



Welsh Government

A483 WREXHAM - 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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Consideration of Measures on the Welsh Government Motorway and Trunk Road Network for Nitrogen Dioxide Reduction

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WSP
1 Capital Quarter
Tyndall Street
Cardiff
CF10 4BZ
Phone: +44 2920 769 200

WSP.com

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Signature			
Checked by	Stephen Hayward	Stephen Hayward	
Signature			
Authorised by	Peter Evans	Peter Evans	
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 (NO₂).

In July 2017, the UK Government published its Air Quality Plan (the 2017 Plan) for tackling roadside NO₂ concentrations¹. 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 NO₂ 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 reports², 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 Three³. 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 NO₂ 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 NO₂ 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 A483 study corridor is located in North Wales to the west of Wrexham, which is part of the Wrexham County Borough. Wrexham is the largest town in the north of Wales, situated close to the Welsh/English borders to the south of Chester. At the 2011 Census, Wrexham had a population of 61,603, and is the fourth largest urban area in Wales.

The study corridor considered in this report covers the principal corridor on the A483 between J5 (Mold Road Interchange) to J6 (Gresford Interchange). This is shown in Figure 1.

Figure 1: The Study Corridor



The A483 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 NO₂ exceedances.

The study corridor is approximately 2.6km in length and has a north east to south west alignment. The A483 study corridor is a 2 lane all-purpose dual carriageway (D2AP).

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 NO₂ 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 19 measures for the A483 study corridor that were taken forward to Stage Two.

The WelTAG Stage Two appraisal examined in greater detail the short list of 19 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 12 measures that were considered to reduce NO₂ 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 A483 between Junction 5 (Mold Interchange) and Junction 6 (Gresford Interchange) and enforce through average speed cameras.
- **S16: Junction Closures:** implement a closure of the southbound off-slip at Junction 5 and the northbound on-slip at Junction 6.
- **S19: Variable Diversions:** implement advisory variable diversion routes for local traffic, utilising other routes including the A5152, through signage to reduce cars on the A483 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 A483 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.
- **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.

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 NO₂. 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 A483 study corridor between Junction 5 (Mold Interchange) and Junction 6 (Gresford Interchange), Wrexham.

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 NO₂ 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 policies.

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 A483 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	Junction Closures, 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 A483 has been derived from a combination of national modelling (the Pollution Climate Mapping – PCM – model) and monitoring undertaken by the local authority, Wrexham County Borough Council (WCBC) 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 NO₂ 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 NO₂ concentrations on the section of the A483 under consideration will reach compliance with air quality limit values in 2018 (i.e. projected concentrations at or below 40µg/m³).

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 NO₂ concentration and Defra's NO_x to NO₂ calculator (v6.1) to calculate the roadside contribution to NO_x concentrations and the level of emissions required to give a roadside concentration of 40µg/m³.

Table 2: Baseline PCM Predicted NO₂ Concentrations at Wrexham, without NO₂ reduction network measures (projections from 2017 Plan, July 2017)

Measure	2015	2017	2018	2019	2020	2021
A483 (ID 30560, Wrexham)	43.4	41.2	39.3	37.6	35.7	33.5
Approx. % Reduction in NO _x Emissions from Road Transport Required for Compliance	12%	4%	-	-	-	-

Local Authority Monitoring

The closest monitoring stations to the section of the A483 under consideration are locations 20 and 32 on Chester Road. Concentrations at these locations are well within the air quality objectives but the sites are too distant from the A483 to assess whether the PCM modelled concentrations are consistent with local monitoring.

The only location close to the A483 at which WCBC monitors air quality is location 30 (Rhostyllen Roundabout), where concentrations are just within the air quality objective. Whilst this monitoring location is at a junction (where concentrations are likely to be higher than on other sections of the road), the A483 is elevated at this location (which will lead to reduced contribution from the A483 in comparison to locations where the road is at grade). As such, it is concluded that concentrations at this location are consistent with the PCM modelled concentrations in Table 2, since a marginal exceedance of the objective is likely at 4m from the A483.

There is no consistent trend over time in the data.

Table 3: Monitored Annual Mean NO₂ concentrations alongside the A483 (µg/m³)

WCBC Location ID	Location	Distance to A483	Bias-adjusted Annual Mean		
			2014	2015	2016
19	Mold Road	>300m	21.6	20.1	21.4
20	Chester Road	90m	25.6	24.2	25.5
32	Chester Road	50m	27.6	25.7	29.1
30	Rhostyllen R'bout	7m	39.9	36.9	35.8

Welsh Government Indicative Monitoring

Welsh Government has commissioned air quality monitoring along the A483 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 a distance of between 2 and 15m from the side of the A483, at a height of approximately 2m above the carriageway.

Under the Ambient Air Quality Directive, the reference method for monitoring ambient NO₂ 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 Directive⁴ 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 roadside⁵.

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.

The monitored concentrations are generally higher than the PCM concentrations.

Table 4: Indicative diffusion tube monitoring (µg/m³)

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)
30560	5	43.4 – 67.8	50.2
<p>NOTE: Data are indicative only and should not be used to assess compliance with limit values</p> <p>(a) Locations considered were compliant with requirements of EU Directive Annex III on micro and macroscale siting of monitoring points</p> <p>(b) Bias adjusted using national factors provided by Defra (0.88); Annualised to 2017 using data from Wirral, Wigan and Stoke</p> <p>(c) Distance corrected using Defra's calculator</p>			

