A37 Options and Feasibility Study

Option Development and Assessment

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Bath and North East Somerset Council

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Executive Summary

Background and Study Objectives

Following the declaration of Air Quality Management Areas (AQMA) in the villages of Temple Cloud and Farrington Gurney, Bath and North East Somerset Council (B&NES) are seeking to draft Air Quality Action Plans (AQAPs) for both villages. As such, the purpose of this study has been to assess a list of potential 'option' measures that could be used in isolation or combination to contribute to improving the air quality within the designated AQMAs. Following this 'long list' development of options, an initial 'sifting' process has been undertaken to remove those which are not considered deliverable given the physical, environmental and built heritage constraints that are present within the villages, or where implementation would have road safety issues or potentially create worsened operational problems. 'Short-list' options taken forward have then been assessed in greater depth using detailed traffic and air quality modelling to more fully understand the extent to which they could improve air quality in both villages and contribute to achieving compliance with the National Air Quality Objectives (i.e. 40 μg/m^3 annual mean).

Temple Cloud

A detailed micro-simulation approach to highway modelling was used. This was critical in attempting to replicate the variable queuing and delay conditions which occur in the narrow section of the A37 through Temple Cloud. The VISSIM micro-simulation model thus developed included the A37 corridor from Cholwell Farm, located north of Temple Cloud, to the junction of the A37 with the A39, located at the top of Rush Hill to the south of Farrington Gurney. Count data (MCC/ATC) was collected in June 2019 for the purposes of developing this model and a corresponding air quality model.

A total of 10 potential options were initially assessed in Temple Cloud. Some of these such as removal of the footway along the west side of the narrow part of the A37, were dismissed on highway safety grounds. Others such as construction of the previously safeguarded (protected) bypass alignment to Temple Cloud and Clutton were dismissed because of the delivery timetable, whilst noting that this safeguarding was removed in the adoption of the current Place Making Plan (PMP). Following 'short-listing' three potential options were taken forward for more detailed highway modelling using VISSIM as follows:

- Option 4: Introducing a system of 'shuttle working' using traffic signals, using the shorter controlled section length of 117m;
- Option 8: Implement a width restriction for larger vehicles using a Traffic regulation Order (TRO); or
- Option 9: Undertake significant 'cutting back' of the high hedge/vegetation on the eastern side of the narrow section between 'The Laurels' and No 1 Gillets Hill Lane to allow more effective use of the existing carriageway by HGVs.

Subsequent highway modelling of Option 4 showed that 'shuttle working' the narrow section with signals would create unacceptable operating problems in excess of the queuing it was intended to alleviate. Not unexpectedly, Option 8 showed significant operating benefits with effective removal of all HGV's, although there are significant concerns over the viability of introducing such a TRO because of significant diversionary routing impacts. Option 9, which could represent a 'quick win', did suggest some operating benefit by increasing the effective width of the existing carriageway, so reducing the potential number of HGV passage incidents creating 'conflict' and the need to 'give way'.

The implementation of Option 8 (vehicle width restriction TRO) in Temple Cloud is predicted to lead to substantial reductions in emission concentrations along the A37. Predicted concentrations at most receptors are predicted to be below the air quality objective, excepting two locations (TC13 and TC4) where concentrations of 41.3μg/m^3 and 45.7μg/m^3 respectively are predicted. This shows that even removing all vehicle passage conflict in the 'narrow' section through Temple Cloud, and by implication most if not all HGV's, would still leave exceedances at receptors above the objective. As such, even if the A37 here were widened to remove all passage conflict, the continued presence of a significant volume of HGVs and the 'street canyon' effect in this location would likely to lead to local exceedances well above 40μg/m^3. Option 9 demonstrates this, where the removal of encroaching vegetation on the east side of the narrow section was assumed in modelling to reduce 'direct' HGV conflict to just two articulated lorries arriving at the same time and traveling in opposing directions. In this situation the air quality modelling predicts concentrations in excess of the objective at four receptors (and potentially a fifth at TC14). Critically, the concentration at TC4 was predicted to remain above 60μg/m^3, resulting in a continued risk of an exceedance of the short-term objective.

Notwithstanding the above, it is recommended that works are done to increase the effective width of the existing carriageway through the narrow section for HGV's (Option 9) by significantly cutting back the high vegetation to the line of the wall (so removing all encroachment across/into the highway). As a pre-cursor to this, it is recommended that a full topographical survey is done of the part of the A37 between Temple Inn Lane and Gillets Hill. This is desirable to accurately assess the increase in the effective carriageway width for HGVs achievable with significant removal of the overhanging vegetation.

Farrington Gurney

A total of 7 potential options were initially assessed in Farrington Gurney. Six of these looked at changes to the A37/A362 junction, the operation of which creates the queuing on the A37 southbound approach where existing exceedances occur. Minor changes to the junction were not found to achieve any operating benefit of significance. As a result, following 'short-listing', two potential options involving more extensive works were taken forward for more detailed highway modelling using VISSIM as follows:

- Option 3: Construction of an additional lane on the A37 southbound approach to the A37/A362 signals; and
- Option 5: Construction of a small 'compact' type of 'Normal' Roundabout with single lane entries to replace the existing traffic signals.

Both short-listed options (Options 3 and 5) were predicted to result in improvements to journey times on all approaches during both weekday 'peak' periods (AM and PM) and the intervening interpeak period. Farrington Gurney is anticipated to have concentrations of nitrogen dioxide below the objective at all receptors in 2021, with or without the implementation of the proposed options. This is because the current exceedances are only slightly above the 40μg/m^3 objective. Notwithstanding this, the implementation of Option 3 is predicted to lead to a large reduction in concentrations at receptors close to the junction between the A37 and A362 where the road layout modification will occur, with reductions in concentrations predicted of up to 8.4μg/m^3. Similarly, the implementation of Option 5 is expected to lead to a substantial reduction in nitrogen dioxide concentrations along the A37 adjacent to the A37/ A362 junction, with reductions up to 14.2 μg/m^3 predicted at the worst-case receptors next to the junction.

However, both the short-listed highway options for Farrington Gurney are relatively expensive to implement. Mindful that the current exceedances are only just above the 40μg/m^3 objective, and compliance expected to be achieved naturally by 2021 with changes to the fleet composition, it would be prudent to simply monitor the on-going situation in the short-term. Changes to the A37/362 junction are proposed to be implemented as part of the emerging Somer Valley Enterprize Zone (SVEZ) development (Option 2). Whilst bespoke operational testing of the amended traffic signal layout suggests this would offer little delay saving or queue length change on the critical A37 southbound approach, it will nevertheless offer some benefit. This together with the on-going improvement in the fleet composition could be adequate to meet the local objective for the AQMA in Farrington Gurney without costly junction improvements.

Acronyms

ANPR	Automatic Number Plate Recognition (Camera)
AQMA	Air Quality Management Area
AQAP	Air Quality Action Plan
ARCADY	Assessment of Roundabout CApacity and DelaY - TRL Software Package
ATC	Automatic Traffic Count (Traffic)
DoS	Degree of Saturation (Flow/Capacity)
ICD	Inscribed Circle Diameter (Roundabouts)
LinSig	Traffic modelling software package (signal-controlled junctions)
MCC	Manual Classified Count (Traffic)
MMQ	Mean Maximum Queue
OGV1	Other Goods Vehicle - Type 1 (HGV-Rigid)
OGV2	Other Goods Vehicle – Type 2 (HGV Articulated)
RSI	Roadside Interview Survey
PROW	Public Right of Way
TRO	Traffic Regulation Order

1. Introduction

1.1 Background

Bath and North East Somerset Council has a statutory obligation under Part iV of the Environment Act 1995 to review and assess air quality within their area. Following a review of the air quality across the authority, areas within the villages of Temple Cloud and Farrington Gurney on the A37 were identified as exceeding the National Air Quality Objectives for Nitrogen Dioxide (NO^2) concentrations. As a result, the Council declared Air Quality Management Areas (AQMAs) for the areas of exceedance in these locations. As might be expected, the exceedances occur on the main A37 passing through each settlement. **Figure 1.1** and **Figure 1.2** show the AQMA extents in each case. Both AQMA areas came into force on the 20th August 2018.

