MetroWest

Portishead Branch Line (MetroWest Phase 1)

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Author: CH2M
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This report was originally submitted in November 2019. This version of the report contains the following update:
- Part 5 - MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report, Appendix C , the Proposed Highway Measures Works Drawing has been updated to reflect the changes in design of pedestrian/cycle provision

PORTISHEAD BRANCH LINE DCO SCHEME
(METROWEST PHASE 1)
ENVIRONMENTAL IMPACT ASSESSMENT

Transport Assessment Appendix N Ashton Vale Road Junction Assessments

Prepared for

West of England Councils

July 2018

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Contents of Appendix N, Ashton Vale Road Junction Assessments

Appendix N to the MetroWest Phase 1 DCO Transport Assessment sets out the analysis that has been carried out considering the Ashton Vale Road junction and level crossing.

- Part 1 of Appendix N – is a Transport Evidence Explanatory Note; this brings together and summarises all the pertinent information related to the assessments of the Ashton Vale Road/Winterstoke Road signal controlled junction and level crossing.

The remainder of the Appendix provides more details of the information and modelling that the Transport Explanatory Note draws on, and includes the following:

- Part 2 – is a technical note outlining the series of traffic counts carried out at the Ashton Vale Road/Winterstoke Road junction since 2014;
- Part 3 – is a technical note describing train operating scenarios at the Ashton Vale Road level crossing;
- Part 4 – sets out the junction modelling carried out using LinSIG; and
- Part 5 – describes development and use of the VISSIM traffic simulation model of the junction area (including model validation and forecasting reports).

Document History

Portishead Branch Line DCO Scheme (MetroWest Phase 1)
Transport Assessment, Appendix N
Ashton Vale Road Junction Assessments

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TECHNICAL MEMORANDUM

MetroWest Phase 1
Ashton Vale Road: Transport Evidence Explanatory Note

PREPARED FOR:	WoE Councils
PREPARED BY:	DL
DATE:	23rd July 2018
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1.0 Introduction

1.1 Background

The MetroWest Phase 1 project comprises the delivery of infrastructure and passenger train operations to introduce new/enhanced rail passenger services across Bristol with a service pattern between Portishead, Bath Spa and Severn Beach, with intermediate stops. This will entail upgrading the existing freight only line between Parson Street junction and Portbury Dock junction (Pill), reinstatement of the current disused line between Portbury Dock junction and Portishead, and various minor works to facilitate the operation of the Phase 1 train services. A new station will be required at Portishead and the former station at Pill will be re-opened.

The Planning Act 2008 introduced the Development Consent Order (DCO) as the means of seeking planning permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP); the scheme is classed as an NSIP. The specific DCO scheme comprises the re-construction of the disused railway line between Portishead and Pill, construction of a new station at Portishead, refurbishment of the disused station in Pill and the enhancement works to the Portbury freight line.

CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the Portishead Branch Line DCO scheme for MetroWest Phase 1 proposal to reopen the Portishead line with stations at Portishead and Pill. The signal controlled Winterstoke Road/Ashton Vale Road junction and adjacent Ashton Vale level crossing has been considered in some detail as part of the Transport Assessment. This is to specifically assess the impact of increased level crossing closures due to MetroWest Phase 1 services on the Portishead line, and has included analysis using LinSIG and VISSIM models of the junction.

This 'Transport Evidence Explanatory Note' (TEEN) draws together all the key data inputs and findings from the modelling work undertaken to assess the severity of impact on local highway operating conditions with a greater frequency of level crossing closures.

1.2 Ashton Vale Level Crossing

The existing freight only line between Parson Street junction and Portbury Dock junction (Pill), includes the existing Ashton Vale level crossing, which crosses Ashton Vale Road close to its junction with Winterstoke Road, the location of which is shown in **Figure 1**. Ashton Vale Road is the sole road access route into the Ashton Vale Industrial Estate. Winterstoke Road forms a key distributor in southern Bristol, linking the A370 at Ashton Gate with the A38 near Parson Street. The junction is signal-controlled. With its proximity to the road junction, the level crossing is linked to the traffic

signals, to prevent traffic from accessing Ashton Vale Road when the level crossing is closed to road vehicles for the passage of trains.

As noted above, MetroWest Phase 1 will introduce an hourly passenger service to Portishead, thus introducing regular passenger trains services through the level crossing at Ashton Vale Road, in addition to the irregular passage of freight trains on the Portbury line related to the Port of Bristol.

After this Introduction, the remainder of this Transport Explanatory Note goes on to consider:

- Section 2 - Traffic counts of the junction in recent years;
- Section 3 - The robustness of assessment tools, LinSIG and VISSIM, against guidance and best practice;
- Section 4 - A summary of level crossing closures times associated with the scheme;
- Section 5 - An assessment of current conditions and current signal operation using LinSIG analyses, and the expected operating outcomes from a 'stand-alone' level closure crossing event with present flows;
- Section 6 - The impacts of level crossing closures associated with the scheme in current and future traffic conditions using VISSIM real-time micro-simulation modelling; and
- Section 7 - An overview on the potential impact taking account of all the modelling findings (LinSIG and VISSIM).

Details in each case are contained in the following documents referenced in this TEEN as appropriate:

- **Technical Memorandum: 'Ashton Vale Road Traffic Counts'**, dated 3rd July 2018;
- **Technical Memorandum: 'Ashton Vale Road: Level Crossing Train Times**, dated 5th July 2018;
- **Technical Memorandum: 'MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road - LinSIG Modelling'**, dated 6th July 2018;
- **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report'**, dated 6th July 2018; and
- **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report'**, dated 6th July 2018.

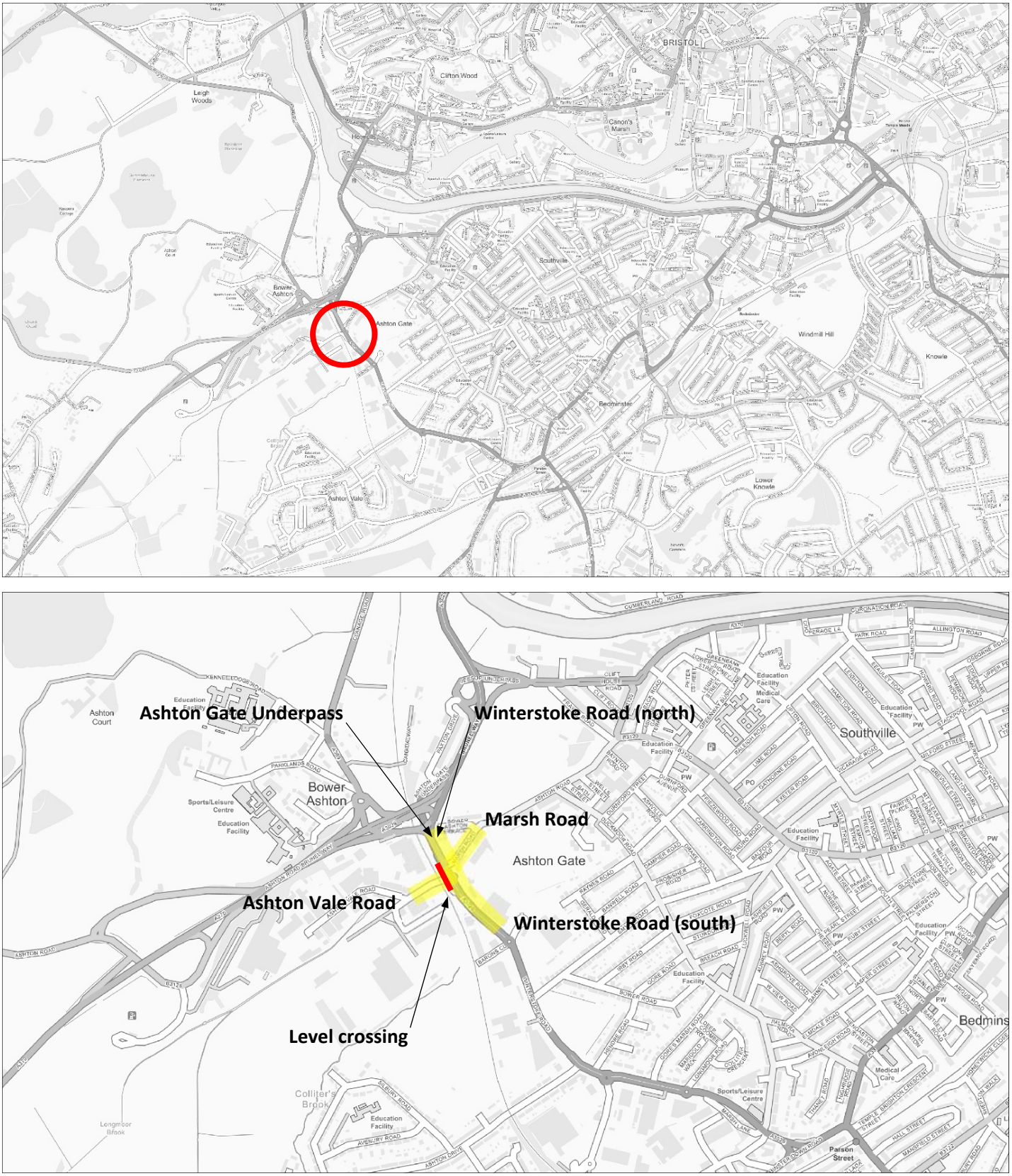

Figure 1: Ashton Vale Road / Winterstoke Road junction

Contains OS data © Crown copyright 2018

2.0 Traffic Count data

The **Technical Memorandum: 'Ashton Vale Road Traffic Counts**', 3rd July 2018 sets out all the data collected at the Winterstoke Road/Ashton Vale Road junction. It is noted that traffic counts have been carried out on five occasions over the period 2014-2018, with the most recent involving comprehensive ATC surveys undertaken over the period Thursday 15th to Wednesday 28th March 2018. The latter were undertaken to verify and validate the 12-hour manual classified traffic count undertaken on the 9th May 2017, which has been used in the LinSIG assessment and, critically, in previously calibrating/ validating the 'base' VISSIM model of the junction.

The analyses of the MCC/ATC data in this Memorandum present, amongst others:

- Table 2: Maximum inflow/outflow by arm over the 24-hour, 12-hour, AM peak hour (8:00-9:00 am) and PM peak hour (5:00-6:00 pm);
- Table 3: As above for just Ashton Vale Road, including additionally 'Maximum Hour Counted';
- Figures 2: 12-hour profiles showing the overall inflow to the junction during the various days covered by the March 2018 ATC surveys, and the mean weekday profile (excluding Fridays);
- Figure 3: 12-hour profiles showing the overall inflow from the 9th May 2017 MCC and the minimum, maximum and average weekday flows from the 2018 ATC surveys (excluding Fridays);
- Figures 4-5: 12-hour profiles showing the traffic flows from/to Ashton Vale Road during the various days covered by the March 2018 ATC surveys, and the mean weekday profile (excluding Fridays; and
- Figure 6-7: 12-hour profiles showing traffic flows from/to Ashton Vale Road from 2014-2017 surveys and the minimum, maximum and average weekday flows from the 2018 ATC surveys (excluding Fridays).

The traffic count figures show clearly that:

- The most recent traffic volumes (ATCs, March 2018) through the Ashton Vale Road/Winterstoke Road junction have reduced overall from previous counts (most notably from the levels observed in the MCC undertaken on the 9th May 2017);
- Whilst the March 2018 ATC survey exhibited a degree of day-to-day variability in movements through the Ashton Vale Road / Winterstoke Road junction, as would be expected, the maximum profile recorded was very similar to the 2017 MCC; and
- Maximum hourly movements for Ashton Vale Road identified in the 2018 surveys (ATC) do not generally coincide with the AM or PM peaks. However, although some are higher, total junction inflows at the same time as maximum Ashton Vale Road flows are typically lower than at peak times, especially when comparing to the PM peak. This is important to note, as a greater reserve capacity and ability to move green time around will exist when Ashton Vale road flows are highest.

The overall 'key' conclusion from the count analyses was that "*it is considered that the traffic counts taken in 2017 are representative of conditions that are present at the junction now, and indeed going back over several years. Comparison of counts over 5 years (2014-2018) indicates that there has been little measurable change in the operation of Ashton Vale Road in the context of the Ashton Vale Road/Winterstoke Road junction. Traffic counted has reduced slightly through the junction overall, and very slightly at Ashton Vale Road itself, though there is a day-to-day variability in movements*". This is despite MetroBus construction works on-going at the time of the 2017 count, which removed the use of the separate left turn lane into Ashton Vale Road. It had been suggested that this would render any modelling analysis based on the 2017 MCC as invalid and potentially atypical. The 2018 ATC surveys undertaken to investigate this show that this is not the case, with the daily overall inflow profile seen in the 2017 survey higher than the average 2018 weekday (excluding Fridays).

3.0 Modelling: LinSig and VISSIM Assessment Tools

3.1 LinSIG

LinSIG is a long-established software package used for assessing the operation of traffic signal junctions. Since its original release in 1985 LinSIG has been the UK industry standard software for the assessment and design of traffic signal junctions. Its unique attribute was and still is the combination of both traffic and controller modelling for comprehensive traffic signal design. The software has been instrumental in advancing UK phase (signal group) based methods of control giving maximum safety and efficiency for all road users.

As will be noted in the discussion on LinSIG modelling later in this Note, and findings, the current controller at the A3029 Winterstoke Road/Ashton Vale Road junction has a complex staging arrangement and sequencing, with certain stages prevented from appearing when a level crossing 'down' input is active. This makes the use of LinSIG particularly appropriate as it can assess:

- Junction operation with a generally consistent 'cyclic' appearance of signal stages, which would generally be the case without a level crossing closure event;
- The non-cyclic appearance of one or more 'demand dependent' stages, where modelling of a sequence containing two or three signal cycles with differing stage 'appearance' assumptions can be undertaken; and
- The operation of a junction over a short period when a specific event takes place, so in this case a level crossing closure followed by one or two cycles when it would be necessary to 'compensate' for the green time lost to Ashton Vale Road.

Whilst 'real-time' micro-simulation modelling undertaken with VISSIM offers the most detailed operational assessment, an advantage of LinSIG is the production of an overall 'Practical Reserve Capacity'(PRC) estimate for the junction under the prevailing flow conditions and/or stage sequence conditions tested. Thus, this software has been additionally employed to assess what level of PRC exists in the base-line case and the flexibility in moving capacity around to provide additional 'compensatory' green time to Ashton Vale Road following a level crossing closure. Provided the same overall level of green time can be provided to Ashton vale Road over the hour, albeit not necessarily cyclically with one or more level crossing closures, then the PRC figure will remain largely unaltered. It is accepted, however, that drivers in this side road could experience slightly longer delay and queuing conditions if arriving shortly before or during the closure.

3.2 VISSIM

Whilst LinSIG could provide a 'robust' assessment of the impact of additional level crossing closures in isolation, the work undertaken for the A3029 Winterstoke Road/Ashton Vale Road has included 'real-time' micro-simulation modelling using VISSIM as an additional and more detailed means of identifying expected junction performance with MetroWest and any adverse impacts.

VISSIM was chosen over other potential 'packages' such as S-Paramics, as this software offers flexibility in several respects, namely the concept of links and connectors which allows the modelling of geometries with any level of complexity. In addition, the VAP logic available within VISSIM can and has been be used to replicate the existing Vehicle Actuated (VA) signal control at the junction, and the 'Special Conditioning' effect of an 'active' level crossing input in suppressing the appearance of certain signal stages during a closure with a reasonable degree of accuracy. The PCMOVA software can also be inter-faced with VISSIM to mimic on-street MOVA operation. However, limitations in replicating the necessary level crossing conditioning logic within PCMOVA meant that it was necessary to continue to use the VAP logic to replicate the added flexibility of using MOVA.

VISSIM can also model the effect of varying traffic flow arrival profiles during a period of interest on one or more approaches. This is of importance where an arrival pattern is particularly 'peaked', which can be the case with Ashton Vale Road. The traffic data described earlier was used to inform these profiles, with vehicle flow matrices developed for specific intervals throughout the model

periods. This is not currently possible with LinSIG, which was another reason for assessing the potential MetroWest impacts at this junction with VISSIM as well.

4.0 Train Operating Scenarios

4.1 Key Operational Parameters

The 'key' factors determining the potential operational impact of a given level crossing closure at this junction are as follows:

- The length of time the barriers are likely to be down when a passenger train service passes through the level crossing. This will include the 'advance' time needed before the train arrives to ensure the gates are safely in the 'down' position and the 'clearance' time needed after the last carriage clears the level crossing point; and
- Whether all level crossing events are likely to be 'stand-alone' in nature, or whether there is any real risk of frequent extended closures when two train paths are close together.

The **Technical Memorandum: 'Ashton Vale Road: Level Crossing Train Times'**, 5th July 2018 describes the work done and liaison with Network Rail in determining the likely length of a typical closure period for an 'up' or 'down' passenger train. It also considers the effect of occasional freight train services operating along this line, and the juxtaposition or time spacing of potential level crossing closures when mixed with MetroWest trains operating on an hourly service in each direction. It should be noted that only freight trains serving the Royal Portbury Dock run through the Ashton Vale Road level crossing. MetroWest Phase 1 will introduce regular passenger trains to the line, with one train per hour per direction operating from (broadly) 6am to 11pm on weekdays (slightly reduced hours at weekends).

4.2 Current Freight Train Operations

Freight trains are seldom scheduled with the same regularity and frequency as passenger trains. Hence, current use of the line (and hence level crossing closures) is irregular and (in historic terms) relatively low. Key points and findings are as follows:

- A limit of 10 trains per day was included as a condition within the original planning permission for the new rail link to the port, though this was subsequently amended to 3,650 trains per annum; this retains the same number of trains overall but removes the unduly restrictive daily limit given the bulk nature of port movements; and
- Freight traffic levels are currently relatively low, and several days can pass with no trains at all. This is unusually low demand, and when freight train data was observed in February and March 2016 this revealed up to four freight trains were running per day (two directions) on weekdays, with up to two on weekends. However, it also indicated that out of 30 days for which data was extracted, freight train movements were only actually made on 15 days.

Therefore, it is far more likely that there will be no freight trains operating on the Portbury Dock line in a typical hour, as opposed to a situation where this is regular.

4.3 Future Operating Scenarios

MetroWest Phase 1 will add regular passenger services to the irregular freight trains that use the line now. Timetable planning for MetroWest services has included paths for freight trains to run, with an allowance for at least one freight train to run per hour in every hour. A series of train operating scenarios were therefore identified for the Ashton Vale Road level crossing, which were then taken forward for consideration in traffic modelling of the effects of the level crossing closures (using LinSIG and VISSIM). In broad terms, these are categorised as:

- Typical - the most likely occurrence in a typical hour; with MetroWest passenger services this is assumed to be no freight trains;

- Realistic worst case - a likely occurrence in a typical hour, but one that will not happen more than a few times a day (adding 1 freight train to MetroWest passenger services); and
- Theoretical maximum - 1 freight train per direction in addition to MetroWest passenger services (which while possible in timetabling terms is considered unlikely to occur regularly, if ever).

Table 1 shows the scenarios considered for a future typical hour used to identify potential closure frequency at the Ashton Vale Road level crossing. Note that the potential to run an 'infill' passenger service at peak times has been considered, with inclusion giving a broadly 45-minute interval passenger service for a 3-hour period. However, it should be noted that this is not part of the current development plans for MetroWest Phase 1.

Table 1: Train operation scenarios: typical hourly sequence
Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Scenario		Freight trains			Passenger trains			All trains
		UP	DOWN	Total	UP	DOWN	Total	per hour
Current operations (WoS)								
Typical:	'up'	1	-	1	-	-	0	1
	'down'	-	1	1	-	-	0	1
Theoretical maximum		1	1	2	-	-	0	2
MetroWest Phase 1 – 1 train per hour per direction (WS)								
Typical		-	-	0	1	1	2	2
Realistic worst case:	'up'	1	-	1	1	1	2	3
	'down'	-	1	1	1	1	2	3
Theoretical worst case		1	1	2	1	1	2	4
MetroWest Phase 1 – 'infill' peak service at 45 min intervals (WS45)								
Typical		-	-	0	1.33	1.33	2.67	2.67
Realistic worst case:	'up'	1	-	1	1.33	1.33	2.67	3.67
	'down'	-	1	1	1.33	1.33	2.67	3.67
Theoretical worst case		1	1	2	1.33	1.33	2.67	4.67

Notes:

UP freight trains run from Portbury to Parson Street Junction, DOWN freight trains run to Portbury

UP passenger trains run from Portishead to Bristol Temple Meads, DOWN passenger trains run to Portishead

Codes in brackets are used in scenario designation for LinSIG and VISSM modelling of the Ashton Vale Road / Winterstoke Road junction – WoS = no passenger trains; WS = MetroWest 1 tph; WS45 = MetroWest infill peak services; NF = no freight trains; 1F = 1 freight train in hour in 1 direction (either direction); 2F = 1 freight train per hour per dir)

4.4 Level Crossing: Expected 'Stand-alone' Closure Durations

The sequences of trains passing the level crossing has been determined from the top-down requirements for passenger and freight trains to serve Portishead and Portbury. Timetabling work carried out by Network Rail to include these trains identified timings within a typical hour. In determining this, future signal control for the level crossing was also considered as part of the works for MetroWest Phase 1. This has resulted in changes for the crossing from the current set-up, that would have the effect of reducing level crossing road closure times to around 2 minutes, with:

- DOWN trains running from Parson Street (to Portbury/Portishead) closing the level crossing to traffic for 1m 50s; and
- UP trains from Pill (i.e. from Portbury/Portishead) closing the level crossing for 2m 05s.

4.5 Indicative Timetables and Closure Frequencies

The data presented in the Technical Memorandum (namely Figure 3) shows that 'gaps' between trains passing the level crossing will typically be around 20 minutes and 35 minutes with just MetroWest passenger services running. With MetroWest passenger services and freight trains running together, the minimum gap between trains passing the level crossing is between around 6 and 10 minutes. Therefore, from a modelling perspective a crossing closure can essentially be treated as a 'standalone' event of around 2 minutes, as the risk of train paths being so close together as to create an extended barrier down time is highly improbable/very low.

The following section which briefly sets out the findings from the LinSIG modelling shows that:

- The expected closure duration will be typically no more than the length of one operational cycle of the traffic signals during the weekday peak hours. In other words, vehicles arriving on the Ashton Vale Road approach would only lose the appearance of the signal stage controlling this phase in a single cycle at most; and
- The expected 'gaps' between successive level crossing closures will be more than sufficient to allow signal controller compensation of green time for Ashton Vale Road in one or more post-closure signal cycles.

5.0 LinSIG Modelling

The Technical Memorandum: 'MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road - LinSIG Modelling', 6th July 2018 discusses the modelling with this software of the existing normal Method of Control in the weekday peak hours. This assessment work has then considered the impact of a single level crossing closure event of 125 seconds (2m 05s), as could be expected with a DOWN passenger service from Pill passing through this part of the line. All assessment work with LinSIG used the MCC undertaken on the 9th May 2017, with vehicle volumes being converted to Passenger Car Units (PCU).

The following conclusions were drawn from examination of the existing Vehicle Actuated (VA) mode of control, and modelling of the 'base-line' case with all six signal stages assumed to appear (1-2-3-4-5-6) under 'normal' operation. It should be noted that some of these stages are only called if demands exist for certain pedestrian crossings, which is unlikely to be cyclic. As such, the predicted Practical Reserve Capacities (PRC) based on these assumptions can be considered 'worst case':

- Under current VA control, the junction could operate with a signal cycle of up to 146 seconds in the weekday AM peak period and up to 160 seconds in the weekday PM peak period. This assumes all phases extend to their allowable maximum green times. Modelling using the full 1-2-3-4-5-6 stage sequence showed that the 'optimum' cycle times based on the May 2017 flows were 118 and 149 seconds respectively;
- The PRC values for the AM and PM peak hours based on the 'optimum' timings (and full stage sequence appearance) are predicted to be +0.2% and +0.5% respectively. This suggests that there is little spare capacity available in either peak hour now. The critical phases are the Winterstoke Road southbound approach from Brunel Way (Phase I) and Ashton Vale Road (Phase B). The operation of the former is heavily influenced by lane utility on this two-lane approach, with observed nearside lane bias applied in modelling; and
- In the PM peak assessment Ashton Vale Road is predicted to need an 'average' cyclic green time of 20 seconds which is just below its current allowable VA MAX of 24 seconds in this period. As such, there is little or no slack in the allowable MAX for this side road to deal with a need for compensating green time when a level crossing closure occurs now due to existing freight services, or indeed if there is a notable 'peak' in the arrival profile during the peak hour.

During a level crossing closure event the controller is prevented from moving to Stages 1, 2 or 3. As such, the controller can only cycle through a 4-5-6 stage sequence whilst the level crossing input is 'active', with Stage 4 acting as the main stage. The latter is effectively the same as the main Stage 1 controlling Winterstoke Road, except that the left turn to Ashton Vale Road is held on a red signal.

The important thing to note is that a level crossing closure does not 'shut down' the junction. Indeed, the main 'straight-ahead' movements along the A3029 are maintained with lesser side-road interruption than might normally occur. So, whilst Ashton Vale Road clearly loses capacity during the closure period, the main-line A3029 can benefit to a degree in capacity terms.

The assessment of a level crossing closure occurring in the AM or PM peak hours considered a shorter period comprising a pre-closure cycle running at the optimum cycle, a closure period of 125 seconds with only stages 4-5-6 active and a post-closure 'compensation' cycle running normally up to the current maximum cycle time permitted under VA (although with phases maximums not constrained). With MOVA installed as proposed, there will be greater flexibility in allowing the stage controlling Ashton Vale Road to run for longer. LinSIG results show that:

AM Peak Hour

- Although the northbound A3029 traffic to the underpass/Ashton Vale Road is expected to remain within the stop-line capacity achievable, there is likely to be a local increase in the mean maximum queue due to the blocking effect of left turning traffic faced with a longer delay during the 'closure'. The proposed extension of the left turn lane proposed as mitigation will address this; and
- Any additional build-up of queuing traffic on Ashton Vale Road could easily be dealt with by a slightly longer green time for this arm in the post-closure 'normal' cycle.

PM Peak Hour

- Any additional build-up of queuing traffic on Ashton Vale Road would need to be dealt with by a longer compensatory green time for this arm in the post-closure 'normal' cycle than is allowable for now by the current VA MAX setting (24 seconds). it would have to accepted that full 'compensation' may take more than one cycle to achieve (with VA mode maintained), or MOVA control introduced. The latter would allow a higher MAX time to be employed for Ashton Vale Road with greater confidence, in the knowledge that this mode of control actively monitors the 'gaps' in vehicle discharge in electing to hold a stage on green or force a move to another stage; and
- Notwithstanding the above, the expected number of 'peak' vehicle arrivals on Ashton Vale Road in this closure period is only 27 vehicles. As such, the maximum extent of the queue is only expected to increase from 12-20 vehicles, with mean delay changing by no more than circa 38 seconds. This impact is not considered severe in the context of NPPF.

The over-riding conclusion from the LinSIG modelling is that the effect of a single 'stand-alone level crossing event with a barrier down-time for a passenger train of circa 110-125 seconds would have a limited impact on traffic conditions in Ashton Vale Road. Full reasoning for this view is set out in the Technical Memorandum. However, this conclusion is based on existing weekday traffic flows (May 2017) and considered only a single closure 'event'. The VISSIM modelling undertaken has extended the level of modelling to 'real time' consideration, considered the effect of traffic growth, as well as the effect of different train operating scenarios with multiple closures over a longer model period. The results from the VISSIM modelling work are outlined in the next part of the Note below.

6.0 VISSIM Modelling

6.1 Base Model Development: LMVR

As with the LinSIG modelling, the base VISSIM model used the weekday count undertaken on the 9th May 2017 for calibration. However, as noted in Section 2, the volumes observed on this weekday correlate very well with the ATC data collected in March 2018. If anything, the peak flows are marginally higher than the average Monday-Thursday figures in the March 2018 data.

The **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report**', 6th July 2018 sets out the calibration 'fit' with the MCC data, and the validation 'fit' with moving observer journey time surveys undertaken at the same time. Tables

3.2-3.5 in the LMVR sets out the calibration fit achieved against the AM count data (7:00-10:00 am), with Tables 3.6-3.9 showing the corresponding results for the PM (4:00-7:00 pm). As might be expected with what is a 'single junction' model with no route choice, this is very good and well within the acceptability criteria set out in the Design Manual for Roads and Bridges (DMRB). However, notwithstanding the relatively simplicity of the model in terms of network extent, it is still a requirement to confirm/prove the calibration fit with count data. It also demonstrates that the VAP controller modelling is correct and achieves the capacities for the various movements through the junction necessary to 'pass' or accommodate the observed flows in each hour.

As noted above, validation was undertaken against moving car surveys that were carried out on the 9th and 10th May 2017. These were carried out within the AM and PM peak periods along three routes, which are detailed in the LMVR. The fact that the journey time data used related to May 2017 was the reason for retaining the use of the MCC undertaken on the 9th May 2017 for calibration purposes, despite the availability of later count data undertaken in March 2018. Whilst the left turn lane into Ashton Vale Road was out of service due to MetroBus related roadworks at this time, this was reflected in the 'base' modelling by excluding use of the lane.

The DMRB acceptability guide-line states in the case of journey times that these shall be within 15% (or 1 minute, if higher) on >85% of all routes considered. In the case of this model, this effectively meant that all routes needed to comply. Tables 4.1 and 4.2 in the LMVR show that this level of validation fit was in fact achieved. The LMVR thus concludes that "*checks have shown that the models validate to TfL and DMRB acceptability criteria. Together with the calibration results, the validation checks confirm that the model is fit for purpose for assessing the impact of the MetroWest Phase 1 scheme and for testing measures aimed at alleviating the impact of longer and more frequent level crossing closures*". In view of this the VISSIM models were subsequently taken forward for model testing.

6.2 Model Testing and Outcomes

The **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report'**, 6th July 2018, sets out the results of all scenarios tested with the VISSIM model. Table 2.1 in this report sets out all the scenarios tested as part of the VISSIM work. In respect of 'future' or forecast scenarios this included the following for the weekday 7:00-10:00 am and 4:00-7:00 pm periods:

- A 2021 'base-line' or 'Without Scheme (WoS) situation. This considered a scenario with no level crossing closures associated with freight train services, and additionally a scenario whereby there was assumed to be one freight train per hour (tph) in one direction. Note that 'Total Closures' given in Table 2.1 relates to the modelled closures per hour, so not the total number in the entire three-hour periods;
- A 2021 'With Scheme (WS) situation, both with proposed mitigation (+M) and without any change. Both scenarios assumed an hourly MetroWest passenger service in each direction and, in addition, a freight service operating in one direction every hour (so three level crossing closures per hour); and
- A series of 'With Scheme' sensitivity tests, all with mitigation, and considering:
  - The above 'With Scheme' scenario but with no freight train services assumed to run in these periods. This is arguably the more likely situation that will arise in view of the low number of freight train paths which occur now;
  - MetroWest services operating on a 'peak' frequency of 45 minutes with, additionally, a freight train service assumed to run every hour in one direction or the other; and
  - MetroWest services operating on a 'peak' frequency of 45 minutes with, additionally, a freight train service assumed to run every hour in both directions.

As noted earlier in this explanatory note, the 'peak' service frequency of 45 minutes is not what is being sought under the Development Consent Order (DCO) for MetroWest Phase 1. As such, these specific sensitivity tests were only done for information/completeness.

The Technical Report presents a wide range of comparative journey time results and maximum queue length profiles. In respect of this explanatory note, the discussion below concentrates on the results from the 'With Scheme' tests with an hourly MetroWest service. Findings were as follows:

- Predicted (2021) route journey times in the weekday 8:00-9:00 am and 5:00-6:00 pm hours (Tables 3.1 and 3.2) were not shown to be materially different when comparing the 2021 'base-line' (with/without freight) with the 'Scheme' case. The results for the Winterstoke Road northbound approach in the AM peak hour as, with LinSIG, confirmed the need for the proposed mitigation in extending the left turn lane. The results for Ashton Vale Road in the critical PM peak hour show that the expected mean journey time could increase by around 38 seconds. This was in fact the same level of change predicted by LinSIG for drivers on the Ashton Vale Road approach when modelling a 'stand-alone' closure. This demonstrates a very high correlation in the results for 'expected outcome' using two quite different traffic modelling software packages;
- Figure D8 in the Model Testing report shows the expected change in the maximum queue length profile on Ashton Vale Road in the PM peak period (4:00-7:00 pm). This compares a 2021 'Do Nothing' situation with no level crossing closures against a 'With Scheme' MetroWest scenario with one hourly service in each direction but no freight trains. The report notes in discussion that "*The graphs also highlight short spikes in queuing on Ashton Vale Road during both the AM (Figure D4) and PM (Figure D8) coinciding with level crossing closures. These spikes are particularly acute during the PM when there are greater volumes exiting the industrial estate with queue lengths roughly doubling from Do-Nothing levels. However, these spikes are relatively 'short-lived' and the graphs show that queue lengths typically return to ambient Do-Nothing levels within three to five minutes*". Within VISSIM the queue lengths are expressed in metres, with the PM graph showing that the maximum length following a closure could extend to circa 100 metres (from typically a length of 50-60 metres). The LinSIG work investigating the effect of a closure concluded that the maximum queue length could change from a typical one of 12 vehicles to around one of 20 vehicles following a closure. The typical occupancy length taken for a queuing vehicle is generally taken to be 5.65 metres, so the expected queue length change predicted by LinSIG and expressed in metres would be from 68-113 metres. There is thus again a high correlation in the queue length change results obtained using the two software packages; and
- Figure D5 showed that a higher frequency of level crossing closure is predicted to result in a net queue length reduction benefit on the Winterstoke Road southbound approach to the junction in the PM peak period. As noted in the earlier dialogue on LinSIG modelling, this is because this movement will experience less interruption and get proportionally more green time when the potential stage sequence is limited to 4-5-6 during a closure. Noting that this and the Ashton Vale Road phases are the critical ones in operating terms, the fact that a higher capacity can be achieved on the southbound Winterstoke Road during a closure means there is greater potential to give compensating green time to Ashton Vale Road in the one or more 'normal' signal cycles following a closure.

As with LinSIG, the VISSIM results thus confirm that an hourly train service proposed under MetroWest Phase 1 can be delivered without detriment to the local highway conditions within the vicinity of the Winterstoke Road /Ashton Vale Road junction.

7.0 Overview

The Transport Evidence Explanatory Note (TEEN) has drawn together all the modelling work (LinSIG and VISSIM) done to assess the potential impact of increased level crossing closures on Ashton Vale Road and the adjacent Winterstoke Road junction. As part of this the valid use of the 9th May 2017

MCC is explained and confirmed as 'typical' of current weekday volumes. The derivation of the typical level crossing closure time, which forms a key input to the modelling, is also explained.

The modelling results obtained from both LinSIG and VISSIM exhibit a high degree of correlation in predicting the additional delay and level of queuing expected on Ashton Vale Road following a level crossing closure during the critical weekday PM peak period. Both confirm that any expected impact would not be severe, whilst recovery to normal operating conditions on this side road is likely to be achievable in only one or two signal cycles following the lifting of the barrier. The main reasons for what is expected to be broadly a 'neutral' impact, and certainly not a severe one, are as follows:

- The expected barrier down-time is no longer than the typical cycle times needed now in the weekday AM and PM peak hours. As such, drivers arriving on the Ashton Vale Road approach would, at worst, have the appearance of the stage controlling this arm curtailed only once;
- Lost green time to Ashton Vale Road incumbent on a closure is capable of being compensated for fully in the first 'normal' cycle following the event, or at worst two cycles;
- The expected closure frequency with two passenger trains per hour and even an intervening freight service, have sufficient duration between them to ensure full 'compensation' and return to normal traffic operation between successive closures; and
- Whilst additional green (compensation) time is needed to clear the build-up of queuing in Ashton Vale Road post-closure, the critical southbound movement on the A3029 also benefits from less interruptions to its green time during the closure when only a 4-5-6 stage sequence operates. As such, these effects tend to cancel each other out when considering the overall capacity and PRC at the junction over a given hour.

Part 2:
Ashton Vale Road Traffic Counts

Contents:

- Technical Note: 'MetroWest Phase 1, Ashton Vale Road Traffic Counts', 3rd July 2018

TECHNICAL MEMORANDUM

MetroWest Phase 1
Ashton Vale Road Traffic Counts

PREPARED FOR:	WoE Councils
PREPARED BY:	GW
DATE:	3rd July 2018
PROJECT NUMBER:	674946.CS.70.01
REVISION NO.:	1
APPROVED BY:	**DRAFT**

1.0 Introduction

The MetroWest Phase 1 project comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

The project is being led by North Somerset Council on behalf of the four West of England (WoE) councils. Infrastructure for the Portishead line and stations at Portishead and Pill is to be consented through the Portishead Branch Line Development Consent Order (DCO) scheme, with some infrastructure falling within Network Rail's General Permitted Development (GPD) rights. CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the DCO.

The Ashton Vale Road / Winterstoke Road signal controlled junction and adjacent Ashton Vale level crossing, the location of which is shown in Figure 1, has been considered in some detail as part of the Transport Assessment. This is to specifically assess the impact of increased level crossing closures due to MetroWest Phase 1 services on the Portishead line, and has included analysis using LinSIG and VISSIM models of the junction; details of these models are not discussed in this technical note.

The purpose of this note is to set out and discuss some of the key information collected in traffic counts, that have been carried out to understand the way traffic moves through the junction and level crossing to provide information for traffic modelling. Ashton Vale Road is the sole access to the industrial estate, which contains traffic generators that can cause surges in demand, such as Manheim Car Auctions. It is used as an ad hoc parking area when there are football matches at the Ashton Gate Stadium. There have also been changes in the area that could affect flows, such as the opening of the South Bristol Link, construction of MetroBus skew bridge over the junction. And with counts having taken place over the course of 5 years, a key aim of this note is to draw-out common data from each, enabling comparisons to be made of the way that traffic flows have changed (or otherwise) at the Ashton Vale Road / Winterstoke Road junction over that time.

Note that other surveys have taken place in the area of the Ashton Vale Road / Winterstoke Road junction that are reported in Appendix C to the MetroWest Phase 1 DCO Transport Assessment (Report of Surveys); this included non-motorised user counts and parking surveys. Also, other information has been collected specifically to feed into the VISSIM modelling process. This has included pedestrian and cycle movements (crossing the main arms of the junction), as well as journey time surveys of traffic on the approaches to the junction. The description of VISSIM modelling of the junction in Appendix N of the Transport Assessment includes further information.

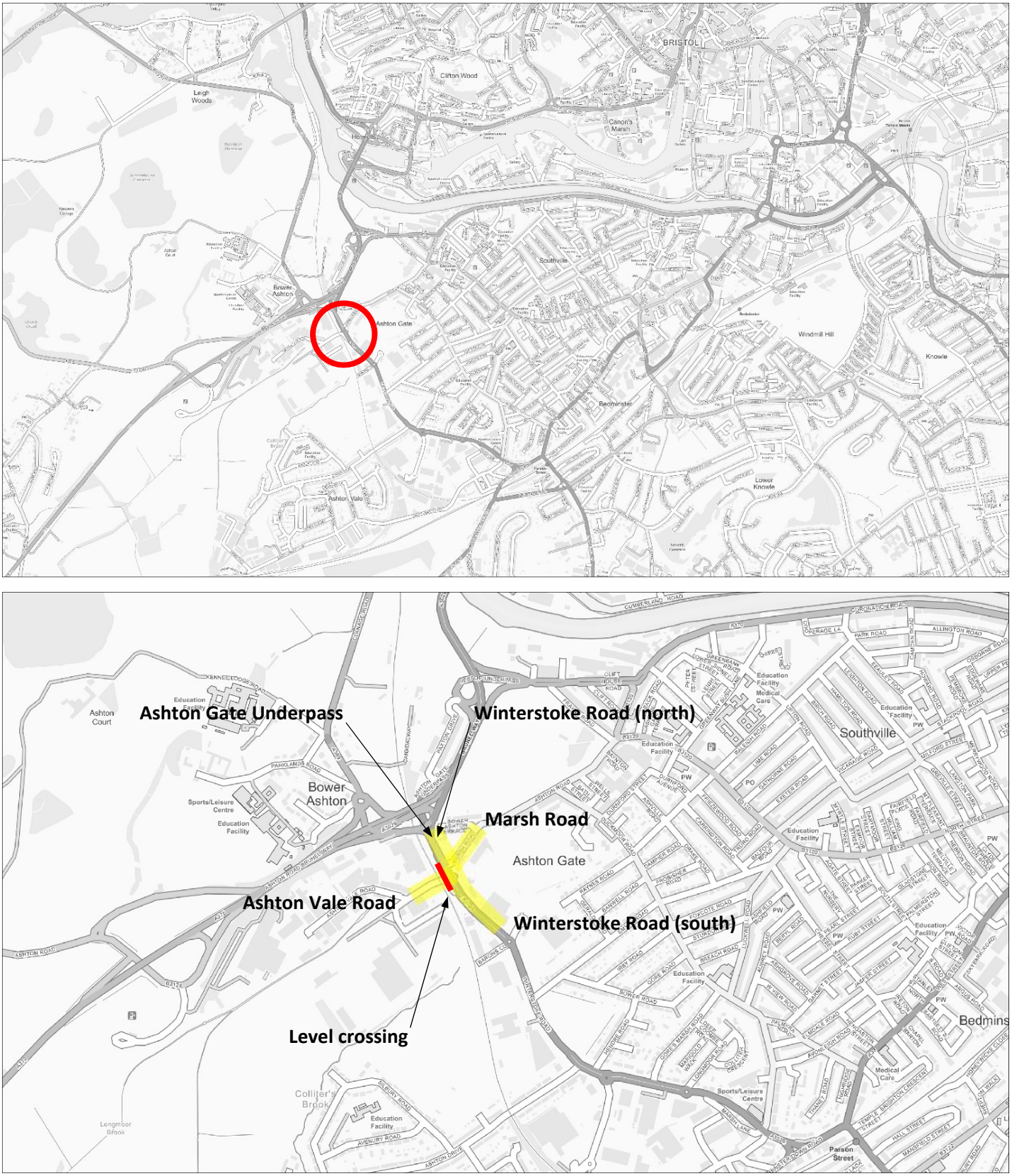

Figure 1: Ashton Vale Road / Winterstoke Road junction

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2.0 Traffic counts carried out

Traffic counts have been undertaken on five occasions, in each of the years 2014-2018, though the detailed scope of counts in each year has varied:

- 2014 – Manual classified count (MCC) of movements on Ashton Vale Road (across the level crossing) for a total of 7 hours across the day; Tuesday 14th January 2014, including AM peak (2.5hrs from 07:00 to 09:30), inter-peak (2hrs from 11:00 to 13:00) and PM peak (2.5hrs from 16:00 to 18:30);
- 2015 – Automatic traffic counts (ATCs), classified, of movements on Ashton Vale Road (across the level crossing); 14 days from Tuesday 3rd to Monday 16th March 2015 inclusive, 24 hours;
- 2016 – MCC of most movements at the junction, including all traffic movements from Winterstoke Road south of the junction and all movements from Ashton Vale Road (separately recording movements from Ashton Vale Road to the Ashton Gate Underpass where other counts, except in 2018, record this within the movement to Winterstoke Road north); Tuesday 8th March 2016, 12hr counts from 07:00 to 19-00;
- 2017 – MCC of all movements at the junction, including all traffic movements from Winterstoke Road approaches both north and south of the junction (Winterstoke Road north and Ashton Gate Underpass combined), and all movements from Ashton Vale Road and Marsh Road; 9th May 2017, 12hr counts from 07:00 to 19:00. This count was commissioned to provide full information about the junction for inclusion in subsequent traffic modelling; and
- 2018 – ATCs, classified, of all movements at the junction (as in the 2017 manual classified count), though with separation of Winterstoke Road north and Ashton Gate Underpass into separate arms; Thursday 15th to Wednesday 28th March 2018 inclusive, 24 hours.

The different elements of the junction and combinations of movements covered in each of the surveys are shown in Table 1.

Table 1: Movements included in each of the counts (movements are 'to' and 'from' unless noted)
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	**2017 MCC Tue 9 May**	**2016 MCC Tue 8 Mar**	**2015 ATCs 3-16 Mar**	**2014 MCC Tue 14 Jan**
Ashton Vale Rd	24hr	Y	-	-	Y	-
	12hr	Y	Y	Y	Y	-
	AM peak	Y	Y	Y	Y	Y
	PM peak	Y	Y	Y	y	Y
Winterstoke Rd (south)	24hr	Y	-	-	-	-
	12hr	Y	Y	Y	-	-
	AM peak	Y	Y	Y	-	-
	PM peak	Y	Y	Y	-	-
Marsh Road	24hr	Y	-	-	-	-
	12hr	Y	Y	-	-	-
	AM peak	Y	Y	-	-	-
	PM peak	Y	Y	-	-	-
Winterstoke Rd (north)	24hr	Y	-	-	-	-
	12hr	Y	Y	'to' only	-	-
	AM peak	Y	Y	'to' only	-	-
	PM peak	Y	Y	'to' only	-	-
Ashton Gate Underpass	24hr	'to' only	-	-	-	-
(northbound	12hr	'to' only	'to' only	'to' only	-	-
movements only)	AM peak	'to' only	'to' only	'to' only	-	-
	PM peak	'to' only	'to' only	'to' only	-	-

3.0 Count results

3.1 Junction overall

The only counts that cover the whole junction are the 2018 ATCs and 2017 MCC. Table 2 shows total junction movements from the 2017 and 2018 counts, broken down by the arms of the junction, inflow, outflow and 2-way movements, and time periods.

Table 2: Total junction in- and outflow, including individual arms
Source: 2017-2018 Traffic counts

From/to arm	2018 ATCs (15-28 Mar)			2017 MCC (Tuesday 9 May)		
	INTO junction	OUT OF junction	2-WAY	INTO junction	OUT OF junction	2-WAY
24-hr						
Winterstoke Rd (N) & A.G.Undps	16,936	14,720	31,656	-	-	-
Marsh Road	1,806	2,929	4,735	-	-	-
Winterstoke Rd (South)	15,290	16,477	31,767	-	-	-
Ashton Vale Road	1,726	1,633	3,358	-	-	-
TOTAL	35,758	35,758	71,516	-	-	-
12-hr (07:00-19:00)						
Winterstoke Rd (N) & A.G.Undps	13,308	11,608	24,917	15,141	12,686	27,827
Marsh Road	1,600	2,370	3,971	1,515	2,989	4,504
Winterstoke Rd (South)	11,991	13,170	25,162	13,064	14,276	27,340
Ashton Vale Road	1,600	1,350	2,950	1,698	1,467	3,165
TOTAL	28,500	28,500	56,999	31,418	31,418	62,836
AM peak (08:00-09:00)						
Winterstoke Rd (N) & A.G.Undps	1,249	995	2,244	1,354	1,058	2,412
Marsh Road	250	274	524	196	295	491
Winterstoke Rd (South)	1,128	1,248	2,376	1,202	1,284	2,486
Ashton Vale Road	58	167	225	78	193	271
TOTAL	2,684	2,684	5,368	2,830	2,830	5,660
PM peak (17:00-18:00)						
Winterstoke Rd (N) & A.G.Undps	1,285	1,139	2,424	1,422	1,318	2,740
Marsh Road	123	274	397	139	384	523
Winterstoke Rd (South)	1,071	1,216	2,287	1,199	1,258	2,457
Ashton Vale Road	179	28	207	229	29	258
TOTAL	2,658	2,658	5,315	2,989	2,989	5,978

Note: 2018 ATC figures are average weekday across surveyed period, excluding Fridays.

Figures 2 and 3 illustrate counts in more detail, with profiles of total amount of traffic entering the junction over the course of a 12-hour day (07:00-19:00) drawn from these surveys, as follows:

- Figure 2: Total junction inflow – 2018 counts, 12hr profile by survey day
- Figure 3: Total junction inflow – 2017 & 2018 counts, 12hr profile (average weekday)

Figure 2 shows profiles for each of the 14 days that the ATCs were operational in March 2018. This indicates that weekday movements through the junction follow a similar pattern, albeit with variation around an average value (also shown on the chart). There are distinct peaks in the morning (08:00-09:00) and evening (16:00-18:00), though flows throughout the day are not significantly lower. Weekend profiles are completely different. The profile for Saturday 17th March 2018 demonstrates the way that a football match at the nearby Ashton Gate Stadium can affect traffic. As such, there are two peaks, in the middle of the day (which is higher than a comparable time on a weekday) and around 5pm (the end of the match). However, on Saturday 24th March (with no event at the stadium), while there is still a middle of the day peak, it is lower, and there is no 5pm peak.

Figure 3 shows a comparison of profiles generated by the 2018 and 2017 counts. The 2018 counts have been summarised to three comparative lines, all based on weekdays; a profile of the average weekday, with corresponding maximum and minimum profiles. Alongside these, the 2017 profile is plotted. It is immediately noticeable that the 2017 profile is very similar to the 'maximum' profile; indeed, the total 12-hour junction inflow in 2017 was slightly higher than the 'maximum' in 2018 (2017 12hr inflow of 31,418 compared to 2018 maximum 12hr inflow of 31,172). More pertinently, the 2017 profile indicates consistently more traffic through the junction in 2017 than an average weekday in 2018 (some 12% more). This is despite the presence of road works affecting the junction during the survey on Tuesday 9th May 2017, notably the absence of the left turn lane into Ashton Vale Road which was coned off and unavailable to traffic.

3.2 Ashton Vale Road

Table 3 summarises various count totals for movements into and out of Ashton Vale Road.

Table 3: Ashton Vale Road
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	2017 MCC Tue 9 May	2016 MCC Tue 8 Mar	2015 ATCs 3-16 Mar	2014 MCC Tue 14 Jan
24-hour	OUT of ind.est	1,726	-	-	1,871	-
	INTO ind.est	1,633	-	-	1,784	-
	2-way	3,358	-	-	3,655	-
12-hour	OUT of ind.est	1,600	1,698	1,628	1,709	-
(07:00-19:00)	INTO ind.est	1,350	1,467	1,527	1,497	-
	2-way	2,950	3,165	3,155	3,206	-
AM peak	OUT of ind.est	58	78	65	69	54
(08:00-09:00)	INTO ind.est	167	193	173	182	169
	2-way	225	271	238	251	223
PM peak	OUT of ind.est	179	229	191	189	192
(17:00-18:00)	INTO ind.est	28	29	26	40	47
	2-way	207	258	217	229	239
Maximum hour	OUT of ind.est	256	229	221	241	229
counted	at…	16:00	17:00	16:00	16:00	16:00
	INTO ind.est	234	241	212	214	169
	at…	09:00	07:00	07:00	09:00	08:00
	2-way	358	313	350	348	337
	at…	12:00	07:00	10:00	16:00	12:00

Note: 2018 and 2015 ATC figures are average weekday across surveyed period, excluding Fridays.

Ashton Vale Road is the only element of the junction that has been counted in every one of the surveys from 2014 to 2018, and therefore provides a good indication of the way that movements have changed. Figures 4-11 (inclusive) illustrate the various counts graphically, as follows:

- Figure 4: Traffic FROM Ashton Vale Road – 2018 counts, 12hr profile by survey day
- Figure 5: Traffic INTO Ashton Vale Road – 2018 counts, 12hr profile by survey day
- Figure 6: Traffic FROM Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile
- Figure 7: Traffic INTO Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile
- Figure 8: Ashton Vale Road 2014-18 – 24hr totals
- Figure 9: Ashton Vale Road 2014-18 – 12hr totals
- Figure 10: Ashton Vale Road 2014-18 – AM peak hour
- Figure 11: Ashton Vale Road 2014-18 – PM peak hour

3.2.1 Pattern of movements

Figures 4 and 5 show the individual daily profiles from and to Ashton Vale Road from the March 2018 ATCs. The patterns of movement are similar day to day, with a morning peak of movements into the industrial area, tailing off across the remainder of the day, and distinct outward peaks in both the late morning and evening. There is a degree of variation in the quantum of traffic, not least allied to the incidence of auctions at the Manheim site (on Monday, Tuesday and Thursday).

An outlier occurs on Saturday 17th March when, as noted previously, a football match at Ashton Gate Stadium generates significant peaks in traffic going into the industrial area (to park) in the early afternoon, and leaving around 5pm soon after the end of the match. In comparison, other weekends generate significantly lower traffic on Ashton Vale Road.

3.2.2 Maximum hourly flows

Table 4 shows the maximum hourly flows counted for movements from Ashton Vale Road into the junction, with corresponding movements into Ashton Vale Road in Table 5. The tables also include the comparative peak direction flow (AM peak into Ashton Vale Road and PM peak out of Ashton Vale Road), as well as total junction inflows. This includes the total junction inflow in the maximum Ashton Vale Road hour, alongside the corresponding values from each survey day from the 2018 ATCs. Finally, the tables include 2017 total junction inflow values for comparison. Figures 12-15 show the relationship between total junction inflows at the times of maximum Ashton Vale Road flows with corresponding AM and PM peaks, as well as 2017 and 2018 average peak time inflows.

The maximum hourly movements for Ashton Vale Road (identified from the 2018 ATCs) do not generally directly coincide with the AM or PM peak hours (hours beginning 08:00 and 17:00 respectively), though the quantum is not significantly different. Although, the largest single hourly flow to or from Ashton Vale Road was recorded at 17:00 on Saturday 17th March, which is specifically linked with people leaving the football match at Ashton Gate Stadium. On weekdays, the maximum flow hours 'to' Ashton Vale Road are associated with the AM peak (hours beginning 07:00, 08:00 and 09:00). Maximum hourly flows 'from' Ashton Vale Road were mostly recorded at the start of the PM peak (hour beginning 16:00 or 15:00), with some in the middle of the day.

However, as an indication of total junction usage and capacity, it is useful to consider the total junction inflow. In general, although some are higher, total junction inflows at the same time as maximum Ashton Vale Road flows are typically lower than at peak times, especially when comparing to the PM peak. Comparison with the 2017 peak periods indicates a greater difference, as 2017 flows into the junction are generally higher than in 2018.

3.2.3 Changes over time

Figures 6 and 7 show profiles from/to Ashton Vale Road from all the surveys (2014-2018), including average, maximum and minimum counts from 2018 ATCs. These illustrate a similar pattern of movements over time. The maximum and minimum profiles from the 2018 ATCs almost entirely encompass all the other counts, indicating that daily variability is essentially the same now as it was previously. Again though, 2017 values are generally higher than 2018 averages.

Figures 8, 9 10 and 11 graphically illustrate the values in Table 3, indicating that, in general, 2018 movements into and out of the Ashton Vale Road industrial area are broadly similar to previous years, with a slight reduction over time for most movements.

