Welsh Government

A494 DEESIDE - WELTAG STAGE THREE REPORT

Consideration of Measures on the Welsh Government Motorway and Trunk Road Network for Nitrogen Dioxide Reduction

Yn gweithio ar ran
Llywodraeth Cymru
Working on behalf of the
Welsh Government

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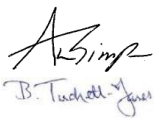
Signature			
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1 INTRODUCTION

1.1 CONTEXT

The European Union Ambient Air Quality Directive (2008/50/EC) sets legally binding limits for concentrations of certain air pollutants in outdoor air, termed 'limit values'. The Directive requires that Member States report annually on air quality within zones designated under the Directive and, where the concentration of pollutants in air exceeds limit values, to develop air quality plans that set out measures in order to attain the limit values. The only limit values that the UK currently fails to meet are those set in respect of nitrogen dioxide (NO_2).

In July 2017, the UK Government published its Air Quality Plan (the 2017 Plan) for tackling roadside NO_2 concentrations[1]. The 2017 Plan set out details of the authorities responsible for delivering air quality improvements including devolved administrations and Local Authorities.

Wales is divided into 4 zones under the Directive:

- Two urban agglomeration zones (Cardiff and Swansea)
- Two non-agglomeration zones (North Wales and South Wales)

WSP have been commissioned by Welsh Government (WG) to undertake a WelTAG Stage One (Strategic Outline Case), Two (Outline Business Case), and Three (Full Business Case) appraisals of potential Network Management measures for reducing NO_2 levels arising from traffic emissions at five separate locations on the Welsh Strategic Road Network (SRN). The five locations (and their respective zones) are:

- A494 Deeside (North Wales)
- A483 Wrexham (North Wales)
- A470 Upper Boat to Pontypridd (South Wales)
- M4 J41 – J42, Port Talbot (South Wales and Swansea)
- M4 J25 – J26, Newport (South Wales)

Given the differences between the five identified locations, and for parity with the WelTAG Stage One and Two reports[2], five separate WelTAG reports have been produced. It is acknowledged that what might represent a practical measure in one location, might not be viable or deliverable in another. Therefore, the reports have been produced independently in parallel to ensure that the individual requirements of any one location do not dictate the measures considered at the others.

All the reports are supported by a WelTAG Stage Two and a Stage Three Impact Assessment Report (IAR), and Effectiveness Review, which are reported in separate documents.

1.2 APPROACH

The Stage One and Two WelTAG reports were undertaken in accordance with the 2017 Consultation Draft WelTAG guidance published in autumn 2016. In December 2017, WG published the final revised WelTAG 2017 which will be applied to activities associated with Stage Three[3]. The revised guidance makes specific reference to the Well Being for Future Generations (Wales) Act 2015 within the appraisal, whilst removing specific reference to individual elements that make up the WelTAG Impact Areas. The final WelTAG 2017 guidance has been used for this study.

[1] UK plan for tackling roadside nitrogen dioxide concentrations; Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633269/air-quality-plan-overview.pdf
[2] Tackling roadside nitrogen dioxide concentrations in Wales; Available at: https://beta.gov.wales/tackling-roadside-nitrogen-dioxide-concentrations-wales
[3] WelTAG 2017 (December 2017), WG; Available at: https://beta.gov.wales/sites/default/files/publications/2017-12/welsh-transport-appraisal-guidance.pdf

A summary of the changes to WelTAG from the draft to final release of the 2017 WelTAG guidance is contained within Appendix A.

The objective of this study is to identify potential network management measures which will assist in bringing forward reductions in NO_2 in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements in five locations on the Welsh SRN listed above.

Therefore, the transport case focuses on air quality and reflects the key considerations in relation to the EU Air Quality Directive and bringing forward compliance with limit values.

The WelTAG guidance states that the purpose of the Stage Three (Full Business Case) is to:

'make a full and detailed assessment of the preferred option to inform a decision as to whether or not to proceed to implementation'.

As such, this Stage Three (Full Business Case) report:

- Determines whether a transport option exists that can address the issues identified, contributes positively to the well-being goals and objectives, and can be delivered within technical and financial constraints, although is mainly driven by if a measure can achieve compliance in the shortest possible time;
- Presents the preferred option(s), referred to as 'likely measure(s)', to be taken forward to procurement and implementation;
- Identifies each dimension of the Five Cases with a level of detail proportionate to scale and/or significance of the impacts and the associated risks; and
- Outlines issues affecting the deliverability of options, the realisation of the anticipated benefits and the mitigation of adverse impacts.

1.3 REPORT STRUCTURE

The structure of this Stage Three report is as follows:

Chapter 2: Strategic case
This chapter presents a summary of the baseline of the existing situation presented in WelTAG Stage One and Two. It outlines the objective and the EU Air Quality Directive and includes an evidence-based description of the current problem. It identifies the process undertaken and the measures that are included within Stage Three.

Chapter 3: Transport case
This chapter provides a summary of the appraisal against the objective through consideration of the key and secondary criteria and appraisal against the aspects of well-being. Supporting technical information is provided within the WelTAG Stage Three Impact Assessment Report (IAR).

Chapter 4: Financial case
This chapter identifies whether the costs for each of the shortlist of measures appraised at Stage Three are affordable, and the potential funding mechanisms for delivery.

Chapter 5: Commercial case
This chapter includes a description as to whether the measures are commercially viable, and provides an analysis as to whether measures could be packaged together for a phased delivery.

Chapter 6: Management case
This chapter identifies the delivery arrangements of the likely measures and then its management during its life time.

The conclusion of this Stage Three report identifies the likely measures that will be implemented to bring forward reductions in NO_2 in the shortest possible time and to do so in a way that reduces exposure as quickly as possible to ensure compliance with the Ambient Air Quality Directive, as per the objective of the study.

2 STRATEGIC CASE – STUDY OVERVIEW

2.1 OVERVIEW

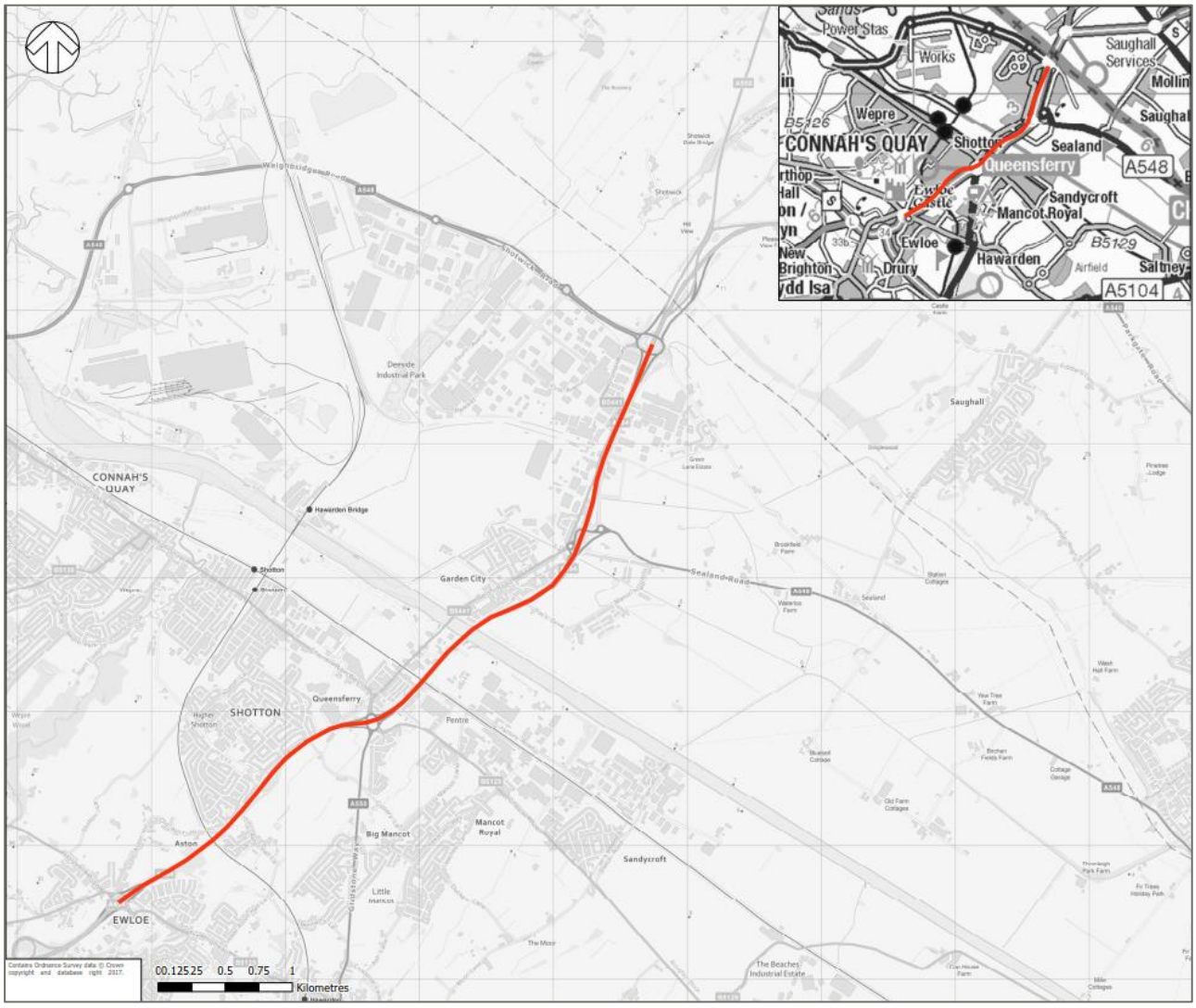
The strategic case 'tells us if we need change and why. It presents an evidence based description of the current situation, describes the likely future situation if no action is taken, and presents the reasons why an intervention is required'.

WelTAG Stages One and Two of this study were finalised in January/February 2018 and include a complete Strategic Case. This Stage Three report therefore provides additional and updated information where relevant, and is intended to be read in conjunction with the previous reports.

2.2 STUDY CORRIDOR

The study corridor considered in this report covers the principal corridor on the A494 between the B5125 St Davids Interchange (Holywell Road) to the A458 Deeside Park Interchange (Shotwick Road) at the Welsh/English borders. This is shown in Figure 1.

Figure 1: The Study Corridor



The A494 study corridor assumed for the purposes of this WelTAG study is centred on, but not limited to, the road links within Defra's Pollution Climate Mapping (PCM) model that have shown an exceedance in limit values. This acknowledges that the measures and their subsequent impacts may be realised beyond the identified area with NO_2 exceedances.

The study corridor is approximately 5.9km in length and has a south west to north east alignment. The A494 between St Davids Interchange and the River Dee bridge crossing is a 2 lane all-purpose dual carriageway (D2AP). The stretch north of the River Dee to the Deeside Park Interchange is a 3 lane all-purpose dual carriageway (D3AP).

2.3 OBJECTIVE OF THIS STUDY

Whilst WelTAG provides a fixed framework for appraisal, the guidance acknowledges that the level of detail provided in the report should be proportionate to the impacts under consideration.

Following on from the WelTAG Stage One and Two reports, **the objective of this Stage Three study is to carry out further investigation and identify potential network management measures which will assist in bringing forward reductions in NO_2 in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements in five locations on the Welsh Strategic Road Network.**

2.4 THE PROCESS

2.4.1 WELTAG STAGE ONE AND TWO

The WelTAG Stage One appraised a long list of 56 measures against the key criteria of the objective based on their ability to bring forward the date of compliance with EU Limit Values (Effectiveness, Timescales, and Deliverability). This resulted in a short list of 18 measures for the A494 study corridor that were taken forward to Stage Two.

The WelTAG Stage Two appraisal examined in greater detail the short list of 18 measures for tackling the problem under consideration. The measures were reappraised against the key criteria and appraised against the secondary criteria for the objective, as well as the WelTAG aspects of well-being.

The appraisal of air quality impacts was undertaken semi-quantitatively using detailed emissions and dispersion modelling underpinned by assumed changes in traffic flow characteristics and volume for each measure.

Typically, at the end of WelTAG Stage Two, a preferred measure is identified to be taken forward to Stage Three. However, because the EU Ambient Air Quality Directive states measures should be implemented to bring forward compliance *in the shortest possible time*, the 13 measures that were considered to reduce NO_2 in part were identified as preferred measures and taken forward to Stage Three.

2.4.2 WELTAG STAGE THREE

Following on from the Stage Two appraisal, further work has been undertaken to refine and develop the preferred measures. This was followed by an additional sifting process to remove duplication of measures to determine the 9 measures to be appraised at Stage Three:

- **S4: Air Quality Screening/ Fencing/ Environmental Barriers**: installation of barriers with or without special surfacing at sensitive locations.
- **S7: Enforce/ Reduce Speed Limit:** introduction of a new speed limit on the A494 between St David's Park Interchange and Deeside Industrial Park Interchange and enforce through average speed cameras.
- **S14: Ramp Metering:** implement ramp metering to control traffic merging from Drome Corner Roundabout onto the A494 southbound using traffic lights.
- **S19: Variable Diversions:** implement advisory variable diversions, utilising other routes including the A548 through signage to reduce cars on the A494 during the Am and PM peak hours.
- **S28: Behaviour Change:** implement a package of several measures aimed at changing travel behaviour, encouraging mode shift away from private car use.
- **S51: Intelligent Traffic Management:** linking real-time emissions / air quality data with traffic management, and / or remote monitoring through use of Intelligent Transport Systems and other innovative technological systems.

- **S62: Signage:** implement signage on the A494 to encourage improved driving behaviour, reminding drivers to turn off their engine when stationary and emphasise awareness of other measures and/or awareness of entering an area of any special measures.
- **S65: Air Quality Areas**: use publicity campaigns and branding of areas to raise awareness of poor air quality within the area.
- **S66: Air Quality Communications**: implement a package of measures to generally raise awareness of air quality.

The sifting process identified the following measures would not be taken forward to Stage Three:

- **S10: Flow Management (Upstream)**: it was considered that managing flows, for instance redistributing traffic flows to alternate routes or smoothing flows, could be achieved as part of S19 Variable Diversions and S14 Ramp Metering.
- **S17: Variable Message Signs (VMS)**: it was considered that VMS could be considered as part of other measures, for instance S62 Signage.
- **S46: Clean Air Zones / Low Emission Zones:** it was considered, on the basis of the latest available information, that Clean Air Zones could not be implemented in a timeframe that would bring forward compliance or assist with reducing NO2 in areas of non-compliance
- **S63: Distance Chevrons:** it was considered that distance chevrons could not be implemented on the A494 due to design limitations.