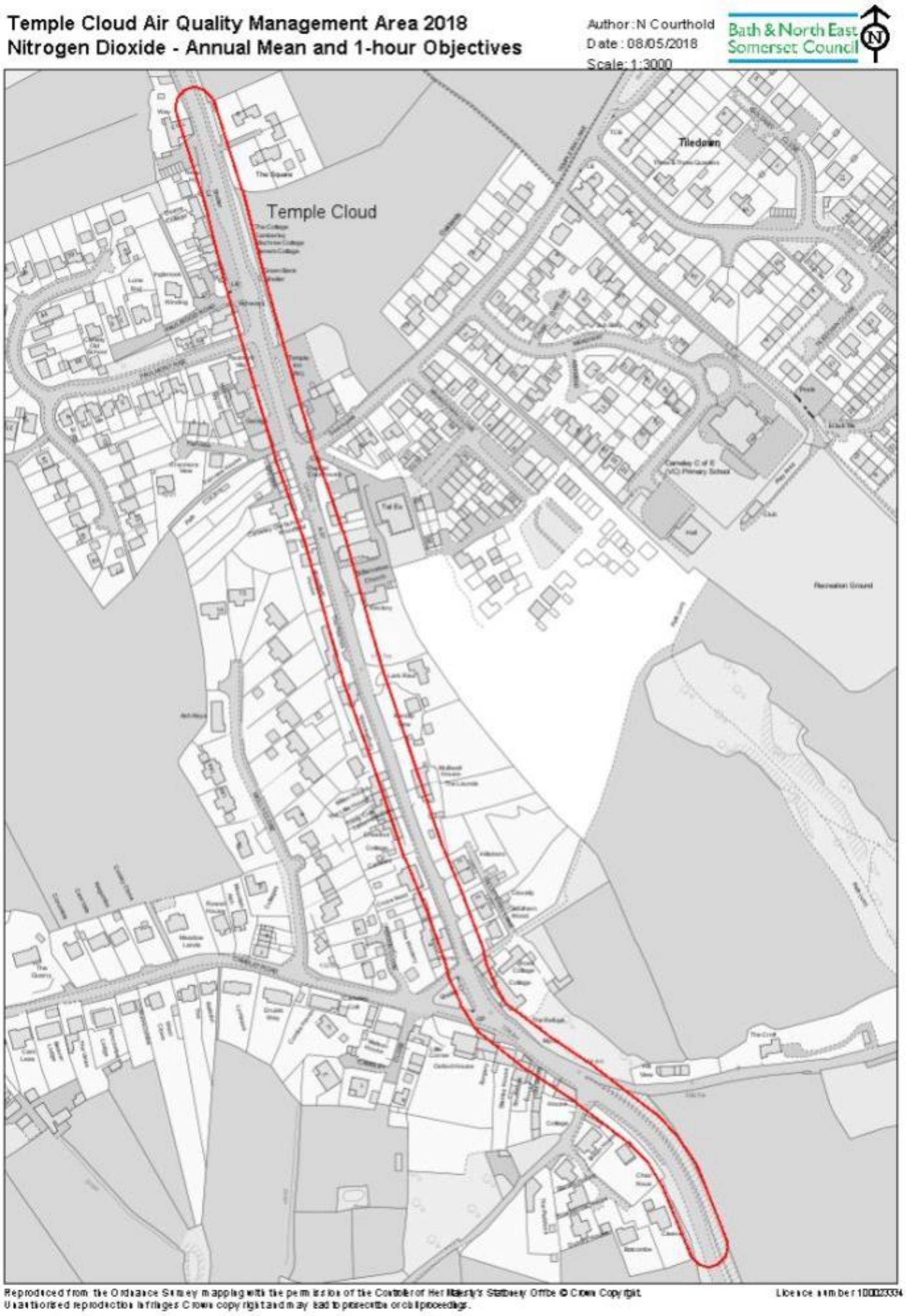

Figure 1.1 Temple Cloud – Air Quality Management Area Boundary

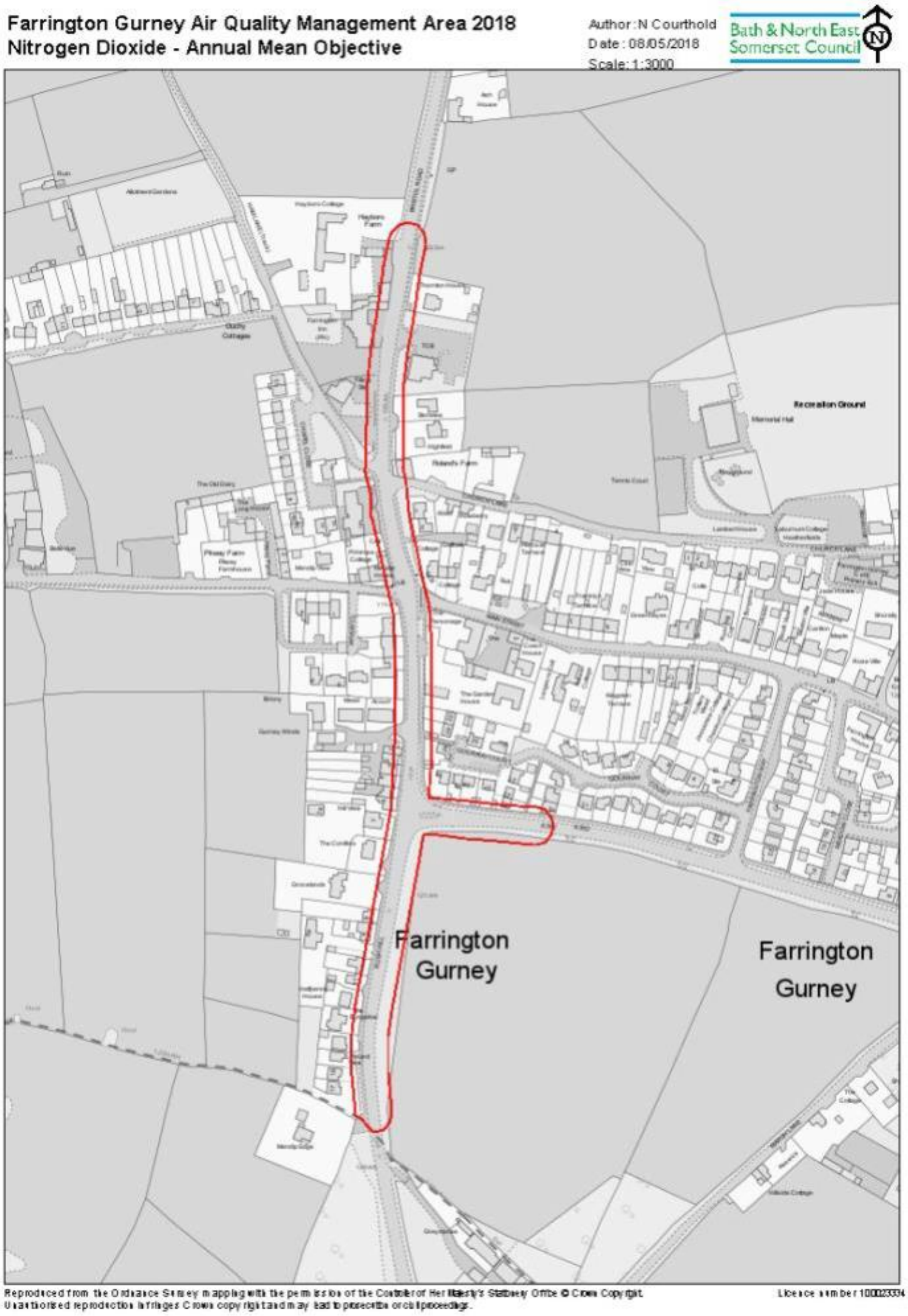

Figure 1.2 Farrington Gurney – Air Quality Management Area Boundary

The part of the A37 through Temple Cloud has a narrow section between the Temple Inn Lane and Cameley Road junctions. The restricted width means that larger vehicles, including most if not all heavy goods vehicles (HGV), are unable to pass one another. Consequently, they are forced to stop and give-way, with southbound queuing often extending back to block and impede the Temple Inn Lane junction. In the case of northbound traffic, the 'wait' position is just north of the Cameley Road junction. The additional engine power used to start again negatively contributes to the vehicular emissions, especially when travelling in the northbound uphill direction. This air quality situation is further exacerbated by retaining walls on the east side of the narrow section and high/overhanging vegetation to the highway on the same side. Both these features act as physical barriers which decrease the circulating air flow, resulting in higher pollutant concentrations and a situation known as a 'street canyon' effect.

In contrast to Temple Cloud, the A37 through Farrington Gurney is relatively flat. Furthermore, the carriageway is wide with no 'street canyon' effects created by high frontage walls or buildings. Notwithstanding this, the monitoring of Nitrogen Dioxide, which began in 2017, has identified two locations of exceedance. Firstly, on the A37 southbound approach to the signal-controlled junction with the A362 and, secondly, near the Farrington Inn pub. The latter location experiences high volumes of vehicular movement from the pub car park, the neighbouring petrol garage and the Co-operative supermarket car park opposite. As such, this creates conditions where traffic on the A37 can be impeded, creating temporal 'shock-wave' slowing of vehicle and queuing.

1.2 Study Objectives

Following the declaration of the areas and creation of the AQMA Orders, B&NES are now seeking to draft Air Quality Action Plans (AQAPs) for both villages. As such, the purpose of this study has been to assess a list of potential 'option' measures that could contribute to improving the air quality within the designated AQMAs. Following this 'long list' development of options, an initial 'sifting' process has been undertaken to remove those which are considered undeliverable given the physical, environmental and built heritage constraints that are present within the villages, or where implementation would have road safety issues or potentially create worsened operational problems. 'Short-list' options taken forward have then been assessed in greater depth using detailed traffic and air quality modelling to more fully understand the extent to which they could improve air quality in both villages and contribute to achieving compliance with the National Air Quality Objectives (i.e. 40 $\mu g/m^3$ annual mean).

