MODELLING GROUP

Modelling Methodology - Level Crossing Study

MG0172 – Level Crossing Study, Cambridgeshire

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03 June 2021

NETWORK RAIL

DOCUMENT CONTROL ISSUE SHEET

Project & document details

Project name	Level Crossing Study, Cambridgeshire
Project number	MG0172
Document title	Modelling Methodology - Level Crossing Study
Document reference	D:\Modelling Group\Communication site - Projects\MG0172 - LevelCrossingStudy, Cambridgeshire\Technical\Reports

Document history

Issue	Status	Reason for issue	Issued to
1	Draft	For comment	Network Rail
2	Final	For approval	Cambridgeshire County Council, Norfolk County Council

Issue control

Issue	Date	Author	Contributors	Approved	Date
1	28/05/2021	Daniel Bent	Nicolas Contentin	Nicolas Contentin	28/05/2021
2	03/06/2021	Daniel Bent	Nicolas Contentin	Nicolas Contentin	03/06/2021

CONTENTS

1 INTRODUCTION 5
1.1 Introduction 5
1.2 Report purpose 5
1.3 Study Extents 5
1.4 Microsimulation Software, VISSIM 5
Figure 1.1: 3D VISSIM Output Example 6
1.5 Report Format 6
2 MODEL EXTENTS 7
2.1 Introduction 7
2.2 Milton Fen VISSIM Model 7
Figure 2.1: Indicative Model Extents – Milton Fen 7
Figure 2.2: 5 & 10-Minute Driving Isochrones – Melton Fen 8
2.3 Waterbeach VISSIM Model 8
Figure 2.3: Indicative Model Extents - Waterbeach 8
Figure 2.4: 5 & 10-Minute Driving Isochrones – Waterbeach 9
2.4 Dimmocks Cote VISSIM Model 9
Figure 2.5: Indicative Model Extents – Dimmocks Cote 9
Figure 2.6: 5 & 10-Minute Driving Isochrones – Dimmocks Cote 10
2.5 Croxton VISSIM Model 10
Figure 2.7: Indicative Model Extents - Croxton 10
Figure 2.8: 5 & 10-Minute Driving Isochrones – Croxton 11
Figure 2.9: Journey time analysis – Croxton Alternative Routes 11
2.6 Six Mile Bottom VISSIM Model 11
Figure 2.10: Indicative Model Extents – Six Mile Bottom 12
Figure 2.11: 5 & 10-Minute Driving Isochrones – Six Mile Bottom 12
2.7 Dullingham VISSIM Model 12
Figure 2.12: Indicative Model Extents - Dullingham 13
Figure 2.13: 5 & 10-Minute Driving Isochrones – Dullingham 13
Figure 2.14: Journey time analysis – Dullingham Alternative Route 14
2.8 Meldreth VISSIM Model 14
Figure 2.15: Indicative Model Extents - Meldreth 14
Figure 2.16: 5 & 10-Minute Driving Isochrones – Meldreth 15
3 TRAFFIC DATA COLLECTION EXERCISE 16
3.1 Introduction 16
3.2 Video Surveys 16
Figure 3.1: Example Camera View 16
3.3 Automatic Traffic Counts (ATCs) 17
Figure 3.2: Example ATC Installation 18
3.4 Survey Data Locations 18

Figure 3.3: Proposed Survey Locations – Milton Fen ... 18
Figure 3.4: Proposed Survey Locations – Waterbeach ... 19
Figure 3.5: Proposed Survey Locations – Dimmocks Cote ... 19
Figure 3.6: Proposed Survey Locations – Cruxton ... 20
Figure 3.7: Proposed Survey Locations – Six Mile Bottom ... 20
Figure 3.8: Proposed Survey Locations – Dullingham ... 21
Figure 3.9: Proposed Survey Locations - Meldreth ... 21
3.5 Data Review ... 21
4 BASE MODEL DEVELOPMENT, CALIBRATION & VALIDATION ... 22
4.1 Introduction ... 22
4.2 Key Model Development Elements ... 22
4.3 Calibration Criteria ... 23
Figure 4.1: TAG Unit 3.1 Flow Calibration Criteria ... 23
4.4 Validation Criteria ... 24
Figure 4.2: TAG Unit 3.1 Journey Time Validation Criteria ... 24
4.5 Local Model Validation Report ... 24
5 FUTURE YEAR SCENARIOS ... 25
5.1 Introduction ... 25
5.2 Modelled Scenarios ... 25
5.3 Proposed Barrier Down Times ... 26
Figure 5.1: Hinxton Level Crossing – Barrier Down Times ... 26
Table 5.1: Calculated Barrier Down Times for Upgraded Level Crossings ... 27
5.4 Outputs & Reporting ... 27
Figure 5.2: Example Queue Length Dispersion Graph ... 27
6 SUMMARY ... 28
6.1 Summary ... 28

APPENDICES

NO TABLE OF CONTENTS ENTRIES FOUND.

1 INTRODUCTION

1.1 Introduction

1.1.1 Modelling Group, in partnership with Tracsis Traffic Data Ltd have been appointed by Network Rail to analyse traffic and congestion implications of upgrading 7 level crossings to MCB-OD2 / MCB-CCTV type operation, with a view to understanding the impacts the upgrades will have on the local communities and the wider transport network.

1.2 Report purpose

1.2.1 This report details the modelling methodology proposed by Modelling Group to assess the impacts of the proposed upgrades, for discussion and agreement with Cambridgeshire County Council (CCC) and Norfolk County Council (NCC).

1.2.2 The purpose of this report is also to agree with CCC and NCC on the modelling areas which consequently inform the extents of the traffic surveys to be undertaken.

1.3 Study Extents

1.3.1 The modelling study involves the assessment of 7 level crossings within Cambridgeshire and Norfolk. These include:

- Milton Fen, Fen Road, CB24 6AF. Ordinance Survey grid reference TL 484 623.
- Waterbeach, Clayhithe Road, CB25 9HS. Ordinance Survey grid reference TL 500 649
- Dimmocks Cote, Newmarket Road, CB6 3LJ. Ordinance Survey grid reference TL 526 730
- Croxton, A1075, IP24 2RQ. Ordinance Survey grid reference TL 902 867
- Six Mile Bottom, London Road, CB8 0UJ, Ordinance Survey grid reference TL 576 567Dullingham, Station Road, CB8 9UT. Ordinance Survey grid reference TL 618 585
- Meldreth, Meldreth Road, SG8 6XA. Ordinance Survey grid reference TL 388 477

1.3.2 A microsimulation model for each of these level crossings will be developed, which will allow the before and after scenarios to be modelled and the impacts on the network to be understood. For the purposes of the modelling, this will be undertaken using PTV's microsimulation software, VISSIM.

1.4 Microsimulation Software, VISSIM

1.4.1 VISSIM is a microsimulation software platform that allows the modelling of the interaction of vehicles, cyclists and pedestrians with each other. A range of results can also be collected and the ability to 'see' the model running is a key output when presenting findings to the general public and/or key stakeholders/decision makers. An example of the type of graphical output able to be extracted from VISSIM is shown in **Figure 1.1**.

FIGURE 1.1: 3D VISSIM OUTPUT EXAMPLE

1.5 Report Format

1.5.1 Following this introduction, this modelling methodology report contains the following sections:

- Section 2 – Model Extents for the 7 Level Crossings
- Section 3 – Traffic Data Collection Exercise
- Section 4 – Base Model Development, Calibration & Validation
- Section 5 – Future Year Scenarios
- Section 6 – Summary

2 MODEL EXTENTS

2.1 Introduction

2.1.1 This section details the indicative VISSIM model extents for each of the 7 level crossings to be assessed, which are proposed to be upgraded by Network Rail.

2.1.2 The model extents identified have been based on an assessment of the 5 and 10-minute journey time isochrones from each of the level crossings. It is anticipated that the change in barrier downtime will increase to approximately 3-4 minutes per train. This value has been observed on similar MCB-OD level crossings.

2.1.3 An analysis of the overall barrier downtime will be carried out as part of this study to estimate the combined downtime period based on the surveyed train frequency and anticipated future increase in train frequency.

2.1.4 A 5 and 10-minute isochrone has been calculated for each level crossing in order to estimate the alternative route choice available.

