilbury 1, 2022 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.77	A
2	untitled	Standard Roundabout		1, 2, 3	2.47	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.68	A

Arms

Arms

Junction	Arm	Name	Description	No give-way line
1	1	untitled		
	2	untitled		
	3	untitled		
2	1	untitled		
	2	untitled		
	3	untitled		

Roundabout Geometry

Junction	Arm	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Entry only	Exit only
1	1	4.65	7.40	1.9	16.7	60.0	26.0		
	2	4.65	7.31	2.2	16.5	60.0	32.0		
	3	3.65	5.91	2.2	17.8	60.0	30.0		
2	1	4.65	7.42	2.5	17.7	60.0	28.0		
	2	2.00	4.55	1.7	10.0	60.0	34.0		
	3	4.65	7.30	2.2	15.6	60.0	32.0		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Junction	Arm	Final slope	Final intercept (PCU/hr)
1	1	0.534	1563
	2	0.526	1545

	3	0.479	1259
2	**1**	0.538	1592
	2	0.366	695
	3	0.524	1539

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D1	Port of Tilbury 1	2022 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	**2**	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	**3**	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	**1**		✓	90	100.000
	2	✓			
	3		✓	74	100.000
2	**1**		✓	0	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	**2**	**3**
From	**1**	0	0	90
	2	0	0	0
	3	0	74	0

Junction 2

Demand (PCU/hr)

		To		
		1	**2**	**3**
From	**1**	0	0	0
	2	0	0	0
	3	74	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	**2**	**3**
From	**1**	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	**2**	**3**
From	**1**	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	**1**	0.07	2.53	0.1	A
	2	0.00	0.00	0.0	A
	3	0.06	3.06	0.1	A
2	**1**	0.00	0.00	0.0	A
	2	0.00	0.00	0.0	A
	3	0.05	2.47	0.1	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	**1**	68	56	1533	0.044	68	0.0	2.456	A
	2	0	68	1509	0.000	0	0.0	0.000	A
	3	56	0	1259	0.044	56	0.0	2.990	A
2	**1**	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	56	0	1539	0.036	55	0.0	2.426	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	**1**	81	66	1527	0.053	81	0.1	2.488	A
	2	0	81	1502	0.000	0	0.0	0.000	A
	3	67	0	1259	0.053	66	0.1	3.017	A
2	**1**	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	66	0	1539	0.043	66	0.0	2.444	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	**1**	99	81	1519	0.065	99	0.1	2.534	A
	2	0	99	1493	0.000	0	0.0	0.000	A
	3	81	0	1259	0.065	81	0.1	3.056	A
2	**1**	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	81	0	1539	0.053	81	0.1	2.469	A

08:30 - 08:45

Junction	Arm	Total Demand	Circulating	Capacity	RFC	Throughput	End queue	Delay (s)	Unsignalised

		(PCU/hr)	flow (PCU/hr)	(PCU/hr)		(PCU/hr)	(PCU)		level of service
1	1	99	81	1519	0.065	99	0.1	2.534	A
	2	0	99	1493	0.000	0	0.0	0.000	A
	3	81	0	1259	0.065	81	0.1	3.056	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	81	0	1539	0.053	81	0.1	2.469	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	81	67	1527	0.053	81	0.1	2.489	A
	2	0	81	1502	0.000	0	0.0	0.000	A
	3	67	0	1259	0.053	67	0.1	3.020	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	67	0	1539	0.043	67	0.0	2.444	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	68	56	1533	0.044	68	0.0	2.456	A
	2	0	68	1509	0.000	0	0.0	0.000	A
	3	56	0	1259	0.044	56	0.0	2.991	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	56	0	1539	0.036	56	0.0	2.428	A

Port of Tilbury 2, 2022 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.92	A
2	untitled	Standard Roundabout		1, 2, 3	2.43	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.74	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D2	Port of Tilbury 2	2022 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	48	100.000
	2	✓			
	3		✓	128	100.000
2	1		✓	47	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	48
	2	0	0	0
	3	63	65	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	47
	2	0	0	0
	3	65	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.03	2.46	0.0	A
	2	0.03	2.46	0.0	A
	3	0.11	3.27	0.1	A
2	1	0.03	2.34	0.0	A
	2	0.00	0.00	0.0	A
	3	0.06	2.48	0.1	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	36	60	1530	0.024	36	0.0	2.409	A
	2	35	36	1526	0.023	35	0.0	2.414	A

	3	96	23	1248	0.077	96	0.1	3.125	A
2	1	35	0	1592	0.022	35	0.0	2.312	A
	2	0	35	682	0.000	0	0.0	0.000	A
	3	60	0	1539	0.039	60	0.0	2.434	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	72	1524	0.028	43	0.0	2.430	A
	2	42	43	1522	0.028	42	0.0	2.431	A
	3	115	28	1246	0.092	115	0.1	3.183	A
2	1	42	0	1592	0.027	42	0.0	2.323	A
	2	0	42	680	0.000	0	0.0	0.000	A
	3	72	0	1539	0.047	72	0.0	2.454	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	53	89	1515	0.035	53	0.0	2.461	A
	2	52	53	1517	0.034	52	0.0	2.456	A
	3	141	34	1243	0.113	141	0.1	3.266	A
2	1	52	0	1592	0.033	52	0.0	2.337	A
	2	0	52	676	0.000	0	0.0	0.000	A
	3	89	0	1539	0.058	89	0.1	2.481	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	53	89	1515	0.035	53	0.0	2.461	A
	2	52	53	1517	0.034	52	0.0	2.456	A
	3	141	34	1243	0.113	141	0.1	3.266	A
2	1	52	0	1592	0.033	52	0.0	2.337	A
	2	0	52	676	0.000	0	0.0	0.000	A
	3	89	0	1539	0.058	89	0.1	2.481	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	73	1524	0.028	43	0.0	2.431	A
	2	42	43	1522	0.028	42	0.0	2.433	A
	3	115	28	1246	0.092	115	0.1	3.186	A
2	1	42	0	1592	0.027	42	0.0	2.325	A
	2	0	42	680	0.000	0	0.0	0.000	A
	3	73	0	1539	0.047	73	0.0	2.456	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	36	61	1530	0.024	36	0.0	2.409	A
	2	35	36	1526	0.023	35	0.0	2.414	A
	3	96	24	1248	0.077	96	0.1	3.128	A
2	1	35	0	1592	0.022	35	0.0	2.314	A
	2	0	35	682	0.000	0	0.0	0.000	A
	3	61	0	1539	0.039	61	0.0	2.436	A

Port of Tilbury Total, 2022 AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3.12	A
2	untitled	Standard Roundabout		1, 2, 3	2.56	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.93	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D3	Port of Tilbury Total	2022 AM	ONE HOUR	07:45	09:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	138	100.000
	2	✓			
	3		✓	202	100.000
2	1		✓	47	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	138
	2	0	0	0
	3	63	139	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	47
	2	0	0	0
	3	139	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.10	2.73	0.1	A
	2	0.04	2.55	0.0	A
	3	0.18	3.53	0.2	A
2	1	0.03	2.34	0.0	A
	2	0.00	0.00	0.0	A
	3	0.11	2.63	0.1	A

Main Results for each time segment

07:45 - 08:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	104	116	1501	0.069	104	0.1	2.577	A
	2	35	104	1491	0.024	35	0.0	2.473	A

	3	152	23	1248	0.122	152	0.1	3.281	A
2	1	35	0	1592	0.022	35	0.0	2.312	A
	2	0	35	682	0.000	0	0.0	0.000	A
	3	116	0	1539	0.075	116	0.1	2.529	A

08:00 - 08:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	124	139	1488	0.083	124	0.1	2.638	A
	2	42	124	1480	0.029	42	0.0	2.503	A
	3	182	28	1246	0.146	181	0.2	3.382	A
2	1	42	0	1592	0.027	42	0.0	2.323	A
	2	0	42	680	0.000	0	0.0	0.000	A
	3	139	0	1539	0.090	139	0.1	2.570	A

08:15 - 08:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	152	170	1472	0.103	152	0.1	2.727	A
	2	52	152	1465	0.035	52	0.0	2.546	A
	3	222	34	1243	0.179	222	0.2	3.527	A
2	1	52	0	1592	0.033	52	0.0	2.337	A
	2	0	52	676	0.000	0	0.0	0.000	A
	3	170	0	1539	0.111	170	0.1	2.629	A

08:30 - 08:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	152	170	1472	0.103	152	0.1	2.727	A
	2	52	152	1465	0.035	52	0.0	2.546	A
	3	222	34	1243	0.179	222	0.2	3.527	A
2	1	52	0	1592	0.033	52	0.0	2.337	A
	2	0	52	676	0.000	0	0.0	0.000	A
	3	170	0	1539	0.111	170	0.1	2.629	A

08:45 - 09:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	124	139	1488	0.083	124	0.1	2.638	A
	2	42	124	1480	0.029	42	0.0	2.504	A
	3	182	28	1246	0.146	182	0.2	3.386	A
2	1	42	0	1592	0.027	42	0.0	2.325	A
	2	0	42	680	0.000	0	0.0	0.000	A
	3	139	0	1539	0.090	139	0.1	2.571	A

09:00 - 09:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	104	117	1500	0.069	104	0.1	2.577	A
	2	35	104	1490	0.024	35	0.0	2.475	A
	3	152	24	1248	0.122	152	0.1	3.288	A
2	1	35	0	1592	0.022	35	0.0	2.314	A
	2	0	35	682	0.000	0	0.0	0.000	A
	3	117	0	1539	0.076	117	0.1	2.530	A

Port of Tilbury 1, 2022 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.64	A
2	untitled	Standard Roundabout		1, 2, 3	2.39	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.57	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D4	Port of Tilbury 1	2022 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	43	100.000
	2	✓			
	3		✓	33	100.000
2	1		✓	0	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	43
	2	0	0	1
	3	0	33	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	33	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.03	2.41	0.0	A
	2	0.00	0.00	0.0	A
	3	0.03	2.94	0.0	A
2	1	0.00	0.00	0.0	A
	2	0.00	0.00	0.0	A
	3	0.02	2.39	0.0	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	32	25	1549	0.021	32	0.0	2.372	A
	2	0	32	1528	0.000	0	0.0	0.000	A

	3	25	0	1259	0.020	25	0.0	2.916	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	25	0	1539	0.016	25	0.0	2.376	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	39	30	1547	0.025	39	0.0	2.386	A
	2	0	39	1525	0.000	0	0.0	0.000	A
	3	30	0	1259	0.024	30	0.0	2.927	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	30	0	1539	0.019	30	0.0	2.384	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	47	36	1543	0.031	47	0.0	2.406	A
	2	0	47	1520	0.000	0	0.0	0.000	A
	3	36	0	1259	0.029	36	0.0	2.943	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	36	0	1539	0.024	36	0.0	2.394	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	47	36	1543	0.031	47	0.0	2.406	A
	2	0	47	1520	0.000	0	0.0	0.000	A
	3	36	0	1259	0.029	36	0.0	2.943	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	36	0	1539	0.024	36	0.0	2.395	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	39	30	1547	0.025	39	0.0	2.386	A
	2	0	39	1525	0.000	0	0.0	0.000	A
	3	30	0	1259	0.024	30	0.0	2.927	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	30	0	1539	0.019	30	0.0	2.384	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	32	25	1549	0.021	32	0.0	2.372	A
	2	0	32	1528	0.000	0	0.0	0.000	A
	3	25	0	1259	0.020	25	0.0	2.916	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	25	0	1539	0.016	25	0.0	2.378	A

Port of Tilbury 2, 2022 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.69	A
2	untitled	Standard Roundabout		1, 2, 3	2.33	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.60	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D5	Port of Tilbury 2	2022 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	39	100.000
	2	✓			
	3		✓	60	100.000
2	1		✓	28	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	39
	2	0	0	28
	3	44	16	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	28
	2	0	0	0
	3	16	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.03	2.38	0.0	A
	2	0.02	2.41	0.0	A
	3	0.05	3.02	0.1	A
2	1	0.02	2.31	0.0	A
	2	0.00	0.00	0.0	A
	3	0.01	2.37	0.0	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	29	12	1556	0.019	29	0.0	2.357	A
	2	21	29	1530	0.014	21	0.0	2.385	A

	3	45	0	1259	0.036	45	0.0	2.964	A
2	1	21	0	1592	0.013	21	0.0	2.291	A
	2	0	21	688	0.000	0	0.0	0.000	A
	3	12	0	1539	0.008	12	0.0	2.356	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	35	14	1555	0.023	35	0.0	2.368	A
	2	25	35	1527	0.016	25	0.0	2.397	A
	3	54	0	1259	0.043	54	0.0	2.986	A
2	1	25	0	1592	0.016	25	0.0	2.297	A
	2	0	25	686	0.000	0	0.0	0.000	A
	3	14	0	1539	0.009	14	0.0	2.360	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	18	1553	0.028	43	0.0	2.383	A
	2	31	43	1522	0.020	31	0.0	2.413	A
	3	66	0	1259	0.052	66	0.1	3.016	A
2	1	31	0	1592	0.019	31	0.0	2.306	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	18	0	1539	0.011	18	0.0	2.365	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	43	18	1553	0.028	43	0.0	2.383	A
	2	31	43	1522	0.020	31	0.0	2.413	A
	3	66	0	1259	0.052	66	0.1	3.016	A
2	1	31	0	1592	0.019	31	0.0	2.306	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	18	0	1539	0.011	18	0.0	2.365	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	35	14	1555	0.023	35	0.0	2.368	A
	2	25	35	1527	0.017	25	0.0	2.399	A
	3	54	0	1259	0.043	54	0.0	2.988	A
2	1	25	0	1592	0.016	25	0.0	2.297	A
	2	0	25	686	0.000	0	0.0	0.000	A
	3	14	0	1539	0.009	14	0.0	2.360	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	29	12	1556	0.019	29	0.0	2.357	A
	2	21	29	1530	0.014	21	0.0	2.386	A
	3	45	0	1259	0.036	45	0.0	2.965	A
2	1	21	0	1592	0.013	21	0.0	2.293	A
	2	0	21	687	0.000	0	0.0	0.000	A
	3	12	0	1539	0.008	12	0.0	2.358	A

Port of Tilbury Total, 2022 PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.77	A
2	untitled	Standard Roundabout		1, 2, 3	2.38	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.66	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D6	Port of Tilbury Total	2022 PM	ONE HOUR	16:45	18:15	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	**2**	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	**3**	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	**1**		✓	82	100.000
	2	✓			
	3		✓	93	100.000
2	**1**		✓	28	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	82
	2	0	0	29
	3	44	49	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	28
	2	0	0	0
	3	49	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.06	2.49	0.1	A
	2	0.02	2.45	0.0	A
	3	0.08	3.11	0.1	A
2	1	0.02	2.31	0.0	A
	2	0.00	0.00	0.0	A
	3	0.04	2.42	0.0	A

Main Results for each time segment

16:45 - 17:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	37	1543	0.040	62	0.0	2.430	A
	2	21	62	1513	0.014	21	0.0	2.413	A

	3	70	0	1259	0.056	70	0.1	3.026	A
2	1	21	0	1592	0.013	21	0.0	2.291	A
	2	0	21	688	0.000	0	0.0	0.000	A
	3	37	0	1539	0.024	37	0.0	2.395	A

17:00 - 17:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	74	44	1539	0.048	74	0.1	2.456	A
	2	25	74	1506	0.017	25	0.0	2.430	A
	3	84	0	1259	0.066	84	0.1	3.061	A
2	1	25	0	1592	0.016	25	0.0	2.297	A
	2	0	25	686	0.000	0	0.0	0.000	A
	3	44	0	1539	0.029	44	0.0	2.407	A

17:15 - 17:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	90	54	1534	0.059	90	0.1	2.493	A
	2	31	90	1498	0.021	31	0.0	2.453	A
	3	102	0	1259	0.081	102	0.1	3.111	A
2	1	31	0	1592	0.019	31	0.0	2.306	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	54	0	1539	0.035	54	0.0	2.423	A

17:30 - 17:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	90	54	1534	0.059	90	0.1	2.493	A
	2	31	90	1498	0.021	31	0.0	2.454	A
	3	102	0	1259	0.081	102	0.1	3.111	A
2	1	31	0	1592	0.019	31	0.0	2.306	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	54	0	1539	0.035	54	0.0	2.423	A

17:45 - 18:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	74	44	1539	0.048	74	0.1	2.458	A
	2	25	74	1506	0.017	25	0.0	2.430	A
	3	84	0	1259	0.066	84	0.1	3.064	A
2	1	25	0	1592	0.016	25	0.0	2.297	A
	2	0	25	686	0.000	0	0.0	0.000	A
	3	44	0	1539	0.029	44	0.0	2.407	A

18:00 - 18:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	37	1543	0.040	62	0.0	2.432	A
	2	21	62	1513	0.014	21	0.0	2.413	A
	3	70	0	1259	0.056	70	0.1	3.027	A
2	1	21	0	1592	0.013	21	0.0	2.293	A
	2	0	21	687	0.000	0	0.0	0.000	A
	3	37	0	1539	0.024	37	0.0	2.396	A

Port of Tilbury 1, 2022 IP

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3.05	A
2	untitled	Standard Roundabout		1, 2, 3	2.60	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.90	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D7	Port of Tilbury 1	2022 IP	ONE HOUR	12:15	13:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	121	100.000
	2	✓			
	3		✓	163	100.000
2	1		✓	0	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	121
	2	0	0	0
	3	24	139	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	24	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.09	2.67	0.1	A
	2	0.00	0.00	0.0	A
	3	0.14	3.33	0.2	A
2	1	0.00	0.00	0.0	A
	2	0.00	0.00	0.0	A
	3	0.10	2.60	0.1	A

Main Results for each time segment

12:15 - 12:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	104	1507	0.060	91	0.1	2.542	A
	2	0	91	1497	0.000	0	0.0	0.000	A

	3	123	0	1259	0.097	122	0.1	3.167	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	104	0	1539	0.068	104	0.1	2.508	A

12:30 - 12:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	109	125	1496	0.073	109	0.1	2.594	A
	2	0	109	1488	0.000	0	0.0	0.000	A
	3	147	0	1259	0.116	146	0.1	3.234	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	125	0	1539	0.081	125	0.1	2.544	A

12:45 - 13:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	133	153	1481	0.090	133	0.1	2.670	A
	2	0	133	1475	0.000	0	0.0	0.000	A
	3	179	0	1259	0.143	179	0.2	3.333	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	153	0	1539	0.099	153	0.1	2.596	A

13:00 - 13:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	133	153	1481	0.090	133	0.1	2.670	A
	2	0	133	1475	0.000	0	0.0	0.000	A
	3	179	0	1259	0.143	179	0.2	3.333	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	153	0	1539	0.099	153	0.1	2.596	A

13:15 - 13:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	109	125	1496	0.073	109	0.1	2.597	A
	2	0	109	1488	0.000	0	0.0	0.000	A
	3	147	0	1259	0.116	147	0.1	3.235	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	125	0	1539	0.081	125	0.1	2.545	A

13:30 - 13:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	105	1507	0.060	91	0.1	2.544	A
	2	0	91	1497	0.000	0	0.0	0.000	A
	3	123	0	1259	0.097	123	0.1	3.167	A
2	1	0	0	1592	0.000	0	0.0	0.000	A
	2	0	0	695	0.000	0	0.0	0.000	A
	3	105	0	1539	0.068	105	0.1	2.509	A

Port of Tilbury 2, 2022 IP

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	3.14	A
2	untitled	Standard Roundabout		1, 2, 3	2.53	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.93	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D8	Port of Tilbury 2	2022 IP	ONE HOUR	12:15	13:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	83	100.000
	2	✓			
	3		✓	208	100.000
2	1		✓	41	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	**2**	**3**
From	**1**	0	0	83
	2	0	0	41
	3	69	139	0

Junction 2

Demand (PCU/hr)

		To		
		1	**2**	**3**
From	**1**	0	0	41
	2	0	0	0
	3	24	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	**2**	**3**
From	**1**	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	**2**	**3**
From	**1**	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.06	2.59	0.1	A
	2	0.03	2.48	0.0	A
	3	0.18	3.49	0.2	A
2	1	0.03	2.33	0.0	A
	2	0.00	0.00	0.0	A
	3	0.10	2.60	0.1	A

Main Results for each time segment

12:15 - 12:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	104	1507	0.041	62	0.0	2.491	A
	2	31	62	1512	0.020	31	0.0	2.429	A

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
	3	157	0	1259	0.124	156	0.1	3.261	A
2	1	31	0	1592	0.019	31	0.0	2.306	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	104	0	1539	0.068	104	0.1	2.508	A

12:30 - 12:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	75	125	1496	0.050	75	0.1	2.532	A
	2	37	75	1506	0.024	37	0.0	2.450	A
	3	187	0	1259	0.149	187	0.2	3.356	A
2	1	37	0	1592	0.023	37	0.0	2.315	A
	2	0	37	682	0.000	0	0.0	0.000	A
	3	125	0	1539	0.081	125	0.1	2.544	A

12:45 - 13:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	153	1481	0.062	91	0.1	2.590	A
	2	45	91	1497	0.030	45	0.0	2.479	A
	3	229	0	1259	0.182	229	0.2	3.493	A
2	1	45	0	1592	0.028	45	0.0	2.327	A
	2	0	45	679	0.000	0	0.0	0.000	A
	3	153	0	1539	0.099	153	0.1	2.596	A

13:00 - 13:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	91	153	1481	0.062	91	0.1	2.590	A
	2	45	91	1497	0.030	45	0.0	2.479	A
	3	229	0	1259	0.182	229	0.2	3.493	A
2	1	45	0	1592	0.028	45	0.0	2.327	A
	2	0	45	679	0.000	0	0.0	0.000	A
	3	153	0	1539	0.099	153	0.1	2.596	A

13:15 - 13:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	75	125	1496	0.050	75	0.1	2.534	A
	2	37	75	1506	0.024	37	0.0	2.452	A
	3	187	0	1259	0.149	187	0.2	3.358	A
2	1	37	0	1592	0.023	37	0.0	2.316	A
	2	0	37	682	0.000	0	0.0	0.000	A
	3	125	0	1539	0.081	125	0.1	2.545	A

13:30 - 13:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	62	105	1507	0.041	63	0.0	2.494	A
	2	31	63	1512	0.020	31	0.0	2.431	A
	3	157	0	1259	0.124	157	0.1	3.267	A
2	1	31	0	1592	0.019	31	0.0	2.308	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	105	0	1539	0.068	105	0.1	2.509	A

Port of Tilbury Total, 2022 IP

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Linked Roundabout	Junction 1 - Arm 2	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Linked Roundabout	Junction 2 - Arm 3	If the distance between linked junctions is small, results should be treated with caution. The linked junctions will be modelled as separate junctions, but the real behaviour may be that of a complex system with interactions that cannot be modelled.
Warning	Vehicle Mix	Junction 1	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.
Warning	Vehicle Mix	Junction 2	HV% is zero for all movements / time segments. Vehicle Mix matrix should be completed whether working in PCUs or Vehs. If HV% at the junction is genuinely zero, please ignore this warning.

Junction Network

Junctions

Junction	Name	Junction type	Use circulating lanes	Arm order	Junction Delay (s)	Junction LOS
1	untitled	Standard Roundabout		1, 2, 3	2.87	A
2	untitled	Standard Roundabout		1, 2, 3	2.38	A

Junction Network

Driving side	Lighting	Network delay (s)	Network LOS
Left	Normal/unknown	2.77	A

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)
D9	Port of Tilbury Total	2022 IP	ONE HOUR	12:15	13:45	15

Vehicle mix source	PCU Factor for a HV (PCU)
HV Percentages	2.00

Linked Arm Data

Junction	Arm	Feeding Junction	Feeding Arm	Link Type	Flow source	Uniform flow (PCU/hr)	Flow multiplier (%)	Internal storage space (PCU)
1	2	2	3	Simple (vertical queueing)	Normal	0	100.00	
2	3	1	2	Simple (vertical queueing)	Normal	0	100.00	

Demand overview (Traffic)

Junction	Arm	Linked arm	Use O-D data	Average Demand (PCU/hr)	Scaling Factor (%)
1	1		✓	204	100.000
	2	✓			
	3		✓	117	100.000
2	1		✓	41	100.000
	2		✓	0	100.000
	3	✓			

Origin-Destination Data

Junction 1

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	204
	2	0	0	41
	3	69	48	0

Junction 2

Demand (PCU/hr)

		To		
		1	2	3
From	1	0	0	41
	2	0	0	0
	3	48	0	0

Vehicle Mix

Junction 1

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Junction 2

Heavy Vehicle Percentages

		To		
		1	2	3
From	1	0	0	0
	2	0	0	0
	3	0	0	0

Results

Results Summary for whole modelled period

Junction	Arm	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
1	1	0.15	2.75	0.2	A
	2	0.03	2.60	0.0	A
	3	0.10	3.18	0.1	A
2	1	0.03	2.33	0.0	A
	2	0.00	0.00	0.0	A
	3	0.03	2.42	0.0	A

Main Results for each time segment

12:15 - 12:30

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	154	36	1543	0.100	153	0.1	2.589	A
	2	31	153	1464	0.021	31	0.0	2.510	A

	3	88	0	1259	0.070	88	0.1	3.073	A
2	1	31	0	1592	0.019	31	0.0	2.306	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	36	0	1539	0.023	36	0.0	2.394	A

12:30 - 12:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	183	43	1540	0.119	183	0.1	2.654	A
	2	37	183	1449	0.025	37	0.0	2.549	A
	3	105	0	1259	0.084	105	0.1	3.119	A
2	1	37	0	1592	0.023	37	0.0	2.315	A
	2	0	37	682	0.000	0	0.0	0.000	A
	3	43	0	1539	0.028	43	0.0	2.405	A

12:45 - 13:00

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	225	53	1534	0.146	224	0.2	2.748	A
	2	45	224	1427	0.032	45	0.0	2.604	A
	3	129	0	1259	0.102	129	0.1	3.184	A
2	1	45	0	1592	0.028	45	0.0	2.327	A
	2	0	45	679	0.000	0	0.0	0.000	A
	3	53	0	1539	0.034	53	0.0	2.421	A

13:00 - 13:15

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	225	53	1534	0.146	225	0.2	2.748	A
	2	45	225	1427	0.032	45	0.0	2.604	A
	3	129	0	1259	0.102	129	0.1	3.184	A
2	1	45	0	1592	0.028	45	0.0	2.327	A
	2	0	45	679	0.000	0	0.0	0.000	A
	3	53	0	1539	0.034	53	0.0	2.421	A

13:15 - 13:30

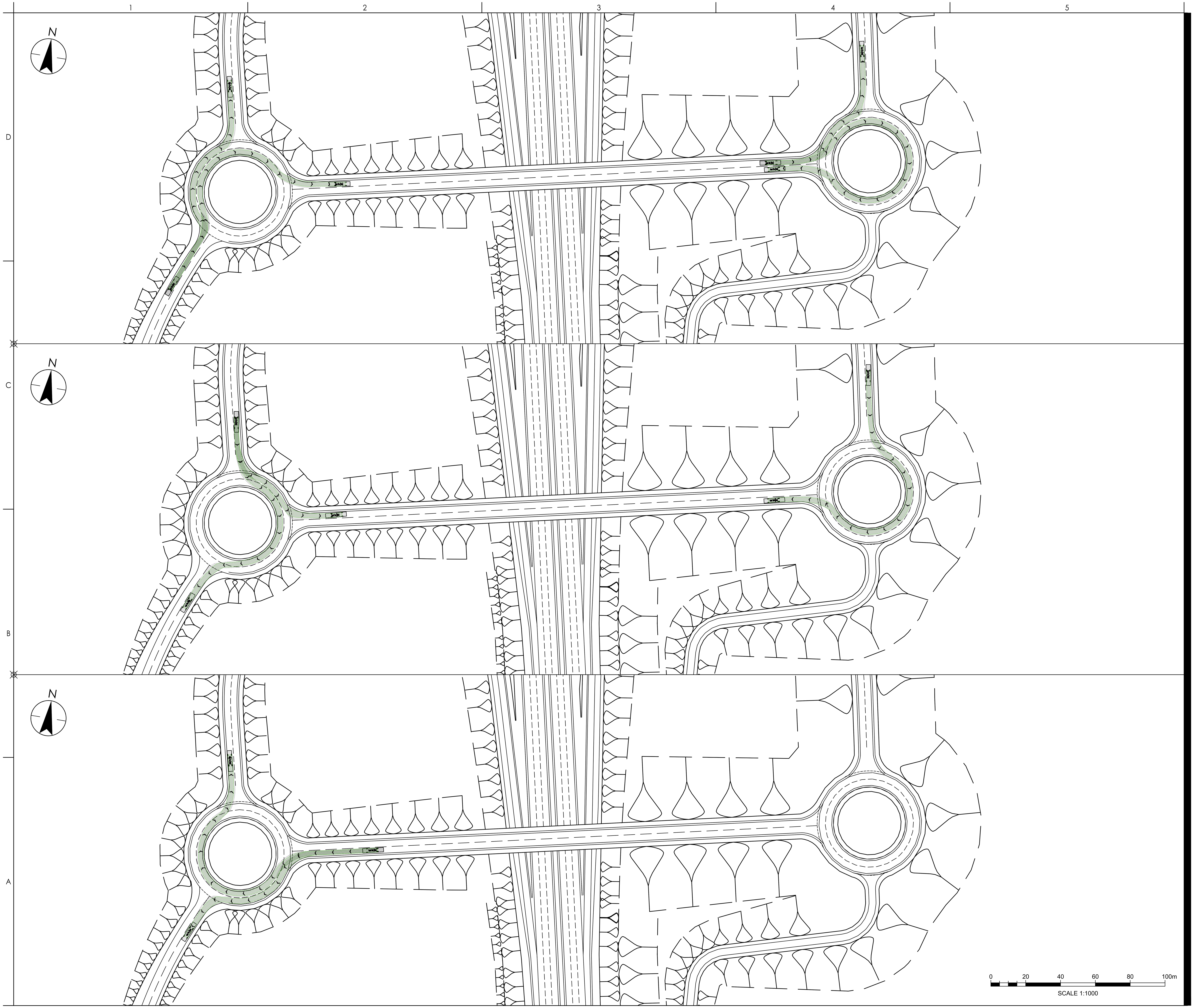
Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	183	43	1539	0.119	184	0.1	2.654	A
	2	37	184	1448	0.025	37	0.0	2.551	A
	3	105	0	1259	0.084	105	0.1	3.119	A
2	1	37	0	1592	0.023	37	0.0	2.316	A
	2	0	37	682	0.000	0	0.0	0.000	A
	3	43	0	1539	0.028	43	0.0	2.406	A

13:30 - 13:45

Junction	Arm	Total Demand (PCU/hr)	Circulating flow (PCU/hr)	Capacity (PCU/hr)	RFC	Throughput (PCU/hr)	End queue (PCU)	Delay (s)	Unsignalised level of service
1	1	154	36	1543	0.100	154	0.1	2.592	A
	2	31	154	1464	0.021	31	0.0	2.513	A
	3	88	0	1259	0.070	88	0.1	3.073	A
2	1	31	0	1592	0.019	31	0.0	2.308	A
	2	0	31	684	0.000	0	0.0	0.000	A
	3	36	0	1539	0.024	36	0.0	2.394	A

TECHNICAL NOTE

Appendix E – Swept Path Tracking Drawings



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TN23 1FB
Tel. +44 1233 527 250
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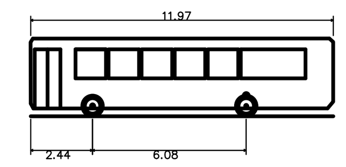

Coach 12m (Setra)	
Overall Length	11.970m
Overall Width	2.500m
Overall Body Height	3.070m
Min Body Ground Clearance	0.306m
Track Width	2.322m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	10.850m

Issued/Revision		By	Appd	YYYY.MM.DD
P01 FIRST ISSUE		GP	NB	2022.12.21
	GP	GP	KM	2022.12.07
	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Issue Status

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Client/Project Logo

Client/Project

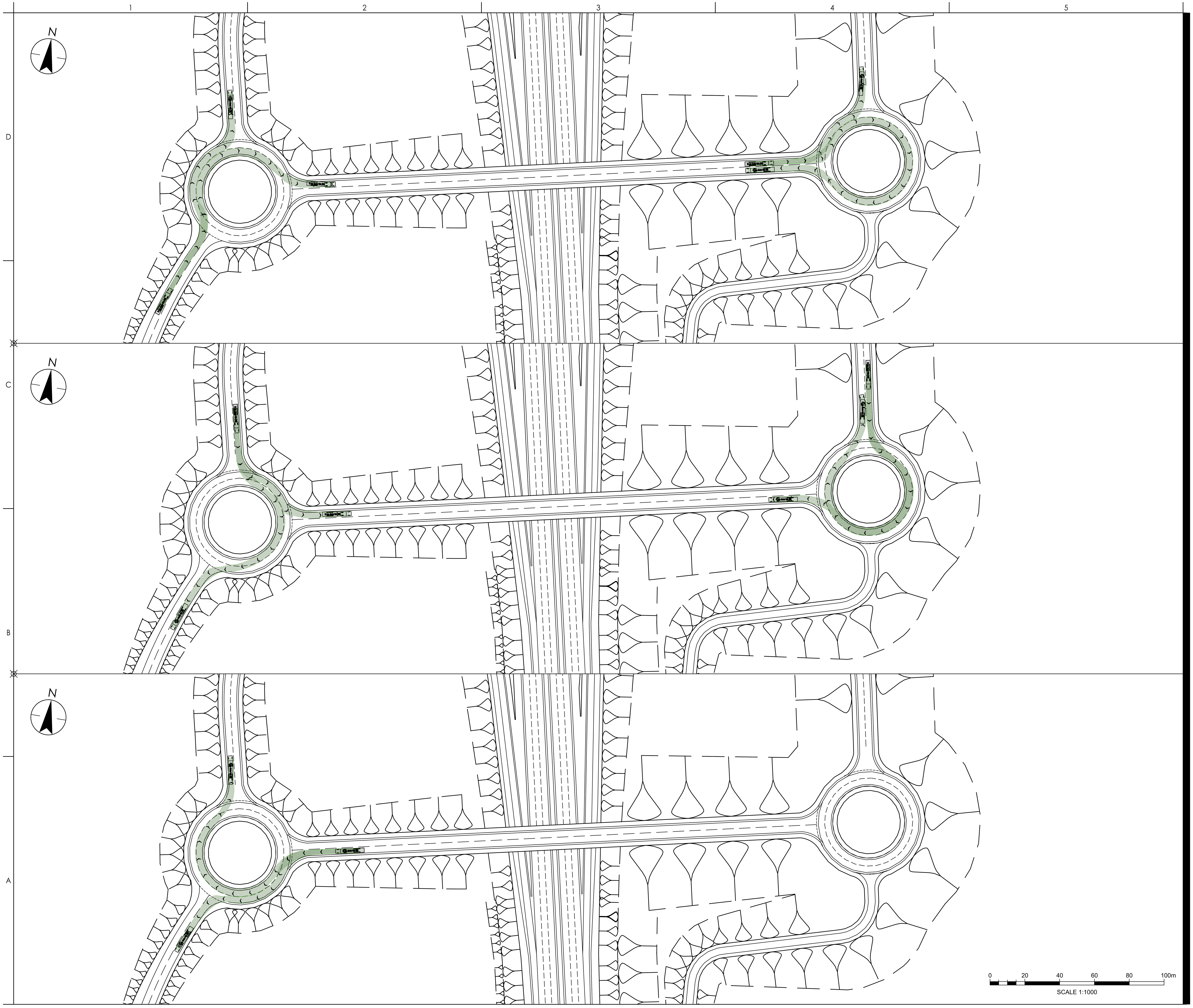
TILBURY LINK ROAD

Title

JUNCTION ARRANGEMENT OPTION 1
VEHICLE SWEPT PATH ANALYSIS
12m BUS

Project No.	A1 Scale
332510754	1:1000

Revision	Drawing No.
P01	332510754-111



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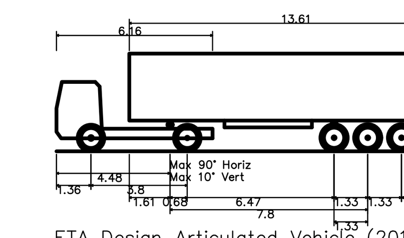

FTA Design Articulated Vehicle (2016)	
Overall Length	16.480m
Overall Width	2.550m
Overall Body Height	3.870m
Min Body Ground Clearance	0.515m
Max Track Width	2.470m
Lock to lock time	3.00s
Kerb to Kerb Turning Radius	6.600m

P01 FIRST ISSUE	GP	NB	2022.12.21
Issued/Revision	By	Appd	YYYY.MM.DD
GP	GP	KM	2022.12.07
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Issue Status

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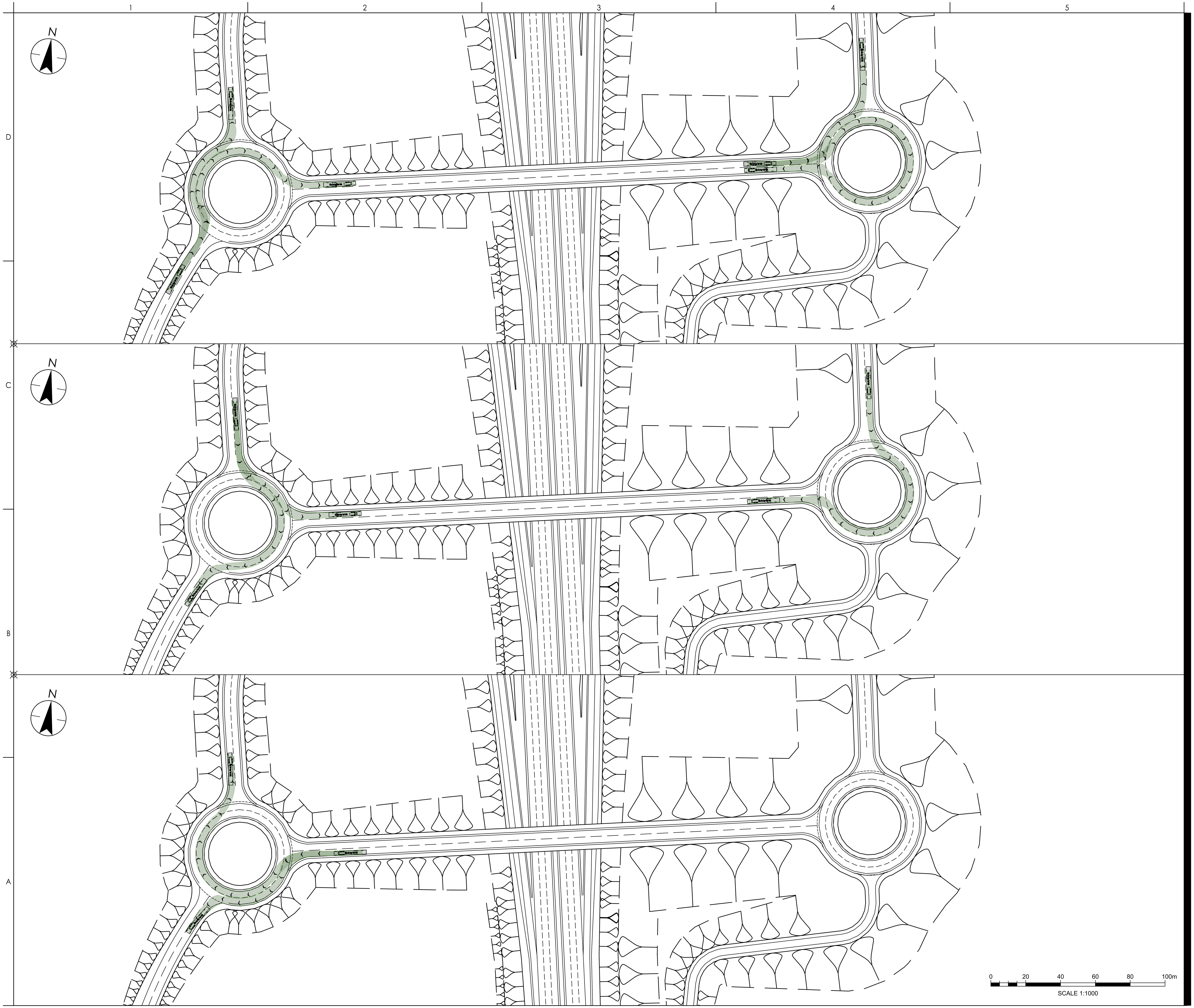
Client/Project Logo

Client/Project
TILBURY LINK ROAD

Title
JUNCTION ARRANGEMENT OPTION 1
VEHICLE SWEPT PATH ANALYSIS
16.5m HGV

Project No.	A1 Scale
332510754	1:1000

Revision	Drawing No.
P01	332510754-112



0 20 40 60 80 100m

SCALE 1:1000

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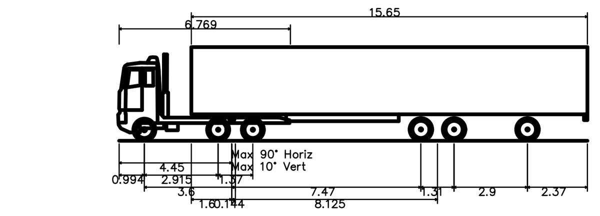

18.5m New longer Semi−trailer

Overall Length	18.500m
Overall Width	2.550m
Overall Body Height	3.693m
Min Body Ground Clearance	0.331m
Max Track Width	2.550m
Lock to lock time	4.00s
Kerb to Kerb Turning Radius	7.450m

P01 FIRST ISSUE	GP	NB	2022.12.21
Issued/Revision	By	Appd	YYYY.MM.DD

GP	GP	KM	2022.12.14
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

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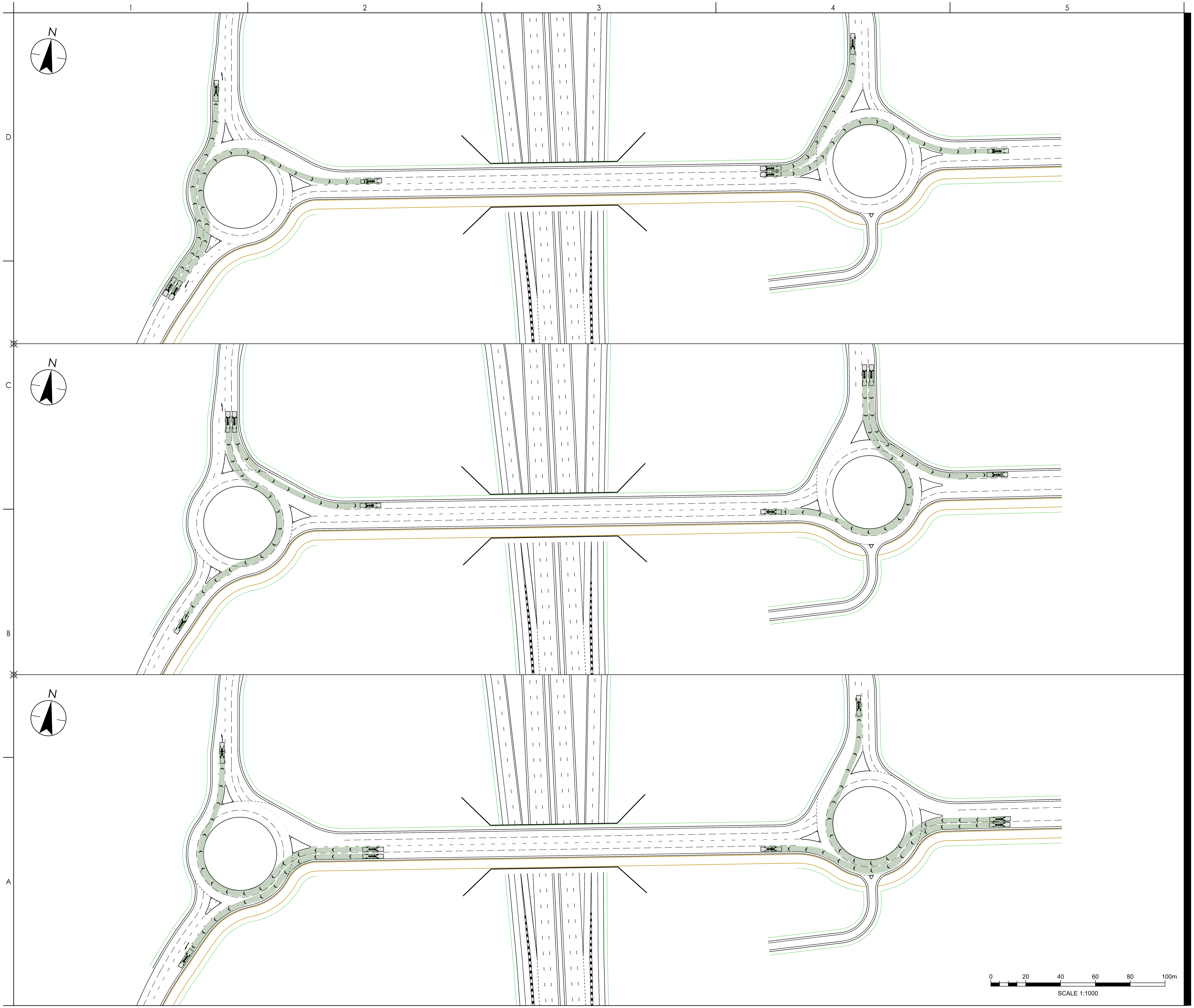
TILBURY LINK ROAD

Title

JUNCTION ARRANGEMENT OPTION 1
VEHICLE SWEPT PATH ANALYSIS
18.5m HGV

Project No.	A1 Scale
332510754	1:1000

Revision	Drawing No.
P01	332510754-113



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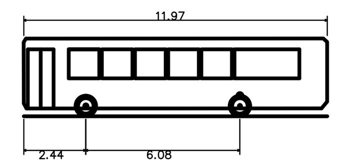

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Track Width	2.322m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	10.850m

Issued/Revision	By	Appd	YYYY.MM.DD
P01 FIRST ISSUE	GP	NB	2022.12.21

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
GP	GP	KM	2022.12.06

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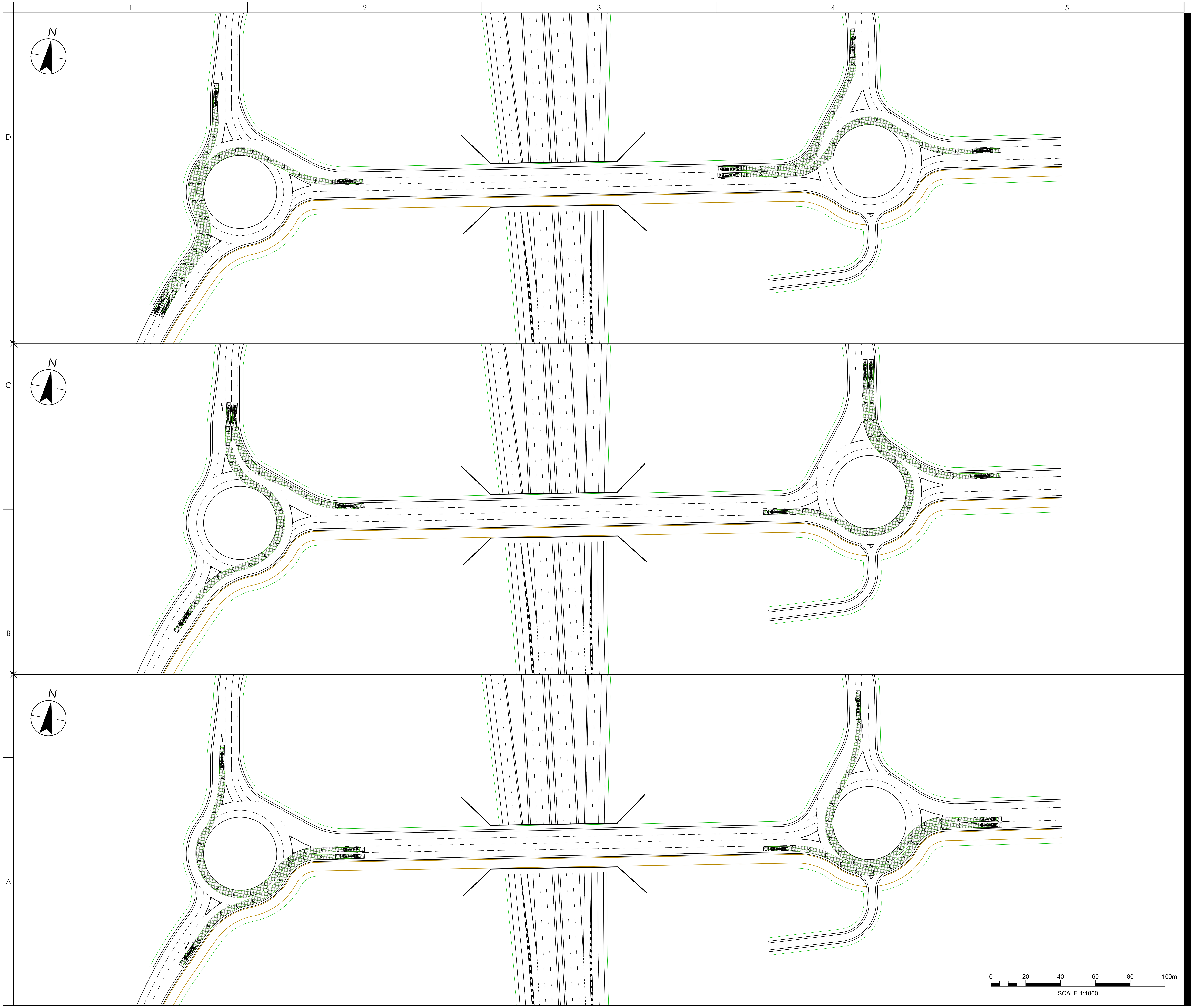
Client/Project Logo

Client/Project
TILBURY LINK ROAD

Title
JUNCTION ARRANGEMENT OPTION 1
VEHICLE SWEPT PATH ANALYSIS
12m BUS

Project No.: 332510754
A1 Scale: 1:1000
Revision: P01
Drawing No.: 332510754-121



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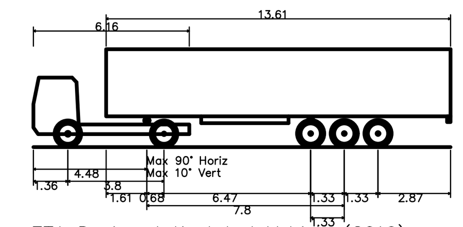

FTA Design Articulated Vehicle (2016)

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Issued/Revision	By	Appd	YYYY.MM.DD
P01 FIRST ISSUE	GP	NB	2022.12.21

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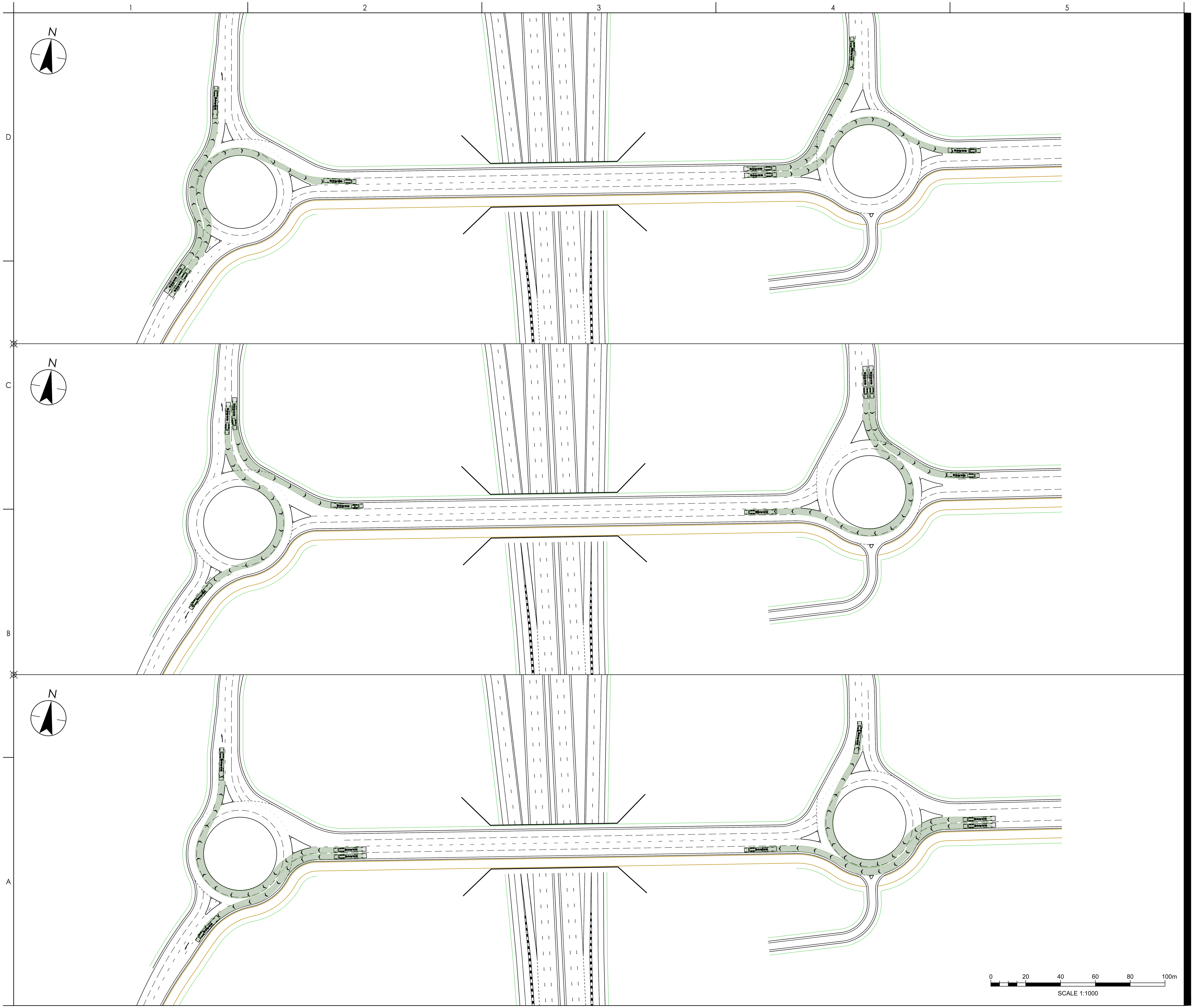
Title
JUNCTION ARRANGEMENT OPTION 1 VEHICLE SWEPT PATH ANALYSIS 16.5m HGV

Project No. 332510754

A1 Scale 1:1000

Revision P01

Drawing No. 332510754-122



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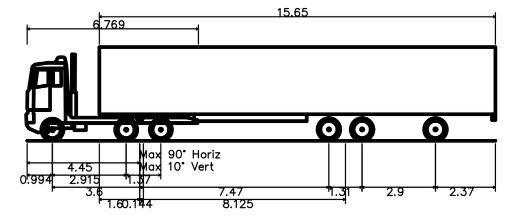

18.5m New longer Semi–trailer	
Overall Length	18.500m
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Issued/Revision	By	Appd	YYYY.MM.DD
P01 FIRST ISSUE	GP	NB	2022.12.21

	Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
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TILBURY LINK ROAD

Title

JUNCTION ARRANGEMENT OPTION 1 VEHICLE SWEPT PATH ANALYSIS 18.5m HGV

Project No.	A1 Scale
332510754	1:1000

Revision	Drawing No.
P01	332510754-123

Sub-annex 2.4 – LTC – Public Transport Access Concepts

TECHNICAL NOTE

Job Name: Lower Thames Crossing

Job No: 332510065
Note No:

Date: 7 May 2021

Prepared By: Bryn Kemp and Alastair Mackie

Subject: Lower Thames Crossing – Public Transport Access Concepts

1. Introduction

1.1. This technical note examines the headline concepts for achieving connectivity between the LTC and the local road network within Thurrock, to facilitate public transport connection along the LTC to complement the opportunities for movement across the river for employment and other purposes. As part of Thurrock Council's engagement with local major stakeholders, the importance of the employment market between the two areas has been expressed.

1.2. The Lower Thames Crossing (LTC) provides a link between A2 Watling Street south of the river Thames and the A13 to the north. The long-term aspiration for the LTC is to accommodate cross-river public Transport connections.

1.3. The current proposals do not give direct connective route between adjacent centres of population, this note considers the opportunities and practicalities for the provision of public transport links within the emerging LTC design.

1.4. The LTC design north of the river relies on the connection from the A13 and the A1089 to link to the wider road network. This arrangement does not provide a direct public transport link from the tunnel to communities of Tilbury and Grays resulting in a 7 mile detour. A similar situation also applies for connectivity to Stanford-le-Hope.

1.5. Whilst there is a strong aspiration to utilise the LTC river crossing to provide additional bus connections, without the junction at East Tilbury and the TLR, effective cross-river bus provision is unviable due to excessive indirect routeing via the A13/LTC interface.

1.6. A similar connectivity issue for public transport south of the river also exists although to lesser extent as the connector road between the tunnel portal and the A2 is significantly shorter than that compared to the north side of the river between the tunnel portal and the A13. Connectivity to Gravesend is via the A2 south of Gravesend and then to return northwards to connect to the town centre.

2. Public Transport Access Option – North of the River

2.1. Work undertaken by Hatch has identified two possible solutions to provide potential public transport connectivity improving the viability of public transport provision by linking LTC to the adjacent local road network.

2.2. The current level of design as to the infrastructure within the proposed emergency access to enforce its use as an emergency point of access/egress is not shown. This may involve in its simplest form prohibition signing, this could be supported by gates to prevent unauthorised use.

2.3. The provision of dedicated public transport links on to the strategic road network has been accommodated on the M32 north of junction 2 with a northbound off slip and a southbound on slip. The LTC proposal replicates this arrangement for the north side of the tunnel.

Image 2.1: M32 north of junction 2 – Bus only exit

2.4. The two options for public transport access on to the LTC corridor are:

2.4.1. Option 1 - proposed emergency access points south of Station Road

2.4.2. Option 2 - proposed emergency access points adjacent to Brentwood Road

2.5. Option 1 utilises the proposed emergency access points south of Station Road, the geometry of the access point does not accommodate merge /diverge for general use as the access is provided for limited emergency use.

2.6. The use by public transport would require the design to be changed to provided appropriate geometric layout to accommodate slowing/accelerating vehicles, intervisibility to accommodate safe merge and direction/warning signs to advise road users of the junctions and the restrictions on that junction.

2.7. In addition to the design changes to the access point on/off the LTC corridor the access roads to the entry/exit points are likely to need widening to accommodate public transport and emergency access.

2.8. The onward route from Station Road to the east which could connect with East Tilbury. Whilst currently constrained in width the corridor could be developed as part of local plan growth options. The route to the west connecting to Tilbury has one area which will present difficulties for buses, this is a short length in Cooper's Shaw Road where the carriageway is reduced to single vehicle width. The west bound connection in time could be facilitated by the Tilbury Link Road which could replace or supplement the use of Cooper's Shaw Road.

2.9. The provision of the legacy rail over bridge and new connections to the east of the LTC corridor would provide opportunities to better connect to the communities of Standford-le –Hope / London gateway, Linford and further into Basildon and Essex.

TECHNICAL NOTE

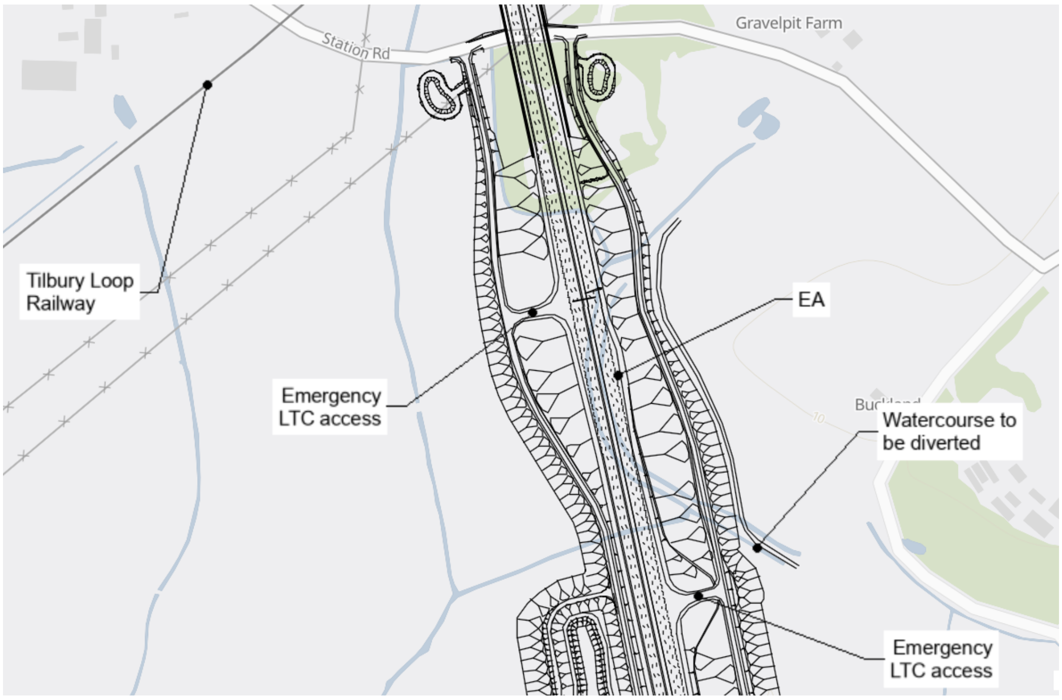

Image 2.2: Emergency access near north portal

2.10. Option 2- utilises the proposed emergency access points adjacent to Brentwood Road, the geometry of the access point does not accommodate merge /diverge for general use as the access is provided for limited emergency use.

2.11. The use by Public Transport would require the design to be changed to provided appropriate geometric layout to accommodate slowing/accelerating vehicles, intervisibility to accommodate safe merge and direction/warning signs to advise road users of the junctions and the restrictions on that junction.

2.12. In addition to the design changes to the access point on/off the LTC corridor the access roads to the entry/exit points are likely to need widening to accommodate public transport, emergency and property access.

2.13. The location of the emergency access on the west bound carriageway does not currently lend itself to a simple design adjustment as its location west of the LTC over bridge precludes the introduction of deceleration lane without widening the bridge. The option to futureproof the layout would be to relocate the emergency access to the east of the bridge. Where a deceleration lane can be provided without impacting the bridge structure.

2.14. The onward routeing from the connection to Brentwood Road and Fort Road to Tilbury does not present any barriers for buses as the carriageway width is sufficient to accommodate passing vehicles. This does preclude access for public transport to directly serve East Tilbury and Lindford from the LTC corridor.

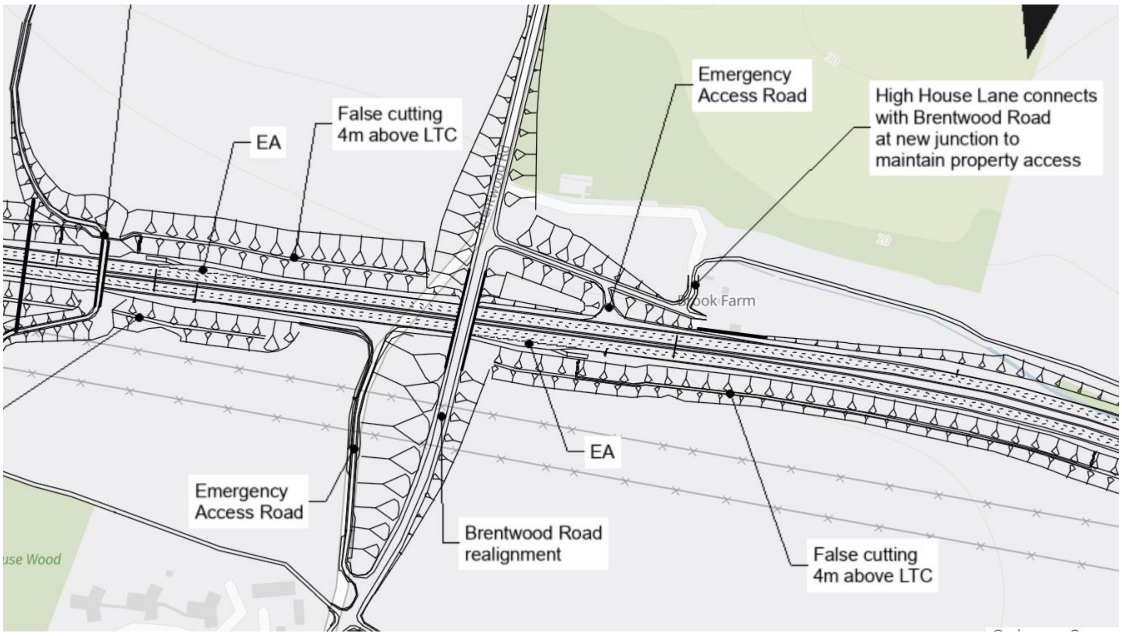

Image 2.3: Emergency access Brentwood Road

3. North Portal Tilbury Link Road connection

3.1. There is merit in providing a link between the LTC corridor and A1089 this would need to be south of Station Road to form the most direct link. The connection would require a bridge or other structure to enable connection on to the southbound carriageway of the LTC. An alternative would be to utilise Station Road as a means of providing the link which would require improvement to part of the Station Road corridor. This provides the potential to be tied into the network associated with the legacy bridge over the railway.

3.2. The provision of a link road is a further iteration of option 1 outlined in section 2 above and would enable provision for public transport to be provided from East Tilbury via the LTC link to Tilbury and Grays and would also serve public transport utilising the tunnel. The link also provides opportunities for pedestrians and cyclists to connect between East Tilbury and Tilbury, an approximate distance of 3 miles, in travel time a 14 minute cycle ride or a 1 hour walk.

3.3. This location should be reviewed in conjunction with he Passive Provision workstream that is being pursued.

4. Control mechanisms

4.1. The mechanism for control and enforcement would need to be reviewed but should reflect experience at the M32 interchange. It is anticipated that free-flow access and egress would be provided with bus lane enforcement. Physical measures would need to be assessed against the safety implications of misuse of the system.

Sub-annex 2.5 – Crossing Structures Widths – Council Requirement to DCO Submission Comparison

	Thurrock Council requirement				NH response pre-DCOv2				DCOv2 ssubmission details				NH Comments prior to DCOv2	Thurrock Council Comments prior to DCO submission	Thurrock Council review + comments of DCOv2 evidence
	Cycling	Walking	Horse Riding	WCH Total	Cycling	Walking	Horse Riding	WCH Total	Cycling	Walking	Horse Riding	WCH Total		GENERAL: NH has only provided the space proposed for WCH. This only presents a partial picture of what is proposed and to be able to consider how well the proposed bridge will integrate into the wider transport network and meet future demands. For all bridges TC request that LTC provide a cross-section (or table) showing the total bridge width proposed and the space allocated for all the different uses within that cross section?	No change to earlier review comments
Muckingford Road	3.0	2.0		5.0	3.0	2.0	5.0	5.0	4.0		0.0	4.0	LTC excludes 7m bus lanes	**Change proposed by NH.** Now meets TC requirements for Walking and Cycling but does not meet TC requirement for bus lanes. Significantly increased walking, cycling and public transport demand is expected along Muckingford Road (and the A1013 Corridor) in the future as a result of emerging Local Plan growth strategy. Whilst, the transport policy and evidence base for the future bus / MRT strategy required to support local plan growth (and the requirement for bus lanes at this location) is not yet developed I think we should maintain our position as it will be a key sustainable travel corridor linking and through growth sites and this is the only bridge crossing of LTC where segregated provision segregated for buses/MRT is proposed.	Horse riding route not provided. Provision of shared footway cycletrack scales at 4m confirmation of route width required. dDCO (AS-038): Works 6B - construction of new public right of way on verge Structures Plan (APP-044): Provision of raised verge, scaled at 4m Rights of Way and Access Plan (AS-032): New or improved footway/cycle track along side of road
Hoford Road	4.0			4.0	3.6			3.6	3.6			3.6		**No Change proposed by NH.** Only small underprovision compared to TC requirements.	No change to earlier review comments dDCO (AS-038): Works 6C - Construction of bridge to carry realigned Hoford Road Structures Plan (APP-044): Provision of bridge carriageway, scaled width 3.6m Rights of Way and Access Plan (AS-032): New alterered or improved highway
Brentwood Road	3.0	2.0		5.0	0.0	0.0		0.0	0.0	0.0		0.0	No WCHR route as separate provision made (2.75 verges provided)	**No Change proposed by NH.** No WCHR provision proposed. Further Question: Why is no provision for cycling and walking made at this crossing using space (5.5m allocated for verge)?	No change to earlier review comments dDCO (AS-038): Works 6D - Construction of bridge to carry realigned Brentwood Road Structures Plan (APP-044): Provision of bridge carriageway, scaled width 2.75 verges and 8.5m carriageway including hard strip Rights of Way and Access Plan (AS-032): New alterered or improved highway
Farmtrack/Footbridge FP79	3.5			3.5	3.5			3.5	3.5			3.5		**No Change proposed by NH.** Meets TC Requirements.	No change to earlier review comments dDCO (AS-038): Works 7B - construction of bridge to carry footpath FB 79 Structures Plan (APP-044): Defined as footpath, cycle path and brideway. Provision of bridge carriageway, scaled 4.5m with hard strips Rights of Way and Access Plan (AS-032): Footpath diverted and recalssified as bridleway
A1013 over A1089	3.0	2.0		5.0	3.0	2.0		5.0	5.0			4.5		**Change proposed by NH.** Meets TC Requirements for Walking and Cycling. As above it is important that LTC rovide a cross-section (or table) showing the total bridge width proposed and the space allocated for all the different uses within that cross section.	No change to earlier review comments dDCO (AS-038): Works 7D - construction of new right of way along verge Structures Plan (APP-044): Provision of raised verge, scaled at 4.5m on two bridges and 5m on one. Rights of Way and Access Plan (AS-032): New or improved footway/cycle track along side of road
Rectory Road	3.0	2.0	3.0	8.0	3.0	2.0	3.5	8.5	3.0	2.0	3.5	8.5		**Change proposed by NH.** Meets TC Requirements for Walking, Cycling and Horse Riding.	Confirmation of route width required as scale plan is not correct dDCO (AS-038): Works 7J Construction of new bridge, new public rights of way on verge Structures Plan (APP-044): Cross section not to scale, verge provided at potentially 8m Rights of Way and Access Plan (AS-032): New or improved footway/cycle track along side of road, horse riding track along the side of a road
Stifford Clays	2.0	2.0	3.0	7.0	3.0	2.0	0.0	5.0	5.0		0.0	4.8	No separate equestrian route provided	**Change proposed by NH.** Exceeds TC Requirements for Walking and Cycling. No provision for Equestrian.	Confirmation of route width required as scale plan is not correct dDCO (AS-038): Works 7L Construction of new bridge, new public rights of way on verge Structures Plan (APP-044): Provision of raised verge, scaled at 4.75m Rights of Way and Access Plan (AS-032): New or improved footway/cycle track along side of road
Green Lane	4.0			4.0	4.0			4.0	4.0			4.0		**No Change.** Meets TC Requirements.	No change to earlier review comments dDCO (AS-038): Works 7M - construction of new bridge for realigned road and new public right of way Structures Plan (APP-044): Provision of bridge carriageway, scaled width 4m Rights of Way and Access Plan (AS-032): Footpath diverted and recalssified as bridleway
Farmtrack/Footbridge FP136	4.0			4.0	4.0			4.0	4.0			4.0		**No Change.** Meets TC Requirements.	No change to earlier review comments dDCO (AS-038): Works 8C - construction of new bridge to carry realigned FP 136 (new Public right of way) Structures Plan (APP-044): Cross section not to scale Rights of Way and Access Plan (AS-032): Footpath diverted
North Road	3.0	2.0		5.0	3.0	2.0		5.0	4.5			4.5		**Change proposed by NH.** Meets TC Requirements.	No change to earlier review comments dDCO (AS-038): Works 8D Construction of new bridge, new public rights of way on verge Structures Plan (APP-044): Provision of raised verge, scaled at 4.5m Rights of Way and Access Plan (AS-032): New non segregated pedestrian and cycle and horse riding track

	Thurrock Council requirement				NH response pre-DCOv2				DCOv2 ssubmission details				NH Comments prior to DCOv2	Thurrock Council Comments prior to DCO submission	Thurrock Council review + comments of DCOv2 evidence
	Cycling	Walking	Horse Riding	WCH Total	Cycling	Walking	Horse Riding	WCH Total	Cycling	Walking	Horse Riding	WCH Total		GENERAL: NH has only provided the space proposed for WCH. This only presents a partial picture of what is proposed and to be able to consider how well the proposed bridge will integrate into the wider transport network and meet future demands. For all bridges TC request that LTC provide a cross-section (or table) showing the total bridge width proposed and the space allocated for all the different uses within that cross section?	No change to earlier review comments
FP252 over LTC	5.0			5.0		3.5		3.5		3.5		3.5	3.5m provided not 5m	**No Change proposed by NH.** Does not fully meet TC requirements but 3.5m width seems reasonable at this location.	Indicated on drawings as FP 151, bridge appears to be outside Thurrock boundary. designated as Bridleway on access plans but referenced as footpath/cycle path on structures plan. Bridleway definition will require 1800mm parapet as opposed to 1500mm for cycle routes dDCO (AS-038): Works 9M - new public right of way Structures Plan (APP-044): Cross section not to scale, potentially 4m with hard strips.parapet indicated as pedestrian, height requirement for cyclists. Rights of Way and Access Plan (AS-032): New or improved bridleway
FP252 over railway	5.0			5.0		3.5		3.5		3.5		3.5	3.5m provided not 5m	**No Change proposed by NH.** Does not fully meet TC requirements but 3.5m width seems reasonable at this location.	Indicated on drawings as FP 151. Designated as Bridleway on access plans but referenced as footpath/cycle path on structures drawing. Bridleway definition will require 1800mm parapet as opposed to 1500mm for cycle routes dDCO (AS-038): Works 9M - new public right of way Structures Plan (APP-044): Cross section not to scale, potentially 4m with hard strips.parapet indicated as pedestrian, height requirement for cyclists. Rights of Way and Access Plan (AS-032): New or improved bridleway
A1013 over LTC	3.0	2.0							4.8			4.8		**Not covered in LTC response table.** Further question: Assume that provision for walking and cycling at A1013 bridge over LTC is the same as indicated for A1013 over A1089? As above it is important that LTC provide a cross-section (or table) showing the total bridge width proposed and the space allocated for all the different uses within that cross section.	No change to earlier review comments dDCO (AS-038): Works 7D - construction of new right of way along verge Structures Plan (APP-044): Provision of raised verge, scaled at 4.8m
A122 to A13 - Over Baker Street															Works 7V needs to coinside with point 28/1 on the access plans to provide connectivity to new bridleway Works 7V - new public right of way adjacent to carriageway , Baker Street Structures Plan (APP-044): Works 7G indicates bridge over Baker Street, no corresponding structures drawing Rights of Way and Access Plan (AS-032): New or improved footway/cycle track along side of road

Lower Thames Crossing

Thurrock Council Local Impact Report

Appendix C Annex 3 – Construction Modelling Review and Governance Approach

Contents

C3.1 Approach to Construction Modelling

C3.1.1. A comprehensive review of the LTAM construction phase models based on the information provided following the Community Impact Consultation is provided at Sub-annex 3.1 of this Annex 3. NH has assured the Council that those models are consistent with the modelling provided and assessed in the DCOv2 evidence base. The review undertaken by the Council (Sub-annex 3.1) has assessed whether the construction model inputs and assumptions included within the models largely reflect the NH's proposed phasing and construction traffic forecasts and are still valid as set out in the Transport Assessment (APP-529) and Transport Assessment Appendices E, G and H (APP-534, APP-536, and APP-537) and the Combined Modelling Appraisal (APP-518) and the ethos of the earthworks strategy within the materials handling processes outlined in the oMHP (APP-338).

C3.1.2. It is considered that the models provide a reasonably appropriate representation of the proposed temporary traffic management measures, however, it is noted that traffic travelling to and from the compounds were included within existing model zones as opposed to being allocated to new compound-specific zones. The zones are large and it is unlikely that construction traffic would be loaded to specific network access points accurately. It is considered that this is likely to underestimate construction traffic and rerouted traffic impacts at access junctions and other LRN links. This reflects the limitations of the strategic model in accurately representing the localised impacts of the construction activities.

C3.1.3. With the exception of Excavated Material HGVs (termed as 'earthworks' HGVs in the construction models), construction related HGV traffic and workforce traffic within the LTAM model is left to freely assign across the cordoned area (i.e. not fixed route), which allows the model to optimise the operation of the network. This is contrary to the commitments that NH has made in engagement with the Council. Through the oTMPfC and in engagement NH has stated that all construction HGV traffic would be assigned to specified and fixed access routes. Therefore, the construction models do no accurately reflect the movement of construction vehicles on the road network.

C3.1.4. LTAM analysis indicated that Phases 5 and 6 of the construction scenarios are likely to have the most significant impacts on the network. In the AM peak hour, Phase 6 is identified as the worst. In the PM peak hour, Phase 5 is identified as the worst. The phase scenarios set out by NH do not reflect the periods where LTC is being connected to the current network in Thurrock – such as the creation of the connection for A13 to Orsett Cock and LTC; and the realignment of Stanford Road (A1013). At those times significant local and strategic disruption will occur on the LRN when sections of the network are expected to be closed or temporarily diverted. Those periods of disruption and severance will need to be worked through with the contractors and NH. That process should involve robust local modelling to understand the effects and to determine necessary mitigation. These periods of the construction process are not assessed within the current evidence base presented by NH.

C3.1.5. In the Framework Construction Travel Plan (FCTP) (APP-546) at Table 5.3, NH predicts that phase 6 of the construction period will represent the peak requirement for workforce across the north compounds. NH estimates that 3,802 workers would be employed across the northern compounds of which only those in the temporary accommodation at the Northern Portal compound would need to travel to the compounds daily. Table 5.3 of FCTP assigns those workers across the compounds and makes a reduction for non-car travel at certain compounds. The Council has compared that assignment with the workforce assignment that has been used in the LTAM cordon construction scenario for phase 6. It is noted that there are significant inconsistencies between the two sets of assumptions, with the LTAM models typically using lower predictions.

C3.1.6. Table C4.1 below sets out the comparison between the FCTP predictions and the LTAM assignment. The figures do not align and indicates that quite different assumptions have been taken for the Northern Portal; Stanford Road; and Stifford Clays Road. The FCTP based its assumptions on inbound movements in the peak period where the LTAM modelling suggests a different shift pattern has been adopted for the Northern Portal. Furthermore, the FCTP predicts that 1,968 workers are to be employed at the Northern Portal at peak of which 70% would travel by single occupancy cars. That should approximate to 1,488 workers (allowing for 480 workers using the temporary on-site accommodation) of which 1,042 would arrive by car. The LTAM construction modelling has applied 474 car arrivals during the morning peak period, which significantly underestimates the effects on the network. The Council therefore questions the validity of the modelling exercise and its consistency with the wider evidence base.

Table C4.1: Comparison of predicted worker arrivals at North Compounds

Compound	FCTP - Table 5.3 Arrivals	LTAM AM Construction Phase 6 Car Movements	
		Departures	Arrivals
Northern Portal	820	313	474
Station Road	38	3	35
Brentwood Road	134	2	124
Stanford Road	46	4	9
Long Lane A and B	41	4	32
Stifford Clays Road West	60	3	48
Stifford Clays Road East	181	4	143
Mardyke	51	2	48
Medebridge	98	1	91

C3.2 Local Impacts during Construction Phase

C3.2.1. Analysis of the construction phase scenarios provided by NH indicated that flow increases are predicted across the Thurrock LRN as a result of construction activities. This is the case in both the AM and PM peak hours including through communities such as Orsett, Chadwell St Mary, West and East Tilbury, Linford, Stanford-le-Hope and Corringham. It is noted that there are also a few flow reductions on some links including the B186 Clay Tye Road and on sections of the A1013 Stanford Road west of Orsett Cock Roundabout.

C3.2.2. The analysis of junction flows and performance indicated that the junctions with significant flow increases and/or exhibiting performance concerns in terms of percentage of volume-to-capacity ratio and delays are:

1. The Manorway roundabout
2. Orsett Cock roundabout
3. ASDA roundabout
4. Daneholes roundabout
5. Marshfoot Road/ A1089 junction
6. Five Bells westbound merge with A13.
7. A1012/Arterial Road North Stifford/Lodge Lane/ Long Lane roundabout
8. A1013/ Rectory Road junction

9 A128 Brentwood Road/ Prince Charles Avenue

10 A13 northbound on-slip road at Five Bells

11 A13/A1012 Gyratory in North Stifford, Grays

12 B149/ Chadwell Hill/ St Chads Road/ Marshfoot Road roundabout

13 Brentwood Road/ Heath Road

14 Muckingford Road/ Construction Haul Road

15 Southend Road/ Lampits Hill

16 Station Road/ Love Lane

17 Stifford Road approach to B1335 Stifford Road

C3.2.3. The Council has recommended that localised modelling using microsimulation modelling is undertaken for the junctions listed above to provide a more detailed assessment of impact on junction capacity and to assist in developing appropriate mitigation measures. It is considered that the strategic model is less suited to representing and helping to understand the impacts of the construction activities at a localised level at these critical junctions given the average temporal nature of the strategic model, simplified assumptions of construction traffic routeing and loading to the strategic model, and differences in the local road network and strategic road network morning peak hours.

C3.2.4. It is further proposed that impacts on those junctions is monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum.

C3.2.5. A number of routes have been analysed for changes in journey times as a result of the construction activities. These are predominantly routes to and from Port of Tilbury and where possible similar routes to those used in analysing the operational impacts of the LTC were maintained. The key routes were through Brentwood Road via the A1013 Stanford Road and routeing through Chadwell St Mary. Routes also included using the A1089/A13/M25N.

C3.2.6. The analysis of journey times predicts increases of up to four minutes dependent on route and time period. It is evident that the construction activities are predicted to result in significant journey time increases on key routes in Thurrock including those routes leading to Port of Tilbury. Given that the LTAM strategic model, represents average conditions in the modelled hour, journey time increases for some vehicles are likely to be significantly higher than those suggested by the strategic model.

C3.3 Management of Construction Traffic

C3.3.1. The Council's position regarding the submitted oMHP (APP-338) is set out at Section 15 of the LIR. It shows that NH has not adopted a progressive approach to the transportation by non-road methods for materials, plant and equipment associated with the construction of LTC.

C3.3.2. The oMHP should recognise the aspects of decarbonising the impacts of moving materials, plant and equipment as well as reducing risk to the public associated with those movements and minimising the impacts of road movements on the LRN. Through the oMHP, NH indicates a Baseline commitment to move by marine transport 80% of the bulk aggregate (defined at paragraph 6.2.13 oMHP (APP-338)) for concrete manufacture at the north portal. NH notes that this is forecast to equate to only 35% of bulk aggregates across the project. It is the Council's opinion that a more stretching commitment should be set out which reduces further the impacts of the construction period on the LRN – minimising inbound and outbound movements. That reduced projection for generated traffic would then be reflected in the traffic modelling to help towards reducing local impacts.

C3.3.3. On the assumption that LTC is granted consent, the currently proposed phasing of the construction works and the assumptions around the movement of materials, plant and equipment is only a first indication of the actual iteration of works and the programming of that work. Given the weaknesses in the LTAM strategic model used by NH to predict and assess the impacts on the LRN in Thurrock, the impacts on the communities in Thurrock during the construction phase are therefore not considered to be fully predicted and understood. Therefore, it is essential that a robust system of on-going review, engagement, collaboration, governance, management and monitoring is put in place through the determination of the DCO. The basis for that system is identified in the oTMPfC including at Section 3 (APP-547) but the details of the governance process and commitments to resolution need to be further refined to give strong guidance to the contractors on the commitments and requirements that are to be adopted by them during the construction phases.

C3.3.4. It is proposed that impacts on the LRN in Thurrock are monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the monitoring and governance framework within the oTMPfC (APP-547).

C3.3.5. Whilst the oTMPfC outlines a monitoring process to be refined post DCO through the preparation of Traffic Management Plans, the resolution of observed impacts is not well defined within the oTMPfC and defers to discussions at the Traffic Management Forum. It is the Council’s opinion that the commitment to resolve identified issues must be captured in the oTMPfC.

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Sub-annex 3.1 – LTC Construction Impact - Modelling Review Report

The Lower Thames Crossing

Thurrock Cordon Model (Construction Phase) Updated Modelling Review

On behalf of **Thurrock Council**

THURROCK COUNCIL

Project Ref: 332510754/001 | Rev: AA | Date: October 2022

Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: Caversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DNCaversham Bridge House, Waterman Place, Reading, Berkshire RG1 8DN

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	Name	Position	Signature	Date
Prepared by:	Norbert Moyo	Principal	N Moyo	17/10/2022
Reviewed by:	Paul Gebbett Adrian Neve Nick Blades	Senior Associate Director Senior Associate	P Gebbett A Neve N Blades	25/10/2022 25/11/2022 30/11/2022
Approved by:	Nadia Lyubimova	Director	N Lyubimova	5/12/2022
For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved

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Executive Summary

Introduction and Purpose

This report provides a review of the impact of the construction traffic management (CTM) for the Lower Thames Crossing (LTC) on the Local Road Network in Thurrock.

In order to understand the construction impacts of the LTC on the Strategic Road Network (SRN) and the LRN, National Highways (NH) developed and used a strategic transport model, the Lower Thames Area Model (LTAM), as the transport evidence base and to provide evidence that the scheme meets relevant planning policy tests and achieves its objectives. For the purposes of this review, NH provided Thurrock Council (TC) with a Thurrock Cordon model of the LTAM and not the full model.

The construction of the LTC is planned to commence in January 2025 and be completed in December 2030. This is a 72 months (6years) construction period. The Opening Year of the scheme is assumed to be 2030. The construction is planned to be undertaken over eleven (11) phases as summarised in the table below.

Phase	Start	End	Duration (Months)	DM Scenario
1	01/01/2025	31/08/2025	8	DMB
2	01/09/2025	28/02/2026	6	DMB
3	01/03/2026	31/05/2026	3	DMB
4	01/06/2026	31/10/2026	5	DMA
5	01/11/2026	31/03/2027	5	DMB
6	01/04/2026	31/08/2027	5	DMB
7	01/09/2027	31/03/2028	7	DMB
8	01/04/2028	30/11/2028	8	DMB
9	01/12/2028	31/03/2029	4	DMA
10	01/04/2029	31/07/2029	4	DMA
11	01/08/2029	31/12/2030	17	DMA
All	**01/08/2025**	**31/12/2030**	**72**	

The models used for the construction modelling were developed by NH and have a forecast year of 2030, the same forecast year as the projected Opening Year of the LTC. Additionally, two sets of Do Minimum (DM) models designated as DMA and DMB have been provided for the same forecast year 2030. It is understood that both the DMA and DMB represent the LTAM forecast of traffic flows without the LTC. However, DMB includes construction trips associated with the Thurrock Flexible Generation Plant (TFGP). Consequently, different construction Phases have been compared against either DMA or DMB as shown in the above table and as per the accompanying document provided with the models (‘LTAM DCO2 Construction Modelling GIS shapefile note May 2022.pdf’).

It is evident that given the long duration of the construction period, the construction activities inclusive of network changes and construction traffic are potentially likely to have disruptive, and intrusive impacts on local communities in Thurrock leading to day-to-day inconvenience to the travelling public, local residents and businesses.

The review has focussed on the analysis of the AM peak hour (0700 – 0800) and PM peak hour (1700 – 1800) where congestion issues are more prevalent. It is noted that the modelled AM peak hour (0700 – 0800) is that of the SRN whereas the LRN typically has an AM peak hour of 0800 – 0900 but was not modelled by NH.

The review has broadly covered three (3) key tasks as follows:

(1) Review whether the construction model inputs and assumptions included within the models provided largely reflect the LTC's latest Traffic Management Measures (TMM) proposed and construction traffic forecasts at each compound as set out in the Community Impacts Consultation (run in Summer 2021 and described in the “Outline Traffic Management Plan for Construction, Construction Update, July 2021 (OTMPfC), Ward Summaries – North of the river, July 2021”).

(2) Review and assess the impacts of construction traffic, construction staff traffic and proposed traffic management measures on the operation of the local road network - identifying key phases of impact and providing a more detailed analysis of impacts during these phases. Three phases have been identified for more detailed review.

(3) Prepare a Technical Report (this report) - including providing recommendations for further work and an assessment as to whether the modelling completed is fit for purpose in assessing the LTC construction impacts.

Summary of Review Findings

Review of Assumptions

The review of the TMM list provided by NH with the cordon construction models concludes that these are broadly consistent with the TMMs outlined in the OTMPfC dated June 2021. The OTMPfC lists TMMs consulted upon with local communities and local businesses in the CIC that took place in Summer 2021.

However, further clarifications with NH highlighted that the construction traffic models provided to the Council for review do not reflect the construction traffic volumes reported by worksite as set out in the CIC material. Instead, they are based on updated construction traffic forecasts, which NH stated will only be made public in the DCOv2 Transport Assessment. These updated forecasts have therefore not been provided in consultation material to local communities. It is unclear what differences may exist between the CIC material and the TMMs included in the updated construction models.

In terms of the coding of TMM, given the lack of modelling documentation setting out key assumptions and approach, it has not been possible to conclude with certainty how and if all measures are represented in the construction models. It is generally considered that the principle of the TMM plans was generally represented in the models but there was not sufficient information to conclude that specific TMM schemes were accurately represented.

In terms of construction traffic assumed to be generated by the compounds, it is considered that apart from minor differences, there is a good consistency between the NH reported daily construction traffic and the construction numbers included in the models in terms of the origin demands. The NH numbers did not report construction numbers destined for the compounds to undertake a comparison with values included in the models.

It is also noted that the compounds appear to be included within existing model zones as opposed to be allocated to new zones dedicated to representing compound traffic only. The zones are large and hence it is unlikely that construction traffic would be loaded to specific network access points accurately. It is considered that this is likely to underestimate construction traffic impacts at access junctions where construction traffic interacts with the local network. This reflects the limitations of the strategic model in accurately representing the localised impacts of the construction activities.

Construction related HGV delivery traffic is also able, within the LTAM SATURN model to freely assign across the cordoned area in an attempt to optimise the operation of the network. This is contrary to the commitments that NH has made in engagement with TC, and through the OTMPfC, that construction HGV traffic will be assigned to specified and fixed access routes. The construction models will therefore not accurately reflect the likely movement of construction vehicles on the road network.

Review of Impacts

The impact of construction on the LRN has been examined using a range of parameters including:

- Summary statistics
- Traffic flow changes
- Junction performance
- Changes in journey times from and to Port of Tilbury

Summary Statistics

The analysis of summary global statistics indicated that Phases 4, 5 and 6 are likely to have the most significant impacts on the network. Of these three, Phase 4 is identified as having the least impact in both the AM and PM peak hours compared to Phases 5 and 6. In the AM peak hour, Phase 6 is identified as the worst followed by Phase 5. In the PM peak hour, Phase 5 is identified as the worst followed by Phase 6.

- When considering the AM peak hour, in total, the construction traffic (HGV deliveries, construction staff car trips and earthworks HGV trips) comprises a relatively small percentage of the total trips (predominantly trips from, to, within and through Thurrock) ranging between 0.27% and 3.44%. In the PM peak hour the construction traffic is between 0.18% and 2.47% of total traffic in Thurrock
- In the AM peak hour, the total construction traffic is highest in Phase 6 (2,540 PCU/hr) and lowest in Phase 11 (193 PCU/hr). Similarly, in the PM peak hour, the total construction traffic is highest in Phase 6 (1,883 PCU/hr) and lowest in Phase 11 (136 PCU/hr).
- In all the phases in the AM peak hour, car construction staff traffic forms the majority of the construction traffic (68% to 85%) compared to HGV construction traffic (15% to 32%). In the PM peak, car construction staff traffic constitutes the majority of the construction traffic (65% to 97%) compared to HGV construction traffic (9% to 35%).

Flow Changes

Analysis indicated that flow increases are predicted across the Thurrock LRN as a result of construction activities. This is the case in both the AM and PM peak hours for the analysed worst Phases 4, 5 and 6. Locations of flow increanses and their magnitude varies between different phases. However, broadly the areas of impact are:

- A13
- Roads to the north of the A13 including the B1007 North Hill including around Horndon on the Hill. Flows increases are also predicted on A128 Brentwood Road, sections of the B186 including Warley Street, and increases in Orsett Village on the B188 although there are some variations by phase. Flow increases are also predicted through South Ockendon.
- South of the A13 and to the west of the A108. Flow increases are predicted including on Arterial Road North Stifford/Arterial Road West Thurrock and on London Road. There are also flow increases on the A1089 itself.
- East of the A1089. There are flow increases predicted on the local roads through villages such as Chadwell St Mary, West and East Tilbury, Linford, Stanford-le-Hope and Corringham in some instances.

It is noted that there are also flow reductions on some links including the M25 itself and on local roads including on sections of the B186 Clay Tye Road and on sections of the A1013 Stanford Road west of Orsett Cock Roundabout.

It is proposed that impacts on the LRN in Thurrock is monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the monitoring and governance framework within the OTMPfC.

Appendix B provides a comprehensive tabulation of flow changes for all eleven phases in respect of roads and areas of concern where these are represented in the model. It is too detailed a list to provide individual commentary, but it enables the reader to study the outputs for any of the phases as they see fit. Where the roads and areas of concern are junctions, these have been reported in Section 8 'Junction Performance Analysis'.

Junction Performance

Analysis of junction performance have been undertaken for a set of key junctions, which were identified from earlier reviews as the main areas of scheme impact in Thurrock:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junction including the A30 westbound merge

The analysis of junction flows and performance indicated that with the introduction of the construction activities the junctions which are showing significant flow increases and/or exhibiting performance concerns in terms of Volume to Capacity Ratio (V/C%) and delay increases of 30 seconds or more on an arm or more are:

- Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- Marshfoot Road/ A1089 Junction
- Five Bells westbound merge with the A13.

In addition to the key junctions considered, a set of additional junctions have been identified, which are forecast to demonstrate increased delays during construction:

- A1012/Arterial Rd North Stifford/Lodge Ln/ Long Ln roundabout (in Little Thurrock/ Chafford Hundred)
- A1013/ Rectory Road junction in Orsett
- A128 Brentwood Road/ Princess Charles Avenue in Orsett
- A13 northbound on-slip road at Five Bells
- A13/A1012 Gyratory in North Stifford, Grays
- B149/ Chadwell Hill/ St Chads Rd/ Marshfoot Rd roundabout
- Brentwood Road/ Heath Road in Chadwell St Mary
- Muckingford Road/ Construction Haul Road in Linford
- Southend Rd/ Lampits Hill in Stanford-le-Hope
- Station Road/ Love Lane in East Tilbury
- Stifford Road approach to B1335 Stifford Road in South Ockendon

It is proposed that impacts on the junctions identified above in Thurrock is monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the monitoring and governance framework within the OTMPfC.

It is recommended that localised modelling using microsimulation modelling is undertaken for the junctions listed above to provide a more detailed assessment of impact on junction capacity and to assist in developing appropriate mitigation measures. It is considered that the strategic model is less suited to representing and helping to understand the impacts of the construction activities at a localised level at these critical junctions given the average temporal nature of the strategic model, simplified assumptions of construction traffic routeing and loading to the strategic model, and differences in the local road network and strategic road network morning peak hours.

Journey Times

A number of routes, predominantly the routes to and from the Port of Tilbury, were analysed for changes in journey times as a result of the construction activities. These routes were through Brentwood Road via the A1013 Stanford Road and routeing through Chadwell St Mary. Routes via the A1089/A13/M25N have also been included. The analysis has focussed on Phases 4, 5 and 6. These phases are 5 months duration each, giving a combined duration of 15 months.

The analysis of journey times predicts increases of up to 4 minutes dependent on route and time period. It is evident that the construction activities are predicted to result in significant journey time increases on key routes in Thurrock including those routes leading to Port of Tilbury.

Given that the LTAM is a strategic model and represents average conditions in the modelled hour, journey time changes for some vehicles are likely to be higher or lower than those suggested by the strategic model.