2.5 SHORT TERM MEASURES

Following Stage Two, it was recognised that reduced speed limits could provide immediate benefits with respect to the reduction of NO_2. As such, a temporary traffic regulation order was put in place by Welsh Ministers (which commenced 18 June 2018), included in Appendix B. This imposed a temporary 50mph speed limit on the length of the A494 study corridor between the St David's Park and Deeside Industrial Park Interchanges in Flintshire.

2.6 STAKEHOLDER CONSULTATION

A stakeholder workshop was undertaken on 17 July 2018 at the South Wales Traffic Management Centre. Key stakeholders from the following organisations were invited:

- Welsh Government
- NMWTRA
- SWTRA
- Neath Port Talbot County Borough Council
- Rhondda Cynon Taf County Borough Council
- Newport City Council
- Flintshire County Council
- Wrexham County Borough Council
- Cardiff Council
- Caerphilly County Borough Council
- Freight Transport Association (FTA)
- Welsh Government Police Liaison Officer

The workshop included an overview of the WelTAG Stage One and Two appraisals, and discussion of the acceptability and risks to implementation of the preferred measures that were identified at Stage Two.

It should be noted that for those stakeholders that were unable to attend the workshop meeting, notes from the meeting were sent out for any additional comments and/or feedback.

2.7 PACKAGING OF MEASURES

The 9 preferred measures have been subdivided into 'hard measures' with tangible benefits and 'soft measures' with marginal indirect benefits. The soft measures are those that passively reduce NO_2 levels by increasing peoples' awareness to the problem and encouraging a behaviour change, which positively impacts upon the problem. The soft measures could provide benefits at all five locations on the network, and potentially across the Welsh SRN.

2.7.1 000 - COMPLEMENTARY PACKAGE – 'SOFT MEASURES'

A workshop on the 17 July 2018 with WG and Stakeholders discussed the measures and identified the 'soft measures' that should be included as a complementary package of measures and implemented universally across all sites. These include:

- S28: Behaviour Change
- S51: Intelligent Traffic Management
- S62: Signage
- S65: Air Quality Areas
- S66: Air Quality Communications

It is expected that the above soft measures will be achieved initially with a significant communications campaign using social media, radio and signs on the network to highlight the air quality issues. This campaign will be reiterated throughout the year at key periods when the air quality is measured to be at a high level from the roadside monitors.

To complement the reduced speed limits, additional signs both permanent and Variable Matrix Signs (VMS) will be placed at the start of the reduced speed limit areas to relay the reasons for the speed limit reductions. A campaign has already been released to drive responsibly using the VMS at all of the sites.

There will also be regular updates and announcements provided on the air quality monitoring results at key stages over the coming years which should help reaffirm the messages and understanding of the issues.

It is anticipated that the complementary package of soft measures could have the following benefits:

- **Reduced demand**: By communicating the problem, and actively encouraging mode shift, a reduction in emission could be realised through reduced dependency on private car, or the passive rerouting of trips away from the exceedance locations.
- **Reduced emissions though more efficient driving**: A reduction in emission could be realised through changed driver behaviour. Vehicle speeds and rates of acceleration have a significant impact on emissions and this could be passively managed through education rather than physical measures.
- **Increased Public Acceptability for 'Hard Measures'**: It is likely that many of the 'hard measures' could face resistance due to potential impacts on journey times and accessibility. The complementary measures would likely mitigate this by highlighting the necessity of the measures.
- **Make best use of existing infrastructure**: Many of the 'soft measures' can make best use of existing infrastructure, therefore providing a cost-effective solution.
- **Minimised adverse impacts**: Whilst the direct benefits of the 'soft measures' are generally less than the 'hard measures', the 'soft measures' have been identified as having little to no adverse impacts against the other WelTAG areas.

The complementary measures will engage and involve the public to prevent the worsening of the problem, and provide short-term solutions that do not have long-term impacts on the people and communities of Wales. Due to the minimal adverse impacts, it is considered that the complementary measures integrate well with the Future Generations Act and other key polices.

2.7.2 MEASURES TO BE APPRAISED – 'HARD MEASURES'

The WelTAG Stage Two appraisal identified 'large beneficial' benefits to air quality from a reduction in the speed limit. In light of this, and the fact that a reduced speed limit has already been implemented on the corridor, each of the 'hard measures' that have been appraised at Stage Three have been packaged with a reduced speed limit. For the A494 at Stage Three, the 'hard measures' that have been appraised are presented in Table 1.

Table 1: Measures to be Appraised – Measure Description

Ref	Measure Description
001	Enforce / Reduce Speed Limit (50mph)
002	Air Quality Barriers, plus 50mph Speed Limit
003	Ramp Metering (Southbound on-slip at Drome Corner), plus 50mph Speed Limit
004	Variable Diversions, plus 50mph Speed Limit

The short list of 'hard measures' have been appraised against the key criteria and secondary criteria for the objective. The measures have also been appraised against the four aspects of well-being in Wales: economic, social, environmental, and cultural. Whilst the individual measures have already been appraised against these criteria at Stage One and Two, they have been revaluated as a package with the reduced speed limit at Stage Three.

3 STRATEGIC CASE – BASELINE

3.1 AIR QUALITY BASELINE

The air quality baseline for the A494 has been derived from a combination of national modelling (the Pollution Climate Mapping – PCM – model) and monitoring undertaken by the local authority, Flintshire County Council (FCC) and Welsh Government.

National Modelling

The PCM model was developed by Ricardo AEA on behalf of Defra/DfT for the purpose of the assessment of compliance with the limit values set out in the European Union Ambient Air Quality Directive. As such, this assessment uses the outputs of the PCM model to define baseline and future baseline NO_2 concentrations for the purpose of assessing the efficacy of measures designed to bring forward the date of compliance with limit values.

The PCM model projections presented in support of the 2017 Plan indicate that annual mean NO_2 concentrations on the section of the A494 under consideration will reach compliance with air quality limit values between 2018 and 2022 (i.e. projected concentrations at or below 40µg/m^3).

The dates in Table 2 provide an indication of the timescales within which the measures must be deliverable to bring forward compliance.

The percentage reduction in emissions from road transport required to achieve compliance has been estimated using the maximum PCM concentration in any given year, the corresponding background NO_2 concentration and Defra's NOx to NO_2 calculator (v6.1) to calculate the roadside contribution to NOx concentrations and the level of emissions required to give a roadside concentration of 40µg/m^3.

Table 2: Baseline PCM Predicted NO_2 Concentrations at Deeside, without NO_2 reduction network measures (projections from 2017 Plan, July 2017)

Measure	2015	2017	2018	2019	2020	2021	2022
A494 (ID 559)	**53.8**	**50.3**	**47.9**	**45.7**	**43.2**	**40.4**	37.8
A494 (ID 30571)	**51.7**	**48.4**	**46.1**	**44.1**	**41.7**	39.1	36.7
A494 (ID 30625)	**44.8**	**41.9**	39.8	37.9	35.9	33.7	31.6
Approx. % Reduction in NOx Emissions from Road Transport Required for Compliance	37%	29%	24%	18%	11%	1%	

Local Authority Monitoring

The PCM modelled concentrations in Table 2 are higher than the concentrations monitored by FCC in the vicinity of the A494 (Table 3). That is to say the monitored concentrations near the roadside (ID 15, 3) are within the EU limit value (<34µg/m^3) whereas the PCM concentrations exceed the limit value (Link 559 = 53.8µg/m^3).

However, the FCC monitoring locations are situated further from the roadside that the PCM assessment distance of 4m. Moreover, locations ID 15 and ID 3 are situated closest to the lanes of the A494 Aston Hill where traffic is running downhill and may, as a result, experience lower concentrations than typical of elsewhere on the route due to the lower emissions with low engine load. In addition, locations ID 2 and ID 27 are screened from the A494 by vegetation and barriers, both of which can reduce pollution levels in comparison to locations within screening.

Monitored concentrations on parallel routes to the A494 are well within the limit value.

Table 3: Monitored Annual Mean NO_2 concentrations alongside the A494 and parallel routes (µg/m³)

FCC Location ID	Location	Distance to A494 (m)	Bias-adjusted Annual Mean		
			2014	2015	2016
Locations within 50m of the A494					
15	Aston Hill	10	27.3	27.9	27.9
3	Aston Hill Roadside	15	30.2	26.3	33.7
27	89 Riverside Park, Garden City	20	21.8	21.7	21.3
2	1 St Davids Close Ewloe	28	20.8	17.4	20.6
Locations within 200m of the A494					
16	4 Belvedere Close, Queensferry	75	26.8	26.2	26.7
4	4 Moorfield Court, Aston	100	14.1	15.9	18
22	Green Lane West, Sealand	140	19.4	18.7	18.6
36	43 Station Road, Queensferry	180	22	21.5	23.2

Welsh Government Indicative Monitoring

Welsh Government has commissioned air quality monitoring along the A494 study corridor. The monitoring is currently undertaken using diffusion tubes, at 6 roadside locations and 1 background location. At each site, the monitoring consists of triplicate diffusion tubes, exposed for ~2week durations. Data for 6 months (12 exposure periods) is currently available. The roadside monitoring is undertaken at distances between 2 and 13m from the side of the A494, at a height of approximately 2m above the carriageway.

Under the Ambient Air Quality Directive, the reference method for monitoring ambient NO_2 is based on chemiluminescence (EN 14211:2005). Diffusion tube monitoring has greater uncertainty and cannot be considered equivalent to reference method monitoring. It provides indicative measurements only. Moreover, the diffusion tube data do not, at the time of writing, meet the data quality objectives for indicative measurements under Annex I of the Directive[4] and should not be used to assess compliance with limit values. The data are, however, useful in the provision of greater spatial information than is practicable with reference method monitoring or national modelling.

Prior to comparison with the annual mean limit value and modelled PCM concentrations, the monitored concentrations require:

- 'bias correction' to account for tubes and laboratory practices to result in either under or over reading relative to reference methods
- 'annualisation' to account for the total survey length being less than 12 months, and
- 'distance correction' to a standard 4m from the roadside[5].

Further to the uncertainty inherent in diffusion tube monitoring and analysis, these corrections introduce additional uncertainty into the monitoring data. Notwithstanding this, Table 4 provides a summary of the available data.

[4] Due to the survey duration not covering a whole year, whether continuously or intermittently
[5] The PCM model provides concentrations at a nominal distance of 4m from the side of the road

The indicative monitoring survey shows that roadside concentrations decrease from north to south which is consistent with the PCM modelling. However, the monitored concentrations are generally higher than the PCM concentrations.

Table 4: Indicative diffusion tube monitoring (µg/m^3)

PCM Link	Number of Monitoring Locations(a)	Annualised and Bias Adjusted Concentration (b) (2017)	Average Indicative Concentration on PCM Link Distance Corrected to 4m (c)(2017)
559	2	46.6 – 46.9	*54.7*
30571	2	39.6 – 48.8	*46.6*
30625	2	38.8 – 41.2	*44.4*

NOTE: Data are indicative only and should not be used to assess compliance with limit values
(a) Locations considered were compliant with requirements of EU Directive Annex III on micro and macroscale siting of monitoring points
(b) Bias adjusted using national factors provided by Defra (0.88); Annualised to 2017 using data from Wirral, Wigan and Stoke
(c) Distance corrected using Defra's calculator

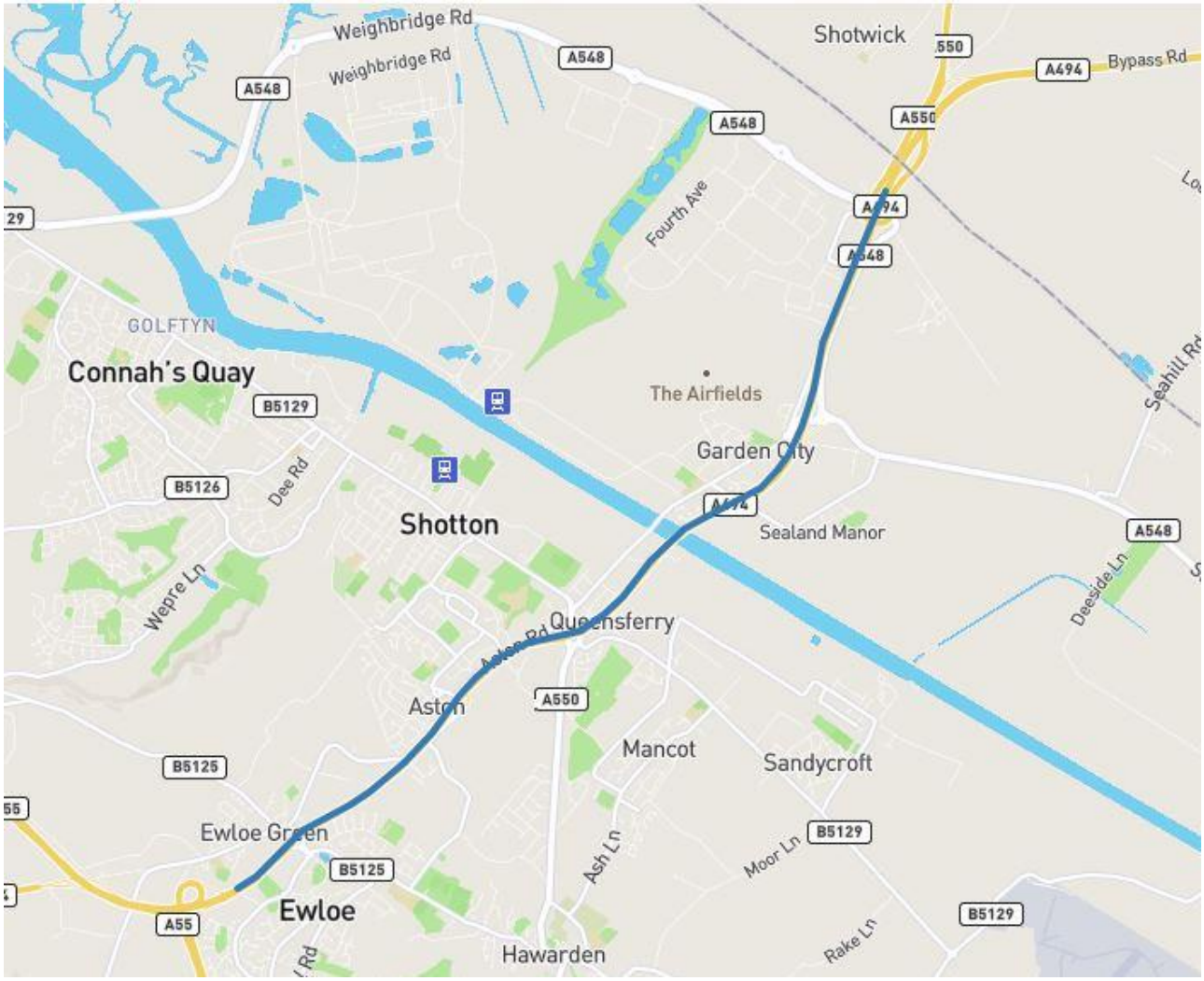
3.2 TRAFFIC BASELINE

An overview of the existing traffic flows and speeds along the A494 corridor is provided in the WelTAG Stage Two report, and includes data extracted from the Department for Transport (DfT) as well as Trafficmaster.