2.2 Milton Fen VISSIM Model

2.2.1 The indicative extents for the Milton Fen VISSIM model are shown in **Figure 2.1**.

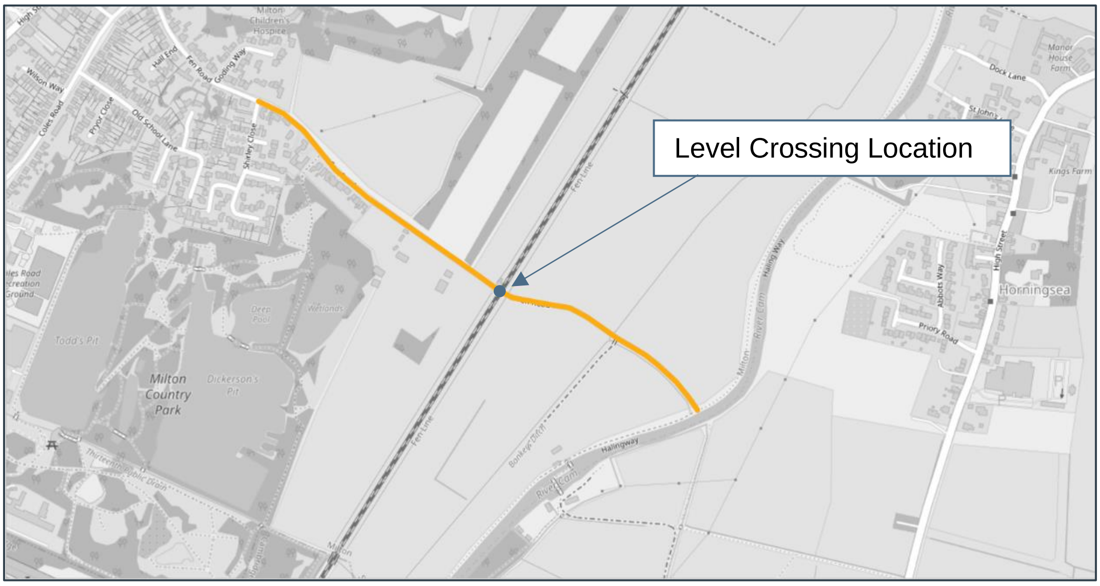

FIGURE 2.1: INDICATIVE MODEL EXTENTS – MILTON FEN

2.2.2 The 5 and 10-minute driving isochrone for the Milton Fen level crossing is shown in **Figure 2.2**.

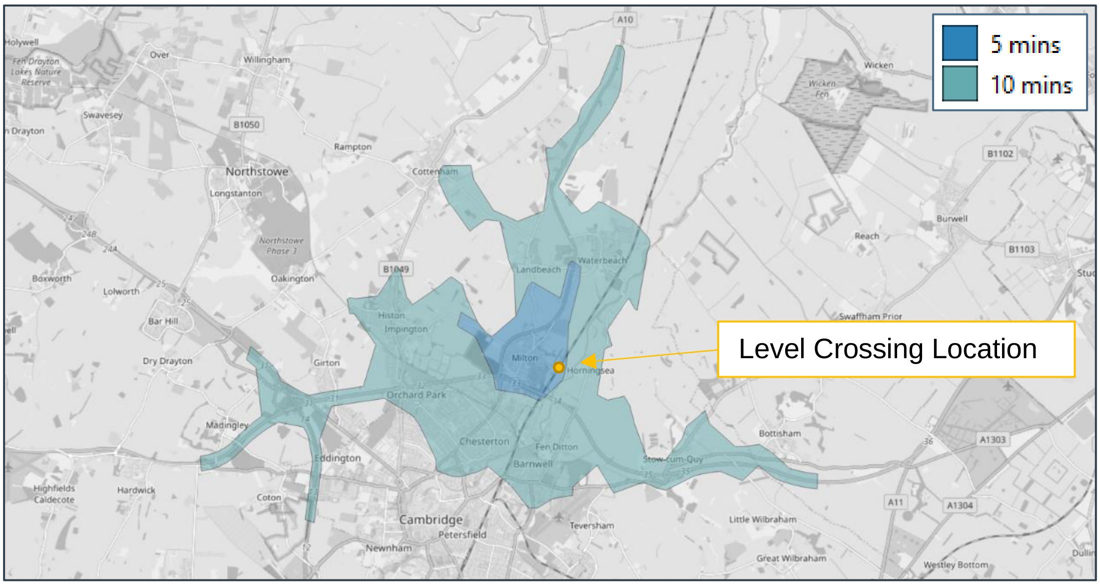

FIGURE 2.2: 5 & 10-MINUTE DRIVING ISOCHRONES – MELTON FEN

2.2.3 The level crossing is located on Fen Road, which is a 'dead-end' road leading to a Public Right of Way (Footpath 162/1) that runs along the western banks of the River Cam. There are no alternative routes available and drivers will wait in the queue rather than find an alternative route.

2.2.4

2.3 Waterbeach VISSIM Model

2.3.1 The indicative extents for the Waterbeach VISSIM model are shown in **Figure 2.3**.

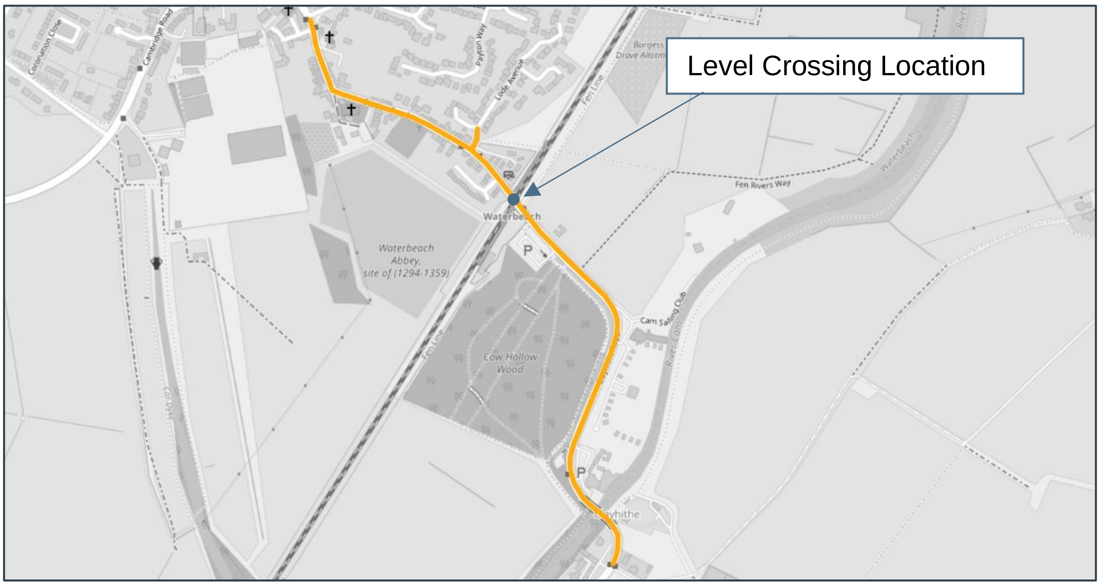

FIGURE 2.3: INDICATIVE MODEL EXTENTS - WATERBEACH

2.3.2 The 5 and 10-minute driving isochrone for the Waterbeach level crossing is shown in **Figure 2.4**.

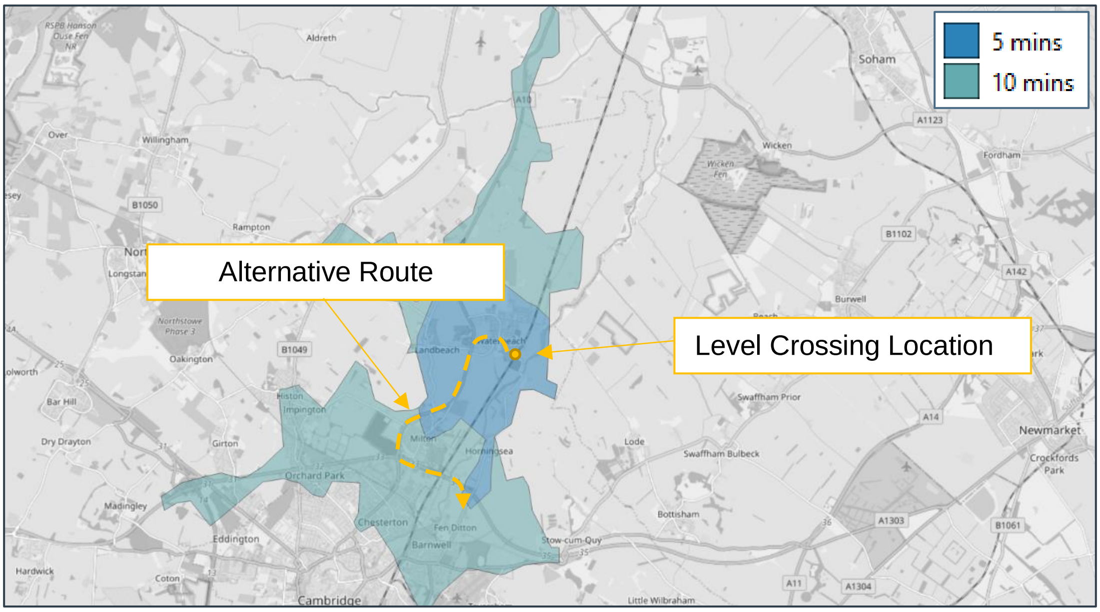

FIGURE 2.4: 5 & 10-MINUTE DRIVING ISOCHRONES – WATERBEACH

2.3.3 The Waterbeach level crossing is located on Clayhite Road and connects Waterbeach to Barnwell, which is located on the east of Cambridge. The isochrone shows that the railway creates a severance between the east and the west. The only alternative route choice between Waterbeach and Barnwell is Car Dyke Road, the A10, the A14 and the B1047 Horningsea Road as shown in **Figure 2.4**. The estimated driving time for this route is 12 minutes, compare to an estimated 10 minutes if drivers stay in the queue. It can be concluded that drivers are highly likely to stay in the queue rather than use this alternative route.

