TOWN AND COUNTRY PLANNING ACT 1990
PINS REFERENCE:

APP/A2280/W/20/3259868

STATEMENT OF CASE
OF
MEDWAY COUNCIL

APPEAL BY A C GOATHAM & SON

LAND OFF PUMP LANE

RAINHAM

KENT

ME8 7TJ

NOVEMBER 2020

Carter Jonas

CONTENTS

1.0 INTRODUCTION

1.1 This Statement of Case relates to an appeal made by A C Goatham & Son ("the Appellant") against the decision of Medway Council ("the Council") to refuse to grant planning permission for the following development ("the Proposed Development"). It should be read together with the delegated report which set out the Council's reasons for refusing permission.

1.2 The scheme, the subject of this appeal, was submitted to the Council on 13 June 2019 and given the application reference number MC/19/1566. Its proposal was an:

> *"Outline planning application with some matters reserved (appearance, landscaping, layout and scale) for redevelopment of land off Pump Lane to include residential development comprising of approximately 1,250 residential units, a local centre, a village green, a two form entry primary school, a 60 bed extra care facility, an 80 bed care home and associated access (vehicular, pedestrian, cycle).."*

1.3 Following its refusal on 12 June 2020, an appeal was submitted and given the reference APP/A2280/W/20/3259868.

1.4 The scheme, the subject of this appeal, was refused for the following reasons:

> *Reason 1*
> *Insufficient information has been provided in relation to mitigation measures, and no agreement has been reached to secure such measures, which are necessary to ensure that there will be no adverse impact on the integrity of the Medway Estuary & Marshes SSSI, SPA and Ramsar site as a result of the additional recreational pressures caused by the proposal.*
>
> *In the absence of imperative reasons of overriding public interest, Regulations 63 and 70 of the Habitats Regulations require permission to be refused.*
>
> *In addition, the lack of information and mechanism to secure the mitigation also results in non-compliance with policies S6 and BNE35 of the Local Plan and NPPF paragraphs 175 &176.*
>
> *Reason 2*
> *The proposed development would have a harmful impact on the local historic landscape, as well as the setting and significance of a number of designated heritage assets, including: listed buildings (York Farmhouse (Grade II); Pump Farmhouse (Grade II); Chapel House (Grade II); 497-501 Lower Rainham Road (Grade II); The Old House (Grade II); Bloors Place (Grade II*); a range of outbuildings including cart lodge and granary west of Bloors Place (Grade II); and, the garden walls to south and east of Bloors Place (Grade II)); and, two Conservation Areas (Lower Twydall; and, Lower Rainham).*
>
> *Applying the great weight which has to be given to the conservation of the designated heritage assets (by virtue of NPPF paragraph 193 and Section 66(1) of the Planning (Listed Buildings and Conservation Areas) Act 1990),*

the proposal is contrary to Local Plan policies BNE 12 and BNE18. In addition, as the public benefits of the scheme would not outweigh the harm to the designated heritage assets, the proposed development is also contrary to the NPPF paragraph 196.

Reason 3
The proposed development would lead to significant long-term adverse landscape and visual effects to the local valued Gillingham Riverside Area of Local Landscape Importance (ALLI), which would not be outweighed by the economic and social benefits of the scheme, in conflict with Local Plan policy BNE34 and NPPF paragraph 170.

Reason 4
The applicant has failed to satisfy Highways England that the development will not materially affect the safety, reliability and / or operation of the Strategic Road Network (SRN). This is contrary the tests set out in department for Transport Circular 2/13 paragraphs 9 & 10 and the NPPF at paragraph 109.

Reason 5
The cumulative impact from the increased additional traffic cannot be accommodated on the highway in terms of overall network capacity without a severe impact. This is contrary to Local Plan policy T1 and the NPPF at paragraph 109.

Reason 6
The cumulative impact from the increased additional traffic from the development is unlikely to be able to create a safe highway environment. This is contrary to Local Plan policy T1 and the NPPF at paragraph 109.

Reason 7
No assessment nor technical details have been provided regarding the two new access points along Pump Lane to serve the proposed development, therefore it has not been possible to appropriately assess the adequacy of these access points. This is contrary to Policy T1 of the Medway Local Plan 2003 and paragraph 109 of the NPPF.

Reason 8
The proposed development would result in the irreversible loss of 'best and most versatile' (BMV) agricultural land, contrary to Local Plan policy BNE48 and the NPPF at paragraph 170 and footnote 53.

Reason 9
In the absence of a completed S106 legal agreement, the proposal fails to secure infrastructure necessary to meet the needs of the development. This is contrary to Local Plan policy S6 and the NPPF at paragraph 54.

1.5 The relevant officers report and delegated Decision Notice were attached to the Council's appeal questionnaire.

2.0 STATEMENT OF COMMON GROUND

2.1 The Council will work with the Appellant to produce a Statement of Common Ground in good time before the Inquiry.

3.0 PLANNING POLICY FRAMEWORK

3.1 The Council's starting point will be section 70(2) of the Town and Country Planning Act 1990 and section 38(6) of the Planning and Compulsory Purchase Act 2004 which, read together, require that the appeals are determined in accordance with the Development Plan unless material considerations indicate otherwise.

3.2 The relevant Development Plan for these purposes comprises the Medway Local Plan 2003 (the Local Plan).

3.3 The Council will draw on those policies in the Development Plan that are relevant to the appeals and will refer, in particular, to those policies listed in its reasons for refusal.

4.0 MATERIAL PLANNING CONSIDERATIONS

4.1 In addition to the Development Plan, the Council will draw on national planning policy as set out in the National Planning Policy Framework ("the NPPF") and national planning guidance contained in the national Planning Practice Guidance ("the PPG") as material planning considerations.

4.2 The Council will refer also to the emerging Local Plan and its supporting Housing Infrastructure Funding (HIF).

4.3 The Council may refer to other planning decisions/appeal decisions of relevance to the Proposed Development and appeal, as necessary.

5.0 THE COUNCIL'S CASE

Reason for Refusal 1 – Insufficient information in relation to ensuring that there will be no adverse impact on the integrity of the Medway Estuary & Marshes SSSI, SPA and Ramsar site.

In the absence of imperative reasons of overriding public interest, Regulations 63 and 70 of the Habitats Regulations require permission to be refused.

5.1 The Council is aware that the Appellant remains in negotiations with Natural England regarding this matter.

5.2 The latest position of which the Council is aware, is that Natural England expects a much more detailed, comprehensive package of measures to be provided to avoid impacts to the coastal designated sites. Natural England has advised that an appropriate tariff of £245.56 per dwelling (excluding legal and monitoring officer's costs, which separately total £550) could be collected to fund *Strategic Access Management and Monitoring Strategy* (SAMMS) measures across the Thames, Medway and Swale Estuaries by way of mitigation.

5.3 Natural England has further advised that - **in addition** to the SAMMS contribution – bespoke mitigation would also be required for the development. Natural England has suggested that this could include:

(i) significant areas of Suitable Alternative Natural Greenspace (SANGS); or/and
(ii) site specific wardens being provided.

5.4 The Council is prepared that, should the Appellant and Natural England reach agreement, this reason for refusal could be withdrawn. An update on this position will be provided at the case conference in December

5.5 In the absence of such an agreement, the Council cannot be confident that appropriate mitigation will be secured for the scheme. Therefore, the Council would be required under the Habitats Regulations to refuse to grant permission unless there were imperative reasons of overriding public interest. On the basis of Natural England's current position, the Council does not consider that this very high threshold is met.

5.6 The Council will refer to the NPPF, at paragraphs 175 &176, where the harm to biodiversity (and the scope for mitigation) is specifically referenced and the where the types of designated sites, or potentially designated sites, to be protected are listed.

5.7 In turn the Council will also explain how the proposals – the subject of this appeal – are contrary to policies S6 and BNE35 of the Local Plan. S6; which requires planning obligations to be agreed to mitigate development and make proposals acceptable in planning terms and BNE35; which, like the NPPF, requires the protection of internationally and nationally important biodiversity sites.

Reason for refusal 2 – The harmful impact on the local historic landscape, as well as the setting and significance of a number of designated heritage assets.

5.8 The Council will explain that the site lies within setting of a range of listed buildings and two conservation areas, all of which are designated heritage assets. The Council will also explain the importance of the site in the historic landscape setting of the area, and the effects of the proposals on non-designated heritage assets.

5.9 The Council will describe the special architectural or historic interest of the designated and non-designated heritage assets and the elements of the setting that contribute to their significance, with reference to the to section 16 of the NPPF and relevant paragraphs including, but not limited to, paragraphs 193 to 196.

5.10 The Council will refer to Policy BNE12 of the Local Plan which requires new development to conserve and enhance conservation areas. The Council will produce evidence to demonstrate that the Proposed Development fails to meet this requirement, especially where the site is the last remaining place in the locality where an important historic relationship of between settlements and different types of landscape is maintained.

5.11 The Council will refer to Policy BNE18 of the Local Plan which seeks the conservation of the significance and setting of listed buildings.

5.12 In addition to the harm to the significance of individual heritage assets[1] which would be caused by the Proposed Development (some of which are accepted by the Appellant), the Council will also maintain that that the Appellant has considered each heritage asset separately, and this omits the cumulative impact of the Development Proposal. This approach has enabled the Heritage Statement to assess the proposals as less harmful than they would appear if assessed in the context of the wider area and its history.

5.13 The Council will further explain that the Appellant failure to consider the landscape to be a heritage asset misses its significance as the setting of discrete small developments — single farms and two hamlets — that maintain their historic separation from one another. It provides the wider historic context for all the heritage assets. The scale of the proposed development demands that it be considered in this wider context.

5.14 The Council will also set out that the Appellant has omitted non-visual aspects of the setting that contribute to the significance of the heritage assets and the impact of the proposed new roads and junctions on the historic character of Pump Lane or the Bridleway from their assessments, and how this has affected the assessment of heritage impacts. The proposed mitigation is also insufficient given the scale of effect has been understated.

5.15 The Council will explain how the significant harms to designated heritage assets are not outweighed by the public benefits proposed by the applicant, which are in part, accepted. In such circumstances the 'titled balance' of NPPF paragraph 11 is not engaged because the caveat of footnote six precludes it when designated heritage assets are at risk.

Reason for refusal 3 – Significant long-term adverse landscape and visual effects to the local valued Gillingham Riverside Area of Local Landscape Importance (ALLI).

5.16 The site is within (and occupies a significant part of) a locally designated landscape, the Gillingham Riverside Area of Local Landscape Importance (ALLI). As recognised by recent Appeal decisions, this is also a valued landscape within the meaning set out in Paragraph 170a of the NPPF.

[1] 1.1 In addition to the listed buildings referred to in the delegated report (paragraphs 4.45-4.88), the Council will provide evidence to show that two large oast houses, formerly part of Bloors Farm and now converted to residential use, to the south-west of Bloors Place should be considered non-designated heritage assets. They also form part of the setting of the listed garden walls of Bloors Place, something not considered by the Appellant.

5.17 The Council's evidence will show that the proposed development would lead to significant long-term adverse effects on the landscape of the site itself, the surrounding area, and of the ALLI, and significant adverse visual effects. The Council notes that the September 2020 Landscape and Visual Impact Assessment submitted by the Appellant identifies (on page 60) moderate to major adverse landscape effects for the area of the site, where major adverse effects are the highest category set out in the methodology. In that methodology, moderate adverse effects are described as those which would cause '*substantial permanent loss or alteration to one or more key elements of the landscape*', and major adverse effects are those which '*would irrevocably damage, degrade or badly diminish landscape character features, elements and their setting*.'

5.18 In the light of that analysis, the Appellant's Statement of Case makes the surprising claim (in section 5.5) that the development complies with Policy BNE34, which seeks to protect the landscape character and function of the ALLIs, even though the Statement of Case then repeats the assessment of moderate to major adverse landscape effects in its section 7.22.

5.19 The Statement of Case also claims (in section 7.12) that the development would retain the function of the site as a green buffer. The Council's evidence will show that a development of this scale, within the ALLI, will not (and indeed cannot) retain its function as a green buffer.

5.20 In section 7.26 the Statement of Case it states that the proposals "*have sought to protect and enhance recognised attributes and function of a locally valued landscape"*. The Council notes the acceptance by the Appellant that this is a valued landscape, but do not agree that it would be protected (and far less would it be enhanced) by the proposed development, and the Council's evidence will explain in detail why this is the case.

5.21 The Development Proposals are large in scale, and would take place within an attractive, designated and valued landscape, and the development would lead to some significant adverse landscape and visual effects and a clear conflict with relevant planning policy at national and local levels, as set out in the Reason for Refusal. While the Council considers that the effects set out in the September 2020 Landscape and Visual Impact Assessment have in some cases been understated, that assessment does also identify some high-level adverse effects. The Council also considers that there would be high level and significant adverse landscape and visual effects. Those effects would tend to decline over time as a result of the proposed provision of open space and new planting, but the adverse effects would persist into the future, and would still be significant in the longer term.

Reason for refusal 4 – The applicant has failed to satisfy Highways England that the development will not materially affect the safety, reliability and /or operation of the Strategic Road network (SRN).

5.22 The Appellant suggests in their Statement of Case Transport Addendum, that an agreed generation and distribution on the SRN has been reached between them and the Highways Agency.

5.23 The Council is aware that Appellant is in direct discussion with Highways England with respect to the impact on the SRN network. However, the "holding objection" will stand until and unless an agreement with Highways England on the contribution and funding of any improvements is reached. This may be complicated by currently planned improvements to the SRN and their funding arrangements.

5.24 As with the first reason for refusal, the Council is prepared that, should the Appellant and Highways England reach agreement, this reason for refusal could be withdrawn.

5.25 In the absence of such an agreement the Council will explain how the safety, reliability and/or operation of the SRN is specially protected by Department for Transport Circular 2/13 paragraph 9 & 10 and the NPPF at paragraph 109.

Reason for refusal 5 – The cumulative impact from the increase additional traffic cannot be accommodated on the Highway in terms of overall network capacity without a severe impact.

5.26 The Appellant has relied on Dynamic traffic assignment (DTA) modelling which they say – taken with appropriate mitigation – demonstrates that the effects on the impacted junctions would not be severe. However, this modelling appraises each junction in isolation and does not take account of queueing between junctions or blocking back within them, which is particularly relevant due to the size of the development being proposed.

5.27 The Council has developed a more sophisticated model (Medway's Strategic Transport Assessment Model (AIMSUM model) designed in the context of their emerging Local Plan for both plan making and decision taking purposes. For example, the Level of Service corridor analysis which can be derived from the AIMSUM shows the cumulative effect of congestion and delay on the network from the new development that cannot be captured in independent junction models. One of the key differences between the DTA and the AIMSUM model is the incorporation of link effects.

5.28 The Council considers that the AIMSUM model is the most appropriate model to use in these circumstances. A sensitivity test has been applied to the model in order represent the effects of the proposed development.

5.29 As detailed in the delegated report (paragraphs 4.137-4.159), the Council has identified a number of junctions and highway corridors where the average delays would be classified as E ('unstable flow') or F ('forced or breakdown flow)' under Levels of Service (LoS). In light of the AIMSUM modelling output the Council concluded that there would be a severe residual cumulative impact in relation to identified junctions and highway corridors.

5.30 Following the refusal of permission, and to ensure that the Proposed Development was being assessed using the latest available AIMSUM information, the Council commissioned the 'Pump Lane and Lower Rainham Transport Impact Appraisal' dated 5th October 2020, to assess the Appeal Development proposal throughout three local sub model areas. This Report is attached to this Statement of Case. A copy has already been provided to the Appellant's transport consultant.

5.31 The Pump Lane proposals (as well as two further scenarios for additional housing above the Pump Lane proposals that are not being considered in this application) were assessed against the Reference Case (without the Pump Lane development but incorporating committed development for 2037). The latest modelling shows a 43.3% increase in delay and a 49.1% increase in stop time over the whole network due to the Pump Lane proposal for the development scenario.

5.32 The results of the traffic loading from the Pump Lane development on a network-wide basis are assessed as causing severe residual cumulative effects on the AIMSUM network in terms of the level of service at junctions and links on a wide area including at non local junction such as the Pier Road Gillingham Gate roundabout, service level F and on the Medway tunnels level F.

5.33 It is understood that the AIMSUM trip generations in the latest modelling have not been accepted by the Appellant's transport consultant, who has also queried the zone connector arrangements to/from the Proposed Development. The Council will work with the Appellant in an attempt to reduce the disagreements concerning modelling.