INRIX Analytics

As part of the Stage Three WelTAG appraisal, INRIX data has also been considered. INRIX gathers real-time, predictive and historical data from more than 300 million sources, including commercial fleets, GPS, mobile devices and cameras. This data has been used to establish speed and travel time throughout the day in both directions on the corridor shown in Figure 2, which is as closely aligned to the A494 study corridor as possible.

Figure 2: INRIX A494 Corridor



Speed data has been extracted for the A494 eastbound and westbound corridors for the period 1st July 2017 to 30th June 2018 (Monday-Thursday). The data shows that speeds reduce for vehicles travelling eastbound during the AM peak period from approximately 06:30 to 09:00, with the lowest average speed of 46mph recorded at 07:45. There is no noticeable reduction in speeds during the PM peak, with speeds averaging approximately 55mph across all other times of the day.

Conversely, speeds reduce for vehicles travelling westbound during the PM peak period from approximately 15:00 to 18:00, with the lowest average speed of 36mph recorded at 16:15. There is no noticeable reduction in speeds during the AM peak, with speeds averaging approximately 55mph across all other times of the day.

Travel times have also been extracted from INRIX for the A494 corridor for the same period.

The travel time of the eastbound carriageway increases during the AM peak period, from an approximate free-flow time of 4 minutes 30 seconds to an average of 5 minutes 20 seconds at 07:45. Delay in this direction on this corridor can therefore be inferred as approximately 50 seconds during the AM peak.

For the A494 westbound corridor, INRIX shows that free-flow travel time is approximately 5 minutes, which increases to 7 minutes at 16:15. Delay in this direction on this corridor can therefore be inferred as approximately 2 minutes during the PM peak.

The INRIX data for this corridor is presented graphically in Appendix C.

3.3 OTHER BASELINE DATA

In addition to the air quality and traffic baselines detailed in this report, the following areas have been covered by the WelTAG Stage One and Two reports.

- Infrastructure and local facilities
- Other related work
- Public Transport
- Economy
- Demographics
- Other sensitive environmental areas

4 TRANSPORT CASE

4.1 OVERVIEW

The transport case 'tells you what the expected impacts of the project are, how the project will contribute to the well-being goals and whether a project will provide value for public money. This is the equivalent of the 'Economic Case' (Option Appraisal) in HM Treasury's Green Book. This is calculated by thinking about social, cultural, environmental and economic costs and benefits of each option'.

Whilst WelTAG provides a fixed framework for appraisal, the guidance acknowledges that the level of detail provided in the WelTAG report should be proportionate to the impacts under consideration. Therefore, the transport case focuses on air quality and reflects the key considerations in relation to the EU Air Quality Directive and bringing forward compliance with limit values.

4.2 METHODOLOGY

4.2.1 APPROACH

The approach to the Stage Three level of appraisal is intended to examine in greater detail the physical 'hard measures', which have tangible benefits for tackling the problem under consideration. The 'soft measures' included within the complementary package have not been modelled as the direct benefits are expected to be intangible. The general approach to the modelling of measures is outlined in Table 5.

Table 5: Modelling Approach to Measures

Ref	Measure	Traffic Modelling	Air Quality Modelling
000	Complementary Package	Not Modelled	Not Modelled
001	Enforce / Reduce Speed Limit (50mph)	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
002	Air Quality Barriers, plus 50mph Speed Limit	Not Modelled	Not Modelled
003	Ramp Metering (Southbound on-slip at Drome Corner), plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
004	Variable Diversions, plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)

The impacts of barriers on air quality were not modelled explicitly. Rather, on the basis of information made available after the publication of the WelTAG Stage One and Two Effectiveness Review, the measure was conservatively estimated to reduce roadside concentrations by a minimum of 2µg/m^3. Further information is available in the WelTAG Stage Three IAR.

The following sections set out how each of the 'hard measures' have been appraised during Stage Three of the study. The appraisals undertaken adhere to the WelTAG 2017 guidance, and consider the seven national well-being goals. The appraisal outcomes have been summarised within Appraisal Summary Tables (AST), which are included at the rear of the chapter.

4.2.2 ENVIRONMENTAL APPRAISAL

TRAFFIC MODELLING

The emissions and dispersion modelling undertaken at Stage Two was based on the assumed impacts of measures on traffic speeds and volumes. At Stage Three a fully quantifiable approach to appraising the benefits of measures has been undertaken, and this required the 'hard measures' to be modelled with micro-simulation traffic modelling. It was not necessary to undertake traffic modelling for all measures as some measures (e.g. Air Quality Barriers) are not fundamentally expected to result in a change in traffic flows.

A static VISSIM micro-simulation model was developed for the morning and evening peak hours only on the A494 study corridor, utilising demand data from the A55/A494/A548 Deeside Corridor Assignment Model prepared by AECOM for the Welsh Government. The model was validated utilising existing data sources. Results were output and averaged over several random seeds to ensure the 'daily variability' in traffic flow was accurately modelled.

High resolution data was output form the model (across 280 data collection points) and included volume, classification and speed data. Robust long-term traffic count sites from Traffic Wales were used to factor the morning and evening peak hour flow data to AM, IP, PM and OP periods covering 24 hours in total.

Whilst the model was developed for the A494 corridor of the exceedance only, general consideration has been given to the wider impacts of displacing traffic in the instance of operating variable diversions.

The full detail on the traffic modelling, including the base model calibration and validation statistics are included within the WelTAG Stage Three Impact Assessment Report.

AIR QUALITY

Emissions Calculation and Dispersion Modelling

The air quality impacts of the measures have been quantified through emissions modelling, using Defra/DfT's emissions factor toolkit (EFT) and detailed dispersion modelling, using the ADMS-Roads model. Vehicle emissions were calculated using the latest EFT (v8) and traffic data from micro-simulation traffic modelling for a year representative of 2017 - 2018 (see below).

To maximise the transfer of information from the micro-simulation modelling to the dispersion modelling, the statistical distribution of speeds (as the 5th, 15th….85th and 95th percentiles) on modelled routes was used to calculate emissions rather than the simple fleet average speed. Since traffic modelling was undertaken for peak hours only, flows and speeds outside of these hours were calculated using a standard factoring approach and assuming free flow speeds derived from INRIX data, unless limited by the measure.

The dispersion modelling was verified against data from the ongoing Welsh Government's diffusion tube survey (with data annualised to 2017).

The modelled area was limited to the A494 study corridor (Figure 1) with the impacts of measures on emissions and roadside NO_2 concentrations calculated for the PCM links only.

Impacts were modelled at a distance of 4m from the roadside. This is the nominal distance at which concentrations area assessed within the UK's national PCM modelling. Multiple assessment locations ('receptors') were modelled along each PCM link, and the impact of the measure was assessed as the average impact at all receptors along the link.

The impact of the measures on the compliance of routes with the EU limit value was assessed following the methodology set out in the Design Manual for Roads and Bridges Interim Advice Note 175/13 and based on the results of the national PCM modelling. That is, the modelled impact of a measure is added to the PCM concentration to derive an Equivalent 'with Measure' PCM concentration.

Equivalent 'With Measure' PCM Concentration = PCM Concentration + Modelled Impact of Measure

(where the modelled impact is generally a decrease in concentration and the Equivalent PCM concentration is lower than the original PCM concentration)

It is necessary to add the locally modelled impact to the output of the national PCM model because the PCM model is not fully available to 3rd parties to directly model the impact of measures on compliance dates.

As stated in Section 4.2.1, impacts of barriers on air quality were not modelled explicitly and they were conservatively estimated to reduce roadside concentrations by a minimum of 2µg/m^3.

Future Years

No forecast traffic models have been developed, as the assessments consider the implementation of measures and the impact relative to the 2017/2018 base year. The air quality impacts in future years have been modelled by running the EFT with 2017/2018 traffic data but year-specific vehicle emissions from 2017 to 2022. It can be reasonably assumed that there will be some, albeit limited, traffic growth in the years to 2022. Taking into account the decrease in vehicle emissions over time (as older more polluting vehicles are replaced by newer vehicles), neglecting the effects of traffic growth in future years may lead to a slight underestimation of the benefits of a measure. However, in the context of the overall study methodology, the neglect of a few percentage points in traffic growth will not place a constraint on the compliance assessment.

In deeming when a particular measure could be deployed in the field, taking into account, *inter alia*, the required investigations and, consultation periods, commissioning and construction times, and existing statutory powers of the trunk road agents, the timescales in Table 6 were assumed.

Table 6: Assumed implementation timescales

Measure	Earliest Implementation Timescale
Speed Limits	Immediate (In Place)
Variable Diversions*	End of 2019
Ramp Metering*	End of 2019
Installation of Barriers	End of 2021

* Measures can be implemented with temporary infrastructure ahead of permanent installations

Offline Screening of Impacts

In addition to the detailed modelling of the A494 corridor, and acknowledging that some measures may have an impact on adjacent routes, screening of potential impacts was undertaken to determine the likelihood of significant 'offline' impacts. This involved the review of location authority monitoring and the attractiveness of potential diversion routes.

OTHER SENSITIVE ENVIRONMENTAL AREAS

A qualitative appraisal has been undertaken to assess the impacts on:

- Noise
- Landscape
- Historic Environment
- Biodiversity
- Water Environment
- Townscape

4.2.3 SOCIAL AND CULTURAL APPRAISAL

A qualitative appraisal has been undertaken to assess the impacts on:

- Journey Quality - taking into consideration the following aspects:
  - Traveller care: aspects such as cleanliness, level of facilities, information, and the general transport environment
  - Travellers' views: the view and pleasantness of the external surroundings in the duration of the journeys
  - Traveller stress: frustration, fear of accidents, and route uncertainty
- Accidents
- Access to Employment and Services

4.2.4 ECONOMIC APPRAISAL

JOURNEY TIME AND JOURNEY TIME RELIABILITY CHANGES

Journey time and journey time reliability changes have been combined within this assessment and have been considered in the appraisals accordingly.

Where possible, the VISSIM model has been used to determine a quantitative appraisal of the changes to journey times along the study corridor in the morning and evening peak hours. This has been supplemented by a qualitative appraisal to assess changes in journey times across the whole network throughout the day by all affected modes both for users and non-users of the measure. The appraisal also considers changes in the variation in journey times between times of day and between journeys made at the same time each day i.e. morning and evening peak periods.

CAPITAL AND REVENUE COSTS

The measures have been costed both in terms of capital (investment costs) and revenue (operating costs). Typical components of capital cost include construction costs, land and property costs, preparation and administration costs, and traffic management during construction. Typical components of revenue costs include routine and non-traffic related maintenance costs.

LAND

A qualitative appraisal has been undertaken to assess the land take required by each measure.

4.2.5 VALUE FOR MONEY ASSESSMENT

The Value for Money assessment has been determined based on capital and revenue costs and broad benefits that have been weighted as far as possible in favour of the objective. Whilst all benefits have been considered, the final value for money score has taken into the impact on air quality as the primary consideration. As such, the Value for Money (VfM) will be presented a £/µg reduction in NO_2 at 4m from the PCM link.

4.3 APPRAISAL AGAINST OBJECTIVES

The Stage One procedure involved undertaking the appraisal of the long list of measures, with each measure assessed against the WelTAG criteria, and then considered within the context of the study objective; namely, the extent to which each measure would be successful in bringing forward reductions in NO_2 in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements.

The Stage Two appraisal essentially comprised a re-undertaking of this process. This was necessary, as it elicited different results in cases where additional evidence had been produced or sourced, allowing appraisals to be undertaken in greater detail and with a greater degree of certainty, with the potential for differing appraisal outcomes in comparison to Stage One.

KEY CRITERIA

The following **key criteria** for the appraisal were established in Stage One, updated in Stage Two, and finalised in Stage Three:

Effectiveness – Is the measure likely to deliver reductions in roadside concentrations proportionate to the scale of the exceedance above the 40µg/m^3 legal limit

This has been updated following more detailed assessment work at Stage Three.

Timescales – Can the measure be implemented within timescales that are meaningful (short enough) to have an impact on bringing forward the projected compliance date

This has been updated following more detailed assessment work at Stage Three.

Deliverability – Can the measure be delivered in the location involved with the powers available to the Welsh Government as Highway or Traffic Authority

This has been updated following more detailed assessment work at Stage Three.

SECONDARY CRITERIA

In addition to the Air Quality Directive, the study contributes to the strategic priorities of the Welsh Government, including that of the Well-being of Future Generations (Wales) Act 2015. As such, the following were considered as **secondary criteria** in the appraisal process at Stage Two:

Will the measure deliver an overall reduction in NO_2 emissions to air

This is a qualitative appraisal based on the likelihood of overall reduction to NO_2 resulting from the measure. This will enable the differentiation of measures which simply redistribute the impacts rather than seeking to reduce overall NO_2 emissions to air.

Will the measure result in unintended consequences or other environmental impacts

This is a qualitative appraisal that considers whether there will be any other adverse environment impacts resulting from the measures. This will summarise the findings of the appraisal against the environmental aspects of well-being.