2.4 Dimmocks Cote VISSIM Model

2.4.1 The indicative extents for the Dimmocks Cote VISSIM model are shown in **Figure 2.5**.

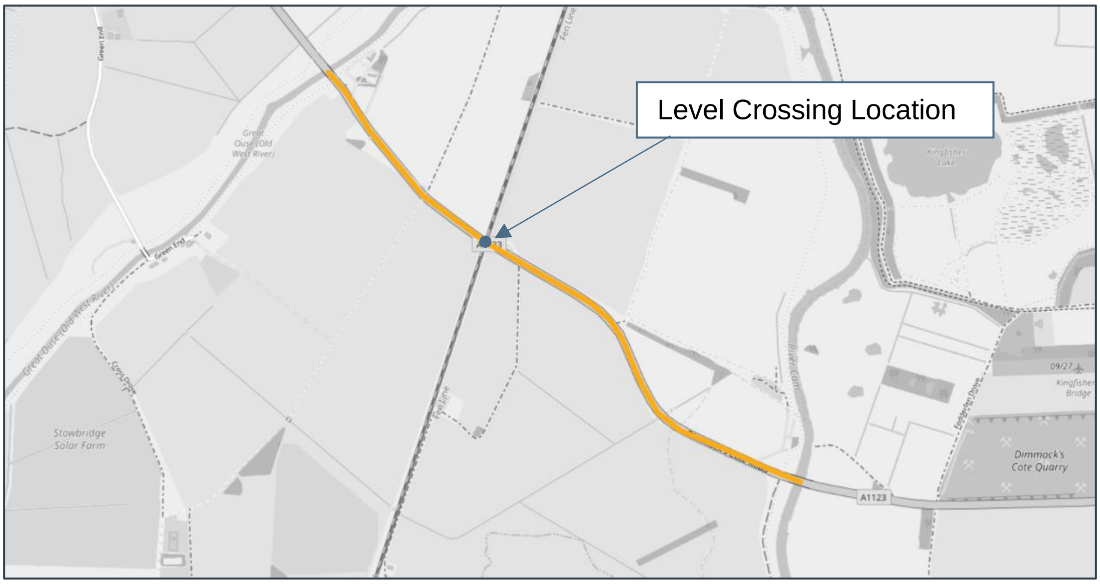

FIGURE 2.5: INDICATIVE MODEL EXTENTS – DIMMOCKS COTE

2.4.2 The 5 and 10-minute driving isochrone for the Dimmocks Cote level crossing is shown in **Figure 2.6**.

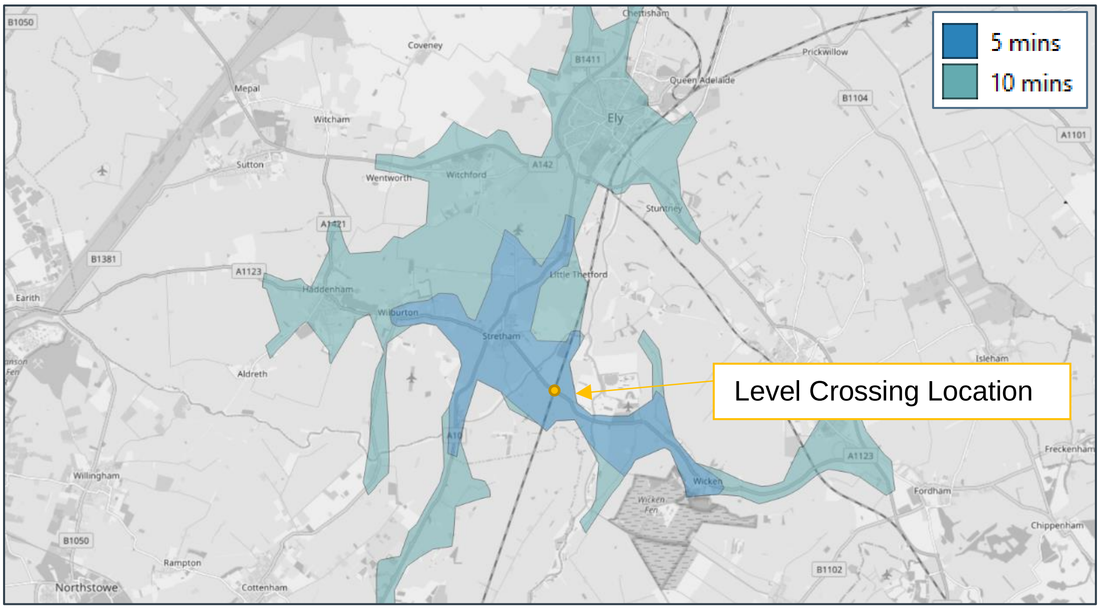

FIGURE 2.6: 5 & 10-MINUTE DRIVING ISOCHRONES – DIMMOCKS COTE

2.4.3 The Dimmocks Cote level crossing is located on Newmarket Road and connects Stretham to Wicken and Upware. The isochrone analysis show that the railway creates a severance for travelling eastbound and westbound. The alternative route would be along the A1123 between the A10 and the A142. However, this will take more than 10 minutes and is therefore highly likely that drivers will stay in the queue to reach their destination.