1.3 Structure of Report

Following this introductory 'Section' the remainder of the report is structured as follows:

- Section 2.0: Traffic Data Collection;
- Section 3.0: 'Long List' Option Identification and Assessment ('Sifting');
- Section 4.0: Cost Estimating ('Short-list' options);
- Section 5.0: Baseline Traffic Model Development,
- Section 6.0: Scenario Testing Results;
- Section 7.0: Air Quality Modelling (Including baseline model calibration); and
- Section 8.0: Summary and Conclusions.

Dialogue in Sections 3.0 to 6.0 is supported by more detailed reporting in **Appendices A-F** as follows:

- Appendix A: 'Long-List' Option analyses - Temple Cloud and Farrington Gurney;
- Appendix B: Option drawings;
- Appendix C: Cost Estimates;
- Appendix D: Local Model Validation Report - VISSIM;
- Appendix E: Scheme Testing Report ('Short-List' Options) - VISSIM; and
- Appendix F: Air Quality Modelling (AQC).

2. Traffic Data Collection

2.1 General

To assist in developing potential traffic management options there was a need to collect up-to-date MCC/ATC count data in certain locations to supplement data already held by B&NES. The main existing source of existing data was an ANPR survey undertaken on the A37 in the 'narrow' section within Temple Cloud between the 31st October and 13th November 2017. As such, an additional ANPR survey was specified in Farrington Gurney to provide registration plate data for subsequent vehicle fleet composition analyses in this village. It was not assumed the characteristics here would necessarily be the same as recorded by the ANPR site in Temple Cloud.

There was additionally an existing turning count survey at the A37/A362 junction (Rush Hill), although this was undertaken on Thursday 13th October 2016 so quite dated. This was used in 'initial' junction modelling, but a more up-to-date count undertaken in June 2019 was used for assessment in later work (see below).

2.2 Manual Classified Counts

Manual classified turning counts were undertaken in the following locations on Tuesday 11th June 2019:

- A37/Temple Inn Lane junction - Temple Cloud,
- A37/Cameley Road junction - Temple Cloud;
- A37/A39 Wells Road junction.
- A37/Ham Lane/Church Lane junction - Farrington Gurney; and
- A37/A362 junction - Farrington Gurney

These were disaggregated to 15-minute intervals and undertaken over the 12-hour period from 0700 am to 7:00 pm

2.3 Automatic Traffic Counts (ATC)

Directional automatic traffic counts (ATC) were also undertaken in two locations on the A37 as follows:

- Temple Cloud: Between the junctions with Temple Inn Lane and Cameley Road (10th to 18th June 2019). In this case the counter was sited close to the junction with Temple Inn Lane (rather than 'mid-link') to reduce the risk of queuing southbound traffic at the 'narrowing' standing on the loops; and
- Farrington Gurney: Between the junctions with Ham Lane/Church Lane and the A362 (10th June to 3rd July 2019). The counter was placed close to the Ham Lane/Church lane junction to reduce the risk of queuing southbound traffic at the A362 junction (Traffic Signals) from resting on the loops.

2.4 Automatic Number Plate Recognitions Survey (ANPR)

As noted above, two ANPR cameras were installed at a suitable point on the A37 in Farrington Gurney to the north of the A362 junction to record the registration numbers of vehicles in both directions over a weekday 24-hr period (00:00 - 24:00). The raw data captured for both directions of travel was in the form of time-stamped Vehicle Registration Mark (VRM) data.

2.5 Key Findings

Some 'key' findings from the various surveys are as follows:

Temple Cloud

- The ATC data collected on the A37 in Temple Cloud (10th to 18th June 2019) between Temple Inn Lane and Cameley Road shows mean 24hr weekday northbound flows of the order of 8,200 vehicles, and southbound flows over the same period of circa 7,900 vehicles (so **16,100** vehicles two-way);
- The ANPR surveys undertaken in November 2017 in Temple Cloud reveal a high percentage of HGVs in the vehicle mix, which was readily apparent during site visits and contributes to the observed frequency of queuing conditions on the approaches to the narrow section. This recorded a mean daily weekday two-way flow of some 336 articulated HGV and 553 rigid HGV, which equated to 2.27% and 3.85% of the total vehicle flow. Euro-class analysis showed that 64.73% of all articulated HGV were Euro 6, whilst 43,32% of all rigid HGV were Euro 6. Applying the same percentages to the observed June 2019 volume would give a total of 985 HGVs, so about 5-6% higher than the recorded mean flow in November 2017;
- The 'peak' hourly flows, as expected, occur in the weekday peak periods (7:00-10:00 am and 4:00-7:00 pm). In the AM peak the highest two-way hourly flow of **1,275** vehicles occurred between 7:00-8:00 am, with 1.191 vehicles recorded in the following 8:00-9:00 am hour. In the PM peak the flows in the 4:00-5:00 pm and 5:00-6:00 pm hours were similar at 1,267 and **1,309** vehicles per hour (two-way); and
- Data for the inter-peak period (10:00 am to 4:00 pm) shows that the 'mean' hourly two-way flow remains significant at circa **980** vehicles, so still circa 75% of the peak flow.

Farrington Gurney

- The MCC undertaken at the A27/A362 junction (7:00 am to 7:00 pm) on 11th June 2019 showed that the total 12-hr flow on the A37 immediately north of the junction through Farrington Gurney was 15.172 vehicles, of which 1,378 (9%) were HGVs falling into the categories 2-4/5 axle 'rigid' or 3/4-6 axle 'articulated'; and
- The peak 'inflows' at the junction occurred between 7:15-8:15 am (AM peak) and 5:00-6:00 pm (PM peak). These were 1,908 and 1,901 vehicles respectively. The similarity and observed operating conditions at these times suggest this is indicative of the maximum capacity throughput of the traffic signals, or close to;
- Peak 'two way' flows on the A37 just north of the junction occurred in the same 'peak' demand hours for the junction. These were 1,578 and 1,550 vehicles per hour respectively. As might be expected, the achievable 'link' flow through Farrington Gurney is dictated by the capacity throughput of the A37/A362 traffic signals at the bottom of Rush Hill.

2.6 Use of Data

The new MCC and ATC data was extensively used to create and calibrate vehicle flow matrices in developing a VISSIM micro-simulation model of the A37 corridor covering both Temple Cloud and Farrington Gurney, as opposed to separate models for each village. This model covers the period 7:00 am to 7:00 pm and was calibrated to ensure a 'fit' with observed flows every hour. The same flow data together with fleet composition information from the ANPR surveys was used to build and calibrate the baseline air quality model.

3. Option Development and 'Long List' Assessment

3.1 Option Listing: Requirement of Study Brief

Options for both villages to be considered explicitly as part of the work were set out in the study Brief. These were as follows:

Temple Cloud

- Reduction or removal of the footway on the western side of the A37 to widen the carriageway;
- Replacement of the footway on the western side of the A37 with other suitable north-south pedestrian routes for the village away from the A37 which would facilitate the removal of the existing footway on the A37;
- A more comprehensive road widening measure to include compulsory purchase of land to allow for road widening to take place whilst retaining the existing footway;
- Introducing a system of 'shuttle working' using traffic signals to allow larger vehicles to pass through unimpeded;
- The use of Vehicle Activated Signs (VAS) further out on the approach to the village to warn northbound HGV drivers of another HGV (southbound) currently in the narrowing;
- The introduction of 'priority' workings;
- The implementation of a Clean Air Zone for this section of the A37; or
- Implementation of a width restriction for larger vehicles (HGV) by way of a TRO.

Farrington Gurney

- Review the existing signals (A37/A362) to increase junction capacity, including potential changes to the existing signal sequencing and/or the removal of the pedestrian stage;
- Construction of a roundabout to replace the existing traffic signals. This was to include both a smaller roundabout that might fit within the existing highway boundary, or one with a larger Inscribed Circle Diameter (ICD) requiring third party land;
- Construction of an additional lane on the A37 southbound approach to the traffic signals, utilising the existing verge and possibly the existing footway or hatched area if required; or
- The implementation of a Clean Air Zone for this section of the A37.

This was not seen as exhaustive, and as such the 'long list' assessment to include other possible options emerging during the work.

3.2 'Long List' Options and Assessment

3.2.1 General

The options specifically considered and assessed are set out below. Full details of the assessment of each option at this stage of the work, and the decision including reasoning to 'dismiss' or 'short-list' for further assessment, are given in Tables 1 and 2 in **Appendix A**. Drawings where referenced are included in **Appendix B**.

