



Welsh Government

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# A470 PONTYPRIDD - 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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## **A470 PONTYPRIDD - WELTAG STAGE THREE REPORT**

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

**FINAL PUBLIC**

**PROJECT NO. 70045408  
OUR REF. NO. 70045408**

**DATE: SEPTEMBER 2018**




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# QUALITY CONTROL

Issue/ revision	First issue	Revision 1	Revision 2
Remarks			
Date	04 Sept 2018	11 Sept 2018	14 Sept 2018
Prepared by	Alison Simpson / Bethan Tuckett-Jones	Alison Simpson / Bethan Tuckett-Jones	Alison Simpson / Bethan Tuckett-Jones
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Signature			
Project number	70045408	70045408	70045408
Report number	70045408-03	70045408-03	70045408-03
File reference	A	A	A



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# 1 INTRODUCTION

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## 1.1 CONTEXT

The European Union Ambient Air Quality Directive (2008/50/EC) sets legally binding limits for concentrations of certain air pollutants in outdoor air, termed 'limit values'. The Directive requires that Member States report annually on air quality within zones designated under the Directive and, where the concentration of pollutants in air exceeds limit values, to develop air quality plans that set out measures in order to attain the limit values. The only limit values that the UK currently fails to meet are those set in respect of nitrogen dioxide (NO<sub>2</sub>).

In July 2017, the UK Government published its Air Quality Plan (the 2017 Plan) for tackling roadside NO<sub>2</sub> concentrations<sup>1</sup>. The 2017 Plan set out details of the authorities responsible for delivering air quality improvements including devolved administrations and Local Authorities.

Wales is divided into 4 zones under the Directive:

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

WSP have been commissioned by Welsh Government (WG) to undertake a WelTAG Stage One (Strategic Outline Case), Two (Outline Business Case), and Three (Full Business Case) appraisals of potential Network Management measures for reducing NO<sub>2</sub> levels arising from traffic emissions at five separate locations on the Welsh Strategic Road Network (SRN). The five locations (and their respective zones) are:

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

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

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

## 1.2 APPROACH

The Stage One and Two WelTAG reports were undertaken in accordance with the 2017 Consultation Draft WelTAG guidance published in autumn 2016. In December 2017, WG published the final revised WelTAG 2017 which will be applied to activities associated with Stage Three<sup>3</sup>. 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.

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<sup>1</sup> 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](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633269/air-quality-plan-overview.pdf)

<sup>2</sup> Tackling roadside nitrogen dioxide concentrations in Wales; Available at: <https://beta.gov.wales/tackling-roadside-nitrogen-dioxide-concentrations-wales>

<sup>3</sup> WelTAG 2017 (December 2017), WG; Available at: <https://beta.gov.wales/sites/default/files/publications/2017-12/welsh-transport-appraisal-guidance.pdf>

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

**The objective of this study is to identify potential network management measures which will assist in bringing forward reductions in NO<sub>2</sub> in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements in five locations on the Welsh SRN listed above.**

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

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

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

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

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

## 1.3 REPORT STRUCTURE

The structure of this Stage Three report is as follows:

### **Chapter 2: Strategic case**

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

### **Chapter 3: Transport case**

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

### **Chapter 4: Financial case**

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

### **Chapter 5: Commercial case**

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

### **Chapter 6: Management case**

This chapter identifies the delivery arrangements of the likely measures and then its management during its life time.

The conclusion of this Stage Three report identifies the likely measures that will be implemented to bring forward reductions in NO<sub>2</sub> 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’.