2.5 Croxton VISSIM Model

2.5.1 The indicative extents for the Croxton VISSIM model are shown in **Figure 2.7**.

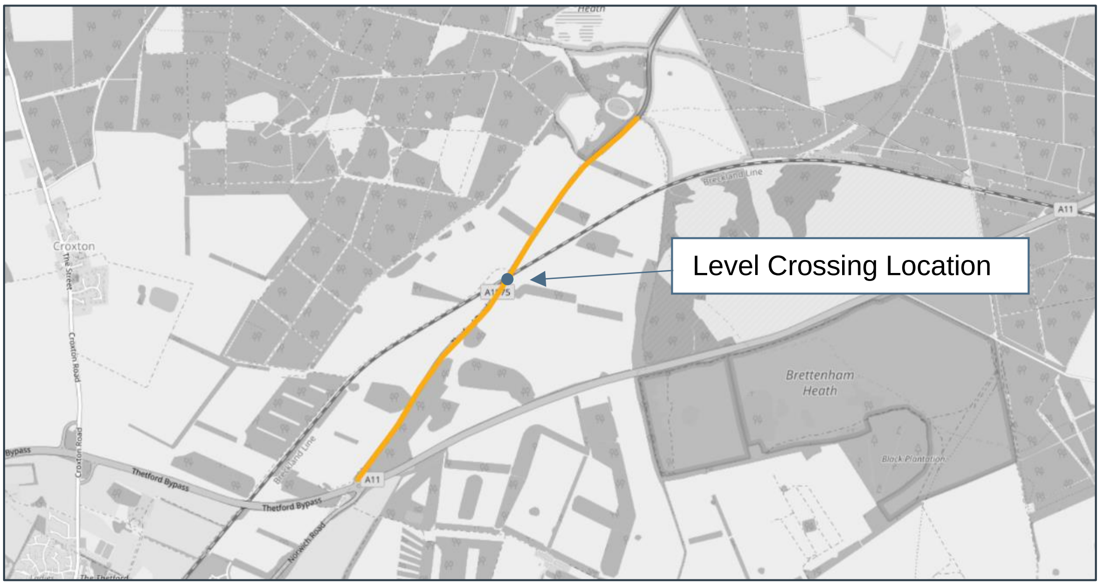

FIGURE 2.7: INDICATIVE MODEL EXTENTS - CROXTON

2.5.2 The 5 and 10-minute driving isochrone for the Croxton level crossing is shown in **Figure 2.8**.

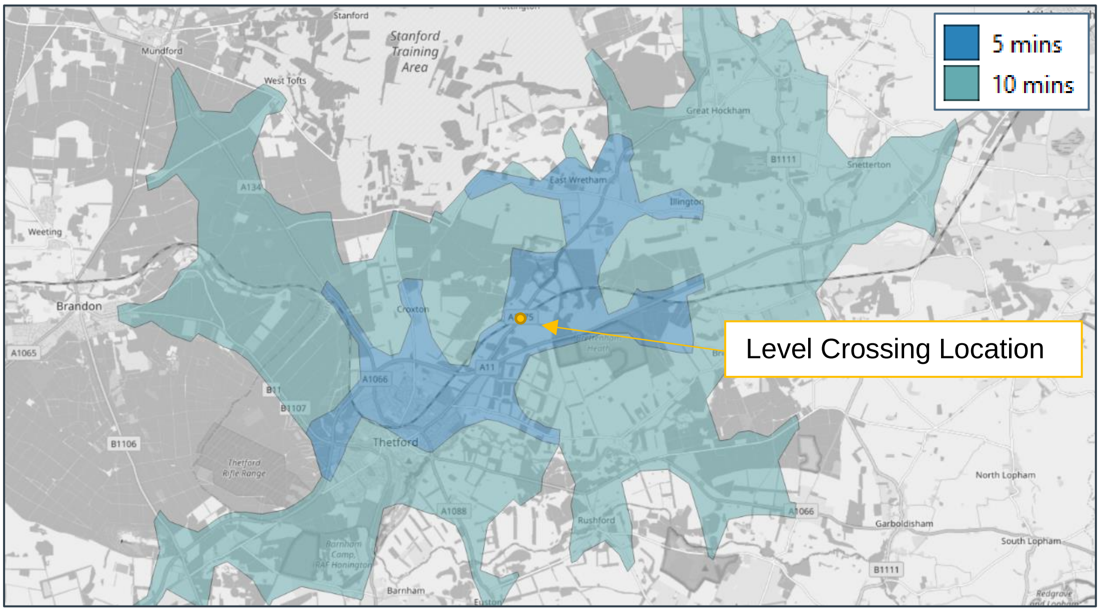

FIGURE 2.8: 5 & 10-MINUTE DRIVING ISOCHRONES – CROXTON

2.5.3 The Croxton level crossing is located on the A1075 Thetford Road and connect Thetford and the A11 to Stonebridge. Two alternative routes have been identified as part of this analysis which shows a journey time of 15 and 17 minutes, compare to 3 minutes travel time plus 5 minutes barrier downtime (see **Figure 2.9**).

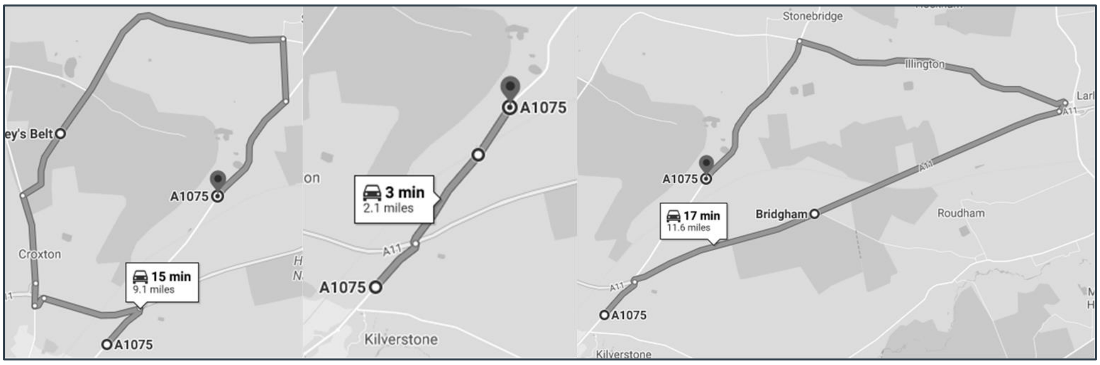

FIGURE 2.9: JOURNEY TIME ANALYSIS – CROXTON ALTERNATIVE ROUTES

2.5.4 Given the additional travel time and distance to travel for these alternative routes, these are not considered likely alternatives and drivers will therefore stay in the queue to reach their destination.

2.6 Six Mile Bottom VISSIM Model

2.6.1 The indicative extents for the Six Mile Bottom VISSIM model are shown in **Figure 2.10**.

FIGURE 2.10: INDICATIVE MODEL EXTENTS – SIX MILE BOTTOM

2.6.2 The 5 and 10-minute driving isochrone for the Six Mile Bottom level crossing is shown in **Figure 2.11**.

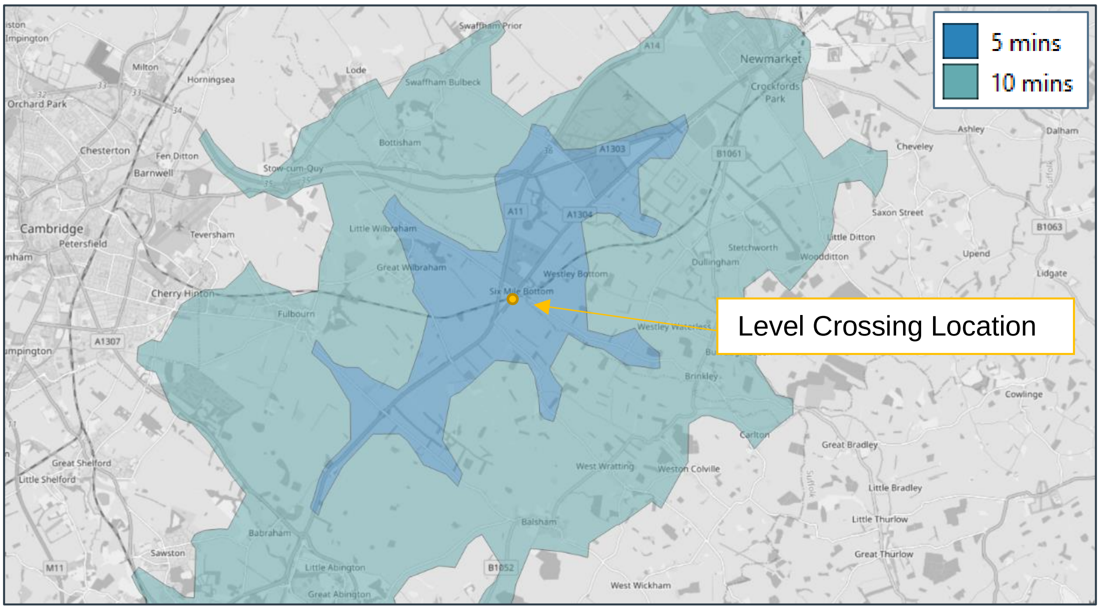

FIGURE 2.11: 5 & 10-MINUTE DRIVING ISOCHRONES – SIX MILE BOTTOM

2.6.3 The Six Mile Bottom level crossing is located on the A1304 London Road and connect Six Mile Bottom and Brinkley to the A11. There are no alternative routes to these destinations and drivers will stay in the queue to reach their destination.