3.2.2 Temple Cloud

3.2.2.1 Options Considered

Options considered and assessed in **Table 1** of **Appendix A** are as follows:

- Option 1: Reduction or removal of the footway on the western side of the A37 through the 'narrowing' to increase carriageway width;
- Option 2: Linked to Option 1, replacement of the footway on the western side of the A37 with other suitable north- south pedestrian routes for the village away from the A37, which would facilitate the removal of the existing footway on the A37;
- Option 3: More comprehensive widening including compulsory purchase of land to allow for road widening to take place whilst retaining the existing footway;
- Option 4: Introducing a system of 'shuttle working' using traffic signals to allow larger vehicles to pass through unimpeded without 'passage conflict. Drawing Nos. **674726CH.CI.59.01-01** and **674726CH.CI.59.01-02** show the possible positions of the signal control stop-line positions. Either would result in a significant 'controlled' section and so the length of inter-green 'clearance' time periods necessary between the main signal phases controlling northbound and southbound traffic on the A37;
- Option 5: The use of Vehicle Activated Signs (VAS) further out on the approach to the village to warn approaching HGV drivers that another HGV is currently in the narrowing;
- Option 6: The introduction of priority workings;
- Option 7: The implementation of a Clean Air Zone for this section of the A37;
- Option 8: Implement a width restriction for larger vehicles using a Traffic Regulation Order (TRO);
- Option 9: Undertake significant 'cutting back' of the high hedge/vegetation on the eastern side of the narrow section between 'The Laurels' and No 1 Gillets Hill Lane to allow more effective use of the existing carriageway by HGVs. This extends in front of the boundary stone wall denoting the edge of highway, requiring some southbound HGVs to move out to a partial encroaching position within the opposing carriageway to avoid wing mirror strike and potential damage. Drawing Nos. **674726CH.CI.59.01-03** and **674726CH.CI.59.01-04** show details as to how 'effective' carriageway width usable by HGV's might be improved in this way; or
- Option 10: Construction of a bypass for Temple Cloud.

3.2.2.2 Assessment Outcome

The outcomes from the initial sifting of the 'long list' options and reason for dismissal or 'short-listing' is summarised below.

- Option 1: DISMISS - This would allow the carriageway running width to be increased by circa 0.7 to 1.1 metres. However, this would have an unacceptable highway safety impact on pedestrians and residents, who would be forced to walk within a heavily trafficked carriageway. It would also severely restrict the visibility achievable at vehicle accesses on the west side;
- Option 2: DISMISS - Residents of most properties fronting this section have no means of access to other pedestrian routes without first using this section of footway. As such, they would be exposed to a high risk of collision with traffic by being forced to walk within a 'live' carriageway. Alternative 'continuous' north-south pedestrian via Molly Close (West) and Gillets Hill Lane-Brandown Close (East) do not exist. Creating a Public Right of Way (PROW) would involve establishment of rights through several private gardens;
- Option 3: DISMISS - Widening either side with a loss off third party land is considered unacceptable and likely to face significant local opposition. Widening affecting the western side is particularly problematic due to short front gardens and/or buildings flanking the back edge of existing footway. Widening on the eastern side would pose a complex construction issue on how to build a new retaining wall whilst ensuring access to the residential units. The land rises from the A37 this side, so alterations to driveways would be required to maintain a suitable gradient and 'tie-in' to a widened carriageway on the east side;
- Option 4: **SHORTLIST** - Initial traffic signal modelling with the software package LinSig using the November 2017 flow data showed that a controlled 'shuttle worked' section of 195m would provide insufficient capacity to cater for the existing 'peak' weekday flows. However, results obtained with the shorter section of 117m indicated it might 'just' operate at practical capacity (<90% DoS). However, results additionally

suggested that a cycle time of up to 180 seconds would be needed in the 7:00-8:00 am period, and circa 120 seconds in the PM peak hour. This was duly taken forward for more detailed VISSIM micro-simulation model testing;

- Option 5: DISMISS - HGV drivers approaching the narrowing from either direction already have a clear line of sight along the restricted section, so the opportunity to gauge 'passage' conditions and whether to enter/yield on reaching the Cameley Road junction (NB) or near the driveway access to 'Lark Rise' (SB). Installing signs to forewarn HGV drivers wass therefore considered to have little impact as this would not remove the passage conflict for HGV's;
- Option 6: DISMISS - If 'one way' working was to be implemented it would need to be actively managed given the length of the controlled section. Existing problems with a long 'narrowing' under priority control can be readily observed on the A362 at the 'Sunnyside' pinch-point (just east of Farrington Gurney). This include disproportionate queuing on the non-priority approach and road safety issues associated with these drivers attempting to 'race the gap' or force a right-of-way. This occurs under less heavy flow conditions than the A37;
- Option 7: DISMISS - Whilst a CAZ 'Type C' charging HGVs would specifically target the vehicle types creating passage issues through the 'narrowing' and associated queuing/delay, a significant amount of this fleet (as surveyed, Nov-17) is Euro Class 6 compliant and so would be unaffected by the CAZ. As such, a significant amount of passage conflict associated with HGV's would remain. The introduction of a local CAZ on what is a primary HGV route is likely to create undesirable diversionary issues affecting local roads which are less suitable. Whilst non-compliant HGV drivers will have the option of paying the charge, many will choose not to, and seek out local diversionary routes. The A39 between Whitecross Gate and Marksbury, and the A368 between Marksbury and Chelwood crossroads are examples, creating potential for additional HGV traffic through Hallatrow, High Littleton, Farmborough, Marksbury and Chelwood. Notwithstanding the benefits that might accrue in Temple Cloud, this measure is likely to attract significant concern and objections from residents in these surrounding settlements.
- Option 8: **SHORTLIST** - In our view the benefit of removing most HGV traffic from Temple Cloud would be outweighed by the potential for adverse impacts on other less suitable roads than the A37 for carrying HGV traffic. The A37 is a key primary route connection between the A303(T)/A39 to the south and Bristol to the north. A more appropriate control may be a weight restriction targeting some of the largest HGVs, but again this would need to be signed well in advance and likely lead to objections. Notwithstanding this, this option was taken forward for more detailed modelling assessment (local effects) at the bequest of B&NES. It should be noted that the modelling undertaken does not consider the wider re-rerouting impact of displaced HGV traffic. Furthermore, additional work would need to be done to understand the origin-destination patterns of HGVs using this part of the A37 using a Roadside Interview (RSI) survey or, as a minimum, the routing pattern surveyed using various ANPR sites covering a much wider area;
- Option 9: **SHORTLIST** - Hedges and trees that grow on the boundary of the highway or on adjacent land but overhang the highway are generally the responsibility of the adjoining property or land owner. However, The Council has power to intervene if there is a safety or highway passage concern associated with the encroaching vegetation. Increasing the 'effective' width for HGVs by cutting back the high vegetation on the east side of the narrow section has potential to be an easy fix with air quality benefits, and so could be viewed as the first stage in a longer-term strategy to find an acceptable solution; and
- Option 10: DISMISS - Whilst probably the most effective measure for significantly reducing emissions within Temple Cloud, the lead-time in delivering a bypass would be too long. Furthermore, the long-standing 'safeguarded' or protected alignment for a bypass to Temple Cloud-Clutton was removed in the adopted B&NES Placemaking Plan (PMP). This was due to concerns about the realistic prospect of delivery with the Plan period, coupled with planning blight issues linked to the long-standing safe-guarding of the alignment to the west of Temple Cloud.

3.2.3 Farrington Gurney

3.2.3.1 Options Considered

Options considered and assessed in **Table 2** of **Appendix A** are as follows:

- Option 1: Review the existing Method of Control or sequencing at the A37/A362 traffic signals to increase junction capacity, including changes to the existing signal sequencing and/or the removal of the pedestrian stage;
- Option 2: Implement proposed junction improvements at the A362/A37 junction linked with the Somer Valley Enterprise Zone (SVEZ) development - Extended two-lane entry on the A362 approach;
- Option 3: Construction of an additional lane on the A37 southbound approach to the A37/A362 signals utilising the existing verge and possibly the existing footway or are of 'hatching' if required. Drawing No. **674726CH.CI.59.01-11** in Appendix B shows the possible improvement scheme assessed in LinSig at this stage. Potential issues, notably to the pedestrian environment, are set out in Table 2 to Appendix A;
- Option 4: Combination of Option 2 and Option 3 works to the A37/A362 junction;
- Option 5: The construction of a roundabout to replace the existing traffic signals. Option 5 considered a small 'compact' type of 'Normal' Roundabout with single lane entries. Drawing No. **674726CH.CI.59.01-12** in Appendix B shows the possible improvement scheme assessed in ARCADY at this stage. It should be noted that even this requires third party land in the SE corner of the junction to deliver; a mini-roundabout whilst smaller in land-take terms was not considered viable;
- Option 6: The construction of a roundabout to replace the existing traffic signals. Option 6 considered a larger 60m ICD 'Normal' Roundabout allowing 'flared' 2-lane entries. Drawing No. **674726CH.CI.59.01-13** in Appendix B shows the possible improvement scheme assessed in ARCADY at this stage; and
- Option 7: The implementation of a Clean Air Zone for this section of the A37.

3.2.3.2 Assessment Outcome

The outcomes from the initial sifting of the 'long list' options and reason for dismissal or 'short-listing' is summarised below.