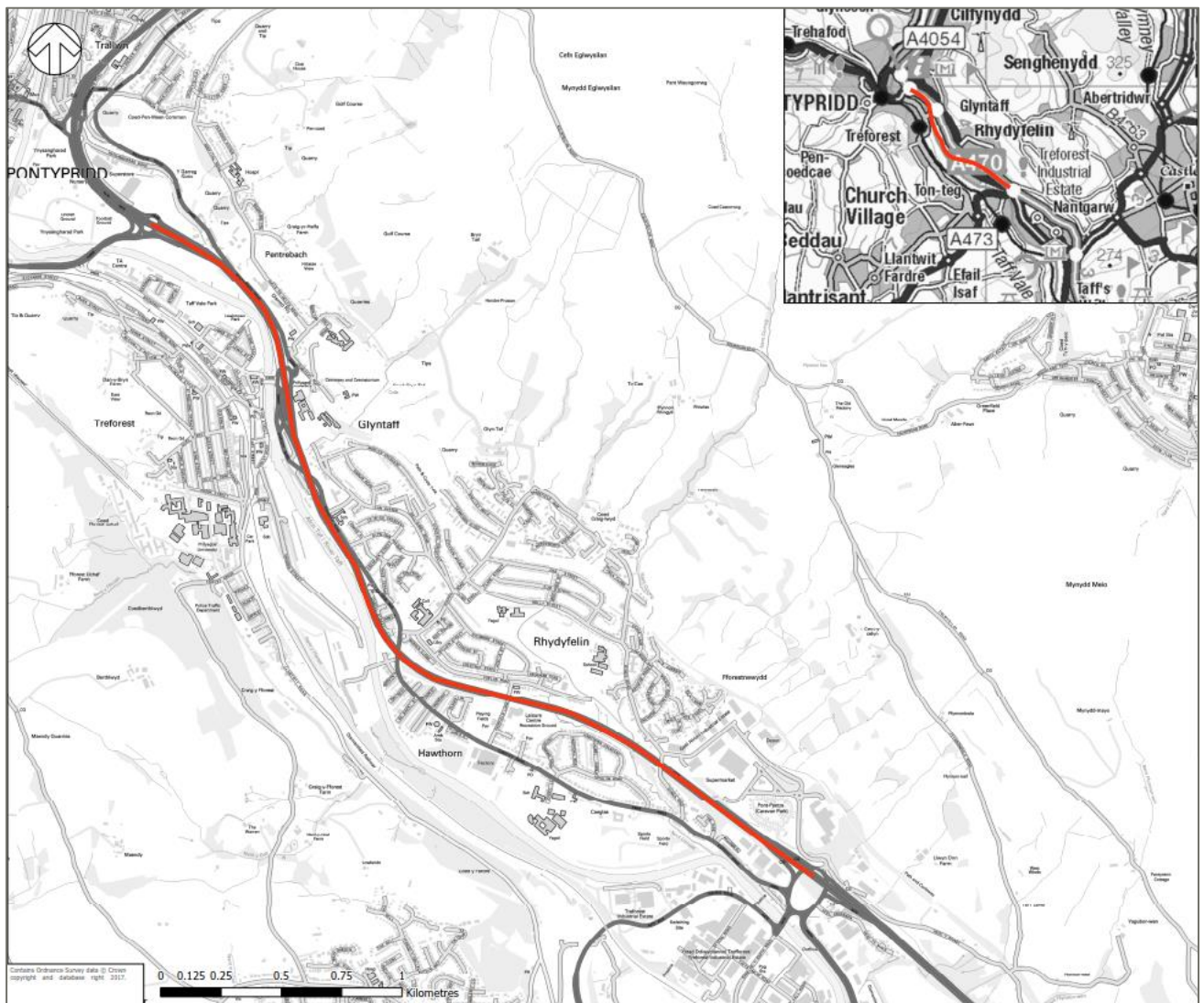
WelTAG Stages One and Two of this study were finalised in January/February 2018 and include a complete Strategic Case. This Stage Three report therefore provides additional and updated information where relevant, and is intended to be read in conjunction with the previous reports.

### 2.2 STUDY CORRIDOR

The A470 study corridor is from Upper Boat to Pontypridd in South Wales, to the north of J32 of the M4 motorway. The area is interspersed by towns and villages including Rhydfelin and Treforest, and is situated within the Taf Valley.

The study corridor considered in this report covers the principal corridor on the A470 between the A4054 Roundabout at The Upper Boat Inn to the A4058 Roundabout at Bridge Street Interchange in Pontypridd, South Wales. This is shown in Figure 1.

**Figure 1: The Study Corridor**



The A470 study corridor assumed for the purposes of this WelTAG study is centred on, but not limited to, the road links within Defra's Pollution Climate Mapping (PCM) model that have shown an exceedance in limit values. This acknowledges that the measures and their subsequent impacts may be realised beyond the identified area with NO<sub>2</sub> exceedances.

The study corridor is approximately 4.2km in length and has a north west to south east alignment. The A470 between the Upper Boat Roundabout junction and the A4058 Roundabout 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 NO<sub>2</sub> 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 57 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 21 measures for the A470 study corridor that were taken forward to Stage Two.

The WelTAG Stage Two appraisal examined in greater detail the short list of 21 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 16 measures that were considered to reduce NO<sub>2</sub> 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 14 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 A470 between the Upper Boat Interchange and Bridge Street Interchange and enforce through average speed cameras.
- **S14: Ramp Metering:** implement ramp metering to control southbound traffic merging from Glyntaff Interchange and Bridge Street Interchange on-slips onto the A470 using traffic lights.
- **S16: Junction Closures:** implement a closure of the southbound on-slips at Bridge Street Interchange and/or Glyntaff Interchange.
- **S19: Variable Diversions:** implement advisory variable diversion routes, for instance on the A4054 or A473, through signage to reduce cars from the A470 in the AM and PM peak hours.
- **S27: Parking Improvement:** provision of parking opportunities to encourage car sharing and use of public transport, for instance at railway stations, at key locations along the strategic road network, and on the outskirts of towns.

- **S28: Behaviour Change:** implement a package of several measures aimed at changing travel behaviour, encouraging mode shift away from private car use.
- **S29: Car Sharing:** promotion of and incentives for car sharing, such as free or reserved parking, supported by technology such as apps, and information / tools on websites.
- **S46: Clean Air Zones / Low Emission Zones:** promotion of clean air zones/ low emission zones for the study corridor along the A470. Welsh Government held a consultation for 'A Clean Air Zone Framework for Wales' which provides guidance to local authorities for addressing local air quality issues. The consultation was held between 25th April and 19th June 2018. The introduction of clean air zones have been appraised however they would need to be introduced by local authorities.
- **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 A470 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.
- **S63: Distance Chevrons:** implement painted signs on road surface and supporting signs on the A470 between Upper Boat Interchange and Bridge Street Interchange to increase buffer distance between vehicles, encouraging slower, smoother and safer driving behaviour.
- **S65: Air Quality Areas:** use publicity campaigns and branding of areas to raise awareness of poor air quality within the area.
- **S66: Air Quality Communications:** implement a package of measures to generally raise awareness of air quality.