Table 4: FROM Ashton Vale Road – maximum hourly flows

Source: 2018 Traffic counts

Count day	FROM Ashton Vale Road				Total Junction INFLOW			
	Max. count	Hour begin	PM peak (max.dir)	At max. count hr. begin	2018 AM peak	2018 PM peak	2017 AM peak	2017 PM peak
Thursday 15 Mar	256	16:00	182	2,704	2,759	2,710		
Friday 16 Mar	188	12:00	91	2,584	2,742	2,507		
Saturday 17 Mar	290	17:00	290	2,281	1,121	2,281		
Sunday 18 Mar	10	14:00	4	1,247	286	889		
Monday 19 Mar	219	12:00	177	2,211	2,385	2,741		
Tuesday 20 Mar	238	16:00	187	2,938	2,869	2,628		
Wednesday 21 Mar	245	16:00	177	2,573	2,751	2,525		
Thursday 22 Mar	252	16:00	172	2,670	2,656	2,684	2,830	2,989
Friday 23 Mar	212	12:00	125	2,423	2,568	2,826		
Saturday 24 Mar	31	10:00	9	2,033	1,088	1,680		
Sunday 25 Mar	13	13:00	6	2,070	870	1,262		
Monday 26 Mar	238	15:00	81	2,706	2,248	2,107		
Tuesday 27 Mar	236	15:00	71	2,706	2,175	2,160		
Wednesday 28 Mar	239	15:00	85	2,798	2,039	2,053		
AV.WKDY (ex Fri)	211	16:00	142	2,691	2,485	2,451		

Note: 'AM peak' denotes the hour beginning 08:00; 'PM peak' denotes the hour beginning 17:00

Table 5: TO Ashton Vale Road – maximum hourly flows

Source: 2018 Traffic counts

Count day	TO Ashton Vale Road				Total Junction INFLOW			
	Max. count	Hour begin	AM peak (max.dir)	At max. count hr. begin	2018 AM peak	2018 PM peak	2017 AM peak	2017 PM peak
Thursday 15 Mar	229	09:00	182	2,482	2,759	2,710		
Friday 16 Mar	173	07:00	173	2,323	2,742	2,507		
Saturday 17 Mar	152	13:00	22	2,673	1,121	2,281		
Sunday 18 Mar	7	11:00	0	1,008	286	889		
Monday 19 Mar	218	09:00	166	2,246	2,385	2,741		
Tuesday 20 Mar	214	07:00	177	2,649	2,869	2,628		
Wednesday 21 Mar	203	07:00	156	2,572	2,751	2,525		
Thursday 22 Mar	234	09:00	154	2,395	2,656	2,684	2,830	2,989
Friday 23 Mar	201	07:00	154	2,409	2,568	2,826		
Saturday 24 Mar	25	08:00	25	1,088	1,088	1,680		
Sunday 25 Mar	12	10:00	3	1,807	870	1,262		
Monday 26 Mar	234	08:00	234	2,248	2,248	2,107		
Tuesday 27 Mar	186	08:00	186	2,175	2,175	2,160		
Wednesday 28 Mar	160	07:00	110	2,236	2,039	2,053		
AV.WKDY (ex Fri)	189	07:00	171	2,395	2,485	2,451		

Note: 'AM peak' denotes the hour beginning 08:00; 'PM peak' denotes the hour beginning 17:00

3.3 Other arms of the junction

Tables 6-8 (inclusive) summarise count information for Winterstoke Road (North) combined with the Ashton Gate Underpass, Marsh Road and Winterstoke Road (South) respectively. Figures 16-31 (inclusive) illustrate this information graphically, as follows:

- Figure 16: Winterstoke Road (north) 2014-18 – 24hr totals
- Figure 17: Winterstoke Road (north) 2014-18 – 12hr totals
- Figure 18: Winterstoke Road (north) 2014-18 – AM peak hour
- Figure 19: Winterstoke Road (north) 2014-18 – PM peak hour
- Figure 20: Winterstoke Road (south) 2014-18 – 24hr totals
- Figure 21: Winterstoke Road (south) 2014-18 – 12hr totals
- Figure 22: Winterstoke Road (south) 2014-18 – AM peak hour
- Figure 23: Winterstoke Road (south) 2014-18 – PM peak hour
- Figure 24: Marsh Road 2014-18 – 24hr totals
- Figure 25: Marsh Road 2014-18 – 12hr totals
- Figure 26: Marsh Road 2014-18 – AM peak hour
- Figure 27: Marsh Road 2014-18 – PM peak hour
- Figure 28: Ashton Gate Underpass 2014-18 – 24hr totals
- Figure 29: Ashton Gate Underpass 2014-18 – 12hr totals
- Figure 30: Ashton Gate Underpass 2014-18 – AM peak hour
- Figure 31: Ashton Gate Underpass 2014-18 – PM peak hour

Although comparative information is not available for all movements and all years, as already identified for total junction inflows, counts indicate a general reduction in traffic through the junction in 2018, when compared to other 2017.

Table 6: Winterstoke Road (North) & Ashton Gate Underpass combined

Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	2017 MCC Tue 9 May	2016 MCC Tue 8 Mar	2015 ATCs 3-16 Mar	2014 MCC Tue 14 Jan
24-hour	Into junction	16,936	-			
	Out of junction	14,720	-	<<<	not counted	>>>
	2-way	31,656	-			
12-hour	Into junction	13,308	15,141			
(07:00-19:00)	Out of junction	11,608	12,686	<<<	not counted	>>>
	2-way	24,917	27,827			
AM peak	Into junction	1,249	1,354			
(08:00-09:00)	Out of junction	995	1,058	<<<	not counted	>>>
	2-way	2,244	2,412			
PM peak	Into junction	1,285	1,422			
(17:00-18:00)	Out of junction	1,139	1,318	<<<	not counted	>>>
	2-way	2,424	2,740			

Table 7: Marsh Road

Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	2017 MCC Tue 9 May	2016 MCC Tue 8 Mar	2015 ATCs 3-16 Mar	2014 MCC Tue 14 Jan
24-hour	Into junction	1,806	-			
	Out of junction	2,929	-	<<<	not counted	>>>
	2-way	4,735	-			
12-hour	Into junction	1,600	1,515			
(07:00-19:00)	Out of junction	2,370	2,989	<<<	not counted	>>>
	2-way	3,971	4,504			
AM peak	Into junction	250	196			
(08:00-09:00)	Out of junction	274	295	<<<	not counted	>>>
	2-way	524	491			
PM peak	Into junction	123	139			
(17:00-18:00)	Out of junction	274	384	<<<	not counted	>>>
	2-way	397	523			

Table 8: Winterstoke Road (South)

Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	2017 MCC Tue 9 May	2016 MCC Tue 8 Mar	2015 ATCs 3-16 Mar	2014 MCC Tue 14 Jan
24-hour	Into junction	15,290	-	-		
	Out of junction	16,477	-	-	<<< not counted	>>>
	2-way	31,767	-	-		
12-hour	Into junction	11,991	13,064	14,473		
(07:00-19:00)	Out of junction	13,170	14,276	-	<<< not counted	>>>
	2-way	25,162	27,340	-		
AM peak	Into junction	1,128	1,202	1,191		
(08:00-09:00)	Out of junction	1,248	1,284	-	<<< not counted	>>>
	2-way	2,376	2,486	-		
PM peak	Into junction	1,071	1,199	1,183		
(17:00-18:00)	Out of junction	1,216	1,258	-	<<< not counted	>>>
	2-way	2,287	2,457	-		

4.0 Summary

The most recent traffic count (ATCs, March 2018) indicate that traffic flows through the Ashton Vale Road / Winterstoke Road junction have reduced overall from previous counts. This is most notable for Winterstoke Road itself, where flows have lower by around 10% (comparing 2018 average weekdays with the 2017 count). It is likely that this is a result of evolving traffic changes since the South Bristol Link (SBL) road was opened, as the SBL provides an alternative route for some journeys that use Winterstoke Road.[1] The effect of this is important though, as total junction inflow feeds through to calculations of reserve capacity in the junction when modelling the traffic signals.

The 2018 ATCs indicated a degree of day-to-day variability in movements through the Ashton Vale Road / Winterstoke Road junction. Within this variation, the maximum profile recorded is very similar to the 2017 MCC (Figures 2 & 3). Day to day variation is more marked on Ashton Vale Road than the other arms of the junction, though Ashton Vale Road only accounts for around 5% of all junction inflows. Again though, 2018 counts show very similar patterns to previous years, if anything slightly lower; indeed the maximum day profile counted in 2018 is not much higher than a similar profile from the 2017 count.

It is particularly apposite to note this for movements into the Ashton Vale Road industrial estate (Figure 7), which indicates that this movement (from Winterstoke Road south to Ashton Vale Road) was higher in 2017 than on average in 2018. This is in spite of MetroBus construction works on-going at the time of the 2017 count that restricted use of one lane out for this movement. The view of enumerators for this survey was that the lane restriction had no effect on the operation of the junction, and this is supported by the counts for 2017 being higher than the average in 2018.

The maximum hourly movements for Ashton Vale Road (identified from the 2018 ATCs) do not generally coincide with the AM or PM peaks. However, although some are higher, total junction inflows at the same time as maximum Ashton Vale Road flows are typically lower than at peak times, especially when comparing to the PM peak. Comparison with the 2017 peak period junction inflows indicates a greater difference, as 2017 flows into the junction are generally higher than in 2018

Overall therefore, it is considered that the traffic counts taken in 2017 are representative of conditions that are present at the junction now, and indeed going back over several years. Comparison of counts over 5 years (2014-2018) indicates that there has been little measurable change in the operation of Ashton Vale Road in the context of the Ashton Vale Road / Winterstoke Road junction. Traffic counted has reduced slightly through the junction overall, and very slightly at Ashton Vale Road itself, though there is a day-to-day variability in movements.

[1] The South Bristol Link road opened a few months before the 2017 count, but changes in traffic behaviour typically take some time to fully materialise.

Figure 2: Total junction inflow – 2018 counts, 12hr profile by survey day

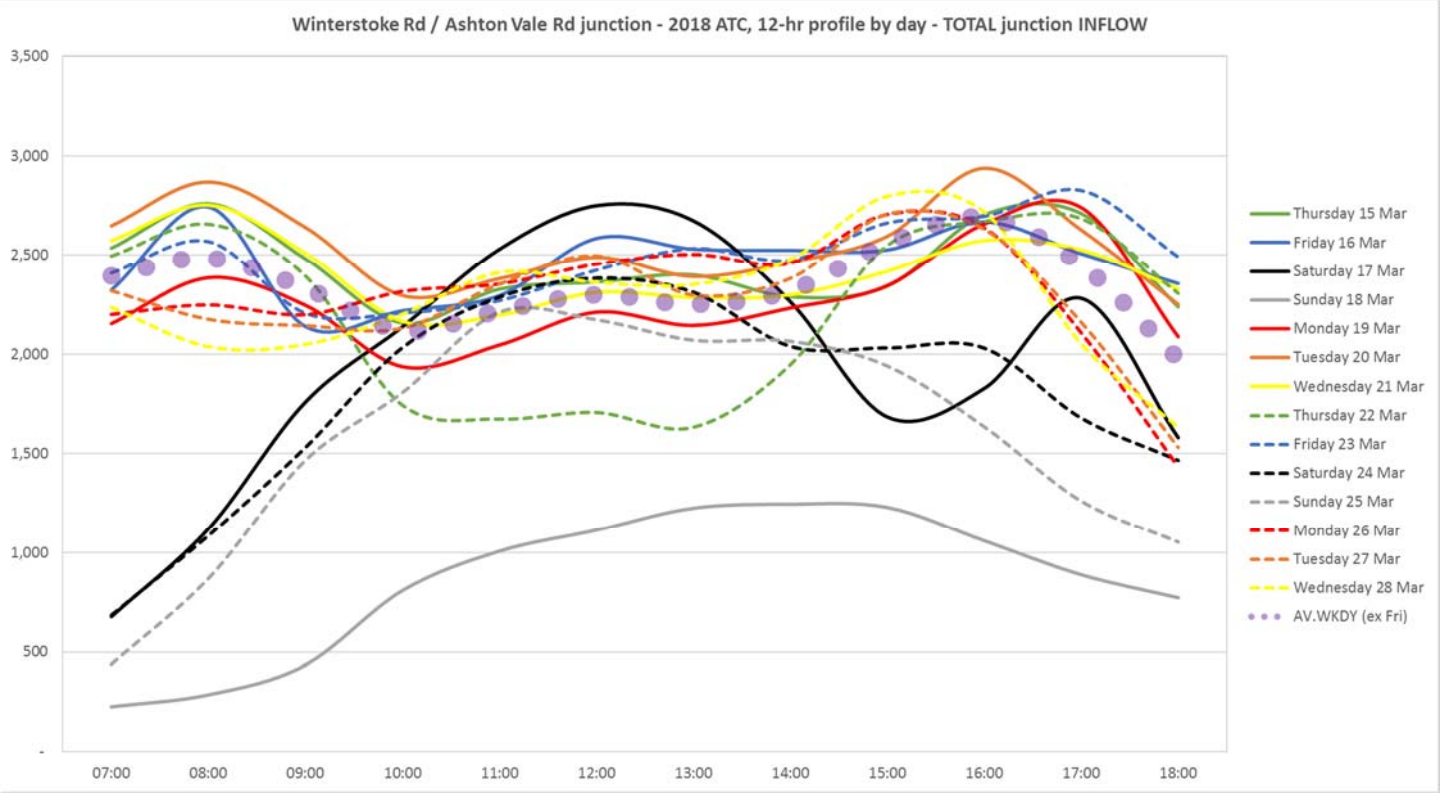


Figure 3: Total junction inflow – 2017 & 2018 counts, 12hr profile (average weekday)

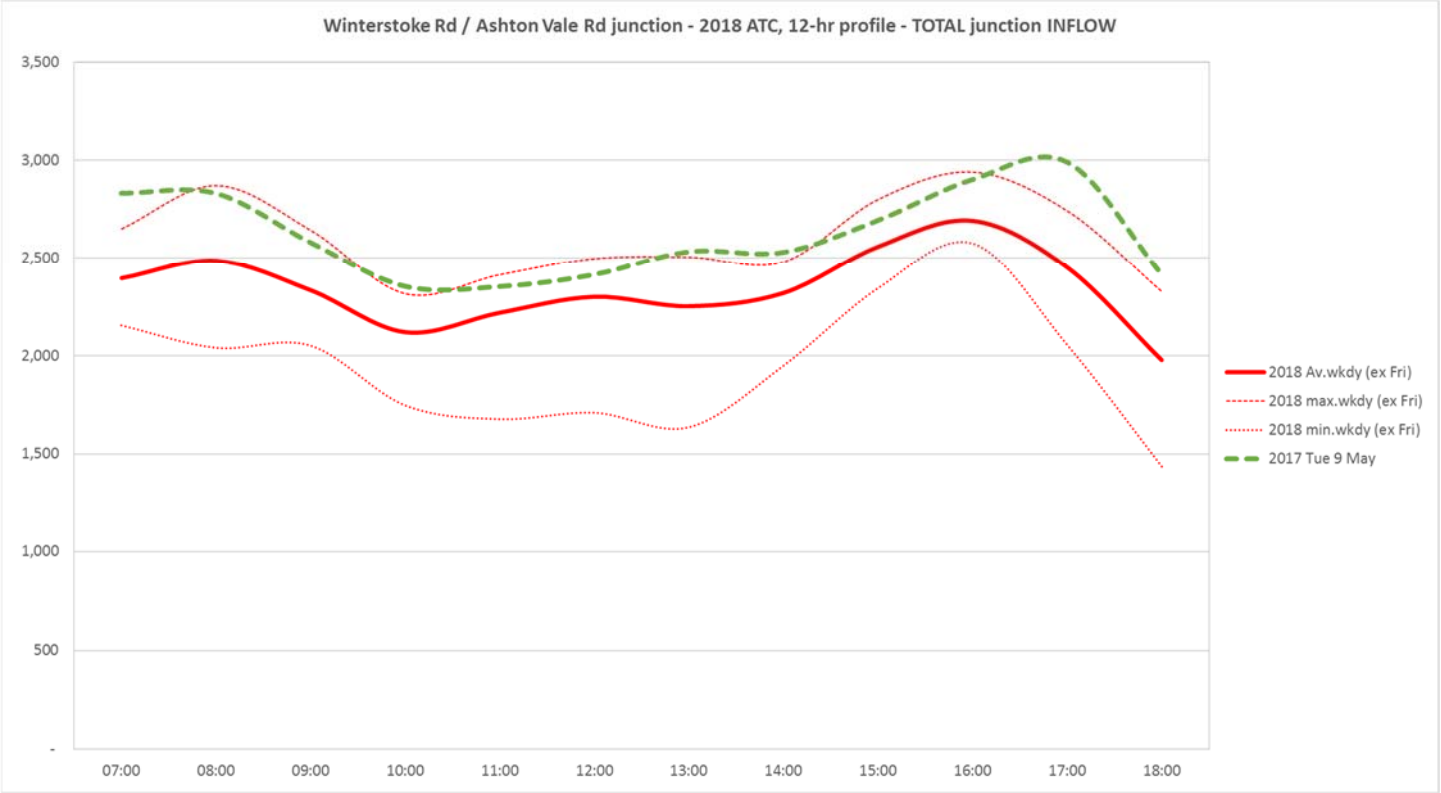


Figure 4: Traffic FROM Ashton Vale Road – 2018 counts, 12hr profile by survey day

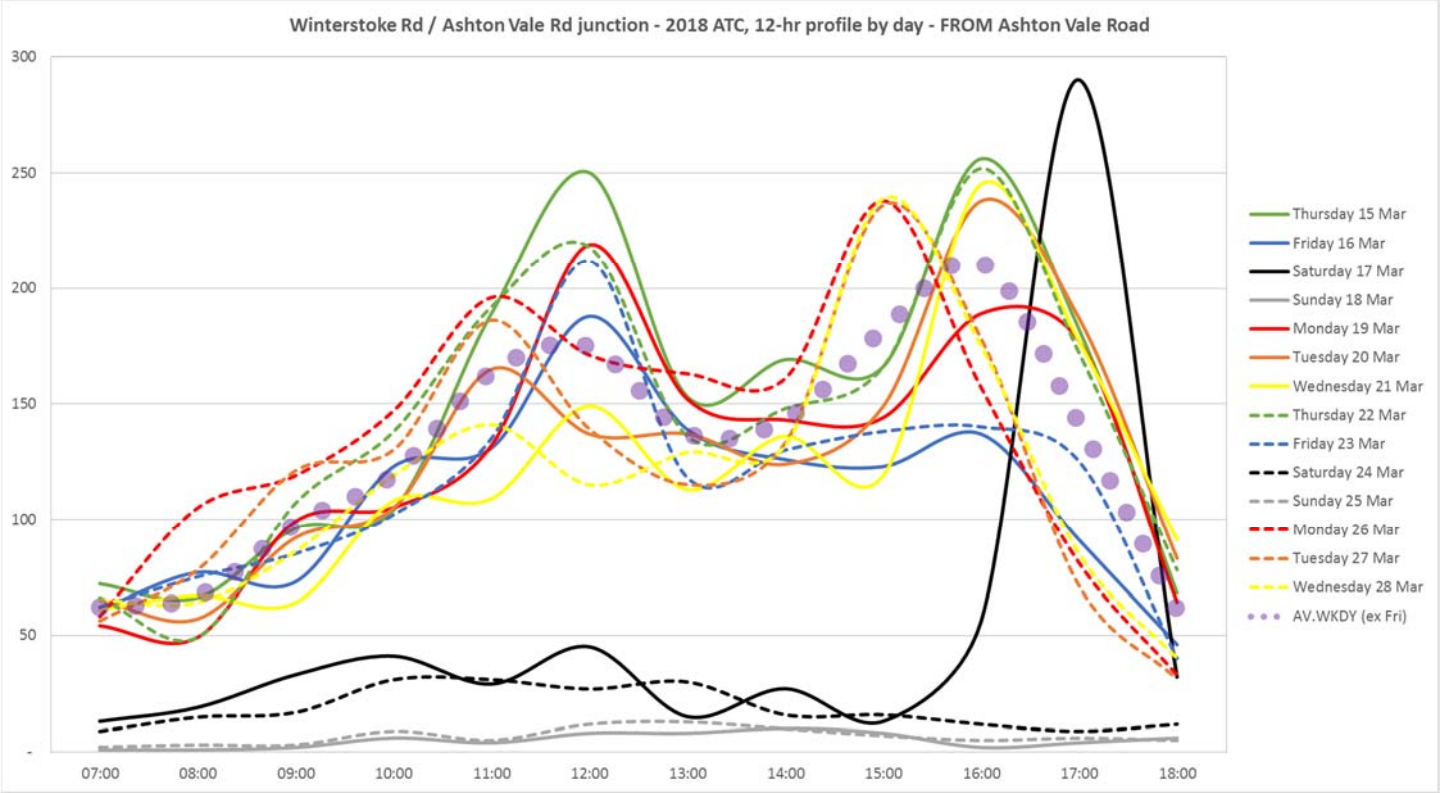


Figure 5: Traffic INTO Ashton Vale Road – 2018 counts, 12hr profile by survey day

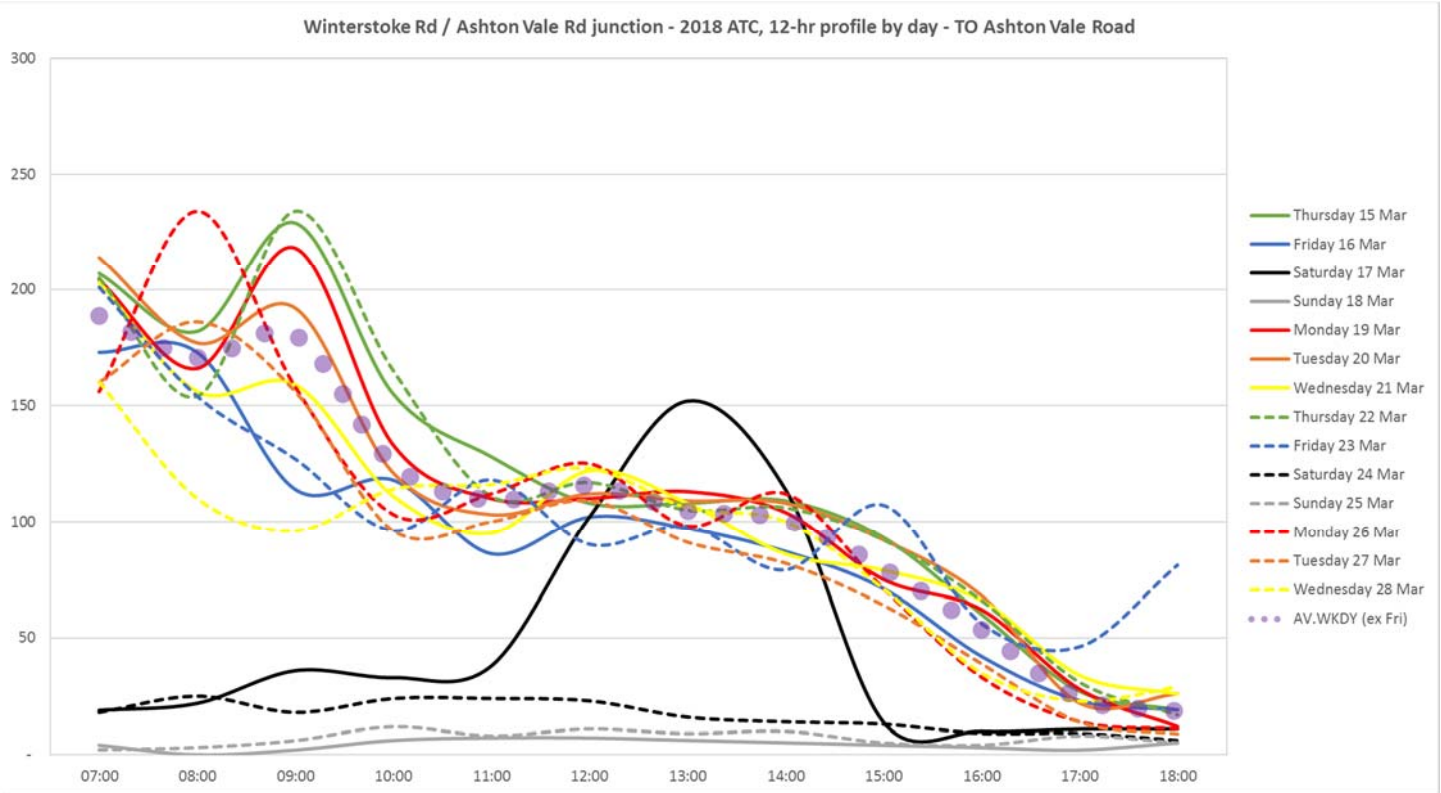


Figure 6: Traffic FROM Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile

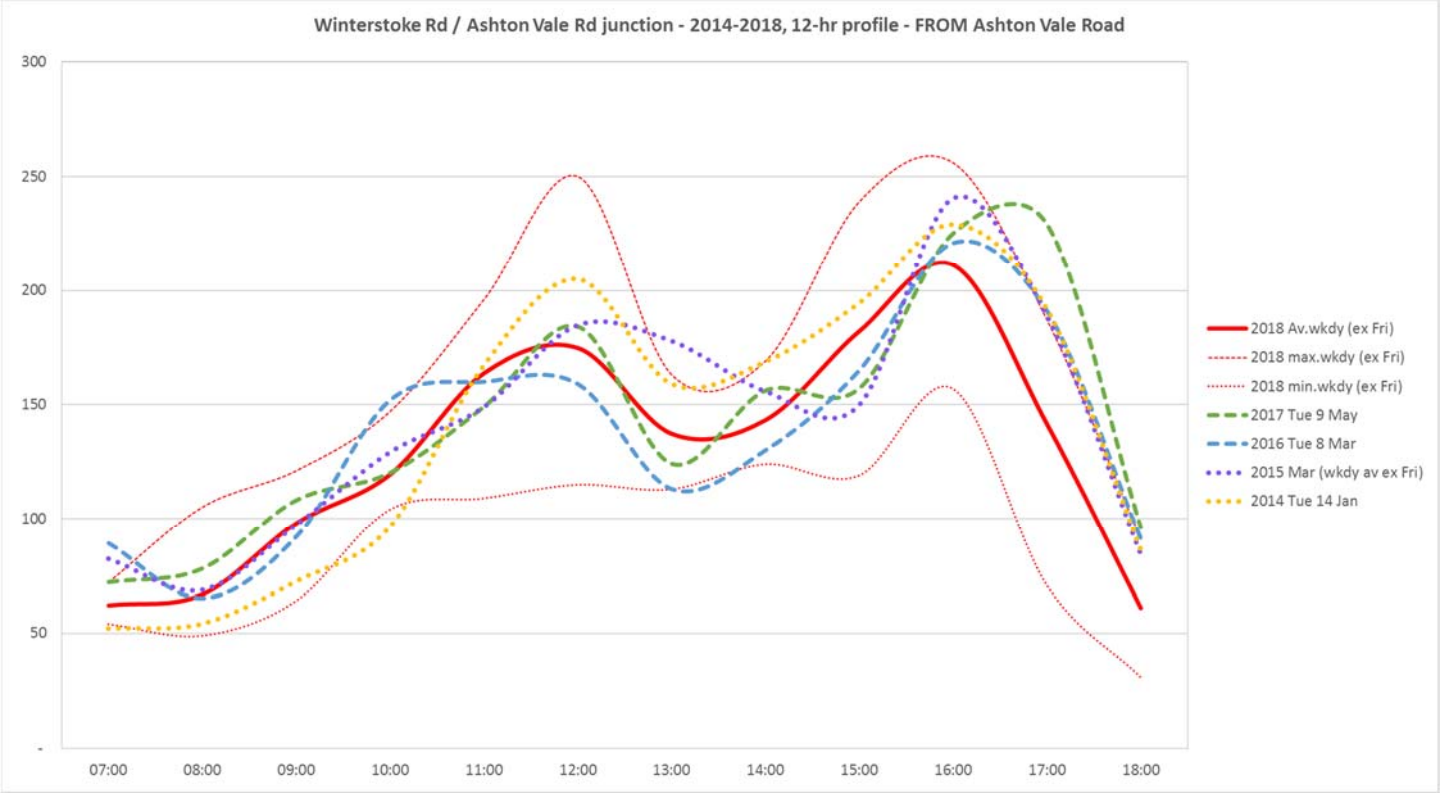


Figure 7: Traffic INTO Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile

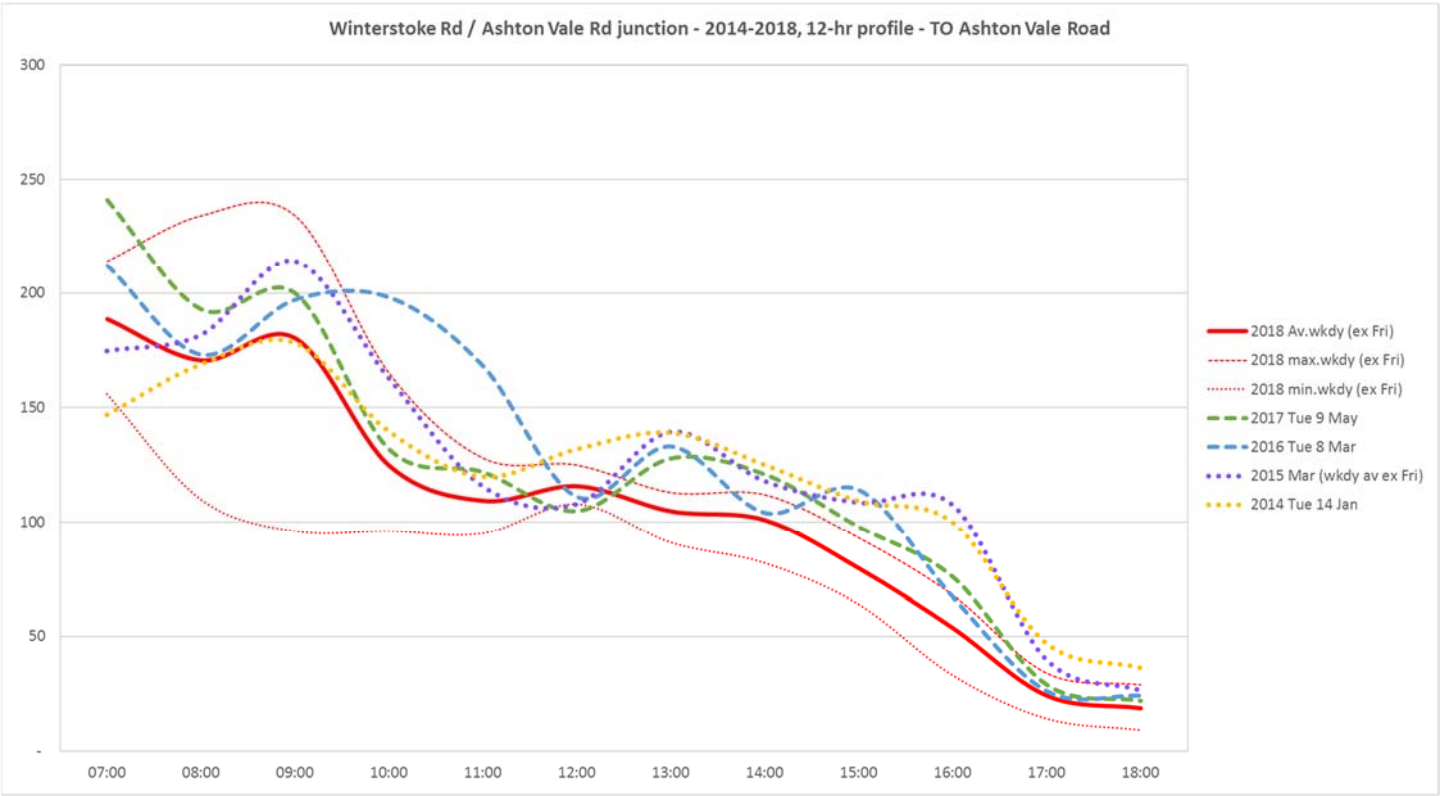


Figure 8: Ashton Vale Road 2014-18 – 24hr totals

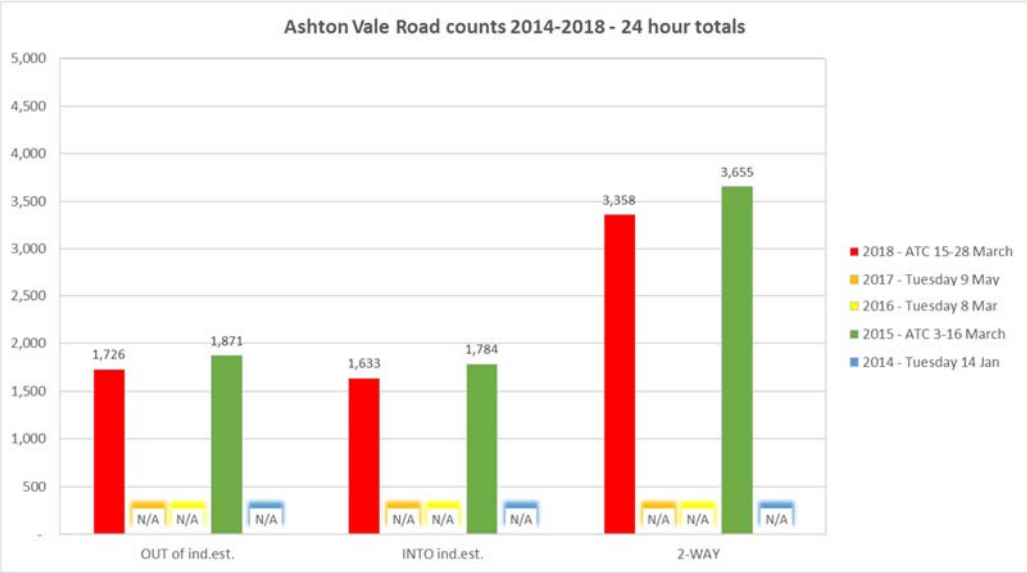


Figure 9: Ashton Vale Road 2014-18 – 12hr totals

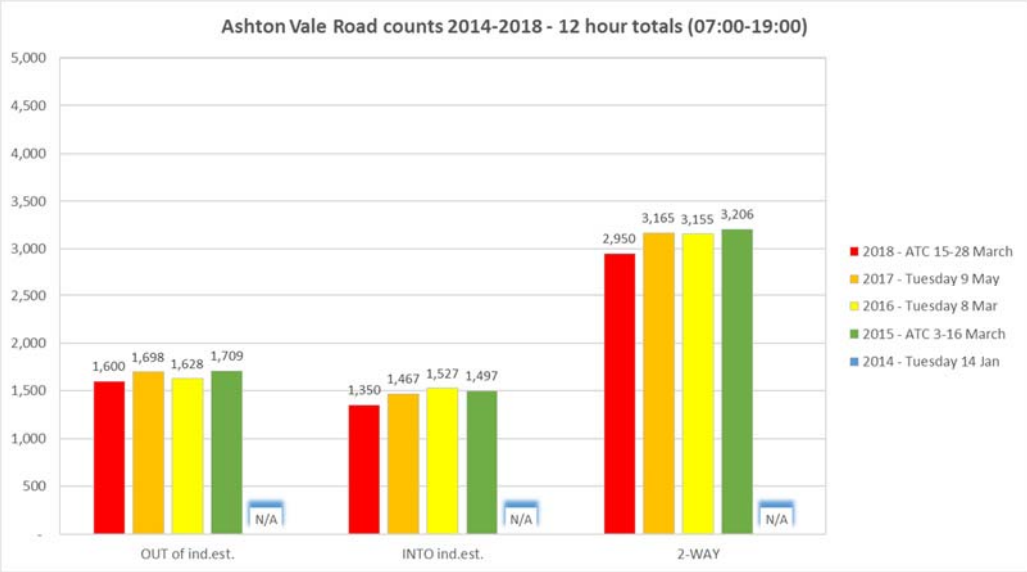


Figure 10: Ashton Vale Road 2014-18 – AM peak hour

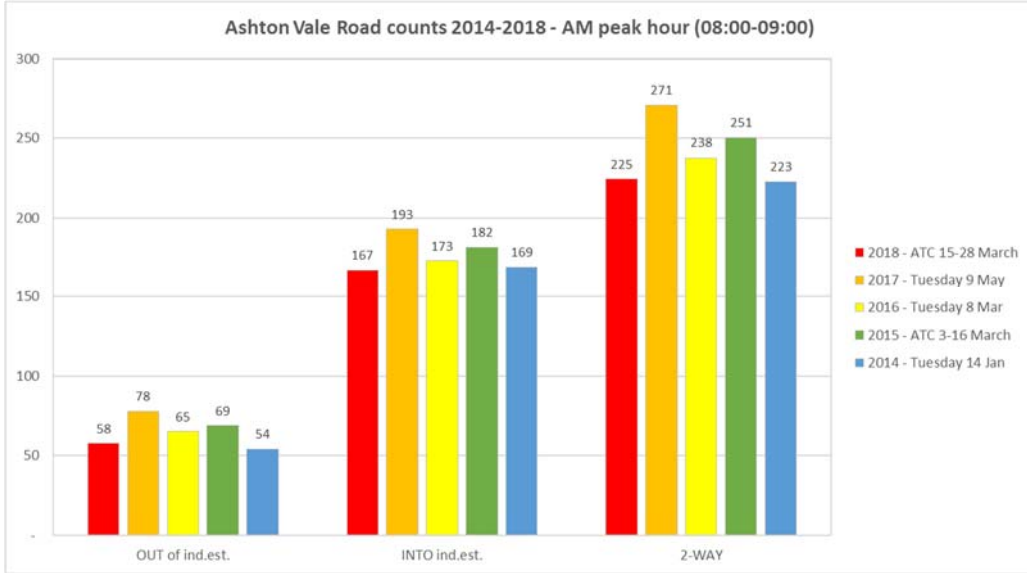


Figure 11: Ashton Vale Road 2014-18 – PM peak hour

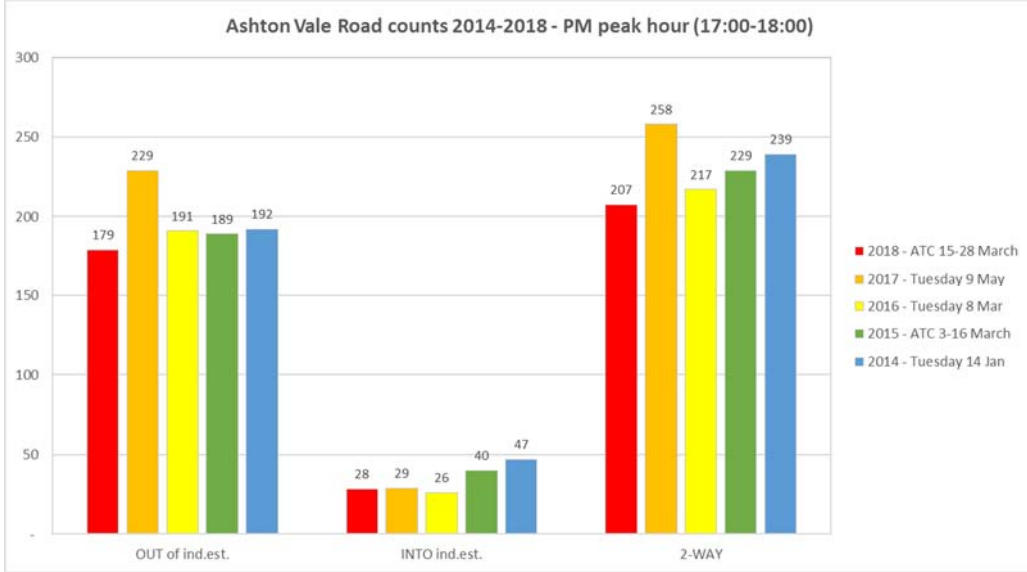


Figure 12: FROM Ashton Vale Road – maximum movements – AM comparison

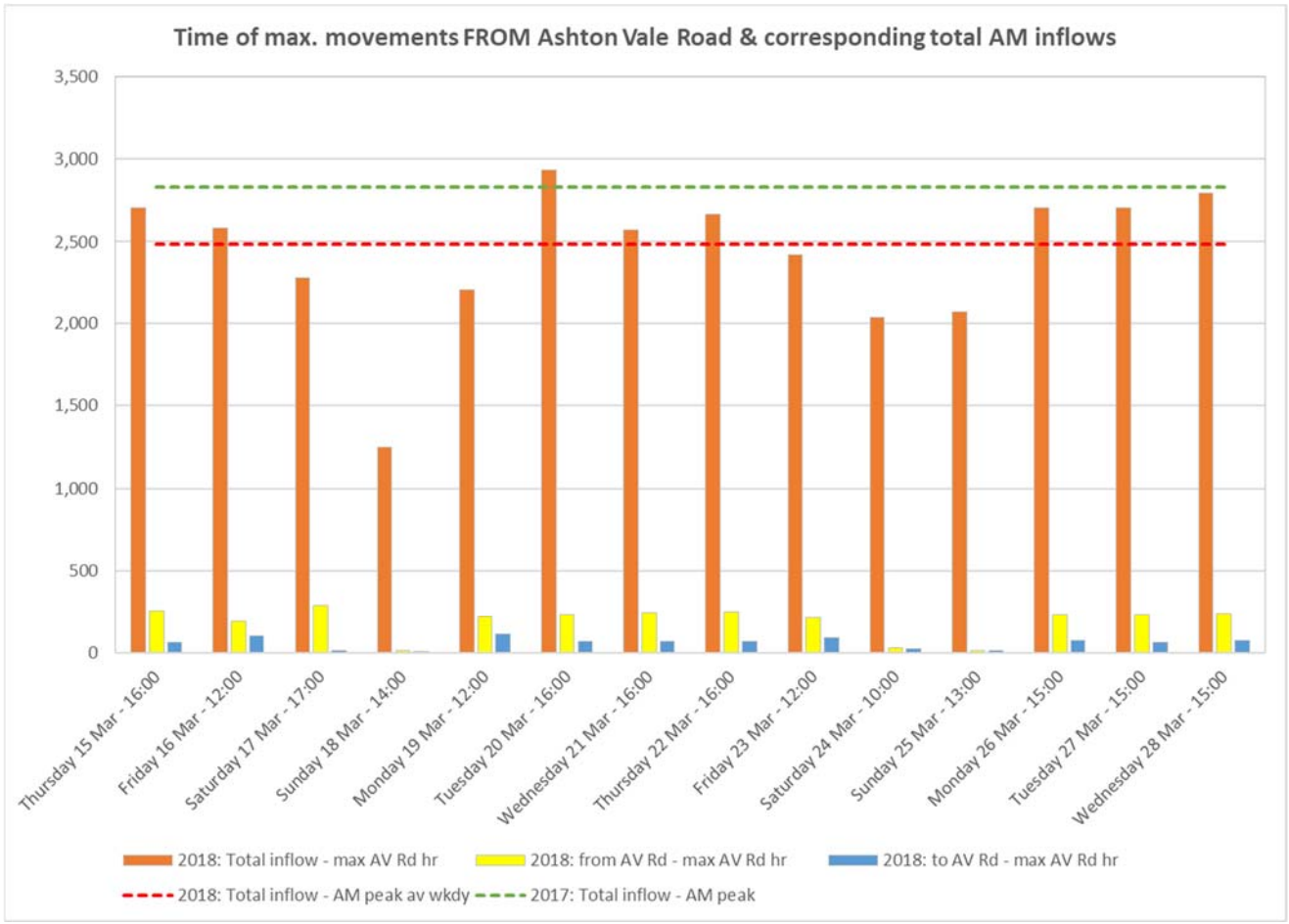


Figure 13: FROM Ashton Vale Road – maximum movements – PM comparison

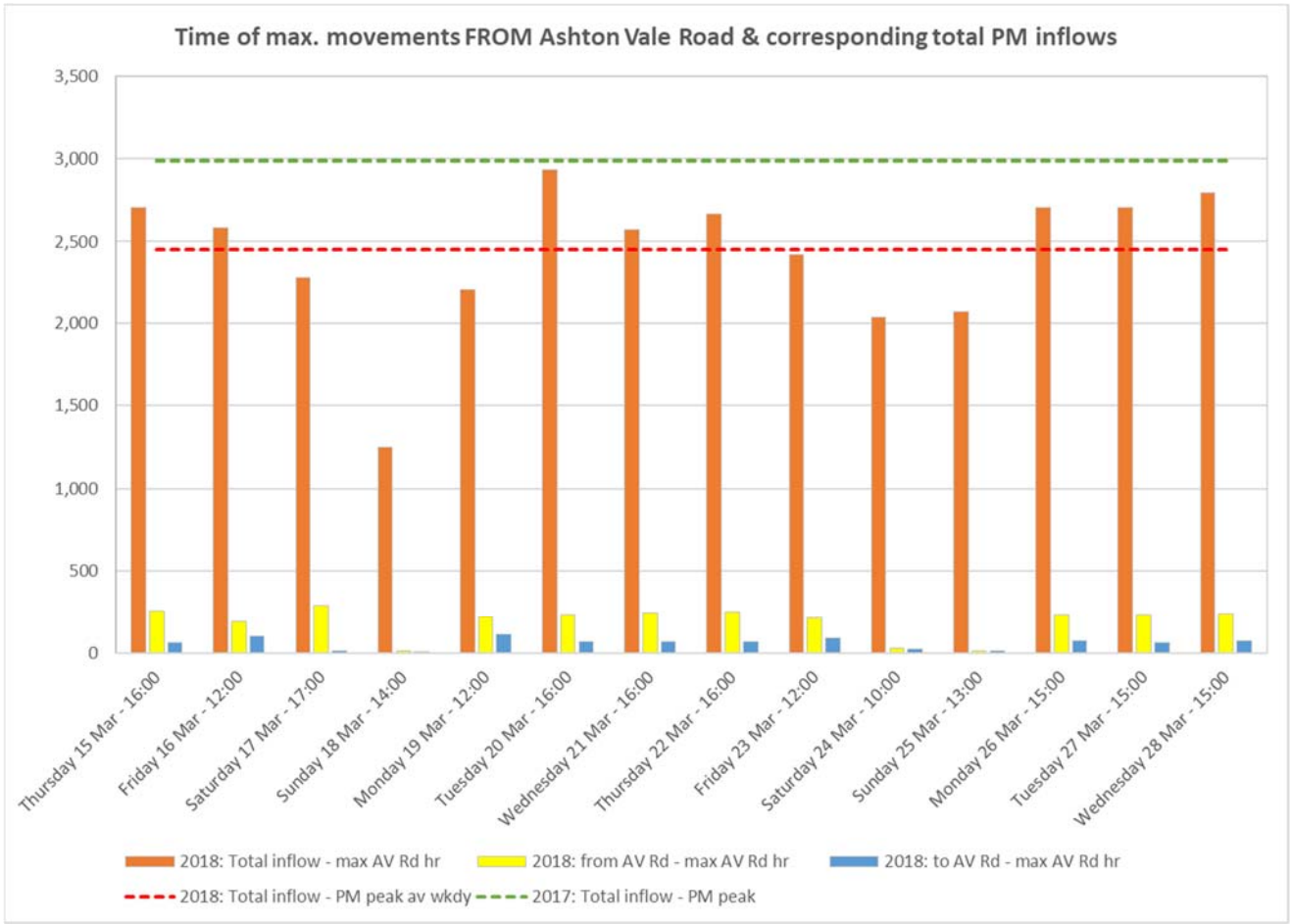


Figure 14: TO Ashton Vale Road – maximum movements – AM comparison

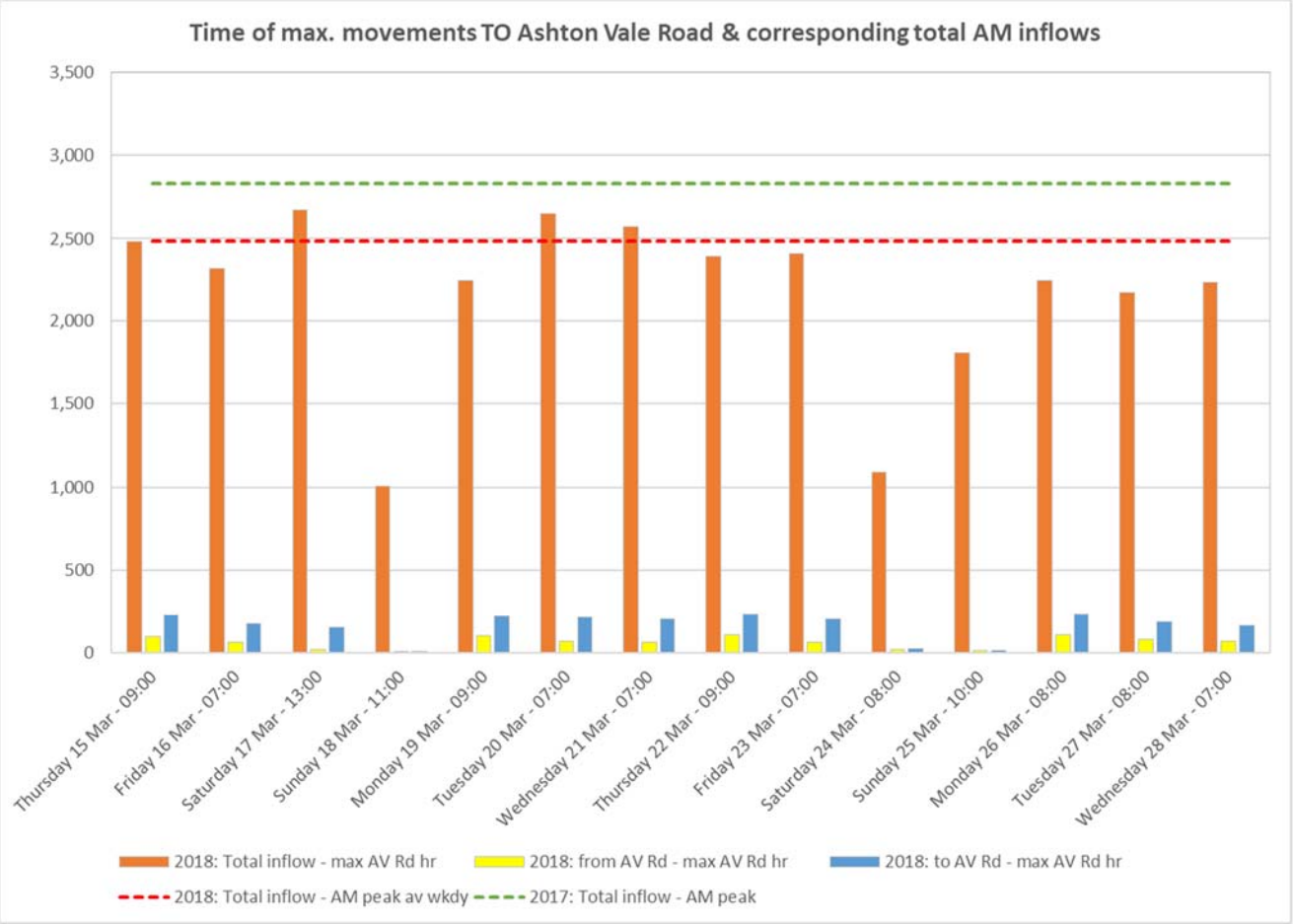


Figure 15: TO Ashton Vale Road – maximum movements – PM comparison

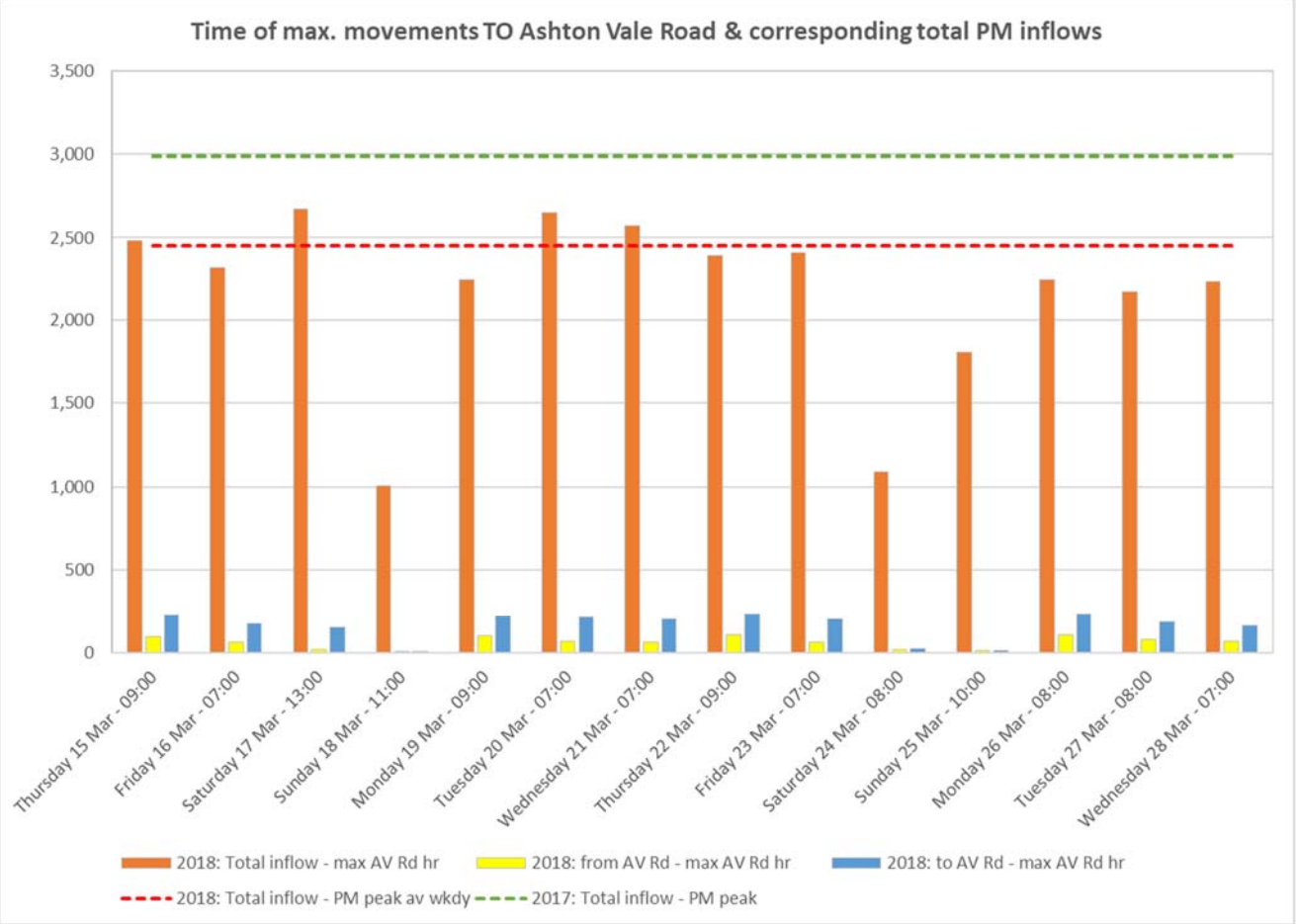
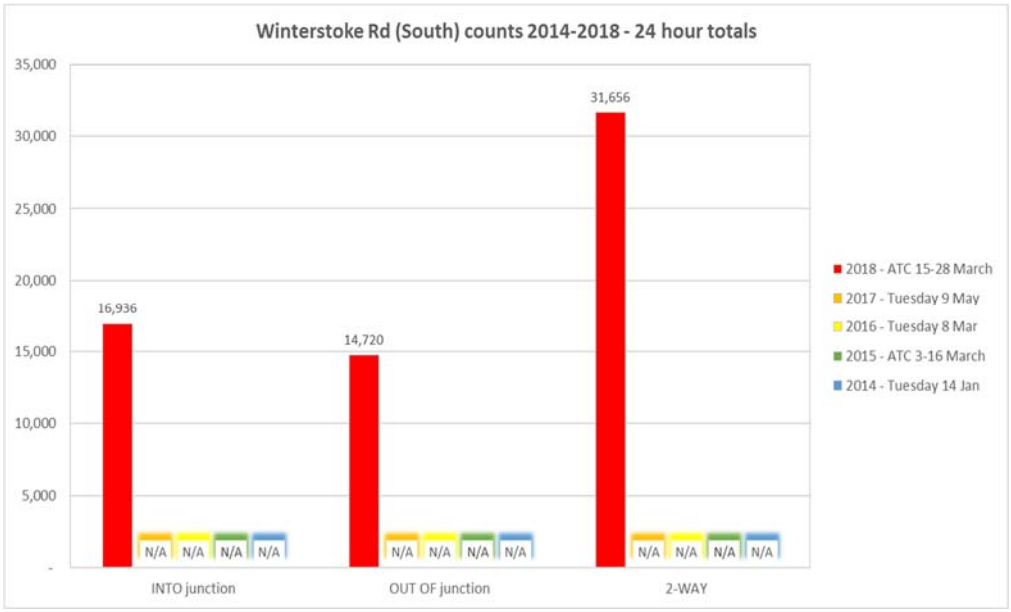
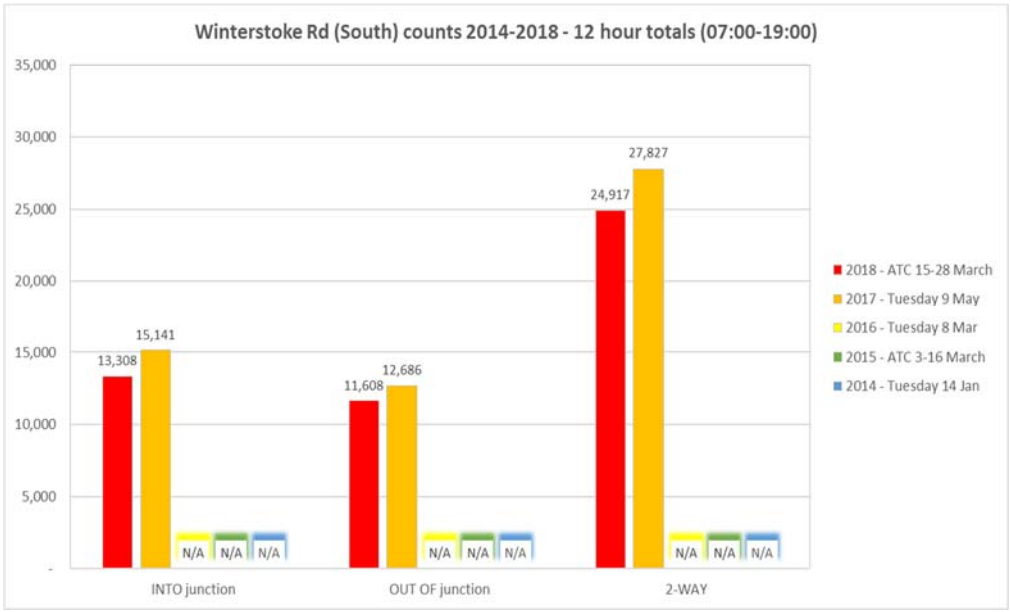