Will the measure contribute to well-being

This is a qualitative appraisal which considers the seven goals of the Well-being of Future Generations (Wales) Act 2015, with the following criteria:

- Will the measure impact equally across multiple vehicle classes and journey types
- Will the measure have a positive impact on wider public health and inequalities

4.3.1 OTHER ISSUES

Further potential issues with each measure have been explored and considered accordingly in the instance that they have not been covered under any of the other appraisal areas. These include:

Overall Acceptability

A qualitative appraisal has been undertaken in order to assess the receptivity of the public, local authorities and key stakeholders, both groups and individuals to the measure. The appraisal has been undertaken on a measure by measure basis.

Technical, Operational and Financial Feasibility

Where appropriate a qualitative appraisal has been undertaken to assess measures on the following criteria:

- Technical: The extent to which the measure is technically feasible within the specified budget and timeframe
- Operational: The extent to which the measure is operationally feasible within the specified budget and timeframe
- Financial: The extent to which the measure is financially feasible

Deliverability and Risk

At this stage, it is difficult to identify issues regarding deliverability and risk given the high-level nature of the measure's development. Where possible, this has been identified as qualitative statements though should be reassessed at WelTAG Stage Three when the measures are developed further.

4.4 STAGE THREE APPRAISAL

For Stage Three of the study, the appraisal outcomes have been summarised as follows:

- Air Quality Impacts
  - Vehicle Emissions and Commentary on Measure (Table 7)
  - Equivalent PCM Concentrations and Compliance Dates (Table 8)
- Overall Impacts
  - Appraisal Summary Tables (ASTs)
  - Summary of Appraisals (Table 9)

The process has identified those measures that have

a) the potential to bring forward compliance dates and/or reduce exposure to NO_2 in non-compliant areas as quickly as possible on PCM links within the study corridor.

but also identified those measures for which there is

b) reasonable scientific doubt as to the efficacy of the measure in reducing exposure to NO_2 in non-compliant areas, or

c) reasonable scientific doubt that the measure would not result in unacceptable dis-benefits, for example significant deterioration of air quality in offline areas, whether compliant or non-compliant with limit values.

The modelling of the impacts of the measures undertaken for the appraisal follows best practice guidance and uses the latest available information on vehicle emissions and local monitoring. Where the modelling has been able to robustly demonstrate a measure's effectiveness in reducing NO_2 concentrations, the measure has been classed as **likely** to bring forward compliance or, depending on the PCM concentration, to reduce exposure to NO_2 alongside the PCM link as quickly as possible. This judgement is based on the measure's impact on NO_2 concentrations on the PCM link. If, in addition, the measure has been demonstrated to be timely in relation to the compliance timescales and, beyond reasonable scientific doubt, to have no unacceptable adverse impacts, the measure is classed as a **likely measure**.

Measures are classed as **unlikely measures** if there is reasonable scientific doubt as to their efficacy in reducing NO_2 concentrations (classed as **unlikely** to reduce NO_2 concentrations) and/or if the measure gives rise to unacceptable dis-benefits. A measure can also be classed as an **unlikely measure** if it is included within, or cannot be implemented at the same time as, another more or equally effective package of measures. In the latter case, the other appraisal areas may be used to identify the optimum measure, including consideration of whether the measure results in an overall beneficial impact on air quality.

Total pollutant concentrations at the roadside, whether taken from the PCM model or from reference method monitoring, are of prime importance in determining when a particular road link becomes compliant with limit values. They are, however, less important in determining whether a measure will bring forward compliance in the shortest possible time or reduce exposure to NO_2 as quickly as possible. That is to say if, for example, the imposition of a measure is assessed as being likely to bring forward compliance in the shortest possible time, that would apply whether or not total pollutant concentrations are, say 50µg/m^3 or 45µg/m^3 in a particular year, although the projected compliance date in the two cases would be different.

In recognising uncertainty within the appraisal methodology, measures that have been identified as being likely to reduce NO_2 concentrations but which fail on the Key Criterion of 'Timeliness' have been classed as **precautionary retained measures**. These are measures which are likely to be effective under the objective of the study, but only if compliance on a link is significantly delayed beyond the current PCM projection timescales.

Key Air Quality Impacts

Table 7 and Table 8 present the impacts of the measures on annual vehicle emissions and annual mean NO_2 concentrations respectively on PCM Links 559, 30571 and 30625.

The imposition and enforcement of a 50mph limit is ***likely*** to remove the risk of exceedance of the limit value in the PCM modelling on Link 30625 and is ***likely*** to bring forward compliance with the limit value on Link 559 by two years (from 2022 to 2020). On Link 30571, the measure is ***likely*** to reduce concentrations but does not bring forward compliance.

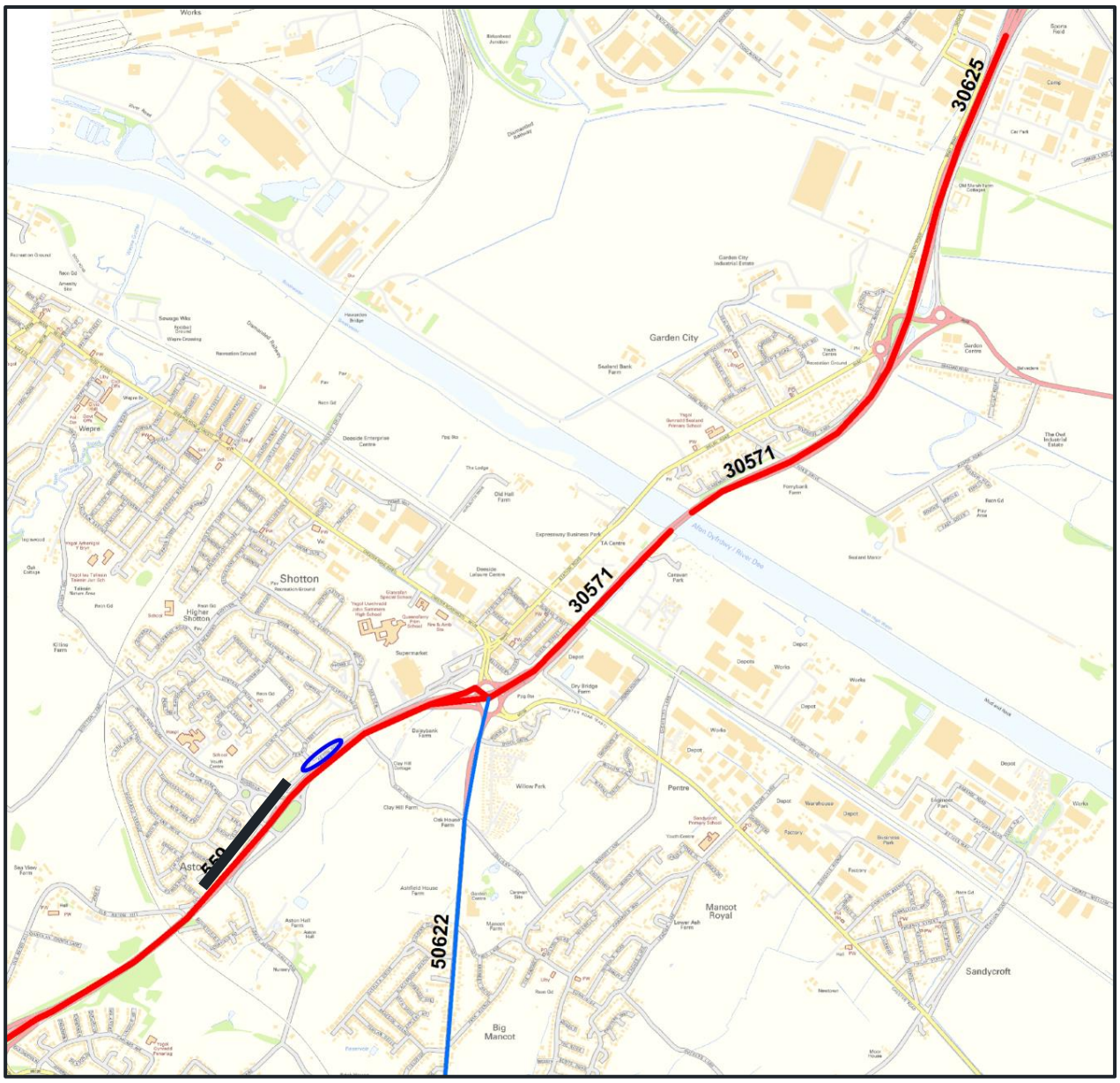
Variable diversions and ramp metering have negligible impacts on concentrations (≤0.1µg/m^3) over and above the benefits resulting from the imposition of the 50mph speed limit and ramp metering may even reduce the benefits of the 50mph speed limit alone on Link 30625. These measures are therefore ***unlikely*** to bring forward compliance with the limit values and are discounted measures. In the case of variable diversions, the negligible impacts are due to the lack of diversion routes that would be sufficiently attractive for drivers to use.

Barriers have ***potential beneficial impacts*** but are unlikely to be implementable within a timeframe that could affect compliance with limit values. However, taking into account the ongoing monitoring programme, initial indications from which suggest that the A494 might not achieve compliance within the projected PCM

timeframe, this measure is retained as a potential measure pending the results of fixed monitoring, using reference methods.

Figure 3 shows the location at which potential benefits from air quality barriers could be realised; along the remainder of the route there are no residential property or publicly accessible spaces where long term exposure is likely within 20m of the road.

Figure 3: Potential Air Quality Barrier Locations



The black marker indicates potential location of barrier

Table 7: Impact of measures on annual vehicle emissions on PCM Link 30625, 30571 and 559

ID	Measure	Emissions Reduction*			Commentary on Impact (First Year of Implementation)
		Link 30625	Link 30571	Link 559	
001	Enforce / Reduce Speed Limit (50mph)	10.0%	4.2%	4.1%	Smoother flow in peak hours improves HDV emissions (2017)
002	Air Quality Barriers, plus 50mph Speed Limit	-	-	-	No reduction in emissions but possible benefits at roadside in areas with properties within 20-50m of the roadside (2021)
003	Ramp Metering (SB on-slip at Drome Corner), plus 50mph Speed Limit	10.8%	4.5%	4.5%	Negligible reduction in flow has limited impact on emissions (2019)
004	Variable Diversions, plus 50mph Speed Limit	11.1%	4.7%	4.6%	Minor reduction in flow has limited impact on emissions (2019)
*Emissions Reductions provided for first year of implementation					

Table 8: Impact of measures on roadside annual mean concentrations (Equivalent PCM Concentration, µg/m^3)

Measure	Impact*	2017	2018	2019	2020	2021	2022
				PCM Link 559			
Baseline		**50.3**	**47.9**	**45.7**	**43.2**	**40.4**	**37.8**
001 Speed Limit (SL)	-1.3	**49.0**	**46.6**	**44.4**	**42.0**	39.3	36.9
003 SL + Ramp Metering	-1.3			**44.4**	**42.0**	39.3	36.8
004 SL + Variable Diversions	-1.3			**44.3**	**41.9**	39.2	36.8
002 SL + Air Quality Barriers	-3.0					37.3	34.9
				PCM Link 30571			
Baseline		**48.4**	**46.1**	**44.1**	**41.7**	39.1	36.7
001 Speed Limit (SL)	-1.5	**46.9**	**44.7**	**42.6**	**40.4**	37.9	35.5
003 SL + Ramp Metering	-1.5			**42.6**	**40.3**	37.8	35.5
004 SL + Variable Diversions	-1.5			**42.6**	**40.3**	37.8	35.5
002 SL + Air Quality Barriers	-3.2					35.9	33.5
				PCM Link 30625			
Baseline		**41.9**	39.8	37.9	35.9	33.7	31.6
001 Speed Limit (SL)	-2.8	39.0	37.0	35.2	33.3	31.2	29.3
003 SL + Ramp Metering	-2.6			35.3	33.4	31.3	29.4
004 SL + Variable Diversions	-2.7			35.2	33.3	31.2	29.3
002 SL + Air Quality Barriers	-4.4					29.2	27.3

***** *µg/m^3 in first year of implementation*

Note: (Red) Non-compliant, (Green) compliance achieved, (Grey) before implementation timeframe

4.4.1 APPRAISAL SUMMARY TABLES

The appraisal outcomes have been summarised within Appraisal Summary Tables (AST). The ASTs provide a breakdown of the impact of each measure on each of the appraisal areas. The scoring has been undertaken using the WelTAG 7-point scale where applicable. This is qualitative for all metrics except air quality impacts, for which the following quantitative criteria apply:

Magnitude of Change

- >10% of limit value — Large Beneficial or Adverse
- ≥5% - 9% of limit value — Medium Beneficial or Adverse
- ≥1% - 4% of limit value — Small Beneficial or Adverse
- <1% of limit value — Negligible

Date Produced - 06/09/2018

Appraisal Summary Table **Measure No.** 001

	Name of measure:	**Enforce/Reduce Speed Limit**
	Location:	**A494**
	Description of measure:	**The Welsh Ministers have made an Order under section 14(1)(b) of the Road Traffic Regulation Act 1984 because of a likelihood of danger to the public on or near the A494 trunk road between St David's Park Interchange and Deeside Industrial Park Interchange, Flintshire. The intention is that lower speed limits will reduce vehicle emissions and improve air quality, aiding compliance with NO2 limits set out in legislation. If successful in reducing NO2 levels, arrangements will be made to make the speed limits permanent.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 2.8µg/m3**
	Timescales:	**Temporary 50mph speed limit order implemented June 2018**
	Deliverability:	**This measure has been delivered by WG Network Management Division**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	The measure reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed (i.e. speeds greater than the optimal speed for minimising emissions from light duty vehicles ~60 - 80 kph). The speed limit will be enforced with average speed cameras and include off-peak/inter-peak periods. It has little impact in areas of congestion. Emissions reduced by up to 10%; Roadside concentrations reduced by up to 2.8µg/m3, which is 7% of the limit value.	Moderate Beneficial
	Noise	There are a couple of noise impact areas on the Bypass Road connecting Welsh Road to the M56. There are sensitive noise receptors within proximity to the carriageway including residential areas, a school, hospital and camping site. The reduction in speed limits is likely to result in a reduction in noise levels between the source and the receptors.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located within 2km's of the carriageway, including Shotwick Hall moated site 100m's north and Shotwick Castle motte and bailey located 1155m's south east. There are several listed buildings located within 100m's of the carriageway. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Dee and Bala Lake SAC flow beneath the A494 with the Deeside and Buckley Newt Site located approximately 1km north west of the A494. Two SSSIs are located within 1km of the carriageway including Connah's Quay Ponds and the River Dee SSSI sites. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Dee and Bala Lake SAC, SSSI site runs underneath the A494 at this location with one subsidiary stream running beneath the carriageway. The site is located within Flood Zone 3 towards the northern extent of the study corridor. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor. There are several listed buildings within 100m's of the carriageway at the northern extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the associated benefits to air quality. The addition of the complementary 'soft' measures should increase public acceptability for the measure.	Slight Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents.	Slight Beneficial
	Access to Employment and Services	A reduction to the speed limit is unlikely to have an impact on access to services, employment, or healthcare.	Neutral
Economy	Journey Time Changes	Reducing speed limits on the strategic route increases total travel time for users, with modelling showing increases of approximately 250 vehicle hours in total across both AM and PM peak hours. There will be further increases in travel time across the rest of the day, including the interpeak and off-peak periods, although these have not been modelled.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£400k. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. Cost estimate takes into account the potential requirement to place cameras at junctions and slip roads and the Police back office costs, which WG may be expected to cover. Has the potential to reduce in cost, as the proposal is to have average speed enforcement cameras operational as part of the ongoing trial and (most likely), 'permanent' sign installations.	£400,000
VfM	Value For Money	Reducing the speed limit to 50mph will reduce the roadside concentrations by up to 2.8µg/m3, at a cost of £400,000. This measure will therefore be a cost of approximately £145,000/µg.	£145,000/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	There will be an overall reduction in NO_2 emissions to air as a result of reducing the speed limit to 50mph on the A494 study corridor.	
	Will the measure result in unintended consequences or other environmental impacts	Aside from a slight increase to journey times, reducing the speed limit will not have any adverse consequences or other environmental impacts.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and provide additional noise benefits.	
Other Issues	Acceptability	A reduction in speed limit has been opposed by some groups and individuals within the Consultation.	
	Technical, Operational & Financial Feasibility	Temporary 50mph speed limit order implemented June 2018. Ongoing discussions with the Police regarding enforcement are taking place.	
	Deliverability & Risk	None identified as measure has already been implemented.	