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

- **S10: Flow Management (Upstream):** it was considered that managing flows, for instance redistributing traffic flows to alternate routes or smoothing flows, could be achieved as part of S19 Variable Diversions and S14 Ramp Metering.
- **S17: Variable Message Signs (VMS):** it was considered that VMS could be considered as part of other measures, for instance S62 Signage.

## 2.5 SHORT TERM MEASURES

Following Stage Two, it was recognised that reduced speed limits could provide immediate benefits with respect to the reduction of NO<sub>2</sub>. 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 A470 study corridor between the Upper Boat and Bridge Street Interchanges.

## 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 14 preferred measures have been subdivided into 'hard measures' with tangible benefits and 'soft measures' with marginal indirect benefits. The soft measures are those that passively reduce NO<sub>2</sub> 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 has also been identified that there is scope to encourage people to car share on the A470, and therefore the following has been included within the complementary package for the study corridor:

- S29: Car Sharing

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 A470 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	Distance Chevrons, plus 50mph Speed Limit
004	Junction Closures (Option A - Southbound on-slip at Bridge Street Interchange), plus 50mph Speed Limit
005	Junction Closures (Option B - Southbound on-slip at Glyntaff Interchange), plus 50mph Speed Limit
006	Junction Closures (Option C - Southbound on-slips at Bridge Street and Glyntaff Interchanges), plus 50mph Speed Limit
007	Ramp Metering (Southbound on-slips at Bridge Street and Glyntaff Interchanges), plus 50mph Speed Limit
008	Variable Diversions (e.g. A473), plus 50mph Speed Limit
009	Clean Air Zone, plus 50mph Speed Limit
010	Parking Improvement, 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 A470 has been derived from a combination of national modelling (the Pollution Climate Mapping – PCM – model) and monitoring undertaken by the local authority, Rhondda Cynon Taf County Borough Council (RCTCBC) and Welsh Government.

##### **National Modelling**

The PCM model was developed by Ricardo AEA on behalf of Defra/DfT for the purpose of the assessment of compliance with the limit values set out in the European Union Ambient Air Quality Directive. As such, this assessment uses the outputs of the PCM model to define baseline and future baseline NO<sub>2</sub> concentrations for the purpose of assessing the efficacy of measures designed to bring forward the date of compliance with limit values.

The PCM model projections presented in support of the 2017 Plan indicate that annual mean NO<sub>2</sub> concentrations on the section of the A470 under consideration will reach compliance with air quality limit values between 2018 and 2021 (i.e. projected concentrations at or below 40µg/m<sup>3</sup>).

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

The percentage reduction in emissions from road transport required to achieve compliance has been estimated using the maximum PCM concentration in any given year, the corresponding background NO<sub>2</sub> concentration and Defra’s NO<sub>x</sub> to NO<sub>2</sub> calculator (v6.1) to calculate the roadside contribution to NO<sub>x</sub> concentrations and the level of emissions required to give a roadside concentration of 40µg/m<sup>3</sup>.

**Table 2: Baseline PCM Predicted NO<sub>2</sub> Concentrations at Pontypridd, without NO<sub>2</sub> reduction network measures (projections from 2017 Plan, July 2017)**

<b>Measure</b>	<b>2015</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>
A470 (ID 40548, Upper Boat)	49.7	47.6	45.7	43.9	41.7	39.1
A470 (ID 10548, Pontypridd)	43.7	41.8	40.1	38.5	36.6	34.3
Approx. % Reduction in NO <sub>x</sub> Emissions from Road Transport Required for Compliance	28%	23%	18%	13%	6%	-

##### **Local Authority Monitoring**

The PCM modelled concentrations in Table 2 are consistent with the concentrations monitored by RCTCBC in the vicinity of the A470 (Table 3). That is to say that concentrations exceed the EU limit value and by a considerable margin in places.

Away from the A470, monitored concentrations also exceed the limit value (and air quality objective). As such, RCTCBC have declared a number of Air Quality Management Areas (AQMA) under their statutory duties for Local Air Quality Management. The Broadway AQMA runs along the A473, parallel to the PCM links of concern. The Town Centre AQMA lies on the A4058, to the north of the study area.

**Table 3: Monitored Annual Mean NO<sub>2</sub> concentrations alongside the A470 and parallel routes (µg/m<sup>3</sup>)**

RTCCBC Location ID	Location	Distance to A470	Bias-adjusted Annual Mean		
			2014	2015	2016
<i>Monitoring with 50m of A470</i>					
108	Nightingales Bush	4.5m	<b>59.8</b>	<b>51.0</b>	<b>50.0</b>
128	Cardiff Road, Treforest	2.5m	<b>41.1</b>	-	<b>43.7</b>
<i>Monitoring within Broadway AQMA</i>					
44	Coronation Terrace	<b>2.5</b>	32.8	37.5	<b>40.5</b>
47-50	Broadway Treforest	<b>9</b>	31.2	28.6	32.0
51	Broadway Treforest	<b>2.5</b>	<b>47.6</b>	<b>41.5</b>	<b>44.9</b>
56	Broadway Treforest	<b>2.5</b>	<b>43.9</b>	<b>43.7</b>	<b>47.7</b>
66	Broadway Treforest	<b>2.5</b>	36.4	36.8	<b>40.6</b>
95	Park Street, Treforest	<b>2.5</b>	34.9	32.4	38.6
119	Park Street, Treforest	<b>2.5</b>	35.8	30.7	35.2