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

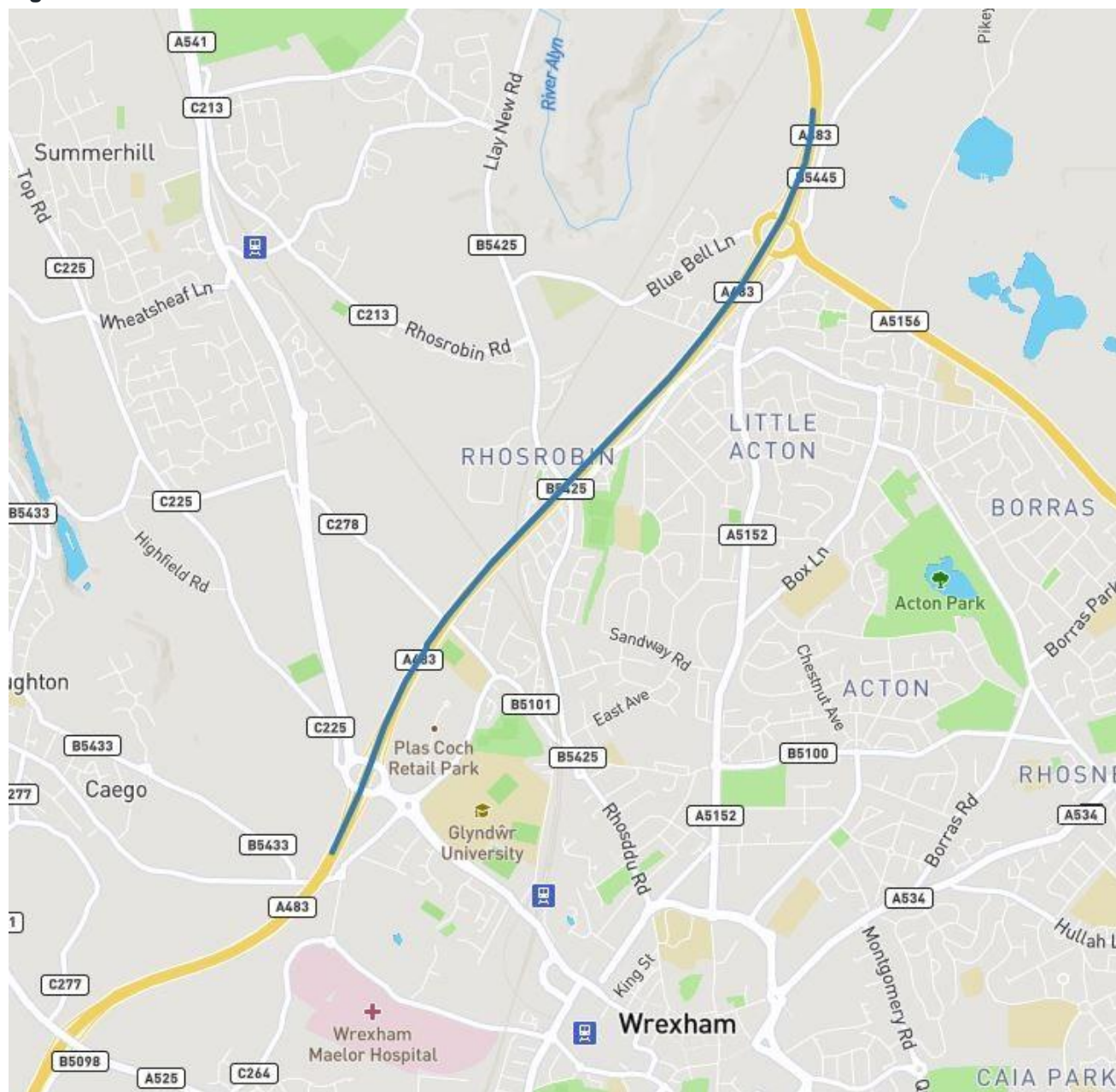
3.2 TRAFFIC BASELINE

An overview of the existing traffic flows and speeds along the A483 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 A483 study corridor as possible.

Figure 2: INRIX A483 Corridor



Speed data has been extracted for the A483 Southbound and Northbound corridors for the period 1st July 2017 to 30th June 2018 (Monday-Thursday). The data shows that speeds remain reasonably consistent throughout the day in both directions, with no noticeable reduction during either the AM or PM peak periods.

The average speeds observed on the Southbound corridor are approximately 62mph at 08:30, midday, and 17:00. Similarly, speeds on the Northbound carriageway are approximately 63mph at 08:30 and midday, and 66mph at 17:00. The data suggests that the road is free-flow throughout the day.

The data shows that speeds reduce during the off-peak period, with average speeds reducing to around 57mph on the Southbound and 56mph on the Northbound corridor. The fastest speeds occur following the PM peak hour, with vehicles averaging around 66mph at approximately 18:00 in both directions.

Travel times have also been extracted from INRIX for the A483 corridor for the same period. Average travel time along the Southbound corridor varies between 2 minutes 1 second at 18:30 and 2 minutes 20 seconds at 23:45. This shows that the route has good journey time reliability, with minimal delays throughout the day.

As with the Southbound corridor, average travel times on the Northbound corridor are consistent throughout the day, varying between 1 minute 53 seconds at 18:00 and 2 minutes 15 seconds at 02:00. The INRIX data shows that minimal delays are experienced during the off-peak period.

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	Junction Closures, plus 50mph Speed Limit	Modelled (AM and PM peak hours)*	Not Modelled
004	Variable Diversions, plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)

* Traffic modelling of junction closures shows insufficient network capacity. Closure of the J6 southbound on-slip and J5 northbound on-slip causes considerable queues which block back onto the mainline. This is considered an unacceptable safety risk and therefore the measure has not been progressed. No Air Quality modelling has been undertaken on this basis.

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/m³. 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 A483 study corridor, utilising demand data from LinSig junction models of J5 and J6 prepared by Mott MacDonald for the Wrexham County Borough Council. The model was calibrated and 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 from the model (across 97 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 A483 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 A483 study corridor (Figure 1) with the impacts of measures on emissions and roadside NO₂ 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 are 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/m³.

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
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 A483 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 use of property counts along potentially affected offline routes i.e. A5152 (Ffordd Caer/Chester Road) into Wrexham and review of local authority monitoring

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 as a £/µg reduction in NO₂ 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 NO₂ 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/m³ 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 NO₂ emissions to air

This is a qualitative appraisal based on the likelihood of overall reduction to NO₂ resulting from the measure. This will enable the differentiation of measures which simply redistribute the impacts rather than seeking to reduce overall NO₂ 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 NO₂ in non-compliant areas as quickly as possible on PCM links within the A483 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 NO₂ in non-compliant areas, or
- a) 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 NO₂ concentrations, the measure has been classed as **likely** to bring forward compliance or, depending on the PCM concentration, to reduce exposure to NO₂ alongside the PCM link as quickly as possible. This judgement is based on the measure's impact on NO₂ 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 NO₂ concentrations (classed as **unlikely** to reduce NO₂ 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 NO₂ 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/m³ or 45µg/m³ 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 NO₂ 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 NO₂ concentrations respectively on PCM Link 30560.