Date Produced - 06/09/2018

Appraisal Summary Table **Measure No.** 002

Name of measure:	**Enforce/Reduce Speed Limit + Air Quality Barriers**
Location:	**A494**
Description of measure:	**As well as reducing the speed limit to 50mph, install a physical barrier to air movement between source & receptor. There is some evidence for effectiveness of 4m high environmental barriers in Canadian studies. One location along the A494 study corridor has been identified where implementation would be most effective.**
Key Criteria	
Effectiveness:	**Roadside concentrations reduced by up to 4.4µg/m4.4**
Timescales:	**End of 2021**
Deliverability:	**Road network is managed by WG Network Management Division.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of screens presents a physical barrier to air movement between source and receptor, reducing roadside exposure to pollution without reducing emissions. Driver exposure to pollution, inside the barriers, is likely to increase although the exposure duration on the road is limited. The use of coatings and aerodynamic design will maximise the benefits. This would result in no net change in overall emissions, over and above what would be achieved through reducing the speed limit. Roadside pollutant concentrations on the A494 reduced by up to 4.4µg/m4.4, which is 11% of the limit value.	Large Beneficial
	Noise	There are a couple of noise impact areas on the Bypass Road connecting Welsh Road to the M56. There are sensitive noise receptors within proximity to the carriageway including residential areas, a school, hospital and camping site. With a proposed reduction in traffic speeds and the installation of barriers, there will be a corresponding reduction in noise that could result in a moderate beneficial impact.	Moderate Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. The barriers would reduce natural views of the landscape; however, as they would be situated within the existing transportation corridor, the impact is likely to be reduced as a result.	Slight Adverse
	Historic Environment	There are two Scheduled Ancient Monuments located within 2km's of the carriageway, including Shotwick Hall moated site 100m's north and Shotwick Castle motte and bailey located 1155m's south east. There are several listed buildings located within 100m's of the carriageway. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. The installation of barriers is considered to have a slight adverse impact on the setting of listed buildings.	Slight Adverse
	Biodiversity	The River Dee and Bala Lake SAC flow beneath the A494 with the Deeside and Buckley Newt Site located approximately 1km north west of the A494. Two SSSIs are located within 1km of the carriageway including Connah's Quay Ponds and the River Dee SSSI sites. The installation of barriers could generate slight adverse impacts to the local ecology due to the need for vegetation clearance.	Slight Adverse
	Water Environment	The River Dee and Bala Lake SAC, SSSI site runs underneath the A494 at this location with one subsidiary stream running beneath the carriageway. The site is located within Flood Zone 3 towards the northern extent of the study corridor. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor. There are several listed buildings within 100m's of the carriageway at the northern extent. The installation of barriers could generate slight adverse impacts to the setting of listed buildings.	Slight Adverse
S&C	Journey Quality	Although some road users may be frustrated with the increases to journey times, reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. It is considered that the installation of barriers along the study corridor may impact on the view and pleasantness of journeys for road users. The addition of the complementary 'soft' measures should increase public acceptability for the measure.	Neutral
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the air quality barriers should not have any further impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	A reduction to the speed limit and installation of air quality barriers is unlikely to have an impact on access to services, employment, or healthcare.	Neutral
Economy	Journey Time Changes	The installation of barriers is not expected to affect journey times over and above the increased travel time for users associated with reducing speed limits on the strategic route.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£400k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £25m for barriers, which could be provided along some sections between the Deeside Park and St David's Interchanges, although there are many sections that would be excluded due to the presence of retaining walls, structures and narrow embankments. To include design and installation of the barriers and required changes to existing infrastructure including traffic signs, safety barriers, street lighting, of which there are significant numbers in both verges.	£25,400,000
VfM	Value For Money	Reducing the speed limit to 50mph and installing air quality barriers will reduce the roadside concentrations by up to 4.4µg/m4.4, at a combined cost of £25.4m. This measure will therefore be a cost of approximately £5.8m/µg.	£5.8m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	The installation of barriers is not expected to reduce overall NO2 emissions over and above what is to be expected with reducing speed limits to 50mph on the A494 study corridor.	
	Will the measure result in unintended consequences or other environmental impacts	Aside from a slight increase to journey times with the speed reduction, the installation of barriers results in a slight adverse consequences to biodiversity, historic environment, and landscape.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and installing barriers should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents. The should also be a reduction of road traffic noise as a consequence of the barriers, which should be a benefit to local residents.	
Other Issues	Acceptability	There may be some local opposition, as several business may no longer be visible from the A494 and residents of nearby properties may argue that the fences will reduce light levels.	
	Technical, Operational & Financial Feasibility	Fence erection may have to be undertaken by a specialist contractor, although this could still be procured by the TRA through their frameworks.	
	Deliverability & Risk	Local opposition and the timescales for implementation have been identified as risks that could affect the achievement of the anticipated outcomes. Detailed design and surveys are required to identify any potential risks to delivery.	

Date Produced - 06/09/2018

Appraisal Summary Table **Measure No.** 003

	Name of measure:	**Enforce/Reduce Speed Limit + Ramp Metering**
	Location:	**A494**
	Description of measure:	**As well as reducing the speed limit to 50mph, use ramp metering to control traffic merging onto the A494 at Drome Corner (southbound on-slip) by traffic lights**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 2.6µg/m3**
	Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
	Deliverability:	**Road network is managed by WG Network Management Division.**

	Impacts	Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed (i.e. speeds greater than the optimal speed for minimising emissions from light duty vehicles ~60 - 80 kph). The speed limit will be enforced with average speed cameras and include off-peak/inter-peak periods. It has little impact in areas of congestion. The addition of ramp metering results in the regulation of flows merging from junctions and potentially reduces lane weaving and braking/acceleration events. In areas of heavy congestion, the measure results in imperceptible disbenefits whereas in areas of moderate congestion, the measure results in imperceptible benefits. The measure has no effect outside of periods/areas of congestion. Emissions reduced by up to 11%; Roadside pollutant concentrations reduced by up to 2.6µg/m3, which is 7% of the limit value.	Moderate Beneficial
	Noise	There are a couple of noise impact areas on the Bypass Road connecting Welsh Road to the M56. There are sensitive noise receptors within proximity to the carriageway including residential areas, a school, hospital and camping site. With a proposed reduction in traffic speeds a corresponding reduction in noise could result in a slight beneficial effect. The addition of ramp metering is unlikely to generate further noise impacts.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located within 2km's of the carriageway, including Shotwick Hall moated site 100m's north and Shotwick Castle motte and bailey located 1155m's south east. There are several listed buildings located within 100m's of the carriageway. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Dee and Bala Lake SAC flow beneath the A494 with the Deeside and Buckley Newt Site located approximately 1km north west of the A494. Two SSSIs are located within 1km of the carriageway including Connah's Quay Ponds and the River Dee SSSI sites. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Dee and Bala Lake SAC, SSSI site runs underneath the A494 at this location with one subsidiary stream running beneath the carriageway. The site is located within Flood Zone 3 towards the northern extent of the study corridor. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor. There are several listed buildings within 100m's of the carriageway at the northern extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the benefits to air quality. It is considered that the installation of ramp metering is likely to improve flow on the strategic network, although this could lead to increased congestion on the local network. The addition of the complementary 'soft' measures should increase public acceptability for the measure.	Slight Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of ramp metering should contribute to smoother flows during peak hours, further decreasing the likelihood of accidents.	Slight Beneficial
	Access to Employment and Services	Ramp metering could cause congestion on roads connecting to the strategic network, however it is not considered that this would impact on local trips to services, employment, and healthcare.	Neutral
Economy	Journey Time Changes	Reducing speed limits on the strategic route increases total travel time for users, with modelling showing increases of approximately 250 vehicle hours in total across both AM and PM peak hours. There will be further increases in travel time across the rest of the day, including the interpeak and off-peak periods, although these have not been modelled. The intention of ramp metering is to control traffic merging onto the A494, which improves the journey time on the strategic network. The model does not result in an increase in journey times in the AM peak; however, in the PM peak the model shows a 1.6% increase on total travel time compared with speed limits alone. Combined with the speed reduction, ramp metering is considered to have a slight adverse impact.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£400k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £450k for ramp metering, taking into account the equipment and ongoing maintenance.	£850,000
VfM	Value For Money	Reducing the speed limit to 50mph and installing ramp metering will reduce the roadside concentrations by up to 2.6µg/m3, at a combined cost of £850,000. This measure will therefore be a cost of approximately £330,000/µg.	£330,000/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	This measure is anticipated to result in minor overall benefits with respect to the overall reduction in NO2 emissions to air, over and above those from the imposition of speed limits alone.	
	Will the measure result in unintended consequences or other environmental impacts	As well as the a slight increase to journey times with the speed reduction, the addition of ramp metering could have a slightly adverse impact on access to local services.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and installing ramp metering should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. The addition of ramp metering will not have any further positive impacts.	
Other Issues	Acceptability	Given the nature of the proposals, this measure is unlikely to be opposed by residents and if it were, it could likely be negated through education of their benefits. It is possible that Flintshire County Council would either not support this measure or at minimum ask for mitigation measures on the local road network to avoid rat-running. However, the use of alternative routes is deemed unlikely due to a lack of other alternative nearby crossings of the River Dee.	
	Technical, Operational & Financial Feasibility	None identified.	
	Deliverability & Risk	Implementation of ramp metering would require collaboration with the local authority.	

Date Produced - 06/09/2018

Appraisal Summary Table **Measure No.** 004

	Name of measure:	**Enforce/Reduce Speed Limit + Variable Diversions**
	Location:	**A494**
	Description of measure:	**As well as reducing the speed limit to 50mph, operate advisory variable diversions within set NO2 limits implement advisory variable diversion routes, utilising other routes including the A548, through signage to reduce cars from the A494 study corridor in the AM and PM peak hours (using continuous monitoring equipment).**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 2.7µg/m3**
	Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
	Deliverability:	**Traffic management is within WG Network Management Division scope.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. In 2019, reducing speed limits will reduce roadside pollutant concentrations by up to 2.7µg/m3. There is reasonable doubt as to whether the addition of variable diversions will have benefit due to lack of attractive alternative routes. Emissions reduced by up to 11%; Roadside pollutant concentrations on the A494 reduced by up to 2.7µg/m3, which is 7% of the limit value.	Moderate Beneficial
	Noise	There are a couple of noise impact areas on the Bypass Road connecting Welsh Road to the M56. There are sensitive noise receptors within proximity to the carriageway including residential areas, a school, hospital and camping site. With a proposed reduction in traffic speeds a corresponding reduction in noise could result in a slight beneficial effect. With the variable diversions, the traffic would be displaced onto other roads, and therefore it is considered that this measure does not have any additional impact on overall noise levels.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located within 2km's of the carriageway, including Shotwick Hall moated site 100m's north and Shotwick Castle motte and bailey located 1155m's south east. There are several listed buildings located within 100m's of the carriageway. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Dee and Bala Lake SAC flow beneath the A494 with the Deeside and Buckley Newt Site located approximately 1km north west of the A494. Two SSSIs are located within 1km of the carriageway including Connah's Quay Ponds and the River Dee SSSI sites. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Dee and Bala Lake SAC, SSSI site runs underneath the A494 at this location with one subsidiary stream running beneath the carriageway. The site is located within Flood Zone 3 towards the northern extent of the study corridor. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor. There are several listed buildings within 100m's of the carriageway at the northern extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	The advisory variable diversion route has the potential to increase journey times for road users that they affect and therefore, along with the change in speed limits, there may be a slight adverse impact on journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. Implementing variable diversions should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	Diversions on to other roads have the potential to lead to congestion; however, as they are advisory they are unlikely to have a significant impact on access to services, employment, and healthcare as traffic is likely to find an equilibrium.	Neutral
Economy	Journey Time Changes	Variable diversions are likely to increase journey times for some car drivers during the peak hours when the diversions are in operation, although, as they are advisory, drivers are able to remain on the A494 if they wish to do so. Reducing speed limits on the strategic route increases total travel time for users, which is considered to be a slight adverse impact.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£400k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £5m for variable diversions. Flintshire CC may have serious concerns over using alternative routes during periods when NO2 levels are highest, as there isn't any obvious route that is of a similar standard to the A494. Cost estimate takes into account the equipment needed, ongoing maintenance and an estimate for measures that the Council may want implemented on the local road network and the 'diversion' route.	£5,400,000
VfM	Value For Money	Reducing the speed limit to 50mph and implementing variable diversions will reduce the roadside concentrations by up to 2.7µg/m3, at a combined cost of £5.4m. This measure will therefore be a cost of approximately £2m/µg.	£2m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	Variable diversions would result in reassignment of traffic onto other roads of equal or longer length. Reducing the speed limit will reduce emissions and the diversions will result in further minor reductions in emissions on the A494, but the latter may be offset by the increase on other roads.	
	Will the measure result in unintended consequences or other environmental impacts	Variable diversions are predicted to have a slight adverse impact on journey times and journey quality, and limit access to services due to congestion.	
	Will the measure impact equally across multiple vehicle classes and journey types	It is anticipated that variable diversions will only be implemented for car drivers during the AM and PM peak periods, and therefore this measure may not have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. The addition of variable diversions will not have any further positive impacts.	
Other Issues	Acceptability	Given the nature of the proposals, this measure is likely to be opposed by the local authority and local residents.	
	Technical, Operational & Financial Feasibility	It may be necessary to improve the alternative route(s), which would increase scheme costs.	
	Deliverability & Risk	As the diversion route is advisory, it may not achieve the assumed numbers of vehicles utilising other routes.	