5.34 At the Inquiry, the Council will set out its case which is that the results of the traffic loading from the Development Proposals on a network wide basis, are assessed as causing severe residual cumulative effects on the AIMSUM network. The Council will explain that sufficient mitigation could not be provided on a cost effective basis, and this is contrary to NPPF 109 and NPPF 108 even if the proposed, more limited, off site mitigation measures were to be provided by the applicant.

5.35 The Council will further explain that where the level of service deteriorates to a low-level traffic flow 'breakdown' occurs which is taken as a severe effect and negatively impacts overall delay. This, the Council will demonstrate, is contrary to policy T1 of the Local Plan which requires that "*the highway network has adequate capacity to cater for the traffic generations of the development*."

Reason for refusal 6 – The cumulative impact from the increased additional traffic from the development is unlikely to be able to create a safe highway environment.

5.36 As explained in the delegated report (paras 4.167-4.170), at the time of the decision to refuse planning permission the Council considered that the evidence concerning Personal Injury Accident data was too narrow.

5.37 This has now been rectified by the Appellant who, in their Appeal documentation, have supplied an analysis covering an expanded study area and including a COBALT accident comparison over the last 5 years.

5.38 While it is not agreed that the accident assessment as set out in the original TA covered a sufficient area to enable a proper assessment to be undertaken the expanded assessment contained in the applicants Transport Addendum appended to their Statement of Case does cover a sufficient area.

5.39 Given the importance of road safety issues the Council's request for additional safety information was entirely appropriate. The number of accidents cannot be completely immaterial for any scheme. Although the number of accidents in the area may increase due to increased traffic volumes it is accepted that the applicant's transport addendum, supplied with the Appeal documentation, shows this development is unlikely to significantly increase accident risk.

5.40 Given the new information now supplied by the Appellant, the Council has decided to withdraw this reason for refusal.

Reason for refusal 7 – No assessment nor technical details have been provided regarding the two new access points along Pump Lane to serve the proposed development.

5.41 The Council has made it clear to the Appellant that, despite access being for determination as part of the planning application, there was no plan submitted with the original application that identified appropriate technical drawings for access or egress between the site, and Pump Lane.

5.42 Appended to the planning application was drawing 20230-05-3A which was not to scale, and the drawing was noted as "*an overall strategy*" and not a detailed drawing.

5.43 The Highway Authority has seen, for the first time, drawings submitted with the appeal as part of the appellant's Statement of Case. These drawings are titled, 20230-05E. Specifically, drawings 20230-05-5E and 20230-05-6E show intersections with Pump Lane. These drawings are all dated August 2020. The Council can only now consider these drawings if they are the correct versions which the Appellant wishes to use to illustrate their plans.

5.44 If the Appellant can clearly set out which plans should be considered to be the definitive drawing upon which the Development Proposal should be decided, and can demonstrate that the inclusion of any new drawing would not unduly prejudice any interested party, then the Council is prepared to withdraw this reason for refusal.

Reason for refusal 8 – The proposed development would result in the irreversible loss of 'best and most versatile' (BMV) agricultural land

5.45 The Council will argue that whilst the need for housing in the area will require agricultural land to be used, the applicant has not demonstrated that poorer quality agricultural land could not be utilised to address that need.

5.46 The Council notes that the Appellant's Environmental Statement concludes (at para. 13.77) that "the Development will have a direct, permanent, substantial adverse effect on BMV agricultural land which would be significant".

5.47 However, the Appellant also suggests several perceived disadvantages with continuing with Pump and Bloor Farms as part of the Appellant's overall farming business (paras. 13.41 to 13.48). In this regard the Appellant has also placed particular reliance on a report they have commissioned from Andersons Midlands dated 31 August 2020.

5.48 The particular issues raised in this regard relate to:

- The recorded yields from the Pump/Bloors Farm orchards;
- The current operation of the site as a satellite to main hub centres (Flanders Farm Hoo, and Howt Green Farm, Bobbing);
- The size and layout of the existing orchard blocks;
- The supposed lack of suitable buildings;
- Hail damage;
- Increasing costs of production vs “static” prices;
- Orchard age and varieties.

5.49 At page 15 of their Statement of Case the Appellant suggests these considerations demonstrate that neither the Appellants nor anyone else could farm the land profitably. The Council will provide an assessment of this argument and provide evidence to the contrary. The Council will set out that this BMV land has not been shown to have such limited economic value, now or in the future, that its permanent loss should not amount to a significant consideration as part of the decision based on the overall Planning balance.

5.50 The Council will set out that the protection afforded to BMV land in Planning policy derives from its long-term value as a National resource, which is irreplaceable once developed. Natural England explains that “*this is the land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses such as biomass, fibres and pharmaceuticals*”. A potential need for more self-sufficiency in UK farming and crop production, as well as a general desire for more locally produced food, in respect of which better quality land makes a valuable contribution.

5.51 The Council will explain how, considering the forgoing, the Development Proposals are contrary to the NPPF at paragraph 170 and footnote 53 where it is explained that where significant development of agricultural land is demonstrated to be necessary, areas of poorer quality land should be preferred to those of a higher quality.

5.52 The Council, however, does accept that Local Plan policy BNE48 which seeks to avoid the loss of BMV is not a saved policy and as such is mistakenly cited in the decision notice. However, it is clear, given NPPF 170, that no-one is prejudiced by this issue.

Reason for refusal 9 – In the absence of a completed S106 legal agreement, the proposal fails to secure infrastructure necessary to meet the needs of the development.

5.53 The Council accepts that the provision of a suitable Section 106 agreement or unilateral undertaking as part of the appeal process could require the withdrawal of this reason for refusal. At this stage, without agreement from Natural England and Highways England – in particular – regarding the level of mitigation and compensation required then this reason for refusal cannot be withdrawn.

6.0 SUMMARY AND CONCLUSIONS

6.1 The Council will maintain the position (consistent with the advice of Natural England) that, on the basis of the information with which they have been provided thus far, they cannot rule out adverse impacts on the European Site , then the appeal is **required to refused** under the Habitats Regulations as there are no imperative reasons of overring public interest. This is regardless of the position under s.38(6).

6.2 However, recognising that it might be that the Appellant can ultimately provide the information that Natural England seeks, the Council's case will turn to the planning balance.

6.3 The Council will then explain conflicts with the Development Plan.

6.4 The Council's case will the turn to the conflict with the NPPF which the Proposed Development presents, and the overall planning balance., having regard to the benefits

6.5 The Council will conclude that the Proposed Development is contrary to Development Plan, as well as the National Planning Policy Framework 2019, and that there are no material considerations in this case that justify the grant of permission. Accordingly, the Council will conclude that the appeal proposal should be dismissed.

APPENDIX A: PUMP LANE AND LOWER RAINHAM TRANSPORT IMPACT APPRAISAL (5TH OCTOBER 2020)

Report

Pump Lane and Lower Rainham Transport Impact Appraisal

On behalf of Medway Council

Sweco UK Limited
3rd Floor Eldon House
2 Eldon Street
London, EC2M 7LS
+44 20 3002 1210

05/10/2020
Project Reference: 0
Document Reference: 2
Revision: 1
Prepared For: Medway Council

Status / Revisions

Rev.	Date	Reason for issue	Prepared		Reviewed		Approved	
[1]	05/10/2020	New draft	GC/AP	05/10/2020	DH	05/10/2020	KJ	05/10/2020
[2]	[00.00.00]	[Text]	[XX]	[00.00.00]	[XX]	[00.00.00]	[XX]	[00.00.00]
[3]	[00.00.00]	[Text]	[XX]	[00.00.00]	[XX]	[00.00.00]	[XX]	[00.00.00]

Reg. Office Address:
Sweco UK Limited
Grove House
Mansion Gate Drive
Leeds, LS7 4DN
+44 113 262 0000

Reg. No.: 2888385
Reg. Office: Leeds

www.sweco.co.uk

Sweco UK Limited
3rd Floor Eldon House
2 Eldon Street
London, EC2M 7LS
+44 20 3002 1210

Giusy Cerreto
Graduate Transport Planner
+44 20 3530 5330

giusy.cerreto@sweco.co.uk

Table of contents

Table of Figures

Table of Tables

Table of Appendices

1 Lower Rainham site sensitivity tests

1.1 Introduction

Medway Council requested the evaluation of development sites in the Rainham area, including Pump Lane. The sites have been converted into highway trips, based on the Strategic Transport Assessment Local Plan site trip generations and trip distribution assumptions. The modelling has been undertaken using the latest 2037 Reference Case scenario (as of August 2020).

Three sensitivity tests were devised based on different build out rate assumptions:

- Sensitivity 1: 1,250 homes
- Sensitivity 2: 2,500 homes
- Sensitivity 3: 5,548 homes

The above sensitivity tests were agreed with Medway Council. The work also includes the development of a new subnetwork (Subnetwork 7) which includes the B2004 Lower Rainham Road.

The aim of the work is to evaluate the traffic impact of the proposed developments related to specific housing sites around Rainham. The location of the sites are shown in Figure 1.

Figure 1: Proposed development sites at Lower Rainham

2 Methodology

In order to assess the impact of the development sites on the traffic operations of the road network in Lower Rainham, several different outputs were used for analysis. This includes:

- Level of Service (LoS) for Junctions:

The Highway Capacity Manual (HCM) defines LoS for signalized and unsignalized junction as a function of the average vehicle control delay. The estimation of the LoS for a junction is based on the following:

- LoS is calculated per movement or per approach of the junction
- LoS for the junction as a whole is based on the average of the queue delay of the approaches, weighted by the flow of each approach
- Different threshold values are provided by HCM depending on the type of the junction (signalised or unsignalised) presented in the following table:

Table 1 Junction Level of service classification

Level of Service	Control Delay(sec/veh) Signalised	Delay (sec/veh) Unsignalised
A	≤ 10	≤ 10
B	10-20	10-15
C	20-35	15-25
D	35-55	25-35
E	55-80	35-50
F	> 80	> 50

- Subnetwork detailed Aimsun statistical output which is includes several indicators presented in the following table:

Table 2 Statistical traffic microsimulation indicators included in the evaluation

Statistic	Units	Description
Travel Time	sec/km	Average time a vehicle needs to travel one kilometre inside the network. This is the mean of all the single travel times (exit time - entrance time) for every vehicle that has crossed the network, converted into time per kilometre.
Delay	sec/km	Average delay time per vehicle per kilometre. This is the difference between the expected travel time (the time it would take to traverse the system under ideal conditions) and the travel time. It is calculated as the average of all vehicles and then converted into time per kilometre. It does not include the time spent in virtual queue.
Flow	veh/h	Average number of vehicles per hour that have passed through the network during the simulation period. The vehicles are counted when leaving the network via an exit section.
Speed	km/h	Average speed for all vehicles that have left the system. This is calculated using the mean journey speed for each vehicle.
Stop Time	sec/km	Average time at standstill per vehicle per kilometre.
Mean Queue	veh	Average queue in the network during the simulation period. It is measured in vehicles.
Mean Virtual Queue	veh	Average virtual queue in the network during the simulation period. It is measured in number of vehicles which are blocked from entering the network.
Waiting Time in Virtual Queue	sec	Average time in seconds that vehicles remained waiting in a virtual queue. The vehicles taken in account in computing this statistic are those which have completed their trips through the network.

- Traffic flow diagrams
- Speed diagrams
- Volume / Capacity diagrams
- Flow differences between Do Something and Reference Case scenarios
- Select link analysis plots; and
- Delay plots

The Level of Service metric has been used in the past to evaluate the performance of key junctions across the other Medway subnetworks and to identify the locations where capacity is exceeded. The outputs have been used to understand the wider impacts of the additional highway trips generated by the proposed schemes.

The development scenario is compared against a 2037 reference case scenario that only contains the traffic demand on the local network without any additional trips stemming from the development.

2.1 Trip Generation

2.1.1 Introduction

Trips associated with committed developments and proposed Local Plan allocations within Medway have been estimated using average person trip rates derived from the TRICS Database. These are subsequently converted to vehicle trips by applying mode share which consider a range of location dependent factors such as accessibility.

2.1.2 Person Trip Rates

2.1.2.1 Effect of Location

Traffic generation is dependent on location, with the greatest influence being the accessibility of the location, particularly with regards to sustainable modes. However, person trip rates are also dependent on location for most development types and, for this reason, trip rates for all land uses except residential houses have been split into two broad categories as follows:

- Central – comprising sites with the “Town Centre” and “Edge of Town Centre” TRICS location categories

- Suburban – comprising sites with the “Suburban”, “Edge of Town” and “Neighbourhood Centre” TRICS location categories.

These TRICS categories are “possibly compatible” location type categories, as set out in the TRICS Good Practice Guide[1].

Further disaggregation of the location categories was not undertaken for the following reasons:

- There are not enough sites within the TRICS Database to provide reliable estimates of average trip rates for many of the land uses considered;

- There are no significant differences between trip rates calculated using the disaggregated location categories that fall within the two broad categories set out above.

This approach is intended to capture the changes in person trip generation as a result of the site location. Further locational factors that affect traffic generation, such as access to local facilities, public transport accessibility and car ownership, are reflected in the mode share that is applied later in the process.

---

[1] *TRICS Good Practice Guide 2016*, TRICS Consortium Limited

2.1.2.2 Residential Trip Rates

The trips rates for residential developments comprising predominately houses have been determined using sites within the “Houses Privately Owned” trip generation category. As such, the trip rates apply to sites with a mixture of tenures (but less than 75% privately owned) and housing types (but less than 25% being flats).

Residential trip rates are dependent on the size of the development, with larger developments generally having lower trip rates due to the internalisation of trips. For example, whilst individual houses may have the same trip rates, more of these trips occur within the development (e.g. to other houses, local shops or other facilities) and the number of trips arriving and leaving the development tends to be lower. This has been captured by deriving trip rates for three broad sizes of residential development, as follows:

- Less than 50 houses;
- Between 50 and 100 houses;
- More than 100 houses.

For larger developments, evidence suggests that external trip making is lower still, however, there are insufficient larger sites (e.g. greater than 500 houses) within the TRICS database to derive reliable trip rates. However, it should be noted that for larger developments, the trip rates derived will therefore be robust.

It has been found that, for person trip rates, the size of development has a greater influence on the trip rate than location and therefore, separate trip rates have been derived for different development sizes rather than different locations. The dependence of traffic generation on location in this case is captured through the application of a location-specific mode share.

Trip rates for developments comprising mostly flats have been derived using the “Flats Privately Owned” category (at least 75% privately owned and at least 75% flats). For these developments, there was no strong trend related to development size apparent in the sites within the TRICS Database. However, there was a locational trend, with central sites having higher person trip generations than suburban sites and therefore separate trip rates have been derived for these categories.

2.1.2.3 Person Trips Rates

Having regard to the above points, person trip rates for a wide range of land uses within the Reference Case and Local Plan (Without Mitigation) scenarios have been derived from the TRICS Database. The search criteria used to query the database are set out in Table 3 and the resulting trip rates are presented in Table 4.