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 30560 due to the optimisation of emissions from light duty vehicles at speeds close to 50mph.

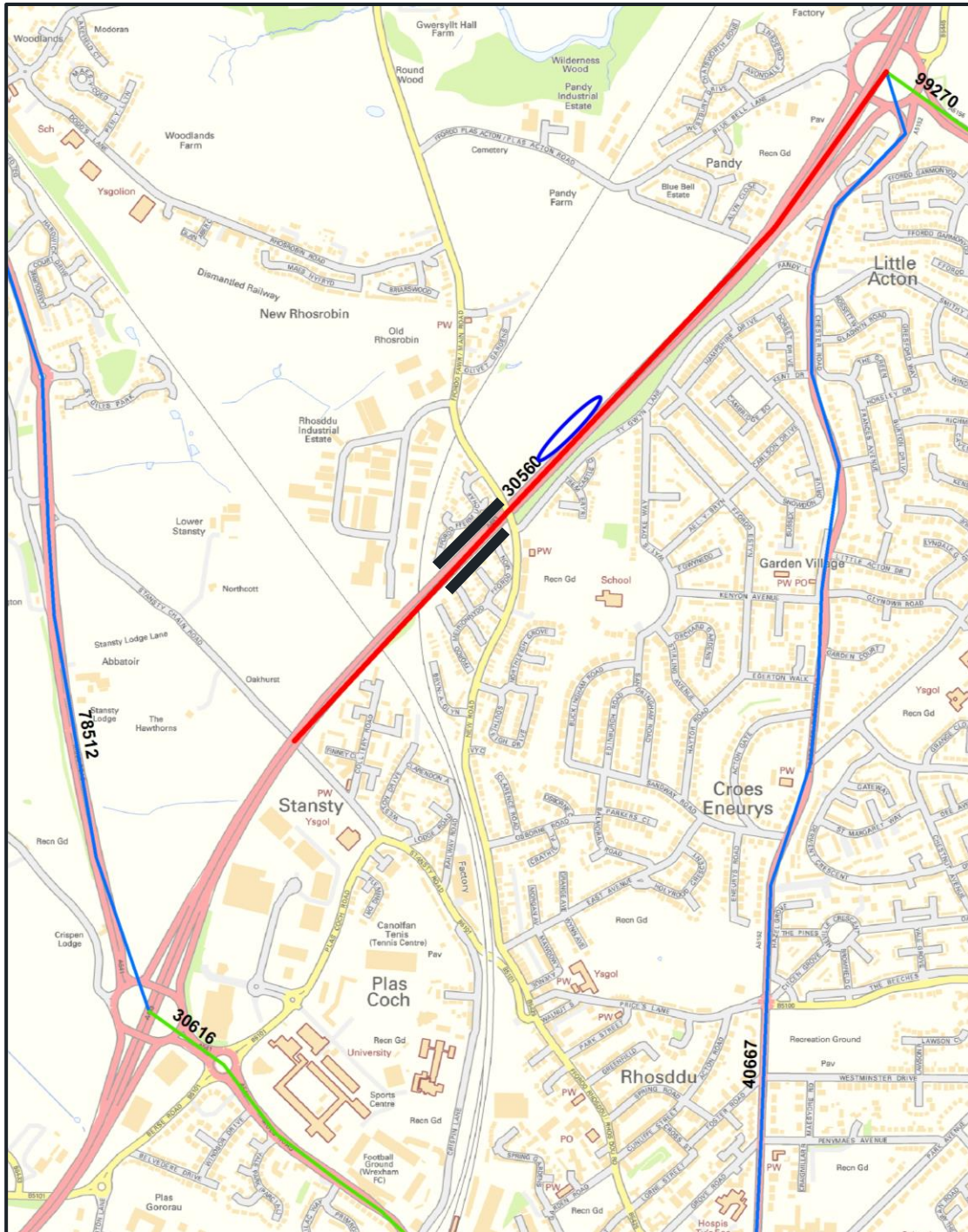
The variable diversion measure (packaged with 50mph speed limit) provides negligible beneficial impacts on the A483 mainline over and above that expected from the imposition of the speed limit alone and potentially results in a net increase in exposure to air pollution due to the greater numbers of receptors (properties) lying in proximity to the principal alternative route (A5152, Chester Road) than to the PCM Link. The measure is therefore discounted on account of it being **unlikely** to bring forward compliance with limit values (whether or not compliance is delayed beyond PCM timescales).

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 A483 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. The identified location has an existing vegetation screen and it is recommended that monitoring is undertaken to establish whether the existing vegetation is already providing the benefits of an air quality barrier prior to implementation. Retention of the existing green barrier would be preferable to the installation of new infrastructure.

Figure 3: Potential Air Quality Barrier Locations



Black markers indicate potential location of barriers

Table 7: Impact of measures on annual vehicle emissions on PCM Link 30560

ID	Measure	Emissions Reduction* Link 30560	Commentary on Impact (First Year of Implementation)
001	Enforce / Reduce Speed Limit (50mph)	13%	Typical speed on link is 55 – 65mph across all periods of day. No reduction in 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)
004	Variable Diversions, plus 50mph Speed Limit	14%	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, $\mu\text{g}/\text{m}^3$)

Measure	Impact *	2017	2018	2019	2020	2021	2022
<i>PCM Link 30560</i>							
Baseline		41.2	39.3	37.6	35.7	33.5	31.4
001 Speed Limit (SL)	-4.3	36.8	35.2	33.6	31.9	29.9	28.1
004 SL + Variable Diversions	-4.2			33.4	31.7	29.7	27.9
002 SL + Air Quality Barriers	-5.6					27.9	26.1