2.7 Dullingham VISSIM Model

2.7.1 The indicative extents for the Dullingham VISSIM model are shown in **Figure 2.12**.

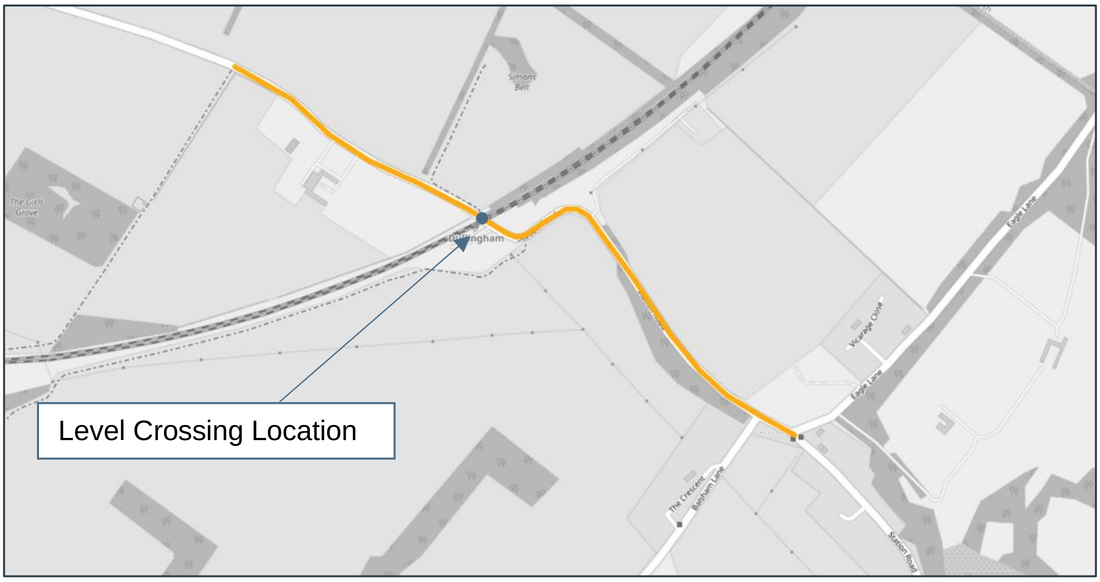

FIGURE 2.12: INDICATIVE MODEL EXTENTS - DULLINGHAM

2.7.2 The 5 and 10-minute driving isochrone for the Dullingham level crossing is shown in **Figure 2.13**.

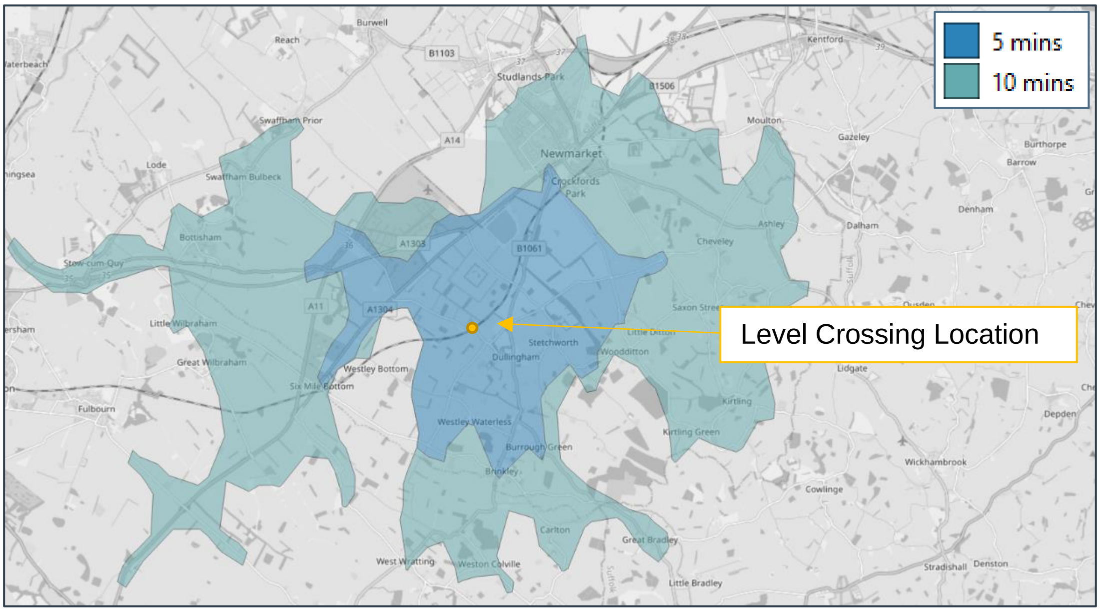

FIGURE 2.13: 5 & 10-MINUTE DRIVING ISOCHRONES – DULLINGHAM

2.7.3 The level crossing is located on Station Road and connects Dulligham to the A1304 and the A11. There is an alternative route to the north, travelling along the B1061 and then along a minor road to the A1303 roundabout (see **Figure 2.14**).

FIGURE 2.14: JOURNEY TIME ANALYSIS – DULLINGHAM ALTERNATIVE ROUTE

2.7.4 However, as this is double the distance and travel time, it is anticipated that vehicles will wait in the queue, rather than turn around.

2.8 Meldreth VISSIM Model

2.8.1 The indicative extents for the Meldreth VISSIM model are shown in **Figure 2.15**.

FIGURE 2.15: INDICATIVE MODEL EXTENTS - MELDRETH

2.8.2 The 5 and 10-minute driving isochrone for the Meldreth level crossing is shown in **Figure 2.16**.

FIGURE 2.16: 5 & 10-MINUTE DRIVING ISOCHRONES – MELDRETH

2.8.3 The level crossing is located on Meldreth Road and connects Meldreth to Shepreth. The only alternative route to these destinations would be along the A10, but this is a significant detour and is considered more likely that drivers will stay in the queue to reach their destination.

3 TRAFFIC DATA COLLECTION EXERCISE

3.1 Introduction

3.1.1 This section details the traffic survey data that is proposed to be collected to assist in the development of the various level crossing VISSIM models.

3.1.2 This data will be collected by Tracsis Traffic Data Ltd, who are a leading independent provider of traffic and transport data collection services and have significant experience in delivering traffic data collection projects for Network Rail.

3.1.3 To model each of the level crossings, the following surveys are proposed at each site:

- Video Surveys, to identify:
    - Manual Classified Counts (MCCs)
    - Traffic Census Data
    - Queue Lengths
    - Journey Times
- Automatic Traffic Counts (ATCs)

3.2 Video Surveys

3.2.1 Tracsis will deploy temporary video camera equipment over a 24-hour period and assess the footage to collect data including MCC's, Traffic Census data, Queue Lengths and Journey Times.

3.2.2 Tracsis utilise small, high-definition camera systems, which are discrete, fully self-powered and attached to street furniture with minimal disruption to the public. High-capacity batteries are used to power the cameras, which helps to ensure continuous, uninterrupted recording of images.

3.2.3 The wide-angle camera views enable accurate identification and classification of movements, with a typical view shown in **Figure 3.1**.

FIGURE 3.1: EXAMPLE CAMERA VIEW

3.2.4 All of the equipment will be installed at a safe distance from the railway and will be fixed appropriately to nearby street furniture on the public highway for each of installation and maintenance.

3.2.5 When all of the footage has been successfully collected, the following data will be extracted at each crossing:

- Trains travelling by direction, with the exact time of passing to the nearest second
- Traffic flows, by direction, classified and tabulated in 15-minute periods
- Pedestrian flows, classified into a number of categories and recorded in 15-minute intervals
- Barrier up/down times recorded to the nearest second
- Cyclist movements, recorded in 15-minute intervals
- Herded animals, equestrians and large/slow moving vehicles, recorded in 15-minute intervals
- Queue lengths in both directions, measured in metres
- Journey times, in both directions, measured in seconds.

3.3 Automatic Traffic Counts (ATCs)

3.3.1 Tracsis will install ATC's over a 2-week period to collect traffic data to inform the daily peak period.

3.3.2 The standard approach is to use Metro Count 5600 Series ATC equipment and pneumatic tubes. One ATC unit will be positioned to capture traffic flows at each level crossing, with additional units on adjacent roads as required.

3.3.3 Each crossing will be assessed to identify the optimum location to install ATC equipment and ensure good quality data is collected.

3.3.4 The tubes will be firmly attached to the carriageway surface and where pedestrian walkways are present, path protectors will be used to ensure that the equipment does not pose a hazard to pedestrians.

3.3.5 Each site will be risk assessed and equipment installed, maintained and removed at time of expected low traffic flows where practicable.

3.3.6 A typical ATC installation is shown in **Figure 3.2**.

FIGURE 3.2: EXAMPLE ATC INSTALLATION

3.4 Survey Data Locations

3.4.1 **Figures 3.3 – 3.9** show the proposed traffic survey data locations at each of the level crossings.