Figure 16: Winterstoke Road (north) 2014-18 – 24hr totals



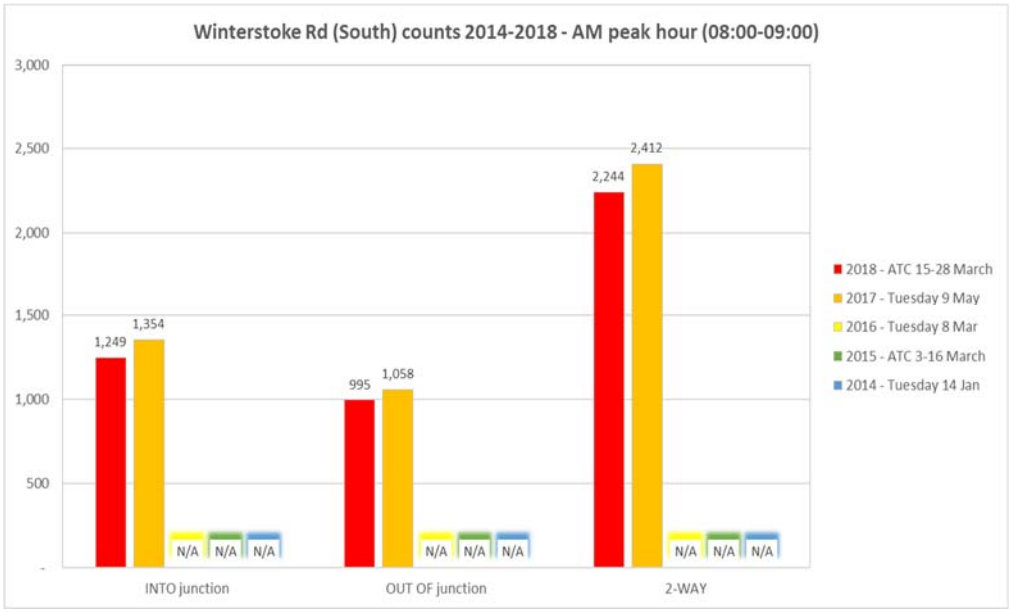
Note: combined flows with Ashton Gate Underpass

Figure 17: Winterstoke Road (north) 2014-18 – 12hr totals



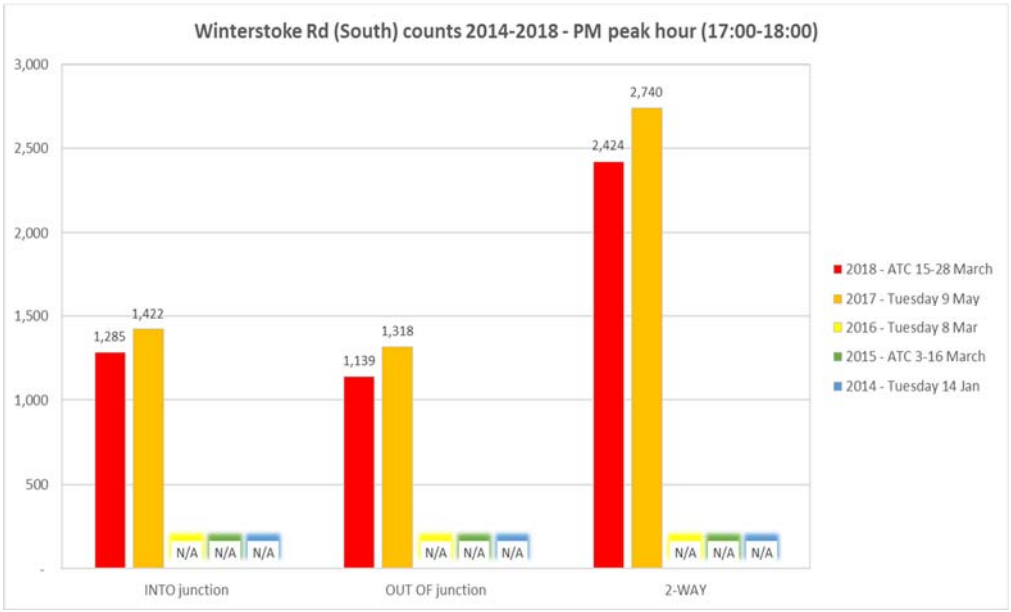
Note: combined flows with Ashton Gate Underpass

Figure 18: Winterstoke Road (north) 2014-18 – AM peak hour



Note: combined flows with Ashton Gate Underpass

Figure 19: Winterstoke Road (north) 2014-18 – PM peak hour



Note: combined flows with Ashton Gate Underpass

Figure 20: Winterstoke Road (south) 2014-18 – 24hr totals

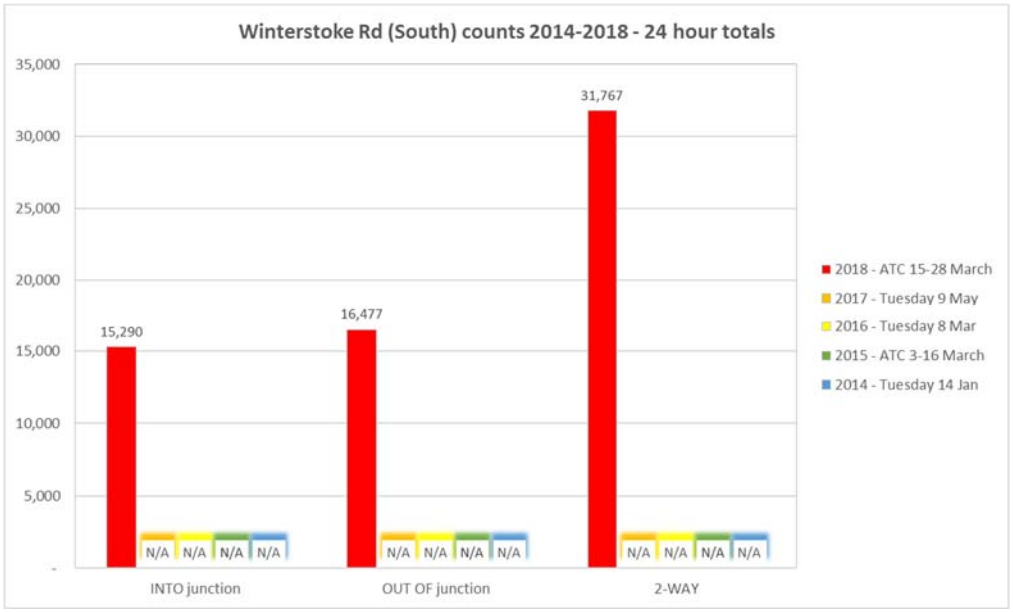


Figure 21: Winterstoke Road (south) 2014-18 – 12hr totals

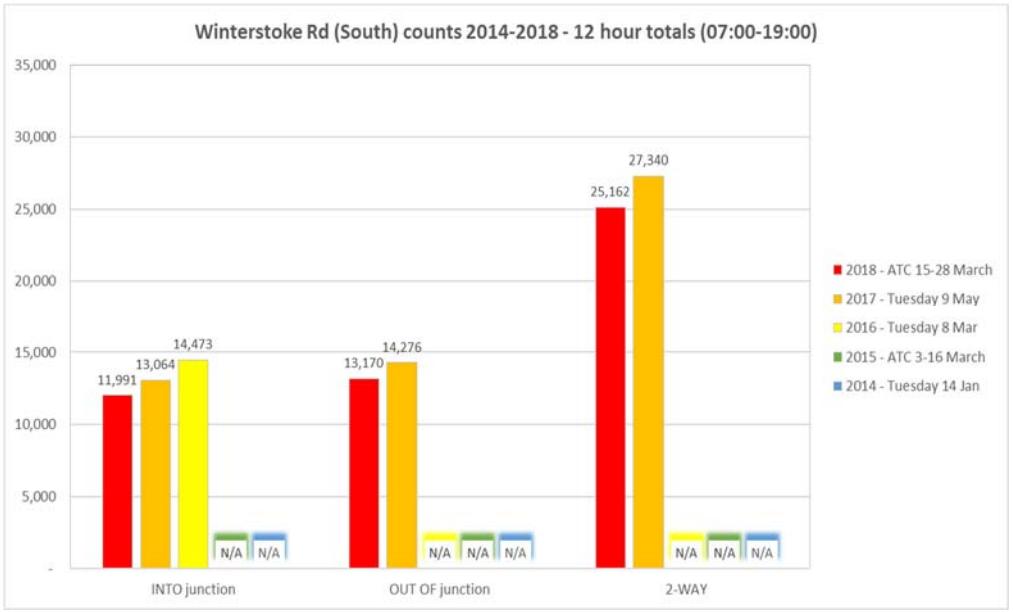


Figure 22: Winterstoke Road (south) 2014-18 – AM peak hour

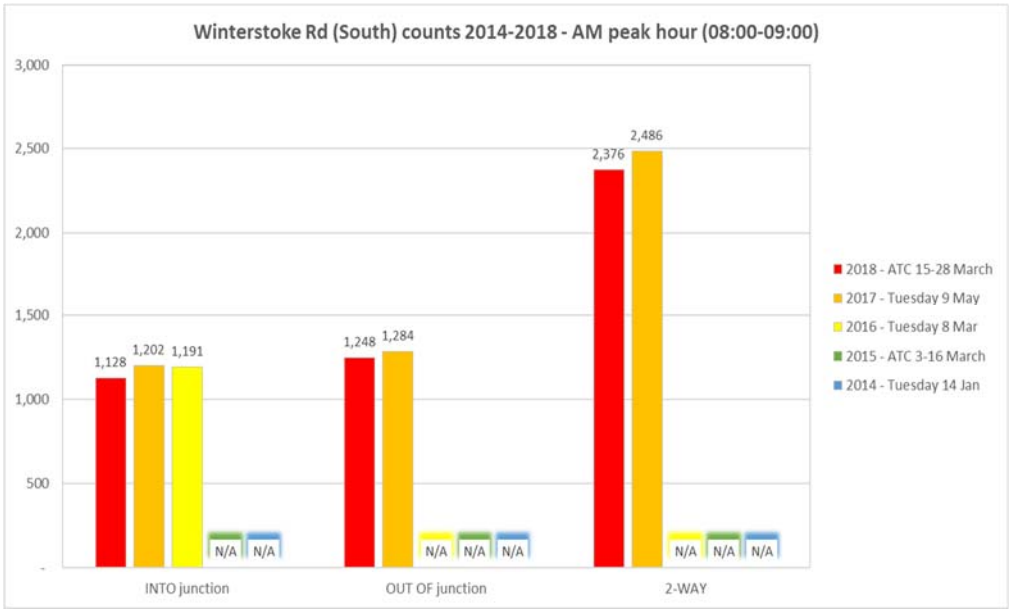


Figure 23: Winterstoke Road (south) 2014-18 – PM peak hour

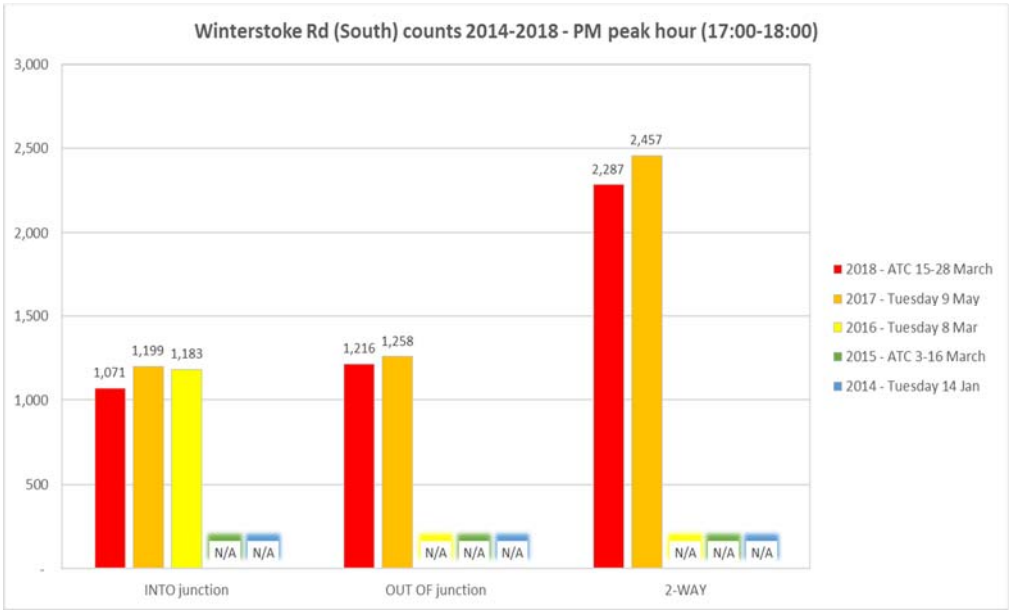


Figure 24: Marsh Road 2014-18 – 24hr totals

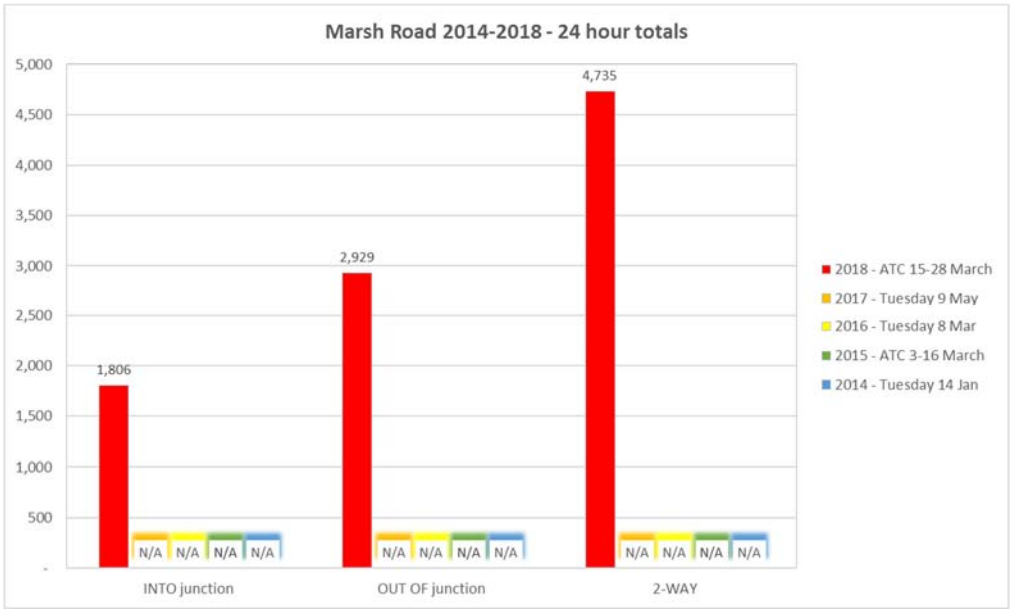


Figure 25: Marsh Road 2014-18 – 12hr totals

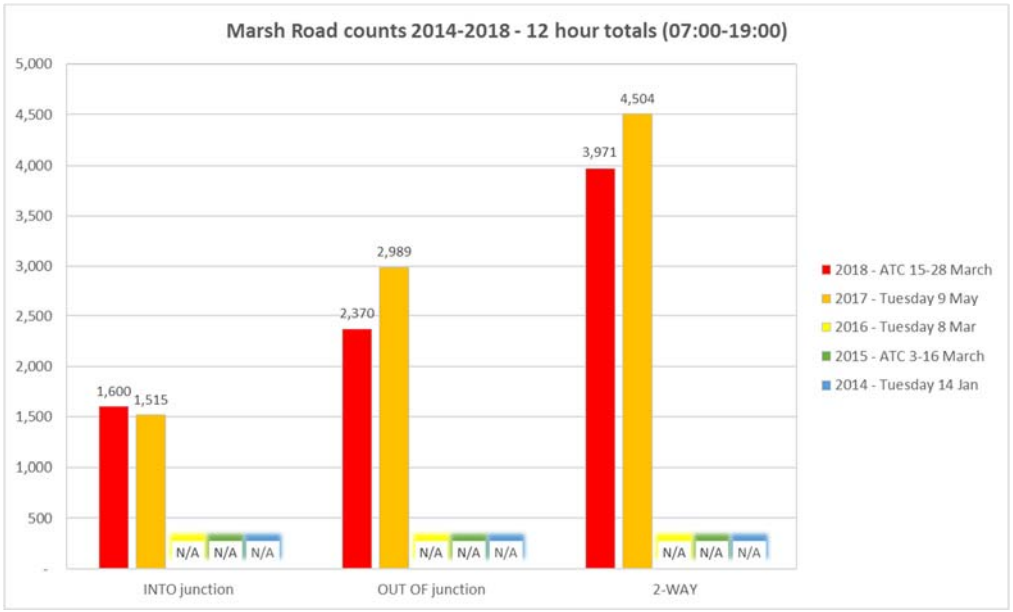


Figure 26: Marsh Road 2014-18 – AM peak hour

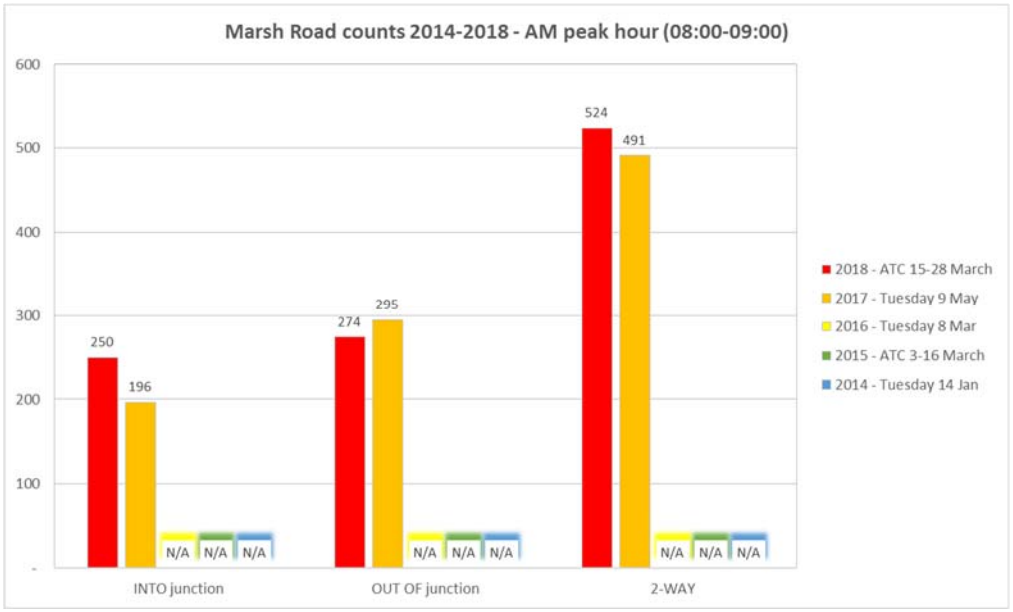


Figure 27: Marsh Road 2014-18 – PM peak hour

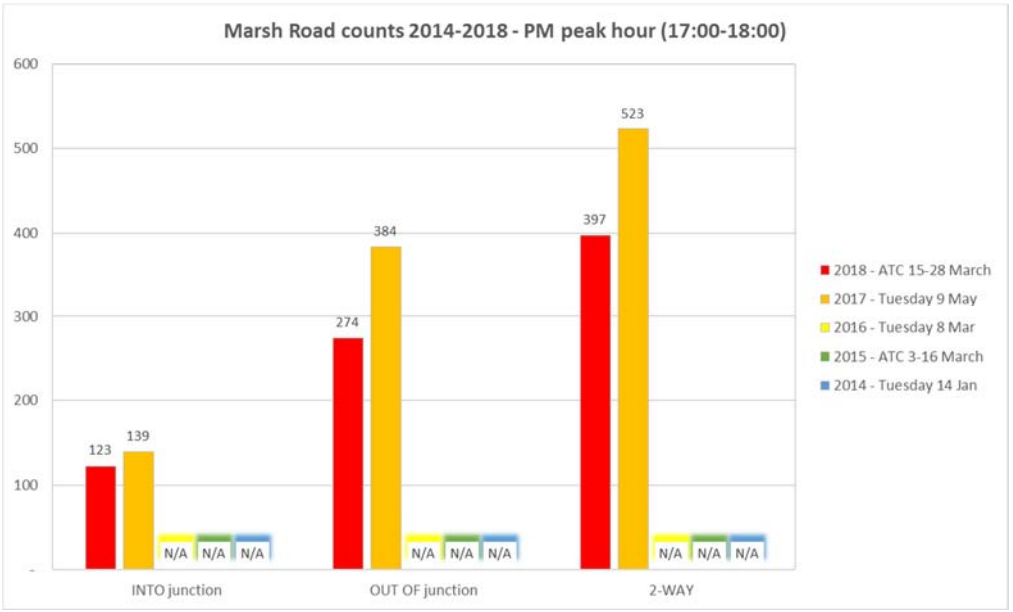


Figure 28: Ashton Gate Underpass 2014-18 – 24hr totals

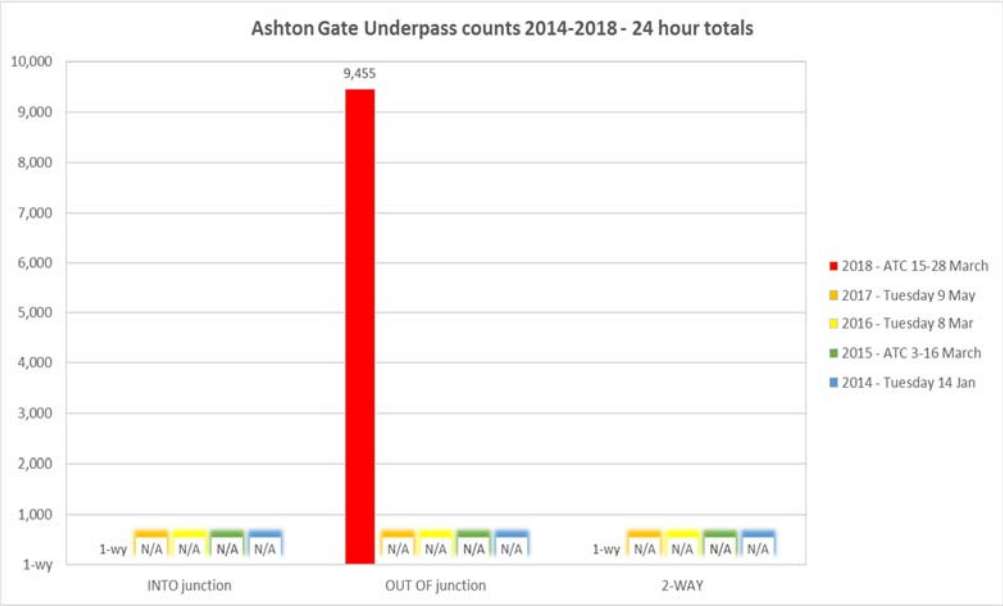


Figure 29: Ashton Gate Underpass 2014-18 – 12hr totals

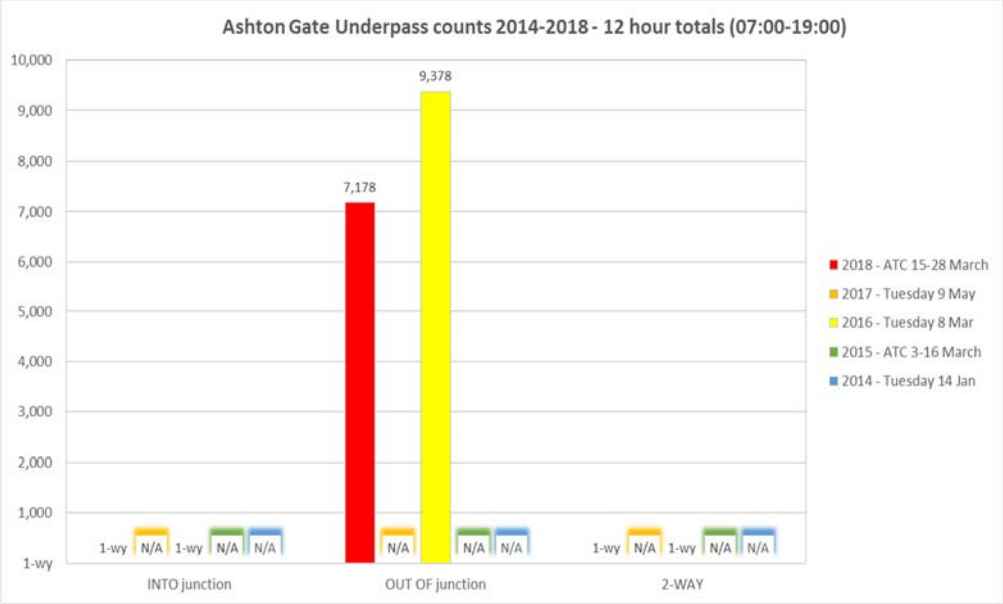


Figure 30: Ashton Gate Underpass 2014-18 – AM peak hour

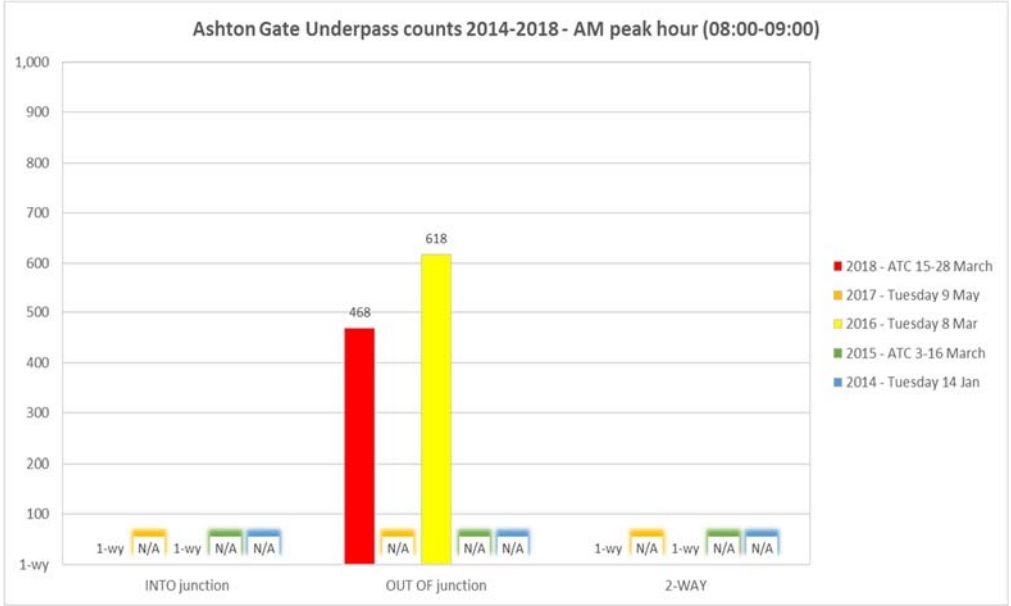
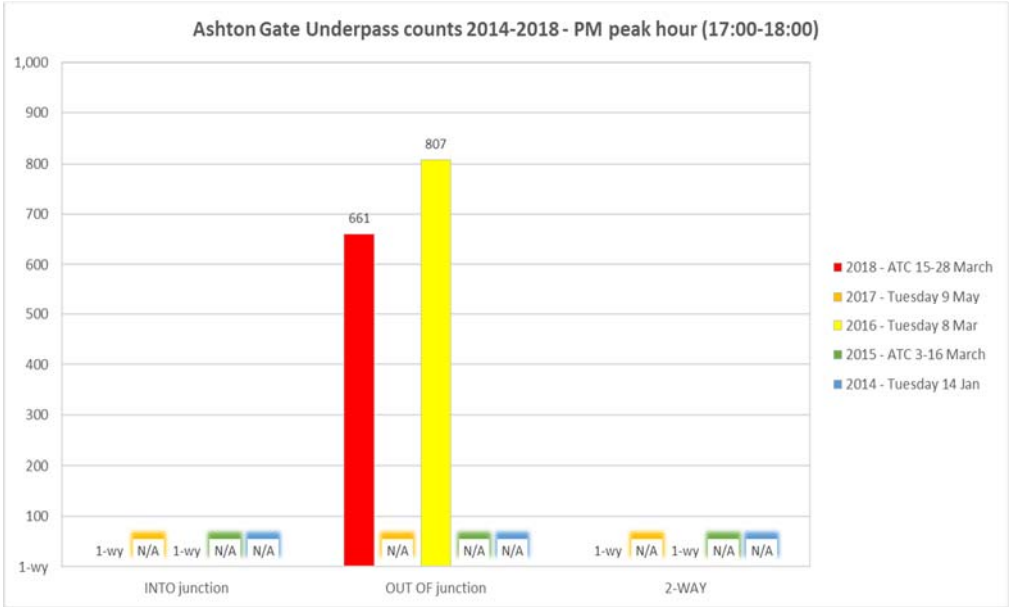


Figure 31: Ashton Gate Underpass 2014-18 – PM peak hour



Part 3:
Ashton Vale Road Level Crossing Train Times

Contents:

TECHNICAL MEMORANDUM

MetroWest Phase 1
Ashton Vale Road Level Crossing Train Times

PREPARED FOR:	WoE Councils
PREPARED BY:	GW
DATE:	5th July 2018
PROJECT NUMBER:	674946.CS.70.01
REVISION NO.:	1
APPROVED BY:	**DRAFT**

1.0 Introduction

The MetroWest Phase 1 project comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

The project is being led by North Somerset Council on behalf of the four West of England (WoE) councils. Infrastructure for the Portishead line and stations at Portishead and Pill is to be consented through the Portishead Branch Line Development Consent Order (DCO) scheme, with some infrastructure falling within Network Rail's General Permitted Development (GPD) rights. CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the DCO.

The Ashton Vale Road / Winterstoke Road signal controlled junction and adjacent Ashton Vale level crossing, the location of which is shown in Figure 1, has been considered in some detail as part of the Transport Assessment. This is to specifically assess the impact of increased level crossing closures due to MetroWest Phase 1 services on the Portishead line, and has included analysis using LinSIG and VISSIM models of the junction. [1]

The purpose of this note is to set out key assumptions relating to train services through the level crossing, based on work carried out by Network Rail as part of its GRIP3/4 analysis of the scheme.

2.0 Ashton Vale Level Crossing

The Ashton Vale Level Crossing is located on the current freight-only line that serves Royal Portbury Dock of the Port of Bristol. The freight spur into the dock was built from the Portishead railway line north of Pill, and opened in 2002. The Portbury dock line is linked to main Bristol-Taunton line at Parson Street junction, and although has a section of twin-track near Parson Street Junction, is single-track through the level crossing itself. The track layout in this area (and through the level crossing) will not be changing for the implementation of MetroWest Phase 1 with an hourly passenger service.

[1] Details of LinSIG assessments of Ashton Vale Road / Winterstoke Road junction can be found in the technical note 'MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road – LinSIG Modelling'. Details of VISSIM modelling can be found in the 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report'. Both reports are part of the MetroWest Phase 1 DCO Transport Assessment.

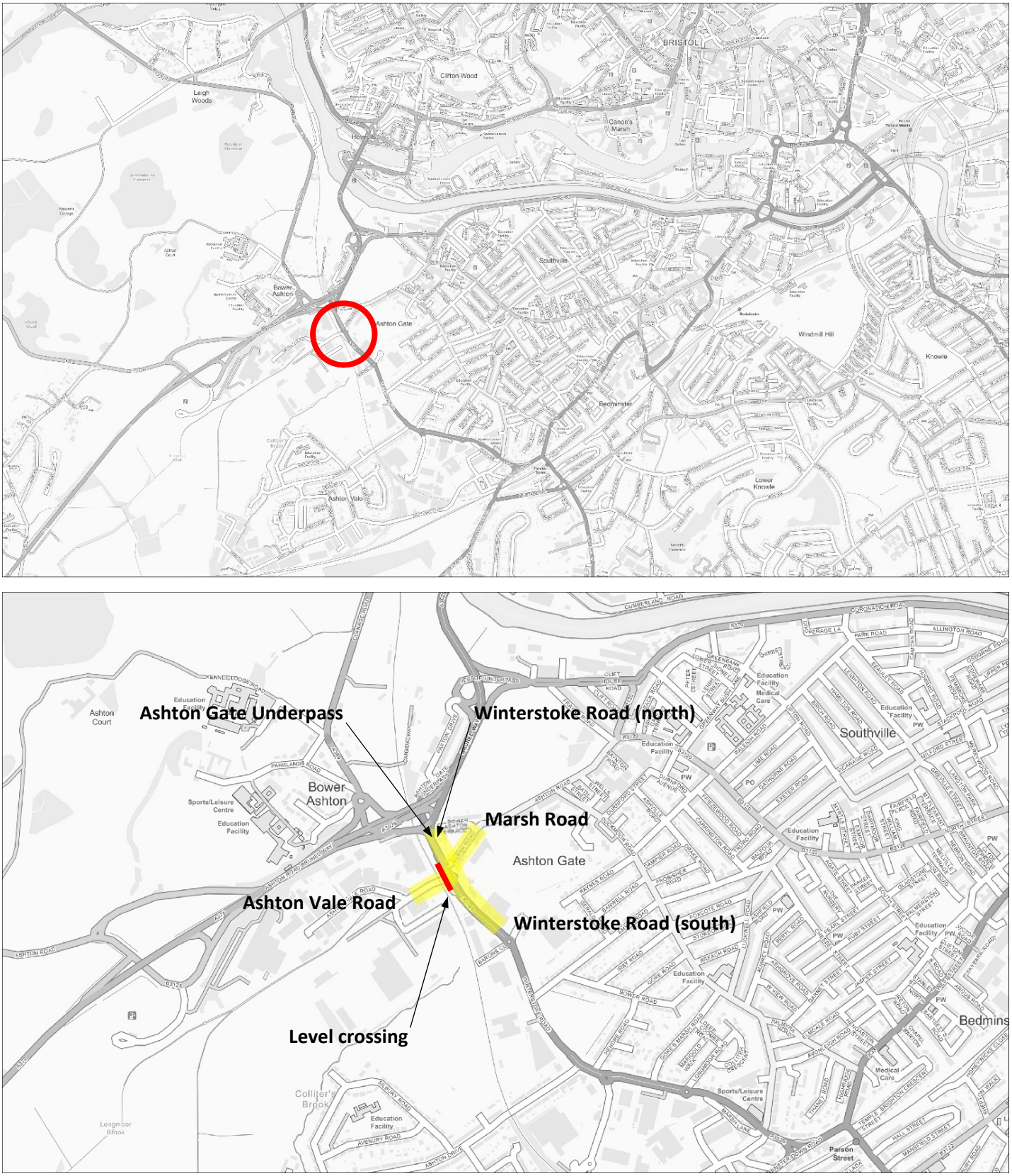


Figure 1: Ashton Vale Road / Winterstoke Road junction

Contains OS data © Crown copyright 2018

3.0 Train operating scenarios

Only freight trains serving the Royal Portbury Dock run through the Ashton Vale Road level crossing. MetroWest Phase 1 will introduce regular passenger trains to the line, with one train per hour per direction operating from (broadly) 6am to 11pm on weekdays (slightly reduced hours at weekends).

3.1 Current freight train operations

As freight trains are seldom scheduled with the same regularity and frequency as passenger trains, current use of the line (and hence level crossing closures) is irregular and (in historic terms) relatively low. A limit of 10 trains per day was included as a condition within the original planning permission for the new rail link to the port, though this was subsequently amended to 3,650 trains per annum; this retains the same number of trains overall, but reflects that the bulk nature of port movements could mean a daily limit would be restrictive. Within this limit, specific access rights are held by train operators to cover flows between the port and various destinations.

The working timetable for the Portbury branch can have as many as 26 freight trains indicated (2-way), but in practice most of these do not run on a daily basis. Not least because many paths are alternative between the same origin-destination at relatively close timings, to take into account variation in shipping access, which would by definition never all be used. Traffic levels are currently relatively low, and several days can pass with no trains at all. This is unusually low demand, and when freight train data was observed in February and March 2016 this revealed up to four freight trains were running per day (two directions) on weekdays, with up to two on weekends. However, it also indicated that out of 30 days for which data was extracted, freight train movements were only actually made on 15 days. It was also noted though from this analysis that rail freight movements could coincide with the off-peak and peak periods on the local highway network.

In essence therefore, in a typical hour, it is far more likely that there will be no freight trains operating on the Portbury dock line.

3.2 Future operating scenarios

MetroWest Phase 1 will add regular passenger services to the irregular freight trains that use the line now. Timetable planning for MetroWest services has included paths for freight trains to run, with an allowance for at least one freight train to run per hour in every hour. Theoretically, one freight train can run in each direction in each hour, though this is considered unlikely to ever be required (and may even not be practical in the port area or further afield on the main line).

Recognising that freight services can run any hour, but in practice are far more likely to be ad hoc, a series of train operating scenarios have been identified for the Ashton Vale Road level crossing, which have been taken forward for consideration in traffic modelling of the effects of the level crossing closures (using LinSIG and VISSIM). In broad terms, these are categorised as:

- Typical – the most likely occurrence in a typical hour; with MetroWest passenger services this is assumed to be no freight trains;
- Realistic worst case – a likely occurrence in a typical hour, but one that will not happen more than a few times a day (adding 1 freight train to MetroWest passenger services); and
- Theoretical maximum – 1 freight train per direction in addition to MetroWest passenger services (which while possible in timetabling terms is considered unlikely to occur regularly, if ever).

In addition, it is potentially possible to run an ‘infill’ passenger service at peak times. This would give a broadly 45-minute interval passenger service for a 3-hour period. It should be noted that this is not part of the current development plans for MetroWest Phase 1, and would require additional rolling stock to be sourced over and above the hourly service anticipated. Table 1 sets out a series of scenarios for future typical hour that have been identified at the Ashton Vale Road level crossing.

Table 1: Train operation scenarios: typical hourly sequence

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Scenario		Freight trains			Passenger trains			All trains
		UP	DOWN	Total	UP	DOWN	Total	per hour
Current operations (WoS)								
Typical:	'up'	1	-	1	-	-	0	1
	'down'	-	1	1	-	-	0	1
Theoretical maximum		1	1	2	-	-	0	2
MetroWest Phase 1 – 1 train per hour per direction (WS)								
Typical		-	-	0	1	1	2	2
Realistic worst case:	'up'	1	-	1	1	1	2	3
	'down'	-	1	1	1	1	2	3
Theoretical worst case		1	1	2	1	1	2	4
MetroWest Phase 1 – 'infill' peak service at 45 min intervals (WS45)								
Typical		-	-	0	1.33	1.33	2.67	2.67
Realistic worst case:	'up'	1	-	1	1.33	1.33	2.67	3.67
	'down'	-	1	1	1.33	1.33	2.67	3.67
Theoretical worst case		1	1	2	1.33	1.33	2.67	4.67

Notes:

UP freight trains run from Portbury to Parson Street Junction, DOWN freight trains run to Portbury

UP passenger trains run from Portishead to Bristol Temple Meads, DOWN passenger trains run to Portishead

Codes in brackets are used in scenario designation for LinSIG and VISSM modelling of the Ashton Vale Road / Winterstoke Road junction – WoS = no passenger trains; WS = MetroWest 1 tph; WS45 = MetroWest infill peak services; NF = no freight trains; 1F = 1 freight train in hour in 1 direction (either direction); 2F = 1 freight train per hour per dir)

4.0 Level crossing closures

4.1 Closure duration

The sequences of trains passing the level crossing has been determined from the top-down requirements for passenger and freight trains to serve Portishead and Portbury. Timetabling work carried out by Network Rail to include these trains has identified timings within a typical hour. As part of this, future signal control for the level crossing has also been considered as part of the works for MetroWest Phase 1. This has resulted in definition of signaling changes for the crossing from the current set-up, that reduce level crossing road closure times to around 2 minutes, with:

- DOWN trains running from Parson Street (to Portbury/Portishead) closing the level crossing to traffic for 1m 50s; and
- UP trains from Pill (i.e. from Portbury/Portishead) closing the level crossing for 2m 05s.

Table 2 indicates the effects that these closure times have in aggregate over a typical hour for the train operating scenarios in Table 1.

Table 2: Train operation scenarios: typical hourly sequence

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Scenario		Level crossing closure times (totals in average hour)		
		UP	DOWN	Total
Current operations (WoS)				
Typical (1F):	'up'	2m 05s	-	2m 05s
	'down'	-	1m 50s	1m 50s
Theoretical maximum (2F)		2m 05s	1m 50s	3m 55s
MetroWest Phase 1 – 1 train per hour per direction (WS)				
Typical (NF)		2m 05s	1m 50s	3m 55s
Realistic worst case (1F):	'up'	4m 10s	1m 50s	6m 00s
	'down'	2m 05s	3m 40s	5m 45s
Theoretical worst case (2F)		4m 10s	3m 40s	7m 50s
MetroWest Phase 1 – 'infill' peak service at 45 min intervals (WS45)				
Typical (NF)		2m 46s	2m 26s	5m 13s
Realistic worst case (1F):	'up'	4m 51s	2m 26s	7m 18s
	'down'	2m 46s	4m 16s	7m 03s
Theoretical worst case (2F)		4m 51s	4m 16s	9m 08s

Notes:

UP freight trains run from Portbury to Parson Street Junction, DOWN freight trains run to Portbury

UP passenger trains run from Portishead to Bristol Temple Meads, DOWN passenger trains run to Portishead

Codes in brackets are used in scenario designation for LinSIG and VISSM modelling of the Ashton Vale Road / Winterstoke Road junction – WoS = no passenger trains; WS = MetroWest 1 tph; WS45 = MetroWest infill peak services; NF = no freight trains; 1F = 1 freight train in hour in 1 direction (either direction); 2F = 1 freight train per hour per dir)

4.2 Indicative timetables and closure sequences

Figure 2 brings together the train operating scenarios and level crossing closure times from Tables 1 and 2, and presents the timings the passage of trains at the level crossing in a typical hour. This indicates the relationship between consecutive trains passing through the level crossing in each scenario presented. Figure 3 illustrates the level crossing closures graphically. Figures 4 and 5 present similar information for scenarios based on an 'infill' (45-minute interval) peak time passenger service.

The timings in Figure 2 indicate that gaps between trains passing the level crossing will typically be around 20 minutes and 35 minutes with just MetroWest passenger services running, which is very similar to the situation if two freight trains were to run in the same hour today. With MetroWest passenger services and freight trains running together, the minimum gap between trains passing the level crossing is between around 6 and 10 minutes, but in each scenario, there is a gap of at least 25 minutes at some point in a typical hour. If an 'infill' peak service was introduced, minimum gaps could fall to around 3-5 minutes, though again a gap of between 25 and 30 minutes between trains would still occur at some point in the sequence.

5.0 Summary

MetroWest Phase 1 will introduce regular passenger trains to the Portbury/Portishead line, serving Portishead on an hourly basis. This will in turn entail two closures of the Ashton Vale Road level crossing to traffic being added to existing freight train closures. Currently though, while freight trains could run on the Portbury dock line once or twice an hour, there are actually only a few trains a week, and sometimes none on any given day.

As such, in most typical hours, the Ashton Vale Level crossing will close twice; 1m 50s for a 'down' passenger train from Bristol Temple Meads to Portishead; and 2m 05s for an 'up' passenger train from Portishead. An additional closure of either 1m 50s or 2m 05s would also occur if a there is a freight train to or from the port (respectively).

Gaps between trains, and hence closures of the level crossing to traffic, will be around 20 mins and 35 mins with 1 passenger train per hour per direction and no freight trains, reducing to 6-10 minutes if a freight train runs. In each scenario though, there is one gap of at least 25 minutes between trains.

SCENARIO	Note that this is for a standard hour, so times also apply to other hours			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
CURRENT - 5/6 times a week 2	1 freight train per hr (up) - NO passenger trains						estimated
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
				TOTAL /hr	02:05		
CURRENT - 5/6 times a week 1	1 freight train per hr (down) - NO passenger trains						estimated
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
				TOTAL /hr	01:50		
CURRENT - theoretical maximum (rarely occurs)	1 freight train per hr per dir - NO passenger trains						estimated
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
				TOTAL /hr	03:55		
FUTURE - most of the time	1 passenger train per hr per dir - NO freight trains						estimated
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	19:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	03:55		
FUTURE - absolute worst case (would rarely occur)	1 passenger train per hr per dir - 1 freight train per hr per dir						1 Unit B
	Pasenger	UP	from Portishead	08:54:25	02:05	08:56:30	11:25
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	09:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	05:40
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	25:25
				TOTAL /hr	07:50		
FUTURE - realistic worst case 2	1 passenger train per hr per dir - 1 freight train per hr in one direction (up)						1 Unit CU
	Passenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:25
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	08:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	06:00		
FUTURE - realistic worst case 1	1 passenger train per hr per dir - 1 freight train per hr in one direction (down)						1 Unit CD
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:10
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	09:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	05:45		

Figure 2: Ashton Vale Road Level Crossing closure times in a standard hour (table)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Figure 3: Ashton Vale Road Level Crossing closure times in a standard hour (chart)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

SCENARIO	Note that this is for a standard hour, so times also apply to other hours			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
CURRENT - 5/6 times a week 2	1 freight train per hr (up) - NO passenger trains						estimated
	Freight	UP	from Portbury	07:08:55	02:05	07:11:00	57:40
	Freight	DOWN	to Portbury	08:08:40	01:50	08:10:30	58:25
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
				TOTAL /hr	02:00		
CURRENT - 5/6 times a week 1	1 freight train per hr (down) - NO passenger trains						estimated
	Freight	DOWN	to Portbury	07:08:40	01:50	07:10:30	58:25
	Freight	UP	from Portbury	08:08:55	02:05	08:11:00	57:40
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
				TOTAL /hr	01:55		
CURRENT - theoretical maximum (rarely occurs)	1 freight train per hr per dir - NO passenger trains						estimated
	Freight	UP	from Portbury	07:07:55	02:05	07:10:00	17:10
	Freight	DOWN	to Portbury	07:27:10	01:50	07:29:00	38:55
	Freight	UP	from Portbury	08:07:55	02:05	08:10:00	17:10
	Freight	DOWN	to Portbury	08:27:10	01:50	08:29:00	38:55
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
				TOTAL /hr	03:55		
45-minute - no freight	1 passenger train every 45 mins per dir - NO freight trains						estimated
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	36:55
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	36:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	36:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	36:55
				TOTAL /hr	05:13		
45-minute - absolute worst case (would rarely occur)	1 passenger train every 45 mins per dir - 1 freight train per hr per dir						45 minute cycles
	Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
	Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	25:25
	Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
	Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	10:55
	Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
	Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	20:55
	Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
	Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	20:55
				TOTAL /hr	10:27		
45-minute - realistic worst case 2	1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (up)						estimated
	Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	31:55
	Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	21:55
	Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	31:55
	Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	31:55
				TOTAL /hr	08:00		
45-minute - realistic worst case 1	1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (down)						estimated
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
	Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	30:25
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
	Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	25:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
	Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	25:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
	Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	25:55
				TOTAL /hr	07:40		

Figure 4: Ashton Vale Road Level Crossing closure times in 3-hour period for 45 min 'infill' service (table)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

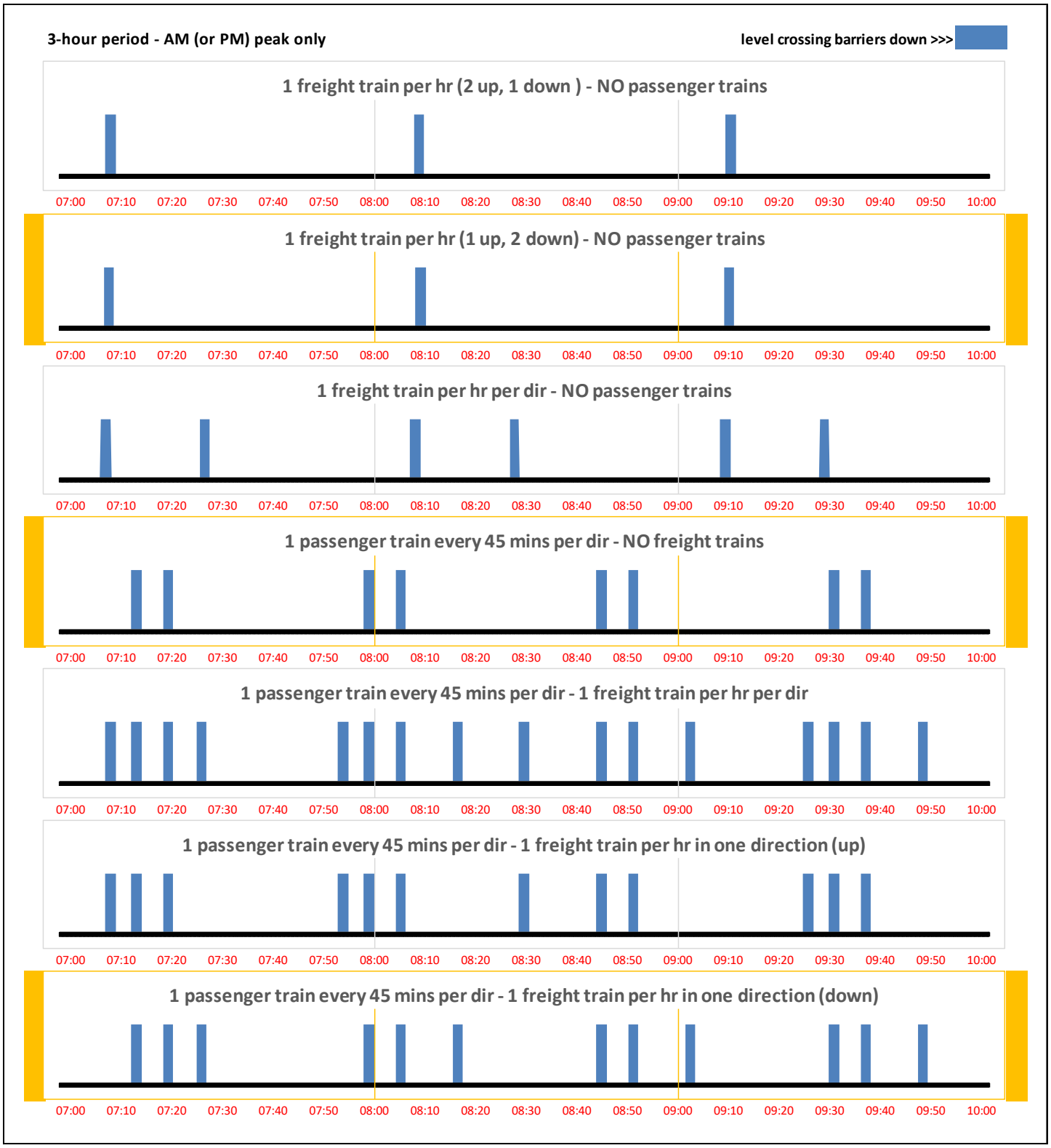


Figure 5: Ashton Vale Road Level Crossing closure times in 3-hour period for 45 min 'infill' service (chart)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Part 4:
Junction Modelling – LinSIG

Contents:

- Technical Note: 'MetroWest Phase 1, A3029 Winterstoke Road/Ashton Vale Road – LinSIG Modelling', 6th July 2018

TECHNICAL MEMORANDUM

MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road – LinSIG Modelling

PREPARED FOR:	North Somerset Council
PREPARED BY:	DL
APPROVED BY:	HS
DATE:	6th July 2018
PROJECT NUMBER:	674946.CS.70.01
REVISION NO.:	Version 0.1

1.0 Introduction

CH2M is currently updating a Transport Assessment (TA) in support of the MetroWest Phase 1 proposals involving the re-introduction of passenger rail services between Bristol and Portishead. The increase in use of existing sections of the railway line could mean that closure times at the level crossing on Ashton Vale Road adjacent to the A3029 Winterstoke Road/Ashton Vale Road signal controlled junction (see **Figure 1**) could be more frequent, resulting in a greater impact on operational conditions on the local highway network.

Figure 1: A3029 Winterstoke Road/Ashton Vale Road, Existing Layout

The purpose of this Technical Note is to present the results of LinSIG modelling which assesses the impact of an hourly MetroWest rail service in each direction, and to support the introduction of the proposed mitigation measures at this junction which includes:

- The extension of the left turning lane into Ashton Vale Road on the Winterstoke Road northbound approach; and
- The introduction of MOVA control (Micro-processor Optimised Vehicle Actuation)

The Technical Note is structured as follows:

- Section 2 explains how the existing Method of Control at the junction works now. It also presents the LinSIG assessment results for the existing layout; and
- Section 3 considers a typical 'closure' scenario with a passenger train passing through the junction. Unlike the base-line scenario which considers a recurrent stage sequence over the full duration of each weekday peak hour, these analyses focus attention on a shorter period covering the level crossing barrier 'down' time and the following one to two signal cycles; and
- Finally, Section 4 provides a summary and conclusions concerning the likely impact of a 'closure' on the overall junction capacity and operating conditions on Ashton Vale Road.

2.0 Base Modelling Assessment

2.1 Traffic Data

Traffic flows for these assessments have been taken from a turning count survey undertaken by North Somerset Council (NSC) on carried out on Tuesday 9th May 2017. These 'base year' traffic flows were converted to passenger car units (PCUs) through the application of the following PCU factors: cars and LGVs = 1, HGVs = 2.3, buses = 2.5, motorcycles = 0.4 and pedal cycles = 0.2.

In the May 2017 survey, the count undertaken on the northbound Winterstoke Road approach did not differentiate between the two 'straight-ahead movement to Ashton Gate underpass (Phase A) and that to Ashton Road for the A370 West/A369 (Phase G). As such, the proportional split observed in the MCC survey undertaken in March 2016 was used. As noted later blow, this 'split' is particularly critical in the weekday AM peak hour, when the flow to Ashton Gate underpass is particularly dominant.