Table 3: TRICS Search Criteria for Residential Sites

Land Use	Location	TRICS Search Criteria			Number of Sites	Reference
		TRICS Land Use / Sub Land Use	Size Range	TRICS Location		
Houses (≤50 Dwellings)	Central	03 – Residential A - Houses Privately Owned	6 to 50 dwellings	Edge of Town Centre Suburban Area Edge of Town	50	03_A_CEN_1-50
Houses (51 to 100 Dwellings)	Central	03 – Residential A - Houses Privately Owned	52 to 98 dwellings	Edge of Town Centre Suburban Area Edge of Town	19	03_A_CEN_51-100
Houses (>100 Dwellings)	Central	03 – Residential A - Houses Privately Owned	108 to 432 dwellings	Edge of Town Centre Suburban Area Edge of Town	15	03_A_CEN_101+
Houses (≤50 Dwellings)	Suburban	03 – Residential A - Houses Privately Owned	6 to 50 dwellings	Edge of Town Centre Suburban Area Edge of Town	50	03_A_SUB_1-50
Houses (51 to 100 Dwellings)	Suburban	03 – Residential A - Houses Privately Owned	52 to 98 dwellings	Edge of Town Centre Suburban Area Edge of Town	19	03_A_SUB_51-100

Land Use	Location	TRICS Search Criteria			Number of Sites	Reference
		TRICS Land Use / Sub Land Use	Size Range	TRICS Location		
Houses (>100 Dwellings)	Suburban	03 – Residential A - Houses Privately Owned	108 to 432 dwellings	Edge of Town Centre Suburban Area Edge of Town	15	03_A_SUB_101+
Flats	Central	03 – Residential C - Flats Privately Owned	6 to 294 dwellings	Town Centre Edge of Town Centre	30	03_C_CEN
Flats	Suburban	03 – Residential C - Flats Privately Owned	8 to 493 dwellings	Suburban Area Edge of Town	28	03_C_SUB
Student Accommodation	Central	03 – Residential G - Student Accommodation	146 to 241 residents	Edge of Town Centre	3	03_G_CEN
Student Accommodation	Suburban	03 – Residential G - Student Accommodation	72 to 265 residents	Suburban Edge of Town	3	03_G_SUB

Table 4: Person Trip Rates by Land Use

Reference	Land Use	Location	Parameter	Person Trip Rates					
				AM Peak Hour (0800 to 0900)			PM Peak Hour (1700 to 1800)		
				Arrivals	Departures	Two-way	Arrivals	Departures	Two-way
03_A_CEN_1-50	Houses (≤50 Dwellings)	Central	Dwelling	0.31	0.95	1.27	0.70	0.40	1.09
03_A_CEN_51-100	Houses (51 to 100 Dwellings)	Central	Dwelling	0.22	0.77	0.99	0.60	0.31	0.92
03_A_CEN_101+	Houses (>100 Dwellings)	Central	Dwelling	0.19	0.69	0.89	0.56	0.34	0.90
03_A_SUB_1-50	Houses (≤50 Dwellings)	Suburban	Dwelling	0.31	0.95	1.27	0.70	0.40	1.09
03_A_SUB_51-100	Houses (51 to 100 Dwellings)	Suburban	Dwelling	0.22	0.77	0.99	0.60	0.31	0.92
03_A_SUB_101+	Houses (>100 Dwellings)	Suburban	Dwelling	0.19	0.69	0.89	0.56	0.34	0.90
03_C_CEN	Flats	Central	Dwelling	0.10	0.45	0.55	0.38	0.19	0.56
03_C_SUB	Flats	Suburban	Dwelling	0.08	0.43	0.51	0.35	0.13	0.48
03_G_CEN	Student Accommodation	Central	Resident	0.01	0.15	0.16	0.18	0.10	0.27
03_G_SUB	Student Accommodation	Suburban	Resident	0.03	0.23	0.26	0.19	0.09	0.27

2.1.3 Person Trip Generation

The relevant trip rates have been applied to each development site for each sensitivity test and are summed to give the total person trip generation as set out in Table 6 and the total vehicle trip generation as set out in Table 7. The site names and ID references are presented in Table 5 for each test.

Table 5 Site name and Site ID for person and vehicle trip generation

Site name	Site ID
Sensitivity 1	
West of (lower) Pump Lane, Rainham	1283
Land Between Pump Lane & Bloors Lane, Rainham	750
South of Lower Rainham Road, west of Pump Lane	1061
Sensitivity 2	
West of (lower) Pump Lane, Rainham	1283
Land Between Pump Lane & Bloors Lane, Rainham	750
South of Lower Rainham Road, west of Pump Lane	1061
Westmoor Farm, Moor Street, Rainham	814
Westmoor Farm, Moor Street, Rainham	1086
Land West of South Bush Lane, Rainham	1288
Meresborough Lane & South Bush Lane, Rainham	1059
Sensitivity 3	
Mill Hill, Grange Road, Gillingham	774
Meresborough Lane & South Bush Lane, Rainham	1059
Wayside, Meresborough Lane, Gillingham	1083
Land at Lower Bloors Lane Rainham	1108
Westmoor Farm, Moor Street, Rainham	814
Siloam Farm, Rainham	847
Land west of 749 Lower Rainham Road	1191
Westmoor Farm, Moor Street, Rainham	1086
Land at Lower Rainham	1303
Land at Mill Hill, Grange Road, Gillingham	1073
West of (lower) Pump Lane, Rainham	1283
Land West of South Bush Lane, Rainham	1288
Land West of Meresborough Lane, Meresborough	1291
Land East of Meresborough Lane, Meresborough	1292
Land btw Lower Rainham Rd and Grange Rd	1304
Land east of Eastcourt Lane, Gillingham	1085
Land Between Pump Lane & Bloors Lane, Rainham	750
South of Lower Rainham Road, west of Pump Lane	1061
Between Ivy Cottage and Providence House Lower Bloors Lane	1158
Whetstead, Off Grange Road, Lower Twydall	1014

309 Lower Rainham Road, Gillingham	1125

Table 6: Person Trip Generation

Site Reference	Person Trip Generation					
	AM Peak Hour (0800 to 0900)			PM Peak Hour (1700 to 1800)		
	Arrivals	Departures	Two-way	Arrivals	Departures	Two-way
1283	16	48	63	35	20	55
750	116	416	532	333	206	539
1061	116	416	532	333	206	539
Sensitivity 1	248	880	1127	701	432	1133
814	68	243	310	194	120	315
1086	3	9	11	6	4	10
1288	90	323	412	258	160	418
1059	92	330	422	264	164	428
Sensitivity 2	501	1785	2282	1423	880	2304
774	77	278	355	222	138	360
847	226	812	1038	649	402	1052
1014	0	1	1	1	0	1
1073	22	77	99	60	31	92
1083	2	5	6	3	2	5
1085	29	104	133	83	52	135
1108	6	17	23	13	7	20
1125	1	4	5	3	2	4
1158	3	10	14	8	4	12
1191	2	7	9	5	3	8
1291	38	138	177	110	68	179
1292	33	117	150	94	58	152
1303	118	423	541	339	210	548
1304	30	107	137	85	53	138
Sensitivity 3	1088	3885	4970	3098	1910	5010

2.1.4 Vehicle Trip Generation

The person trips were then translated into vehicle trips by applying the Census MSOA car mode share for the zone that each development site is located within. Please refer to Table 7 that outlines the vehicle trip generation per site and sensitivity test.

SWECO

Table 7 Vehicle Trip Generation

Site Reference	Vehicle Trip Generation					
	AM Peak Hour (0800 to 0900)			PM Peak Hour (1700 to 1800)		
	Arrivals	Departures	Two-way	Arrivals	Departures	Two-way
1283	11	34	45	25	14	39
750	82	295	377	236	146	382
1061	82	295	377	236	146	382
Sensitivity 1	175	624	799	497	306	803
814	49	175	224	140	87	227
1086	2	6	8	5	3	7
1288	65	232	297	186	115	301
1059	66	238	304	190	118	308
Sensitivity 2	357	1275	1632	1018	629	1646
774	55	197	251	157	98	255
847	163	585	747	468	290	758
1014	0	1	1	0	0	1
1073	16	55	70	43	22	65
1083	1	3	5	3	1	4
1085	21	74	94	59	37	96
1108	4	12	16	9	5	14
1125	1	3	4	2	1	3
1158	2	7	10	5	3	9
1191	1	4	6	3	2	5
1291	28	99	127	80	49	129
1292	23	84	108	68	42	109
1303	83	300	383	240	149	389
1304	21	76	97	61	38	98
Sensitivity 3	776	2775	3551	2216	1366	3581

2.2 Assignment

2.2.1 Macroscopic Model

Traffic has been assigned in the macroscopic model using user equilibrium. Whilst several assignment algorithms are available in Aimsun, experience has shown that where junction delay functions are used (see Capacity Restraint Mechanisms, below), it is necessary to use the Method of Successive Averages (MSA) in order to achieve convergence and this approach has been adopted for this model.

2.2.2 Microscopic Model

A proportion of paths from the macroscopic model has been used by vehicles in the microscopic model. These user equilibrium paths can be thought of as representing the routes that drivers habitually follow day after day based on their historic knowledge of the highway network. Following the best practice from other Aimsun models, the following proportions have been assigned to follow user equilibrium paths:

- Car – 85%
- LGV – 90%
- HGV 95%

The remaining vehicles are set to follow dynamically chosen path-based costs experienced by vehicles currently travelling through the network. Drivers choose these paths before they depart on their journey however some of these may alter their paths within their journey. These dynamic paths represent those drivers that have additional knowledge of current network conditions obtained, for example, from satellite navigation systems and radio traffic alerts.

2.2.3 Generalised Cost

The generalised cost equation used in the Medway Aimsun Model takes the following form:

$$cost = \text{travel time}$$
$$+ \frac{\text{vehicle operation cost per km} \times \text{distance}}{\text{value of time}}$$
$$+ \frac{\text{first user defined cost}}{\text{value of time}}$$
$$+ \frac{\text{first usecond user defined cost} \times \text{distance}}{\text{value of time}}$$

The generalised cost is expressed in units of time (seconds in the Medway Aimsun Model) to removes the difficulty of changes in costs over time, due to inflation and other changes, which may change from year to year.

2.2.4 Travel Time

Travel time is calculated using the volume delay, turn penalty and junction delay functions (see below) and represents the time taken to travel along a section, to make a turn and any delay associated with passing through a junction.

SWECO

2.2.5 Vehicle Operating Cost

The vehicle operating cost has two components: fuel costs and non-fuel costs and are calculated in accordance with the guidance set out in WebTAG unit A1.3.

Fuel costs, L, are calculated using the following formula:

$$L = \frac{a}{v} + b + (c \times v) + (d \times v^2)$$

where L is the cost expressed in pence per kilometre,

v is the average speed in km/h,

a, b, c and d are parameters defined for each vehicle category.

The values for the parameters are taken from Table A1.3.12 of the WebTAG Data Book (November 2016) for the 2016 base year and are summarised Table 8 below.

Table 8: Vehicle Operating Cost Parameters

Vehicle Type	Parameter			
	A	b	c	d
Average Car	61.475	4.215	-0.028	0.0003
Average LGV	110.255	2.608	-0.017	0.0006
Average OGV1	165.225	29.783	-0.451	0.0039
Average OGV2	263.691	55.000	-0.787	0.0059
Average HGV	230.114	46.401	-0.672	0.0052

Note: Average HGV is calculated as a weighted average of OGV1 and OGV2 using the surveyed proportions of 34.1% and 65.9%, respectively, derived from ATC survey information across Medway.

Non-fuel operating costs are calculated using the following formula:

$$C = a1 + \frac{b1}{v}$$

Where C is the cost in pence per kilometre,

V is the average speed in km/h,

b1 is a parameter for the vehicle capital saving defined for each vehicle category.

The values for parameters a1 and b1 are taken from Table A 1.3.15 of the WebTAG shown in Table 9.

Table 9: Vehicle Operating Cost Parameters

Vehicle Type	Parameter	
	a1	b1
Average Car	3.972	16.394
Average LGV	7.213	41.458
Average OGV1	6.714	263.817
Average OGV2	13.061	508.525
Average HGV	10.897	425.080

Note: Average HGV is calculated as a weighted average of OGV1 and OGV2 using the surveyed proportions of 34.1% and 65.9%, respectively, derived from ATC survey information across Medway.

The values of time used in the model have been taken from the WebTAG Databook and are set out below.

Table 10 Value of time table

User Class	Value of Time (£ / h)

	AM Peak Hour (08:00 to 09:00)	Interpeak Hour (13:00 to 14:00)	PM Peak Hour (17:00 to 18:00)
Car (HBW) (1)	12.15	12.35	12.19
LGV (HBW) (2)	9.62	9.62	9.62
Car (NHBW) (3)	21.56	22.09	21.87
LGV (NHBW) (4)	15.76	15.76	15.76
HGV (NHBW) (5)	15.47	15.47	15.47
Car (HBO+NHBO) (6)	8.38	8.93	8.78
LGV (HBO+NHBO) (7)	9.62	9.62	9.62

2.2.6 First and Second User Defined Costs

The first user defined cost is effectively a fixed monetary cost of travelling along a link and could be used to model a toll road, for example. However, this is not currently used in the model.

The second user defined cost can be used to represent additional perceived costs incurred travelling along a link or turn as a function of distance travelled. It can be used to represent other costs that are explicitly considered in the cost function or cruise speeds, such as the deterrence effect of a narrow carriageway or cobbled street.

2.2.7 Capacity Restraint Mechanisms

Macroscopic Model

In the macroscopic model, travel time and delay are determined using the following functions:

- Volume Delay Function (VDF) – these calculate the cost of travelling along a section and is set to represent the free-flow cost using the generalised cost equation set out above.
- Turn Penalty Function (TPF) – these calculate the cost of traversing a turn and is set to represent the free-flow cost using the generalised cost equation set out above.
- Junction Delay Function (JDF) – these calculate the additional cost of completing a turn at junctions and consider the volume of traffic sharing an approach or undertaking conflicting turns. These are used to model the additional delay incurred at traffic signal controlled junctions, pedestrian crossings, give-ways, roundabouts and merges.

The above functions use information taken from the detailed microscopic coding of the highway network. For example, VDFs and TPFs use the coded lengths of links and turns. JDFs use the coded signal timings, give-way parameters and geometry to determine the available capacity and delay. In this way, the macro model is consistent with the micro model coding and provides appropriate capacity constraint within the macroscopic assignment. Furthermore, the detailed nature of the microscopic coding means that mid-block delays caused by pedestrian crossings and minor road right turns and other minor junctions will be explicitly taken into account in the macro assignment. The delay functions used in the model are discussed further in section 8.5.

Microscopic Model

Within the microsimulations, capacity constraint, queuing and blocking back is fully taken into account by virtue of the nature of the simulation.

2.2.8 Dynamic Traffic Assignment (Micro)

As set out in above, stochastic dynamic traffic assignment (DTA) has been used to determine the paths that the non-user equilibrium vehicles will take between a given origin and destination from a set of alternative routes. In a stochastic model, the probability of a vehicle taking a particular route depends on the cost of that route relative to the costs of the alternative route(s). The costs are determined by the cost function and the probabilities are determined by the route choice model. The route choice model defines the drivers' decision of which path to take from a set of alternatives, connecting one origin to one destination, depending on the cost calculation by the cost function. The 'standard' route choice models within Aimsun include:

- Fixed (time);
- Binomial;
- Proportional;
- Logit;
- C-Logit.

The fixed model is not appropriate to use, as it will not allow vehicles to respond to congestion as it determines fixed routes at the start of simulation using travel time in free-flow conditions (or the travel time during the warm-up period). The Binomial model has not been used as it does not consider the travel costs in the decision process. The proportional model has also not been used, as it is not particularly sensitive to small changes in travel costs.

The remaining models are therefore the Logit and the C-Logit model. In these models, the probability of a given path is expressed as a function of the difference between the costs of that path and all other alternative paths. In the C-Logit model, a commonality factor is introduced which controls the degree to which overlapping routes between a given OD pair are used in large networks where many alternative paths between origins and destinations exist.

In calibrating the model, there are a number of parameters that need calibrating in the C-Logit model as follows:

- Cycle time: this is the length of the period after which the route choice paths and probabilities are recalculated;
- Number of intervals: this is the number of preceding cycles that are used to calculate the route choice paths in the next route choice cycle;
- Initial K-SPs: the number of route choice paths used at the beginning of the simulation;
- Maximum number of routes: the maximum number of routes for each O-D pair to which vehicles are assigned;
- Scale factor, θ: this influences the standard error of the distribution of expected travel times and effectively determines the weight given to differences in costs between routes. For a small value of the scale factor (θ <1), there is a large variability about the true route costs and hence a trend towards using many routes whereas for large value of the scale factor (θ > 1) there is a small variability about the true route costs and route choice is concentrated in very few routes;
- Commonality factor: this is directly proportional to the degree of overlap of a given path with other alternative paths and is scaled by the parameters β and γ. The β parameter scales the commonality factor such that as β gets larger, the overlapping factor has greater importance with respect to utility (or cost). The γ parameter has a smaller influence than β and has the opposite effect.
- Attractiveness weight: this is the weighting afforded to the capacity when the route costs are calculated by the cost function;
- User defined cost weight: this is the weighting afforded to the user defined costs when the route costs are calculated by the cost function.

The final calibrated values for the route choice model are shown in Table 11.

Table 11: DTA Model Calibrated Values

Logit Model Parameter	Final Calibrated Values
Cycle time	00:15:00
Initial K-SPs	3
Maximum Number of Paths	3
Scale Factor, θ	1
Beta Factor, β	0.15
Gamma Factor, γ	1
Attractiveness Weight	1
User-Defined Cost Weight	1

2.3 Trip Distribution

A methodology has been adopted to generate the vehicle trip matrices, based wholly on observed data (mobile network data, Census origin-destination data, Census mode share data, traffic count data and car park capacity data).

2.4 Future Growth projections

2.4.1 Trip End Growth – Medway

The developments within the Reference Case in Medway have been assigned a model zone and where necessary, new zones have been created. The vehicle arrivals and departures are then summed for each zone and added to the respective destination and origin totals to provide the growth in traffic for each zone within the Medway local authority area. In this way, growth for trip ends within Medway are based solely of the projected development in the Reference Case Scenarios.