Summary and Conclusion of Report

Overall, it is concluded that the use of the LTAM strategic model is suitable to understand strategic impact of the Scheme, during operational and construction phases. In terms of more localised impacts of construction, the use of the strategic model is likely to underestimate impacts given the average hour nature of the strategic model and the difference between the strategic road network peak hour (0700-0800 as represented by LTAM) and the LRN peak hour (0800-0900).

The strategic modelling has indicated that there are roads and junctions across the LRN which are predicted to experience substantial delays and disruption, many of which are not suited to the predicted quantum or type of traffic flow.

The strategic model provides an indication of these impacts but is not detailed enough for a more detailed analysis of key impacted junctions. More disaggregated models such as microsimulation models are more suitable, hence the recommendation to undertake such modelling at selected named junctions in this report.

Whilst the models seek to provide predictions of the impacts, the phasing and programming of the delivery of the LTC project is not completely defined or set by the current DCO submission and will be the subject of refinement and change by the Main Works Contractors (MWCs); Statutory Undertakers' contractors; and by NH through the detailed design process and the construction period.

On the assumption that the project is granted consent, the currently proposed phasing of the construction works can be nothing more than a first indication of the actual iteration of works and the programming of that work. Given the weaknesses in the LTAM strategic model used by NH to predict and assess the impacts on the LRN in Thurrock, the impacts on the communities in Thurrock are therefore not considered to be fully predicted and understood. Therefore, it is essential that a robust system of on-going review, engagement, collaboration, governance, management and monitoring is put in place through the determination of the Development Consent Order (DCO).

1 Introduction

1.1.1 The Lower Thames Area Model (LTAM) has been developed and used by National Highways (NH) to understand the impacts of the Lower Thames Crossing (LTC) on the Strategic Road Network (SRN) and Local Road Network (LRN) and to provide evidence that the scheme meets relevant planning policy tests and achieves its objectives. The LTAM is a multi-modal strategic model. For different future years the model is used to forecast how travellers will change their behaviour as a result of highway interventions e.g. construction of the LTC scheme and the impact this is predicted to have on traffic flows, levels of congestion, driver route choice, the cost of fuel and other external factors.

1.1.2 In May 2022 NH issued Thurrock Council (TC) with the LTAM Thurrock Area Cordon Construction Phase Models to enable a review of the potential impacts of the eleven construction phases of the Lower Thames Crossing (LTC) scheme on the operation and performance of the strategic and local road network.

1.1.3 The models used for the construction modelling have a forecast year of 2030, the same forecast year as the projected Opening Year of the LTC. Additionally, two sets of Do Minimum Models (DM) designated as DMA and DMB have been provided for the same forecast year 2030. The DM models assume no construction activities or construction traffic associated with LTC. The DM models are used to provide a reference case against which to compare the construction phase models so their impacts can be identified. It is noted that the main construction period would start in early 2025, with the LTC opening in 2030.

1.1.4 It is understood that both the DMA and DMB represent the LTAM forecast of traffic flows without the LTC. For some phases the Thurrock Flexible Generation Plant (TFGP) scheme at Tilbury is modelled as also being under construction and there are additional vehicles on the network associated with its construction. The TFGP is only included in the DMB.

1.1.5 Consequently, different construction Phases have been compared against either DMA or DMB as per the accompanying document (‘LTAM DCO2 Construction Modelling GIS shapefile note May 2022.pdf’), provided with the models and summarised in Section 2 of this report. This comparison has formed the main basis of assessing the impacts of each of the Construction Phases against the relevant DM scenario without any construction activities.

1.1.6 This report provides a summary of Stantec’s review of the impact of the phases on the Thurrock highway network, providing an indication of the forecast impacts arising from the traffic arriving and departing at the construction compounds, as well as the temporary diversions, road closures, contraflow, Heavy Goods Vehicle (HGV) bans and other traffic management measures (TMM) proposed during the construction period. It will show that it is predicted that there are to be extensive delays and protracted disruption to the LRN, which is the road network for which TC will remain the Highway and Traffic Authority.

1.1.7 Whilst the models seek to provide predictions of the impacts, the phasing and programming of the delivery of the LTC project is not completely defined or set by the current DCO submission and will be the subject of refinement and change by the Main Works Contractors (MWCs); Statutory Undertakers’ contractors; and by NH through the detailed design process and the construction period. On the assumption that the LTC project is given consent, it is fundamental that a robust system of on-going review, engagement, collaboration, governance, management and monitoring is put in place through the determination of the Development Consent Order (DCO). That framework will assist TC; NH; the MWCs (and their sub-contractors); and Statutory Undertakers’ contractors to manage and co-ordinate the construction period to reduce the impact of the works so that the communities within Thurrock are not significantly adversely affected by the works.

1.1.8 Prior to the consent and construction period, it is essential that adequate controls are put in place within the DCO and accompanying control documents which set out commitments and constraints on operations to which NH and MWC will adhere during construction (which will include the enabling, associated constructions works and demobilisation and commissioning).

1.1.9 The review has broadly covered three (3) key tasks as follows:

(1) Review whether the construction model inputs and assumptions included within the models provided largely reflect the LTC's latest Traffic Management Measures (TMM) proposed and construction traffic forecasts at each compound as set out in the Community Impacts Consultation (run in Summer 2021 and described in the "Outline Traffic Management Plan for Construction, Construction Update, July 2021, Ward Summaries – North of the river, July 2021").

(2) Review and assess the impacts of construction traffic, construction staff traffic and proposed traffic management measures on the operation of the local road network - identifying key phases of impact and providing a more detailed analysis of impacts during these phases. Three phases have been identified for more detailed review.

(3) Prepare a Technical Report - including providing recommendations for further work and an assessment as to whether the modelling completed is fit for purpose in assessing the LTC construction impacts (this report).

1.2 Information Received

1.2.1 The following information was received from the LTC team and used to inform the construction modelling review and impacts on the network.

- Eleven LTC Construction Phases SATURN cordon models comprising AM, IP, PM hour models (Received 27/05/2022).
- DMA and DMB SATURN cordon models comprising AM, IP, PM hour models (Received 27/05/2022).
- LTAM DCO2 Construction Modelling GIS shapefile note May 2022.pdf (Received 30/05/2022) (CM GIS shapefile note) (hereafter referred to as **Document 1**). The document tabulates TMMs included in the construction models.
- Community Impacts Consultation (CIC) Ward Impacts Construction Compound traffic tables.xlsx (**Document 2**). The document tabulates average daily compound and utility hub construction traffic.
- Outline Traffic Management Plan for Construction.pdf (OTMPfC) dated June 2021 (**Document 3**). The document lists the TMMs consulted upon with local communities and local businesses in the CIC that took place in Summer 2021.
- NH's response to TC on Construction Modelling queries.pdf (received on 21 October 2022) (**Document 4**). This was provided following the concerns the Council raised about underlying assumptions for the construction traffic modelling not having been explained. A request for the technical documentation was made to NH on 15 September 2022 with NH providing a response on 21 October 2022, 10 days prior to the DCOv2 submission.

1.2.2 It is noted that no accompanying model documentation, setting out detailed modelling assumptions and how specific TMM have been coded in the models, was available as part of the review. This has made task 1 listed above a more difficult and onerous task and required an element of professional judgement when reviewing the models, to ascertain if the models do indeed contain the appropriate coding of TMM.

1.2.3 In this document Stantec has also referred to the 'Lower Thames Crossing Transport Assessment', February 2021[1] (**Document 5**). It is understood from NH responses to Stantec queries in October 2022 (**Document 4**) that an updated version of the Transport Assessment (TA) further detailing the TM measures and how they are included in the construction models will be issued with the DCOv2 submission, but it was not available at the time of this review.

1.2.4 The review itself has focussed on the analysis of the AM peak hour (0700 – 0800) and PM peak hour (1700 – 1800) where congestion issues are more prevalent. It is noted that the modelled AM peak hour (0700 – 0800) is that of the SRN whereas the local Thurrock network has an AM peak hour of 0800 – 0900 but was not modelled by NH.

1.3 Report Structure

1.3.1 Following this introduction, this document is structured as follows:

- Section 2 provides an overview of the Construction Phases
- Section 3 considers TMM and assumptions reflected in the models
- Section 4 considers Construction Compounds and Utility Hubs assumptions reflected in the model
- Section 5 reports on model wide statistics
- Section 6 reports on Construction Traffic Demand Matrices
- Section 7 reports on link flow changes
- Section 8 reports on junction flows and performance
- Section 9 reports on analysed journey time routes
- Section 10 provides a summary and conclusions.

[1] Lower Thames Crossing – Chapter 8: Construction Impacts: 2024 – 2029 (Dataset B)

2 Overview of Construction Phases

2.1 Introduction

2.1.1 This section provides an overview of the eleven proposed construction phases in terms of their proposed dates and durations as well as the Do Minimum (DM) model against which each phase is compared.

2.1.2 The trip matrices of each modelled construction phase contain additional traffic associated with the construction of the LTC while the model networks are understood to reflect the project construction related TMM proposed to be in place during the construction phase. The network changes and matrices as a result of the construction phases are discussed in Section 3 and Section 6 of this report respectively.

2.1.3 The impacts of the construction phases are compared to one of the two DM scenarios without the LTC construction activities, dependent on the phase. The impacts are presented in Section 5, 7, 8 and 9.

2.2 Phase Outline and Durations

2.2.1 Table 2-1 shows the eleven phases of construction, their proposed start and end dates and hence their proposed duration. The table also shows the DM scenario corresponding to each of the phases of construction.

Phase	Start	End	Duration (Months)	DM Scenario
1	01/01/2025	31/08/2025	8	DMB
2	01/09/2025	28/02/2026	6	DMB
3	01/03/2026	31/05/2026	3	DMB
4	01/06/2026	31/10/2026	5	DMA
5	01/11/2026	31/03/2027	5	DMB
6	01/04/2026	31/08/2027	5	DMB
7	01/09/2027	31/03/2028	7	DMB
8	01/04/2028	30/11/2028	8	DMB
9	01/12/2028	31/03/2029	4	DMA
10	01/04/2029	31/07/2029	4	DMA
11	01/08/2029	31/12/2030	17	DMA
All	**01/08/2025**	**31/12/2030**	**72**	

Table 2-1 Summary of Phase Durations and associated DM

2.2.2 It is noted that Phases 4, 9, 10 and 11 are compared to DMA while the other seven phases are compared to DMB with the Thurrock Flexible Generation Plant (TFGP) in place. It is also noted that the phase durations range between 3 months (Phase 3) to 17 months (Phase 11), with the construction activities comprising all the eleven phases totalling a period of 72 months or six years.

2.2.3 This report will show that given the long duration and cumulative nature of the construction period, the construction activities are likely to have disruptive, and intrusive impacts on local communities in Thurrock leading to day-to-day inconvenience to the travelling public, local residents and businesses. This report, however, does not consider the cumulative impacts and disruption but reviews the implications of the most probable worst case phases on communities within Thurrock.

3 Review of Modelled Traffic Management Measures assumptions

3.1 Introduction

3.1.1 This section reviews the proposed TMM, and network changes in the model made to represent these. It is considered whether the measures and assumptions are consistent with the construction information presented during the CIC.

3.1.2 The LTAM DCOv2 Construction Modelling GIS shapefile note (Document 1) provided tables listing specific TMM assumed in each phase, and this was used in the first instance to understand the location and nature of the TMM. The document does not provide any detail on how and where these changes have been coded in the LTAM SATURN models.

3.2 Traffic Management Measures

3.2.1 Document 1 (see paragraph 1.2.1) presented 11 tables (as Tables 4 to 14) listing the TMM assumed in each construction phase. To enable a better understanding of which measures occur in multiple phases, Stantec has produced Table 2-1 which summarises the information in a single table. Only TMM in the Thurrock Cordon area are included in the table.

No.	ID	Location	TMM	Phases	Total Duration (Total Months)	Phase Duration										
						8	6	3	5	5	5	7	8	4	4	17
Road Closures																
1	RNTM27	Hornsby Lane	Permanent closure	1,2,3,4,5,6,7,8,9,10,11	72											
2	RNTM52	Fen Lane/Green Lane	Closure (in sections)	1,2	14											
3	RNTM38	Baker Street	Closure	3,4	8											
4	RNTM58	Ockendon Rd	Closure	4,5,6,7	22											
5	RNTM20	Rectory Rd	Closure	9	4											
HGV Bans																
6	HB6	Rectory Road	HGV Ban	1,2,3,4,5,6,7,8,9,10,11	72											
7	HB8	B188 High Road	HGV Ban	1,2,3,4,5,6,7,8,9,10,11	72											
8	HB9	Prince Charles Avenue	HGV Ban	1,2,3,4,5,6,7,8,9,10,11	72											
				HGV Ban Lifted												
9	HB10	Stifford Clay Road	HGV Ban lifted	1	8											
10	HB11	North end of Brentwood Road	HGV Ban lifted	1,2,3,4,5,6,7,8,9,10,11	72											
				Contraflow												
11	RNTM12	Brentwood Road	Contraflow (300m sections)	1	8											
12	RNTM60	Ockendon Road	Contraflow	1	8											
13	RNTM43	Stifford Clay Road	Contraflow (300m sections)	1	8											
14	RNTM05	Marshfoot Road/Chadwell Hill/Brentwood Road	Contraflow (300m sections)	1,2	14											

No.	ID	Location	TMM	Phases	Total Duration (Total Months)	Phase Duration										
						8	6	3	5	5	5	7	8	4	4	17
15	RNTM41	High Road	Contraflow (300m sections)	1	8											
16	RNTM56	B186	Contraflow (300m sections)	1,2	14											
17	RNTM80	Baker Street	Contraflow (300m sections)	1	8											
18	RNTM68	St Marys Lane	Contraflow	2,3	9											
19	RNTM01	Muckingford Rd	Contraflow (300m sections)	3,4	8											
20	TUTM11	Love Lane/Princess Margaret Rd/Station Rd	Contraflow (300m sections)	3	3											
21	RNTM23	A1013	Contraflow	4,5	10											
				Narrow Lanes 50mph												
22	RNTM74	A127	Narrow lanes, 50mph	3,4,5,6,7,8	33											
23	RNTM105	M25 Slips	Narrow Lanes, 50mph	7,8,9	19											
				Narrow Lanes 60 mph												
24	RNTM64	M25SB	Narrow lanes, 60mph	3,4,5,6,7,8,9,10	41											
25	RNTM61	M25SB	Narrow lanes, 60mph	3,4	8											
26	RNTM62	M25NB	Narrow lanes, 60mph	3,4	8											
27	RNTM65	M25NB	Narrow lanes, 60mph	5,6,7,8,9,10	33											
28	RNTM24b	A13WB	Narrow lanes, 60mph	9	4											
29	RNTM24a	A13EB	Narrow lanes, 60mph	10	4											

No.	ID	Location	TMM	Phases	Total Duration (Total Months)	Phase Duration										
						8	6	3	5	5	5	7	8	4	4	17
				Crossing Point												
30	RNTM54	B186 North Road	Crossing Point	2,3,4,5,6,7	31											
31	RNTM66	St Marys Lane	Crossing Point	2,3,4,5,6,7,8,9,10	47											
32	RNTM02	Muckingford Rd	Crossing Point	2,3,4	14											
33	RNTM11	Brentwood Rd	Crossing Point	2,3,4,5,6	24											
34	RNTM19	Rectory Rd	Crossing Point	2,3,4,5,6,7,8,9	43											
35	RNTM39	Baker Street	Crossing Point	2,3,4,5,6,7,8,9,10	47											
36	RNTM48	Stifford Clays Rd	Crossing Point	2,3,4,5,6,7	31											
37	RNTM51	Green Lane	Crossing Point	2,3,4,5,6,7,8,9,10,11	64											
38	RNTM57	Ockendon Rd	Crossing Point	2,3,4,5,6,7,8,9,10	47											
39	RNTM67	St Marys Lane	Crossing Point	2,3,4,5,6,7,8,9,10	47											
40	RNTM107	Baker Street	Crossing Point	5,6,7,8,9	29											
41	RNTM108	A1013	Crossing Point	5,6,7,8,9	29											
				Switchover												
42	RNTM81	Muckingford Rd	Switchover	5,6,7,8,9,10,11	50											
43	RNTM84	Heath Road & A1013	Switchover	5,6,7,8,9,10,11	50											
44	RNTM97	Baker Street	Switchover	5,6,7,8,9	29											
45	RNTM83	Brentwood Rd	Switchover	7,8,9,10,11	40											

No.	ID	Location	TMM	Phases	Total Duration (Total Months)	Phase Duration										
						8	6	3	5	5	5	7	8	4	4	17
46	RNTM89	Stifford Clays Rd	Switchover	8,9,10,11	33											
47	RNTM91	B186 North Road	Switchover	8,9,10,11	33											
48	RNTM92	Ockendon Rd	Switchover	8,9,10,11	33											
49	RNTM85	Baker Street	Switchover	10,11	21											
50	RNTM86	A13WB to A1089 SB	Switchover	10,11	21											
51	RNTM87	Rectory Rd	Switchover	10,11	21											
52	RNTM88	A13 WB On-Slip	Switchover	10,11	21											
53	RNTM81	Muckingford Rd	Switchover	5,6,7,8,9,10,11	50											
				Lane Restrictions												
54	RNTM13	Medebridge Road	Lane restrictions	1	8											
55	RNTM15	Orsett Cock Rbt	Lane restrictions	3	3											

Table 3-1 Proposed Traffic Management Measures (TMM) by Phase and Duration

3.2.2 It can be seen from the table that there are various types of TMM proposed, some of which occur in a limited number of phases and some that are scheduled in multiple or even across all phases. Some notable observations include:

- Permanent closure of Hornsby Lane and temporary road closures proposed on Fen Lane/Green Lane (Phases 1 & 2), Baker Street (Phases 3to 4), Ockendon Road (Phases 4 to 7), and on Rectory Road (Phase 9).
- The HGV bans are proposed on the local roads including Rectory Road, B188 High Road and Prince Charles Avenue for all 11 phases and hence for the 72- month duration of the construction period. They thus appear to be focussed in the Orsett village area.
- Contraflow (i.e. temporary mobile traffic signals) seems to be planned on a number of local roads in the earlier Phases 1 to 5 although not at the same time in these phases.
- Narrow lanes are generally proposed for most of the phases on sections of the A127, M25 and A13. It is understood that these have been represented through reduced capacity and reduced speed limits on planned sections.
- There are various crossing points proposed across the local network for most of the phases where haul routes cross the local network.
- There are switchover measures planned in various phases from Phase 5 onwards on various local roads including the A13WB.
- Lane restrictions are proposed on Medebridge Road in Phase 1 and at the Orsett Cock Roundabout in Phase 3.
- The most frequently occurring TMMs, which are seen to last across many phases, appear to be HGV bans, crossing points, narrow lanes and contraflows.

3.2.3 It is noted that no specific details were given by NH in Document 1 as to how the TMM had actually been coded into the model and historical Document 5 (2021 Transport Assessment) has been used by Stantec for the assumptions related to coding practices thus making an assumption that these have been maintained.

3.2.4 This review has made an attempt at understanding how the various TMM have been represented in the transport models through a proportionate check of the models. Given the multitude of TMMs, their location and the number of phases, this makes for a long list as shown in Table 2-1. Therefore, a level of pragmatism and professional judgement was used in checking the coding.

3.2.5 A further challenge was the lack of a single plan marking locations of the various TMM within the modelling documents. The OTMPfC (Document 3) provides indicative TMM locations across various figures and has been used in this regard to understand the geographic locations of TMM.

3.2.6 The review of the TMM list presented in Document 1 (and summarised in Table 3-1) and included in the construction models concludes that these are broadly consistent with the TMM outlined in Document 3 and consulted upon in the CIC that took place in Summer 2021.

3.2.7 However, further clarifications with NH highlighted that the construction traffic models provided to TC for review do not reflect the construction traffic volumes reported by worksite as set out in the CIC material. Instead, they are based on updated traffic data, which NH stated will only be made public in the DCOv2 TA and therefore were not consulted on with the local communities. It is therefore unclear what other differences exist between the CIC material and the TMMs included in the construction models.

3.3 Traffic Management Measures Representation in the Models

3.3.1 Taking into account the large number of TMMs and phases in which they occur, a proportionate approach has been undertaken in reviewing the construction models to understand how the TMM in Table 2-1 have been coded in the models.

3.3.2 The OTMPfC (Document 3) provides information about the TMM measures and in some cases how the TMM are represented in the LTAM.

3.3.3 The 2021 TA (Document 5) has been used for the assumptions related to coding practices. The following have been summarised from the previous TA (an updated version of the TA was not available at the time of this review):

- Road closures are represented in the LTAM as a series of bans to stop vehicles using the closed road. They pertain to full carriageway closure of the road
- Narrow lanes are represented through reduced capacity and reduced speed limits
- Contraflows are represented in the LTAM through the use of traffic signals and a reduced capacity along the road.

3.3.4 The OTMPfC states that the following measures are proposed as TMM during construction:

- Closure – full carriageway closure of road
- Contraflow – typically traffic lights closing one half of the road
- Crossing point – where the haul routes bisect the local road network thereby requiring a crossing point to maintain flow for construction vehicles and public traffic (typically traffic lights)
- Lane closure – single lane closure on given road
- Narrow lanes – maintaining same number of lanes (unless coupled with another measure) but with narrower lanes (generally on the SRN network with associated reduced speed limits)
- Switchover – where the alignment of the road is temporarily or permanently moved from one road alignment to another road alignment. The switchovers to temporary alignments are not envisaged to add more than a couple of minutes to the journey time (e.g. the road may need to be realigned to go around the overbridge works thereby increasing the length of the road by a few hundred metres). The switchovers to permanent alignments denote switching over to the proposed permanent alignment.
- Lane restrictions – exact TMM is not yet known but it is likely that traffic flow would be maintained (i.e. the road would not be closed), however, some restriction may be in place.

3.3.5 Previous documentation from the TA indicated that:

- Some measures have not been included in the models as a result of detailed examination of the proposed measures and the likely limited impact that their inclusion in the modelling would have. For example, this includes measures which have a proposed duration of less than half the length of a particular phase, so their inclusion would overestimate their impact.

- In addition, some measures have been excluded as a result of the road that traffic management is scheduled to be on is not represented in the LTAM, or that the measure has been included within the modelling of another proposed traffic management measure.

3.3.6 The available limited current documentation does not indicate whether this is still the case in the updated models. These assumptions are likely to be detailed within modelling documents or commented on within the model input network files and may not be easily discerned by a third party.

3.4 Model Checks of Traffic Management Measures

3.4.1 When undertaking coding changes within a SATURN model it is common practice to add a comment against any specific coding which explains the changes made in simple textual terms. SATURN's comments facility has not been used in general by NH to indicate what new changes have been coded into the model either from the DMA or DMB to a phase or between successive phases. In the absence of such comments, a proportionate check of the model coding was undertaken.

3.4.2 Checks were initially undertaken using SATURN's model comparing facility to understand the changes between DMA or DMB and the corresponding phase model(s). This indicated the nodes and links that had been modified from a DM to the respective Phase as a result of the TMM measures coded in. Whilst this approach was able to identify nodes and links that had changed from the relevant DM or between two successive phases, it was not always straight forward to link these changes to a specific TMM.

3.4.3 Given that Phase 1 represents the most direct link to the models without any construction activities (DMA, DMB), it was considered logical to therefore consider the changes in Phase 1 to try and understand how TMM were represented in the model as subsequent phases then build on Phase 1. Table 3-2 provides a summary of observations in terms of the representation of key TMM in Phase 1 models.

Ref	Location	TMM	Observations
RNTM27	Hornsby Lane	Perm closure	Appears to be modelled as link ban to all traffic (UC1 to UC12) on Link 86031-86039-86031. Flows on northern end of Hornsby Lane suggests northern end is still used by construction traffic into/out of Zone 5067 (which is presumably a Compound).
RNTM52	Fen Lane/Green Lane	Closure (in sections)	Road does not appear to be in model
HB6	Rectory Road	HGV Ban	Appears to be modelled as bans on UC11 (construction HGV deliveries) on Rectory Road (south of B188 jn) on Link 71899_76344 (NB), L76344_71899 (SB); and north of B188 jn on L75374_76344 (SB), L76344_75374 (NB)
HB8	B188 High Road	HGV Ban	Appears to be modelled as ban on UC11 on High Road (Link 76344_71897, L71897_76344; L75364_86043, L86043_75364)
HB9	Prince Charles Avenue	HGV Ban	Appears to be modelled as ban on UC11 on Prince Charles Avenue Link 75374_75412 (EB), L75412_75374 (WB)
RNTM12	Brentwood Road	Contraflow (300m sections)	Appears to be modelled as signalised node 84483 which is coded as priority in DM
RNTM60	Ockendon Road	Contraflow	Appears to be modelled as signalised node 83599 which is coded as priority in DM
RNTM43	Stifford Clay Road	Contraflow (300m sections)	Appears to be modelled as signalised node 84460 which is coded as priority in DM
RNTM05	Marshfoot Road/Chadwell Hill/Brentwood Road	Contraflow (300m sections)	Appears to be modelled as signalised node 95202 converted from roundabout of Marshfoot Road/St Chads Road/B149/Chadwell Hill
RNTM41	High Road	Contraflow (300m sections)	Appears to be modelled as signalised node 84460 which is coded as priority in DM
RNTM56	B186	Contraflow (300m sections)	Appears to be modelled as signalised node 89555 which is coded as priority in DM
RNTM80	Baker Street	Contraflow (300m sections)	Appears to be modelled as signalised node 75373 which is coded as priority in DM
RNTM13	Medebridge Road	Lane restrictions	Node 83600 signalised from priority in DM. Also northern end i.e. Link 83600_76304 banned to all traffic UC1 t oUC10 in DMB/A & ban retained in P1 but CTM UC11 & UC12 permitted. Not clear these changes meant to represent lane restrictions

Table 3-2 Phase 1 key TMM coding observations

3.4.4 The analysis presented in Table 3-2 shows Stantec's interpretation of modelled network changes associated with Phase 1 TMMs. Without any modelling documents or commentary in the Construction Traffic Management (CTM) model files, it is not possible to conclude that the construction models accurately reflect the TMM assumptions.

Haul Roads

3.4.5 It is understood that internal haul roads are proposed by NH to limit construction traffic using the LRN and thus minimise impacts to general traffic. A check of the construction models was made to get an understanding of the locations of the off-road haul roads. Figure 3-1 indicates (in red) the new links coded into the construction models.

3.4.6 As these links were also present in DMA and DMB, the comparison was made against the operational DCO2v2 DM models (used to assess the impacts of the operational LTC scheme). It is considered that in the main, the red links illustrate the haul routes which are predominantly planned along the alignment of the proposed LTC.

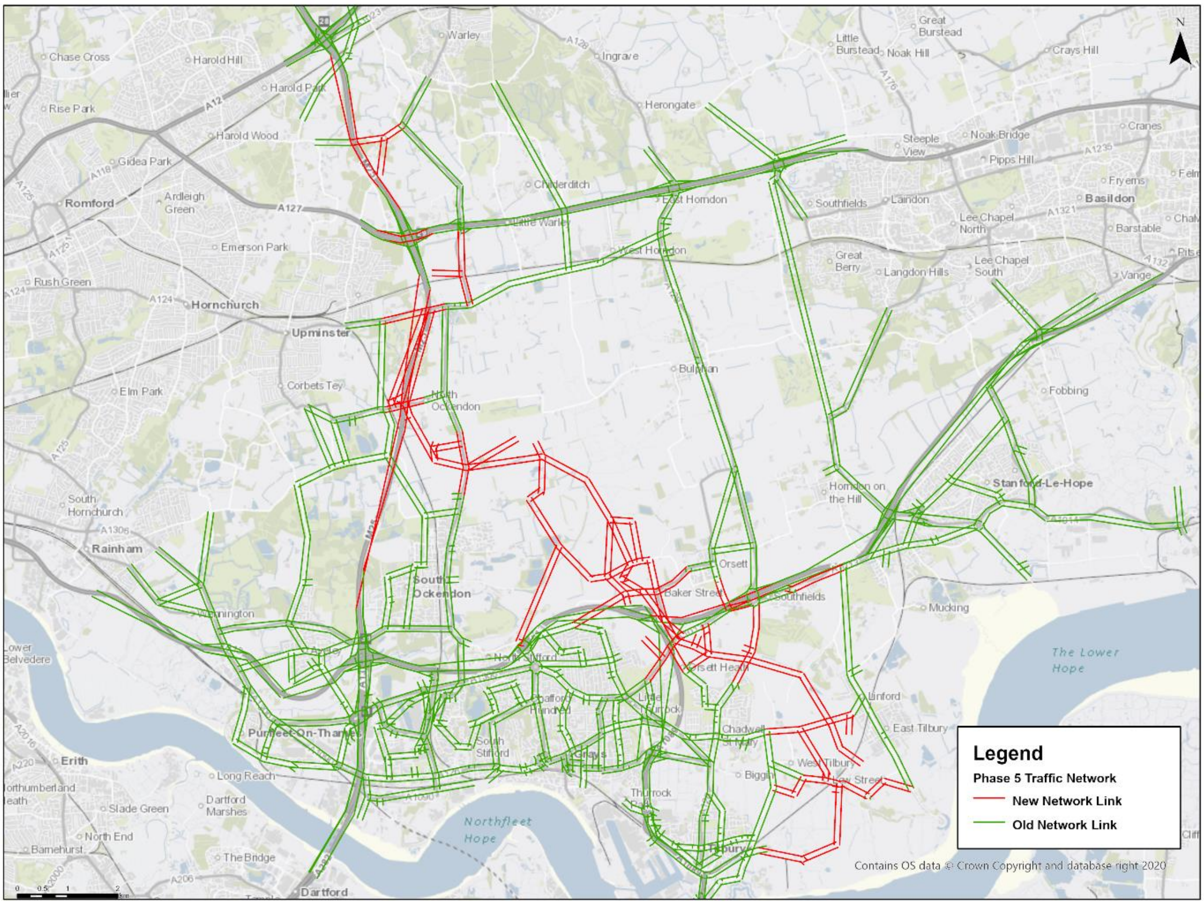

Figure 3-1 New Network Links in Construction Traffic Models

3.4.7 In some cases the haul routes bisect the LRN thereby requiring a crossing point to maintain flow for construction vehicles and general traffic. It is understood that these crossing points will have traffic signals.

3.4.8 To provide an example, Figure 3-2 illustrates a section of haul road linking Zone 5084 to the south and Zone 5067 (assumed to be compounds). The circled signal nodes (illustrated as squares) in SATURN illustrate crossing points, the southerly one on Muckingford Road and the northerly one on Hornsby Lane. The Muckingford Road crossing point is consistent with TMM plans and is expected to be in Phases 2 to 4. The TMM do not list a crossing point on

Hornsby Lane, although it is recognised that Hornsby Lane is subject to permanent closure and is assumed to be the case from Phase 1.

3.4.9 Without any modelling documents or commentary in the CTM model files, it is not possible to check network coding of every single haul road or to conclude if the construction models accurately reflect the TMM assumptions or the scale of impacts on the network.

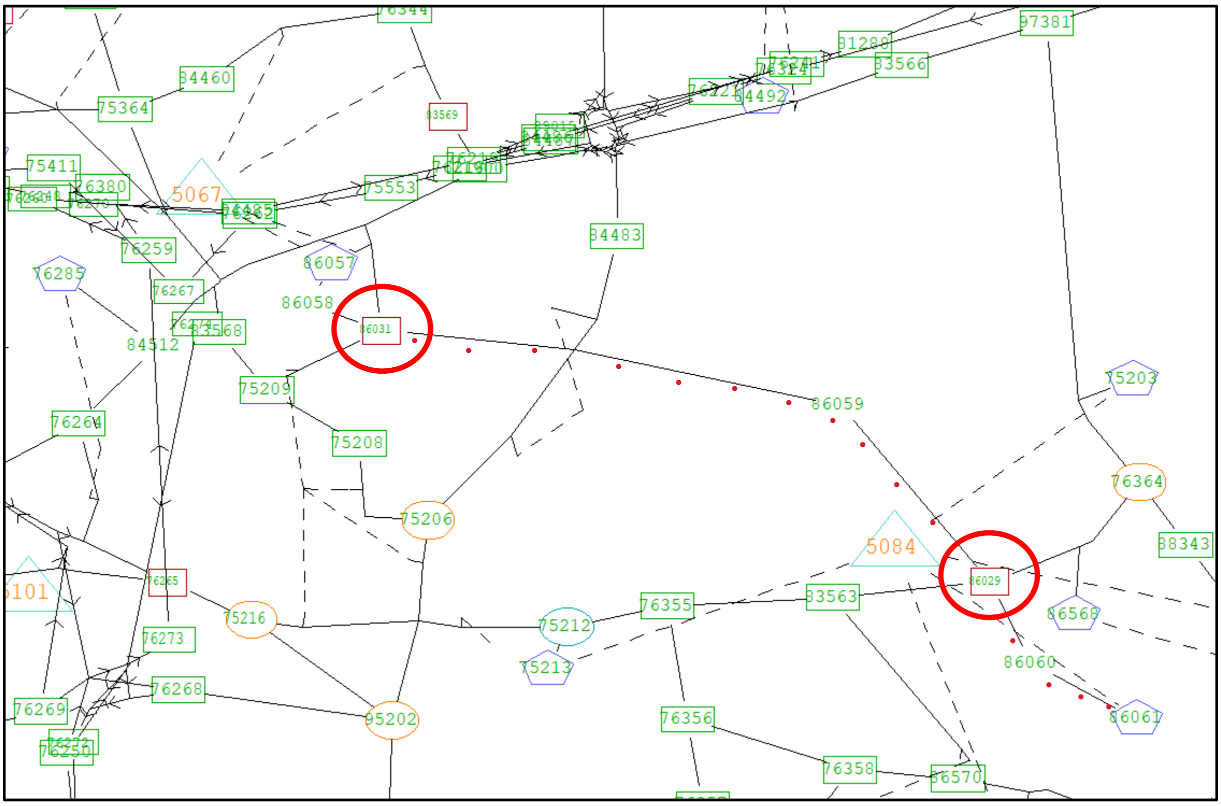

Figure 3-2 Illustration of Crossing points

3.5 Summary

3.5.1 This section has sought to understand the TMM proposed during construction. Eleven Phases of construction are proposed. It is considered that the TMM proposed in the phases are broadly consistent with those listed in the OTMPfC, which has been provided by NH with the cordoned models and which NH consulted upon in the CIC, which took place in Summer 2021.

3.5.2 However, further clarifications with NH highlighted that the construction traffic models provided to TC for review do not reflect the construction traffic volumes reported by worksite as set out in the CIC material. Instead, they are based on updated traffic data, which NH stated will only be made public in the DCOv2 TA and therefore not consulted on with the local communities. It is therefore unclear what other differences exist between the CIC material and the TMMs included in the construction models.

3.5.3 No modelling documentation setting out detailed assumptions underpinning the construction traffic models was made available for the review, nor were there comments in the SATURN cordon model files indicating how and where coding changes have been made to represent the TMM in the models. Proportionate checks were therefore undertaken by Stantec of the models to understand the representation of the TMM in the models given the considerable number of measures and phases and the unavailability of modelling documents at this time.

3.5.4 A concerted effort was made to understand the coding of key TMM changes in Phase 1, this being the first step from the DM models and subsequently forms the basis on which other phases are built. While it was possible to assume that certain coding changes were associated with certain proposed TMM measures, it was not possible to conclude this with certainty. It is considered that the principle of the TMM plans was generally represented in the models but there was not sufficient information to conclude that specific TMM schemes were accurately represented.

3.5.5 Document 4 (NH’s Response to TC on Construction Modelling queries received on 21/10/2022) indicates that details of what traffic management measures are included in the construction model will be described in the updated TA, which will be issued as part of the DCOv2 submission.

4 Construction Compounds and Utility Hubs

4.1 Introduction

4.1.1 The objective of this section is to identify whether the proposed construction compounds and utility hubs and their accesses are appropriately reflected in the models. It is understood that the compound and utility hub assumptions are the same as those in the CIC material.

4.2 Overview of Analysis

4.2.1 Following queries by Stantec NH provided details of the compounds and utility hubs presented in the model and their zone numbers (Document 4). This indicates that there are sixteen compounds or utility hubs within the Thurrock cordon model area as shown in Table 4-1.

Item No.	Compound/Utility Name	NH Unique ID No.	Zone
1	Northern tunnel entrance compound	CA5	5013
2	Station Road compound	CA5a	5084
3	Brentwood Road compound	CA6	5117
4	Stanford Road	CA7	5067
5	Long Lane compound A & B	CA8	5098
6	Stifford Clays Road compound West	CA9	5112
7	Stifford Clays Road compound East	CA10	5069
8	Mardyke compound	CA11	5087
9	Medebridge compound	CA13	6154
10	M25 compound	CA14	5086
11	Ockendon Road compound	CA15	6106
12	Warley Street compound	CA16	6153
13	Utility Logistics Hub	ULH1	5063
14	Utility Logistics Hub	ULH6	5068
15	Utility Logistics Hub	ULH11	5083
16	Utility Logistics Hub	ULH12	5111

Table 4-1 Compound/Utility Hubs and assumed Zones

4.2.2 Using available documentation, the compounds and utility hubs were overlaid on OS mapping using GIS. Figure 4-1 shows the location of compounds overlaid on the cordon model zoning system. This also enables an understanding of how the movements from the compounds access the local network.

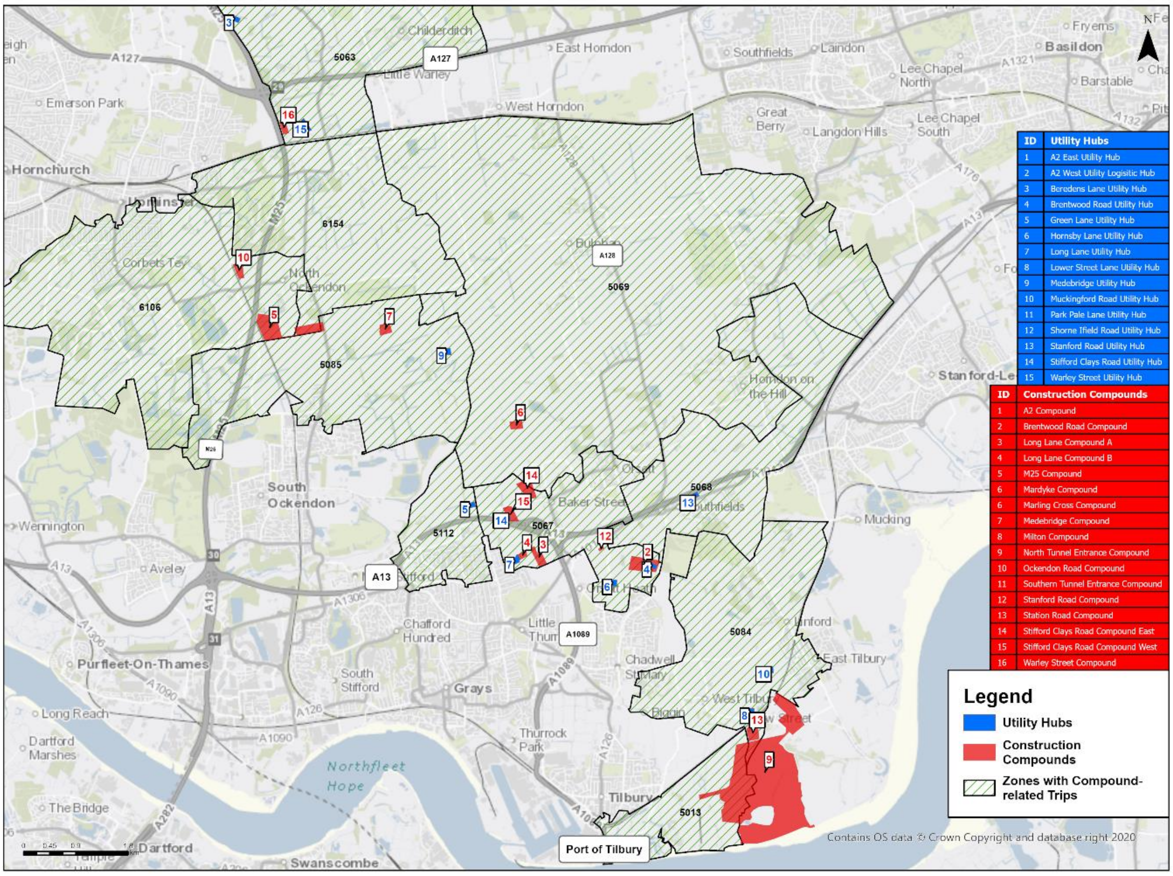

Figure 4-1 Compound and Utility Hub Locations in Relation to Cordon Model Zone

4.2.3 It is noted that most of the proposed the compounds appear to be included within existing model zones while some zones in Table 4-1 are not in the GIS file provided by NH. The zones are large and hence construction traffic would not be loaded to specific network access points accurately. This is likely to underestimate construction traffic impacts at access junctions where construction traffic interacts with the local network. Importantly, this reflects the limitations of the strategic model in accurately representing the localised impacts of the construction activities.

4.2.4 Some construction related HGV traffic is also able, within the LTAM SATURN model to freely assign across the cordoned area in an attempt to optimise the operation of the network (see section 6.1). This is contrary to the commitments that NH has made, through the OTMPfC, that construction HGV traffic will be assigned to specified and fixed access routes. The construction models will therefore not accurately reflect the likely movement of construction vehicles on the road network. General traffic and construction staff traffic will be able to reassign within the modelled network.

4.3 Compound Trip[2]s

4.3.1 Document 4 has provided the latest assumptions about daily construction traffic demands of each compound and supersedes the demand information from the CIC that was tabulated in Document 2. The construction traffic demands in the model were checked to determine whether they were consistent with the daily demands presented in Document 4. The

[2] A trip in this modelling review is a movement of a vehicle to or from a point in the model.

construction model flows are hourly Passenger Car Units (PCUs) for each of the modelled AM peak, IP peak and PM peak whereas the NH figures are provided as daily average vehicles.

4.3.2 NH advised that to convert the model demands to daily data, the following methodology should be applied: for construction staff vehicles (UC12 in the models), the daily numbers are AM + IP + PM + transposed IP. The transposition of the IP flows is required as a proxy for construction movements which occur outside of the modelled time periods. For construction HGV deliveries (UC11) it is AM + 6 * IP + 4 * PM. For construction earthworks HGVs (Pre-loads) it's AM*2 + IP *6 + PM * 4.

4.3.3 Using the above information, Stantec were able to convert the modelled hourly construction demands to daily demands. Table 4-2 provides a summary of the comparison of the total origin daily construction demands summed for all the compounds/utility hubs by phase. It is clear that the NH numbers provided in Document 4 pertained to origin trips.

4.3.4 Apart from minor differences, there is a good consistency between the NH daily construction traffic provided in Document 4 and the construction numbers included in the models as shown in Table 4-2. It is understood that to reflect the current levels of uncertainty regarding the total amount of HGV traffic generated from each compound, and to ensure a robust assessment, an additional 20% was added to the HGV traffic volumes. The comparison by Stantec took this into account and is equivalent to assuming an HGV PCU factor of 3 instead of 2.5 to convert HGV PCUs from the model to HGV vehicles.

4.3.5 There are noticeably more variations when the comparison is considered at a compound by compound level. This is particularly the case for car construction traffic and is especially noticeable for the North Tunnel Entrance compound in Phase 2 where there are 98 fewer (-12%) car construction trips in the model than is planned, which is a significant difference. Generally, it is considered that there is good agreement between the model assumptions and proposed construction daily traffic when compared at an origin level. Table 4-3 shows the comparison at a compound level.

	NH Data (Document 4)			Model (estimated)			Difference (Model -NH)			% Difference		
Phase	**HGV**	**Cars**	**Total**	**HGV**	**Cars**	**Total**	**HGV**	**Cars**	**Total**	**HGV**	**Cars**	**Total**
1	157	866	1023	157	851	1007	0	-15	-16	0%	-2%	-2%
2	368	1535	1903	367	1473	1840	-1	-62	-63	0%	-4%	-3%
3	518	1853	2371	518	1853	2371	0	0	0	0%	0%	0%
4	830	1846	2676	830	1847	2677	0	1	1	0%	0%	0%
5	686	1986	2672	688	2026	2714	2	40	42	0%	2%	2%
6	1316	2098	3414	1315	2102	3418	-1	4	4	0%	0%	0%
7	946	1772	2718	946	1809	2755	0	37	37	0%	2%	1%
8	570	1415	1985	569	1426	1995	-1	11	10	0%	1%	0%
9	294	1213	1507	293	1239	1532	-1	26	25	0%	2%	2%
10	242	916	1158	241	913	1154	-1	-3	-4	0%	0%	0%
11	32	182	214	32	181	213	0	-1	-1	-1%	0%	0%

Table 4-2 Summary of Comparison of Daily Compound/Utility construction vehicles with model -- Origin Traffic

Daily Average number of Vehicles - Origin Numbers Only (Model)

Phase	North Tunnel Entrance (combined 5013)		Station Rd (5084)		Brentwood Rd Compound (5117)		Stanford Road Compound (5067)		Long Lane Compound A&B (5098)		Stifford Clays Road Compound West (5112)		Stifford Clays Compound East (5069)		Mardyke Compound (5087)		Medebridge Compound (6154)		M25 Compound (5086)		Ockendon Rd (6106)		Warley Street Compound (6153)		Total		
	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	All Vehicles
1	54	356	3	26	20	68	8	37	0	10	0	49	31	111	0	0	11	44	28	108	2	24	0	18	157	851	1007
2	145	719	8	36	30	98	9	50	0	14	0	61	60	185	0	3	12	80	35	161	52	41	17	24	367	1473	1840
3	195	1016	13	41	45	54	10	52	0	15	0	62	92	186	5	23	16	99	52	196	63	49	26	58	518	1853	2371
4	199	941	30	41	106	112	9	46	0	15	0	62	143	184	11	40	17	99	111	213	141	38	62	54	830	1847	2677
5	181	1062	28	41	87	138	3	43	4	29	5	65	86	172	15	54	13	99	80	212	124	34	61	77	688	2026	2714
6	224	1160	90	41	177	138	0	15	21	39	24	56	224	163	19	55	18	98	166	212	241	44	111	81	1315	2102	3418
7	201	903	39	29	107	137	0	10	18	46	27	44	145	162	14	47	13	95	110	211	188	44	84	81	946	1809	2755
8	219	685	14	22	34	111	0	4	15	24	33	40	143	134	9	26	13	91	41	191	30	38	19	61	569	1426	1995
9	170	780	4	2	14	67	0	4	0	3	18	27	50	46	1	2	10	90	17	158	7	17	3	41	293	1239	1532
10	165	658	5	1	5	46	0	4	0	3	0	3	50	3	0	2	6	59	11	132	0	2	0	2	241	913	1154
11	28	99	0	1	0	0	0	1	0	1	0	0	0	1	0	0	1	23	3	55	0	1	0	1	32	181	213

Daily Average number of Vehicles - Origin Numbers Only (NH)

Phase	North Tunnel		Station Rd (5084)		Brentwood Rd		Stanford Road		Long Lane		Stifford Clays Road		Stifford Clays		Mardyke		Medebridge		M25 Compound		Ockendon Rd		Warley Street		Total		
	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	All Vehicles
1	54	388	3	25	20	67	8	34	0	8	0	47	31	109	0	0	11	43	28	107	2	22	0	16	157	866	1023
2	145	816	8	33	30	95	9	46	0	10	0	58	60	181	0	0	12	79	35	158	52	38	17	21	368	1535	1903
3	195	1059	13	38	45	50	10	46	0	10	0	58	92	181	5	20	16	98	52	193	63	46	27	54	518	1853	2371
4	199	983	31	38	106	108	9	41	0	10	0	58	143	179	11	37	17	98	111	210	141	34	62	50	830	1846	2676
5	181	1068	28	38	87	134	3	37	4	23	5	60	86	166	14	51	13	98	80	208	124	30	61	73	686	1986	2672
6	224	1204	91	38	177	134	0	8	21	33	24	51	224	157	19	51	18	97	166	208	241	40	111	77	1316	2098	3414
7	201	907	39	26	107	134	0	5	18	41	27	40	145	157	14	43	13	94	110	208	188	40	84	77	946	1772	2718
8	219	708	14	19	34	109	0	0	15	20	33	36	143	130	9	23	13	89	41	188	30	35	19	58	570	1415	1985
9	170	785	4	0	14	65	0	0	0	0	18	23	50	42	1	0	10	89	17	156	7	15	3	38	294	1213	1507
10	165	684	5	0	5	44	0	0	0	0	0	0	50	0	0	0	6	58	11	130	0	0	0	0	242	916	1158
11	28	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	23	3	54	0	0	0	0	32	182	214

Difference in Daily Average number of Vehicles - Origin Numbers Only (Model - NH)

Phase	North Tunnel		Station Rd (5084)		Brentwood Rd		Stanford Road		Long Lane		Stifford Clays Road		Stifford Clays		Mardyke		Medebridge		M25 Compound		Ockendon Rd		Warley Street		Total		
	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	All Vehicles
1	0	-32	0	1	0	1	0	3	0	2	0	2	0	2	0	0	0	1	0	1	0	2	0	2	0	-15	-16
2	0	-98	0	3	0	3	0	4	0	4	0	3	0	4	0	3	0	1	0	3	0	3	0	3	-1	-62	-63
3	0	-43	0	3	0	4	0	6	0	5	0	4	0	5	0	3	0	1	0	3	0	3	-1	4	0	0	0
4	0	-42	-1	3	0	4	0	5	0	5	0	4	0	5	0	3	0	1	0	3	0	4	0	4	0	1	1
5	0	-6	0	3	0	4	0	6	0	6	0	5	0	6	1	3	0	1	0	4	0	4	0	4	2	40	42
6	0	-44	-1	3	0	4	0	7	0	6	0	5	0	6	0	4	0	1	0	4	0	4	0	4	-1	4	4
7	0	-4	0	3	0	3	0	5	0	5	0	4	0	5	0	4	0	1	0	3	0	4	0	4	0	37	37
8	0	-23	0	3	0	2	0	4	0	4	0	4	0	4	0	3	0	2	0	3	0	3	0	3	-1	11	10
9	0	-5	0	2	0	2	0	4	0	3	0	4	0	4	0	2	0	1	0	2	0	2	0	3	-1	26	25
10	0	-26	0	1	0	2	0	4	0	3	0	3	0	3	0	2	0	1	0	2	0	2	0	2	-1	-3	-4
11	0	-6	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	-1	-1

% Difference in Daily Average number of Vehicles - Origin Numbers Only

Phase	North Tunnel		Station Rd (5084)		Brentwood Rd		Stanford Road		Long Lane		Stifford Clays Road		Stifford Clays		Mardyke		Medebridge		M25 Compound		Ockendon Rd		Warley Street		Total		
	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	HGVs	Cars	All Vehicles
1	0%	-8%	-14%	6%	-1%	2%	0%	7%	0%	28%	0%	4%	1%	2%	0%	0%	2%	1%	0%	1%	-2%	8%	0%	11%	0%	-2%	-2%
2	0%	-12%	-3%	9%	-1%	4%	-5%	10%	0%	43%	0%	6%	-1%	2%	0%	0%	-2%	2%	-1%	2%	1%	8%	0%	15%	0%	-4%	-3%
3	0%	-4%	2%	9%	-1%	7%	-3%	13%	0%	54%	0%	8%	0%	3%	-1%	16%	0%	1%	1%	2%	0%	8%	-2%	7%	0%	0%	0%
4	0%	-4%	-2%	9%	0%	4%	4%	13%	0%	52%	0%	7%	0%	3%	2%	7%	-1%	1%	0%	2%	0%	13%	0%	8%	0%	0%	0%
5	0%	-1%	1%	8%	0%	3%	10%	17%	12%	27%	-4%	8%	0%	4%	4%	6%	3%	1%	0%	2%	0%	14%	1%	6%	0%	2%	2%
6	0%	-4%	-1%	8%	0%	3%	0%	88%	0%	17%	1%	10%	0%	4%	-1%	7%	-1%	1%	0%	2%	0%	10%	0%	6%	0%	0%	0%
7	0%	0%	0%	12%	0%	2%	0%	107%	0%	13%	-1%	10%	0%	3%	-3%	9%	1%	1%	0%	2%	0%	9%	0%	5%	0%	2%	1%
8	0%	-3%	-2%	14%	1%	2%	0%	0%	-1%	20%	-1%	10%	0%	3%	3%	12%	-1%	2%	0%	2%	-1%	8%	-2%	5%	0%	1%	0%
9	0%	-1%	5%	0%	0%	4%	0%	0%	0%	0%	-1%	16%	0%	10%	-44%	0%	-3%	2%	-3%	2%	-4%	14%	10%	8%	0%	2%	2%
10	0%	-4%	1%	0%	9%	5%	0%	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%
11	-2%	-5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	-6%	1%	0%	0%	0%	0%	-1%	0%	0%

Table 4-3 Summary of Comparison of Daily Compound/Utility construction vehicles with model for Origin Traffic by Compound/Utility

5 Review of Global Network Performance Statistics

5.1 Introduction

5.1.1 This section provides the first step in understanding the predicted impacts of the CTM on overall road network performance in the Thurrock area. The section provides a summary of the global statistics of the network model in each of the construction phases providing details of total travel time, travel distance, average speed and total trips for the updated construction models. The global statistics provide an overview of the Thurrock area wide impacts.

5.2 Summary Statistics

5.2.1 Table 5-1 shows the global statistics of the AM peak hour phase models while Table 5-2 shows outputs for the PM peak hour phase models.

Global Statistics/Peak Hour	Total Trips	Transient Queues	Over-Capacity Queues	Link Cruise T ime	Total Travel T ime	Travel	Average S peed
	PCUs	PCU. HRS	PCU. HRS	PCU. HRS	PCU. HRS	PCU. KMS.	KPH
DMA (cpd Phases 4,9,10,11)	74,448	3,055	297	13,823	17,174	997,059	58
DMB (cpd to Phases 1,2,3,5,6,7,8)	74,525	3,070	297	13,842	17,209	998,026	58
Phase 1	75,305	3,307	382	14,098	17,787	1,011,014	57
Difference to DMB	780	237	85	256	578	12,988	-1
% Difference	1%	8%	29%	2%	3%	1%	-2%
Phase 2	75,611	3,354	359	14,208	17,921	1,014,196	57
Difference to DMB	1,086	284	62	366	712	16,170	-1
% Difference	1%	9%	21%	3%	4%	2%	-2%
Phase 3	75,551	3,473	418	14,232	18,123	1,006,165	56
Difference to DMB	1,027	403	122	390	914	8,139	-3
% Difference	1%	13%	41%	3%	5%	1%	-4%
Phase 4	75,510	3,514	424	14,260	18,198	1,007,830	55
Difference to DMA	1,063	459	127	437	1,024	10,771	-3
% Difference	1%	15%	43%	3%	6%	1%	-5%
Phase 5	75,603	3,574	374	14,340	18,287	1,006,188	55
Difference to DMB	1,078	503	77	498	1,079	8,162	-3
% Difference	1%	16%	26%	4%	6%	1%	-5%
Phase 6	75,559	3,518	392	14,336	18,246	1,006,062	55
Difference to DMB	1,034	448	95	494	1,037	8,036	-3
% Difference	1%	15%	32%	4%	6%	1%	-5%
Phase 7	75,483	3,492	382	14,293	18,167	1,003,762	55
Difference to DMB	958	422	85	452	959	5,736	-3
% Difference	1%	14%	29%	3%	6%	1%	-5%
Phase 8	75,294	3,448	366	14,230	18,044	1,001,530	56
Difference to DMB	769	377	70	389	836	3,504	-3
% Difference	1%	12%	23%	3%	5%	0%	-4%
Phase 9	74,941	3,399	306	14,107	17,812	996,158	56
Difference to DMA	494	344	9	285	638	-900	-2
% Difference	1%	11%	3%	2%	4%	0%	-4%
Phase 10	74,776	3,340	269	14,058	17,666	993,893	56
Difference to DMA	329	285	-28	235	492	-3,166	-2
% Difference	0%	9%	-9%	2%	3%	0%	-3%
Phase 11	74,555	3,084	301	13,856	17,241	998,699	58
Difference to DMA	108	29	4	34	67	1,640	0
% Difference	0%	1%	1%	0%	0%	0%	0%

Table 5-1 Network Global Statistics – AM peak hour

Global Statistics/Peak Hour	Total Trips	Transient Queues	Over-Capacity Queues	Link Cruise Time	Total Travel Time	Travel	Average Speed
	PCUs	PCU. HRS	PCU. HRS	PCU. HRS	PCU. HRS	PCU. KMS.	KPH
DMA (cpd Phases 4,9,10,11)	71,713	3,413	1,021	14,160	18,594	1,024,857	55
DMB (cpd to Phases 1,2,3,5,6,7,8)	71,785	3,236	933	13,968	18,137	1,015,813	56
Phase 1	72,422	3,413	1,021	14,160	18,594	1,024,857	55
Difference to DMB	637	177	88	192	457	9,044	-1
% Difference	1%	5%	9%	1%	3%	1%	-2%
Phase 2	72,810	3,420	1,033	14,192	18,645	1,029,734	55
Difference to DMB	1,025	183	101	224	508	13,921	-1
% Difference	1%	6%	11%	2%	3%	1%	-1%
Phase 3	73,000	3,576	1,193	14,322	19,090	1,024,236	54
Difference to DMB	1,215	339	261	354	953	8,423	-2
% Difference	2%	10%	28%	3%	5%	1%	-4%
Phase 4	72,924	3,600	1,164	14,454	19,218	1,024,672	53
Difference to DMA	1,211	187	143	294	624	-185	-2
% Difference	2%	5%	14%	2%	3%	0%	-3%
Phase 5	73,087	3,649	1,175	14,426	19,251	1,023,539	53
Difference to DMB	1,302	413	243	458	1,114	7,726	-3
% Difference	2%	13%	26%	3%	6%	1%	-5%
Phase 6	73,112	3,630	1,192	14,469	19,291	1,025,136	53
Difference to DMB	1,328	393	260	501	1,154	9,323	-3
% Difference	2%	12%	28%	4%	6%	1%	-5%
Phase 7	72,981	3,602	1,165	14,401	19,169	1,021,848	53
Difference to DMB	1,197	366	232	433	1,032	6,035	-3
% Difference	2%	11%	25%	3%	6%	1%	-5%
Phase 8	73,112	3,630	1,192	14,469	19,291	1,025,136	53
Difference to DMB	1,328	393	260	501	1,154	9,323	-3
% Difference	2%	12%	28%	4%	6%	1%	-5%
Phase 9	72,526	3,557	895	14,195	18,647	1,015,700	55
Difference to DMA	813	144	-126	35	53	-9,157	-1
% Difference	1%	4%	-12%	0%	0%	-1%	-1%
Phase 10	72,283	3,602	971	14,160	18,732	1,012,160	54
Difference to DMA	570	189	-50	-1	138	-12,697	-1
% Difference	1%	6%	-5%	0%	1%	-1%	-2%
Phase 11	71,850	3,256	946	13,996	18,198	1,017,617	56
Difference to DMA	137	-157	-75	-165	-396	-7,240	1
% Difference	0%	-5%	-7%	-1%	-2%	-1%	1%

Table 5-2 Network Global Statistics – PM peak hour

5.3 Summary of Global Statistics comparison

5.3.1 Generally, the summary statistics indicate comparable overall network performance at a Thurrock area wide level between the phases when compared against each other and also when compared to their respective DMA or DMB as applicable.

- In the AM peak, for example, the average network speed for the 11 phases ranges between 53.1 kph (Phase 6) to 55.9 kph (Phase 11). This in comparison to 55.1 kph for DMA and 56.0 kph in DMB.

- In the PM peak, the average network speed for the phases ranges between 55 kph (Phase 4) to 57.9 kph (Phase 11). This is in comparison to 58.1 kph for DMA and 58.0 kph for DMB.

5.3.2 The summary statistics will tend to mask out the worst road network impacts. The construction impacts are likely to be more acute in the specific areas of the network used by construction traffic and in areas of the network where TMM is proposed and has been coded into the models. The variations in global or summary statistics is, however, discernible enough to be used in ranking the scale of impacts of the 11 construction phases as is now discussed.

5.4 Ranking the Construction Phases with Most Significant Impact

5.4.1 Using the summary statistics and the amount of construction traffic, the phases have been ranked in order to identify the worst three phases in which impacts on the local road network are likely to be most significant.

5.4.2 In coding the construction traffic NH has considered delivery HGV's (User Class - UC 11) and Car construction staff (UC12) only. T More detailed analysis of the demand matrices is discussed in Section 6.

5.4.3 For each of the parameters analysed, the phases have been ranked from 1 (least impact) to 11 (highest impact/significant impact) for that parameter. The rankings were then summed up across each phase to give a Total Index. The Total Index was then used to rank the Phases from 1 (least impact) to 11 (highest/significant impact).

5.4.4 Table 5-3 shows the ranking for the AM peak while Table 5-4 shows the ranking for the PM peak.

Phase	Total Trips (pcus)	Avg. Speed (km/hr)	Total Travel Distance (pcu.kms)	Delays (pcu.hrs)	Over Capacity Queues (pcu.hrs)	Delivery HGV Trips (UC11)	CTM Car Construction Staff Trips (UC12)	Total Index	Rank
Phase 1	3	3	9	4	3	2	3	27	4
Phase 2	6	2	11	1	4	4	6	34	5
Phase 3	9	7	7	6	6	6	8	49	7
Phase 4	7	8	8	11	9	7	9	59	9
Phase 5	10	10	6	9	8	9	10	62	10
Phase 6	11	11	10	10	10	10	11	73	11
Phase 7	8	8	5	8	7	11	7	54	8
Phase 8	5	6	4	7	11	8	5	46	6
Phase 9	4	4	2	2	5	5	4	26	3
Phase 10	2	5	1	5	2	3	2	20	2
Phase 11	1	1	3	3	1	1	1	11	1

Table 5-3 Ranking of Phases to identify construction phases with most significant impacts – AM Peak hour

Phase	Total Trips (pcus)	Avg. Speed (km/hr)	Total Travel Distance (pcu.kms)	Delays (pcu.hrs)	Over Capacity Queues (pcu.hrs)	Delivery HGV (UC11)	CTM Car Construction Staff (UC12)	Total Index	Rank
Phase 1	5	2	10	2	3	2	4	28	3
Phase 2	11	3	11	3	5	4	7	44	6
Phase 3	8	6	7	5	7	6	8	47	7
Phase 4	7	8	9	7	8	7	10	56	9
Phase 5	10	11	8	11	11	9	11	71	11

Phase	Total Trips (pcus)	Avg. Speed (km/hr)	Total Travel Distance (pcu.kms)	Delays (pcu.hrs)	Over Capacity Queues (pcu.hrs)	Delivery HGV (UC11)	CTM Car Construction Staff (UC12)	Total Index	Rank
Phase 6	9	10	6	10	10	10	9	64	10
Phase 7	6	9	5	9	9	11	6	55	8
Phase 8	4	6	4	8	6	8	5	41	5
Phase 9	3	5	2	6	4	5	3	28	3
Phase 10	2	4	1	4	2	3	2	18	2
Phase 11	1	1	3	1	1	1	1	9	1

Table 5-4 Ranking of Phases to identify construction phases with most significant impacts – PM Peak hour

5.4.5 Based on this analysis of global statistics and the volume of construction related traffic in each phase, Phase 4, Phase 5 and Phase 6 are identified as the phases with the most significant impacts in both the AM and PM peak hours and hence will be analysed further in Section 7.

6 Construction Traffic Demand Matrix Trips

6.1 Introduction

6.1.1 This section provides a summary of the trip demand matrices in the construction models. The construction models include twelve user or vehicle classes measured in Passenger Car Units (PCUs). User classes 1 to 10 represent general traffic, i.e. non construction traffic, while user classes 11 and 12 represent construction traffic as follows:

- User Class 11 – delivery HGV construction traffic. NH has coded these vehicles such that they will choose lowest cost routes and their route choice is only limited by HGV bans and is not assigned to fixed/designated routes. The cost governing the route choice of these delivery HGV's is similar to that specified for UC10, i.e. Port HGV traffic.
- User Class 12 – Car construction traffic staff. NH has coded that the route choice of these vehicles is not restricted to any particular routes and is similar to a route choice of an average car commuter with medium income (UC3).
- Additionally, HGV (earthworks vehicles) are modelled as fixed flows and are not included in the demand matrices. These are assigned to fixed routes.

6.1.2 The construction models do not specifically differentiate Light Goods Vehicle[3] (LGV) demand that specifically relate to construction activity. It is not clear whether such vehicles are assumed to be part of the car-based staff construction traffic (UC 12) or are included as part of the construction HGV demand.

6.2 Trip Matrices and Construction Traffic Demands

6.2.1 Table 6-1 and Table 6-2 summarise the construction cordon trip matrix composition by phase, for the AM and PM peak hours respectively as coded in the CTM models. Construction DM trips for scenarios DMA and DMB are also tabulated and represent demands on the network without construction phase traffic.

Phase	General Traffic (UC1-10)	Delivery HGV Construction (UC11)	Car staff construction traffic (UC12)	HGV (earthworks trips)	Total Construction	Total Traffic	% Construction Traffic
DMA (cpd to Phases 4,9,10,11)	71,962	n/a	n/a	n/a	n/a	71,962	n/a
DMB (cpd to Phases 1,2,3,5,6,7,8)	72,033	n/a	n/a	n/a	n/a	72,033	n/a
1	71,720	118	832	28	978	72,698	1.35%
2	71,543	211	1,304	89	1604	73,147	2.19%
3	71,444	253	1,551	142	1946	73,390	2.65%
4	71,342	273	1,558	286	2117	73,459	2.88%
5	71,343	286	1,707	208	2201	73,544	2.99%
6	71,330	309	1,722	509	2540	73,870	3.44%

[3] NH has classified Light Goods Vehicle as a construction vehicle with a Gross Vehicle Weight of 3.5 Tonne or below

Phase	General Traffic (UC1-10)	Delivery HGV Construction (UC11)	Car staff construction traffic (UC12)	HGV (earthworks trips)	Total Construction	Total Traffic	% Construction Traffic
7	71,383	318	1,528	321	2167	73,550	2.95%
8	71,490	281	1,198	151	1630	73,120	2.23%
9	71,580	211	984	46	1241	72,821	1.70%
10	72,532	159	698	45	902	73,434	1.23%
11	71,906	34	159	0	193	72,099	0.27%

Table 6-1 Summary of Matrix trips (Pcu/Hour)– AM peak hour by Phase

6.2.2 Generally, it can be seen that in the AM peak hour:

- In total, the construction traffic (UC 11, UC12 and Earthworks HGVs) comprises a relatively small percentage of the construction cordon models trip matrices varying between 0.27% and 3.44% of total cordon model traffic.
- The total construction traffic is highest in Phase 6 (2,540 PCU/hr) and lowest in Phase 11 (193 PCU/hr).
- In all the phases, car construction staff traffic contributes the majority of the construction traffic (68% to 85%) compared to HGV construction traffic (15% to 32%).

6.2.3 When considering the non-construction traffic (i.e. UC1 to UC10), this is generally lower during the construction phases, when compared to the corresponding DMA or DMB models. This suggests that an impact of the construction phases is that they are likely to force existing traffic to find alternative routes, avoiding the LRN in Thurrock or to stop making a trip all together.

6.2.4 For example, Phase 6 has 71,330 PCU/hr compared to its corresponding DMB which has 71,962 PCU/hr, which is 632 PCU/hr fewer trips. This is a significant number of traffic displaced to other existing roads when compared to the 2,540 PCU/hr construction traffic in Phase 6.

Phase	General Traffic (UC1-10)	Delivery HGV Construction (UC11)	Car staff construction traffic (UC12)	HGV (earthworks trips)	Total Constructi on	Total Traffic	% Construction Traffic
DMA (cpd to Phases 4,9,10,11)	74,680	n/a	n/a	n/a	n/a	74,680	n/a
DMB (cpd to Phases 1,2,3,5,6,7,8)	74,757	n/a	n/a	n/a	n/a	74,757	n/a
1	74,642	58	837	28	923	75,565	1.22%
2	74,559	104	1,180	90	1374	75,933	1.81%
3	74,456	125	1,203	143	1471	75,927	1.94%
4	74,390	134	1,218	288	1640	76,030	2.16%
5	74,428	141	1,266	210	1617	76,045	2.13%
6	74,421	152	1,218	513	1883	76,304	2.47%
7	74,428	157	1,131	324	1612	76,040	2.12%
8	74,457	139	931	151	1221	75,678	1.61%

Phase	General Traffic (UC1-10)	Delivery HGV Construction (UC11)	Car staff construction traffic (UC12)	HGV (earthworks trips)	Total Construction	Total Traffic	% Construction Traffic
9	74,473	104	597	46	747	75,220	0.99%
10	74,544	79	386	45	510	75,054	0.68%
11	74,652	17	119	0	136	74,788	0.18%

Table 6-2 Summary of Matrix trips (Pcu/Hour)– PM peak hour by Phase

6.2.5 Generally, it can be seen that in the PM peak:

- In totality, the construction traffic (UC 11, UC12 and Earthworks HGVs) comprises a relatively small percentage of the construction cordon models varying between 0.18% (Phase 11) and 2.47% (Phase 6) of total cordon traffic;
- The total construction traffic is highest in Phase 6 (1,883 PCU/hr) and lowest in Phase 11 (136 PCU/hr).
- In all the phases, car construction staff traffic contributes the majority of the construction traffic (65% to 97%) compared to HGV construction traffic (9% to 35%).
- As in the AM peak, there is a generally lower level of general traffic (UC1 to UC10) during the construction phases, when compared to the corresponding DMA or DMB models.

6.2.6 The reduction of general traffic trips is most likely due to trip suppression or reassignment within the wider LRN as a result of running these models using the VDM process and delays caused by the construction traffic. However, this would need to be confirmed by NH based on the analysis of the whole LTAM model. If this trip suppression or reassignment were not realised the impacts on the LRN would be greater than that shown within the models.

7 Link Traffic Flows Changes

7.1 Introduction

7.1.1 This section outlines the traffic flow changes on roads within Thurrock as a result of the proposed LTC construction activities. The focus of analysis is on Phases 4, 5 and 6, which have been identified as the most significantly impacted phases. Appendix A provides flow difference plots of all eleven construction phases.

7.1.2 Initially the focus has been to get an overall understanding of flow changes across the network i.e. identify in general terms common locations in Phases 4 to 6 in the AM and PM peak hours at which significant flow changes occur.

7.2 Phases 4, 5 and 6 Traffic Flow Change Locations

7.2.1 Figure 7-1 and Figure 7-2 show the locations of traffic flow changes in Phase 4. In all plots, red bandwidth indicates a flow increase while green bandwidth indicates a flow decrease. The equivalent plots for Phase 5 are shown in Figure 7-3 (AM peak) and Figure 7-4(PM peak), while those from Phase 6 are shown in Figure 7-5 (AM peak) and Figure 7-6 (PM peak).

7.2.2 The locations of traffic flow changes are generally similar across all these phases although some differences occur given the variations in TMM measures and construction traffic volumes in the different phases. The flow change plots within Figures 7-1 to 7-6 reflect the impact of the addition of the LTC construction traffic (HGVs and workforce travel), and also the reassignment of general traffic within the modelled cordon. The changes exclude any construction traffic that might have been applied to the network associated with the construction of TFGP. Note, Appendix A presents these figures as well as figures for the other eight phases in a better resolution.

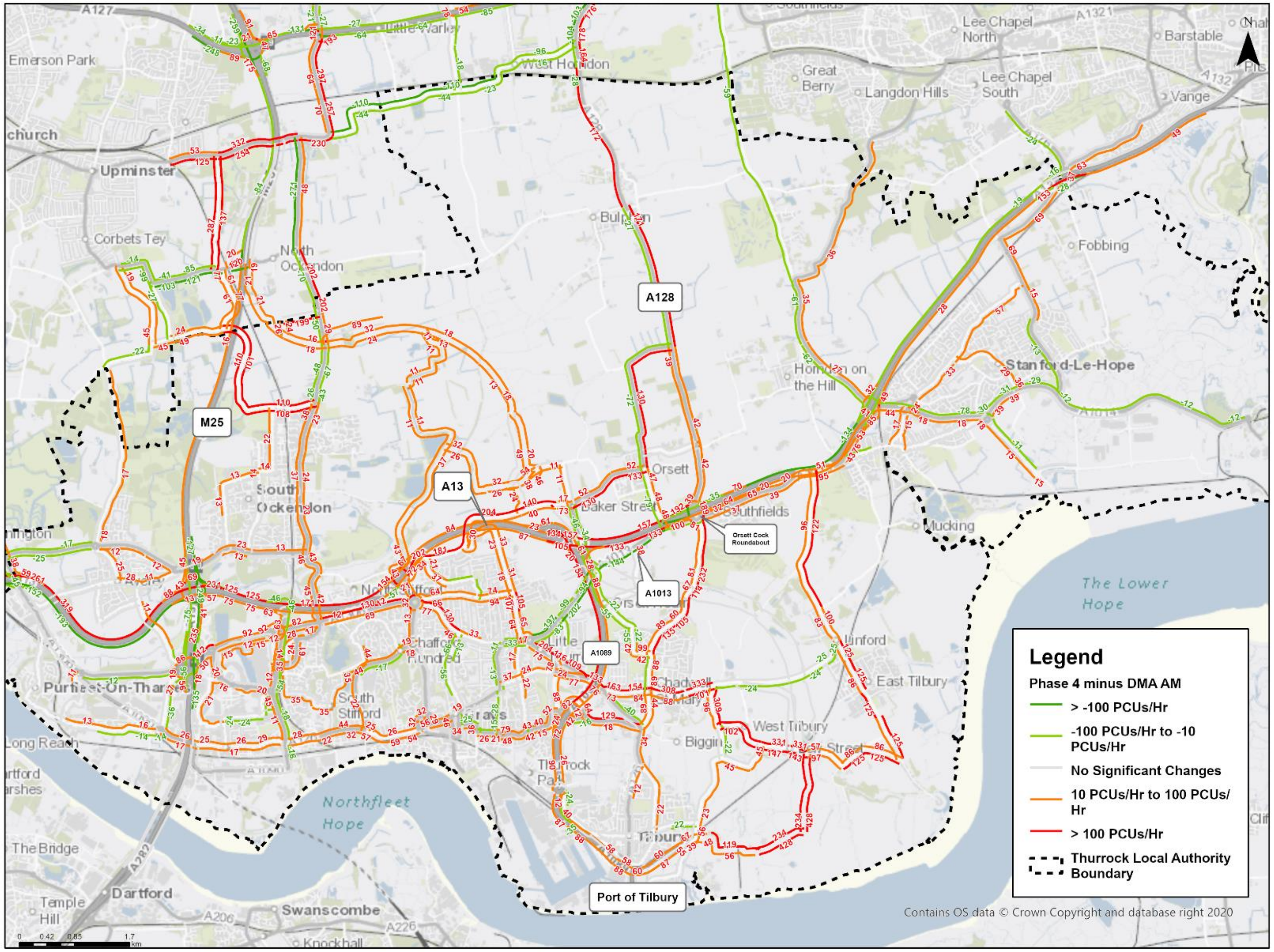

Figure 7-1 Phase 4 minus DMA. Flow Changes – AM peak

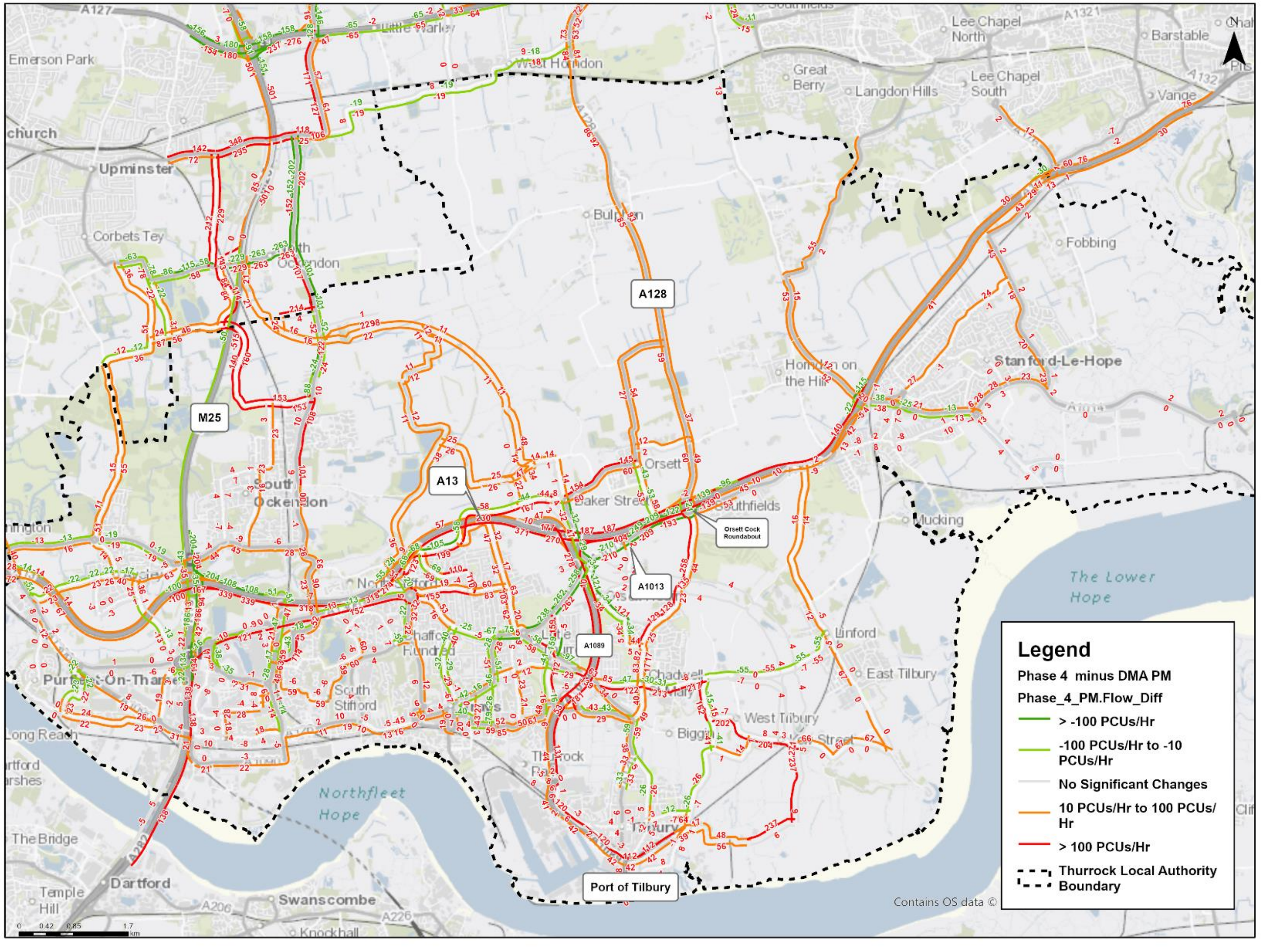

Figure 7-2 Phase 4 minus DMA. Flow Changes – PM peak

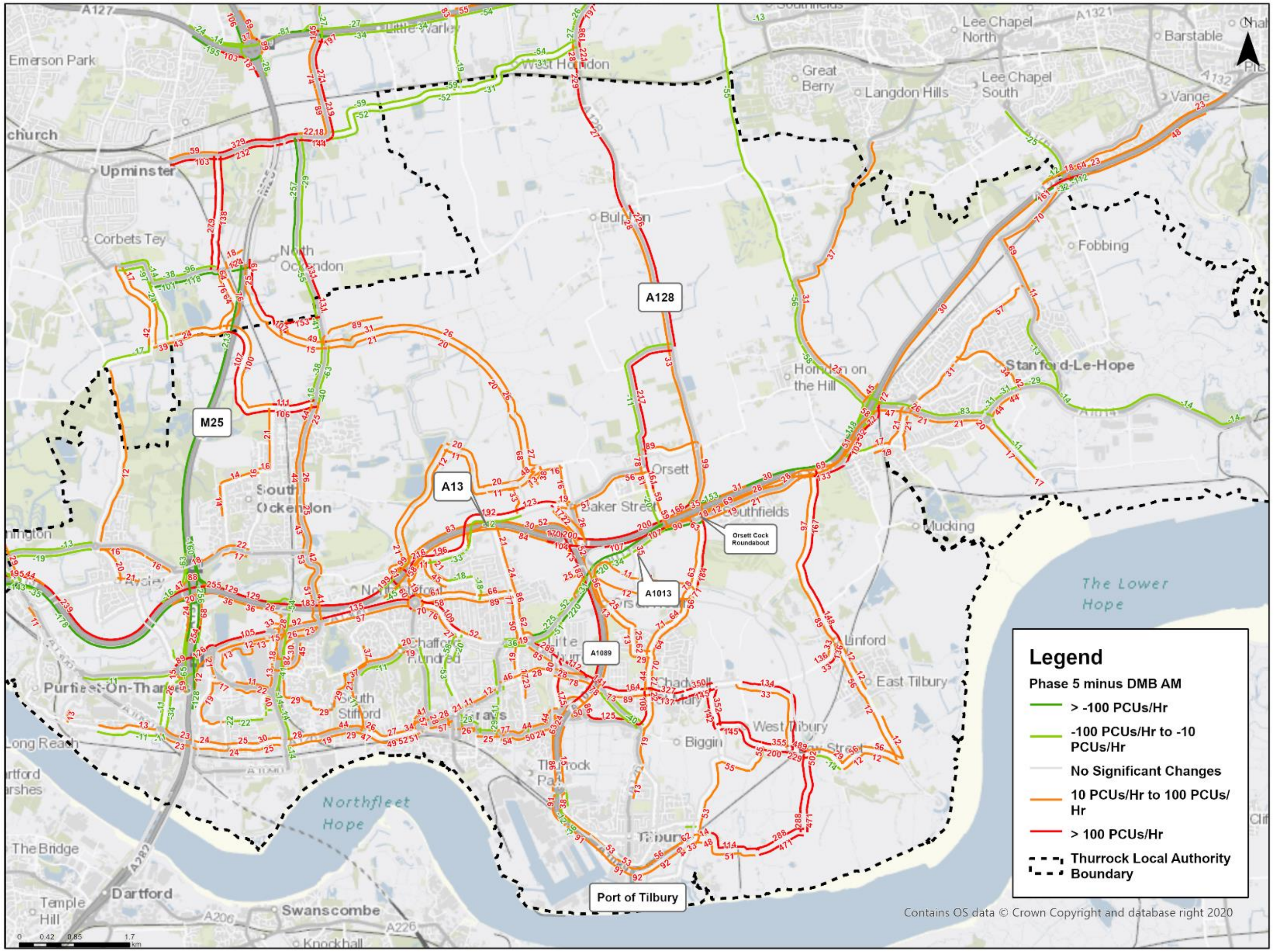

Figure 7-3 Phase 5 minus DMB. Flow Changes – AM peak

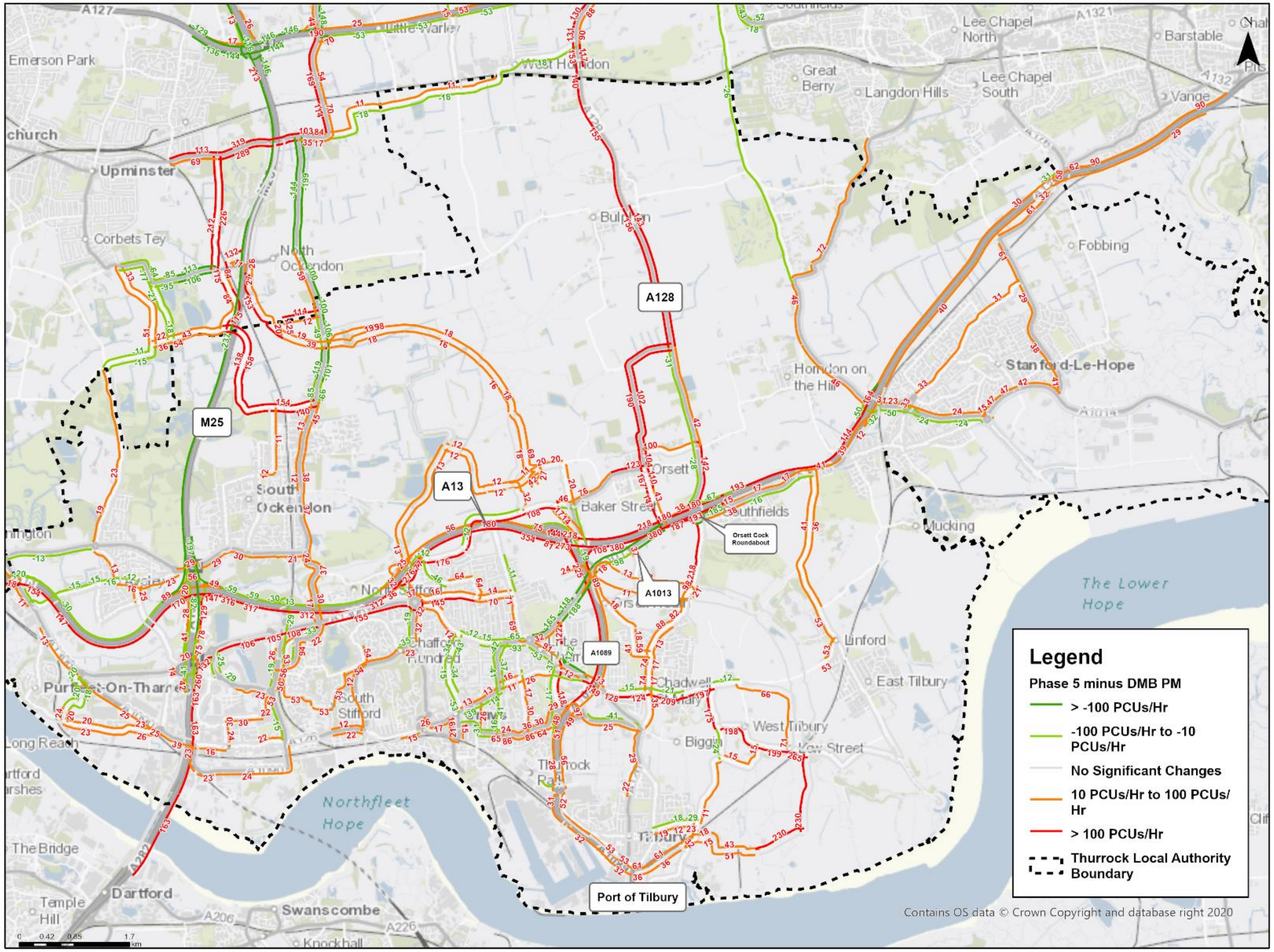

Figure 7-4 Phase 5 minus DMB. Flow Changes – PM peak

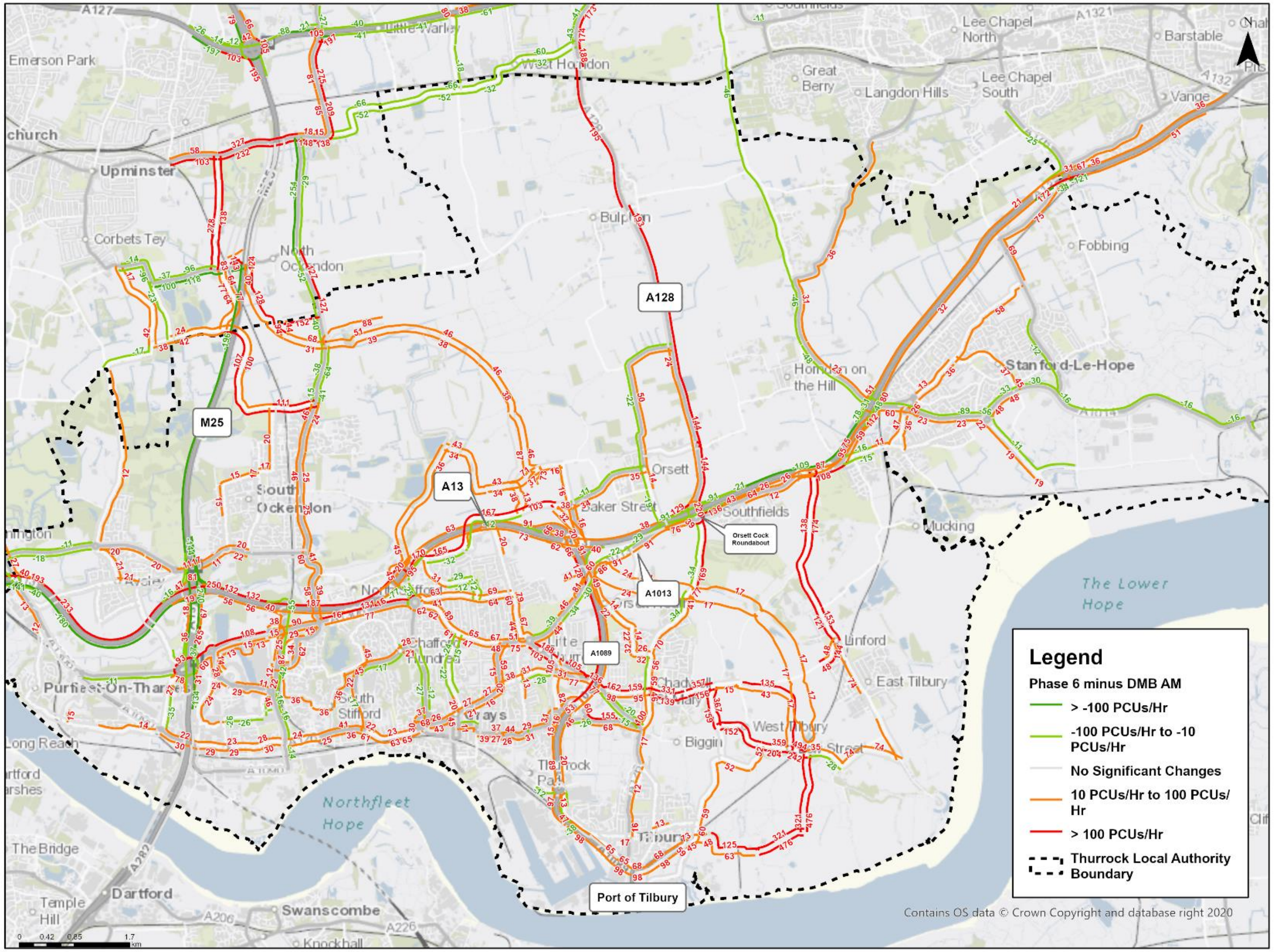

Figure 7-5 Phase 6 minus DMB. Flow Changes – AM peak

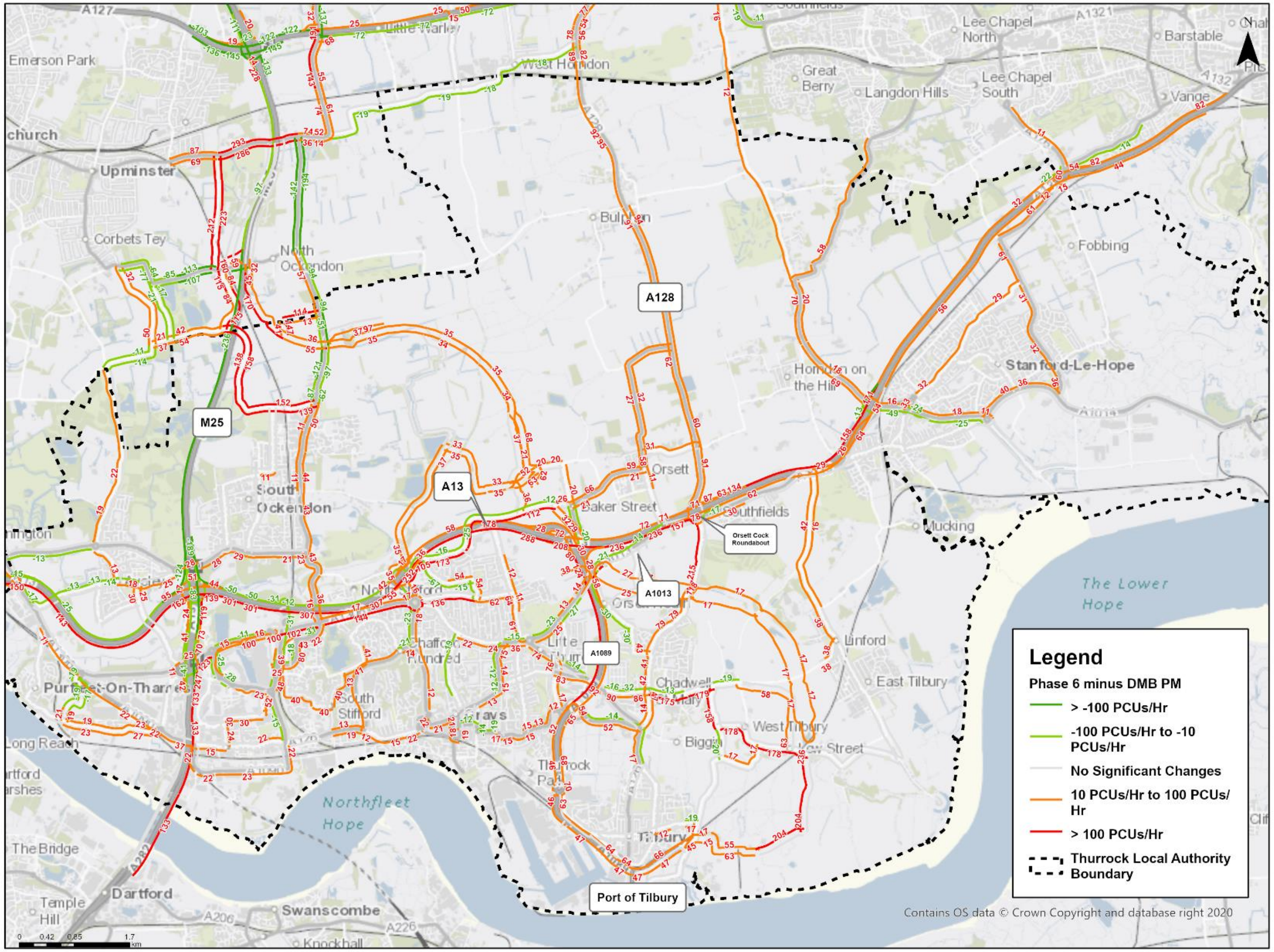

Figure 7-6 Phase 6 minus DMB. Flow Changes – PM

7.2.3 In general, traffic flow increases are predicted across the Thurrock LRN as a result of the construction activities associated with LTC. This is the case in both the AM and PM peak hours for the analysed Phases 4, 5 and 6. This includes:

- Increases on the A13.
- Increases are predicted on some roads to the north of the A13 including the B1007 North Hill including around Horndon on the Hill. Flow increases are also predicted on A128 Brentwood Road, sections of the B186 including Warley Street, and increases in Orsett Village on the B188 although there are some variations by phase. Flow increases are also predicted through South Ockendon.
- Flow increases are predicted on roads South of the A13 and to the west of the A108, including Arterial Road North Stifford/Arterial Road West Thurrock and on London Road. There are also flow increases on the A1089 itself.
- East of the A1089, there are flow increases predicted on the local roads through villages such as Chadwell St Mary, West and East Tilbury, Linford, Stanford-le-Hope and Corringham in some instances.
- Junctions such as Orsett Cock Roundabout, Manorway Roundabout, Five Bells Junction, ASDA Roundabout, Marshfoot Junction and Cross Keys/Chadwell Hill amongst others generally show flow increases.
- It is noted that there are also flow reductions on some links including the M25 itself and on local roads including on sections of the B186 Clay Tye Road and on sections of the A1013 Stanford Road west of Orsett Cock Roundabout.

7.2.4 Section 7.3 'Roads and Areas of Concern' and Section 8 'Junction Performance Analysis' aim to quantify and detail the changes.

7.3 Roads and Areas of Concern

7.3.1 As part of ongoing engagement between TC and NH regarding construction impacts an 'Initial' List and a 'Further' List of Roads/Areas of Concern was drawn up by TC. Figure 7-7 illustrates these roads and areas of concern.