#### **Welsh Government Indicative Monitoring**

Welsh Government has commissioned air quality monitoring along the A470 study corridor. The monitoring is currently undertaken using diffusion tubes, at 6 roadside locations and 1 background location. At each site, the monitoring consists of triplicate diffusion tubes, exposed for ~2week durations. Data for 6 months (12 exposure periods) is currently available. The roadside monitoring is undertaken at distances between 2.5 and 4m from the side of the A470, at a height of approximately 2m above the carriageway.

Under the Ambient Air Quality Directive, the reference method for monitoring ambient NO<sub>2</sub> is based on chemiluminescence (EN 14211:2005). Diffusion tube monitoring has greater uncertainty and cannot be considered equivalent to reference method monitoring. It provides indicative measurements only. Moreover, the diffusion tube data do not, at the time of writing, meet the data quality objectives for indicative measurements under Annex I of the Directive<sup>4</sup> and should not be used to assess compliance with limit values. The data are, however, useful in the provision of greater spatial information than is practicable with reference method monitoring or national modelling.

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

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

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.

<sup>4</sup> Due to the survey duration not covering a whole year, whether continuously or intermittently

<sup>5</sup> The PCM model provides concentrations at a nominal distance of 4m from the side of the road

The indicative monitoring survey shows that roadside concentrations are higher on PCM Link 40548 than Link 10548 which is consistent with the PCM modelling. However, the monitored concentrations are generally higher than the PCM concentrations.

**Table 4: Indicative diffusion tube monitoring ( $\mu\text{g}/\text{m}^3$ )**

PCM Link	Number of Monitoring Locations(a)	Annualised and Bias Adjusted Concentration (b) (2017)	Average Indicative Concentration on PCM Link Distance Corrected to 4m (c)(2017)
40548	2	58.0 – 76.2	65.3
10548	2	44.7 – 55.3	48.7

NOTE: Data are indicative only and should not be used to assess compliance with limit values

- (a) Locations considered were compliant with requirements of EU Directive Annex III on micro and macroscale siting of monitoring points
- (b) Bias adjusted using national factors provided by Defra (0.88); Annualised to 2017 using data from Cardiff, Cwmbran and Bristol
- (c) Distance corrected using Defra's calculator

As will be set out in the following section, dispersion modelling has been used to assess the impact of the various measures identified to reduce NO<sub>2</sub> concentrations within the study corridor. The monitored concentrations were used to verify this dispersion modelling (see WelTAG Stage Three IAR, 2018). Whilst the dispersion modelling underestimated the monitored concentrations overall, the under-prediction was most significant where the monitoring was located in areas of dense vegetation lining both sides of the road.

There is both field and modelling evidence to suggest that concentrations increase within the canyon formed by roadside vegetation screening and decrease outside of the screening<sup>6</sup>. The monitored concentrations on the A470 are consistent with increased concentrations within dense vegetation screening (see WelTAG Stage Three IAR, 2018). The extension to this conclusion is that the existing vegetation alongside the A470 is, in parts, already providing a level of mitigation against exposure to pollution since, with the exception of Nightingales Bush, residential properties sit outside the vegetation. Additional monitoring will be undertaken to quantify this impact and its effect on limit value compliance dates.