2.4.2 Trip End Growth – Other Areas

For all other zones in the model (i.e. those outside of Medway) trip end growth for non-home-based work (NHBW) LGV and HGV trips has been based on the forecasts contained in "*Road Traffic Forecasts 2015*" for LGV, rigid and artic vehicle types.

Trip end growth for all car trips and other LGV trips outside Medway (e.g. in neighbouring authorities) has been estimated using TEMPro v7.2. The resulting growth factors have also been modified using the income and fuel adjustment factors set out in WebTAG Databook Table M4.2.1.

In order to determine whether the level of growth from neighbouring authorities is appropriate, the projected household growth within NTEM has been compared with that set out in the Adopted Local Plans for Gravesham, Maidstone, Swale and Tonbridge & Malling. The results are set out in Table 12.

Table 12: Comparison of NTEM and Adopter Local Plan Growth

Local Authority	Household Growth (2016 to 2037)	
	National Trip End Model	Adopted Local Plan
Gravesham	8,785	6,897
Maidstone	18,350	16,777
Swale	9,170	21,073
Tonbridge & Malling	13,265	8,075
Total	**49,570**	**52,882**

The table shows that the NTEM projections for Gravesham and Maidstone are slightly above, but similar too, those set out in the Adopted Local Plans. However, for Tonbridge & Malling the growth in households is overestimated by 64%. Despite this, the level of growth assumed in NTEM has been adopted to ensure model robustness.

Given the large discrepancy between NTEM growth and Swale's adopted Local Plan, alternative growth assumptions have been adopted following liaison with Swale Council. Following discussions, it was understood that Swale's predicted household growth assumed 776 households per year pre 2022 and 1,054 households from 2022 to 2037. This alternative assumption was then used to generate updated growth factors within TEMPro. Based on this approach, an updated comparison is provided below.

Table 13: Comparison of NTEM and Adopted Local Plan Growth – Alternative Swale Assumptions

Local Authority	Household Growth (2016 to 2037)	
	National Trip End Model	Adopted Local Plan
Gravesham	8,785	6,897
Maidstone	18,350	16,777
Swale (Alternative Assumption)	20,744	21,073
Tonbridge & Malling	13,265	8,075
Total	**61,144**	**52,882**

The table above demonstrates that the level of growth assumed in NTEM, and therefore in the model, is broadly similar to that set out in the Adopted Local Plans. Additionally, the above demonstrates that the level of growth in neighbouring areas is robust, with a difference of 16% observed.

2.5 Infrastructures changes

The infrastructure changes from the Base Case to the Reference Case are presented below.

Table 14 Infrastructure changes from the Base Case to the Reference Case

Scheme Reference	Development	Planning Reference	Scheme Description
1	Former Cement Works, Halling (St Andrews Park)	MC/07/2153, MC/12/1791 (Amended by MC/14/1486)	Site connection to eastern arm of existing A228 Formby Road / Kent Road roundabout
			New ghost island priority-controlled junction access off A228 Formby Road
2	Land Rear of 187-193 Princes Avenue, Rear of 32/41 Gatcombe Close and North of Peacock Rise, Walderslade	MC/08/1043 & MC/14/1685	New development access – affects roads not included within the model
3	Land Between Roman Way and Knight Road, East of the Medway Valley Railway Line (Temple Waterfront) (Reserved Matters (Phase 1A)	MC/09/0417 & MC/16/0600 (Reserved Matters (Phase 1A)	Third access arm off existing Roman Way / Chariot Way roundabout
4	Mid Kent College Site, Horsted Centre, Maidstone Road, Chatham (Horsted Park)	MC/11/0001, MC/15/0335, MC/15/4540	Two new priority-controlled access junctions off A229 Maidstone Road
5	Land at Station Road (Bakersfield), Rainham, Kent ME8 7QZ	MC/14/0285 (granted by APP/A2280/W/15/3002877) & MC/17/1820	New priority-controlled access junction off Station Road, Rainham
6	Former Temple School, Brompton Farm Road, Strood, ME2 3NP	MC/14/1760	New priority-controlled access junction off Brompton Farm Road at location of existing school access
7	Gilbratar Farm, Ham Lane, Hempstead, Gillingham, Kent, ME7 3JJ	MC/14/2395 (granted by APP/A2280/W/16/3143600), MC/18/0556	New residential development road network connecting via a new arm to North Dane Way / Albemarle Road junction
8	Street Farm, Stoke Road, Hoo, ME3 9BH	MC/15/0098 (Outline, all matters reserved), MC/18/1795	New priority-controlled access off Stoke Road

Scheme Reference	Development	Planning Reference	Scheme Description
9	Land at Otterham Quay Lane, Rainham	MC/15/0761, MC/16/2051, MC/18/2328	New priority-controlled access off Otterham Quay Lane plus new signal-controlled pedestrian crossing
10	Land North of Peninsula Way, Main Road, Chattenden, Rochester	MC/15/3104 & MC/16/4229	New access road to existing eastern stub arm at the A228 Peninsula Way / Main Road Hoo Roundabout plus new Toucan crossing on A228 Peninsula Way
11	Land to East of Mierscourt/South of Oastview Rainham, ME8 8JF	MC/15/4539	New priority-controlled access off Mierscourt Road
12	Land at 185 Walderslade Road, Chatham, ME5 0ND	MC/16/0370	New priority-controlled access off Walderslade Road
13	Land South of Stoke Road, Hoo,	MC/18/0702	New priority-controlled access off Stoke Road
14	Land North of Commissioners Road Strood, ME2 4EQ	MC/16/4268	New priority-controlled access off Commissioners Road
15	Pier Road (Victory Pier)	MC/04/1214,	Signal-controlled A289 Pier Road / Pier Approach Road junction already included in the base year model
16	Land at Chatham Docks	MC/11/2756	New signal-controlled junction to replace existing A289 Pier Road / Church Road / Strand Approach Road roundabout
			Signalisation of Gillingham Gate Roundabout already included in the base year model
17	Former Southern Water Site, Capstone Road	MC/14/2737	New signal-controlled junction to replace existing A289 Pier Road / Church Road / Strand Approach Road roundabout
			Signalisation of Gillingham Gate Roundabout already included in the base year model

SWECO

Scheme Reference	Development	Planning Reference	Scheme Description
18	Rochester Riverside	MC/17/2333	Introduction of two exit lanes on New Road at the A2 Star Hill / A2 New Road / A229 City Way roundabout plus relocation of existing pedestrian crossing
19	Land at Brickfields, Darland Farm, Pear Tree Lane	MC/16/2776, MC/18/0705	Traffic Calming on a Pear Tree Lane plus
20	Kitchener Barracks	MC/15/0079, MC/17/1392	Residential road layout –affects roads not included in the model
21	Chatham Quayside (Formerly Colonial House)	MC/14/3631, MC/17/1250	Development road layout – affects roads not included in the model
22	10-40 & 48-86 Corporation St, Rochester (MHS Homes)	MC/15/2039	Two new priority-controlled accesses off A2 Corporation Street
23	Land Rear of 43-107 Beatty Avenue (Centenary Gardens)	MC/14/1912, MC/15/1909	Residential road layout – affects roads not included in the model
24	Land South of Ratcliffe Highway, BAE Systems, Hoo	MC/17/1884	Two new priority-controlled accesses off Ratcliffe Highway
25	Former Peters Pit and Peters Works	TM/05/00989/OAEA, TM/07/03045/RM	New highway layout comprising Rochester Road, Court Road and New Court Road
26	Kingsnorth Industrial Estate	MC/08/0370, MC/16/0479	Improvements to Ropers Lane including new roundabouts at the Ropers Lane / Stoke Road and Stoke Road / Eshcol Road junctions – already included in base year model
27	Aldi Foodstore, Strood	MC/11/3017	New priority-controlled access junction off Friary Place
28	Land Off Bailey Drive, Gillingham Business Park	MC/13/0750	New development accesses – affects roads not included in the model
29	Rochester Fire Station	MC/13/1265	New priority-controlled access junction off Marconi Way
30	Former Military Site, Upnor Depot, Lower Upnor	MC/13/1804	New priority-controlled access junction off Upnor Road
31	Temporary Access Road, Manor Farm Quarry	MC/10/2068	Construction of temporary access road

Scheme Reference	Development	Planning Reference	Scheme Description
32	Gillingham Islamic Centre (Formerly Croneens Car Park), Railway St, Gillingham	MC/13/0102, MC/16/4403	New priority-controlled access junction off Railway Street
33	Chatham Driving Range, Street End Road, Chatham	MC/17/2767	
34	Land at White House Farm, Stoke Road, Hoo	MC/18/0247	New priority-controlled access junction off Stoke Road – appropriate access already in the model
35	Former DX Freight Site, Maidstone Road	MC/18/0556	New priority-controlled access junction off North Dane Way – appropriate access already in the model
36	Walnut Tree Farm, High Halstow	MC/17/4408	New priority-controlled access junction off Britannia Road – appropriate access already in the model
37	Berenegrave Nursery, Berengrave Lane	MC/17/3687	New priority-controlled access junction off Berengrave Lane – appropriate access already in the model
38	Rear of 7-13, New Road, Rochester	MC/17/0092	Appropriate access already in the model
39	Rookery Lodge, Thacters Lane	MC/17/0410	Existing site access arrangements assumed
40	Yeoman House, Princes Street	MC/17/1192	Existing site access arrangements assumed
41	Former NHS Walk-in Centre, Canterbury Street, Gillingham	MC/17/2872	Existing site access arrangements assumed
42	Tara, 419 Walderslade Road, Walderslade	MC/18/0207	Appropriate access already in the model
43	Former Grieveson House, 1-26 Cross Street, Chatham	MC/18/0224	Existing site access arrangements assumed
44	Acorn Shipyard, Gas House, Rochester	MC/18/0706	Existing site access arrangements assumed
45	Land Adj to Rochester Train Station	MC/18/2309	Existing site access arrangements assumed
46	HE 001 M2 J5		

Scheme Reference	Development	Planning Reference	Scheme Description
47	HE 002 M20 J7		
48	STA SCH01 Leigh Academy (STA)		
49	002_ Laker Road Private Access Closure (other)		
50	CH2 2021 Strood Town Centre Improvements		

2.6 Amendments to model –

The latest August 2020 version of the Reference Case model contains several changes compared to the previous version. The changes are as follows:

- The demand data for committed developments for Medway has been updated with data 2018 – 2037.
- We have updated wider growth assumptions from TEMPRO and adjustments for Swale borough development plans.
- Finally, we have added in some additional strategic highway schemes to the model. This includes M2 Junction 5 upgrade and the upgrade to M20 Junction 7 in line with feedback from Highways England.

2.7 Proposed mitigations in the area

The latest version of the model was updated with mitigations in two of the locations as outlined in correspondence with David Tucker Associates. The following mitigations have been adopted in the Aimsun model and the results presented in sections 4.1, 4.2 and 4.3 include the effect of these mitigations.

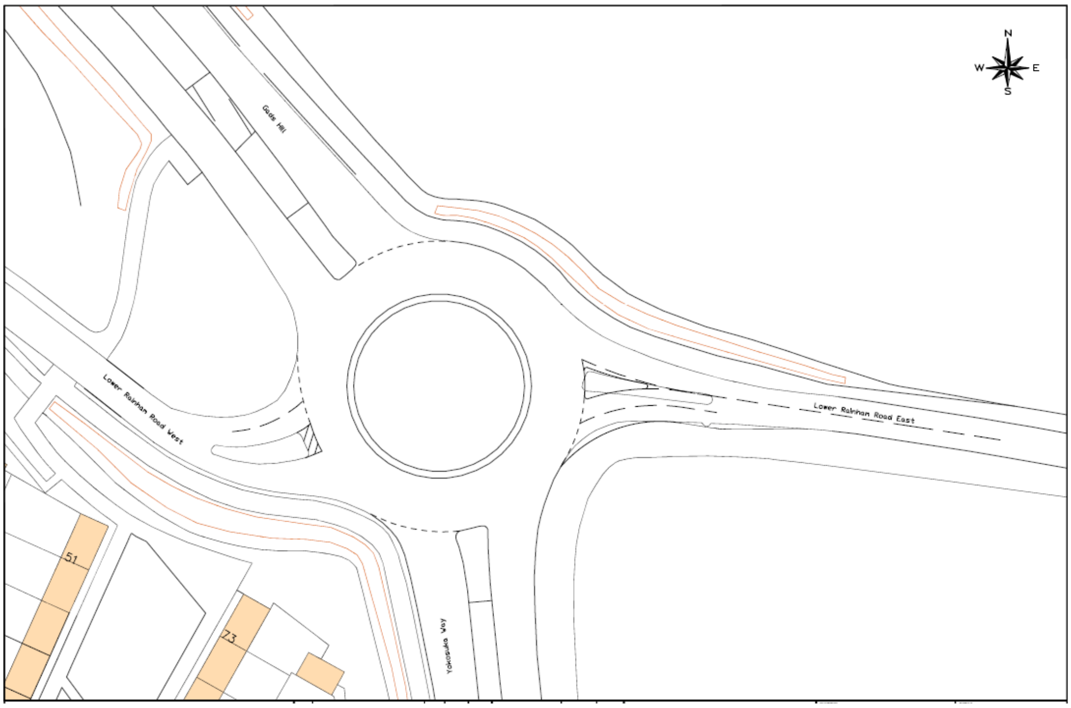

Figure 2 Proposed Improvements Yokosuka Way – Lower Rainham Road Lower Rainham Road East Arm

Figure 3 Proposed A2-Bloor Lane Junction Improvement works

The change proposed at Pump Lane in terms of signal shuttle working was not directly adopted in the model, but instead the access along the link was coded in with higher Generalised Cost to reflect impacts on journey time from the shuttle set up.

Figure 4 Proposed Pump lane Railway Bridge Improvements

3 Sensitivity Test 1, 2 & 3

For this report three sensitivity tests were conducted which examined the impact of the three tests which are described in section 1.1. Sections 3.1, 3.2 and 3.3 will describe each test in more detail.

3.1 Sensitivity Test 1

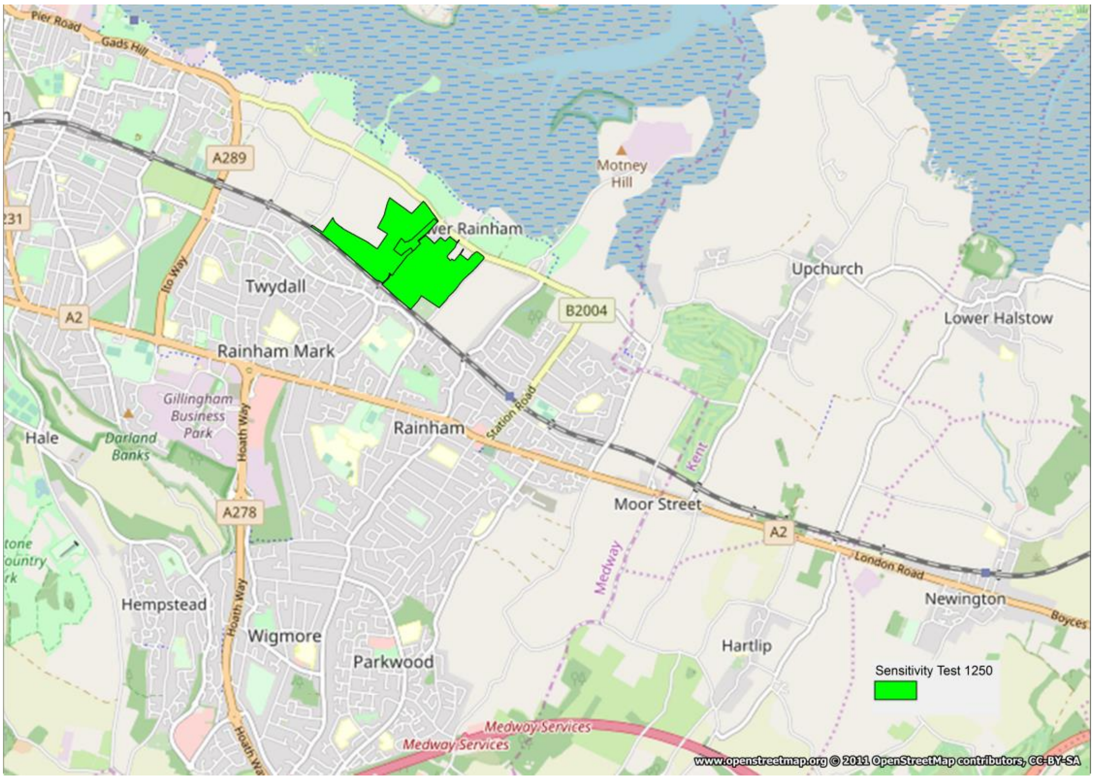

Figure 5 – Sensitivity test 1 (1,250 homes)

Sensitivity Test 1 involved a new residential development between the Lower Rainham Road and the railway line leading to Rainham railway station around Pump Lane. Sensitivity Test 1 included the building of 1,250 new homes. The exact area can be seen in Figure 5. The demand matrix of the reference case of Aimsun was adapted based on the new housing of this sensitivity test by adding the new traffic demand arising from the new residential area.