7.3.2 Given the substantive list, flow changes at most of these locations have been tabulated separately for the AM, IP and PM peaks for all phases. Some of these locations are junctions that have been considered as part of the analysis in Section 8 'Junction Performance Analysis'.

7.3.3 Appendix B includes tables providing link flow analysis for the above locations. This includes tabulation of general traffic (User Classes 1 to 10) for the links in both DMA and DMB and for the corresponding flows for each of the phases. The three sets of construction vehicles (UC11 – HGV deliveries, UC12 for Construction Staff Cars and fixed flow earthworks HGVs) have also been tabulated making it possible to see a breakdown of each of the construction vehicle types using a particular link. Where the locations are junctions, these have been reported as part of the analysis in Section 8, while a few of the locations are not represented in the model and hence are not tabulated.

7.3.4 Flow differences between the total link flow for a link in a given phase against the corresponding DMA or DMB flows have also been tabulated indicating the flow changes as a result of construction activities.

7.3.5 By looking at the changes between the general traffic on a link in a given phase, against the general traffic in the corresponding DM, the analysis gives an indication of the levels of general traffic that diverts from a link as a result of construction activities. In essence, the changes in flows on a link as a result of construction activities comprise construction traffic (where it uses a link) and general traffic diverted to or away from the link. The analysis thus provides a comprehensive tabulation of flow information for the roads of concern for all phases. The analysis provides a complementary information to the flow change plots in Appendix A.

7.3.6 There is a significant level of variation in traffic flow changes across different construction phases and different time peaks, which makes it difficult to provide a summary description of flow changes. It is therefore recommended for the reader to refer and study the tables included in Appendix B.

7.3.7 It is proposed that impacts on the LRN in Thurrock are monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the governance framework within the OTMPfC. An initial network monitoring plan for the LTC construction period has been proposed by TC for inclusion in the OTMfC and is shown in Figure 7-8. Monitoring during construction will need to be flexible to reflect changes in proposed activity during each construction phase and to address unexpected impacts.

Roads and Areas of Concern

Initial List from Community Impacts Consultation
1. Rectory Road, Orsett Village
2. Stifford Clays Road, Orsett Village
3. B186, North Ockendon (and Ockendon Rd)
4. B186, South Ockendon
5. B188, Baker Street Village
6. A1014, North Bound
7. A128 Brentwood Road (North of Orsett Cock)
8. A1089
9. Buckingham Hill Road (North Bound)
10. A13WB Stanford Le-Hope Bypass to Orsett Cock
11. A13 The Manorway Roundabout
12. M25 Junction 30
13. Asda Roundabout
14. A1013 and Daneholes Roundabout

Further List
15. A13 Orsett Cock Roundabout
16. Brentwood Road (North of Orsett Cock)
17. Brentwood Road / Chadwell St Mary
18. Marshfoot Rd
19. Hoford Rd
20. Muckingford Road / Linford Road
21. Princess Margaret Road, East Tilbury
22. Fort Road / Gun Hill / Turnpike Lane (West Tilbury)
23. Station Road / Love Lane / Low Street Ln
24. Dock Road
25. Green Lane
26. Stifford Clays Road
27. North Hill B1007 /Orsett Road, Horndon on the Hill
28. A1013 The Manorway to Buckingham Hill Road
29. A1013 Orsett Cock to Buckingham Hill Road
30. A1013 Orsett Cock to A1089
31. Heath Road
32. Old Dock Approach Rd
33. Dock Road
34. A1012 Elizabeth Road
35. Blackshots Lane
36. Medebridge Road
37. Dennis Road / West Road
38. A 1306 Arterial Road North Stifford
39. St Chads Rd / Feenan Highway

Figure 7-7 Roads and Areas of Concern

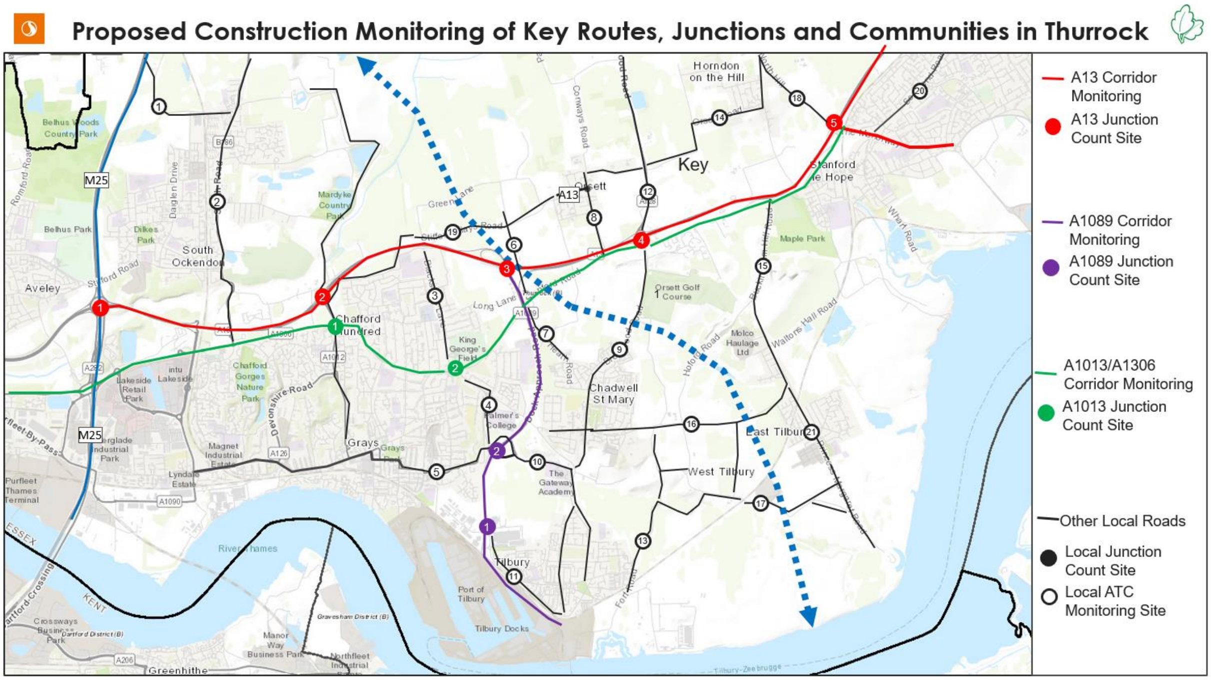

Figure 7-8 Proposed Construction of Key Routes, Junctions and Communities in Thurrock

7.4 Construction Compound Traffic Select Link Analysis (SLA)

7.4.1 Select Link Analysis (SLA) has also been undertaken in order to understand routes taken by Construction Traffic. This has been undertaken as two-way flows into and from the construction compounds. The SLA plots have focussed on Phase 6 which is one of the most significantly impacted phases. Analysis was based on the compounds with the most construction traffic which are:

- Northern Tunnel entrance compound;
- M25 compound;
- Brentwood Road compound;
- Stifford Clays Road compound East;
- Ockendon Road compound;
- Medebridge compound;
- Warley Street compound;
- M25 compound.

7.4.2 As previously noted, the zones are large and hence it is unlikely that construction traffic would be loaded to specific network access points accurately. It is considered that this is likely to underestimate construction traffic impacts at access junctions where construction traffic interacts with the local network. This reflects the limitations of the strategic model in accurately representing the localised impacts of the construction activities and is contrary to the commitments that NH has made in assigning its traffic to specified routes.

7.4.3 UC11 (HGV construction vehicles, understood to be delivery HGVs) and UC12 (Car Construction staff vehicles) each have their own matrix demand and have been analysed. Additionally, HGV (earthworks) modelled as fixed flows have also been included in the analysis.

7.4.4 The flows presented in Appendix C are the sum of all three construction traffic vehicle types and are in PCU/hour. The busiest compound appears to be the Northern Tunnel entrance compound in Phase 6 in the AM peak. The construction traffic in Phase 6 to and from the Northern Tunnel entrance compound is seen to be spread across a number of routes including but not limited to the following strategic routes:

- Dartford Crossing;
- M25 including through Junction 30 and Junction 29 and onwards beyond the northern edge of the Cordon Model;
- B149/Woodview Road/A1013 Lodge Lane/Long Lane/Arterial Road North Stifford/Arterial Road West Thurrock and onwards through M25 Junction 31 and the Dartford Crossing;
- A1089 including through ASDA Roundabout and onwards onto/from A13 West of the A13/A1089 Interchange;
- A13 northeast and southwest of the Manorway Roundabout;

And more localised roads such as:

- Marshfoot Road
- B1007 North Hill;
- Chadwell Hill/Brentwood Road through Chadwell St Mary including Cross Keys junction;
- A128 Brentwwood Road north of Orsett Cock Roundabout and through Orsett Cock Roundabout;
- Buckingham Hill Road/East Tilbury Road through Linford;
- Other local roads in East Tilbury and West Tilbury including but not limited to Linford Road, Muckingford Road, Gun Hill, Fort Road, Station Road/Church Road and Princess Margaret Road.

7.4.5 It is therefore evident that unless the vehicles are effectively and robustly monitored and managed by NH and its contractors construction traffic will use and impact on local roads in Thurrock particularly to the east of the A1089 including in sensitive local communities such as Chadwell St Mary, West Tilbury, East Tilbury, Linford, Orsett and Horndon on the Hill in some phases.

8 Junction Performance Analysis

8.1 Introduction

8.1.1 This section reviews the impacts of the construction activities at individual junctions, which were identified from earlier reviews as the main likely areas of scheme impact in Thurrock.

8.1.2 The section provides further detail regarding the turning flows extracted from the CTM models as well as junction performance of the analysed junctions. The analysis is presented for the AM and PM peak hours for a set of key junctions identified as key junctions in the LTC operational model review. The junctions are listed below and are shown in Figure 8-1. Outputs are provided for all phases.

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junction

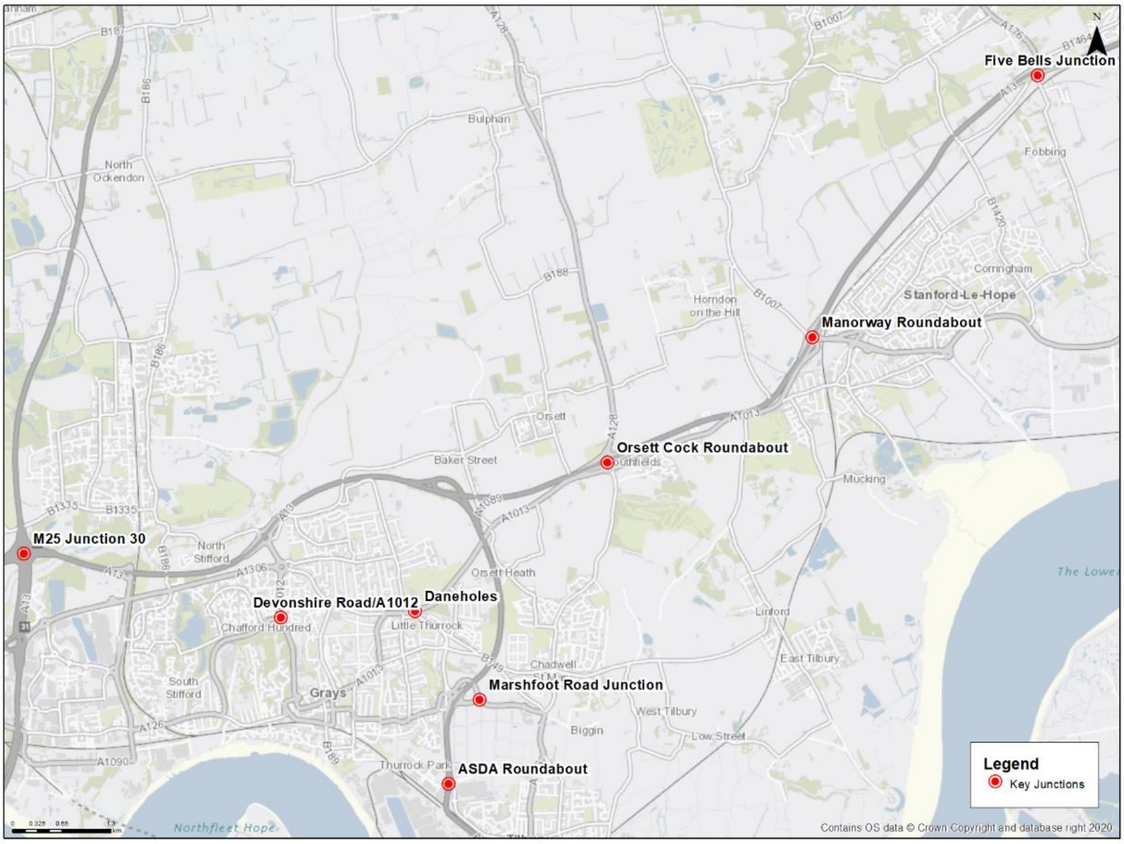

Figure 8-1: Key Junctions

8.1.3 Comparisons are shown for all junction approach arm considering the following performance measures - traffic flows, Volume to Capacity Ratio (VC%) and delays in seconds. For each junction, changes in these performance measures are shown alongside the absolute values in a tabular format. The change is the difference between the construction phase and its respective DM, which is either DMA or DMB. Table 8-1 shows which of DMA and DMB are compared to which phase. In the difference or change tables, red values depict an increase compared to the respective DM and green values depict a reduction for flows and VC% changes. Delay changes of < 30 seconds are shown in green values while those between 30 and 120 seconds are shown in orange and those > 120 seconds are shown in red. It is considered that delay increases of 30 seconds and above imply a significant impact.

Do Minimum (DM)	Phases compared against
DMA	Phase 1, 2, 3, 5, 6, 7, 8
DMB	Phases 4, 9, 10, 11

Table 8-1 Do minimums and Phases against which they are compared

8.1.4 Appendix D graphically presents a comparison of changes in delays between each phase and its respective DM. No junctions in addition to those considered in this section are forecast to experience increased delays during the construction phases.

8.1.5 This aspect of the review has been undertaken to demonstrate how the key junctions within Thurrock may be impacted in traffic terms as a result of the LTC construction activities with any increases in traffic flows most likely resulting in the worsening of congestion and junction operation. It is assumed that each phase proceeds sequentially as indicated and does not coincide with other phases or works.

8.2 The Manorway Roundabout

8.2.1 Figure 8-2 provides a diagram of the junction within the LTAM Saturn model including the labels of each arm.

Figure 8-2 Manorway Junction arm IDs

8.2.2 Table 8-2 shows the junction flows and performance outputs for the AM peak hour and PM peak hour at the Manorway Junction.

- Flows are predicted to change by between +1% and + 4% in the AM peak and by between -1% and +2% in the PM peak;

- In both the AM and PM peaks, the VC% is predicted to be within 100%, i.e. to operate within capacity;
- In the AM peak Arm A (B1007) is predicted to show delay increases ranging between 13 seconds and 138 seconds depending on phase while in the PM peak no delay increases are predicted;
- The AM delay increases on Arm A are in excess of 30 seconds for Phases 1 to 10 which have a combined duration of 55 months. The worst three phases are:
    - Phase 4 (+114 seconds) (5 months duration);
    - Phase 5 (+138 seconds) (5 months duration);
    - Phase 6 (+120 seconds) (5 months duration).

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	595	593	598	608	622	622	616	615	616	615	608	603	590
B	592	595	669	678	637	641	667	675	662	648	646	645	612
C	2028	2035	2065	2073	2083	2071	2083	2095	2090	2075	2046	2062	2048
D	375	376	412	406	427	417	427	451	440	420	417	455	425
E	2885	2890	2882	2861	2832	2844	2869	2887	2861	2843	2918	2939	2896
Total	**6475**	**6489**	**6626**	**6625**	**6601**	**6595**	**6661**	**6724**	**6668**	**6600**	**6636**	**6704**	**6571**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	5	15	29	27	23	23	23	22	13	8	-5
B	0	0	74	83	41	49	72	80	66	53	54	53	20
C	0	0	29	37	48	44	47	60	54	39	19	34	20
D	0	0	36	31	51	43	51	75	64	44	43	80	50
E	0	0	-9	-30	-58	-41	-22	-3	-29	-48	33	54	10
Total	0	0	136	136	111	121	172	235	179	111	161	229	96
% Increase			2%	2%	2%	2%	3%	4%	3%	2%	2%	4%	1%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	47	47	49	49	51	51	51	51	51	50	49	49	48
B	37	37	42	43	40	40	42	42	41	41	41	40	38
C	49	49	50	50	50	50	50	51	50	50	49	50	49
D	48	49	55	56	60	58	59	65	62	58	55	62	56
E	36	36	36	36	36	36	36	36	36	36	37	37	36
Maximum	**49**	**49**	**55**	**56**	**60**	**58**	**59**	**65**	**62**	**58**	**55**	**62**	**56**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	1	2	3	3	3	4	3	3	2	2	0
B	0	0	5	5	3	3	4	5	4	3	3	3	1
C	0	0	1	1	1	1	1	1	1	1	0	1	0
D	0	0	7	7	11	10	11	16	14	10	7	13	8
E	0	0	0	0	-1	-1	0	0	0	-1	0	1	0
Maximum	0	0	7	7	11	10	11	16	14	10	7	13	8

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	175	179	227	250	296	289	305	317	300	270	242	243	188
B	28	28	29	29	28	28	29	29	29	28	28	28	28
C	9	9	9	9	9	9	9	9	9	9	9	9	9
D	10	10	11	12	13	12	13	14	13	12	11	13	11
E	1	1	1	1	1	1	1	1	1	1	1	1	1
Maximum	**175**	**179**	**227**	**250**	**296**	**289**	**305**	**317**	**300**	**270**	**242**	**243**	**188**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	47	71	116	114	126	138	120	91	68	68	13
B	0	0	1	1	0	0	1	1	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	1	1	2	2	2	4	3	2	1	2	1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	47	71	116	114	126	138	120	91	68	68	13

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	558	556	563	559	578	570	552	574	571	570	574	568	554
B	583	583	629	602	582	582	583	585	584	583	587	583	583
C	2759	2764	2770	2734	2718	2721	2714	2715	2725	2741	2748	2757	2751
D	278	276	340	328	288	291	314	302	295	289	283	284	270
E	3213	3212	3247	3197	3169	3159	3144	3171	3177	3183	3194	3197	3204
Total	**7390**	**7391**	**7550**	**7421**	**7335**	**7322**	**7306**	**7346**	**7350**	**7366**	**7386**	**7389**	**7362**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	7	3	22	12	-4	18	15	14	16	10	-4
B	0	0	46	19	-1	-1	0	2	1	0	5	0	0
C	0	0	7	-29	-46	-38	-50	-49	-39	-23	-11	-2	-8
D	0	0	64	53	12	13	39	26	19	14	5	6	-7
E	0	0	35	-15	-43	-54	-69	-42	-36	-29	-19	-16	-9
Total	0	0	159	31	-56	-68	-84	-44	-40	-24	-4	-1	-28
% Increase			2%	0%	-1%	-1%	-1%	-1%	-1%	0%	0%	0%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	43	43	43	41	41	41	40	41	41	42	42	42	43
B	37	37	39	38	36	37	37	37	37	37	37	37	37
C	67	67	67	66	66	66	66	66	66	66	66	67	66
D	66	66	82	75	65	65	67	67	67	67	66	67	63
E	40	40	41	40	40	40	40	40	40	40	40	40	40
Maximum	67	67	82	75	66	66	67	67	67	67	66	67	66

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	-2	-2	-2	-4	-2	-2	-2	-1	-1	-1
B	0	0	3	1	0	0	0	0	0	0	0	0	0
C	0	0	0	-1	-1	-1	-1	-1	-1	-1	0	0	0
D	0	0	16	9	-1	-1	1	2	1	1	0	1	-3
E	0	0	0	0	-1	-1	-1	-1	0	0	0	0	0
Maximum	0	0	16	9	0	0	1	2	1	1	0	1	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	30	30	29	24	24	23	21	24	24	25	26	26	28
B	28	28	28	28	28	28	28	28	28	28	28	28	28
C	14	14	14	13	13	13	13	13	13	13	13	14	13
D	22	22	32	25	21	21	20	21	21	22	22	22	21
E	1	1	1	1	1	1	1	1	1	1	1	1	1
Maximum	**30**	**30**	**32**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-1	-6	-5	-7	-9	-6	-6	-5	-4	-4	-2
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	10	3	-1	-1	-1	-1	-1	0	0	0	-1
E	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	10	3	0	0	0	0	0	0	0	0	0

Table 8-2 Manorway roundabout Flows and Junction Performance

8.3 Orsett Cock Roundabout

8.3.1 Figure 8-3 provides a diagram of the junction within the LTAM Saturn model including the labels of each arm.

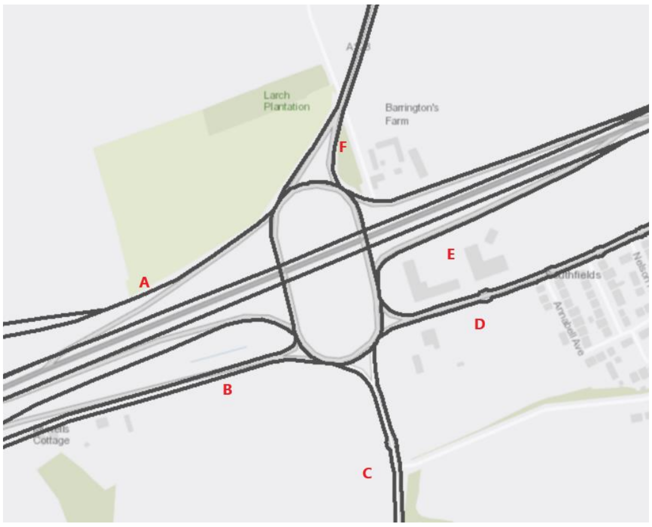

Figure 8-3 Orsett Cock Junction Arm IDs

8.3.2 Table 8-3 shows the junction flows and performance outputs for the AM and PM peak hours at the Orsett Cock Junction.

- Flows are predicted to change by between 0% and + 7% in the AM peak and by between -2% and +4% in the PM peak
- In the AM peak, Arm D (A1013 Stanford Road – east) is predicted to go from below capacity in the DM to VC% of 100% and above, i.e. overcapacity in Phases 3, 4, 6, 7,8, 10 and 11. No overcapacity issues are predicted in the PM peak.
- In the AM peak Arm D is predicted to show delay changes ranging between -6 seconds and 78 seconds while in the PM peak delay changes ranging between -1 second and 21 seconds are predicted at the junction depending on phase. The AM peak has large delay increases of 30 seconds and above on this arm for the following phases:
  - Phase 3 (37 seconds) (3 months duration);
  - Phase 6 (39 seconds) (5 months duration);
  - Phase 7 (78 seconds) (7 months duration);
  - Phase 11 (77 seconds) (17 months duration)

8.3.3 Arm C, Brentwood Road is a critical route for construction traffic, however, as the HGV delivery vehicles and construction car traffic are not fixed to routes such as Brentwood Road, but allowed to route across the network, it is likely that impacts at Orsett Cock roundabout including on Brentwood Road may be underestimated in the strategic model. Construction impacts at the junction could be better understood through restricting HGV construction traffic to planned routes and modelling potential impacts using localised tools such as microsimulation modelling.

8.3.4 It is also noted that the strategic model represents average conditions in the modelled hours and is likely to underestimate impacts of construction activities and traffic at critical junctions such as Orsett Cock Junction. While the strategic model maybe an adequate model to inform the economic costs of the delays due to construction activities as part of cost benefit analysis of the LTC, it is less suitable for understanding localised impacts at critical locations or junctions such as Orsett Cock.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	805	806	905	885	957	847	906	950	940	927	1048	970	848
B	918	918	899	1000	1045	951	931	1054	1045	1004	1009	1311	1278
C	1069	1066	1091	1076	1064	1106	1085	1076	1070	1075	1025	978	1035
D	642	645	539	523	618	723	708	610	611	635	634	526	494
E	727	728	766	787	786	583	363	712	706	688	648	724	691
F	689	688	837	833	816	881	854	817	798	767	667	698	726
Total	4850	4851	5037	5104	5287	5090	4845	5219	5171	5096	5032	5207	5072

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	99	79	151	42	99	144	134	121	243	166	43
B	0	0	-19	82	127	33	13	136	127	86	90	392	360
C	0	0	25	10	-1	37	19	10	4	9	-43	-91	-33
D	0	0	-106	-121	-27	81	63	-34	-33	-10	-8	-116	-148
E	0	0	38	59	58	-145	-365	-16	-22	-40	-79	-4	-36
F	0	0	149	145	128	192	166	129	110	78	-22	10	38
Total	0	0	186	253	436	240	-6	368	320	245	182	357	222
% Increase			4%	39%	68%	5%	0%	8%	7%	5%	4%	7%	5%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	30	30	35	36	38	33	30	37	36	35	37	34	29
B	48	48	47	53	55	50	49	56	55	53	53	69	67
C	64	63	65	64	63	66	65	64	64	64	61	58	62
D	92	92	89	84	101	100	89	101	101	100	96	103	102
E	55	55	58	59	59	44	27	54	53	52	49	54	52
F	60	60	73	73	79	77	74	71	70	67	58	61	63
Maximum	92	92	89	84	101	100	89	101	101	100	96	103	102

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	5	6	8	3	0	7	6	5	7	4	-1
B	0	0	-1	4	7	2	1	7	7	5	5	21	19
C	0	0	2	1	0	2	1	1	0	1	-3	-5	-2
D	0	0	-2	-8	9	8	-3	9	9	8	4	10	10
E	0	0	3	4	4	-11	-28	-1	-2	-3	-6	0	-3
F	0	0	13	13	19	17	14	11	10	7	-2	1	3
Maximum	0	0	13	13	19	17	14	11	10	8	7	21	19

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	4	4	5	5	5	4	4	5	5	4	4	4	4
B	12	12	12	12	12	12	12	13	12	12	12	15	14
C	29	29	30	29	29	30	29	29	29	29	27	26	28
D	31	30	31	24	67	56	24	68	69	56	42	109	108
E	1	1	1	1	1	0	0	1	1	1	1	1	1
F	26	26	28	28	32	29	29	28	27	27	25	26	26
Maximum	31	30	31	29	67	56	29	68	69	56	42	109	108

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	1	0	0	1	1	0	1	3	2
C	0	0	1	0	0	1	1	0	0	0	-1	-3	-1
D	0	0	0	-6	37	26	-6	38	39	26	12	78	77
E	0	0	0	0	0	0	-1	0	0	0	0	0	0
F	0	0	3	2	6	4	3	2	2	1	0	0	1
Maximum	0	0	3	2	37	26	3	38	39	26	12	78	77

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	961	964	1072	1028	1073	1010	1106	1055	1052	1037	1132	1050	975
B	958	963	829	944	991	819	778	946	937	929	985	1119	1116
C	730	730	820	816	793	783	768	760	730	731	685	741	741
D	386	394	340	471	579	643	612	609	601	572	484	494	423
E	941	940	976	997	1049	819	526	936	947	941	939	1011	980
F	1072	1067	1084	1075	951	1151	1105	1068	1072	1082	1030	982	1073
Total	5048	5057	5121	5331	5435	5226	4894	5376	5337	5292	5255	5398	5308

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	109	65	109	49	142	91	88	73	170	89	13
B	0	0	-134	-19	28	-139	-185	-17	-27	-34	27	161	158
C	0	0	90	86	63	53	38	30	0	1	-46	11	10
D	0	0	-55	76	185	258	218	215	207	178	98	108	38
E	0	0	36	58	109	-122	-414	-3	7	1	-2	71	39
F	0	0	17	8	-116	79	38	1	5	15	-42	-90	1
Total	0	0	109	86	185	258	218	215	207	178	170	161	158
% Increase			2%	13%	29%	5%	4%	4%	4%	4%	3%	3%	3%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	49	49	51	53	56	51	48	54	53	53	52	52	49
B	51	51	44	50	52	43	41	50	49	49	52	59	59
C	43	43	49	49	47	47	46	45	43	43	41	44	44
D	32	33	33	45	52	48	44	51	49	46	40	48	41
E	71	71	73	75	79	62	40	71	71	71	71	76	74
F	70	70	71	70	92	75	72	70	70	71	67	64	70
Maximum	71	71	73	75	92	75	72	71	71	71	71	76	74

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	2	4	7	2	-1	5	5	4	4	4	1
B	0	0	-7	-1	1	-7	-10	-1	-1	-2	1	9	8
C	0	0	5	5	4	3	2	2	0	0	-3	1	1
D	0	0	0	12	19	16	12	18	16	13	8	16	9
E	0	0	3	4	8	-9	-31	0	1	0	0	5	3
F	0	0	1	1	23	5	2	0	0	1	-3	-6	0
Maximum	0	0	5	12	23	16	12	18	16	13	8	16	9

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	6	6	6	6	6	6	5	6	6	6	5	6	6
B	12	12	11	12	12	11	11	12	12	12	12	13	13
C	18	18	21	20	20	19	19	19	18	18	16	18	18
D	7	7	7	8	8	7	7	8	8	7	7	8	8
E	1	1	1	1	1	1	0	1	1	1	1	1	1
F	24	24	24	24	45	25	24	24	24	24	23	23	24
Maximum	24	24	24	24	45	25	24	24	24	24	23	23	24

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	-1	0	0	0	0	0	0
B	0	0	-1	0	0	-1	-1	0	0	0	0	1	1
C	0	0	3	3	2	2	1	1	0	0	-1	0	0
D	0	0	1	1	2	0	0	1	1	1	0	2	1
E	0	0	0	0	0	0	-1	0	0	0	0	0	0
F	0	0	0	0	21	1	1	0	0	0	-1	-1	0
Maximum	0	0	3	3	21	2	1	1	1	1	0	2	1

Table 8-3 Orsett Cock Junction Flows and Junction Performance

8.4 ASDA Roundabout

8.4.1 Figure 8-4 provides a diagram of the junction within Saturn including the labels of each arm.

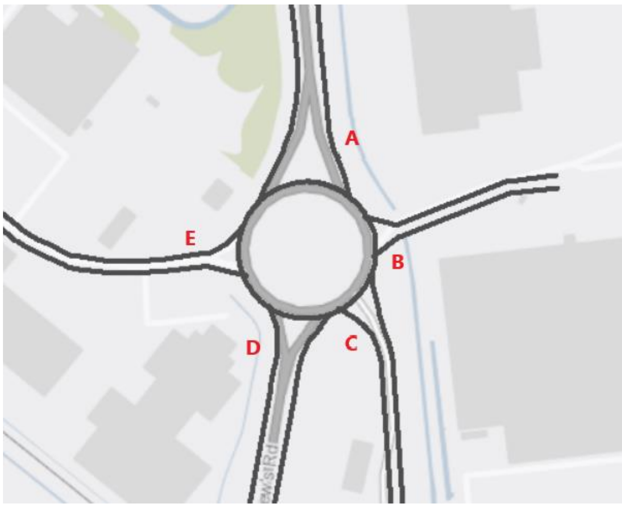

Figure 8-4 ASDA Junction Arm IDs

8.4.2 Table 8-4 shows the junction flows and performance outputs for the AM and PM peak hours at the ASDA Roundabout.

- Flows are predicted to change by between 2% and +5% in the AM peak and by between -1% and +10% in the PM peak

- In the AM peak, Arm D (A1089 St Andrew's Road) is predicted to go from below capacity in the DM (93% DMA, 94% DMB) to a VC% of 100% and above, i.e. overcapacity in most phases. Arm A (A1089 St Andrew's Road) which is already overcapacity in the AM peak DM scenario sees further increases in VC% or remains overcapacity in all phases in the AM peak. In the PM peak, Arm E (Thurrock Park Way) becomes overcapacity in Phase 1 and has VC% ranging between 91% and 98% in the construction phases, with VC% values equal to and in most cases greater than those seen in the DMs.

- In the AM peak, Arm A and Arm D are predicted to have delay increases of 30 seconds or more:

  - Phase 1 (33 seconds) (8 months duration) for Arm A;
  - Phase 1 (135 seconds) for Arm D and the following phases also for Arm D:
  - Phase 3 (41 seconds) (3 months duration)
  - Phase 6 (46 seconds) (5 months duration)
  - Phase 7 (31 seconds) (7 months duration)
  - Phase 9 (31 seconds) (4 months duration)

- In the PM peak a delay increase of 211 seconds is predicted in Phase 1 on Arm E.

8.4.3 The ASDA roundabout is a critical junction that is expected to carry construction traffic hence would benefit from localised modelling such as microsimulation to better understand the impacts of construction activities as the strategic model is likely to underestimate impacts.

This junction is also critical to the operation of the Port of Tilbury and the other commercial activities around that junction.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	2522	2529	2573	2547	2553	2547	2544	2549	2545	2550	2512	2541	2529
B	112	112	112	112	112	112	112	112	112	112	112	112	112
C	452	452	636	463	471	463	456	465	460	453	468	452	450
D	1088	1108	1092	1160	1188	1175	1199	1205	1197	1192	1186	1172	1103
E	304	304	303	312	311	313	313	312	312	311	308	307	305
Total	**4477**	**4505**	**4716**	**4594**	**4635**	**4611**	**4625**	**4642**	**4628**	**4618**	**4587**	**4584**	**4500**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	44	18	24	26	15	20	16	21	-10	19	8
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	185	12	19	12	4	13	9	2	17	1	-2
D	0	0	-16	52	80	87	91	97	89	84	98	85	15
E	0	0	-1	8	7	8	9	8	8	7	4	2	1
Total	**0**	**0**	**211**	**89**	**130**	**133**	**120**	**137**	**123**	**113**	**109**	**107**	**22**
% Increase			**5%**	**2%**	**3%**	**3%**	**3%**	**3%**	**3%**	**3%**	**2%**	**2%**	**1%**

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	101	102	104	103	103	102	103	103	103	103	101	102	101
B	71	71	71	71	71	71	71	71	71	71	71	71	71
C	57	58	84	61	62	60	60	61	61	60	61	59	57
D	93	94	106	98	101	100	101	102	101	100	101	99	94
E	40	40	44	44	44	44	45	45	45	44	44	43	40
Maximum	**101**	**102**	**106**	**103**	**103**	**102**	**103**	**103**	**103**	**103**	**101**	**102**	**101**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	2	1	1	1	1	1	1	1	0	1	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	26	3	4	3	2	3	3	2	3	1	0
D	0	0	13	4	8	7	7	8	7	6	8	6	1
E	0	0	4	3	4	5	5	5	5	4	5	3	1
Maximum	**0**	**0**	**26**	**4**	**8**	**7**	**7**	**8**	**7**	**6**	**8**	**6**	**1**

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	59	70	103	85	90	81	84	87	85	88	55	76	66
B	51	51	51	51	51	52	51	51	51	51	51	51	51
C	11	11	20	12	12	12	12	12	12	12	12	12	11
D	21	22	157	36	62	41	49	67	53	38	52	38	22
E	9	9	10	10	10	10	10	10	10	10	10	10	9
Maximum	**59**	**70**	**157**	**85**	**90**	**81**	**84**	**87**	**85**	**88**	**55**	**76**	**66**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	33	15	20	21	14	17	15	18	-5	16	6
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	9	1	1	1	0	1	1	1	1	0	0
D	0	0	135	14	41	20	27	46	31	16	31	17	1
E	0	0	1	1	1	1	1	1	1	1	1	1	0
Maximum	**0**	**0**	**135**	**15**	**41**	**21**	**27**	**46**	**31**	**18**	**31**	**17**	**6**

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	1859	1877	2047	1935	1994	1990	1933	1945	1940	1941	1903	1927	1873
B	112	112	112	112	112	112	112	112	112	112	112	112	112
C	451	451	689	461	458	457	458	456	453	454	459	448	454
D	919	956	1214	998	998	960	987	1002	996	1001	949	948	923
E	812	810	577	807	808	807	799	806	808	806	810	810	812
Total	**4153**	**4206**	**4639**	**4313**	**4371**	**4326**	**4291**	**4322**	**4310**	**4315**	**4233**	**4246**	**4175**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	169	58	116	131	56	68	62	64	43	68	14
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	238	10	8	6	8	6	3	3	9	-2	3
D	0	0	258	42	42	41	31	46	40	45	30	29	4
E	0	0	-233	-3	-2	-5	-10	-4	-2	-4	-2	-2	0
Total	**0**	**0**	**433**	**107**	**164**	**173**	**84**	**116**	**103**	**109**	**80**	**93**	**22**
% Increase			**10%**	**3%**	**4%**	**4%**	**2%**	**3%**	**2%**	**3%**	**2%**	**2%**	**1%**

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	74	76	82	78	80	80	78	78	78	78	76	77	75
B	33	34	41	36	38	38	36	36	36	36	34	35	33
C	48	48	74	49	49	49	49	49	49	49	49	48	49
D	61	64	96	67	67	65	66	67	67	67	64	63	62
E	91	93	110	97	98	94	96	97	97	97	94	93	91
Maximum	**91**	**93**	**110**	**97**	**98**	**94**	**96**	**97**	**97**	**97**	**94**	**93**	**91**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	7	2	5	5	2	3	3	3	2	3	1
B	0	0	7	2	4	5	2	3	2	2	2	2	0
C	0	0	26	1	1	1	1	1	0	0	1	0	0
D	0	0	32	4	4	4	3	4	3	3	3	2	0
E	0	0	16	4	4	4	2	4	4	4	3	2	1
Maximum	**0**	**0**	**32**	**4**	**5**	**5**	**3**	**4**	**4**	**4**	**3**	**3**	**1**

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	6	6	7	6	7	7	6	7	6	6	6	6	6
B	15	16	20	17	19	18	17	17	17	17	16	17	16
C	7	7	11	8	8	8	8	8	8	8	8	8	7
D	9	9	27	10	10	9	10	10	10	10	9	9	9
E	21	25	236	40	41	27	32	40	38	39	25	24	21
Maximum	**21**	**25**	**236**	**40**	**41**	**27**	**32**	**40**	**38**	**39**	**25**	**24**	**21**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	1	0	1	1	0	0	0	0	0	0	0
B	0	0	4	1	3	3	1	2	1	1	1	1	0
C	0	0	4	0	1	1	0	0	0	0	0	0	0
D	0	0	18	1	1	0	0	1	0	1	0	0	0
E	0	0	211	16	16	6	7	15	13	14	4	3	1
Maximum	**0**	**0**	**211**	**16**	**16**	**6**	**7**	**15**	**13**	**14**	**4**	**3**	**1**

Table 8-4 ASDA roundabout Flows and Junction Performance

8.5 Daneholes Roundabout

8.5.1 Figure 8-5 provides a diagram of the junction within Saturn including the labels of each arm.

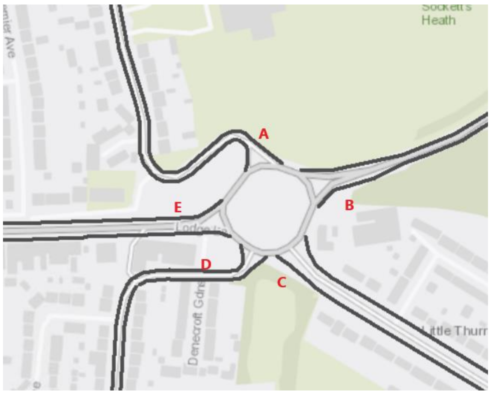

Figure 8-5 Daneholes Roundabout Arm IDs

8.5.2 Table 8-5 shows the junction flows and performance outputs for the AM and PM peak hours at the Daneholes Junction.

- Flows are predicted to change by between -2% and +10% in the AM peak and by between -4% and +6% in the PM peak
- In both the AM and PM peaks the VC% are less than 100% and though the junction is predicted to operate within capacity in the DMA and DMB as well as most phases, Phase 1 estimates that the maximum VC% can reach 90%.
- In both the AM and PM peaks the delay changes are low and well below 30 seconds.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	541	542	598	604	614	606	604	609	592	577	570	577	540
B	819	819	832	870	880	736	768	863	865	853	890	828	782
C	601	602	620	646	705	676	687	705	692	672	606	656	619
D	264	264	280	261	263	281	282	265	264	264	264	263	273
E	710	714	789	806	785	672	675	765	741	731	741	727	673
Total	2934	2940	3119	3187	3247	2971	3017	3206	3154	3099	3070	3053	2886

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	56	62	71	65	62	67	50	35	29	36	-1
B	0	0	13	51	61	-83	-51	44	46	34	71	9	-37
C	0	0	19	44	103	75	85	103	90	70	5	55	18
D	0	0	16	-3	0	17	19	1	0	1	0	0	9
E	0	0	75	93	71	-38	-38	51	27	18	31	17	-37
Total	0	0	179	247	307	36	77	266	214	159	136	118	-49
% Increase			6%	8%	10%	1%	3%	9%	7%	5%	5%	4%	-2%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	85	85	90	78	78	75	75	78	75	73	72	73	67
B	46	46	47	49	50	42	43	49	49	48	50	47	44
C	34	34	35	36	40	38	39	40	39	38	34	37	35
D	50	50	53	49	50	53	53	50	50	50	50	50	51
E	33	33	37	38	37	32	32	36	35	34	34	34	31
Maximum	85	85	90	78	78	75	75	78	75	73	72	73	67

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	5	-7	-6	-10	-10	-7	-10	-12	-13	-12	-18
B	0	0	1	3	3	-5	-3	2	3	2	4	1	-2
C	0	0	1	2	6	4	5	6	5	4	0	3	1
D	0	0	3	-1	0	3	4	0	0	0	0	0	2
E	0	0	4	5	4	-1	-1	3	2	1	1	1	-2
Maximum	0	0	5	5	6	4	5	6	5	4	4	3	2

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	32	32	37	38	38	37	37	38	36	35	34	35	32
B	20	20	21	22	22	19	19	21	21	21	22	21	20
C	13	13	13	14	14	14	14	14	14	14	13	14	13
D	30	30	31	30	30	32	32	30	30	30	30	30	31
E	13	13	14	14	14	14	14	14	14	13	14	14	13
Maximum	32	32	37	38	38	37	37	38	36	35	34	35	32

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	5	6	6	5	5	6	4	3	2	3	0
B	0	0	0	1	1	-1	-1	1	1	1	1	0	-1
C	0	0	0	1	1	1	1	1	1	1	0	1	0
D	0	0	1	0	1	2	2	1	1	1	0	1	1
E	0	0	1	1	1	0	0	1	0	0	0	0	0
Maximum	0	0	5	6	6	5	5	6	4	3	2	3	1

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	640	640	671	660	672	660	633	646	643	639	637	639	644
B	732	733	690	752	770	722	765	757	758	753	783	731	736
C	575	582	660	692	686	518	528	655	645	632	625	637	577
D	291	291	304	287	285	296	291	286	288	288	288	291	289
E	925	925	931	931	957	850	861	910	909	906	911	941	925
Total	3163	3170	3256	3323	3371	3046	3078	3256	3243	3218	3244	3239	3172

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	32	21	32	20	-7	7	4	-1	-3	-1	4
B	0	0	-43	19	38	-9	32	25	25	20	51	-1	5
C	0	0	79	111	105	-58	-53	74	63	50	49	61	2
D	0	0	13	-4	-5	5	0	-4	-3	-2	-4	0	-2
E	0	0	6	6	32	-75	-65	-16	-16	-19	-14	16	0
Total	0	0	87	153	201	-117	-92	86	73	48	81	76	8
% Increase			3%	5%	6%	-4%	-3%	3%	2%	2%	3%	2%	0%

V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	85	85	90	88	90	85	81	85	85	84	84	85	85
B	41	41	39	42	44	41	43	43	43	43	44	41	42
C	33	33	37	39	39	29	30	37	36	36	35	36	33
D	55	55	57	54	54	56	55	54	54	54	54	55	55
E	43	43	44	44	45	40	40	43	42	42	42	44	43
Maximum	85	85	90	88	90	85	81	85	85	84	84	85	85

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	5	3	5	0	-4	0	0	-1	-1	1	1
B	0	0	-2	1	2	-1	2	1	1	1	3	0	0
C	0	0	4	6	6	-3	-3	4	4	3	3	3	0
D	0	0	3	-1	-1	1	0	-1	-1	0	-1	0	0
E	0	0	2	1	2	-3	-3	0	0	0	0	1	0
Maximum	0	0	5	6	6	1	2	4	4	3	3	3	1

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	43	43	47	46	48	44	41	43	43	42	42	43	43
B	19	19	19	19	20	19	20	20	20	20	20	19	19
C	13	13	14	15	15	12	12	14	14	14	14	14	13
D	31	31	33	31	31	31	30	31	31	31	31	31	31
E	14	14	15	15	15	14	14	14	14	14	14	15	14
Maximum	43	43	47	46	48	44	41	43	43	42	42	43	43

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	5	3	5	1	-2	0	0	-1	-1	0	0
B	0	0	0	0	0	0	0	0	0	0	1	0	0
C	0	0	1	2	1	-1	-1	1	1	1	1	1	0
D	0	0	2	0	0	0	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	5	3	5	1	0	1	1	1	1	1	0

Table 8-5 Daneholes Roundabout Flows and Junction Performance

8.6 M25 Junction 30

8.6.1 Figure 8-6 provides a diagram of the junction within Saturn including the labels of each arm.

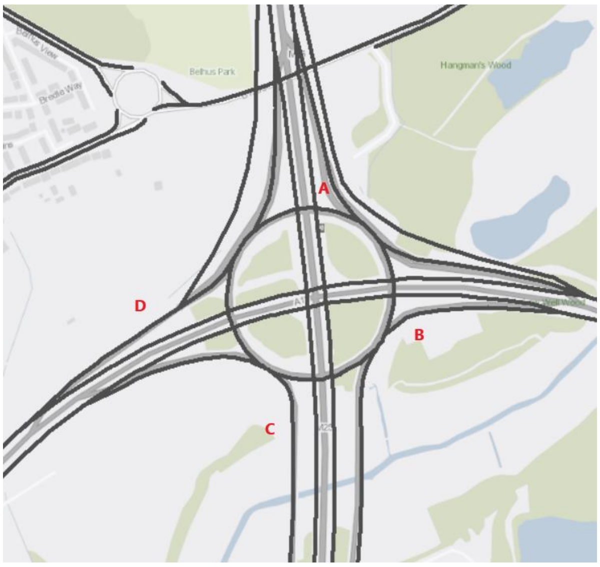

Figure 8-6 M25 Junction 30 Arm IDs

8.6.2 Table 8-6 shows the junction flows and performance outputs for the AM and PM peak hours at M25 Junction 30.

- Flows are predicted to change by between -1% and +2% in the AM peak and by between 0% and +5% in the PM peak
- In both the AM and PM peaks the VC% are less than 100% and below capacity in the DMA and DMB as well as in all phases. The VC% are in the range 98% to 99% in the PM peak on Arm C.
- In both the AM and PM peaks the delay changes are low and well below 30 seconds.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	1367	1366	1380	1397	1153	1163	1160	1159	1156	1153	1198	1190	1367
B	3405	3407	3424	3440	3471	3462	3401	3416	3412	3412	3260	3370	3454
C	2335	2337	2356	2357	2328	2341	2361	2356	2350	2363	2390	2388	2324
D	252	252	250	249	304	296	299	299	302	303	305	299	249
Total	5993	5995	6029	6046	6104	6099	6061	6070	6064	6079	5955	6058	6027

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	15	32	-212	-205	-205	-206	-210	-213	-170	-177	0
B	0	0	17	33	65	57	-5	9	6	6	-145	-35	49
C	0	0	19	20	-9	6	24	18	12	26	55	53	-11
D	0	0	-2	-3	53	43	47	47	50	52	53	47	-3
Total	0	0	34	50	108	106	66	75	68	84	-37	65	34
% Increase			1%	2%	1%	2%	1%	1%	1%	1%	-1%	1%	1%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	61	61	62	63	52	52	52	52	52	52	54	54	61
B	81	81	82	82	83	82	81	81	81	81	78	80	82
C	86	86	86	86	85	86	87	86	86	87	88	88	85
D	53	53	53	53	64	62	63	63	64	64	64	63	53
Maximum	86	86	86	86	85	86	87	86	86	87	88	88	85

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	1	1	-10	-9	-9	-9	-9	-10	-8	-8	0
B	0	0	0	1	2	1	0	0	0	0	-3	-1	1
C	0	0	1	1	0	0	1	1	0	1	2	2	0
D	0	0	0	-1	11	9	10	10	11	11	11	10	-1
Maximum	0	0	1	1	11	9	10	10	11	11	11	10	1

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	22	22	22	22	20	21	21	20	20	20	21	21	22
B	20	20	20	20	20	20	20	20	20	20	19	20	20
C	24	24	25	25	24	24	25	25	24	25	25	25	24
D	41	41	41	41	44	43	43	43	44	44	44	43	41
Maximum	41	41	41	41	44	43	43	43	44	44	44	43	41

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	0
B	0	0	0	0	1	1	0	0	0	0	-1	0	0
C	0	0	0	0	0	0	0	0	0	0	1	1	0
D	0	0	0	0	3	2	3	3	3	3	3	3	0
Maximum	0	0	0	0	3	2	3	3	3	3	3	3	0

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	1345	1345	1351	1355	1215	1220	1290	1294	1295	1281	1293	1284	1359
B	3173	3176	3274	3296	3343	3346	3323	3315	3311	3302	3221	3228	3173
C	3387	3388	3393	3396	3401	3400	3416	3413	3416	3414	3407	3405	3389
D	401	402	397	390	405	401	407	406	408	410	415	414	401
Total	3387	3388	3393	3396	3401	3400	3416	3413	3416	3414	3407	3405	3389

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	6	10	-131	-125	-55	-52	-50	-64	-52	-61	14
B	0	0	98	120	167	173	147	139	135	126	48	54	0
C	0	0	4	8	12	13	28	24	28	25	21	18	2
D	0	0	-5	-12	3	0	5	4	6	8	14	13	0
Total	0	0	98	120	167	173	147	139	135	126	48	54	14
% Increase			3%	4%	5%	5%	4%	4%	4%	4%	1%	2%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	60	60	61	61	55	55	58	58	58	58	58	58	61
B	79	79	81	82	83	83	82	82	82	82	80	80	79
C	98	98	99	99	99	99	99	99	99	99	99	99	98
D	85	85	84	82	86	85	86	86	86	87	88	87	85
Maximum	98	98	99	99	99	99	99	99	99	99	99	99	98

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	-6	-6	-2	-2	-2	-3	-2	-3	1
B	0	0	2	3	4	4	4	3	3	3	1	1	0
C	0	0	0	0	0	0	1	1	1	1	1	1	0
D	0	0	-1	-3	1	0	1	1	1	2	3	3	0
Maximum	0	0	2	3	4	4	4	3	3	3	3	3	1

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	22	22	22	22	21	21	21	21	21	21	21	21	22
B	20	20	21	21	21	21	21	21	21	21	20	20	20
C	38	38	39	39	40	40	43	43	43	43	41	41	38
D	57	58	56	55	59	57	59	59	59	60	62	62	57
Maximum	57	58	56	55	59	57	59	59	59	60	62	62	57

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	-1	-1	0	0	0	0	0	0	0
B	0	1	1	1	1	2	1	1	1	1	0	0	0
C	0	0	1	1	2	2	5	4	5	5	4	3	0
D	0	0	-1	-3	1	0	2	1	2	3	5	4	0
Maximum	0	0	-1	-3	1	0	2	1	2	3	5	4	0

Table 8-6 M25 Junction 30 Flows and Junction Performance

8.7 Marshfoot Junction

8.7.1 Figure 8-7 provides a diagram of the junction within Saturn including the labels for each arm. Arm C in the figure below is a minor arm representing the on and off slip to the A1089.

Figure 8-7 Marshfoot Junction Arm ID

8.7.2 Table 8-7 shows the junction flows and performance outputs for the AM and PM peak hours at the Marshfoot Raod Junction.

- Flows are predicted to change by between -21% and + 8% in the AM peak and by between -8% and +14% in the PM peak
- In the AM peak Arm C (A126 Marshfoot Road) sees an increase in VC% from 77% in DMA and DMB to values of 100% to 101% in Phases 3 to 6 while other phases have VC% values ranging between 91% and 99% except Phase 1 which has a VC% of 71%. Similar trends are seen on Arm C in the PM peak.
- In the AM peak there are delay increases of over 30 seconds on Arm C (A126 Marshfoot Road) in Phases 2 to Phase 10 (combined duration of 47 months)
- The delay increases on this arm range between 37 seconds and 73 seconds depending on phase. The worst three phases are:
  - Phase 4 (73 seconds) (5 months duration)
  - Phase 5 (76 seconds) (5 months duration)
  - Phase 6 (67 seconds) (5 months duration)
- In the PM peak only Phase 4 has a significant delay increase of 33 seconds.

8.7.3 The Marshfoot Road Junction is a critical junction that is expected to be impacted by construction activities and would benefit from localised modelling such as microsimulation to better understand the impacts of construction activities as the strategic model is likely to underestimate impacts. This junction has an existing poor safety record and this should be taken into consideration when analysing the operation of the junction.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	770	772	596	829	835	834	858	832	810	796	823	788	774
B	773	774	524	865	836	791	771	843	828	803	890	854	807
C	242	242	295	239	246	289	291	245	245	258	226	257	290
Total	1785	1788	1416	1933	1917	1913	1920	1919	1883	1856	1939	1899	1871

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-176	57	63	64	86	60	38	24	53	18	4
B	0	0	-250	90	62	18	-4	68	54	28	117	81	34
C	0	0	54	-2	5	47	50	3	4	16	-16	15	48
Total	0	0	-372	145	129	128	132	131	95	69	154	114	86
% Increase			-21%	8%	7%	7%	7%	7%	5%	4%	9%	6%	5%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	57	57	43	62	62	61	62	62	60	59	66	61	58
B	47	47	32	53	51	48	47	51	51	49	54	52	49
C	77	77	71	99	100	101	101	101	97	96	96	97	91
Maximum	77	77	71	99	100	101	101	101	97	96	96	97	91

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-14	5	4	3	5	5	3	1	9	3	1
B	0	0	-15	6	4	1	0	4	3	2	7	5	2
C	0	0	-6	22	23	24	24	24	20	19	19	20	14
Maximum	0	0	-6	22	23	24	24	24	20	19	19	20	14

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	11	11	8	12	12	11	12	12	11	11	13	11	11
B	8	8	4	10	9	8	8	10	9	9	11	10	9
C	27	27	18	86	91	100	103	94	77	65	75	74	41
Maximum	27	27	18	86	91	100	103	94	77	65	75	74	41

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-2	1	1	1	1	1	1	0	3	1	0
B	0	0	-4	2	1	0	0	1	1	1	3	2	1
C	0	0	-10	58	63	73	76	67	50	37	48	47	14
Maximum	0	0	-2	58	63	73	76	67	50	37	48	47	14

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	772	771	686	777	772	767	770	769	768	768	769	775	764
B	442	441	162	530	505	471	466	493	483	476	521	477	454
C	353	352	363	324	334	403	392	344	347	351	321	350	351
Total	1566	1564	1211	1631	1611	1641	1628	1606	1598	1595	1611	1602	1569
Change			-353	67	47	74	63	42	34	31	45	36	3

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-85	6	0	-5	-2	-3	-3	-3	-3	3	-8
B	0	0	-279	89	64	29	25	52	42	34	79	35	12
C	0	0	11	-28	-18	50	40	-7	-5	-1	-31	-3	-1
Total	0	0	-353	67	47	74	63	42	34	31	45	36	3
% Increase			3%	-8%	-5%	14%	11%	-2%	-1%	0%	-9%	-1%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	47	47	42	47	47	47	47	47	47	47	47	47	47
B	27	27	10	32	31	29	28	30	29	29	32	29	28
C	96	97	67	97	101	101	100	98	98	98	97	100	97
Maximum	96	97	67	97	101	101	100	98	98	98	97	100	97

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-5	0	0	0	0	0	0	0	0	0	0
B	0	0	-17	5	4	2	2	3	3	2	5	2	1
C	0	0	-30	1	4	5	4	1	1	1	1	4	1
Maximum	0	0	-5	5	4	5	4	3	3	2	5	4	1

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	7	7	6	8	8	7	7	7	7	7	8	8	7
B	3	3	1	4	4	3	3	4	4	3	4	3	3
C	53	56	12	64	80	86	69	63	62	61	63	69	57
Maximum	53	56	12	64	80	86	69	63	62	61	63	69	57

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-1	0	0	0	0	0	0	0	0	0	0
B	0	0	-2	1	1	0	0	1	0	0	1	0	0
C	0	0	-44	8	24	33	14	7	6	5	10	17	5
Maximum	0	0	-1	8	24	33	14	7	6	5	10	17	5

Table 8-7 Marshfoot Junction Flows and Junction Performance

8.8 Devonshire Road/A1012

8.8.1 Figure 8-8 provides a diagram of the junction within Saturn including the labels of each arm.

Figure 8-8 Devonshire/A1012 Junction Arm IDs

8.8.2 Table 8-8 shows the junction flows and performance outputs for the AM and PM peak hours at the this junction.

- Flows are predicted to change by between -3% and + 2% in the AM peak and by between 0% and +1% in the PM peak
- In both the AM and PM peaks, the VC% is predicted to be well within 100%, i.e. to operate below capacity in all phases
- In both the AM and PM peaks, the absolute delays are predicted to be low as are changes in delay.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	629	567	525	550	564	566	568	564	565	567	528	564	563
B	131	131	130	131	131	143	138	135	135	133	136	133	132
C	363	363	381	368	338	370	368	337	339	346	367	363	361
D	452	452	460	462	478	470	472	480	474	469	521	466	457
Total	**1575**	**1513**	**1496**	**1510**	**1511**	**1548**	**1546**	**1516**	**1513**	**1515**	**1552**	**1525**	**1512**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-42	-17	-3	-64	1	-3	-2	0	-102	-66	-67
B	0	0	0	0	1	12	7	4	4	2	5	2	1
C	0	0	17	5	-26	6	5	-27	-24	-17	4	-1	-3
D	0	0	8	9	26	19	20	28	22	17	70	15	5
Total	**0**	**0**	-17	-3	-2	-27	33	3	0	2	-23	-50	-63
% Increase			-1%	0%	0%	-2%	2%	0%	0%	0%	-1%	-3%	-4%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	32	32	30	31	32	32	32	32	32	32	30	32	32
B	5	5	5	5	5	6	6	5	5	5	5	5	5
C	21	21	22	21	19	21	21	19	19	20	21	20	20
D	48	48	49	49	51	50	51	51	51	50	56	50	49
Maximum	**48**	**48**	**49**	**49**	**51**	**50**	**51**	**51**	**51**	**50**	**56**	**50**	**49**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-2	-1	0	0	0	0	0	0	-2	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	1	0	-1	0	0	-2	-1	-1	0	0	0
D	0	0	1	1	3	2	2	3	2	2	7	2	1
Maximum	**0**	**0**	1	1	3	2	2	3	2	2	7	2	1

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	6	6	5	5	6	6	6	6	6	6	5	6	6
B	4	4	4	4	4	4	4	4	4	4	4	4	4
C	5	5	5	5	5	5	5	5	5	5	5	5	5
D	11	11	11	11	11	11	11	11	11	11	12	11	11
Maximum	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**12**	**11**	**11**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	1	0	0	1	0	0
Maximum	**0**	**0**	0	0	0	0	0	1	0	0	1	0	0

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	629	629	627	636	644	661	662	647	645	645	621	639	626
B	127	127	128	128	128	150	146	127	127	127	127	127	127
C	460	460	467	467	466	466	465	467	467	466	463	463	460
D	487	487	474	471	462	444	452	466	472	476	488	487	489
Total	**1704**	**1704**	**1696**	**1701**	**1699**	**1721**	**1725**	**1706**	**1711**	**1713**	**1699**	**1716**	**1703**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-2	6	14	32	33	18	16	15	-8	9	-3
B	0	0	0	0	0	23	19	0	0	0	0	0	0
C	0	0	7	6	5	6	4	6	7	5	3	3	0
D	0	0	-13	-16	-25	-43	-35	-21	-15	-11	1	0	2
Total	**0**	**0**	-8	-3	-5	18	21	2	7	9	-5	12	-1
% Increase			0%	0%	0%	1%	1%	0%	0%	1%	0%	1%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	36	36	35	36	36	37	37	37	36	36	35	36	35
B	5	5	5	5	5	6	6	5	5	5	5	5	5
C	26	26	26	26	26	26	26	26	26	26	26	26	26
D	52	52	51	50	49	48	48	50	50	51	52	52	52
Maximum	**52**	**52**	**51**	**50**	**49**	**48**	**48**	**50**	**50**	**51**	**52**	**52**	**52**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	1	2	2	1	1	1	0	1	0
B	0	0	0	0	0	1	1	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	-1	-2	-3	-5	-4	-2	-2	-1	0	0	0
Maximum	**0**	**0**	0	0	1	2	2	1	1	1	0	1	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	6	6	6	6	6	6	6	6	6	6	6	6	6
B	4	4	4	4	4	4	4	4	4	4	4	4	4
C	6	6	6	6	6	6	6	6	6	6	6	6	6
D	12	12	11	11	11	11	11	11	11	11	12	12	12
Maximum	**12**	**12**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**12**	**12**	**12**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	-1	-1	0	0	0	0	0	0
Maximum	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0

Table 8-8 Devonshire/A1012 Flows and Junction Performance

8.9 Five Bells Junctions and A13 Merge

8.9.1 Figure 8-9 provides a diagram of the two junctions and the westbound merge with the A13, which are of a particular interest.

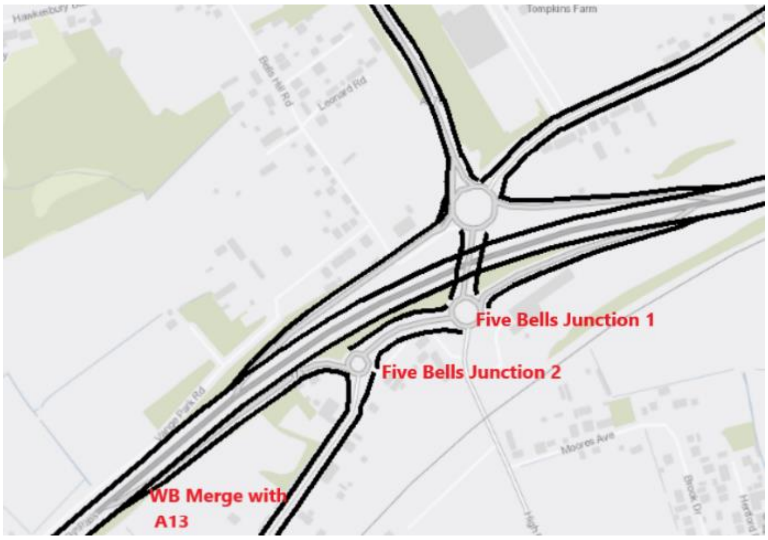

Figure 8-9: Five Bells Junctions and A13 Merge

8.9.2 Figure 8-10 provides a diagram of the Five Bells Junction 1 including the labels of each arm.

Figure 8-10: Five Bells Junction 1 Arm IDs

8.9.3 Table 8-9 shows the junction flows and performance outputs for the AM and PM peak hours at the Five Bells Junction 1.

- Flows are predicted to change by an order of-1% to -3% in the AM peak and an order of 0% to 3% in the PM peak.
- In both the AM and PM peaks, the VC% is predicted to be well below 100%, i.e. to operate below capacity in all phases
- In both the AM and PM peaks, the absolute delays are predicted to be low as are changes in delay.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	1389	1390	1390	1401	1426	1426	1426	1431	1427	1418	1403	1403	1390
B	780	781	741	702	676	676	669	661	673	692	728	735	774
C	575	575	576	579	579	579	580	580	580	580	581	581	576
Total	2744	2746	2706	2682	2681	2681	2675	2672	2680	2689	2712	2718	2740

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	11	37	37	36	42	37	28	15	14	2
B	0	0	-40	-79	-106	-104	-112	-121	-108	-90	-53	-46	-7
C	0	0	1	4	4	4	5	5	5	5	6	5	1
Total	0	0	-40	-64	-65	-64	-71	-74	-66	-57	-33	-26	-4
% Increase			-1%	-2%	-2%	-2%	-3%	-3%	-2%	-2%	-1%	-1%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	45	45	45	45	46	46	46	46	46	46	46	46	45
B	38	38	36	34	33	33	33	33	33	34	36	36	38
C	30	30	29	30	30	30	30	30	30	30	30	30	30
Maximum	45	45	45	45	46	46	46	46	46	46	46	46	45

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	1	1	1	1	1	1	0	0	0
B	0	0	-2	-4	-5	-5	-5	-5	-5	-4	-2	-2	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	0	0	1	1	1	1	1	1	0	0	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	14	14	14	14	14	14	14	14	14	14	14	14	14
B	12	12	12	12	12	12	12	12	12	12	12	12	12
C	9	9	9	9	9	9	9	9	9	9	9	9	9
Maximum	14	14	14	14	14	14	14	14	14	14	14	14	14

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	918	919	919	915	935	930	923	934	934	932	926	932	916
B	741	741	742	741	741	742	739	741	741	739	742	742	741
C	702	703	725	761	754	746	764	764	752	736	714	709	703
Total	2361	2364	2385	2417	2430	2418	2426	2439	2427	2406	2381	2382	2360

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-1	-5	15	12	3	14	14	12	8	14	-2
B	0	0	0	0	0	1	-2	0	0	-2	1	1	0
C	0	0	21	58	51	43	61	61	49	32	11	6	1
Total	0	0	21	53	66	57	61	75	63	42	20	21	-1
% Increase			1%	2%	3%	2%	3%	3%	3%	2%	1%	1%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	30	30	30	30	30	30	30	30	30	30	30	30	30
B	30	30	30	30	30	30	30	30	30	30	30	30	30
C	36	36	37	39	39	39	39	40	39	38	37	37	36
Maximum	36	36	37	39	39	39	39	40	39	38	37	37	36

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	1	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	1	3	3	2	3	3	3	2	1	0	0
Maximum	0	0	1	3	3	2	3	3	3	2	1	0	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	14	14	14	14	14	14	14	14	14	14	14	14	14
B	11	11	11	11	11	11	11	11	11	11	11	11	11
C	10	10	10	10	10	10	10	10	10	10	10	10	10
Maximum	14	14	14	14	14	14	14	14	14	14	14	14	14

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8-9 Five Bells Junction 1 Flows and Junction Performance

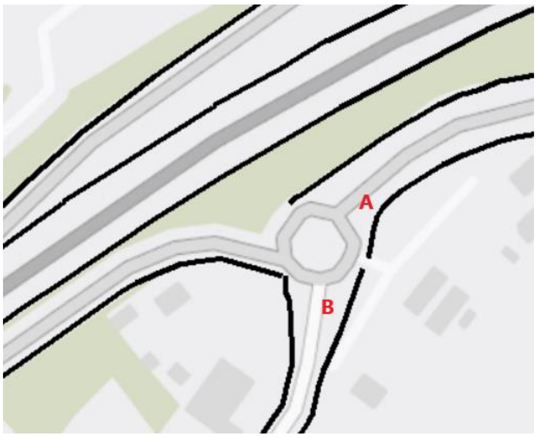

Figure 8-11: Five Bells Junction 2 Arm IDs

8.9.4 Table 8-10 shows the junction flows and performance outputs for the AM and PM peak hours at the Five Bells Junction 2.

- Flows are predicted to change by an order of 0% -1% to -3% in the AM peak and an order of 0% to +4% in the PM peak.
- In both the AM and PM peaks, the VC% is predicted to be well below100%, i.e. to operate below capacity in all phases
- In both the AM and PM peaks, the absolute delays are predicted to be low as are changes in delay.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	1862	1863	1858	1833	1834	1834	1831	1829	1834	1841	1861	1866	1863
B	577	576	577	580	580	581	581	581	581	582	582	582	577
Total	2439	2440	2435	2413	2415	2414	2413	2411	2416	2422	2443	2448	2441

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-5	-30	-29	-28	-32	-34	-29	-22	-1	4	1
B	0	0	1	4	4	4	5	5	5	5	6	5	1
Total	0	0	-5	-27	-25	-24	-27	-29	-24	-17	4	10	2
% Increase			0%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	0%	0%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	74	75	74	73	73	73	73	73	73	74	74	75	75
B	41	41	41	41	41	41	41	41	41	41	41	41	41
Maximum	74	75	74	73	73	73	73	73	73	74	74	75	75

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	-1	-1	-1	-1	-1	-1	-1	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	13	13	13	13	13	13	13	13	13	13	13	13	13
B	20	20	20	20	20	20	20	20	20	20	20	20	20
Maximum	20	20	20	20	20	20	20	20	20	20	20	20	20

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	0	0	0	0	0	0	0	0	0	0	0	0	0

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	1342	1344	1344	1342	1360	1356	1348	1359	1359	1357	1351	1357	1341
B	704	705	726	763	755	747	766	766	753	737	715	710	704
Total	2046	2049	2071	2105	2115	2103	2114	2125	2112	2094	2066	2067	2045

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	-2	16	13	4	15	15	12	9	15	-2
B	0	0	21	58	51	43	61	61	49	32	11	6	1
Total	0	0	21	56	66	57	64	76	63	44	20	21	-1
% Increase			1%	3%	3%	3%	3%	4%	3%	2%	1%	1%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	54	54	54	54	54	54	54	54	54	54	54	54	54
B	50	50	52	54	54	53	54	54	54	52	51	51	50
Maximum	54	54	54	54	54	54	54	54	54	54	54	54	54

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	1	1	0	1	1	0	0	1	0
B	0	0	2	4	4	3	4	4	3	2	1	0	0
Maximum	0	0	2	4	4	3	4	4	3	2	1	1	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	12	12	12	12	12	12	12	12	12	12	12	12	12
B	23	23	23	24	24	24	24	24	24	24	23	23	23
Maximum	23	23	23	24	24	24	24	24	24	24	23	23	23

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	1	2	1	1	2	2	1	1	0	0	0
Maximum	0	0	1	2	1	1	2	2	1	1	0	0	0

Table 8-10 Five Bells Junction 2 Flows and Junction Performance

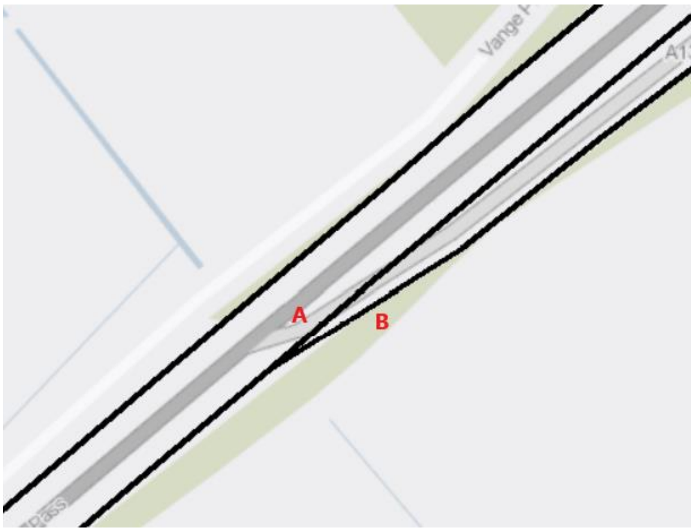

Figure 8-12: Merge with A13 Arms IDs

8.9.5 Table 8-11 shows the junction flows and performance outputs for the AM and PM peak hours at this merge.

- Flows are predicted to change by an order of 0% to +2% in the AM peak and an order of 0% to +2% in the PM peak.

- In the AM the VC% is predicted to be significantly overcapacity on both A and B arms across all phases. On Arm A the VC% is substantially overcapacity in both the DMA (108%) and DMB (109%). In the phases, the VC% on Arm A in the AM peak ranges from 109% in Phase 1 to 115% in Phases 5, 6 and 7. Arm A has VC% of 100% in DMA and DMB and is maintained at 100% VC in all 11 phases. It is evident that there are significant capacity issues without the construction activities in the AM peak Arms A and B and these get worse with the construction activities on Arm A. In the PM peak all phases including the DM's operate well within capacity with VC% of 52% to 53% on Arm A and VC% of 77% to 79% on Arm B.

- High delay increases of 53 seconds to 131 seconds are predicted on Arm A in the AM peak with actual delays of 188 seconds (DMA), 190 seconds (DMB). These rise in the phases to absolute high delays ranging between 200 seconds and 321 seconds. Arm B delays are maintained at 37 seconds in both DM's and across all phases. In summary the delay increases are as follows:

- In the AM peak there are delay increases of 53 seconds to 131 seconds on Arm A for Phases 1 to 10, a combined duration of 55 months. The three worst phases are:

- Phase 5 (118 seconds) (5 months duration)

- Phase 6 (131 seconds) (5 months duration)

- Phase 7 (115 seconds) (7 months duration).

- No delay issues are predicted in the PM peak on both Arm A and Arm B.

8.9.6 It is evident that mitigation measures will be required to mitigate the impacts of construction in the AM peak at this merge junction. This must include reviewing whether traffic is diverted to alternative local roads through Corringham and Stanford le Hope.

AM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	836	833	796	755	738	739	731	725	735	752	786	793	827
B	3302	3307	3372	3426	3457	3455	3467	3478	3462	3434	3388	3379	3319
Total	**4138**	**4140**	**4168**	**4181**	**4196**	**4194**	**4198**	**4203**	**4197**	**4187**	**4174**	**4172**	**4145**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-38	-79	-95	-97	-102	-108	-98	-81	-50	-43	-9
B	0	0	65	119	151	153	161	172	155	128	85	77	16
Total	**0**	**0**	28	41	56	56	58	63	57	47	35	34	7
% Increase			1%	1%	1%	1%	1%	2%	1%	1%	1%	1%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	108	109	111	113	114	114	115	115	115	113	112	112	109
B	100	100	100	100	100	100	100	100	100	100	100	100	100
Maximum	**108**	**109**	**111**	**113**	**114**	**114**	**115**	**115**	**115**	**113**	**112**	**112**	**109**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	3	4	6	6	6	7	6	5	4	4	1
B	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	**0**	**0**	3	4	6	6	6	7	6	5	4	4	1

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	188	190	243	266	302	298	308	321	305	280	255	253	200
B	37	37	37	37	37	37	37	37	37	37	37	37	37
Maximum	**188**	**190**	**243**	**266**	**302**	**298**	**308**	**321**	**305**	**280**	**255**	**253**	**200**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	53	76	112	110	118	131	115	90	67	66	13
B	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	**0**	**0**	53	76	112	110	118	131	115	90	67	66	13

PM Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	636	636	635	636	650	647	644	649	649	649	641	646	635
B	2665	2666	2653	2651	2707	2695	2698	2710	2710	2715	2681	2707	2663
Total	**3301**	**3302**	**3288**	**3288**	**3357**	**3342**	**3342**	**3358**	**3359**	**3365**	**3322**	**3353**	**3298**

Change in Actual Flows (Pcu/hr)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	-1	0	14	12	8	12	13	13	6	11	-1
B	0	0	-13	-15	41	29	32	44	44	50	15	42	-2
Total	**0**	**0**	-14	-14	55	41	40	56	57	63	21	52	-3
% Increase			0%	0%	2%	1%	1%	2%	2%	2%	1%	2%	0%

V/C %

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	52	52	52	52	53	53	53	53	53	53	53	53	52
B	77	77	76	76	78	78	78	78	78	79	77	78	77
Maximum	**77**	**77**	**76**	**76**	**78**	**78**	**78**	**78**	**78**	**79**	**77**	**78**	**77**

Change in V/C%

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	1	1	1	1	1	2	1	1	0
B	0	0	0	0	2	1	1	2	2	2	1	1	0
Maximum	**0**	**0**	0	0	2	1	1	2	2	2	1	1	0

Delays (Seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	6	6	6	6	7	7	7	7	7	7	6	7	6
B	6	6	5	5	6	6	6	6	6	6	6	6	6
Maximum	**6**	**6**	**6**	**6**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**7**	**6**

Change in Delays (seconds)

APPROACH ARM	DMA	DMB	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11
A	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0

Table 8-11:Merge with A13 Flows and Junction Performance

8.10 Additional Junctions

8.10.1 In addition to the key junctions considered above, a set of additional junctions have been identified through analysis of the construction models, which are forecast to demonstrate increased delays during the LTC construction phases. Table 8-12 below lists and identifies these junctions and provides high level commentary on the forecast impact.

8.10.2 The analysis has identified that the following junction are also like to experience additional congestion and delays as a result of the LTC construction traffic:

- A1012/Arterial Rd North Stifford/Lodge Ln/ Long Ln roundabout (in Little Thurrock/ Chafford Hundred)
- A1013/ Rectory Road junction in Orsett
- A128 Brentwood Road/ Princess Charles Avenue in Orsett
- A13 northbound on-slip road at Five Bells
- A13/A1012 Gyratory in North Stifford, Grays
- B149/ Chadwell Hill/ St Chads Rd/ Marshfoot Rd roundabout
- Brentwood Road/ Heath Road in Chadwell St Mary
- Muckingford Road/ Construction Haul Road in Linford
- Southend Rd/ Lampits Hill in Stanford-le-Hope
- Station Road/ Love Lane in East Tilbury
- Stifford Road approach to B1335 Stifford Road in South Ockendon

Table 8-12: Additional Junctions Forecast to Demonstrate Increased Delays

Phase	AM or PM	Junction	Forecast Impact
1	AM	B149/ Chadwell Hill/ St Chads Rd/ Marshfoot Rd roundabout	Delays are forecast to increase on all arms and the increases are estimated to range between 92 seconds and 130 seconds.
1	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
1	PM	A1013/ Rectory Road junction	Delays are forecast to increase on Rectory Road approach by 46 seconds
1	PM	B149/ Chadwell Hill/ St Chads Rd/ Marshfoot Rd roundabout	Delays are forecast to increase on all arms and the increases are estimated to range between 89 seconds and 98 seconds.
2	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 37 seconds.
2	AM	Brentwood Road/ Heath Road in Chadwell St Mary	Delays are forecast on all arms. Delays increases are estimated to be between 31 seconds and 51 seconds.
2	AM	Stifford Road approach to B1335 Stifford Road.	39 seconds increases in delays.
2	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 37 seconds.
2	PM	Brentwood Road/ Heath Road in Chadwell St Mary	Delays are forecast to increase on two out of three arms. Delays increases are estimated to be between 50 seconds and 59 seconds.
3	AM	Southend Rd/ Lampits Hill in Stanford-le-Hope	Delays are forecast on the Lampits Hill approach from the north, which may block back upstream B1420/ One Tree Hill/ Southend roundabout
3	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 37 seconds.
3	AM	Stifford Road approach to B1335 Stifford Road.	31 seconds increases in delays.
3	AM	Muckingford Road/ Construction Haul Road	Additional 45-62 seconds delays on Muckingford Road as a result of a new intersection with a haul road.
3	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 37 seconds.
3	PM	Stifford Road approach to B1335 Stifford Road.	38 seconds increases in delays.
3	PM	Muckingford Road/ Construction Haul Road	Additional 41-44 seconds delays on Muckingford Road as a result of a new intersection with a haul road.
3	PM	Station Road/ Love Lane	Extra 42-44 seconds delays on Station Road approaches
3	PM	A13 northbound on-slip road at Five Bells	Extra 46 seconds delays

Phase	AM or PM	Junction	Forecast Impact
4	AM	Southend Rd/ Lampits Hill in Stanford-le-Hope	Delays are forecast on the Lampits Hill approach from the north, which may block back upstream B1420/ One Tree Hill/ Southend roundabout
4	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
4	AM	Muckingford Road/ Construction Haul Road	Additional 38-44 seconds delays on Muckingford Road as a result of a new intersection with a haul road.
4	PM	A13 northbound on-slip road at Five Bells	Extra 60 seconds delays
4	PM	Stifford Road approach to B1335 Stifford Road.	35 seconds increases in delays.
4	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
4	PM	A1012/Arterial Rd North Stifford/Lodge Ln/ Long Ln roundabout (in Little Thurrock/ Chafford Hundred)	31 seconds increase in delays on Lodge Ln approach
4	PM	Muckingford Road/ Construction Haul Road	Additional 35-44 seconds delays on Muckingford Road as a result of a new intersection with a haul road.
5	AM	Southend Rd/ Lampits Hill in Stanford-le-Hope	Extra 44 seconds delays are forecast on the Lampits Hill approach from the north, which may block back upstream B1420/ One Tree Hill/ Southend roundabout
5	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
5	PM	Stifford Road approach to B1335 Stifford Road.	31 seconds increases in delays.
5	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
6	AM	Southend Rd/ Lampits Hill in Stanford-le-Hope	Extra 44 seconds delays are forecast on the Lampits Hill approach from the north, which may block back upstream B1420/ One Tree Hill/ Southend roundabout
6	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
6	PM	Stifford Road approach to B1335 Stifford Road.	32 seconds increases in delays.
6	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
7	AM	Southend Rd/ Lampits Hill in Stanford-le-Hope	Extra 44 seconds delays are forecast on the Lampits Hill approach from the north, which may block back upstream B1420/ One Tree Hill/ Southend roundabout
7	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 37 seconds.
7	PM	Stifford Road approach to B1335 Stifford Road.	33 seconds increases in delays.
7	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 37 seconds.

Phase	AM or PM	Junction	Forecast Impact
7	PM	A13 northbound on-slip road at Five Bells	Extra 44 seconds delays
8	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
8	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 38 seconds.
9	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
9	AM	A128 Brentwood Road/ Princess Charles Avenue in Orsett	Extra delays are forecast on two approaches reaching 122 seconds on Princess Charles Avenue approach.
9	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
10	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
10	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
11	AM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.
11	PM	A13/A1012 Gyratory	Delay increases on Stifford Clays Road approach reaching 36 seconds.

8.11 Summary

8.11.1 This section has provided further detail and analysis of the approach arm flows and junction performance for a set of key junctions in Thurrock:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junctions including the A13 westbound merge

8.11.2 The analysis has considered the impact of the various construction phase activities compared to their respective DMA or DMB without construction activities and looked at a range of network performance measures including traffic flow changes, VC% and delay changes in the AM and PM peak hours.

8.11.3 As expected, the introduction of the construction activities is generally predicted to result in traffic flow increases at many junctions with consequent deterioration in level of service as measured by the performance measures of VC% and delay changes. The impacts due to construction are due to a combination of the construction traffic, reassignment of general traffic, and the TMM that are proposed during construction of the LTC. Some junctions are seen to have less flows, which may be because of reassignment of traffic as drivers look to avoid the TMM measures and associated construction traffic.

8.11.4 The impacts are generally predicted to vary by phase depending on the intensity of construction activities i.e. prevalence of TMM and volume of construction traffic. In most cases, initial Phases such as Phase 1 and later phases such as Phase 11 are predicted to have the least impact, with Phases 4, 5 and 6 predicted to have the most significant impacts.

8.11.5 Comparison of changes in delays and VC% between DS and DM scenarios did not identify any additional junctions that are forecast to experience increased congestion during construction.

8.11.6 The analysis has shown that with the introduction of the construction activities the junctions which are showing significant flow increases and/or exhibiting performance concerns in terms of VC% and delays are:

- Orsett Cock Roundabout
- ASDA Roundabout
- Marshfoot Road/ A1089 Junction
- Manorway Roundabout
- Five Bells westbound merge with the A13.

8.11.7 It is required that localised modelling using microsimulation modelling be undertaken for Orsett Cock Junction, ASDA Roundabout, Five Bells westbound merge with A13 and at the Marshfoot Road Junction for reasons explained in this section of the report. It is considered that the strategic model is less suited to representing and help understand the impacts of the construction activities at a localised level at these critical junctions given the average temporal nature of the strategic model and simplified assumptions of construction traffic routeing in the strategic model.

8.11.8 In addition to the key junctions considered, a set of additional junctions have been identified, which are forecast to experience increased delays during construction as a result of the LTC construction traffic:

- A1012/Arterial Rd North Stifford/Lodge Ln/ Long Ln roundabout (in Little Thurrock/ Chafford Hundred)
- A1013/ Rectory Road junction in Orsett
- A128 Brentwood Road/ Princess Charles Avenue in Orsett
- A13 northbound on-slip road at Five Bells
- A13/A1012 Gyratory in North Stifford, Grays
- B149/ Chadwell Hill/ St Chads Rd/ Marshfoot Rd roundabout
- Brentwood Road/ Heath Road in Chadwell St Mary
- Muckingford Road/ Construction Haul Road in Linford
- Southend Rd/ Lampits Hill in Stanford-le-Hope
- Station Road/ Love Lane in East Tilbury
- Stifford Road approach to B1335 Stifford Road in South Ockendon

8.11.9 It is proposed that the junctions identified in 8.11.6 and the additional junctions identified above are also monitored and managed during the construction periods with actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the governance framework within the OTMPfC. These should be added to the construction traffic monitoring plan (see Figure 7-8) included in the OTMPfC.

9 Journey Times

9.1 Introduction

9.1.1 A number of routes have been analysed for changes in journey times as a result of the construction activities. Figure 9-1 provides an illustration of these routes. The analysis has focussed on Phases 4, 5 and 6. These phases are each of 5 months duration, giving a combined duration of 15 months.

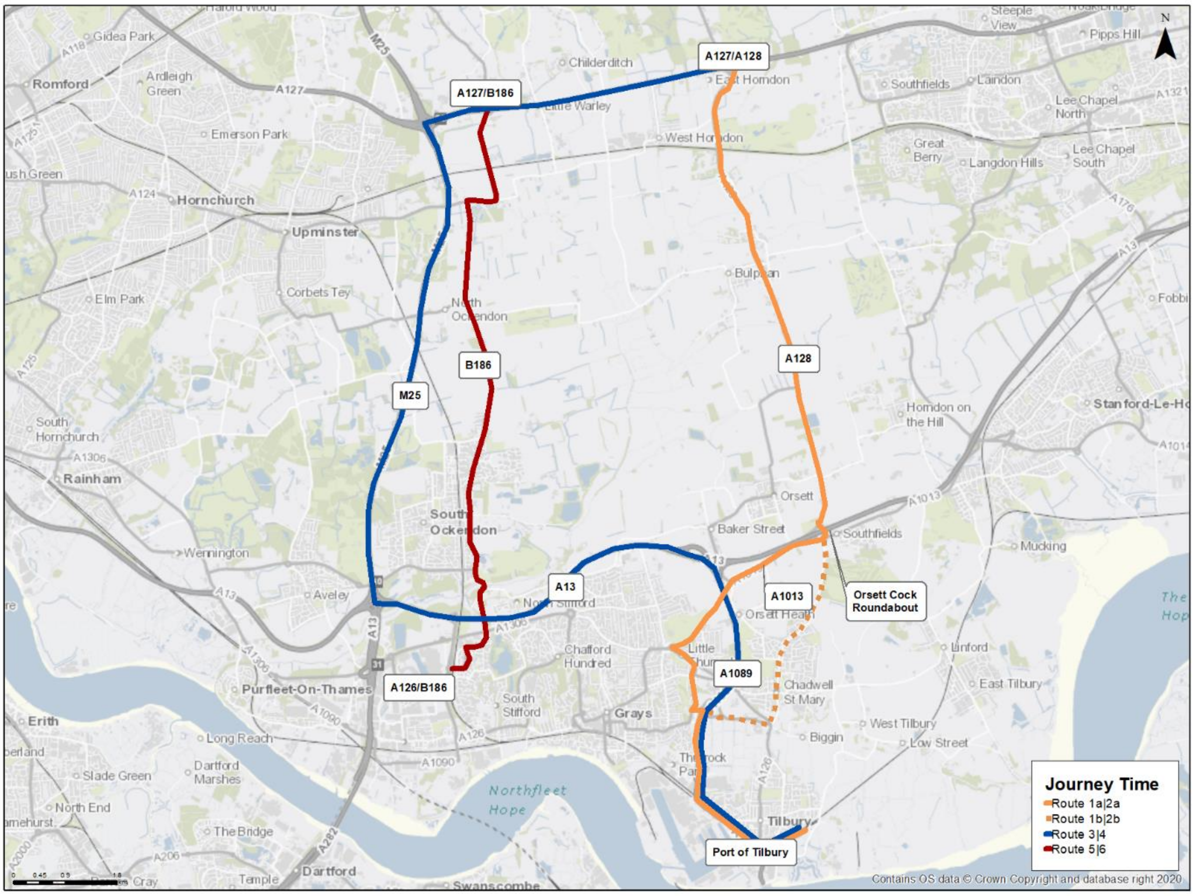

Figure 9-1 Analysed Thurrock Model Journey Time Routes

9.2 Journey Time Analysis

9.2.1 The results of the journey time analysis are summarised in Table 9-1 for the AM peak hour and Table 9-2 for the PM peak hour. It can be seen that:

- Routes 1a and 1b through Brentwood Road experience significant increases in journey times in both the AM and PM peak. The journey time increases range between just over two minutes to four minutes in the AM peak for these routes compared to their respective DM scenarios.
- In the PM peak the journey time increases range between 38 seconds to nearly three minutes for these routes compared to their respective DM scenarios.
- Routes 2a and 2b through Brentwood Road experience significant increases in journey times in both the AM and PM peak. The journey time increases range between just over

two minutes to four minutes in the AM peak for these routes. In the PM peak the journey time increases range between 38 seconds to nearly three minutes for these routes.

- Routes 3 and 4 through the A1089/A13/M25N experience significant increases in journey times in both the AM and PM peak. The journey time increases range between just over two minutes to four minutes in the AM peak for these routes.

- In the PM peak the journey time increases range between 38 seconds to nearly three minutes for these routes 3 and 4.

9.2.2 The increase in journey times on routes 3 and 4 are likely to be a result of the narrow lane traffic management measures on sections of the M25.

9.2.3 The increase on routes 1a/2a and 1b/2b are likely to be a result of measures proposed on Brentwood Rad including crossing points.

9.2.4 It is evident that the construction activities are predicted to result in significant journey time increases on key routes in Thurrock. Given that the LTAM SATURN model, represents average conditions in the modelled hour, journey time increases for some vehicles are likely to be significantly higher than those suggested by the strategic model.

Route ID	Route Description	Distance (km)	Journey Time in (s) for Construction Phases					Difference (DS-DM)		
			DMA	DMB	Phase 4	Phase 5	Phase 6	Phase 4	Phase 5	Phase 6
1a	SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128 and A1089	16450	00:19:59	00:20:29	00:23:48	00:24:29	00:23:00	00:03:49	00:04:00	00:02:31
1b	SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128, Chadwell St Mary and A1089	15632	00:19:43	00:20:13	00:21:58	00:22:23	00:22:35	00:02:15	00:02:10	00:02:22
2a	NB – Port of Tilbury (junction of A128/A127) to Brentwood via A1089 and A128	16119	00:21:06	00:21:08	00:22:57	00:23:42	00:22:15	00:01:51	00:02:34	00:01:07
2b	NB – Port of Tilbury (junction of A128/A127) to Brentwood via A1089, Chadwell St Mary and A128	16089	00:21:07	00:21:08	00:22:13	00:22:02	00:22:52	00:01:06	00:00:54	00:01:44
3	SB – Brentwood (junction of A128/A127) to the Port of Tilbury via M25 and A1089	25449	00:25:02	00:25:32	00:29:17	00:29:54	00:29:55	00:04:15	00:04:22	00:04:23
4	NB – Port of Tilbury via M25 and A1090 to Brentwood (junction of A128/A127)	25866	00:32:50	00:32:51	00:34:32	00:35:28	00:34:37	00:01:42	00:02:37	00:01:46
5	SB- A127/B186 to Lakeside Shopping Centre via B186	11557	00:14:36	00:14:36	00:15:18	00:15:06	00:15:06	00:00:42	00:00:30	00:00:30
6	NB-A127/B186 to Lakeside Shopping Centre via B186	11557	00:15:51	00:15:51	00:15:09	00:15:07	00:15:10	-00:00:42	-00:00:44	-00:00:41
Average			**00:21:17**	**00:21:29**	**00:23:09**	**00:23:31**	**00:23:11**	**00:01:52**	**00:02:03**	**00:01:43**

Table 9-1 AM Journey Time on Selected Routes

Route ID	Route Description	Distance (km)	Journey Time in (s) for Construction Phases					Difference (DS-DM)		
			DMA	DMB	Phase 4	Phase 5	Phase 6	Phase 4	Phase 5	Phase 6
1a	SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128 and A1089	16450	00:19:16	00:19:18	00:22:06	00:21:44	00:20:03	00:02:50	00:02:26	00:00:45
1b	SB – Brentwood (junction of A128/A127) to Port of Tilbury via A128, Chadwell St Mary and A1089	15632	00:19:06	00:19:07	00:19:53	00:19:45	00:19:48	00:00:47	00:00:38	00:00:41
2a	NB – Port of Tilbury (junction of A128/A127) to Brentwood via A1089 and A128	16119	00:19:01	00:19:03	00:21:26	00:21:48	00:19:42	00:02:25	00:02:45	00:00:39
2b	NB – Port of Tilbury (junction of A128/A127) to Brentwood via A1089, Chadwell St Mary and A128	16089	00:18:21	00:18:23	00:18:55	00:18:56	00:18:57	00:00:34	00:00:33	00:00:34
3	SB – Brentwood (junction of A128/A127) to the Port of Tilbury via M25 and A1089	25449	00:23:58	00:24:00	00:26:18	00:26:28	00:26:29	00:02:20	00:02:28	00:02:29
4	NB – Port of Tilbury via M25 and A1090 to Brentwood (junction of A128/A127)	25866	00:30:03	00:30:07	00:31:45	00:31:54	00:31:59	00:01:42	00:01:47	00:01:52
5	SB- A127/B186 to Lakeside Shopping Centre via B186	11557	00:15:56	00:15:56	00:17:34	00:16:44	00:16:52	00:01:38	00:00:48	00:00:56
6	NB-A127/B186 to Lakeside Shopping Centre via B186	11557	00:16:24	00:16:22	00:16:41	00:16:09	00:16:21	00:00:17	-00:00:13	-00:00:01
Average			**00:20:16**	**00:20:17**	**00:21:50**	**00:21:41**	**00:21:16**	**00:01:34**	**00:01:24**	**00:00:59**

Table 9-2: PM Journey Time on Selected Routes

10 Summary and Conclusions

10.1 Introduction

10.1.1 The construction of the LTC is planned to be undertaken in 11 phases spanning a construction period of 72 months (6 years). It is evident that given the long duration of the construction period, the construction activities inclusive of network changes and construction traffic are potentially likely to have disruptive, and intrusive impacts on local communities in Thurrock leading to day-to-day inconvenience to the travelling public, local residents and businesses.

10.1.2 This report has sought to understand the assumptions regarding the TMM and their representation in the LTAM cordon construction models, which were developed and provided by NH to TC.

10.1.3 The review has also assessed whether the construction model inputs and assumptions included within the models largely reflect the TMM proposals and construction traffic forecasts as set out in the CIC (run in Summer 2021 and described in the "Outline Traffic Management Plan for Construction, Construction Update, July 2021, Ward Summaries – North of the river, July 2021").

10.1.4 The report has also sought to understand the impacts of construction activities on the LRN.

10.1.5 The models used for the construction modelling were developed by NH and have a forecast year of 2030, the same forecast year as the projected Opening Year of the LTC. Additionally, two sets of DM Models designated as DMA and DMB have been provided for the same forecast year 2030. It is understood that both the DMA and DMB represent the LTAM forecast of traffic flows without the LTC. However, DMB includes construction trips associated with the Thurrock Flexible Generation Plant (TFGP). Consequently, different construction Phases have been compared against either DMA or DMB as per the accompanying document provided with the models ('LTAM DCO2 Construction Modelling GIS shapefile note May 2022.pdf').

10.1.6 The review has focussed on the analysis of the AM peak hour (0700 – 0800) and PM peak hour (1700 – 1800) where congestion issues are more prevalent. It is noted that the modelled AM peak hour (0700 – 0800) is that of the SRN whereas the LRN typically has an AM peak hour of 0800 – 0900 but was not modelled by NH.

10.2 Modelling Assumptions

10.2.1 The review of the TMM list provided by NH with the cordon construction models concludes that these are broadly consistent with the TMMs outlined in the OTMPfC dated June 2021. The OTMPfC lists TMMs consulted upon with local communities and local businesses in the CIC that took place in Summer 2021.