## 3.2 TRAFFIC BASELINE

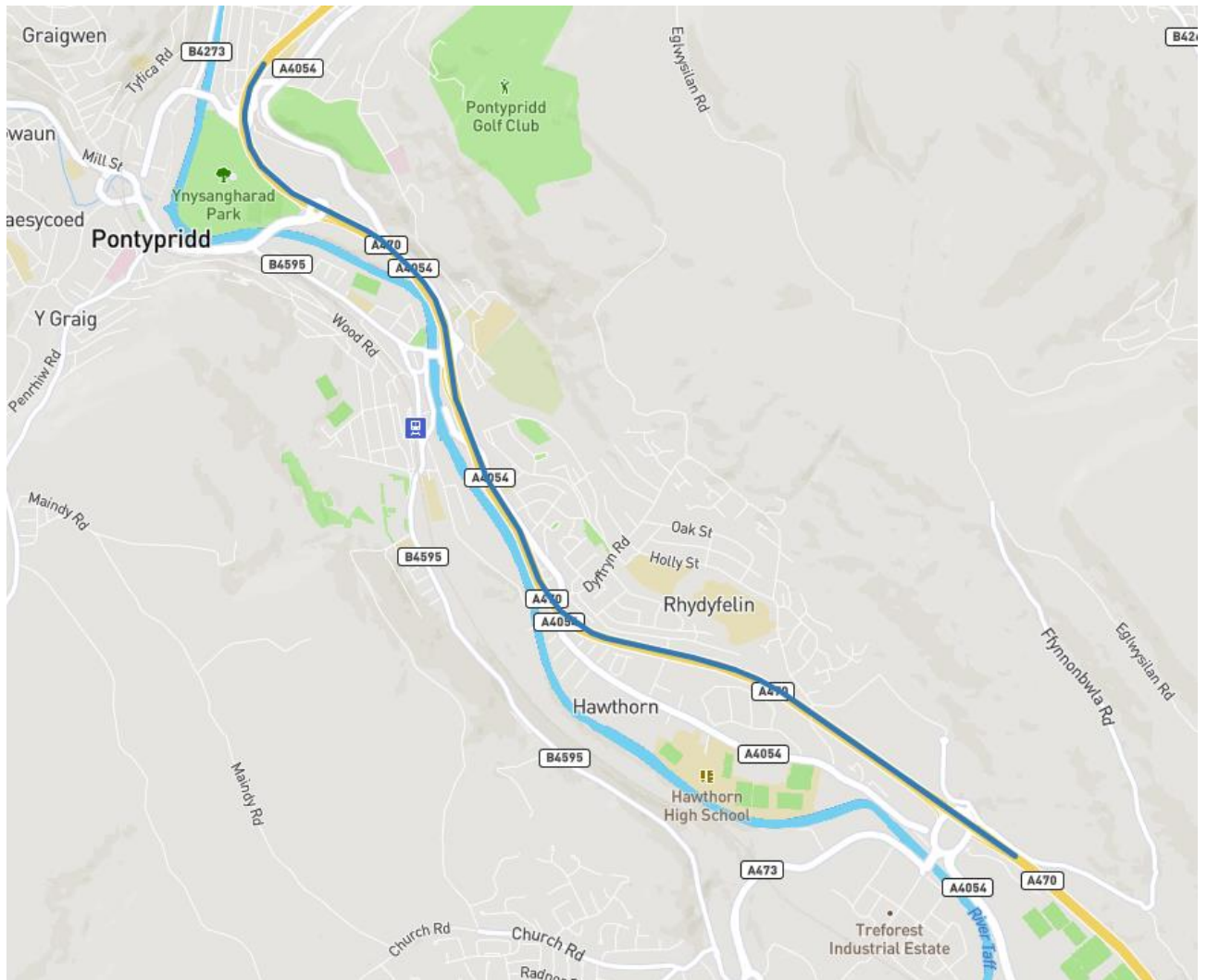
An overview of the existing traffic flows and speeds along the A470 corridor is provided in the WelTAG Stage Two report, and includes data extracted from the Department for Transport (DfT) as well as Trafficmaster.

### *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 A470 study corridor as possible.

<sup>6</sup> Impacts of Vegetation on Urban Air Pollution, Air Quality Expert Group, 2018

**Figure 2: INRIX A470 Corridor**



Speed data has been extracted for the A470 southbound and northbound directions for the period 1<sup>st</sup> July 2017 to 30<sup>th</sup> June 2018 (Monday-Thursday). The data shows that speeds drastically reduce for vehicles travelling southbound during the AM peak period from approximately 05:30 to 09:30, with the lowest average speed of 28mph recorded at 07:15. There is no noticeable reduction in speeds during the PM peak, with speeds averaging approximately 60mph across all other times of the day.

For vehicles travelling northbound on the A470, speeds average approximately 60mph throughout most of the day, with a small reduction during the PM period. The lowest average speed of 49mph occurs at 16:15.

Travel times have also been extracted from INRIX for the A470 corridor for the same period.

Travel time on the southbound carriageway significantly increases during the AM peak period, from an approximate free-flow time of 3 minutes to an average of 7 minutes at 07:15. Delay in this direction on this corridor can therefore be inferred as approximately 4 minutes during the AM peak.

For the A470 northbound corridor, INRIX shows that free-flow travel time is approximately 3 minutes 15 seconds, which increases to 4 minutes at 16:15. Delay in this direction on this corridor can therefore be inferred as approximately less than 1 minute during the PM peak.

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

### 3.3 OTHER BASELINE DATA

In addition to the air quality and traffic baselines detailed in this report, the following areas have been covered by the WeITAG 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	Distance Chevrons, plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
004	Junction Closures (Option A - Southbound on-slip, Bridge St), plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
005	Junction Closures (Option B - Southbound on-slip, Glyntaff), plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
006	Junction Closures (Option C - Southbound on-slips, Glyntaff and Bridge St.), plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
007	Ramp Metering, plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
008	Variable Diversions, plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
009	Clean Air Zone, plus 50mph Speed Limit	Not Modelled	Modelled (AM, IP, PM, OP periods)
010	Improved Car Parking, plus 50mph Speed Limit	Not Modelled	Modelled (AM, IP, PM, OP periods)

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

Clean Air Zones (CAZ) are defined under the Clean Air Zone Framework for Wales as:

*“A geographical target area where a range of co-ordinated actions are applied with the purpose of ensuring, in the soonest time possible, a significant reduction in public and environmental exposure to harmful airborne pollutants for all sources”.*

With the target area being a stretch of the strategic network, many of the measures suggested in the Framework have limited applicability (vehicle idling policies, provision of public transport infrastructure, use of wood burning stoves etc.) whilst others have been assessed during the WelTAG process as individual measures or packages (traffic management, adjusting speed limits, improved facilities for car sharing, information campaigns etc.).