During the May 2017 survey the junction was affected by the AVTN (MetroBus) works in the area, insofar as the separate left turn lane into Ashton Vale Road was closed off by coning. Separate ATC counts undertaken on Thursday 15th to Wednesday 28th March 2018 have subsequently been used to verify that, despite these works, the flows throughout the day on Tuesday 0th May 2017 were typical of normal weekday conditions and were not reduced. A full comparison of count data available for the Winterstoke Road/Ashton Vale Road/Marsh Road junction is contained in the report '**MetroWest Phase 1 Ashton Vale Road Traffic Counts**', dated 22nd June 2018

Traffic demand sets were created for the AM (8:00-9:00 am) and PM (5:00-6:00 pm).

2.2 Modelling Methodology

2.2.1 General

The junction layout, including number of lanes and flare lengths, was coded into LinSig using as-built layout information from NSC. Lane saturation flows were based on RR67 calculations using the geometry taken from the layout drawing. Observations of peak hour conditions and the traffic data suggests that there are specific issues which affect the operation of the junction, and which needed to be reflected in the modelling as follows:

- The split in the A3029 Winterstoke Road northbound 'straight-ahead' movement between traffic heading inbound via the Ashton Gate underpass and vehicles travelling outbound on the A370/A369. The March 2016 MCC showed that the movement toward the underpass was notably more dominant, particularly in the AM peak. This is critical, as this movement is catered for by the lane immediately adjacent to the short 'flared' left turn lane into Ashton Vale Road. As such, excess queuing in the left turn flare exceeding the storage capacity of this short lane could have significant implications for operational conditions. As noted above, the appropriate traffic split for each peak hour was taken from the March 2016 MCC, when these movements were separately counted;

- The amount of left turning traffic capable of storing within the left turn flare during a level crossing closure before the adjacent ahead lane is impeded. Video survey footage of the junction during a level crossing closure showed that around eight or nine vehicles could be accommodated in this lane before the queue encroached onto the adjacent ahead lane, this blocking and impeding the 'ahead' movement to the Ashton Gate underpass. However, there is some potential for vehicles to use the ghost island hatching to bypass queuing extending from the left turn lane for a short length. Taking all this into consideration, a left turn flare length of 10 PCUs was used in the LinSIG modelling;
- Exit blocking from the Ashton Gate underpass in the AM peak hour due to capacity limitations imposed by the merging/weaving capacity at the slip-road entry to the A370 Brunel Way. No specific allowance was made for this by, say, lowering the calculated saturation flow for this 'straight-ahead' movement (Phase A). However, the performance here was checked in the 'closure' scenario tests to ensure that effects did not result in a large increase in the Degree of Saturation for Phase A, to the extent that a close to capacity situation could be a possible outcome under 'free exit' conditions;
- The respective driver usage of the two approach lanes on the southbound Winterstoke Road from Brunel Way. Whilst both entry lanes can cater for the 'straight-ahead' movement, the outer lane on exit eventually terminates as a right turn only lane at the downstream roundabout junction with Barons Close and Wedlock Way. As the dominant southbound movement at the roundabout is 'ahead' on the A3029, drivers electing to use the outside lane on approach to the Marsh Road junction must at some point make a lane change into the nearside lane on exit, although the distance available to do this is some 260 metres. Notwithstanding this, site observations show that there is dis-utility of this outer lane when compared to the nearside lane. To reflect this imbalance in lane usage it was assumed that 'ahead' driver use was equally likely. This together with a relatively high left turn flow into Marsh Roade created a high bias towards use of the nearside lane.

2.2.2 Signal Controller: Method of Control and Operating Mode

Normal Method of Control

Traffic signal controller parameters such as phase minima, phase inter-green values and stages were input in accordance with the controller configuration (TR2500) supplied by the Bristol City Council Traffic Signals team.

Under 'normal' cyclic operating conditions with no level crossing closure, and 'demands' present for all phases including all pedestrian crossings, the signals can operate on a 1-2-3-4-5-6 staging sequence as shown in **Figure 2**.

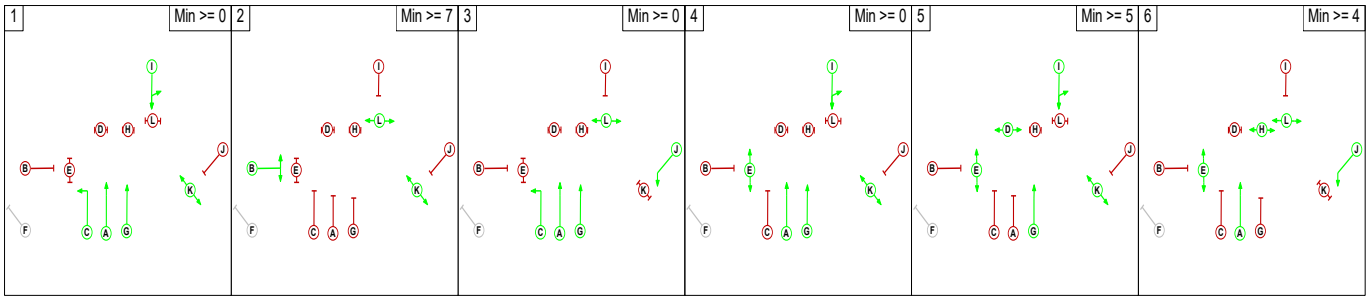


Figure 2: A3029 Winterstoke Road/ Ashton Vale Road 'Normal' Staging Sequence

It is important to note that lot of these stages will only appear if there is a demand for a specific phase, which may not occur cyclically. Examples include:

- Stage 3: which only appears if there is a demand for Marsh Road (Phase J);
- Stage 4: which only occurs normally if there if a demand for the pedestrian crossing over Ashton Vale Road (Phase E). However, as noted later, a level crossing input will prevent the appearance of Stages 1, 2 and 3 and, as such, demands for Phases A, G or I on Winterstoke Road will call/extend Stage 4 under this scenario;
- Stage 5: which only appears if there is a demand for the pedestrian crossing over the exit to the Ashton Gate underpass (Phase D); and
- Stage 6: which only appears if there is a demand for the pedestrian crossing over the exit to the westbound A370 and A369 (Phase H).

As such, 'base case' modelling of a 1-2-3-4-5-6 stage sequence every cycle can be considered a 'worst case' typical scenario in the absence of the specific consideration of a level crossing closure event.

Effect of a Level Crossing Closure

During a period when the level crossing on the Ashton Vale Road arm is down, the signal controller is configured to run a stage sequence that prevents both the left turn into Ashton Vale Road and the movement out from this side road from appearing, but enables other movements to operate as normal. This has the effect of suppressing or preventing the appearance of Stages 1-3, with only the stages shown in **Figure 3** allowed to operate. As before, this sequence assumes that all pedestrian crossing phases are demanded, which call Stages 5 and 6. Stage 4 will be called and extended by Phases A, G and I. It is important to note that the critical phases on Winterstoke Road are kept running in Stage 4 during a level crossing closure, with potential continuity only interrupted in the northbound direction by a demand for the crossing on the Ashton Gate underpass exit (Phase D) and in the southbound direction by a demand for Marsh Road or the crossing over the A370 West/A369 exit (Phases J and H).

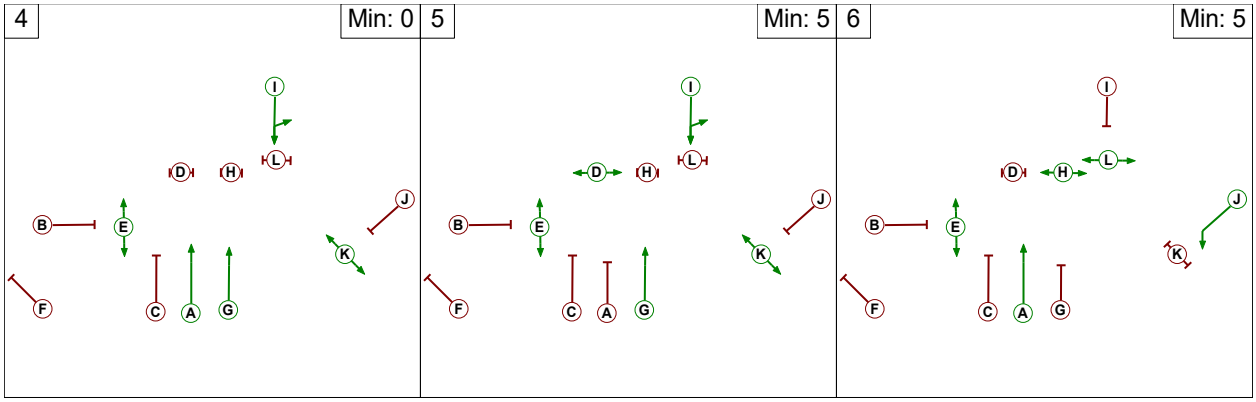


Figure 3: A3049 Winterstoke Road/ Ashton Vale Road: Level Crossing Closure Staging Sequence

Mode of Operation

Although most of the traffic signals in the City Centre operate under the centralised SCOOT UTC system as the normal mode of control, the Winterstoke Road/Ashton Vale Road junction operates under 'local' Vehicle Actuated (VA) mode. This decision is largely influenced by the need to make specific 'stage allowance' intervention in the event of a level crossing closure, which is most easily handled by local controller conditioning of the VA control. Under VA control the ability of the

controller to respond to fluctuating traffic conditions, which would include a post level crossing closure situation, is governed by the allowable phase maximums in the different time of day plans (MAX SETS).

In the weekday AM (7:00-10:00 am) and PM peak (3:00-7:00 pm) periods the current operational MAX SETS are MAX B and MAX C. The VA configuration settings in terms of the maximum time a phase green can run in these two weekday periods are set out below:

Phase	MAX B	MAX C	Notes
A	40	30	A3029 Northbound: To Ashton Gate Underpass
B	20	24	Ashton Vale Road
C	20	20	Left turn to Ashton Vale Road
D	0	0	Pedestrian crossing: No MAX
E	0	0	Pedestrian crossing: No MAX
F	0	0	Unused Phase
G	30	20	A3029 Northbound: To A370(W) and A369
H	0	0	Pedestrian crossing: No MAX
I	60	70	A3029 Southbound
J	12	12	Marsh Road
K	0	0	Pedestrian crossing: No MAX

The important points to note are as follows:

- Phase I controlling the southbound A3029 is the one having the ability to drive up the operational cycle time, and can extend up to 70 seconds in the PM peak (Stage 1). Under a level crossing closure scenario, it can similarly extend Stage 4;
- Ashton Vale Road is currently tightly constrained under VA, and can only extend Stage 2 for up to 24 seconds in the critical PM peak period (even if a longer green time was in fact needed after a level crossing closure). Altering the mode of control here to MOVA would allow greater opportunity for increasing the maximum green time allowable for Phase B. This is because, unlike VA, MOVA monitors the density of traffic discharge during green and would not allow Ashton Vale Road to run an unnecessarily long green time to the detriment of Winterstoke road if the headways or 'gaps' between vehicles crossing the stop-line became unduly extended. The same principle would apply in the MOVA monitoring of other traffic phases running on green in other stages.

2.3 Assessment Results

2.3.1 No Closure Scenario

Two scenarios have been considered for the weekday AM and PM peak periods as follows

- A 'full' stage sequence of 1-2-3-4-5-6 with timings optimised to give the most likely operational cycle time. In doing so, the resultant phase timings were checked to ensure that phase maximums (VA) were not violated. If so, any falling beyond the allowable MAX were adjusted to the maximum permissible in the respective period; and
- An assumed 1-2-3-4-5-6 stage sequence with all phases running to their allowable maximums. This give the maximum cycle the controller 'could' run to now in the weekday peak periods. It should be noted, however, that this may not necessarily be the most efficient use of green time, as it is often the case that MAX Plan timings can become out-of-date and may not necessarily reflect the relative proportions of green time needed by critical phases with the current traffic pattern.

Tables 1 and 2 below compare the results of the LinSig assessments for the AM peak hour (8:00-9:00 am). Full LinSIG summary results are included in **Annex A**.

Table 1: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - OPTIMISED - AM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	230/719	61.6%	8	7.7/21.1
A3029 NBD: to A370(W) and A369	357	26.2%	3	5.7
Ashton Vale Road	114	89.1%	7	145.6
A3029 SBD: Including LT to Marsh Road	898/578	89.8%/55.9%	22/9	29.9/14.0
Marsh Road	211	75.5%	6	49.6

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an optimum cycle time of 118 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

Table 2: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - VA MAXIMA -AM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	230/719	66.7%	12	11.2/13.3
A3029 NBD: to A370(W) and A369	357	27.3%	5	9.2
Ashton Vale Road	114	42.0%	5	68.3
A3029 SBD: Including LT to Marsh Road	898/578	94.6%/58.9%	35/12	58.2/24.1
Marsh Road	211	76.4%	9	68.1

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled with all phases assumed to run the allowable MAX (VA). In the AM peak period this would give a MAX cycle of 146 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

The results for this period show that:

- Results are heavily influenced by the respective assumed usage of the two approach lanes on the southbound A3029 entry from Brunel Way;
- Under the 'optimised' scenario the controller runs Ashton Vale Road on a minimum green time given the low demand in this period. This results in high delays which are not reflected in journey times used in parallel VISSIM modelling. Part of the reason is possibly the pessimistic assumption that all stages appear cyclically. However, in practice, the VA MAX setting for Ashton

Vale Road (20 seconds) will allow this stage to run longer than the minimum as required. Table 2 shows the result with Ashton Vale Road operating at its MAX, which shows a degree of saturation of only 42.0% and average delay more than halved; and

- It is clear from the LinSIG analyses for this period that the critical approaches governing junction performance are West Ashton Road and the southbound A3029 (Phases B and I). Whilst the northbound flow on the A3029 to Ashton Gate Underpass is also high in this period, it is evident that the constraint on flow is likely to be the downstream merge/weave capacity onto Brunel Way, as opposed to 'potential' stop-line capacity here.

Tables 3 and 4 below show the corresponding results for the weekday PM peak hour (5:00-6:00 pm).

Table 3: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - OPTIMISED - PM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	37/774	60.7%	13	11.2/25.3
A3029 NBD: to A370(W) and A369	407	30.8%	6	8.4
Ashton Vale Road	232	87.3%	13	108.1
A3029 SBD: Including LT to Marsh Road	906/521	89.6%/49.5%	28/11	33.9/16.1
Marsh Road	139	62.8%	4	53.0

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an optimum cycle time of 149 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

The PM peak hour results, when outflow from Ashton Vale Road is more critical, shows similar features to the AM peak hour scenario. These are as follows:

- The critical phases governing junction operation and performance again are Ashton Vale Road and the southbound A3029 approaches (Phases B and I). As before, results are heavily influenced by the relative lane usage or 'bias' assumed on the southbound Winterstoke Road entry;
- In the 'optimised' scenario, the results assume that Ashton Vale Road gets 'and needs' 20 seconds which is just below its allowable VA MAX of 24 seconds in this period. In consequence the results for Ashton Vale Road in Tables 3 and 4 are similar, whereas there was a big difference in the AM (Tables 1 and 2). A key point to note is that there is little or no slack in the allowable MAX for this side road to deal with a need for compensating green time when a level crossing closure occurs now due to existing freight services.

It is notable that, unlike the AM peak hour, the 'optimised' cycle time in the PM peak at 149 seconds is very close to its operational MAX under VA (160 seconds). The results show that, with all phases allowed to run to the MAX, there is little operational benefit, with the nearside lane on the southbound A3029 running at just over practical capacity (90.0%).

Table 4: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - VA MAXIMA - PM

Arm/Movement)	Operating Statistics			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	37/774	61.1%	15	13.4/12.9
A3029 NBD: to A370(W) and A369	407	30.9%	6	9.1
Ashton Vale Road	232	78.7%	12	92.1
A3029 SBD: Including LT to Marsh Road	906/521	92.7%/51.3%	36/11	53.9/22.6
Marsh Road	129	55.2%	6	62.3

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled with all phases assumed to run the allowable MAX (VA). In the PM peak period this would give a MAX cycle of 160 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

2.3.2 With Level Crossing Closure

The above modelling for the normal situation has assumed that no level crossing closure occurs throughout the modelled hours. However, a full 1-2-3-4-5-6 stage sequence is assumed to occur cyclically in determining typical delays/queues each cycle over the hour. In mimicking the effect of a level crossing closure the same approach cannot be used. This because closures will be limited to a small number of specific events in each hour. In other words, they will not occur cyclically.

To model a 'closure event' with LINSIG a smaller timeframe was employed to mimic a set number of cycles incorporating:

- A pre-closure cycle running optimised timings as described above;
- One or two cycles running the 'closure' 4-5-6 stage sequence during the expected barrier down-time. In separate work undertaken examining passenger train service scenarios associated with MetroWest it is estimated that the duration of the level crossing down-times would be as follows:
  - 2 minutes and 5 seconds for a train coming from Portishead; and
  - 1 minute and 50 seconds for a train going to Portishead.
- A post-closure cycle (or cycles) running extended 'compensatory' green time for Ashton Vale Road as required. The objective of this was to ascertain how much green time beyond the current VA Maxima would be needed to clear the build-up of queuing on Ashton Vale Road following a closure, and whether this could be actioned in a single cycle or need more.

Tables 5 and 6 below show the bespoke modelling of a four-cycle sequence for a closure 'event' within each hour comprising the following sequence 1-2-3-4-5-6-4-5-6-4-5-6-1-2-3-4-5-6. This gives rise to the following modelled time internal:

- AM: A 373 second period comprising an initial optimum cycle of 118 seconds, two cycles with a 4-5-6 stage sequence within the 125 second 'closure' period and a following 'necessary' compensatory cycle (determined as 130 seconds); and

- PM: A 434 second period comprising an initial optimum cycle of 149 seconds, two cycles with a 4-5-6 stage sequence within the 125 second 'closure' period and a following 'necessary' compensatory cycle (determined as 160 seconds). Note that the length of the compensatory cycle was not assumed to be longer than the MAX that the controller could operate at now in the PM peak period.

To model these smaller time periods, it was necessary to 'scale' the hourly traffic flows to represent the arrival demand expected over the four cycles considered.

Table 5: Winterstoke Road/Ashton Vale Road: Level Crossing Closure Event (4nr cycles) - AM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	24/74	83.4%	31	16.4/54.4
A3029 NBD: to A370(W) and A369	37	26.8%	5	6.0
Ashton Vale Road	12	87.9%	10	138.1
A3029 SBD: Including LT to Marsh Road	95/57	88.4/55.3%	30/10	31.4/14.2
Marsh Road	22	82.9%	8	57.4

Notes:

A 1-2-3-4-5-6-4-5-6-4-5-6-1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an overall time of 373 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane

Table 6: Winterstoke Road/Ashton Vale Road: Level Crossing Closure Event (4nr cycles) - PM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	4/92	62.7%	18	15.4/42.6
A3029 NBD: to A370(W) and A369	48	26.8%	9	9.4
Ashton Vale Road	27	88.6%	20	129.7
A3029 SBD: Including LT to Marsh Road	107/61	88.3/48.5%	40/13	39.1/19.2
Marsh Road	16	60.2%	6	58.7

Notes:

A 1-2-3-4-5-6-4-5-6-4-5-6-1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an overall time of 434 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane

The results and LinSIG models show that:

AM Peak Hour

- Although the northbound A3029 traffic to the underpass/Ashton Vale Road remains within the stop-line capacity achievable, there is a local increase in the mean maximum queue (8-31 PCU) due to the blocking effect of left turning traffic faced with a longer delay during the 'closure'. As such, the proposed extension of the left turn lane proposed as mitigation is wholly justified. This has not been modelled in this LinSIG work per-se, but can be expected to improve conditions by reducing the risk of impedance to northbound straight-ahead traffic accessing the underpass;
- Any additional build-up of queuing traffic on Ashton Vale Road would easily be dealt with by a slightly longer green time for this arm in the post-closure 'normal' cycle. The analyses suggest that the 'typical' cycle time would need to rise from 118-130 seconds, giving a green time of 18 seconds for Ashton Vale Road. It should be noted that this is within the permissible range allowed by the VA MAX setting used now in this period (20 seconds); and
- The expected number of vehicle arrivals on Ashton Vale Road in this closure period is only 12 vehicles. The maximum extent of the queue only expected to increase from 5-10 vehicles. With mean delay changing by circa 70 seconds (138.1-68.3).

PM Peak Hour

- As expected, the effect of the level crossing on the capacity/operation of the straight-ahead northbound A3029 traffic to Ashton Gate underpass is negligible. This is because the left turn into Ashton Vale Road is negligible in the PM peak hour, and even less so during a closure event;
- Any additional build-up of queuing traffic on Ashton Vale Road would need to be dealt with by a longer compensatory green time for this arm in the post-closure 'normal' cycle than is allowable for now by the current VA MAX setting (24 seconds). The analyses suggest that the 'typical' cycle time would need to rise from 149-160 seconds, with necessary green time allocated to Ashton Vale Road rising from 19-39 seconds. It is questionable whether simply increasing the VA MAX to this level would be wise, given the tendency for this mode to maintain extensions when flow rates fall well below 'saturated' level. As such, it would have to accepted that full 'compensation' may take more than one cycle to achieve (with VA mode maintained), or MOVA control introduced. The latter would allow a higher MAX time to be employed for Ashton Vale Road with greater confidence, in the knowledge that this mode of control actively monitors the 'gaps' in vehicle discharge in electing to hold a stage on green or force a move to another stage; and
- The expected number of 'peak' vehicle arrivals on Ashton Vale Road in this closure period is still only 27 vehicles. The maximum extent of the queue only expected to increase from 12-20 vehicles. With mean delay changing by no more than circa 38 seconds (129.7-92.1).

In overall terms, the LinSIG modelling shows that the effect of a single level crossing event with a barrier down-time for a passenger train of circa 110-125 seconds would have a limited impact on traffic conditions in Ashton Vale Road. This is because:

- The expected barrier down-time is no longer than the typical cycle times needed now in the weekday AM and PM peak hours. As such, drivers arriving on the Ashton Vale Road approach would, at worst, have the appearance of the stage controlling this arm curtailed only once; and
- Lost green time to Ashton Vale Road incumbent on the closure is capable of being compensated for fully in the first 'normal' cycle sequence following the event (and the lifting of the restriction on the appearance of Stage 2). Whilst the LinSIG results do predict a change in the extent of the maximum queue and average delay to drivers using Ashton Vale Road in both peak hours, the numbers of affected drivers are small whilst the change can hardly be regarded as severe in the context of NPPF.

3.0 Summary and Conclusions

This Technical Note has presented the results from LinSIG modelling of the Winterstoke Road/Ashton Vale Road signal controlled junction with typical 2017 weekday peak hour flows. The present Method of Control and mode has been discussed, as well as current operating constraints. The results presented for the 'normal' situation consider both 'optimised' cycle times, as well as the maximum cycle times the controller could give in the weekday peak hours with current VA maxima. It is important to note that, whilst this base-line case assumes no level crossing closures, it does assume that a full 1-2-3-4-5-6 stage sequence occurs each cycle. This is probably optimistic, and so pessimistic in capacity terms, as it assumes that the pedestrian crossings calling Stages 4, 5 and 6 are always demanded. This is considered unlikely in normal operation given the level of pedestrian flow in the area.

The results from the base-line testing shows that:

- Operation and so the LinSIG results are heavily influenced by the respective assumed usage of the two approach lanes on the southbound A3029 entry from Brunel Way. Whilst both entry lanes can cater for the 'straight-ahead' movement, the outer lane on exit eventually terminates as a right turn only lane at the downstream roundabout junction with Barons Close and Wedlock Way. As the dominant southbound movement at the roundabout is 'ahead' on the A3029, drivers electing to use the outside lane on approach to the Marsh Road junction must at some point make a lane change into the nearside lane on exit, although the distance available to do this is some 260 metres. A bias has been allowed for in the LinSIG modelling to reflect the higher nearside lane usage;
- It is clear from the LinSIG analyses for both periods that the critical approaches governing junction performance are West Ashton Road and the southbound A3029 (Phases B and I). Whilst the northbound flow on the A3029 to Ashton Gate Underpass is also high in the AM peak hour, it is evident that the constraint on flow is likely to be the downstream merge/weave capacity onto Brunel Way, as opposed to 'potential' stop-line capacity here;
- In the 'optimised' PM peak scenario, the results show that Ashton Vale Road gets 'and needs' 20 seconds, which is just below its allowable current VA MAX of 24 seconds in this period. A key point to note is that there is little or no slack in the allowable MAX for this side road to deal with a need for compensating green time when a level crossing closure occurs now due to existing freight services.

The results suggest that there is little reserve capacity available at the junction now in either peak hour, whilst assuming the controller runs to the maximum cycle time it can in each period does nothing to change this potential outcome or conclusion.

The analyses have then looked at the impact of a level crossing closure 'event' in each peak hour. To do this the assessments have considered a shorter four-cycle period covering a pre-closure cycle, the closure period and a post-closure cycle incorporating 'compensation' time for Ashton Vale Road. The level crossing closure period which has been modelled is 125 seconds, which has been derived from separate work on MetroWest train paths and scheduling. The results of the assessment has shown that:

- Although the northbound A3029 traffic to the underpass/Ashton Vale Road in the AM peak hour remains within the stop-line capacity achievable, there is a local increase in the mean maximum queue (8-31 PCU) due to the blocking effect of left turning traffic faced with a longer delay during the 'closure'. As such, the proposed extension of the left turn lane proposed as mitigation is wholly justified; and

- In the PM peak hour, any additional build-up of queuing traffic on Ashton Vale Road would need to be dealt with by a longer compensatory green time for this arm in the post-closure 'normal' cycle. What would be needed is greater than allowed for now by the current VA MAX setting (24 seconds). The analyses suggest that the 'typical' cycle time would need to rise from 149-160 seconds, with necessary green time allocated to Ashton Vale Road rising from 19-39 seconds. It is questionable whether simply increasing the VA MAX to this level would be wise, given the tendency for this mode to maintain extensions when flow rates fall well below 'saturated' level. As such, it would have to accepted that full 'compensation' may take more than one cycle to achieve (with VA mode maintained), or MOVA control introduced. The latter would allow a higher MAX time to be employed for Ashton Vale Road with greater confidence, in the knowledge that this mode of control actively monitors the 'gaps' in vehicle discharge in electing to hold a stage on green or force a move to another stage. In consequence, the installation of MOVA as advocated is recommended as part of MetroWest mitigation.

In overall terms, the LinSIG modelling shows that the effect of a single level crossing event with a barrier down-time for a passenger train of circa 110-125 seconds can be expected to have a limited impact on traffic conditions in Ashton Vale Road. This is because:

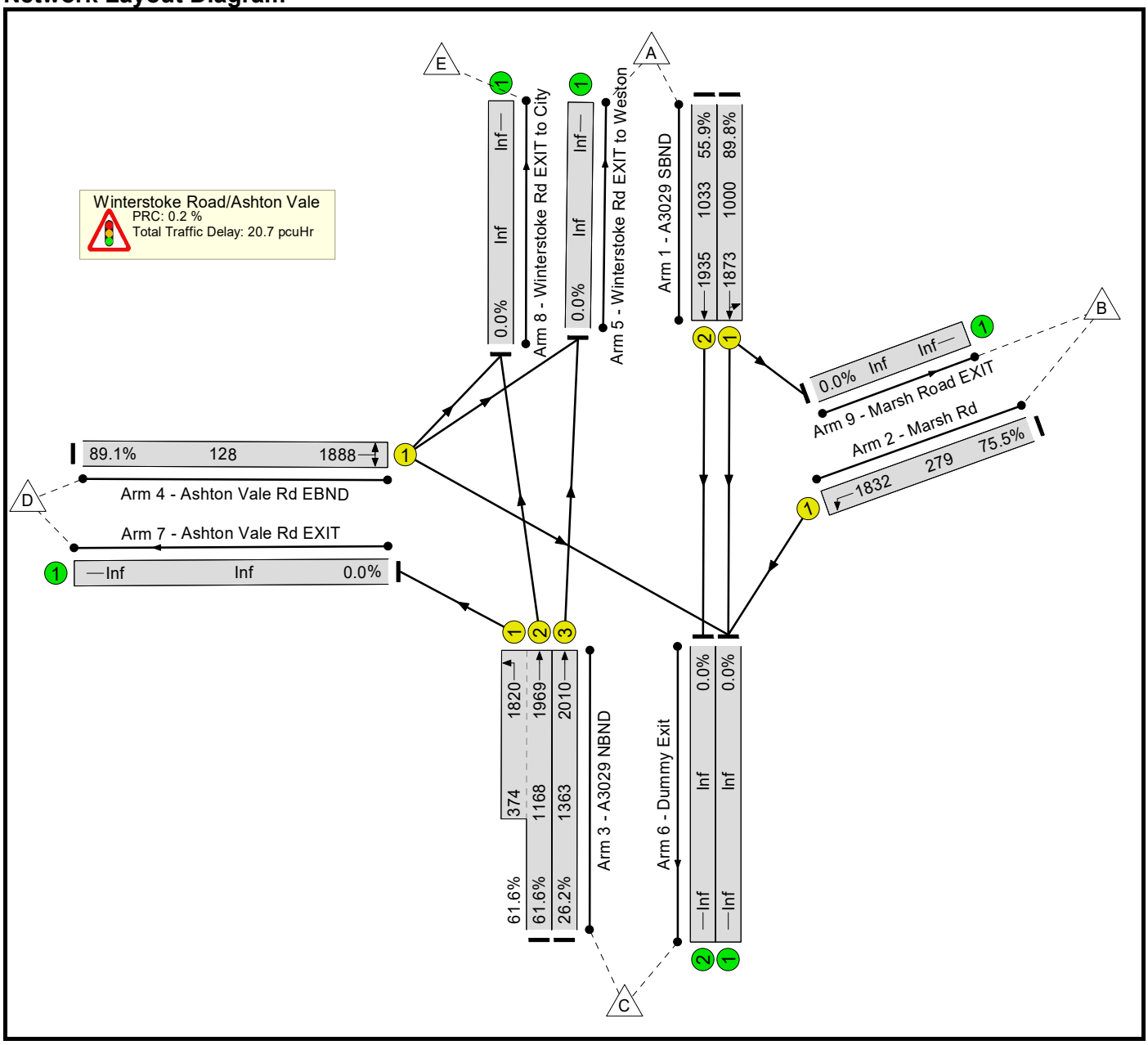
- The expected barrier down-time is no longer than the typical cycle times needed now in the weekday AM and PM peak hours. As such, drivers arriving on the Ashton Vale Road approach would, at worst, have the appearance of the stage controlling this arm curtailed only once;
- Lost green time to Ashton Vale Road incumbent on the closure is capable of being compensated for fully in the first 'normal' cycle sequence following the event (and the lifting of the restriction on the appearance of Stage 2). Whilst the LinSIG results do predict a change in the extent of the maximum queue and average delay to drivers using Ashton Vale Road in both peak hours, the numbers of affected drivers are small whilst the change can hardly be regarded as severe in the context of NPPF;
- Further to the point above, the closure frequency with two passenger trains per hour and even an intervening freight service have sufficient duration between them to ensure full 'compensation' and return to normal traffic operation is achieved between each event; and
- Whilst additional green time will be needed to clear the build-up of queuing in Ashton Vale Road post-closure, the critical southbound movement on the A3029 also benefits from less interruptions to its green time during the closure when only a 4-5-6 stage sequence operates. These effects thus tend to cancel each other out when considering the capacity retained for these critical phases over the four cycle sequence considered.

ANNEX A:
LinSIG Summary Results - Normal Operation

A3029 Winterstoke Road/Ashton Vale Road - Existing Layout and Normal Stage Sequence: No Level Crossing Closure

Scenario 4: '2017 AM (No Rail)-Optimised' (FG11: 'AM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram



Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**89.8%**	**0**	**0**	**0**	**20.7**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**89.8%**	**0**	**0**	**0**	**20.7**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	61	-	898	1873	1000	89.8%	-	-	-	7.5	29.9	21.3
1/2	A3029 SBND Ahead	U	I		2	61	-	578	1935	1033	55.9%	-	-	-	2.2	14.0	8.8
2/1	Marsh Rd Left	U	J		2	16	-	211	1832	279	75.5%	-	-	-	2.9	49.6	5.2
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	79:39	-	949	1969:1820	1168+374	61.6 : 61.6%	-	-	-	2.9 (1.5+1.3)	10.9 (7.7:21.1)	7.4
3/3	A3029 NBND Ahead	U	G		2	78	-	357	2010	1363	26.2%	-	-	-	0.6	5.7	2.9
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	7	-	114	1888	128	89.1%	-	-	-	4.6	145.6	6.6

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd

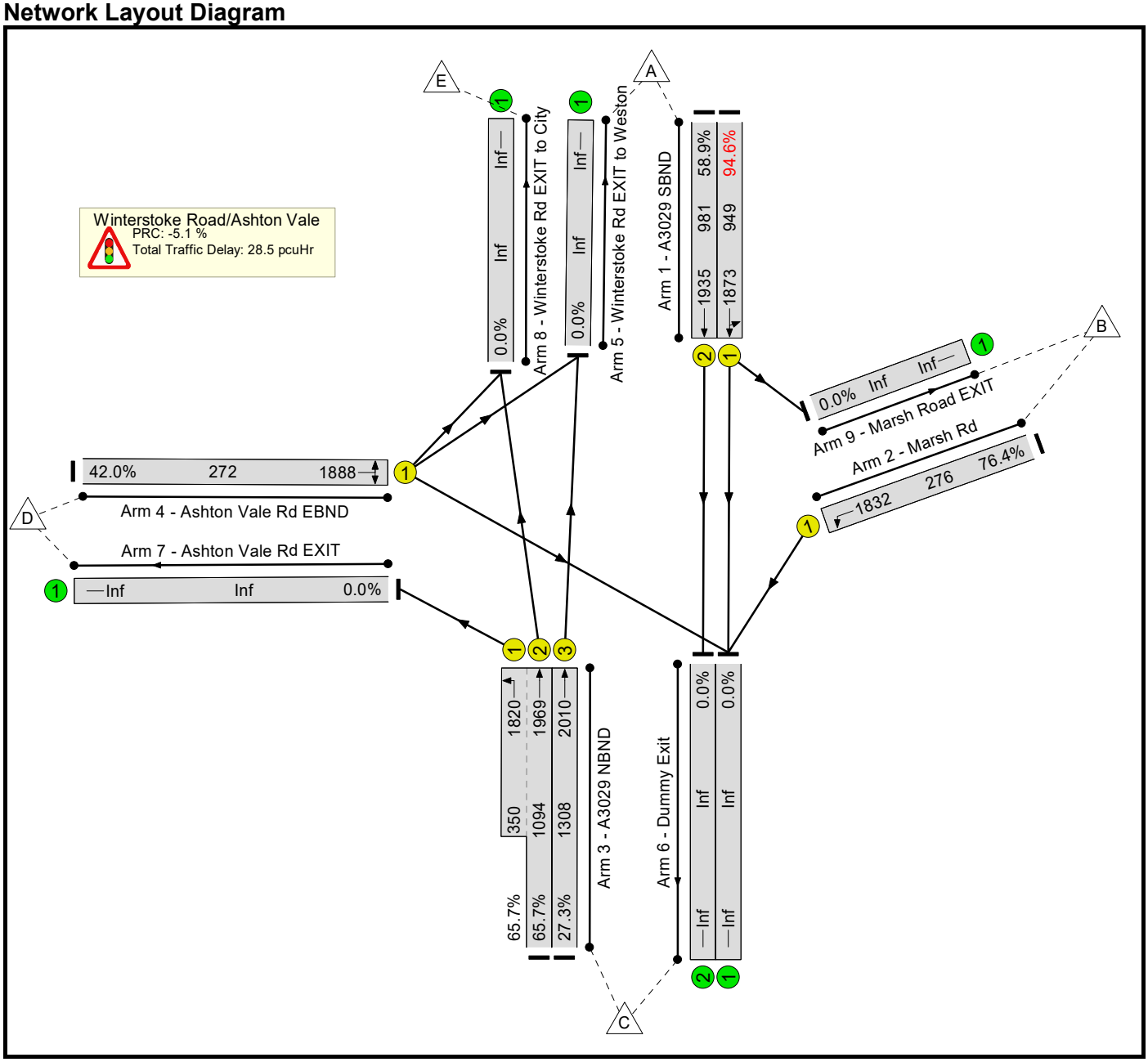
PRC for Signalled Lanes (%): 0.2
PRC Over All Lanes (%): 0.2

Total Delay for Signalled Lanes (pcuHr): 20.66
Total Delay Over All Lanes(pcuHr): 20.66

Cycle Time (s): 118

Scenario 5: '2017 AM (No Rail)-MAX VA' (FG11: 'AM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram



Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**94.6%**	**0**	**0**	**0**	**28.5**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**94.6%**	**0**	**0**	**0**	**28.5**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	72	-	898	1873	949	94.6%	-	-	-	14.5	58.2	34.6
1/2	A3029 SBND Ahead	U	I		2	72	-	578	1935	981	58.9%	-	-	-	3.9	24.1	11.3
2/1	Marsh Rd Left	U	J		2	20	-	211	1832	276	76.4%	-	-	-	4.0	68.1	8.2
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	94:74	-	949	1969:1820	1094+350	65.7 : 65.7%	-	-	-	3.1 (2.2+0.9)	11.7 (11.2:13.3)	12.0
3/3	A3029 NBND Ahead	U	G		2	93	-	357	2010	1308	27.3%	-	-	-	0.8	8.2	4.5
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	20	-	114	1888	272	42.0%	-	-	-	2.2	68.3	4.6

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd

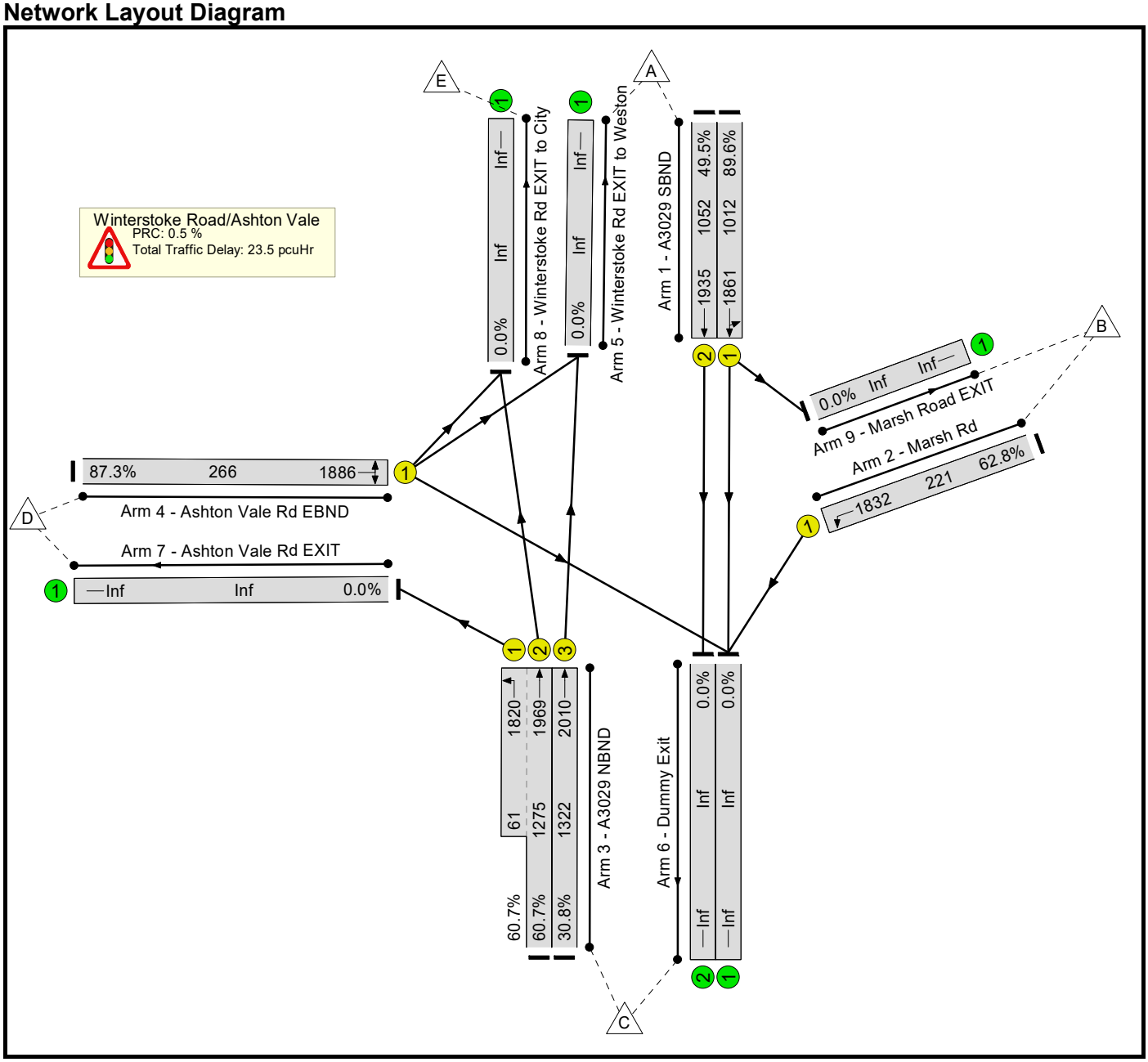
PRC for Signalled Lanes (%): -5.1
PRC Over All Lanes (%): -5.1

Total Delay for Signalled Lanes (pcuHr): 28.46
Total Delay Over All Lanes(pcuHr): 28.46

Cycle Time (s): 146

Scenario 6: '2017 PM (No Rail)-Optimised' (FG12: 'PM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram



Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**89.6%**	**0**	**0**	**0**	**23.5**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**89.6%**	**0**	**0**	**0**	**23.5**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	79	-	906	1861	1012	89.6%	-	-	-	8.5	33.9	27.9
1/2	A3029 SBND Ahead	U	I		2	79	-	521	1935	1052	49.5%	-	-	-	2.3	16.1	10.2
2/1	Marsh Rd Left	U	J		2	16	-	139	1832	221	62.8%	-	-	-	2.0	53.0	3.8
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	97:42	-	811	1969:1820	1275+61	60.7 : 60.7%	-	-	-	2.7 (2.4+0.3)	11.9 (11.2:25.3)	12.8
3/3	A3029 NBND Ahead	U	G		2	96	-	407	2010	1322	30.8%	-	-	-	0.9	8.4	5.3
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	20	-	232	1886	266	87.3%	-	-	-	7.0	108.1	12.3

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd

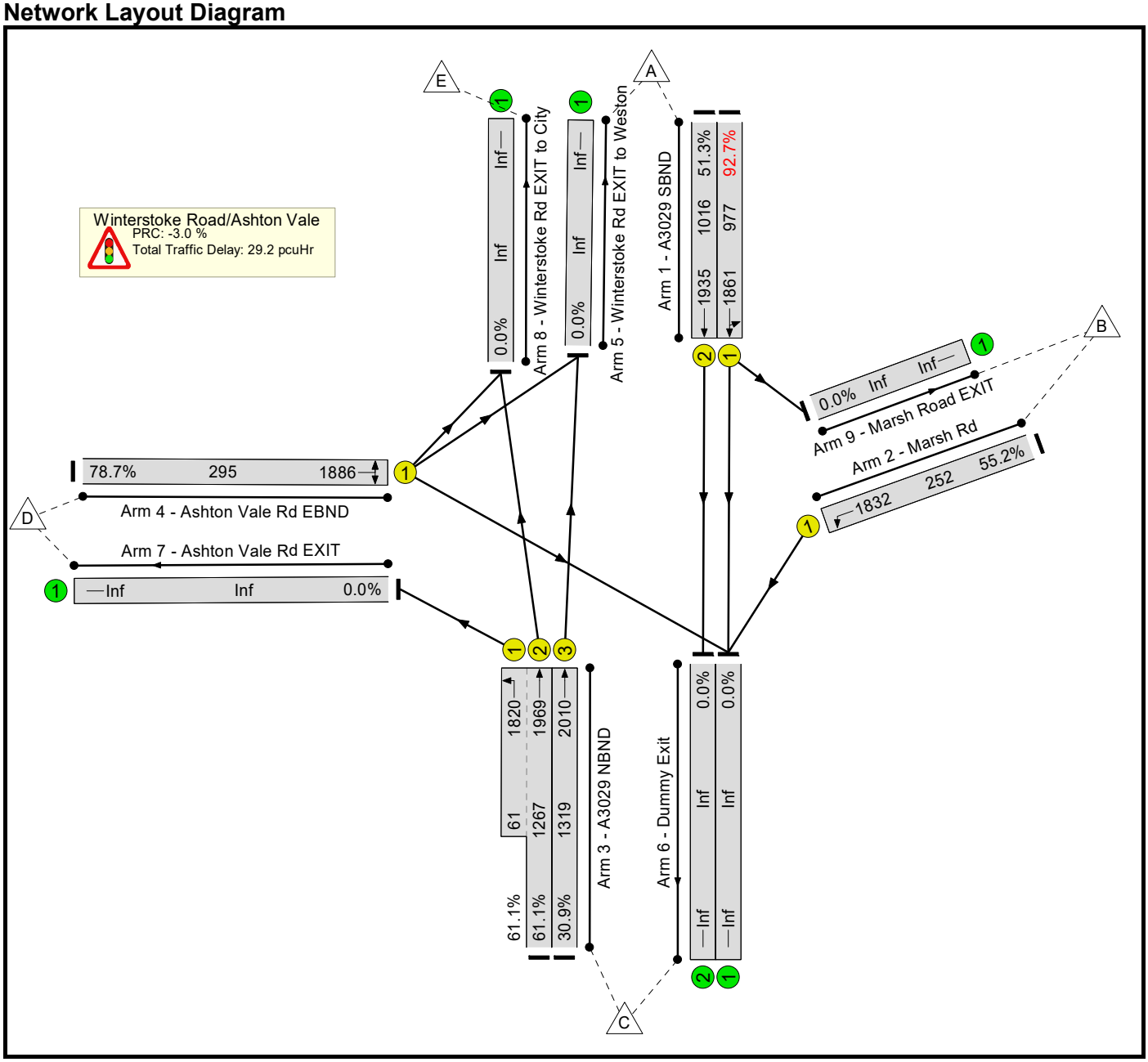
PRC for Signalled Lanes (%): 0.5
PRC Over All Lanes (%): 0.5

Total Delay for Signalled Lanes (pcuHr): 23.49
Total Delay Over All Lanes(pcuHr): 23.49

Cycle Time (s): 149

Scenario 7: '2017 PM (No Rail)-MAX VA' (FG12: 'PM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram



Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**92.7%**	**0**	**0**	**0**	**29.2**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**92.7%**	**0**	**0**	**0**	**29.2**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	82	-	906	1861	977	92.7%	-	-	-	13.6	53.9	36.0
1/2	A3029 SBND Ahead	U	I		2	82	-	521	1935	1016	51.3%	-	-	-	3.3	22.6	10.7
2/1	Marsh Rd Left	U	J		2	20	-	139	1832	252	55.2%	-	-	-	2.4	62.3	5.4
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	104:84	-	811	1969:1820	1267+61	61.1 : 61.1%	-	-	-	3.0 (2.9+0.1)	13.4 (13.4:12.9)	14.4
3/3	A3029 NBND Ahead	U	G		2	103	-	407	2010	1319	30.9%	-	-	-	1.0	9.1	5.9
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	24	-	232	1886	295	78.7%	-	-	-	5.9	92.1	11.6

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd

PRC for Signalled Lanes (%): -3.0
PRC Over All Lanes (%): -3.0

Total Delay for Signalled Lanes (pcuHr): 29.23
Total Delay Over All Lanes(pcuHr): 29.23

Cycle Time (s): 160

ANNEX B:
LinSIG Summary Results - 'With' Level Crossing Closure

A3029 Winterstoke Road/Ashton Vale Road - Level Crossing Closure EVENTS

Network Results

Scenario 8: '2017 AM (125s Closure)' (FG13: 'AM May 2017 - Closure Sequence', Plan 2: '110-125 Closure Seq')

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**88.4%**	**0**	**0**	**0**	**2.6**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**88.4%**	**0**	**0**	**0**	**2.6**	-	-
1/1	A3029 SBND Ahead Left	U	I		6	208	-	95	1874	108	88.4%	-	-	-	0.8	31.4	29.9
1/2	A3029 SBND Ahead	U	I		6	208	-	57	1935	111	51.3%	-	-	-	0.2	14.2	10.0
2/1	Marsh Rd Left	U	J		6	48	-	22	1832	27	82.9%	-	-	-	0.4	57.9	7.5
3/2+3/1	A3029 NBND Left Ahead	U	A C		6:4	250:119	-	98	1969:1820	89+29	83.4 : 83.4%	-	-	-	0.7 (0.3+0.4)	25.7 (16.4:54.4)	30.3
3/3	A3029 NBND Ahead	U	G		6	250	-	37	2010	138	26.8%	-	-	-	0.1	6.0	4.4
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		2	25	-	12	1886	14	87.9%	-	-	-	0.5	138.1	9.8

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd

PRC for Signalled Lanes (%): 1.9
PRC Over All Lanes (%): 1.9

Total Delay for Signalled Lanes (pcuHr): 2.63
Total Delay Over All Lanes(pcuHr): 2.63

Cycle Time (s): 373

Scenario 9: '2017 PM (125s Closure)' (FG14: 'PM May 2017 - Closure Sequence', Plan 2: '110-125 Closure Seq')

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**88.6%**	**0**	**0**	**0**	**3.3**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**88.6%**	**0**	**0**	**0**	**3.3**	-	-
1/1	A3029 SBND Ahead Left	U	I		6	236	-	107	1862	121	88.3%	-	-	-	1.2	39.1	39.1
1/2	A3029 SBND Ahead	U	I		6	236	-	61	1935	126	48.5%	-	-	-	0.3	19.2	12.2
2/1	Marsh Rd Left	U	J		6	48	-	16	1832	27	60.2%	-	-	-	0.3	58.7	5.5
3/2+3/1	A3029 NBND Left Ahead	U	A C		6:4	278:147	-	96	1969:1820	147+6	62.7 : 62.7%	-	-	-	0.4 (0.4+0.0)	16.5 (15.4:42.6)	18.0
3/3	A3029 NBND Ahead	U	G		6	278	-	48	2010	153	31.3%	-	-	-	0.1	9.4	8.1
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		2	58	-	27	1890	30	88.6%	-	-	-	1.0	129.7	19.8

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd

PRC for Signalled Lanes (%): 1.6
PRC Over All Lanes (%): 1.6

Total Delay for Signalled Lanes (pcuHr): 3.29
Total Delay Over All Lanes(pcuHr): 3.29

Cycle Time (s): 434

Part 5:
Junction Modelling – VISSIM

Contents:

- 'MetroWest Phase 1, Winterstoke Road/Ashton Vale Road VISSIM Model, Local Model Validation Report', 6th July 2018
- 'MetroWest Phase 1, Winterstoke Road/Ashton Vale Road VISSIM Model, Testing Report', 6th July 2018

MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report

Prepared for

North Somerset Council

July 2018

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Document history

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Reference: 674946.CS.70.01
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Version	Date	Description	Created by	Verified by	Approved by
1	15 June 2018	Draft	SS	LT	HS
2	6 July 2018	Final	SS	LT	HS

Contents

Acronyms and Abbreviations

ATC	Automatic Traffic Counter
DMRB	Design Manual for Roads and Bridge
LMVR	Local Model Validation Report
MCC	Manually Classified Count
MOVA	Microprocessor Optimised Vehicle Actuation
VPH	Vehicles Per Hour

SECTION 1

Introduction

1.1 Background

The West of England (WoE) Councils comprising of Bath & North-East Somerset, Bristol City, North Somerset and South Gloucestershire, together with the West of England Combined Authority (WCA), and working alongside Network Rail (NR), Great Western Railway (GWR) and the wider rail industry, are progressing plans to deliver a series of strategic enhancements to the local rail network over the next five years and beyond, through the MetroWest Programme. The programme currently comprises:

- the MetroWest Phase 1 scheme;
- the MetroWest Phase 2 scheme;
- the Portway Park & Ride station scheme; and
- a range of new station/re-opening schemes, subject to separate business cases and smaller scale localised enhancement schemes.

The MetroWest Phase 1 project is being led by North Somerset Council, and comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

MetroWest Phase 1 includes infrastructure to be consented through a Development Consent Order (DCO) and infrastructure which falls within Network Rail's General Permitted Development rights (the GPD works). The passenger train service is to be delivered through either the Department for Transport's re-franchising process or via a bi-lateral agreement between the four councils and a train operating company (TOC). The project is to be delivered by the rail industry and the four councils, and is being led by North Somerset Council on behalf of the four West of England (WoE) councils.

CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the Portishead Branch Line Development Consent Order (DCO) scheme (MetroWest Phase 1) proposal to reopen the Portishead line with stations at Portishead and Pill in North Somerset ("the DCO scheme").

A key element of the MetroWest Phase 1 project is reopening of the Portishead branch line, and within this is the reinstatement of passenger services on the currently freight-only Portbury dock line (which splits from the Portishead line north of Pill). As such, the scheme will therefore increase the number of trains using the level crossing on Ashton Vale Road adjacent to the Winterstoke Road/Ashton Vale Road signal controlled junction. These signals are configured such that, during level crossing closures, traffic entering and exiting Ashton Vale Road is held on red whilst the other arms are serviced within a restricted staging sequence. There is therefore a need to understand the impact of the MetroWest Phase 1 scheme on operational conditions at this junction.

1.2 Purpose of Report

The purpose of this report is to explain the methodology used in the creation of a base VISSIM micro-simulation traffic model of Winterstoke Road/Ashton Vale Road signal controlled junction and adjacent Ashton Vale Road level crossing. The results of the model calibration and validation checks are also presented. These checks aim to prove the model's fitness for purpose for assessing the impact of increased level crossing closures times on the signals associated with the MetroWest Phase 1 scheme and for testing measures aimed at alleviating the impact of longer and more frequent closures.

1.3 Structure of Report

Following this introduction, the remainder of this report is structured as follows:

- **Section 2**: Network Development, including software specification, model parameters, coverage and durations, signal timings employed and public transport routes modelled;
- **Section 3**: Model Calibration, including traffic data used, matrix development, model adjustments to improve fit and results of observed and modelled 'turning' count comparisons;
- **Section 4**: Model Validation, including results of the observed and modelled travel time comparisons and checks on the number of seed runs used; and
- **Section 5**: Summary, including overall fit of the model and an assessment of its fitness for purpose in assessing the impact of the MetroWest Phase 1 scheme and associated highway works.

SECTION 2

Network Development

2.1 Software Specification

The Winterstoke Road/Ashton Vale Road VISSIM model has been developed using Version 8.00-06 of the software. This was the latest version of the software at the time of model development.

2.2 Network Coverage

The model network includes the Winterstoke Road/Ashton Vale Road junction and its approach arms comprising the A3029 Winterstoke Road, Marsh Road and Ashton Vale Road, as well as the Ashton Vale level crossing and railway line. The extents of the modelled network can be seen in Figure 2.1.