10.2.2 However, further clarifications with NH highlighted that the construction traffic models provided to the Council for review do not reflect the construction traffic volumes reported by worksite as set out in the CIC material. Instead, they are based on updated construction traffic forecasts, which NH stated will only be made public in the DCOv2 TA. These updated forecasts have therefore not been provided in consultation material provided to local communities. It is unclear what differences may exist between the CIC material and the TMMs included in the updated construction models.

10.2.3 In terms of the coding of TMM, given the lack of modelling documentation setting out key assumptions and approach, it has not been possible to conclude with certainty how and if all measures are represented in the construction models. It is generally considered that the principle of the TMM plans was generally represented in the models but there was not sufficient information to conclude that specific TMM schemes were accurately represented.

10.2.4 In terms of construction traffic assumed generated by the compounds, it is considered that apart from minor differences, there is a good consistency between the NH reported daily construction traffic and the construction numbers included in the models in terms of the origin demands. The NH numbers did not report construction numbers destined for the compounds to undertake a comparison with values included in the models.

10.2.5 It is also noted that the compounds appear to be included within existing model zones as opposed to be allocated to new zones dedicated to representing compound traffic only. The zones are large and hence it is unlikely that construction traffic would be loaded to specific network access points accurately. It is considered that this is likely to underestimate construction traffic impacts at access junctions where construction traffic interacts with the local network.   This reflects the limitations of the strategic model in accurately representing the localised impacts of the construction activities.

10.2.6 Construction related HGV delivery traffic is also able, within the LTAM SATURN model to freely assign across the cordoned area in an attempt to optimise the operation of the network (see section 6). This is contrary to the commitments that NH has made in engagement with TC, and through the OTMPfC, that construction HGV traffic will be assigned to specified and fixed access routes. The construction models will therefore not accurately reflect the likely movement of construction vehicles on the road network network.

10.3 Network Impacts

Summary Statistics

10.3.1 The analysis of summary global statistics indicated that Phases 4, 5 and 6 are likely to have the most significant impacts on the network. Of these three, Phase 4 is identified as having the least impacts in both the AM and PM peak hours compared to Phases 5 and 6. In the AM peak hour, Phase 6 is identified as the worst followed by Phase 5. In the PM peak hour, Phase 5 is identified as the worst followed by Phase 6.

Flow Changes

10.3.2 In terms of flow changes, analysis indicated that flow increases are predicted across the Thurrock LRN as a result of construction activities. This is the case in both the AM and PM peak hours for the analysed Phases 4, 5 and 6. This also includes increases on the A13 itself.

10.3.3 Increases are predicted on some roads to the north of the A13 including the B1007 North Hill including around Horndon on the Hill. Flows increases are also predicted on A128 Brentwood Road, sections of the B186 including Warley Street, and increases in Orsett Village on the B188 although there are some variations by phase. Flow increases are also predicted through South Ockendon.

10.3.4 South of the A13 and to the west of the A108, flow increase are predicted including on Arterial Road North Stifford/Arterial Road West Thurrock and on London Road. There are also flow increases on the A1089 itself.

10.3.5 East of the A1089, there are flow increases predicted on the local roads through villages such as Chadwell St Mary, West and East Tilbury, Linford, Stanford-le-Hope and Corringham in some instances.

10.3.6 It is noted that there are also flow reductions on some links including the M25 itself and on local roads including on sections of the B186 Clay Tye Road and on sections of the A1013 Stanford Road west of Orsett Cock Roundabout.

10.3.7 It is proposed that impacts on the LRN in Thurrock is monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the monitoring and governance framework within the OTMPfC.

Junction Performance

10.3.8 Analysis of junction performance for a set of key junctions, which were identified from earlier reviews as the main areas of scheme impact in Thurrock, have been undertaken:

- The Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- M25 Junction 30
- Marshfoot Road/ A1089 Junction
- Devonshire Road/ A1012
- Five Bells Junction including the A30 westbound merge

10.3.9 The analysis of junction flows and performance indicated that that with the introduction of the construction activities the junctions which are showing significant flow increases and/or exhibiting performance concerns in terms of V/C% and delays are:

- Manorway Roundabout
- Orsett Cock Roundabout
- ASDA Roundabout
- Daneholes Roundabout
- Marshfoot Road/ A1089 Junction
- Five Bells westbound merge with the A13.

10.3.10 It is recommended that localised modelling using microsimulation modelling is undertaken for the junctions listed above to provide a more detailed assessment of impact on junction capacity and to assist in developing appropriate mitigation measures. It is considered that the strategic model is less suited to representing and helping to understand the impacts of the construction activities at a localised level at these critical junctions given the average temporal nature of the strategic model, simplified assumptions of construction traffic routeing and loading to the strategic model, and differences in the local road network and strategic road network morning peak hours.

10.3.11 In addition to the key junctions considered, a set of additional junctions have been identified, which are forecast to demonstrate increased delays during construction. Table 8-12 listed and identified these junctions and provided high level commentary on the forecast impact.

10.3.12 The analysis has identified that the following junction are also like to experience additional congestion and delays as a result of the LTC construction traffic:

- A1012/Arterial Rd North Stifford/Lodge Ln/ Long Ln roundabout (in Little Thurrock/ Chafford Hundred)
- A1013/ Rectory Road junction in Orsett
- A128 Brentwood Road/ Princess Charles Avenue in Orsett
- A13 northbound on-slip road at Five Bells
- A13/A1012 Gyratory in North Stifford, Grays
- B149/ Chadwell Hill/ St Chads Rd/ Marshfoot Rd roundabout
- Brentwood Road/ Heath Road in Chadwell St Mary

- Muckingford Road/ Construction Haul Road in Linford
- Southend Rd/ Lampits Hill in Stanford-le-Hope
- Station Road/ Love Lane in East Tilbury
- Stifford Road approach to B1335 Stifford Road in South Ockendon

10.3.13 It is proposed that impacts on the junctions identified above in Thurrock is monitored and managed during the construction period with appropriate management and mitigation actions taken as needed, promoted through the relevant Traffic Management Forum with NH, the MWCs and TC. This is identified through the monitoring and governance framework within the OTMPfC.

Journey Times

10.3.14 A number of routes have been analysed for changes in journey times as a result of the construction activities. These are predominantly routes to and from Port of Tilbury and where possible similar routes to those used in analysing the operational impacts of the LTC were maintained. The key routes were through Brentwood Road via the A1013 Stanford Road and routeing through Chadwell St Mary. Routes also included using the A1089/A13/M25N.

10.3.15 The analysis of journey times predicts increases of up to 4 minutes dependent on route and time period. It is evident that the construction activities are predicted to result in significant journey time increases on key routes in Thurrock including those routes leading to Port of Tilbury. Given that the LTAM strategic model, represents average conditions in the modelled hour, journey time increases for some vehicles are likely to be significantly higher than those suggested by the strategic model.

10.4 Summary and Conclusion

10.4.1 Overall, it is concluded that the use of the LTAM strategic model may be more suited to understand strategic impact of the Scheme, during operational and construction phases. In terms of more localised impacts of construction, the use of the strategic model is likely to underestimate impacts given the average hour nature of the strategic model and the difference between the strategic road network peak hour (0700-0800 as represented by LTAM) and the LRN peak hour (0800-0900). The strategic modelling has indicated that there are roads and junctions across the LRN which are predicted to experience substantial delays and disruption, many of which are not suited to the predicted quantum or type of traffic flow.

10.4.2 The strategic model is not adequate to analyse these impacts and so more detailed analysis of key impacted junctions, more disaggregated models such as microsimulation are more suitable, hence the recommendation to undertake such modelling at selected named junctions in this report.

10.4.3 On the assumption that the project is granted consent, the currently proposed phasing of the construction works can be nothing more than a first indication of the actual iteration of works and the programming of that work. Given the weaknesses in the LTAM strategic model used by NH to predict and assess the impacts on the LRN in Thurrock, the impacts on the communities in Thurrock are therefore not considered to be fully predicted and understood. Therefore, it is essential that a robust system of on-going review, engagement, collaboration, governance, management and monitoring is put in place through the determination of the Development Consent Order (DCO).

Appendix A Flow Difference Plots (PCU/hr)

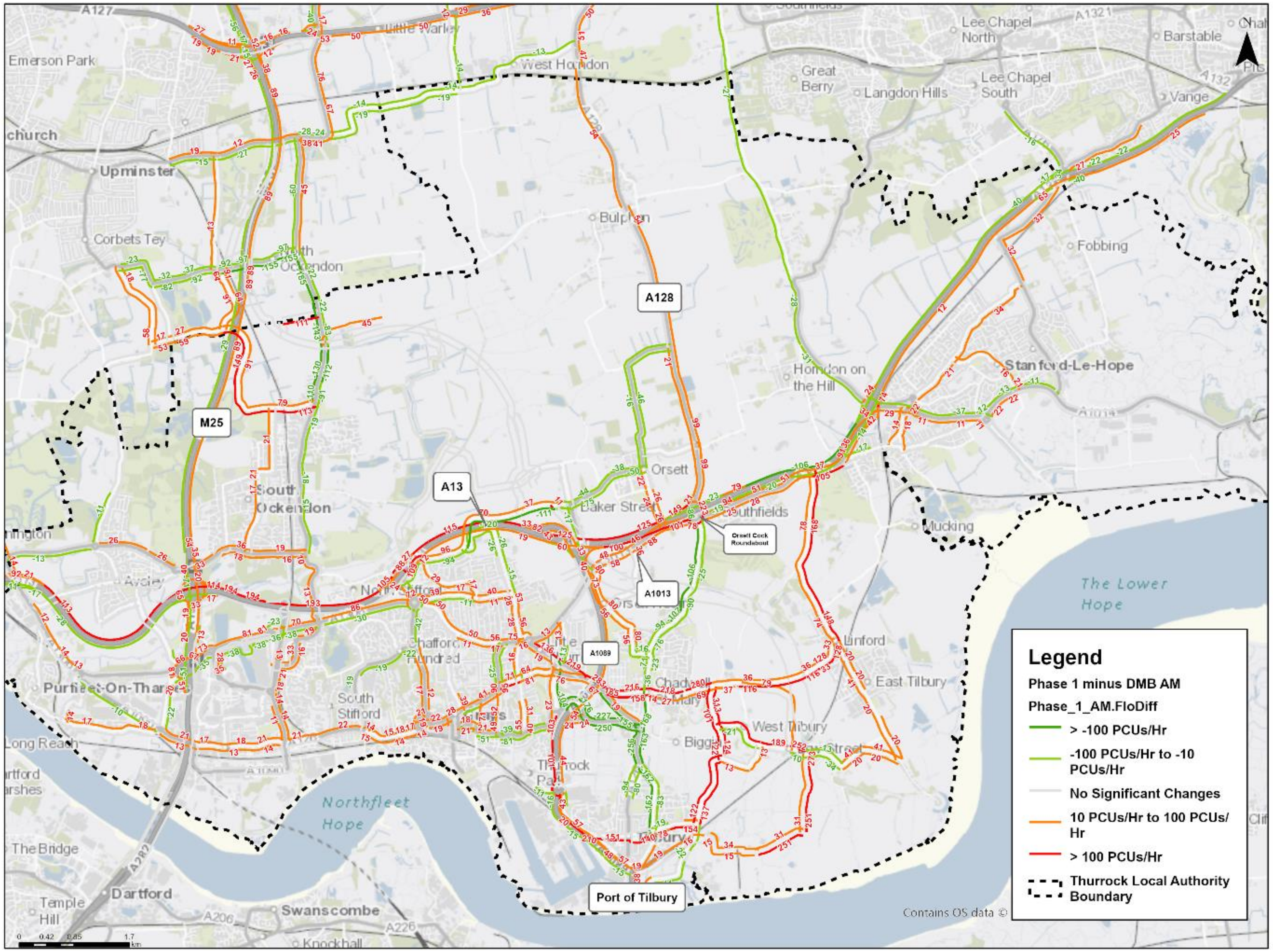

Figure 10-1: Actual Flow Differences (Phase 1 minus DMB AM)

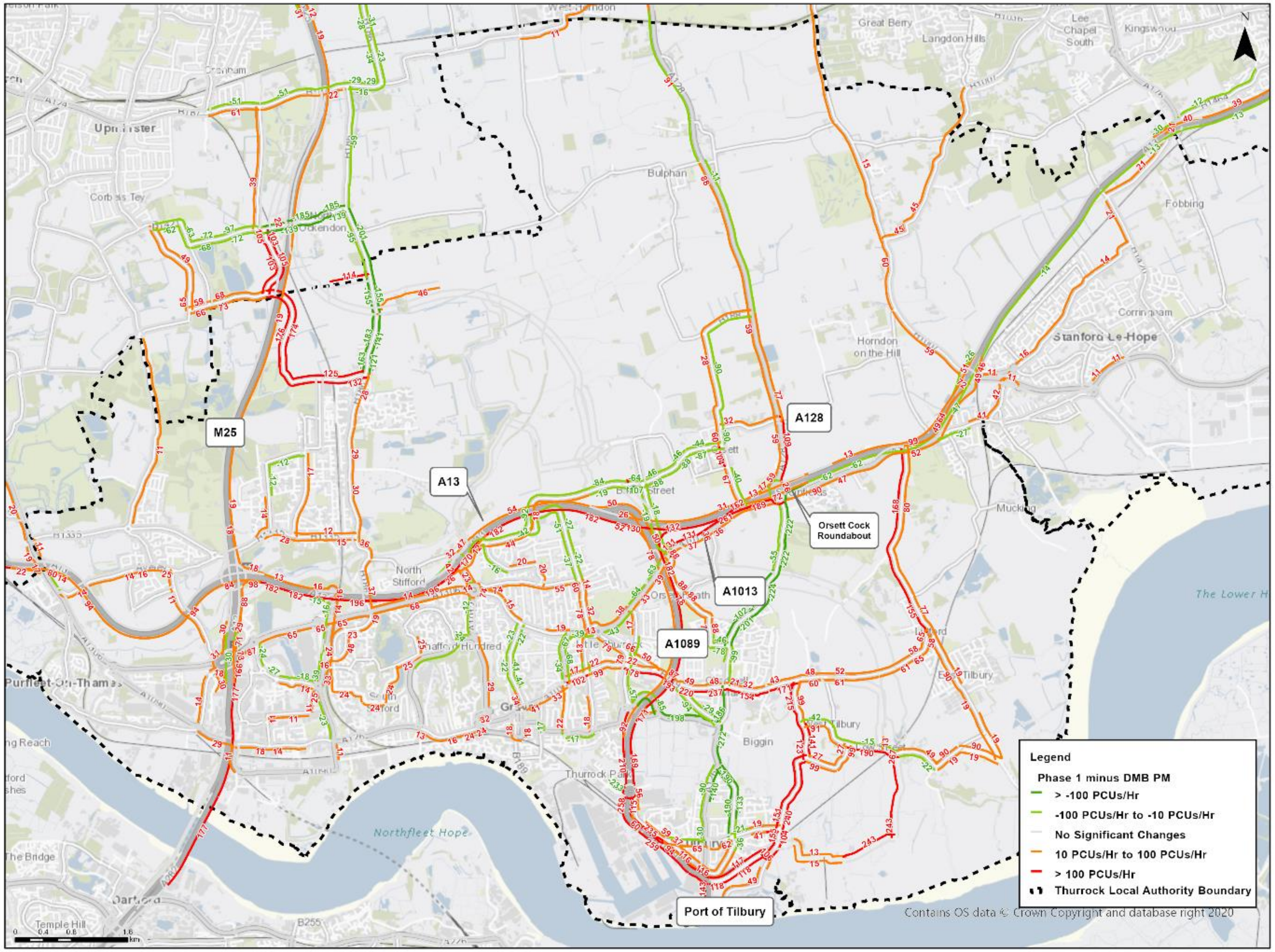

Figure 10-2: Actual Flow Differences (Phase 1 minus DMB PM)

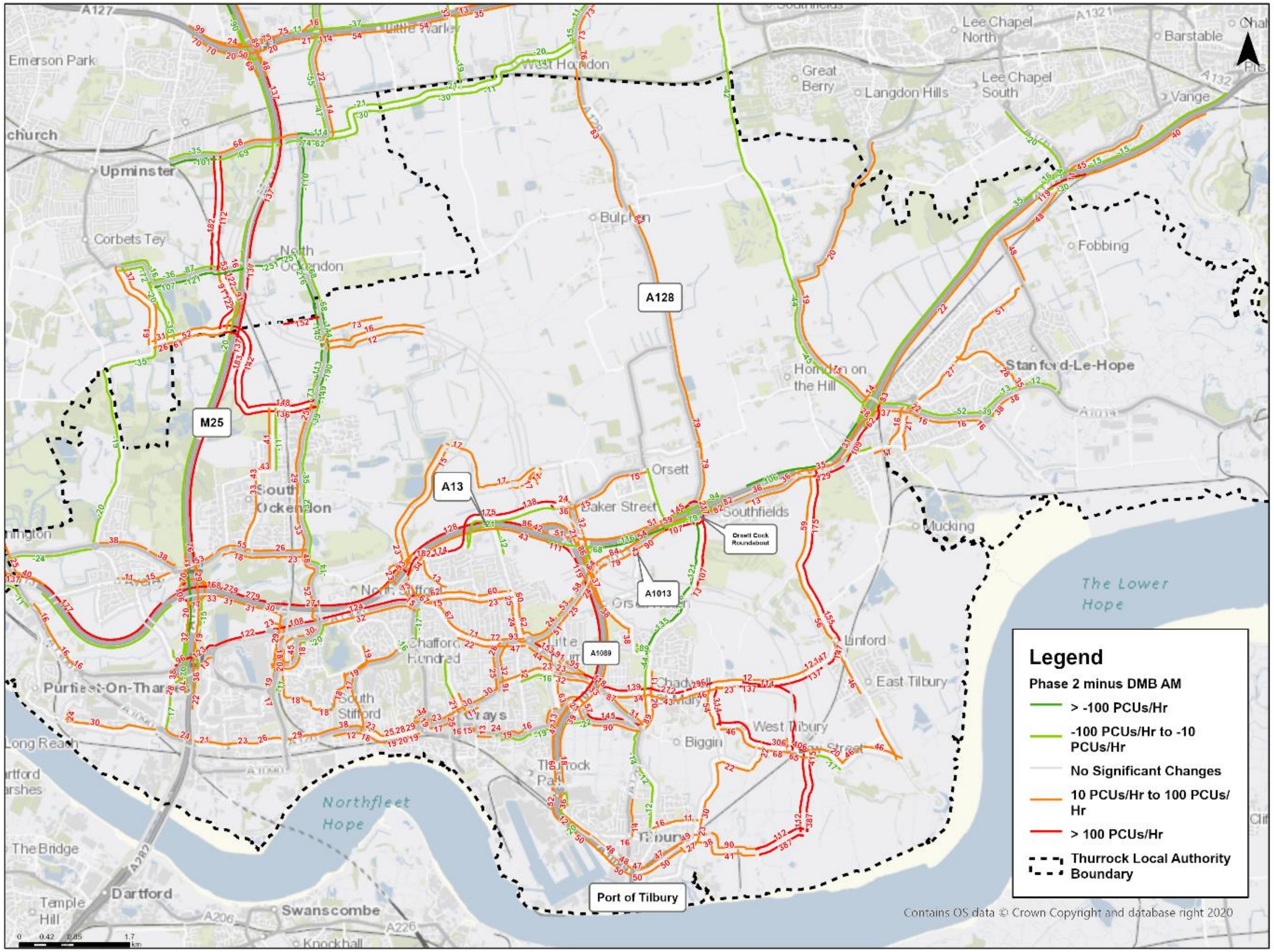

Figure 10-3: Actual Flow Differences (Phase 2 minus DMB AM)

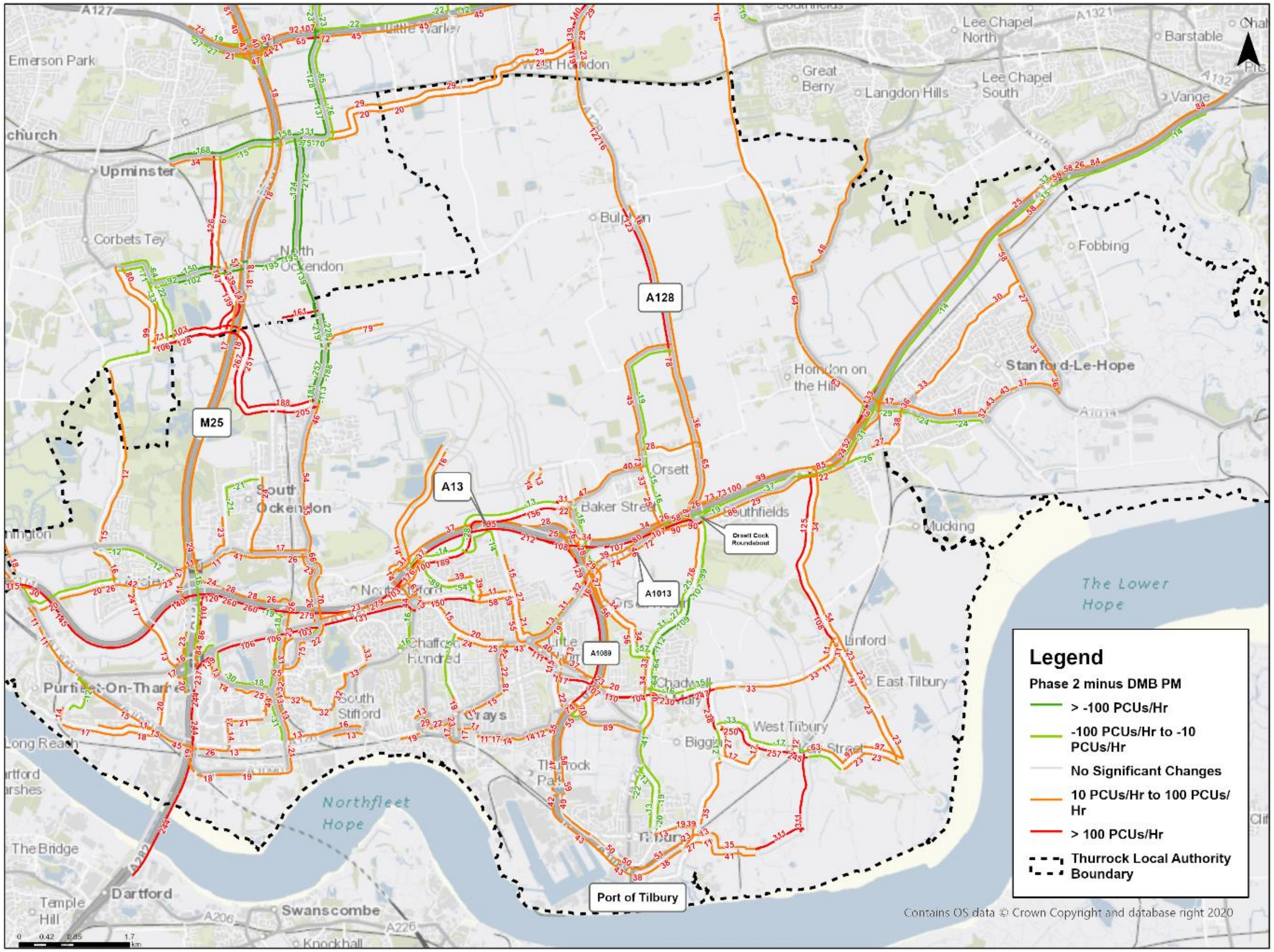

Figure 10-4: Actual Flow Differences (Phase 2 minus DMB PM)

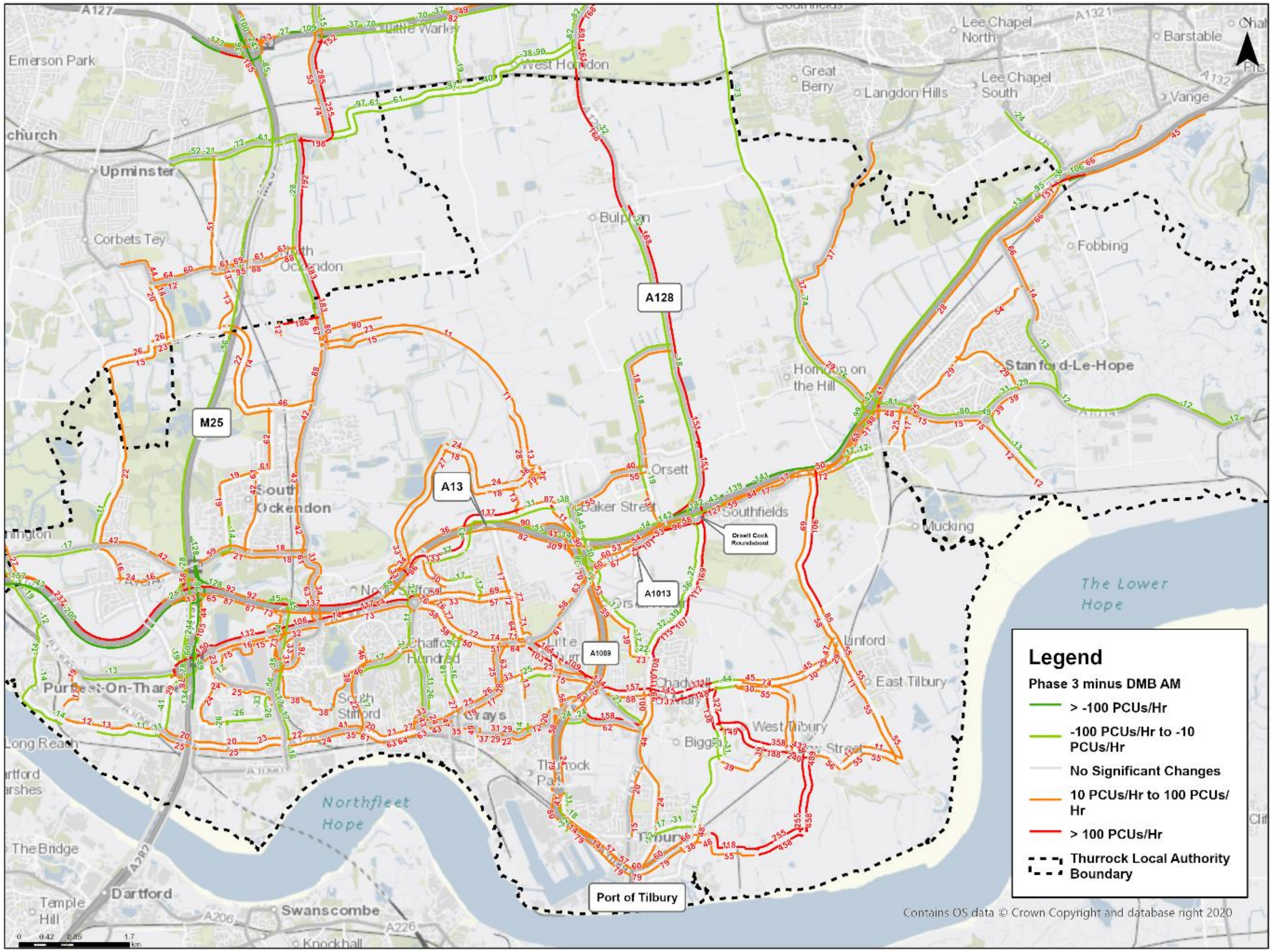

Figure 10-5: Actual Flow Differences (Phase 3 minus DMB AM)

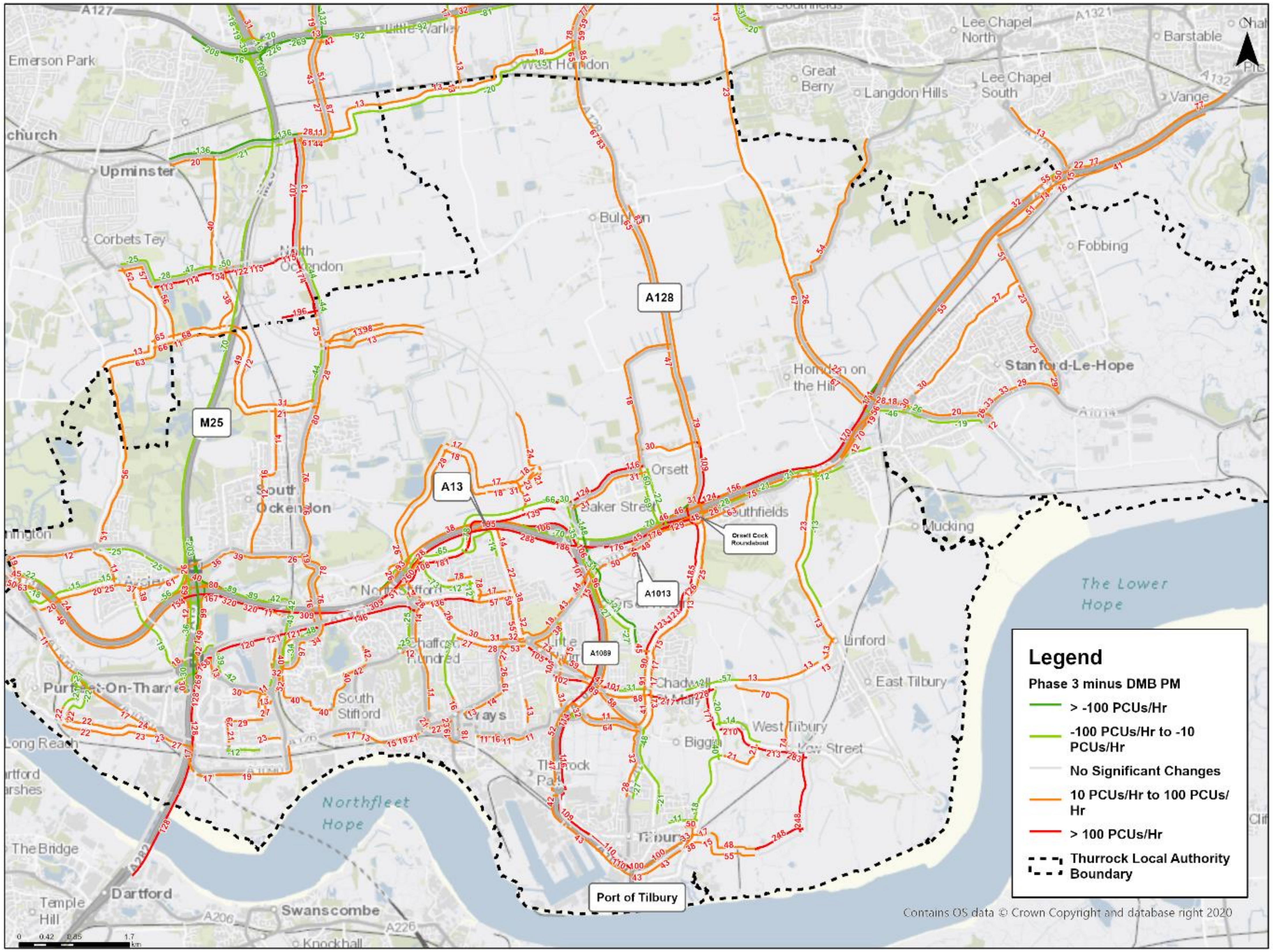

Figure 10-6: Actual Flow Differences (Phase 3 minus DMB PM)

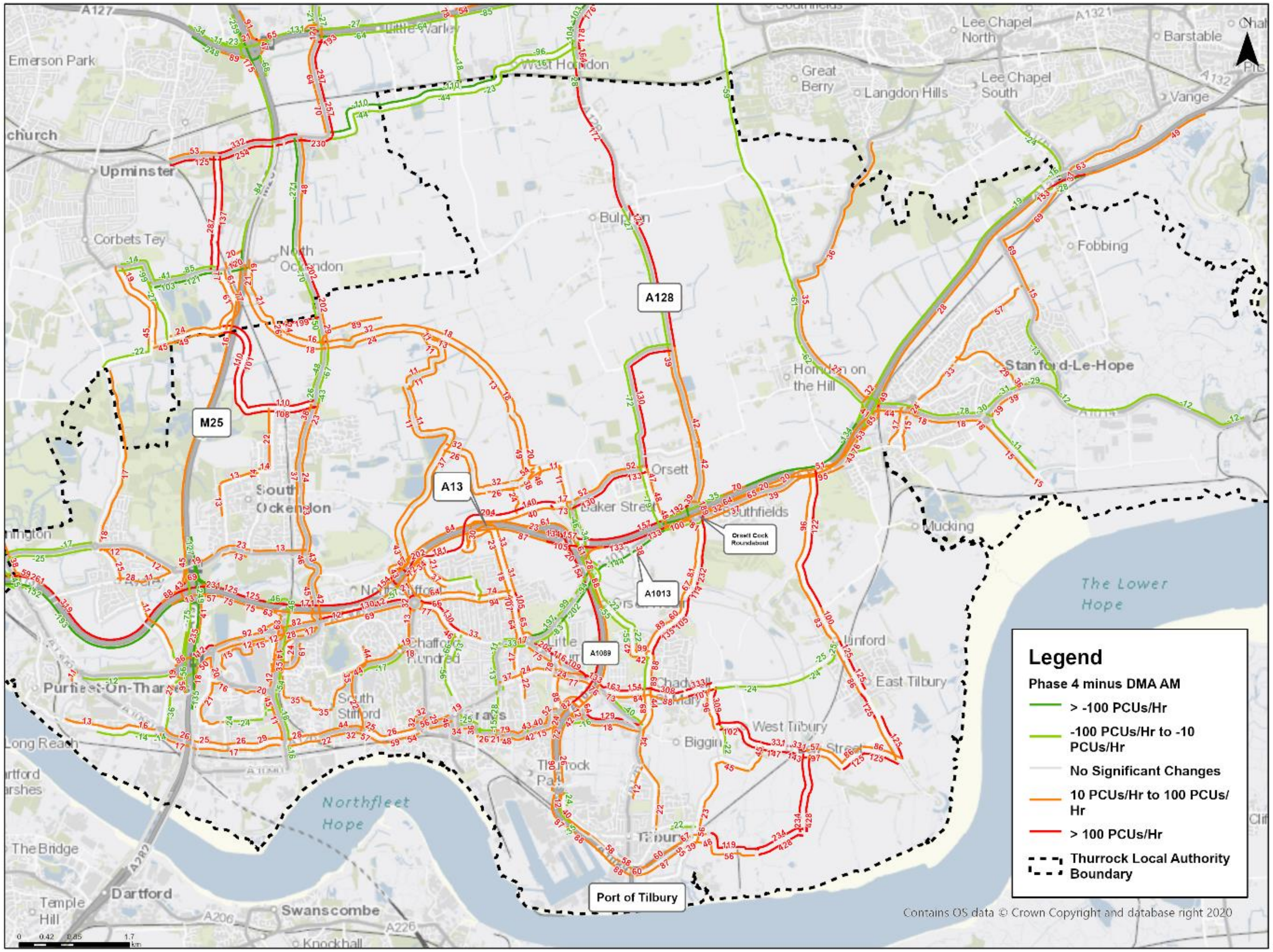

Figure 10-7: Actual Flow Differences (Phase 4 minus DMA AM)

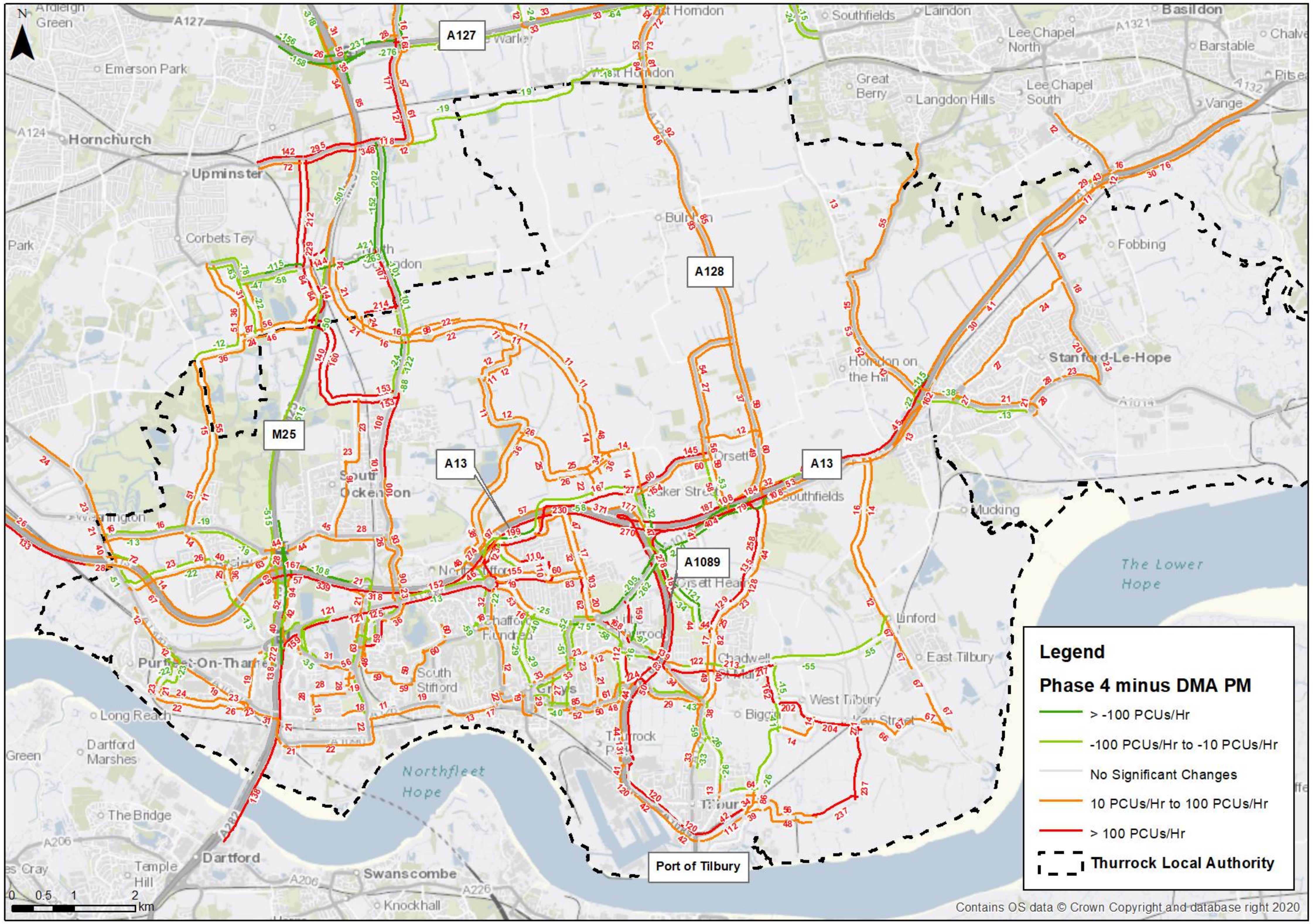

Figure 10-8: Actual Flow Differences (Phase 4 minus DMA PM)

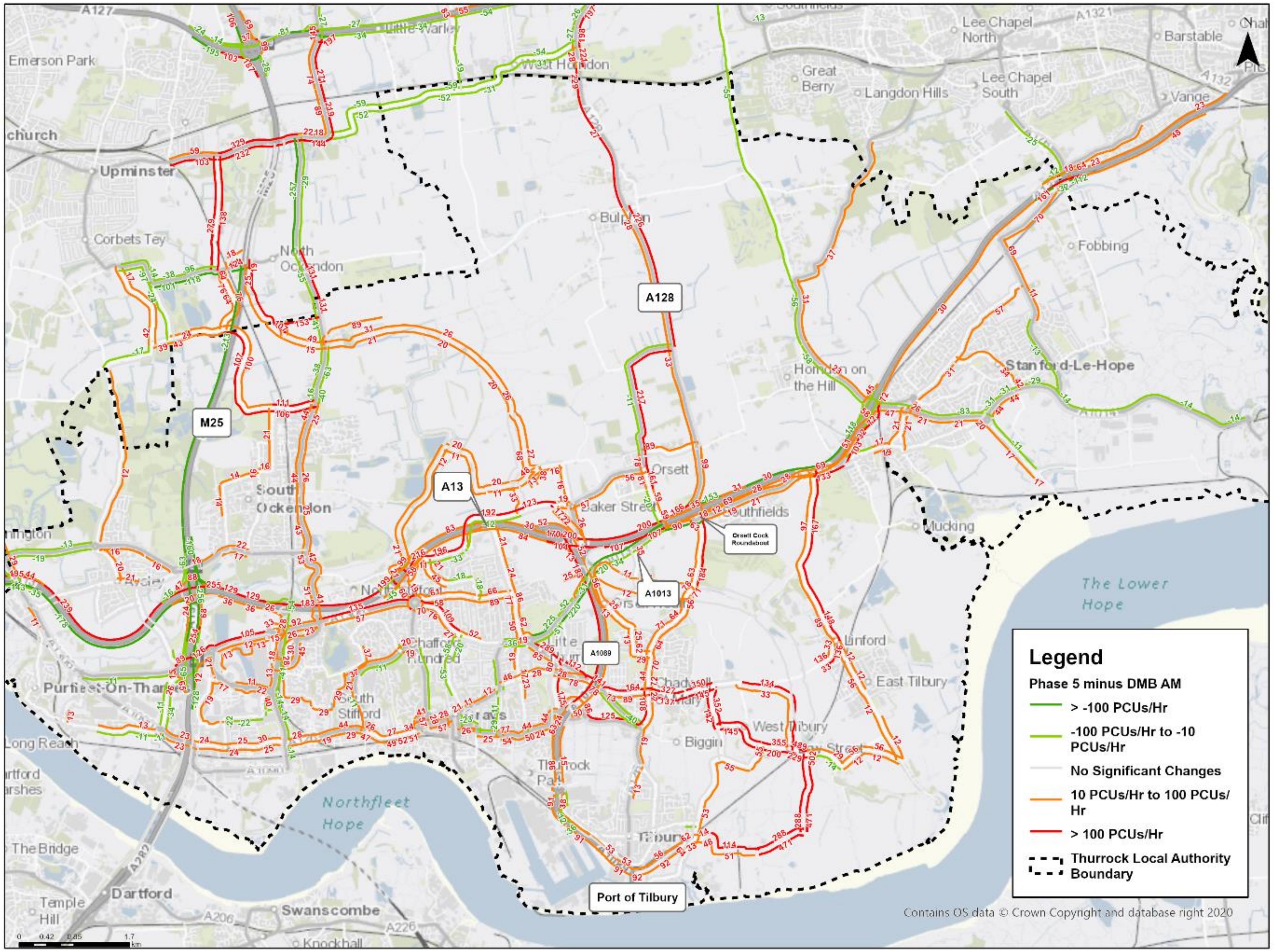

Figure 10-9: Actual Flow Differences (Phase 5 minus DMB AM)

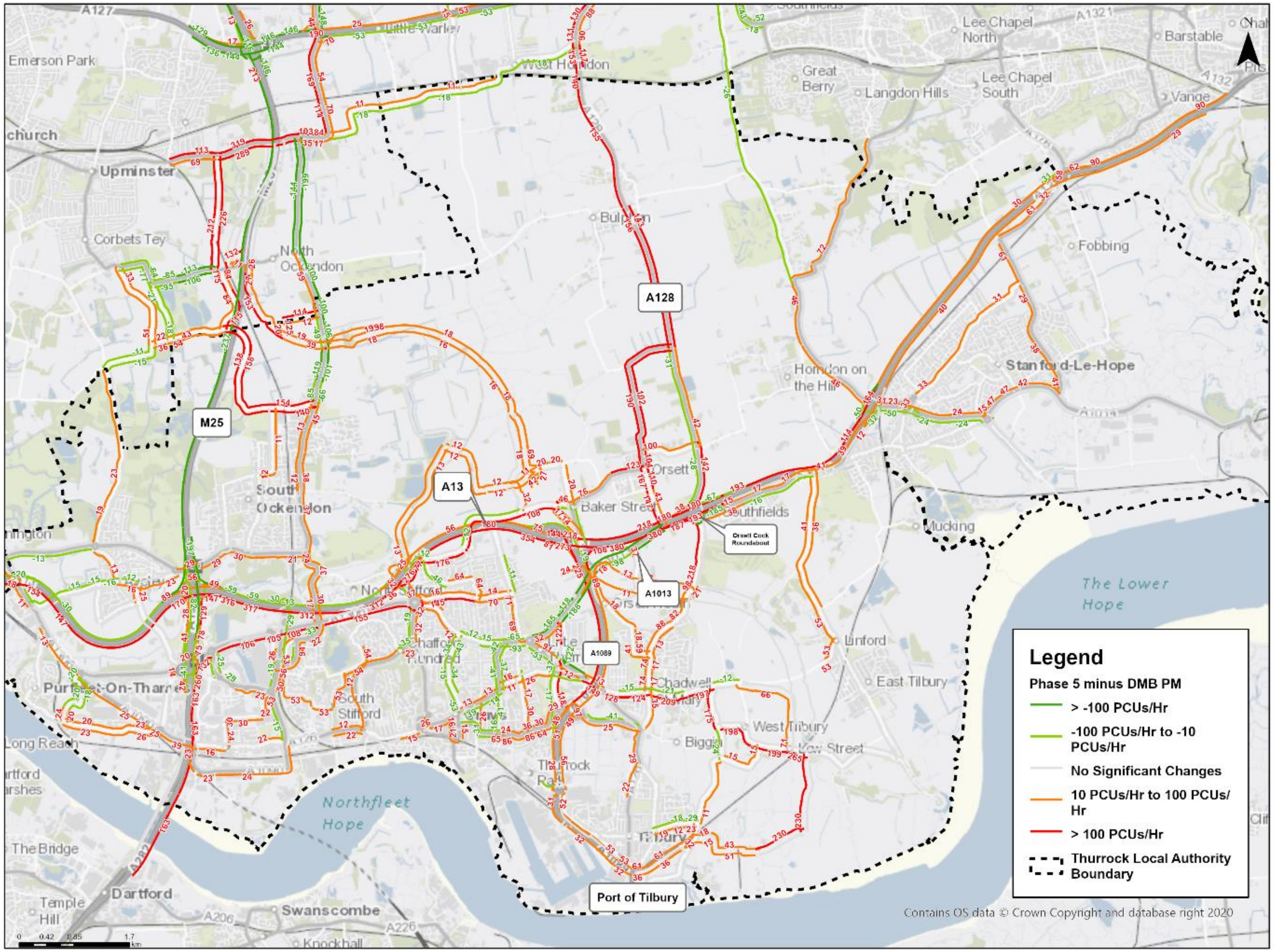

Figure 10-10: Actual Flow Differences (Phase minus DMB PM)

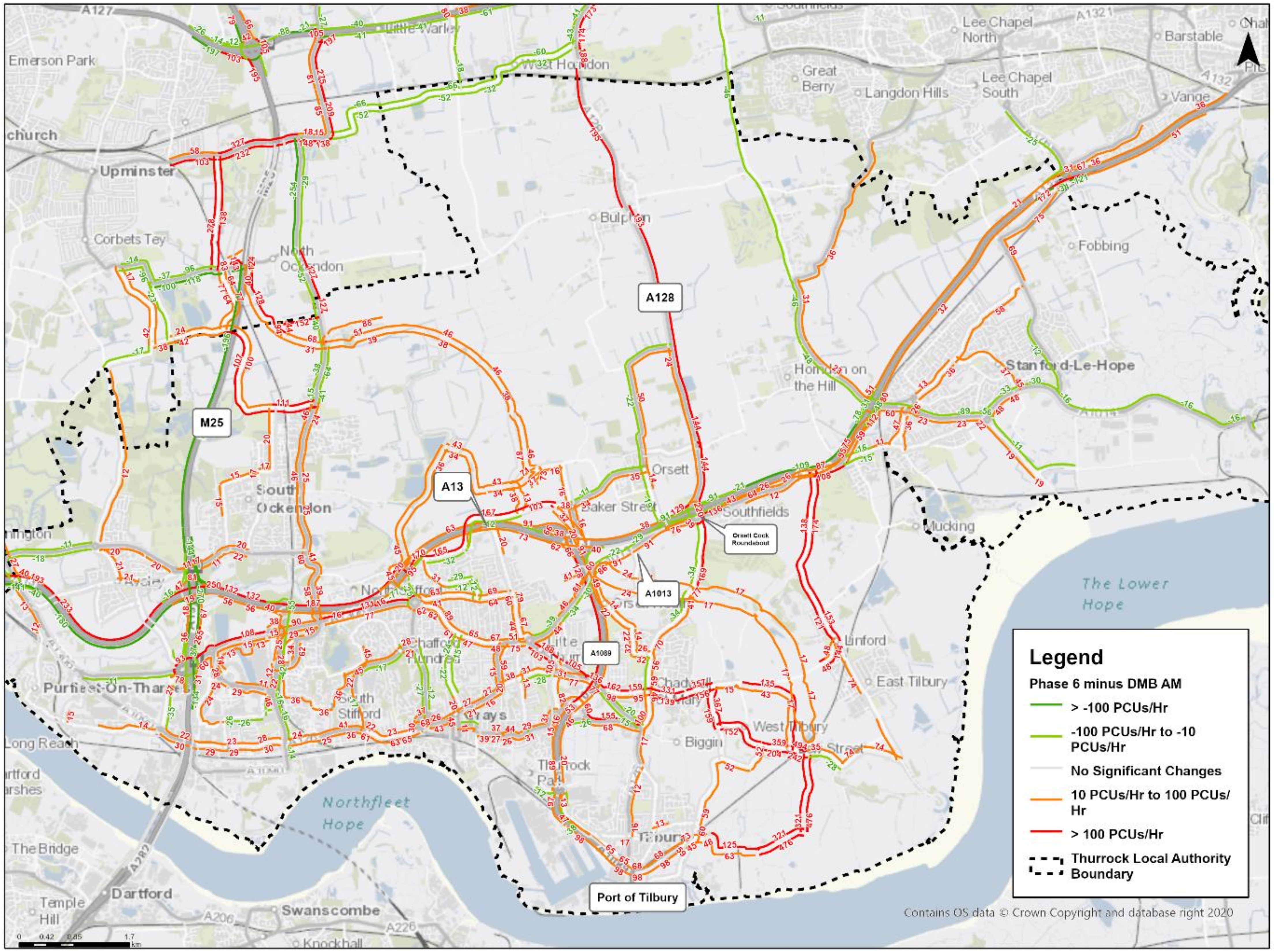

Figure 10-11: Actual Flow Differences (Phase 6 minus DMB AM)

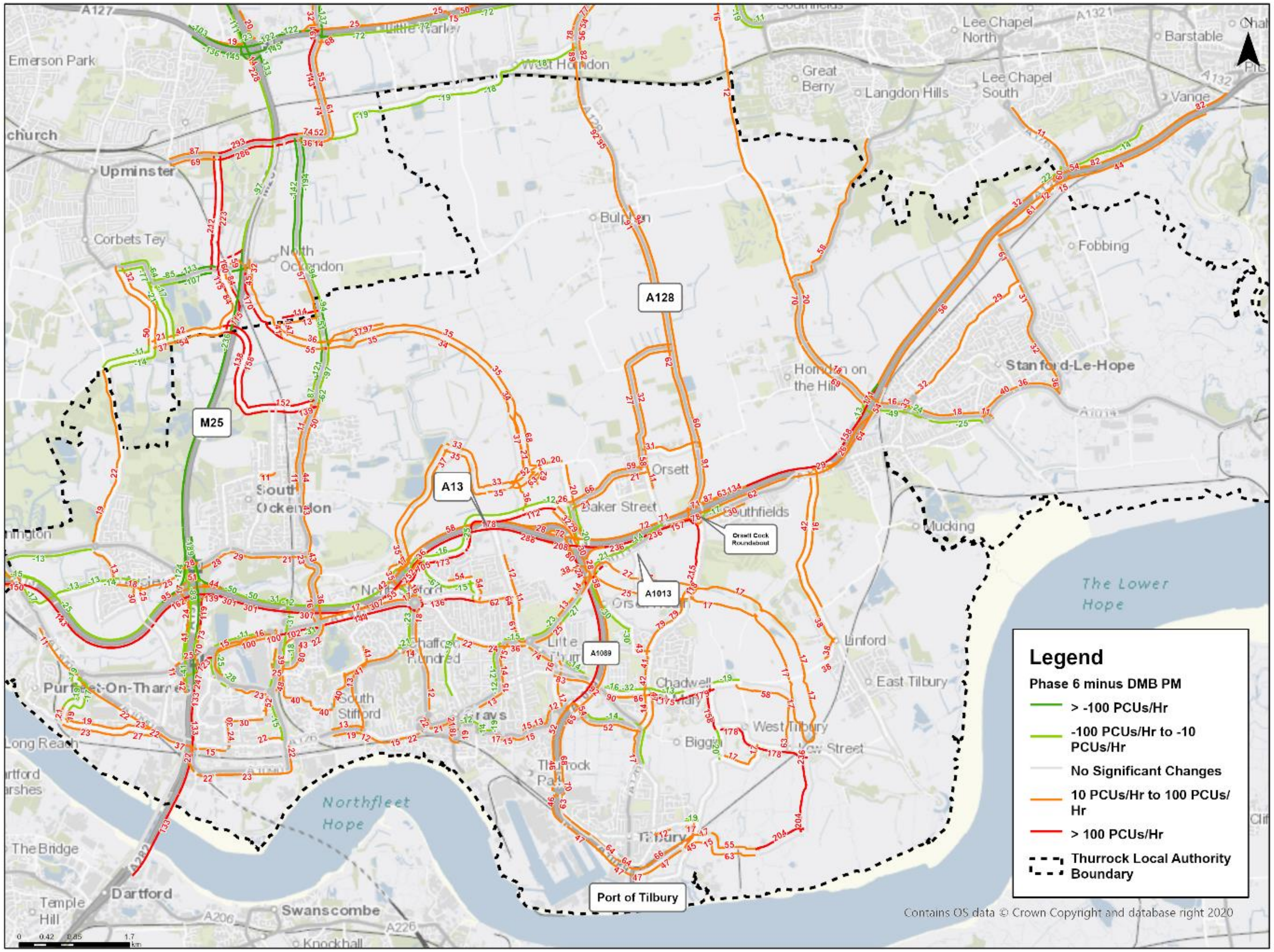

Figure 10-12: Actual Flow Differences (Phase 6 minus DMB PM)

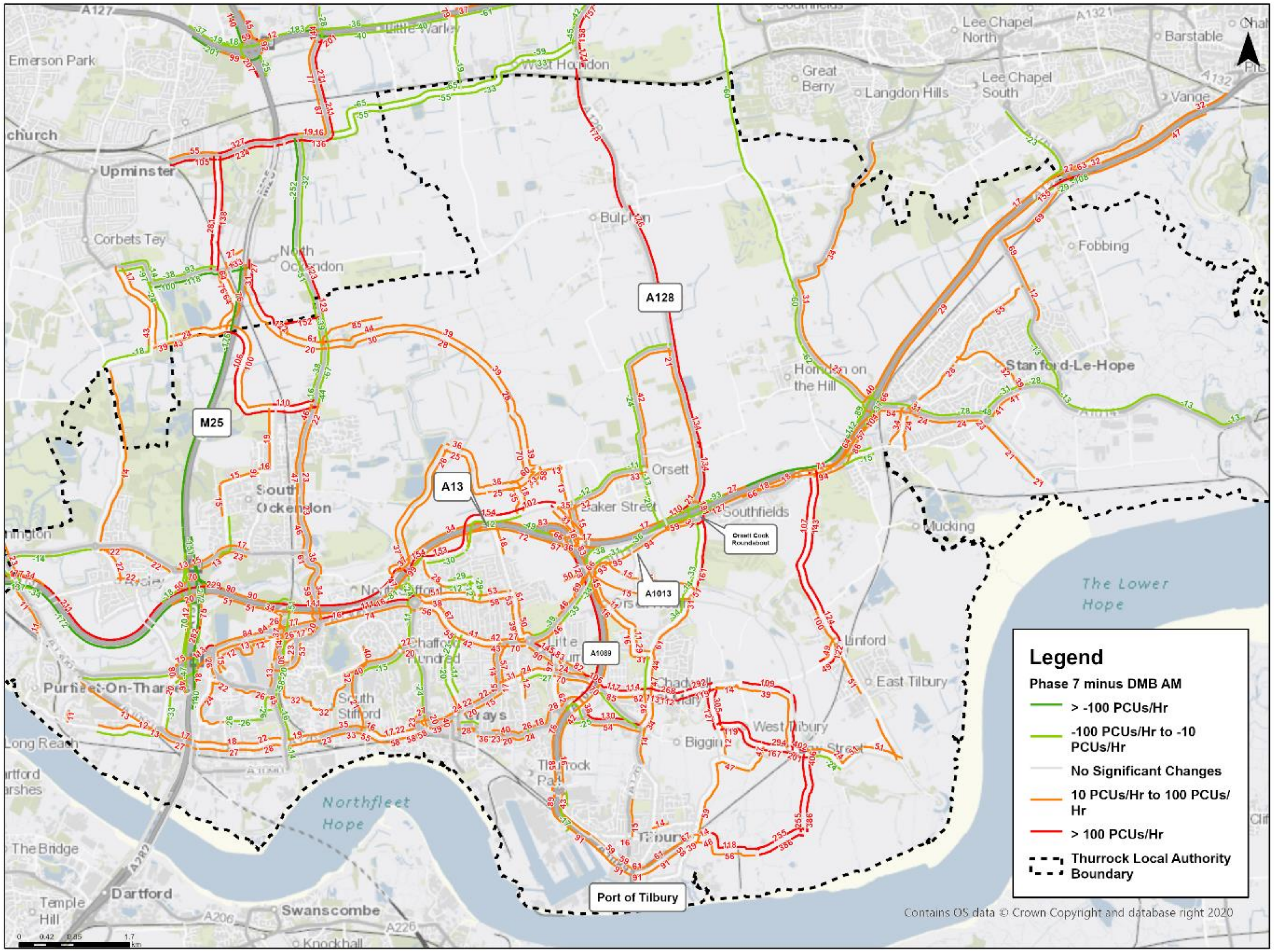

Figure 10-13: Actual Flow Differences (Phase 7 minus DMB AM)

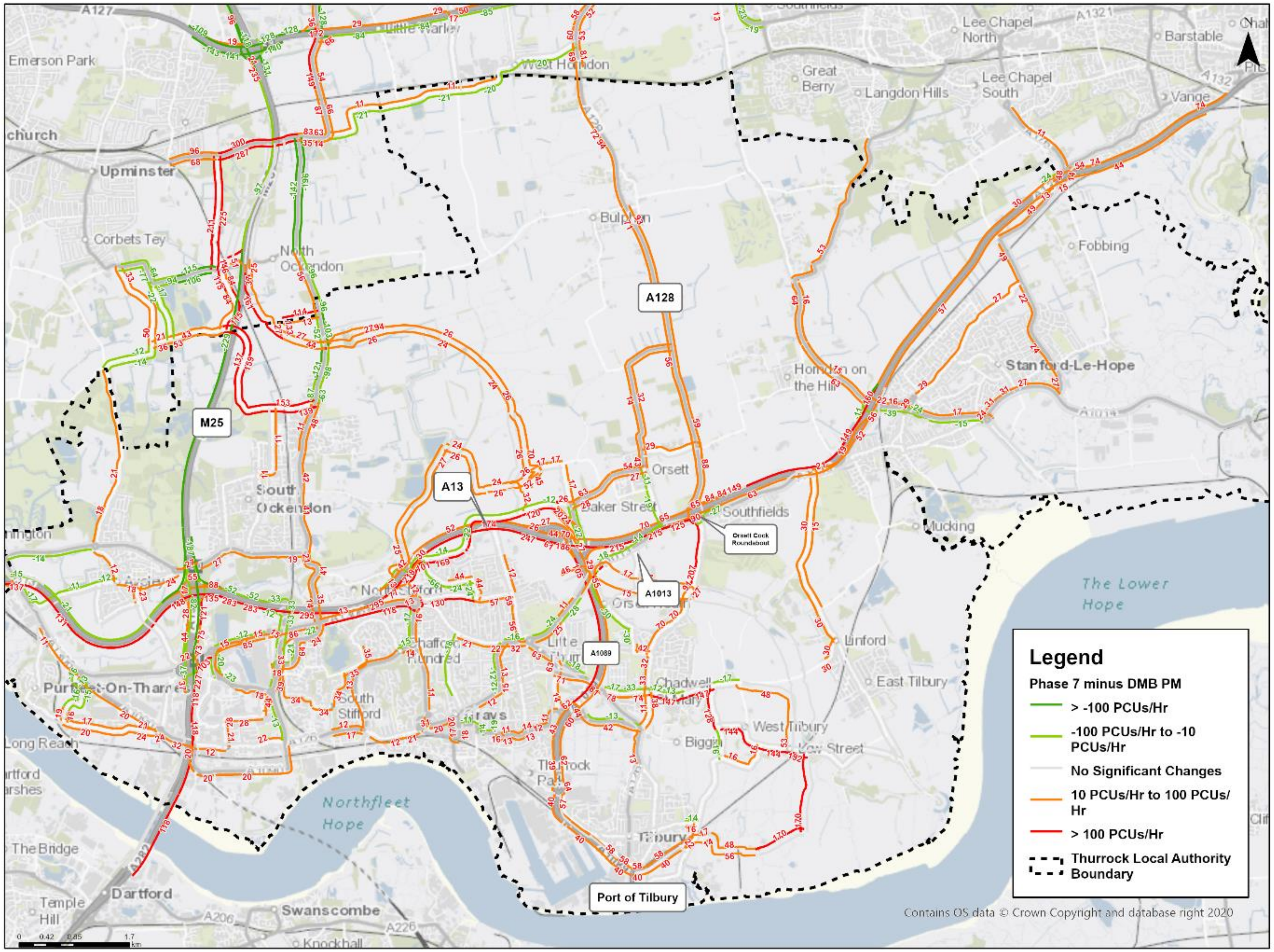

Figure 10-14: Actual Flow Differences (Phase 7 minus DMB PM)

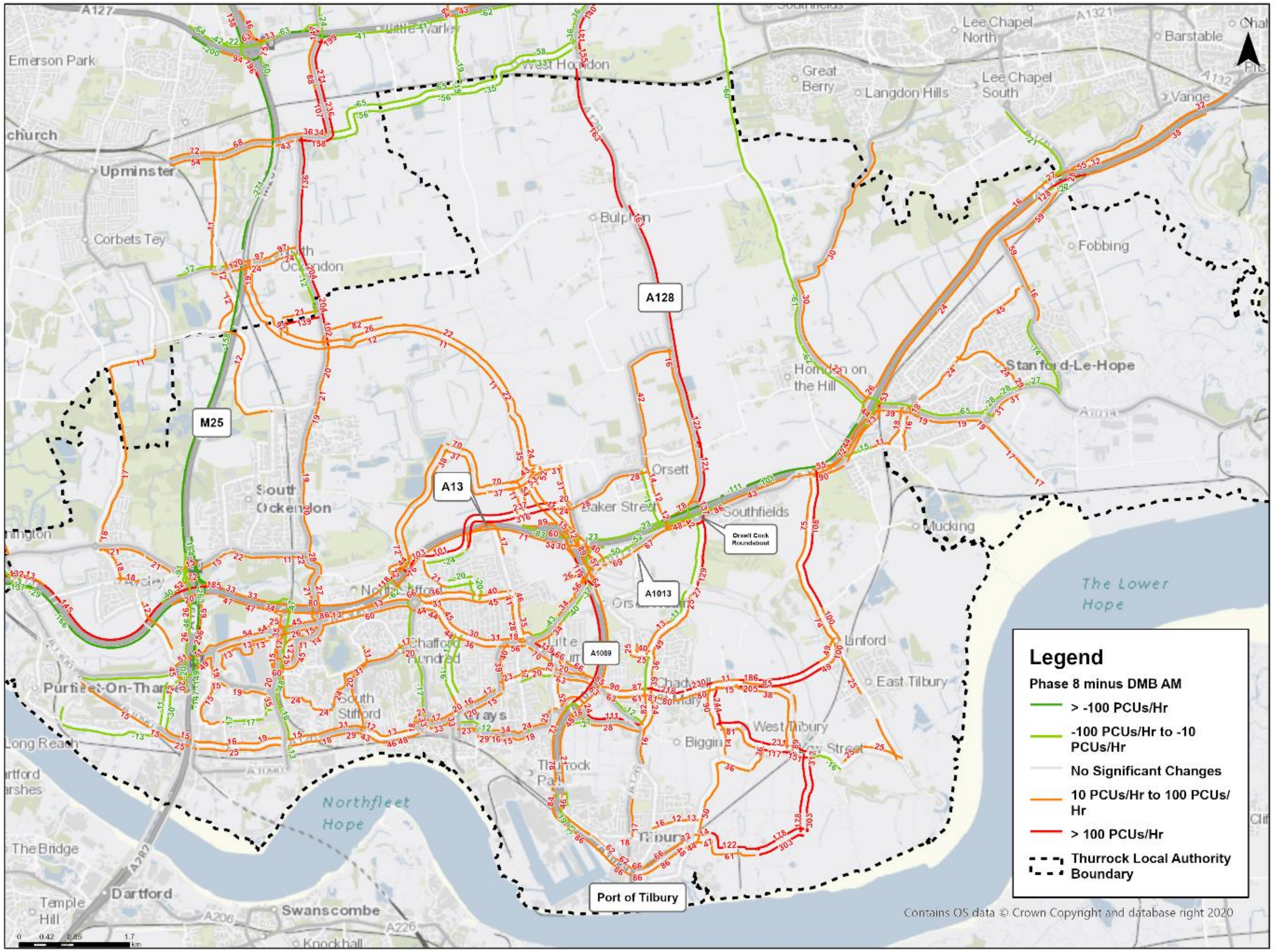

Figure 10-15: Actual Flow Differences (Phase 8 minus DMB AM)

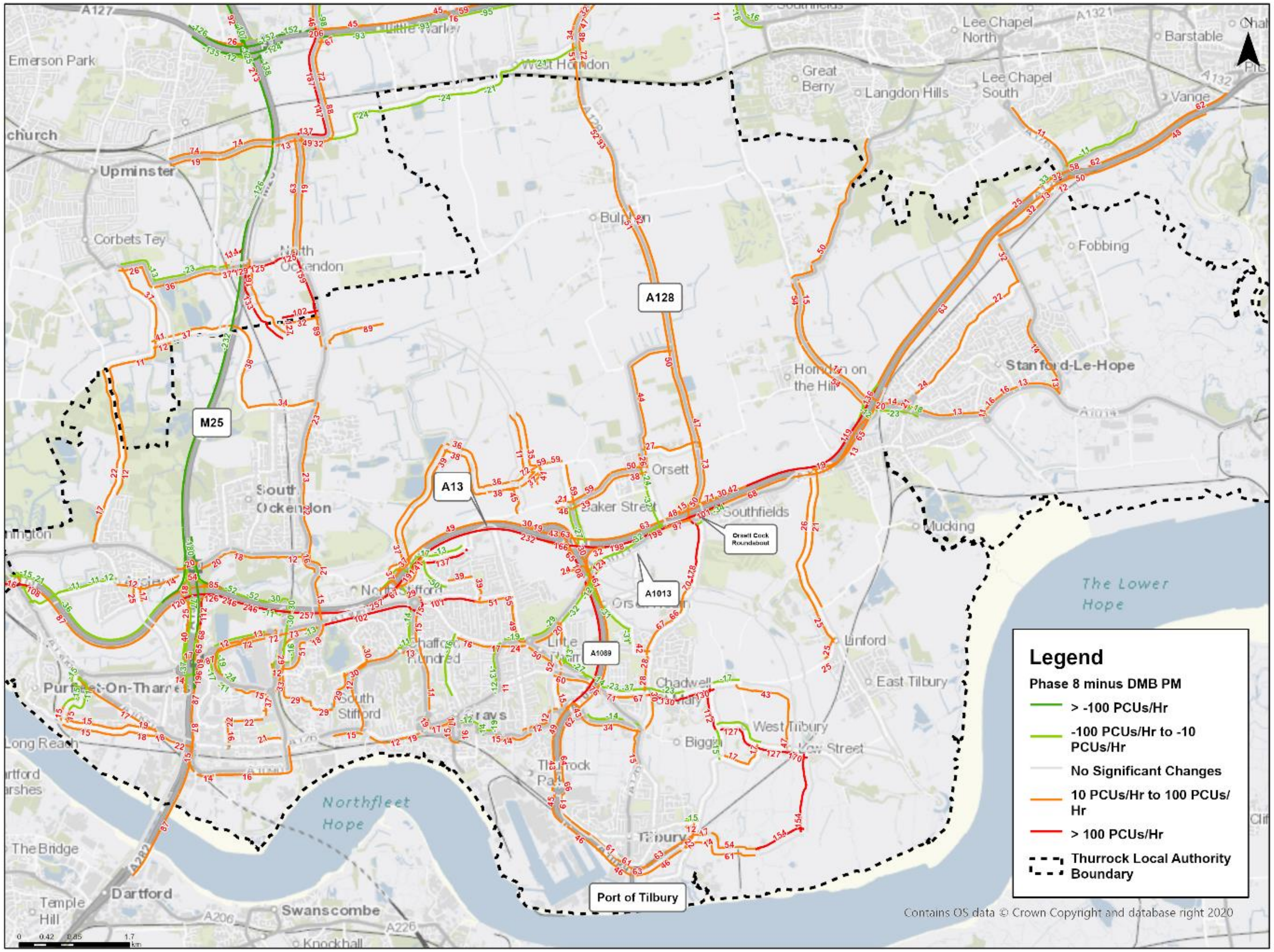

Figure 10-16: Actual Flow Differences (Phase 8 minus DMB PM)

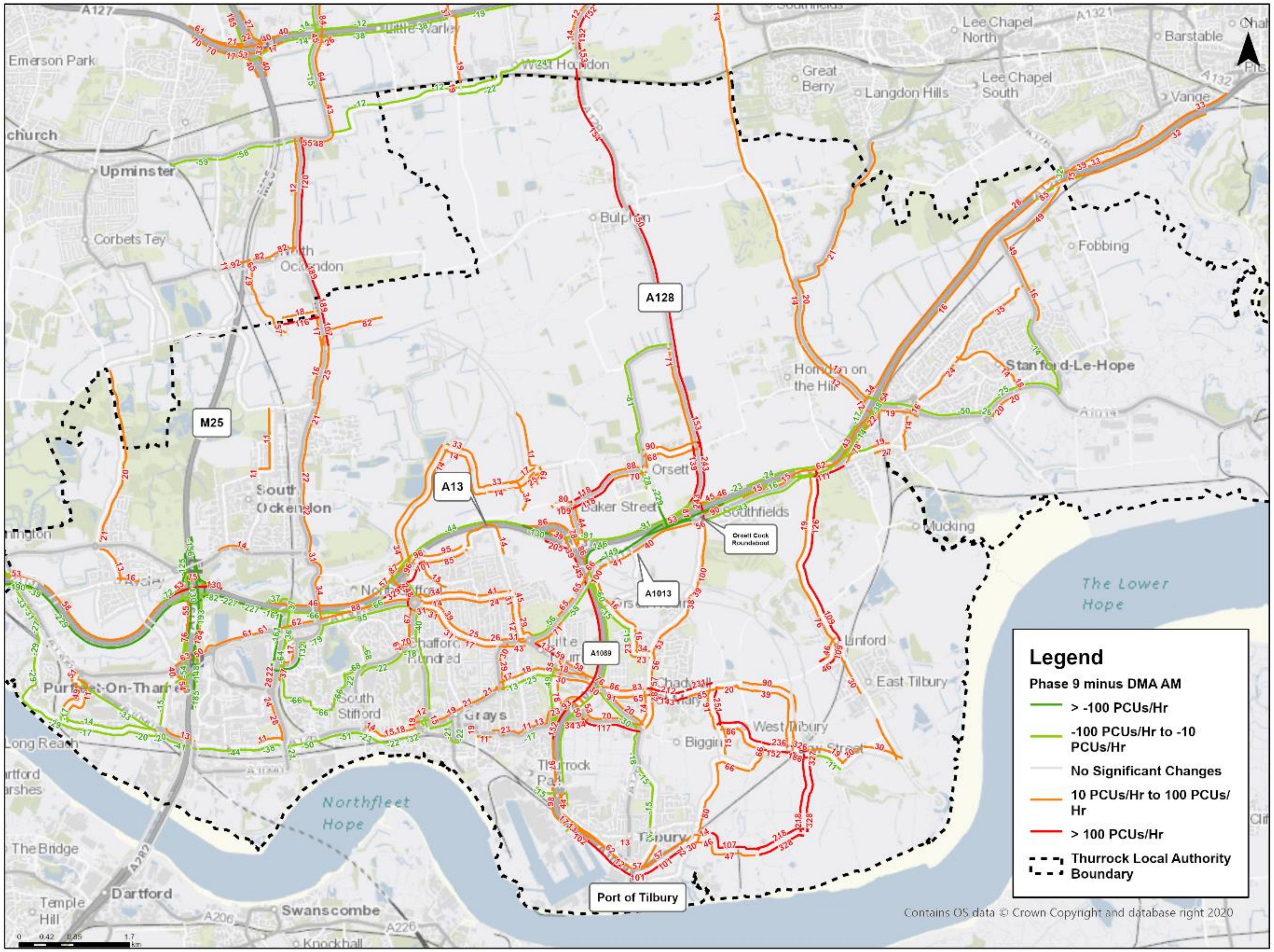

Figure 10-17: Actual Flow Differences (Phase 9 minus DMB AM)

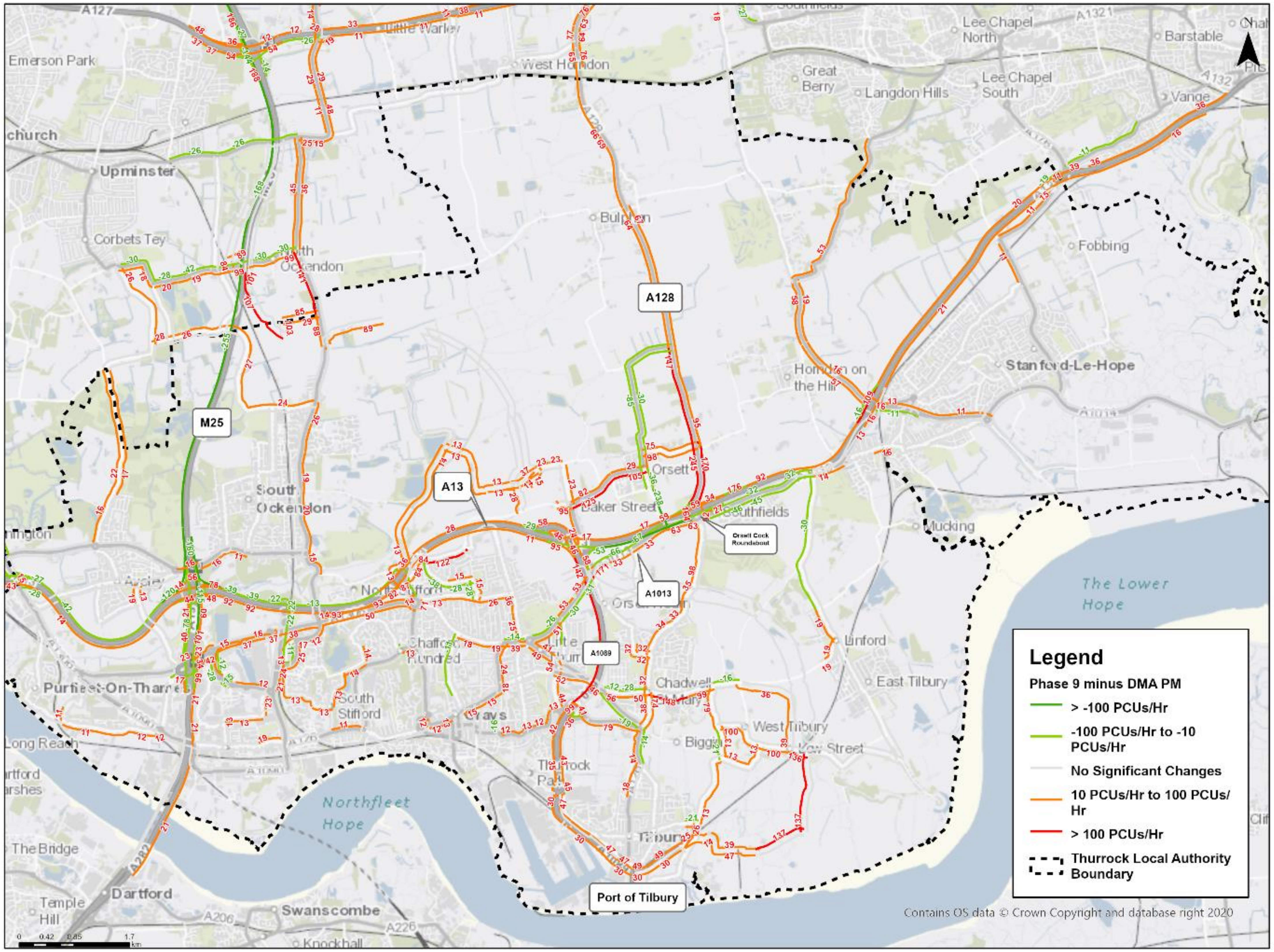

Figure 10-18: Actual Flow Differences (Phase 9 minus DMA PM)

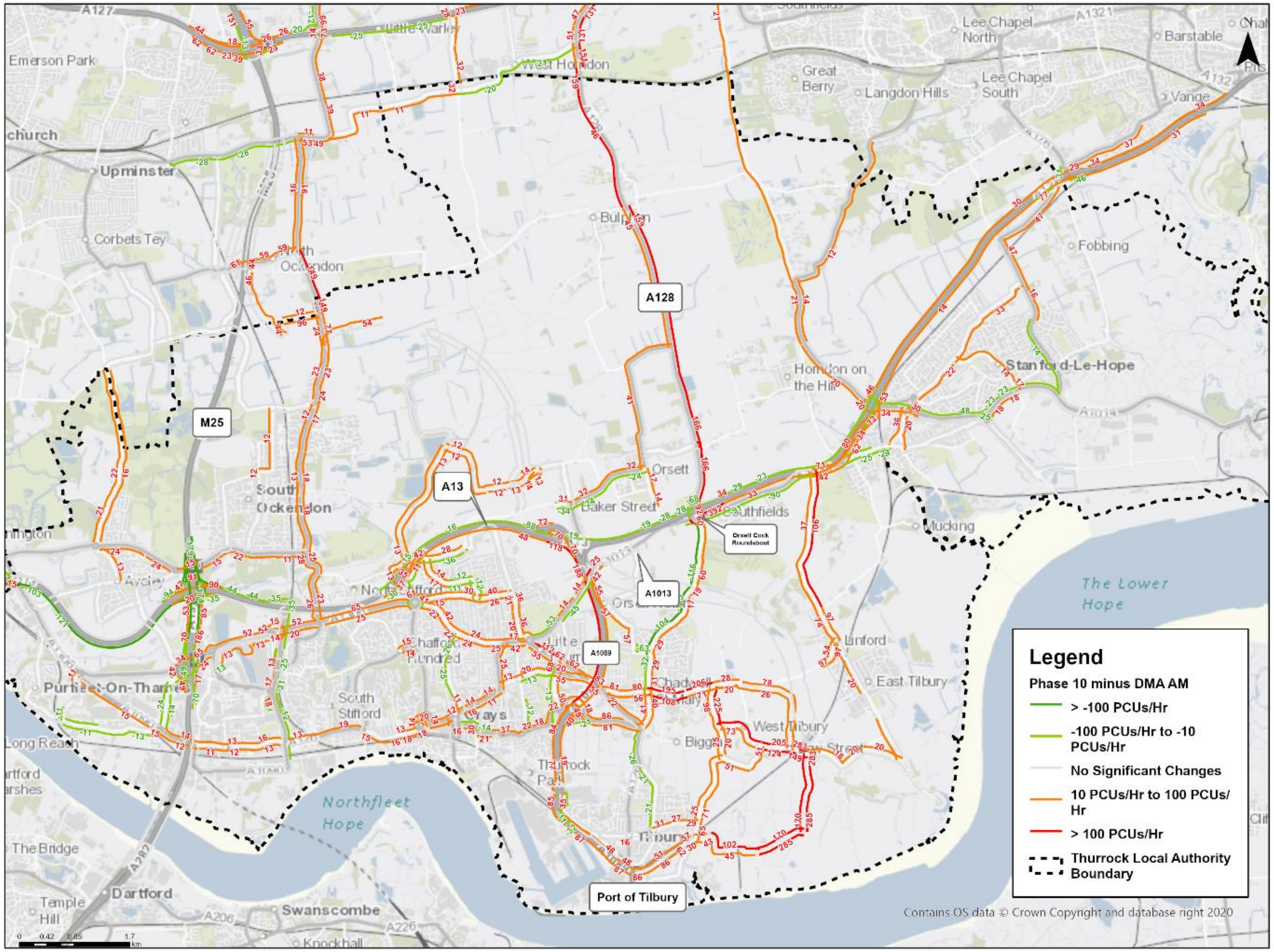

Figure 10-19: Actual Flow Differences (Phase 10 minus DMA AM)

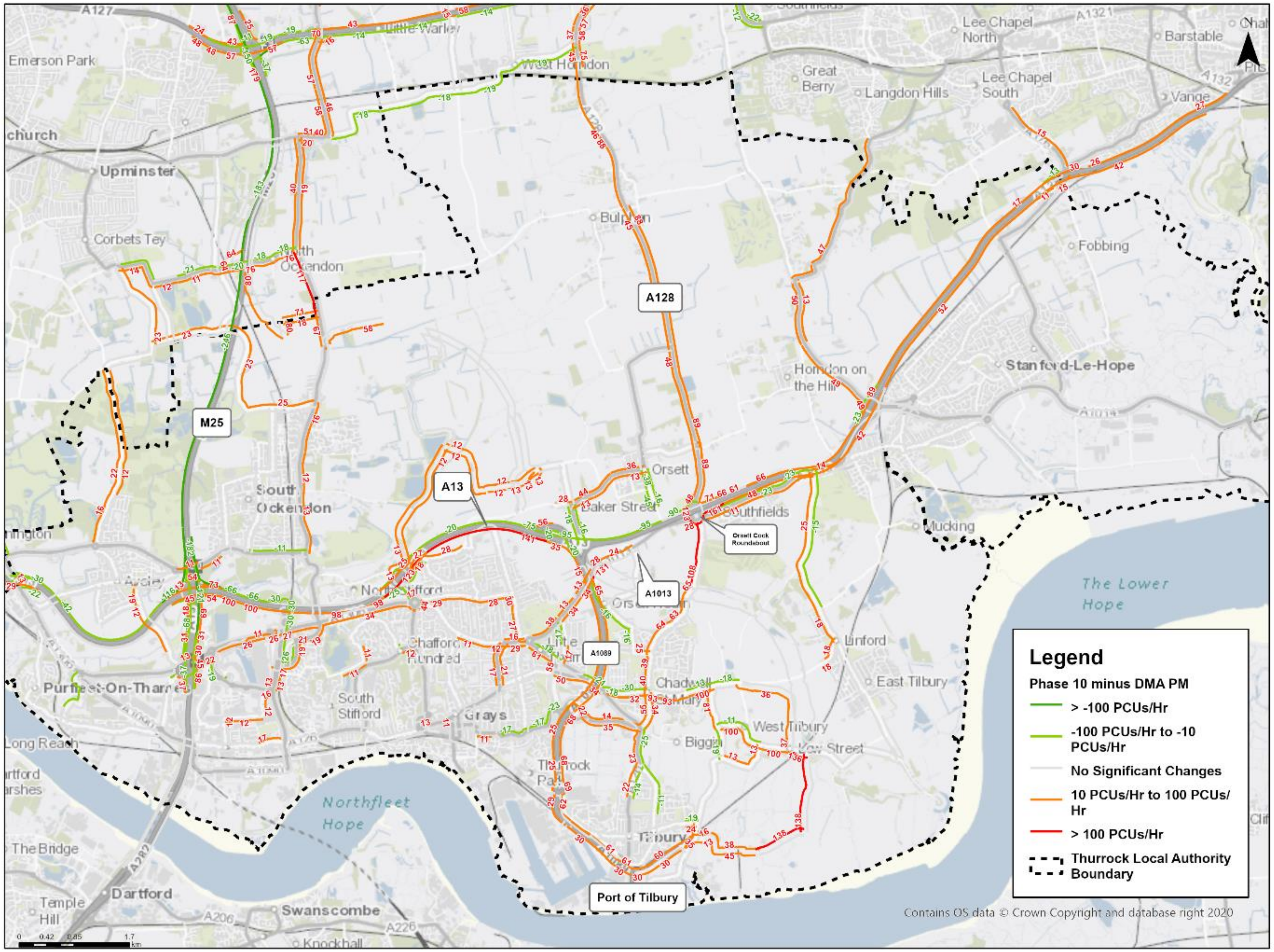

Figure 10-20: Actual Flow Differences (Phase 10 minus DMA PM)

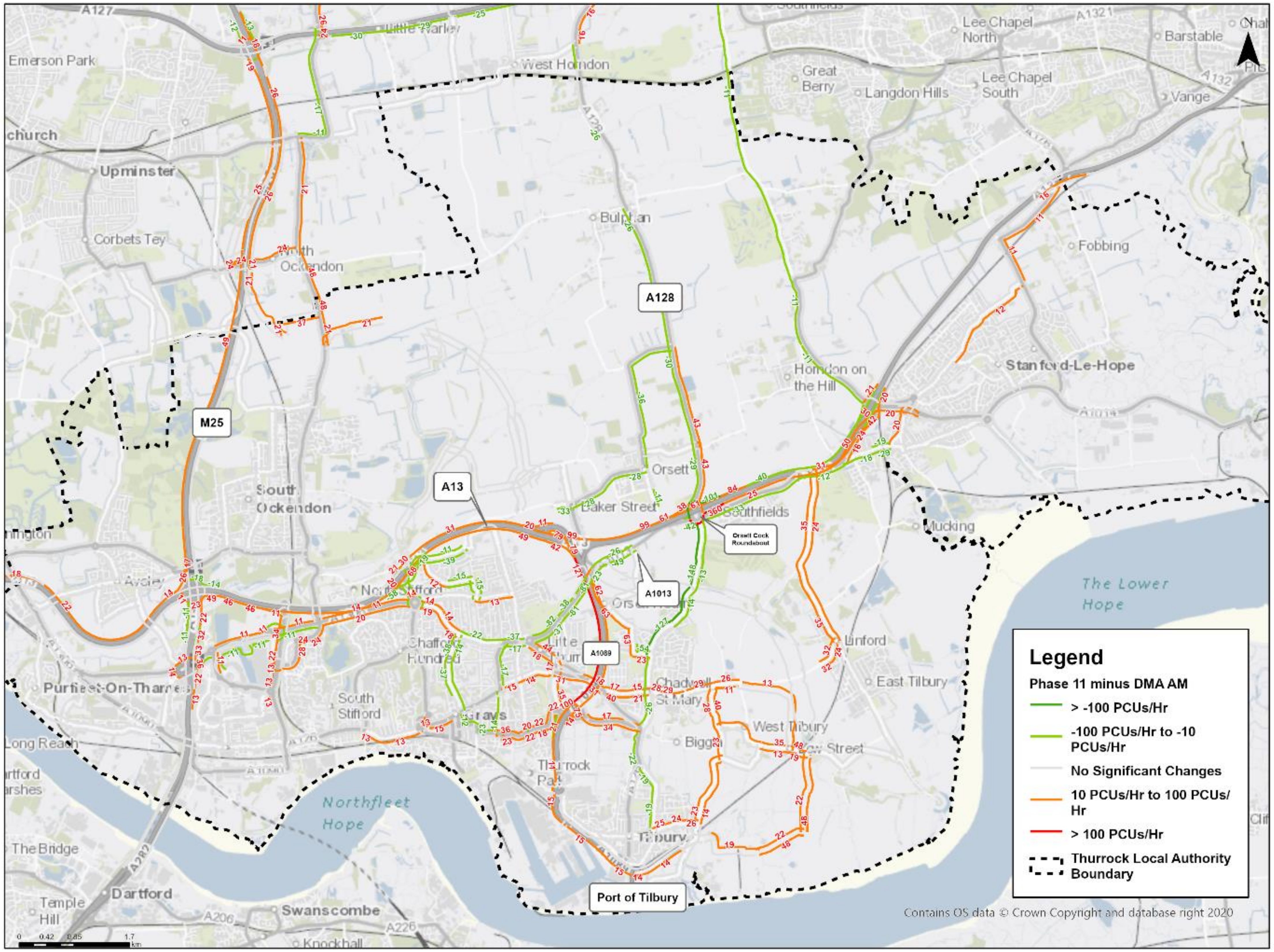

Figure 10-21: Actual Flow Differences (Phase 11 minus DMA AM)

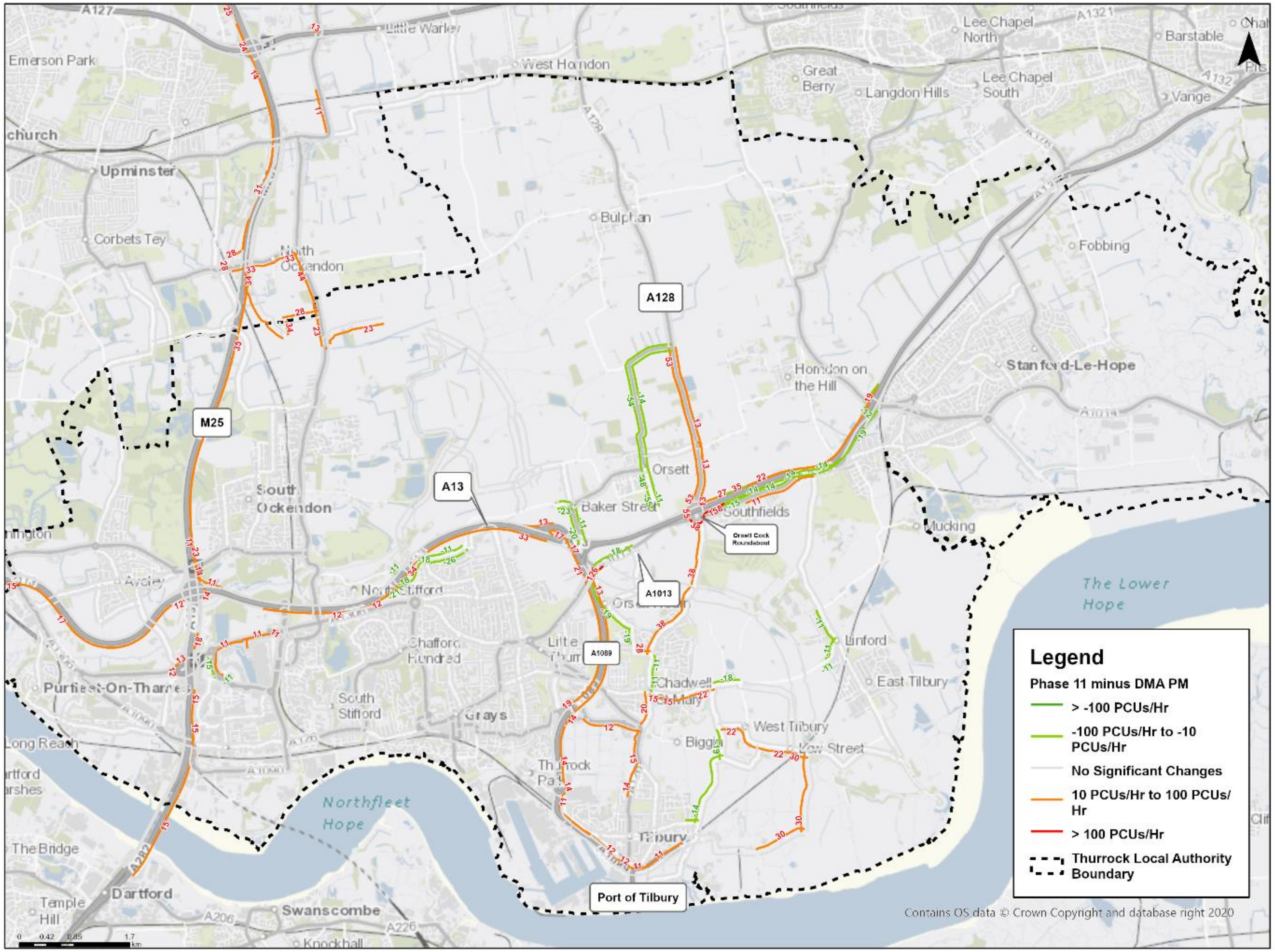

Figure 10-22: Actual Flow Differences (Phase 11 minus DMA PM)

Appendix B Initial Roads and Further Roads/Areas of concern Flow Outputs (PCU/hr)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 1 v DMB