* $\mu\text{g}/\text{m}^3$ 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

Appraisal Summary Table

Measure No. 001

Name of measure:		Enforce/Reduce Speed Limit
Location:		A483
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 A483 trunk road between Junction 5 and Junction 6, Wrexham County Borough. The intention is that lower speed limits will reduce vehicle emissions and improve air quality, aiding compliance with NO ₂ limits set out in legislation. If successful in reducing NO ₂ levels, arrangements will be made to make the speed limits permanent.
Key Criteria	Effectiveness:	Roadside concentrations reduced by up to 4.3µg/m ³
	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 13%; Roadside concentrations reduced by up to 4.3µg/m ³ , which is 11% of the limit value.	Large Beneficial
	Noise	There are no noise impact areas within 1km of the study corridor. The A483 runs along the outskirts of Wrexham adjacent to sensitive receptors including residential housing, schools, hospitals and the university. 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 no Conservation Areas within 1km of A483 between J5 and J6, nor are there any Historic Parks and Gardens. Wat's Dyke a scheduled ancient monument is located to the northern extent of the study corridor with Wat's Dyke garden village section located between the two junctions. Several listed buildings are located within 1km of the study corridor in both directions. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There is one SSSI site within 1km of the study corridor called Gatewen Marsh at the southern extent of the scheme with Chwarel Singret and Marford Quarry SSSI located at the northern extent of the scheme. There are no SPA, SAC or RAMSAR Sites within 1km of the study corridor. 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 Gwenfro is located 500m north of J4 along with an unnamed stream located south of J5. 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	There are no conservation areas located within 1km of the study corridor, although there are several listed buildings located within 1km in both directions. 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 65 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	£275k. 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 (although mainline enforcement only may be appropriate) 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.	£275,000
VfM	Value For Money	Reducing the speed limit to 50mph will reduce the roadside concentrations by up to 4.3µg/m ³ , at a cost of £275,000. This measure will therefore be a cost of approximately £65,000/µg.	£65,000/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO ₂ 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 A483 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.	

Appraisal Summary Table

Measure No. 002

Name of measure:		Enforce/Reduce Speed Limit + Air Quality Barriers
Location:		A483
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.
Key Criteria	Effectiveness:	Roadside concentrations reduced by up to 5.6µg/m3
	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 A483 reduced by up to 5.6µg/m3, which is 14% of the limit value.	Large Beneficial
	Noise	There are no noise impact areas within 1km of the study corridor. The A483 runs along the outskirts of Wrexham adjacent to sensitive receptors including residential housing, schools, hospitals and the university. 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 no Conservation Areas within 1km of A483 between J5 and J6, nor are there any Historic Parks and Gardens. Wat's Dyke a scheduled ancient monument is located to the northern extent of the study corridor with Wat's Dyke garden village section located between the two junctions. Several listed buildings are located within 1km of the study corridor in both directions. The installation of barriers is considered to have a slight adverse impact on the setting of listed buildings.	Slight Adverse
	Biodiversity	There is one SSSI site within 1km of the study corridor called Gatewen Marsh at the southern extent of the scheme with Chwael Singret and Marford Quarry SSSI located at the northern extent of the scheme. There are no SPA, SAC or RAMSAR Sites within 1km of the study corridor. 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 Gwenfro is located 500m north of J4 along with an unnamed stream located south of J5. 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	There are no conservation areas located within 1km of the study corridor, although there are several listed buildings located within 1km in both directions. The installation of barriers is unlikely to generate significant townscape impacts.	Neutral
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	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £30m for barriers, which could be provided along many sections between Junctions 5 and 6, although there are 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.	£30,275,000
VfM	Value For Money	Reducing the speed limit to 50mph and installing air quality barriers will reduce the roadside concentrations by up to 5.6µg/m3, at a combined cost of £30.3m. This measure will therefore be a cost of approximately 5.4m/µg.	£5.4m/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 A483 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	This measure is less likely to receive opposition, as no properties are close to this section of A483 and there are no nearby visible businesses.	
	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.	

Appraisal Summary Table

Measure No. 004

Name of measure:		Enforce/Reduce Speed Limit + Variable Diversions
Location:		A483
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 for local traffic, utilising other routes including the A5152, through signage to reduce cars from the A483 study corridor in the AM and PM peak hours (using continuous monitoring equipment).
Key Criteria	Effectiveness:	Roadside concentrations reduced by up to 4.2µg/m ³
	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. The addition of variable diversions further reduces emissions on the A483 study corridor in the peak hours only by removing traffic from the link. The measure will increase flows on other roads, such as the A5152, which is closer to a significant number of receptors, therefore has the potential to increase human exposure to NO2. Emissions reduced by up to 14%; Roadside pollutant concentrations on the A483 reduced by up to 4.2µg/m ³ , which is 11% of the limit value.	Large Beneficial
	Noise	There are no noise impact areas within 1km of the study corridor. The A483 runs along the outskirts of Wrexham adjacent to sensitive receptors including residential housing, schools, hospitals and the university. With the variable diversions, the traffic would be displaced onto other strategic 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 no Conservation Areas within 1km of A483 between J5 and J6, nor are there any Historic Parks and Gardens. Wat's Dyke a scheduled ancient monument is located to the northern extent of the study corridor with Wat's Dyke garden village section located between the two junctions. Several listed buildings are located within 1km of the study corridor in both directions. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There is one SSSI site within 1km of the study corridor called Gatewen Marsh at the southern extent of the scheme with Chwarel Singret and Marford Quarry SSSI located at the northern extent of the scheme. There are no SPA, SAC or RAMSAR Sites within 1km of the study corridor. 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 Gwenfro is located 500m north of J4 along with an unnamed stream located south of J5. 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	There are no conservation areas located within 1km of the study corridor, although there are several listed buildings located within 1km in both directions. The variable diversions through Wrexham will increase traffic flows through the town; however, this is unlikely to generate any significant impact 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 local 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 A483 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	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £6m for variable diversions. Wrexham CBC may have concerns over using alternative routes during periods when NO2 levels are highest, as the A5152 and A541 Mold Road run towards and through the town centre. 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 prescribed 'diversion' route.	£6,275,000
VfM	Value For Money	Reducing the speed limit to 50mph and implementing variable diversions will reduce the roadside concentrations by up to 4.2µg/m ³ , at a combined cost of £6.3m. This measure will therefore be a cost of approximately £1.5m/µg.	£1.5m/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 local roads between routes of equivalent or longer length. Reducing the speed limit will reduce emissions and the diversions will result in further minor reductions in emissions on the A483, but the latter will be offset by the increase on local 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 with reductions in exposure to pollution on the A483 potentially more than offset by increases in exposure on local roads.	
Other Issues	Acceptability	Given the nature of the proposals, this measure is anticipated 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	Displacement of traffic onto local roads would require collaboration with the local authority.	