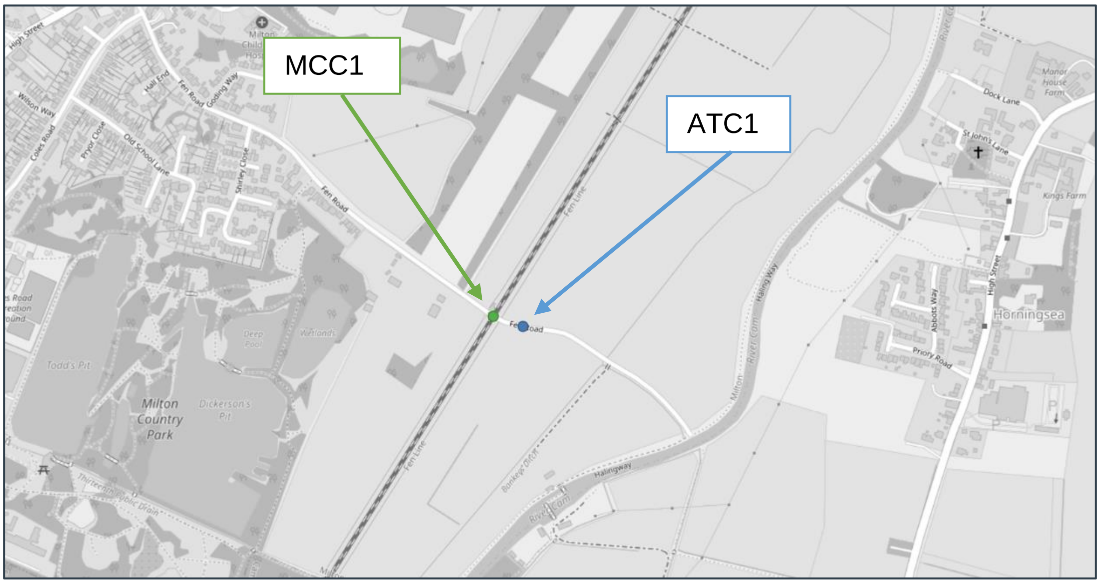

FIGURE 3.3: PROPOSED SURVEY LOCATIONS – MILTON FEN

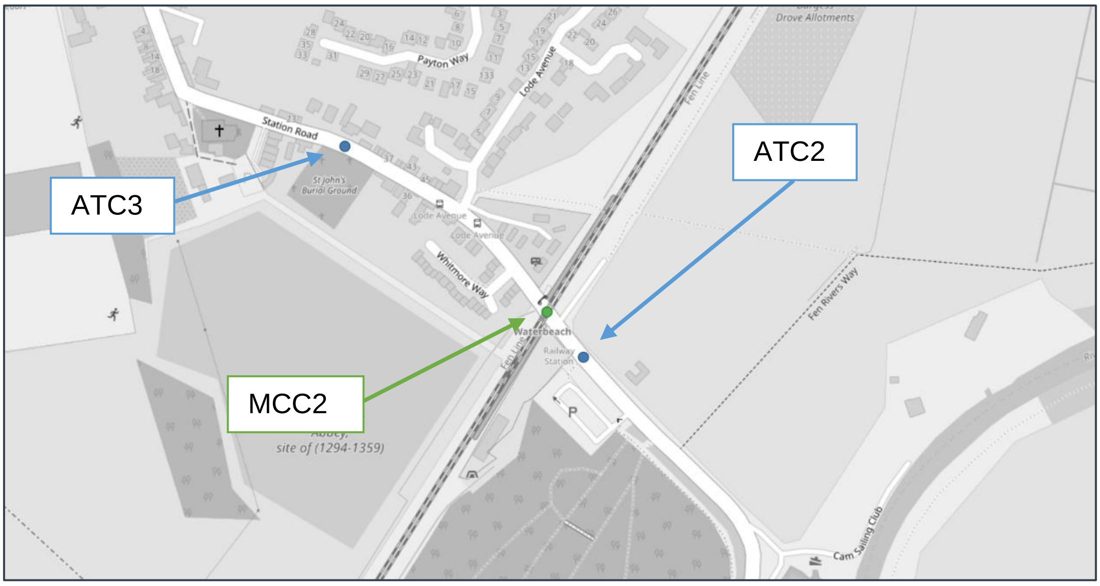

FIGURE 3.4: PROPOSED SURVEY LOCATIONS – WATERBEACH

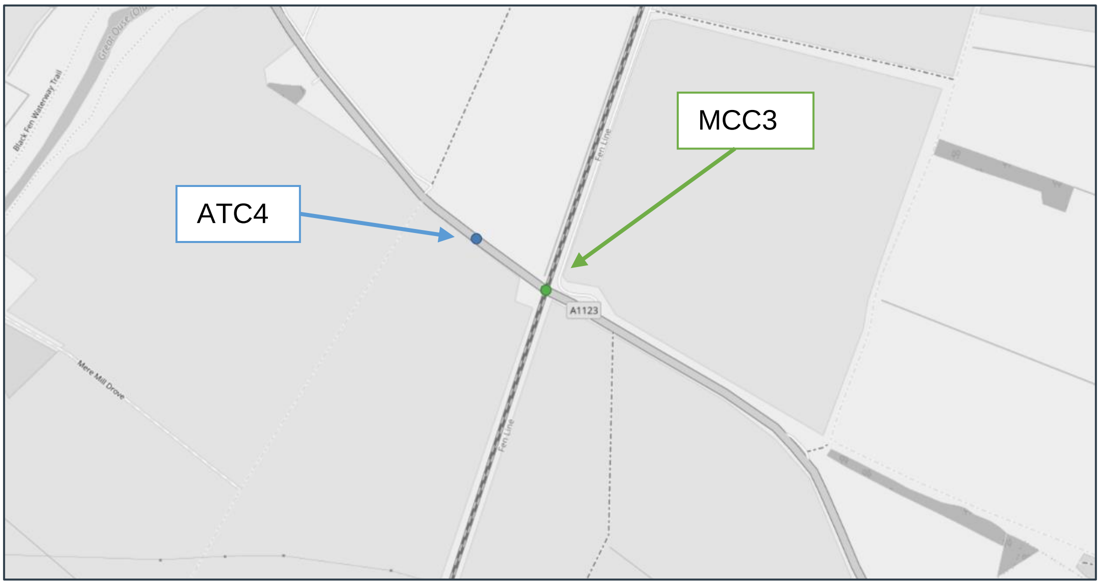

FIGURE 3.5: PROPOSED SURVEY LOCATIONS – DIMMOCKS COTE

FIGURE 3.6: PROPOSED SURVEY LOCATIONS – CRUXTON

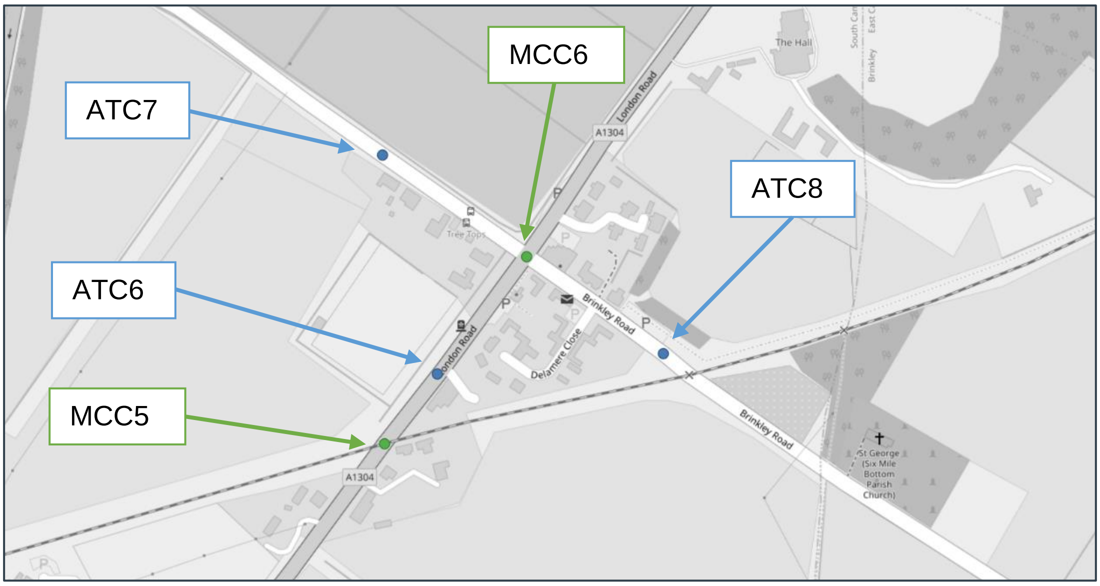

FIGURE 3.7: PROPOSED SURVEY LOCATIONS – SIX MILE BOTTOM

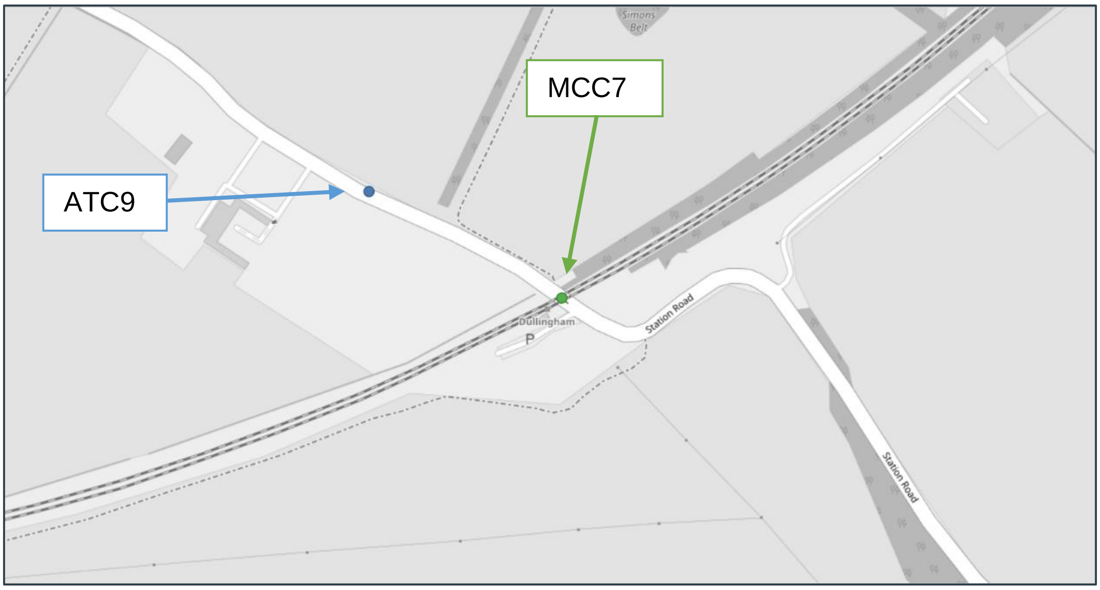

FIGURE 3.8: PROPOSED SURVEY LOCATIONS – DULLINGHAM

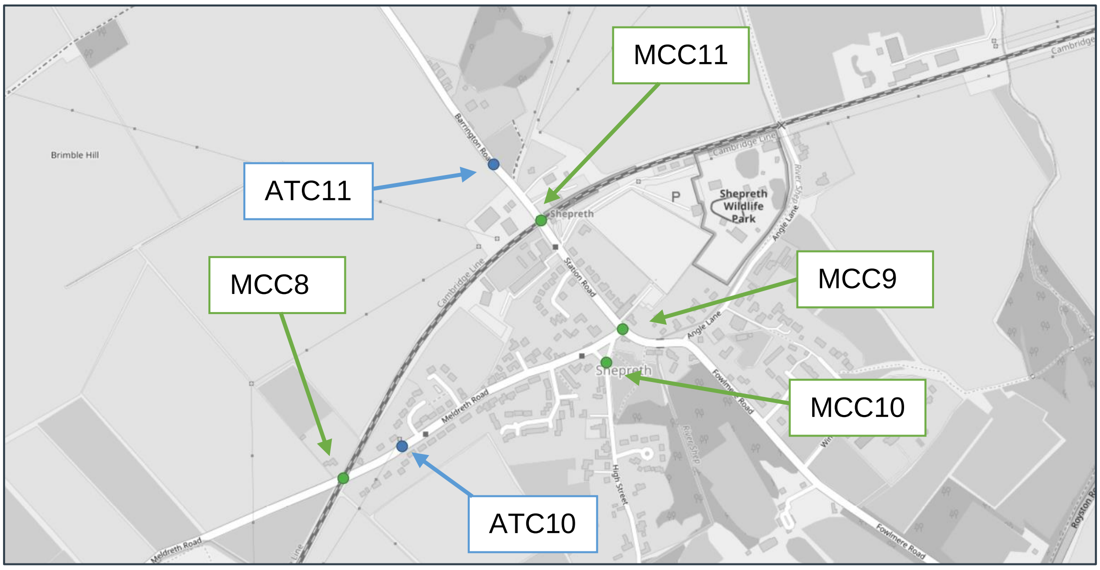

FIGURE 3.9: PROPOSED SURVEY LOCATIONS - MELDRETH

3.5 Data Review

3.5.1 Due to the effects of Covid on traffic levels, an assessment of the data collected will be required to compare it against pre-Covid levels.

3.5.2 Tracsis have collected data for three level crossings prior to the pandemic and the data from these sites will be used to calculate a readjustment factor to compensate for any reductions in traffic as a result of the pandemic.

3.5.3 Where historic data is not available for a level crossing site, then a generic factor will be applied based on the other data available.

4 BASE MODEL DEVELOPMENT, CALIBRATION & VALIDATION

4.1 Introduction

4.1.1 This section details the key model development elements, along with the calibration and validation comparisons proposed to ensure that the level crossing models are representative of on-site conditions and meet criteria as set out in the Department for Transport's (DfT's) Transport Analysis Guidance (TAG).

4.2 Key Model Development Elements

Background Mapping

4.2.1 The level crossing models will be built based on aerial photography and normal photography taken during a site visit. This will allow a realistic representation of the physical layout and lane markings/allocations.

Speed Limits

4.2.2 The level crossing models will include the appropriate speed limits, which will be confirmed through a site visit.

Modelled Time Periods

4.2.3 The level crossing models will be developed for two daily peak periods, which will be determined from the MCC and ATC data.

4.2.4 Suitable 'shoulders' either side of the peak periods will be included, known as a 'warm-up' and 'cool-down' period. These will be of at least 15 minutes and will allow for the full build-up of any site delays and queuing, prior to the peak period, as well as the assessment of the time taken for any queues to disperse after the peak period.

Modelled Vehicle Classes

4.2.5 The level crossing models will include the following vehicle classes:

- Cars
- Light Goods Vehicles (LGVs)
- Heavy Goods Vehicles (HGVs)
- Motorcyclists
- Cyclists

4.2.6 Pedestrians will also be included, in areas where there is a high demand. This will be determined through the video survey data.

Public Transport Timetables

4.2.7 The bus timetables will be reviewed in the vicinity of each level crossing and all associated routes, stops, dwell times and frequencies will be included for the specified model periods.

Train Timetables

4.2.8 The railway timetables will be reviewed to identify the number of services passing through each of the level crossings during the modelled period. This will then be checked against the video footage collected on site, to ensure that these tie in.

Level Crossing Operation