			DMB (AM)	Phase 1 (AM)								DMA (IP)	Phase 1 (IP)								DMB (PM)	Phase 1 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	288	311	0	0	0	0	311	24	24	118	123	0	0	0	0	123	5	5	276	338	0	0	5	5	343	67	62
		SB	229	254	0	0	1	1	256	26	25	180	194	0	0	0	0	194	15	15	237	197	0	0	0	0	197	-40	-40
2	Stifford Clays Road, Orsett Village	EB	134	80	0	0	3	3	83	-50	-53	143	143	0	0	0	0	143	0	-1	324	225	0	0	35	35	260	-64	-99
		WB	324	195	0	0	36	36	231	-92	-129	205	189	0	0	0	0	189	-17	-17	303	193	0	0	3	3	196	-107	-110
3	B186, North Ockendon (and Ockendon Rd)	NB	661	487	5	0	59	64	551	-110	-174	438	377	2	0	0	2	378	-60	-61	470	304	2	0	2	3	308	-163	-166
		WB	376	282	2	0	2	4	285	-91	-95	469	388	2	0	0	2	390	-79	-81	671	482	2	0	66	68	550	-121	-189
4	B186, South Ockendon	NB	384	346	4	0	31	35	381	-3	-38	243	265	1	0	0	1	267	24	22	253	243	1	0	2	4	246	-6	-10
		SB	259	236	1	0	3	4	240	-19	-23	279	295	1	0	0	2	297	17	16	400	390	1	0	37	39	428	28	-10
5	B188, Baker Street Village	NB	45	2	0	0	26	26	28	-17	-43	39	13	0	0	0	0	13	-26	-26	35	12	0	0	3	3	15	-19	-22
		SB	34	24	0	0	3	3	27	-6	-9	48	39	0	0	0	0	40	-9	-9	148	104	0	0	26	26	130	-18	-44
6	A1014, North Bound	EB	1798	1758	3	0	1	3	1761	-37	-41	1951	1933	3	0	1	3	1937	-14	-17	1351	1348	3	0	9	12	1360	9	-3
		WB	1372	1369	8	0	6	14	1383	11	-3	2092	2092	2	0	1	3	2095	3	0	2207	2200	2	0	0	2	2202	-5	-7
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1278	2	0	5	6	1284	21	15	787	785	2	0	5	6	792	5	-2	870	858	2	0	68	70	928	59	-11
		SB	806	859	2	0	45	47	905	99	53	650	719	1	0	6	7	727	77	70	964	1037	1	0	2	3	1041	77	73
8	A1089	NB	2210	2195	6	3	8	17	2212	2	-15	2040	2078	6	3	4	13	2092	51	38	2143	2169	6	3	43	52	2221	78	26
		SB	2232	2224	15	3	63	81	2305	73	-8	2107	2053	5	3	13	21	2075	-32	-54	1956	2125	5	3	5	13	2138	182	169
9	Buckingham Hill Road (North Bound)	NB	689	759	0	0	8	8	767	78	70	496	498	0	0	7	7	505	9	1	499	580	0	0	86	86	666	168	81
		SB	345	422	0	0	91	91	513	168	77	428	467	0	0	15	15	482	54	39	463	543	0	0	1	1	543	80	80
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4393	4	1	0	5	4398	-106	-111	3934	3971	4	2	0	5	3977	43	38	4822	4782	4	1	49	54	4836	13	-40
		WB	5085	5012	10	1	41	52	5065	-20	-73	4073	4122	3	2	1	5	4127	54	49	4406	4339	3	2	0	5	4344	-62	-67
16	Brentwood Road (North of Orsett Cock)	NB	644	529	2	3	4	9	539	-106	-115	346	363	2	3	5	10	373	28	18	394	228	2	3	106	112	340	-55	-166
		SB	225	111	6	3	79	88	200	-25	-114	376	374	2	3	6	11	385	10	-2	639	411	2	3	1	6	417	-222	-227
17	Brentwood Road / Chadwell St Mary	NB	284	205	0	0	8	8	213	-71	-79	236	220	0	0	5	5	225	-11	-16	235	154	0	0	48	48	202	-32	-80
		SB	218	165	0	0	29	29	194	-23	-52	214	211	0	0	7	7	219	5	-3	276	170	0	0	6	6	177	-99	-105
18	Marshfoot Rd	EB	490	199	0	0	64	64	263	-227	-291	643	577	0	0	2	2	579	-64	-66	801	603	0	0	0	0	603	-199	-199
		WB	774	523	0	0	1	1	524	-250	-251	505	504	0	0	0	0	504	-1	-1	441	162	0	0	0	0	162	-279	-279
20	Muckingford Road / Linford Road	EB	2	2	0	0	79	79	81	79	0	4	4	0	0	15	15	19	15	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	0	0	2	0	0	3	3	0	0	0	0	3	0	0	2	2	0	0	4	4	6	4	0
21	Princess Margaret Road, East Tilbury	NB	69	103	0	0	8	8	110	41	33	47	47	0	0	7	7	55	8	0	35	56	0	0	68	68	124	90	21
		SB	26	46	0	0	0	0	46	20	20	50	50	0	0	0	0	50	0	0	54	73	0	0	0	0	73	19	19
24	Dock Road	NB	167	371	0	0	6	6	377	210	205	37	37	0	0	0	0	37	0	0	39	274	0	0	0	0	274	235	235
		SB	0	8	0	0	0	0	8	8	8	50	83	0	0	0	0	83	33	33	174	233	0	0	1	1	233	59	58
25	Green Lane	EB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Stifford Clays Road	EB	87	60	18	2	104	123	183	96	-27	106	104	5	2	0	7	111	4	-3	252	203	5	2	0	7	211	-42	-49
		WB	278	176	7	2	0	9	185	-94	-102	162	144	7	2	0	8	153	-10	-18	238	157	7	2	118	126	283	44	-82
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	521	0	0	1	1	522	-28	-29	499	503	0	0	1	1	504	4	4	1008	1053	0	0	14	14	1068	60	46
		SB	591	581	0	0	19	19	600	9	-10	456	463	0	0	2	2	465	9	7	580	589	0	0	0	0	589	9	9
28	A1013 The Manorway to Buckingham Hill Road	NB	376	404	0	0	7	7	412	36	29	281	255	0	0	7	7	262	-19	-25	276	271	0	0	69	69	340	64	-5
		SB	182	197	0	0	76	76	273	91	16	183	181	0	0	13	13	195	12	-2	212	261	0	0	0	0	261	49	49
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	474	0	0	13	13	487	51	38	530	565	0	0	0	0	565	35	35	737	740	0	0	5	5	744	7	2
		WB	844	867	0	0	6	6	873	28	23	631	632	0	0	0	0	632	1	1	662	697	0	0	12	12	709	47	35
30	A1013 Orsett Cock to A1089	EB	800	840	2	1	3	5	845	46	40	569	527	2	1	0	2	529	-40	-42	1007	1113	2	1	54	56	1169	162	107
		WB	935	971	4	1	47	51	1023	88	37	602	631	1	1	0	2	633	30	29	878	908	1	1	4	6	914	36	30
31	Heath Road	NB	107	159	0	0	4	4	163	56	52	43	17	0	0	0	0	18	-25	-26	38	112	0	0	4	4	116	78	73
		SB	36	107	0	0	8	8	115	80	72	51	54	0	0	1	1	55	5	4	143	227	0	0	4	4	231	88	84
32	Old Dock Approach Rd	NB	113	132	0	0	4	4	136	23	19	107	99	0	0	0	0	99	-7	-7	145	144	0	0	0	0	144	0	0
		SB	344	240	0	0	0	0	240	-104	-104	200	218	0	0	0	0	218	17	17	232	172	0	0	3	3	175	-57	-60
33	Dock Road	EB	588	549	0	0	0	0	549	-39	-39	508	536	0	0	2	2	538	30	29	647	647	0	0	0	0	647	0	0
		SB	716	634	0	0	1	1	635	-81	-82	586	578	0	0	1	1	578	-8	-9	625	598	0	0	10	10	607	-17	-27
34	A1012 Elizabeth Road	NB	363	378	0	0	3	3	381	17	15	469	482	0	0	0	0	482	13	13	460	467	0	0	0	0	467	7	7
		SB	305	317	0	0	0	0	317	12	12	252	252	0	0	0	0	252	0	0	276	298	0	0	7	7	305	29	22
35	Blackshots Lane	NB	111	103	0	0	1	1	103	-7	-8	84	88	0	0	0	0	88	4	4	126	88	0	0	0	0	88	-37	-37
		SB	92	77	0	0	0	0	77	-15	-15	75	75	0	0	0	0	75	0	0	100	77	0	0	1	1	78	-22	-23
36	Medebridge Road	NB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	Dennis Road / West Road	EB	279	326	1	0	31	31	357	79	47	197	303	0	0	0	0	303	106	105	235	357	0	0	2	2	360	125	123
		WB	119	230	0	0	2	2	232	113	111	192	284	0	0	0	0	285	93	93	288	388	0	0	32	32	420	132	100
38	A 1306 Arterial Road North Stifford	EB	1181	1164	3	0	100	103	1267	86	-18	1334	1340	2	0	15	16	1356	23	6	1696	1697	2	0	11	13	1709	14	1
		WB	1639	1587	3	0	19	22	1609	-30	-52	1335	1324	1	0	9	10	1333	-2	-11	1448	1416	1	0	99	100	1516	68	-32
39	St Chads Rd / Feenan Highway	NB	36	28	0	0	1	1	29	-7	-8	44	37	0	0	0	0	37	-7	-7	62	31	0	0	0	0	31	-30	-30
		SB	100	95	0	0	0	0	95	-5	-5	32	32	0	0	0	0	32	0	0	37	40	0	0	0	0	40	3	3

Table 10-1:Flow Changes of Initial & further list of roads of concern (Phase 1 vs DMB)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 2 v DMB

			DMB (AM)	Phase 2 (AM)								DMA (IP)	Phase 2 (IP)								DMB (PM)	Phase 2 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned General Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned General Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned General Traffic
1	Rectory Road, Orsett Village	NB	288	289	0	0	0	0	289	1	1	118	118	0	0	0	0	118	0	0	276	294	0	0	7	7	301	25	18
		SB	229	217	0	0	2	2	219	-10	-12	180	141	0	0	0	0	141	-39	-39	237	220	0	0	0	0	220	-16	-17
2	Stifford Clays Road, Orsett Village	EB	134	124	0	0	33	33	158	24	-9	143	136	0	0	2	2	138	-5	-7	324	296	0	0	59	59	355	31	-28
		WB	324	301	0	0	59	59	360	36	-23	205	204	0	0	1	1	205	-1	-2	303	317	0	0	8	8	325	22	14
3	B186, North Ockendon (and Ockendon Rd)	NB	661	477	2	0	109	111	588	-73	-184	438	248	1	0	0	1	249	-189	-190	470	286	1	0	2	3	289	-181	-184
		WB	376	224	1	0	3	3	227	-149	-153	469	271	1	0	1	1	272	-196	-198	671	435	0	0	123	124	558	-113	-236
4	B186, South Ockendon	NB	384	342	2	0	66	68	409	25	-43	243	225	1	0	1	1	226	-17	-18	253	243	1	0	3	4	247	-6	-9
		SB	259	215	1	0	4	5	219	-40	-44	279	255	1	0	1	2	256	-23	-24	400	371	1	0	74	75	446	46	-29
5	B188, Baker Street Village	NB	45	22	0	0	44	44	66	21	-23	39	34	0	0	1	1	36	-3	-4	35	53	0	0	8	8	60	26	18
		SB	34	32	0	0	33	33	66	32	-1	48	43	0	0	2	2	45	-3	-5	148	120	0	0	12	12	132	-16	-28
6	A1014, North Bound	EB	1798	1740	4	0	2	6	1746	-52	-58	1951	1939	4	0	2	6	1945	-6	-12	1351	1351	4	0	12	15	1367	16	0
		WB	1372	1369	10	0	9	19	1388	16	-3	2092	2092	3	0	3	6	2098	6	0	2207	2180	3	0	0	3	2183	-24	-27
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1257	2	0	11	13	1270	8	-6	787	772	2	0	17	19	791	4	-15	870	860	2	0	86	88	947	78	-10
		SB	806	822	2	0	62	63	885	79	16	650	673	1	0	19	20	693	43	23	964	996	1	0	3	4	1000	36	32
8	A1089	NB	2210	2278	15	10	26	51	2329	119	68	2040	2059	15	10	16	42	2101	61	19	2143	2191	15	10	56	81	2272	129	48
		SB	2232	2123	39	10	97	146	2269	37	-108	2107	2081	12	10	87	109	2191	84	-26	1956	1952	12	10	9	31	1983	27	-4
9	Buckingham Hill Road (North Bound)	NB	689	718	0	0	29	29	748	59	29	496	535	0	0	28	28	563	67	39	499	520	0	0	104	104	624	125	22
		SB	345	394	0	0	126	126	520	175	49	428	448	0	0	53	53	501	73	20	463	497	0	0	1	1	497	34	33
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4389	5	4	0	9	4398	-106	-116	3934	3884	5	4	0	9	3893	-40	-50	4822	4823	5	4	89	98	4921	99	1
		WB	5085	4994	15	4	75	93	5087	2	-91	4073	4064	4	4	2	10	4075	2	-9	4406	4360	5	4	0	9	4369	-37	-46
16	Brentwood Road (North of Orsett Cock)	NB	644	502	4	6	12	22	523	-121	-143	346	216	4	6	17	27	243	-102	-129	394	312	4	5	148	158	471	76	-82
		SB	225	195	12	5	120	137	332	107	-30	376	288	4	6	19	28	316	-60	-88	639	528	4	5	3	12	540	-99	-111
17	Brentwood Road / Chadwell St Mary	NB	284	221	0	0	20	20	240	-44	-63	236	177	0	0	19	19	196	-40	-58	235	207	0	0	61	61	268	33	-28
		SB	218	182	0	0	46	46	227	9	-36	214	186	0	0	22	22	209	-5	-28	276	206	0	0	6	6	212	-64	-70
18	Marshfoot Rd	EB	490	517	0	0	118	118	635	145	27	643	602	0	0	94	94	696	53	-41	801	795	0	0	1	1	796	-5	-6
		WB	774	859	0	0	6	6	865	90	84	505	513	0	0	22	22	535	30	8	441	452	0	0	79	79	530	89	10
20	Muckingford Road / Linford Road	EB	2	2	0	0	114	114	117	114	0	4	4	0	0	53	53	56	53	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	0	0	2	0	0	3	3	0	0	0	0	3	0	0	2	2	0	0	4	4	6	4	0
21	Princess Margaret Road, East Tilbury	NB	69	87	0	0	29	29	115	46	17	47	47	0	0	28	28	76	28	0	35	45	0	0	87	87	132	97	10
		SB	26	34	0	0	0	0	34	8	8	50	56	0	0	0	0	56	7	7	54	77	0	0	0	0	77	23	23
24	Dock Road	NB	167	173	0	0	1	1	174	7	6	37	38	0	0	0	0	38	1	1	39	45	0	0	0	0	45	6	6
		SB	0	0	0	0	0	0	0	0	0	50	87	0	0	0	0	87	37	37	174	177	0	0	1	1	177	3	2
25	Green Lane	EB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Stifford Clays Road	EB	87	78	0	0	183	183	261	174	-10	106	103	0	0	0	0	103	-3	-3	252	238	0	0	1	1	239	-14	-15
		WB	278	268	0	0	1	1	269	-9	-10	162	160	0	0	0	0	160	-2	-2	238	248	0	0	179	179	427	189	10
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	503	0	0	3	3	506	-44	-47	499	505	0	0	3	3	508	9	6	1008	1054	0	0	18	18	1072	64	46
		SB	591	582	0	0	28	28	610	19	-8	456	454	0	0	6	6	461	4	-2	580	584	0	0	0	0	584	4	4
28	A1013 The Manorway to Buckingham Hill Road	NB	376	379	0	0	27	27	406	31	4	281	299	0	0	25	25	324	43	18	276	242	0	0	86	86	328	52	-34
		SB	182	179	0	0	111	111	290	109	-2	183	182	0	0	46	46	228	45	-1	212	236	0	0	0	0	236	24	24
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	462	0	0	10	10	472	36	26	530	549	0	0	0	0	549	18	18	737	732	0	0	6	6	739	1	-5
		WB	844	850	0	0	7	7	858	13	6	631	630	0	0	0	0	630	-1	-1	662	680	0	0	11	11	691	29	18
30	A1013 Orsett Cock to A1089	EB	800	844	3	0	6	10	854	54	45	569	642	3	0	0	3	645	76	73	1007	1035	3	0	49	52	1087	80	28
		WB	935	972	9	0	44	53	1025	90	37	602	686	3	0	0	3	689	87	84	878	938	3	0	8	11	949	72	61
31	Heath Road	NB	107	139	0	0	6	6	145	38	32	43	110	0	0	2	2	112	69	67	38	88	0	0	6	6	94	56	50
		SB	36	33	0	0	7	7	40	4	-3	51	108	0	0	3	3	111	61	58	143	172	0	0	5	5	177	34	29
32	Old Dock Approach Rd	NB	113	103	0	0	6	6	109	-4	-10	107	108	0	0	0	0	108	1	1	145	140	0	0	0	0	140	-4	-4
		SB	344	407	0	0	0	0	407	63	63	200	208	0	0	0	0	208	8	8	232	251	0	0	4	4	254	22	18
33	Dock Road	EB	588	588	0	0	19	19	607	19	0	508	511	0	0	6	6	517	9	3	647	651	0	0	0	0	651	4	4
		SB	716	700	0	0	6	6	706	-10	-16	586	576	0	0	6	6	582	-4	-10	625	618	0	0	21	21	639	14	-7
34	A1012 Elizabeth Road	NB	363	364	0	0	4	4	368	5	1	469	473	0	0	0	0	473	4	4	460	467	0	0	0	0	467	6	6
		SB	305	301	0	0	0	0	301	-4	-4	252	252	0	0	0	0	252	0	0	276	276	0	0	6	6	282	6	0
35	Blackshots Lane	NB	111	113	0	0	1	1	114	3	2	84	82	0	0	0	0	82	-2	-2	126	124	0	0	0	0	124	-1	-1
		SB	92	89	0	0	0	0	89	-3	-3	75	77	0	0	0	0	77	2	2	100	113	0	0	2	2	115	15	13
36	Medebridge Road	NB	0	0	10	12	0	23	23	23	0	0	0	3	12	0	15	15	15	0	0	0	2	12	0	14	14	14	0
		SB	0	0	3	12	0	15	15	15	0	0	0	4	12	0	16	16	16	0	0	0	4	12	0	16	16	16	0
37	Dennis Road / West Road	EB	279	377	1	0	48	49	426	148	99	197	285	0	0	0	1	285	88	88	235	418	0	0	4	4	423	188	184
		WB	119	251	0	0	4	4	255	136	132	192	278	0	0	0	0	278	87	86	288	439	0	0	54	54	493	205	151
38	A 1306 Arterial Road North Stifford	EB	1181	1159	4	0	142	146	1305	124	-22	1334	1348	1	0	12	13	1361	27	14	1696	1683	2	0	34	36	1719	23	-13
		WB	1639	1605	2	0	64	66	1671	32	-34	1335	1340	0	0	34	34	1374	39	5	1448	1451	2	0	126	128	1579	131	2
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	34	-2	-2	44	34	0	0	0	0	34	-10	-10	62	60	0	0	0	0	60	-1	-1
		SB	100	0	0	0	0	0	0	-100	-100	32	0	0	0	0	0	0	-32	-32	37	0	0	0	0	0	0	-37	-37

Table 10-2:Flow Changes of Initial & further list of roads of concern (Phase 2 vs DMB)

Stantec

Initial & Further List Roads/Areas of Concern Flow Changes Phase 3 v DMB

			DMB (AM)	Phase 3 (AM)								DMA (IP)	Phase 3 (IP)								DMB (PM)	Phase 3 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	288	267	0	0	34	34	301	13	-20	118	118	0	0	2	2	121	2	0	276	204	0	0	3	3	207	-69	-72
		SB	229	215	0	0	8	8	223	-6	-14	180	189	0	0	3	3	192	12	9	237	211	0	0	4	4	215	-22	-26
2	Stifford Clays Road, Orsett Village	EB	134	91	0	0	5	5	96	-38	-43	143	98	0	0	2	2	100	-44	-46	324	245	0	0	49	49	294	-30	-79
		WB	324	280	0	0	48	48	328	4	-44	205	172	0	0	2	2	174	-31	-33	303	296	0	0	3	3	299	-4	-7
3	B186, North Ockendon (and Ockendon Rd)	NB	661	633	4	0	113	116	749	88	-28	438	405	1	0	1	2	407	-31	-33	470	422	1	0	3	4	426	-44	-48
		WB	376	377	1	0	4	5	382	5	0	469	465	1	0	1	2	467	-2	-4	671	613	1	0	85	85	699	28	-58
4	B186, South Ockendon	NB	384	363	3	0	61	64	427	42	-21	243	252	1	0	1	2	254	11	9	253	247	1	0	3	3	250	-3	-6
		SB	259	263	1	0	4	5	268	9	4	279	285	1	0	1	2	287	7	6	400	409	1	0	70	71	480	80	9
5	B188, Baker Street Village	NB	45	0	0	0	0	0	0	-45	-45	39	0	0	0	0	0	0	-39	-39	35	0	0	0	0	0	0	-35	-35
		SB	34	0	0	0	0	0	0	-34	-34	48	0	0	0	0	0	0	-48	-48	148	0	0	0	0	0	0	-148	-148
6	A1014, North Bound	EB	1798	1709	4	0	5	9	1718	-80	-89	1951	1934	4	0	5	10	1944	-7	-16	1351	1356	4	0	10	14	1371	20	5
		WB	1372	1366	12	0	10	22	1388	15	-6	2092	2092	4	0	4	8	2099	8	0	2207	2184	4	0	0	4	2188	-19	-23
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1217	2	0	26	28	1245	-18	-46	787	780	2	0	39	41	821	34	-7	870	852	2	0	62	64	917	47	-17
		SB	806	889	3	0	65	68	957	151	83	650	722	1	0	29	30	753	103	73	964	1034	2	0	6	8	1042	79	71
8	A1089	NB	2210	2191	19	16	54	89	2280	70	-19	2040	2051	20	16	37	73	2123	83	11	2143	2164	20	16	44	80	2244	101	20
		SB	2232	2109	49	16	110	175	2284	53	-123	2107	2065	16	16	110	142	2207	100	-42	1956	2012	15	16	9	40	2052	96	56
9	Buckingham Hill Road (North Bound)	NB	689	690	0	0	68	68	758	69	1	496	460	0	0	65	65	525	29	-37	499	452	0	0	70	70	522	23	-46
		SB	345	322	0	0	129	129	451	106	-23	428	455	0	0	21	21	476	48	27	463	449	0	0	2	2	451	-13	-14
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4351	6	7	0	13	4363	-141	-154	3934	3972	6	7	0	13	3985	52	39	4822	4909	6	7	71	84	4993	170	86
		WB	5085	5089	17	7	57	81	5170	84	4	4073	4124	5	7	56	67	4192	119	52	4406	4470	5	7	0	12	4481	75	64
16	Brentwood Road (North of Orsett Cock)	NB	644	579	4	10	25	39	618	-27	-65	346	395	4	10	39	53	449	103	50	394	472	4	10	94	107	579	185	77
		SB	225	284	11	10	90	110	394	169	58	376	393	3	10	83	96	489	113	17	639	646	3	10	5	18	664	25	8
17	Brentwood Road / Chadwell St Mary	NB	284	257	0	0	33	33	290	6	-27	236	259	0	0	44	44	304	68	23	235	276	0	0	48	48	324	90	42
		SB	218	268	0	0	58	58	326	108	50	214	212	0	0	89	89	301	86	-2	276	285	0	0	7	7	292	17	9
18	Marshfoot Rd	EB	490	516	0	0	132	132	648	158	26	643	582	0	0	116	116	697	54	-62	801	811	0	0	1	1	812	11	10
		WB	774	814	0	0	22	22	836	62	40	505	510	0	0	50	50	560	54	4	441	443	0	0	62	62	505	64	2
20	Muckingford Road / Linford Road	EB	2	2	0	0	74	74	76	74	0	4	4	0	0	21	21	24	21	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	55	55	57	55	0	3	3	0	0	65	65	69	65	0	2	2	0	0	70	70	72	70	0
21	Princess Margaret Road, East Tilbury	NB	69	69	0	0	11	11	81	11	0	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	26	0	0	56	56	82	55	0	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	180	0	0	1	1	181	14	13	37	38	0	0	0	0	38	1	1	39	46	0	0	0	0	46	7	7
		SB	0	0	0	0	0	0	0	0	0	50	81	0	0	0	0	81	32	32	174	173	0	0	0	0	173	-1	-2
25	Green Lane	EB	0	0	0	0	2	2	2	2	0	0	0	0	0	1	1	1	1	0	0	0	0	0	6	6	6	6	0
		WB	0	0	0	0	6	6	6	6	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	49	0	0	171	171	220	133	-38	106	63	0	0	0	0	63	-44	-44	252	186	0	0	1	1	188	-65	-66
		WB	278	239	0	0	1	1	241	-37	-39	162	129	0	0	0	0	129	-34	-34	238	228	0	0	191	191	420	181	-10
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	469	0	0	7	7	476	-74	-80	499	507	0	0	6	6	514	14	8	1008	1060	0	0	14	14	1075	67	53
		SB	591	598	0	0	30	30	628	37	8	456	474	0	0	7	7	481	25	17	580	606	0	0	0	0	606	26	26
28	A1013 The Manorway to Buckingham Hill Road	NB	376	364	0	0	63	63	427	51	-11	281	234	0	0	59	59	293	12	-47	276	223	0	0	65	65	288	12	-53
		SB	182	127	0	0	122	122	250	68	-54	183	176	0	0	17	17	193	10	-7	212	206	0	0	0	0	206	-6	-6
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	452	0	0	1	1	453	17	16	530	565	0	0	0	0	565	35	35	737	709	0	0	7	7	717	-21	-28
		WB	844	837	0	0	8	8	846	1	-7	631	635	0	0	0	0	636	4	4	662	667	0	0	0	0	667	6	5
30	A1013 Orsett Cock to A1089	EB	800	838	4	0	11	15	853	54	39	569	581	4	0	3	6	587	18	12	1007	997	4	0	51	54	1052	45	-9
		WB	935	978	11	0	47	58	1036	101	44	602	637	3	0	3	6	643	40	34	878	914	3	0	9	12	926	48	36
31	Heath Road	NB	107	137	0	0	9	9	146	39	30	43	18	0	0	4	4	22	-21	-25	38	9	0	0	2	2	11	-27	-30
		SB	36	9	0	0	10	10	19	-17	-27	51	11	0	0	5	5	16	-34	-40	143	18	0	0	4	4	21	-121	-125
32	Old Dock Approach Rd	NB	113	110	0	0	6	6	116	3	-3	107	107	0	0	0	0	107	0	0	145	148	0	0	0	0	148	4	4
		SB	344	400	0	0	0	0	400	56	56	200	210	0	0	0	0	210	10	10	232	259	0	0	5	5	263	31	26
33	Dock Road	EB	588	598	0	0	19	19	617	29	10	508	508	0	0	9	9	517	9	0	647	641	0	0	0	0	641	-6	-6
		SB	716	725	0	0	13	13	738	22	9	586	577	0	0	13	13	591	5	-9	625	619	0	0	17	17	636	11	-6
34	A1012 Elizabeth Road	NB	363	330	0	0	7	7	338	-26	-33	469	481	0	0	0	0	481	12	11	460	466	0	0	0	0	466	5	5
		SB	305	294	0	0	0	0	294	-11	-11	252	252	0	0	0	0	252	0	0	276	281	0	0	6	6	287	11	5
35	Blackshots Lane	NB	111	119	0	0	9	9	127	17	8	84	85	0	0	0	0	85	2	2	126	125	0	0	0	0	125	0	0
		SB	92	96	0	0	0	0	96	4	4	75	77	0	0	0	0	77	2	2	100	112	0	0	10	10	121	22	12
36	Medebridge Road	NB	0	0	9	23	0	33	33	33	0	0	0	3	24	0	26	26	26	0	0	0	3	23	0	26	26	26	0
		SB	0	0	3	23	0	27	27	27	0	0	0	4	24	0	28	28	28	0	0	0	4	24	0	28	28	28	0
37	Dennis Road / West Road	EB	279	272	1	0	52	52	325	46	-6	197	155	0	0	0	0	155	-42	-43	235	266	0	0	0	0	266	31	31
		WB	119	117	0	0	0	0	117	-3	-3	192	182	0	0	0	0	183	-9	-9	288	294	0	0	15	15	309	21	6
38	A 1306 Arterial Road North Stifford	EB	1181	1142	4	0	152	156	1298	117	-40	1334	1346	1	0	28	29	1375	42	12	1696	1665	2	0	20	22	1686	-9	-31
		WB	1639	1612	2	0	97	99	1712	73	-27	1335	1325	0	0	77	77	1403	68	-9	1448	1488	2	0	104	107	1594	146	39
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	34	-2	-2	44	36	0	0	0	0	36	-8	-8	62	63	0	0	0	0	63	2	2
		SB	100	115	0	0	0	0	115	15	15	32	32	0	0	0	0	32	0	0	37	37	0	0	0	0	37	0	0

Table 10-3: Flow Changes of Initial & further list of roads of concern (Phase 3 vs DMB)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 4 v DMA

			DMA (AM)	Phase 4 (AM)								DMA (IP)	Phase 4 (IP)								DMA (PM)	Phase 4 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	287	173	0	0	36	36	209	-79	-114	118	117	0	0	2	2	119	1	-1	274	213	0	0	8	8	221	-53	-61
		SB	229	268	0	0	8	8	276	48	39	180	198	0	0	2	2	200	20	18	238	267	0	0	29	29	296	58	29
2	Stifford Clays Road, Orsett Village	EB	133	148	0	0	3	3	151	17	14	142	113	0	0	1	1	114	-28	-29	325	265	0	0	51	51	316	-8	-59
		WB	323	349	0	0	47	47	396	73	27	204	194	0	0	2	2	195	-9	-11	301	325	0	0	3	3	328	27	24
3	B186, North Ockendon (and Ockendon Rd)	NB	661	610	5	0	28	34	644	-18	-51	438	373	2	0	1	3	376	-62	-65	470	386	2	0	2	4	389	-80	-84
		WB	376	335	2	0	4	6	341	-35	-42	468	392	1	0	1	2	394	-74	-76	671	602	1	0	86	87	689	18	-69
4	B186, South Ockendon	NB	384	395	4	0	24	28	423	38	10	243	261	1	0	1	2	263	20	18	252	260	1	0	2	3	263	10	7
		SB	259	276	1	0	4	6	282	23	17	279	299	1	0	1	2	301	22	20	400	437	1	0	71	72	509	109	37
5	B188, Baker Street Village	NB	46	0	0	0	0	0	0	-46	-46	38	0	0	0	0	0	0	-38	-38	32	0	0	0	0	0	0	-32	-32
		SB	34	0	0	0	0	0	0	-34	-34	48	0	0	0	0	0	0	-48	-48	148	0	0	0	0	0	0	-148	-148
6	A1014, North Bound	EB	1792	1705	5	0	5	10	1715	-78	-87	1945	1930	5	0	5	10	1940	-5	-15	1345	1350	5	0	10	15	1365	21	5
		WB	1365	1359	14	0	10	24	1383	18	-6	2086	2086	4	0	4	8	2094	8	0	2201	2183	4	0	0	4	2188	-13	-18
7	A128 Brentwood Road (North of Orsett Cock)	NB	1262	1273	4	0	24	27	1301	39	12	787	759	3	0	37	40	799	12	-28	869	858	3	0	66	69	927	59	-11
		SB	805	776	5	0	65	71	847	42	-29	652	690	2	0	29	31	721	69	38	961	990	3	0	6	9	998	37	28
8	A1089	NB	2203	2268	19	17	53	89	2357	154	65	2029	2123	20	17	32	69	2192	163	94	2122	2320	20	17	43	80	2400	278	198
		SB	2219	2143	49	17	98	164	2307	88	-76	2096	2127	16	17	86	119	2246	150	31	1940	2076	15	17	13	45	2121	181	136
9	Buckingham Hill Road (North Bound)	NB	685	719	0	0	63	63	782	96	34	496	465	0	0	60	60	525	29	-31	500	448	0	0	67	67	516	16	-52
		SB	332	331	0	0	122	122	453	122	-1	429	447	0	0	58	58	505	77	18	468	481	0	0	2	2	482	14	13
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4502	4353	7	8	0	15	4368	-134	-149	3929	3963	7	8	0	15	3978	49	34	4812	4862	7	8	75	90	4952	140	50
		WB	5081	5056	20	6	65	90	5146	65	-25	4067	4130	6	6	13	25	4155	88	63	4400	4433	6	6	0	12	4445	45	33
16	Brentwood Road (North of Orsett Cock)	NB	642	669	6	20	28	54	723	81	27	346	399	6	20	39	66	465	119	53	386	470	6	20	147	173	643	258	85
		SB	221	278	16	20	139	175	453	232	57	376	411	5	20	40	65	476	101	36	638	652	5	20	5	30	682	44	15
17	Brentwood Road / Chadwell St Mary	NB	282	233	0	0	34	34	267	-15	-49	235	243	0	0	42	42	285	50	8	224	261	0	0	45	45	305	82	37
		SB	214	249	0	0	52	52	301	88	35	214	225	0	0	44	44	269	55	11	275	284	0	0	8	8	292	17	9
18	Marshfoot Rd	EB	483	492	0	0	120	120	612	129	9	643	576	0	0	94	94	670	28	-67	798	754	0	0	1	1	755	-43	-44
		WB	773	778	0	0	13	13	791	18	5	505	487	0	0	44	44	531	26	-18	442	415	0	0	55	55	471	29	-26
20	Muckingford Road / Linford Road	EB	2	2	0	0	0	0	2	0	0	4	4	0	0	0	0	4	0	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	0	0	2	0	0	3	3	0	0	0	0	3	0	0	2	2	0	0	0	0	2	0	0
21	Princess Margaret Road, East Tilbury	NB	69	94	0	0	61	61	155	86	25	47	47	0	0	60	60	107	60	0	35	35	0	0	67	67	102	67	0
		SB	26	29	0	0	122	122	151	125	3	50	50	0	0	58	58	108	58	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	173	0	0	1	1	174	7	6	38	38	0	0	0	0	38	0	0	39	45	0	0	0	0	45	6	6
		SB	0	0	0	0	0	0	0	0	0	50	90	0	0	0	0	90	39	39	175	171	0	0	1	1	171	-3	-4
25	Green Lane	EB	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	14	14	14	14	0
		WB	0	0	0	0	11	11	11	11	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	89	0	0	179	179	268	181	2	106	67	0	0	0	0	67	-39	-39	253	146	0	0	1	1	148	-105	-106
		WB	277	272	0	0	1	1	273	-4	-5	162	139	0	0	0	0	139	-23	-23	236	239	0	0	195	195	435	199	4
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	553	486	0	0	6	6	492	-61	-67	499	499	0	0	6	6	505	6	0	1008	1047	0	0	14	14	1061	53	39
		SB	593	599	0	0	29	29	627	35	6	458	469	0	0	8	8	477	20	12	582	597	0	0	0	0	597	15	15
28	A1013 The Manorway to Buckingham Hill Road	NB	375	360	0	0	57	57	417	43	-15	281	239	0	0	54	54	293	11	-42	278	224	0	0	67	67	291	13	-54
		SB	176	136	0	0	116	116	251	76	-40	183	165	0	0	49	49	214	32	-17	212	206	0	0	0	0	206	-5	-5
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	456	0	0	1	1	457	20	20	531	565	0	0	0	0	565	34	33	741	740	0	0	12	12	752	10	-2
		WB	847	878	0	0	9	9	887	39	30	631	629	0	0	0	0	630	-1	-2	662	661	0	0	0	0	662	0	0
30	A1013 Orsett Cock to A1089	EB	799	506	4	0	5	9	515	-284	-293	568	435	4	0	0	4	439	-130	-133	1006	708	4	0	45	48	757	-249	-298
		WB	935	774	10	0	40	50	824	-111	-161	602	477	3	0	2	5	482	-121	-125	872	653	3	0	6	9	663	-209	-219
31	Heath Road	NB	107	49	0	0	4	4	52	-55	-59	42	4	0	0	2	2	6	-36	-38	36	2	0	0	1	1	3	-34	-34
		SB	36	8	0	0	5	5	14	-22	-27	50	15	0	0	4	4	19	-32	-35	143	20	0	0	2	2	22	-121	-123
32	Old Dock Approach Rd	NB	112	104	0	0	5	5	109	-3	-8	106	99	0	0	0	0	99	-8	-8	143	127	0	0	0	0	127	-16	-16
		SB	343	431	0	0	0	0	431	88	88	200	215	0	0	0	0	215	14	14	232	341	0	0	3	3	344	112	109
33	Dock Road	EB	587	646	0	0	20	20	666	79	59	508	578	0	0	9	9	586	78	70	646	698	0	0	0	0	698	52	52
		SB	716	752	0	0	12	12	764	48	36	586	621	0	0	12	12	633	47	35	625	698	0	0	12	12	710	85	73
34	A1012 Elizabeth Road	NB	363	361	0	0	8	8	370	6	-2	470	469	0	0	0	0	469	0	0	460	466	0	0	0	0	466	6	6
		SB	305	297	0	0	0	0	297	-8	-8	252	250	0	0	0	0	250	-2	-2	275	280	0	0	7	7	287	12	5
35	Blackshots Lane	NB	111	119	0	0	10	10	129	18	8	84	92	0	0	0	0	92	8	8	125	157	0	0	0	0	157	32	32
		SB	92	122	0	0	2	2	124	31	30	74	73	0	0	1	1	74	-1	-2	100	106	0	0	11	11	117	17	6
36	Medebridge Road	NB	0	0	10	33	0	43	43	43	0	0	0	3	33	0	36	36	36	0	0	0	3	33	0	36	36	36	0
		SB	0	0	4	33	0	37	37	37	0	0	0	4	33	0	38	38	38	0	0	0	4	33	0	38	38	38	0
37	Dennis Road / West Road	EB	279	375	2	0	4	6	381	102	96	197	304	1	0	0	1	304	107	106	234	379	1	0	0	1	379	145	145
		WB	119	218	1	0	0	1	219	100	99	191	284	0	0	0	0	285	93	93	288	418	0	0	15	15	433	145	130
38	A 1306 Arterial Road North Stifford	EB	1179	1152	5	0	152	156	1309	130	-27	1333	1349	1	0	39	41	1390	57	16	1692	1656	2	0	21	23	1679	-13	-36
		WB	1637	1615	2	0	89	91	1706	69	-22	1334	1333	0	0	71	71	1404	70	-1	1445	1494	3	0	101	104	1598	152	49
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	35	-1	-1	44	35	0	0	0	0	35	-9	-9	60	65	0	0	0	0	65	6	6
		SB	95	103	0	0	0	0	103	7	7	32	32	0	0	0	0	32	0	0	37	37	0	0	0	0	37	0	0

Table 10-4:Flow Changes of Initial & further list of roads of concern (Phase 4 vs DMA)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 5 v DMB

			DMB (AM)	Phase 5 (AM)								DMA (IP)	Phase 5 (IP)								DMB (PM)	Phase 5 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	288	266	0	0	1	1	267	-20	-21	118	251	0	0	0	0	251	133	133	276	415	0	0	9	9	424	147	138
		SB	229	284	0	0	5	5	288	59	54	180	254	0	0	0	0	254	74	74	237	280	0	0	0	0	280	43	43
2	Stifford Clays Road, Orsett Village	EB	134	121	0	0	32	32	153	19	-13	143	143	0	0	2	2	145	2	0	324	311	0	0	60	60	371	46	-13
		WB	324	311	0	0	58	58	368	44	-13	205	185	0	0	2	2	187	-18	-20	303	261	0	0	30	30	291	-12	-42
3	B186, North Ockendon (and Ockendon Rd)	NB	661	618	6	0	30	35	653	-8	-43	438	377	2	0	1	3	380	-58	-61	470	390	2	0	2	4	394	-77	-80
		WB	376	343	0	0	2	2	344	-32	-34	469	387	0	0	0	0	387	-81	-81	671	600	0	0	13	13	613	-58	-71
4	B186, South Ockendon	NB	384	399	4	0	25	29	429	44	15	243	265	1	0	1	2	267	25	22	253	262	1	0	2	3	265	13	9
		SB	259	282	0	0	2	2	284	25	23	279	294	0	0	0	0	295	15	15	400	436	0	0	8	8	445	45	37
5	B188, Baker Street Village	NB	45	2	0	0	47	47	49	3	-43	39	13	0	0	3	3	16	-23	-26	35	1	0	0	29	29	30	-5	-34
		SB	34	26	0	0	33	33	60	26	-7	48	38	0	0	3	3	41	-7	-10	148	122	0	0	16	16	138	-10	-26
6	A1014, North Bound	EB	1798	1704	6	0	6	12	1716	-83	-95	1951	1935	6	0	6	12	1947	-4	-16	1351	1359	6	0	10	16	1375	24	8
		WB	1372	1366	17	0	11	27	1393	21	-6	2092	2092	5	0	4	9	2101	9	0	2207	2178	5	0	0	5	2183	-24	-29
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1256	4	0	36	40	1295	33	-7	787	665	3	0	46	49	715	-73	-122	870	766	3	0	69	72	839	-31	-103
		SB	806	740	5	0	72	77	817	10	-66	650	675	2	0	30	32	707	58	25	964	997	1	0	8	9	1006	42	33
8	A1089	NB	2210	2305	19	11	57	88	2393	183	95	2040	2118	20	12	44	75	2193	153	78	2143	2294	20	12	42	74	2368	225	151
		SB	2232	2120	49	11	107	167	2287	56	-112	2107	2114	16	12	89	117	2230	123	6	1956	2008	15	11	11	37	2045	89	52
9	Buckingham Hill Road (North Bound)	NB	689	709	0	0	77	77	786	97	20	496	497	0	0	74	74	571	75	1	499	474	0	0	66	66	540	41	-25
		SB	345	377	0	0	134	134	511	167	32	428	465	0	0	74	74	539	111	37	463	498	0	0	1	1	499	36	35
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4373	8	6	0	14	4386	-118	-132	3934	3964	8	6	0	14	3978	44	30	4822	4837	8	6	85	99	4936	114	15
		WB	5085	5019	22	5	70	96	5115	30	-66	4073	4113	7	5	0	12	4125	52	40	4406	4402	7	5	0	12	4414	8	-4
16	Brentwood Road (North of Orsett Cock)	NB	644	665	6	3	34	43	708	63	20	346	351	6	3	46	55	406	60	6	394	437	7	3	166	175	612	218	42
		SB	225	230	16	3	161	179	409	184	5	376	377	5	3	30	38	415	39	1	639	635	3	3	5	11	646	8	-4
17	Brentwood Road / Chadwell St Mary	NB	284	278	0	0	50	50	327	43	-6	236	221	0	0	52	52	273	37	-15	235	265	0	0	43	43	308	74	30
		SB	218	228	0	0	60	60	288	70	10	214	217	0	0	36	36	253	39	3	276	279	0	0	14	14	293	17	3
18	Marshfoot Rd	EB	490	483	0	0	131	131	614	125	-6	643	574	0	0	99	99	673	30	-69	801	760	0	0	0	0	760	-41	-41
		WB	774	755	0	0	16	16	771	-4	-19	505	485	0	0	60	60	545	40	-20	441	411	0	0	55	55	466	25	-30
20	Muckingford Road / Linford Road	EB	2	2	0	0	134	134	137	134	0	4	4	0	0	74	74	77	74	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	33	33	35	33	0	3	3	0	0	74	74	78	74	0	2	2	0	0	66	66	68	66	0
21	Princess Margaret Road, East Tilbury	NB	69	83	0	0	43	43	125	56	14	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	38	0	0	0	0	38	12	12	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	168	0	0	1	1	168	2	1	37	37	0	0	0	0	37	-1	-1	39	47	0	0	0	0	47	8	8
		SB	0	0	0	0	0	0	0	0	0	50	85	0	0	0	0	85	35	35	174	166	0	0	1	1	167	-8	-9
25	Green Lane	EB	0	0	0	0	2	2	2	2	0	0	0	0	0	1	1	1	1	0	0	0	0	0	20	20	20	20	0
		WB	0	0	0	0	16	16	16	16	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	80	0	0	203	203	283	196	-7	106	105	0	0	0	0	105	-1	-1	252	244	0	0	2	2	246	-6	-8
		WB	278	244	0	0	1	1	245	-33	-34	162	140	0	0	0	0	140	-23	-23	238	193	0	0	221	221	414	176	-45
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	486	0	0	8	8	494	-56	-63	499	490	0	0	7	7	498	-1	-9	1008	1040	0	0	14	14	1054	46	32
		SB	591	590	0	0	31	31	622	31	0	456	462	0	0	9	9	471	15	6	580	576	0	0	0	0	576	-3	-3
28	A1013 The Manorway to Buckingham Hill Road	NB	376	356	0	0	71	71	427	51	-20	281	258	0	0	67	67	325	44	-23	276	252	0	0	62	62	314	39	-24
		SB	182	158	0	0	127	127	285	103	-24	183	184	0	0	65	65	248	65	1	212	218	0	0	0	0	218	5	5
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	463	0	0	1	1	464	28	27	530	562	0	0	0	0	562	32	31	737	748	0	0	7	7	755	17	10
		WB	844	857	0	0	9	9	866	21	13	631	630	0	0	0	0	631	0	-1	662	646	0	0	0	0	646	-16	-16
30	A1013 Orsett Cock to A1089	EB	800	548	5	0	2	8	556	-244	-251	569	478	6	0	0	6	484	-85	-92	1007	821	5	0	27	32	853	-154	-185
		WB	935	847	13	0	47	60	908	-27	-87	602	533	4	0	0	4	537	-65	-70	878	748	4	0	4	8	756	-122	-130
31	Heath Road	NB	107	108	0	0	12	12	120	13	1	43	31	0	0	5	5	36	-7	-12	38	39	0	0	5	5	43	5	0
		SB	36	48	0	0	13	13	61	25	12	51	58	0	0	5	5	63	12	7	143	155	0	0	6	6	161	18	12
32	Old Dock Approach Rd	NB	113	114	0	0	5	5	118	5	1	107	98	0	0	0	0	98	-9	-9	145	128	0	0	0	0	128	-17	-17
		SB	344	519	0	0	0	0	519	175	175	200	222	0	0	0	0	222	21	21	232	345	0	0	4	5	350	118	113
33	Dock Road	EB	588	643	0	0	22	22	665	77	55	508	568	0	0	9	9	577	70	61	647	671	0	0	0	0	671	24	24
		SB	716	755	0	0	15	15	770	54	39	586	619	0	0	15	15	634	48	32	625	699	0	0	12	12	711	86	74
34	A1012 Elizabeth Road	NB	363	363	0	0	6	6	368	5	-1	469	470	0	0	0	0	470	1	1	460	465	0	0	0	0	465	4	4
		SB	305	295	0	0	0	0	295	-10	-10	252	250	0	0	0	0	250	-2	-2	276	280	0	0	4	4	284	8	4
35	Blackshots Lane	NB	111	107	0	0	1	1	108	-3	-4	84	88	0	0	0	0	88	4	4	126	130	0	0	0	0	130	5	5
		SB	92	117	0	0	0	0	117	24	24	75	64	0	0	0	0	64	-11	-11	100	88	0	0	1	1	89	-11	-12
36	Medebridge Road	NB	0	0	11	9	0	21	21	21	0	0	0	4	9	0	13	13	13	0	0	0	4	9	0	13	13	13	0
		SB	0	0	3	9	0	13	13	13	0	0	0	4	9	0	14	14	14	0	0	0	4	9	0	13	13	13	0
37	Dennis Road / West Road	EB	279	375	2	0	4	6	381	103	97	197	303	1	0	0	1	304	106	106	235	379	1	0	0	1	380	146	145
		WB	119	218	0	0	0	0	218	98	98	192	284	0	0	0	0	284	92	92	288	415	0	0	5	5	420	132	127
38	A 1306 Arterial Road North Stifford	EB	1181	1144	5	0	167	172	1317	135	-37	1334	1344	2	0	45	47	1391	57	10	1696	1692	2	0	11	13	1705	9	-4
		WB	1639	1587	2	0	108	110	1696	57	-53	1335	1322	0	0	82	82	1404	69	-13	1448	1496	2	0	105	107	1603	155	48
39	St Chads Rd / Feenan Highway	NB	36	36	0	0	1	1	37	1	0	44	37	0	0	0	0	37	-7	-7	62	72	0	0	0	0	72	10	10
		SB	100	0	0	0	0	0	0	-100	-100	32	0	0	0	0	0	0	-32	-32	37	0	0	0	0	0	0	-37	-37

Table 10-5:Flow Changes of Initial & further list of roads of concern (Phase 5 vs DMB)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 6 v DMB

			DMB (AM)	Phase 6 (AM)								DMA (IP)	Phase 6 (IP)								DMB (PM)	Phase 6 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	288	267	0	0	1	1	268	-19	-20	118	118	0	0	0	0	118	0	0	276	261	0	0	6	6	267	-9	-15
		SB	229	235	0	0	3	3	238	9	6	180	194	0	0	0	0	194	15	15	237	246	0	0	1	1	247	10	10
2	Stifford Clays Road, Orsett Village	EB	134	118	0	0	19	19	137	3	-16	143	143	0	0	3	3	145	2	-1	324	298	0	0	52	52	350	26	-26
		WB	324	310	0	0	51	51	362	38	-13	205	189	0	0	2	2	191	-14	-17	303	289	0	0	10	10	300	-4	-14
3	B186, North Ockendon (and Ockendon Rd)	NB	661	616	6	0	32	37	654	-7	-45	438	377	2	0	1	3	379	-58	-61	470	388	2	0	2	4	392	-79	-82
		WB	376	340	0	0	3	3	343	-33	-36	469	388	0	0	0	0	388	-80	-81	671	604	0	0	14	14	618	-54	-68
4	B186, South Ockendon	NB	384	399	4	0	27	31	430	46	15	243	265	1	0	1	2	268	25	22	253	261	1	0	2	3	264	11	8
		SB	259	281	0	0	3	3	283	24	22	279	295	0	0	0	0	295	16	16	400	441	0	0	9	9	450	50	41
5	B188, Baker Street Village	NB	45	20	0	0	44	44	65	20	-25	39	13	0	0	3	3	16	-23	-26	35	0	0	0	10	10	11	-24	-34
		SB	34	30	0	0	20	20	50	16	-4	48	39	0	0	4	4	43	-6	-9	148	116	0	0	12	12	128	-20	-32
6	A1014, North Bound	EB	1798	1696	7	0	6	13	1709	-89	-102	1951	1933	7	0	7	14	1947	-4	-17	1351	1353	7	0	9	16	1369	18	1
		WB	1372	1365	19	0	10	30	1395	23	-7	2092	2092	6	0	5	11	2103	11	0	2207	2176	6	0	0	6	2182	-25	-31
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1249	4	0	33	37	1286	24	-13	787	785	4	0	51	55	840	53	-2	870	868	4	0	61	64	932	62	-2
		SB	806	877	6	0	68	74	950	144	70	650	719	3	0	37	40	759	109	70	964	1014	1	0	9	10	1024	60	50
8	A1089	NB	2210	2226	19	23	68	111	2337	128	17	2040	2078	20	24	54	97	2175	135	38	2143	2187	19	24	38	81	2267	124	43
		SB	2232	2096	49	23	112	184	2281	49	-135	2107	2053	16	24	115	154	2208	101	-54	1956	1965	15	23	11	49	2014	58	9
9	Buckingham Hill Road (North Bound)	NB	689	742	0	0	85	85	827	138	53	496	498	0	0	82	82	580	84	1	499	482	0	0	58	58	541	42	-16
		SB	345	384	0	0	135	135	519	174	39	428	467	0	0	92	92	559	131	39	463	478	0	0	1	1	479	16	14
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4376	9	10	0	19	4396	-109	-128	3934	3971	9	10	0	20	3991	57	38	4822	4884	9	10	78	97	4981	158	61
		WB	5085	5048	25	8	68	101	5149	64	-37	4073	4122	8	8	3	19	4140	68	49	4406	4452	8	8	0	16	4468	62	46
16	Brentwood Road (North of Orsett Cock)	NB	644	571	6	2	31	39	610	-34	-73	346	363	6	2	51	59	422	77	18	394	438	6	2	164	171	610	215	44
		SB	225	216	15	2	161	178	395	169	-9	376	374	5	2	37	44	418	42	-2	639	635	3	2	6	11	646	7	-4
17	Brentwood Road / Chadwell St Mary	NB	284	224	0	0	46	46	270	-14	-60	236	220	0	0	58	58	278	42	-16	235	237	0	0	39	39	275	41	2
		SB	218	215	0	0	59	59	273	56	-3	214	211	0	0	44	44	255	41	-3	276	268	0	0	12	12	281	5	-7
18	Marshfoot Rd	EB	490	508	0	0	137	137	644	155	18	643	577	0	0	119	119	696	53	-66	801	787	0	0	0	0	787	-14	-14
		WB	774	812	0	0	30	30	843	68	38	505	504	0	0	70	70	574	69	-1	441	439	0	0	55	55	493	52	-3
20	Muckingford Road / Linford Road	EB	2	2	0	0	135	135	137	135	0	4	4	0	0	92	92	95	92	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	43	43	45	43	0	3	3	0	0	70	70	74	70	0	2	2	0	0	58	58	61	58	0
21	Princess Margaret Road, East Tilbury	NB	69	97	0	0	46	46	143	74	28	47	47	0	0	12	12	59	12	0	35	35	0	0	0	0	35	0	0
		SB	26	35	0	0	0	0	35	9	9	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	174	0	0	1	1	175	8	7	37	37	0	0	0	0	37	0	0	39	41	0	0	0	0	41	2	2
		SB	0	0	0	0	0	0	0	0	0	50	83	0	0	0	0	83	33	33	174	170	0	0	1	1	171	-4	-5
25	Green Lane	EB	0	0	0	0	2	2	2	2	0	0	0	0	0	1	1	1	1	0	0	0	0	0	20	20	20	20	0
		WB	0	0	0	0	16	16	16	16	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	71	0	0	181	181	252	165	-16	106	104	0	0	0	0	104	-3	-3	252	234	0	0	2	2	236	-16	-18
		WB	278	245	0	0	1	1	246	-32	-33	162	144	0	0	0	0	144	-18	-18	238	221	0	0	190	190	411	173	-17
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	495	0	0	8	8	504	-46	-55	499	503	0	0	8	8	511	12	4	1008	1064	0	0	13	13	1077	70	57
		SB	591	590	0	0	31	31	622	31	0	456	463	0	0	11	11	474	18	7	580	600	0	0	0	0	600	20	20
28	A1013 The Manorway to Buckingham Hill Road	NB	376	372	0	0	79	79	451	75	-4	281	255	0	0	74	74	330	49	-25	276	248	0	0	54	54	302	26	-28
		SB	182	161	0	0	116	116	277	95	-21	183	181	0	0	80	80	261	78	-2	212	218	0	0	0	0	218	6	6
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	462	0	0	1	1	463	26	26	530	565	0	0	0	0	566	35	35	737	731	0	0	6	6	737	0	-6
		WB	844	849	0	0	7	7	856	12	5	631	632	0	0	1	1	633	1	1	662	664	0	0	0	0	664	2	2
30	A1013 Orsett Cock to A1089	EB	800	757	7	3	4	14	771	-29	-43	569	527	8	3	0	11	538	-32	-42	1007	955	8	3	27	38	993	-14	-52
		WB	935	960	18	3	45	66	1026	91	25	602	631	5	3	0	8	639	37	29	878	872	5	3	6	14	886	8	-6
31	Heath Road	NB	107	119	0	0	10	10	129	22	12	43	17	0	0	6	6	23	-20	-26	38	5	0	0	4	4	9	-30	-34
		SB	36	38	0	0	11	11	49	14	2	51	54	0	0	6	6	61	10	4	143	133	0	0	5	5	138	-5	-9
32	Old Dock Approach Rd	NB	113	106	0	0	5	5	111	-2	-7	107	99	0	0	0	0	99	-7	-7	145	142	0	0	0	0	142	-2	-2
		SB	344	426	0	0	0	0	426	82	82	200	218	0	0	0	0	218	17	17	232	245	0	0	3	3	249	17	13
33	Dock Road	EB	588	611	0	0	21	21	632	44	23	508	536	0	0	11	11	548	40	29	647	657	0	0	0	0	657	10	10
		SB	716	725	0	0	16	16	741	26	9	586	578	0	0	17	17	594	8	-9	625	624	0	0	16	16	640	15	-1
34	A1012 Elizabeth Road	NB	363	330	0	0	7	7	337	-27	-34	469	482	0	0	0	0	482	13	13	460	467	0	0	0	0	467	6	6
		SB	305	294	0	0	0	0	294	-12	-12	252	252	0	0	0	0	252	0	0	276	282	0	0	6	6	289	12	6
35	Blackshots Lane	NB	111	106	0	0	1	1	107	-3	-5	84	88	0	0	0	0	88	4	4	126	130	0	0	0	0	130	4	4
		SB	92	99	0	0	0	0	99	7	7	75	75	0	0	0	0	75	0	0	100	110	0	0	2	2	112	12	10
36	Medebridge Road	NB	0	0	14	31	0	45	45	45	0	0	0	4	31	0	36	36	36	0	0	0	4	31	0	35	35	35	0
		SB	0	0	4	31	0	36	36	36	0	0	0	6	32	0	37	37	37	0	0	0	5	32	0	37	37	37	0
37	Dennis Road / West Road	EB	279	375	2	0	5	6	381	103	96	197	303	1	0	0	1	303	106	105	235	378	1	0	0	1	379	144	143
		WB	119	218	0	0	0	0	218	99	99	192	284	0	0	0	0	284	93	93	288	414	0	0	5	5	419	131	126
38	A 1306 Arterial Road North Stifford	EB	1181	1141	6	0	165	171	1312	131	-41	1334	1340	2	0	52	54	1394	60	6	1696	1699	3	0	10	13	1712	17	3
		WB	1639	1595	3	0	119	122	1717	77	-44	1335	1324	0	0	88	88	1412	77	-11	1448	1493	3	0	97	100	1592	144	44
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	35	-1	-2	44	37	0	0	0	0	37	-7	-7	62	60	0	0	0	0	60	-1	-1
		SB	100	115	0	0	0	0	115	16	16	32	32	0	0	0	0	32	0	0	37	37	0	0	0	0	37	0	0

Table 10-6: Flow Changes of Initial & further list of roads of concern (Phase 6 vs DMB)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 7 v DMB

			DMB (AM)	Phase 7 (AM)								DMA (IP)	Phase 7 (IP)								DMB (PM)	Phase 7 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff)	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	288	266	0	0	1	1	267	-20	-21	118	118	0	0	0	0	118	0	0	276	249	0	0	8	8	257	-19	-27
		SB	229	230	0	0	3	3	233	4	1	180	189	0	0	0	0	189	9	9	237	243	0	0	1	1	243	7	6
2	Stifford Clays Road, Orsett Village	EB	134	116	0	0	19	19	135	1	-17	143	142	0	0	2	2	144	0	-1	324	301	0	0	49	49	350	26	-23
		WB	324	310	0	0	48	48	359	35	-13	205	189	0	0	2	2	190	-15	-17	303	296	0	0	12	12	308	5	-8
3	B186, North Ockendon (and Ockendon Rd)	NB	661	616	6	0	31	37	653	-8	-45	438	376	2	0	1	3	379	-59	-62	470	388	2	0	2	3	391	-79	-82
		WB	376	338	0	0	2	2	340	-36	-38	469	386	0	0	0	0	387	-82	-82	671	602	0	0	14	14	616	-55	-69
4	B186, South Ockendon	NB	384	400	4	0	27	31	431	46	16	243	265	1	0	1	2	267	24	22	253	261	1	0	2	3	264	11	8
		SB	259	279	0	0	2	2	281	22	20	279	294	0	0	0	0	295	15	15	400	440	0	0	9	9	448	48	40
5	B188, Baker Street Village	NB	45	20	0	0	41	41	62	16	-25	39	13	0	0	2	2	15	-23	-26	35	0	0	0	12	12	13	-22	-34
		SB	34	29	0	0	20	20	48	15	-5	48	39	0	0	3	3	41	-7	-10	148	116	0	0	11	11	128	-20	-32
6	A1014, North Bound	EB	1798	1708	7	0	5	13	1720	-78	-91	1951	1936	8	0	5	13	1949	-2	-15	1351	1352	8	0	8	16	1368	17	1
		WB	1372	1366	21	0	9	30	1396	24	-6	2092	2092	6	0	4	10	2102	10	0	2207	2185	6	0	0	6	2192	-15	-22
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1252	4	0	28	32	1284	21	-11	787	782	4	0	41	45	827	40	-5	870	872	4	0	50	54	925	56	2
		SB	806	880	6	0	55	60	940	134	74	650	719	3	0	26	29	748	98	69	964	1013	1	0	9	10	1023	59	49
8	A1089	NB	2210	2240	19	17	56	93	2332	123	30	2040	2084	19	18	38	75	2159	119	44	2143	2181	19	18	30	67	2248	105	38
		SB	2232	2116	49	17	94	161	2277	45	-115	2107	2067	16	18	93	126	2193	86	-40	1956	1969	15	17	10	42	2011	55	13
9	Buckingham Hill Road (North Bound)	NB	689	728	0	0	68	68	796	107	39	496	497	0	0	65	65	563	66	1	499	481	0	0	48	48	529	30	-18
		SB	345	379	0	0	109	109	488	143	35	428	460	0	0	65	65	526	98	32	463	477	0	0	1	1	478	15	14
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4375	10	6	1	18	4393	-112	-129	3934	3976	10	7	1	18	3994	60	42	4822	4880	10	6	75	91	4971	149	58
		WB	5085	5052	27	5	67	100	5151	66	-33	4073	4123	8	5	4	18	4141	68	50	4406	4455	8	5	0	14	4469	63	49
16	Brentwood Road (North of Orsett Cock)	NB	644	578	6	2	26	33	611	-33	-67	346	360	6	2	41	48	409	63	15	394	436	6	2	157	165	601	207	42
		SB	225	217	15	2	152	169	386	161	-8	376	375	5	2	26	33	408	32	-1	639	637	3	2	6	11	647	9	-2
17	Brentwood Road / Chadwell St Mary	NB	284	226	0	0	39	39	265	-19	-58	236	217	0	0	46	46	263	27	-19	235	235	0	0	32	32	267	32	0
		SB	218	215	0	0	47	47	262	44	-3	214	211	0	0	31	31	243	29	-3	276	270	0	0	12	12	282	6	-6
18	Marshfoot Rd	EB	490	505	0	0	115	115	620	130	15	643	583	0	0	101	101	684	41	-60	801	788	0	0	0	0	788	-13	-13
		WB	774	812	0	0	17	17	828	54	37	505	507	0	0	51	51	557	52	1	441	438	0	0	44	44	483	42	-3
20	Muckingford Road / Linford Road	EB	2	2	0	0	109	109	111	109	0	4	4	0	0	65	65	69	65	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	39	39	41	39	0	3	3	0	0	65	65	69	65	0	2	2	0	0	48	48	50	48	0
21	Princess Margaret Road, East Tilbury	NB	69	93	0	0	27	27	120	51	24	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	28	0	0	0	0	28	2	2	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	170	0	0	1	1	171	4	3	37	37	0	0	0	0	37	0	0	39	38	0	0	0	0	38	-1	-1
		SB	0	0	0	0	0	0	0	0	0	50	81	0	0	0	0	81	31	31	174	170	0	0	1	1	171	-3	-4
25	Green Lane	EB	0	0	0	0	2	2	2	2	0	0	0	0	0	1	1	1	1	0	0	0	0	0	17	17	17	17	0
		WB	0	0	0	0	13	13	13	13	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	70	0	0	170	170	240	153	-17	106	103	0	0	0	0	103	-3	-3	252	237	0	0	2	2	239	-14	-15
		WB	278	247	0	0	1	1	248	-30	-31	162	144	0	0	0	0	144	-18	-18	238	227	0	0	180	180	407	169	-11
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	483	0	0	7	7	490	-60	-67	499	502	0	0	6	6	509	10	3	1008	1060	0	0	11	11	1071	64	53
		SB	591	596	0	0	25	25	621	31	5	456	464	0	0	8	8	472	15	7	580	596	0	0	0	0	596	16	16
28	A1013 The Manorway to Buckingham Hill Road	NB	376	377	0	0	63	63	440	64	1	281	261	0	0	59	59	320	39	-20	276	251	0	0	43	43	295	19	-24
		SB	182	170	0	0	97	97	268	86	-12	183	184	0	0	57	57	241	58	1	212	217	0	0	0	0	217	4	4
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	454	0	0	1	1	454	18	17	530	558	0	0	0	0	558	28	27	737	733	0	0	5	5	738	0	-4
		WB	844	844	0	0	5	5	849	5	-1	631	631	0	0	1	1	632	1	0	662	662	0	0	0	0	662	0	0
30	A1013 Orsett Cock to A1089	EB	800	752	8	1	3	12	764	-36	-48	569	527	9	1	0	10	537	-32	-42	1007	953	9	1	29	39	993	-14	-53
		WB	935	960	21	1	47	69	1029	94	26	602	621	6	1	0	7	628	26	18	878	870	6	1	4	11	882	4	-7
31	Heath Road	NB	107	114	0	0	9	9	123	16	7	43	17	0	0	4	4	22	-21	-26	38	5	0	0	3	3	8	-30	-34
		SB	36	37	0	0	9	9	47	11	2	51	54	0	0	4	4	59	8	4	143	133	0	0	4	4	138	-5	-9
32	Old Dock Approach Rd	NB	113	102	0	0	5	5	107	-6	-11	107	99	0	0	0	0	99	-7	-7	145	144	0	0	0	0	144	0	0
		SB	344	406	0	0	0	0	406	62	62	200	209	0	0	0	0	209	8	8	232	243	0	0	3	3	247	14	11
33	Dock Road	EB	588	611	0	0	18	18	628	40	23	508	538	0	0	8	8	546	38	30	647	657	0	0	0	0	657	11	11
		SB	716	723	0	0	13	13	736	20	7	586	585	0	0	13	13	598	12	-2	625	625	0	0	14	14	638	13	0
34	A1012 Elizabeth Road	NB	363	332	0	0	7	7	339	-24	-31	469	479	0	0	0	0	479	9	9	460	467	0	0	0	0	467	7	7
		SB	305	296	0	0	0	0	296	-9	-9	252	252	0	0	0	0	252	0	0	276	281	0	0	6	6	287	11	5
35	Blackshots Lane	NB	111	106	0	0	1	1	107	-4	-5	84	88	0	0	0	0	88	4	4	126	130	0	0	0	0	130	4	4
		SB	92	98	0	0	0	0	98	6	6	75	75	0	0	0	0	75	1	1	100	110	0	0	2	2	112	12	10
36	Medebridge Road	NB	0	0	16	21	0	37	37	37	0	0	0	5	21	0	26	26	26	0	0	0	5	20	0	25	25	25	0
		SB	0	0	5	21	0	26	26	26	0	0	0	6	21	0	27	27	27	0	0	0	6	21	0	27	27	27	0
37	Dennis Road / West Road	EB	279	374	2	0	4	6	380	102	95	197	302	1	0	0	1	303	105	105	235	379	1	0	0	1	380	145	144
		WB	119	217	0	0	0	0	217	98	98	192	283	0	0	0	0	283	92	92	288	414	0	0	5	5	420	131	126
38	A 1306 Arterial Road North Stifford	EB	1181	1154	7	0	131	139	1292	111	-28	1334	1352	2	0	27	30	1381	47	18	1696	1695	3	0	10	13	1709	13	0
		WB	1639	1611	3	0	99	102	1713	74	-28	1335	1328	0	0	76	76	1404	69	-7	1448	1485	3	0	78	81	1566	118	37
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	35	-1	-2	44	37	0	0	0	0	37	-7	-7	62	58	0	0	0	0	58	-3	-3
		SB	100	0	0	0	0	0	0	-100	-100	32	0	0	0	0	0	0	-32	-32	37	0	0	0	0	0	0	-37	-37

Table 10-7:Flow Changes of Initial & further list of roads of concern (Phase 7 vs DMB)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 8 v DMB

			DMB (AM)	Phase 8 (AM)								DMA (IP)	Phase 8 (IP)								DMB (PM)	Phase 8 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMB)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	288	271	0	0	1	1	272	-15	-16	118	118	0	0	0	0	118	0	0	276	241	0	0	4	4	245	-32	-35
		SB	229	239	0	0	1	1	241	12	10	180	188	0	0	0	0	188	8	8	237	243	0	0	0	0	243	6	6
2	Stifford Clays Road, Orsett Village	EB	134	131	0	0	22	22	153	20	-3	143	144	0	0	1	1	145	1	1	324	312	0	0	33	33	345	21	-12
		WB	324	315	0	0	32	32	347	24	-9	205	189	0	0	1	1	190	-16	-16	303	307	0	0	43	43	349	46	4
3	B186, North Ockendon (and Ockendon Rd)	NB	661	642	2	0	20	23	665	3	-19	438	435	1	0	1	1	436	-2	-3	470	467	1	0	1	2	469	-1	-3
		WB	376	396	0	0	1	1	398	21	20	469	487	0	0	0	0	487	18	18	671	656	0	0	7	7	663	-8	-15
4	B186, South Ockendon	NB	384	369	2	0	19	21	390	6	-16	243	255	1	0	1	1	257	14	12	253	255	1	0	1	2	257	4	2
		SB	259	276	0	0	1	1	277	19	17	279	290	0	0	0	0	291	11	11	400	418	0	0	6	6	423	24	18
5	B188, Baker Street Village	NB	45	24	0	0	33	33	57	12	-21	39	13	0	0	2	2	15	-24	-25	35	0	0	0	7	7	7	-27	-34
		SB	34	30	0	0	10	10	40	6	-4	48	40	0	0	2	2	41	-7	-9	148	119	0	0	13	13	132	-16	-29
6	A1014, North Bound	EB	1798	1724	6	0	4	10	1734	-65	-74	1951	1939	6	0	4	10	1949	-2	-12	1351	1351	6	0	7	13	1364	13	0
		WB	1372	1367	17	0	7	24	1391	19	-5	2092	2092	5	0	3	8	2100	8	0	2207	2197	5	0	0	5	2202	-5	-10
7	A128 Brentwood Road (North of Orsett Cock)	NB	1263	1255	4	0	20	24	1279	16	-8	787	787	3	0	28	31	819	32	0	870	874	3	0	43	46	919	50	4
		SB	806	883	3	0	42	45	927	121	76	650	729	2	0	20	22	750	101	79	964	1003	1	0	7	8	1010	47	39
8	A1089	NB	2210	2240	19	23	41	84	2324	114	31	2040	2082	19	24	25	68	2150	109	41	2143	2183	19	24	27	69	2252	109	40
		SB	2232	2144	48	23	81	152	2296	64	-87	2107	2072	15	24	83	122	2194	87	-35	1956	1970	15	23	10	47	2017	61	14
9	Buckingham Hill Road (North Bound)	NB	689	717	0	0	47	47	764	75	28	496	497	0	0	46	46	543	47	1	499	481	0	0	43	43	524	26	-17
		SB	345	368	0	0	85	85	453	108	23	428	455	0	0	51	51	506	78	27	463	484	0	0	1	1	484	21	20
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4504	4387	9	8	0	17	4404	-101	-118	3934	3977	9	8	0	17	3994	60	43	4822	4869	9	8	56	72	4941	119	47
		WB	5085	5053	23	7	47	76	5129	43	-32	4073	4124	7	7	3	17	4141	68	51	4406	4460	7	7	0	14	4474	68	54
16	Brentwood Road (North of Orsett Cock)	NB	644	610	5	2	18	25	635	-10	-35	346	361	5	2	29	35	396	50	15	394	435	5	2	130	137	572	178	41
		SB	225	219	10	2	123	135	354	129	-6	376	375	3	2	20	26	400	25	-1	639	637	2	2	5	9	646	8	-1
17	Brentwood Road / Chadwell St Mary	NB	284	240	0	0	28	28	268	-16	-44	236	222	0	0	32	32	254	18	-14	235	234	0	0	28	28	262	28	0
		SB	218	217	0	0	37	37	254	36	-1	214	212	0	0	24	24	236	22	-2	276	271	0	0	9	9	280	4	-5
18	Marshfoot Rd	EB	490	503	0	0	97	97	601	111	14	643	590	0	0	90	90	680	37	-53	801	787	0	0	0	0	787	-14	-14
		WB	774	793	0	0	10	10	803	28	19	505	506	0	0	34	34	540	34	1	441	437	0	0	39	39	476	34	-5
20	Muckingford Road / Linford Road	EB	2	2	0	0	85	85	88	85	0	4	4	0	0	51	51	54	51	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	38	38	40	38	0	3	3	0	0	46	46	49	46	0	2	2	0	0	43	43	45	43	0
21	Princess Margaret Road, East Tilbury	NB	69	86	0	0	9	9	95	25	16	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	26	0	0	0	0	26	0	0	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	164	0	0	1	1	165	-2	-3	37	37	0	0	0	0	37	0	0	39	38	0	0	0	0	38	-1	-1
		SB	0	0	0	0	0	0	0	0	0	50	75	0	0	0	0	75	26	26	174	170	0	0	1	1	171	-4	-5
25	Green Lane	EB	0	0	0	0	3	3	3	3	0	0	0	0	0	1	1	1	1	0	0	0	0	0	59	59	59	59	0
		WB	0	0	0	0	31	31	31	31	0	0	0	0	0	1	1	1	1	0	0	0	0	0	2	2	2	2	0
26	Stifford Clays Road	EB	87	83	0	0	105	105	188	101	-4	106	104	0	0	0	0	104	-2	-2	252	238	0	0	1	1	239	-13	-15
		WB	278	253	0	0	1	1	254	-24	-25	162	145	0	0	0	0	145	-17	-18	238	238	0	0	137	137	376	137	0
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	550	484	0	0	5	5	489	-61	-65	499	504	0	0	4	4	508	9	5	1008	1053	0	0	9	9	1062	54	45
		SB	591	601	0	0	19	19	620	30	10	456	468	0	0	6	6	474	18	12	580	594	0	0	0	0	595	15	15
28	A1013 The Manorway to Buckingham Hill Road	NB	376	376	0	0	44	44	420	44	0	281	267	0	0	41	41	308	28	-14	276	251	0	0	39	39	289	13	-25
		SB	182	175	0	0	79	79	254	72	-7	183	185	0	0	44	44	230	47	2	212	216	0	0	0	0	216	4	4
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	443	0	0	0	0	443	7	7	530	552	0	0	0	0	552	21	21	737	744	0	0	4	4	748	10	7
		WB	844	849	0	0	4	4	853	9	5	631	632	0	0	0	0	632	1	0	662	663	0	0	0	0	663	1	1
30	A1013 Orsett Cock to A1089	EB	800	737	7	2	3	11	748	-52	-63	569	527	7	2	0	9	536	-34	-42	1007	951	7	2	15	24	974	-32	-56
		WB	935	953	16	2	30	48	1001	67	19	602	617	5	2	0	7	624	21	15	878	866	5	2	3	10	876	-2	-12
31	Heath Road	NB	107	96	0	0	7	7	103	-4	-11	43	18	0	0	3	3	21	-22	-25	38	5	0	0	3	3	8	-31	-34
		SB	36	37	0	0	7	7	45	9	2	51	50	0	0	3	3	54	3	0	143	135	0	0	4	4	138	-5	-8
32	Old Dock Approach Rd	NB	113	101	0	0	3	3	104	-9	-12	107	100	0	0	0	0	100	-7	-7	145	143	0	0	0	0	143	-2	-2
		SB	344	396	0	0	0	0	396	52	52	200	201	0	0	0	0	201	1	1	232	245	0	0	2	2	247	15	13
33	Dock Road	EB	588	609	0	0	14	14	622	34	21	508	538	0	0	6	6	544	36	30	647	657	0	0	0	0	657	10	10
		SB	716	722	0	0	9	9	731	15	6	586	583	0	0	9	9	593	6	-3	625	627	0	0	12	12	638	14	2
34	A1012 Elizabeth Road	NB	363	340	0	0	6	6	346	-17	-23	469	475	0	0	0	0	475	6	5	460	466	0	0	0	0	466	5	5
		SB	305	298	0	0	0	0	298	-7	-7	252	254	0	0	0	0	254	1	1	276	283	0	0	5	5	288	11	6
35	Blackshots Lane	NB	111	106	0	0	1	1	107	-3	-4	84	88	0	0	0	0	88	4	4	126	133	0	0	0	0	133	7	7
		SB	92	96	0	0	0	0	96	4	4	75	75	0	0	0	0	75	0	0	100	108	0	0	1	1	109	9	8
36	Medebridge Road	NB	0	0	15	33	25	73	73	73	0	0	0	5	33	0	38	38	38	0	0	0	4	33	0	37	37	37	0
		SB	0	0	5	33	0	38	38	38	0	0	0	5	33	0	39	39	39	0	0	0	5	33	0	39	39	39	0
37	Dennis Road / West Road	EB	279	275	0	0	2	2	277	-2	-4	197	182	0	0	0	0	182	-15	-15	235	268	0	0	0	0	268	34	34
		WB	119	122	0	0	0	0	122	3	3	192	199	0	0	0	0	199	7	7	288	294	0	0	2	2	296	7	6
38	A 1306 Arterial Road North Stifford	EB	1181	1167	7	0	94	101	1268	86	-14	1334	1358	2	0	10	12	1370	36	24	1696	1692	3	0	7	10	1702	7	-3
		WB	1639	1628	3	0	68	71	1699	60	-11	1335	1333	0	0	55	55	1388	53	-2	1448	1482	3	0	65	68	1550	102	34
39	St Chads Rd / Feenan Highway	NB	36	35	0	0	0	0	35	-1	-1	44	37	0	0	0	0	37	-7	-7	62	60	0	0	0	0	60	-1	-1
		SB	100	0	0	0	0	0	0	-100	-100	32	0	0	0	0	0	0	-32	-32	37	0	0	0	0	0	0	-37	-37

Table 10-8:Flow Changes of Initial & further list of roads of concern (Phase 8 vs DMB)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 9 v DMA

			DMA (AM)	Phase 9 (AM)								DMA (IP)	Phase 9 (IP)								DMA (PM)	Phase 9 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	287	0	0	0	0	0	0	-287	-287	118	0	0	0	0	0	0	-118	-118	274	0	0	0	0	0	0	-274	-274
		SB	229	0	0	0	0	0	0	-229	-229	180	0	0	0	0	0	0	-180	-180	238	0	0	0	0	0	0	-238	-238
2	Stifford Clays Road, Orsett Village	EB	133	211	0	0	2	2	213	80	78	142	143	0	0	1	1	144	2	1	325	318	0	0	11	11	329	5	-7
		WB	323	421	0	0	11	11	432	109	98	204	223	0	0	1	1	223	19	18	301	380	0	0	16	16	396	95	79
3	B186, North Ockendon (and Ockendon Rd)	NB	661	660	2	0	16	18	678	16	-1	438	436	0	0	1	1	437	-1	-2	470	467	0	0	1	1	468	-1	-2
		WB	376	401	0	0	1	1	402	25	24	468	488	0	0	0	0	489	20	20	671	673	0	0	5	5	678	7	2
4	B186, South Ockendon	NB	384	374	2	0	15	16	390	5	-11	243	256	0	0	1	1	257	14	13	252	253	0	0	1	1	254	2	1
		SB	259	279	0	0	1	1	280	21	20	279	289	0	0	0	0	289	10	10	400	422	0	0	4	4	426	26	22
5	B188, Baker Street Village	NB	46	110	0	0	14	14	124	78	64	38	59	0	0	2	2	61	23	21	32	55	0	0	2	2	57	24	22
		SB	34	74	0	0	4	4	78	44	40	48	56	0	0	2	2	58	10	8	148	135	0	0	11	11	146	-2	-13
6	A1014, North Bound	EB	1792	1735	3	0	5	8	1742	-50	-58	1945	1933	3	0	5	8	1941	-4	-12	1345	1348	3	0	5	8	1355	11	3
		WB	1365	1361	8	0	6	14	1375	10	-4	2086	2086	3	0	3	6	2091	5	0	2201	2194	3	0	0	3	2196	-5	-7
7	A128 Brentwood Road (North of Orsett Cock)	NB	1262	1309	1	0	22	24	1333	71	47	787	784	1	0	36	37	821	35	-2	869	983	1	0	31	33	1016	147	114
		SB	805	921	1	0	36	37	958	153	116	652	793	1	0	23	24	816	164	140	961	1052	0	0	4	5	1057	95	91
8	A1089	NB	2203	2369	18	9	51	79	2447	245	166	2029	2078	19	9	58	86	2164	135	49	2122	2215	19	9	21	49	2264	142	93
		SB	2219	2027	46	9	77	133	2159	-60	-192	2096	1989	15	9	96	121	2109	13	-108	1940	1915	14	9	6	30	1945	5	-25
9	Buckingham Hill Road (North Bound)	NB	685	645	0	0	59	59	704	19	-40	496	456	0	0	57	57	513	16	-41	500	435	0	0	36	36	471	-30	-66
		SB	332	367	0	0	90	90	457	126	36	429	461	0	0	57	57	519	90	33	468	466	0	0	0	0	466	-2	-2
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4502	4470	5	2	1	8	4478	-24	-32	3929	3958	5	2	1	8	3967	37	29	4812	4872	5	2	25	32	4904	92	60
		WB	5081	5031	12	2	20	35	5066	-16	-51	4067	4061	4	2	1	7	4068	1	-6	4400	4404	4	2	0	6	4410	10	4
16	Brentwood Road (North of Orsett Cock)	NB	642	610	3	0	20	24	634	-8	-32	346	328	3	0	36	39	367	21	-18	386	398	3	0	82	85	484	98	13
		SB	221	228	7	0	87	94	321	100	6	376	380	2	0	23	25	406	30	5	638	639	1	0	3	4	644	6	2
17	Brentwood Road / Chadwell St Mary	NB	282	252	0	0	28	28	280	-2	-30	235	229	0	0	40	40	269	34	-6	224	232	0	0	23	23	255	32	9
		SB	214	231	0	0	38	38	269	56	17	214	224	0	0	27	27	251	37	10	275	276	0	0	6	6	282	6	1
18	Marshfoot Rd	EB	483	460	0	0	93	93	553	70	-23	643	584	0	0	103	103	688	45	-59	798	794	0	0	0	0	794	-4	-4
		WB	773	878	0	0	12	12	890	117	105	505	524	0	0	70	70	593	88	18	442	490	0	0	31	31	521	79	48
20	Muckingford Road / Linford Road	EB	2	2	0	0	90	90	92	90	0	4	4	0	0	57	57	61	57	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	39	39	41	39	0	3	3	0	0	57	57	61	57	0	2	2	0	0	36	36	39	36	0
21	Princess Margaret Road, East Tilbury	NB	69	80	0	0	19	19	100	30	11	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	26	0	0	0	0	26	0	0	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	179	0	0	1	1	180	13	12	38	40	0	0	0	0	40	2	2	39	44	0	0	0	0	44	5	5
		SB	0	0	0	0	0	0	0	0	0	50	73	0	0	0	0	73	23	23	175	168	0	0	1	1	168	-6	-7
25	Green Lane	EB	0	0	0	0	3	3	3	3	0	0	0	0	0	1	1	1	1	0	0	0	0	0	23	23	23	23	0
		WB	0	0	0	0	7	7	7	7	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	155	0	0	27	27	182	95	68	106	103	0	0	0	0	103	-3	-3	253	251	0	0	1	1	252	-1	-2
		WB	277	361	0	0	1	1	362	85	84	162	177	0	0	0	0	177	16	16	236	312	0	0	46	46	358	122	76
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	553	561	0	0	6	6	567	14	9	499	506	0	0	6	6	512	13	7	1008	1060	0	0	6	6	1066	58	52
		SB	593	594	0	0	18	18	613	20	1	458	465	0	0	7	7	472	14	8	582	601	0	0	0	0	601	19	19
28	A1013 The Manorway to Buckingham Hill Road	NB	375	362	0	0	55	55	417	43	-12	281	263	0	0	52	52	314	33	-19	278	250	0	0	32	32	283	5	-27
		SB	176	170	0	0	84	84	254	78	-6	183	194	0	0	50	50	243	61	11	212	221	0	0	0	0	221	10	10
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	451	0	0	1	1	451	15	15	531	549	0	0	0	0	549	18	18	741	708	0	0	2	2	710	-32	-33
		WB	847	802	0	0	2	2	804	-43	-45	631	594	0	0	0	0	595	-37	-37	662	616	0	0	0	0	617	-45	-45
30	A1013 Orsett Cock to A1089	EB	799	645	3	0	1	4	648	-150	-154	568	514	3	0	0	3	517	-52	-54	1006	929	3	0	7	10	939	-67	-77
		WB	935	960	7	0	7	14	974	40	25	602	669	2	0	0	2	671	69	66	872	901	2	0	2	4	905	33	29
31	Heath Road	NB	107	88	0	0	5	5	93	-15	-20	42	49	0	0	4	4	53	11	7	36	38	0	0	2	2	40	4	1
		SB	36	44	0	0	7	7	51	16	8	50	52	0	0	4	4	56	5	1	143	135	0	0	2	2	136	-7	-8
32	Old Dock Approach Rd	NB	112	62	0	0	1	1	63	-49	-50	106	96	0	0	0	0	96	-11	-11	143	138	0	0	0	0	138	-5	-5
		SB	343	421	0	0	0	0	421	78	78	200	215	0	0	0	0	215	15	15	232	276	0	0	1	1	276	44	44
33	Dock Road	EB	587	597	0	0	13	13	610	23	11	508	535	0	0	7	7	542	34	27	646	658	0	0	0	0	658	12	12
		SB	716	696	0	0	11	11	707	-9	-20	586	556	0	0	12	12	567	-19	-31	625	619	0	0	8	8	628	2	-6
34	A1012 Elizabeth Road	NB	363	364	0	0	3	3	367	3	0	470	478	0	0	0	0	478	9	9	460	463	0	0	0	0	463	3	3
		SB	305	295	0	0	0	0	295	-10	-10	252	249	0	0	0	0	249	-3	-3	275	276	0	0	2	2	278	3	0
35	Blackshots Lane	NB	111	117	0	0	0	0	118	7	7	84	90	0	0	0	0	90	7	7	125	134	0	0	0	0	134	9	9
		SB	92	94	0	0	0	0	94	2	2	74	76	0	0	0	0	76	1	1	100	108	0	0	0	0	108	8	8
36	Medebridge Road	NB	0	0	7	11	16	34	34	34	0	0	0	2	11	0	14	14	14	0	0	0	2	11	0	13	13	13	0
		SB	0	0	2	11	0	14	14	14	0	0	0	2	11	0	14	14	14	0	0	0	2	11	0	14	14	14	0
37	Dennis Road / West Road	EB	279	288	0	0	1	1	289	10	9	197	183	0	0	0	0	183	-15	-15	234	258	0	0	0	0	258	24	24
		WB	119	123	0	0	0	0	123	3	3	191	202	0	0	0	0	202	10	10	288	295	0	0	1	1	296	8	7
38	A 1306 Arterial Road North Stifford	EB	1179	1174	3	0	91	94	1268	88	-6	1333	1357	1	0	9	10	1368	34	24	1692	1701	1	0	5	6	1707	14	8
		WB	1637	1463	1	0	77	78	1541	-95	-174	1334	1332	0	0	40	40	1373	39	-2	1445	1449	0	0	46	46	1495	50	4
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	34	-2	-2	44	37	0	0	0	0	37	-7	-7	60	57	0	0	0	0	57	-3	-3
		SB	95	0	0	0	0	0	0	-95	-95	32	0	0	0	0	0	0	-32	-32	37	0	0	0	0	0	0	-37	-37

Table 10-9:Flow Changes of Initial & further list of roads of concern (Phase 9 vs DMA)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 10 v DMA

ID	Location Name	Direction	DMA (AM)	Phase 10 (AM)									DMA (IP)	Phase 10 (IP)									DMA (PM)	Phase 10 (PM)								
			(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	287	292	0	0	0	0	292	5	4	118	118	0	0	0	0	118	0	0	274	228	0	0	0	0	228	-45	-45
		SB	229	243	0	0	0	0	243	14	14	180	164	0	0	0	0	164	-16	-16	238	223	0	0	0	0	223	-16	-16
2	Stifford Clays Road, Orsett Village	EB	133	163	0	0	1	1	164	31	29	142	147	0	0	1	1	148	5	5	325	352	0	0	1	1	352	28	27
		WB	323	288	0	0	1	1	288	-34	-35	204	188	0	0	1	1	188	-16	-17	301	295	0	0	1	1	296	-5	-6
3	B186, North Ockendon (and Ockendon Rd)	NB	661	671	1	0	13	14	685	23	9	438	437	0	0	1	1	438	0	0	470	476	0	0	1	1	477	7	6
		WB	376	399	0	0	1	1	400	24	23	468	483	0	0	0	0	483	15	14	671	671	0	0	3	3	674	3	0
4	B186, South Ockendon	NB	384	384	1	0	12	13	397	12	-1	243	257	0	0	1	1	258	15	14	252	257	0	0	1	1	257	5	4
		SB	259	275	0	0	1	1	276	17	16	279	286	0	0	0	0	287	8	7	400	414	0	0	2	2	416	16	14
5	B188, Baker Street Village	NB	46	35	0	0	2	2	36	-9	-11	38	15	0	0	2	2	16	-21	-23	32	13	0	0	2	2	15	-18	-19
		SB	34	31	0	0	3	3	35	1	-3	48	46	0	0	2	2	48	0	-2	148	132	0	0	0	0	132	-16	-16
6	A1014, North Bound	EB	1792	1740	1	0	4	5	1745	-48	-52	1945	1933	1	0	4	5	1938	-7	-12	1345	1341	1	0	4	5	1346	1	-3
		WB	1365	1361	3	0	5	7	1368	4	-4	2086	2086	1	0	3	4	2089	3	0	2201	2199	1	0	0	1	2199	-2	-2
7	A128 Brentwood Road (North of Orsett Cock)	NB	1262	1248	1	0	15	15	1263	1	-14	787	792	1	0	28	28	821	34	6	869	888	1	0	28	29	916	48	19
		SB	805	942	1	0	27	28	970	166	138	652	766	0	0	20	20	786	133	113	961	1050	0	0	0	0	1050	89	89
8	A1089	NB	2203	2326	17	10	36	64	2390	188	124	2029	2031	17	10	24	52	2083	54	2	2122	2089	17	10	20	48	2137	15	-33
		SB	2219	2145	44	10	74	129	2274	55	-74	2096	2066	14	10	85	109	2175	79	-30	1940	1977	14	10	4	28	2005	65	37
9	Buckingham Hill Road (North Bound)	NB	685	677	0	0	45	45	723	37	-8	496	500	0	0	45	45	544	48	4	500	490	0	0	36	36	526	25	-11
		SB	332	360	0	0	78	78	438	106	28	429	450	0	0	50	50	500	71	21	468	453	0	0	0	0	453	-15	-15
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4502	4474	2	2	1	5	4479	-23	-28	3929	3958	2	2	1	5	3963	34	28	4812	4862	2	2	12	16	4878	66	50
		WB	5081	5098	6	2	9	17	5115	33	17	4067	4087	2	2	2	6	4093	26	20	4400	4444	2	2	0	4	4448	48	45
16	Brentwood Road (North of Orsett Cock)	NB	642	510	1	0	14	16	526	-116	-132	346	365	2	0	28	30	395	49	19	386	428	2	0	64	66	494	108	42
		SB	221	214	5	0	62	67	281	60	-7	376	372	1	0	20	21	394	18	-3	638	634	1	0	0	1	635	-3	-4
17	Brentwood Road / Chadwell St Mary	NB	282	231	0	0	20	20	250	-32	-51	235	228	0	0	31	31	260	24	-7	224	239	0	0	23	23	263	39	16
		SB	214	212	0	0	30	30	242	29	-2	214	210	0	0	24	24	234	20	-4	275	268	0	0	1	1	269	-6	-7
18	Marshfoot Rd	EB	483	482	0	0	86	86	569	86	-1	643	593	0	0	91	91	683	41	-50	798	812	0	0	0	0	812	14	14
		WB	773	845	0	0	9	9	854	81	72	505	503	0	0	33	33	536	31	-2	442	448	0	0	29	29	477	35	6
20	Muckingford Road / Linford Road	EB	2	2	0	0	78	78	80	78	0	4	4	0	0	50	50	54	50	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	26	26	28	26	0	3	3	0	0	44	44	48	44	0	2	2	0	0	36	36	39	36	0
21	Princess Margaret Road, East Tilbury	NB	69	70	0	0	19	19	89	20	1	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	26	0	0	0	0	26	0	0	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	165	0	0	0	0	165	-2	-2	38	37	0	0	0	0	37	-1	-1	39	37	0	0	0	0	37	-1	-1
		SB	0	0	0	0	0	0	0	0	0	50	76	0	0	0	0	76	26	26	175	176	0	0	1	1	177	2	2
25	Green Lane	EB	0	0	0	0	2	2	2	2	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0
		WB	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	1	1	1	1	0
26	Stifford Clays Road	EB	87	115	0	0	0	0	115	28	28	106	103	0	0	0	0	103	-3	-3	253	280	0	0	1	1	281	28	28
		WB	277	240	0	0	0	0	241	-36	-37	162	144	0	0	0	0	144	-17	-17	236	227	0	0	0	0	227	-9	-9
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	553	569	0	0	4	4	574	21	17	499	506	0	0	4	4	510	11	7	1008	1052	0	0	6	6	1058	50	44
		SB	593	592	0	0	15	15	607	14	0	458	467	0	0	6	6	473	16	10	582	595	0	0	0	0	595	13	13
28	A1013 The Manorway to Buckingham Hill Road	NB	375	412	0	0	43	43	455	80	37	281	263	0	0	40	40	303	22	-19	278	251	0	0	32	32	284	6	-26
		SB	176	167	0	0	71	71	238	62	-9	183	184	0	0	46	46	230	47	1	212	216	0	0	0	0	216	5	5
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	444	0	0	0	0	444	8	7	531	549	0	0	0	0	549	18	18	741	717	0	0	1	1	718	-23	-24
		WB	847	756	0	0	1	1	757	-90	-91	631	649	0	0	0	0	649	18	18	662	673	0	0	0	0	673	11	11
30	A1013 Orsett Cock to A1089	EB	799	803	0	0	1	1	804	5	5	568	572	0	0	0	0	572	4	4	1006	1029	0	0	0	0	1029	23	23
		WB	935	942	0	0	0	0	942	7	7	602	623	0	0	0	0	623	21	21	872	881	0	0	1	1	882	10	9
31	Heath Road	NB	107	161	0	0	3	3	164	57	53	42	19	0	0	3	3	22	-20	-23	36	18	0	0	2	2	20	-16	-19
		SB	36	39	0	0	6	6	45	9	3	50	50	0	0	3	3	53	3	-1	143	136	0	0	0	0	136	-7	-8
32	Old Dock Approach Rd	NB	112	99	0	0	1	1	99	-13	-13	106	106	0	0	0	0	106	-1	-1	143	150	0	0	0	0	150	6	6
		SB	343	393	0	0	0	0	393	50	50	200	189	0	0	0	0	189	-12	-12	232	225	0	0	0	0	225	-7	-7
33	Dock Road	EB	587	613	0	0	11	11	623	37	26	508	509	0	0	6	6	515	7	1	646	629	0	0	0	0	629	-17	-17
		SB	716	715	0	0	9	9	723	7	-1	586	574	0	0	9	9	583	-4	-13	625	620	0	0	8	8	629	3	-5
34	A1012 Elizabeth Road	NB	363	361	0	0	2	2	363	-1	-2	470	474	0	0	0	0	474	5	5	460	463	0	0	0	0	463	3	3
		SB	305	299	0	0	0	0	299	-6	-6	252	253	0	0	0	0	254	1	1	275	278	0	0	1	1	279	4	3
35	Blackshots Lane	NB	111	107	0	0	0	0	107	-4	-4	84	87	0	0	0	0	87	4	4	125	129	0	0	0	0	129	3	3
		SB	92	87	0	0	0	0	87	-5	-5	74	75	0	0	0	0	75	0	0	100	106	0	0	0	0	106	7	7
36	Medebridge Road	NB	0	0	1	12	0	13	13	13	0	0	0	0	12	0	13	13	13	0	0	0	0	12	0	13	13	13	0
		SB	0	0	1	12	0	13	13	13	0	0	0	0	12	0	12	12	12	0	0	0	0	12	0	12	12	12	0
37	Dennis Road / West Road	EB	279	288	0	0	1	1	289	10	10	197	183	0	0	0	0	183	-14	-14	234	259	0	0	0	0	259	25	25
		WB	119	125	0	0	0	0	125	6	6	191	199	0	0	0	0	199	7	7	288	297	0	0	1	1	297	9	9
38	A 1306 Arterial Road North Stifford	EB	1179	1170	0	0	74	74	1244	65	-9	1333	1354	0	0	8	8	1362	29	21	1692	1681	0	0	3	3	1684	-9	-12
		WB	1637	1601	0	0	61	61	1662	25	-36	1334	1328	0	0	53	53	1380	46	-6	1445	1436	0	0	44	44	1479	34	-10
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	34	-2	-2	44	38	0	0	0	0	38	-6	-6	60	61	0	0	0	0	61	1	1
		SB	95	105	0	0	0	0	105	10	10	32	0	0	0	0	0	0	-32	-32	37	0	0	0	0	0	0	-37	-37

Table 10-10:Flow Changes of Initial & further list of roads of concern (Phase 10 vs DMA)