- Option 1: DISMISS - This This proposal would require the loss of the only controlled crossing point over the A37 in Farrington Gurney, to the detriment of pedestrian safety. As the appearance of the crossing phase occurs in the same stage as that controlling the right turn to the A362 (Stage 1), the only phase that would benefit from its removal would be the northbound 'ahead' phase on the A37. As such the queuing/delay on the southbound A37 approach where air quality exceedances occur would not be improved by the potential allocation of additional green time;
- Option 2: DISMISS - LinSig modelling indicates that, as an isolated measure, the effect in reducing queuing and delay on the A37 southbound approach would be negligible;
- Option 3: **SHORTLIST** - Initial LinSig modelling showed that this could assist in notably reducing the mean maximum queue (MMQ) on the A37 southbound approach at 'end of red' in both peak hours. In the AM peak period the predicted Mean Maximum Queue (MMQ) could be reduced from 30 to 19 vehicles, and from 28 to 14 vehicles in the PM peak period. Results also suggest the operational cycle time needed could be lower in both periods, particularly in the PM peak hour. This will assist in reducing delays, which will also serve to reduce the MMQ;
- Option 4: DISMISS - Option 2 has little impact in isolation, so there would be little benefit in increasing the cost of the Option 3 works which deliver a tangible operating benefit to the critical area for emissions on their own;
- Option 5: **SHORTLIST -** Initial ARCADY modelling showed that this 'compact' roundabout layout (single lane approaches) could accommodate existing flows in the weekday 'peak' hours. Modelling suggested that the single lane entries could achieve maximum capacities of circa 1,350 pcu/hr with negligible circulating

cross-flow. Results for the AM peak hour indicated MAX 'Ratio of Flow to Capacity (RFC) figures of circa 0.74 and 0.71 on the A37 southbound and northbound entries to the roundabout. A lower RFC of 0.46 was predicted for the A362 entry. An RFC of 0.85 is taken as accepted design capacity, so there was some predicted 'spare' capacity for growth, albeit limited. Results for the PM peak hour indicated MAX RFCs of circa 0.73 and 0.75 on the A37 southbound and northbound entries to the roundabout. A lower RFC of 0.54 was predicted for the A362 entry;

- Option 6: DISMISS - The 'compact' roundabout of 40m ICD considered under Option 5 was shown by the ARCADY modelling to cater adequately with peak flows with some 'headroom' for growth. As such, there was no justification for seeking to implement a much larger layout with significantly increased land-take and cost. It was, however, accepted this may need to be reviewed if more detailed modelling of Option 5 with VISSIM showed up operating issues not picked up with the simpler ARCADY assessment; and
- Option 7: DISMISS - As noted with Temple Cloud, whilst a CAZ 'Type C' charging HGVs would specifically target a key contributor to emissions, a significant amount of this fleet (as surveyed, Nov-17) is Euro Class 6 compliant and so would be unaffected by the CAZ. There are similar key concerns with lorry re-routing. The absence of suitable alternative HGV routes to the A37 for north-south movements between the Yeovil area (A303(T)) and Bristol is a strategic network issue. As such, a 'point' restriction at Farrington Gurney could have regional impacts, to the point that many operators may simply pay the charge when faced with the additional operating costs of significant diversion.

3.3 Shortlisted Options

As a result of the 'sifting' process the following schemes were taken forward for more detailed traffic and air quality modelling, whilst high level 'budget' cost estimates were also produced:

Temple Cloud

- Option 4: Introducing a system of 'shuttle working' using traffic signals, using the shorter controlled section length of 117m;
- Option 8: Implement a width restriction for larger vehicles using TSRGD signing to diagram 629A; or
- Option 9: Undertake significant 'cutting back' of the high hedge/vegetation on the eastern side of the narrow section between 'The Laurels' and No 1 Gillets Hill Lane to allow more effective use of the existing carriageway by HGVs.

Farrington Gurney

- Option 3: Construction of an additional lane on the A37 southbound approach to the A37/A362 signals; and
- Option 5: Construction of a small 'compact' type of 'Normal' Roundabout with single lane entries to replace the existing traffic signals.

4. Cost Estimating

4.1 Temple Cloud

Costs associated with implementing either Options 4, 8 or Option 9 in Temple Cloud have not been specifically calculated, The only 'short-list' option with a significant cost out-turn is the 'shuttle working' signals (Option 4), it is expected this could be circa **£300K**. Option 9 is simply a maintenance operation, but one looking at a more severe cut-back of the overhanging trees on the east side of the 'narrowing'. A 'worst case' might be a need to remove these trees and replant at a greater separation from the wall to back of highway. This would allow the shape/form of the trees to be maintained, but clear of any overhang to the highway. We'd suggest a cost allowance of **£30-40K** for necessary tree works including possible removal/replanting. Option 8 costs would revolve around the TRO costs and associated signing, so again relatively minor.

4.2 Farrington Gurney

High level 'Budget' cost estimates have been prepared for the short-listed schemes in Farrington Gurney (Options 3 and 5), and additionally for the larger roundabout option (Option 6). It should be noted that costs do not allow for third party land acquisition where this is needed outside of the existing public highway, which is the case with both roundabout options. It may also exclude some of the Council's internal costs, although a 30% 'Risk Pot' allowance has been made in respect of the construction costs and 10% and 5% contingencies additionally added for 'Design and Project Management' and 'Supervision' costs respectively. If formal Outline and Full Business Cases are expected to be needed to secure funding through WECA (which may be likely given the high capital cost of the highway works) then additional cost allowance for this would need to be factored in.

The cost estimates for the three options including a breakdown by Series are included in **Appendix C**. Rates used are based on the existing B&NES Term Maintenance Contract. The overall estimated budget costs excluding land and any OBC/FBC submissions for funding are as follows:

Option 3: **£934K**;

Option 5: **£1.98M**; and

Option 6: **£2.95M**.

5. Baseline Traffic Model Development

5.1 Model Type and Network Extent

Given the specific HGV passage conflict factors creating the congestion problems in Temple Cloud in particular, it was considered that a detailed micro-simulation approach to highway modelling was required. The package chosen was **PTV VISSIM** version 9, which allows a great deal of user flexibility in modelling conflicts between different vehicle types and bespoke driver behaviours in 'non-standard' situations. This was critical is attempting to replicate queuing and delay conditions in the Temple Cloud 'narrowing'.

The VISSIM model includes the A37 corridor from Cholwell Farm, located north of Temple Cloud, to the junction of the A37 with the A39, located at the top of Rush Hill to the south of Farrington Gurney as shown in **Figure 5.1** below. This includes the following junctions / side roads:

- Temple Inn Lane;
- Cameley Lane;
- A39 Wells Road;
- Ham Lane / Church Lane; and
- A362 Farrington Gurney Bypass

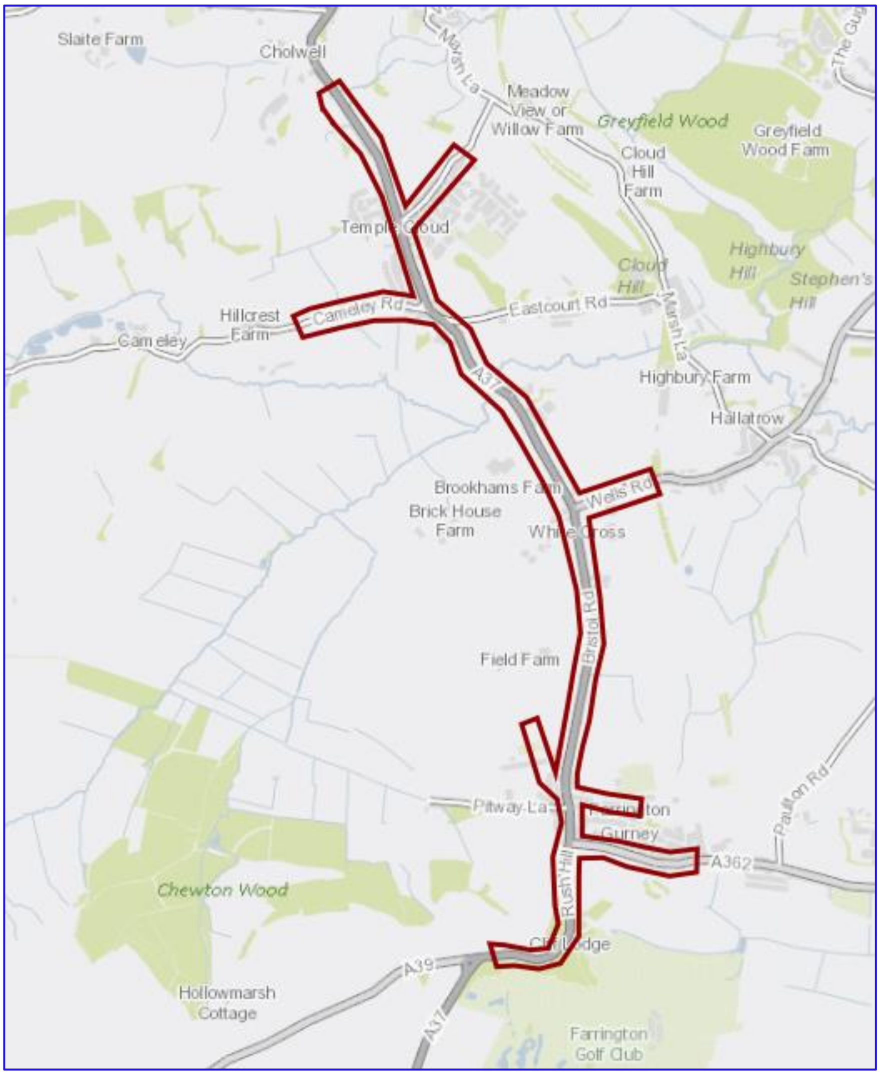

Figure 5.1 VISSIM Model extents (Source: OS OpenData)

5.2 Model Calibration and Validation

Full details of the level of 'fit' of the base model (June 2019) in given in the 'Local Model Validation Report' (LMVR) in **Appendix D**. The base model has been developed as a 12-hour weekday model between 07:00 am and 7:00 pm based on the manual classified counts (MCC) and automatic traffic counts (ATC) described earlier in Section 2.