4.2.9 The level crossing operation and in particular the barrier downtime, will be modelled based on the train timetable operation and current observed operation durations. Bespoke logic will be developed to model the operation of the barriers to ensure a realistic operation at each site.

4.3 Calibration Criteria

Traffic Flows

4.3.1 The level crossing models will be calibrated against the traffic flow data, with DfT's TAG Unit 3.1 criteria (*para. 3.3.11 and Table 2*) used as shown in **Figure 4.1**.

Table 2 Link Flow and Turning Movement Validation Criteria and Guidelines

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

FIGURE 4.1: TAG UNIT 3.1 FLOW CALIBRATION CRITERIA

Queue Lengths

4.3.2 Whilst not a strict measure of calibration due to the subjective nature in how a queue is defined and measured, an exercise will be undertaken to compare the observed and modelled queues over each of the modelled periods. This will allow the profiles to be checked, to ensure that the flow patterns and behaviour is representative of on-site conditions.

4.4 Validation Criteria

Journey Times

4.4.1 The level crossings will be validated against journey times. These times will be extracted from the survey footage for each of the sites. DfT's TAG Unit 3.1 criteria (*para. 3.3.15 and Table 3*) will be used to compare the modelled and observed times, as shown in **Figure 4.2**.

Table 3 Journey Time Validation Criterion and Guideline	
Criteria	Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	> 85% of routes

FIGURE 4.2: TAG UNIT 3.1 JOURNEY TIME VALIDATION CRITERIA

4.5 Local Model Validation Report

4.5.1 Once the level crossing models have been successfully calibrated and validated, a Local Model Validation Report will be prepared for each site. This will detail the key model development elements, key assumptions and then a comparison of the observed and modelled outputs to demonstrate that the models calibrate against flows and queues and validate against journey times.

5 FUTURE YEAR SCENARIOS

5.1 Introduction

5.1.1 This section details the future year scenarios proposed to be tested using the level crossing VISSIM models, along with the associated growth assumptions.

5.2 Modelled Scenarios

5.2.1 There are two scenarios proposed to be tested:

- Do-Nothing
- Do-Something

Do-Nothing Scenario

5.2.2 For the Do-Nothing scenario, the following key assumptions have been made:

- A future growth factor will be calculated using TEMPRO and agreed with Network Rail and the local highway authorities prior to testing. This will include any readjustment factor required as a result of Covid.
- Committed improvements will be added to the models, if there are any proposals that fall within the model extents.
- Any future changes to train services in terms of frequencies etc. will be incorporated into the model.

Do-Something Scenario

5.2.3 For the Do-Something scenario, the following key assumptions have been made:

- The same future year flows will be used for the Do-Something scenario as for the Do-Nothing scenario.
- Any committed improvements will be added, as per the Do-Nothing scenario.
- Any future changes to train services will be added as per the Do-Nothing scenario.
- The level crossings will be updated to test the impacts of replacing the existing operation with an MCB-OD/MCB-CCTV system, which will increase the barrier down time. The barrier downtimes associated with these changes will be provided by Network Rail.