Table 9: Summary of WelTAG Stage Three Appraisals

	Key Criteria			Environment							Social and Cultural			Economy			VfM	
Measures	Effectiveness	Timescales	Deliverability	Air Quality	Noise	Landscape	Historic Environment	Biodiversity	Water Environment	Townscape	Journey Quality	Accidents	Access to Services	Journey Time Changes	Land	Capital and Revenue Costs	Value for Money	Outcome
001: Enforce / Reduce Speed Limit (50mph)	✓	✓	✓	+2	+1	0	0	0	0	0	+1	+1	0	-1	0	£400,000	£145,000/µg	Likely Measure
002: Air Quality Barriers, plus 50mph Speed Limit	✓	✓	=	+3	+2	-1	-1	-1	0	-1	0	+1	0	-1	0	£25,400,000	£5.8m/µg	Precautionary Retained Measure
003: Ramp Metering (Southbound on-slip at Drome Corner), plus 50mph Speed Limit	✗	✓	✓	+2	+1	0	0	0	0	0	+1	+1	0	-1	0	£850,000	£330,000/µg	Unlikely Measure
004: Variable Diversions, plus 50mph Speed Limit	✗	✓	=	+2	+1	0	0	0	0	0	-1	+1	0	-1	0	£5,400,000	£2m/µg	Unlikely Measure

Where +3 *Large Beneficial*, +2 *Moderate Beneficial*, +1 *Slight Beneficial*, 0 *Neutral*, -1 *Slight Adverse*, -2 *Moderate Adverse*, -3 *Large Adverse*

✓ Pass, ✗ Fail, = Risks identified, see ASTs for more information

4.5 APPRAISAL OUTCOME

4.5.1 LIKELY MEASURES

These are measures for which the evidence supports the conclusion that the measure is **likely** to bring forward compliance with limit values on the basis of its effectiveness, timeliness and deliverability, and for which there is no reasonable scientific doubt as to the efficacy or unintended consequences.

001 – Enforce / Reduce Speed Limit (50mph)

000 – Complementary Package of Soft Measures

The Speed Limit measure, 001, is, in part, installed on the A494. The realisation of the benefits of the measure are, however, dependent on the enforcement of the measure. Work is currently ongoing to install the infrastructure and procedures for the speed limit to be enforced effectively.

4.5.2 UNLIKELY MEASURES (DISCOUNTED)

These measures have been discounted on account of reasonable scientific doubt as to their efficacy

003 – Ramp Metering (Southbound on-slip at Drome Corner), plus 50mph Speed Limit – Fails on effectiveness due to ramp metering providing negligible benefit over and above that achieved through the use of speed limits alone.

004 – Variable Diversions, plus 50mph Speed Limit – Fails on effectiveness due to there being limited diversion routes available and the measure providing negligible benefit over and above that achieved through the use of speed limits alone.

4.5.3 'PRECAUTIONARY' RETAINED MEASURES

It is recognised that there is uncertainty in both the national PCM modelling and Welsh Government's indicative monitoring. As such, should compliance on the A494 be delayed beyond current projections, additional measures may be required to keep the time of exceedance of the limit values as short as possible. The following measure has been identified in the analysis as likely to give rise to significant benefits but will only be of benefit in bringing forward compliance if compliance is delayed beyond 2021 due to the relatively long implementation timescales of the measure.

It is recommended that work on the implementation of this measures is progressed until such time as the links become compliant or the retained measure is implemented:

002 - Air Quality Barriers, plus 50mph Speed Limit – One location has been identified where there is potential exposure to air pollution above the limit value where the installation of barriers could be of benefit.

5 FINANCIAL CASE

5.1 OVERVIEW

The financial case 'tells you whether an option is affordable in the first place and the long term financial viability of a scheme. It covers both capital and revenue requirements over the life time of the project and the implications of these for the balance sheet, income and expenditure accounts for public sector organisations'.

5.2 SCHEME COSTS

Capital and revenue costs have been considered for the 'hard measures' included within this Stage Three Full Business Case. The costs of likely measures are detailed below. The costs for all other measures are detailed within the ASTs.

5.2.1 001: ENFORCE / REDUCE SPEED LIMIT (50MPH)

It is estimated that implementing a permanent 50mph speed limit on the A494 study corridor would cost in the region of £400,000. This would include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance.

6 COMMERCIAL CASE

6.1 OVERVIEW

The commercial case ‘tells you if a scheme will be commercially viable, whether it is going to be possible to procure the scheme and then to continue it in to the future’.

6.2 ASSESSMENT

For this assessment, it is considered that all of the ‘soft’ and ‘hard’ measures considered at Stage Three are commercially viable and can be procured by the existing Trunk Road Agent through their supply chain partners.

7 MANAGEMENT CASE

7.1 SUMMARY OF MANAGEMENT CASE FROM STAGE ONE AND TWO

The management case tells you if an option is achievable. This case 'covers the delivery arrangements for the project and then its management during its life time. It covers the arrangements for the procurement, construction and on-going operation of the intervention, details of the monitoring arrangements and the undertaking of the evaluation plan. The management case should embed the five ways of working.'

The WelTAG Stage One and Two reports outlined:

- Project Planning – Governance, organisational Structure
- Key Project Parties & Roles
- Identified the Review Group
- Communications & Stakeholder Management Plan

As part of the stakeholder and public engagement strategy, Welsh Government published the WelTAG Stage One and Stage Two reports, Stage Two Impact Assessment Report, and Effectiveness Review as part of the consultation on the 'Welsh Government Interim Supplemental Plan' (WGSP).

7.2 WELSH GOVERNMENT INTERIM SUPPLEMENTAL PLAN TO THE UK PLAN FOR TACKLING ROADSIDE NITROGEN DIOXIDE CONCENTRATIONS 2017

The Welsh Government is working alongside the other devolved administrations to meet their joint objective with the UK Government to transform the UK's most polluted towns and cities into clean and healthy urban spaces, supporting those most directly affected and ensuring the vehicle manufacturers play their part to improve the nation's air quality.

The Welsh Ministers accept the 2017 Plan does not, insofar as it relates to Wales, satisfy the requirements of the Ambient Air Quality Directive or the Air Quality Standards (Wales) Regulations 2010. This is because the Welsh Government did not, at the time when the 2017 Plan was drawn up, have sufficient information to properly consider what measures within their devolved competence (if any) would ensure compliance with the limit values for NO_2 laid down by the Directive and the Regulations within the shortest possible time. As such, the Welsh Ministers have published and consulted on a draft supplement to the 2017 Plan which satisfies the Directive and the Regulations.

This consultation was launched on the 25th April 2018 (and 19th June 2018) seeking views on the Welsh Government supplemental plan to the 'UK plan for tackling roadside nitrogen dioxide concentrations 2017 ("the 2017 Plan")'. The WGSP builds on Section 7.6 (Additional Actions in Wales) of the 2017 Plan and sets out actions the Welsh Government will take to ensure compliance within the shortest possible time with the limit values for nitrogen dioxide (NO_2) laid down by the Ambient Air Quality Directive (2008/50/EC) and the Air Quality Standards (Wales) Regulations 2010.

In total, the Welsh Government received 35 responses from a range of stakeholders from various sectors, including members of the public, commercial entities, non-governmental organisations, registered charities, and public bodies. One response was subsequently withdrawn. Not all respondents commented on every question in the consultation document, and some respondents did not clearly express whether they agreed or disagreed with measures proposed within the WGSP.

7.3 MEASURE IMPLEMENTATION

There are a number of options available to facilitate the implementation of the likely measures.

It is envisaged that measures that involve physical works, e.g. painting, installation of fencing, signing, are likely to be procured through the appropriate Trunk Road Agent (TRA) for geographical location of the site. The TRAs have further options to procure construction directly through their maintenance partnerships, or via existing Consultant and Contractor Frameworks.

Proposals associated with the use of Traffic Officers or which involve policy, publications, communication and advertising are likely to be undertaken jointly between the Welsh Government and Traffic Wales.

Traffic Wales also have the capability to implement ITS solutions themselves or via their own supply chain. The supply chain could also extend to the TRA's Consultant and Contractor Frameworks.

By adopting a flexible approach to implementation and integrating robust measurement and evaluation of the performance of these measures to meet the objective, measures can be adjusted based on an improving evidence base. As such, measures which have been identified as 'likely measures' will be implemented as soon as is practicably possible, whilst 'precautionary retained measures' will be implemented if compliance on the A494 is delayed beyond current projections.

7.4 MONITORING AND EVALUATION PLAN

As per the five stages of WelTAG, it will be critical to monitor the impacts of the measures during and post implementation. The monitoring of outcomes during implementation in Stage Four will allow for adjustments to be made, if required, to realise the benefits of the intervention and mitigate any unforeseen adverse impacts. The longer term evaluation provided in Stage Five covers both the process of delivering the scheme and the outcomes achieved. This makes WelTAG a learning process and future WelTAG appraisals will benefit from the sharing of experience gained elsewhere.

It is recognised that there is uncertainty in both the national PCM modelling and Welsh Government's indicative monitoring. As such, should compliance on the A494 be delayed beyond current projections, additional measures may be required to keep the time of exceedance of the limit values as short as possible. As such, measures will be considered for implementation as per the following:

7.4.1 AIR QUALITY MONITORING

Air quality monitoring along the A494 should comprise a combination of reference and indicative methods.

The reference method for the measurement of nitrogen dioxide and oxides of nitrogen is that described in EN 14211:2005 'Ambient air quality — Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by chemiluminescence.'

Reference method monitoring will be undertaken at a minimum of one location within the study corridor, with the recommended location being shown in Figure 4. This location has been selected with regards to the criteria in Annex III of the Directive and specifically the criteria that:

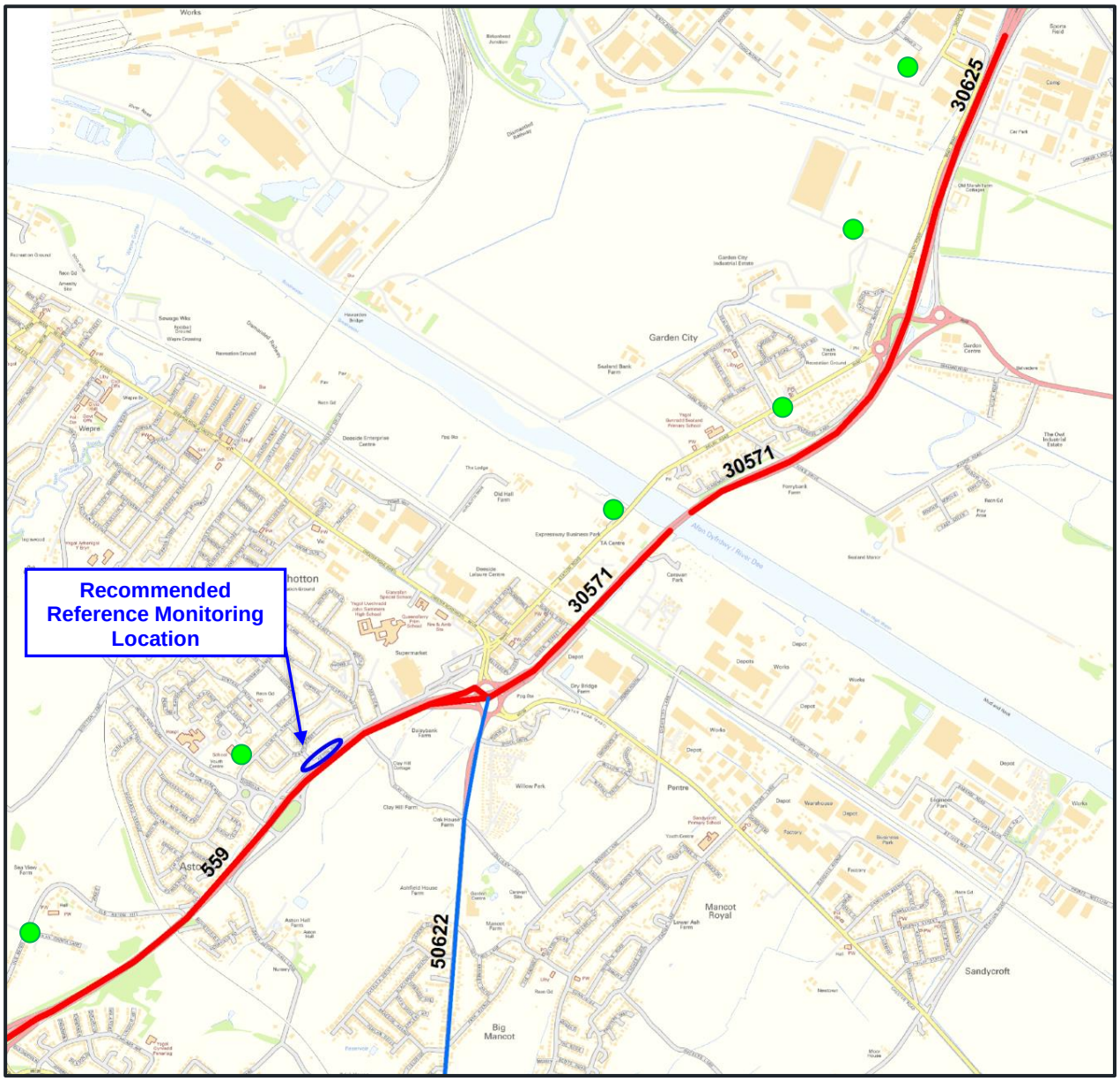
Sampling should be directed at locations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value (Para B.1a)

For all pollutants, traffic-orientated sampling probes shall be at least 25 m from the edge of major junctions and no more than 10 m from the kerbside (Para C)

The final choice for the reference monitoring location will need to take account of Health and Safety and provision of infrastructure.