The GEH statistic was adopted as the main indicator of the extent to which modelled flows matched the corresponding observed values, with modelled turning flows calibrated for each of the 12 modelled hours. A summary of the "goodness-of-fit" achieved by the model is provided in **Table 5.1**. The table shows the proportion of turning flows within a GEH of 3.0 and 5.0, where 5.0 is the acceptable limit set for strategic models and 3.0 the lower value for 'critical turns set in the TfL modelling guidelines for microsimulation models. All turning flows were found to be within a GEH of 5.0, and there are only a small number of cases where they exceeded a GEH of 3.0. It will be noted that car, LGV, OGV1 and OGV2 vehicle types were modelled separately. This was to allow differential passage conflicts for HGVs to be modelled in 'real time' detail within the Temple Cloud part of the simulation model.

Table 5.1: Base Model Calibration - Modelled turning flows

	GEH Turns <3.0				GEH Turns <5.0			
Hour	**CAR**	**LGV**	**OGV1**	**OGV2**	**CAR**	**LGV**	**OGV1**	**OGV2**
07:00 – 08:00	100%	98%	100%	100%	100%	100%	100%	100%
08:00 – 09:00	100%	100%	100%	100%	100%	100%	100%	100%
09:00 – 10:00	100%	100%	98%	100%	100%	100%	100%	100%
10:00 – 11:00	100%	100%	100%	100%	100%	100%	100%	100%
11:00 – 12:00	98%	100%	100%	100%	100%	100%	100%	100%
12:00 – 13:00	100%	100%	98%	100%	100%	100%	100%	100%
13:00 – 14:00	100%	100%	100%	100%	100%	100%	100%	100%
14:00 – 15:00	100%	100%	100%	100%	100%	100%	100%	100%
15:00 – 16:00	100%	100%	95%	100%	100%	100%	100%	100%
16:00 – 17:00	100%	98%	100%	100%	100%	100%	100%	100%
17:00 – 18:00	100%	100%	100%	100%	100%	100%	100%	100%
18:00 – 19:00	100%	100%	100%	100%	100%	100%	100%	100%

Tom-Tom NV journey time data as measured by in-vehicle navigation devices was used for model validation. A total of 14 route sections were assessed for compliance as follows:

1. A37 southbound from New Cholwell Farm to Temple Inn Lane
2. A37 southbound from Temple Inn Lane to Cameley Road
3. A37 southbound from Cameley Road to A39 Wells Road

4. A37 southbound from A39 Wells Road to Church Lane / Ham Lane
5. A37 southbound from Church Lane / Ham Lane to A362 Farrington Gurney Bypass
6. A37 southbound from A362 Farrington Gurney Bypass to Rush Hill
7. A37 northbound from Rush Hill to A362 Farrington Gurney Bypass
8. A37 northbound from A362 Farrington Gurney Bypass to Church Lane / Ham Lane
9. A37 northbound from Church Lane / Ham Lane to A39 Wells Road
10. A37 northbound from A39 Wells Road to Cameley Road
11. A37 northbound from Cameley Road to Temple Inn Lane
12. A37 northbound from Temple Inn Lane to New Cholwell Farm
13. A362 westbound from Marsh Lane to A37
14. A362 eastbound from A37 to Marsh Lane

For the purposes of subsequent air quality emissions modelling and current 'exceedance' areas the most critical sections were those through the 'narrowing' in Temple Cloud (Sections 2 and 11), and the A37 southbound approach to the A362 junction (Section 5). In keeping with recommendations set out by Transport for London (TfL) and the Design Manual for Roads and Bridges (DMRB), average modelled journey times within 15 per cent of the observed averages were targeted in at least 85 per cent of cases. As noted above, full details of the 'goodness of fit' is given in the LMVR in Appendix D for all periods.

In the AM peak, all the modelled journey time sections were within 15% of the observed data except route Section 4 (A37 southbound from A39 Wells Road to Church Lane / Ham Lane). This section was significantly faster in the model than was observed. It is likely that this was due to the influence of turning vehicle movements to and from locations that were not expressly included in the model and for which observed data was not collected. This includes local businesses such as the Radstock Co-operative supermarket and the Texaco petrol filling station. In the PM peak the results were very similar to those of the AM peak, so with all modelled journey time sections within 15% of the observed data except route Section 4. In the inter-peak period, a 100% compliance with observed data was achieved.

5.3 Overview

A 2019 12-hour VISSIM weekday 'base' model was developed in accordance with nationally recognised best-practice guidance. Based on the average results presented in the LMVR (Appendix D), the model was shown to display a good fit against the available observed data, which met and exceeded the recommended criteria for model calibration and validation. It was therefore considered that the developed base model offered a realistic representation of existing highway conditions in all periods, and so therefore suitable for assessing the shortlisted transport scheme proposals for both Temple Cloud and Farrington Gurney.

6. Highway Scheme Testing

6.1 General

Full details of the scheme testing undertaken with VISSIM and the results are contained in the 'Scheme Testing Report - VISSIM' in **Appendix E.** As such, this report includes only the 'headline' findings and key assumptions made.

6.2 Options

As noted in sub-section 3.3 VISSIM was used to test all the 'short-listed' options. The following three options were tested for the 'narrow' section through Temple Cloud:

- Option 4: Signalled 'shuttle-working' with a controlled length of circa 117 metres;
- Option 8: Width restriction for larger vehicles. For the purposes of the model, it has been assumed that this would result in:
  - 20% of OGV1 (HGV-Rigid) vehicles using the A37 through Temple Cloud re-routing away the local area, so effectively disappearing from the model network under consideration;
  - 80% of OGV1 (HGV-Rigid) vehicles rerouting locally by means of the A39 Wells Road through Hallatrow, High Littleton and Farmborough; and,
  - All the larger OGV2 (HGV-Articulated) vehicles using the A37 through Temple Cloud again re-routing away the local area, so effectively disappearing from the model network under consideration.
- Option 9: Significantly cutting back of the high hedge / vegetation on the eastern side of the narrow section between The Laurels and No 1 Gillets Hill Lane to allow more effective use of the existing carriageway by HGVs. For the purposes of the VISSIM modelling it has been assumed that this could resolve all two-way passage issues except OGV2-OGV2 conflicts.

The following two options were tested at the signalised junction between the A37 and A362 at Farrington Gurney:

- Option 3: Additional lane on the A37 southbound approach to the junction; and,
- Option 5: Compact roundabout to replace existing junction.

The options for the two locations were tested independently, i.e. when a Temple Cloud option was tested, the Farrington Gurney base model layout was used, and vice versa.

6.3 Key Findings

6.3.1 Temple Cloud Options

The results for the narrow section in Temple Cloud showed that:

- Option 4 (signalled 'shuttle working') has a very significant negative effect as it makes travel times and queues considerably longer in all weekday hours modelled (7:00 am to 7:00 pm). As such, this option was not considered further in subsequent air quality modelling described in Section 7 and Appendix F;
- Option 8 (width restriction for larger vehicles) has, not unexpectedly, a significant positive effect through Temple Cloud as it removes most of the vehicles (HGVs) that cause the present two-way passage conflicts in the narrow section. However, this scenario has been modelled with little consideration as to where affected HGVs would re-route and what effect they may have on those other roads. In other words, the VISSIM modelling is necessarily local to the part of the A37 under consideration and does not seek to mimic

strategic HGV movements along the A37 corridor and surrounding routes. Actual HGV Origin-Destination (O-D data) would be needed to understand this, with ANPR data of lesser value; and

- Option 9 (cutting back of the high hedge / vegetation) is shown to have a minor positive effect on travel times and delay as it reduces the number of HGV conflicts occurring. However, these conflicts cannot be entirely removed by simple vegetation removal/cutting-back, and the VISSIM results suggest that these could still occur with some frequency. As such this option, whilst an improvement, could remain highly susceptible to queuing 'spikes' when those conflicts do materialise.