Initial & Further List Roads/Areas of Concern Flow Changes Phase 11 v DMA

			DMA (AM)	Phase 11 (AM)								DMA (IP)	Phase 11 (IP)								DMA (PM)	Phase 11 (PM)							
ID	Location Name	Direction	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic	(UC1 to UC10) General Traffic (DMA)	(UC1 to UC10) General Traffic (Phase)	UC11 (HGV_constr)	Fixed Flow (Earthworks HGV_constr)	UC12 (Car_constr_staff	Total_Constr (CTM)	Total Flow (Phase)	Change in Total Flow	Reassigned Geneal Traffic
1	Rectory Road, Orsett Village	NB	287	293	0	0	0	0	293	5	5	118	118	0	0	0	0	118	0	0	274	218	0	0	0	0	218	-55	-55
		SB	229	218	0	0	0	0	218	-11	-11	180	135	0	0	0	0	135	-45	-45	238	228	0	0	0	0	228	-11	-11
2	Stifford Clays Road, Orsett Village	EB	133	124	0	0	0	0	124	-9	-9	142	141	0	0	0	0	141	-2	-2	325	314	0	0	0	0	314	-10	-10
		WB	323	289	0	0	0	0	289	-33	-34	204	181	0	0	0	0	182	-23	-23	301	278	0	0	0	0	278	-23	-23
3	B186, North Ockendon (and Ockendon Rd)	NB	661	658	0	0	5	5	663	2	-3	438	438	0	0	0	0	438	0	0	470	470	0	8	0	8	478	8	0
		WB	376	376	0	0	0	0	377	0	0	468	469	0	0	0	0	469	1	1	671	671	0	8	0	8	679	8	0
4	B186, South Ockendon	NB	384	382	0	0	5	5	387	3	-2	243	243	0	0	0	0	243	0	0	252	252	0	8	0	8	260	8	0
		SB	259	258	0	0	0	0	259	0	0	279	279	0	0	0	0	279	0	0	400	400	0	8	0	8	408	8	0
5	B188, Baker Street Village	NB	46	40	0	0	0	0	41	-5	-5	38	15	0	0	0	0	15	-23	-23	32	12	0	0	0	0	12	-20	-20
		SB	34	31	0	0	1	1	32	-2	-3	48	41	0	0	0	0	41	-6	-7	148	137	0	0	0	0	137	-11	-11
6	A1014, North Bound	EB	1792	1785	0	0	0	1	1786	-6	-7	1945	1944	0	0	1	1	1945	0	-1	1345	1346	0	0	0	0	1346	1	1
		WB	1365	1364	0	0	1	1	1366	1	-1	2086	2086	0	0	0	1	2086	1	0	2201	2200	0	0	0	0	2201	0	-1
7	A128 Brentwood Road (North of Orsett Cock)	NB	1262	1230	0	0	2	2	1232	-30	-31	787	780	0	0	4	4	783	-3	-7	869	917	0	0	0	0	917	49	49
		SB	805	843	0	0	4	4	848	43	38	652	698	0	0	3	3	701	48	46	961	975	0	0	0	0	975	13	13
8	A1089	NB	2203	2314	4	0	6	10	2323	121	111	2029	2052	4	0	4	7	2060	31	23	2122	2135	4	0	0	4	2139	17	13
		SB	2219	2257	9	0	15	24	2281	62	38	2096	2114	3	0	13	16	2130	33	18	1940	1948	3	0	0	3	1951	11	8
9	Buckingham Hill Road (North Bound)	NB	685	715	0	0	6	6	720	35	29	496	497	0	0	6	6	503	7	1	500	489	0	0	0	0	489	-11	-11
		SB	332	342	0	0	13	13	355	24	11	429	428	0	0	7	7	435	6	-1	468	460	0	0	0	0	460	-8	-8
10	A13WB Stanford Le-Hope Bypass to Orsett Cock	EB	4502	4461	0	0	1	1	4462	-40	-42	3929	3921	0	0	1	1	3922	-7	-9	4812	4828	0	0	0	1	4829	17	16
		WB	5081	5102	1	0	4	5	5107	25	21	4067	4048	0	0	1	2	4049	-18	-19	4400	4385	0	0	0	0	4385	-14	-15
16	Brentwood Road (North of Orsett Cock)	NB	642	492	0	0	2	2	494	-148	-150	346	358	0	0	4	4	362	16	12	386	419	0	0	0	0	419	33	33
		SB	221	203	0	0	4	5	208	-13	-18	376	372	0	0	3	3	375	-1	-4	638	631	0	0	0	0	631	-6	-7
17	Brentwood Road / Chadwell St Mary	NB	282	215	0	0	2	2	217	-65	-67	235	222	0	0	4	4	226	-10	-14	224	227	0	0	0	0	227	3	3
		SB	214	200	0	0	5	5	206	-8	-13	214	207	0	0	3	3	211	-3	-6	275	264	0	0	0	0	264	-11	-11
18	Marshfoot Rd	EB	483	484	0	0	16	16	500	17	1	643	637	0	0	13	13	650	7	-6	798	794	0	0	0	0	794	-4	-4
		WB	773	806	0	0	1	1	807	34	33	505	504	0	0	4	4	508	3	-1	442	448	0	0	0	0	448	6	6
20	Muckingford Road / Linford Road	EB	2	2	0	0	13	13	15	13	0	4	4	0	0	7	7	11	7	0	3	3	0	0	0	0	3	0	0
		WB	2	2	0	0	6	6	8	6	0	3	3	0	0	6	6	9	6	0	2	2	0	0	0	0	2	0	0
21	Princess Margaret Road, East Tilbury	NB	69	72	0	0	0	0	72	3	3	47	47	0	0	0	0	47	0	0	35	35	0	0	0	0	35	0	0
		SB	26	26	0	0	0	0	26	0	0	50	50	0	0	0	0	50	0	0	54	54	0	0	0	0	54	0	0
24	Dock Road	NB	167	163	0	0	0	0	163	-4	-4	38	38	0	0	0	0	38	0	0	39	39	0	0	0	0	39	0	0
		SB	0	0	0	0	0	0	0	0	0	50	57	0	0	0	0	57	7	7	175	178	0	0	0	0	178	3	3
25	Green Lane	EB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Stifford Clays Road	EB	87	76	0	0	0	0	76	-11	-11	106	101	0	0	0	0	101	-5	-5	253	241	0	0	0	0	241	-11	-11
		WB	277	237	0	0	0	0	238	-39	-39	162	138	0	0	0	0	138	-23	-23	236	210	0	0	0	0	210	-26	-26
27	North Hill B1007 /Orsett Road, Horndon on the Hill	NB	553	541	0	0	1	1	541	-11	-12	499	498	0	0	1	1	498	-1	-1	1008	1008	0	0	0	0	1008	0	0
		SB	593	586	0	0	3	3	589	-4	-6	458	457	0	0	1	1	458	0	0	582	578	0	0	0	0	578	-4	-4
28	A1013 The Manorway to Buckingham Hill Road	NB	375	419	0	0	5	5	425	50	45	281	273	0	0	5	5	278	-3	-8	278	263	0	0	0	0	263	-14	-14
		SB	176	180	0	0	12	12	192	16	4	183	187	0	0	7	7	194	11	4	212	216	0	0	0	0	216	4	4
29	A1013 Orsett Cock to Buckingham Hill Road	EB	436	435	0	0	0	0	435	-1	-1	531	529	0	0	0	0	529	-2	-2	741	727	0	0	0	0	727	-15	-15
		WB	847	814	0	0	0	0	815	-33	-33	631	647	0	0	0	0	647	16	16	662	672	0	0	0	0	672	11	11
30	A1013 Orsett Cock to A1089	EB	799	771	0	0	0	0	771	-28	-28	568	546	0	0	0	0	546	-22	-22	1006	988	0	0	0	0	988	-18	-18
		WB	935	886	0	0	0	0	886	-49	-49	602	587	0	0	0	0	587	-15	-15	872	869	0	0	0	0	869	-3	-3
31	Heath Road	NB	107	170	0	0	0	0	170	63	63	42	19	0	0	0	0	20	-23	-23	36	17	0	0	0	0	17	-19	-19
		SB	36	35	0	0	1	1	36	0	0	50	48	0	0	0	0	49	-2	-2	143	140	0	0	0	0	140	-3	-3
32	Old Dock Approach Rd	NB	112	113	0	0	0	0	113	1	1	106	104	0	0	0	0	104	-2	-2	143	146	0	0	0	0	146	3	3
		SB	343	378	0	0	0	0	378	35	35	200	201	0	0	0	0	201	1	1	232	224	0	0	0	0	224	-8	-8
33	Dock Road	EB	587	621	0	0	2	2	622	36	34	508	521	0	0	1	1	522	14	13	646	652	0	0	0	0	652	6	6
		SB	716	738	0	0	1	1	740	23	22	586	597	0	0	1	1	598	11	10	625	620	0	0	0	0	620	-5	-5
34	A1012 Elizabeth Road	NB	363	360	0	0	1	1	361	-3	-3	470	470	0	0	0	0	470	0	0	460	460	0	0	0	0	460	0	0
		SB	305	302	0	0	0	0	302	-3	-3	252	252	0	0	0	0	252	0	0	275	275	0	0	0	0	275	0	0
35	Blackshots Lane	NB	111	107	0	0	0	0	107	-4	-4	84	87	0	0	0	0	87	4	4	125	127	0	0	0	0	127	1	1
		SB	92	87	0	0	0	0	87	-5	-5	74	75	0	0	0	0	75	0	0	100	103	0	0	0	0	103	3	3
36	Medebridge Road	NB	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	Dennis Road / West Road	EB	279	278	0	0	0	0	278	-1	-1	197	197	0	0	0	0	197	0	0	234	234	0	0	0	0	234	0	0
		WB	119	120	0	0	0	0	120	1	0	191	192	0	0	0	0	192	1	1	288	288	0	0	0	0	288	0	0
38	A 1306 Arterial Road North Stifford	EB	1179	1183	0	0	10	11	1194	14	3	1333	1334	0	0	1	1	1336	2	1	1692	1695	0	0	0	0	1695	2	2
		WB	1637	1647	0	0	10	10	1657	20	10	1334	1335	0	0	7	7	1342	8	1	1445	1440	0	0	0	0	1440	-5	-5
39	St Chads Rd / Feenan Highway	NB	36	34	0	0	0	0	34	-1	-1	44	38	0	0	0	0	38	-6	-6	60	55	0	0	0	0	55	-4	-4
		SB	95	97	0	0	0	0	97	2	2	32	32	0	0	0	0	32	0	0	37	37	0	0	0	0	37	0	0

Table 10-11:Flow Changes of Initial & further list of roads of concern (Phase 11 vs DMA)

Appendix C Select Link Analysis Flow Plots for Construction Traffic

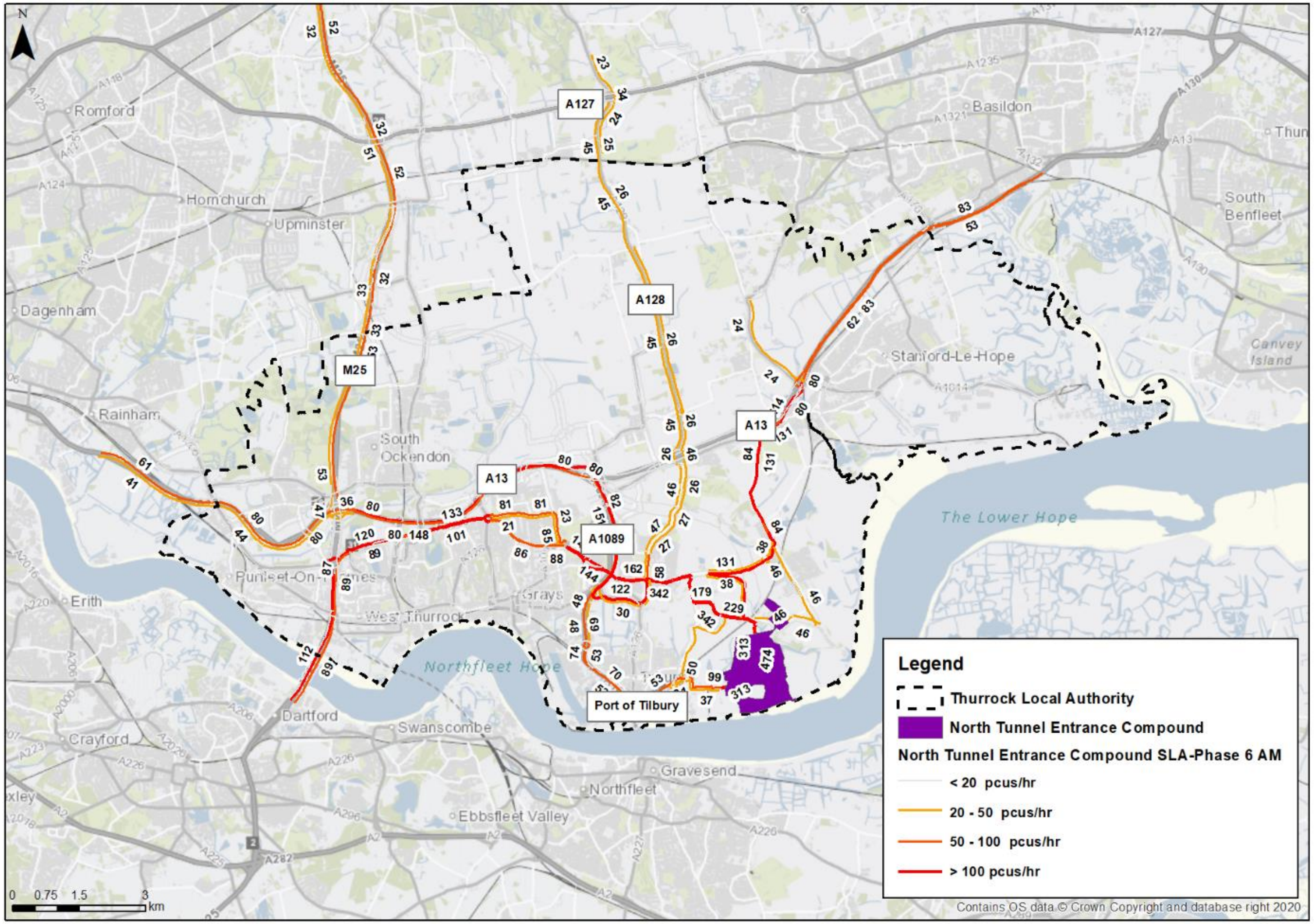

Figure 10-23: Select Link Analysis for North Tunnel Entrance Compound AM

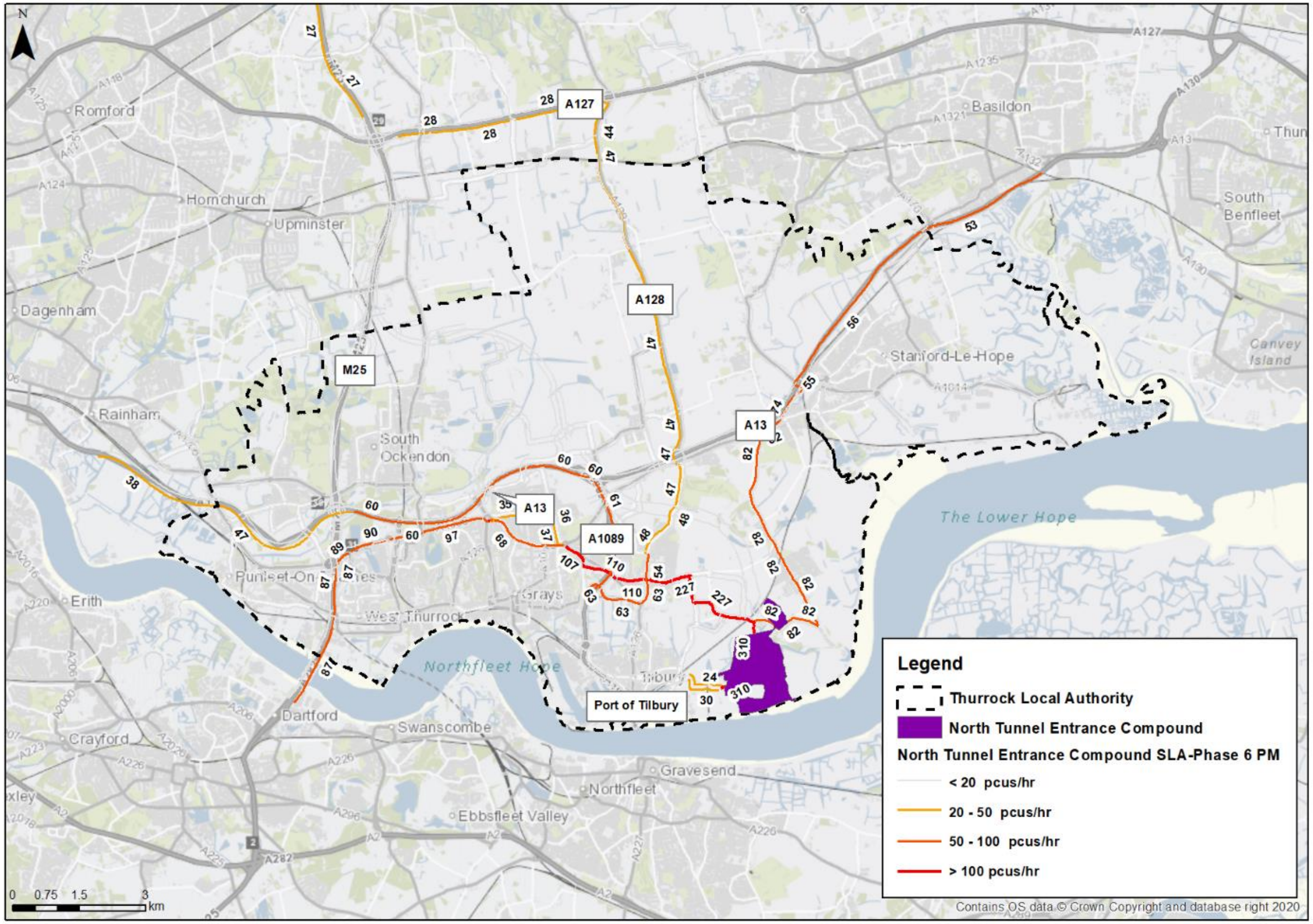

Figure 10-24: Select Link Analysis for North Tunnel Entrance Compound PM

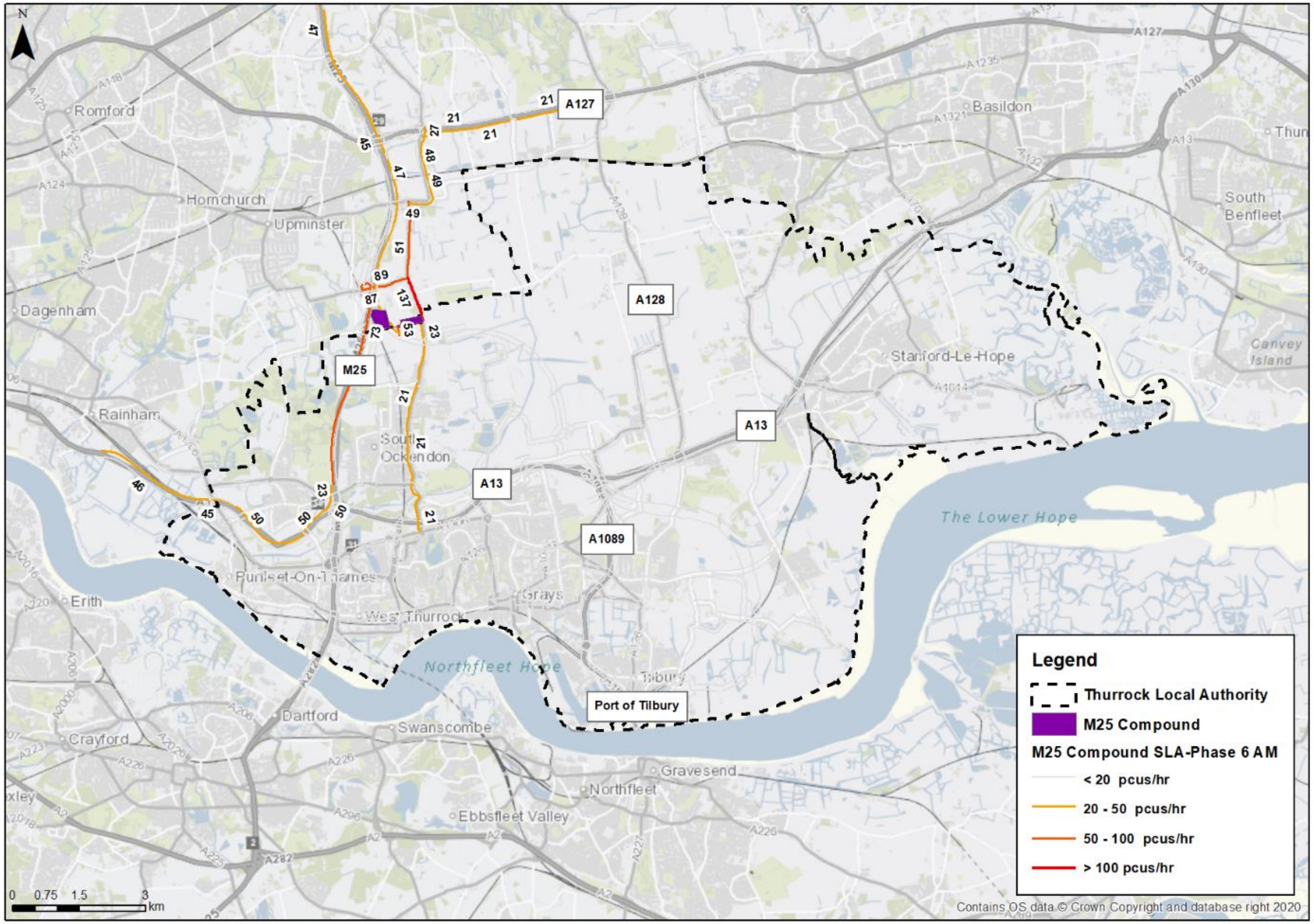

Figure 10-25: Select Link Analysis for M25 Compound AM

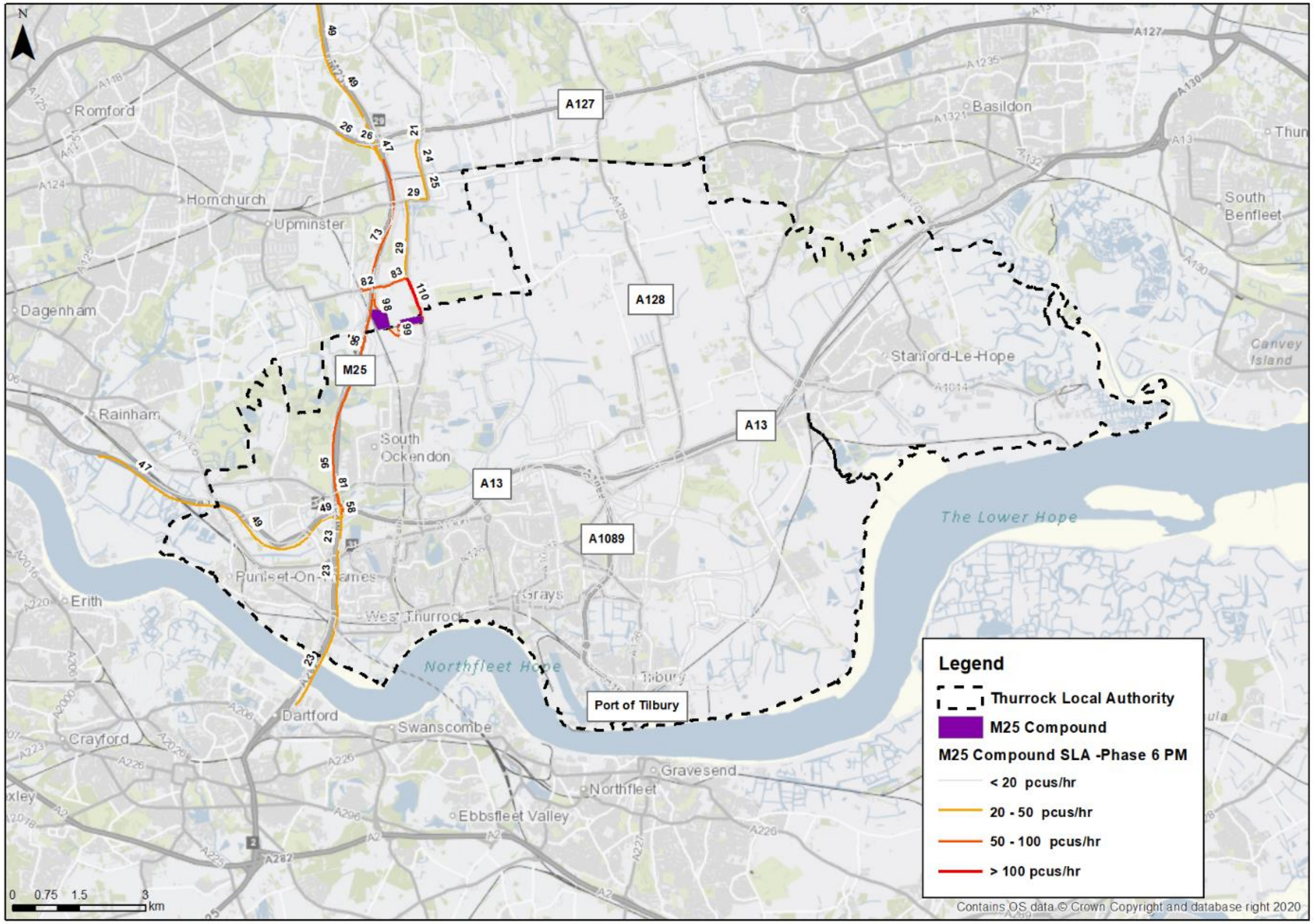

Figure 10-26: Select Link Analysis for M2 Compound PM

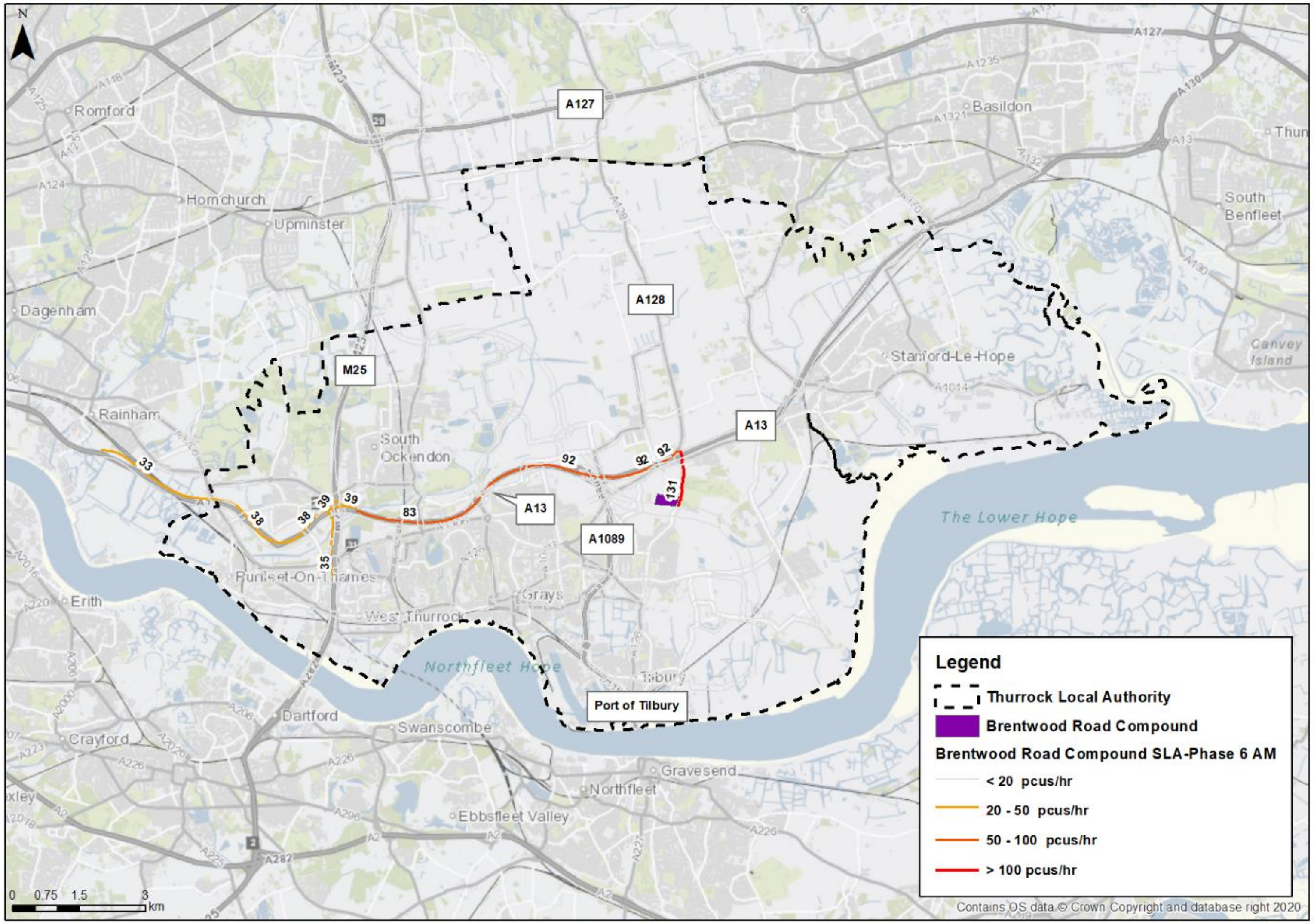

Figure 10-27: Select Link Analysis for Brentwood Road Compound AM

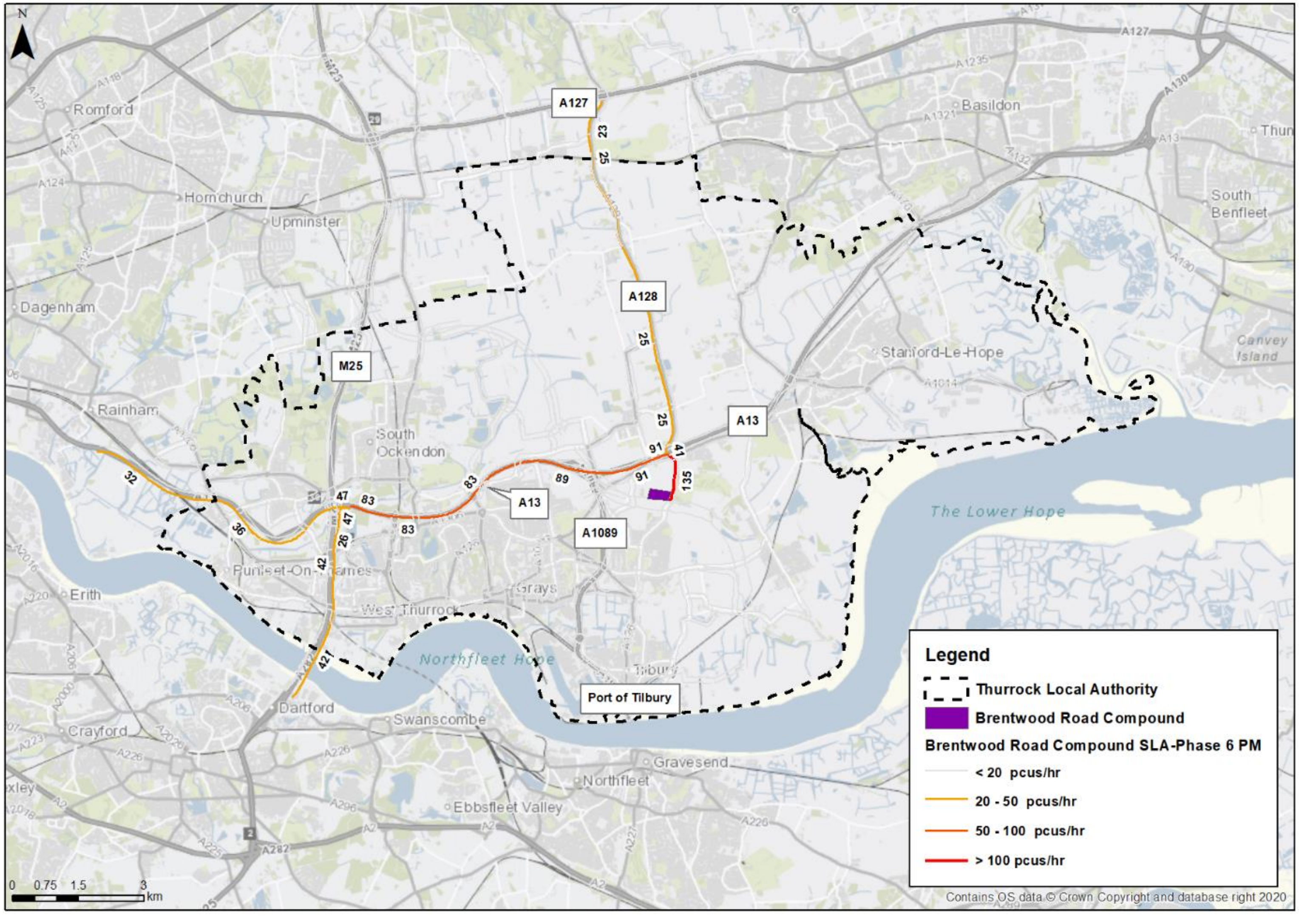

Figure 10-28: Select Link Analysis for Brentwood Road Compound PM

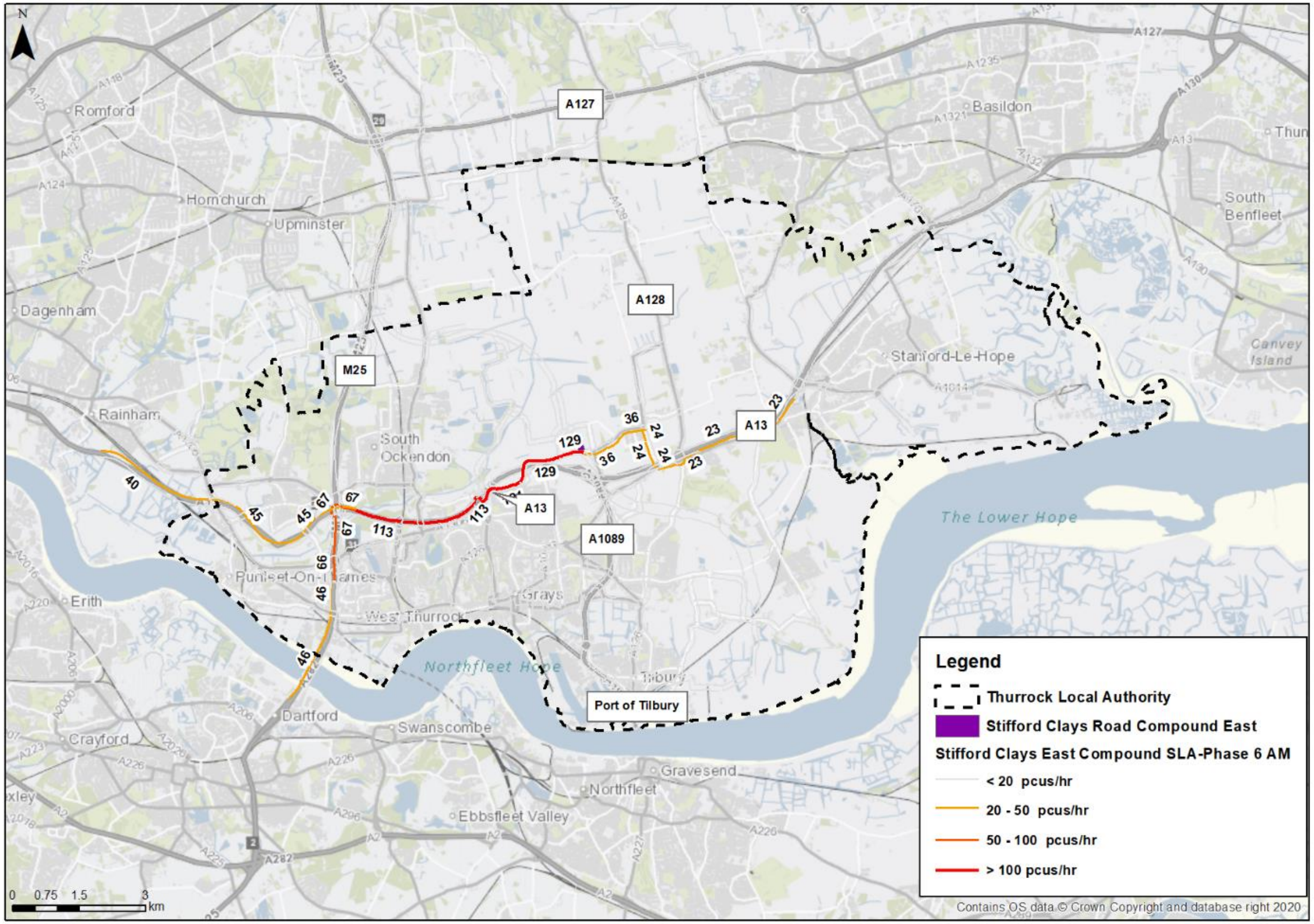

Figure 10-29: Select Link Analysis for Stifford Clays Compound AM

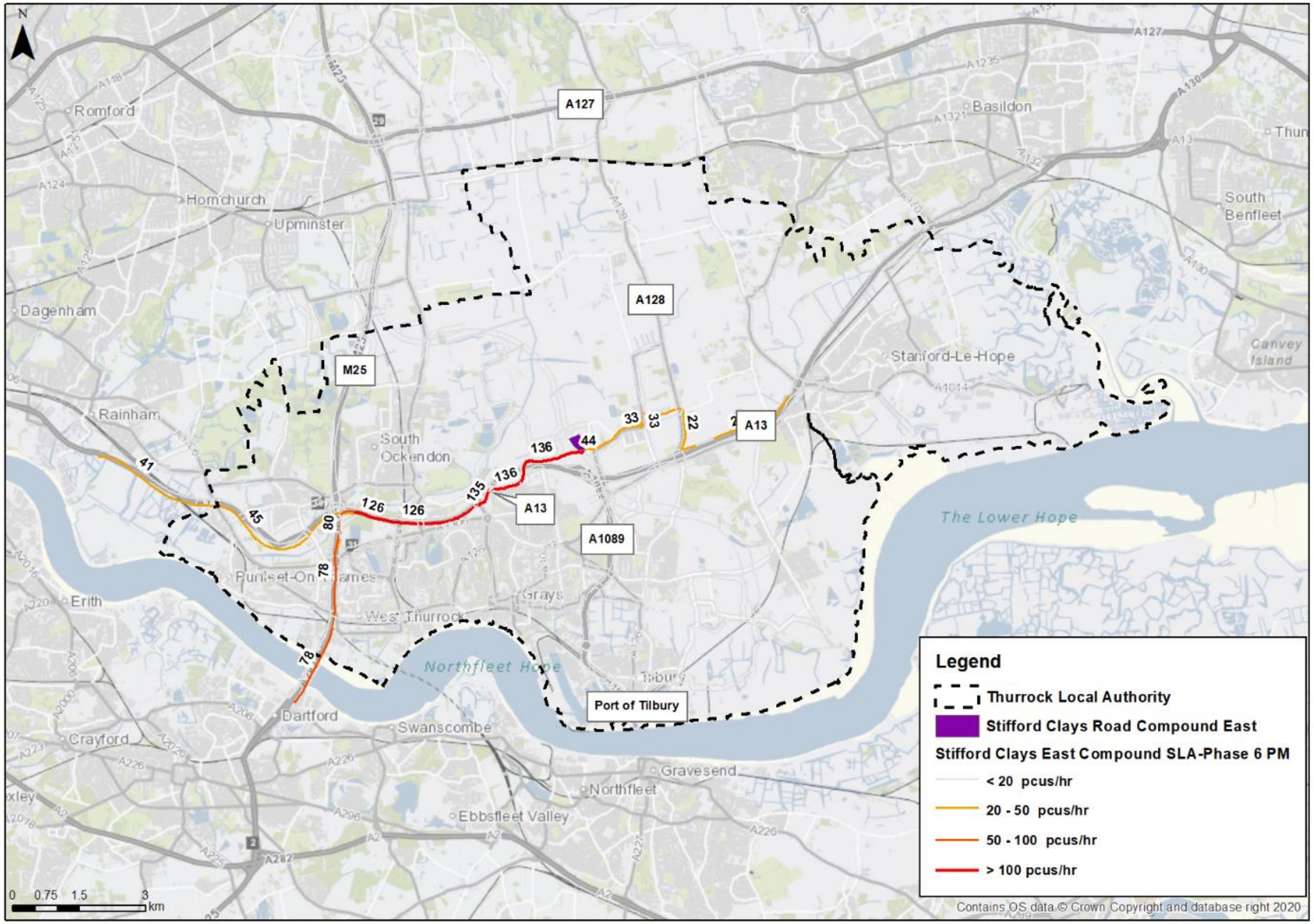

Figure 10-30: Select Link Analysis for Stifford Clays Compound PM

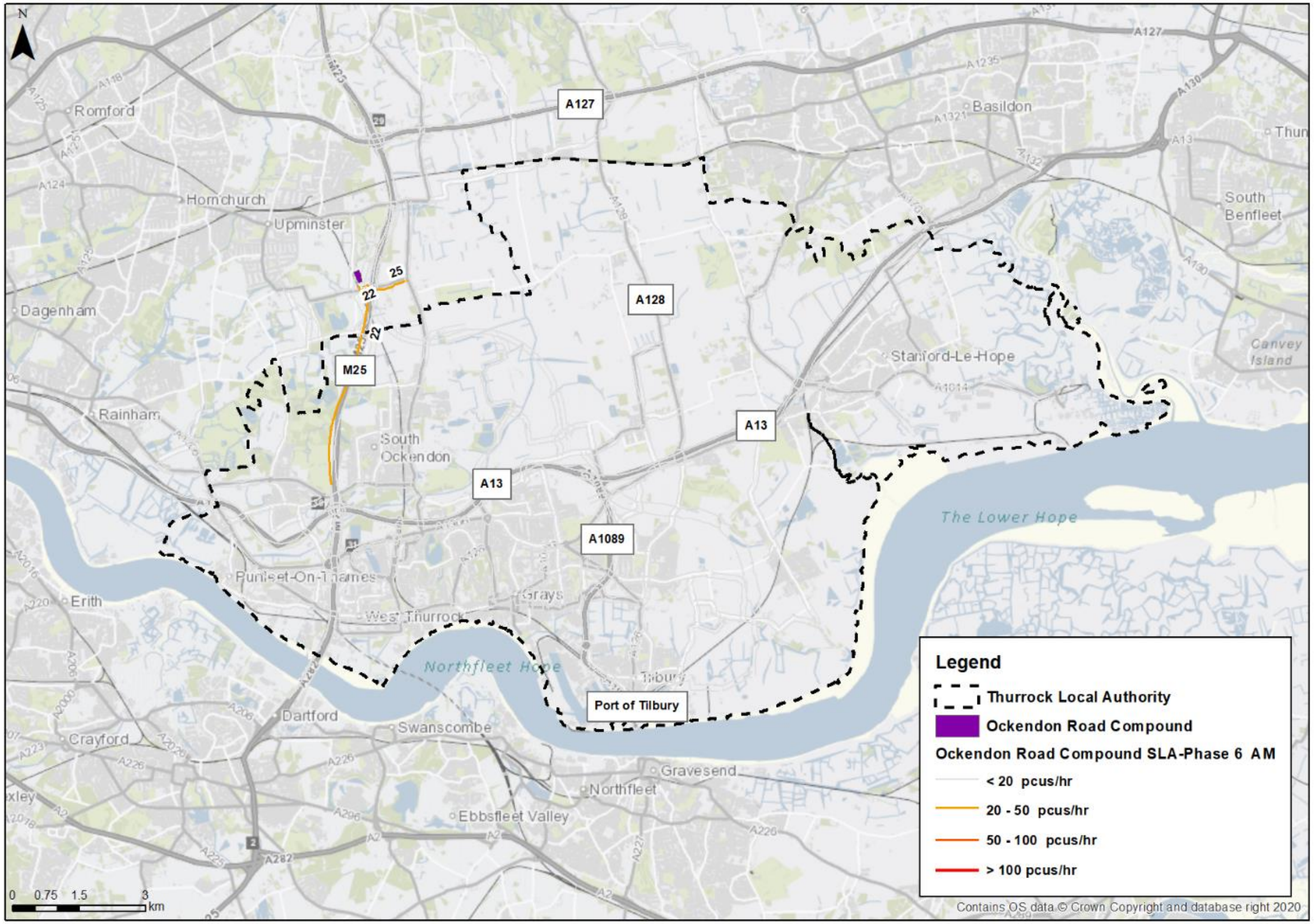

Figure 10-31: Select Link Analysis for Ockendon Road Compound AM

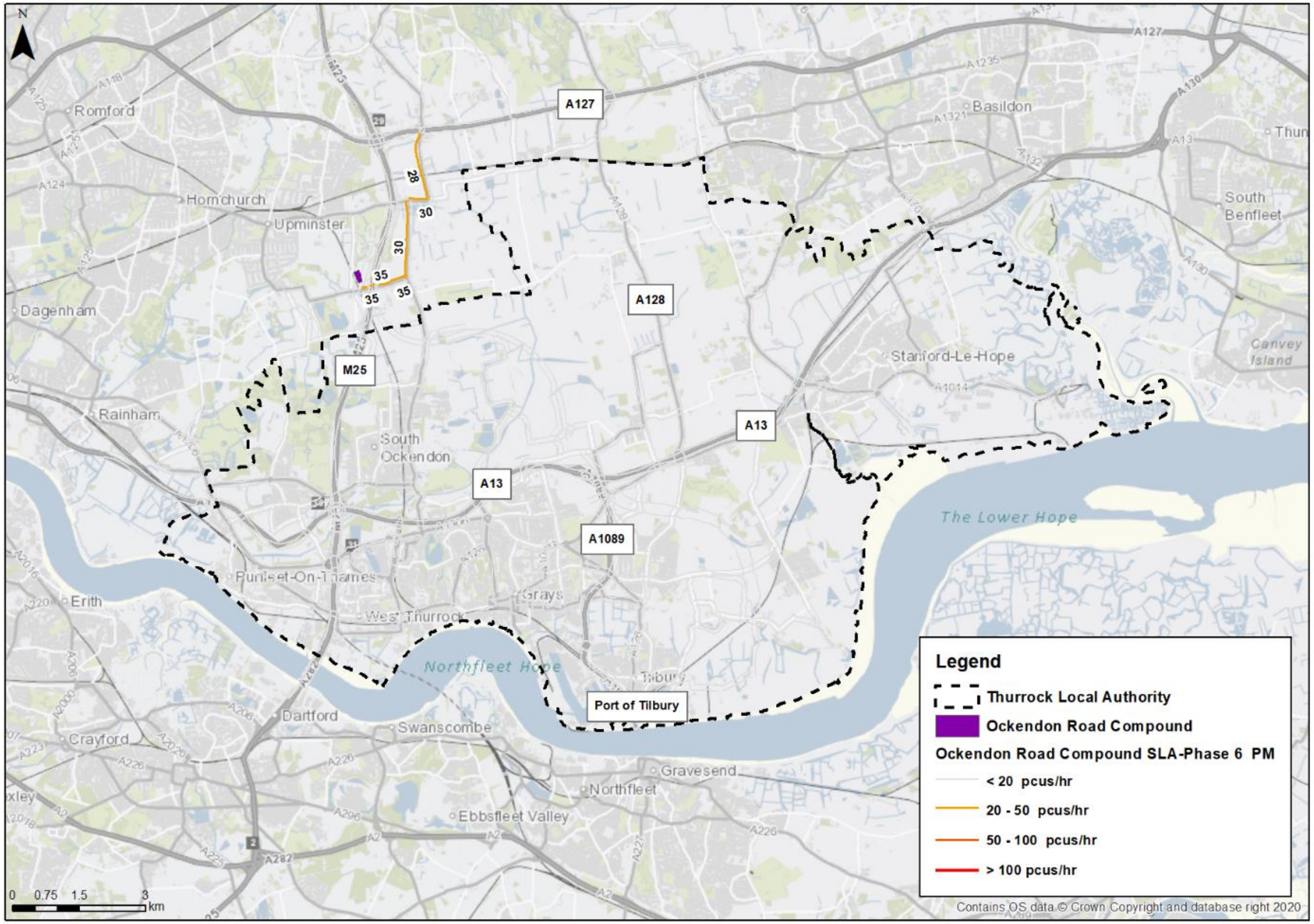

Figure 10-32: Select Link Analysis for Ockendon Road Compound PM

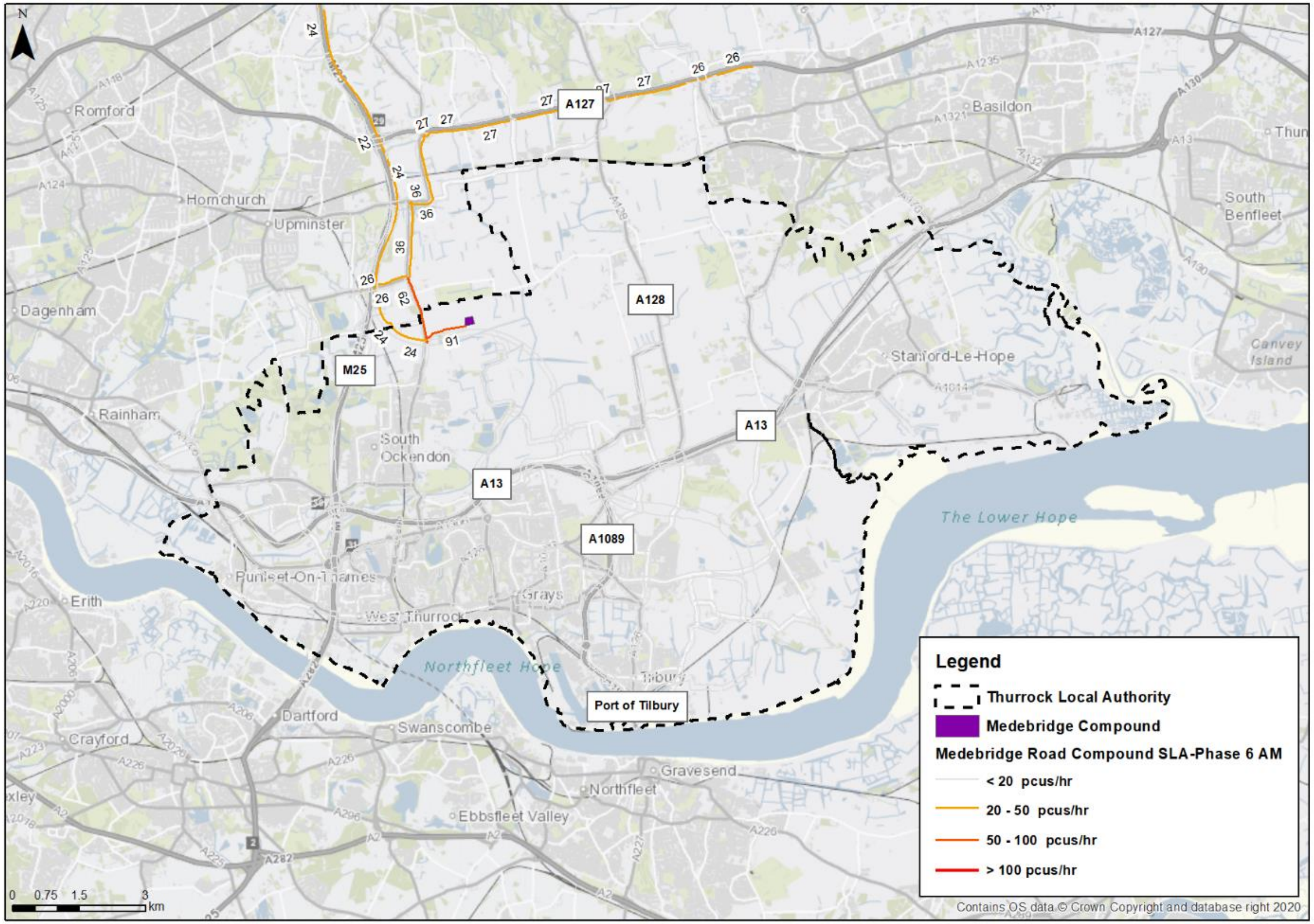

Figure 10-33: Select Link Analysis for Medebridge Road Compound AM

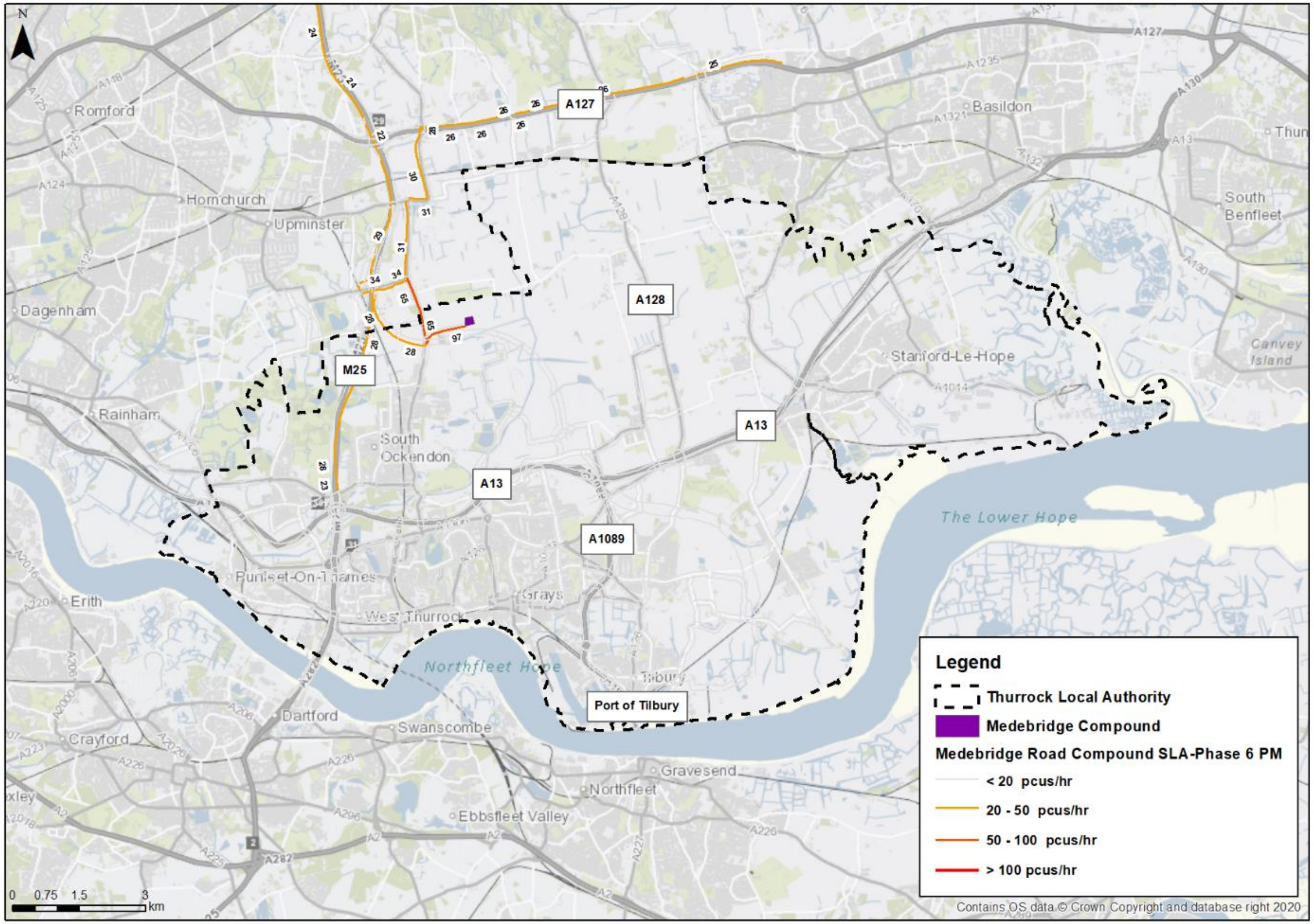

Figure 10-34: Select Link Analysis for Medebridge Compound PM

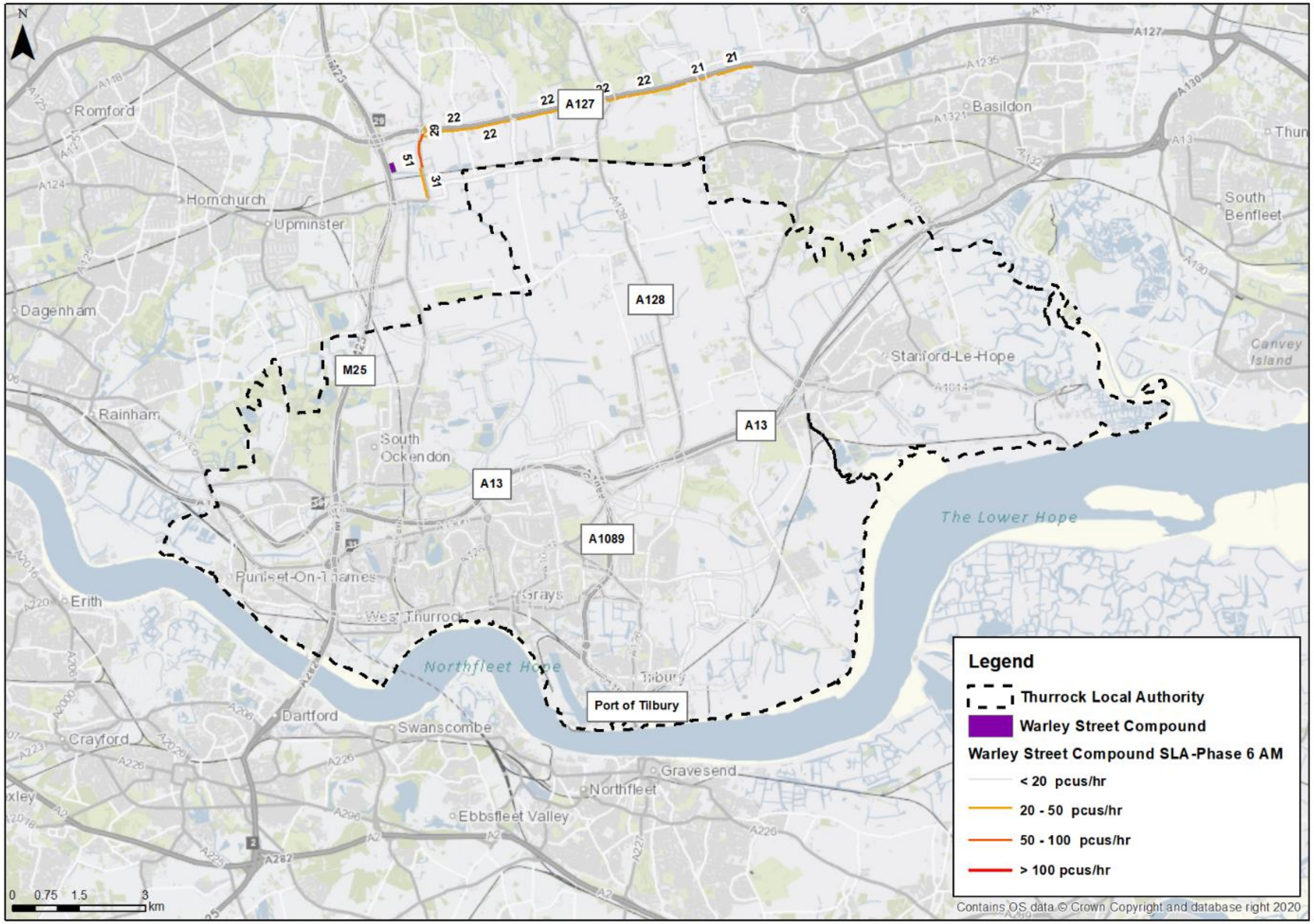

Figure 10-35: Select Link Analysis for Warley Street Compound AM

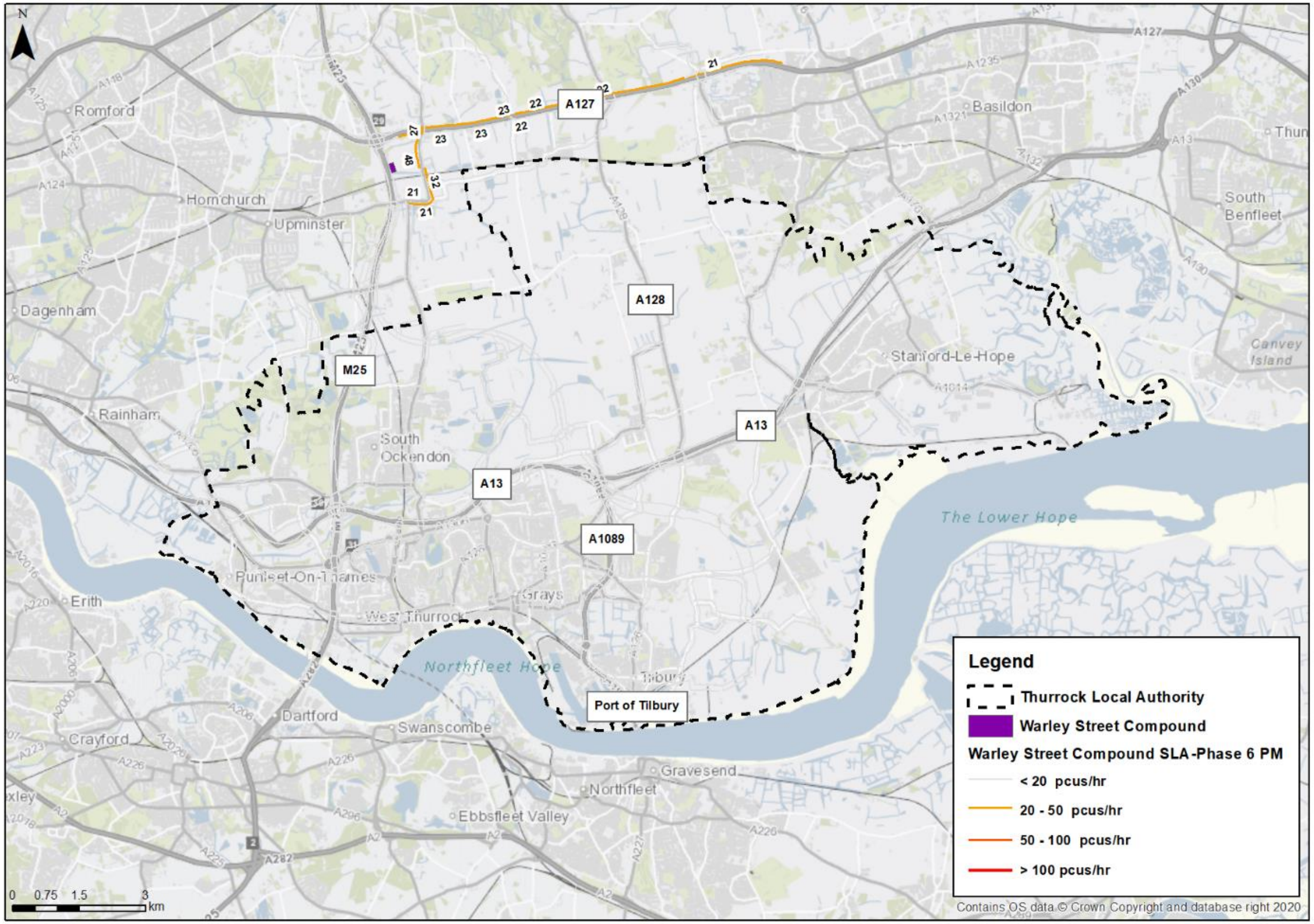

Figure 10-36: : Select Link Analysis for Warley Street Compound PM

Appendix D Delay Changes Plots

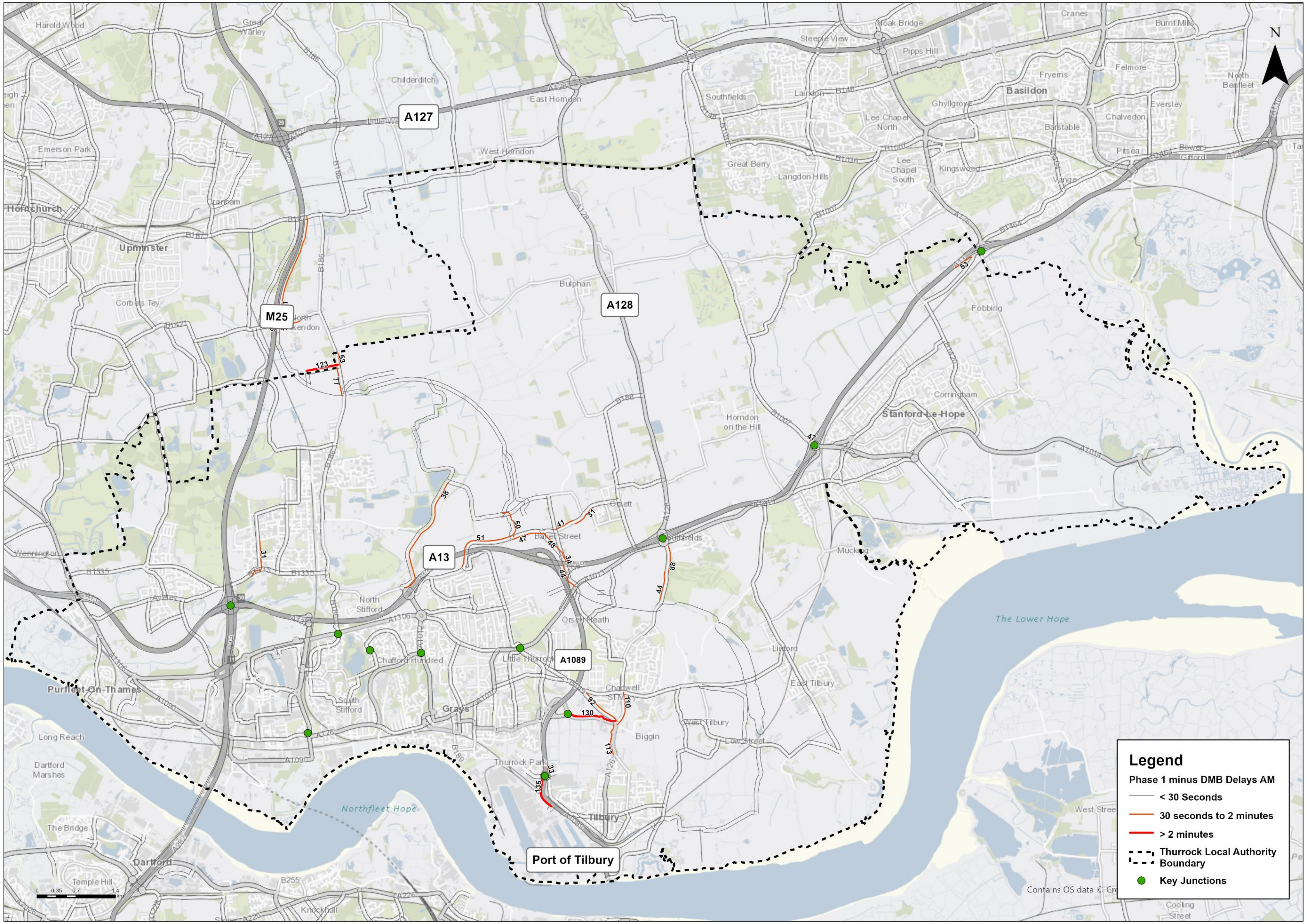

Figure 10-37: Delay Differences (Phase 1 minus DMB AM)

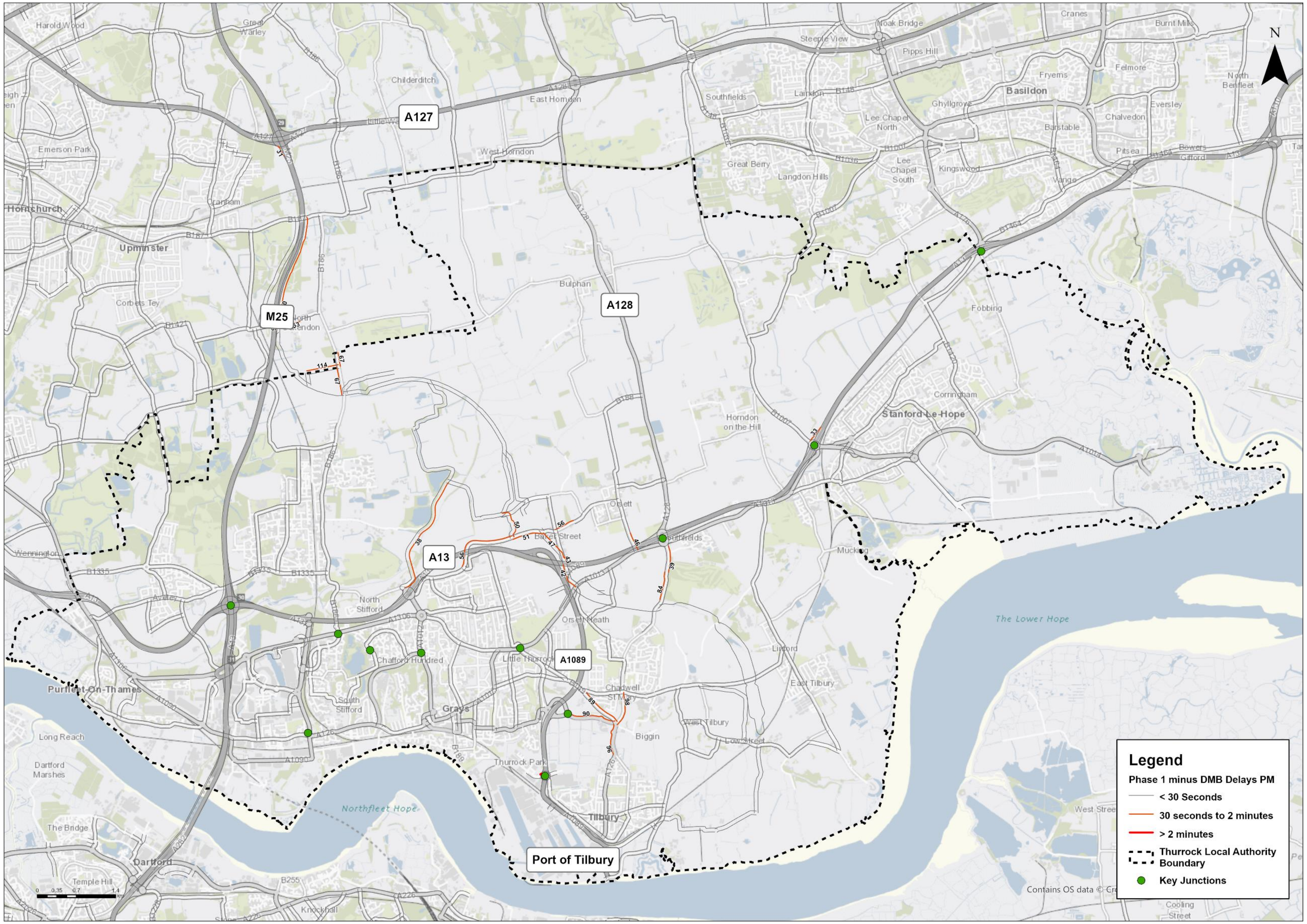

Figure 10-38: Delay Differences (Phase 1 minus DMB PM)

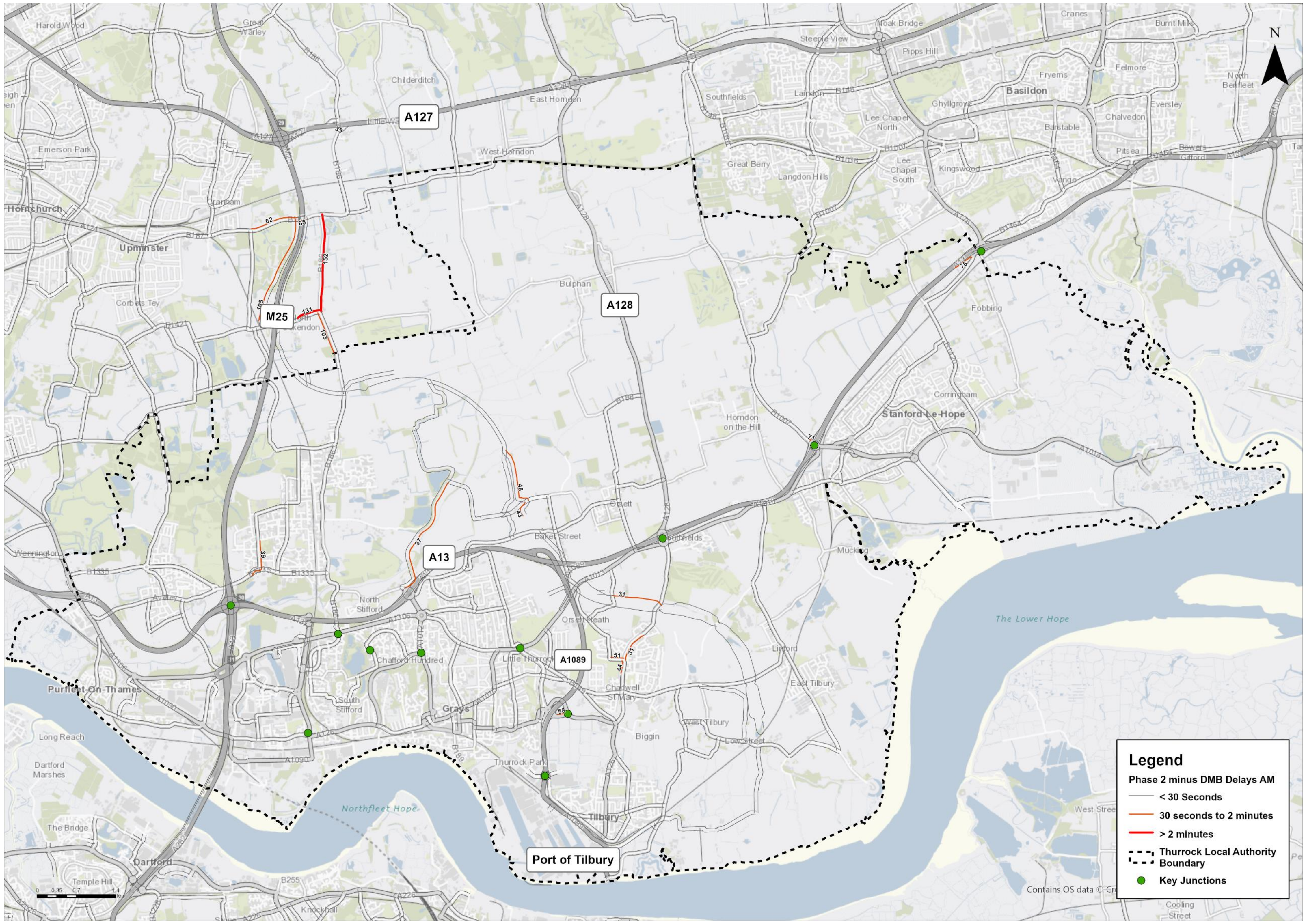

Figure 10-39: Delay Differences (Phase 2 minus DMB AM)

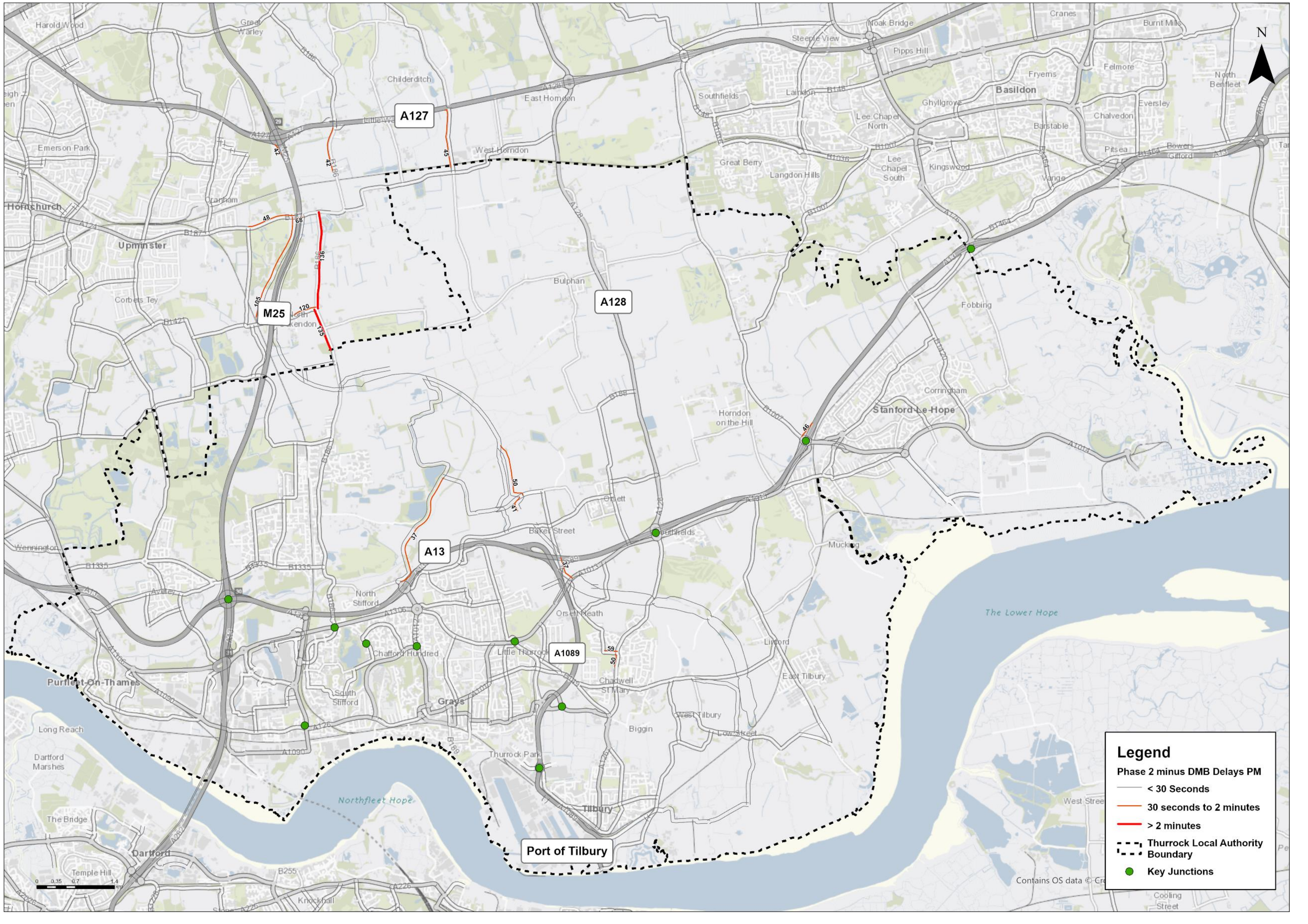

Figure 10-40: Delay Differences (Phase 2 minus DMB PM)

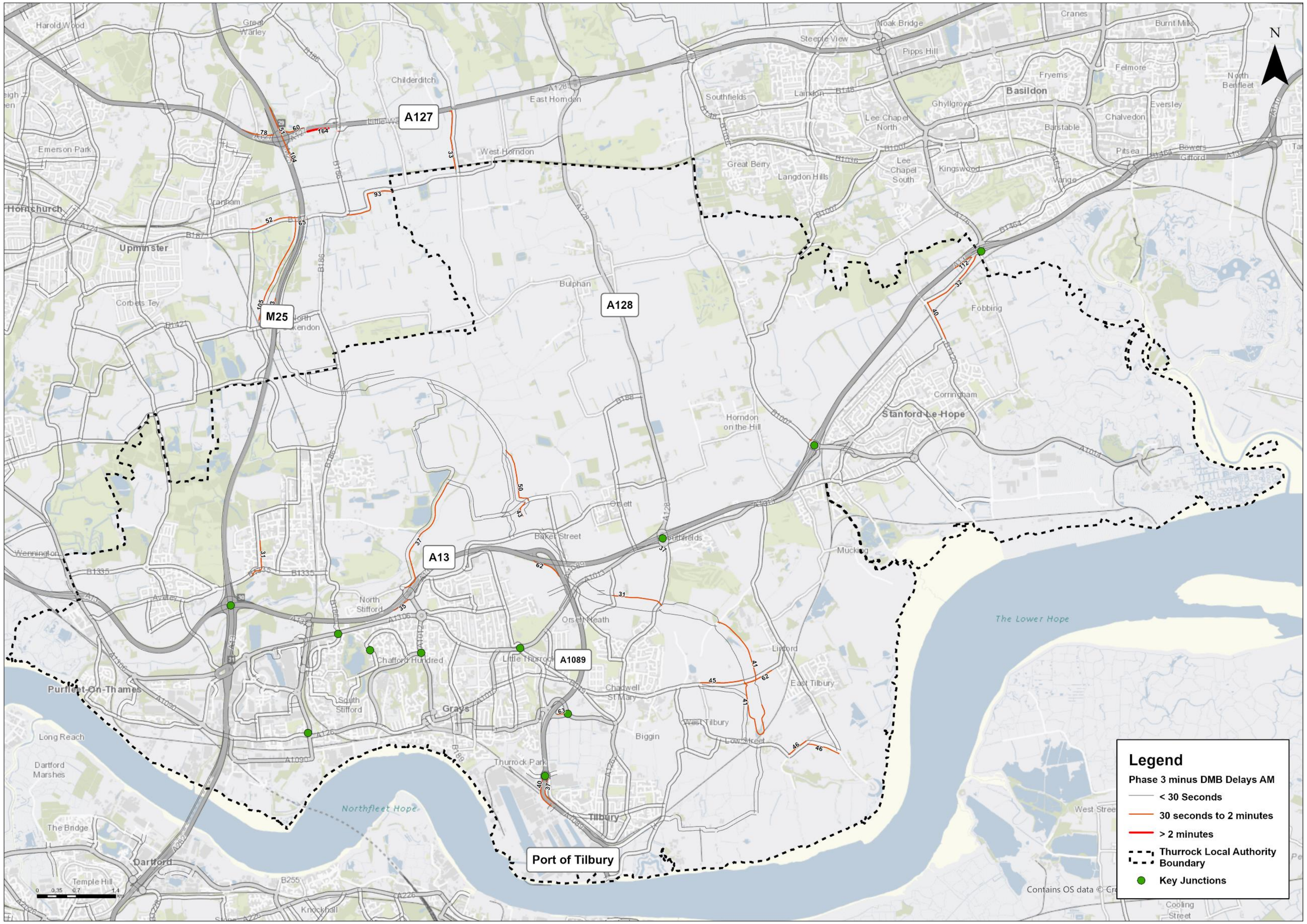

Figure 10-41: Delay Differences (Phase 3 minus DMB AM)

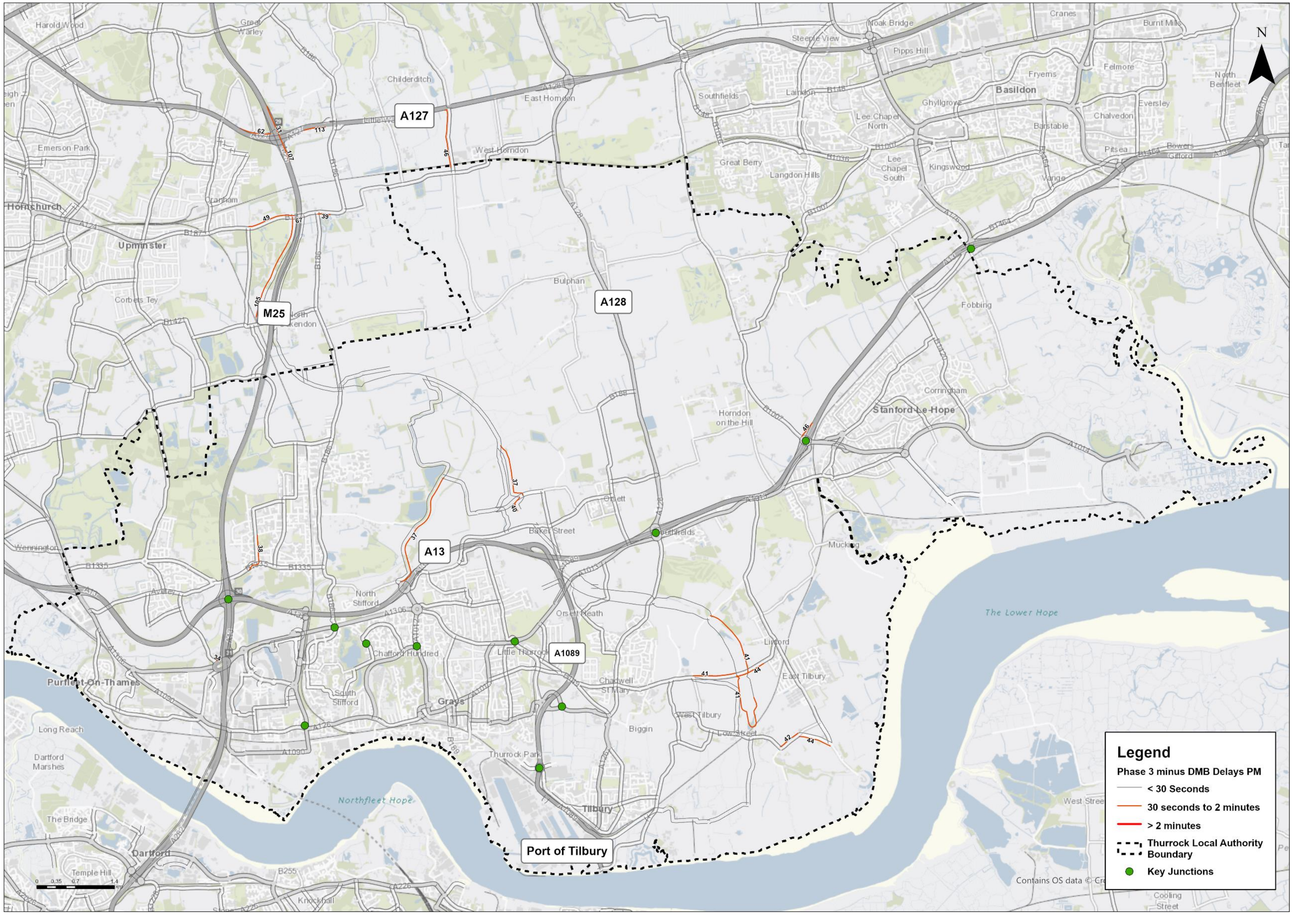

Figure 10-42: Delay Differences (Phase 3 minus DMB PM)

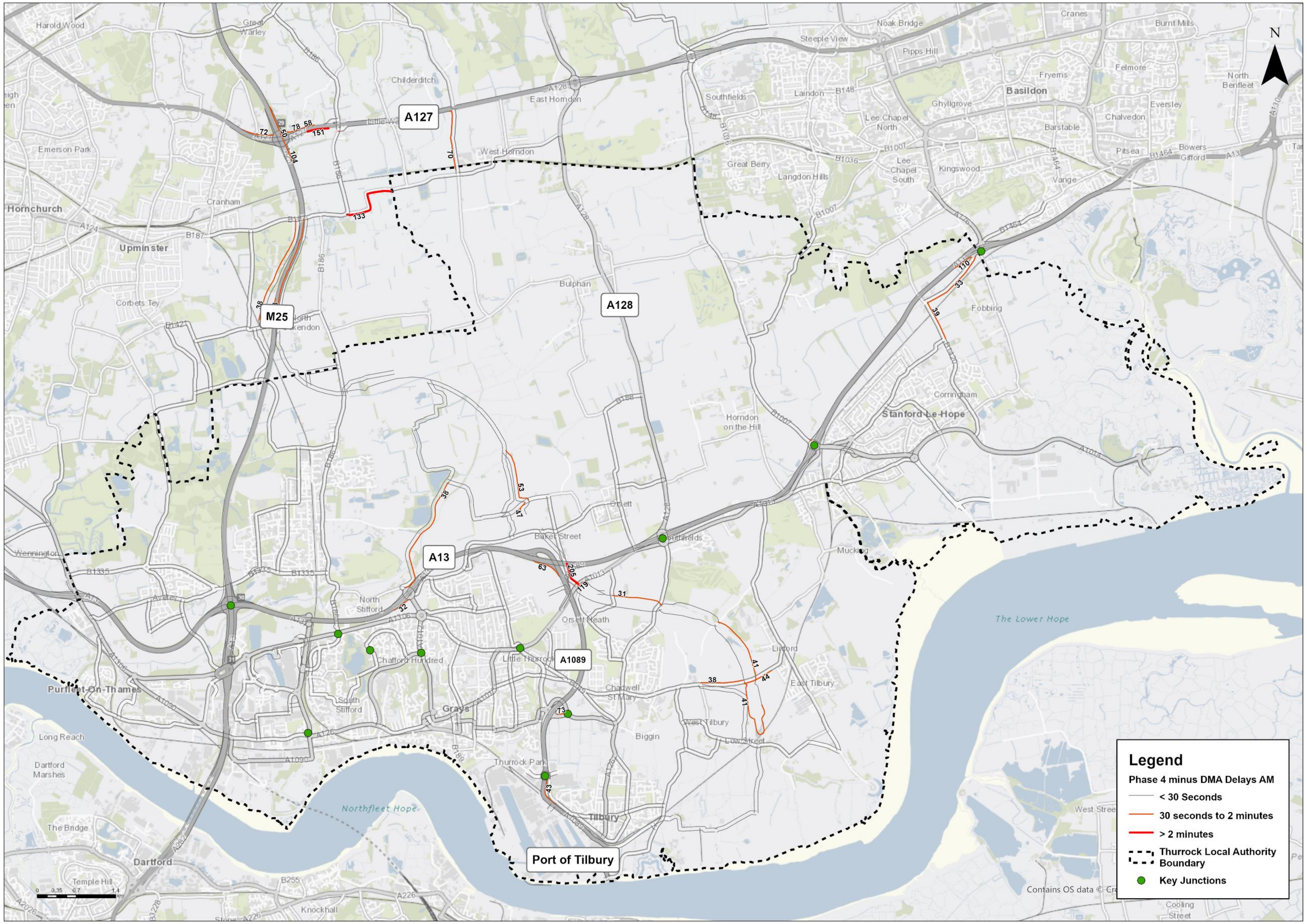

Figure 10-43: Delay Differences (Phase 4 minus DMA AM)

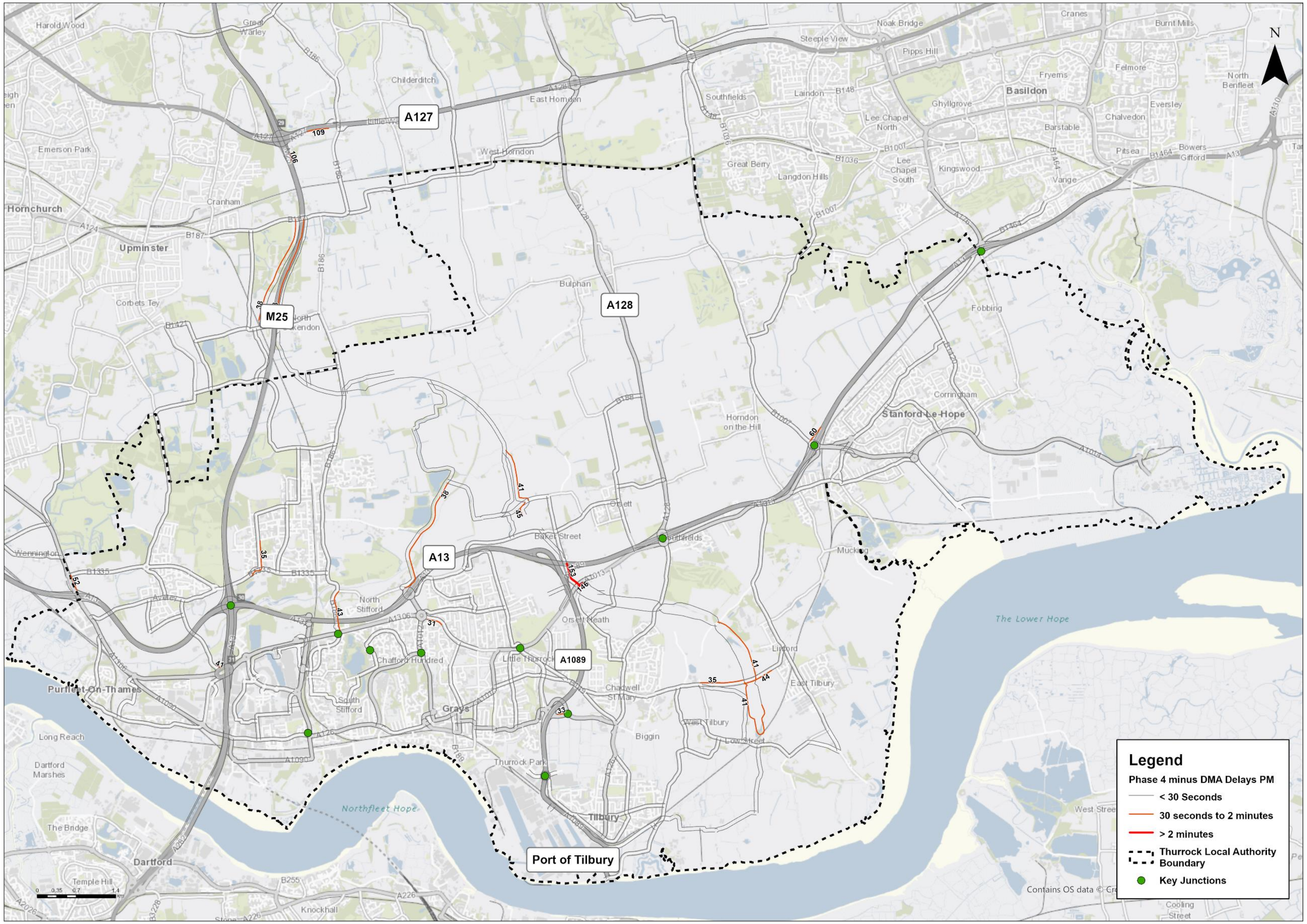

Figure 10-44: Delay Differences (Phase 4 minus DMA PM)

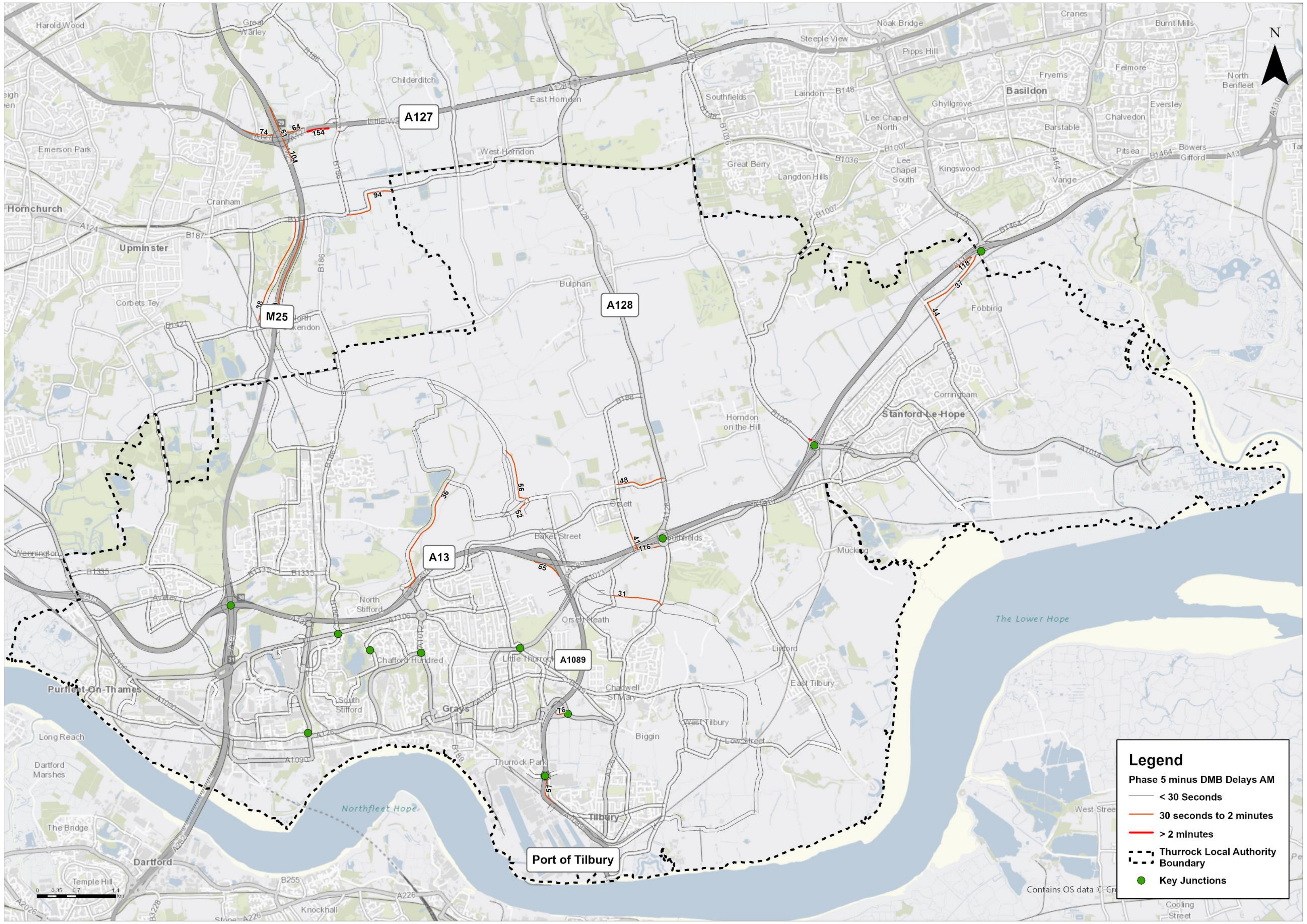

Figure 10-45: Delay Differences (Phase 5 minus DMB AM)