However, the preferred model for a CAZ in Wales is to restrict access to only the least polluting vehicles, via either a total ban or via a charging scheme to allow limited access to certain vehicles. The CAZ measure has, therefore, been modelled using the same traffic data as provided for Measure 001 – Enforce/Reduce Speed Limit but assuming the elimination of all vehicles older than Euro 5/VI from the fleet. This is a somewhat more conservative CAZ than the Welsh Government preferred model (Euro VI/6 for HDVs and diesel LDVs, Euro 4 for petrol LDVs) but takes account of the economic disadvantage of certain areas and the potential for limited access by Euro 5 vehicles.

The impacts of improved car parking were not modelled within VISSIM, with the air quality modelling using data as provided for Measure 001 – Enforce/Reduce Speed Limit but removed 300 vehicles from the study corridor in the morning and evening peaks.

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 A470 study corridor, utilising demand data from the South East Wales Transport and Land Use Model prepared by Mott MacDonald for the Welsh Government. The study was supplemented by additional data collection, including count data at the Bridge Street Interchange, and the micro-simulation 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 263 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 A470 corridor of the exceedance only, general consideration has been given to the wider impacts of displacing traffic in the instance of closing junctions or 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 5<sup>th</sup>, 15<sup>th</sup>...85<sup>th</sup> and 95<sup>th</sup> 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 A470 study corridor (Figure 1) with the impacts of measures on emissions and roadside NO<sub>2</sub> 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 3<sup>rd</sup> parties to directly model the impact of measures on compliance dates.

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

### ***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)
Distance Chevrons	End of 2019
Variable Diversions*	End of 2019
Ramp Metering*	End of 2019
Junction Closures*	End of 2019
Improved Car Park Provision	End of 2020
Installation of Barriers	End of 2021
Implementation of Clean Air Zone	End of 2022

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

### **Offline Screening of Impacts**

In addition to the detailed modelling of the A470 corridor, and acknowledging that some measures may have an impact on adjacent routes, screening calculations of potential impacts were undertaken to determine the likelihood of significant ‘offline’ impacts.

This involved the use of ‘Headroom’ Calculations in which the monitoring undertaken by RCTBC was used to infer a relationship between the monitored roadside NO<sub>2</sub> and vehicle flow. This relationship was then used to quantify the impact of a change in vehicle flow with a measure and to assess whether this impact would be likely to cause or exacerbate existing exceedances of air quality standards.

### **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 NO<sub>2</sub> at 4m from the PCM link.

## 4.3 APPRAISAL AGAINST OBJECTIVES

The Stage One procedure involved undertaking the appraisal of the long list of measures, with each measure assessed against the WelTAG criteria, and then considered within the context of the study objective; namely, the extent to which each measure would be successful in bringing forward reductions in NO<sub>2</sub> in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements.

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

### KEY CRITERIA

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

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

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

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

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

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

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

### SECONDARY CRITERIA

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

**Will the measure deliver an overall reduction in NO<sub>2</sub> emissions to air**

This is a qualitative appraisal based on the likelihood of overall reduction to NO<sub>2</sub> resulting from the measure. This will enable the differentiation of measures which simply redistribute the impacts rather than seeking to reduce overall NO<sub>2</sub> emissions to air.

***Will the measure result in unintended consequences or other environmental impacts***

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

***Will the measure contribute to well-being***

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

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

### 4.3.1 OTHER ISSUES

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

***Overall Acceptability***

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

***Technical, Operational and Financial Feasibility***

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

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

***Deliverability and Risk***

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

## 4.4 STAGE THREE APPRAISAL

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

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

The process has identified those measures that have

- a) the potential to bring forward compliance dates and/or reduce exposure to NO<sub>2</sub> in non-compliant areas as quickly as possible on PCM links within the A470 study corridor.

but also identified those measures for which there is

- b) reasonable scientific doubt as to the efficacy of the measure in reducing exposure to NO<sub>2</sub> in non-compliant areas, or
- c) reasonable scientific doubt that the measure would not result in unacceptable dis-benefits, for example significant deterioration of air quality in offline areas, whether compliant or non-compliant with limit values.

The modelling of the impacts of the measures undertaken for the appraisal follows best practice guidance and uses the latest available information on vehicle emissions and local monitoring. Where the modelling has been able to robustly demonstrate a measure's effectiveness in reducing NO<sub>2</sub> concentrations, the measure has been classed as **likely** to bring forward compliance or, depending on the PCM concentration, to reduce exposure to NO<sub>2</sub> alongside the PCM link as quickly as possible. This judgement is based on the measure's impact on NO<sub>2</sub> concentrations on the PCM link. If, in addition, the measure has been demonstrated to be timely in relation to the compliance timescales and, beyond reasonable scientific doubt, to have no unacceptable adverse impacts, the measure is classed as a **likely measure**.

Measures are classed as **unlikely measures** if there is reasonable scientific doubt as to their efficacy in reducing NO<sub>2</sub> concentrations (classed as **unlikely** to reduce NO<sub>2</sub> concentrations) and/or if the measure gives rise to unacceptable dis-benefits. A measure can also be classed as an **unlikely measure** if it is included within, or cannot be implemented at the same time as, another more or equally effective package of measures. In the latter case, the other appraisal areas may be used to identify the optimum measure, including consideration of whether the measure results in an overall beneficial impact on air quality.