Table 9: Summary of WeITAG Stage Three Appraisals

Measures	Key Criteria			Environment							Social and Cultural			Economy			VfM	Outcome
	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	
001: Enforce / Reduce Speed Limit (50mph)	✓	✓	✓	+3	+1	0	0	0	0	0	+1	+1	0	-1	0	£275,000	£65,000/µg	Likely Measure
002: Air Quality Barriers, plus 50mph Speed Limit	✓	=	=	+3	+2	-1	-1	-1	0	0	0	+1	0	-1	0	£30,275,000	£5.4m/µg	Precautionary Retained Measure
004: Variable Diversions, plus 50mph Speed Limit	✗	✓	=	+3	+1	0	0	0	0	0	-1	+1	0	-1	0	£6,275,000	£1.5m/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 A483. 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 or their unintended adverse consequences.

004 – Variable Diversions, plus 50mph Speed Limit – Fails on effectiveness.

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 A483 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, including monitoring of the impact of the existing vegetation screening, until such time as the links become compliant or the retained measure is implemented:

002 - Air Quality Barriers, plus 50mph Speed Limit – One stretch of the A483 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 £275,000. 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 NO₂ 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 (NO₂) 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 A483 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 A483 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 A483 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:

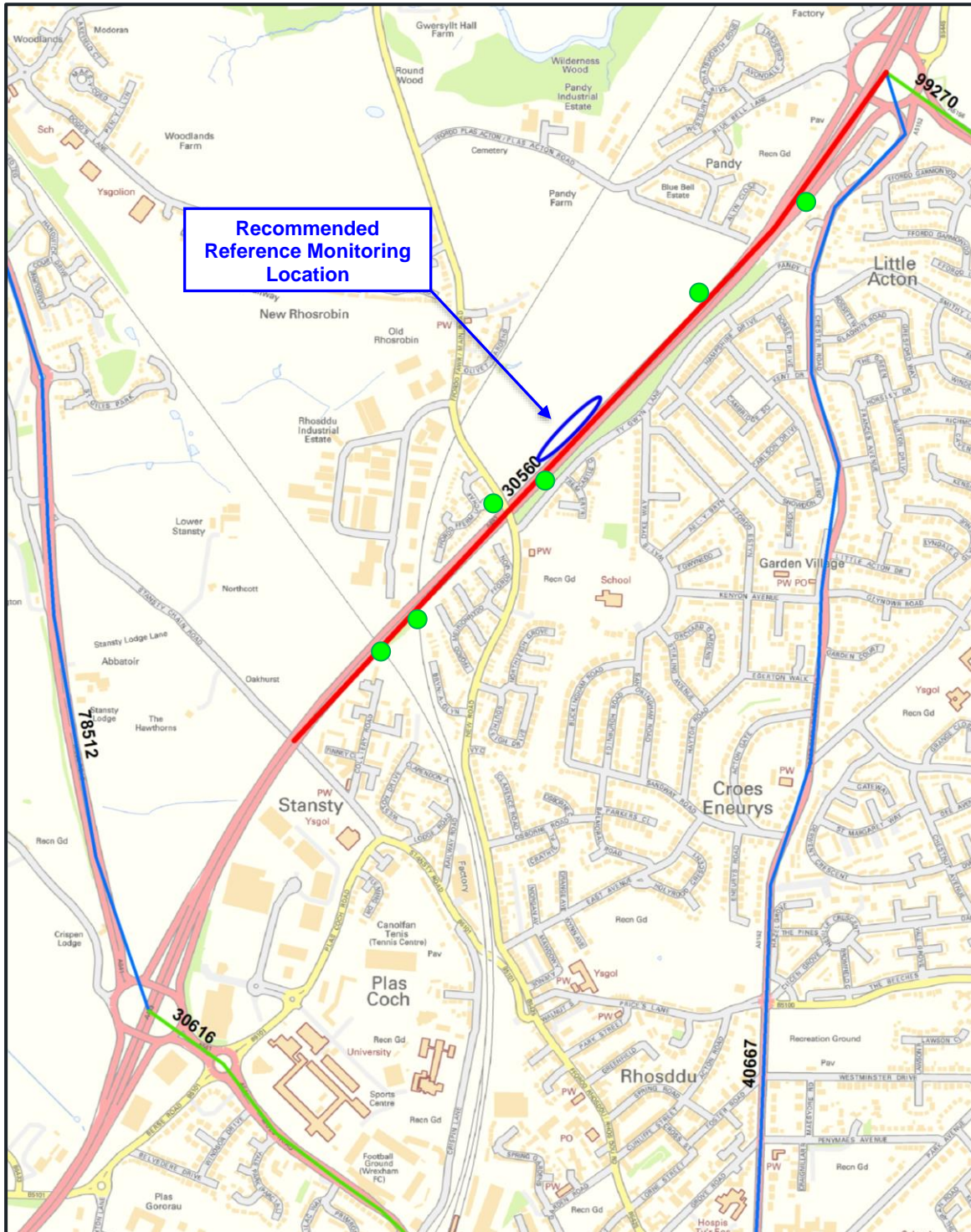
Sampling should be directed at locations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value (Para B.1a)

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 6 sites: 2 locations on the A483 to the south of, but within 1km of, the PCM link 30560; 2 locations on the A483 to the north of, but within 1km of, the PCM Link 30560, and 2 sites that lie on the population side of the vegetation screening near the proposed locations for barriers. 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 A483 lies within the North Wales zone for the purpose of the assessment of compliance with the EU Air Quality Directive. The national assessment¹ of roadside NO₂ 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 J34 (Ewloe) of the A55 and the Welsh/English borders. The section of the A483 under consideration in this study is expected to have achieved compliance in 2018.