6.3.2 Further Commentary: Temple Cloud – Option 8

Returning to Option 8 a roadside interview survey (HGV only) would ideally be needed on the A37 somewhere between the A37/A39 (White Cross) junction and the A37/A368 (Chelwood) junction to determine the true origin and destination of HGV trips affected by any such 'width restriction' TRO. However, the high traffic flows on the A37 would, in our view, preclude a 'stop-go' site, whereby all other traffic is forced to wait behind the HGV(s) being interviewed. As such, a suitable site with width to allow 'bypass' would be needed. The alternative to using an RSI site(s) would be to identify ANPR sites (bi-directional) in the wider area to get a better idea of the pattern of movement in terms of approach and exit route. Note that this would not give the 'ultimate' origin or 'destination' addresses, whilst covering a large area in this way does create a risk of a low 'match rate' between HGV's entering and leaving the survey 'catchment' area. However, only HGV registration plates would be targeted whilst, given the relatively rural nature of the area, it is likely most HGV's movements would be 'through' trips. Survey cost will depend on the number of bi-directional ANPR camera sites, which will clearly increase with the area extent (cordon) beyond the Temple Cloud area. However, a larger area would provide better and more complete route pattern data than a restricted one. As an example, the following sites creating a rough outer cordon could be done:

- Site 1: A37: North of B3139 'Emborough';
- Site 2: A39: Just NE of Chewton Mendip;
- Site 3: A368: Just west of junction with the B3114 'West Harptree';
- Site 4: A37: North of Chelwood junction (Pensford);
- Site 5: A39: NE of Bence Garage junction (Marksbury);
- Site 6: B3115: NE of Red Hill (Timsbury); and
- Site 7: A362: Just west of Thicketmead Roundabout

In finalising any 'cordon' area, routes would need to be checked for any existing weight restrictions.

6.3.3 Farrington Gurney Options

Both short-listed options (Options 3 and 5) are predicted to result in improvements to journey times on all approaches during all three periods. The provision of an additional southbound lane on the A37 approach to the traffic signals (Option 3) provides additional capacity through the junction and thus greatly improves the journey time on that approach. The change also 'frees- up' green time to be used by other phases, so there are also journey time improvements on the other two approaches. While the A37 northbound sees only a marginal improvement, there is a significant improvement to the A362 westbound approach.

The compact roundabout option (Option 5) again provides significant travel time improvements on all approaches. The improvement on the A37 southbound approach is of similar magnitude to Option 3. However, the reductions in delay on the A37 northbound and A362 approaches are much greater. Notably, the travel time on the A362 approach is more than halved in both the AM and PM peak periods.

In terms of queuing the base model demonstrated persistent queueing on the A37 southbound approach to the junction where the exceedances occur. Results suggest that the 'average' maximum queue is consistently above 100 metres in length throughout both peak periods, and at times exceeds 200 metres. Both the A37 southbound widening option (Option 3) and the compact roundabout option (Option 5) demonstrate improvement over the base model, although the results for these two options are generally comparable.

7. Air Quality Modelling

7.1 General

Details of the air quality assessment work undertaken by AQC is contained within the report 'Air Quality Assessment - A37 Options and Feasibility Study', dated December 2019 in **Appendix F**. This report describes existing local air quality conditions (base year 2018) and the predicted air quality in the future, assuming that the proposed schemes do or do not proceed. The assessment of traffic-related impacts focuses on 2020 in Temple Cloud, and 2021 in Farrington Gurney; the earliest years the schemes could be operational. The assessment focuses on nitrogen dioxide as this is the pollutant for which the AQMA is designated.

7.2 Traffic Data and Emissions Calculations - Base

As described earlier, traffic data was sourced from the VISSIM micro-simulation traffic model. However, the VISSIM model was only developed as a 12-hour weekday model for the hours between 07:00 and 19:00. As such, AQC derived traffic data outside of these hours (including weekends) based on village specific diurnal profiles sourced from traffic counts in Temple Cloud and Farrington Gurney. Emissions were then calculated for every hour using Defra's Emission Factor Toolkit (EFT v 9.0). Road gradients were included within the emissions calculations.

In respect of sensitive locations, concentrations of nitrogen dioxide were predicted at several locations close to the proposed schemes, in proximity to the AQMAs. Receptors were identified to represent a range of exposure, including the worst-case locations (these being at the façades of the residential properties closest to affected road links). When selecting receptors, specific attention was paid to assessing impacts close to junctions.

Some existing residential properties were identified as receptors for the assessment. In addition, in Temple Cloud, concentrations were modelled at three current diffusion tube monitoring sites, and a further five decommissioned diffusion tube monitoring locations within the study area. In Farrington Gurney concentrations were modelled at five diffusion tube monitoring locations.

7.3 Predicted Scheme Impacts

7.3.1 Options Assessed

As noted in earlier dialogue, the VISSIM modelling dismissed the signal controlled 'shuttle working' as a viable option in Temple Cloud (Option 4) so air quality modelling was limited to the following four scenarios:

Temple Cloud

- Option 8: Width restriction for larger vehicles (TRO); and
- Option 9: Cutting back of the high hedge/vegetation on the east side of the narrow section to increase the effective carriageway width for HGVs.

Farrington Gurney

- Option 3: Additional lane on the A37 southbound approach to the junction; and,
- Option 5: Compact roundabout to replace existing junction.

7.3.2 Headline Results

7.3.2.1 Option 8: Temple Cloud

The implementation of Option 8 (vehicle width restriction TRO) in Temple Cloud is predicted to lead to substantial reductions in concentrations along the A37. Predicted concentrations at most receptors are predicted to be below the air quality objective, excepting locations TC13 and TC4 where concentrations of 41.3μg/m^3 and 45.7μg/m^3 respectively are predicted.

Significant beneficial impacts are predicted throughout Temple Cloud with Option 8, largely due to reductions in the number of HGVs along the length of the A37 though the village. The vehicle width restrictions within Temple Cloud could provide further beneficial impacts within Farrington Gurney to the south, with the diversion of HGVs away from the A37. However, the scope of these wider impacts has not been considered within this study. The assessment does not however consider the impact of the displaced vehicles from the A37 onto roads outside of Temple Cloud, which would be expected to lead to adverse impacts to air quality elsewhere. A further study would be required to quantify the impacts of diverted traffic on existing properties outside of Temple Cloud.

7.3.2.2 Option 9: Temple Cloud

The implementation of Option 9 (cutting back vegetation) is expected to lead to a reduction in nitrogen dioxide concentrations along the A37, However, as might be expected, the changes aren't as significant as those predicted with Option 8. Predicted concentrations are expected to remain above the objective at four receptors (and potentially a fifth at TC14). Critically, the concentrations at TC4 is predicted to remain above 60μg/m3, resulting in a continued risk of an exceedance of the short-term objective. However, the cutting back to vegetation is predicted to lead to a reduction in concentrations of 2.8 μg/m^3 at the worst-case property (TC4). The scheme overall is predicted to result in moderate to substantial beneficial impacts at the worst-case receptors, with negligible impacts at all other receptors within Temple Cloud.

7.3.2.3 Option 3: Farrington Gurney

Farrington Gurney is anticipated to have concentrations of nitrogen dioxide below the objective at all receptors in 2021 with or without the implementation of the proposed options.

However, the implementation of Option 3 is predicted to lead to a large reduction in concentrations at receptors close to the junction between the A37 and A362 where the road layout modification will occur, with reductions in concentrations predicted of up to 8.4μg/m^3. Moderate and slight beneficial impacts are predicted at the worst-case receptors next to the junction. All other impacts are predicted to be negligible, excepting two slight beneficial impacts located on the A37 adjacent to Pitway Lane and Church Lane.

7.3.2.4 Option 5: Farrington Gurney

The implementation of Option 5 is expected to lead to a substantial reduction in nitrogen dioxide concentrations along the A37 adjacent to the A37/ A362 junction, with reductions up to 14.2 μg/m^3 predicted at the worst-case receptors next to the junction. Close to the junction impacts are predicted to range from moderate to substantial beneficial, due to increased traffic speeds and alterations to the road realignment which increase the distance of receptors to the carriageway. There are, however, increases in concentrations at three receptors to the south of the proposed roundabout along the A37. This causes one slight adverse impact as a result of the new junction type (and therefore slower traffic) moving south towards these receptors. However, at this receptor, concentrations are not predicted to exceed 27.3 μg/m^3, and so concentrations will remain well below the objective.

8. Summary and Recommendations

8.1 Summary

8.1.1 Objectives and Study Approach

Following the declaration of Air Quality Management Areas (AQMA) in the villages of Temple Cloud and Farrington Gurney, B&NES are now seeking to draft Air Quality Action Plans (AQAPs) for both villages. As such, the purpose of this study has been to assess a list of potential 'option' measures that could contribute to improving the air quality within the designated AQMAs. Following this 'long list' development of options, an initial 'sifting' process has been undertaken to remove those which are not considered deliverable given the physical, environmental and built heritage constraints that are present within the villages, or where implementation would have road safety issues or potentially create worsened operational problems. 'Short-list' options taken forward have then been assessed in greater depth using detailed traffic and air quality modelling to more fully understand the extent to which they could improve air quality in both villages and contribute to achieving compliance with the National Air Quality Objectives (i.e. 40 $\mu g/m^3$ annual mean).