Total pollutant concentrations at the roadside, whether taken from the PCM model or from reference method monitoring, are of prime importance in determining when a particular road link becomes compliant with limit values. They are, however, less important in determining whether a measure will bring forward compliance in the shortest possible time or reduce exposure to NO<sub>2</sub> as quickly as possible. That is to say if, for example, the imposition of a measure is assessed as being likely to bring forward compliance in the shortest possible time, that would apply whether or not total pollutant concentrations are, say 50µg/m<sup>3</sup> or 45µg/m<sup>3</sup> in a particular year, although the projected compliance date in the two cases would be different.

In recognising uncertainty within the appraisal methodology, measures that have been identified as being likely to reduce NO<sub>2</sub> 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 on annual mean NO<sub>2</sub> concentrations, respectively, on PCM Links 40548 and 10548.

The impacts on Link 40548 are given less weight in the analysis where the impacts are potentially mitigated by the existing vegetation screening (Section 2) and concentrations outside of the vegetation screening are likely to be lower than those presented.

The imposition and enforcement of a 50mph limit is **likely** to reduce NO<sub>2</sub> concentrations such that the exceedance of the limit value is removed in the PCM modelling on Link 10548 and compliance with the limit value is brought forward on Link 40548 by two years (from 2021 to 2019). No adverse impacts on air quality have been identified outside of the PCM Links.

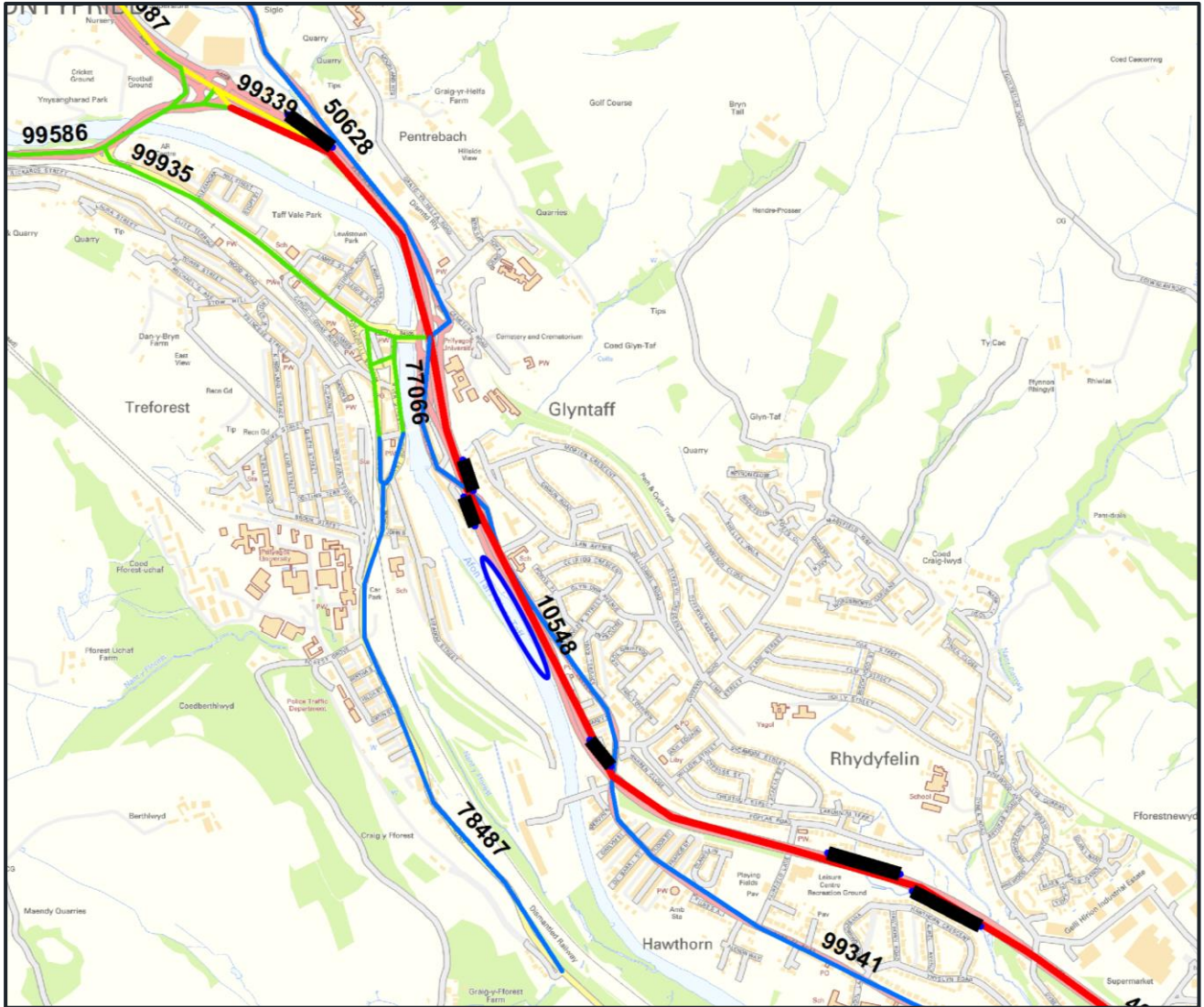
Ramp metering may reduce the benefits of the 50mph speed limit on Link 10548 and produces a negligible benefit (<0.1µg/m<sup>3</sup>) on Link 40548 and is therefore **unlikely** to reduce NO<sub>2</sub> concentrations and is a discounted measure. Distance chevrons may provide some benefits on Link 40548; however, they potentially offset the benefits of the 50mph speed limit on Link 10548 (whether painted along the whole corridor, or between Upper Boat and the Cardiff Road underbridge) and are **unlikely** to reduce NO<sub>2</sub> concentrations and they are a discounted measure.