This report has presented the Stage Three: Full Business Case of the WelTAG process for reducing the levels of NO₂ on the A483 dual carriageway network in North East Wales. Elevated concentrations of NO₂ on this study corridor are due to a combination of high traffic volumes.

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
004: Variable Diversions, plus 50mph Speed Limit	Unlikely Measure

8.2 PREFERRED MEASURES

8.2.1 LIKELY MEASURES

For the A483 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 A483. 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 A483 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 Barriers 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.

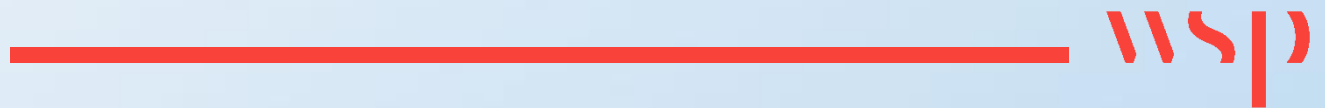


A Wales of vibrant culture and thriving Welsh language: A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.

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



2018 No. (W.)

ROAD TRAFFIC, WALES

The A483 Trunk Road (Junction 5
(Mold Road Interchange) to
Junction 6 (Gresford Interchange),
Wrexham County Borough)
(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 A483 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 A483 Trunk Road (Junction 5 (Mold Road Interchange) to Junction 6 (Gresford Interchange), Wrexham County Borough) (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 A483 Swansea to Manchester 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 Junction 5 (Mold Road Interchange) to the centre-point of Junction 6 (Gresford Interchange), Wrexham County Borough.

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

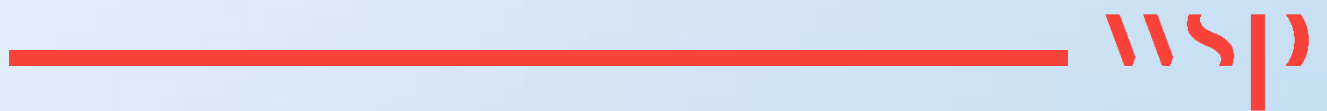
14 June 2018

Richard Morgan

Head of Planning, Asset Management and Standards
Welsh Government

Appendix C

INRIX TRAFFIC DATA

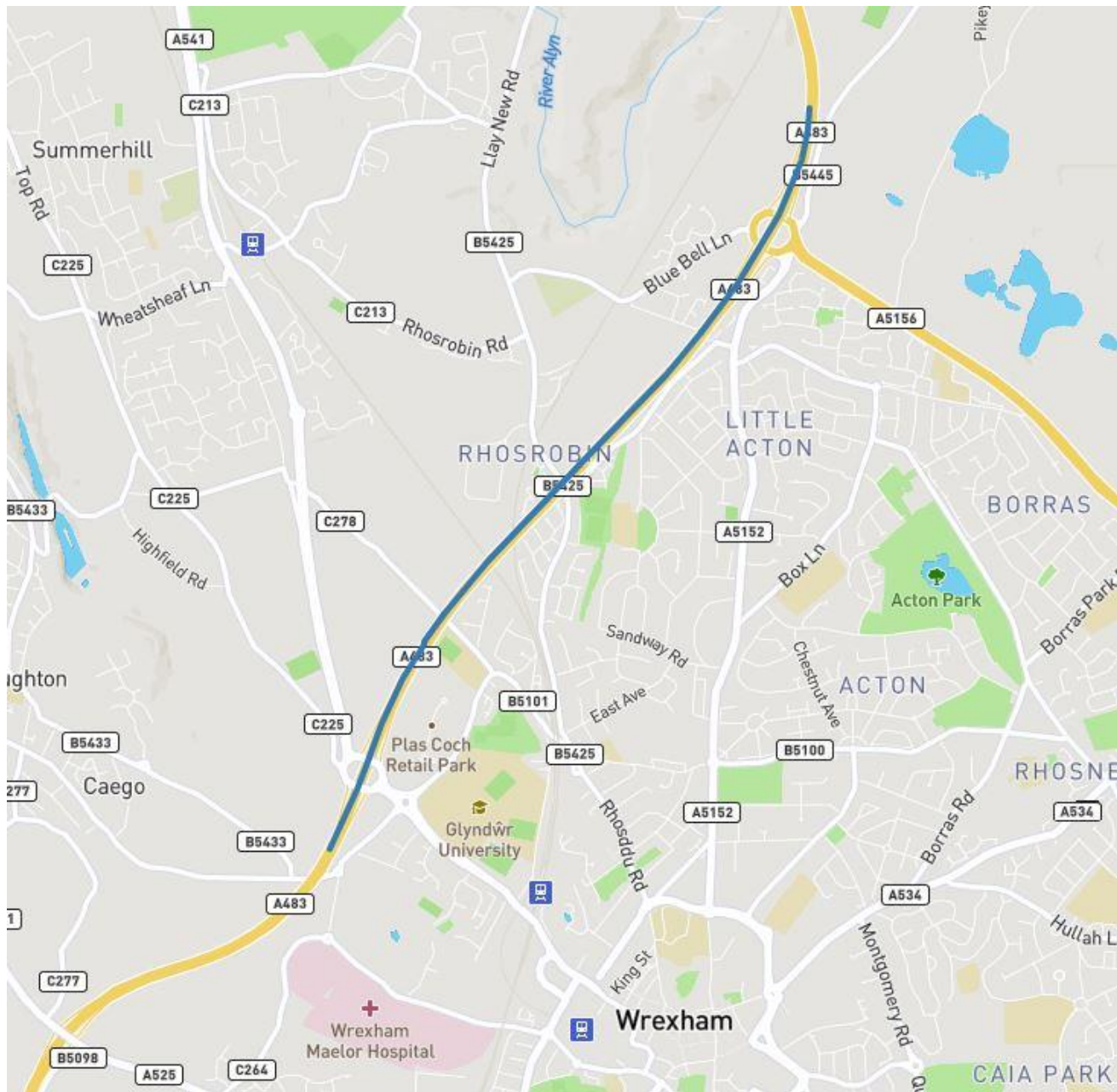


INRIX – TRAFFIC SPEED DATA

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 A483 study corridor as possible.