Future Years

5.2.4 The following future years are proposed for the level crossings, in line with Network Rail's anticipated commissioning dates:

- Milton Fen – 2023 (prospective start May 2023)
- Waterbeach – 2023 (prospective start May 2023)
- Dimmocks Cote – 2023 (prospective start May 2023)
- Croxton – 2024 (prospective start April 2024)
- Six Mile Bottom – 2024 (prospective start December 2024)
- Dullingham – 2024 (prospective start December 2024)
- Meldreth – 2023 (prospective start December 2023)

5.3 Proposed Barrier Down Times

5.3.1 To inform the proposed barrier down times for the upgraded level crossings, Network Rail has provided Modelling Group with the following data:

- A set of absolute minimum barrier closure times for each crossing, with the exception of Meldreth where the times are proposed to be in line with the Shepreth crossing.
- Barrier down times for the Hinxton level crossing from 11th December 2017, which has been upgraded to MCB-OD control.

5.3.2 To develop suitable barrier down times for each level crossing, the Hinxton level crossing data has been analysed and plotted to show the variation across the day, as well as the average time from all of the samples. This is shown in **Figure 5.1**.

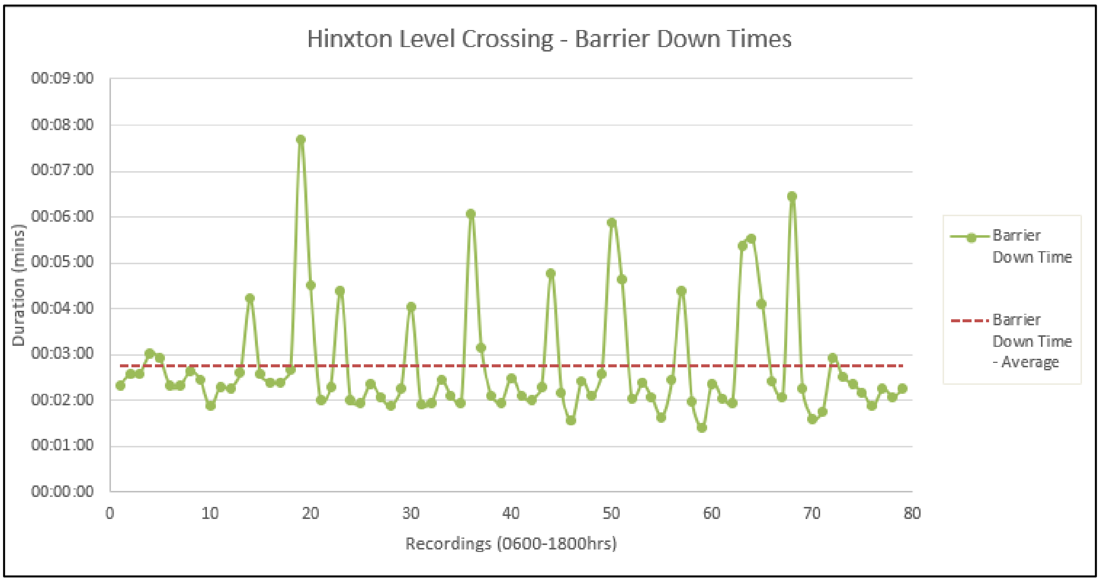

FIGURE 5.1: HINXTON LEVEL CROSSING – BARRIER DOWN TIMES

5.3.3 From the Hinxton level crossing data, the absolute minimum barrier down time was 84 seconds (01:24), whilst the average barrier down time was 165 seconds (02:45). The difference between the absolute minimum down time and the average was therefore 81 seconds (01:21).

5.3.4 To calculate the average barrier times for each of the level crossings, the absolute minimum times and the difference between the minimum and average times from the Hinxton crossing have been used. The resulting barrier down times proposed to be used for each of the upgraded level crossings are shown in **Table 5.1**.

No.	Level Crossing	Min Barrier Down Time (s)	Min Barrier Down Time + Hinxton Difference (s)	Min Barrier Down Time + Hinxton Difference (mm:ss)
1	Milton Fen	150	231	03:51
2	Waterbeach	125	206	03:26
3	Dimmocks Cote	149	230	03:50
4	Croxton	119	200	03:20
5	Six Mile Bottom	140	221	03:41

No.	Level Crossing	Min Barrier Down Time (s)	Min Barrier Down Time + Hinxton Difference (s)	Min Barrier Down Time + Hinxton Difference (mm:ss)
6	Dullingham	113	194	03:14
7	Meldreth		214*	03:24

TABLE 5.1: CALCULATED BARRIER DOWN TIMES FOR UPGRADED LEVEL CROSSINGS

**For the Meldreth level crossing, as no other data is available, the barrier down time has been based on the average time from all of the other level crossings.*

5.4 Outputs & Reporting

Outputs

5.4.1 In order to assess the impacts of the level crossing upgrades and the resulting increased time that the barriers are down, outputs including queue lengths and journey times will be extracted from the VISSIM models.

5.4.2 A detailed impact assessment will be provided for each mode of transport at the crossing and all relevant junctions assessed as part of this study.

5.4.3 An example of the anticipated queue length reporting is shown in **Figure 5.2**.

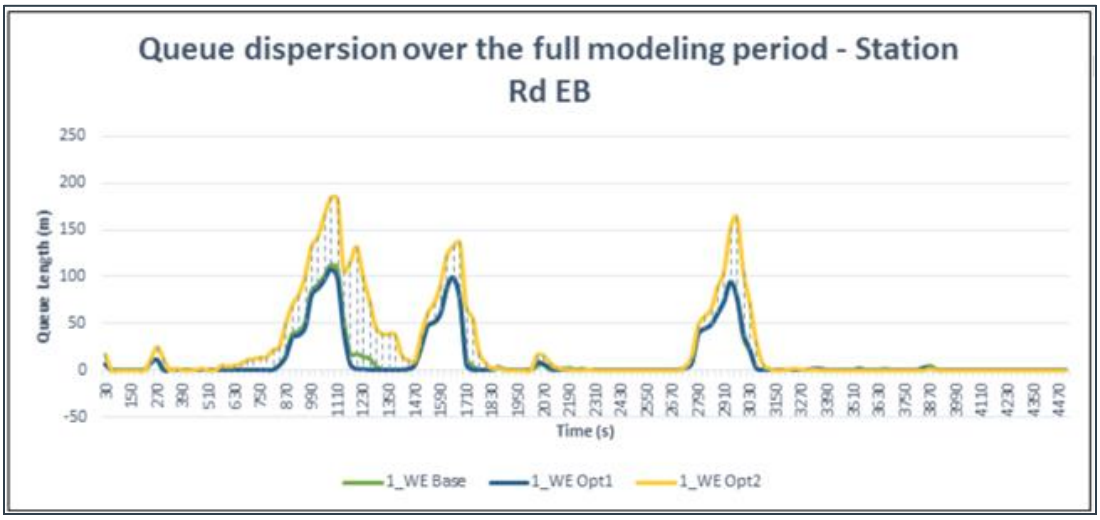

FIGURE 5.2: EXAMPLE QUEUE LENGTH DISPERSION GRAPH

Report

5.4.4 A report outlining the model purpose, methodology, results, conclusions and any recommendations will be produced. This will include a detailed analysis of the queue lengths and journey times for all affected users, the impacts on all adjacent junctions and the before and after barrier down times.

5.4.5 The report will also address any issues raised by the local highway authorities and counsellors and will allow Network Rail to engage with the relevant stakeholders with evidence regarding the impact of each level crossing.

6 SUMMARY

6.1 Summary

6.1.1 Modelling Group, in partnership with Tracsis Traffic Data Ltd have been appointed by Network Rail to analyse traffic and congestion implications of upgrading 7 level crossings to MCB-OD2 / MCB-CCTV type operation, with a view to understanding the impacts the upgrades will have on the local communities and the wider transport network.

6.1.2 This report details the modelling methodology proposed by Modelling Group to assess the impacts of the proposed upgrades, for discussion and agreement with Cambridgeshire County Council (CCC) and Norfolk County Council (NCC).

6.1.3 The modelling study involves the assessment of 7 level crossings within Cambridgeshire. These include:

- Milton Fen
- Waterbeach
- Dimmocks Cote
- Croxton
- Six Mile Bottom
- Dullingham
- Meldreth

6.1.4 A microsimulation model for each of these level crossings will be developed, which will allow the before and after scenarios to be modelled and the impacts on the network to be understood. For the purposes of the modelling, this will be undertaken using PTV's microsimulation software, VISSIM.

6.1.5 This report has detailed the modelling methodology in regard to:

- The indicative VISSIM model extents for the 7 level crossings
- The traffic data collection exercise
- The base VISSIM model development, calibration & validation
- The future year scenarios to be tested

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