3.2 Sensitivity Test 2

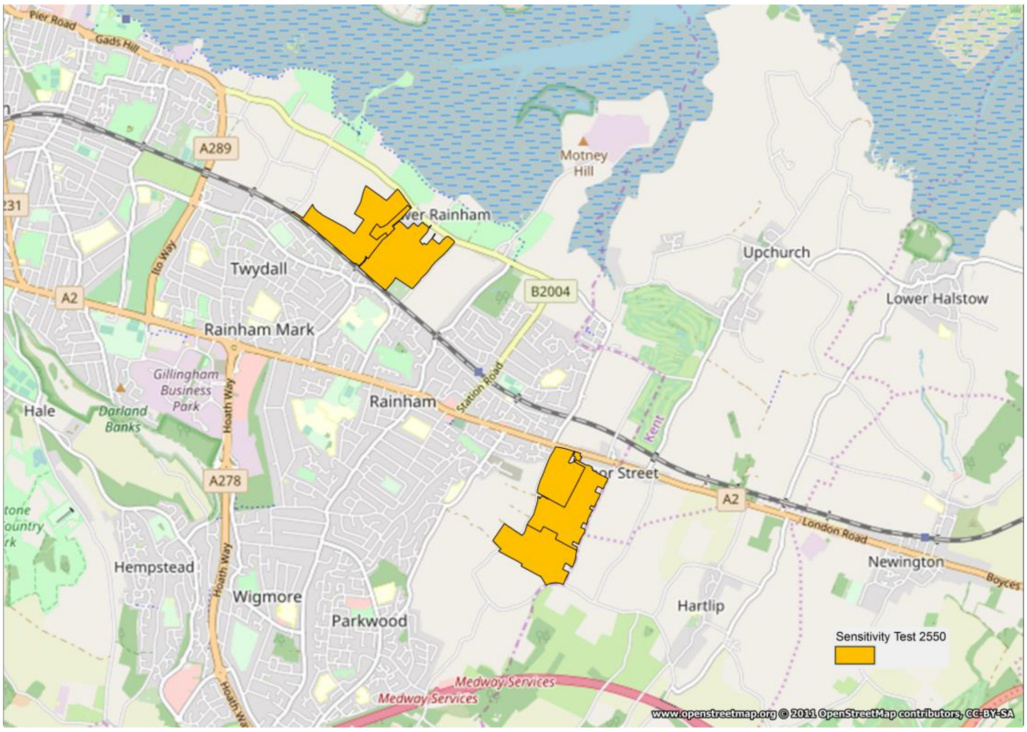

Figure 6 – Sensitivity test 2 (2550 homes)

Sensitivity Test 2 involved the development of two new residential areas. One of them was identical to the area included in Sensitivity Test 1 (see section 3.1). The second residential area was developed south of Moor street and west of South Bush Lane in Rainham (see Figure 6). The total number of homes for this sensitivity test was 2,550. Like sensitivity test 1, the additional traffic demand created by the development of these two new residential areas was added to the demand of the reference case.

3.3 Sensitivity Test 3

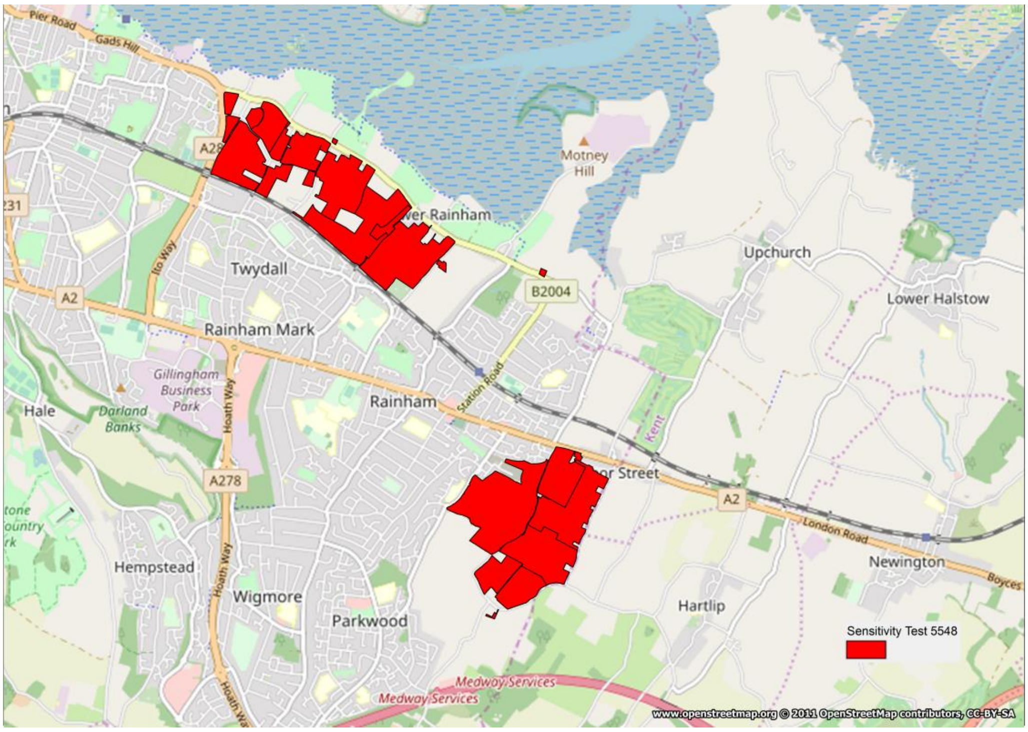

Figure 7 – Sensitivity 3 (5,548 homes)

Finally, Sensitivity Test 3 involved the development of two new housing areas around the areas described in Sensitivity Test 2. The difference between Sensitivity test 2 and 3 is that Sensitivity test 3 included the building of more than double the amount of homes than sensitivity test 2 (5,548 homes instead of 2,550). Once again, the default Aimsun demand was adapted to accommodate the demand arising from the new homes.

4 Model Run Outputs

4.1 Subnetworks

The Aimsun Medway model consists of 8 main sub-networks which can be seen in Figure 8. This report will analyse the impact of the sensitivity tests on three of them, namely subnetwork 2, subnetwork 3 and subnetwork 7, as they are located next to the proposed development sites.

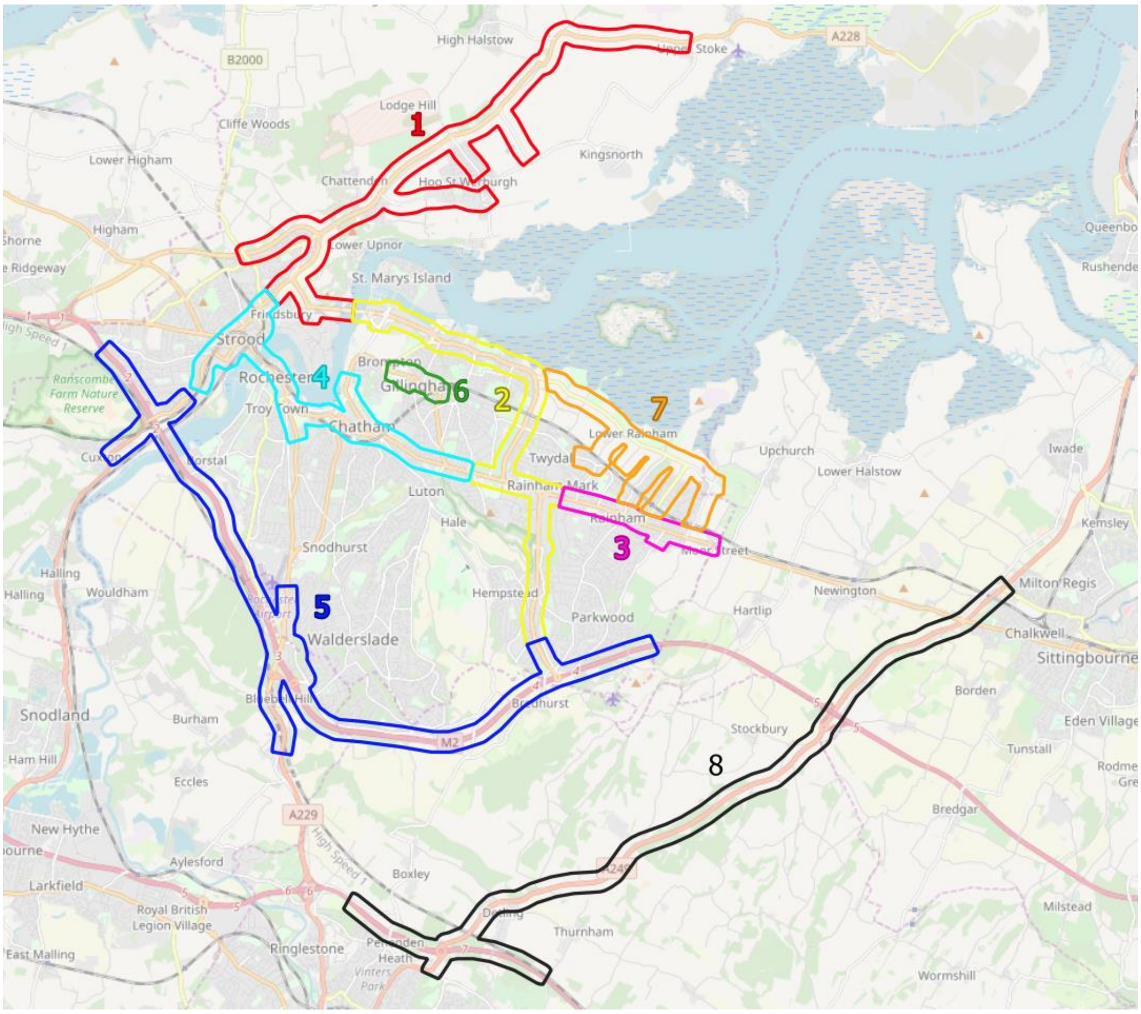

Figure 8 Subnetworks included in the Medway Aimsun Model

Subnetwork 2 covers the A289 from Medway Tunnel to the A2, the short section of A2 that links from the A289 to the A278 Hoath Way, and the A278 Hoath Way. It must be emphasised that subnetwork 2 is significantly bigger than the other 2 subnetworks and covers some part of the Strategic Road Network. Subnetwork 3 covers the A2 east of Bowaters Roundabout through

Rainham to the Medway boundary. Subnetwork 7 covers the link along Lower Rainham Road from the A2 in Rainham to the A289 junction at Yokosuka Way.

The following sections will present the subnetworks in question in more detail and discuss the main simulation findings from subnetworks 2, 3 and 7. It must be noted that in total eight simulation scenarios were ran for each subnetwork. One for each (three) sensitivity test and the reference case, for AM and PM peak periods using macro and micro simulation.

4.2 Traffic Impact Summary

Each sensitivity test has been compared against the Reference Case. The table below summarises the key changes between the scenarios within each of the subnetworks and the percentage change from the Reference Case.

Table 15 Traffic demand for the three subnetwork and percent change compared to the reference case

Subnetwork		AM				PM			
		RC	S1	S2	S3	RC	S1	S2	S3
2	Demand	21,123	21,423	21,561	21,973	20,710	21,383	21,443	23,639
	% Change	-	1.4%	2.1%	4.0%	-	3.2%	3.5%	14.1%
3	Demand	4,758	4,833	5,362	5,537	4,821	5,012	5,376	5,676
	% Change	-	1.5%	12.6%	16.3%	-	3.9%	11.5%	17.7%
7	Demand	11,224	11,835	12,416	12,648	11,224	11,343	11,432	12,355
	% Change	-	5.4%	10.6%	12.6%	-	1.0%	1.8%	10.0%

4.3 Subnetwork 2

The outline of subnetwork 2 along with its main corridors is presented in Figure 9. This subnetwork covers an area of 2024053 m^2, has a total section length of 64 km and includes 689 sections, 245 nodes and 161 centroids among 4 centroid configurations.

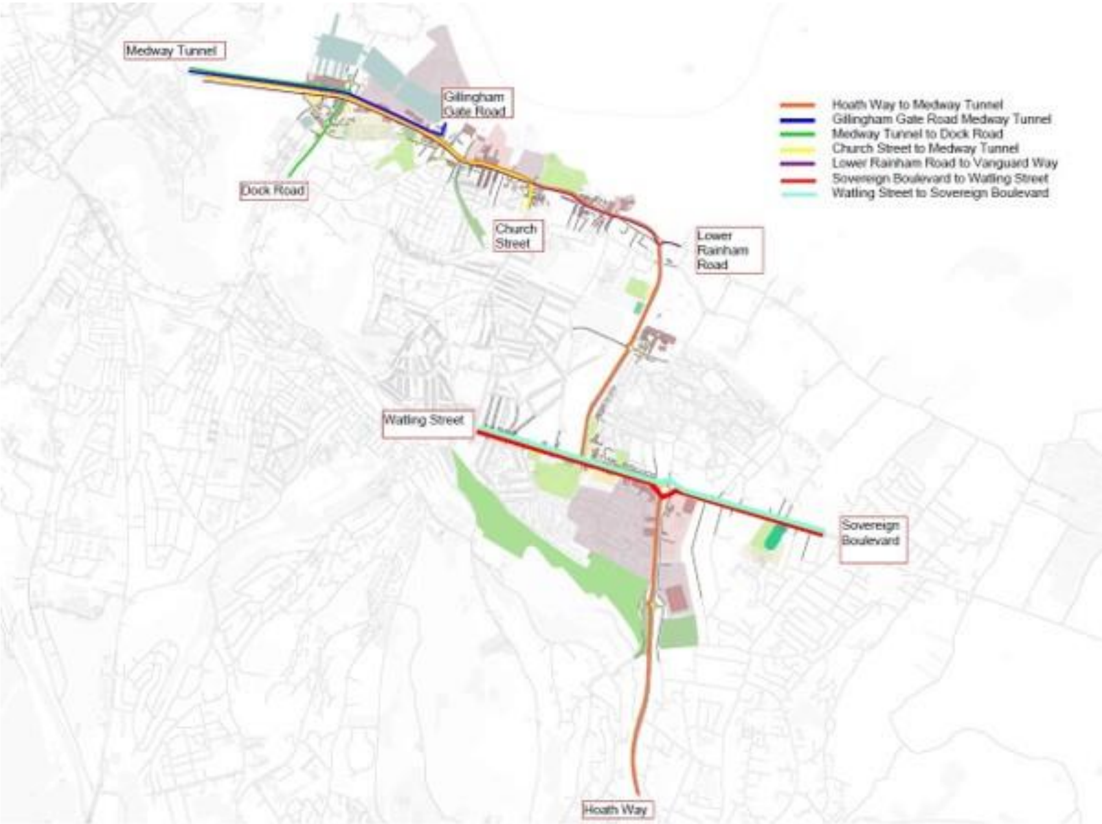

Figure 9 – Subnetwork 2 corridors

Figure 10 presents the main junctions of subnetwork 2, while Table 16 and Table 17 present the junction LoS results.

Figure 10 – Subnetwork 2 Junctions

It is observed that except for Pier Road /Gillingham Gate Road Roundabout West the LoS of all other junctions deteriorates significantly as the number of new houses increases, a result which is expected. For several junctions, the flow at the junction, approaches or exceeds capacity, as the level of service reaches level F. More specifically, level of service reaches level F at the following junctions:

- Pier Road/Maritime Way Roundabout in sensitivity 3 scenario during the AM peak and in all three sensitivity scenarios during the PM peak
- Yokosuka Way Roundabout in all scenarios including reference case during the AM peak and in sensitivity tests 2 and 3 in the PM scenario. This specific junction is already highly congested in the reference case. Adding extra traffic makes the traffic conditions worse.
- Rotary Gardens/Woodlands Road/Sovereign Boulevard Junction in the sensitivity 1, 2 and 3 during the AM peak and sensitivity tests 2 and 3 during the PM peak scenario
- Bowater Roundabout in the sensitivity tests 2 and 3 during the AM peak period and in the sensitivity tests 1 and 3 during the PM peak period
- Eastcourt Lane/South Avenue Junction in all tests including reference case during the AM peak period and in sensitivity tests 1, 2 and 3 during the PM peak. This junction is

highly congested in the reference case. Adding extra traffic arising from the proposed developments will make traffic conditions at the roundabout deteriorate further.