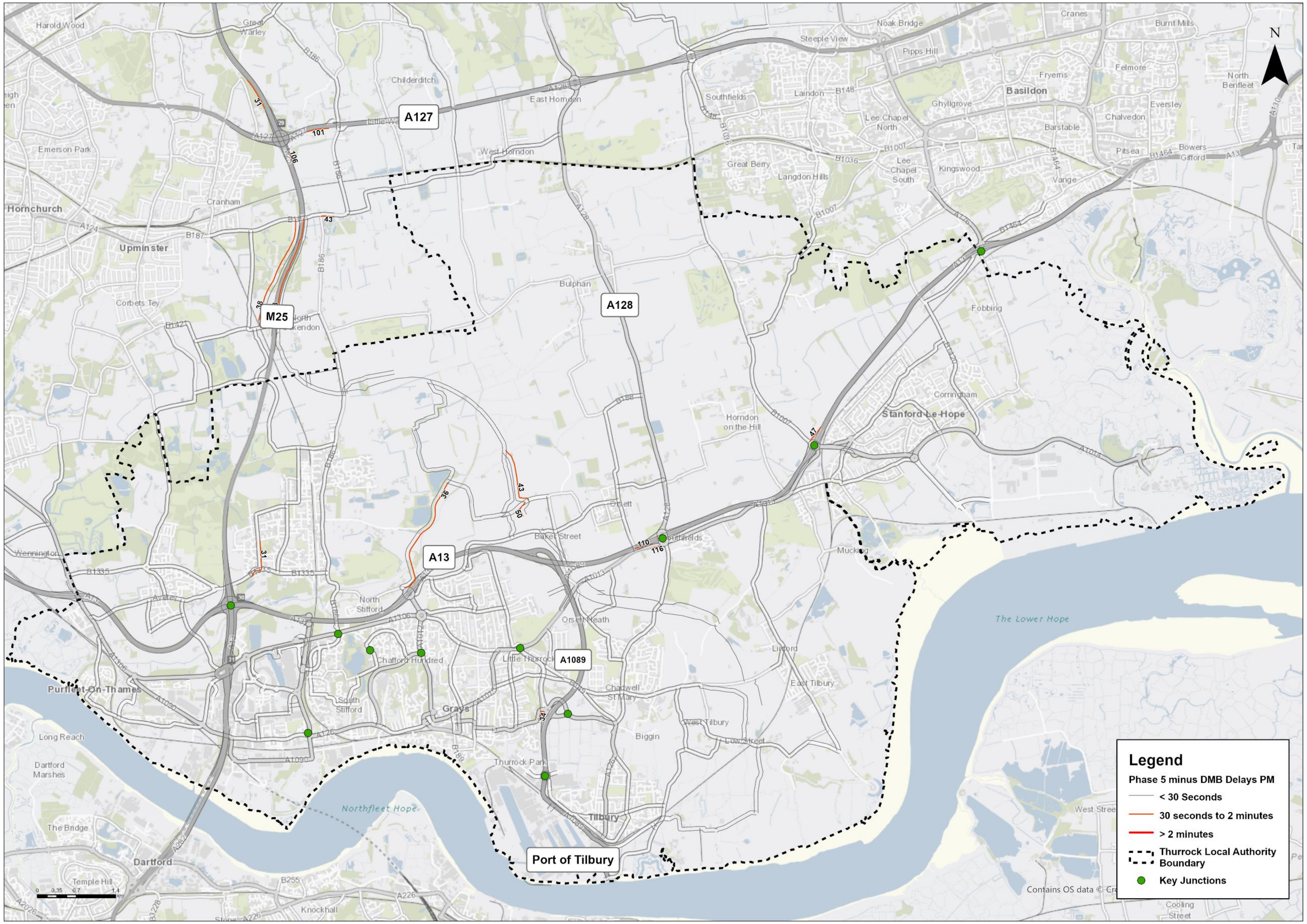

Figure 10-46: Delay Differences (Phase 5 minus DMB PM)

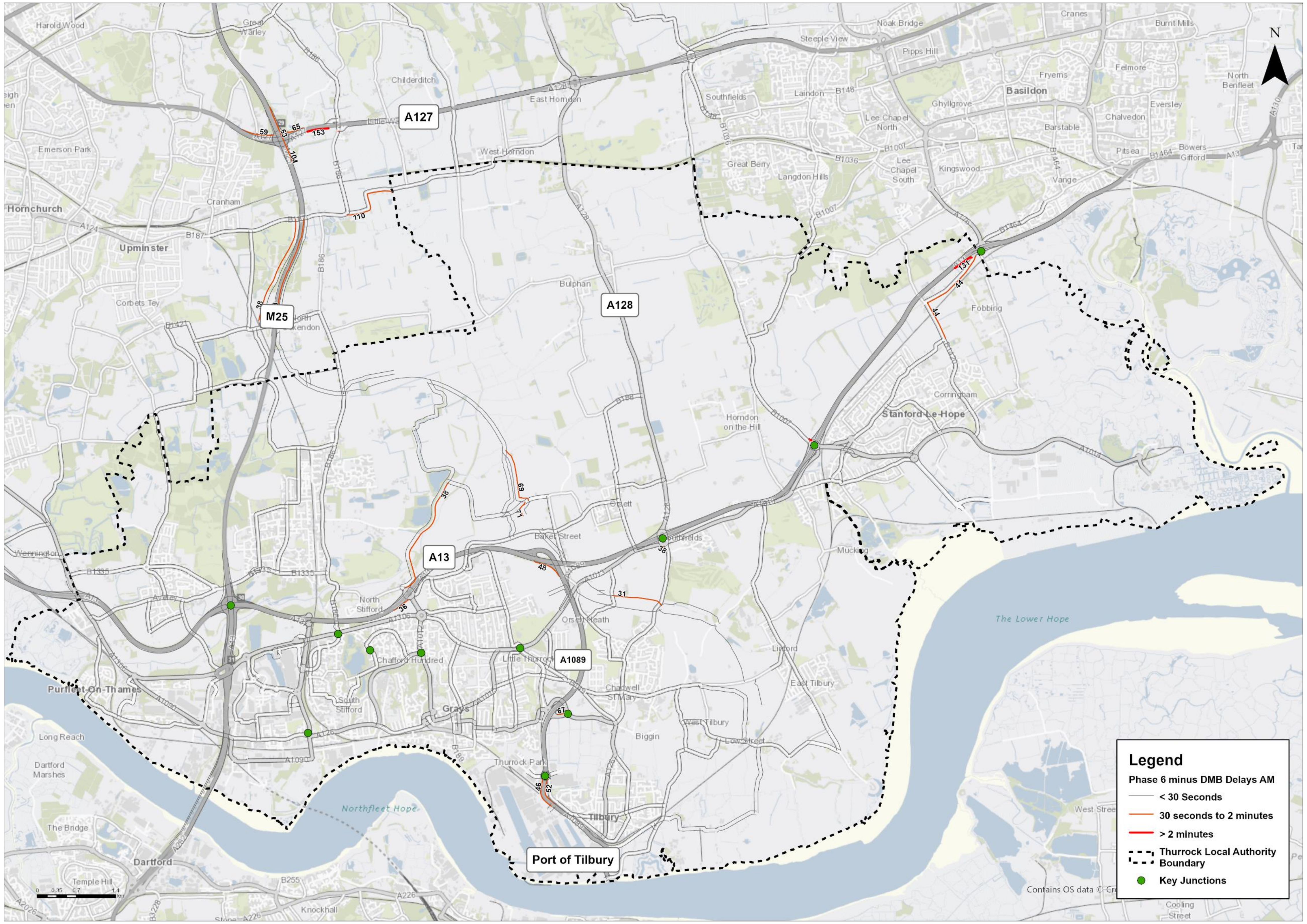

Figure 10-47: Delay Differences (Phase 6 minus DMB AM)

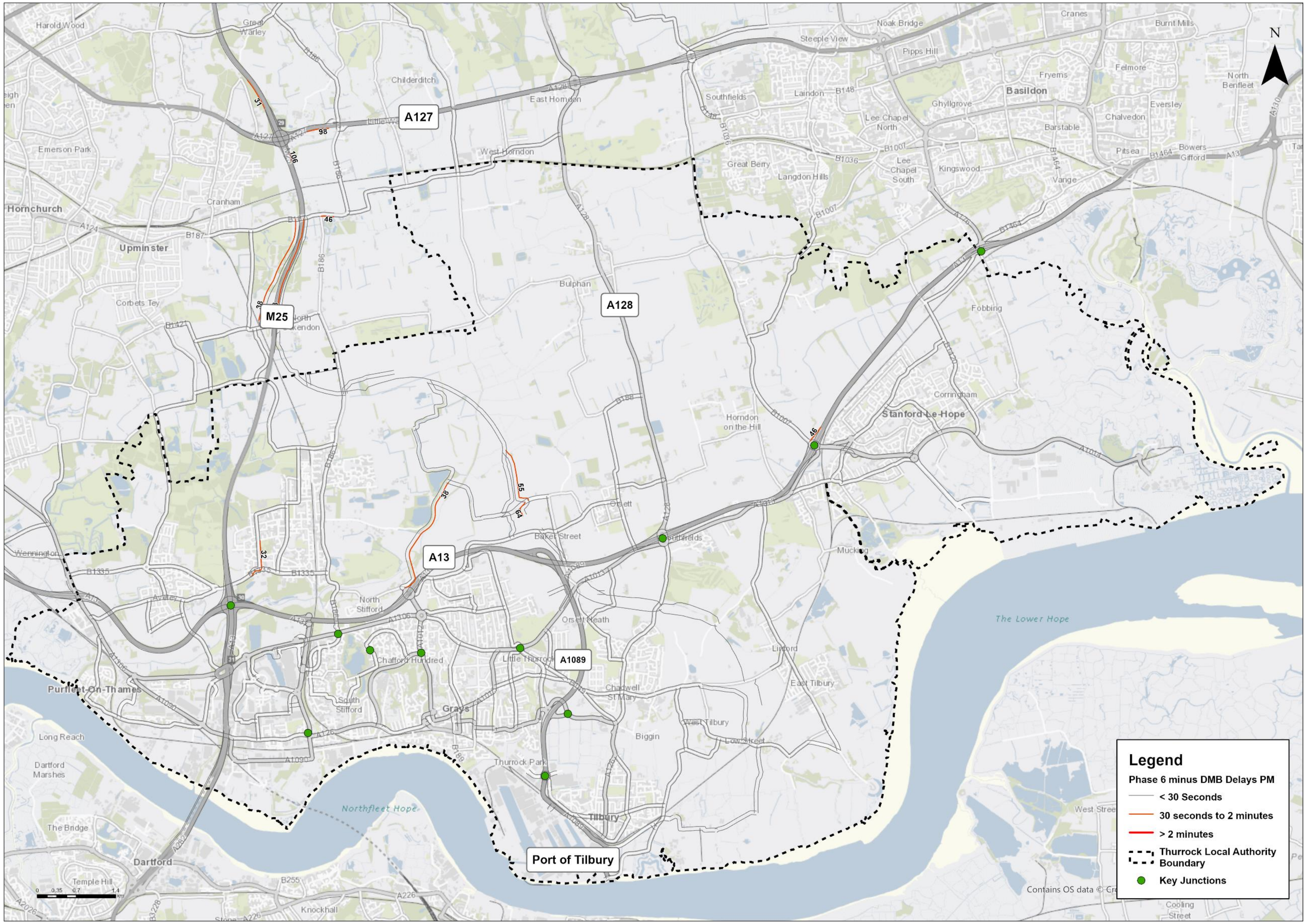

Figure 10-48: Delay Differences (Phase 6 minus DMB PM)

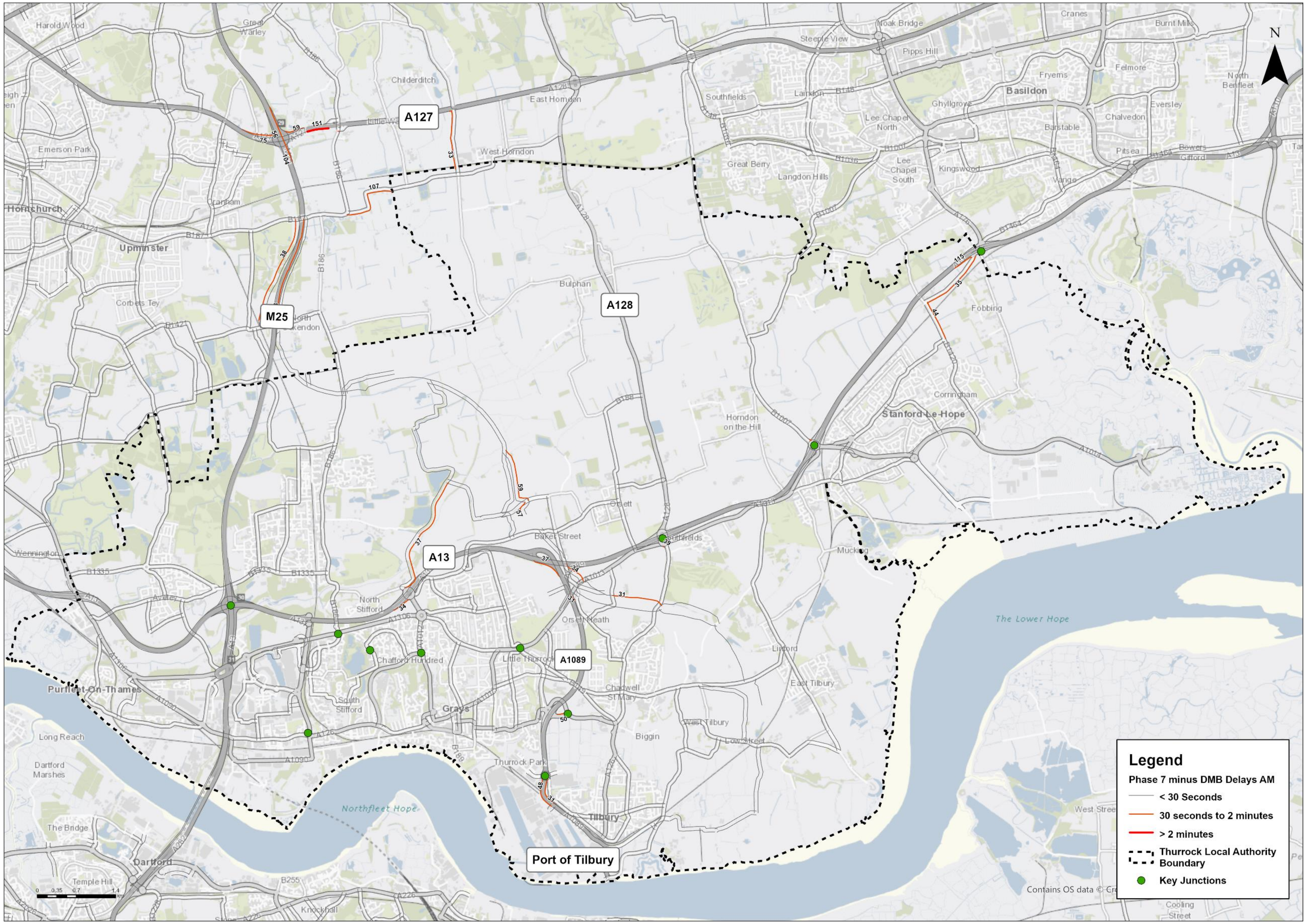

Figure 10-49: Delay Differences (Phase 7 minus DMB AM)

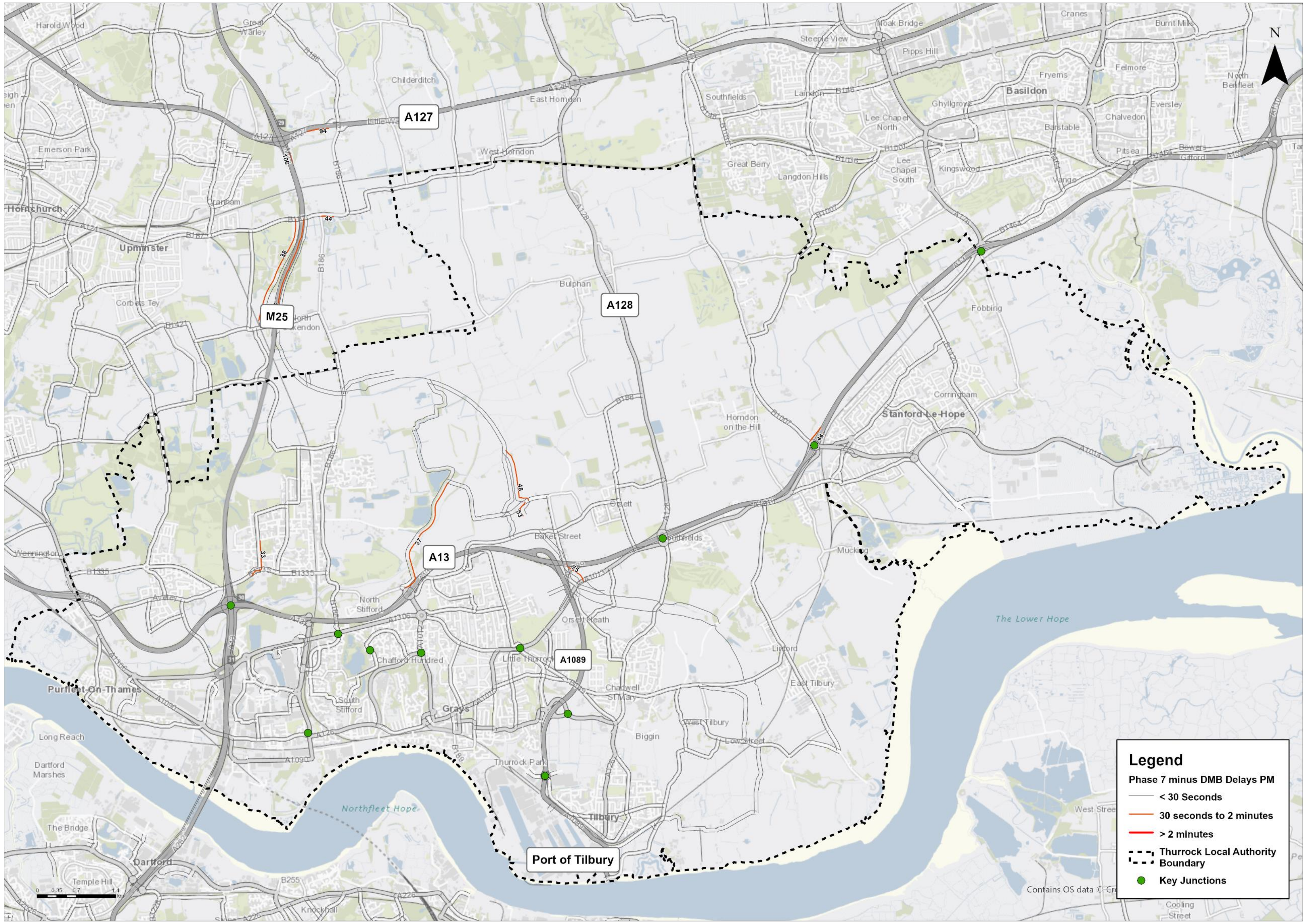

Figure 10-50: Delay Differences (Phase 7 minus DMB PM)

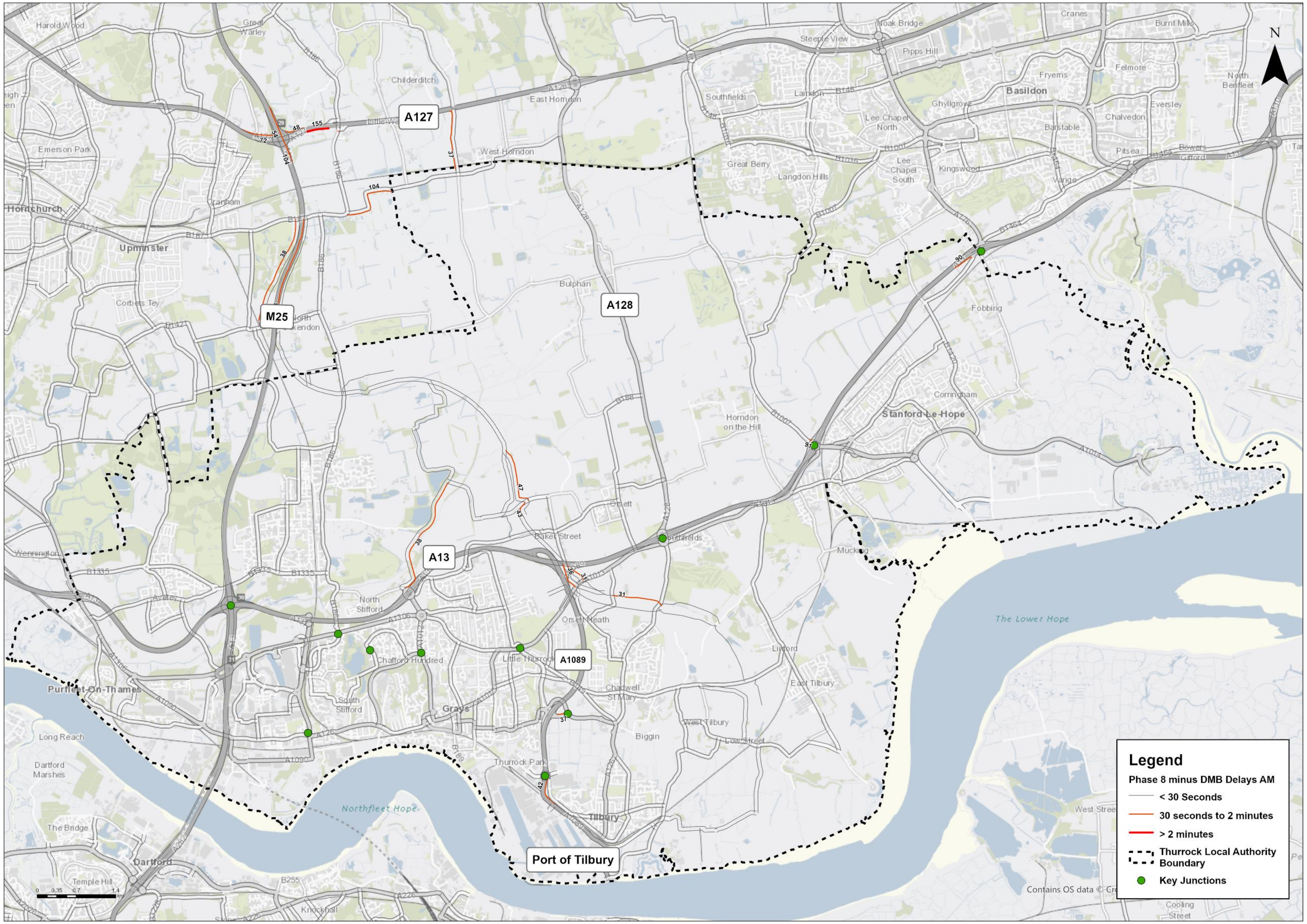

Figure 10-51: Delay Differences (Phase 8 minus DMB AM)

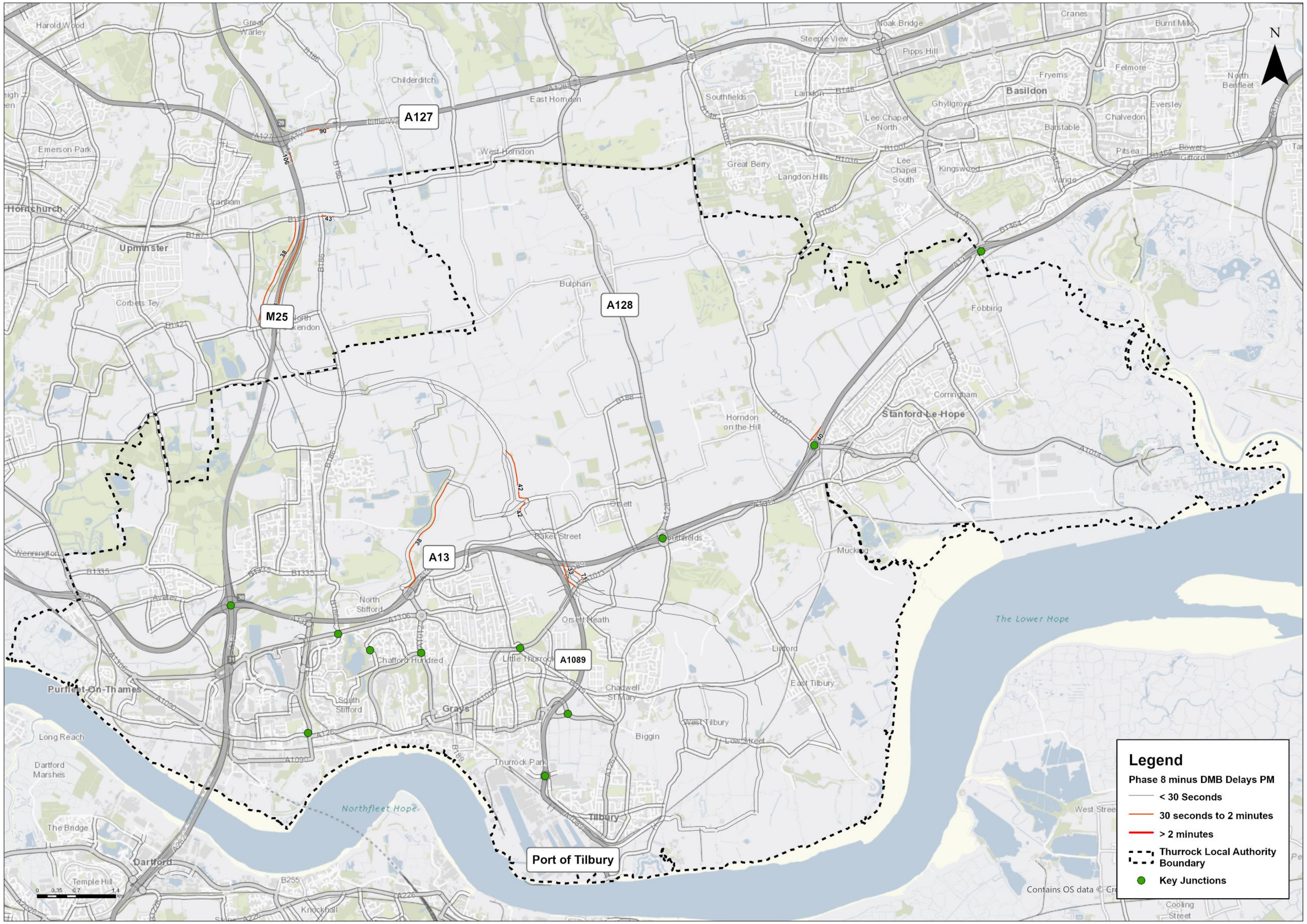

Figure 10-52: Delay Differences (Phase 8 minus DMB PM)

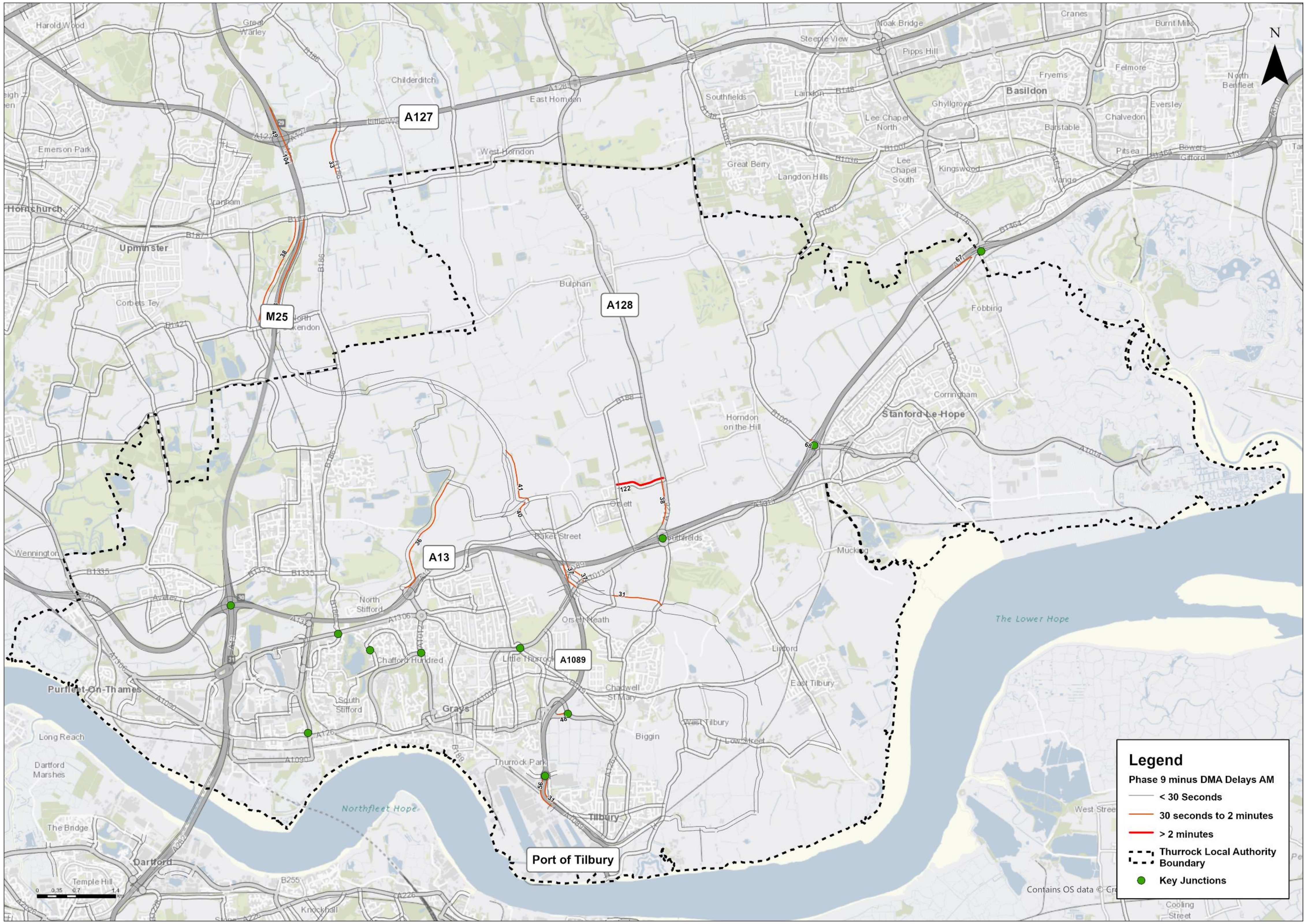

Figure 10-53: Delay Differences (Phase 9 minus DMA AM)

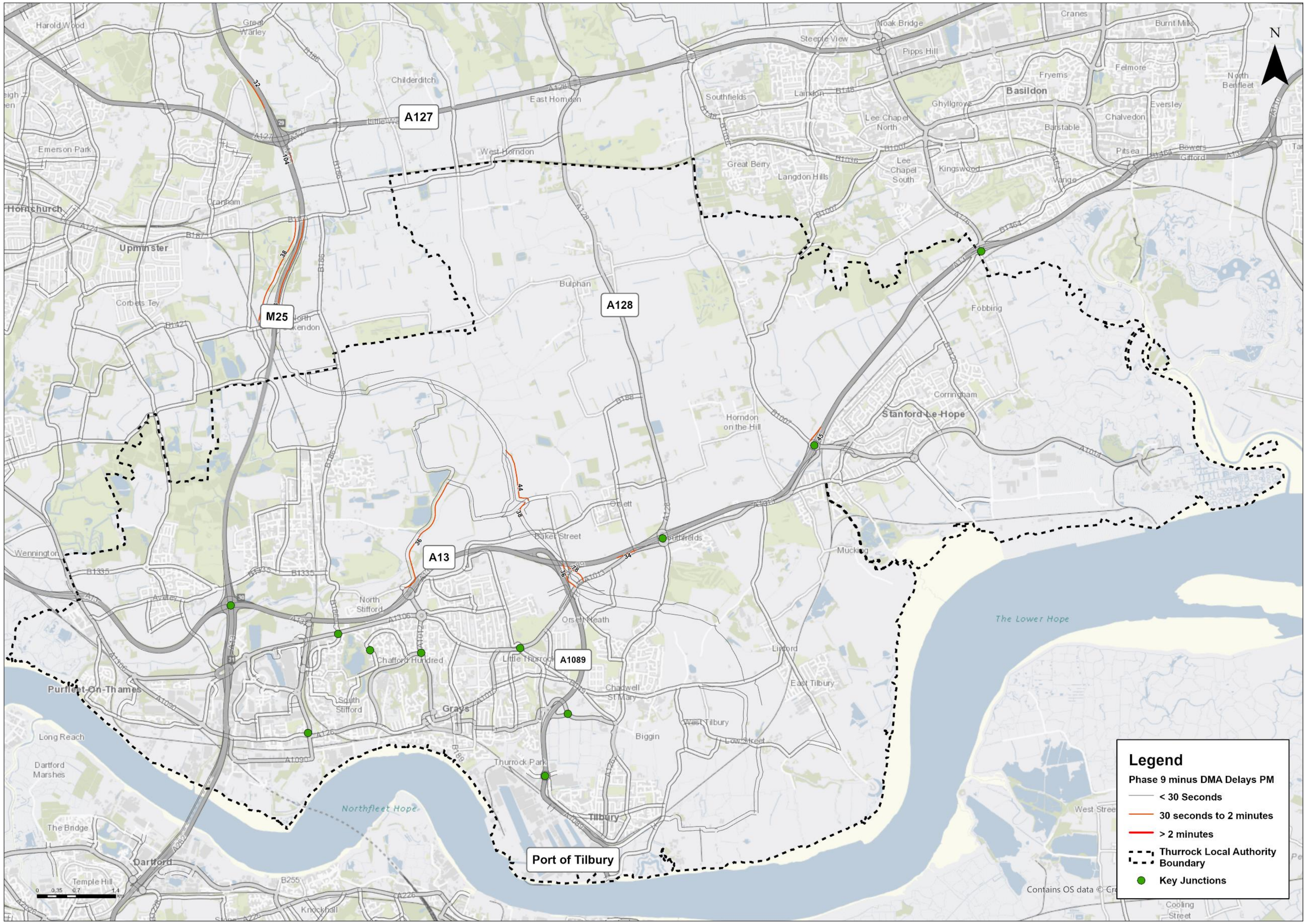

Figure 10-54: Delay Differences (Phase 9 minus DMA PM)

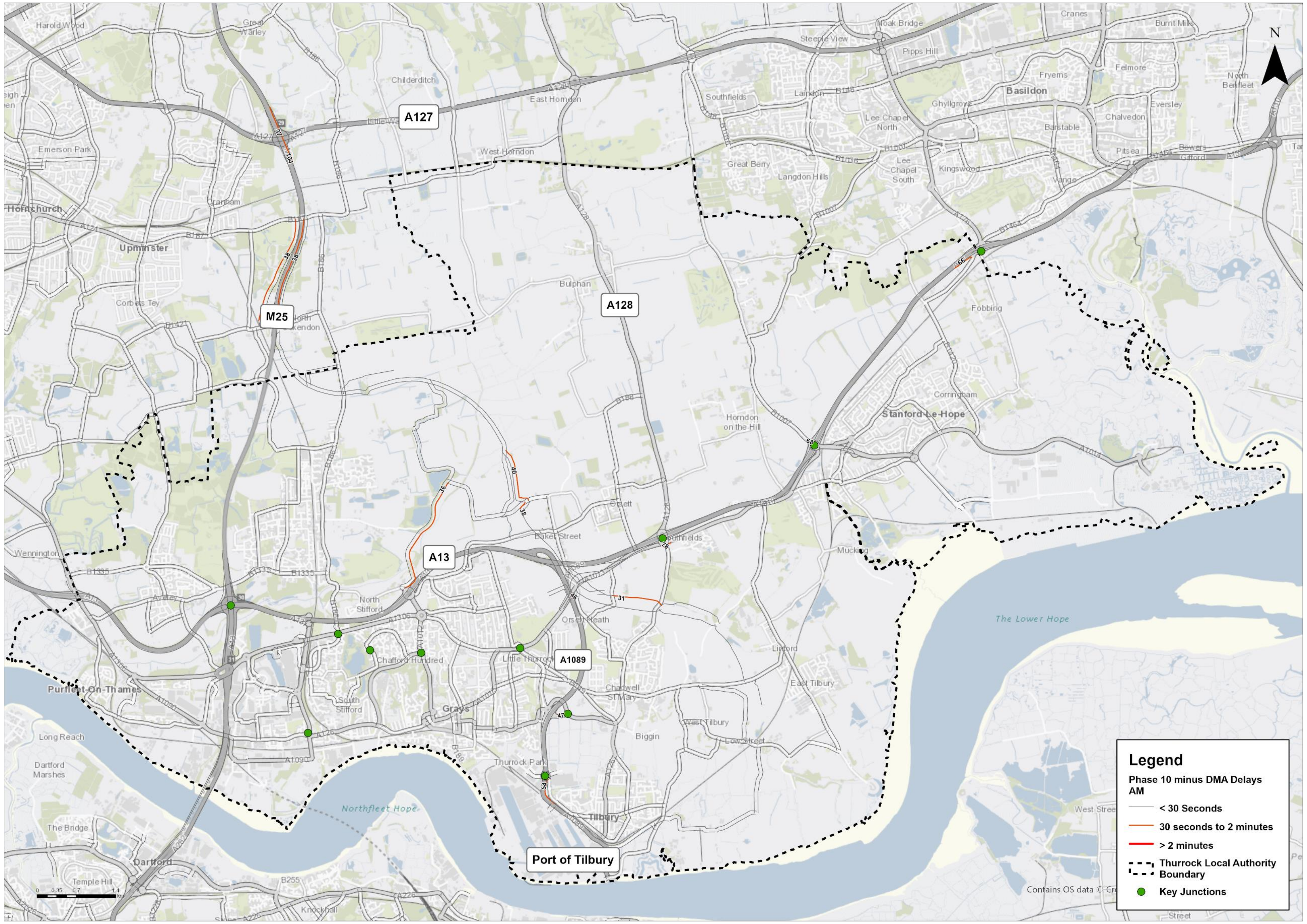

Figure 10-55: Delay Differences (Phase 10 minus DMA AM)

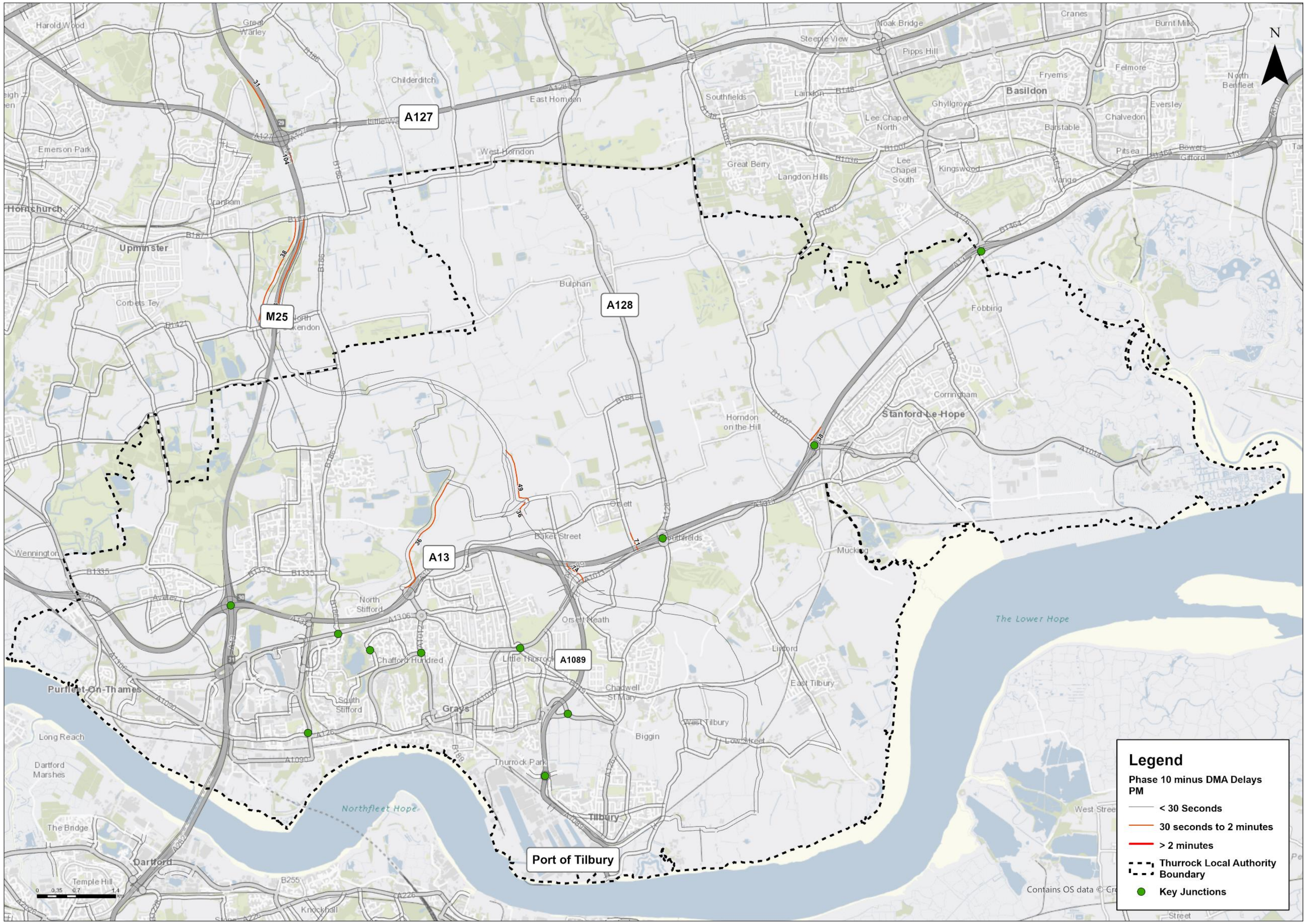

Figure 10-56: Delay Differences (Phase 10 minus DMA PM)

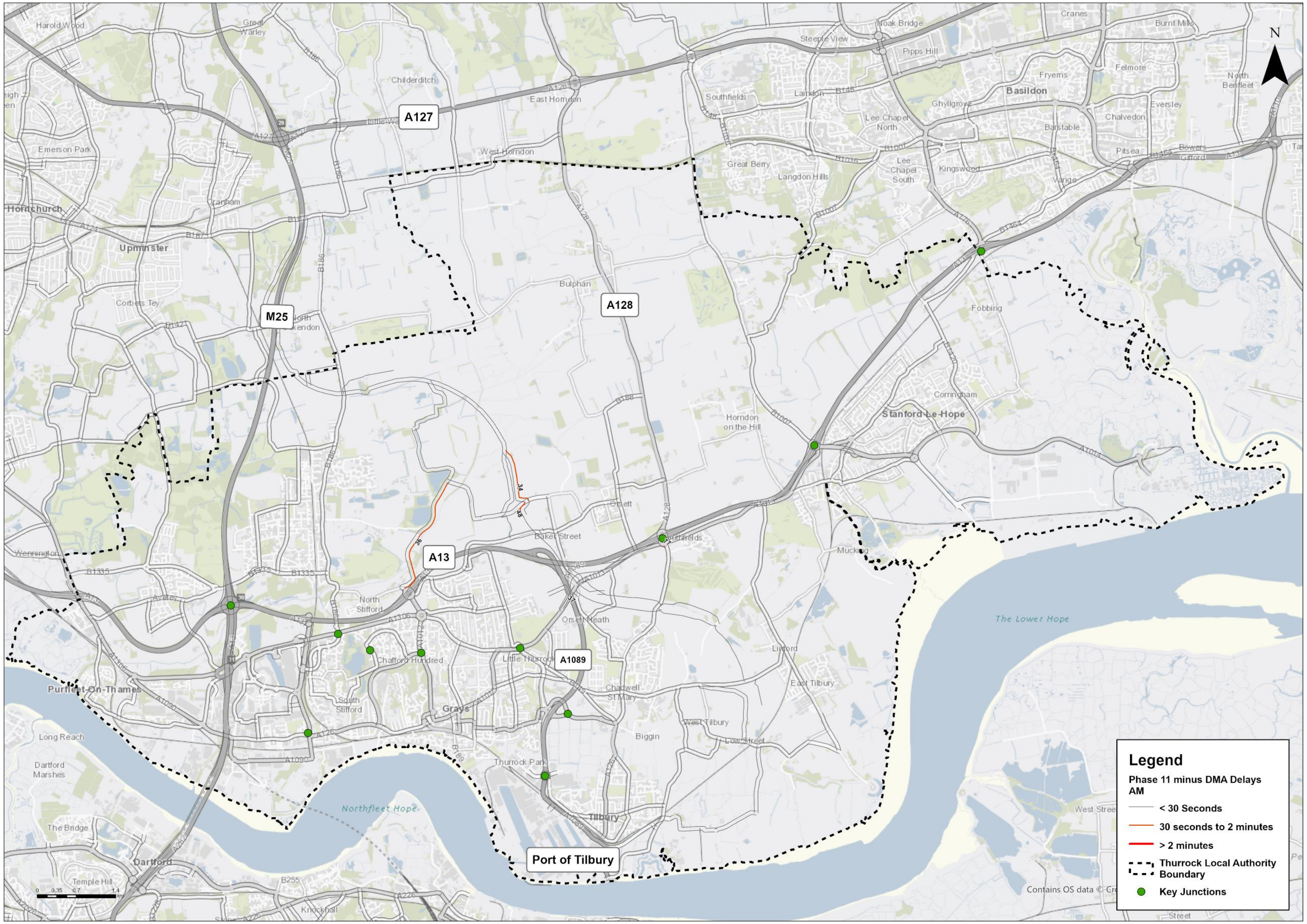

Figure 10-57: Delay Differences (Phase 11 minus DMA AM)

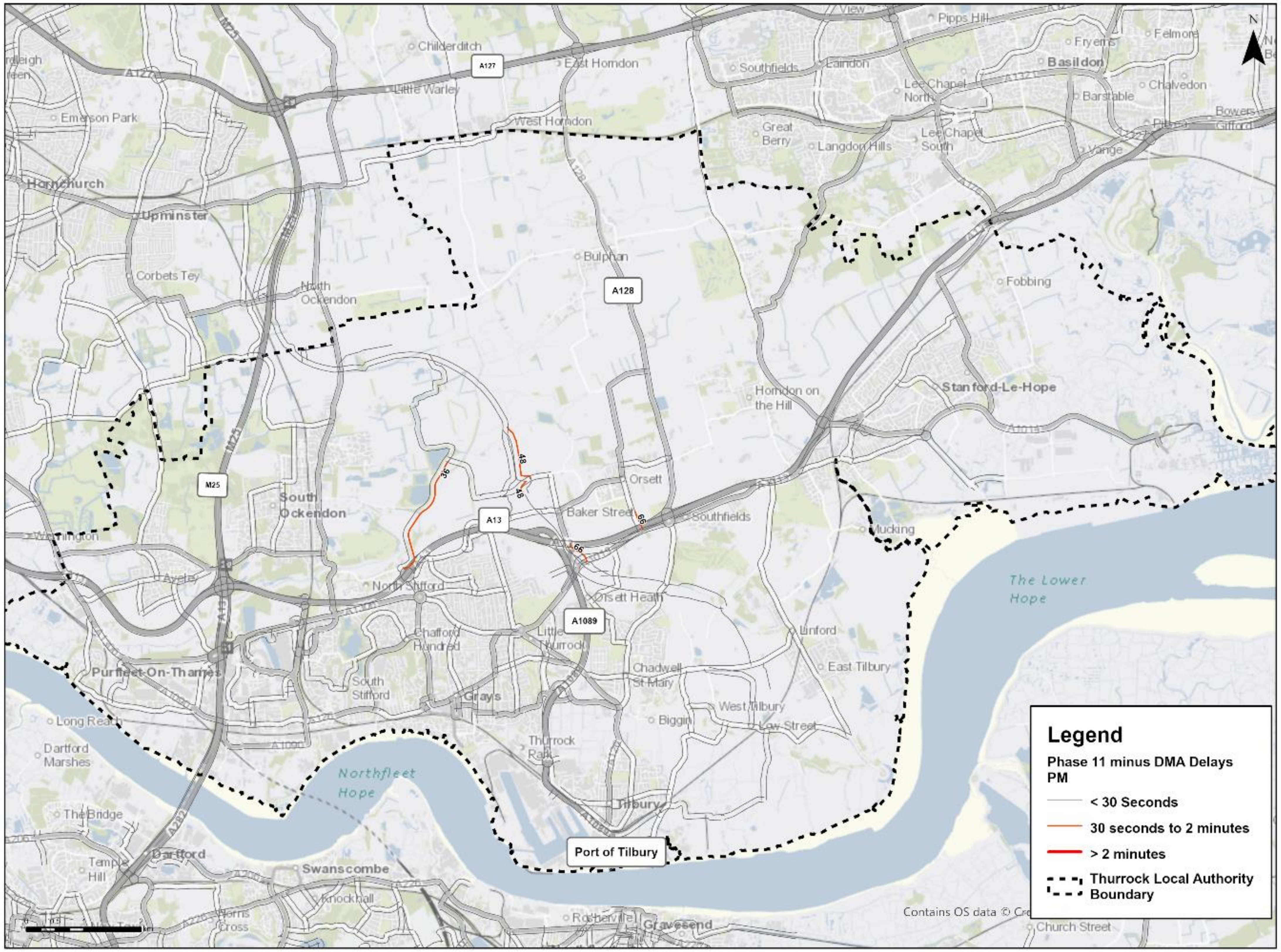

Figure 10-58: Delay Differences (Phase 11 minus DMA PM)

Lower Thames Crossing

Thurrock Council Local Impact Report

Appendix C Annex 4 – Materials Handling Plan: Joint Council PLA Technical Note

TECHNICAL NOTE

Job Name: Thurrock – Lower Thames Crossing

Job No: 332510911

Date: 21 October 2022

Prepared By: Adrian Neve & Stephen Anderson

Subject: **A Genuine Commitment to being a Pathfinder project – Marine transport for Materials, Equipment and Plant Handling**

1. Introduction and Scene Setting

1.1. Thurrock Council (the Council) has received a series of documents and information from National Highways (NH) regarding the movement of materials to and from the Lower Thames Crossing project (the project). Those documents include NH's:

- proposed Outline Materials Handling Plan (OMHP) (version 0.2 June 2021);
- draft Preliminary Navigational Risk Assessment (dPNRA) (version 1.0 dated September 2021 and received December 2021);
- proposed commitment to move some sand and aggregate by marine transport to the North Portal Construction Area (NH refers to this as 'the Baseline Commitment'), provided to the Council on 22 April 2022; and,
- response to the six summary points and Table 1 of the Council's comments on the OMHP, received by the Council on 05 August 2022.

1.2. The Council has previously set out its position through formal responses to NH on the above documents on:

- 05 October 2021 – response submitted on the OMHP;
- 10 February 2022 – response submitted on the dPNRA;
- 23 April 2022 – response submitted on the draft Baseline Commitment
- 06 July 2022 – virtual meeting on the dPNRA
- 26 July 2022 – virtual meeting on the OMHP and the Baseline Commitment.

1.3. NH's response to the Council's comments on the draft additional commitment for the OMHP is provided as part of the Group 3 Issues log and includes a response to the six summary points made by the Council and to Table 1 of the Council's 23 April 2022 submission. The Council's response to NH's comments is provided as Appendix 1 to this technical note. NH's response to the Council's comments on the Baseline Commitment is dismissive. The Council is concerned that the response demonstrates a lack of appreciation and dedication to a robust and progressive strategy for marine and rail transport for the project. NH appears not to have grasped the intentions behind the beneficial use to the project of marine and rail transport and the legacy that this would achieve. The absence of focus on such matters questions the integrity of NH's often quoted commitment to ensure LTC is a 'pathfinder' project on matters of carbon reduction and construction best practice.

1.4. The Port of London Authority (the PLA) and the Council have been in regular communication on this aspect of the project and the two bodies have established that our opinions are aligned with regards to the use of marine transport. Whilst the Council concerns itself specifically with the effects on Thurrock Borough it is cognisant of the wider benefits which could be achieved by a pan-project strategy. The PLA has a broader focus for riparian legacy and benefits using facilities north and south of the river Thames and similarly has substantive experience in helping to facilitate effective delivery of major infrastructure projects which capitalise on marine transport.

1.5. Notwithstanding the Council's opinion on the beneficial and complementary use of rail transportation as part of the strategy for moving materials, equipment and plant associated with the construction of the LTC project, this note considers only the joint position of the Council and the PLA on the use of marine transport as part of the materials, equipment and plant handling strategy. NH should not consider that the absence of reference to rail transport within this technical note is that the Council and PLA see no value to the project and any legacy of the use of rail transport.

1.6. In establishing its position, the PLA has engaged with NH and following a meeting on 23 May 2022 was provided with an extract from the OMHP (June 2022) on 06 June 2022 and provided its response to NH on 28 June 2022.

1.7. The PLA has only seen parts of the latest version (June 2022) of the proposed OMHP and is therefore not able to provide a fully informed view on the strategy. It has, however, consistently made comments to NH about the role that the River could play in a sustainable transport strategy. This included when the PLA responded to the formal consultations undertaken by NH.

1.8. The PLA has met with NH and its consultants regarding the dPNRA including on 10 March 2021 regarding the detailed scope of the NRA. As with all documents produced to support a Development Consent Order, the dPNRA and resultant NRA need to be kept under constant review as the project is refined and developed.

1.9. The Council and the PLA have expressed concerns that NH has adopted a ‘road transport first’ approach on the Project such that the use of marine transport is not proactively promoted when mitigating the effects of the delivery of the project. The Council and the PLA have sought to encourage NH to properly appraise the options to maximise the use of non-road transport for the movement of materials to and from the project. The Council and the PLA are also seeking to expand this materials’ handling initiative to include a wider variety of materials and the movement of plant and equipment. It is our opinion that, for items carried to or from the project, the default should be to use sustainable transport options either to locations within the Order Limits; or failing that, to locations close to and outside of the Order Limits and as a major part of the journey. When transporting those materials and items the agreed objectives should be to:

- reduce safety concerns on the road network associated with goods vehicle movements;
- protect the use of the river and riparian facilities for this type of operation and create a legacy; and
- reduce the environmental impact of the movement of those materials and items.

1.10. These objectives have precedent across many major infrastructure projects including local Nationally Significant Infrastructure Projects, such as Crossrail and Thames Tideway Tunnel, which has derived a significant proportion of material, plant and equipment being transported by marine operations. Appendix 2 of this note sets out information on the commitments for Thames Tideway Tunnel and Silvertown Tunnel. The PLA is currently working to ensure at the very least compliance with the commitments set out within the consented DCO for the Silvertown Tunnel. The structure and relatively open wording of the CoCP has led to on-going conversations around what material is and is not included within the commitment; what the commitments are and what is for the undertaker's discretion, leaving the challenge of interpretation post-DCO consent. The Council and PLA have raised concern with NH that opportunities for interpretation and misinterpretation should be avoided within the LTC DCO and Control Documents, helping to avoid this challenge.

1.11. This report is a joint submission by the Council and the PLA, intended to emphasise the importance of promoting and securing greater use of marine transport as part of the strategy to handle materials, plant and equipment associated with the delivery of the project and to give that objective thorough and robust appraisal to optimise opportunities and to lead the industry in creating a legacy from its operations.

1.12. There are very clear and well documented benefits to offsetting safety risks and reducing environment impacts through the use of marine transport within the construction strategy. NH has badged the Project as a pathfinder project and claims that the Lower Thames Crossing will be the "*greenest road ever built in the UK*". NH's 'Net zero highways: our 2030 / 2040 / 2050 plan' emphasises the commitment to:

> *"…Use our Lower Thames Crossing scheme as a key project to test low carbon innovation and approaches"* (page 18, 2nd bullet) and "*Encourage our supply chain partners to use the lowest (sic –[polluting]) form of feasible and available transport"* (page 19, 2nd bullet, Transporting Materials to Our Sites)

1.13. Evidently there are many more opportunities to move construction materials, exported and imported excavated material and fill, plant and equipment by means other than road than have been recognised by NH to date. There is a critical requirement for clear and transparent commitments to targets which NH and its contractors must meet, to reduce road traffic impacts, reduce environmental effects and save lives. Those commitments should be set out clearly with the DCO and secured as part of the consent.

2. Appropriate Commitments

2.1 The Environmental Impact Assessment will provide an appraisal of the reasonable worst-case scenario, which currently assumes an all-by road approach, the mitigation of what can be achieved across the project by maximising the use of non-road transport should be based around four key strands, which:

i. provides an assessment of the opportunities to maximise non-road movement of construction materials, excavated material and fill, plant and equipment and the potential cost of delivering that strategy. At present NH adopts a negative approach maintaining its insistence on a road-based strategy as the basis for the DCO;

ii. promotes the role of sustainable transport within the wider supply chain (e.g. First and last mile), for items that cannot be moved directly to or from site;

iii. sets targets for each material type in line with agreed objectives, with any additional costs justified against the benefits to economy, environment, health and safety, perhaps including baseline and stretch targets for contractors; and

iv. details clear commitments in the DCO and relevant Control Documents to maximise the use of non-road transport.

2.2 This approach will frame how the project will commit to minimise the negative effects of moving plant, materials, and equipment and how it will leave a positive legacy to the industry from the delivery of the project. Cost to the project must be set against the wider benefits and legacy to adopt a balanced view to decisions considering the wider benefits to communities and society. A conscious decision was made for the Thames Tideway Tunnel project that the use of marine transport would be maximised with the objective of saving lives, acknowledging that this may increase direct financial costs to the project but crucially recognising the wider societal benefit and legacy.

2.3 Without evidence, it is a grave concern that NH has already dismissed the use of riparian facilities to the south of the river to serve either directly the delivery of the project within Gravesham or indirectly via cross river connections to serve the delivery of the project within Thurrock. As well as the port facilities within Thurrock and neighbouring London Boroughs, there are valuable riparian facilities within Kent which could readily support the project and in doing so reduce the road mileage associated with those items. These facilities have been successfully used during the Thames Tideway Tunnel project and remain available. Their involvement in allowing the use of the River for day-to-day freight and logistics movements and supplying the project will assist in protecting them for future use, an approach which has been wholly positive through schemes such as Tideway and Crossrail.

2.4 To date, NH has proposed a commitment simply to import an unsubstantiated proportion of sand and aggregates to the North Portal Construction Area. This requires further definition, but it is noted that this considers only one material stream of inbound material. It does not consider the substantial quantities of materials, plant and equipment that will leave the project, such as sprayed concrete lining waste material; excess excavated material; rejected, hazardous or contaminated material; rejected preformed materials; etc. NH must recognise other inbound and outbound movements to all three proposed main contracts and the associated statutory undertaker works. It must provide evidence and a risks'-based assessment of what can be moved by non-road-based transport. The resistance of NH to commit to reasonable requests to adopt good practice on its 'pathfinder' is woefully inadequate and wholly unacceptable. Issues of connectivity between contracts and compounds / worksites should be resolved to facilitate connectivity to non-road-based transport facilities.

2.5 The assessment of opportunities that must be undertaken by NH should allow for the potential and appropriate changes required to facilitate the strategy to allow for future flexibility and optimising sustainable and safety benefits leading up to and during the delivery of the scheme. This could include protecting, repairing, and improving existing riparian facilities and altering and optimising off-site storage points. For instance, the project could propose the use underutilised existing storage areas for bulk storage of materials, such as steels, which might then become viable for non-road-based transport.

2.6 Furthermore, NH should review and keep under review the available markets within the locus of the project which could serve the project for inbound or outbound material, plant, and equipment by non-road-based transport. A cursory review by the Council of opportunities to use riparian and rail facilities and suppliers shows steel suppliers; aggregates shipping; multi-modal and transhipment facilities; concrete batching and concrete product manufacturers within good connections to the project. The available markets are existing and should be capitalised on.

2.7 To inform this technical note, Appendix 2 sets out an initial appraisal of some of the opportunities that NH could adopt, adapt, and extend as the basis for developing a much more positive strategy for the project. Appendix 2 uses only publicly available information and knowledge and gives an indication of the rigour and research that could have been adopted by NH. It considers:

- potentially suitable infrastructure;
- potential types and quanta of materials for marine transportation; and

- initial considerations of constraints which might need to be resolved before determining strong and clear commitments to be applied across the entire project.

2.8 This information is provided to NH with the intention to stimulate and encourage discussion and further work and not as a proposed strategy.

3. Next Steps

3.1 NH must provide evidence prior to the Examination as to the anticipated origins and estimations of the main component materials, plant and equipment of the project.

3.2 It is essential that NH recognises the potential for moving material, plant and equipment by marine transport. Where it has considered and discounted opportunities for marine transport, NH must provide clear justification and evidence to support its position.

3.3 It is acknowledged that NH is expected to deliver the Project within an agreed budget envelope, which has already had to increase fourfold, however, for the reasons previously stated this does not legitimise the acceptability for NH to defer the decisions on the use of marine transport to the appointed contractors

3.4 It is wholly inappropriate for NH to suggest instead that it will put the onus on the contractors to adopt an altruistic approach to good practice approaches. It is NH's preference to avoid commitments to marine transport in the DCO and associated Control Documents simply to allow it to select the cheapest options presented by its supply chain. Without binding legal commitments to optimise marine transport there is little incentive to do so, and instead budgetary pressures will be such that NH will most likely adopt the cheapest options that work to its processes and programme. It is precisely for this reason that other public bodies have agreed to make firm commitments to optimise marine transport in other DCOs. These DCOs now set the benchmark for improvement and lessons learned on commitment setting within DCOs and can point to good practice on materials handling. Such approaches must act as a de minimis standard for a NH that is sincere in its commitment to be a 'pathfinder' project intended to set higher future standards.

3.5 Contractors must be incentivised around a clear and challenging framework which would be set out in the DCO and Control Documents. That framework should include a governance process by which operational exemptions, safety improvements, and sustainability improvements could be proposed by the contractors to NH. That process should allow proposed exemptions to be challenged and determined through an appropriately constituted forum which also includes the Council and the PLA. The underlying strategy and the exemptions protocol should be reviewed at defined periods during the delivery of the project to keep it relevant and effective. The contractors and client should then report on commitments and targets at defined period, no less than quarterly from the start of mobilisation to the end of demobilisation.

3.6 Adopting an approach to identify and realise good practice opportunities has been highly successful and has created lasting precedent in the Thames Tideway Tunnel project. The DCO for that project established a robust mechanism for incentivising, managing, and reporting stretching commitments and targets for the use of marine transport for a wide range of material, plant, and equipment. Main Works Contactors were further tasked, through the contracting process, to put forward extensions to the defined commitments. Following commencement, due to the carefully selected locations of the project worksites and connections to the river and improved riparian facilities, contractors have additionally opted to use the river for other materials and equipment. It is shown that at February 2022 the operations of the Tideway project has transferred to river transport more than 5.5m tonnes of material and equipment that otherwise would have been moved by road if the marine strategy had not been adopted. Through the DCO commitments, the Thames Tideway Tunnel project has saved in the region of 550,000-580,000 road movements across the project, to date.

4. Summary

4.1 The Council and the PLA remain extremely concerned that NH is not applying sufficient weight or credence to a strategy to reduce the safety impacts and minimise the environmental impacts of the material, plant and equipment handling for the project. To date, NH has provided only scant and inadequate information within the OMHP. NH has provided no evidence that the matters highlighted in this report have been properly considered as a basis for the paucity of commitment that has been made.

4.2 It is fundamental that this concern is given serious attention by NH. If these crucial matters continue to remain inadequately considered and unresolved, it is our intention to raise our concerns for the attention of the Examining Authority.

4.3 In summary the Council and the PLA request that NH:

- adopts DCO commitments to materials, plant and equipment handling by non-road-based transport for the project to minimises the safety impacts of moving those items by road and reduces the environmental impacts of those movements;
- overcomes the challenges that might otherwise reduce the effectiveness of the materials, plant and equipment handling strategy;
- provides evidence of a revised and refreshed adopted strategy that demonstrates the progressive, stretching, and binding targets and commitments for the project;
- builds positively on the precedents set by other major infrastructure projects and sets out the benefits and legacy of the adopted strategy; and
- defines the procedures and governance that would accompany the adopted strategy, including the involvement of the PLA and the council; and
- sets out and secures its commitments and governance processes within the DCO and appropriate Control Documents.

Appendix 1: Council's response to NH's comments on April 2022 comments on draft OMHP (v0.2) and the draft Baseline Commitment.

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
THURROCK-OMHP-MISC-001	NH should extend its commitments to moving materials, plant and equipment associated with the delivery of the project beyond the current commitment relating solely to 35% of bulk aggregates and revisits the wording such that it is specifically expressed that movement must be by non-road transport. The current commitment is insufficient for a "pathfinder" and exemplar sustainable project and has insufficient clarity and definition. Specific reference should be made to previous exemplar DCO and major projects by other promoters.	*In determining our commitment for movement of material via port facilities consideration of existing infrastructure and building of new infrastructure has been taken into consideration - the north tunnel entrance compound is the largest compound on the Project and is the only compound to be river facing and closely connected to port facilities. The current commitment equates to transporting 80% of material (by weight) to this compound.* *Expanding of this commitment to the Roads North compounds is limited due to the need of using the A0189- Asda RB from the nearest port facilities. This reliance on the use of the A1089-Asda RB which itself is currently congested, results in adverse impacts rather than benefits. (refer to paragraph 6.2.12 bullet c and 6.2.17 bullet a in the oMHP). In addition It is anticipated that supply chain for the procurement of material associated with compounds situated in Roads North lends to the reliance of using the road network due to its proximity from the river.* *Following discussions with Thurrock on this matter on the 26th July 2022, there was a request for further clarity on what were the constraints and limitations that does not lend to expanding the river use commitment for material deliveries to works associated with Roads North (north of the Tilbury viaduct). In response to this clarification:* *The intent of the commitment is to minimise HGV movements and its associated impact to the road network, including environmental impacts. The location of the North Portal Site lends to the use of the river for the delivery of material with minimal use of the road network. On the other hand the proximity to the river for compounds situated north of the Tilbury Loop Rail line requires the use of the road network and does not lend to a non-road based approach.* *The Projects current understanding of the local supply chain identifies several material delivery hubs that deliver material via*	The Council and the Port of London (the PLA) recognise NH's intent to move material by marine or multi-modal transport to the Project, however, NH has not configured the Project to optimise benefits from rail and marine interfaces. NH has also not considered the movement of materials, plant and equipment away from the Project – such as waste material, excavated material and decommissioning procedures. This is discussed further in this joint response with the PLA. As a pathfinder project the Project must include environmentally sound initiatives much more broadly than the aspects of materials handling. This is a significant and important part of the delivery of the Project which requires thorough appraisal and commitment. The Council and the PLA acknowledge that there are challenges to achieving efficient and suitable connections to rail or marine transport for aspects of the Project. NH should adopt, however, a strategy which promotes opportunities to reduce the project's impacts on the local road network and communities, rather than the current strategy which sets out why marine, rail or multi-modal opportunities are not practical or practicable. The need to reconfigure the layout of compounds and storage or resequencing delivery of the project would be an inadequate justification for inaction. In developing the strategy, NH should further emphasise what it is including as current aspirations for multi-modal or transhipment opportunities – such as the proposal in the OMHP which suggests the possible use of marine for the movement of the TBMs. This should be made a stronger commitment, even if allowing the contractor and supplier to propose, in due course, an approach which is felt to be more environmentally sound or an option with even lower risk.

Issue Ref.	Council's first response	National Highways' response (August 2022)	Council and PLA joint second response (August 2022)
		river and or rail with onward transportation to the Projects compound via the road network. To set the scene and for context those potential supply sites are generally PoT&Tilbury2, DP World London Gateway and several sites further west towards London, including Purfleet and Dagenham. A non-exhaustive list is detailed in Appendix A of the OMHP. *When reviewing those sites feasibility to support a Roads North river use commitment that lends to a reduction of HGV on the road network, this was limited due to the level of reliance of the road network. PoT/Tilbury 2 is dependent on the use of the A1089 via the Asda roundabout, which is heavily congested. The projects construction traffic impact model is based on a broader spread of delivery routes (from all points of the compass) and is intended to demonstrate wider supply network. A higher dependency on river use results in more concentrated vehicle deliveries from the same supply site / start point i.e. PoTT, which in turn increases pressure on the A1089, already identified as at or over capacity. The Project position is that, increased use of river becomes counter to the intent to reduce impact to the road network. In addition the approach to construct an offline route is dependent on the construction of a 20+ km haul road, alongside the proposed route of the LTC and temporary structures. This is in the opinion of the project team, of more significant impact due to the draw on temporary materials, installation using plant and equipment and future disposal, all of which create a negative carbon impact which is unnecessary, when in fact the construction of the permanent LTC serves as a progressively developing haul route, from compound to developing work face -rendering "alongside" haul route a wasteful exercise due to that proposal impact of extending attendance, noise, emissions and disposal of temporary materials.* *Whilst the construction of a continuous haul road would seem to enable a higher commitment to river use, what it actually does, due to geographical reasons, is concentrate materials filtering through PoTT, to the exclusion of any other river facility, it also discounts that the supply chain is more widely distributed, including from North, East and West of the project as demonstrated in Appendix A of the OMHP (A non-exhaustive list*	In its response, NH references sections within an OMHP which do not align with the Version 0.2, dated June 2021, that has been provided to the Council. The Council and PLA are therefore not in a position to comment on the points of reference that are made in NH's response (e.g. 6.2.12 and 6.2.17). The Council and PLA can only make responses based on the draft material that was provided in June 2021 and the subsequent draft Baseline Commitment for bulk aggregates. In that Baseline Commitment, NH has indicated a provisional commitment to move approximately 35% of bulk aggregates to the Project by a marine operation. NH now states that any further use of marine or rail would be restricted by its "*heavily congested*" road network at A1089 / Asda roundabout. It is assumed that this is then viewed by NH as an insurmountable constraint to access to the Project north of the Tilbury Loop line and no mitigation approach is proposed. NH should consider appropriate measures to create a genuine commitment to ensure the Project is a "pathfinder" project. In considering the possible options for moving materials to the Project, NH would need to set out the restrictions on the use for each compound and the modelled assumptions for each compound relating to its use within the wider project. That would then enable a refined, fixed and informed assessment of the benefits and negative impacts of a proactive strategy. Without evidence, the Council and the PLA cannot provide an adequately informed view as to whether NH's assertions regarding the materials handling strategy are accurate or whether a better-balanced scenario could be proposed, when taking account of moving other materials and equipment by rail or marine to and / or from the Project. Alternative scenarios have not been tested by NH. The Council and the PLA do not seek to limit marine or rail operations only to the existing facilities at the Port of Tilbury, nor that those operations should necessarily result in added traffic on the A1089 corridor. Options and scenarios, therefore, need to be assessed and evidenced by NH. Within the DCO and Control Documents NH could then translate the resultant agreed proactive strategy to its contractors through a

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
		is detailed) *The wording of the commitment clearly defines the use of "port facilities as: facilities within, or next to, the Port of Tilbury or facilities along the River Thames which do not require the use of the road network next to the Thames Freeport. The Project believes this definition is of the same intent of the term non-road-transport suggested (but not defined) in TCC response.* *The local authority is of the opinion that the current commitment is insufficient for an exemplar sustainable project and has insufficient clarity and definition. The Project designation as a Pathfinder, which is defined as a project that explores carbon neutral construction, which means it will work with a broad range of partners from major engineering companies to small businesses and universities, to identify, test and scale-up innovative ways of building and maintaining low carbon infrastructure. In defining the project as a pathfinder and exemplar sustainable project, a wide focus approach has been taken (not just river usage) looking at reducing carbon emissions through removing diesel from its sites by only using hydrogen and electric plant, and looking at alternatives to carbon-intensive materials such as concrete and steel, after which the project will also consider carbon offsetting to address any residual emissions.*	series of commitments which may be further challenged and improved through the contracting processes and the Project delivery. Without any guidance from NH, its contractors will not be incentivised to minimise the use of road for transport. That clear and proactive strategy would give comfort to the Council and the PLA that NH has taken action to improve safety around the delivery of the Project and to minimise environmental impacts associated with materials', plant and equipment movement. The intention of the list provided to NH within the Council's previous response (Table 1) was to provoke thought and appraisal across a range of materials plant and equipment. It is purposefully explicit to inform decisions and clarity and remove the ambiguity of a more generic commitment. The Baseline Commitment leaves too much ambiguity which would be capitalised on by contractors. As an example, the wording proposed by NH does not specify that the tunnel segments must be constructed on site and if they are not constructed on site that they should be transported to site by a marine operation. NH has since sought to confirm, in its response to the Council's Table 1 (included within its 23 April 2022 document), that bulk aggregate associated with the construction of segments is to be moved by marine operation irrespective of the location of the segment factory. It does not then confirm that the cast segments would then need to be brought to site by a marine operation – albeit road or rail are expected not to be appropriate options for that material movement. That NH had to confirm this point, and other points of clarification, demonstrates that the Baseline Commitment as proposed is ambiguous. Even the term used in the additional commitment text for the "*North Portal Construction Area*" and the description of that compound can be interpreted to exclude the tunnelling works themselves. A contractor could interpret the commitment only to apply to material imported into that compound without having to reflect the works that are to occur from that compound. The ambiguity in NH's wording must be closed out, therefore, a fuller definition is proposed by the Council – setting out targets for a range of major components of the Project.

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
			NH must give evidence as to how it has allowed for non-road transport for the Project south of the river or for cross river movements. The non-road commitment should not be restricted to the use of facilities within the Port of Tilbury, and this can then include first and last mile commitments from other facilities where that demonstrates a safety improvement and environmental benefit. The Council is, of course directly concerned with the operations within its Borough but is aligned with the PLA that marine operations and rail transport should be collectively optimised across the entire Project.
THURROCK-OMHP-MISC-002	NH should set out opportunities to move other materials, plant and equipment both into and away from the project by marine and rail and agree a list of committed materials, equipment and plant for which non-road transport is the first call. Table 1 provides an indication of the types of material, plant and equipment that NH should consider for non-road-based transportation and to provide justification if and why road-based transportation is considered to be the most appropriate mechanism.	*The intent of the commitment is to minimise HGV movements and its associated impact to the road network, including environmental impacts. The location of the North Portal Site lends to the use of the river for the delivery of material with inconsiderable use of the road network. On the other hand the proximity to the river for compounds situated north of the Tilbury Loop Rail line requires the use of the road network and does not lend to a non-road based approach. With this in mind and the intent of the commitment is the North Portal Entrance Compound with a focus on materials that lend to marine logistics and are significant in quantities.* *In response to Table 1 the bulk of the suggestions made are already included within the commitment, whereby the Project defines bulk aggregates as:* *I. Sand and aggregates for the manufacturing of concrete, aggregates for the construction of permanent and temporary infrastructure such as haul routes and working platforms.* *ii. Excludes cement for the construction of permanent and temporary infrastructure including for the manufacturing of concrete, the use of aggregates for bituminous bound materials and site won excavated material.* *Referring to Table 1 the suggestion to include sands and aggregates associated with concrete for the construction of temporary and permanent infrastructure already forms part of the commitment and definition of "bulk aggregates". In addition several suggestions are based on different forms of manufacturing concrete, which forms part of the river use*	NH's intent is welcomed; however, the Council and the PLA require NH to extend the current Baseline Commitment. This extension should include other materials, plant and equipment associated with the North Portal Compound Area. Table 1 of the Council's response proposed a working list of items that should be considered by NH in defining a strategy that fully assess the opportunities to use marine and rail transport to support the project delivery and ensure its "pathfinder" status. The Council' response to NH's comments on the Table 1 items is also provided in this Appendix. The Council and the PLA's opinion on the ambiguity over the definitions that NH uses for the material and works to be associated with the Baseline Commitment is set out earlier in this Appendix. The Council and the PLA jointly do not agree with NH and proposes that the ambiguity within the description of materials and associated works must be removed; and the Baseline Commitment should be extended to the wider Project and other inbound and outbound materials, plant and equipment.

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
		commitment and definition of "bulk aggregates". *A response to each suggestion made to "Table 1" is provided, refer to attachment.* *During the meeting with Thurrock Council on the 26th July there was a request to amend the definition of bulk aggregates to a prescriptive list . In response to this request the Project appreciates the help in defining bulk aggregates and the suggested prescriptive list. The definition as provided by LTC will be retained as this achieves the same outcome committed to and desired by both the Project and Thurrock, without the prescriptive nature of itemising uses and applications of on or off site concrete manufacturing, which reduces the contractors opportunities to innovate through DfMA and modern methods of construction in pursuit of our better than baseline aspirations.*	
THURROCK-OMHP-MISC-003	NH should set out the justification for exclusion of any material, plant or equipment that is dismissed by NH within the oMHP. If road-based movement is the anticipated method of movement to be adopted by NH and, as a consequence, its contractors, the justification should indicate why that approach is preferred from an environmental, social and safety perspective.	*The issue of minimising road-based movements from an environmental, social and safety perspective is one that is integral to the oMHP and forms one of the key purposes of the commitment. However, the Project seeks to employ a strategy for material movement which minimises these impacts from the source of the material and not only the final leg of the movement. As such, section 6.2 in the oMHP details how the primary source of aggregates is anticipated either via Mendip Hills in Somerset, Leicestershire or the Peak District. The Projects current understanding of the local supply chain identifies several material delivery hubs that deliver material via river and or rail with onward transportation to the Projects compound via the road network. This multimodal transport approach for transportation of material from its source to the recipient compounds promotes a sustainable deliverable position* *The final movement of this material, defined as the final mile strategy and detailed in section 8.4 of the oMHP, defines the principles that the Contractor must adopt when making the final movement of materials to the recipient project compound. This section concludes it is not feasible to construct a new rail head for this final mile movement due to the limited space adjacent to the compounds. Similarly, it is not possible to execute the final mile movement via river for compounds situated within the Roads*	The Council and the PLA jointly concur with NH that the OMHP should be founded on the principles to minimise environmental, social and safety effects. The Council and the PLA further concur that the materials handling strategy should include multi-modal transport and first and last mile considerations where those considerations add to the optimisation of the use of rail and marine transport to reduce safety impacts and minimise environmental impacts. The Council and the PLA are of the opinion that NH must fully assess opportunities to optimise non-road movements to and from the Project by rail and marine transport. That assessment and resultant strategy should inform and incentivise contractors in the lead into the project and during its delivery. NH must be committed to providing a positive legacy during the delivery of this major infrastructure project. It follows that where it is currently considered that the Order Limits are restrictive NH should review its Order Limits to include other existing facilities or the potential to create new necessary facilities. Stating that there is limited space to construct a rail head does not conclude that sufficient space could not be included within the Order Limits to utilise or create a suitable interface. The same is true for a new or upgraded marine interface for materials export, where to date

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		North due to their proximity to the river. *It may seem beneficial in theory to commit to use of the river, as an example, for sites further north (north of Tilbury Loop rail line) and onward distribution from PoT, however, in practice, this is not such a good idea from an environmental, social and safety impacts perspective as the opportunities for multi-modal (onward distribution from PoT or points along the river) determines that road transport for onward distribution of bulk materials from the river is the only option which in turn increases pressure on the SRN & LRN out of Tilbury and effectively guarantees increased numbers of HGV on the LRN & SRN within concentrated areas. Therefore, furthering the current commitment to Roads North results in deliveries of bulk materials from one location which is bottlenecked by the A1089 (current TA assesses it as severely congested, without presence of LTC). As a result a likely scenario is created where all/majority of deliveries are constrained to this one route which results in high intensity and frequency of deliveries (due to the reliance of one port facility) that would result in a greater impact. The significance of construction traffic impact at the A1089/Asda roundabout is acknowledged in the commitment and forms as a named consideration in realising the commitment (see paragraph 6.2.12 bullet c). It is understood the authority seeks to reduce dependency on the LRN as far as is reasonably practical, however, by increasing this commitment it would result in an increased dependency of the LRN. From a safety perspective taking a risk based approach whereby fewer HGV movements lessens the likelihood of an incident, the expansion of the commitment to Roads North would oppose this risk based approach as a result of worsening the traffic conditions in and around the port facilities.* *Enhancing or constructing new connectivity (river or rail) in achieving improved multi-modal material movement would require significant land take and resources with the required construction activity having its own significant impact from an environmental, social and safety perspective. This is not an aim for NH and therefore is not considered an option.*	NH has dismissed, without strong rationale, the use of the current jetties and wharves. NH references additional impacts on the Local Road Network if the Baseline Commitment were to be extended. NH should explain where and how the materials handling strategy would impact further on the LRN and how that impact might be mitigated. That evidence would inform the review of the proposed wider strategy that needs to be developed and presented by NH.

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
THURROCK-OMHP-MISC-004	NH should indicate how road safety and reductions in transport-based carbon has been taken into account when proposing that material, plant and equipment is proposed to be moved by road- based transport as opposed to rail or marine.	*When determining the mode of transport for movement of materials from a safety and carbon perspective on LTC, an approach for Contractors has been provided for the entire journey of the material. This means that consideration has been given to the movements from likely source locations (see section 6.2 in the oMHP) to the end destination compounds. Due to limitations in expanding existing infrastructure, a multi-modal approach is considered the most sustainable approach. The Projects current understanding of the local supply chain identifies several material delivery hubs that deliver material via river and or rail with onward transportation to the Projects compound via the road network. This multimodal transport approach for transportation of material from its source to the recipient compounds promotes a sustainable deliverable position* *The final movement of this material, defined as the final mile strategy details the principles that the Contractor must adopt when making the final movement of materials to the recipient project compound. This section concludes it is not feasible to construct a new rail head for this final mile movement due to the limitations set out in the OMHP. Similarly, it is not possible to execute the final mile movement via river for compounds situated within the Roads North due to their proximity to the river.* *Road safety will form a core principal in the development of traffic management plan and material handling plans at the delivery stage. Focal to this principal has been eliminating or reducing road traffic movements where reasonably practical. Taking a risk based approach whereby fewer HGV movements lessens the likelihood of an incident, the river use commitment has been considerate to this and hence why the commitment is focused to the North Portal site, materials that lend to stockpiling and not dependent to "Just In Time" delivery approach, as opposed to extending to Roads North which would as a result of worsening the traffic conditions on the local and strategic road network.* *In working towards reducing transport based carbon and defining the river commitment an holistic approach has been taken. There has been consideration of the source of the material and receiving sites location including existing infrastructure links, which links*	As stated above, the Council and the PLA concur that multi-modal transport can assist and be part of optimising the materials, plant and equipment strategy for the Project and reducing road mileage by lorries and HGVs. NH's response does not provide evidence that the adopted strategy has presented the most favourable approach for limiting carbon use and optimising road safety. This should form part of a full assessment of appropriate opportunities and a strategy which also considers what facilities existing or new would be appropriate to derive a more proactive and challenging strategy for the entire Project. As suggested by NH, that should include the flexibility to respond to future developments in transport and connectivity which might emerge during the delivery of the Project.

Issue Ref.	Council's first response	National Highways' response (August 2022)	Council and PLA joint second response (August 2022)
		back to the importance to a multimodal approach for material deliveries. Consideration of other environmental impacts, traffic and safety. The Project carbon emissions is not just related to transport of material, but a lot wider where significant emphasis has been on the larger contributing factors. For instance, but not limited to, removing diesel from its sites by only using hydrogen and electric plant, and looking at alternatives to carbon-intensive materials such as concrete and steel, after which the project will also consider carbon offsetting to address any residual emissions.	
THURROCK-OMHP-MISC-005	NH should establish a process within the oMHP by which contractors would apply for a derogation from the contracted commitments, if required. That process should allow suitable notification, review and approval between NH, the contractor and the Council. The process should be designed by NH to incentivise the contractor to pursue movements by non-road-based transport except in exceptional circumstances	*In the event that unforeseen circumstances , as set out in oMHP, under which the use of the River will be restricted to fulfil the commitment, NH will use the use the platform of the Traffic Management Forum (TMF) set out in the oTMPfC to discuss the circumstances and alternative delivery methods to be employed to progress the Works. Thurrock are a consultee at TMF and TMF would be an appropriate vehicle by which to discuss events, alternatives and measures to be employed....* *The TMF will be established and part of its function is to bring issues, including potential derogations from commitments to consultees that results in impact to the local and strategic road network.* *For context the Project is of the view that such derogations are likely to be rare due to the nature of river use logistics and existing river logistics infrastructure, in addition there are several safeguarding elements that would be expected to be in place to minimise the need of any derogations. River use logistics lends to materials less of a dependent for "Just in Time" deliveries and material that can be stockpiled, which is reflective within the commitment. It is good practice for contractors to ensure sufficient reserve of material is stockpiled to mitigate against any supply chain and logistic issues. Such measure will reduce the likelihood of enforcing such derogations.*	The Council and the PLA welcome that NH proposes that safeguards would be in place to limit the need for derogations away from the Baseline Commitment, however, these are not specified, and the Baseline Commitment is not sufficiently far reaching in promoting or committing to the movement of other materials, plant and equipment by rail and marine transport. Furthermore, it is essential that a robust process is put in place that holds the contractor and NH to meet its commitments. The Contractor will be able to explain and justify its proposed variations to that commitment at the time of the request for the derogation. As part of that process for management, pre- and post-event mitigation measures must be clearly defined and adhered to. The PLA is an essential stakeholder in this regard but is not currently a party to the Traffic Management Forum and as such would have no mechanism to input to the considerations of derogations. NH must provide a mechanism by which the PLA would be a party to the process. The Council and the PLA are aware that applications for derogations on marine operations are generated by myriad reasons and require careful and challenged consideration and determination to deter contractors from moving to a road-based operation without properly justified reason. That process of review, consideration and determination must be set out in the DCO or associated Control Documents and must allow for the Council and the PLA to make our objections clear and heard. A process must be included to allow derogations to be rebutted, governed and signed off by the affected stakeholders.

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
THURROCK-OMHP-MISC-006	NH should confirm why the existing jetties are not available or appropriate to the project and how alternative marine and rail facilities would be used or created	*On the north bank of the River Thames, there are currently two operational jetties close to the Order Limits (the North Portal area). However, both jetties are fully utilised by existing landowners and business owners and do not have additional capacity to import materials for the construction of the Project. The land providing access to the existing jetties also form part of the Freeport development, furthering the project position to why additional capacity to import or export material is not feasible. As a result the land associated with jetties is no longer within the Projects Order Limit. In addition when considering conceding the river front land in question to the PoT, the Project has recognised the busy navigational channel of the River Thames and proposed Freeport development would give rise to significant difficulties in the creation of a new jetty (deep or shallow water) on the north side of the river.* *The existing local supply network provides various means to transport material via river to existing jetties/wharves and or to local hubs via rail for onward transportation to work sites via the road network. Appendix A of the OMHP provides an overview of non-exhaustive list of suppliers and their river and rail capabilities, whilst also taking into consideration their proximity to the Project compounds.* *The location of the jetties which is situated at the North Portal site is an evolving area with various variables yet to be defined, but always under the umbrella of Freeport masterplan. The Project is in ongoing discussions with third parties to work towards an aligned position where the projects interface. The current river use commitment is reflective of change for betterment and defined as the better than baseline position. For example this commitment may result through development of engagement with third parties, changes to infrastructure for river use and innovation.*	NH has previously maintained that the existing jetties at East Tilbury are at full utilisation through a conjunction of Thames Tideway Tunnel and Silvertown Tunnel operations. The Council is aware that both of those projects would have finished sending material to the jetties by the start of the construction period of the LTC Project. NH should therefore explore more fully whether those facilities or others in the area on both sides of the river could be used to facilitate a marine operation for such materials as exporting excavated material, waste material or for handling other materials, plant and equipment for the Project. This should be explored in conjunction with the emergence of the Freeport facilities and in conjunction with the Port of Tilbury. The Council and the PLA remain unconvinced that a comprehensive approach to extending the use of rail and marine facilities has been assessed and adopted by NH. NH has separately noted as part of the considerations of the draft Preliminary Navigational Risk Assessment (dPNRA) that the river within the location of the Port of Tilbury and the locus of the Project has sufficient spare capacity to cater for Project related movements. It is, therefore, interesting to note that NH now has concerns that the busy channel could impede a marine operation. The Council and the PLA would welcome NH's explanation and evidence on this point and to understand how this aligns with the dPNRA and the NRA for the Port of Tilbury. The Council and the PLA do not propose that the Project uses only facilities at the Port of Tilbury, although noting the convenient juxtaposition of the port to the Project. Opportunities to utilise marine and rail interfaces elsewhere should also be assessed in detail, north and south of the river and east and west of the Project. This research should be evidenced within the DCO and associated documents, with fuller specific reference to the inbound and outbound materials, plant and equipment for the Project. Contractors should be incentivised to meet the stated requirements of NH or to evidence why those proposed commitments cannot be met. The Council notes references in the OMHP to a series of origins and destinations for materials, which could serve the Project, yet no evidence has been presented as to

Issue Ref.	Council's first response	*National Highways' response (August 2022)*	Council and PLA joint second response (August 2022)
			the most suitable sources or destinations and their capacity to serve the Project. That work would inform the strategy and give definition to the possible solutions that should be adopted.

TECHNICAL NOTE

The following table provides the Council's and the PLA's response to NH's comments on Table 1.0 of the Council's April 2022 response on the proposed Baseline Commitment.

LTC Response to Table 1.0

Import and Export	Response Notes	Thurrock Council response (August 2022)
Sand and Aggregates for:		
• on-site batched concrete • off-site batched concrete • cast in situ concrete structures • temporary roads and compounds • cast segments (primary lining) – manufactured on site • spayed concrete lining • secondary lining	The proposals provided by Thurrock are based on different forms of manufacturing concrete i.e. on site/offsite. The sands and aggregates associated with manufacturing concrete (on & off site) to construct permanent and temporary infrastructure thus falls within the definition of bulk aggregates and thus forms part of the commitment.	The wording for the commitment must make it entirely clear which groups of material are included in the commitment, be that on-site or off-site manufacture, cast in situ or precast. The word "impoorted" in the commitment allows contractors not to meet the commitment where that material was brought to site as part of another material. Furthermore, the current NH commitment is for the North Portal works only and does not include the northern roads contract, which will use significant quantities of sand and aggregate that are not covered by a non-road transport commitment. NH has not demonstarted why the commitment for marine or rail transport will only apply to the North Portal works. As presented the Council wold not support the wording of the commitment.
Concrete (containerised / bulk)	The delivery of batched concrete via the river is not considered to be feasible and would present considerable risk to the quality of the material. Not a standard practice to deliver batched concrete containerised via the river.	This was an error in preparing the table. The bulk material is the cement, which can be containerised for rail and marine movement.
Fill material for:		
• temporary roadways • compounds	The importation of aggregates associated with temporary roadways i.e. haul roads and access roads, compound forms part of the commitment and thus falls within the definition of bulk aggregates.	The wording for the commitment must make it entirely clear which areas of construction are included in the commitment. For example, what does "working platforms" include and does "haul roads" include access roads? NH should set out why it is limiting the commitment to the North Portal compound only for movement of material by marine or rail.
Steel:		
• Temporary and permanent piles • Reinforcement bar	A large part of the UK steel is manufactured north of England and South of Wales which lends to better connectivity via road or rail to local hubs in proximity of the site. Manufacturer vs stockist. Steel is rolled in Wales and North East and shipping may be a feature...but steel stockists are likely to be nearer and we are mindful that we don't prejudice opportunities for local businesses to supply due to overly prescriptive commitments In terms of level of impact to minimise HGV truck movements. The North Portal Entrance Compound material forecast that Steel forms a small proportion of truck movements associated with this compound. The commitment is focused on materials that lend to marine logistics of "bulk" materials that are easily stored, do not deteriorate in storage and can be placed into the permanent works in "bulk".	Thurrock Council is wholly aware that steel products are not manufactured locally but is seeking to encourage NH to consider non-road-based transport as a method of transporting material to the project and so it welcomes NH's approach to the potential use of local suppliers which use rail (or marine) to move materials. It is wholly possible to specify that suppliers would be those that move their product largely by rail or marine with the first or last mile being by road. It is noted that some groups of materials might represent smaller proportions of the whole but encourages NH to consider the cumulative nature of its commitments. Steel does not deteriorate in storage and can be handled in bulk and so can be the focus of possible movement by non-road-based transport. It is noted that NH refers to its commitment for moving material by non-road-based transport to be "focused on materials" plural. The Council therefore welcomes proposals for moving more than bulk aggregates to the project.

TECHNICAL NOTE

Offsite precast structures and materials:		
• Bridge sections	The sands and aggregates associated with manufacturing concrete to build bridge sections forms part of the commitment and thus falls within the definition of bulk aggregates.	The commitment currently refers only to the North Portal Construction Area and does not refer to the broader works north of the river. Furthermore, the commitment as worded would certainly not clearly specify to a contractor that sand and aggregate used in the off-site manufacture of bridge sections should be transported by marine (or rail). Bridge sections does not always include concrete sections and may include steel elements which could be readily moved by marine transport. As worded the response from NH commits third party suppliers to complying with the commitment.
• Tunnel primary lining segments (not cast on site)	The sands and aggregates associated with batching concrete to construct tunnel segments forms part of the commitment (pre cast/off site casting) and thus falls within the definition of bulk aggregates.	The commitment currently refers only to the North Portal Construction Area and does not refer to the broader works north of the river. Furthermore, the commitment as worded would certainly not clearly specify to a contractor that sand and aggregate used in the off-site manufacture of segments should be transported by marine (or rail). As worded the response from NH commits third party suppliers to complying with the commitment.
• Kerbing and drainage materials	The sands and aggregates associated with batching concrete to construct kerbing and drainage infrastructure forms part of the commitment and thus falls within the definition of bulk aggregates.	The commitment currently refers only to the North Portal Construction Area and does not refer to the broader works north of the river. Furthermore, the commitment as worded would certainly not clearly specify to a contractor that sand and aggregate used in the off-site manufacture of kerbs and drainage products should be transported by marine (or rail). As worded the response from NH commits third party suppliers to complying with the commitment.
Slurry material	Further clarification required, on what is meant by slurry material.	This relates to slurry component used in the tunnelling process.
Plant		
Tunnel Boring Machines	It is anticipated some parts if not all of the TBM will be via the river with local connection to the compound via the road network, due to the size and weight of some TBM components. The contractor will take a risk based approach to the delivery of the TBM once procured.	The commitment should refer to the contractor using marine (or rail) transport for the movement of the primary components of the TBMs, unless otherwise agreed through the Traffic Management Forum such that an alternative method of movement is more sustainable or safer.
Rails, ducting and ventilation for TBM operations	Does not form part of the commitment to deliver via the river. For context the focus of the commitment is to material that lend to marine logistics of "bulk" materials that are easily stored, do not deteriorate in storage and can be placed into the permanent works in "bulk".	The Council is encouraging NH to consider not just marine movements but also rail transportation. These items are easily stored; do not deteriorate in storage and can be handled in bulk and so can be the focus of possible movement by non-road-based transport.
AIL excavators and piling rigs		
Equipment		
Welfare units and temporary accommodation	Does not form part of the commitment to deliver via the river. The focus of the commitment is on material that lend to marine logistics of "bulk" materials that are easily stored, do not deteriorate in storage and can be placed into the permanent works in "bulk".	None of the listed equipment would be viewed as deteriorating in storage; they are bulky or bulk; and are easily stored. The NH response demonstrates its absence of consideration or commitment to the use of marine and rail transportation. The commitment should reflect the whole project and not just the North Portal Construction Area - in so far as much broader welfare and site security equipment can make the opportunities to use marine or rail a viable approach to transportation.
Worksite and compound fencing and hoardings		
Export only		
Waste and rejected concrete, sand and	Does not form part of the commitment to deliver via the river. The Project is committed to re-using such material where practicable for instance in the use of haul roads or temporary working platforms.	This is not a clear commitment and cannot be measured. If NH intends to use all (or a defined proportion) of these materials within the works then this should be stated in the commitment. This needs to be supported by evidence that the reuse of these materials will be consented within the project. Where it is judged that the materials cannot be reused or deposited within the Order Limits then that resultant export should be by marine or rail transport.
aggregates		
Excavated Material	Earthworks associated at the North Portal Entrance site: The earthwork strategy is based on keeping all clean excavated material on site. There is provision for taking material offsite that is hazardous, which is anticipated to be small in quantity over a prolonged period.	The Council is not focused solely on the North Portal Construction Area and is concerned with all project works north of the river that affect Thurrock. NH's current prediction is that in the region of 700,000m3 of EM is to be removed from the Order Limits. This is a significant sum and does not allow for the rejection of other EM. The commitment should include for EM to be removed by marine or rail transport. A process and mechanism could be established by which contractors apply to move EM by road subject to rigourous appraisal of evidence as to the justification to change to road transport - assessed and determined through the Traffic Management Forum.