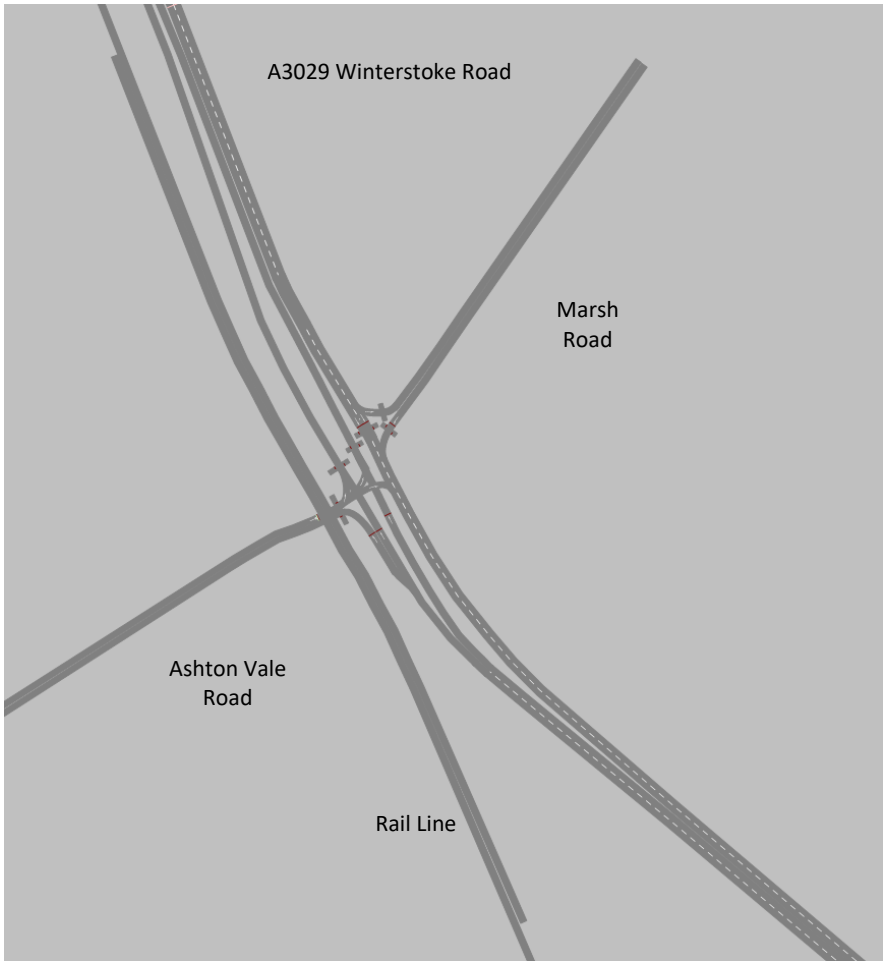

Figure 2.1: Wraxall Rd Roundabout VISSIM Model Extents

2.3 Time Periods Modelled

The model simulates the weekday morning (7:00-10:00am) and evening (4:00-7:00pm) peak periods within the local highway network.

2.4 Model Parameters

The 'urban' link type has been applied to all links within the models. The link type includes modifications to the default driver behaviour parameters as detailed in Table 2.1.

Table 2.1: Model Urban Link Type Behaviour Parameter Changes

Parameter	Value	Comments
Average Standstill Distance	1.5m	The average standstill distance defines the average desired distance between stopped vehicles. It has a variation between -1.0 m and +1.0 m which is normally distributed. The value of 1.5m represents a reduction from the default 2.0m in line with micro-simulation best-practice guidelines published by Highways England.
Number of Observed Vehicles	10	The number of observed vehicles determines how well drivers predict the movement of others and react accordingly. The value of 10 represents an increase from the default value of 4 to allow for more accurate modelling of network operation.
Reaction to Red/Amber at Signals	Stop	To account for the fact that VISSIM treats the red-amber periods at signal as green time, an adjustment to the default has been made. Doing so ensures that vehicle behaviour will more accurately reflect actual reaction times of drivers as they receive red-amber followed by green.
Waiting time before diffusion	90s	The removal of vehicles from the network (a phenomenon called 'diffusion' in VISSIM) occurs when a vehicle is unable to change lanes within a specified time due to a lack of adequate gaps. Due to traffic signal cycle times, often being in excess of 60 seconds, the default time of 60 seconds has been increased.

2.5 Network Coding

The network was created using aerial photography which was scaled to the necessary level. Aerial photography acted as a base mapping, which allowed junction geometry to be checked to ensure that the network incorporated in the model was representative. Lane widths and flare lengths have been checked using the base mapping and as-built layout information for the Winterstoke Road/Ashton Vale Road junction, together with site visit photos and Google Streetview.

2.6 Traffic Signals

A signal controller has been included within the model in order to replicate the existing signalised junction. To model the operation of the signals, the full traffic signal controller configuration was obtained from Bristol City Council. The signals within the model have been coded using VISVAP in order to accurately simulate the Vehicle Actuated (VA) mode of control in operation at the site as well as the restrictive stage sequence in operation when the level crossing is down. The relevant VA MaxSets in the controller configuration have been used in the AM and PM peak models.

SECTION 3

Model Calibration

3.1 Modelled Traffic

3.1.1 Traffic Data

To provide data for the development of the VISSIM model, traffic count information was collected at the junction. The data collected included manually classified turning counts (MCCs), journey time surveys and pedestrian counts at crossing points. These were all collected on 9th May 2017 with the counts carried out between 7:00am and 7:00pm and disaggregated at 15-minute intervals to provide in-flow profile information.

3.1.2 Validity of Data

At the time of the surveys the left turn filter lane on the Winterstoke Road northbound carriageway was closed because of traffic management associated with the Ashton Vale to Temple Meads MetroBus fly-over construction. There was therefore a concern that these works could have affected volumes at the site, with traffic levels potentially lower due to reduced capacity on the Winterstoke Road northbound approach arm.

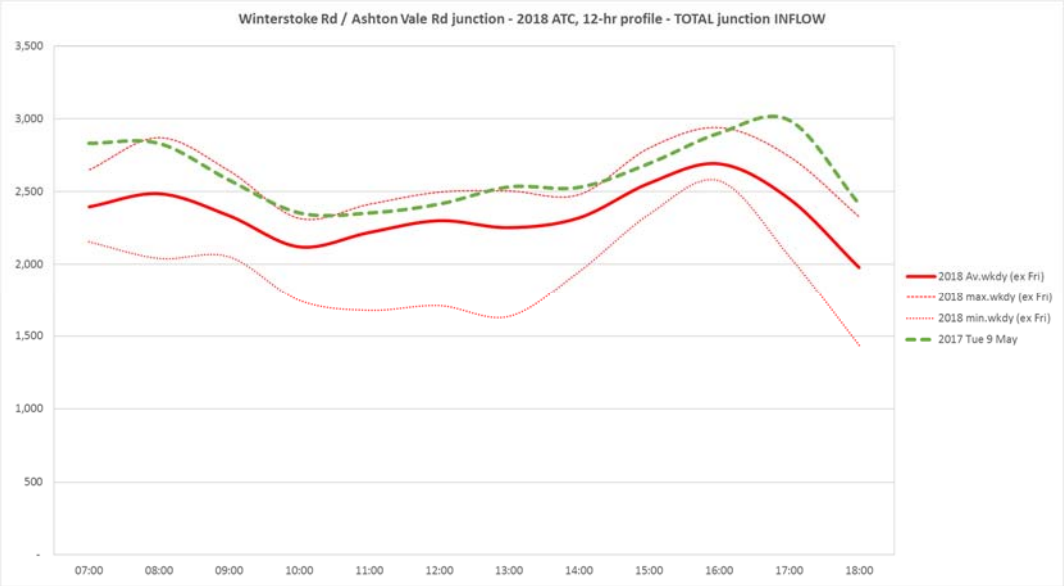

Figure 3.1: Comparison of May 2017 and March 2018 Total Junction In-Flows

A detailed analysis of various traffic counts carried out at the Winterstoke Road/Ashton Vale Road junction is presented in the 'MetroWest Phase 1: Ashton Vale Road Traffic Counts' Technical Note (May 2018). Figure 3.1 (above), which is an extract from that Technical Note, compares the 9th May 2017 count with an average, minimum and maximum total junction in-flow from counts carried out between the 15th and 28th March 2018. The graph shows that the 2017 profile indicates consistently more traffic through the junction in 2017 than an average weekday in 2018 (some 12% more).

The analyses in the 'MetroWest Phase 1: Ashton Vale Road Traffic Counts' Technical Note therefore concluded that the weekday traffic count taken in 2017 was representative of conditions that are present at the junction now in a weekday. Traffic counted has reduced slightly through the junction overall when comparing the 2017 and 2018 in-flow and very slightly at Ashton Vale Road itself, though there is a day-to-day variability in movements.

3.1.3 Vehicle Inputs/Routes

The flows used in the model have been derived through the collection, analysis and subsequent assembly of classified count data surveyed at the junction. The sum of the entry flows (from the turning counts) for each VISSIM entry point were apportioned by these turning percentages to derive the flows for use in the model. The approach ensures that any differences in traffic arrival profile and turning proportions over the modelled period are fully reflected in the model.

The Ashton Vale Level Crossing junction VISSIM model uses static assignment. Static assignment allows traffic, based on route movements, to be allocated a turning movement at the time they enter the simulation. There is no route choice within the model network and so no need to run the models to achieve assignment convergence criteria. Note that whilst vehicles have no route choice from origin to destination they are still free to select different lanes on multi-lane sections.

3.2 Model Adjustments

During the calibration process, the model network and matrices were fined-tuned to achieve the fit with the observed turning count information. Any errors, such as the incorrect specification of 'routes' defining vehicle paths through intersections, were also highlighted and corrected. Calibration adjustments were made to the 'base network' to ensure that changes would be consistent between the AM and PM model scenarios.

The 2017 traffic and journey time data used for developing the base-line model reflects volumes and conditions during the works to construct the MetroBus fly-over. As such, the base model coding assumes that vehicles cannot use the Winterstoke Road northbound left-turn into Ashton Vale Road, which was coned off at the time. This ensures that reduced capacity with its exclusion is reflected in the base model. The left turn lane will, however, be reinstated for forecasting and option testing.

3.3 Calibration Checks

Model calibration has been carried out through the comparison of observed and modelled turning movements at the Winterstoke Road/Ashton Vale Road junction for every hour modelled. These have been based on 10 seed runs with different random seed values in each modelled period.

3.3.1 Calibration Methodology

The GEH statistic has been adopted as the main indicator of the extent to which modelled flows match the corresponding observed values with a GEH of five or less indicating an acceptable level of fit as per the guidelines set out in WebTAG/DMRB (see Table 3.1). Additionally, the WebTAG/DMRB flow criteria of being within 100 vehicles per hour (vph) for flows under 700 vph, or being within 15% if greater than 700vph has also been assessed.

Table 3.1: DMRB Assignment Validation, Acceptability Criteria

Criteria and Measures	Acceptability Guideline
Assigned hourly flows compared with observed flows	
Individual flows within 15% for flows 700-2,700vph	>85% of flows
Individual flows within 100vph for flows < 700vph	>85% of flows
Individual flows within 400vph for flows > 2,700vph	>85% of flows
Total screen-line flows (>5 links) to be within 5%	All (nearly all) screen-lines
GEH statistic	
Individual flows: GEH < 5	>85% of cases
Modelled journey times compared with observed times	
Journey times within 15% (or 1 minute, if higher)	>85% of routes

3.3.2 Calibration Results

3.3.2.1 AM peak

Tables 3.2 to 3.5 present the calibration results comparing observed and modelled link and turning flows for the modelled weekday AM peak period. The results demonstrate that the modelled link flows represent a high correlation to the observed traffic data and that capacity of the signals is being correctly modelled. The link and turn count flow criteria exceeded the guidelines, with 100% of link flows and 100% of turns have a GEH<5.

The linear regression of the modelled total flows and observed total flows was also analysed. A high co-efficient correlation (R2) was achieved and the results are shown in Figure 3.2. The value of R2 =1 implies a perfect match while R2=0 an imperfect match between the observed and modelled flows. The resulting value of R2 provides further confirmation that the traffic movements at the junction are comparable with observed data to a reasonably high degree.

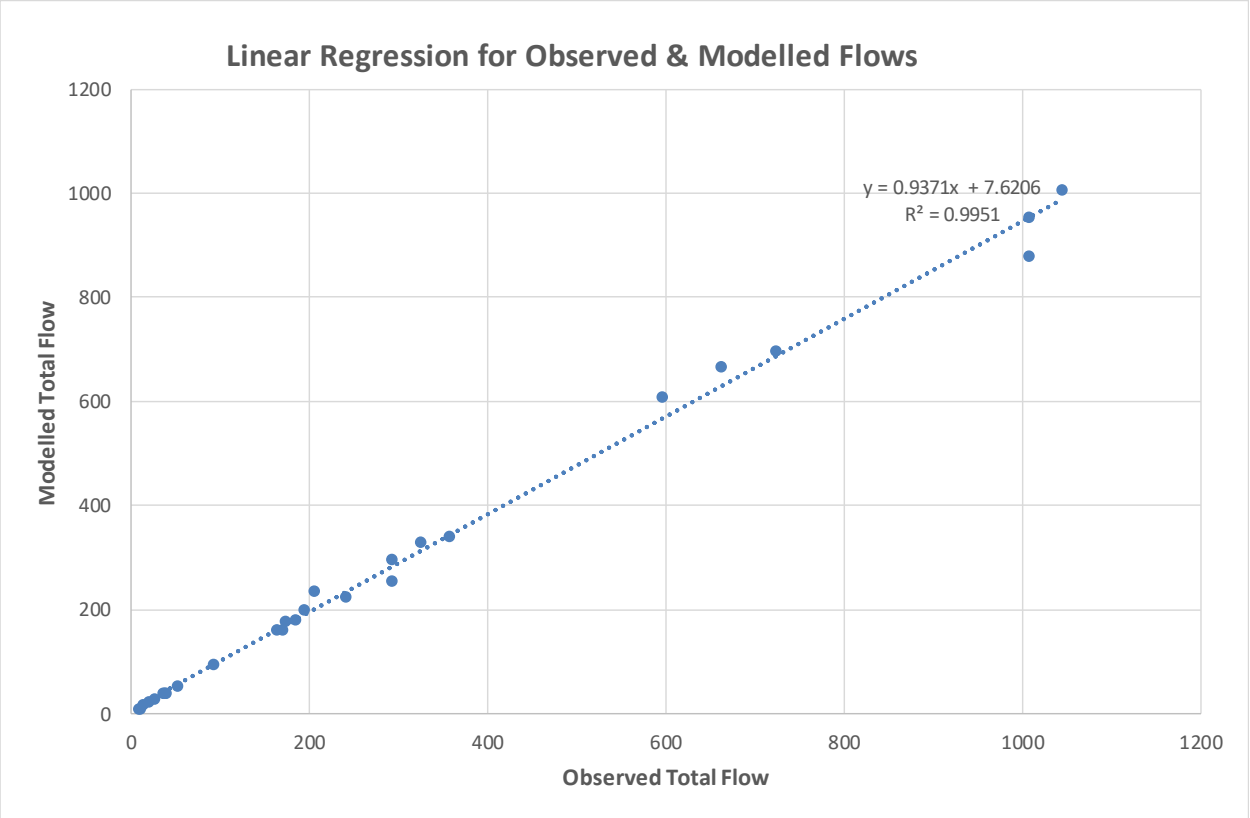

Figure 3.2 Linear Regression for Observed and Modelled Flows of the Base Model – AM Peak

Table 3.2: AM Flow Calibration (Light vehicles) - Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	1154	1125	-29	-3%	✓	✓
		Marsh Road	159	152	-7	-4%	✓	✓
		A3029 South	1167	1115	-52	-4%	✓	✓
		Ashton Vale Road	36	40	4	11%	✓	✓
	08:00-09:00	A3029 North	1239	1157	-82	-7%	✓	✓
		Marsh Road	183	187	4	2%	✓	✓
		A3029 South	1072	1073	1	0%	✓	✓
		Ashton Vale Road	50	51	1	2%	✓	✓
	09:00-10:00	A3029 North	1149	1017	-132	-11%	✓	✓
		Marsh Road	87	87	0	0%	✓	✓
		A3029 South	966	962	-4	0%	✓	✓
		Ashton Vale Road	70	69	-1	-1%	✓	✓

Table 3.3: AM Flow Calibration (Heavy's vehicles) – Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	60	61	1	2%	✓	✓
		Marsh Road	6	8	2	33%	✓	✓
		A3029 South	101	102	1	1%	✓	✓
		Ashton Vale Road	36	33	-3	-8%	✓	✓
	08:00-09:00	A3029 North	101	103	2	2%	✓	✓
		Marsh Road	12	11	-1	-8%	✓	✓
		A3029 South	92	99	7	8%	✓	✓
		Ashton Vale Road	27	27	0	0%	✓	✓
	09:00-10:00	A3029 North	103	84	-19	-18%	✓	✓
		Marsh Road	7	7	0	0%	✓	✓
		A3029 South	97	104	7	7%	✓	✓
		Ashton Vale Road	35	37	2	6%	✓	✓

Table 3.4: AM Flow Calibration (Light vehicles) – Turns

Junction Name	Time Period	From Arm	To Arm	Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	201	224	23	11%	✓	✓
			A3029 South	953	901	-52	-5%	✓	✓
		Marsh Road	A3029 South	159	152	-7	-4%	✓	✓
		A3029 South	Ashton Vale Road	172	166	-6	-3%	✓	✓
			A3029 Underpass	666	638	-28	-4%	✓	✓
			A3029 North	329	311	-18	-5%	✓	✓
		Ashton Vale Road	A3029 Underpass	18	22	4	22%	✓	✓
			A3029 North	4	6	2	50%	✓	✓
			A3029 South	14	12	-2	-14%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	275	234	-41	-15%	✓	✓
		A3029 South	A3029 South	964	923	-41	-4%	✓	✓
		Marsh Road	A3029 South	183	187	4	2%	✓	✓
		A3029 South	Ashton Vale Road	142	162	20	14%	✓	✓
			A3029 Underpass	623	611	-12	-2%	✓	✓
			A3029 North	307	300	-7	-2%	✓	✓
		Ashton Vale Road	A3029 Underpass	24	25	1	4%	✓	✓
			A3029 North	6	7	1	17%	✓	✓
			A3029 South	20	19	-1	-5%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	233	205	-28	-12%	✓	✓
			A3029 South	916	812	-104	-11%	✓	✓
		Marsh Road	A3029 South	87	87	0	0%	✓	✓
		A3029 South	Ashton Vale Road	137	146	9	7%	✓	✓
			A3029 Underpass	556	548	-8	-1%	✓	✓
			A3029 North	273	268	-5	-2%	✓	✓
		Ashton Vale Road	A3029 Underpass	31	35	4	13%	✓	✓
			A3029 North	8	10	2	25%	✓	✓
			A3029 South	31	24	-7	-23%	✓	✓

Table 3.5: AM Flow Calibration (Heavy's vehicles) – Turns

Junction Name	Time Period	From Arm	To Arm	Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	5	10	5	100%	✓	✓
			A3029 South	55	51	-4	-7%	✓	✓
		Marsh Road	A3029 South	6	8	2	33%	✓	✓
		A3029 South	Ashton Vale Road	14	15	1	7%	✓	✓
			A3029 Underpass	58	58	0	0%	✓	✓
			A3029 North	29	29	0	0%	✓	✓
		Ashton Vale Road	A3029 Underpass	22	18	-4	-18%	✓	✓
			A3029 North	7	4	-3	-43%	✓	✓
			A3029 South	7	11	4	57%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	19	21	2	11%	✓	✓
			A3029 South	82	82	0	0%	✓	✓
		Marsh Road	A3029 South	12	11	-1	-8%	✓	✓
		A3029 South	Ashton Vale Road	32	16	-16	-50%	✓	✓
			A3029 Underpass	41	55	14	34%	✓	✓
			A3029 North	19	28	9	47%	✓	✓
		Ashton Vale Road	A3029 Underpass	15	14	-1	-7%	✓	✓
			A3029 North	4	3	-1	-25%	✓	✓
			A3029 South	8	10	2	25%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	10	18	8	80%	✓	✓
			A3029 South	93	66	-27	-29%	✓	✓
		Marsh Road	A3029 South	7	7	0	0%	✓	✓
		A3029 South	Ashton Vale Road	34	15	-19	-56%	✓	✓
			A3029 Underpass	42	60	18	43%	✓	✓
			A3029 North	21	29	8	38%	✓	✓
		Ashton Vale Road	A3029 Underpass	22	17	-5	-23%	✓	✓
			A3029 North	7	6	-1	-14%	✓	✓
			A3029 South	6	14	8	133%	✓	✓

3.3.2.2 PM peak

Table 3.6 to 3.9 show the calibration results for the PM peak period model. The results demonstrate that the modelled link flows represent a high correlation to the observed traffic data. The link and turn count flow criteria exceeded the guidelines, with 100% of link flows, (Lights and Heavy's) and 100% of turns had a GEH<5 (Lights) and 96% (Heavys).

The linear regression of the PM peak period modelled total flows and observed total flows was also analysed. A high co-efficient correlation (R2) was achieved and the results are shown in Figure 3.3. The value of R2 =1 implies a perfect match while R2=0 an imperfect match between the observed and modelled flows. Again, the resulting value of R2 provides further confirmation that the traffic movements at the junction are comparable with observed data to a reasonably high degree during this period.

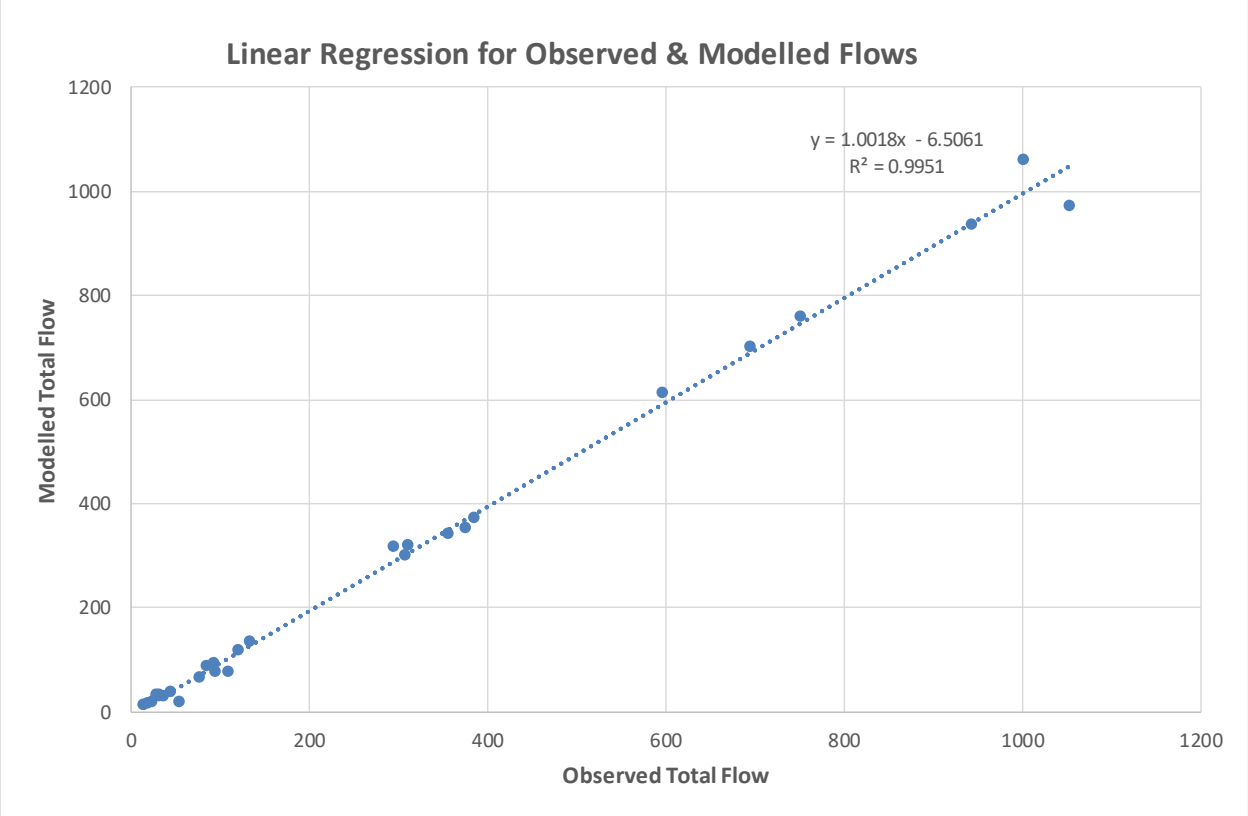

Figure 3.3 Linear Regression for Observed and Modelled Flows of the Base Model – PM Peak

Table 3.6: PM Flow Calibration (Light vehicles) – Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	16:00-17:00	A3029 North	1286	1209	-77	-6%	✓	✓
		Marsh Road	116	113	-3	-3%	✓	✓
		A3029 South	1039	988	-51	-5%	✓	✓
		Ashton Vale Road	208	191	-17	-8%	✓	✓
	17:00-18:00	A3029 North	1357	1381	24	2%	✓	✓
		Marsh Road	132	132	0	0%	✓	✓
		A3029 South	1133	1111	-22	-2%	✓	✓
		Ashton Vale Road	219	169	-50	-23%	✓	✓
	18:00-19:00	A3029 North	1222	1239	17	1%	✓	✓
		Marsh Road	86	87	1	1%	✓	✓
		A3029 South	906	911	5	1%	✓	✓
		Ashton Vale Road	86	80	-6	-7%	✓	✓

Table 3.7: PM Flow Calibration (Heavy's vehicles) – Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	16:00-17:00	A3029 North	79	82	3	4%	✓	✓
		Marsh Road	5	6	1	20%	✓	✓
		A3029 South	68	73	5	7%	✓	✓
		Ashton Vale Road	14	13	-1	-7%	✓	✓
	17:00-18:00	A3029 North	23	31	8	35%	✓	✓
		Marsh Road	2	2	0	0%	✓	✓
		A3029 South	30	41	11	37%	✓	✓
		Ashton Vale Road	5	3	-2	-40%	✓	✓
	18:00-19:00	A3029 North	18	13	-5	-28%	✓	✓
		Marsh Road	0	0	0	0%	✓	✓
		A3029 South	20	19	-1	-5%	✓	✓
		Ashton Vale Road	4	3	-1	-25%	✓	✓

Table 3.8: PM Flow Calibration (Light vehicles) – Turns

Junction Name	Time Period	From Arm		Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	305	300	-5	-2%	✓	✓
			A3029 South	981	909	-72	-7%	✓	✓
		Marsh Road	A3029 South	116	113	-3	-3%	✓	✓
		A3029 South	Ashton Vale Road	29	19	-10	-34%	✓	✓
			A3029 Underpass	667	650	-17	-3%	✓	✓
			A3029 North	343	319	-24	-7%	✓	✓
		Ashton Vale Road	A3029 Underpass	86	88	2	2%	✓	✓
			A3029 North	29	31	2	7%	✓	✓
			A3029 South	93	72	-21	-23%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	374	346	-28	-7%	✓	✓
			A3029 South	983	1035	52	5%	✓	✓
		Marsh Road	A3029 South	132	132	0	0%	✓	✓
		A3029 South	Ashton Vale Road	19	19	0	0%	✓	✓
			A3029 Underpass	736	732	-4	-1%	✓	✓
			A3029 North	378	360	-18	-5%	✓	✓
		Ashton Vale Road	A3029 Underpass	106	77	-29	-27%	✓	✓
			A3029 North	36	28	-8	-22%	✓	✓
			A3029 South	77	64	-13	-17%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	294	314	20	7%	✓	✓
			A3029 South	928	925	-3	0%	✓	✓
		Marsh Road	A3029 South	86	87	1	1%	✓	✓
		A3029 South	Ashton Vale Road	14	16	2	14%	✓	✓
			A3029 Underpass	589	600	11	2%	✓	✓
			A3029 North	303	295	-8	-3%	✓	✓
		Ashton Vale Road	A3029 Underpass	43	36	-7	-16%	✓	✓
			A3029 North	15	13	-2	-13%	✓	✓
			A3029 South	28	31	3	11%	✓	✓

Table 3.9: PM Flow Calibration (Heavy's vehicles) - Turns

Junction Name	Time Period	From Arm		Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	6	19	13	217%	✓	✓
			A3029 South	73	63	-10	-14%	✓	✓
		Marsh Road	A3029 South	5	6	1	20%	✓	✓
		A3029 South	Ashton Vale Road	26	1	-25	-96%	×	✓
			A3029 Underpass	28	50	22	79%	✓	✓
			A3029 North	14	22	8	57%	✓	✓
		Ashton Vale Road	A3029 Underpass	8	6	-2	-25%	✓	✓
			A3029 North	3	2	-1	-33%	✓	✓
			A3029 South	3	5	2	67%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	3	7	4	133%	✓	✓
			A3029 South	20	24	4	20%	✓	✓
		Marsh Road	A3029 South	2	2	0	0%	✓	✓
		A3029 South	Ashton Vale Road	6	0	-6	100%	✓	✓
			A3029 Underpass	16	28	12	75%	✓	✓
			A3029 North	8	13	5	63%	✓	✓
		Ashton Vale Road	A3029 Underpass	4	1	-3	-75%	✓	✓
			A3029 North	1	1	0	0%	✓	✓
			A3029 South	0	1	1	0%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	2	3	1	50%	✓	✓
			A3029 South	16	10	-6	-38%	✓	✓
		Marsh Road	A3029 South	0	0	0	0%	✓	✓
		A3029 South	Ashton Vale Road	6	1	-5	-83%	✓	✓
			A3029 Underpass	9	13	4	44%	✓	✓
			A3029 North	5	5	0	0%	✓	✓
		Ashton Vale Road	A3029 Underpass	3	2	-1	-33%	✓	✓
			A3029 North	0	0	0	0%	✓	✓
			A3029 South	1	1	0	0%	✓	✓

SECTION 4

Model Validation

4.1 General

Validation is the process whereby modelled outputs are compared against independently collected observed data. In this case, comparisons with observed travel times have been used to assess the overall robustness of the models and ensure that typical operational conditions within the modelled network are being simulated accurately.

4.2 Journey Times

4.2.1 Observed Data

In order to obtain journey time data, moving car surveys were carried out along a number of routes on the 9th and 10th May 2017. This was carried out within the AM and PM peak periods. The full results from the journey time survey can be found in **Appendix A.** In all, three routes were used for the AM and PM peak. The routes used are shown in **Table 4.1**.

Table 4.1: Journey Time Routes

Routes	Directions	Description
1	Northbound	From A3029 Sainsbury's Rbt to Ashton Gate Underpass, passing Paxton Drive
2	Southbound	From A370 Brunel Way to A3029 Stadium
3	Eastbound	From Ashton Vale Road to the A3029 Junction stop line

4.2.2 Acceptability Criteria

Acceptability criteria set out by Transport for London (TfL) in their latest micro-simulation best-practice guidelines recommend that:

- Average modelled travel times be within 15% of the corresponding observed values on 85% of routes.

Further guidance provided in the Design Manual for Road & Bridges (DMRB) suggests a suitable overall fit to have been achieved once:

- 85% of routes validate to within 15% of the corresponding observed values, or within one minute (if higher).

4.3 Validation Results

Model validation has been undertaken using 10 simulation seed runs. The travel time validation results for the AM modelled period can be seen in Table 4.2, and the PM modelled period in Table 4.3. The results show a good match between observed and modelled journey times. Critically, modelled journey times within core AM (8:00-9:00am) and PM (5:00-6:00pm) assessment hours are all within 15% of observed journey times meeting both TfL and DMRB acceptability guidelines.

Table 4.2: Journey Time Validation results – AM Peak

Road Name	Route	Dir	Time Period	Obs (s)	Mod (s)	Diff (s)	% Diff	Pass/ Fail
A3029 Winterstoke Road	1	NB	0700-0800	191	157	-34	-18%	Pass
	1	NB	0800-0900	227	208	-19	-8%	Pass
	1	NB	0900-1000	177	147	-30	-17%	Pass
A3029 Winterstoke Road	2	SB	0700-0800	99	112	13	13%	Pass
	2	SB	0800-0900	121	129	8	7%	Pass
	2	SB	0900-1000	102	103	2	2%	Pass
Ashton Vale Road	3	EB	0700-0800	77	90	13	17%	Pass
	3	EB	0800-0900	96	121	25	26%	Pass
	3	EB	0900-1000	N/A	90	N/A	N/A	N/A

Table 4.3: Journey Time Validation results – PM Peak

Road Name	Route	Dir	Time Period	Obs (s)	Mod (s)	Diff (s)	% Diff	Pass/ Fail
A3029 Winterstoke Road	1	NB	1600-1700	112	153	41	37%	Pass
	1	NB	1700-1800	190	161	-29	-15%	Pass
	1	NB	1800-1900	99	134	35	35%	Pass
A3029 Winterstoke Road	2	SB	1600-1700	121	132	11	9%	Pass
	2	SB	1700-1800	137	129	-8	-6%	Pass
	2	SB	1800-1900	93	99	7	7%	Pass
Ashton Vale Road	3	EB	1600-1700	132	133	1	1%	Pass
	3	EB	1700-1800	106	120	15	14%	Pass
	3	EB	1800-1900	62	94	33	53%	Pass

SECTION 5

Summary and Conclusions

5.1 Summary

This report has explained the process employed in the creation of a VISSIM micro-simulation traffic model of the Winterstoke Road/Ashton Vale Road signal controlled junction and adjacent Ashton Vale Road level crossing. The report has described the development of the model and set out the traffic data used to create the model matrices. It has also presented the results of calibration and validation checks that seek to ensure that observed traffic volumes and operational conditions within the modelled network replicate observed conditions.

5.2 Conclusions

Model calibration has been achieved through comparison of observed and modelled turning movements for every hour modelled. The calibration results achieved by the model not only confirmed the accuracy in the input of observed traffic flows into the model, but also confirm that the modelling of signals, saturation flows, gap acceptances and reduced speed areas offer a realistic representation of reality and replicate operational conditions within the modelled network.

The models have been validated through comparison of observed (floating car observer) and modelled journey times on the approaches to the junction. These checks have shown that the models validate to TfL and DMRB acceptability criteria. Together with the calibration results, the validation checks confirm that the model is fit for purpose for assessing the impact of the MetroWest Phase 1 scheme and for testing measures aimed at alleviating the impact of longer and more frequent level crossing closures.

Appendix A: Observed Journey Time Results

ROUTE 1:		Distance (m)
1	A3029 Sainsbury's Rbt, Passing store access arm	0
2	A3029 Stadium Rbt, Entering Rbt	460
3	A3029/Ashton Vale Jct, Passing stopline	700
4	A3029 Ashton Gate Underpass, Passing Paxton Drive	1025

ROUTE 2:		Distance (m)
1	A370 Brunel Way, Entering from Jessops Underpass	0
2	A370/A3029, Entering Ashton Rd	340
3	A3029/Marsh Lane Jct, Crossing stopline	550
4	A3029 Stadium Rbt, Entering Rbt	805

ROUTE 3:		Distance (m)
1	Ashton Vale Rd, Passing Avonline	0
2	Ashton Vale Rd, Passing Manheim Access	100
3	Ashton Vale Rd / A3029 Jct, Passing stopline	270

ROUTE 1:

1	A3029 Sainsbury's Rbt, Passing store access arm
2	A3029 Stadium Rbt, Entering Rbt
3	A3029/Ashton Vale Jct, Passing stopline
4	A3029 Ashton Gate Underpass, Passing Paxton Drive

AM PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	07:01:26	07:02:17	07:02:43	07:03:08	07:07:53	00:00:51	00:00:26	00:00:25	00:01:42
	07:10:16	07:11:19	07:11:51	07:12:14	08:07:53	00:01:03	00:00:32	00:00:23	00:01:58
	07:19:51	07:21:02	07:21:23	07:21:46	09:07:53	00:01:11	00:00:21	00:00:23	00:01:55
	07:30:03	07:31:11	07:31:55	07:34:29	10:07:53	00:01:08	00:00:44	00:02:34	00:04:26
	07:43:42	07:45:16	07:46:58	07:49:34	11:07:53	00:01:34	00:01:42	00:02:36	00:05:52
	07:59:53	08:02:19	08:03:38	08:05:24	12:07:53	00:02:26	00:01:19	00:01:46	00:05:31
	08:15:53	08:17:26	08:18:38	08:21:00	13:07:53	00:01:33	00:01:12	00:02:22	00:05:07
	08:30:05	08:31:34	08:32:29	08:33:28	14:07:53	00:01:29	00:00:55	00:00:59	00:03:23
	08:42:23	08:43:50	08:44:27	08:45:22	15:07:53	00:01:27	00:00:37	00:00:55	00:02:59
	08:53:18	08:54:02	08:54:47	08:55:15	16:07:53	00:00:44	00:00:45	00:00:28	00:01:57
	09:03:29	09:06:03	09:07:11	09:07:39	17:07:53	00:02:34	00:01:08	00:00:28	00:04:10
	09:15:07	09:16:04	09:16:26	09:16:50	18:07:53	00:00:57	00:00:22	00:00:24	00:01:43

INTER-PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	10:58:52	10:59:45	11:00:05	11:00:28	10:58:52	00:00:53	00:00:20	00:00:23	00:01:36
	11:06:54	11:07:34	11:07:57	11:08:19	11:58:52	00:00:40	00:00:23	00:00:22	00:01:25
	11:13:19	11:14:03	11:14:23	11:14:46	12:58:52	00:00:44	00:00:20	00:00:23	00:01:27
10th May	11:09:07	11:09:51	11:10:14	11:10:38	10:58:52	00:00:44	00:00:23	00:00:24	00:01:31
	11:13:46	11:14:25	11:15:05	11:15:25	11:58:52	00:00:39	00:00:40	00:00:20	00:01:39
	11:18:23	11:19:10	11:19:33	11:19:55	12:58:52	00:00:47	00:00:23	00:00:22	00:01:32

PM PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	16:00:50	16:01:37	16:02:07	16:02:31	16:00:50	00:00:47	00:00:30	00:00:24	00:01:41
	16:12:14	16:13:21	16:13:45	16:14:10	16:12:14	00:01:07	00:00:24	00:00:25	00:01:56
	16:26:14	16:27:00	16:27:22	16:27:46	16:26:14	00:00:46	00:00:22	00:00:24	00:01:32
	16:39:08	16:40:14	16:40:48	16:41:15	16:39:08	00:01:06	00:00:34	00:00:27	00:02:07
	16:51:47	16:52:49	16:53:20	16:53:51	16:51:47	00:01:02	00:00:31	00:00:31	00:02:04
	17:02:41	17:03:43	17:04:01	17:04:24	17:02:41	00:01:02	00:00:18	00:00:23	00:01:43
	17:16:25	17:18:42	17:19:28	17:21:56	17:16:25	00:02:17	00:00:46	00:02:28	00:05:31
	17:34:31	17:36:53	17:37:17	17:38:03	17:34:31	00:02:22	00:00:24	00:00:46	00:03:32
	17:50:41	17:51:42	17:52:07	17:52:34	17:50:41	00:01:01	00:00:25	00:00:27	00:01:53
	18:03:36	18:04:29	18:04:53	18:05:19	18:03:36	00:00:53	00:00:24	00:00:26	00:01:43
	18:21:53	18:22:33	18:22:52	18:23:14	18:21:53	00:00:40	00:00:19	00:00:22	00:01:21
	18:33:44	18:34:24	18:35:05	18:35:30	18:33:44	00:00:40	00:00:41	00:00:25	00:01:46
	18:44:52	18:45:34	18:46:13	18:46:38	18:44:52	00:00:42	00:00:39	00:00:25	00:01:46
					Min	00:00:40	00:00:18	00:00:22	00:01:21
					Max	00:02:22	00:00:46	00:02:28	00:05:31
					Avg	00:01:07	00:00:29	00:00:36	00:02:12

ROUTE 2:

1	A370 Brunel Way, Entering from Jessops Underpass (Passing 40mph Limit Signs)
2	A370/A3029, Entering Ashton Rd (Passing start of island)
3	A3029/Marsh Lane Jct, Crossing stopline
4	A3029 Stadium Rbt, Entering Rbt

	1	2	3	4	Start	1-2	2-3	3-4	Sum
	07:05:48	07:06:13	07:06:43	07:07:11	07:05:48	00:00:25	00:00:30	00:00:28	00:01:23
	07:15:16	07:15:41	07:17:23	07:17:49	07:15:16	00:00:25	00:01:42	00:00:26	00:02:33
	07:26:05	07:26:28	07:27:05	07:27:29	07:26:05	00:00:23	00:00:37	00:00:24	00:01:24
	07:40:21	07:40:46	07:41:04	07:41:32	07:40:21	00:00:25	00:00:18	00:00:28	00:01:11
	07:55:52	07:56:15	07:57:13	07:57:37	07:55:52	00:00:23	00:00:58	00:00:24	00:01:45
	08:11:00	08:11:24	08:11:57	08:12:34	08:11:00	00:00:24	00:00:33	00:00:37	00:01:34
	08:25:01	08:25:29	08:26:54	08:27:20	08:25:01	00:00:28	00:01:25	00:00:26	00:02:19
	08:37:42	08:38:33	08:39:57	08:40:22	08:37:42	00:00:51	00:01:24	00:00:25	00:02:40
	08:48:33	08:48:56	08:50:05	08:50:42	08:48:33	00:00:23	00:01:09	00:00:37	00:02:09
	08:59:57	09:00:24	09:00:47	09:01:19	08:59:57	00:00:27	00:00:23	00:00:32	00:01:22
	09:11:37	09:12:02	09:12:38	09:13:01	09:11:37	00:00:25	00:00:36	00:00:23	00:01:24
	09:20:21	09:20:47	09:21:57	09:22:20	09:20:21	00:00:26	00:01:10	00:00:23	00:01:59
INTER-PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	11:04:13	11:04:35	11:05:24	11:05:50	11:04:13	00:00:22	00:00:49	00:00:26	00:01:37
	11:10:53	11:11:19	11:11:36	11:12:09	12:04:13	00:00:26	00:00:17	00:00:33	00:01:16
	11:16:10	11:16:31	11:18:26	11:18:51	13:04:13	00:00:21	00:01:55	00:00:25	00:02:41
10th May	11:11:23	11:11:45	11:12:25	11:12:56	11:04:13	00:00:22	00:00:40	00:00:31	00:01:33
	11:16:10	11:16:37	11:17:08	11:17:31	12:04:13	00:00:27	00:00:31	00:00:23	00:01:21
	11:21:19	11:21:42	11:22:29	11:22:55	13:04:13	00:00:23	00:00:47	00:00:26	00:01:36
PM PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
	16:08:05	16:08:37	16:09:19	16:09:49	16:08:05	00:00:32	00:00:42	00:00:30	00:01:44
	16:22:20	16:22:44	16:23:34	16:24:00	16:22:20	00:00:24	00:00:50	00:00:26	00:01:40
	16:34:20	16:34:49	16:35:28	16:36:35	16:34:20	00:00:29	00:00:39	00:01:07	00:02:15
	16:46:46	16:47:14	16:48:52	16:49:20	16:46:46	00:00:28	00:01:38	00:00:28	00:02:34
	16:57:30	16:57:53	16:58:41	16:59:22	16:57:30	00:00:23	00:00:48	00:00:41	00:01:52
	17:10:00	17:10:27	17:11:36	17:12:19	17:10:00	00:00:27	00:01:09	00:00:43	00:02:19
	17:26:57	17:27:24	17:28:57	17:29:24	17:26:57	00:00:27	00:01:33	00:00:27	00:02:27
	17:45:48	17:46:20	17:47:22	17:48:09	17:45:48	00:00:32	00:01:02	00:00:47	00:02:21
	17:59:26	17:59:53	18:01:02	18:01:28	17:59:26	00:00:27	00:01:09	00:00:26	00:02:02
	18:14:48	18:15:14	18:15:57	18:16:20	18:14:48	00:00:26	00:00:43	00:00:23	00:01:32
	18:28:53	18:29:19	18:29:59	18:30:25	18:28:53	00:00:26	00:00:40	00:00:26	00:01:32
	18:40:35	18:41:04	18:41:49	18:42:13	18:40:35	00:00:29	00:00:45	00:00:24	00:01:38
	18:50:47	18:51:16	18:51:50	18:52:16	18:50:47	00:00:29	00:00:34	00:00:26	00:01:29
					Min	00:00:23	00:00:34	00:00:23	00:01:29
					Max	00:00:32	00:01:38	00:01:07	00:02:34
					Avg	00:00:28	00:00:56	00:00:33	00:01:57

ROUTE 3:

1	Ashton Vale Rd, Passing Avonline
2	Ashton Vale Rd, Passing Manheim Access
3	Ashton Vale Rd / A3029 Jct, Passing stopline

Tuesday 9th May

1	2	3	Start	1-2	2-3	Total
07:00:15	07:00:36	07:01:22	07:00:15	00:00:21	00:00:46	00:01:07
07:03:38	07:04:00	07:05:08	07:03:38	00:00:22	00:01:08	00:01:30
07:07:20	07:07:46	07:08:45	07:07:20	00:00:26	00:00:59	00:01:25
07:12:30	07:12:51	07:13:22	07:12:30	00:00:21	00:00:31	00:00:52
07:18:26	07:18:48	07:18:56	07:18:26	00:00:22	00:00:08	00:00:30
07:23:34	07:24:04	07:24:51	07:23:34	00:00:30	00:00:47	00:01:17
07:33:46	07:34:07	07:35:19	07:33:46	00:00:21	00:01:12	00:01:33
07:40:20	07:40:41	07:40:54	07:40:20	00:00:21	00:00:13	00:00:34
07:45:50	07:46:13	07:48:02	07:45:50	00:00:23	00:01:49	00:02:12
07:55:44	07:56:09	07:57:33	07:55:44	00:00:25	00:01:24	00:01:49
08:01:29	08:01:57	08:02:10	08:01:29	00:00:28	00:00:13	00:00:41
08:08:29	08:08:49	08:09:53	08:08:29	00:00:20	00:01:04	00:01:24
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08:33:09	08:33:33	08:35:22	08:33:09	00:00:24	00:01:49	00:02:13
08:38:07	08:38:31	08:39:36	08:38:07	00:00:24	00:01:05	00:01:29
08:43:31	08:43:59	08:45:07	08:43:31	00:00:28	00:01:08	00:01:36
08:51:01	08:51:28	08:52:25	08:51:01	00:00:27	00:00:57	00:01:24
08:55:30	08:55:52	08:56:10	08:55:30	00:00:22	00:00:18	00:00:40
09:00:54	09:01:20	09:01:58	09:00:54	00:00:26	00:00:38	00:01:04
			Min	00:00:07	00:00:08	00:00:30
			Max	00:00:30	00:02:30	00:02:37
			Avg	00:00:23	00:01:04	00:01:27

1	2	3
11:00:52	11:01:15	11:01:30
11:11:42	11:12:06	11:14:46
11:21:35	11:22:00	11:24:56
11:29:28	11:29:52	11:30:34
11:39:42	11:40:07	11:41:33
11:51:23	11:51:50	11:51:58
12:00:31	12:00:54	12:01:26
12:11:36	12:11:59	12:12:31
12:20:45	12:21:01	12:22:00
12:32:00	12:32:18	12:36:28
12:40:27	12:41:01	12:42:21
12:50:06	12:50:24	12:52:05
12:59:41	13:00:10	13:02:08
14:00:59	14:01:21	14:02:39
14:14:45	14:15:09	14:15:18
14:24:22	14:24:43	14:25:12
14:31:49	14:32:08	14:33:46
14:40:21	14:40:43	14:44:04
14:50:52	14:51:11	14:51:21
14:59:51	15:00:15	15:01:49

Start	1-2	2-3	Total
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11:11:42	00:00:24	00:02:40	00:03:04
11:21:35	00:00:25	00:02:56	00:03:21
11:29:28	00:00:24	00:00:42	00:01:06
11:39:42	00:00:25	00:01:26	00:01:51
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12:59:41	00:00:29	00:01:58	00:02:27
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Max	00:00:34	00:04:10	00:04:28
Avg	00:00:23	00:01:24	00:01:47

1	2	3
16:00:33	16:00:56	16:02:19
16:04:45	16:05:07	16:06:09
16:09:54	16:10:18	16:11:41
16:15:10	16:15:36	16:16:08
16:19:32	16:19:47	16:19:57
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16:30:05	16:30:28	16:31:25
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17:35:52	17:36:11	17:37:33
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17:48:21	17:48:37	17:48:53
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17:58:44	17:59:01	17:59:49
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18:18:20	18:18:38	18:19:46
18:23:05	18:23:25	18:24:54
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18:37:07	18:37:33	18:37:43
18:42:55	18:43:12	18:44:06
18:53:15	18:53:32	18:54:22

Start	1-2	2-3	Total
16:00:33	00:00:23	00:01:23	00:01:46
16:04:45	00:00:22	00:01:02	00:01:24
16:09:54	00:00:24	00:01:23	00:01:47
16:15:10	00:00:26	00:00:32	00:00:58
16:19:32	00:00:15	00:00:10	00:00:25
16:25:02	00:00:17	00:00:11	00:00:28
16:30:05	00:00:23	00:00:57	00:01:20
16:34:40	00:00:49	00:02:14	00:03:03
16:39:49	00:00:21	00:03:08	00:03:29
16:43:58	00:00:30	00:02:52	00:03:22
16:52:41	00:00:19	00:03:26	00:03:45
16:59:54	00:00:28	00:04:06	00:04:34
17:05:20	00:01:40	00:02:10	00:03:50
17:10:27	00:00:21	00:00:54	00:01:15
17:14:45	00:00:17	00:01:23	00:01:40
17:18:57	00:00:18	00:01:03	00:01:21
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17:31:47	00:00:25	00:01:25	00:01:50
17:35:52	00:00:19	00:01:22	00:01:41
17:42:51	00:00:25	00:01:16	00:01:41
17:48:21	00:00:16	00:00:16	00:00:32
17:53:00	00:00:15	00:03:28	00:03:43
17:58:44	00:00:17	00:00:48	00:01:05
18:08:57	00:00:17	00:00:14	00:00:31
18:13:12	00:00:19	00:00:44	00:01:03
18:18:20	00:00:18	00:01:08	00:01:26
18:23:05	00:00:20	00:01:29	00:01:49
18:29:30	00:00:17	00:00:12	00:00:29
18:37:07	00:00:26	00:00:10	00:00:36
18:42:55	00:00:17	00:00:54	00:01:11
18:53:15	00:00:17	00:00:50	00:01:07
Min	00:00:15	00:00:10	00:00:25
Max	00:01:40	00:04:06	00:04:34
Avg	00:00:24	00:01:20	00:01:44

MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report

Prepared for

North Somerset Council

July 2018

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Document history

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Contents

Appendices

Acronyms and Abbreviations

ATC	Automatic Traffic Counter
DMRB	Design Manual for Roads and Bridge
LMVR	Local Model Validation Report
MCC	Manually Classified Count
MOVA	Microprocessor Optimised Vehicle Actuation
NTEM	National Trip End Model
VPH	Vehicles Per Hour

SECTION 1

Introduction

1.1 Background

The West of England (WoE) Councils comprising of Bath & North-East Somerset, Bristol City, North Somerset and South Gloucestershire, together with the West of England Combined Authority (WCA), and working alongside Network Rail (NR), Great Western Railway (GWR) and the wider rail industry, are progressing plans to deliver a series of strategic enhancements to the local rail network over the next five years and beyond, through the MetroWest Programme. The programme currently comprises:

- the MetroWest Phase 1 scheme;
- the MetroWest Phase 2 scheme;
- the Portway Park & Ride station scheme; and
- a range of new station/re-opening schemes, subject to separate business cases and smaller scale localised enhancement schemes.

The MetroWest Phase 1 project is being led by North Somerset Council, and comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

MetroWest Phase 1 includes infrastructure to be consented through a Development Consent Order (DCO) and infrastructure which falls within Network Rail's General Permitted Development rights (the GPD works). The passenger train service is to be delivered through either the Department for Transport's re-franchising process or via a bi-lateral agreement between the four councils and a train operating company (TOC). The project is to be delivered by the rail industry and the four councils, and is being led by North Somerset Council on behalf of the four West of England (WoE) councils.

CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the Portishead Branch Line Development Consent Order (DCO) scheme (MetroWest Phase 1) proposal to reopen the Portishead line with stations at Portishead and Pill in North Somerset ("the DCO scheme").

A key element of the MetroWest Phase 1 project is reopening of the Portishead branch line, and within this is the reinstatement of passenger services on the currently freight-only Portbury dock line (which splits from the Portishead line north of Pill). As such, the scheme will therefore increase the number of trains using the level crossing on Ashton Vale Road adjacent to the Winterstoke Road/Ashton Vale Road signal controlled junction. These signals are configured such that, during level crossing closures, traffic entering and exiting Ashton Vale Road is held on red whilst the other arms are serviced within a restricted staging sequence. There is therefore a need to understand the impact of the MetroWest Phase 1 scheme on operational conditions at this junction.

1.2 Purpose of Report

The purpose of this report is to explain the methodology and results from forecast VISSIM micro-simulation traffic modelling of the Winterstoke Road/Ashton Vale Road junction and level crossing under a range of Do-Nothing and MetroWest scheme scenarios. The assessment includes scenarios incorporating highway works and measures aimed at alleviating the impact of longer and more frequent level crossing closures on the local highway network.

1.3 Structure of Report

Following this introduction, the remainder of this report is structured as follows:

- **Section 2**: Methodology, including the approach employed in the modelling work, forecasting and other modelling assumptions;
- **Section 3**: Testing Results, including the result from the VISSIM modelling comparing the forecast Do-Nothing situation to a range of MetroWest scenarios;
- **Section 4**: Conclusions, including a summary of the modelling work and some conclusions based on the findings from the testing.

SECTION 2

Methodology

2.1 Modelling Approach

The assessment has been carried out using the Winterstoke Road/Ashton Vale Road VISSIM model. This was developed using Version 8.00-06 of the software. This was the latest version of the software at the time of model development. The model network includes the Winterstoke Road/Ashton Vale Road junction and its approach arms comprising the A3029 Winterstoke Road, Marsh Road and Ashton Vale Road, as well as the Ashton Vale level crossing and railway line. The extents of the modelled network can be seen in Figure 2.1.

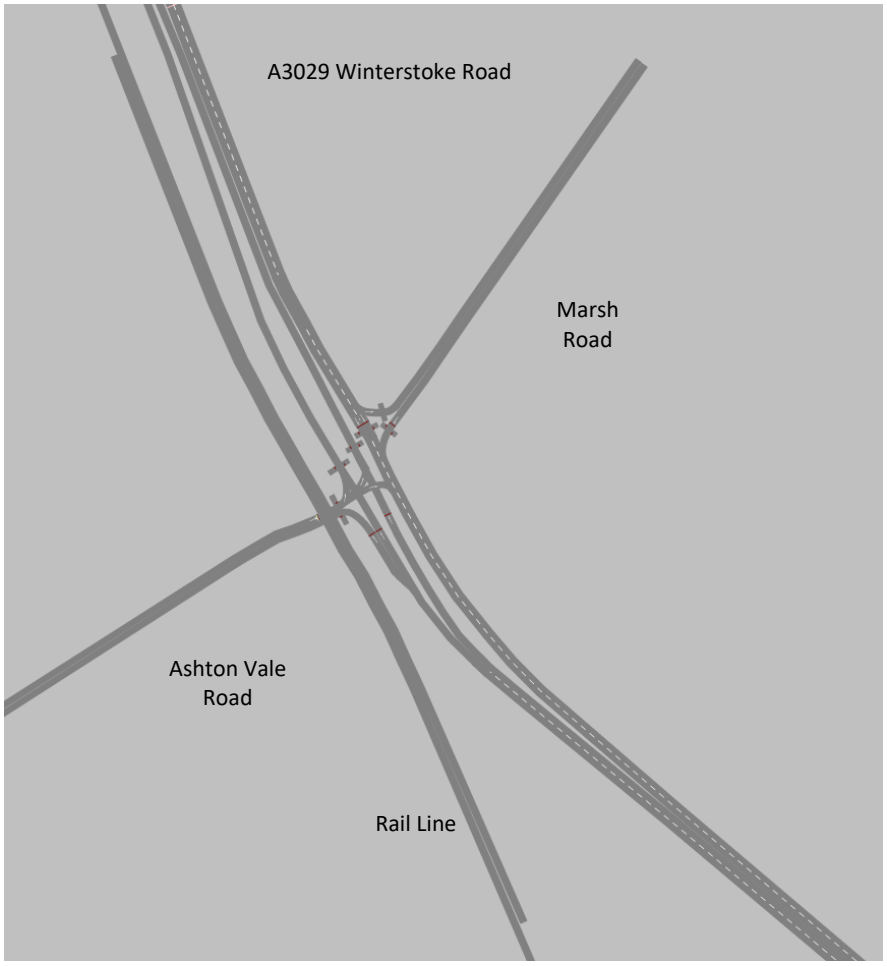


Figure 2.1: Winterstoke Road/Ashton Vale Road VISSIM Model Extents

2.2 Forecast Traffic

The testing has been carried out for a 2021 forecast year. This is expected to be the opening year of the MetroWest Phase 1 scheme. Traffic growth in the VISSIM model has been assumed in line with TEMPRO forecasts from the National Trip End Model (NTEM). This provides growth between the 2017 base year and 2021 forecast year of 5.8 per cent in the weekday AM peak period and 5.4 per cent in the PM peak period. This growth with applied in the model to the Winterstoke Road ahead through-movements only under the assumption that the growth trips to and from Ashton Vale Road and Marsh Lane would be constrained.