- London Road/Bloors Lane Junction in the sensitivity test 3 scenario during the PM peak.

Table 16 – Junctions AM Peak Period LoS Subnetwork 2

Jct No.	Junction	LoS (HMC) 2037 AM RC	LoS PUMP LANE 2037 AM Sensitivity test 1	LoS PUMP LANE 2037 AM Sensitivity test 2	LoS PUMP LANE 2037 AM Sensitivity test 3
1	Pembroke / Dock Road / Western Avenue / Maritime Way Roundabout	C	C	C	C
2	Pier Road/Maritime Way Roundabout	C	C	D	F
3	Pier Road /Gillingham Gate Road Roundabout	D	D	E	E
4	Pier Road /Gillingham Gate Road Roundabout West	D	E	E	E
5	Pier Road /Gillingham Gate Road Roundabout East	C	C	C	C
6	Pier Road/ChuLPh Street/Strand Junction	C	C	D	D
7	Yokosuka Way Roundabout	F	F	F	F
8	Rotary Gardens / Woodlands Road / Sovereign Boulevard Junction	D	F	F	F
9	Bowater Roundabout	C	E	F	F
10	Eastcourt Lane / South Avenue Junction	F	F	F	F
11	London Road /Bloors Lane Junction	D	D	D	D

Table 17 – Junctions PM Peak Period LoS Subnetwork 2

Jct No.	Junction	LoS (HMC) 2037 PM RC	LoS PUMP LANE 2037 PM Sensitivity 1	LoS PUMP LANE 2037 PM Sensitivity 2	LoS PUMP LANE 2037 PM Sensitivity 3
1	Pembroke / Dock Road / Western Avenue / Maritime Way Roundabout	A	B	C	C
2	Pier Road/Maritime Way Roundabout	E	F	F	F
3	Pier Road /Gillingham Gate Road Roundabout	D	D	D	E
4	Pier Road /Gillingham Gate Road Roundabout West	E	F	D	E
5	Pier Road /Gillingham Gate Road Roundabout East	B	C	C	C
6	Pier Road/ChuLPh Street/Strand Junction	C	C	D	D
7	Yokosuka Way Roundabout	A	A	F	F
8	Rotary Gardens / Woodlands Road / Sovereign Boulevard Junction	C	E	F	F
9	Bowater Roundabout	D	F	E	F
10	Eastcourt Lane / South Avenue Junction	D	F	F	F
11	London Road /Bloors Lane Junction	C	D	D	F

Table 18 and Table 19 present the simulation output in terms of travel time, delay, flow, speed, stop time, density, mean queue, and virtual queue. Overall, the results are showing the anticipated effect with increasing housing:

- An increase of travel time
- An increase in delay
- An increase in traffic flow
- A reduction of average network speed

- An increase in time that vehicles spend stopped
- An increase in the queue and the time that vehicles spend in queue waiting to get in

However, it must be noted that there is small difference in the network's statistics between sensitivity test 1 and sensitivity test 2. This can be attributed to the fact that the demand difference between those two scenarios is small compared to the overall traffic. Hence this difference can be considered statistically insignificant.

Figure 11 and Figure 12 present the increase in travel time, delay and stop time graphically for the AM and PM peak hours accordingly.

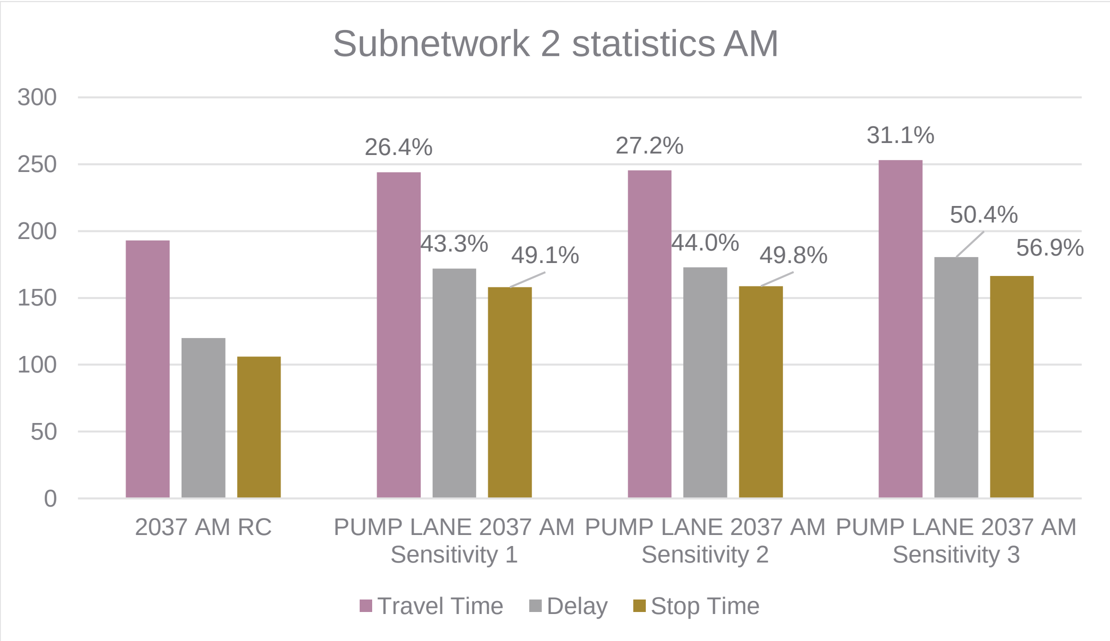

Figure 11 – Travel time, delay time and stop time statistics for subnetwork 2 AM

The increase in Travel time, Delay and Stop time between sensitivity tests 1 and 2 is similar due to the fact that the traffic demand is similar within subnetwork 2 in both tests. The largest increase in Delay is observed in Sensitivity test 3, ultimately reaching 50% and 59% in the AM and the PM peak scenarios accordingly. This increase in average network delay is a significant impact on the local network and traffic operations.

Table 18 – Simulation output AM Peak Period – Subnetwork 2

Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Travel Time	sec/km	193	244	245	253
Delay	sec/km	120	172	172	180
Flow	veh/h	11,266	11,380	11,473	11,653
Speed	km/h	28	27	26	25.7
Stop Time	sec/km	106	158	158	166
Mean Queue	veh	502	860	873	1015
Mean Virtual Queue	veh	146	574	607	815
Waiting Time in Virtual Queue	sec	46	178	186	234

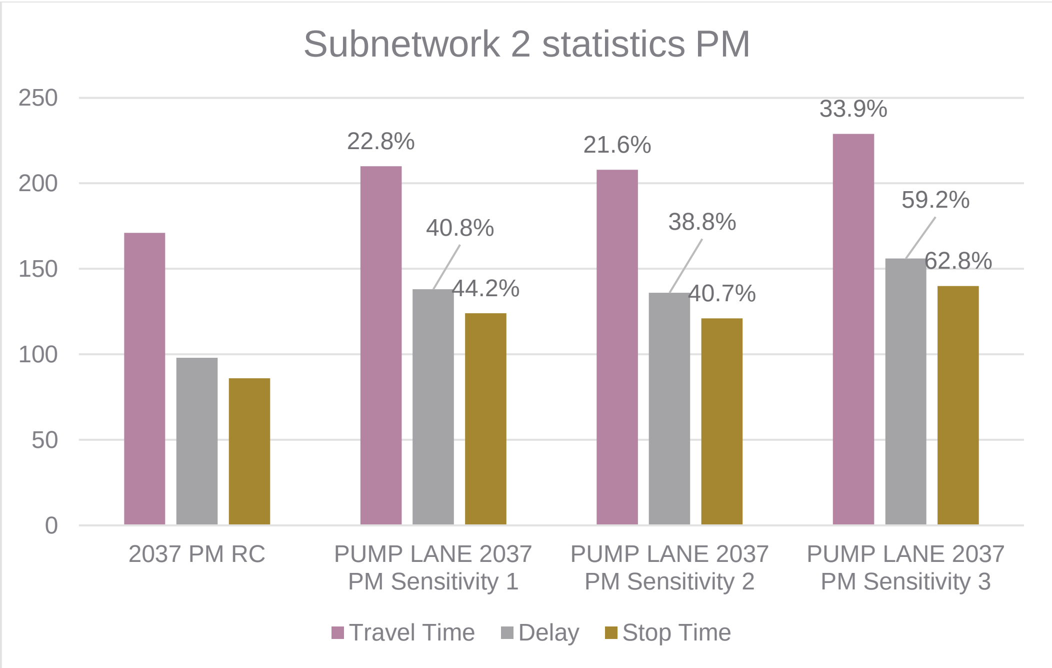

Figure 12 Travel time, delay time and stop time statistics for subnetwork 2 PM

Table 19 – Statistics PM Peak Period – Subnetwork 2

Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity 1	PUMP LANE 2037 PM Sensitivity 2	PUMP LANE 2037 PM Sensitivity 3
Travel Time	sec/km	171	210	208	229
Delay	sec/km	98	138	136	156
Flow	veh/h	11,124	11,495	11,454	12,731
Speed	km/h	30	27	27	25
Stop Time	sec/km	86	124	121	140
Mean Queue	veh	325	581	588	697
Mean Virtual Queue	veh	180	342	298	783
Waiting Time in Virtual Queue	sec	58	105	92	217

Tables 20 and 21 provide the total statistics for subnetwork 2 in terms of total travelled time, travelled distance, average travel time per vehicle, waiting time in virtual queue and total travel time including virtual queue for all vehicles in the network. Once again it can be observed that congestion increases as more houses are being built in the network both in the AM and PM peak periods.

Table 20 – Total Statistics AM Peak Period – Subnetwork 2

Total Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Total Travelled Time	h	2,236	2,951	3004	3297
Total Travelled Distance	km	52,434	53,374	54,137	55,782
Average travel time per vehicle	s/veh	357	467	471	509
Total Waiting Time in Virtual Queue	h	143	561	595	759
Total travel time including virtual queue	h	2,379	3,512	3,600	4,083
Total Queue	veh	648	1,435	1,480	1,831

Table 21 – Total Statistics PM Peak Period – Subnetwork 2

Total Statistics	**Units**	**2037 PM RC**	**PUMP LANE 2037 PM Sensitivity test 1**	**PUMP LANE 2037 PM Sensitivity test 2**	**PUMP LANE 2037 PM Sensitivity test 3**
Total Travelled Time	h	1,817	2,445	2,459	2,801
Total Travelled Distance	km	51,350	53,893	53,713	56,416
Average travel time per vehicle	s/veh	294	383	386	396
Total Waiting Time in Virtual Queue	h	3	10	8	47
Total travel time including virtual queue	h	1,820	2,455	2,467	2,856
Total Queue	veh	505	924	886	1,480

Finally, Tables 22 and 23 provide the throughput statistics for subnetwork 2 for AM and PM peak periods. It must be underlined that in the AM sensitivity test 3 scenario even when the simulation run finishes, there are still vehicles waiting to enter. This means that there are points in the network where the capacity of the road cannot accommodate the new increased demand. After observing all the plots attached in the appendix of this document, these points were observed around the development areas.

Table 22 – Throughput AM Peak Period – Subnetwork 2

Throughput Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Vehicles Out	veh	22,531	22,761	22,947	23,307
Vehicles In	veh	6	7	6	83
Vehicles Waiting to Enter	veh	0	0	0	30
Total	veh	22,538	22,768	22,953	23,420
Vehicles In and Waiting to Enter	veh	6	7	6	112

Table 23 – Throughput PM Peak Period – Subnetwork 2

Throughput Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Vehicles Out	veh	22,247	22,990	22,908	25,462
Vehicles In	veh	6	6	6	21
Vehicles Waiting to Enter	veh	0	0	0	9
Total	veh	22,253	22,996	22,914	25,491
Vehicles In and Waiting to Enter	veh	6	6	6	29

4.3.1 Subnetwork 2 Summary

In summary, the Sensitivity tests have a significant impact on the performance of the highway network along the A289 and A278, and the linking A2 section. In particular, the data shows that:

1. Pier Road / Maritime Way Roundabout
2. Eastcourt Lane / South Avenue Junction
3. Yokosuka Way Roundabout and
4. London Road /Bloors Lane Junction

are particularly impacted. Their level of service consistently reaches level F which indicates that in the sensitivity scenarios these roundabouts' demand would exceed their capacity. Overall, Sensitivity test 1 sees delay rise around 40% in both AM and PM scenarios in comparison to RC, Sensitivity test 2 46% (AM) and 41% (PM), and Sensitivity test 3 50% (AM) and 59% (PM). The significant increase between sensitivity test 1 and 2 to sensitivity test 3 in the AM scenario clearly indicates the negative impact of the new developments on the performance of the network.

4.4 Subnetwork 3

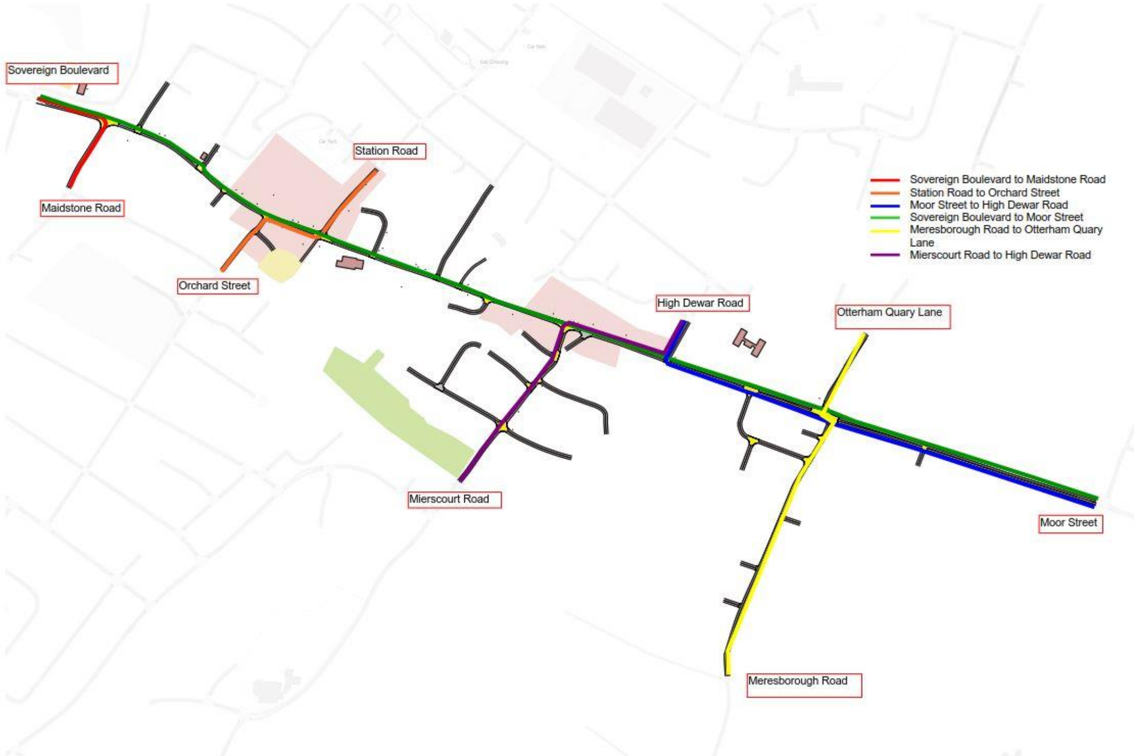

Figure 13 – Subnetwork 3 Corridors

The outline of subnetwork 3 along with its main corridors is presented in Figure 13. This subnetwork covers an area of 450918 m^2, has a total section length of 8 km and includes 146 sections, 36 nodes and 30 centroids among 5 centroid configurations.