8.1.2 Modelling

Given the specific HGV passage conflict factors creating the congestion problems in Temple Cloud in particular, it was considered that a detailed micro-simulation approach to highway modelling was required. The package chosen was VISSIM, which allows a great deal of user flexibility in modelling conflicts between different vehicle types and bespoke driver behaviours in 'non-standard' situations. This was critical in attempting to replicate queuing and delay conditions which occur in the narrow section of the A37 through Temple Cloud. The VISSIM model thus developed included the A37 corridor from Cholwell Farm, located north of Temple Cloud, to the junction of the A37 with the A39, located at the top of Rush Hill to the south of Farrington Gurney. Count data (MCC/ATC) was collected in June 2019 for the purposes of developing this model and was also used in the corresponding air quality model.

8.1.3 Option Development and Assessment - Temple Cloud

A total of 10 potential options were initially assessed in Temple Cloud. Some of these such as removal of the footway along the west side of the narrow part of the A37, were dismissed on highway safety grounds. Others, such as construction of the previously safeguarded bypass were dismissed because of the delivery timetable, whilst noting that the safeguarding was removed in the Place Making Plan (PMP) because of problems with planning blight. Also, the likelihood of funding being available to implement what was an extended bypass alignment to the west of both Temple Cloud and Clutton. Following 'short-listing' three potential options were taken forward for more detailed highway modelling using VISSIM as follows:

- Option 4: Introducing a system of 'shuttle working' using traffic signals, using the shorter controlled section length of 117m;
- Option 8: Implement a width restriction for larger vehicles using a Traffic regulation Order (TRO); or
- Option 9: Undertake significant 'cutting back' of the high hedge/vegetation on the eastern side of the narrow section between 'The Laurels' and No 1 Gillets Hill Lane to allow more effective use of the existing carriageway by HGVs.

Subsequent detailed VISSIM modelling of Option 4 shows that 'shuttle working' the narrow section with signals would create unacceptable operating problems in excess of the queuing it was intended to alleviate. Whilst earlier 'long list' assessment with LinSig and November 2017 'peak' flows suggested it might just operate successfully, the use of more up-to-date June 2019 data revealed higher flows and so potential for extended 'over-capacity' conditions in both weekday peak hours. Not unexpected, Option 8 showed significant operating benefits with effective removal of all HGV's, although there are concerns over the viability of introducing such a TRO because of significant diversionary routing impacts. Option 9, which could represent a 'quick win', did suggest some operating benefit by increasing the effective width of the existing carriageway, so reducing the potential number of HGV passage incidents creating 'conflict' and the need to 'give way'.

The implementation of Option 8 (vehicle width restriction TRO) in Temple Cloud is predicted to lead to substantial reductions in concentrations along the A37. Predicted concentrations at most receptors are predicted to be below the air quality objective, excepting locations TC13 and TC4 where concentrations of 41.3μg/m^3 and 45.7μg/m^3 respectively are predicted. This is an interesting outcome, as it suggests that even removing all passage conflict in the 'narrow' section through Temple Cloud, and by implication most if not all HGV's, would still give exceedances at receptors above the objective. As such, even if the A37 here was widened to remove all passage conflict, the continued presence of a significant volume of HGVs and the 'street canyon' effect in this location would likely to lead to local exceedances well above 40μg/m^3. Option 9 puts this in context, where the removal of encroaching vegetation on the east side of the narrow section was assumed in VISSIM modelling to reduce 'direct' HGV to two articulated lorries arriving at the same time and traveling in opposing directions. In this situation the air quality modelling predicted concentrations in excess of the objective at four receptors (and potentially a fifth at TC14). Critically, the concentration at TC4 was predicted to remain above 60μg/m3, resulting in a continued risk of an exceedance of the short-term objective.

8.1.4 Option Development and Assessment – Farrington Gurney

A total of 7 potential options were initially assessed in Farrington Gurney. Six of these looked at changes to the A37/A362 junction, the operation of which creates the queuing on the A37 southbound approach where existing exceedances occur. Minor changes to the junction were not found to achieve any operating benefit of significance. As a result, following 'short-listing', two potential options involving more extensive works were taken forward for more detailed highway modelling using VISSIM as follows:

- Option 3: Construction of an additional lane on the A37 southbound approach to the A37/A362 signals; and
- Option 5: Construction of a small 'compact' type of 'Normal' Roundabout with single lane entries to replace the existing traffic signals.

Both short-listed options (Options 3 and 5) were predicted to result in improvements to journey times on all approaches during all three periods. The provision of an additional southbound lane on the A37 approach to the traffic signals (Option 3) provided additional capacity through the junction, and thus greatly improved the journey time on what is the critical approach in air quality terms. The compact roundabout option (Option 5) again provided significant travel time improvements on all approaches.

The air quality assessment of traffic-related impacts focused on 2020 in Temple Cloud, and 2021 in Farrington Gurney; the earliest years the schemes could be operational. This is important to note, as Farrington Gurney is anticipated to have concentrations of nitrogen dioxide below the objective at all receptors in 2021, with or without the implementation of the proposed options. The is because the current exceedances are only slightly above the 40μg/m^3 objective. Notwithstanding this, the implementation of Option 3 is predicted to lead to a large reduction in concentrations at receptors close to the junction between the A37 and A362 where the road layout modification will occur, with reductions in concentrations predicted of up to 8.4μg/m^3. Similarly, the implementation of Option 5 is expected to lead to a substantial reduction in nitrogen dioxide concentrations along the A37 adjacent to the A37/ A362 junction, with reductions up to 14.2 μg/m^3 predicted at the worst-case receptors next to the junction. However, this benefit must be balanced against high estimated construction costs for both options, particularly Option 5, whilst there are also the added difficulties of securing third party land outside of the existing public highway. In other words, this cost must be balanced against probable achievement of the local objective which may occur naturally through cleaner engine technology by 2021.

8.2 Recommendations

8.2.1 Temple Cloud

As a short term measure it is recommended that works are done to increase the effective width of the existing carriageway through the narrow section for HGV's (Option 9) by significantly cutting back the high vegetation to the line of the wall (so removing all encroachment across/into the highway). As a pre-cursor to this, it is recommended that a full topographical survey is done of the part of the A37 between Temple Inn Lane and Gillets Hill. If possible, and with consent of landowners, it would be helpful to include parts of the property curtilages on the east side within this survey to pick up the position of tree boles and ground levels behind the boundary walls to the highway. This will provide the design data necessary should there be any intent to examine land acquisition and possible levels issues (Option 3) in seeking to physically widen this part of the A37 as a follow-on. However, the initial purpose of the topographical survey would be to accurately assess the increase in the effective carriageway width achievable with significant removal of the overhanging vegetation.

The modelling evidence suggests, however, that measures to increase the 'effective' carriageway width through the narrow section (or indeed widening it physically to remove 'all' passage conflict) may not achieve the local objective due to the high volume of two-way traffic throughout the day and the 'street canyon' effects in this specific location. Introducing a width restriction (TRO) to effectively remove all HGV's (Option 8) is seen to get close to achieving the objective as early as 2020. However, there are real concerns about HGV displacement effects (given the surveyed volumes of HGVs) and unacceptable impacts on potentially less suitable surrounding routes. As such, a much fuller picture of the origin-destination pattern of HGVs is needed before this could be recommended, although there appear to be no viable alternative routes to the A37 available for HGV movements between the A303(T)/Yeovil area and Bristol.

8.2.2 Farrington Gurney

Both the short-listed highway options for Farrington Gurney are relatively expensive to implement. Mindful that the current exceedances are only just above the 40μg/m^3 objective, and compliance expected to be achieved naturally by 2021 with changes to the fleet composition, it would be prudent to simply monitor the on-going situation in the short-term. Changes to the A37/362 junction are proposed to be implemented as part of the emerging Somer Valley Enterprize Zone (SVEZ) development (Option 2). Whilst bespoke operational testing of the amended traffic signal layout suggests this would offer little delay saving or queue length change on the critical A37 southbound approach, it will nevertheless offer some benefit. This together with the on-going improvement in the fleet composition could be adequate to meet the local objective for the AQMA without costly junction improvements.

However, it should be noted that the analyses undertaken to-date with the VISSIM model do not take specific account of the potential traffic generation created by the SVEZ development on the A362 to the east of Farrington Gurney at Old Mills. This could be significant in the longer term with full build-out, although traffic distribution work based on 2011 Census 'Travel to Work' data for this part of Midsomer Norton suggests that most traffic (70-75%) would be drawn from Midsomer Norton, Westfield, Radstock and areas to the NE (ie Peasedown St John/Bath). However, there will be some additional traffic impact on the A37/A362 junction which the SVEZ proposals (Option 2) here are intended to mitigate.

Appendix A. 'Long-List' Option analyses - Temple Cloud and Farrington Gurney

Appendix B. Scheme Drawings

Appendix C. Cost Estimating

Appendix D. Local Model Validation Report – VISSIM

Appendix E. Scheme Testing Report – VISSIM

Appendix F. Air Quality Modelling Report - AQC