2.3 Scenarios Tested

Table 2.1 lists the range of Do-Nothing and MetroWest scheme scenarios tested in the VISSIM model and summarises the assumptions employed within each.

Table 2.1: Modelled Scenarios

Scenario name	Year	Freight	Scheme	Measures	Period	Total Closures
BASE MODELLING ONLY						
2017_AM_NF_WoS	2017	No	No	No	AM	0
2017_PM_NF_WoS	2017	No	No	No	PM	0
FUTURE WITHOUT SCHEME						
2021_AM_NF_WoS	2021	No	No	No	AM	0
2021_PM_NF_WoS	2021	No	No	No	PM	0
2021_AM_1F_WoS	2021	1 tph in one dir	No	No	AM	1
2021_PM_11_WoS	2021	1 tph in one dir	No	No	PM	1
FUTURE WITH SCHEME (1tph)						
2021_AM_1F_WS	2021	1 tph in one dir	1 tph	No	AM	3
2021_PM_1F_WS	2021	1 tph in one dir	1 tph	No	PM	3
2021_AM_1F_WS+M	2021	1 tph in one dir	1 tph	Yes	AM	3
2021_PM_1F_WS+M	2021	1 tph in one dir	1 tph	Yes	PM	3
SENSITIVITY TESTS						
2021_AM_1F_WS45+M	2021	1 tph in one dir	45min peak freq	Yes	AM	4 or 5
2021_PM_1F_WS45+M	2021	1 tph in one dir	45min peak freq	Yes	PM	4 or 5
2021_AM_NF_WS+M	2021	No	1 tph	Yes	AM	2
2021_PM_NF_WS+M	2021	No	1 tph	Yes	PM	2
2021_AM_2F_WS45+M	2021	1 tph in each dir	45min peak freq	Yes	AM	5 or 6
2021_PM_2F_WS45+M	2021	1 tph in each dir	45min peak freq	Yes	PM	5 or 6

2.4 Rail Assumptions

As shown in Table 2.1, there are a range of potential rail scenarios involving movements of both MetroWest Phase 1 passenger trains and freight trains that currently use the railway that passes through the level crossing. Network Rail has carried out operational analysis of these rail scenarios in RailSys which has informed the frequency and duration level crossing closures assumed in the VISSIM model. The outcomes from this work and the rail pattern and level crossing closure times associated with an hourly MetroWest service are contained in **Appendix A**. The RailSys output from a 45-minute MetroWest service are shown in **Appendix B**.

2.5 Highway Measures

The highway measures proposed as part of the MetroWest scheme include an extension of the Winterstoke Road left turn lane to a length of circa 150 metres. These works are shown in Drawing No. 674946.BD.29.01-SK31 contained in **Appendix B**. The aim of this change is to ensure that vehicles queuing to turn left into Ashton Vale Road during level crossing closures can be stored without impeding the adjacent ahead movement. This measure has been directly coded into the relevant 'measures' scenarios in the VISSIM model as a longer left turn flare as per the layout drawing.

The other main element of the MetroWest highway measures works in this locality is an upgrade of the mode of control of the Winterstoke Road/Ashton Vale Road signals to MOVA This is a highly adaptive form of signal control that can respond very quickly to changes in traffic volumes. Typically, MOVA would be modelled through linking VISSIM to the PCMOVA software. However, this was not possible in the simulation due to the complication of operating MOVA with the level crossing. Consequently, MOVA has been modelled by proxy by an increase in the phase maxima used in the VAP logic file.

SECTION 3

Testing Results

3.1 General

The 2021 forecast scenarios were run for 15 seed runs to provide robust mean output results. The models were configured to provide outputs focused on the performance of affected arms. This included mean journey times on Winterstoke Road in the northbound and southbound directions and on the Ashton Vale Road approach to the junction. Queue lengths were also recorded at each stop line at the junction with queue lengths recorded every minute so that the queue length profile between scenarios could be compared.

3.2 Journey Times

Tables 3.1 and 3.1 compare, respectively, the mean hourly journey times (in seconds) for the AM peak (8:00-9:00am) and PM peak (5:00-6:00pm) hours.

Table 3.1: Mean Journey Time (seconds) Comparison, AM Peak Hour (8:00-9:00am)

Route	2021_NF_ WoS	2021_F_ WoS	2021_F_ WS	2021_F_ WS+M	2021_F_ WS45+M	2021_NF_ WS+M	2021_2F_ WS45+M
A3029 NB	278	275	353	203	202	205	200
A3029 SB	181	194	181	168	169	171	160
Ashton Vale	122	124	136	130	136	128	143

Table 3.2: Mean Journey Time (seconds) Comparison, PM Peak Hour (5:00-6:00pm)

Route	2021_NF_ WoS	2021_F_ WoS	2021_F_ WS	2021_F_ WS+M	2021_F_ WS45+M	2021_NF_ WS+M	2021_2F_ WS45+M
A3029 NB	213	212	211	212	215	211	211
A3029 SB	267	229	191	216	189	229	164
Ashton Vale	120	137	158	141	170	130	186

The results show that the MetroWest scheme without highway measures, and assuming a coincidence with a freight train movement ('2021_F_WS'), is predicted to increase mean journey times on Winterstoke Road northbound by around 75 seconds in the AM compared to the Do-Nothing scenario ('2021_NF_WoS'). Delays on Ashton Vale Road also increase by 14 seconds. During the PM, there is no increase on Winterstoke Road, but Ashton Vale Road is expected to experience an increase in mean journey time of 38 seconds.

The proposed measures under scenario '2021_F_WS+M' are predicted to be effective at alleviating the impact of the MetroWest scheme even when assuming a worst-case scenario alongside an assumed freight rail movement every hour. Mean journey times compared to the Do-Nothing actually show an improvement on Winterstoke Road northbound with a reduction in journey times from 278 to 203 seconds. This is likely to be a result of a combination of longer flared approach and higher green times resulting from the introduction of MOVA control. There is a slight improvement in mean journey times on Ashton Vale Road in the AM peak hour, and in the PM peak hour the measures reduce the increase in delay from 38 to 21 seconds over to the Do-Nothing scenario.

If a freight rail movement were to occur during the weekday peak hours, as could happen at the moment without MetroWest, the relative impact of the MetroWest scheme compared to the 'current' situation is much less, especially on Ashton Vale Road during the PM. Mean PM peak hour journey times under this scenario are predicted to be 137 seconds. As such, the impact of the MetroWest scheme with highway measures is only four seconds during the PM. The impact on this arm in the AM is also reduced when compared to the Do-Nothing situation assuming one freight rail movement.

The impact of the MetroWest scheme is also notably lesser when tested with no freight rail movements. Since the actual number of freight movements is only around six per week with few if any happening during peak periods, this scenario ('2021_NF_WS+M') is likely to be the most realistic. A comparison with the Do-Nothing scenario ('2021_NF_WoS') shows that the impact on Ashton Vale Road of MetroWest amounts to an increase in mean journey time of six seconds in the AM and 10 seconds in PM. Elsewhere, there is are reductions in delay on Winterstoke Road southbound of nearly 40 seconds in the PM peak hour.

Sensitivity testing with a 45-minute MetroWest service and assuming one freight movement per hour ('2021_F_WS45+M'), not surprisingly, increases the impact of MetroWest on delays at the Winterstoke Road/Ashton Vale Road junction compared to an hourly service. Mean journey times on Ashton Vale Road are predicted to increase by 14 seconds in the AM and 50 seconds in the PM compared to the Do-Nothing situation even with highway measures. This represents an increase in mean delay of six and 29 seconds in the AM and PM, respectively, relative to the comparable hourly MetroWest service pattern.

The results for the absolute worst-case scenario involving a 45-minute MetroWest service and two freight rail movements per hour ('2021_2F_WS45+M') show greater impacts over the scenario assuming only one freight rail movement ('2021_F_WS45+M'). Consequently, the impacts compared to the Do-Nothing scenario, assuming no freight rail movement, are greater with an increase in mean journey times on Ashton Vale Road of 21 seconds in the AM and 66 seconds in the PM, or 19 and 49 seconds respectively when compared to the Do-Nothing scenario with freight.

3.3 Queue Lengths

The range of scenarios modelled and multiple stop lines at the Winterstoke Road/Ashton Vale Road junction means that a large number of maximum queue length profile graphs have been generated from the model output. The high number of scenarios also means that it is not possible to display the results from every scenario on the same graph. Consequently, scenarios have been paired-up with those with which the profiles can be logically compared. The resulting graphs can be found in **Appendices D to G.** The most relevant graphs are reproduced below for ease of illustration in discussion on the results.

3.3.1 Do-Nothing vs MetroWest (No Freight)

Appendix D contains graphs comparing the maximum queue length (in metres) profile for the 2021 Do-Nothing (No Freight) and the 2021 MetroWest Scheme (No Freight) with highway measures. This is considered to be the most likely scenario for both the Do-Nothing and Scheme scenarios. Examination of the graphs show little change on most arms in the AM with the exception of a notable improvement in queuing on the Winterstoke Road northbound approach to the junction in the AM (Figure D3, reproduced below). This reflects the betterment in terms of junction operation through the extension of the left turn flare on this arm and the introduction of MOVA control.

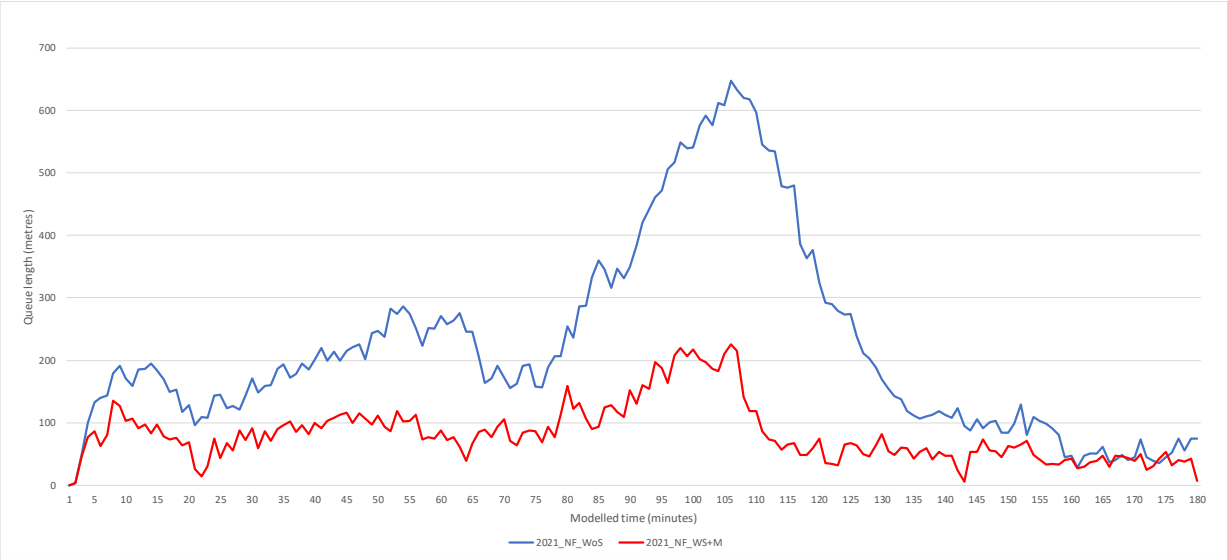


Figure D3 (from Appendix D): Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Measures, Winterstoke Road Northbound, AM Peak Period

The graphs also highlight short spikes in queuing on Ashton Vale Road during both the AM (Figure D4) and PM (Figure D8, also reproduced below) coinciding with level crossing closures. These spikes are particularly acute during the PM when there are greater volumes exiting the industrial estate with queue lengths roughly doubling from Do-Nothing levels. However, these spikes are relatively short-lived and the graphs show that queue lengths typically return to ambient Do-Nothing levels within three to five minutes.

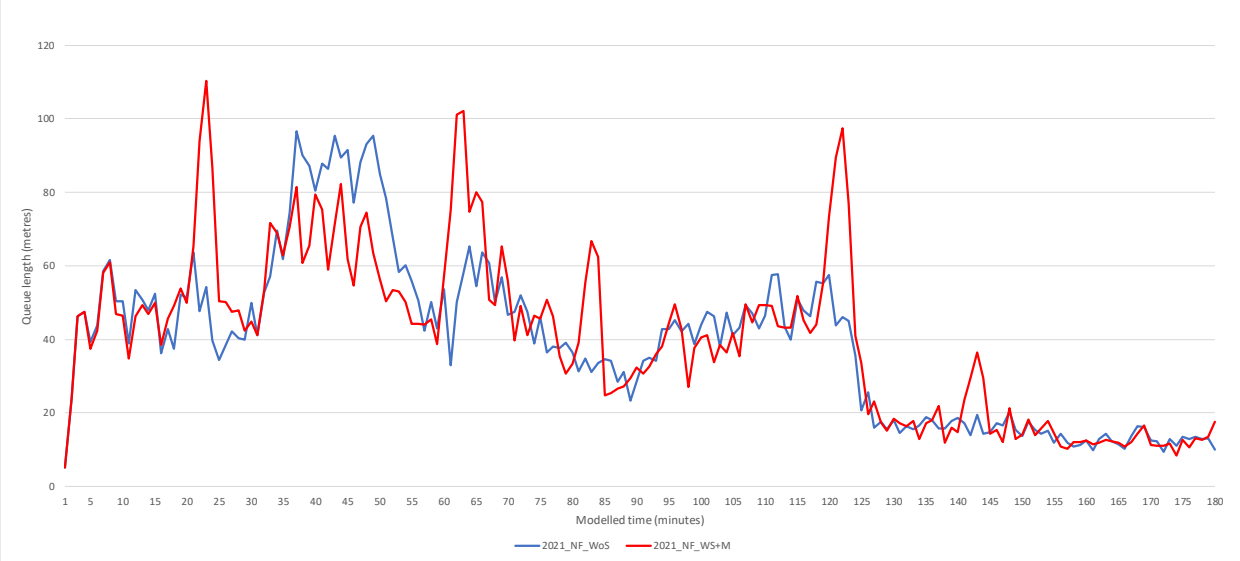


Figure D8 (from Appendix D): Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Measures, Ashton Vale Road, PM Peak Period

Notably, the impact of MetroWest on the Winterstoke Road southbound approach is a reduction in maximum queue lengths throughout much of the PM peak period. This is shown in Figure D5 (reproduced below). This improvement in queuing reflects the more frequent level crossing closures in the MetroWest scheme scenario during which this arm receives a greater proportion of green time within the restricted sequence compared to the full stage sequence under normal conditions.

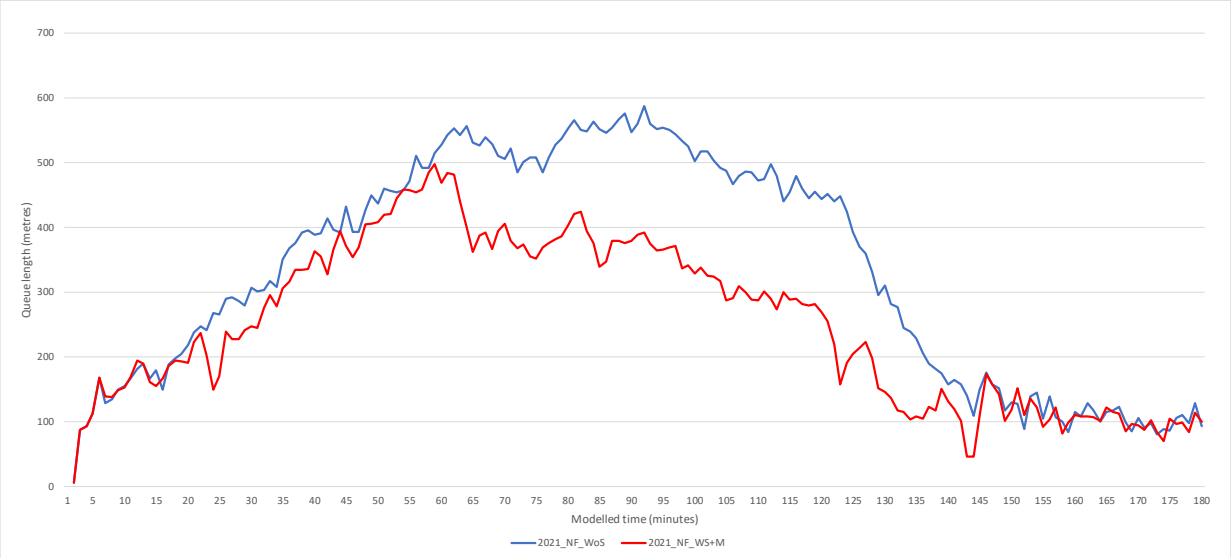


Figure D5 (from Appendix D): Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Measures, Winterstoke Road Southbound, PM Peak Period

3.3.2 Do-Nothing vs MetroWest (With Freight)

Appendix E contains graphs comparing the maximum queue length (in metres) profile for the 2021 Do-Nothing and the 2021 MetroWest Scheme with measures with both including one freight movement per hour. As before, queuing during the AM is comparable between the two scenarios except for an improvement on Winterstoke Road northbound. Queue lengths on Ashton Vale Road show similar spikes where freight movements coincide in the two scenarios, particularly during the PM peak period as shown in Figure E8 (reproduced below).

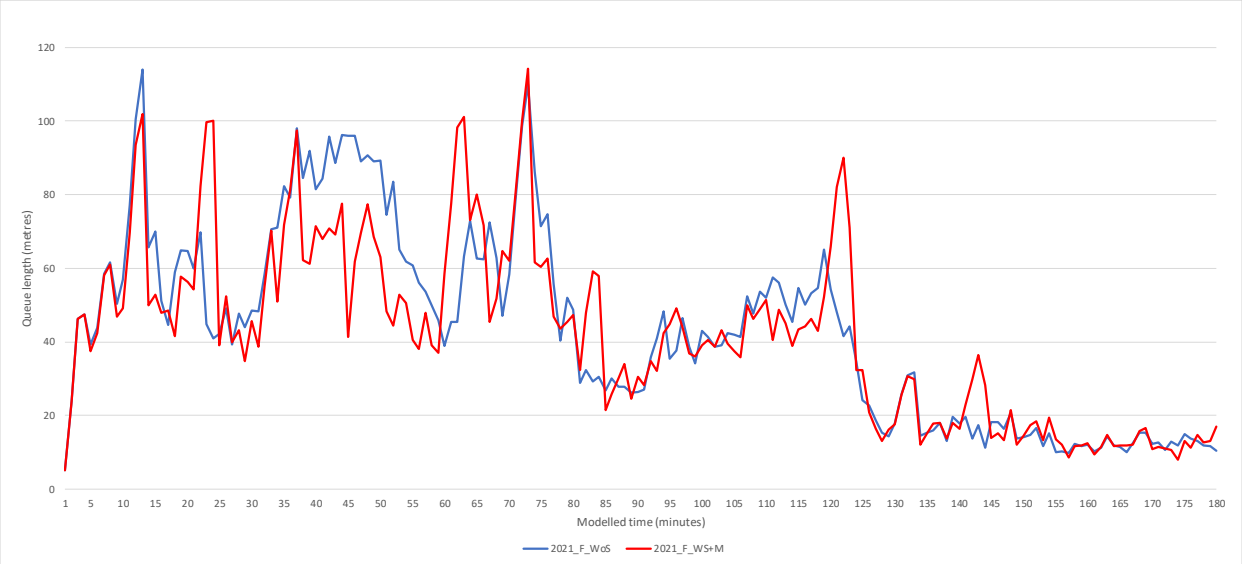


Figure E8 (from Appendix E): Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Measures, Ashton Vale Road, PM Peak Period

3.3.3 MetroWest Without and With Highway Measures

Appendix F contains queue length profile graphs comparing MetroWest (with freight) without and with the proposed highway measures. These comparisons aim to illustrate the effectiveness of the proposed measures in ameliorating some of the impact of more frequent and longer level crossing closures. For instance, Figure F3 (reproduced below) highlights a significant reduction in queuing on the Winterstoke Road northbound approach to the junction.

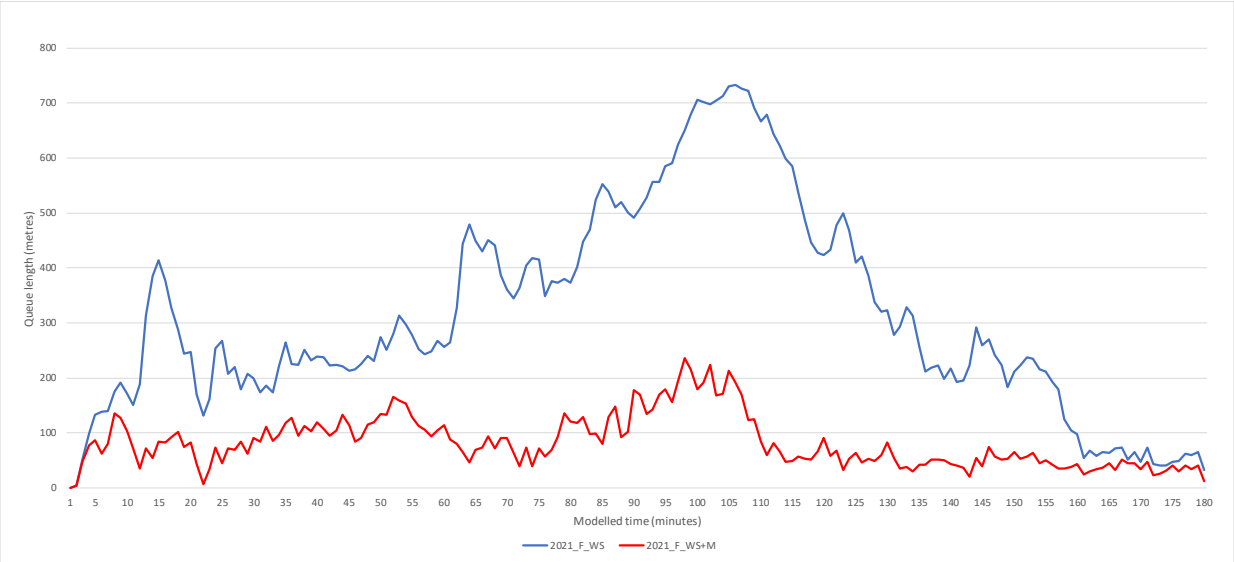


Figure F3 (from Appendix E): Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Measures, Winterstoke Road Northbound, AM Peak Period

For the Ashton Vale Road arm, Figures F4 and F8 (reproduced below) show that the proposed highway measures, in particular the assumed longer green times associated with MOVA control, results in shorter overall queue lengths in both the AM and PM, and enables queues to recover faster compared to the scenario where no measures is included.

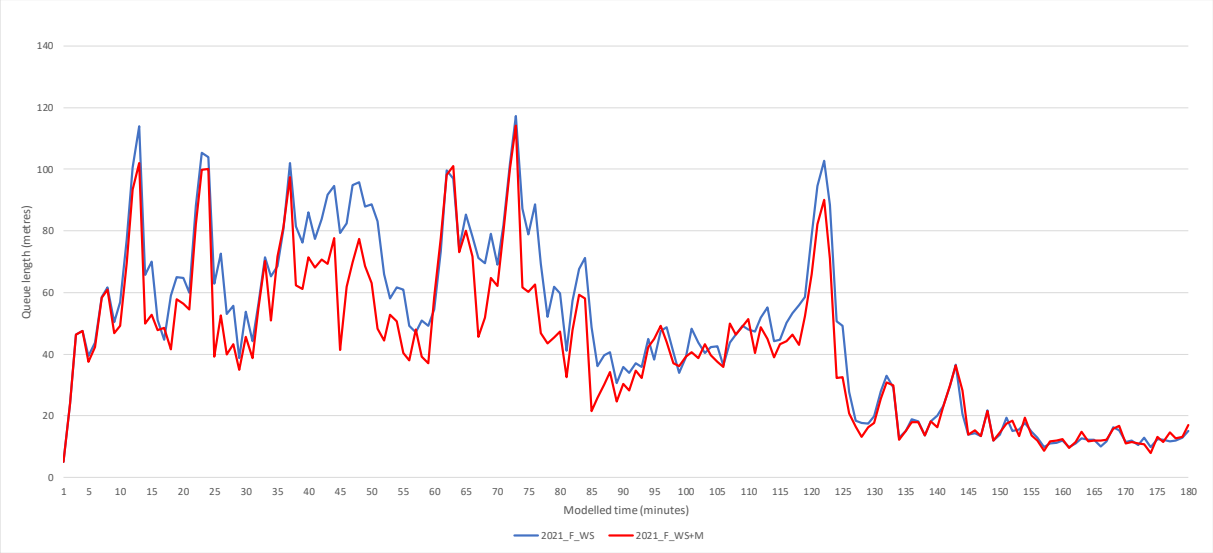


Figure F8 (from Appendix F): Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Measures, Ashton Vale Road, PM Peak Period

3.3.4 Do-Nothing (With Freight) vs 45 Min MetroWest (With Freight)

Appendix G contains graphs comparing the 'worst-case' Do-Nothing and MetroWest scenarios with the latter assuming a 45-minute service frequency and two freight movements per hour. The graphs show generally improved levels of queueing across most arms in the AM under the MetroWest scenario, especially on Winterstoke Road northbound, with the exception being more frequent and longer spikes in queuing on Ashton Vale Road (see Figure G4, reproduced below).

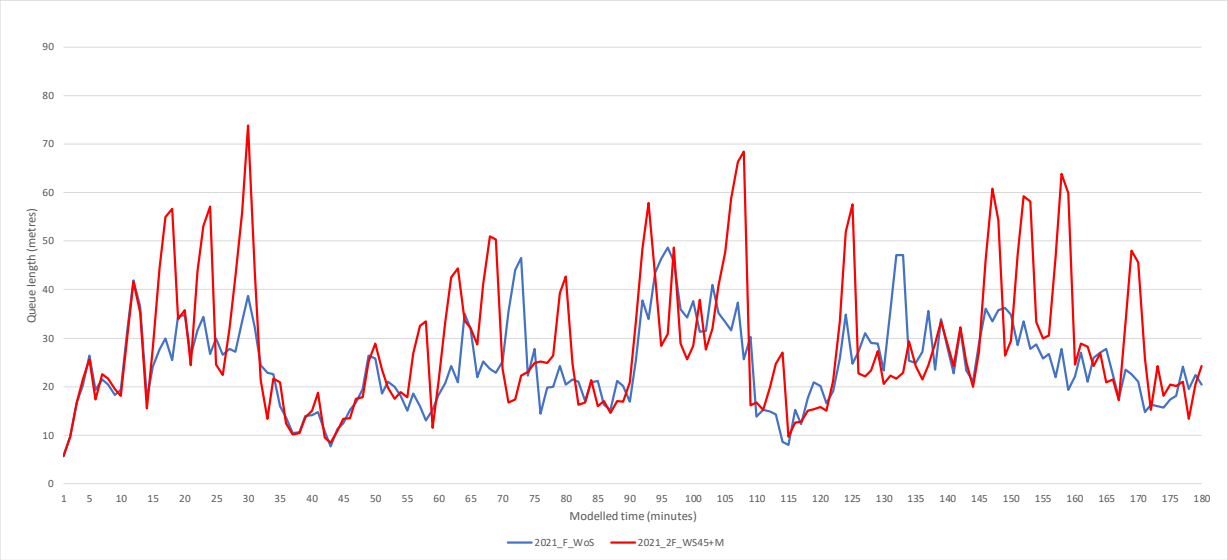


Figure G4 (from Appendix G): Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Measures, Ashton Vale Road, AM Peak Period

During the PM, Figure G5 (reproduced below) shows that reductions in queuing on Winterstoke Road southbound predicted under other MetroWest scenarios are lower under this 'worst-case'. This reflects the higher number of level crossing closures and hence increased green time to Winterstoke Road.

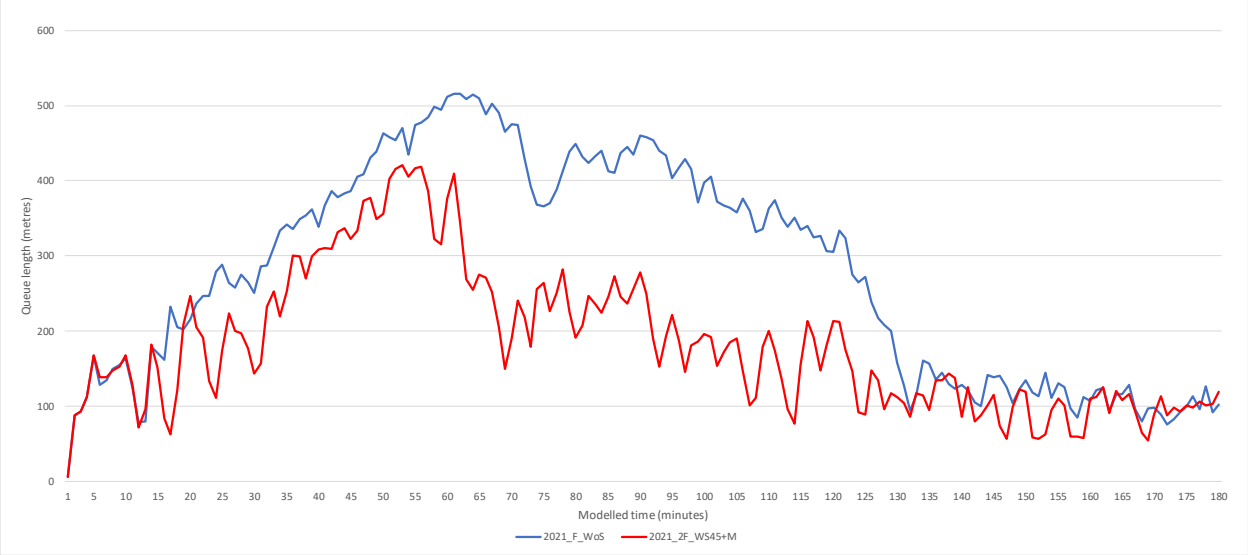


Figure G5 (from Appendix G): Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Measures, Winterstoke Road Southbound, PM Peak Period

Figure G8 (reproduced below) shows that on Ashton Vale Road, there are some similarities in the short spikes in queuing between these two scenarios. Under the MetroWest scenario there are, however, more frequent spikes associated with the higher number of rail services and level crossing closures. These spikes are expected to be more sustained than under other MetroWest scenarios and show greater queuing than the Do-Nothing but in some instances queues fall to lower levels reflecting the benefits of increases green time assumed in the MetroWest scenario.

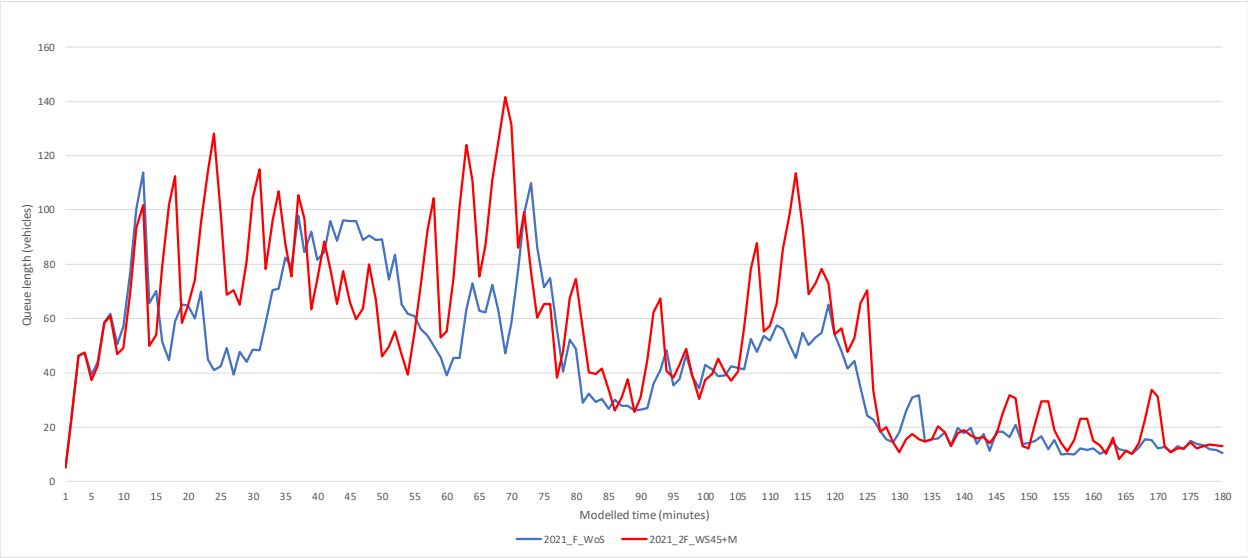


Figure G8 (from Appendix G): Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Measures, Ashton Vale Road, PM Peak Period

SECTION 4

Conclusions

This report has presented the results of an assessment of the impact of MetroWest Phase 1 proposals on operational conditions within the local highway network on the approaches to the Winterstoke Road/Ashton Vale Road traffic signals and adjacent level crossing. MetroWest Phase 1 will result in greater use of the railway line that passes through this level crossing leading to potentially longer and more frequent level crossing closures during which traffic on Winterstoke Road turning left into Ashton Vale Road, and on Ashton Vale Road are held on red. There is therefore a need to understand the impact of the scheme and associated highway measures.

The assessment has been carried out using a VISSIM micro-simulation traffic model which has been developed for the Winterstoke Road/Ashton Vale Road junction and adjacent level crossing. This model has been calibrated using recent turning count data collected during 2017 and validated to moving car observer journey times also collected during 2017. The calibration and validation checks meet and exceed the required acceptability criteria and demonstrate that the model is fit for purpose of assessing the impact of MetroWest and testing associated highway measures.

A broad range of 2021 forecast Do-Nothing and MetroWest scenarios have been tested using the model. For the Do-Nothing scenario, this includes scenarios assuming no rail movements, a scenario which is typically of most peak periods at the junction, to a scenario where one rail freight movement per hour occurs, which could potentially happen with existing freight passages. The MetroWest scheme has been tested without and with highway measures, without/with freight and for both an hourly service pattern and 45-minute services. Mean peak hour journey times through the junction and maximum queue length profiles have been output from the model and compared across these scenarios.

The majority of MetroWest scheme scenarios modelled included highway measures aimed at ameliorating the impact of more frequent level crossing closures on the local highway network. This includes an extension of the Winterstoke Road left turn flare into Ashton Vale Road to a length of 150 metres. The highway measures also include the proposed upgrade of the traffic signal controller mode of operation from VA to more flexible and adaptive MOVA control. The latter has been modelled by proxy in VISSIM through the use of higher VA Max values. In reality, MOVA is likely to operate more intelligently resulting in better conditions than those modelled.

The testing has shown that, with highway measures, the overall impact of the MetroWest scheme on the local highway network is reasonable. The extension of the Winterstoke Road left turn flare is effective at alleviating the impact of level crossing closures during the weekday AM peak period. Indeed, mean journey times and queue lengths are expected to improve on this arm with the proposed MetroWest highway works. The modelling shows that with MetroWest and highway measures the impact on mean journey times on the Ashton Vale Road approach is small at six seconds in the AM peak, and 10 second in the PM compared to the Do-Nothing (assuming no freight movements in either scenario). Queue lengths on this arm show more frequent and longer spikes, but return to Do-Nothing levels within minutes.

The modelling has highlighted reductions in queuing and delay on the Winterstoke Road southbound approach to the signals with MetroWest and highway measures during the PM peak period. The modelling suggests that more frequent level crossing closures reduces queuing on this approach. This is because this arm receives more frequent green within the restricted Stage 4,5 6 sequence that the signals operate with the level crossing down. This reflects a greater proportion of green time within each cycle compared to the full Stage 1 to 6 sequence that the signals could run under normal operating conditions with no level crossing closure.

It is also apposite to consider briefly that analysis of the junction using LinSIG (see the Winterstoke Road/Ashton Vale Road LinSIG Modelling technical note for details) sets out how the current junction control works and that how, following a closure of around two minutes, any build-up of queuing traffic on Ashton Vale Road could be addressed by additional compensation green time applied over no more than two signals cycles post-closure (PM peak). And that this could be a single cycle if the MOVA Stage MAX green time is allowed to be set high (for example, at around 40 seconds). The trade-off would be the impact on the southbound Winterstoke Road approach from Brunel Way, as LinSIG analysis clearly show that the two critical phases are Ashton Vale Road and the southbound A3029. The northbound A3029 traffic phases all appear to have considerable capacities based on potential capacity through the stop-lines here. In reality, the dominant flow through to the A370 underpass is constrained by the merge/weaving capacity onto Brunel Way, and northbound flow through the junction to the underpass can't reach the theoretical capacity level which the green time/unrestrained saturation flow dictates is possible with exit blocking.

Bearing in mind the discussion of the results of LinSIG modelling, it is then evident from the VISSIM modelling that level crossing closures can, in fact, benefit the Winterstoke Road southbound approach. This is because the signals don't have to service Ashton Vale Road when the level crossing is down so Winterstoke Road southbound receives more green within the cycle during these periods. The VISSIM modelling indicates an improvement in Winterstoke Road southbound queuing and delay for the MetroWest scenarios compared to the Do-Nothing, so it appears that the reallocation of green from Winterstoke Road southbound to Ashton Vale Road needed to recover from a level crossing closure is more than compensated for by the extra green Winterstoke Road southbound receives during closures.

Overall, testing of the MetroWest Phase 1 operations and junction improvements confirms that an hourly train service can be delivered without detriment to the local highway conditions within the vicinity of the Winterstoke Road /Ashton Vale Road junction. Indeed, modelling suggests that a 45-minute rail service could also be accommodated, although this would be at the cost of increased delays on Ashton Vale Road of circa 50 seconds over the Do-Nothing in the PM peak period.

Note that testing presented in this report is robust in that it has assumed growth in through-traffic passing along Winterstoke Road. It is also important to note that, in reality, MOVA will be far more adaptive and intelligent than the way that MOVA can be modelled theoretically. It is therefore likely that the assessment set out in this report is conservative, and conditions will be better than those modelled.

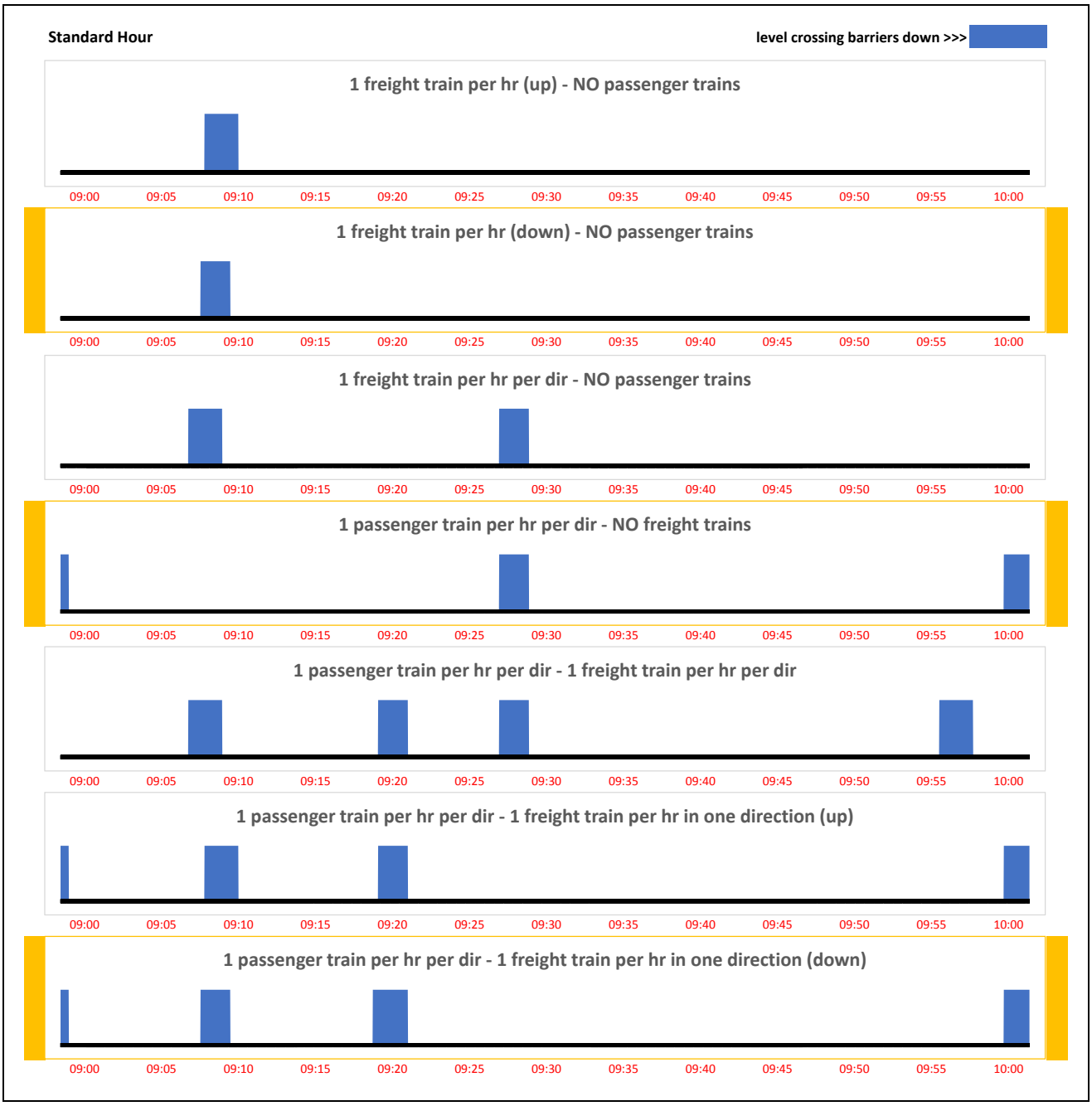
Appendix A: Rail Service/Level Crossing Closure Assumptions (Hourly Service)

USING 'CALCULATED' TIMES

WITH signalling mitigation

Note that this is for a standard hour, so times also apply to other hours

				Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
CURRENT - 5/6 times a week 2	1 freight train per hr (up) - NO passenger trains						estimated
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
				TOTAL /hr	02:05		
CURRENT - 5/6 times a week 1	1 freight train per hr (down) - NO passenger trains						estimated
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
				TOTAL /hr	01:50		
CURRENT - theoretical maximum (RARE)	1 freight train per hr per dir - NO passenger trains						estimated
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
				TOTAL /hr	03:55		
FUTURE - most of the time	1 passenger train per hr per dir - NO freight trains						estimated
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	19:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	03:55		
FUTURE - absolute worst case (RARE)	1 passenger train per hr per dir - 1 freight train per hr per dir						1 Unit B
	Pasenger	UP	from Portishead	08:54:25	02:05	08:56:30	11:25
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	09:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	05:40
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	25:25
				TOTAL /hr	07:50		
FUTURE - realistic worst case 2	1 passenger train per hr per dir - 1 freight train per hr in one direction (up)						1 Unit CU
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:25
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	08:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	06:00		
FUTURE - realistic worst case 1	1 passenger train per hr per dir - 1 freight train per hr in one direction (down)						1 Unit CD
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:10
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	09:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	05:45		


Standard Hour
level crossing barriers down >>>
1 freight train per hr (up) - NO passenger trains
1 freight train per hr (down) - NO passenger trains
1 freight train per hr per dir - NO passenger trains
1 passenger train per hr per dir - NO freight trains
1 passenger train per hr per dir - 1 freight train per hr per dir
1 passenger train per hr per dir - 1 freight train per hr in one direction (up)
1 passenger train per hr per dir - 1 freight train per hr in one direction (down)
09:00 09:05 09:10 09:15 09:20 09:25 09:30 09:35 09:40 09:45 09:50 09:55 10:00

Appendix B: Rail Service/Level Crossing Closure Assumptions (45 Min Service)

USING 'CALCULATED' TIMES

WITH signalling mitigation

Note that this is for a standard hour, so times also apply to other hours

CURRENT - 5/6 times a week 2

1 freight train per hr (up) - NO passenger trains						estimated
Freight	UP	from Portbury	07:08:55	02:05	07:11:00	57:40
Freight	DOWN	to Portbury	08:08:40	01:50	08:10:30	58:25
Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
			TOTAL /hr	02:00		

CURRENT - 5/6 times a week 1

1 freight train per hr (down) - NO passenger trains						estimated
Freight	DOWN	to Portbury	07:08:40	01:50	07:10:30	58:25
Freight	UP	from Portbury	08:08:55	02:05	08:11:00	57:40
Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
			TOTAL /hr	01:55		

CURRENT - theoretical maximum (RARE)

1 freight train per hr per dir - NO passenger trains						estimated
Freight	UP	from Portbury	07:07:55	02:05	07:10:00	17:10
Freight	DOWN	to Portbury	07:27:10	01:50	07:29:00	38:55
Freight	UP	from Portbury	08:07:55	02:05	08:10:00	17:10
Freight	DOWN	to Portbury	08:27:10	01:50	08:29:00	38:55
Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
			TOTAL /hr	03:55		

45-minute - no freight

1 passenger train every 45 mins per dir - NO freight trains						estimated
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	36:55
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	36:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	36:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	36:55
			TOTAL /hr	05:13		

45-minute - absolute worst case (RARE)

1 passenger train every 45 mins per dir - 1 freight train per hr per dir						45 minute cycles
Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	25:25
Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	10:55
Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	20:55
Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	20:55
			TOTAL /hr	10:27		

45-minute - realistic worst case 2

1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (up)						estimated
Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	31:55
Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	21:55
Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	31:55
Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	31:55
			TOTAL /hr	08:00		

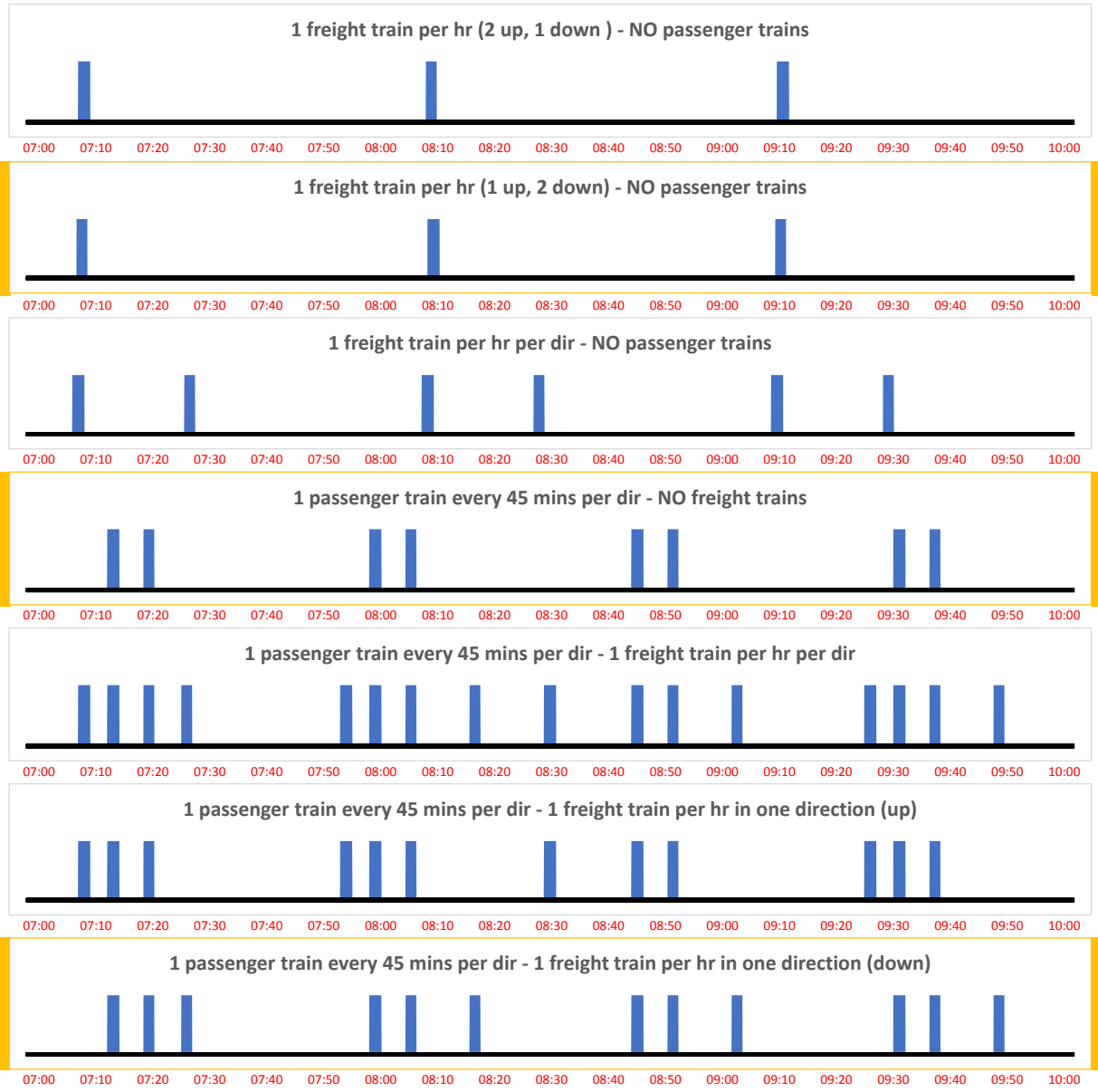
45-minute - realistic worst case 1

1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (down)						estimated
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	30:25
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	25:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	25:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	25:55
			TOTAL /hr	07:40		

Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*

3-hour period - AM (or PM) peak only

level crossing barriers down >>>



Appendix C:
Proposed Highway Measures Drawings

Drawing file path & name

Notes:

1. All dimensions are in metres unless noted otherwise.
2. Ground levels have been estimated from the limited spot height information gained from the OS mapping and from Topographical Survey that was commissioned as part of the AVTM MetroBus project.
3. The heights of structures and extent of earthworks must therefore be seen within this context of available information.
4. It has not been possible to obtain utility information.

KEY:

- Proposed new kerb
- Proposed kerb edging
- Order Limits
- Existing road markings
- Existing road markings repositioned
- Proposed shared cycle/footway
- Existing shared cycle/footway

WINTERSTOKE UNDERPASS
Existing 3m signal controlled crossing
ASHTON ROAD
El Sub Sta
WINTERSTOKE ROAD
Existing underpass
Existing double bus stop
Cycle route towards City Centre via Greville Smyth Park
BOWER ASHTON TERRACE 7.3m
Drain
MP 121.25
Existing 3m wide shared footway/cycleway
Traffic signal detection
ASHTON GATE UNDERPASS
Cumberland House
MARSH ROAD
Existing level crossing
Charnwood House
Works
Traffic signal detection
ASHTON VALE ROAD
Existing pedestrian crossings
Proposed 'Keep Clear'
Traffic signals to be upgraded and optimised using MOVA
Tie into existing kerb line
Traffic signal detection
Proposed double yellow lines
Cala Trading Estate
MetroBus overbridge
For Section A refer to drawing 674946.BD.29.01-SK33
The Sidings
3m wide shared footway/cycleway
Ward Bdy
El Sub Sta
Proposed retaining wall
Existing right turn lane to remain
Approximate distance of 0.55m from back of wall to corner of the building
Extended of left turning lane
WINTERSTOKE ROAD
MetroWest Phase 1 to designate path as Public Right of Way
Vegetation to be cleared, along with land to be acquired, and replacement retaining wall between the footway and Trading Estate car park
South Bristol Trade Park
Gas Gov

DO NOT SCALE. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 10 20 30 40 50 METRES

SCALE 1:500 (A1)
SCALE 1:1000 (A3)

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Rev	By	Chkd	Apprvd	Date	Description
L	OHP	ADL	ADL	12/02/2021	Updated Order Limits & Minor amendments
K	FG	ADL	ADL	15/12/2020	Minor amendments
J	OHP	ADL	ADL	31/10/2019	Minor amendments
I	OHP	ADL	ADL	31/07/2019	Ramp removed and minor amendments
H	OHP	ADL	ADL	31/07/2019	Order limits added and minor amendments
G	OHP	ADL	ADL	28/06/2018	Minor amendments
F	ADS	LT	ADL	11/06/20118	Traffic signal detector loops added (3/38/81m FSL) Toucan crossing by Babcock removed
E	OHP	MF	ADL	26/02/2018	Tactile paving updated
D	MF	ADL	ADL	05/10/2017	Minor amendments
C	OHP	KS	ADL	04/10/2017	Title amendments
B	OHP	KS	ADL	28/09/2017	Minor amendments
A	MF/OHP	MF	ADL	22.09.17	Design amended to tie in to extended topo survey.