Figure 14 presents the main junctions included in subnetwork 3 and Tables 24 and 25 demonstrate the LoS results for the corresponding junctions. It is observed that the level of service deteriorates along with the increase in housing in all junctions of subnetwork 3. However, the junctions that are heavily impacted are:

- Otterham Quay Lane - Meresborough where the flow of the junction is greater than its capacity and the level of service becomes F in the PM scenario
- Mierscourt Road - High Street Junction where the level of service becomes E consistently in the sensitivity tests

Figure 14 – Subnetwork 3 Junctions

Table 24 – Junctions AM Peak Period LoS – subnetwork 3

Jct No.	Junction	LoS (HMC) 2035 AM RC	LoS PUMP LANE 2037 AM Sensitivity test 1	LoS PUMP LANE 2037 AM Sensitivity test 2	LoS PUMP LANE 2037 AM Sensitivity test 3
1	Mierscourt Road_High Street Junction	C	E	E	E
2	Otterham Quay Lane_Meresborough	D	D	E	E
3	Sovereign Bd & Maidstone Rd	C	D	D	D
4	Sovereign Bd & Station Rd	C	D	D	D

Table 25 – Junctions PM Peak Period LoS - subnetwork 3

Jct No.	Junction	LoS (HMC) 2035 PM RC	LoS PUMP LANE 2037 PM Sensitivity test 1	LoS PUMP LANE 2037 PM Sensitivity test 2	LoS PUMP LANE 2037 PM Sensitivity test 3
1	Mierscourt Road_High Street Junction	D	E	E	E
2	Otterham Quay Lane_Meresborough	D	F	F	F
3	Sovereign Bd & Maidstone Rd	C	C	C	D
4	Sovereign Bd & Station Rd	C	D	D	E

Tables 26 and 27 present the simulation output in terms of travel time, delay, flow, speed, stop time, density, mean queue, and virtual queue. Overall, the results are showing the anticipated effect due to the increased number of trips both in the AM and the PM time periods:

- An increase of travel time as the number of houses completed increases
- An increase in delay
- An increase in traffic flow
- A great reduction of average network speed
- An increase in time that vehicles spend stopped

- An increase in the queue and the time that vehicles spend in queue waiting to get in the network

Figure 15 and Figure 16 present the increase in travel time, delay and stop time graphically for the AM and PM periods accordingly.

It is observed that for Subnetwork 3 the difference between sensitivity test 1 and the reference case is not significant, as the proposed developments are far away from the subnetwork. However, as the South development areas show up in sensitivity tests 2 and 3 the impact on this subnetwork is clear, ultimately increasing the delay by 18% and 15% in sensitivity test 2 in the AM and PM peak scenarios respectively and 63% and 41% in the sensitivity test 3 scenarios. A large increase in delay is forecast between sensitivity tests 2 and 3, emphasising once again the magnitude of the development.

Table 26 – Statistics AM Peak Period – Subnetwork 3

Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Travel Time	sec/km	247	248	274	347
Delay	sec/km	161	162	190	263
Flow	veh/h	2,475	2,502	2,801	2,901
Speed	km/h	19	20	19	16
Stop Time	sec/km	146	146	173	244
Mean Queue	veh	66	72	94	139
Mean Virtual Queue	veh	8	43	96	188
Waiting Time in Virtual Queue	sec	12	62	123	231

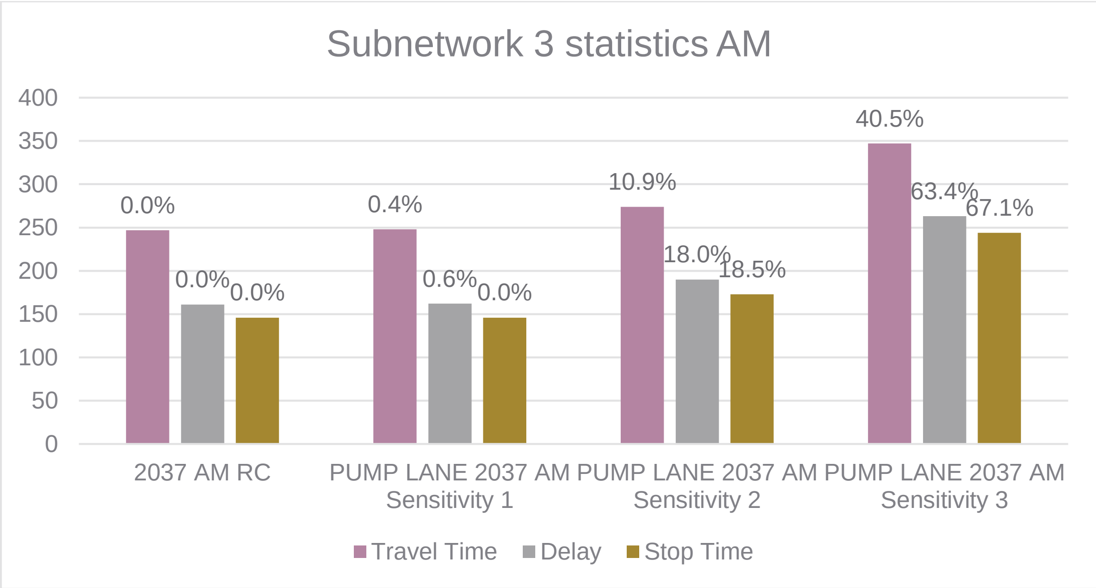

Figure 15 Travel time, delay and stop time results for subnetwork 3 AM

Table 27 – Statistics PM Peak Period – Subnetwork 3

Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Travel Time	sec/km	272	284	299	347
Delay	sec/km	186	199	214	263
Flow	veh/h	2,529	2,649	2,855	2,901
Speed	km/h	18	18	19	16
Stop Time	sec/km	171	182	197	244
Mean Queue	veh	72	96	108	139
Mean Virtual Queue	veh	12	127	160	188
Waiting Time in Virtual Queue	sec	16	173	203	231

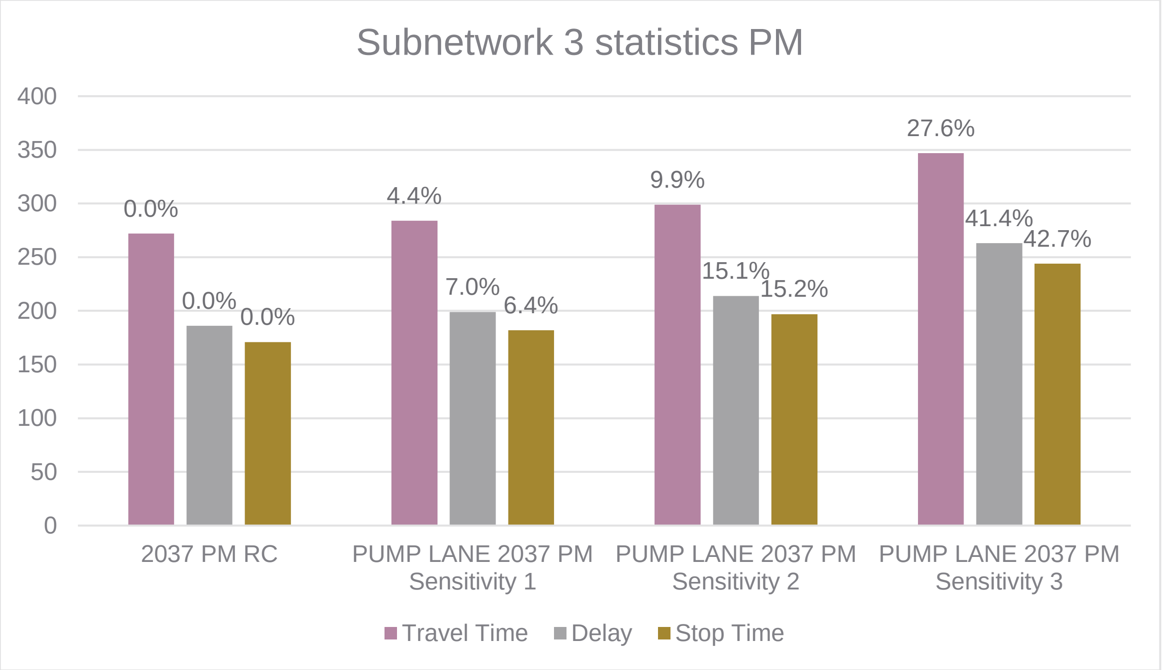

Figure 16 Travel time, delay and stop time results for subnetwork 3 PM

Tables 28 and 29 provide the total statistics for subnetwork 3 in terms of total travelled time, travelled distance, average travel time per vehicle, waiting time in virtual queue and total travel time including virtual queue for all vehicles in the network. Once again it can be observed that congestion increases as more houses are being built in the network both in the AM and PM peak periods.

Table 28 – Total Statistics AM Peak Period – Subnetwork 3

Total Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity 1	PUMP LANE 2037 AM Sensitivity 2	PUMP LANE 2037 AM Sensitivity 3
Total Travelled Time	h	242	260	320	419
Total Travelled Distance	km	3,607	3,785	4,236	4,413
Average travel time per vehicle	s/veh	176	187	206	260
Total Waiting Time in Virtual Queue	h	0	1	3	12
Total travel time including virtual queue	h	242	261	323	431
Total Queue	veh	74	115	190	328

Table 29 – Total Statistics PM Peak Period – Subnetwork 3

Total Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Total Travelled Time	h	264	324	358	419
Total Travelled Distance	km	3,896	4,165	4,415	4,413
Average travel time per vehicle	s/veh	188	220	226	253
Total Waiting Time in Virtual Queue	h	0	6	9	12
Total travel time including virtual queue	h	264	330	367	431
Total Queue	veh	84	223	269	328

Finally, Tables 30 and 31 provide the throughput statistics for subnetwork 3 for AM and PM peak periods respectively.

Table 30 Throughput AM Peak Period – Subnetwork 3

Throughput Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Vehicles Out	veh	4,950	5,005	5,601	5,801
Vehicles In	veh	1	1	1	1
Vehicles Waiting to Enter	veh	0	0	0	0
Total	veh	4,952	5,006	5,602	5,803
Vehicles In and Waiting to Enter	veh	1	1	1	1

Table 31 Throughput PM Peak Period – Subnetwork 3

Throughput Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Vehicles Out	veh	5,058	5,297	5,710	5,972
Vehicles In	veh	2	2	2	2
Vehicles Waiting to Enter	veh	0	0	0	0
Total	veh	5,060	5,299	5,712	5,974
Vehicles In and Waiting to Enter	veh	2	2	2	2

4.4.1 Subnetwork 3 summary

In Summary, subnetwork 3 results indicate that the sensitivity tests have an immediate impact on the performance of the network. More specifically and after also observing the plots attached in the appendixes of the document, it is observed that the performance of A2 Eastbound direction is significantly affected in terms of average travel speed. As far as junctions are concerned, the most significant impact is observed in Otterham Quay Lane/Meresborough where the flow of the junction is greater than its capacity and the level of service becomes F in the PM scenario and the Mierscourt Road_High Street Junction where the level of service becomes E consistently in the sensitivity tests.

With regards to travel time, it was observed that in the AM scenario the difference between sensitivity test 1 and the reference case is not as great as it was in subnetwork 2. This was attributed to the fact that subnetwork 3 is more far away from the Pump lane developments than subnetwork 2. Once again, significant increase is observed between sensitivity test 2 and 3 is observed in network delay from 18% to 63% in the AM scenario and 15% to 41% in the PM scenario. This jump even though it is significant, it is not as high as in subnetwork 2.

4.5 Subnetwork 7

The outline of subnetwork 7 along with its main corridors is presented in Figure 17. This subnetwork covers an area of 2372593 m^2, has a total section length of 35 km and includes 329 sections, 86 nodes and 87 centroids among 5 centroid configurations.

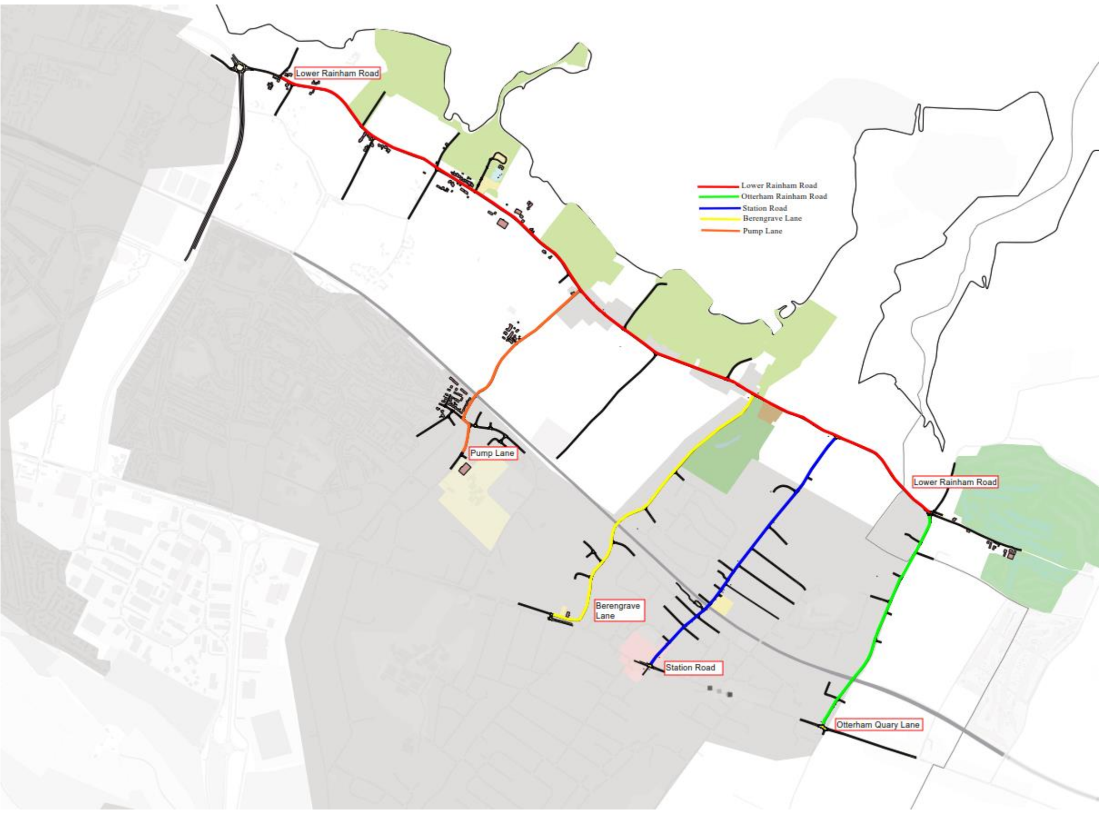

Figure 17 –Subnetwork 7 Corridors

Figure 18 presents the main junctions included in subnetwork 7 and tables 32 and 33 demonstrate the LoS results for the corresponding junctions. It is observed that the level of service of

- Lower Rainham Road / Berengrave Lane deteriorates along with the increase in housing, ultimately reaching level of service F both in the AM and the PM peak scenarios
- B2004 Lower Rainham Road / B2004 Station Road junction level of service becomes C from A in sensitivity test 3 in the AM scenario

Figure 18 – Subnetwork 7 Junctions

Table 32 – Junctions AM Peak Period – Subnetwork 7

Jct No.	Junction	LoS (HMC) 2035 AM RC	LoS PUMP LANE 2037 AM Sensitivity test 1	LoS PUMP LANE 2037 AM Sensitivity test 2	LoS PUMP LANE 2037 AM Sensitivity test 3
1	B2004 Lower Rainham Road / Pump Lane	A	A	A	A
2	Beechings Way / Pump Lane (North)	A	A	A	A
3	Beechings Way / Pump Lane (South)	A	A	A	A
4	B2004 Lower Rainham Road / Berengrave Lane	C	C	F	F
5	B2004 Lower Rainham Road / B2004 Station Road	A	A	A	C
6	Lower Rainham Road / Otterham Quay Lane	A	A	A	A

Table 33 Junctions PM Peak Period – Subnetwork 7

Jct No.	Junction	LoS (HMC) 2037 PM RC	LoS PUMP LANE 2037 PM Sensitivity test 1	LoS PUMP LANE 2037 PM Sensitivity test 2	LoS PUMP LANE 2037 PM Sensitivity test 3
1	B2004 Lower Rainham Road / Pump Lane	A	A	A	B
2	Beechings Way / Pump Lane (North)	A	A	A	A
3	Beechings Way / Pump Lane (South)	A	A	A	A
4	B2004 Lower Rainham Road / Berengrave Lane	C	C	D	F
5	B2004 Lower Rainham Road / B2004 Station Road	A	A	A	A
6	Lower Rainham Road / Otterham Quay Lane	A	A	A	A

Tables 34 and 35 present the simulation output in terms of travel time, delay, flow, speed, stop time, density, mean queue, and virtual queue. Overall, even though subnetwork 7 is much less congested than the other two subnetworks, the results are still showing the anticipated effect due to the increased number of trips both in the AM and the PM time periods:

- An increase of travel time as the number of houses completed increases
- An increase in delay
- An increase in traffic flow
- A great reduction of average network speed
- An increase in time that vehicles spend stopped
- An increase in the queue and the time that vehicles spend in queue waiting to get in

However, it must be noted that there is small difference in the network's statistics between sensitivity test 1 and sensitivity test 2. This can be attributed to the fact that the demand difference between those two scenarios is small compared to the overall traffic. Hence this difference can be considered statistically insignificant.