INRIX A483 Corridor



Speed data has been extracted for the A483 Southbound and Northbound corridors for the period 1st July 2017 to 30th June 2018 (Monday-Thursday), as shown in Figure 1 and Figure 2, respectively.



Figure 1: A483 Southbound Speeds (mph)

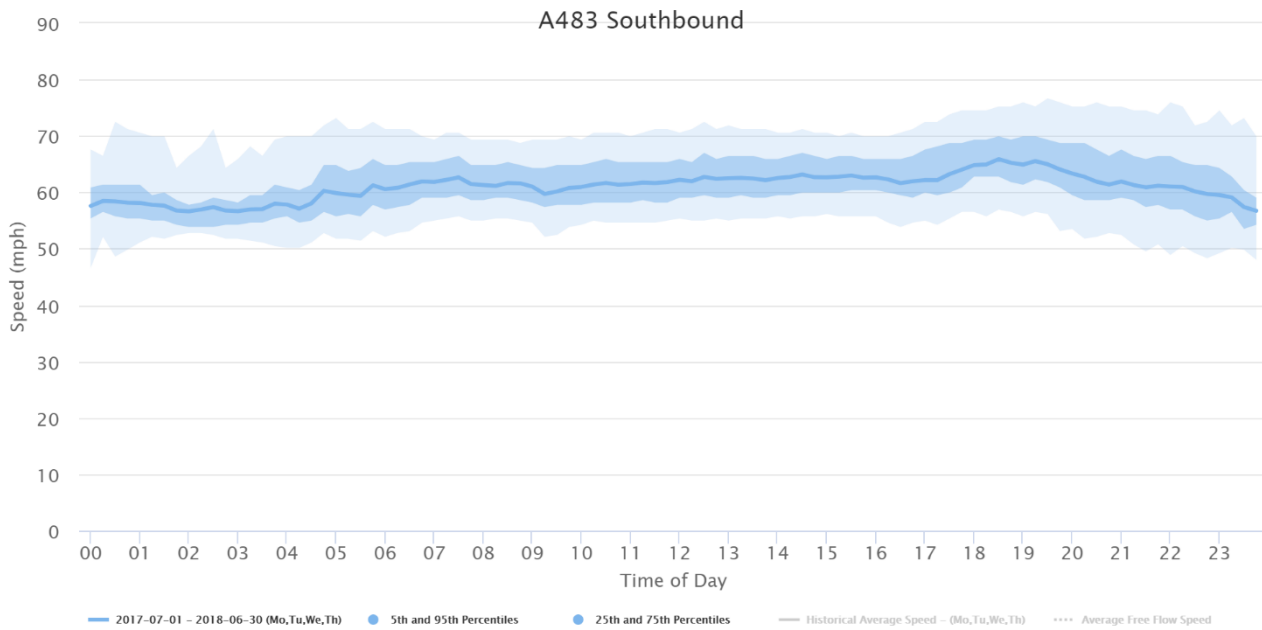
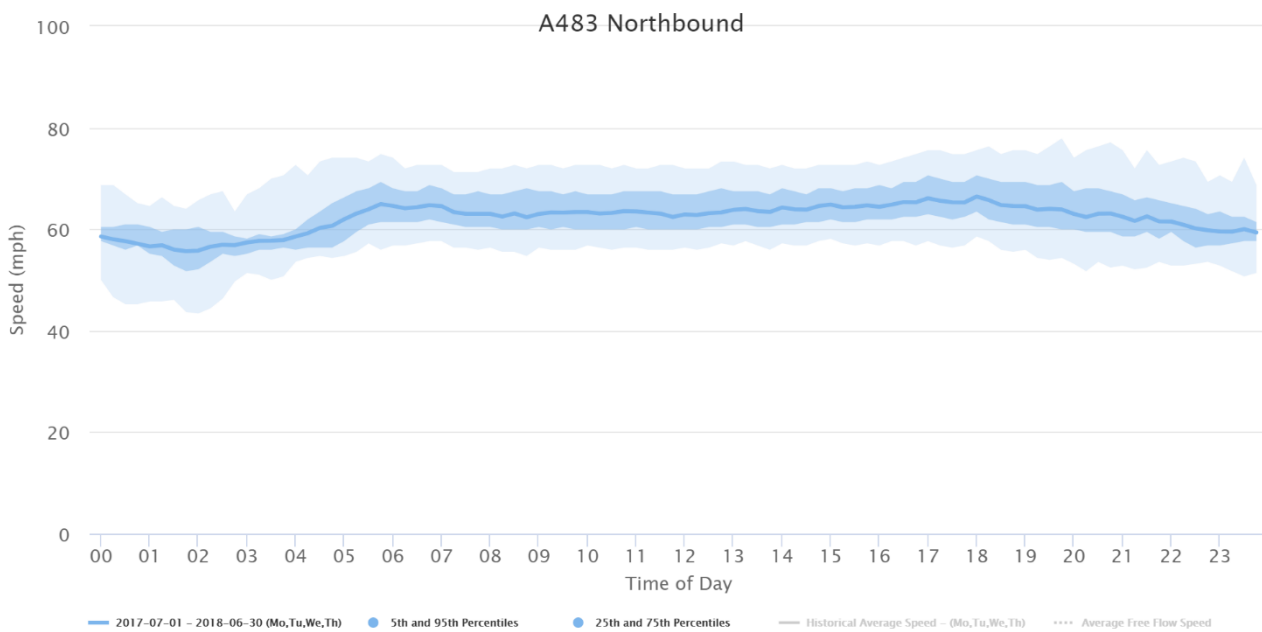


Figure 2: A483 Northbound Speeds (mph)