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Project
PORTISHEAD BRANCH LINE
METROWEST PHASE 1

Drawing
ASHTON VALE ROAD AND WINTERSTOKE ROAD HIGHWAY WORKS PLAN

Drawn by: ADS Date: 20/11/2015
Checked by: MF Date: 01/08/2017
Approved by: AL Date: 01/08/2017

Drawing No. 674946.BD.29.01-SK31
Revision L

Drawing Scale: 1:500 @ A1 or 1:1000 @ A3

: \\brsfpp01\Proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BD.29.01 Ashton Vale Alternate Access\90 AutoCAD\91 AutoCAD\ 674946.BD.29.01-SK31 Rev L.dwg

Appendix D: Queue Profile Results, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) with Highway Measures

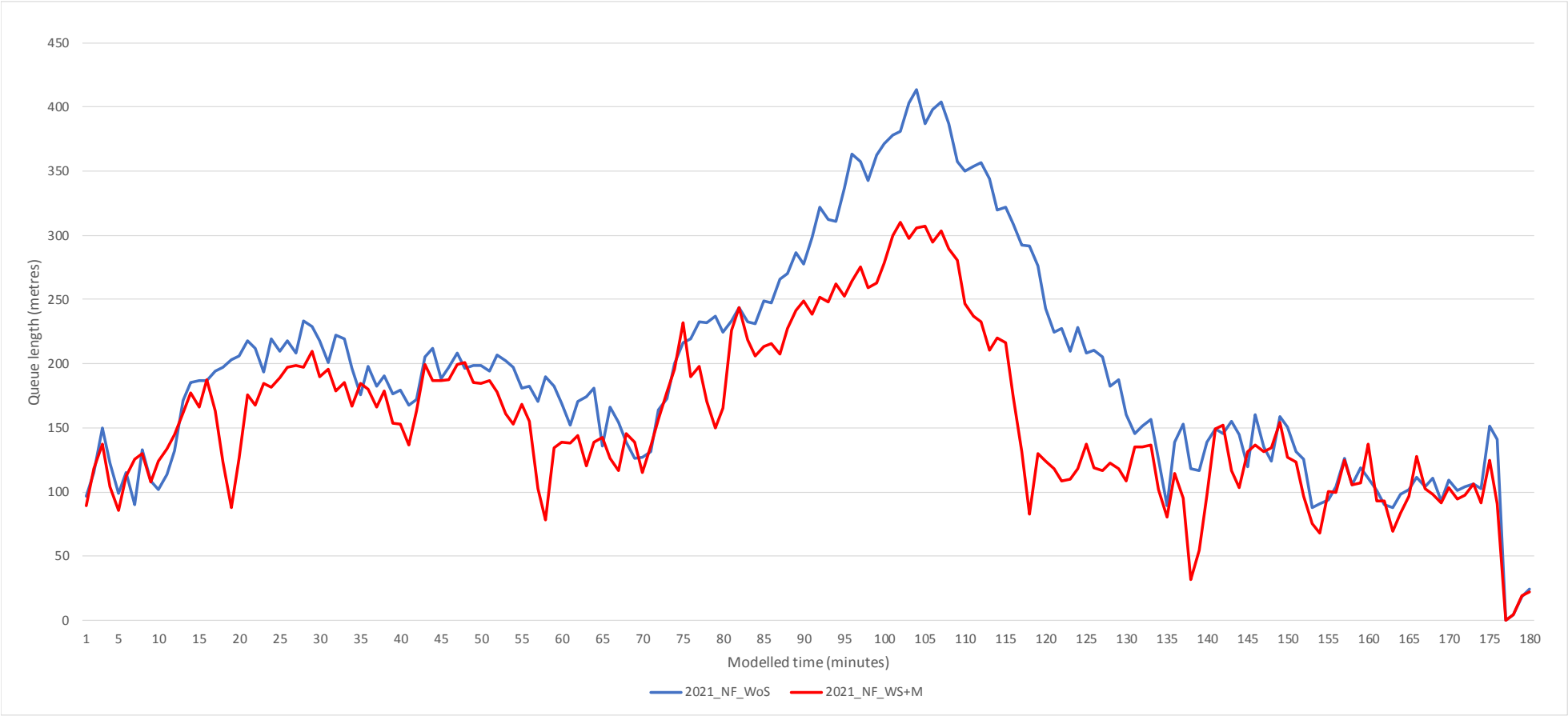

Figure D1: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

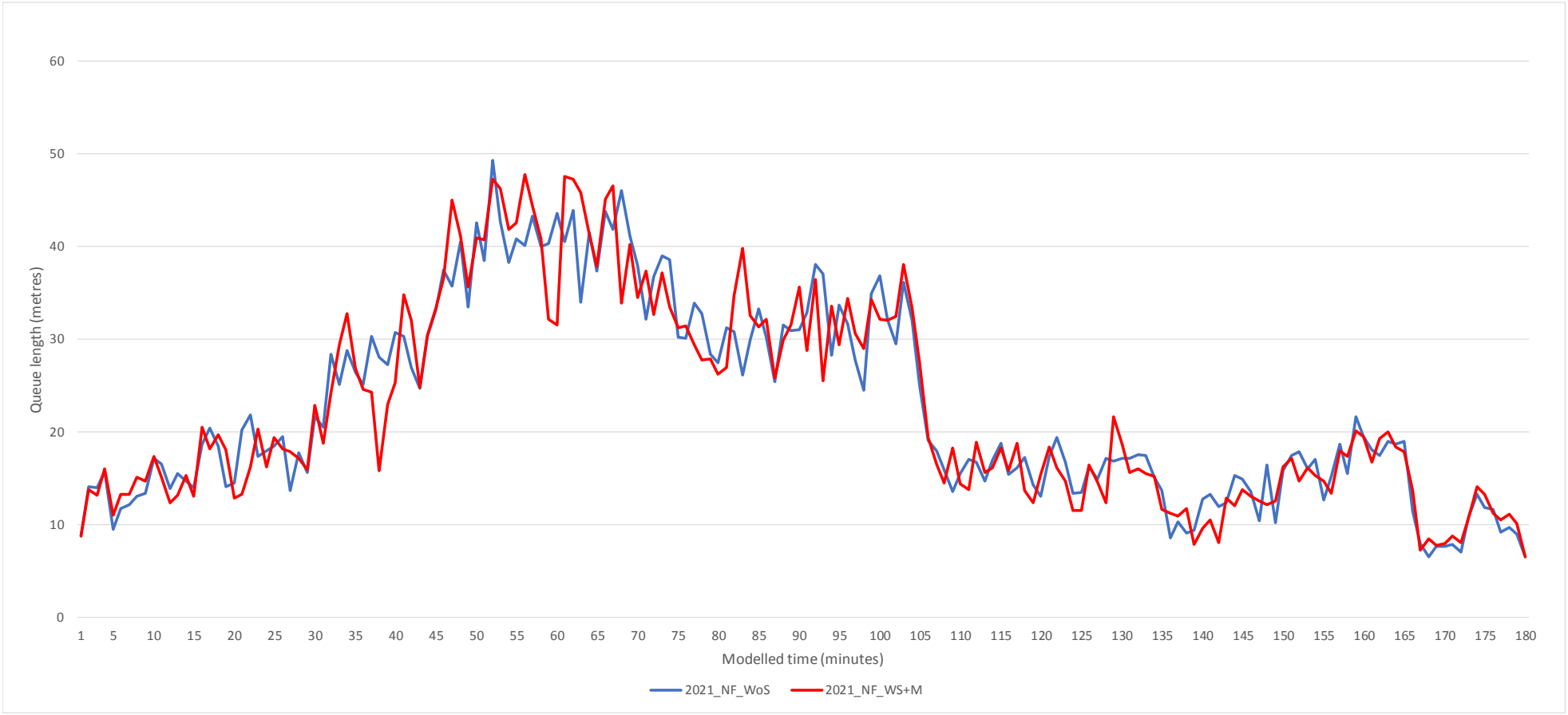

Figure D2: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Marsh Lane, AM Peak Period

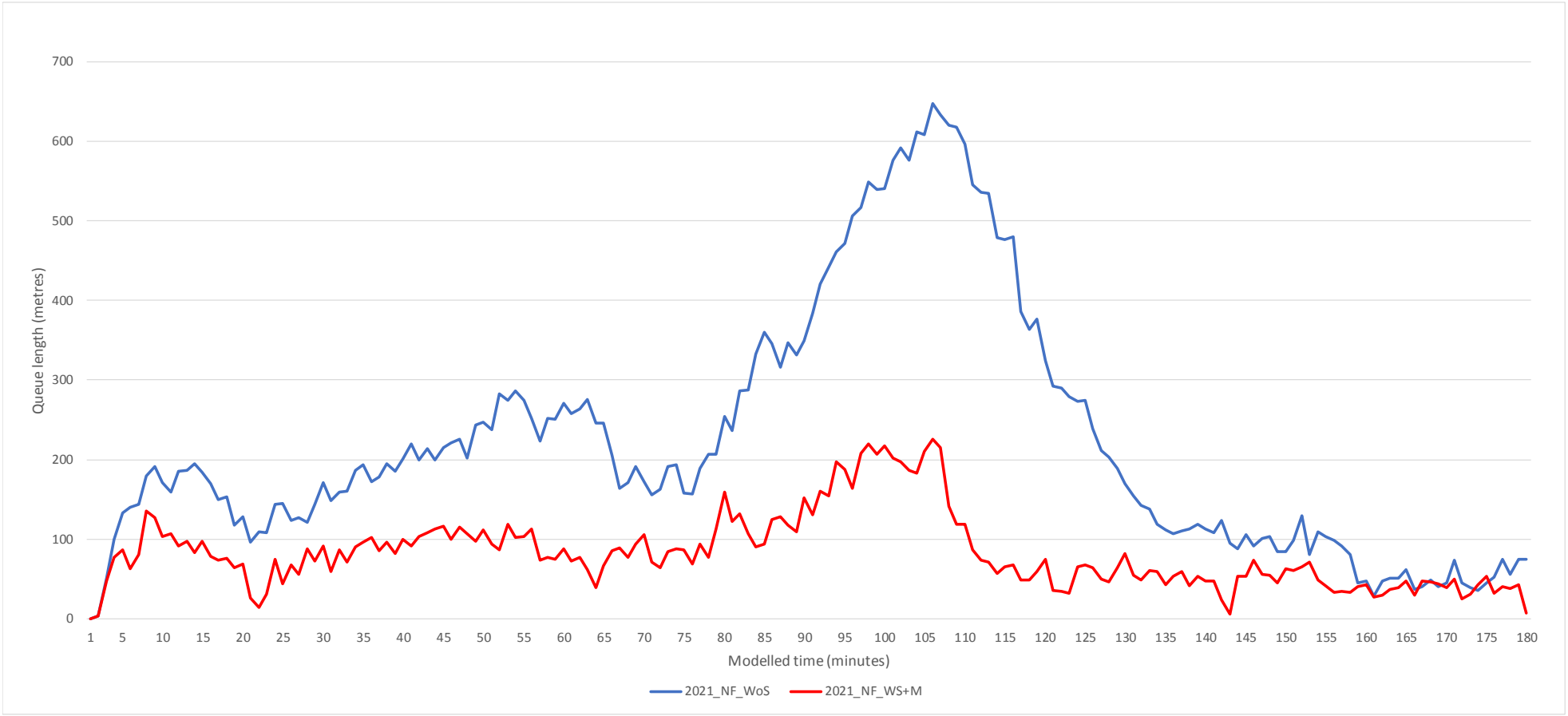

Figure D3: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

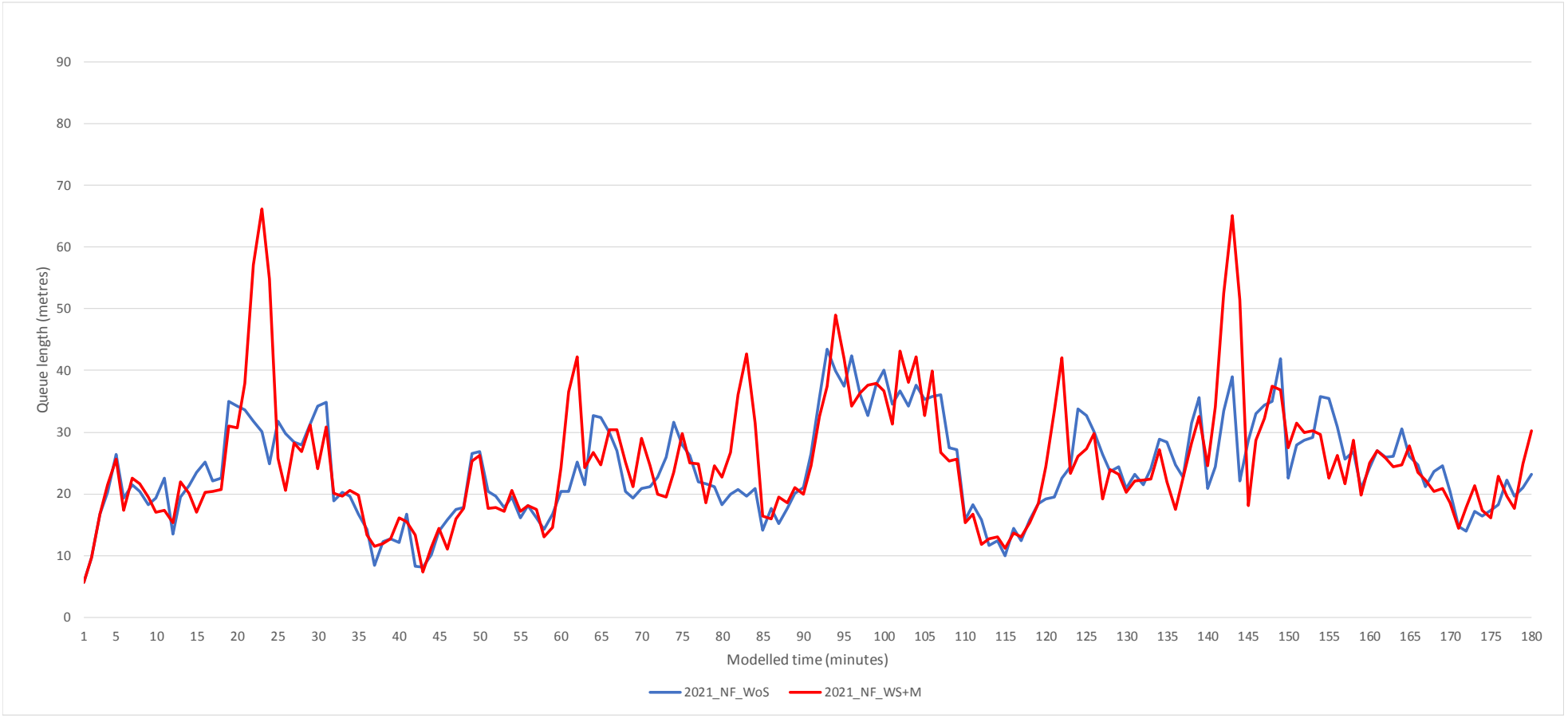

Figure D4: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

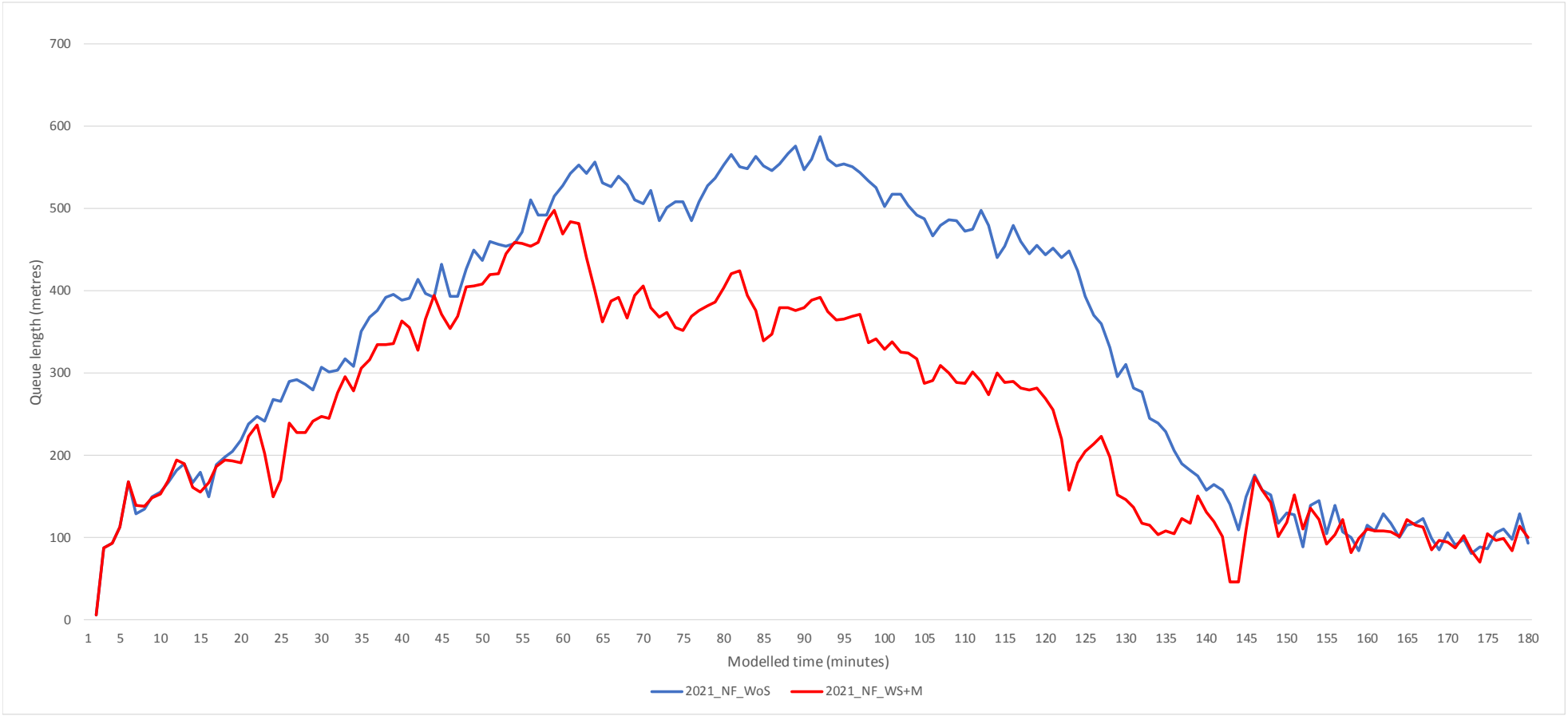

Figure D5: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

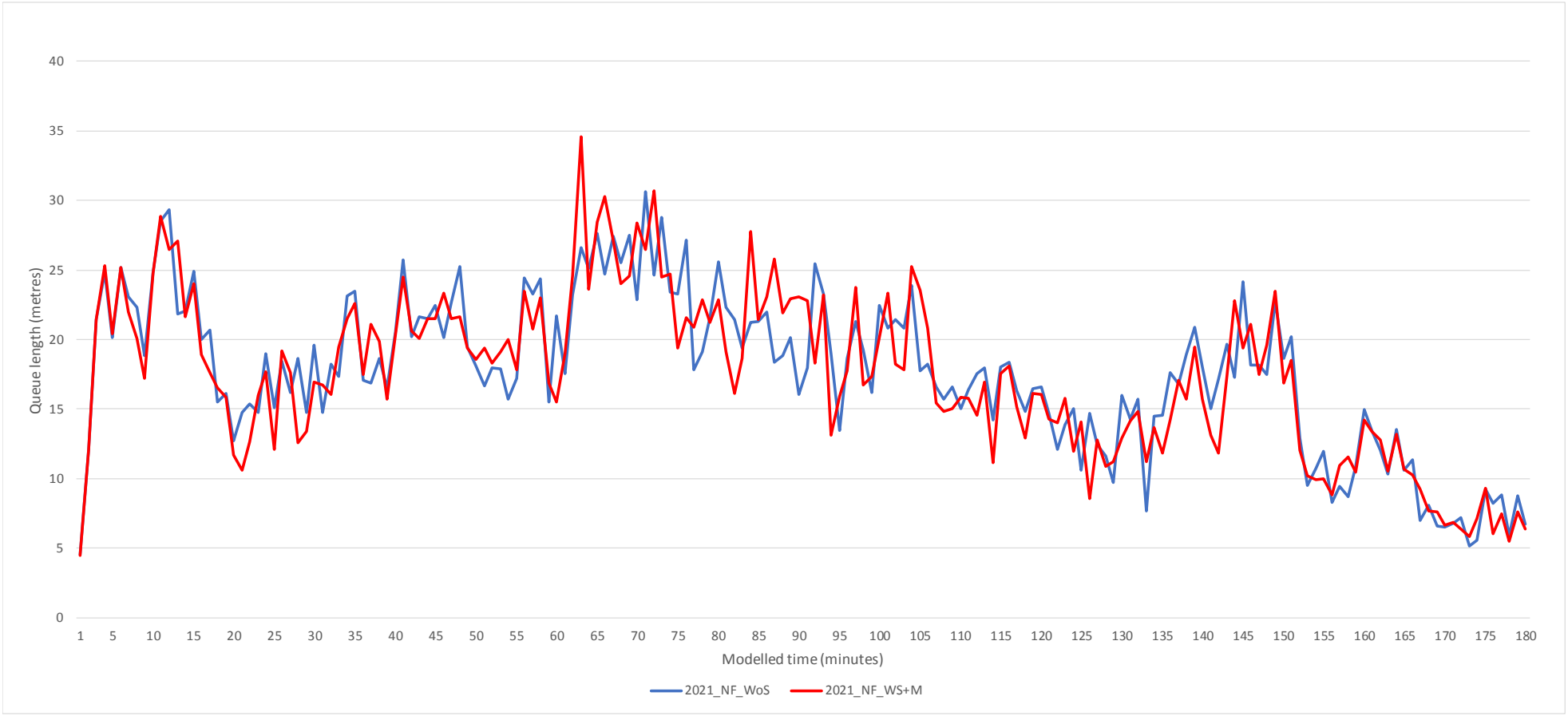

Figure D6: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Marsh Lane, PM Peak Period

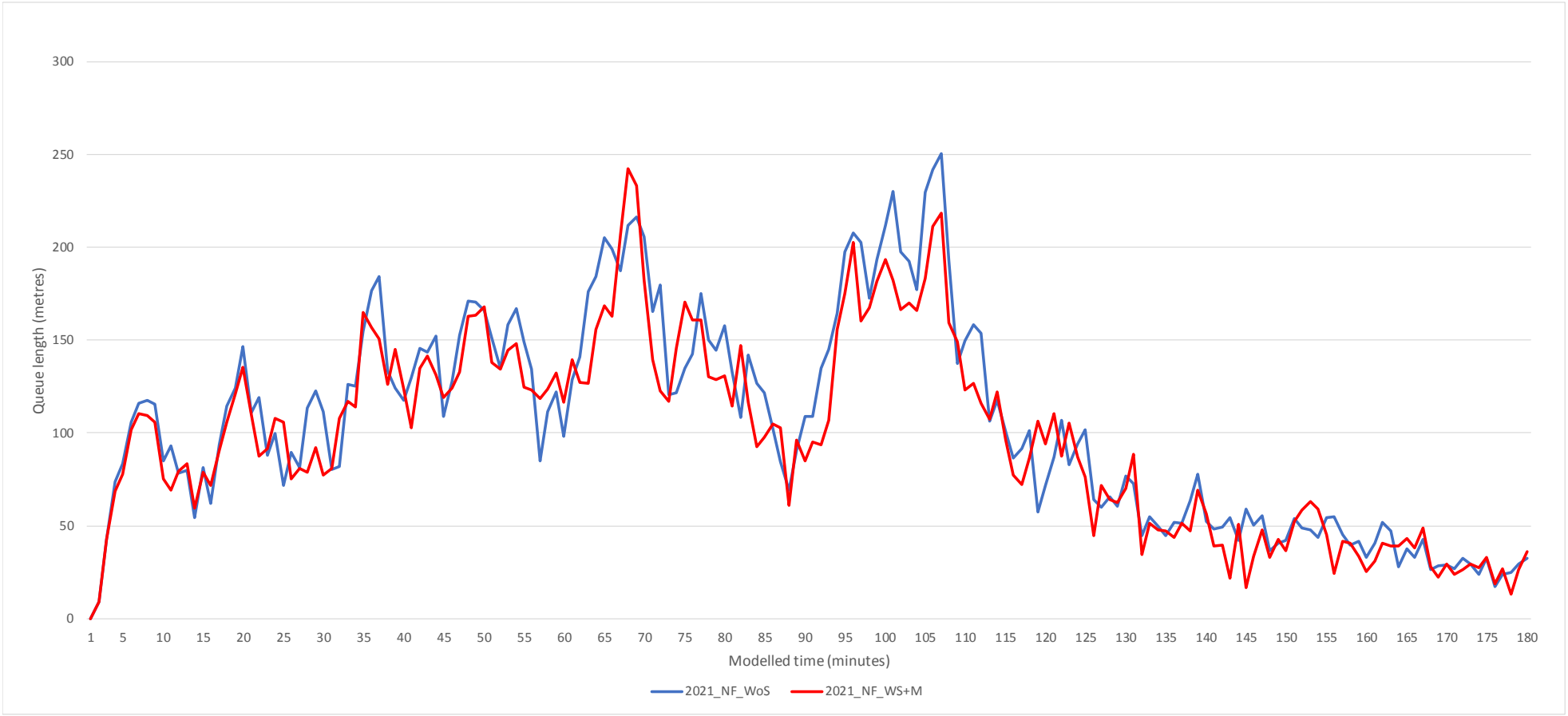

Figure D7: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

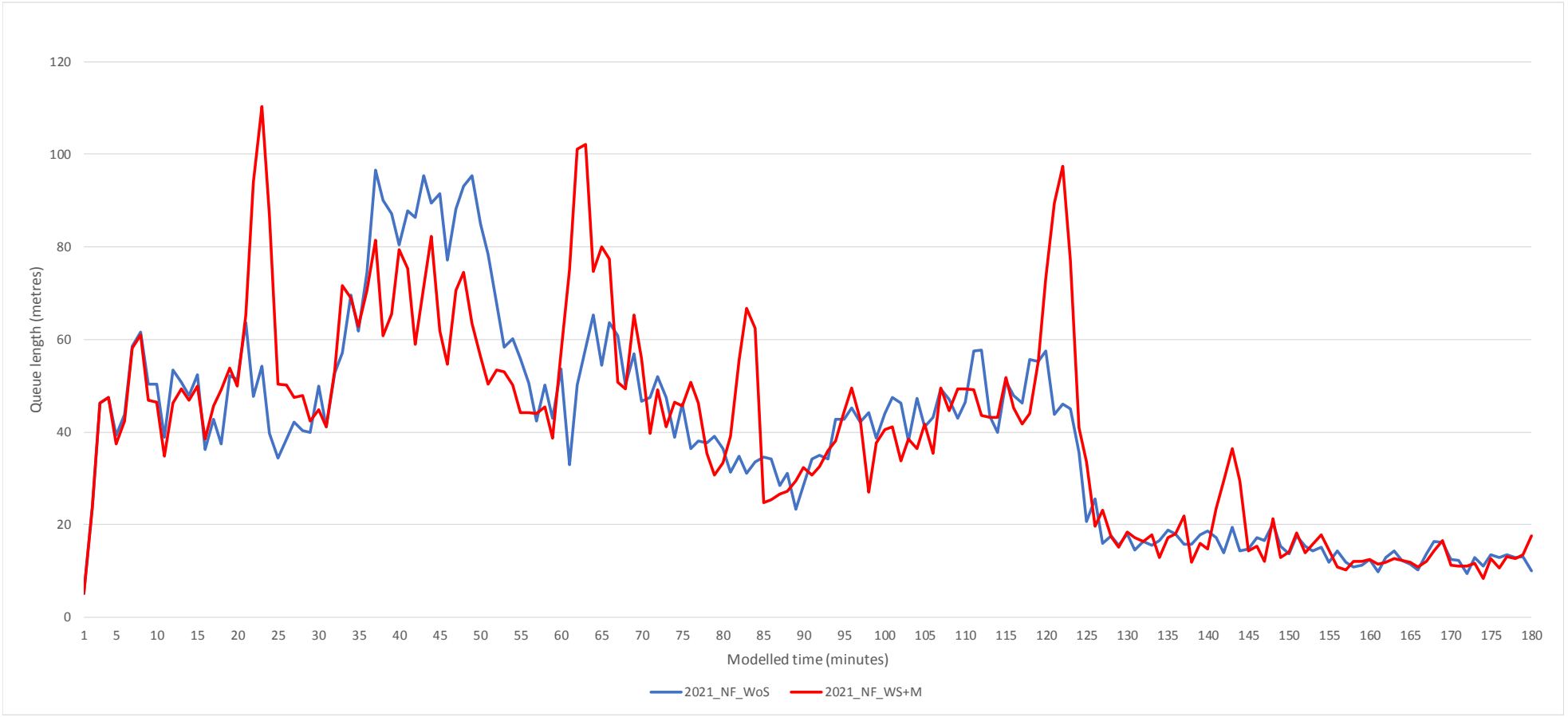

Figure D8: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Ashton Vale Road, PM Peak Period

Appendix E: Queue Profile Results, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) with Highway Measures

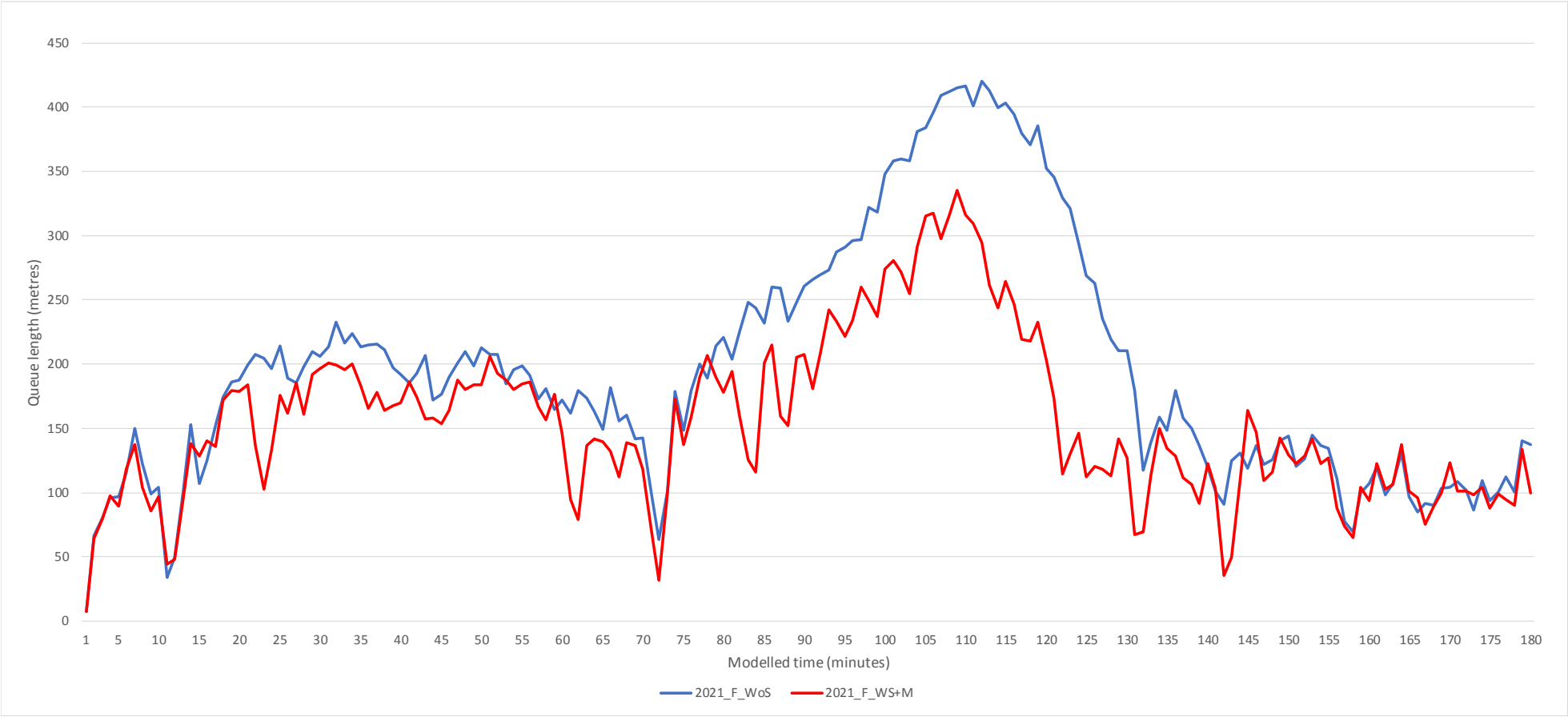

Figure E1: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

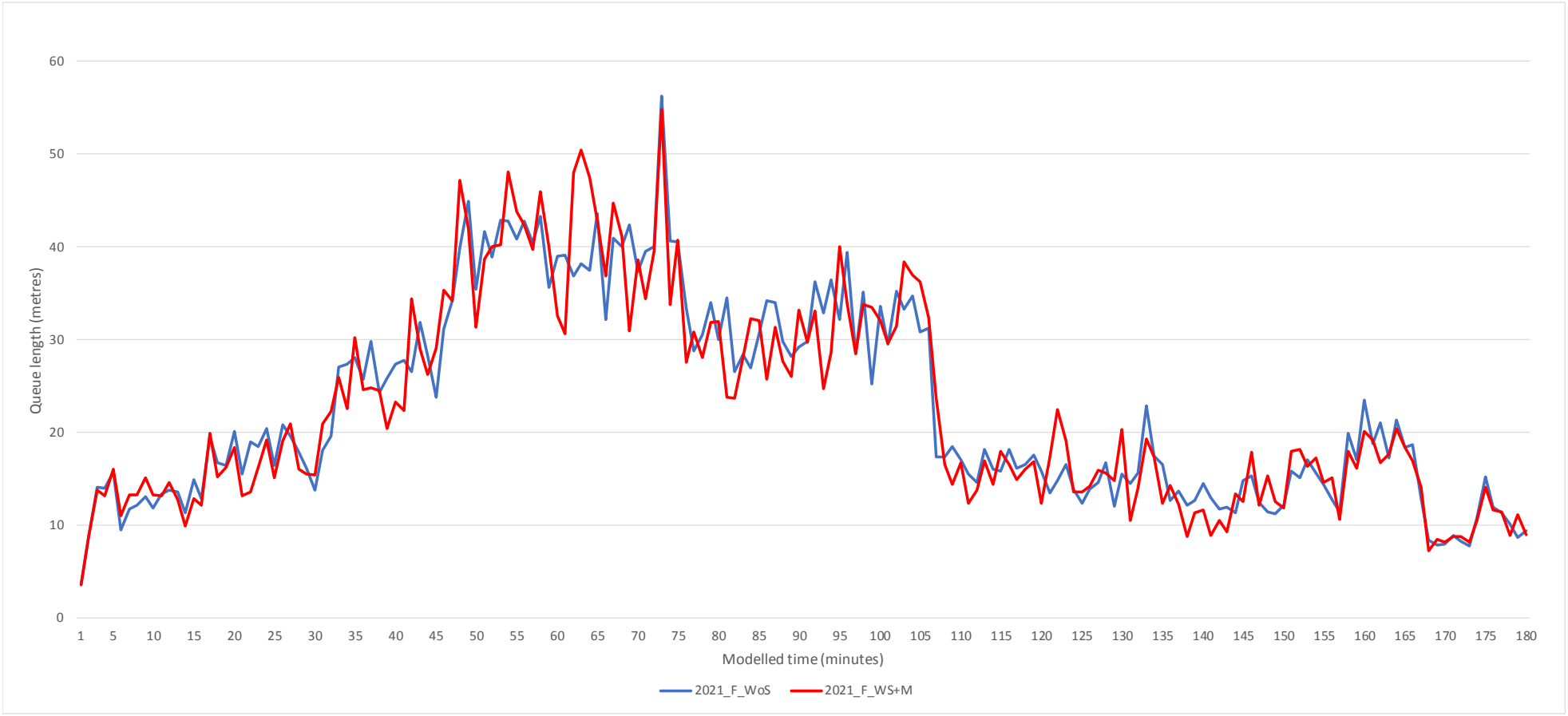

Figure E2: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, AM Peak Period

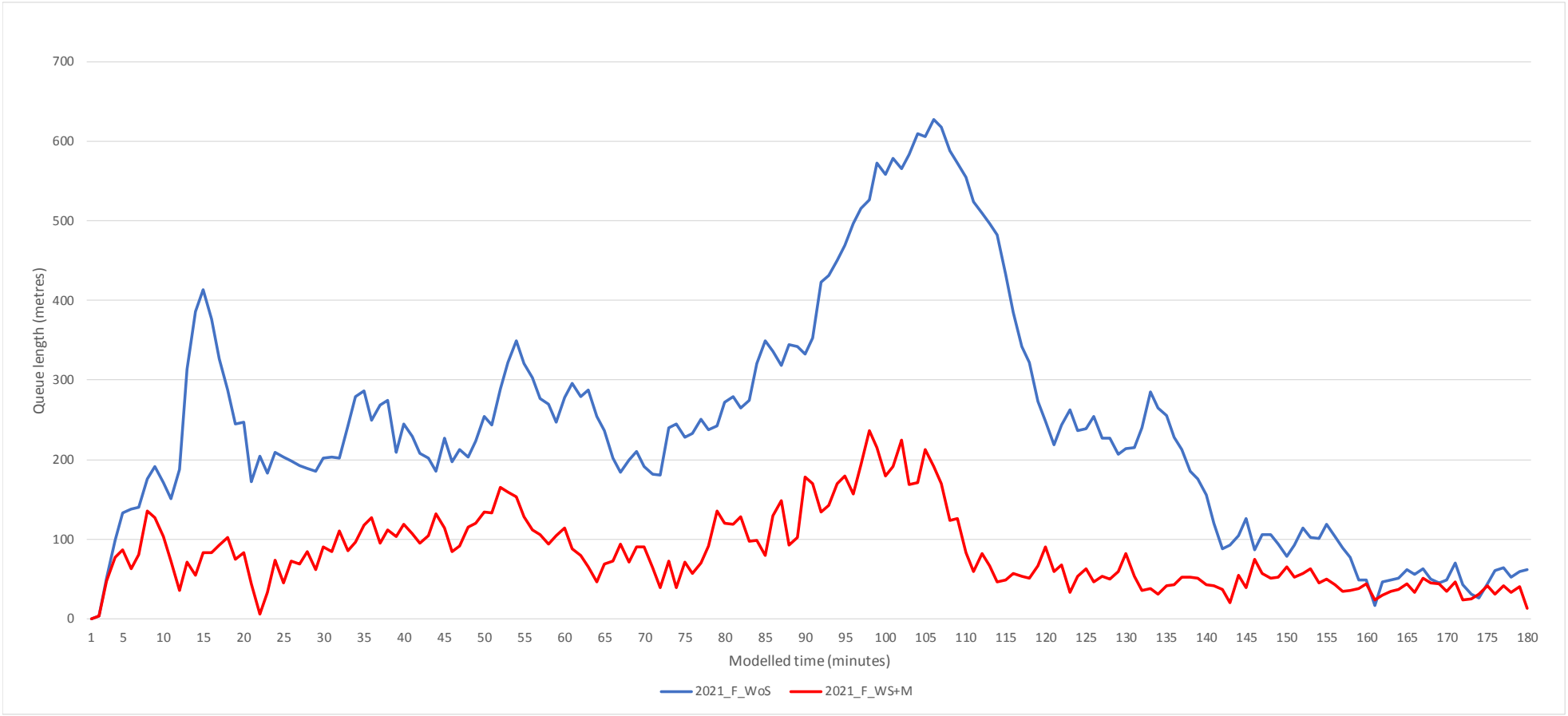

Figure E3: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

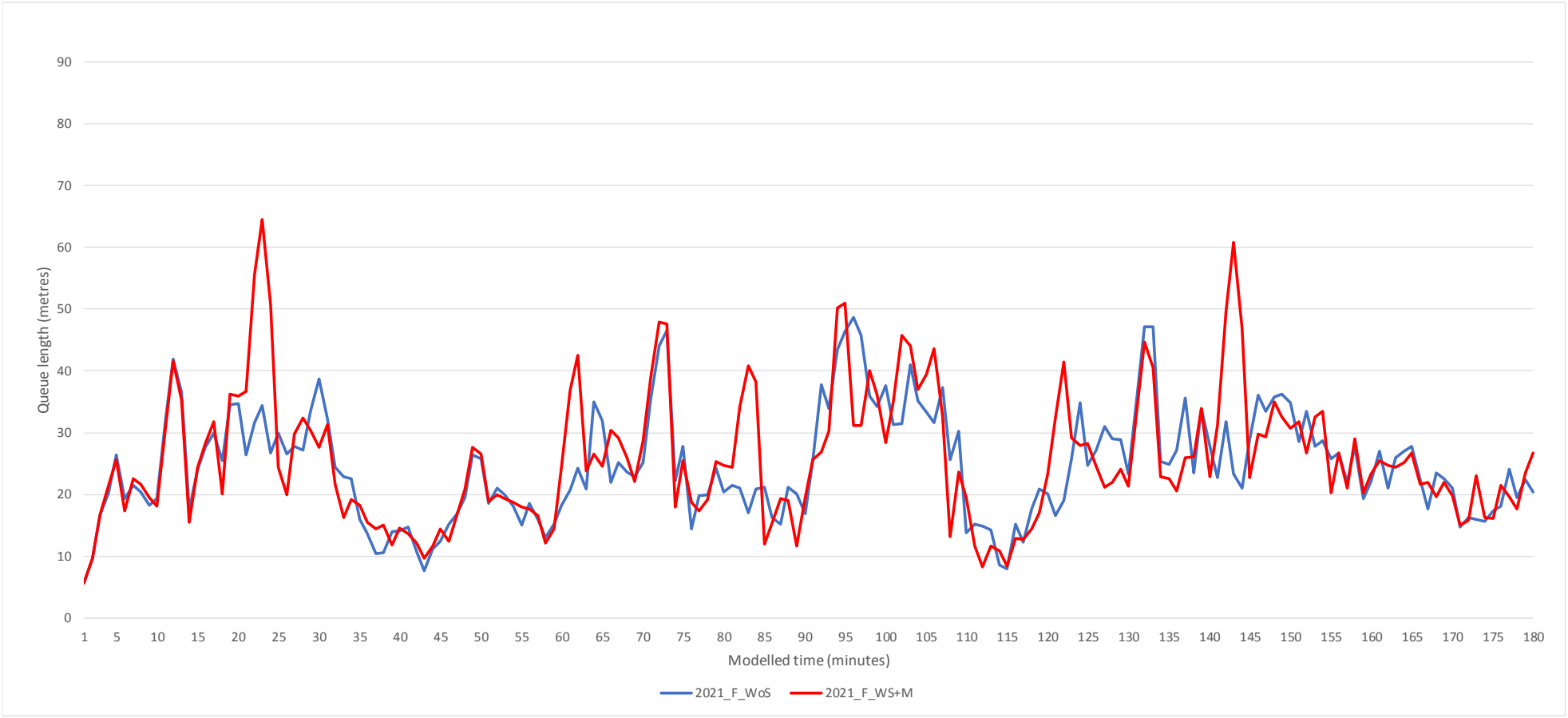

Figure E4: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

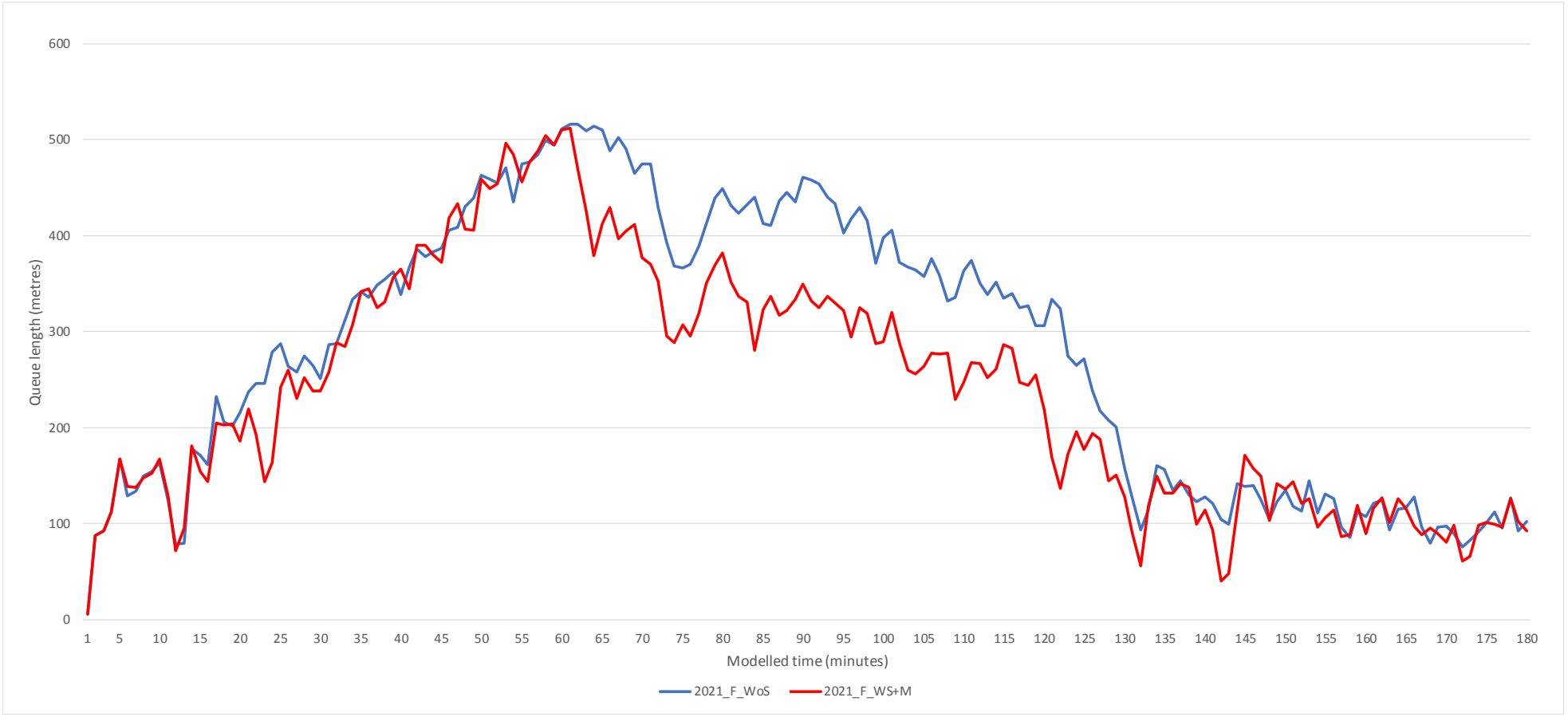

Figure E5: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

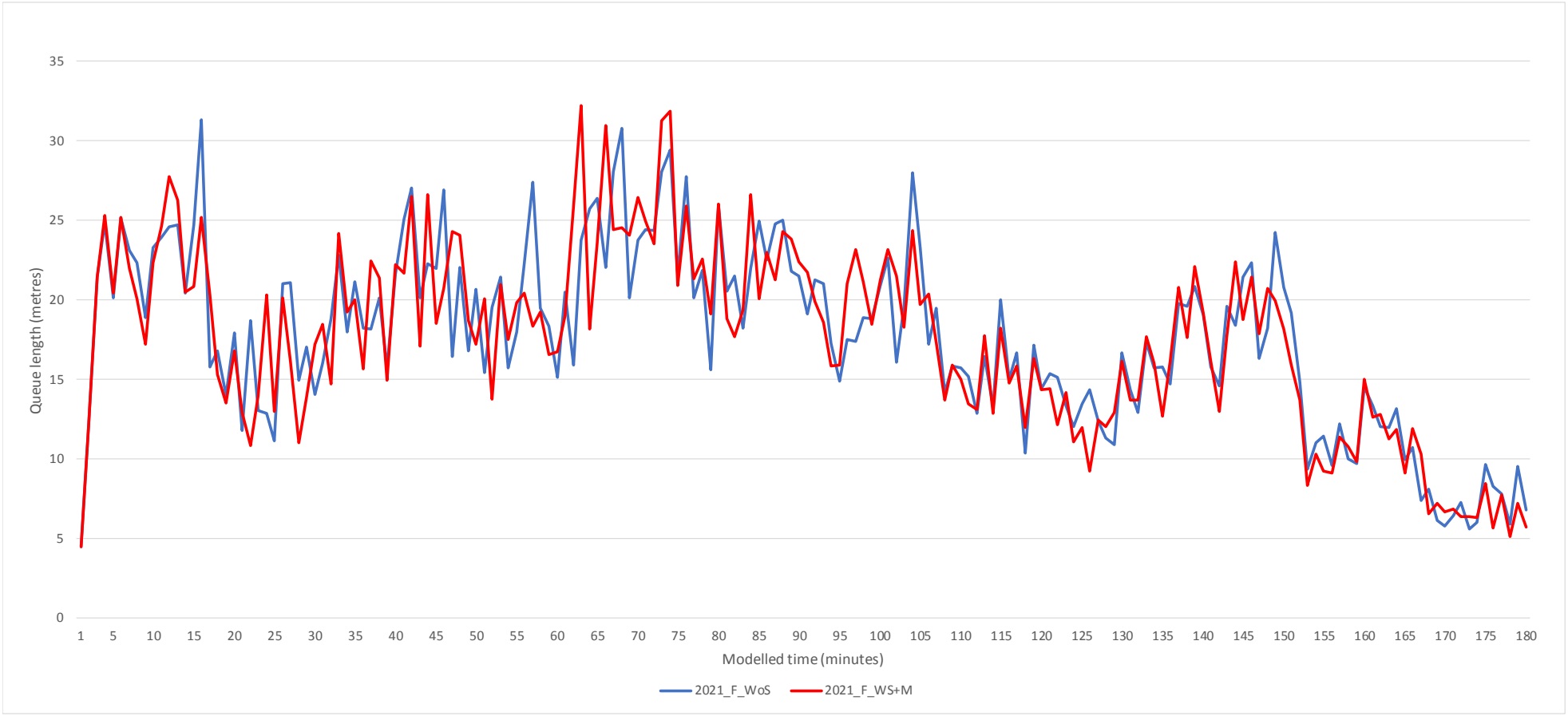

Figure E6: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, PM Peak Period

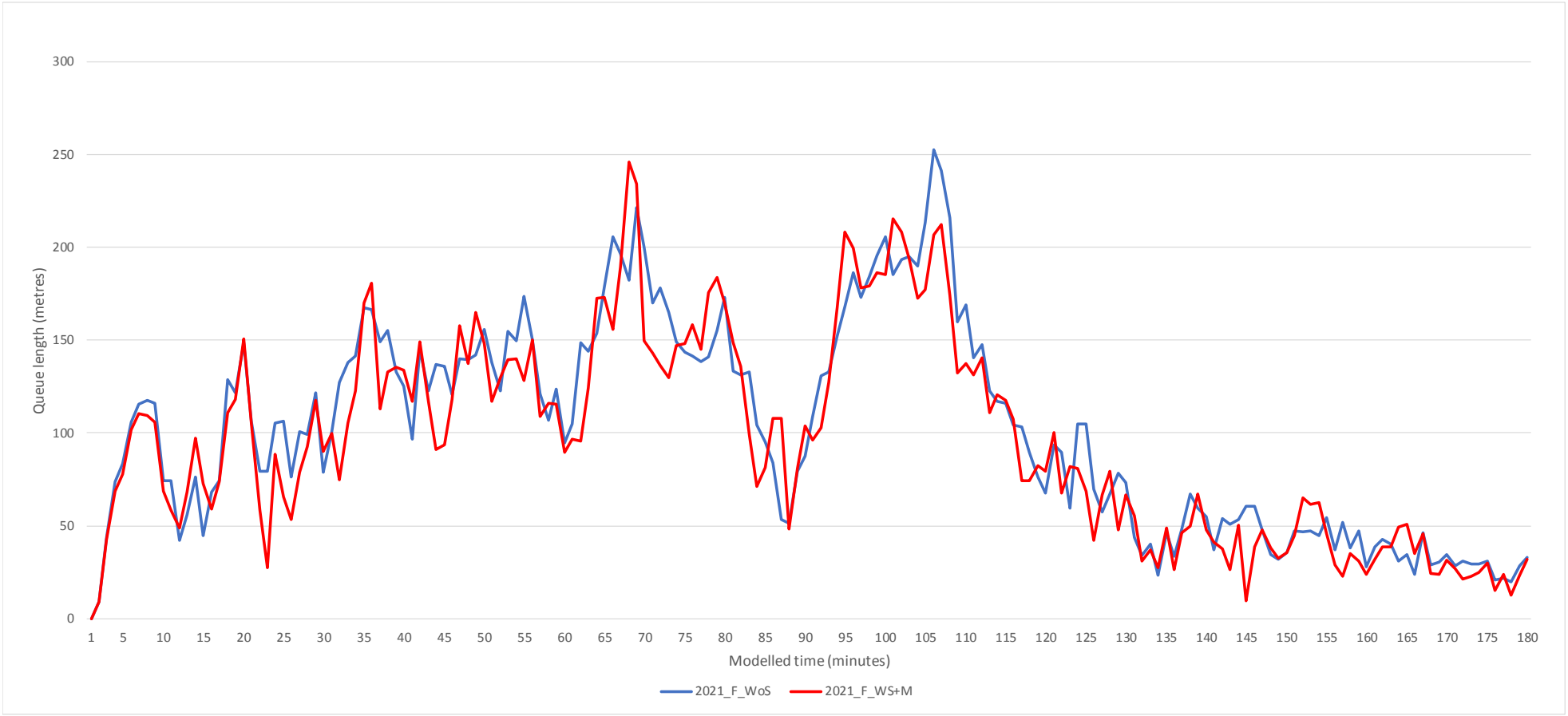

Figure E7: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

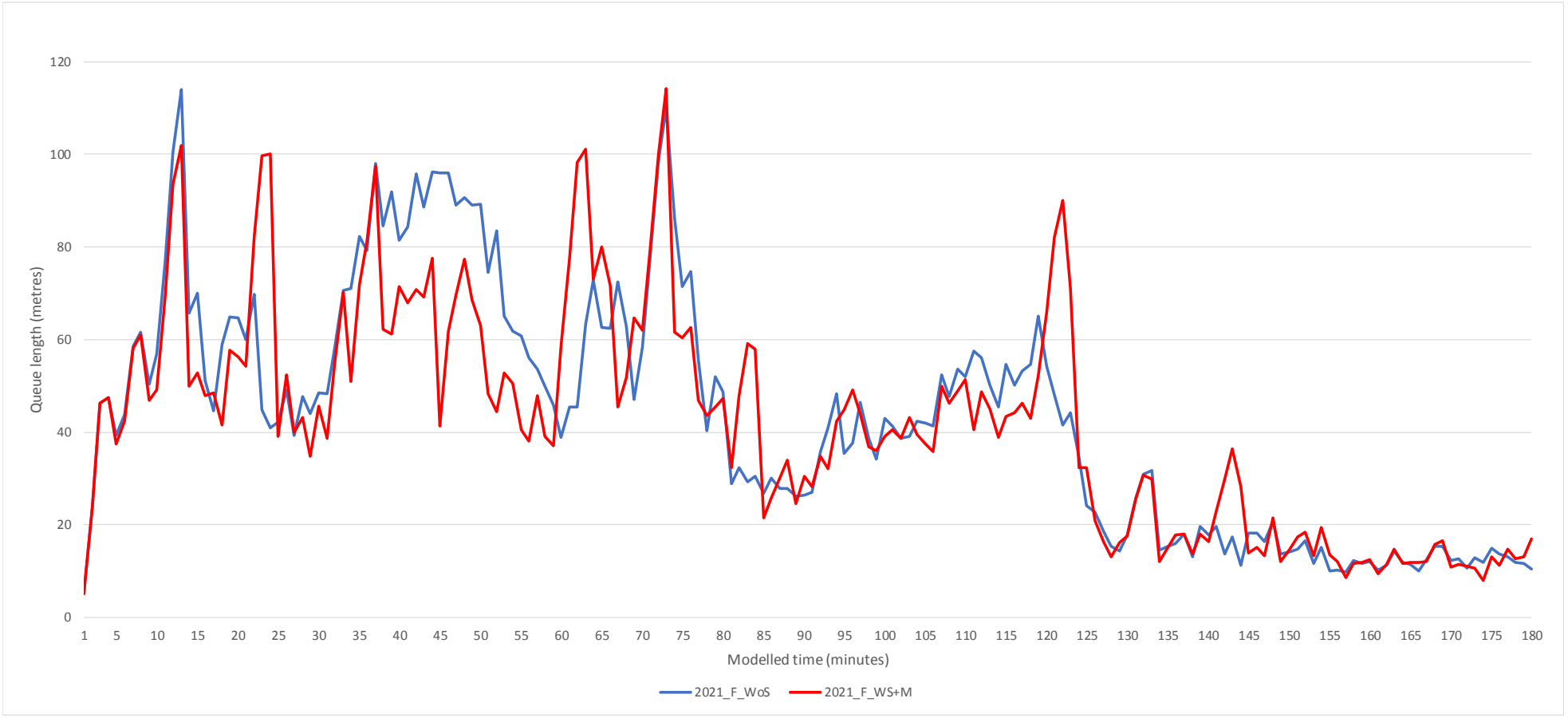

Figure E8: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, PM Peak Period

Appendix F: Queue Profile Results, 2021 MetroWest Without Measures vs 2021 MetroWest With Highway Measures