Figure 19 and Figure 20 present the increase in travel time, delay and stop time graphically for the AM and PM periods accordingly.

In the AM scenario, a linear increase in delay is observed in delay: 34%, 48% and 87% increase in Sensitivity tests 1, 2 and 3 accordingly. However, the same effect cannot be observed in the PM peak scenario where the delay fluctuates around 70% between the sensitivity scenarios compared to the reference case. Other indicators such as flow and average network speed seem to agree with this result as they show very small differences between the sensitivity scenarios. This can be attributed to the fact that subnetwork 7 is a subnetwork much less congested overall than subnetwork 2.

Table 34 Statistics AM Peak Period – Subnetwork 7

Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Travel Time	sec/km	140	162	171	194
Delay	sec/km	61	82	90	114
Flow	veh/h	5,853	6,170	6,454	6,654
Speed	km/h	36	34	33	32
Stop Time	sec/km	51	70	78	102
Mean Queue	veh	57	155	171	213
Mean Virtual Queue	veh	4	69	130	224
Waiting Time in Virtual Queue	sec	2	39	72	119

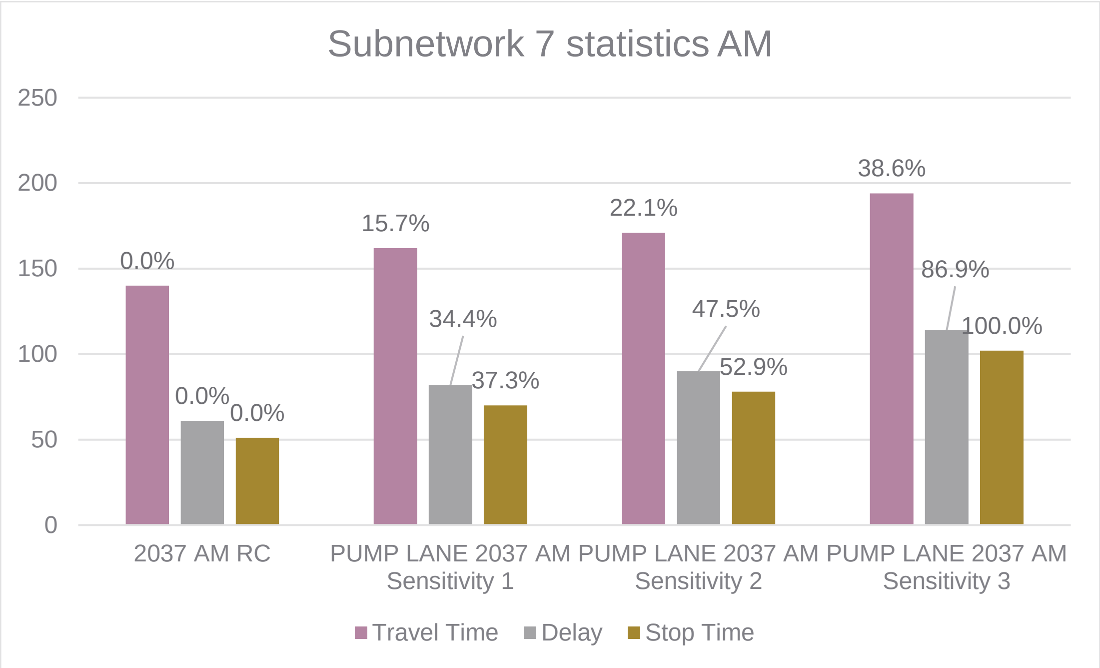

Figure 19 Travel time, delay time and stop time statistics for subnetwork 7 *- AM*

Table 35 – Statistics PM Peak Period – Subnetwork 7

Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Travel Time	sec/km	123	154	146	154
Delay	sec/km	42	74	65	73
Flow	veh/h	5,542	5,964	6,004	6,461
Speed	km/h	38	36	36	35
Stop Time	sec/km	35	64	56	63
Mean Queue	veh	28	68	43	63
Mean Virtual Queue	veh	2	87	153	121
Waiting Time in Virtual Queue	sec	1	53	93	68

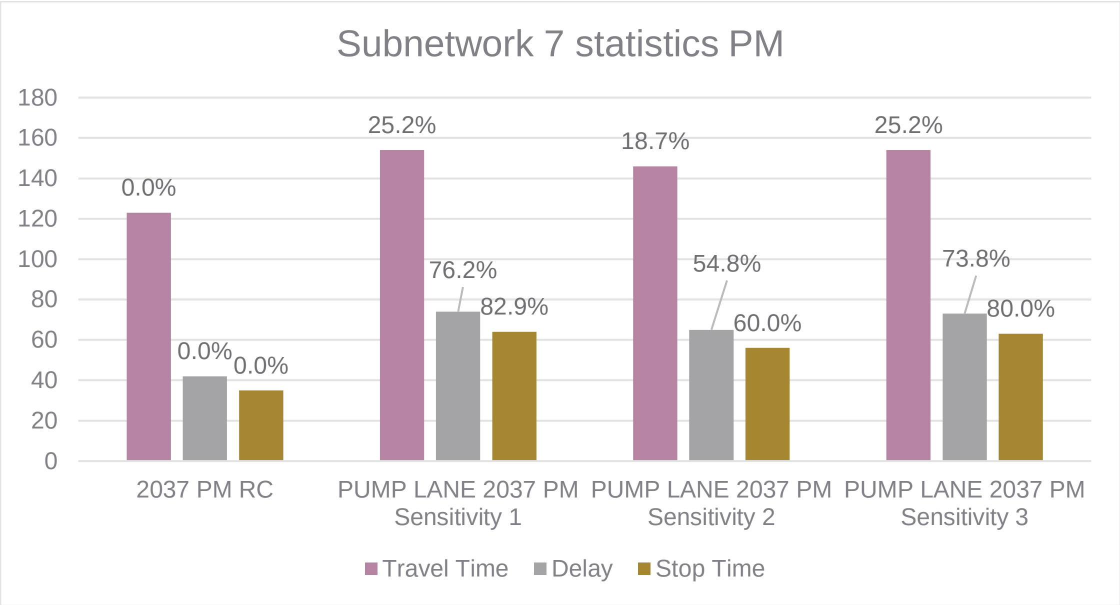

Figure 20 Travel time, delay time and stop time statistics for subnetwork 7 – *PM*

Tables 36 and 37 provide the total statistics for subnetwork 7 in terms of total travelled time, travelled distance, average travel time per vehicle, waiting time in virtual queue and total travel time including virtual queue for all vehicles in the network. Once again it can be observed that congestion increases as more houses are being built in the network both in the AM and PM peak periods.

Table 36 Total Statistics AM Peak Period – Subnetwork 7

Total Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Total Travelled Time	h	445	701	750	837
Total Travelled Distance	km	13,043	14,357	14,784	14,981
Average travel time per vehicle	s/veh	137	205	209	226
Total Waiting Time in Virtual Queue	h	0	1	3	7
Total travel time including virtual queue	h	445	702	752	844
Total Queue	veh	61	224	302	437

Table 37 Total Statistics PM Peak Period – Subnetwork 7

Total Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Total Travelled Time	h	358	484	419	499
Total Travelled Distance	km	12,201	13,572	13,128	14,564
Average travel time per vehicle	s/veh	116	146	126	139
Total Waiting Time in Virtual Queue	h	0	1	4	2
Total travel time including virtual queue	h	358	486	423	501
Total Queue	veh	30	155	196	184

Finally, Tables 38 and 39 provide the throughput statistics for subnetwork 7 for AM and PM peak periods accordingly.

Table 38 Throughput AM Peak Period – Subnetwork 7

Throughput Statistics	Units	2037 AM RC	PUMP LANE 2037 AM Sensitivity test 1	PUMP LANE 2037 AM Sensitivity test 2	PUMP LANE 2037 AM Sensitivity test 3
Vehicles Out	veh	11,705	12,340	12,908	13,308
Vehicles In	veh	2	2	2	2
Vehicles Waiting to Enter	veh	0	0	0	0
Total	veh	11,707	12,342	12,910	13,310
Vehicles In and Waiting to Enter	veh	2	2	2	2

Table 39 Throughput PM Peak Period – Subnetwork 7

Throughput Statistics	Units	2037 PM RC	PUMP LANE 2037 PM Sensitivity test 1	PUMP LANE 2037 PM Sensitivity test 2	PUMP LANE 2037 PM Sensitivity test 3
Vehicles Out	veh	11,084	11,927	12,008	12,922
Vehicles In	veh	2	2	2	2
Vehicles Waiting to Enter	veh	0	0	0	0
Total	veh	11,086	11,929	12,009	12,924
Vehicles In and Waiting to Enter	veh	2	2	2	2

4.5.1 Subnetwork 7 summary

In summary, it is observed that the sensitivity tests will significantly affect subnetwork 7 as well compared to the 2037 reference case. The link speed diagrams in the appendix of this report can be observed that the network elements that will most significantly be affected are:

- B2004 Lower Rainham Road / Berengrave Lane where the flow of the junction is greater than its capacity and the level of service becomes F in the PM scenario

- Lower Rainham Road westbound especially close to the Lower Rainham Road/Yokosuka Way Roundabout

In terms of network delay, in the AM scenario, a significant increase in travel time and delay is observed in sensitivity tests 1 (34%), 2 (48%) and 3 (87%). However, following the results of the other two subnetworks a jump of approximately 30% is observed between sensitivity tests 2 and 3. In the PM scenario, the average network delay seems to fluctuate around 70% between the three sensitivity tests, a result that arises from the fact that the subnetwork is not as congested as the other 2 subnetworks. Nevertheless, an increase in delay of around 70% cannot be considered negligible. With regards to junction level of service, it can be observed that in all junctions except B2004 Lower Rainham Road / Berengrave Lane, the level of service remains mostly unchanged throughout the sensitivity tests. Consequently, it is considered that these junctions can accommodate the new housing.

5 Select link analysis on the entry and exit of the proposed Development (Development to/from bandwidth plots)

The select link analysis plots can be found in the PDF attachments. Please refer to Appendix 1 for the exact file names of the Select link analysis plots.

The key outcomes from the review of the Select Link plots are as follows:

- A significant increase of assigned traffic is observed around the links where the development sites are located
- The primary links used are
  - A289 via junction with Yokosuka Way to link to employment sites around Gillingham including the hospital and Business Park, Medway Tunnel, and westbound on the A2
  - Eastbound on the A2 via Rainham High Street
  - A278 Hoath Way on the M2 eastbound via Pump Lane

6 DS-DM bandwidth plots

The DS-DM bandwidth plots can be found in the PDF attachments of Appendix 2. Please refer to Appendix 2 for the exact file names**Appendix *2* Do something versus reference case traffic flow plots**.

Specific comments about the DS-DM plots for all sensitivity tests:

Large increases in assigned volume compared to the reference case for the following links:

- Pier Road eastbound
- Ito Way and Yokosuka way southbound
- Lower Rainham road westbound

7 Network Stress (V/C) Diagrams

The category-based network stress V/C diagrams can be found in the PDF attachments of Appendix 3. Please refer to Appendix 3 for the exact names of the attachments.

Key insights from the V/C diagrams are:

- The main impact is along the A289 corridor
- High V/C values for the important roundabouts in Pier Road/Maritime Way, Pier Road/ Gillingham gate road East and West
- The section V/C ratios seem to increase as more houses are being built.
- The highest V/C ratios are observed on Pier Road, east of the junction with Gillingham Gate Road.

8 Link Speed Diagrams

The link speed diagrams can be found in the PDF attachments of Appendix 4. Please refer to Appendix 4 for the exact file names of the Link speed Diagrams.

Significant drops of speed are observed in all the subnetworks. This observation can be confirmed by the statistics results tables presented in sections 4.1, 4.2 and 4.3. Some of the most significant differences are observed in the following links:

- A2 west of Ito Way in Subnetwork 2
- A2 Eastbound in Subnetwork 3
- Lower Rainham Road Westbound for Subnetwork 7

9 Junction delays in terms of bandwidths

The junction delays diagrams in terms of bandwidths plots can be found in the PDF attachments of Appendix 5. Please refer to Appendix 5 for the exact file names of the Junction delay plots.

Significant increase in delays is observed in all subnetworks as more houses are being built in the network. More specifically the largest increases are observed in:

- Ito Way and Yokosuka Way Northbound approaches in Subnetwork 2
- A2 Westbound and Eastbound in Subnetwork 3
- Lower Rainham Road / Yokosuka Way approach

SWECO

10 Reassignment Flow Plots

The reassignment flow plots can be found in the PDF attachments of Appendix 6. Please refer to Appendix 6 for the exact file names of the reassignment flow plots.

Significant increase in flows is observed around the development area (Pump lane). However, some decrease in flows is observed in some of the main arterials of the network such as Yokosuka Way and Ito Way. This is attributed to the fact that due to congestion on the network from the new development sites the traffic microsimulation vehicles dynamically change their route avoiding highly congested routes.

11 Summary

This report evaluates the traffic impact of three proposed developments in the Lower Rainham Road area. The developments included the building of new residential areas around Pump Lane and south of Moor street/West of South Bush Lane in Rainham. Three tests (Sensitivity test 1, 2 and 3) were developed for the year 2037 including these two development areas and were compared with the reference case for the same future year. The demand matrices of these three scenarios were adapted in order to accommodate the new trips arising from the new houses. The tests were evaluated separately.

The evaluations were conducted using the traffic simulation software Aimsun. The Aimsun network developed was calibrated and validated using observed – real world census origin destination data following TAG. The trip generation for the different trip purposes was conducted using TRICS. For the purpose of this report, the Aimsun model was divided into three subnetworks and for each subnetwork two analyses were conducted for the AM and PM peak periods.

The simulation results provide useful insights regarding the impact of the proposed developments. Overall, through most subnetworks and sensitivity tests a significant impact is observed in average simulated travel time, delay and stop time as a result of the housing developments. In more detail in:

- Sensitivity test 1, the increase in average network delay is around 43% in subnetwork 2, around 7% in subnetwork 3 and 76% in subnetwork 7 in the worst peak period
- Sensitivity test 2, the increase in average network delay is around 45% in subnetwork 2, 18% in subnetwork 3 and 54% in subnetwork 7 in the worst-case peak period
- Sensitivity test 3, the increase in average network delay is around 59% in subnetwork 2, 63% in subnetwork 3 and 86% in subnetwork 7 in the worst-case peak period

It is observed that sensitivity test 3 has a much greater impact on the traffic performance of the subnetworks than the other 2 sensitivity tests.

Additionally, it is observed that the level of service in most of the key junctions in all subnetworks deteriorates significantly in all sensitivity tests, ultimately reaching level of service F which indicates that the flow of the junction exceeds its capacity. More specifically the following junctions are most heavily impacted:

- Pier Road/Maritime Way Roundabout
- London Road /Bloors Lane Junction
- Bowater Roundabout
- Yokosuka Way Roundabout
- Otterham Quay Lane/Meresborough Junction
- B2004 Lower Rainham Road / Berengrave Lane Junction

In terms of links, after observing the link speed diagrams and the DS-DM plots, the following links are most significantly affected by the sensitivity tests:

- A289 and A278, and the linking A2 section
- A2 Eastbound direction
- Lower Rainham Road Westbound

The aforementioned congestion hotspots were also confirmed by observing the delay and simulated flow plots located in Appendix 5 and Appendix 6. The results were a direct product of the new trips arising from the new housing areas. It is observed that the impacts are more severe during the AM peak time where the demand is higher in most subnetworks.

Based on the above, there is a significant traffic impact on the local road network in all of the housing scenarios (all sensitivity tests). The results in terms of congestion in the road network surrounding Pump Lane and Moor Street would be detrimental for the traffic flow of Rainham and Gillingham and would significantly affect the road users' perceived level of service.

12 Appendices

Appendix 1 Select link analysis plots

The select link analysis plots are included in the attachment “Select Link Analysis Plots.zip” folder.

Appendix 2 Do something versus reference case traffic flow plots

The Do something versus reference case traffic flow plots are included in the attachment “DS-DM Bandwidth Plots.zip” folder.

Appendix 3 Network Stress (V/C) diagrams

The network stress (V/C) diagrams are included in the attachment “V_C Plots.zip” folder.

Appendix 4 Link speed diagrams

The Link speed diagrams are included in the attachment “Speed Diagram Plots.zip” folder.

Appendix 5 Junction delays in terms of bandwidths plots

The junction delays in terms of bandwidths plots are included in the attachment “Simulated Delay Plots.zip” folder.

Appendix 6 Reassignment flow plots

The reassignment flow pots are included in the attachment “Flow Plots.zip” folder.