In addition to the reference monitoring, it is recommended that indicative diffusion tube monitoring is continued. The existing monitoring locations are provided in Figure 4. The number of monitoring locations should be expanded to include a minimum of a further 4 sites: 2 locations on the A494 to the north of, but within 1km of, the PCM link 30625 and 2 locations on the A494 to the south of, but within 1km of, the PCM Link 559. Diffusion tubes should be exposed in triplicate, with tubes changed monthly.

Figure 4: Existing monitoring locations (green circles) and proposed location for reference method (automatic) monitoring (blue oval)



7.4.2 TRAFFIC MONITORING

This study has highlighted the intrinsic link between air quality and traffic volumes, speeds and fleet mix. As such, it is recommended that the air quality monitoring is supplemented with either long term or regular short-term traffic monitoring in order to better understand any observed change in air quality. The following surveys should be considered:

Classified Link (Volume) Counts

This would require at least 1 full week (24 hours a day) of data for a DMRB neutral period. This data would be used to infer changes in Annual Average Daily Traffic (AADT) over time. Long term permanent count site data would be preferable so that the data would not need to be corrected for seasonality and the impacts of any incidents on the network could be fully understood.

Speed Data

The effectiveness of reduced speed limits is a function of compliance. Traffic speeds should be monitored post implementation to identify the real impacts of a change in speed limit and the speed data should be used to inform any decision on the requirement for and nature of enforcement. INRIX traffic data could be used to monitor speeds post implementation of measures though where possible should be backed up with surveyed data. Whilst undertaking surveys would potentially provide more robust data (larger sample size), it will be important to consider whether the survey is likely to impact upon typical driver behaviour and could underestimate real speeds on the corridors.

Automatic Number Plate Recognition

In addition to the classified link count data, there would be significant benefit in undertaking ANPR surveys. This data can be linked back to the DVLA database to determine not only vehicle classification, but also emission standards of vehicles. The data could be used to identify the rate of change of the fleet towards cleaner, newer, low emissions vehicles and could be used to evidence the need for additional measures to accelerate the rate of change, e.g. a scrappage scheme.

8 SUMMARY AND NEXT STEPS

8.1 OVERVIEW

The European Union Ambient Air Quality Directive (2008/50/EC) sets legally binding limits for concentrations of certain air pollutants in outdoor air, termed 'limit values'. The Directive requires that Member States report annually on air quality within zones designated under the Directive and, where the concentration of pollutants in air exceeds limit values, to develop air quality plans that set out measures in order to attain the limit values.

The A494 lies within the North Wales zone for the purpose of the assessment of compliance with the EU Air Quality Directive. The national assessment[1] of roadside NO_2 undertaken for the North Wales zone indicates that the annual limit value was exceeded in 2015 but it is likely to be achieved by 2021 through the introduction of committed measures. WG are investigating additional network management measures for the Strategic Trunk Road and Motorway Network that could bring forward the projected compliance date.

The compliance date of the North Wales zone is, in current projections, determined by the compliance of the A494 between the B5125 St Davids Interchange to the A458 Deeside Park Interchange.

This report has presented the Stage Three: Full Business Case of the WelTAG process for reducing the levels of NO_2 on the A494 dual carriageway network in North East Wales. Elevated concentrations of NO2 on this study corridor are due to a combination of high traffic volumes and periods of congestion.

The appraisal of measures has been undertaken in accordance with the Welsh Government's WelTAG [2017] guidance.

A more detailed quantitative analysis of traffic and air quality has been undertaken at Stage Three. The preferred measures have been re-appraised against the key criteria and secondary criteria for the objective and the four WelTAG aspects of well-being. The likely measures have been determined to reflect the more detailed appraisal work undertaken at Stage Three, and the outcome of the appraisal of measures is included in Table 10.

Table 10: Appraisal Outcome

Measure	Outcome
001: Enforce / Reduce Speed Limit (50mph)	Likely Measure
002: Air Quality Barriers, plus 50mph Speed Limit	Precautionary Retained Measure
003: Ramp Metering (Southbound on-slip at Drome Corner), plus 50mph Speed Limit	Unlikely Measure
004: Variable Diversions, plus 50mph Speed Limit	Unlikely Measure

8.2 PREFERRED MEASURES

8.2.1 LIKELY MEASURES

For the A494 these include:

- 001: Enforce/ Reduce Speed Limit
- 000: Complementary Package of Soft Measures
  - Behaviour Change
  - Intelligent Traffic Management
  - Signage
  - Air Quality Areas
  - Air Quality Communications

The Speed Limit measure, 001, is, in part, installed on the A494. The realisation of the benefits of the measure are, however, dependent on the enforcement of the measure. Work is currently ongoing to install the infrastructure and procedures for the speed limit to be enforced effectively.

8.2.2 PRECAUTIONARY RETAINED MEASURES

It is recognised that there is uncertainty in both the national PCM modelling and Welsh Government's indicative monitoring. As such, should compliance on the A494 be delayed beyond current projections, additional measures may be required to keep the time of exceedance of the limit values as short as possible. The following measure has been identified in the analysis as likely to give rise to significant benefits but will only be of benefit in bringing forward compliance if compliance is delayed beyond 2021 due to the relatively long implementation timescales of the measures.

It is recommended that work on the implementation of the measure is progressed until such time as the links become compliant or the measure is implemented:

- 002 Air Quality Barrier (~3m barriers) plus 50mph speed limit

8.3 NEXT STEPS

All likely measures will be fully implemented (WelTAG Stage Four) by the end of 2019. These are:

- 001: Enforce/ Reduce Speed Limit
- 000: Complementary Package of Soft Measures
  - Behaviour Change
  - Intelligent Traffic Management
  - Signage
  - Air Quality Areas
  - Air Quality Communications

There will be a significant communications campaign made on the likely measures using social media, radio and signs on the network. This campaign will be reiterated at key times on an ongoing basis along with key announcements made on the air quality results.

Post implementation and analysis of 12 months of monitoring data, an updated EU Directive Compliance Report will be prepared (WelTAG Stage Five) based on post implementation and analysis of 12 months of monitoring data. This will include a review of the performance of the likely measures and the requirement for additional retained measures.

Further work is required to assess the design feasibility of the Air Quality Barrier in the location identified. This should include topographical surveys and Utility Stats Searches. Despite this measure being identified as a precautionary retained measure, design should be progressed to minimise implementation timeframes should the requirement for the measure be necessary.

Appendix A

WELTAG 2017 GUIDANCE UPDATE

WELTAG 2017 GUIDANCE UPDATE

The main changes in the final WelTAG 2017 relative to the Consultation Draft used for Stage One and Two are as follows:

- The application of the **five ways of working** to the consideration of possible solutions;
- A consideration of how solutions enable public bodies to maximise their contribution to each of the **seven national well-being goals**: A prosperous Wales, a resilient Wales, a healthier Wales, a more equal Wales, a Wales of cohesive communities, a Wales of vibrant culture and Welsh language, and a globally responsible Wales.
- A commitment towards the **four aspects of well-being** in Wales: economic, social, environmental and cultural; and
- A move from Delivery Case to **Management Case**.

WelTAG 2017 combines the principles of the HM Treasury Green Book and WG's Five Case Model for Better Business Cases, represented by the five WelTAG Stage Reports. The 2017 guidance also differs from the previous consultation version wherein the five case business model now more closely reflects the model adopted by the DfT WebTAG guidance.

The contents of each Stage Report must be presented using the structure of the Five Cases Model as follows:

- **Strategic case:** the case for change, fit with other policies and objectives
- **Transport case:** does the proposal offer good public value for money and maximise contribution to the well-being goals?
- **Financial case:** is the proposed spend affordable?
- **Commercial case:** how can the scheme be procured? Is it commercially viable?
- **Management case:** is the scheme achievable? Can it be delivered?

Whilst WelTAG provides a fixed framework for appraisal, the guidance acknowledges that the level of detail provided in the WelTAG reports should be proportionate to the impacts under consideration and using the five ways of working set out in the Well-being of Future Generations Act. All major impacts and issues that could have a significant influence on delivery should be presented, but the level of detail in any analytical work should be proportionate to the scale and significance of the impact and sufficiently accurate for the decisions that need to be made.

The WelTAG Guidance has also been revised to reflect the Well-being of Future Generations (Wales) Act, which strives to improve the social, economic, environmental and cultural well-being of Wales and identifies seven well-being goals:

A prosperous Wales: An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.

A resilient Wales: A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).

A healthier Wales: A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.

A more equal Wales: A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio economic background and circumstances).

A Wales of cohesive communities: Attractive, viable, safe and well-connected communities.

A Wales of vibrant culture and thriving Welsh language: A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.

A globally responsible Wales: A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.

Appendix B

TEMPORARY TRAFFIC REGULATION ORDER (TTRO) – SPEED LIMITS

WELSH STATUTORY INSTRUMENTS

2018 No. (W.)

ROAD TRAFFIC, WALES

The A494 Trunk Road (St David's Park Interchange to Deeside Industrial Park Interchange, Flintshire) (Temporary 50 mph Speed Limit) Order 2018

Made	*14 June 2018*
Coming into force	*18 June 2018*

The Welsh Ministers, as traffic authority for the relevant length of the A494 Trunk Road, are satisfied that traffic on a specified length of the trunk road should be restricted because of the likelihood of a danger to the public.

The Welsh Ministers, therefore, in exercise of the powers conferred upon them by section 14(1)(b) and (7) of the Road Traffic Regulation Act 1984(**1**), make this Order.

Title, Commencement and Interpretation

1. The title of this Order is the A494 Trunk Road (St David's Park Interchange to Deeside Industrial Park Interchange, Flintshire) (Temporary 50 mph Speed Limit) Order 2018 and it comes into force on 18 June 2018.

2. In this Order:

"exempted vehicle" *("cerbyd esempt")* means:

(a) any vehicle being used for the purposes described in section 87 of the Road Traffic Regulation Act 1984(**2**); and

(**1**) 1984 c.27; section 14 was substituted by the Road Traffic (Temporary Restrictions) Act 1991 (c.26), section 1(1) and Schedule 1. By virtue of S.I. 1999/672, and section 162 of, and paragraph 30 of Schedule 11 to, the Government of Wales Act 2006 (c.32), these powers are now exercisable by the Welsh Ministers in relation to Wales.

(**2**) Section 87 was amended by the Fire and Rescue Services Act 2004 (c.21), Schedule 1, paragraph 55, the Serious Organised Crime and Police Act 2005 (c.15), Schedule 4, paragraph 42, the Crime and Courts Act 2013 (c.22), Schedule 8, paragraph 29(2) and the Deregulation Act 2015 (c.20), section 50(4) and (5).

(b) any vehicle being used for naval, military or air force purposes and being driven by a person for the time being subject to the orders of a member of the armed forces of the Crown, who is a member of the special forces—

(i) in response, or for practice in responding, to a national security emergency by a person who has been trained in driving at high speeds; or

(ii) for the purpose of training a person in driving vehicles at high speeds;

"special forces" *("lluoedd arbennig")* means those units of the armed forces the maintenance of whose capabilities is the responsibility of the Director of Special Forces or which are for the time being subject to the operational command of that Director;

"the trunk road" *("y gefnffordd")* means the A494 Dolgellau to South of Birkenhead Trunk Road.

Restriction

3. No person may drive any motor vehicle, other than an exempted vehicle, at a speed exceeding 50 miles per hour on the length of the trunk road that extends from the centre-point of St David's Park Interchange to the centre-point of Deeside Industrial Park Interchange, Flintshire.

Application

4. The restriction in article 3 applies only during such times and to such extent as indicated by traffic signs.

Suspension

5. Any statutory provisions restricting the speed of motor vehicles on the length of the trunk road are suspended during such times as the restriction specified in article 3 applies.

Duration of this Order

6. The maximum duration of this Order is 18 months.

Signed under authority of the Cabinet Secretary for Economy and Transport, one of the Welsh Ministers.