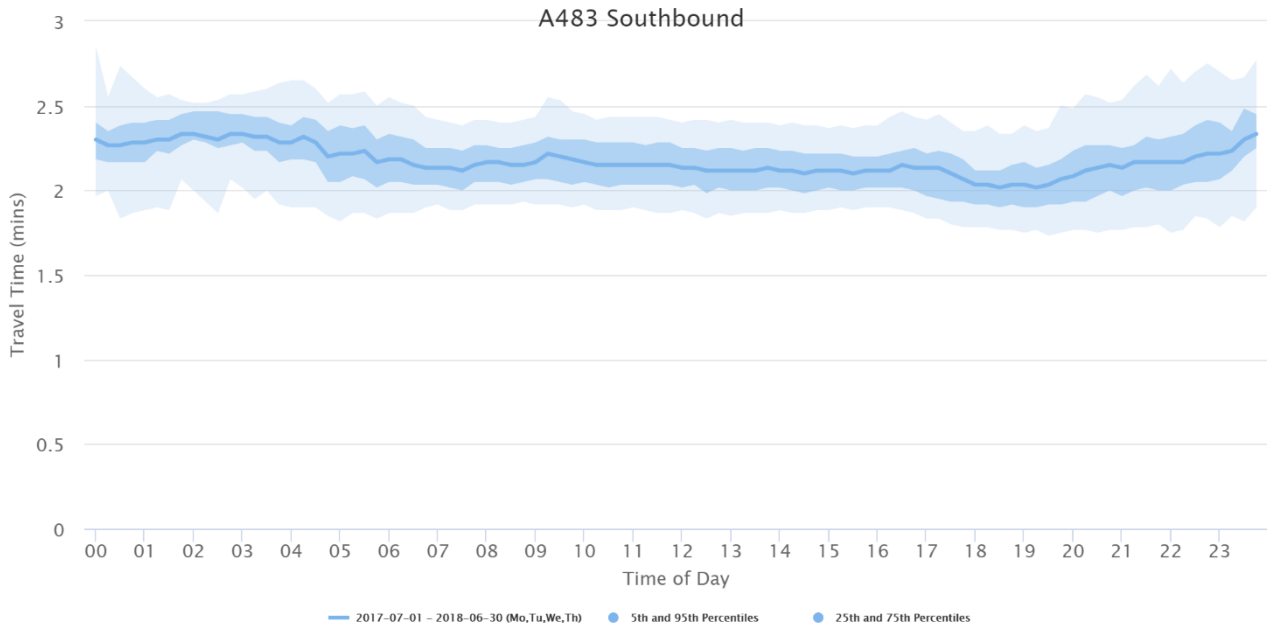
This data shows that speeds remain reasonably consistent throughout the day in both directions, with no noticeable reduction during either the AM or PM peak periods.

The average speeds observed on the Southbound corridor are approximately 62mph at 08:30, midday, and 17:00. Similarly, speeds on the Northbound carriageway are approximately 63mph at 08:30 and midday, and 66mph at 17:00. This data suggests that the road is free-flow throughout the day.

Speeds are shown to reduce during the off-peak period, with average speeds reducing to around 57mph on the Southbound and 56mph on the Northbound corridor. The fastest speeds occur following the PM peak hour, with vehicles averaging around 66mph at approximately 18:00 in both directions.

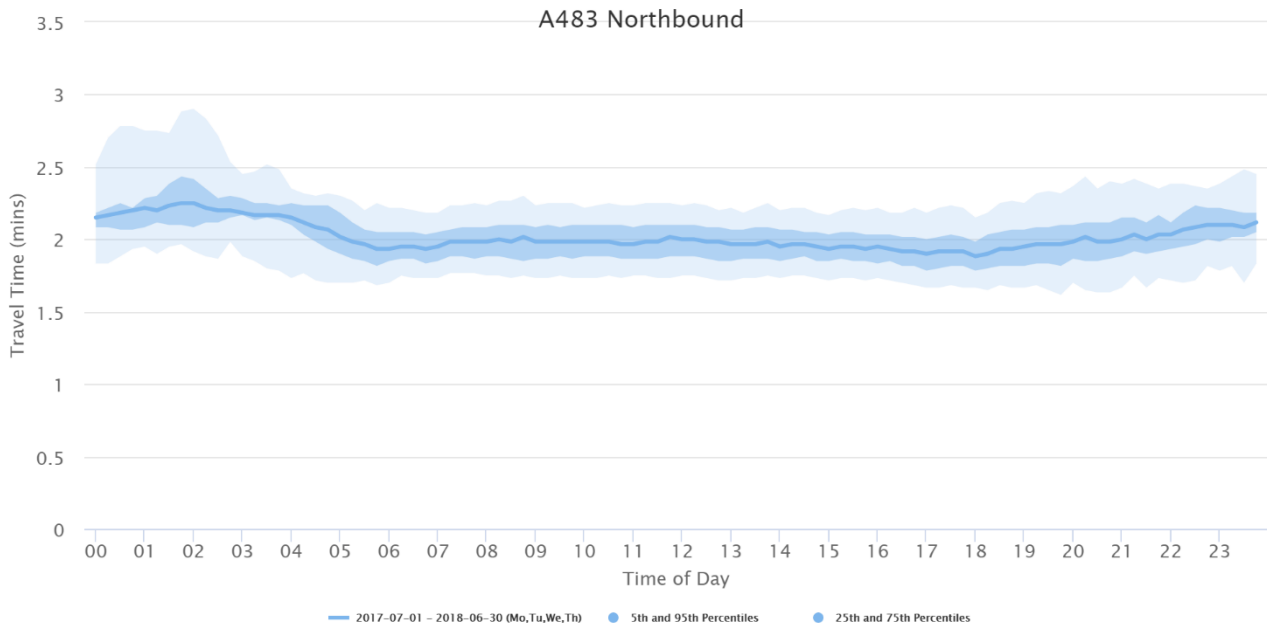
Travel times have also been extracted from INRIX for the A483 corridor for the same period, as shown in Figure 3 and Figure 4.

Figure 3: A483 Southbound Travel Time (mins)



Average travel time along the Southbound corridor varies between 2 minutes 1 second at 18:30 and 2 minutes 20 seconds at 23:45. This shows that the route has good journey time reliability, with minimal delays throughout the day.

Figure 4: A483 Northbound Travel Time (mins)



As with the Southbound corridor, average travel times on the Northbound corridor are consistent throughout the day, varying between 1 minute 53 seconds at 18:00 and 2 minutes 15 seconds at 02: The INRIX data shows that minimal delays are experienced during the off-peak period.



1 Capital Quarter
Tyndall Street
Cardiff
CF10 4BZ

wsp.com