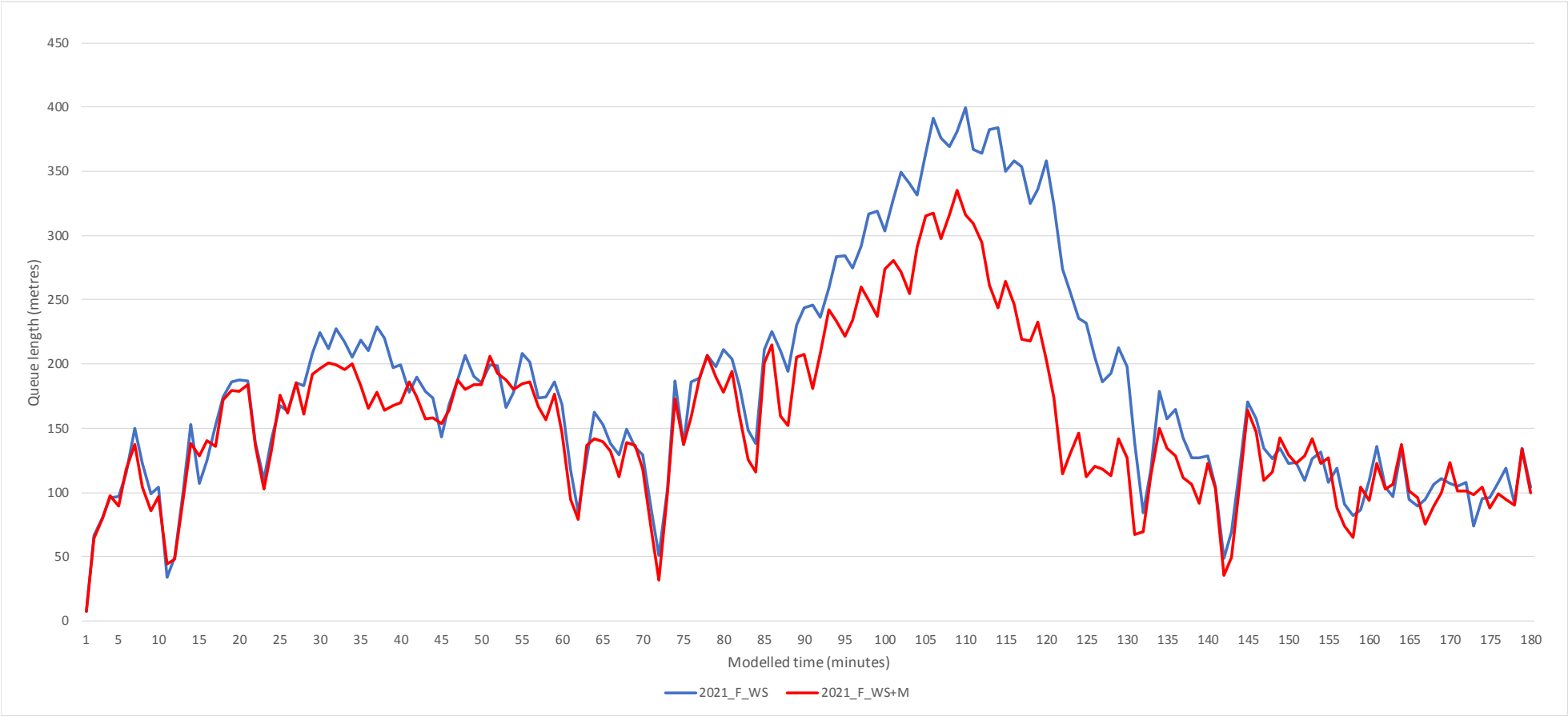

Figure F1: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

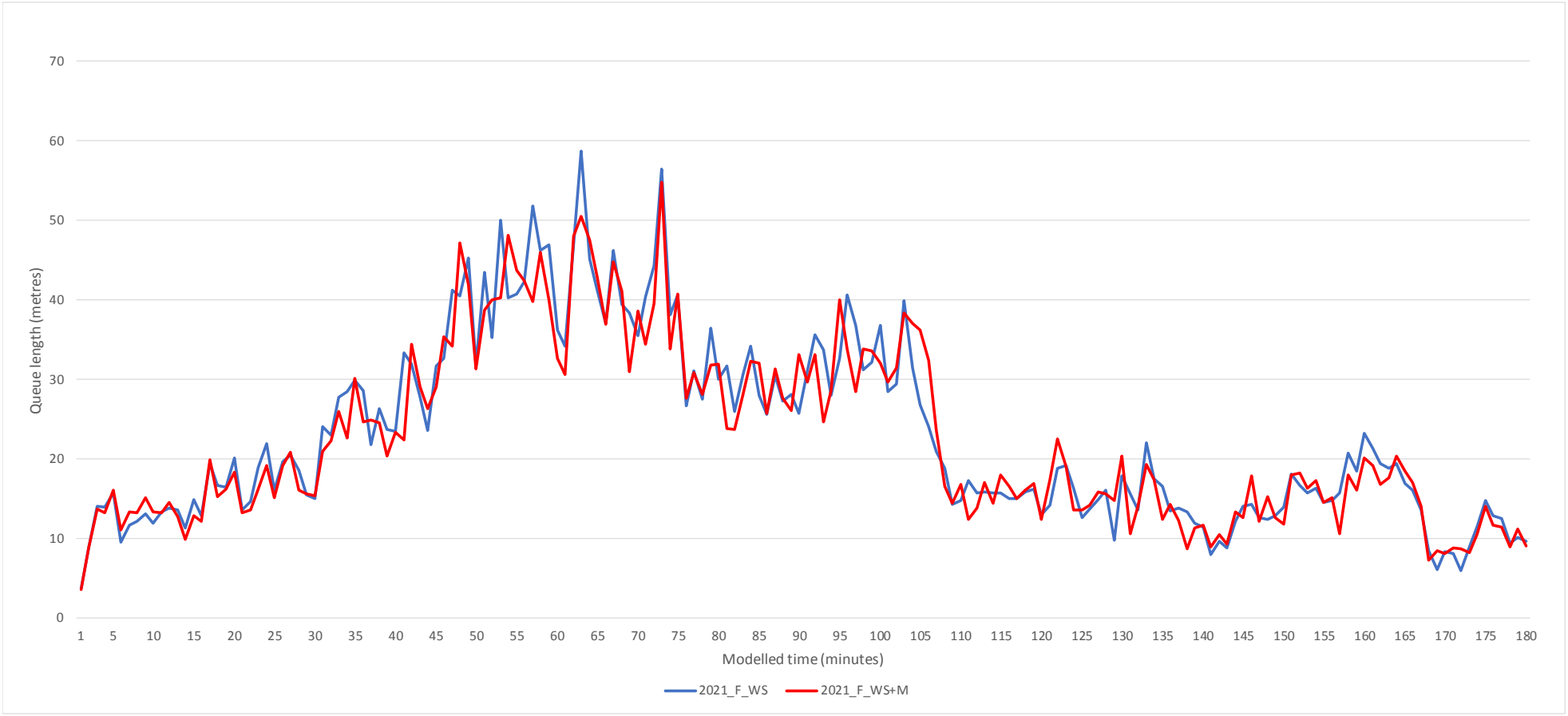

Figure F2: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, AM Peak Period

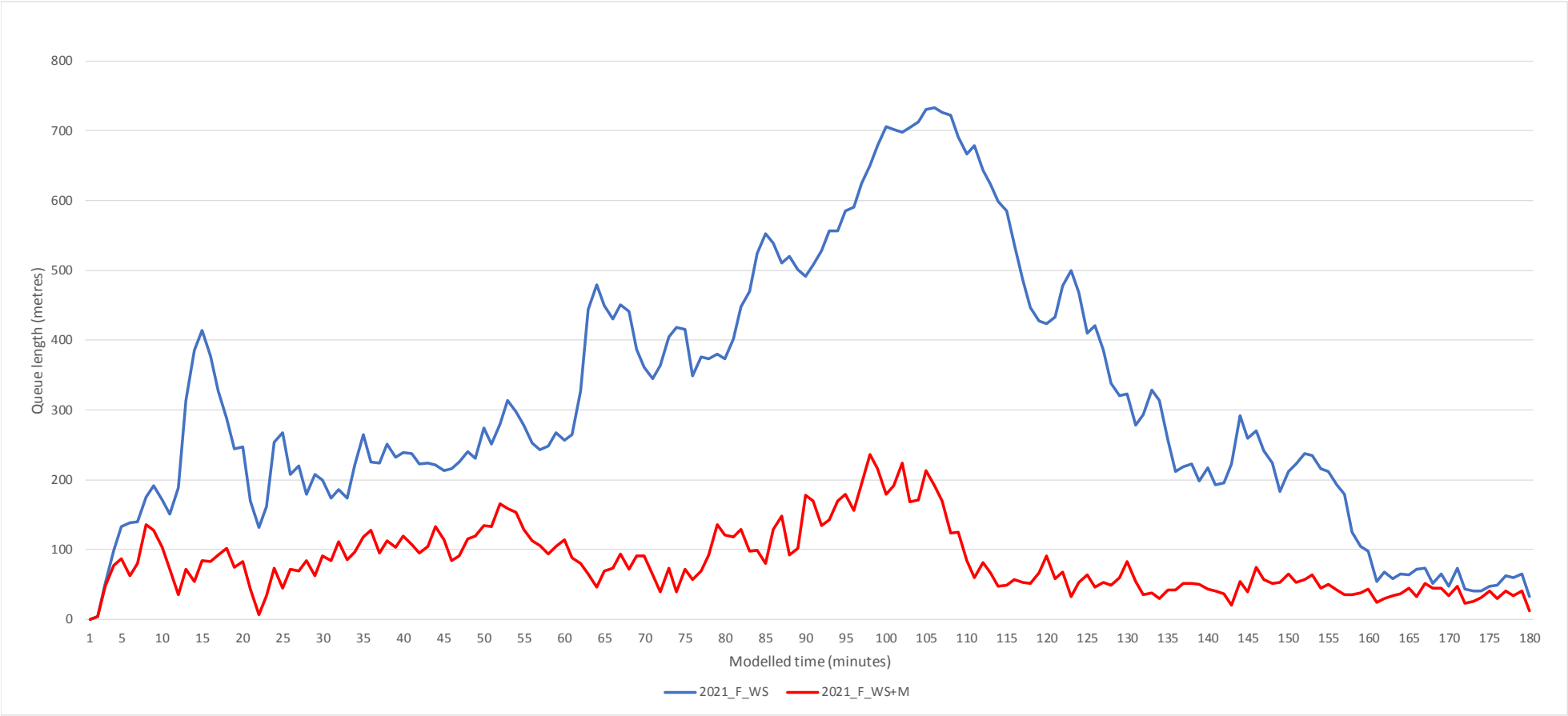

Figure F3: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

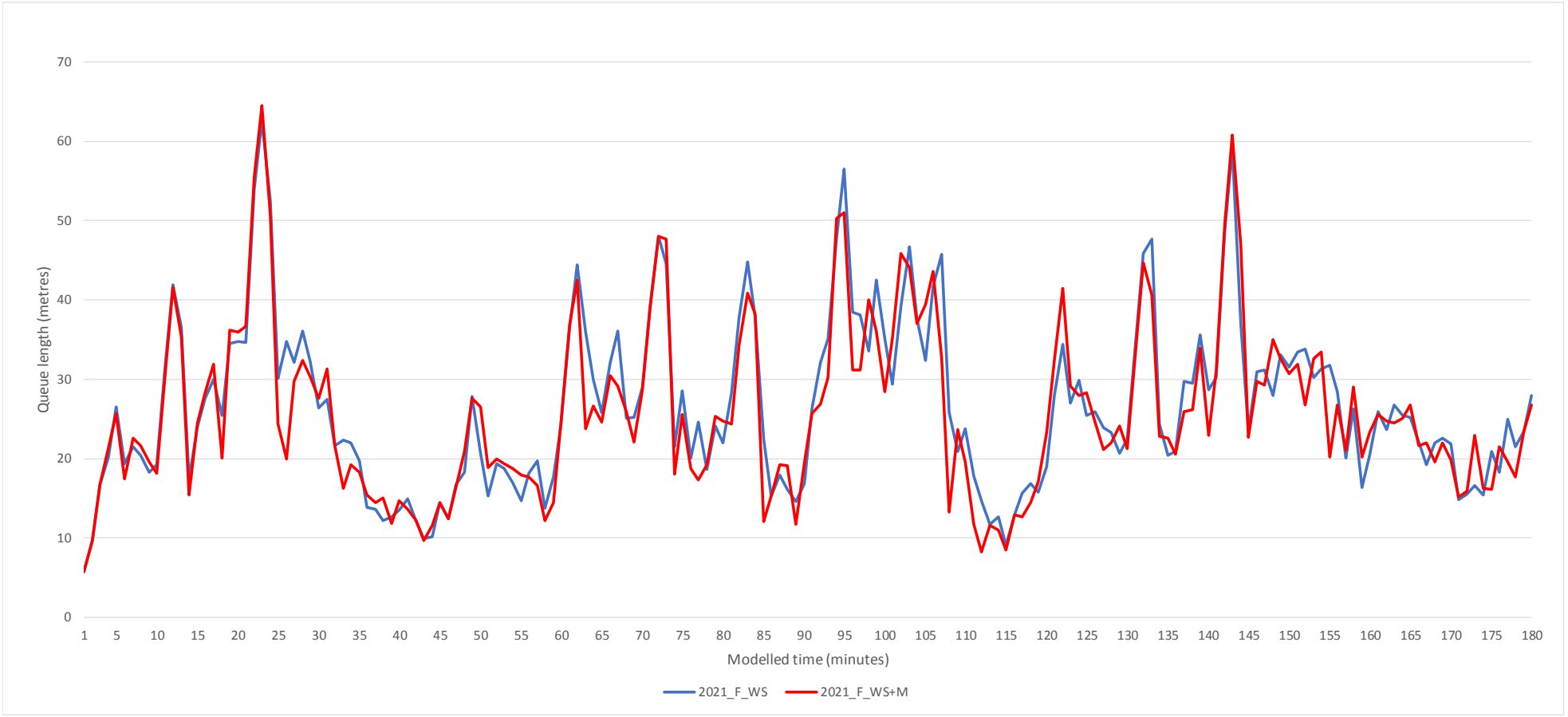

Figure F4: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

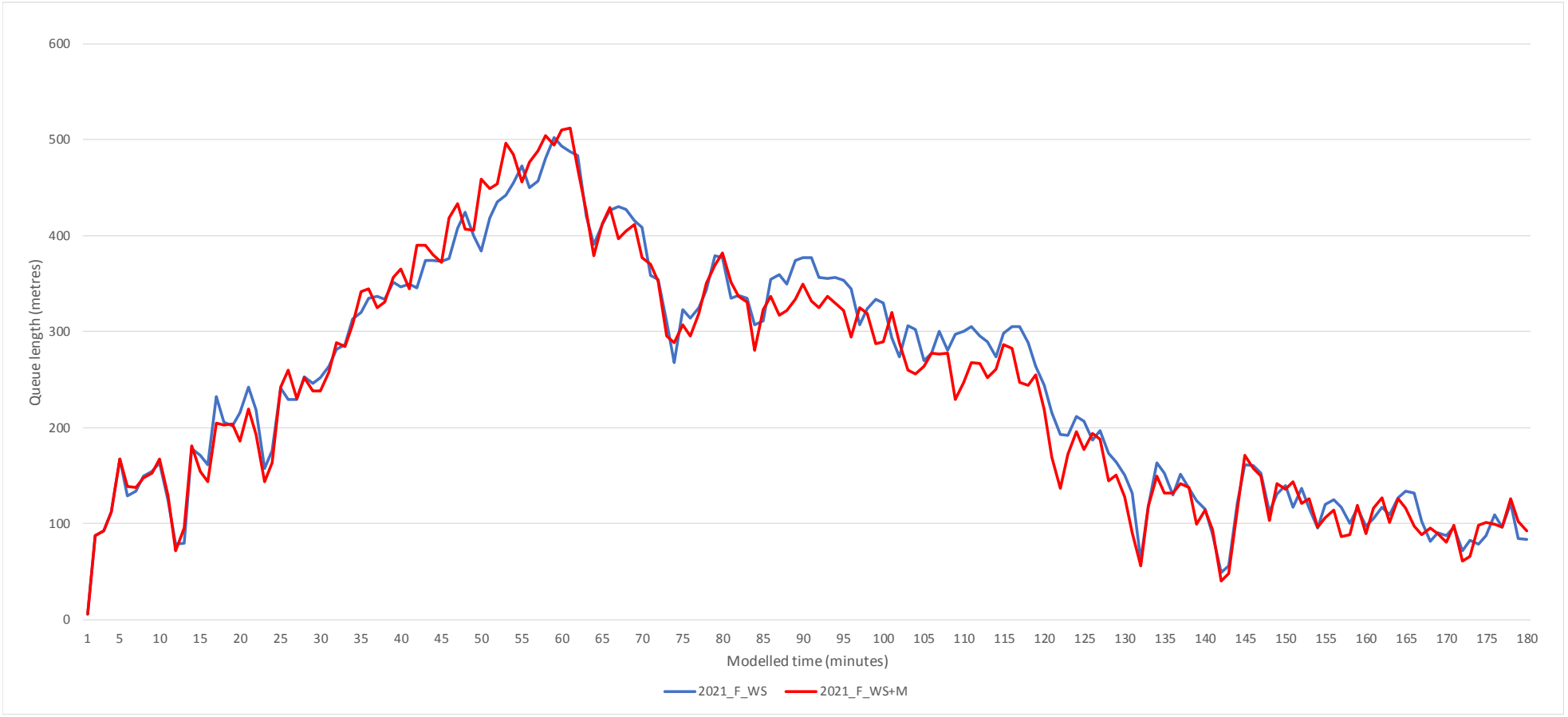

Figure F5: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

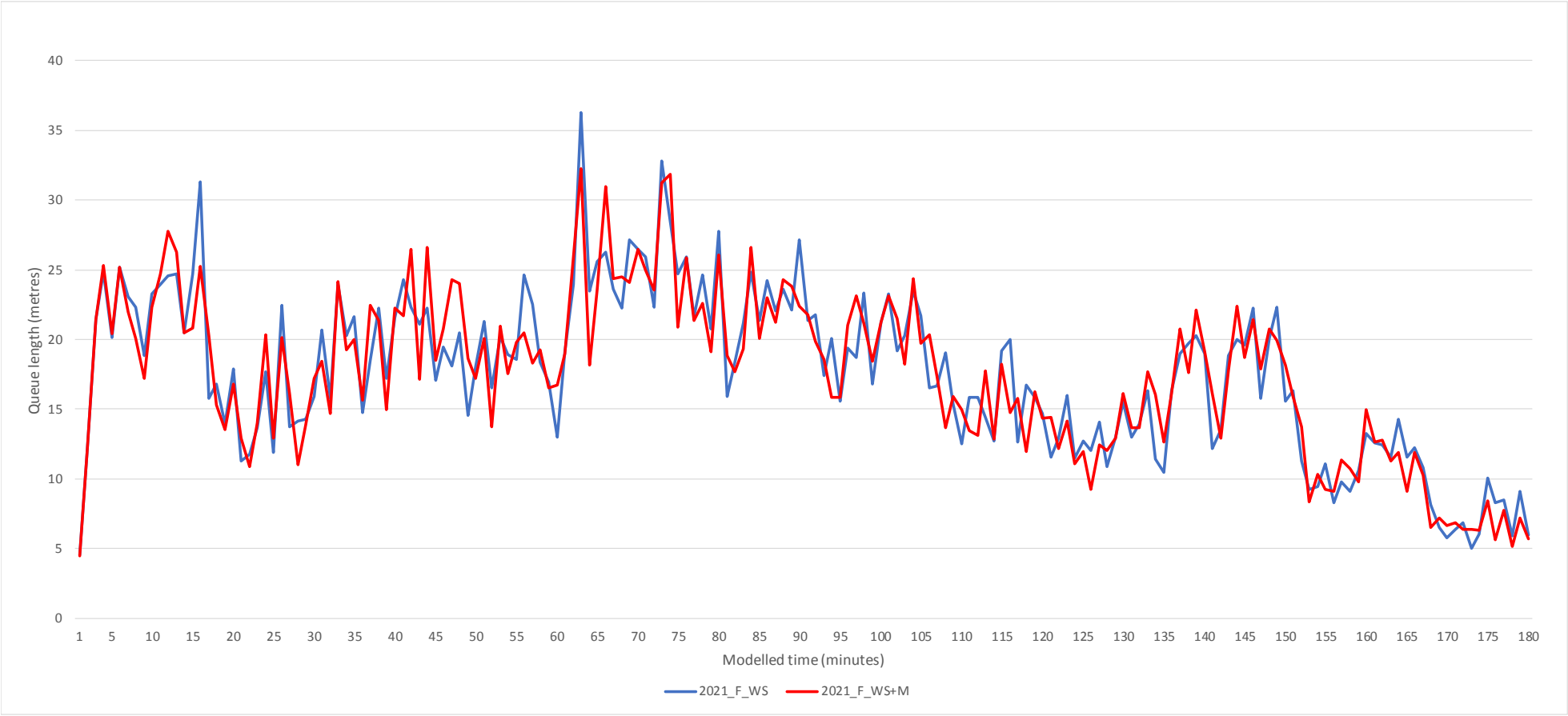

Figure F6: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, PM Peak Period

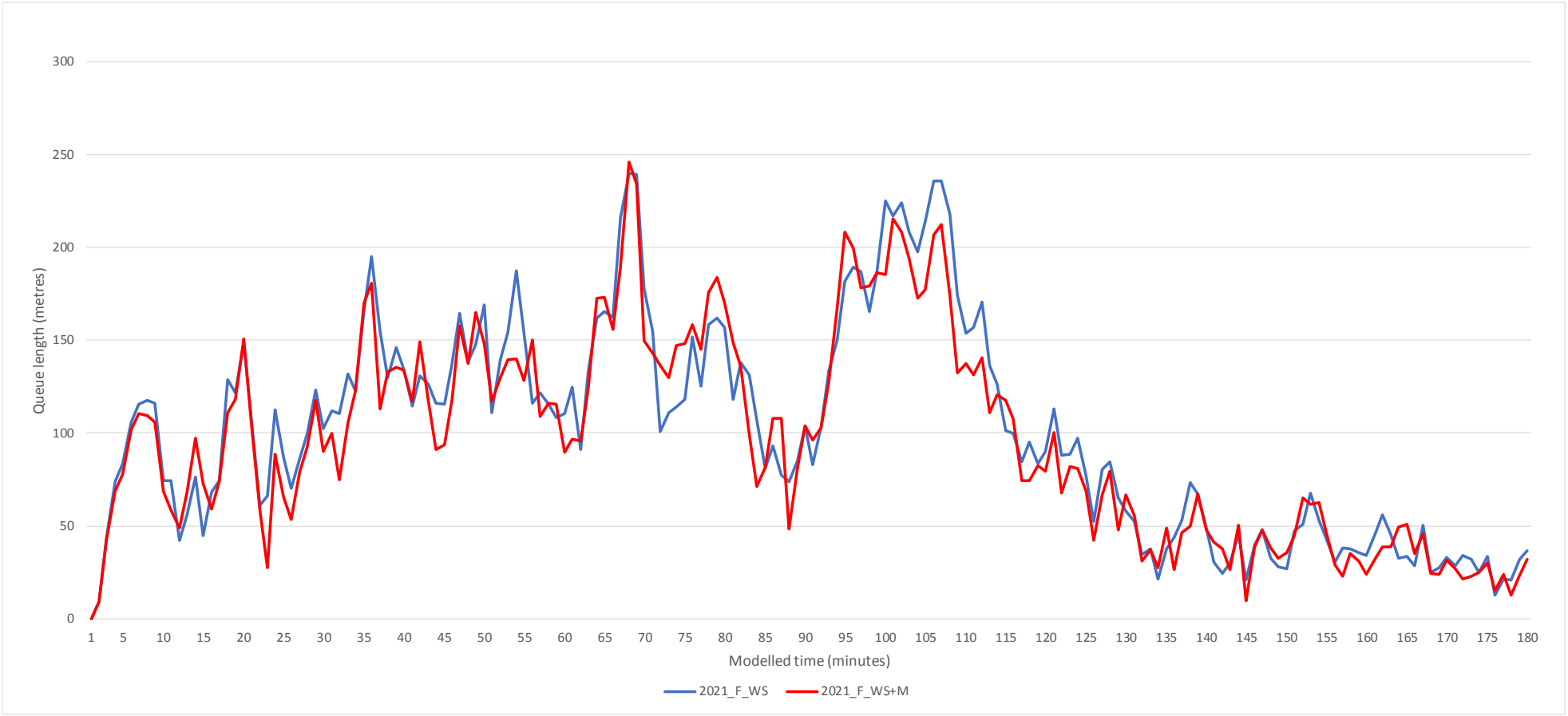

Figure F7: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

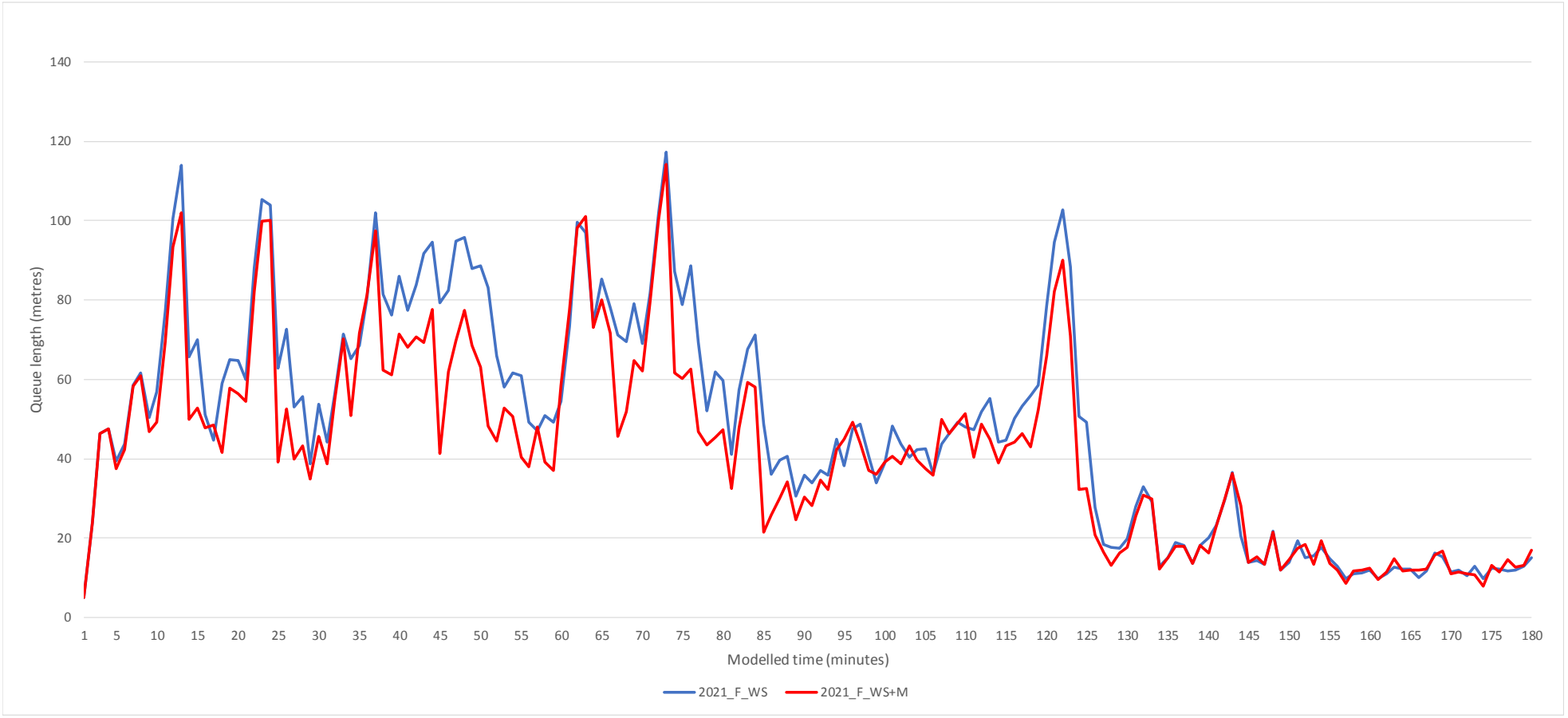

Figure F8: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, PM Peak Period

Appendix G: Queue Profile Results, 2021 Do-Nothing (With Freight) vs 2021 45 Min MetroWest (With 2 Freight) with Highway Measures

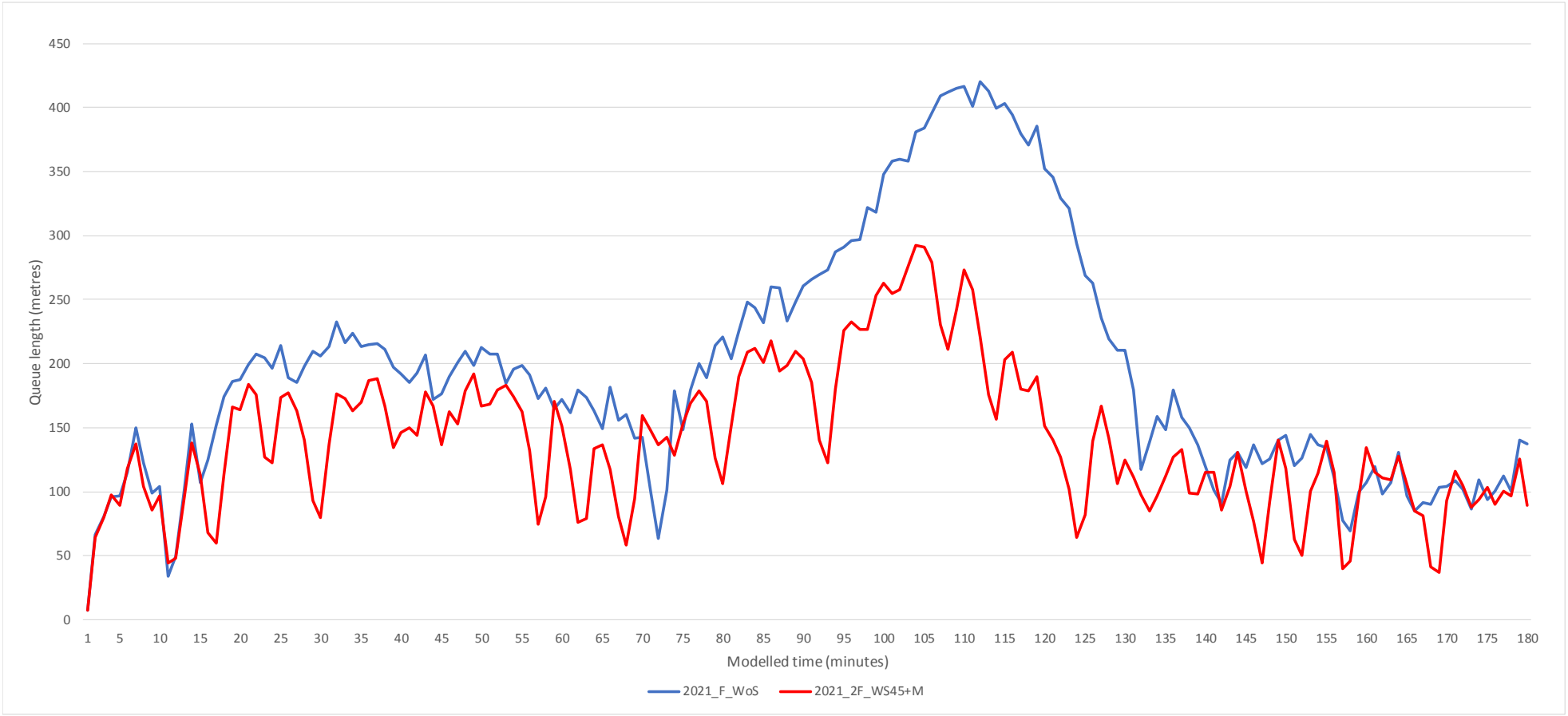

Figure G1: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

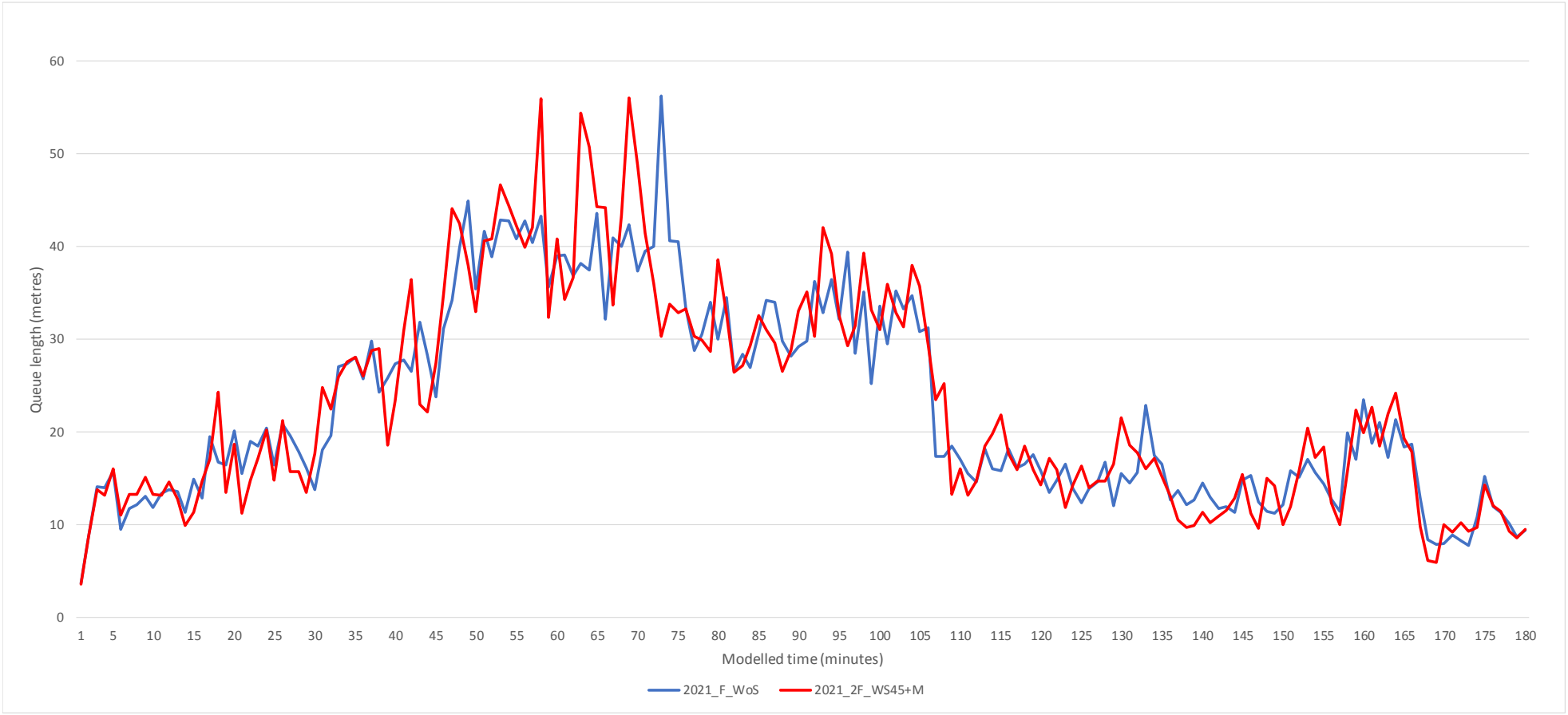

Figure G2: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Marsh Lane, AM Peak Period

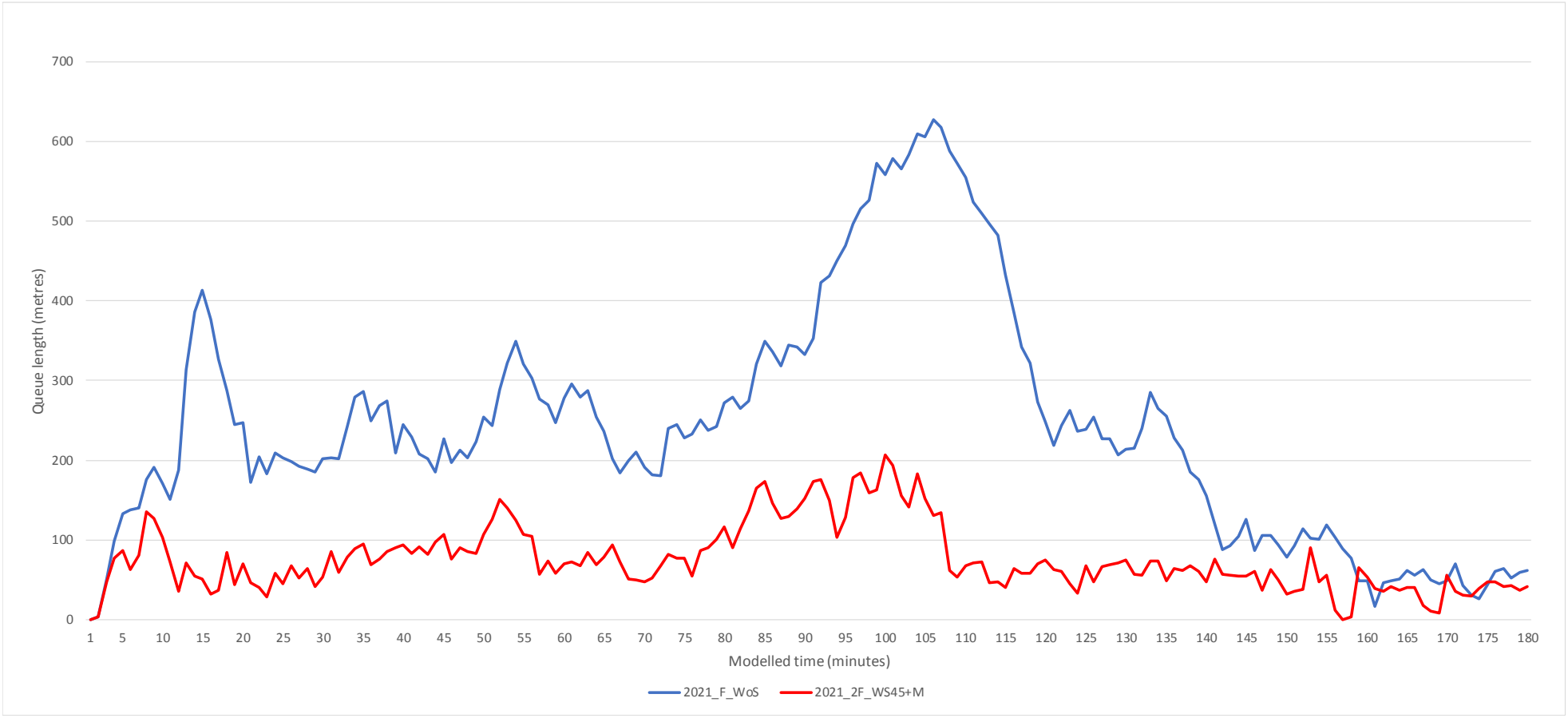

Figure G3: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

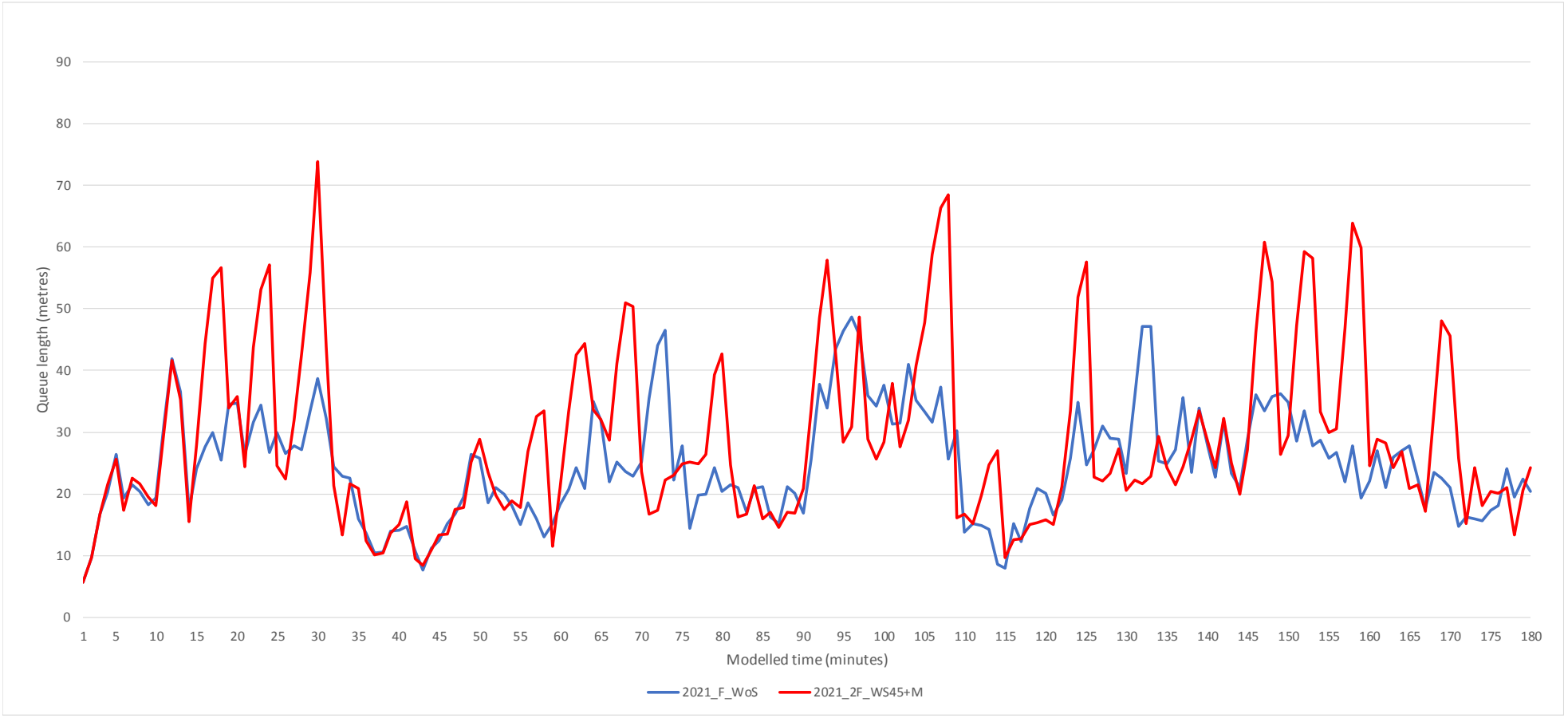

Figure G4: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

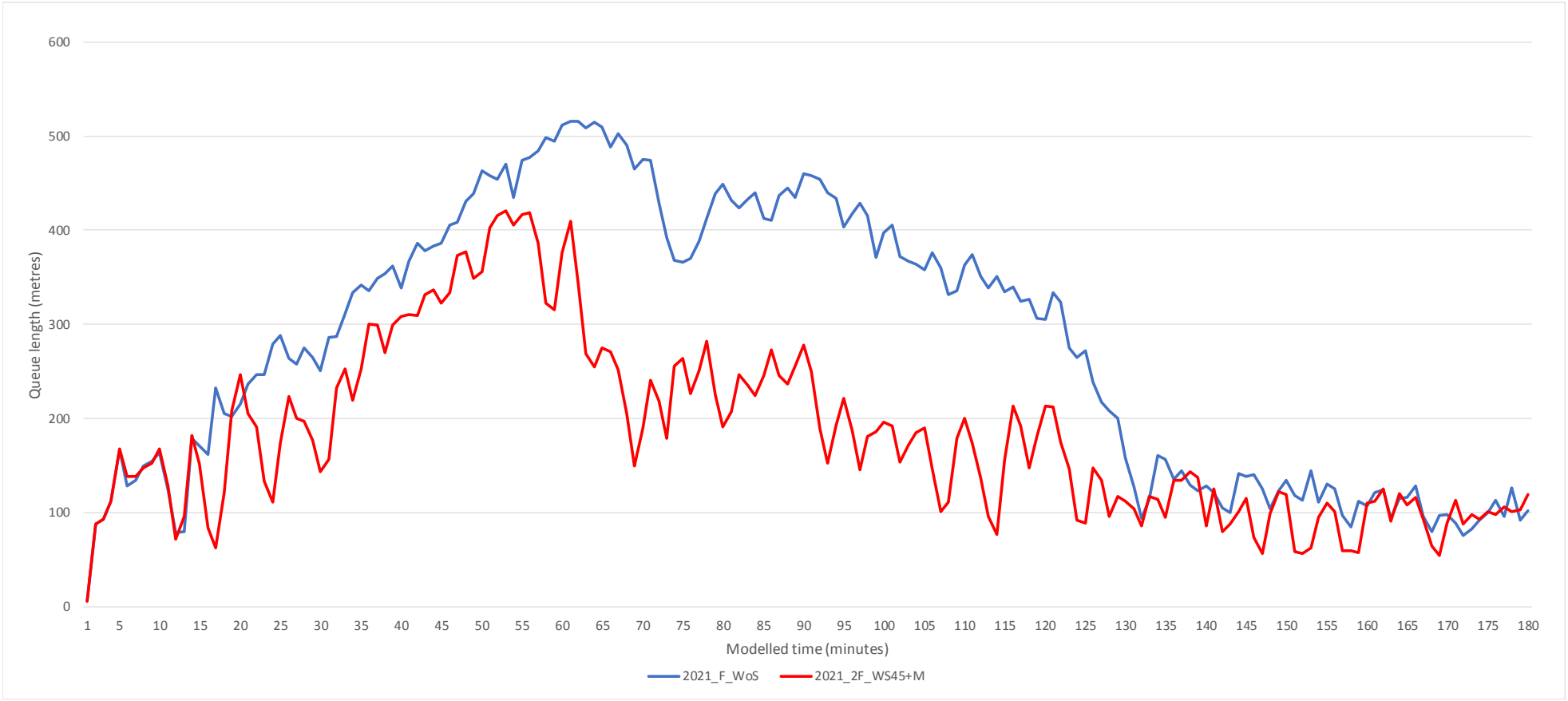

Figure G5: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

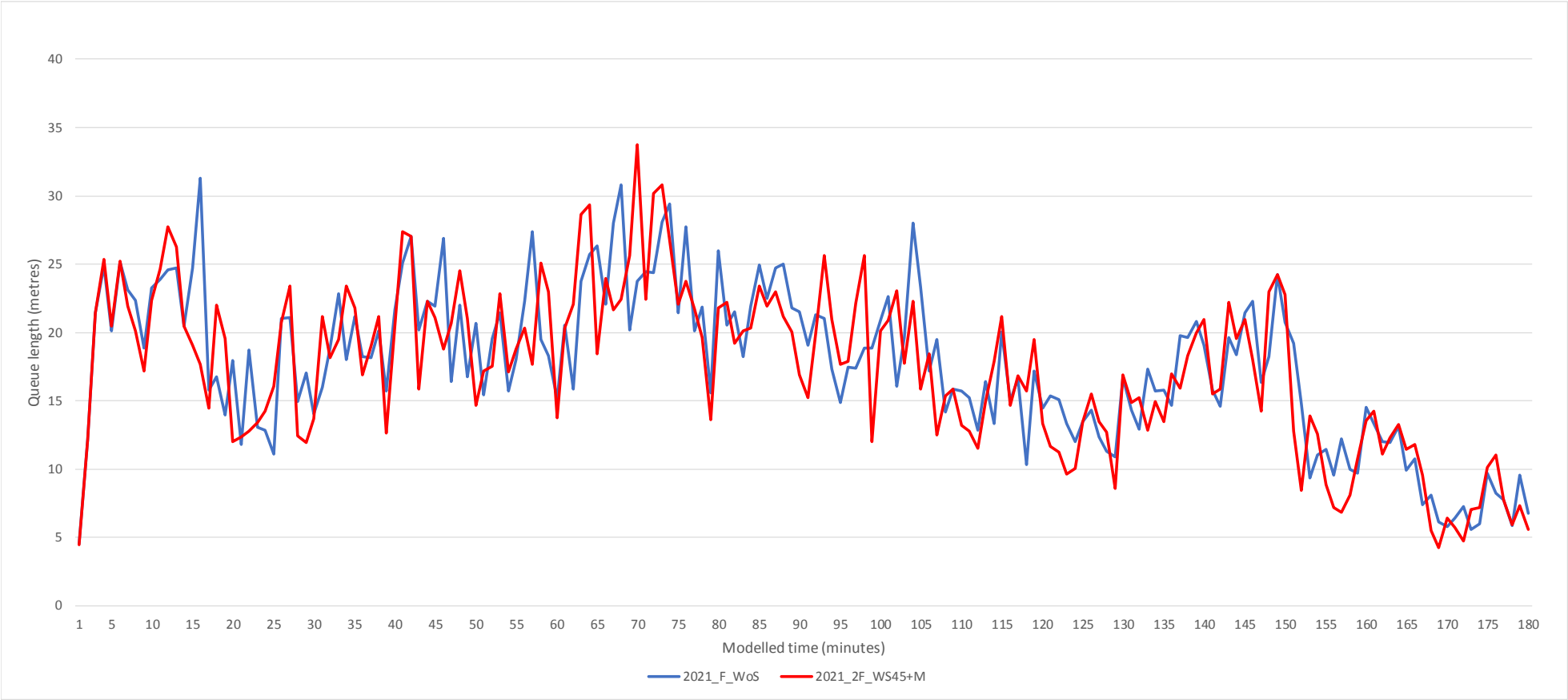

Figure G6: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Marsh Lane, PM Peak Period

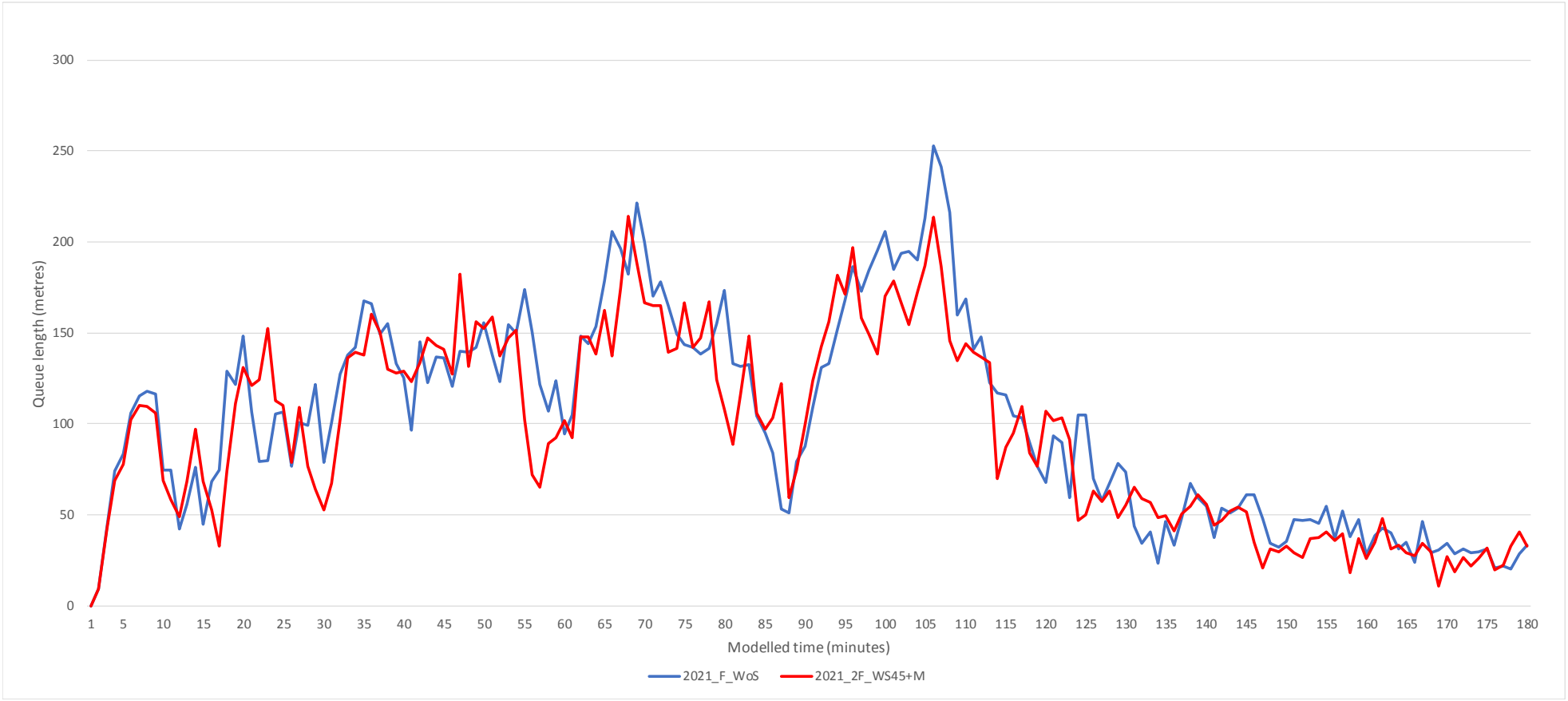

Figure G7: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

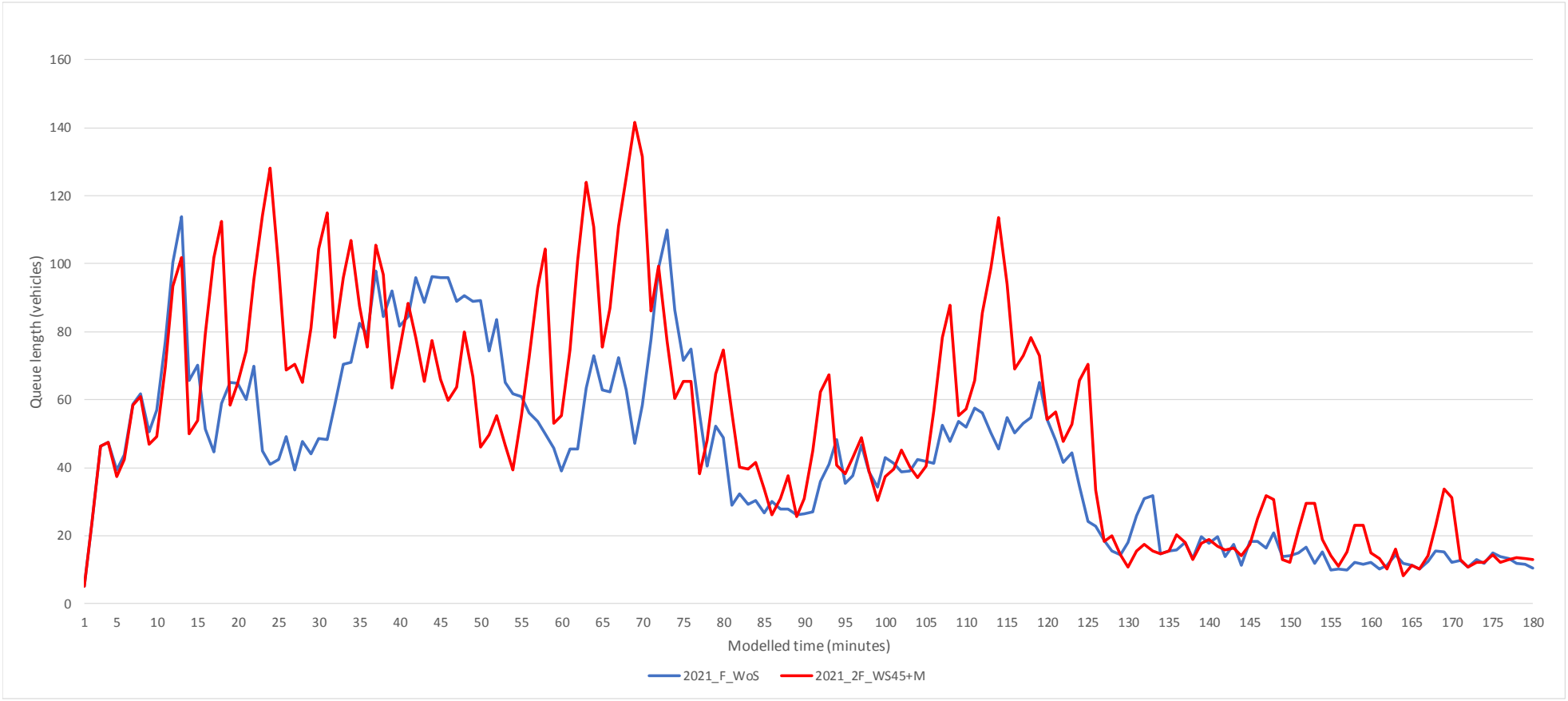

Figure G8: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Ashton Vale Road, PM Peak Period