Appendix 2: Initial consideration of marine transport options, infrastructure and constraints.

A2.1 Introduction

A2.1.1 The Lower Thames Crossing Project is in preparation for a Development Consent Order (DCO) submission. The location of the infrastructure including its proximity to Tilbury Docks offers the opportunity to consider a multimodal approach for the construction logistics activity that will be associated to the Project. In order to elaborate a robust 'Construction Logistics Strategy' it is necessary to specify information and assumptions on which the strategy is based.

A2.1.2 The aim of this Note is to review the potential for handling construction materials, plant and equipment using marine transport for the largest proportion of an inbound or outbound journey. It is acknowledged that not all materials, plant and equipment are suitable for marine or multimodal transport methods and therefore the focus will be on those with the greatest potential to reduce safety risks and minimise the sustainability impacts of those movements. In order to assess the potential to transport by marine operations it is fundamental thoroughly to assess options and test those assumptions and conclusions. This Note provides a preliminary basis from which that testing and strategy development could be based.

A2.1.3 To understand the basis of this Note, it should be read in conjunction with National Highway's (NH's) *Lower Thames Crossing – Outline Materials Handling Plan* (LTC – OMHP) (June 2021 version 0.2), which sets out the construction logistics approach being considered by NH thus far for the project. Further to this, NH has provided to the Council proposed text which indicates a commitment that "*the Project shall utilise port facilities for at least [80% by weight] of bulk aggregates imported to the North Portal Construction Area (the Baseline Commitment). This commitment translates into [35%] of the total bulk aggregates across the project being transported via port facilities*" (e-mailed correspondence of 22 April 2022). Currently the commitment suggests that the associated sand and aggregate would be for use only within the 'North Portal Construction Area' and the construction of the tunnel up to (and excluding) the South Portal. The commitment does not include construction operations or works for the wider project and does not specifically state the works that are included within the North Portal Construction Area.

A2.1.4 This Note further develops the Council's opinion on where the use of cross-modal and multimodal transport approaches could be considered for optimisation. Over the following sections this Note will considers:

- Transport access infrastructure by mode
- Potential materials for marine transport
- Quantities of materials
- Constraints and possible resolutions

A2.2 Transport Access infrastructure

Marine

A2.2.1 Immediately adjacent to the DCO area limit there are two jetties, an inner jetty to the shoreline, which is 75m long and 19m wide, providing approximately 1,010m^2 of working area, and an outer jetty which is 123m long and 27m wide, providing approximately 2,200m^2 of working area. The inner jetty is accessed by a single ramp, while the outer has two ramps. All ramps are approximately 4m wide. Both jetties are floating variants, offering marine access for prolonged periods, subject to dredging.

A2.2.2 Aerial photography from 2021 (Google Earth Pro) indicates that the inner jetty is either in a state that is causing it to sink, or the jetty pontoon is stuck in the mud which has silted up around it. This would suggest that the jetty is currently not being used and could therefore be available for the LTC use, once restored and dredged.

A2.2.3 Immediately to the west of the inner jetty there is a disused wharf which has been used for receiving inert waste for the restoration of the old Goshems Farm Landfill. This is currently badly silted and in general need of restoration, but if dredged and the wharf pilings and surface were brought up to a useable standard, this provides an option for handling bulk and other materials. The wharf frontage is 60m long, with a working area of about 1,500m^2 behind the wharf, although this is not fixed. Aerial photography (Google Earth Pro, July 2014) shows that the wharf has previously been used concurrently with the inner jetty. Given that the LTC – OMHP has currently ruled out the use of the inner jetty, the potential to utilise the disused wharf dilutes arguments dispelling the use of marine freight. The wharf's status should be confirmed and a strategy to bring it back into use could be adopted. The justification for NH not using the jetties is not accurate in its assertion that the jetties will be in use by the Thames Tideway Tunnel project and the Silvertown Tunnel project. Both projects will have completed their use of the jetties by the planned time of construction of this Project.

A2.2.4 The outer jetty is relatively new, being put in place around 2018 and is currently used for unloading inert material destined for Tilbury Ash Disposal Site, which is within the DCO retained area. The jetty is used for the disposal of excavated material from the Thames Tideway Tunnel project. It is anticipated that the jetty will also be used for the disposal of excavation arisings from the Silvertown Tunnel main tunnel boring works, which we estimate to complete by the end of 2024/25.

A2.2.5 The size of the outer jetty is able to berth two barges with a capacity of up to 1,600t (approx. 660m^3), concomitantly. Machinery for unloading these is driven onto the jetty, which lift inert spoil into 20t or 30t earth moving dumpers.

A2.2.6 A jetty of this size could potentially accommodate coaster sized ships with a capacity up to 2,000 dead weight tonnes (DWT), subject to dredging and any navigation constraints. This would be equivalent to approximately 115 lorry loads per ship, at 17-18 tonnes per lorry.

A2.2.7 There is sufficient space to install a conveyor system between either of the jetties and the shore for the handling of aggregates, fill material and surplus excavation arisings.

A2.2.8 Other materials such as steel and possibly precast items, accommodation units and tunnelling grease could be potentially unloaded at the jetty locations within the DCO Order Limits or via the PoT or, potentially, alternative riparian facilities.

A2.2.9 If tunnel lining segments were to be manufactured off site, the outer jetty should be able to accommodate a suitable crane and provide space for the transfer vehicles (e.g. adapted artic, or a multi-service vehicle).

A2.2.10 Tilbury Docks is approximately 4.7km away via the preferred route presented in the LTC – OMHP (i.e. along A1089 and Fort Road). Tilbury handles a wide range of materials, including cement, aggregates, steel, unitised, and ash. Tilbury's proximity to the tunnelling portals mean it is the best location for the delivery of the tunnel boring machines (TBMs) for onward road transfer.

Road as a complementary part of a marine operation

A2.2.11 The movement of materials by road should be regarded as the last option for bulk materials and be minimised where possible for other items and commodities. As mentioned above, the current primary link into the CA5 area is along A1089 and the new infrastructure link road.

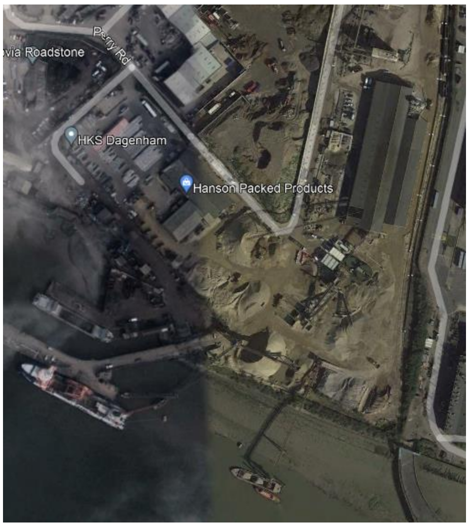
A2.2.12 To reduce local road use at this location, there is potential to install a temporary road bridge over the railway in the proximity of the EMR East Tilbury facility, within the LTC site. Such installations are not uncommon, for example, a bridge was used to carry two lanes of highway traffic for a period of 12 months during the expansion of Heron Quays – see Section A2.5 for more details.

A2.2.13 It is understood that the Port of Tilbury does not permit lorries to turn right out of the port to avoid congestion at its gate. Given that all lorry movements from the Port of Tilbury connected with the LTC project would have to turn left and circulate via the Asda Roundabout, this would effectively add approximately one mile to each PoT to LTC site journey. In terms of greenhouse emissions, this would add 1.6kg CO_2e[1] per LTC site-bound movement from the Port.

A2.2.14 A solution to permit LTC-bound vehicles to turn right out of the Port gate should be investigates, such as installing a roundabout or traffic signal-controlled junction at the Port entrance. Given that the port access road is dualled between the Asda Roundabout and the Port entrance, this is unlikely to inhibit traffic visiting the Port and would instal a recognised traffic management scheme at the junction.

Multimodal Transport

A2.2.15 Considering other wharf facilities up and down the Thames, there are options to use a 'multimodal' approach to the delivery or removal of materials. For aggregates this is common practice on the Thames, with several wharves having rail connects as well as being able to berth dredgers and barges. The closest such facility upstream of the LTC site is Hanson Aggregates at Dagenham. This facility receives hardstone by rail, marine dredged aggregates and dispatches aggregates to Thameside batching plants by barge. The © Google Earth Pro image (from 3/2022) shows all three modes at the site being used. Other facilities are available for bulk aggregates and bulk materials, such as Brett at Cliffe and other facilities within the Port of Tilbury.



A2.2.16 On the south shore of the Thames at Gravesend Stema has a facility for hardstone on Red Lion Wharf, while Lafarge has a similar facility on Bevan Wharf, which also has a rail link that is currently unused. Aggregates could be relayed by barge from these facilities to the LTC jetties or by using Stema's interface within the Port of Tilbury. Other operators for bulk materials include Cemex at Northfleet and Port of Tilbury and Clubb at Denton.

A2.2.17 For other goods, if trainloads could be organised, for example creating logistics hubs at existing railheads (e.g. Birmingham Hams Hall Freight Terminal, Trafford Park Freight Terminal), it might be possible to consolidate loads from suppliers located around the country. Unloading locations in for the LTC site could be Tilbury 2 railhead or Barking Multimodal Freight Terminal.

A2.3 Potential Materials for Marine and/or Rail Transport

A2.3.1 It is worth noting the commitments to use marine transport in the Silvertown Tunnel DCO and the Thames Tideway Tunnel DCOs. The commitment for Silvertown Tunnel is:

- *"at least 50% by weight of **all materials** associated with the Scheme by River; and*
- *100% of suitable **excavated material** out by River."*[2]

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[1] Freighting goods tab, All HGV (miles) cell, *conversion-factors-2021-full-set-advanced-users.xlsm*, Defra, 2022

[2] Silvertown Tunnel, 6.10 Code of Construction Practice, April 2016

A2.3.2 Similarly, the Thames Tideway Tunnel committed to the following for movement by river for specified riverside sites:

- **100% movement of excavated material;**
- **100% of permanent fill inbound;**
- **100% of temporary fill in and outbound;**
- **100% of excavated material at specified Foreshore Sites for short connection tunnels; CSO interception chambers and associated structures; and other underground structures;**
- **Main Tunnel lining segments to Chambers Wharf; and**
- **sand and aggregates for the manufacture of concrete to be installed for the secondary lining to the Main Tunnel from the Main Tunnel Drive Sites.**[3]

A2.3.3 For Thames Tideway Tunnel, the Main Works Contractors were incentivised to propose the movement of further materials, plant and equipment as part of their contracting – including steel piles and tunnel lining segments. Further to this, a range of other materials beyond those committed to have been moved by marine, including welfare and accommodation units and TBMs. The commitments contained within the DCO were captured within a comprehensive River Transport Strategy that was then supplemented by contractual commitments between the scheme promoter and the main works contractors and agreed with key stakeholders, including the PLA. This gave a robust basis of agreement for all parties to work from.

A2.3.4 It should be noted that the HS2 project is monopolising aggregates sources in UK. However, hardstone aggregates are imported to Tilbury (PoT1) and Northfleet by the Norwegian company Stema (Mibau Stema Group), which could be an important potential source if the UK market could not meet the LTC requirements.

A2.3.5 Consequently, a similarly high commitment or target should be set for the LTC involving the combined used of rail and marine across a range of materials, plant and equipment.

A2.3.6 This note does not consider deposit sites for excavated, demolition and waste materials that would be removed from the project but there are a number of locations within the Thames and Medway estuaries and around the southern England coast.

A2.3.7 Materials and equipment assessed by the Council to be contenders for marine a transport are listed in the table below. These exceed the materials to which NH has committed to in the LTC – OMHP and its additional text. This list and targets are proposed as an initial indication for further discussion and development with NH and other stakeholders.

Table 1: Potential materials and equipment for marine transport

Material	Marine		Final Transport	Target
Import				
Sand and Aggregates for:				
On-site batched concrete	X		Conveyor / dumper from jetty/wharf	100%
Off-site batched concrete	X		Conveyor / dumper from jetty/wharf	100%
Cast in situ concrete structures	X		Conveyor / dumper from jetty/wharf	100%
Temporary roads & compounds	X		Conveyor / dumper from jetty/wharf	100%
Cast segments (primary lining) – manufactured on site*	X		Conveyor / dumper from jetty/wharf	100%

[3] Thames Tideway Tunnel, River Transport Strategy, March 2014

Material	Marine		Final Transport	Target
Spayed concrete lining*	X		Conveyor / dumper from jetty/wharf	100%
Secondary lining*	X		Conveyor / dumper from jetty/wharf	100%
Grout*	X		Conveyor / dumper from jetty/wharf	100%
Fill material for:				
Temporary roadways	X		Conveyor / dumper from jetty/wharf	100%
Compounds and aprons	X		Conveyor / dumper from jetty/wharf	100%
Permanent highway sub-base & capping	X		Conveyor / dumper from jetty/wharf	100%
Cement**				
Cement for:				
On-site batched concrete	X		Road from Tilbury	100%
Cast in situ concrete structures	X		Road from Tilbury	100%
Temporary roads & compounds	X		Road from Tilbury	100%
Cast segments (primary lining) – manufactured on site*	X		Road from Tilbury	100%
Spayed concrete lining*	X		Road from Tilbury	100%
Secondary lining*	X		Road from Tilbury	100%
Permanent highway concrete layer	X		Road from Tilbury	100%
Steel				
Temporary and permanent piles	X		Trailer from jetty/wharf	50%
Reinforcement bar	X		Trailer from jetty/wharf	50%
Segment factory	X		Trailer from jetty/wharf	50%
Road bridge box sections	X		Trailer from jetty/wharf	50%
Overhead gantry assemblies	X		Trailer from jetty/wharf	50%
Offsite precast structures & materials				
Bridge sections	X		Road from Tilbury	50%
Tunnel primary lining segments (not cast on site)	X		Trailer from jetty/wharf	100%
Kerbing and drainage materials	X		Trailer from jetty/wharf	50%
Plant				
Tunnel Boring Machines	X		Road from Tilbury	100%
Rails, piping, ducting and ventilation from TBM operations	??			
AIL excavators and piling rigs	??			
Slurry treatment facility	??			
Conveyors	??			
Equipment				
Welfare units & temporary accommodation	X		Trailer from jetty/wharf	50%
Worksite & compound fencing and hoardings	X		Trailer from jetty/wharf	50%
Export				
Excavation arisings	X		Conveyor / dumper to jetty/wharf	100%

Material	Marine		Final Transport	Target
Construction waste – including SCL overspray	X		Dumper to jetty/wharf	50%
All temporary fill	X		Conveyor / dumper to jetty/wharf	100%
Tunnel Boring Machines (if dismantled / scrapped to north portal)	X		Trailer to jetty/wharf	100%
Conveyors	??			
Welfare units & temporary accommodation	X		Trailer to jetty/wharf	100%
Worksite & compound fencing and hoardings	X		Trailer to jetty/wharf	50%
*NH current proposed commitment	**Potential connection for dry bulk transfer from Tarmac siding			

A2.3.8 It is acknowledged that the practicality of transporting some materials and equipment directly to site by marine may not be appropriate. In such cases, it should be the aim of the Project to deliver these via the Port of Tilbury, or other riparian facility, with the final transfer by road. If it is still considered by NH that marine transport cannot form the largest proportion of the journey to or from the Project for the material or plant, equipment, then NH should set out evidence to support that case.

A2.4 Quantities of Materials

A2.4.1 A summary of the headline estimated quantities of excavated materials based on the data published by NH in its OMHP Table 6.1 adjusted using the updated estimation within the Local Refinements Consultation for the project north of the river, are set out in the table below. These values exclude hazardous or contaminated materials or rejected material. These should be updated by NH as its assumptions refine and evolve.

Table 2: LTC – OMHP quantities of excavation arisings estimate

LTC Works Section	Excavated arisings (cubic metres)		
	Total Material	Material to retain on site	Material to export from site
Section B (North of River Thames) – Tunnels & Approaches	2,135,000	2,110,000	520,000* *To IVL within DCO area limits.
Section C – Roads North	3,195,000	5,016,000* *Within DCO area limits	563,000
Section D – Roads North	2,405,000		
Total for Works North of Thames	7,735,000	7,126,000	1,083,000

A2.4.2 Based on these figures, it is indicated that around 563,000m^3 of excavated material will be exported offsite outside of the DCO area limits. This is equivalent to 70,375 lorry loads (@ 8m^3 per lorry load), which will result in 140,750 lorry movements (i.e. 1 x inbound + 1 x outbound). Over the four-year project programme (assuming 300 working day/yr) this would equal approximately 59 loads / day (118 mvts/day). Assuming a 10hr working day there would be 6 loads per hour (12 mvts) which is 1 load (20 mvts) every 10 minutes at a constant flat rate. A significant flow of vehicles.

A2.4.3 If the material was shipped from site by barge via a consolidate interface, this is equivalent to 750 loads (@1500t per barge).

A2.4.4 The LTC – OMHP has reviewed the import of aggregates and cement but has not quantified these. Below is a broad estimate by Stantec of primary materials that are likely to be used in the project. The figures include a 20% contingency above the base estimate to take account of the wide range of uses where they will be applied. The table also includes surface water drainage pipe, as these are heavy bulky units that are required in high quantities.

A2.4.5 The table below **does not include quantities for materials to form the compounds**, as it is uncertain what types of surfaces will be laid at these and it is assumed will depend on their use.

Table 3: Stantec estimate of key construction materials

Material	Quantity	Unit of measurement	Vehicle loads
Sand & Aggregates*	808,314	Cubic metres	101,039
Cement**	94,243	Cubic metres	4,712
Rebar***	26,832	Tonnes	1,789
Surface water drainage	19,920	Tonnes	996
* Includes sub-base aggs, capping aggs, all concrete aggs, incl tunnel linings ** Includes tunnel linings, road base, bridges & viaducts, central road barriers *** Excludes tunnel linings			

A2.4.6 The above estimates are probably conservative and are likely to be higher, plus there will be a whole range of materials not considered for this note.

A2.4.7 Large quantities of steel will be required for sheet piling, reinforcement cages, bridge box or preformed sections, overhead gantries and signs, but the quantities for these are an unknown at present. In addition to the drainage pipes, there will be gully chambers, gully gratings, metal inspection covers and precast kerbing.

A2.4.8 There are several sources on the Thames and Medway that could supply aggregates, fill and other materials using marine operations, for example four options include.

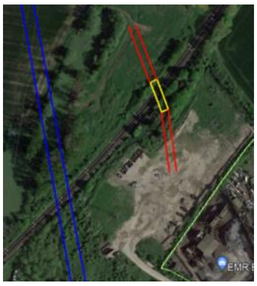
- Aggregate Industries – Isle of Grain, Kent
- Brett Aggregates – Cliffe, Kent
- Hy-Ten Reinforcement – Chatham Docks, Kent
- Midland Steel Reinforcement – London Thames Port, Kent

A2.5 Constraints and Possible Resolutions

A2.5.1 A number of constraints regarding moving materials within the DCO Order Limits have been identified during the review of LTC and the OMHP, which might inhibit the use of non-road-based transport or produce high levels of construction traffic on local roads. These are summarised in the table below with an indication of possible mitigation or resolution.

Table 4: Key modal constraints and solutions

Constrain	Impact	Solution	Outcome
No direct access to rail network.	Increases reliance on a road-base transhipment operation between railhead and site compounds or results in	Explore potential to access rail siding adjacent Tarmac aggregates facility north of Tilbury2 or another suitable railhead	Reduction of road-based bulk transhipment from third-party railhead or wholly road-based operation.

Constrain	Impact	Solution	Outcome
	a wholly road-based strategy		
Potential restricted access to Thames jetties within the DCO area limit or other riparian facilities.	Removes the possible use of marine transport for project materials and equipment.	Restore and possibly enlarge basic wharf adjacent to existing jetties. Select alternative wharfage to allow marine transport for major portion of journey.	Provides access to marine transport for project materials and equipment.
Station Road Level Crossing – Tilbury Loop Line	Limits capacity of vehicle movements for the transfer of earthwork materials.	(1) Install temporary bridge over railway line in the proximity of EMR East Tilbury site – 6m high bridge with a 75m ramp gives 1:12.5 gradient, e.g. as per sketch below  (2) Install temporary conveyor over railway line in the proximity of EMR East Tilbury site.	(1) & (2) Retains movement of excavations and other bulk materials within DCO area limits and removes construction traffic off public roads.
Connectivity between compounds within the Project trace which constrains access to marine or rail transport	Requires movements to and between compounds via the local road network.	Complete connectivity within the project trace and facilitate free movement of materials, plant and equipment between contracts and compounds	Substantial reduction in road safety risk on local roads and improvement in sustainable handling of plant, equipment and materials.

A2.6 Summary

A2.6.1 The LTC – OMHP and associated further commitment has **underplayed the potential role of marine transport** in the project – the constraints come across as insurmountable and therefore the use of road transport prevails.

A2.6.2 However, there appears to be opportunities to make further use of these modes if a more robust and, perhaps, imaginative approach to the logistics is made.

A2.6.6 Marine freight offers strong potential for the transport of materials and equipment to and from the north worksite and wider northern works areas. Currently, there is a single working jetty, installed in 2018 for the deposal of Thames Tideway Tunnel excavations. This facility is likely to be used during the construction of the Silvertown Tunnel, but this should end at the end 2024/25. A smaller jetty is available but needs restoration and dredging. On the riverbank there is a disused earth surfaced wharf, which, with restoration (and possibly enlarging) and dredging, could provide a valuable asset for handling materials and equipment using marine transport.

A2.6.7 Road freight would be able to tranship materials between the Port of Tilbury and the LTC worksites with minimal impact on the local road network.

A2.6.8 The existing level crossing on Station Road, is stated by NH as a point limiting project related road transport, and thus limiting the use of non-road-based transport. However, a solution to circumvent this barrier, would be to install a temporary road bridge of the Tilbury Loop Line in the vicinity of the ERM East Tilbury works. Such a bridge would provide a through internal haul route within the DCO Order Limits.

A2.6.9 **Table 1** of this note presents an overview of the types of materials and equipment that could be transported by marine operations, along with indicative targets that could be adopted. This should be regarded as a point for further discussion and negotiation between NH, the Council and other stakeholders.

A2.6.10 The LTC-OMHP states that approximately 563,000m^3 of excavated material will be exported off-site, excluding any rejected material. No estimates are provided within the LTC-OMHP for construction materials or other ancillary items. Our estimates for sand & aggregates, cement, rebar and surface water drainage pipe are set out in **Table 3**. These estimates need enhancing and refinement and require verifying but provide an indication as to the quanta of materials and equipment which could be moved by marine operations if NH and its contractors were so minded.

T: +44 (0)118 950 0761

Lower Thames Crossing

Thurrock Council Local Impact Report

Appendix C Annex 5 – BSI PAS 500: 2008 National Specification for Workplace Travel Plans

PUBLICLY AVAILABLE SPECIFICATION

PAS 500:2008

National specification for workplace travel plans

British Standards

: 03.100.01

Publishing and copyright information

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Contents

Foreword

This Publicly Available Specification (PAS) has been sponsored by London European Partnership for Transport (LEPT), supported and funded by Transport for London (TfL) in collaboration with The British Standards Institution (BSI). Acknowledgement is given to the following organisations that were consulted in the development of this specification:

- ACT TravelWise
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- National Business Travel Network (NBTN)
- Highways Agency
- Transport for London (TfL)
- TravelWise Northern Ireland
- Welsh Assembly Government

Wider comments from other parties were invited by BSI. The expert contributions made from organisations and individuals consulted in the development of this PAS are gratefully acknowledged.

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Compliance with this PAS does not of itself confer immunity from legal obligations.

This PAS is not to be regarded as a British Standard.

Introduction

Background

The Eddington Report [1] on transport carried out for the UK government emphasized the clear links between a high performing transport system and sustained economic prosperity. It argued that a 5% reduction in travel time for all businesses and freight travel on the roads could generate around £2.5 billion of costs savings – some 0.2% of GDP.

Eddington also argued that if left unchecked, the rising cost of congestion would have a considerable impact on the UK economy, for example it is estimated that it would waste an extra £22 billion of time in England alone by 2025. By this date 13% of all traffic will be subject to stop-start travel conditions.

Finding ways to make the best possible use of transport infrastructure and minimizing loss of time and economic damage is a clear priority and an activity that all businesses and sectors of the economy can engage in.

Travel plans offer one proven methodology for bringing about this change. The UK Department of Transport has concluded that, on average, travel plans can reduce the number of single-occupancy vehicle trips to a destination by 18% (Smarter Choices [2]). Reductions in traffic levels of this magnitude at peak time can make a huge difference to easing traffic flows, increasing the reliability of journey times and improving the commuting experience. Travel plans are specifically recommended in Planning Policy Guidance 13: Transport [3]

The King Review [4] reiterated the recommendation in the 2004 White Paper that all government departments should reduce car commuting by 5% by 2006.

What is a travel plan?

The original concept of travel planning came from the private sector in response to business pressures and have matured considerably since they first appeared in the UK in the early 1990s. They now provide a coherent approach to transport management that brings benefits to commuters, business travellers, businesses and the urgent need to address climate change, congestion and air pollution problems.

A travel plan is a long-term management strategy for an organisation and its various sites or business park that seeks to deliver transport objectives through positive action and is articulated in a document that is regularly reviewed.

What are the benefits of a travel plan?

Workplace travel plans (WTP) generate benefits to the business, the local economy, the individual members of staff, the community, the environment and increase the quality of life for all those who live and work in the area or location addressed by the travel plan. Businesses benefit by reducing expenditure on car parking and travel in course of work and through being able to release land allocated for car parking for more productive core-business purposes.

In addition, there is well documented evidence that staff who walk and cycle occasionally and embrace "active travel" are healthier, have reduced incidence of cardiovascular disease, have fewer days off work and are more productive. These benefits accrue to both individuals and organisations and assist recruitment and retention and the reduction of turnover rates. WTPs are a key element in healthier workplace policies and in dealing with the obesity epidemic now hitting the UK. Active travel makes a substantial contribution to reducing obesity and reducing early onset diabetes.

Reduced car use to a particular site feeds directly to reduced air pollution which can assist in delivering compliance with air quality management objectives and reduces greenhouse gases allowing both companies and local authorities to deliver reductions in greenhouse gases in line with statutory objectives set out in the Climate Change Bill.

Reducing congestion is a headline objective for local and central government and is of great value to businesses in reducing time and monetary penalties as a result of delays caused by congested traffic. Reducing numbers of vehicles will also benefit road safety objectives and increase the attractiveness of

walking and cycling through its impact on creating safer conditions for these sustainable modes. Travel plans make a substantial contribution to widening social inclusion and enabling many more people than is currently the case to gain access to jobs, training and education and the ability to make contact with these facilities without a car is of great value to those groups who are traditionally excluded from wider participation in social, educational and work opportunities.

NOTE *More information on the role of transport improvements in promoting social inclusion can be found in "The value of new transport in deprived areas. Who benefits, how and why?" [5]*

What can a travel plan cover?

A travel plan typically focuses on journeys to and from a site made by staff and visitors of all types, but often includes business travel, fleet activities and the delivery of goods, supplies and services.

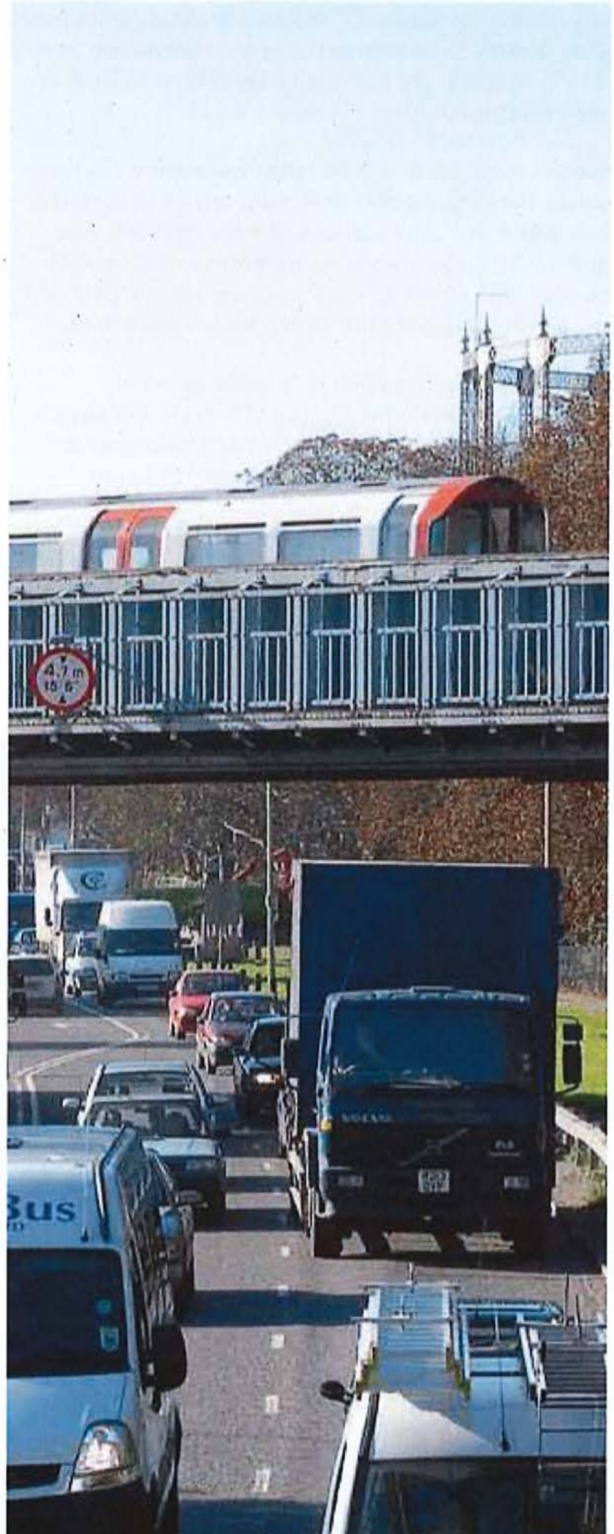
It should establish a structured strategy with clear objectives and targets, supported by suitable policies and quality measures for implementation. It is a continuous process for improvement, requiring monitoring, review and revision to ensure it remains relevant to the organisation. These aspirations and actions should be documented in a travel plan. The structure and content of such a document will depend on a range of factors, including the location of the site to which it relates, the nature of the development and of the occupier and end users.

[*Guidance for workplace travel planning for development* [6]]

Requirements regarding the nature and content of the travel plan, are provided in **Clause 3**.

A WTP is traditionally organisationally based. This means that the travel plan would be owned by the local authority, university, hospital, business etc and would apply to the staff of that single organisation. In recent years travel plans have developed so that a group of organisations on a business park (for example) would co-operate to share ideas, budgets and bring about target modal shift. Airports are special cases where considerable work has been done across hundreds of individual organisations to bring about modal shift.

Organisations frequently have many sites. This is especially the case for local authorities, universities and NHS trusts. In these cases a travel plan should be developed and owned by the organisational body



responsible for corporate decisions and budgeting and should apply to all sites within that organisation (see **3.1**), taking into account the unique characteristics of each constituent site.

For the purposes of a WTP, "site" means any location where the organisation carries out any of its activities (see **2.9**). Some organisations operate over 250 sites and a WTP under these circumstances would have to be very clear about its organisational wide impact and its relevance to every site within that organisation.

Travel plans can form part of a wider menu of transport interventions and are often referred to as a specific example of Transport Demand Management (TDM) or Mobility Management. Both TDM and Mobility Management are defined in the glossary (see **Annex A**).

Annex B contains further information on travel plans and sources of information that will be useful to those involved with travel plans.

PAS 500 is intended to improve the quality and consistency of the WTP. It does not supplant or replace local authority guidance on travel plans or Transport Assessments and does not supplant any part of the development control process which will often impose travel plan conditions on applicants for new developments.

DfT has published *Guidance on Transport Assessments* [7]

A Transport Assessment is intended to assist developers proposing a new development to assess and manage the transport impacts of that development. Those who are involved in producing travel plans for new developments should follow this guidance and make sure that the travel plan is an integral part of the travel assessment process and is consistent with the requirements of the local planning authority.

1 Scope

This Publicly Available Specification (PAS) defines requirements for developing and implementing a workplace travel plan (WTP), including public availability, resources and claims of conformity.

It is intended for use by any organisation planning or developing WTPs and applies to all WTPs and all the situations in which WTPs are initiated, developed and implemented. This includes (but is not limited to) WTPs:

- initiated as part of an organisational policy to manage transport impacts for the benefit of staff, the environment, corporate social responsibility, the reduction of congestion, the better management of parking and to foster good relationships with neighbours;
- submitted with planning applications and/or transport assessments as part of the development control process;
- designed to reduce pollution from motor vehicles as part of an air quality strategy.

PAS 500 is applicable in all situations where the term "travel plan" is likely to be used and is deemed relevant to all those involved in the travel plan process including but not limited to:

- managers charged with transport and parking responsibilities;
- planners in local authorities;
- consultants;
- transport, traffic, planning, architectural and engineering consultants advising on transport impacts and plans designed to reduce the need to travel;
- transport demand management staff in central and local government;
- developers bringing forward plans for new developments or changes to existing developments likely to result in traffic generation and impacts;
- public transport operators interested in attracting customers presently using cars;
- cycle planners and pedestrian planners interested in increasing the use of these modes of transport;
- campaign groups;
- urban designers and architects seeking to create attractive environments with less traffic and a greater reliance on walking and cycling and public transport.

This PAS applies to all the main components of transport generated by a particular site. These include:

- commuter trips made by staff;
- trips made by staff in undertaking their duties or otherwise in relation to their work;
- visitors to the site e.g. patients and visitors to hospitals, clinics and other NHS facilities, local residents visiting council offices, suppliers or customers making trips to businesses;
- contractors involved in carrying out projects at a

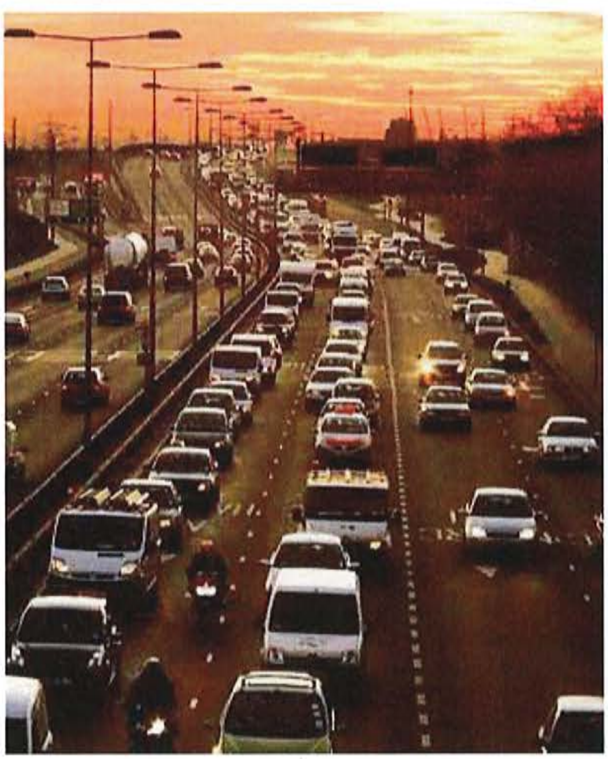
particular site e.g. building and construction, catering and cleaning;
- students travelling to university and college campuses and sites;
- trips made by all those carrying out work related tasks at premises covered by the travel plan (e.g. servicing plant and equipment, delivering supplies);
- trips made by delivery vehicles of all types where the delivery is directly the result of demands made by the site to which the travel plan applies.

This PAS provides valuable requirements for organisations of all sizes but would be of particular use to workplaces or groups of organisations with more than 100 employees.

This PAS does not cover:
- the design of attractive walking and cycling facilities;
- public or private bus, coach and train operations;
- the design and operation of public transport services;
- the detailed design and operation of car share and car club schemes.

It does not specify detailed measures or interventions that are likely to succeed in reducing car trips.

This PAS does not establish specific targets, objectives or outcomes.



2 Terms and definitions

For the purposes of this PAS the following terms and definitions apply.

NOTE *An additional glossary can be found in Annex A which aims to provide more in-depth explanations of some of the key aspects of WTPs.*

2.1 aim

intention or purpose of an organisation or activity

2.2 alternative mode (of transport)

means of transport, the availability of which, reduces reliance on cars

NOTE *These can include walking, cycling, public transport, motorcycles, mopeds, car share and/or car clubs, carpools etc.*

2.3 dot-map

visual representation of the area in which the site under discussion is located which shows the main roads, railway lines and station and any other public transport facilities and a dot representing each member of staff working at that site

2.4 intervention

specific, planned, timed and co-ordinated action designed to produce changes in travel behaviour in line with the aims and objectives of the travel plan

2.5 objective

goal intended to be achieved

2.6 organisation

entity (e.g. company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not and whether public or private) that has its own identity, functions and administration

NOTE *Where organisations operate from more than one site, the organisation is made up of all sites.*

2.7 outcome

change in modal split

2.8 output

measure to be implemented

2.9 site

premises at a specific geographical location which, either individually or combined, form part of an organisation

NOTE *This can include business parks.*

2.10 SMART

specific, measurable, achievable, realistic and timebound

2.11 transport demand management (TDM) staff

employees with skills in transport demand management, including transport planners, travel planners/coordinators and those involved in developing smarter choices and for whom travel plans form a key part of their work

NOTE *These could include facilities managers working in HR, environmental etc.*

2.12 workplace

specific geographical location to which employees, visitors and others travel

NOTE 1 *This covers a wide variety of destinations with substantial commuter, visitor, student and/or user flows e.g. hospitals, clinics, universities, colleges, offices of all kinds , business parks, town halls, government departments and manufacturing facilities.*

NOTE 2 *Separate guidance and best practices exists for schools and residential locations and they are not included in the PAS 500 definition of a workplace.*

2.13 workplace travel plan (WTP)

long-term management strategy for an organisation(s) and or an area(s) that seeks to deliver sustainable transport objectives through action and is articulated in a document that is regularly reviewed

[*Guidance for workplace travel planning for development* [6]]

3 The workplace travel plan process

3.1 General

Organisations developing WTPs for which conformance with this PAS is to be claimed shall ensure that those plans are aligned with the long-term management strategy of that organisation, contributing to the delivery of high level objectives for the organisation as a whole.

A single organisational travel plan can be implemented irrespective of the number of sites occupied by that organisation. However, that organisational travel plan shall specify how implementation is to be achieved, on each site (see Introduction – What can a travel plan cover?).

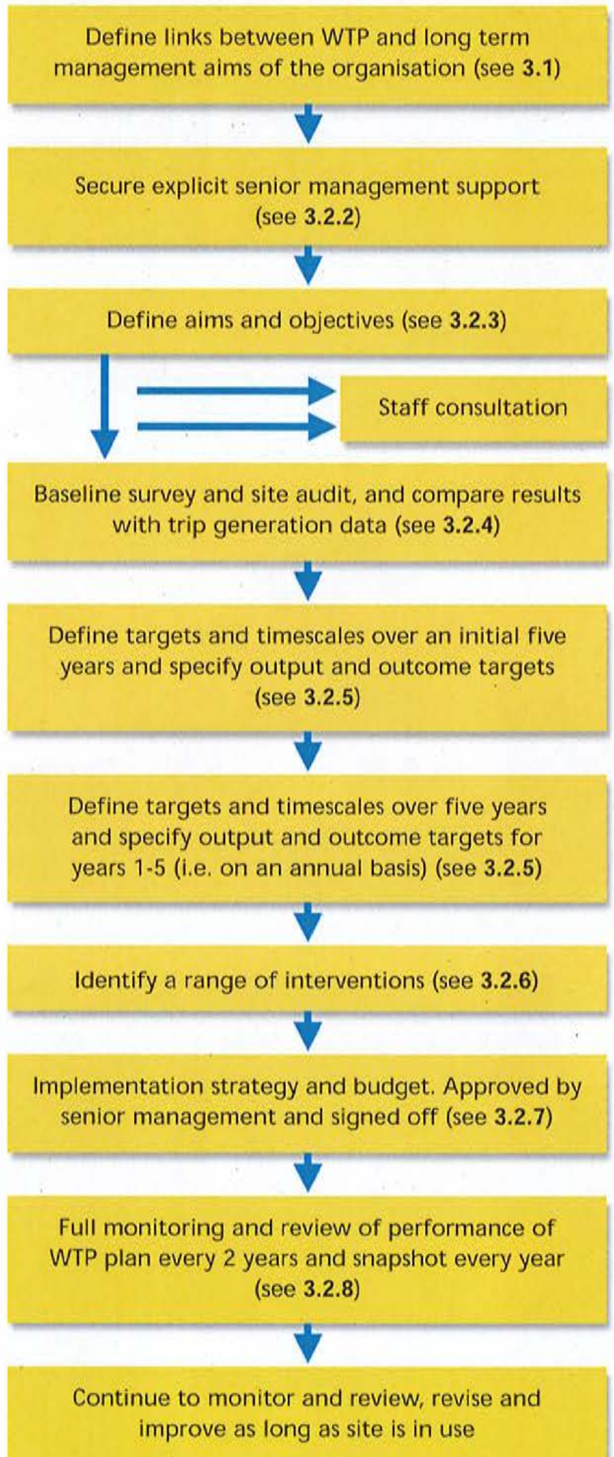
The process for the design, development and implementation of any WTP shall be configured into the areas of activity illustrated in Figure 1 (for existing sites) and Figure 2 (for new sites). The plan shall reflect the decisions and outputs from all development areas and shall document the steps taken to meet its objectives.

3.2 Existing sites

3.2.1 General

The organisation responsible for the design, development and implementation of a WTP for an existing site, for which conformance with this PAS is to be claimed, shall ensure that all the activity stages identified in Figure 1 and specified in **3.2.2** to **3.2.8** are included.

Figure 1 Activities to be undertaken for a travel plan for an existing site (voluntary travel plans)



3.2.2 Senior management support

The WTP and its implementation strategy shall have documented support from senior management.

This support shall be reaffirmed at appropriate milestones throughout the project e.g. budget allocation.

3.2.3 Defining aims and objectives

This section of the travel plan shall identify both the benefits that the travel plan will deliver and the issues which it is intended to address. These shall be set out as aims and objectives.

3.2.4 Measuring baseline travel behaviour

This section of the travel plan shall describe the organisation's travel survey design, methodology and execution and compare site specific results with trip generation data (such as census, National Travel Survey, trip generation databases, travel plan monitoring data etc),. It shall detail the results of consultation with staff and relevant groups (e.g. visitors, students) to establish a deeper insight into the nature of the problems and the range of interventions that are likely to be effective in achieving targets. It shall include an assessment of possible interventions and measures based on evidence from the smarter choices literature and from staff and other user groups, followed by an action plan selecting appropriate interventions.

Surveys shall be designed and carried out in line with the requirements in **Annexes C** and **D**.

NOTE *Annex B provides a list of sources of information on interventions and measures and the smarter choices agenda.*

3.2.5 Defining the targets to be achieved and the associated timescales

This section of the travel plan shall include specification of output and outcome targets (see **2.7** and **2.8**) and set out the action to be taken to achieve those targets. The actions identified shall be SMART (see **2.10**) with unambiguous requirements for monitoring and reporting. The targets shall be clearly broken down for years one through to five.

NOTE 1 *The targets and associated timescales should reflect industry good practice in consultation with the local planning authority.*

NOTE 2 *Annex E provides sources of information and examples of target setting.*

3.2.6 Identify a range of interventions

The WTP shall identify a range of interventions.

NOTE *The output of a WTP is the list of practical, deliverable, funded interventions that will deliver the targets and objectives. The DfT guidance documents listed in Annex B provide detailed information on what should be considered for inclusion in this list of interventions and those responsible for developing travel plans are strongly advised to investigate all possible interventions as part of the process of determining site-specific and organisationally relevant prioritized interventions.*

3.2.7 Implementation strategy and budgetary resources

This section of the travel plan shall include the implementation strategy for the first five years of the travel plan. The travel plan shall include evidence that the budgetary requirements of the implementation have been fully investigated and that sufficient resources have been allocated. Budget information and staffing inputs shall be explicitly included in the WTP documentation.

WTPs with adequate budgets and appropriately trained and experienced staff are more likely to be successful. It will be up to each organisation designing and submitting a travel plan to determine what is appropriate for staff and budgets. However, there shall be sufficient information available to give confidence that the WTP is adequately resourced and that these resources are commensurate with the number and variety of the interventions proposed in the travel plan.

NOTE *Communication with staff and visitors is a key element of a WTP and the active, well-informed participation of staff at an early stage is a good predictor of travel plan success. Resources should be deployed in such a way that staff are actively informed, involved and see themselves as full partners in the development of a travel plan.*

3.2.8 Periodic review

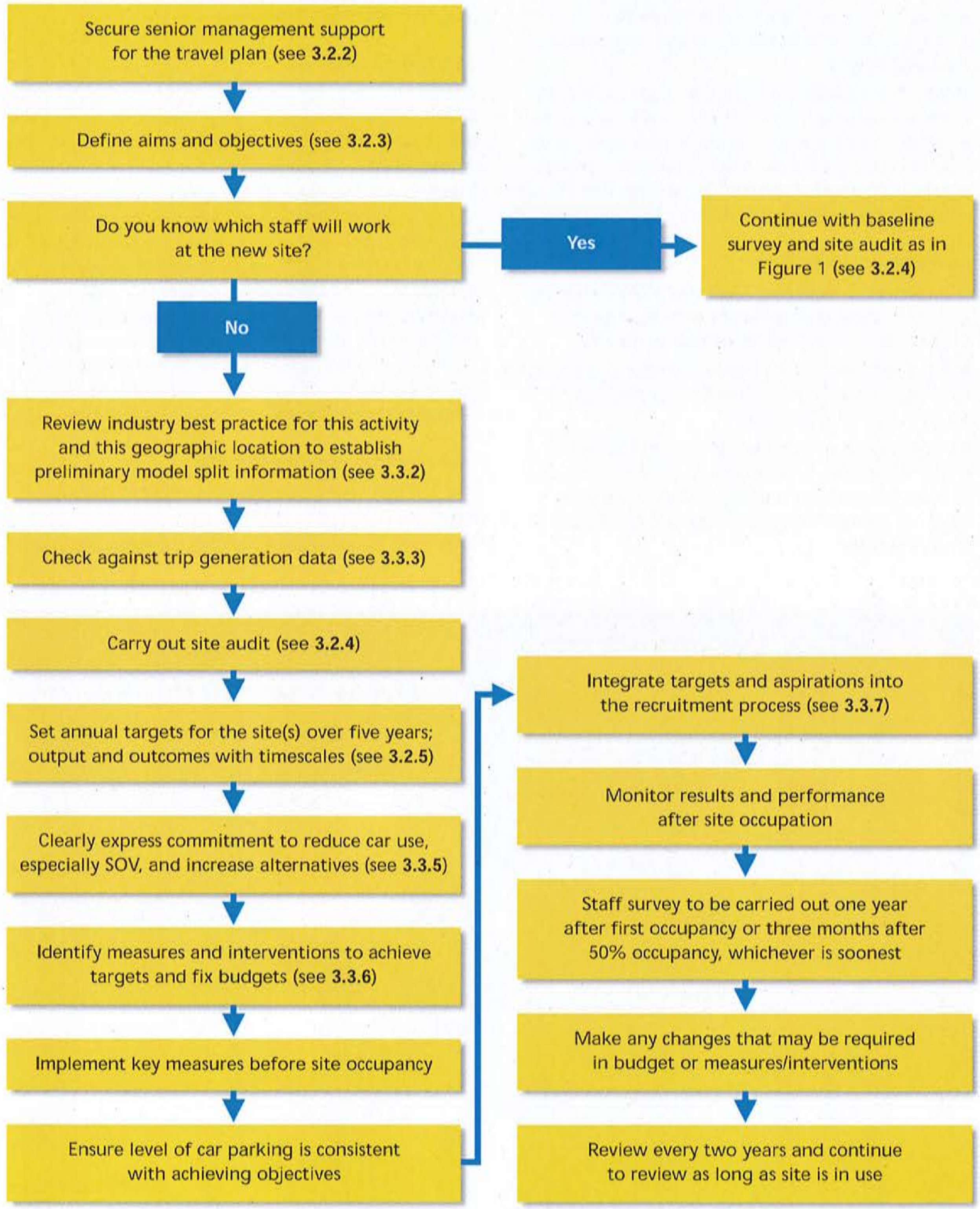
The WTP shall be reviewed annually and progress towards targets reported. Every five years there shall be a major review of the aims, objectives, targets and budgets to ensure that the WTP is still relevant to local organisational and geographical circumstances. The annual and five yearly reviews shall continue to be carried out as long as the site is a travel destination.

3.3 New sites

3.3.1 General

The organisation responsible for the design, development and implementation of a WTP for a new site, for which conformance with this PAS is to be claimed, shall ensure that all the activity stages identified in Figure 2 and specified in **3.3.2** to **3.3.8** are included.

Figure 2 Activities for a travel plan for a new site (planning obligation and planning related)



3.3.2 Establishing preliminary modal split information

A WTP for a new site shall make reference to good practice examples in the UK (see **Annex B**) to provide a clear picture of what the travel plan can achieve in the location type.

NOTE *When estimating possible outcomes from the WTP it should be assumed that WTPs will be effective and that significant improvements in the use of walk, cycle, public transport and car share can be achieved when compared to regional averages obtained from the National Travel Survey or similar sources of transport statistics.*

3.3.3 Trip generation data

Trip generation data (e.g. TRICS and TRAVL) shall be utilized to provide an evidence base in support of travel behaviour and modal choices in the UK.

NOTE 1 *There should be a presumption that a well-founded travel plan can improve on situations that have been in place for more than three years.*

NOTE 2 *Airports are not represented in trip generation databases. In these cases judgements will have to be used to assess the relevance of these databases for specific classes of use e.g. the retail or office functions located on an airport site.*

3.3.4 Site audits

A WTP shall include a site audit which meets the requirements given in **Annex C**.

3.3.5 Commitment

A WTP for a new site shall clearly express commitment to reducing single occupancy car use and increasing the use of more sustainable alternatives travel and working arrangements.

NOTE *There are two sources of baseline data for a new site and both can be used to provide a benchmark against which reductions in SOV use can be measured. The first is travel data. The National Travel Survey and national transport statistics both published by DfT give regionally specific modal split data for the journey to work. This can be used as a benchmark. The second source is already existing travel plans. Existing travel plans should be used as comparators to give an indication of what can be achieved over what timescale in the percentage of trips that are SOV trips.*

3.3.6 Measures and interventions

The WTP shall identify a range of interventions.

NOTE *The output of a WTP is the list of practical, deliverable, funded interventions that will deliver the targets*

and objectives. The DfT guidance documents listed in Annex B provide detailed information on what should be considered for inclusion in this list of interventions and those responsible for developing travel plans are strongly advised to investigate all possible interventions as part of the process of determining site-specific and organisationally relevant prioritized interventions.

3.3.7 Integration of targets and aspirations into the recruitment process

The targets and aspirations of the travel plan shall be integrated into the recruitment process for staff at the new site so that prospective staff can form a clear view on the importance of changing travel behaviour in favour of walking, cycling, car sharing, public transport and alternative working practices (as appropriate).

The WTP shall set out in detail, the package of benefits and recruitment incentives to be offered to prospective staff including discounted public transport offers and other physical and fiscal measures by means of which sustainable transport choice is to be rewarded. The WTP shall also include identification of the means whereby this information is to be made known to prospective staff.

3.3.8 Site design

The configuration of new sites shall be included in the development of WTPs as soon as the relevant information becomes available.

NOTE 1 *A travel plan retro-fitted on a site with large areas of car parking and little thought for the ways in which cyclists, pedestrians and public transport users can be prioritized through physical design is unlikely to be successful. A site that gives physical expression to the prioritization of walking, cycling and public transport users will have a much better chance of supporting a higher modal share for these users than would otherwise be the case.*

Design guidance on these principles can be found in Shaping neighbourhoods. A guide for health, sustainability and vitality [8].

Guidance on cycling can be found in the Nottinghamshire County Council Cycling Design Guide [9] and Design Standards [10] produced by TfL.

Guidance on walking and pedestrian facilities can be found in Pedestrian planning and design guide – The pedestrian network planning process [11].

NOTE 2 *Those involved with developing new sites should instruct appropriate professional groups (e.g. architects) to produce designs that enhance and celebrate walking, cycling and public transport use.*

4 Archiving and public availability

The WTP shall be made available (in a range of formats including, electronically) upon request by interested parties. This may be in a version from which information judged to be commercially sensitive has been removed.

NOTE *It is expected that the availability of this PAS will improve the consistency and quality of WTPs and that an increase in their general availability will accelerate the learning process and the dissemination of good practice.*

5 Classification grades

5.1 General

This PAS provides for three grades of conformance, Bronze, Silver and Gold. The requirements for each grade are given in **Clauses 5.2**, **5.3** and **5.4**, respectively. A matrix of these requirements is given in **Annex F**.

5.2 Bronze grade

5.2.1 Organisations having WTP(s) for which conformance with the bronze grade for PAS 500 is claimed shall ensure that the WTP meets the requirements given in **Clauses 3** and **4** together with those in **5.2.2** to **5.2.6**.

5.2.2 The WTP shall demonstrate that budgetary requirements have been fully investigated and sufficient budget and resources have been allocated to achieve the defined objectives.

5.2.3 The WTP shall be based on a survey, undertaken and analysed to identify the travel behaviour of existing/proposed staff and visitors. Where the survey has been undertaken for new sites, it shall be based upon evidence from secondary sources showing geographically relevant travel choices for the journey to work and travel in course of work.

5.2.4 The WTP shall identify a director/senior manager as holding overall responsibility for the travel plan strategy, its implementation and progress and for the individuals appointed to implement the plan.

NOTE 1 *The identified director/senior manager and the implementer(s) of the travel plan can be the same person.*

NOTE 2 *The appointed individual should be given the opportunity to undergo training in travel planning and associated issues.*

5.2.5 The WTP shall include an implementation strategy giving clearly defined targets and milestones covering at least five years.

5.2.6 The WTP implementation plan shall include a marketing and communications strategy covering at least five years.

5.3 Silver grade

5.3.1 Organisations having WTP(s) for which conformance with the silver grade for PAS 500 is claimed shall ensure that the WTP meets the requirements given in **Clauses 3**, **4** and **5.2** and that those set out in **5.3.2** to **5.3.8** are also met.

5.3.2 The detail of the WTP survey (**5.2.3**) including questions, results and the process of analysis to identify how the results will be used to achieve the travel plan objectives, shall be published.

5.3.3 The WTP targets specified for the first year shall have been achieved or where not achieved the requirements of **5.3.4** shall have been implemented,

5.3.4 Where a review of WTP targets is found to be necessary, the reasons for undertaking the review, detail of its findings and its outcomes shall be clearly documented and made available on request together with any supporting evidence, external to the review.

5.3.5 Implementation of the WTP shall have resulted in an increase in the use of alternative travel/work practices and a commensurate reduction in the proportion of SOV trips (see **A.4**) and evidence supporting this shall be made available.

NOTE *The reduction in SOV trips need not apply to organisations with an SOV mode share of less than 5%.*

5.3.6 A response rate of at least 30% of employees shall be achieved on the travel survey (see **5.2.3**).

5.3.7 Evidence shall be available that the detail of the WTP and the full list of measures in place to achieve WTP objectives have been communicated to all staff and remain available on request.

5.3.8 Evidence shall be available that staff members responsible for the implementation of the WTP have undertaken training on travel planning and/or its associated issues.

5.4 Gold grade

5.4.1 Organisations having WTP(s) for which conformance with the gold grade for PAS 500 is claimed shall ensure that the travel plan meets the requirements given in **Clauses 3**, **4**, **5.2**, **5.3** and that those set out in **5.4.2** to **5.4.6** are also met.

5.4.2 The WTP shall have been in operation for at least five years.

5.4.3 A survey undertaken in accordance with the specification provided in **Annexes C** and **D** shall have been undertaken at the end of year five and the results published.

5.4.4 The survey undertaken in response to the requirement in **5.3.2** shall have achieved a response rate of at least 50% of respondents approached

5.4.5 All targets included in the WTP for the first five year period shall have been achieved and evidence to support this shall be made available on request.

5.4.6 The organisation shall be able to demonstrate that good practice in WTP has been promoted, as opportunity arose.

NOTE *This could be achieved through conference presentations, articles in trade press, support of area-wide travel plans.*

6 Claims of conformity

6.1 General

Claims of conformance with this PAS shall be made in the principal documentation provided for the travel plan for which the claim is being made, in accordance with BS EN ISO/IEC 17050 [12] and in the form relevant to that particular claim as provided for in **6.3**. This statement shall include unambiguous identification of the organisation claiming conformance.

6.2 Scope of claim

In making a claim of conformance with this PAS, the organisation shall address all of the provisions of the PAS.

6.3 Basis of claim

6.3.1 General

The claim shall identify the type of conformity assessment undertaken as one of:

1. self-declaration in accordance with **6.3.2**;
2. other party validation in accordance with **6.3.3**.

NOTE *Attention is drawn to the fact that claims of conformity made in accordance with 6.3.3, are most likely to gain confidence.*

6.3.2 Self-declaration

In undertaking self-declaration, organisations shall be able to demonstrate how they meet the requirements of this PAS using supporting documentation. The appropriate method for self-validation and for presentation of the results shall be through the application of BS EN ISO/IEC 17050 [12].

NOTE *Organisations, for whom other party validation is not a realistic option, may rely on self-validation, but in so doing they should be aware that external validation could be required in the event of challenge and that potential customers could have less confidence in this option. Customers may well have strong preference for demonstration of independent other party validation.*

All claims of conformity based on self-declaration shall include identification of the basis of the claim, using the appropriate form of disclosure, as follows:

> "Workplace travel plan provided by [insert unambiguous identification of the claimant] in accordance with PAS 500, self-declared."

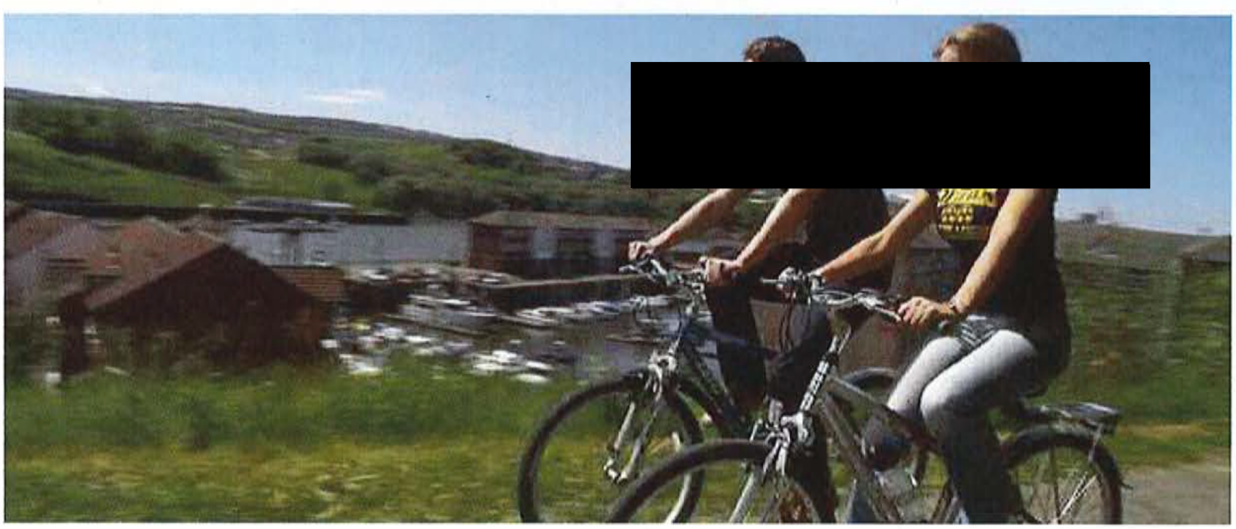
6.3.3 Other party validation

An organisation seeking to demonstrate that their WTP has been independently validated as being in accordance with this PAS, shall undergo assessment by an independent other party validation body that is able to demonstrate its compliance with recognized standards setting out requirements for such bodies.

NOTE *An example of such a recognized standard is BS EN 45011 [13].*

All claims of conformity based on other party validation shall include identification of the basis of the claim, using the appropriate form of disclosure, as follows:

> "Workplace travel plan provided by [include unambiguous identification of the entity acting as the provider] to PAS 500, National Specification for Workplace Travel Plans. [identification of verifying body]."



Annex A (informative)
Glossary

A.1 Active travel

Active travel is used to describe interventions that are designed to produce greater levels of physical activity especially walking and cycling and is used to link transport and health policy objectives. There is an assumption that "active travel" will make a contribution to reduced levels of obesity. More information can be found at www.sustrans.org.uk/default.asp?sID=1089735305687

A.2 Alternatives

The term "alternatives" is used to indicate alternatives to the single occupancy vehicle or SOV (see **A.4**). Alternatives include a variety of possibilities that go wider than traditional modal choices. In this PAS the term is used to include:

- All modal choices including bus, minibus, train, bike, walk, underground, tram, urban rail systems of any kind whether overground, underground or elevated and powered two wheeler;
- All alternatives to SOV that are car based including car share schemes, car clubs, taxis and guaranteed ride home schemes;
- All forms of electronic substitution that can be deployed to reduce the physical need to travel (videoconferencing, teleworking etc);
- All organisational changes that can be used to reduce the number of trips and or the distances travelled e.g. compressed working, the nine day fortnight, hot-desking, shared offices near to where people live.

A.3 Multi-modal count

Multi-modal counts are counts and/or surveys that set out to collect data on all possible modes of transport to a particular destination including walking, cycling and public transport.

A.4 Single occupancy vehicle (often referred to as SOV)

This is a vehicle where the only occupant is the driver.

A.5 Transport Demand Management (often referred to as TDM)

The now generally accepted view of TDM is: "*designed to better balance people's needs to travel with the capacity of available facilities to efficiently handle this demand*".

If 'predict and provide' was the old approach to transport planning then TDM is the new approach – a new paradigm in transport planning. However TDM means more than just 'managing' – implicit in the use of the term is the assumption that it is accompanied by the implementation of sustainable mobility, introduction of full cost pricing and organisational/structural measures to ensure a broad range of complementary interventions work effectively together to realise the benefits of integration. It is the *unifying philosophy* of TDM that underpins the policy objective of a more sustainable system of transport. Put another way, TDM is the approach by which we deliver a more sustainable system of transport and is not just a stack of measures and initiatives called TDM.

TDM is based on three inter-linked assumptions:

- Meeting year on year increases in the demand for mobility into an indefinite future is not feasible or desirable and does not represent value for money;
- It will continue to be necessary to satisfy the need for access to services and facilities and this can be achieved through a variety of mechanisms including greater attention to locational decisions, better quality alternatives, the substitution of electronic communication for physical travel where appropriate and greater levels of mixing of modal choices and organisational changes to reduce the need to travel;
- Pricing and charging are important so that transport choices and decisions can be based on accurate costings and prices. An example of this is parking. The provision of parking spaces is costly and it is fair to build those costs into a pricing regime.

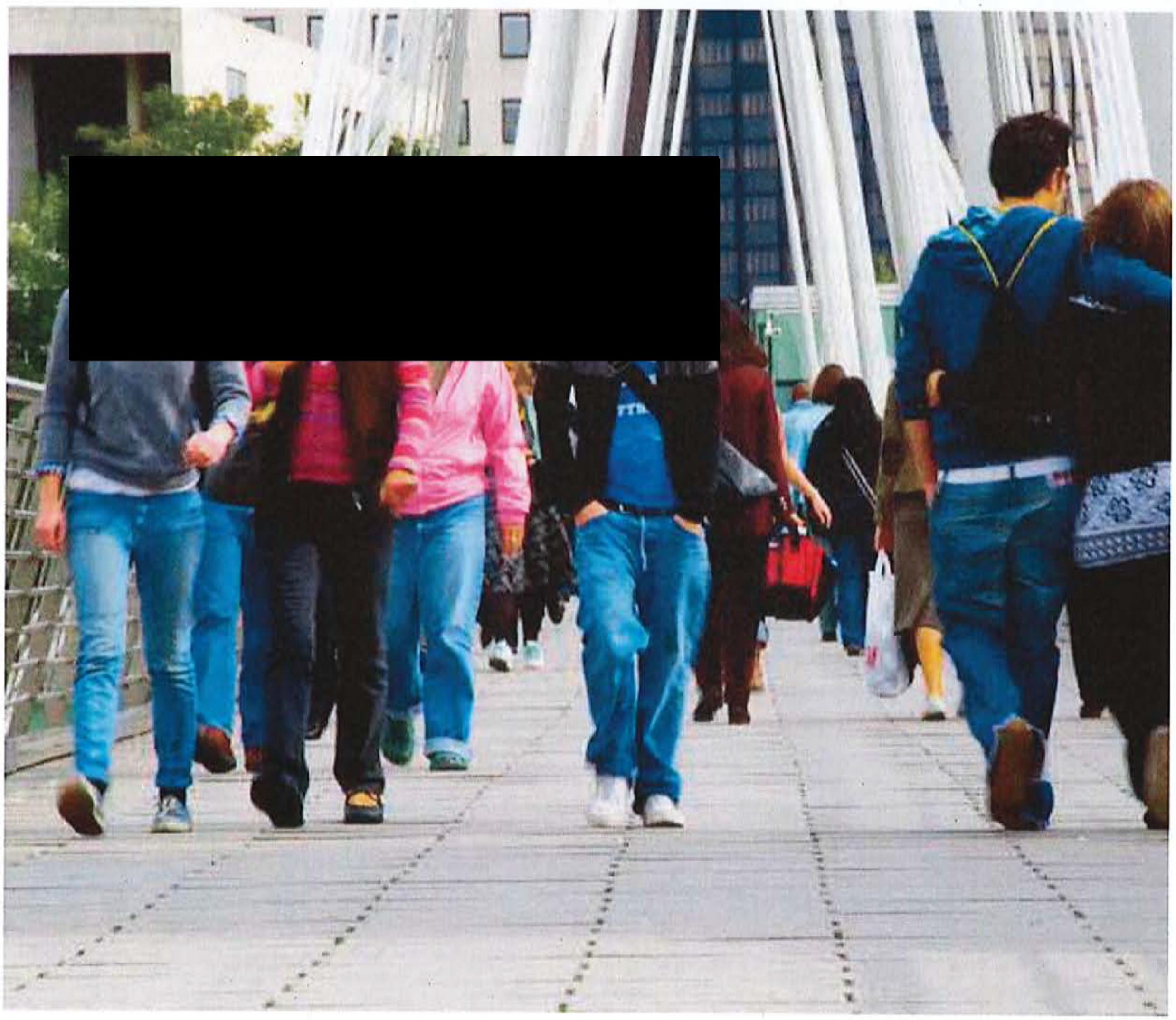
NOTE 1 *Parking and its management is a crucially important issue in designing and implementing travel plans. Those preparing travel plans should take a view in consultation with the local planning authority on what is an appropriate number of parking spaces for that site and what is an appropriate charging regime for those spaces. Chapter 11 of the DfT publication "The essential guide to travel planning" referred to in Annex B contains guidance on parking and parking management in travel plans.*

NOTE 2 *Further guidance can be found in How to create a travel plan – Managing car parking [14].*

Travel planning is an important part of an effective TDM, usually referred to as an 'organisational' component of TDM as shown in Table A.1.

Table A.1 Summary of the components of an effective TDM strategy

	Component	Focus
A	Physical	infrastructure to make TDM happen
B	Operational	technology to manage demand and maximize operational effectiveness
C	Financial	using economics to affect trip choice
D	Organisational	integration with other activities
E	Research	analysis to evaluate performance
F	Political	commitment to address obstacles and provide appropriate funding
G	Integration	effective inter-disciplinary communication and work practices



Annex B (informative)
Publications, government guidance and best practice on workplace travel plans

B.1 General

The Department for Transport has produced general guidance on travel plans in its publication "The essential guide to travel planning", March 2008.

www.dft.gov.uk/pgr/sustainable/travelplans/work/essentialguide.pdf

The same DfT publication identifies the main sources of guidance and support for WTPs.

NBTN has prepared a useful guide to the taxation implications of travel plans and all those involved with travel plans should consult this guidance. It can be found on: www.nbtn.org.uk/NBTN_ADVISORY_NOTE_1.pdf

In addition to this guidance, the NBTN has published an advisory note on the inclusion of powered two wheelers in travel plans. The note can be found on the NBTN website at www.nbtn.org.uk

Guidance on travel plans can be found in documents from the Welsh Assembly Government, the Scottish Government and the Northern Ireland Executive.

Welsh Assembly Government
Planning Policy Wales. Technical Note 18, Transport
http://new.wales.gov.uk/docrepos/40382/epc/planning/403821/40382/1333429/TAN_18_Final_April_2007.pdf?lang=en

Scottish Government
Travel Plans: an overview
www.scotland.gov.uk/Publications/2002/10/15454/11007

Northern Ireland Executive
Workplace Travel Plans
www.travelwiseni.co.uk/index/employers/workplacetravelplans.htm

WTP guidance relating to travel plans in London can be found at www.newwaytowork.org

B.2 National Business Travel Network

National Business Travel Network (NBTN) is a business network which enables organisations to share best practice and promote the business case for travel plans and Smarter Choices. Through regular meetings and a range of resources, NBTN members can engage with other businesses, develop partnerships, access free information and tools and provide advice and feedback to Government on related policy issues. A Department for Transport initiative, NBTN promotes and demonstrates the benefits to business of sustainable travel measures, working in partnership with and supporting existing organisations and networks.

For further information, contact info@nbtn.org.uk

B.3 Department for Transport

Information and resources on travel planning can be found on the 'Sustainable travel' section of the Department for Transport website www.dft.gov.uk/pgr/sustainable/

The DfT THINK campaign has a number of resources available on its website. www.thinkroadsafety.gov.uk/campaigns/drivingforwork/employers.htm

B.4 ACT TravelWise

ACT TravelWise is the leading network for travel planning expertise in the UK. A membership association of large public and private sector employers, it provides support and information to organisations on implementing effective travel plans, as well as news, contacts and services.

For more information, contact ACT TravelWise on 020 7348 1970 or see www.acttravelwise.org

B.5 Transport Direct

www.transportdirect.info is a free website that provides travel information and enables journey planning by car and public transport to any destination in Great Britain.

B.6 RoadSafe

RoadSafe is acknowledged as a leading forum for promoting and devising solutions to road safety problems. www.roadsafe.com

B.7 Bike for All

www.bikeforall.net is a gateway to find cycling promotion, contacts and sources of information.

B.8 Carplus

Carplus offers information, advice and support to communities, local authorities and partner associations developing car share hubs across the UK. www.carplus.org.uk

B.9 Telework Association

The Telework Association provides information, advice and support to enable individuals and managers to make a success of mobile, home-based and flexible ways of working.

For more information contact enquiries@telework.org.uk or 0800 616008 or see www.tca.org.uk

B.10 Other sources of information

The Department for Transport has published several reports on the definition of a travel plan, best practice and case studies and these are summarized and referenced on the DfT web site: www.dft.gov.uk/pgr/sustainable/travelplans/work/publications/travelplans?page=1#a1003

A full travel plan resource pack setting out clear guidance and information on every stage of the travel plan process with case studies is available on www.travelplans.org.uk/index2.html

In 2004 DfT published its "Smarter Choices" report which contains a full review of the performance of WTPs and how they can contribute to achieving transport policy objectives. The report can be downloaded from www.dft.gov.uk/pgr/sustainable/smarterchoices/ctwwt/chapter3workplacetravelplans

The "Smarter Choices" report reviews case studies of travel plans in seven locations in England and discusses the costs of travel plans, their effectiveness and take-up by public and private sectors.

MerseyTravel has produced clear guidance on travel plans and the content is of general relevance and not limited to Liverpool and the surrounding local authorities www.letstravelwise.org/travelwise/travel-plans.html and www.letstravelwise.org/116/

London guidance on WTPs is also of general relevance to the content and quality control of WTPs wherever the organisation is based. The main document "*Guidance for workplace travel planning for development*" has been produced by Transport for London (March 2008) and is available on www.tfl.gov.uk/assets/downloads/corporate/Guidance-workplace-travel-planning-2008.pdf

TfL also has a suite of publications on other aspects of travel plans including cycling, smarter working and car sharing and they can be downloaded from www.tfl.gov.uk/corporate/projectsandschemes/workplacetravelplanning/7680.aspx

The same source of downloads has a selection of documents aimed specifically at travel plans for NHS sites (including hospitals).

Most local authorities have specialized travel plan officers who are able to assist and advise on WTPs and they should be contacted in the early stages of travel plan formulation.

Annex C (normative)
Survey checklist

C.1 Information for all sites

The surveys and information gathering exercises carried out at new and/or existing sites shall include the following information:

For both new and existing sites:

- Date of compilation of this checklist;
- Organisation name;
- Organisation address (including post code);
- Name of local authority area in which site is located;
- The details of any planning applications or consents related to this site (including application number);
- The name and full postal address of the business park or industrial estate where the site is located if it is located in one of these categories;
- Name and job title of person responsible for the travel plan;
- Contact details (e.g. e-mail, telephone number, fax number);
- Land use category (please tick which category your organisation falls under).

C.2 Land use categories

The land use categories selected shall follow the definitions and use classes in the following documents. In all cases those using these official classifications of land use should check for subsequent amendments.

England

www.planningportal.gov.uk/england/genpub/en/1011888237913.html. The latest amendment to this document was issued in 2006 and can be found on: www.opsi.gov.uk/si/si2006/20060220.htm

Wales

www.opsi.gov.uk/legislation/wales/wsi2002/20021875e.htm

Scotland

www.opsi.gov.uk/si/si1997/19973061.htm

Northern Ireland

www.opsi.gov.uk/sr/sr2004/20040458.htm

C.3 Existing sites

For existing sites the following information shall be reported in the WTP:

General

- Total number of employees identifying those in full time, part time and those involved in shift work
- Details of the travel plan budget in each of the first 3 years of the currency of the plan

Car parking

- Number of car parking spaces by category:
  - Employees (total)
  - Senior Staff
  - Disabled
  - A drop off point
  - Patients
  - Visitors
  - Essential car users
  - Car sharers
  - Pool cars
  - Fleet vehicles (excluding HGVs)
  - HGVs
  - Other *(please describe)*
- How are the spaces managed:
  - Free for all
  - Needs based
  - According to grade
  - Allocated spaces
- The charge per space per day or per other period (It should be stated if no charge is made)
- Details of car share programme or car club availability
- Details of guaranteed ride home scheme (if present)
- Bicycles:
  - Number of bicycle spaces
  - Are there cycle racks? (Please specify number by category)
    - Covered
    - Secure
    - Lit
    - Overlooked by CCTV
    - Near building entrance(s)
- Details of the incentives to cycle which are in place focusing specifically on assisted bike purchase, tax-free bike purchase, bike maintenance, discounted purchase of bike clothing and accessories, shower facilities and lockers
- Details of bike mileage allowance for use of bike on work purposes

Pedestrians

- Details of pedestrian access to the site and condition of footpaths including lighting and CCTV (both public paths and on site)

Motorcycling

- How many motorcycle parking spaces exist and how many are:
  - Conveniently near the entrances(s) to the building(s)?
  - Secure?
  - Covered?
  - Lit?
  - Overlooked by CCTV?
- The business mileage rate for motorcyclists

Public transport

- Details of public transport facilities in close proximity to the site including how many bus stops are within 400m of the site
- What is available at each bus stop:
  - Are there any shelters?
  - Are they clean?
  - Are they well lit?
  - Is there timetable/live travel information?
  - Are there seats?
- Which services currently use these bus stops?
- Is there a railway station near the site? Give the name or names of any stations within 800m of the site.
- Is there a tram stop near the site? Give details of the name of the stop and its location.
- Are there private buses/minibuses run for staff and/or visitors to the site?
- Are any of the following available:
  - Free rail/bus season tickets
  - Subsidised rail/bus season tickets
  - Rail/bus season ticket loans
  - Clothing allowance (walkers, cyclists, motorcyclists)
  - Equipment allowance (walkers, cyclists, motorcyclists)
- Smart working practices adopted by the organisation including details of the following:
  - Flexi-time

- Teleworking
- Teleconferencing
- Audioconferencing
- Compressed working week
- Home working
- Hot-desking

C.4 Scope of the baseline survey

The baseline survey shall produce actual numbers of staff travelling to work by all the modes listed in Table C.1.

This table shall report actual numbers and not percentages and shall be based on an actual survey.

It shall include the date of survey on which this table is based.

Table C.1 Summary of baseline data and requirements by mode

Mode	Actual number
Car driver alone (SOV) (see A.4)	
Car as passenger	
Motorbike	
Bus	
Tram	
London underground	
Rail (suburban rail and main line rail)	
Metro (e.g. Merseyrail, Tyne and wear Metro)	
Bike	
Bike and train (combined)	
Foot	
Other	

C.5 Targets

C.5.1 New sites

Surveys for new sites shall identify a target based on the percentage of all staff that will travel to the new site by car alone (SOV or single occupancy vehicle).

C.5.2 Existing sites

Any targets based on modal shift shall be provided as "percentage point change" targets e.g. an increase in the current level of cycling by 5% (percentage points) means that a baseline share of 10% would now be 15%. Actual figures shall also be shown so that if 100 people were cycling in the baseline data a 5% increase would mean that 105 people are now cycling.

All targets shall be listed as detailed in Table C.2 (the first line is an example for illustrative purposes only):

Table C.2 Summary of targets

	Details of target	% change required	Baseline number and date	Target number and date
Target 1	Increase cycling levels	+5%	100 cyclists at 30 May 2008	105 cyclists at 30 May 2009
Target 2				
Target 3				
Target 4				

Where modal shift targets cannot be specified (e.g. in the case of a completely new development where there is no baseline data) there shall be a target based on the percentage of staff who will travel to the specified site by SOV (single occupancy vehicle) (see **A.4**) e.g. "No more than 40% of all staff will travel to work by car as driver (SOV) by [insert month and year]"

The organisation shall determine the actual percentage.

Annex D (normative)
Survey methodology including trip generation databases

D.1 Evidence base

The WTP shall be based on an evidence base resulting from at least the following:

- The results from an employee survey;
- The results from a visitor survey;
- Multi-modal count (direct observation at all site entry and exit points);
- Vehicle parking counts by type of vehicle and throughout the day and including any off-site parking where this has been provided as part of the parking option for staff and visitors;
- Deliveries (number of vehicles, types of vehicles).

D.2 Employee survey and travel diary

NOTE 1 *For most organisations seeking to develop a travel plan this will mean a survey of existing staff to establish the baseline travel data and modal choices.*

NOTE 2 *PAS 500 does not provide a "ready made" survey. Many of the sources of information in Annex B provide examples of surveys and survey design suggestions and the Transport for London publication "Guidance for workplace travel planning for development" (March , 2008) covers survey methodology and trip generation databases in Appendix 11.*

A survey of the travel behaviour of existing staff at a workplace shall include questions that will provide accurate and reliable information on the following:

- Home origin of trips defined by home postcode;
- Destination identified by postcode;
- Distance from home to work;
- Choice of mode for the journey to work in sufficient detail to identify multi-modal trips (e.g. a walk to a bus stop or cycle to a railway station);

This information shall be collected for both the journey to work and the return journey.

Modes shall include walk, cycle, car with driver alone (generally referred to as Single Occupancy Vehicle Use or SOV) (see **A.4**), car as passenger, train, tram, other. Attitudinal questions about propensity to change shall also be included.

NOTE 3 *Attitudinal questions are useful as part of the process of discussing options and interventions with staff and other interested parties. A question of the kind "Would you be more likely to cycle to work at least two days a week if there were a segregated cycle path along the main road to this site?" is very useful for stimulating discussion and supporting the psychological processes underpinning behavioural change. These questions should be relatively few in number and should be linked to questions about the degree of support for particular interventions and packages of measures e.g. "Would you support the introduction of a parking charge of £5 per day where the income from this charge was used to fund a 30% discount on buses in this area?"*

Personal data on age/job grade/job location/gender/disability/ethnicity/full time or part time shall be gathered.

Those competing the survey shall be encouraged to make their own comments about travel issues relevant to their site.

The survey shall be structured to enable trip variability to be captured (e.g. I work from home on a Friday, cycle on a Monday but drive on the other days).

NOTE 4 *Where possible, staff travel surveys should be carried out online. This saves paper, time and money and the answers can be directly entered into standard software for statistical analysis (e.g. SPSS) to produce descriptive statistics, tables, diagrams and histograms.*

Where appropriate, the survey results shall be presented in visual form in order that the significance of the survey results is understood by all those responsible for making decisions about the travel plan. This shall include a "dot-map" showing the home locations of staff.

The dot-map shall be marked so that it shows concentric circles around the site at a radius of 1-5 km, 6-10 km, 10-20 km or any other radii that local conditions would indicate are useful. The detail on the map in terms of individual streets and house numbers shall not be such as to identify individual addresses and the map need not be published.

NOTE 5 *The dot-map is intended to stimulate and inform the internal discussion about the role of walking, cycling, bus routes and other transport choices that are specifically relevant to the site in question. For publication purposes it is recommended that a table be drawn up showing how many staff live within specific distance bands of the site in question.*

The results of the staff travel survey shall be benchmarked against information contained in standard trip generation databases.

NOTE 6 Examples of such databases are TRAVL which is largely London based and TRICS which is national with some sites in London.

NOTE 7 The purpose of benchmarking is to show how the baseline and subsequent travel survey updates perform against what is recorded at comparable sites in trip generation databases.

NOTE 8 Where TRICS and TRAVL are used these should be modified so that:

- *they adopt the same definitions of trips and measure multi-modal trips in the same way;*
- *incorporate spatial information (postcodes) into their databases;*
- *adopt the same system of land use classification;*
- *adopt the same definitions of trips rates so that results across TRICS and TRAVL and at WTP sites can be compared;*
- *agree a protocol on the ways that survey days are defined (it is not helpful if data collected on different days are compared one with another across two databases).*

NOTE 9 Information is not currently collected by both organisations in a directly comparable way and the increase in travel plan numbers in London and nationally and the importance of quality control and the widespread adoption of PAS 500 would suggest that there are considerable advantages to be gained from harmonization between the databases and the survey methodology in PAS 500.

Annex E (informative)
Sources of information and examples of target setting

The DfT publication, "*The essential guide to travel planning*", presents information on the performance of travel plans which is a key source of guidance on targets:

> Whether your targets are entirely internal or required as part of a planning agreement, they should be both achievable and stretching. The information that you have collected through surveys and other means will enable you to make a judgement about the opportunities for change. To arrive at targets, you need to access these opportunities against the effort and money that your organisation can commit to them.
>
> The overall target should be expressed in terms of reducing driver trips to site, which can usefully be expressed as the number of commuter cars arriving per 100 employees. This measurement allows you to judge your progress over time, even if staff numbers on site go up or down, and enables direct comparison with the performance of other organisations, whatever their size. You may also find it helpful to set sub-targets to show the increases you aim to achieve in other ways of travelling to your site, such as walking or public transport, and a target for reducing the proportion of business travel made by car.

DfT "*The essential guide to travel planning*", March 2008

www.dft.gov.uk/pgr/sustainable/travelplans/work/essentialguide.pdf

The DfT report recommends looking at the performance of other travel plans and using this information as a guide to what can be achieved at the site under discussion. Targets should be "achievable and stretching" but there should also be recognition of the link between targets and the potency of interventions. Poor quality interventions within a generally aspirational context will produce very little modal shift whereas large scale intervention with incentives and disincentives and dramatic improvements in bus quality will produce significant shifts in travel behaviour. The example of Pfizer at its Sandwich (Kent) manufacturing plant is often quoted as a significant intervention producing a good result:

www.kent.gov.uk/transport-and-streets/sustainable-transport/travel-plans/pfizer-travel-plan.htm

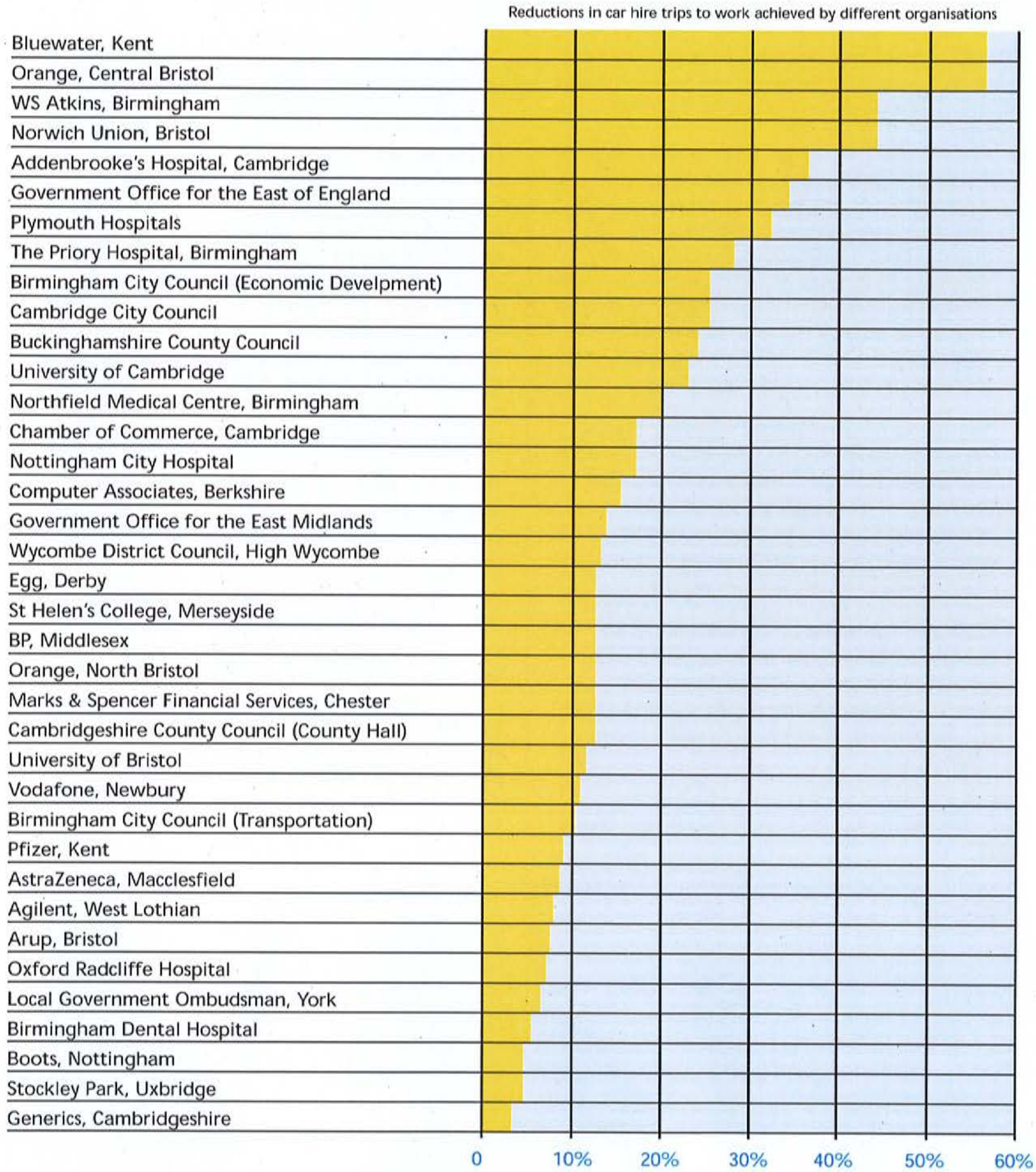
The reports from DfT, "*Making travel plans work*", provide case studies and guidance on setting targets and they should be a starting point for any target setting exercise:

www.dft.gov.uk/pgr/sustainable/travelplans/work/publications/makingtravelplansworklessons5783

www.dft.gov.uk/pgr/sustainable/travelplans/work/publications/makingtravelplansworkresearc5784

Figure E.1, taken from "*The essential guide to travel planning*", summarises the results of some of the travel plans most frequently quoted in the UK.

Figure E.1 Results of some of the travel plans most frequently quoted in the UK



Source: DfT "*The essential guide to travel planning*", March 2008, page 20
www.dft.gov.uk/pgr/sustainable/travelplans/work/essentialguide.pdf

An example of target setting practice in the NHS has been published by TfL:

Croydon Primary Care Trust set the following targets (Table E.1) and, in their executive summary to the Board for approval of the travel plan, included a justification as to how and why the targets had been set:

Table E.1 Sample targets

Target	Comment
To increase the proportion of staff cycling/walking for to/from work from 1% to 7% by December 2006.	The staff travel survey showed that 56% of respondents live within five miles of their place of work, suggesting that there is much scope for increasing walking/cycling for the journey to/from work. In addition, 29 of the 42 respondents who live less than 2 miles from their place of work usually travel to work by car, suggesting that there is scope for a shift from car use to walking amongst these staff.
To increase the proportion of staff travelling by public transport to/from work from 22% to 25% by December 2006.	The travel survey showed that there was scope for increasing use of the bus, train and Tramlink, with 8%, 12% and 2% currently travelling by these modes respectively.
To reduce the proportion of staff driving to work from 73% to 63% by December 2006.	The reduction in car use will be achieved through increases in walking, cycling and public transport use, and will be supported by encouraging car sharing.
To increase bus use for travel on Trust business from 15% to 20% by December 2006.	76% of staff currently use their own car as the main mode of transport when travelling on Trust business. However, there was a feeling that alternatives to the car could often be used for Trust business. In particular, it was felt that taxis were often used when bus would provide a better and cheaper alternative.

Great Ormond Street Hospital NHS Trust set the following targets in October 2003:

- To increase the proportion of cyclists regularly cycling all, or some of the way to work, from 7% to 9% by January 2006.
- To increase the proportion of cyclists occasionally cycling all, or some of the way to work, from 2% to 4% by January 2006.
- To increase the proportion of staff regularly walking to work as their main mode from 9% to 11% by January 2006.
- To reduce the proportion of staff driving alone to the site from 5% to 4% by January 2006.
- To ensure that any reduction in public transport mode split from 79% is due to a transfer to walk/cycling and not a transfer to car use.

Source: www.tfl.gov.uk/assets/downloads/corporate/06-objectives-targets-and-monitoring.pdf

Target setting is essentially a matter for local determination but there should be a presumption that all sites can perform as least as well as case study sites showing similar characteristics and an assumption that the travel plan is serious and willing to apply best practice and deploy a raft of measures that are known to work with as many measures as possible working synergistically to achieve the targets set.

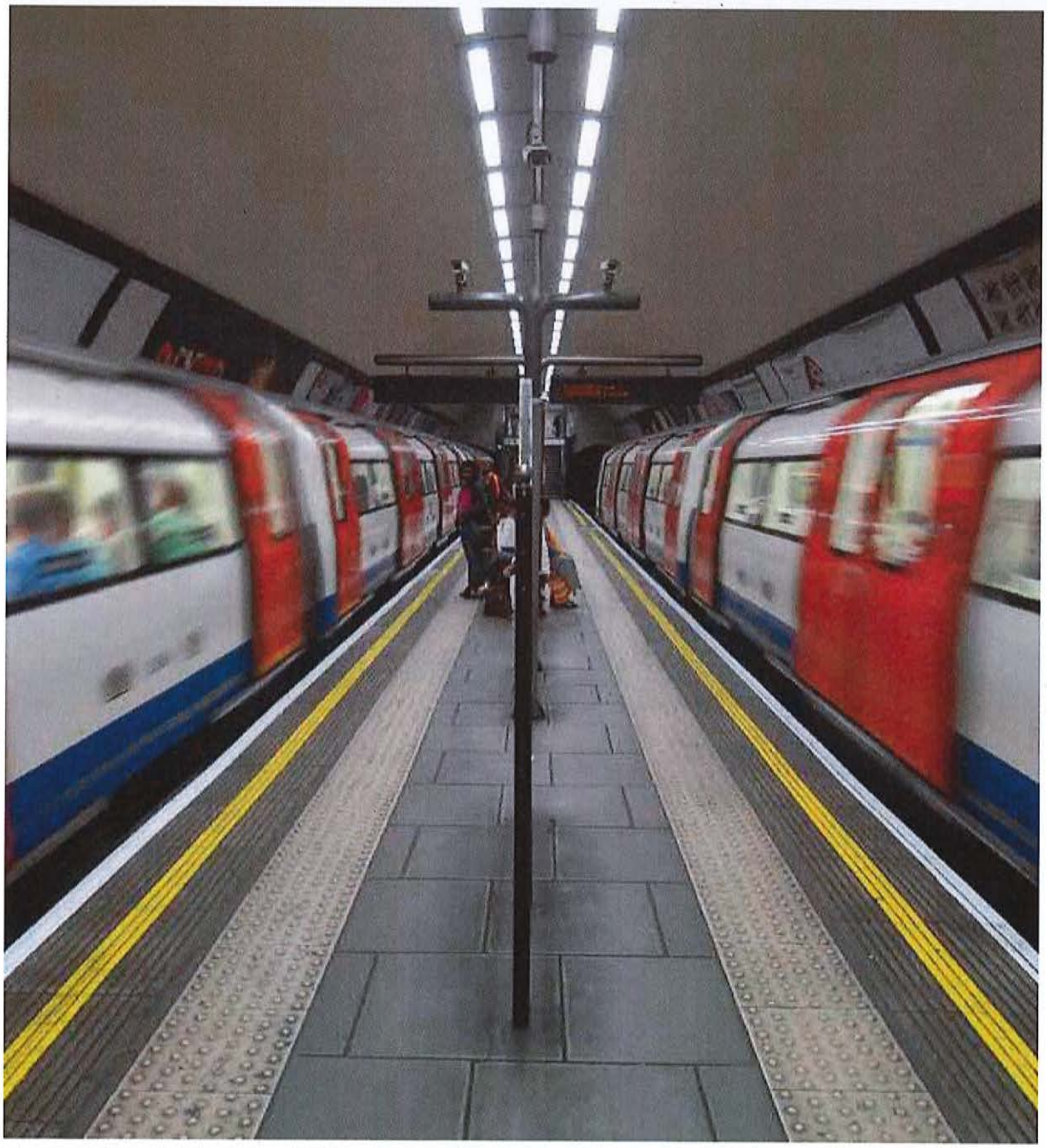
Annex F (normative)
Classification grades matrix

Figure F.1 provides a matrix of the classification grade requirements defined in **Clauses 5.2, 5.3** and **5.4.**

Table F.1 Classification grade matrix

	Bronze	Silver	Gold
Requirements of clauses 3 and 4 met	✔	✔	✔
Budgetary requirements met	✔	✔	✔
Survey carried out and analysed (existing sites)	✔	✔	✔
Secondary sources on travel behaviour evaluated for new sites	✔	✔	✔
A named director or senior manager has overall responsibility	✔	✔	✔
A named individual is responsible for implementation	✔	✔	✔
Implementation strategy with targets and milestones for five years	✔	✔	✔
A marketing and communication strategy shall be in place for a five year period	✔	✔	✔
Travel survey questions and results shall be published and survey must have a 30% response rate		✔	✔
First year targets achieved		✔	✔
There shall be an increase in the use of alternative modes and a reduction in SOV trips		✔	✔
Full list of measures shall be communicated to all staff and made available on request to others		✔	✔
The member of staff responsible for implementation shall have completed training		✔	✔
The travel plan shall have been in place for five years			✔
A full survey shall be carried out at the end of year five and the results published			✔
The response rate for this survey shall be at least 50%			✔

	Bronze	Silver	Gold
There shall be evidences that all the targets in the travel plan up to and including year five have been achieved			✔
Good practice in travel planning shall be promoted to a wider audience			✔



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United Kingdom

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