Dated 14 June 2018

Richard Morgan
Head of Planning, Asset Management and Standards
Welsh Government

Appendix C

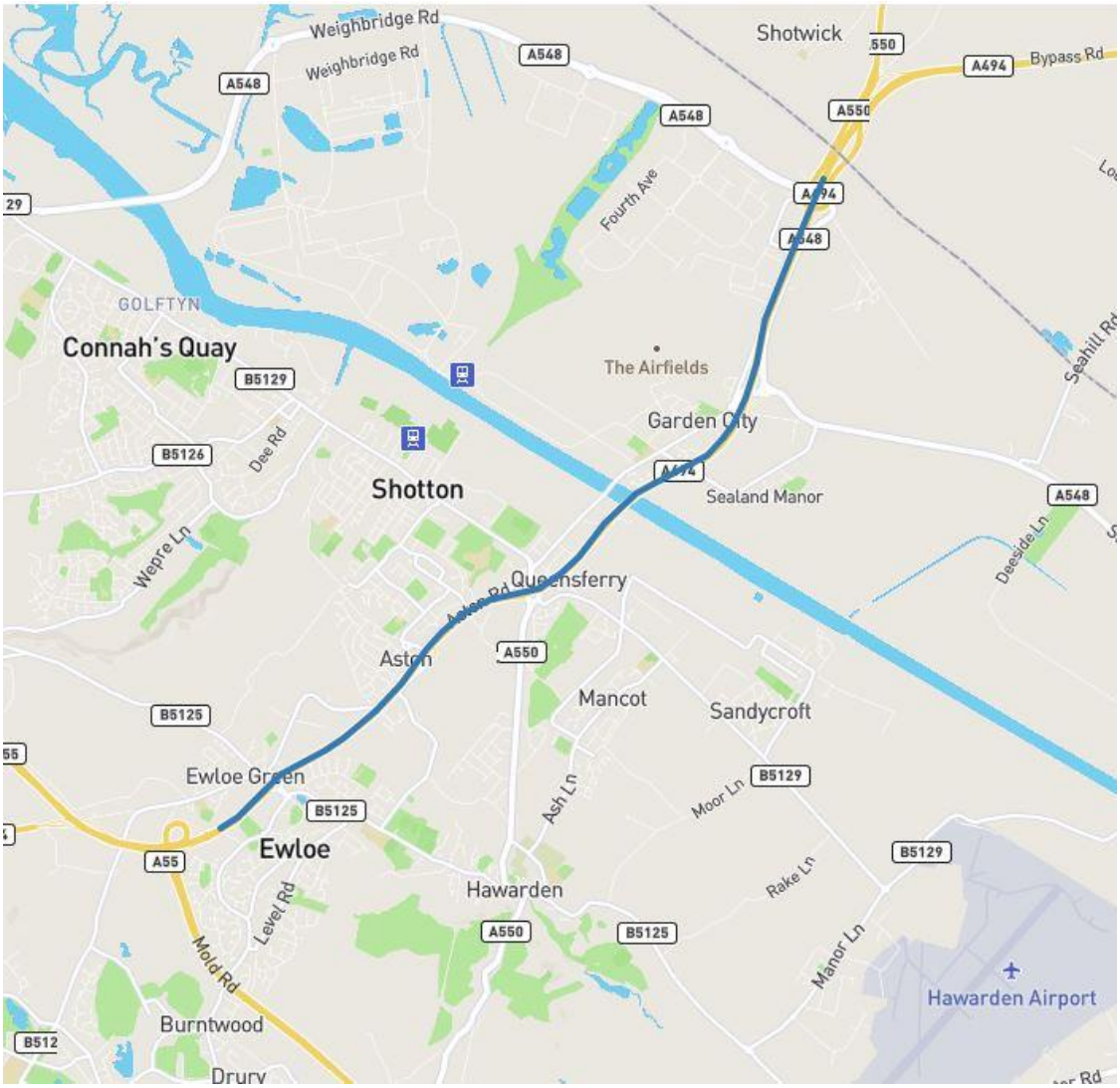
INRIX TRAFFIC DATA

INRIX - TRAFFIC SPEED DATA

INRIX Analytics

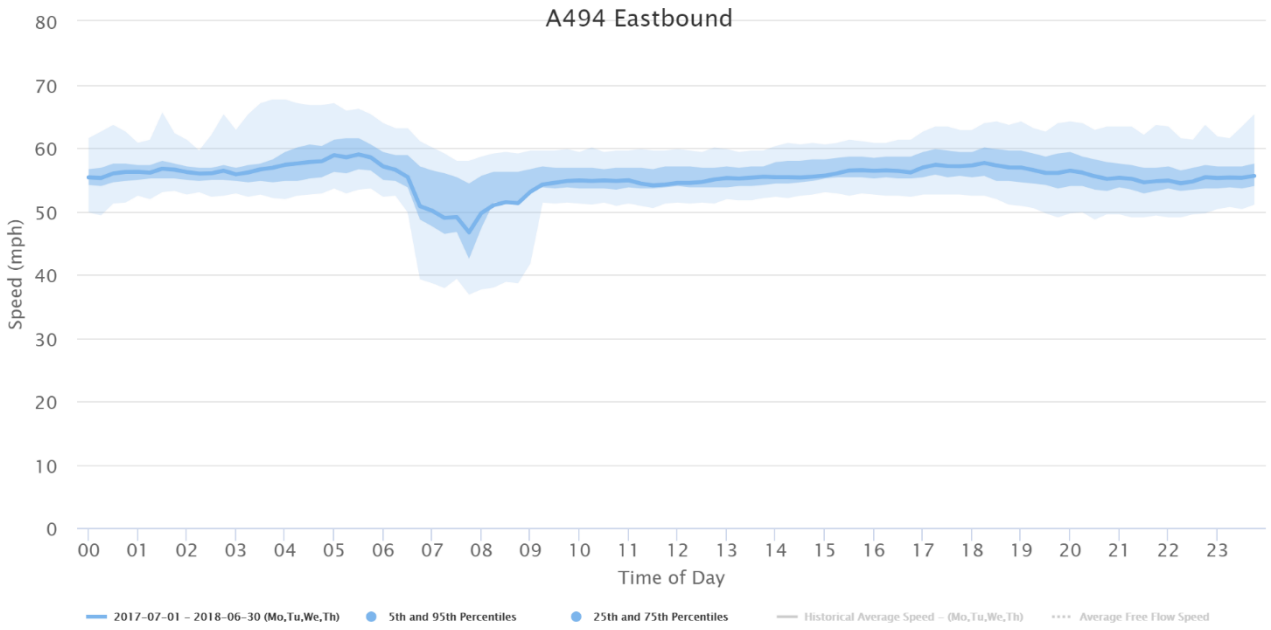
As part of the Stage Three WelTAG appraisal, INRIX data has also been considered. INRIX gathers real-time, predictive and historical data from more than 300 million sources, including commercial fleets, GPS, mobile devices and cameras. This data has been used to establish speed and travel time throughout the day in both directions on the corridor, which is as closely aligned to the A494 study corridor as possible.

INRIX A494 Corridor



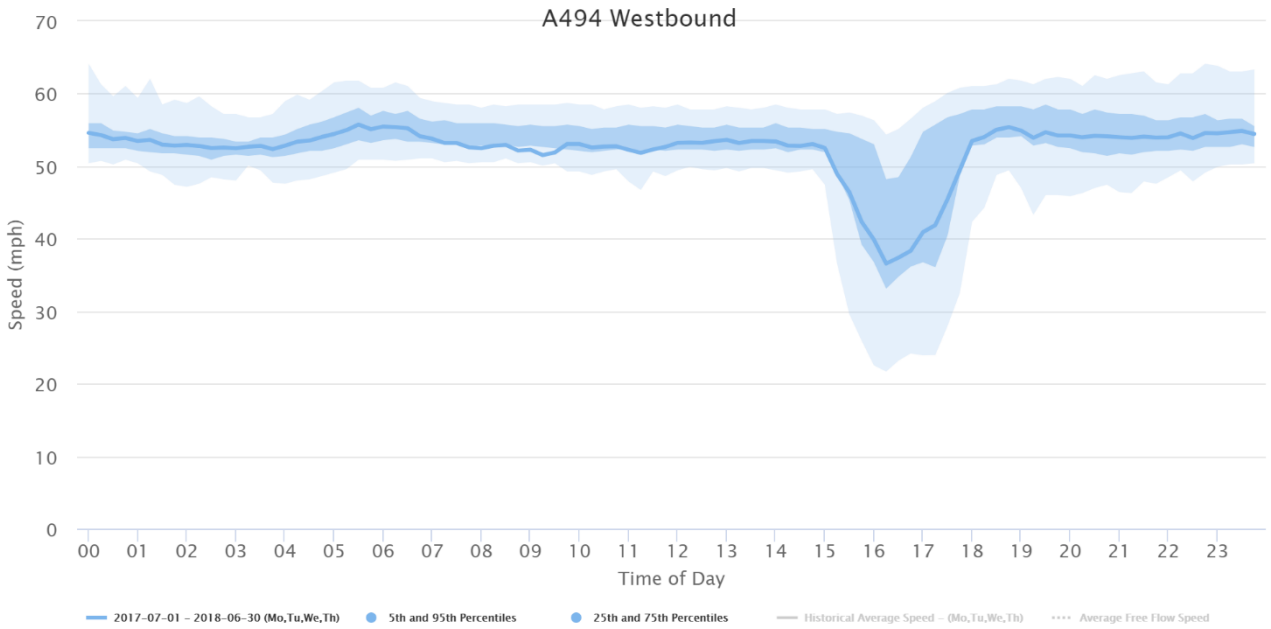
Speed data has been extracted for the A494 eastbound and westbound corridors for the period 1st July 2017 to 30th June 2018 (Monday-Thursday), as shown in Figure 1 and Figure 2, respectively.

Figure 1: A494 Eastbound Speeds (mph)



The data shows that speeds reduce for vehicles travelling eastbound during the AM peak period from approximately 06:30 to 09:00, with the lowest average speed of 46mph recorded at 07:45. There is no noticeable reduction in speeds during the PM peak, with speeds averaging approximately 55mph across all other times of the day.

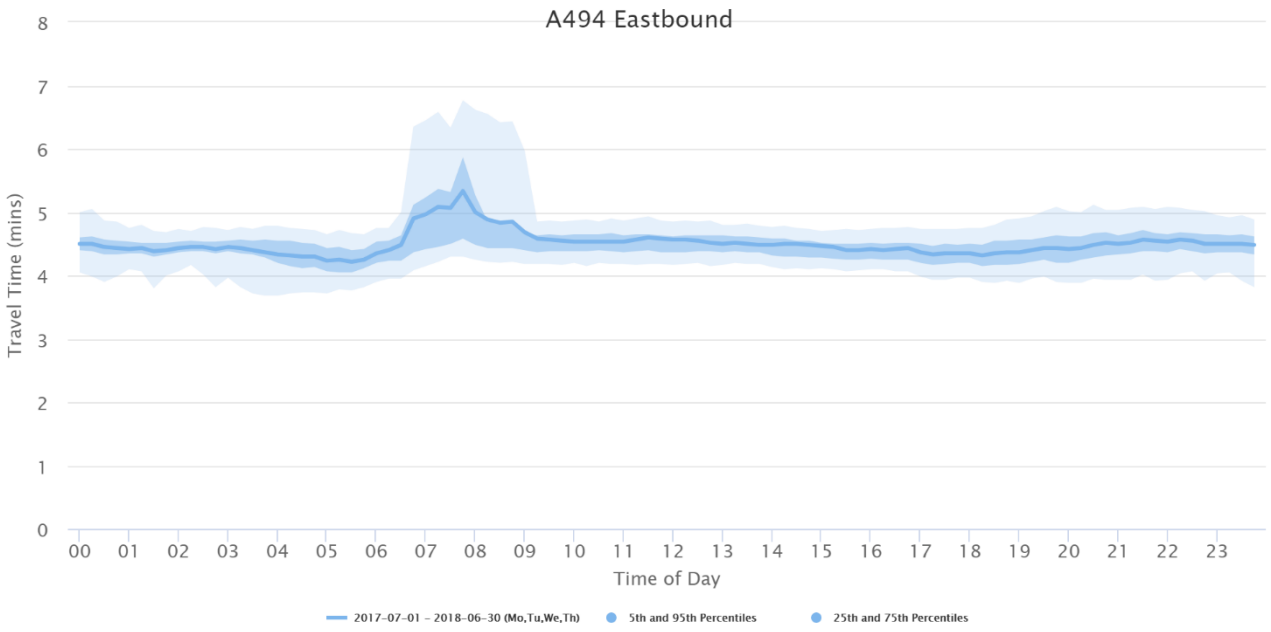
Figure 2: A494 Westbound Speeds (mph)



Conversely, speeds reduce for vehicles travelling westbound during the PM peak period from approximately 15:00 to 18:00, with the lowest average speed of 36mph recorded at 16:15. There is no noticeable reduction in speeds during the AM peak, with speeds averaging approximately 55mph across all other times of the day.

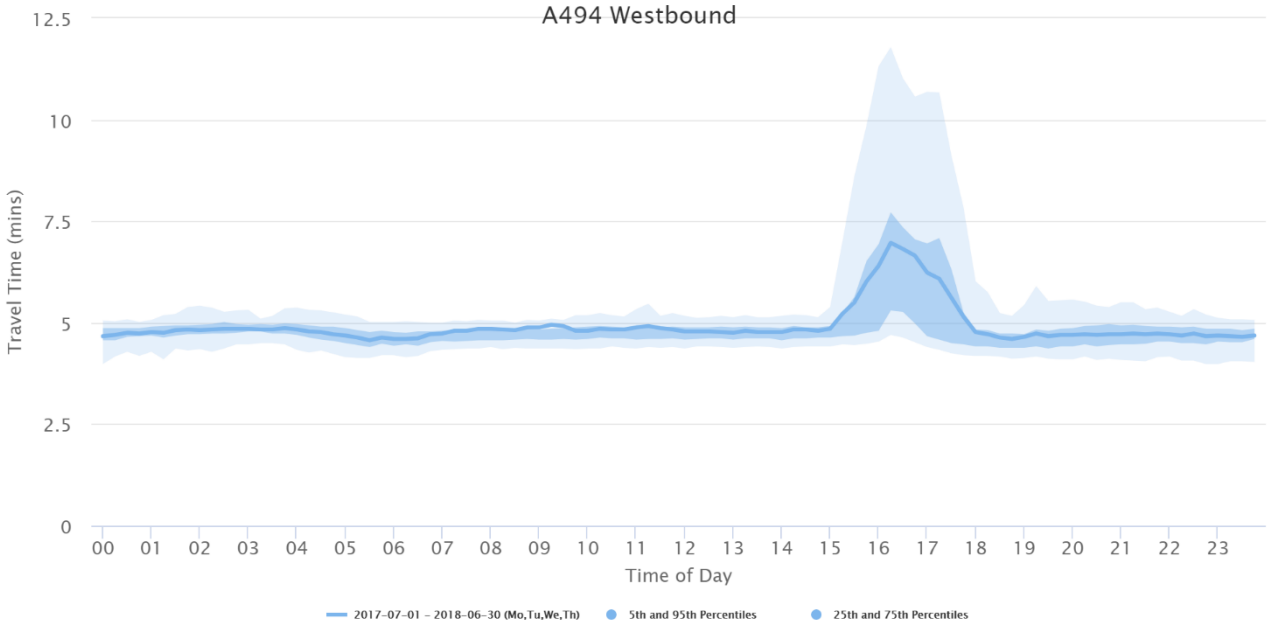
Travel times have also been extracted from INRIX for the A494 corridor for the same period, as shown in Figure 3 and Figure 4.

Figure 3: A494 Eastbound Travel Time (mins)



The travel time of the eastbound carriageway increases during the AM peak period, from an approximate free-flow time of 4 minutes 30 seconds to an average of 5 minutes 20 seconds at 07:45. Delay in this direction on this corridor can therefore be inferred as approximately 50 seconds during the AM peak.

Figure 4: A494 Westbound Travel Times (mins)



For the A494 westbound corridor, INRIX shows that free-flow travel time is approximately 5 minutes, which increases to 7 minutes at 16:15. Delay in this direction on this corridor can therefore be inferred as approximately 2 minutes during the PM peak.

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