The junction closure and variable diversion measures have significant beneficial impacts on the mainline but they are discounted on account of the adverse impacts offline. Concentrations at the roadside in the Broadway AQMA increase by up to 10µg/m<sup>3</sup> with these measures. Moreover, there are just 28 properties within 20m of the A470 PCM links but 360 properties within 20m of the most accessible diversion route (A473) (and 401 and 494 within 50m respectively). Therefore, whilst the measures have beneficial impacts on compliance with limit values along the PCM Links, they would result in a **net increase in exposure** to air pollution and cannot, therefore, be considered as effective measures.

Barriers, improved car parking and the imposition of a Clean Air Zone all 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, in which initial indications suggest that the

A470 might not achieve compliance within the projected PCM timeframe, these measures are retained as potential measures pending the results of fixed monitoring, using reference methods. Figure 3 shows the locations at which potential benefits from air quality barriers could be realised; along the remainder of the route there is either a) an effective vegetation barrier or b) no residential property or publicly accessible space within 20m of the road.

**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 40548 and 10458**

ID	Measure	Emissions Reduction*		Commentary on Impact (First Year of Implementation)
		Link 40548	Link 10548	
001	Enforce / Reduce Speed Limit (50mph)	8.8%	6.9%	Reduction in LDV emissions partially offset by HDV increase (2017)
002	Air Quality Barriers, plus 50mph Speed Limit	-	-	No reduction in emissions but possible benefits at roadside in areas without existing vegetation screening and properties within 20-50m of the roadside (2021)
003	Distance Chevrons, plus 50mph Speed Limit	12.3%	7.7%	Reduces benefits of Speed Limit on 10548 (2019)
004	Junction Closures (Option A - SB on-slip, Bridge St), plus 50mph Speed Limit	20.5%	23.5%	Benefits on mainline due to traffic diversion; but significant worsening of exceedances of air quality standard for NO <sub>2</sub> in Broadway AQMA (Offline concentrations increase by up to 10µg/m <sup>3</sup> with exceedance) (2019)
005	Junction Closures (Option B - SB on-slip, Glyntaff), plus 50mph Speed Limit	9.8%	8.1%	
006	Junction Closures (Option C - SB on-slips, Glyntaff and Bridge St.), plus 50mph Speed Limit	34.7%	32.7%	
007	Ramp Metering, plus 50mph Speed Limit	9.4%	7.2%	Reduces benefits of Speed Limit on 10548 (2019)
008	Variable Diversions, plus 50mph Speed Limit	9.4%	8.8%	Benefits on mainline due to traffic diversion; but moderate worsening of exceedances of air quality standard for NO <sub>2</sub> in Broadway AQMA (2019)
009	Clean Air Zone, plus 50mph Speed Limit	10.5%	8.7%	Modelled with all Euro 4 and older vehicles excluded by 2022 (2022)
010	Improved Car Parking, plus 50mph Speed Limit	10.8%	9.0%	Possible benefits due to reduction in peak hour traffic (2020)

\*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
<b>PCM Link 40548</b>							
Baseline		47.6	45.7	43.9	41.7	39.1	36.7
001 Speed Limit (SL)	-4.8	42.7	41.0	39.4	37.4	35.1	33.0
003 SL + Distance Chevrons	-6.2			37.7	35.9	33.7	31.7
007 SL + Ramp Metering	-4.6			39.3	37.3	35.0	32.9
008 SL + Variable Diversions	-4.6			39.3	37.3	35.0	32.9
004 SL + J-Close SB Bridge St.	-10.3			33.6	32.0	30.1	28.4
005 SL + J-Close SB Glyntaff	-4.8			39.1	37.1	34.9	32.7
006 SL + J-Close SB Both Jcts	-18.2			25.7	24.7	23.4	22.3
010 SL + Improved Car Parking	-5.0				36.7	34.5	32.4
002 SL + Air Quality Barriers	-6.0					33.1	31.0
009 SL + Clean Air Zone	-4.1						32.7
<b>PCM Link 10548</b>							
Baseline		41.8	40.1	38.5	36.6	34.3	32.2
001 Speed Limit (SL)	-2.7	39.1	37.5	36.0	34.1	32.0	30.0
003 SL + Distance Chevrons	-2.5			36.0	34.2	32.1	30.1
007 SL + Ramp Metering	-2.5			36.1	34.2	32.1	30.1
008 SL + Variable Diversions	-3.2			35.4	33.6	31.5	29.6
004 SL + J-Close SB Bridge St.	-8.8			29.7	28.4	26.8	25.2
005 SL + J-Close SB Glyntaff	-2.9			35.6	33.8	31.8	29.8
006 SL + J-Close SB Both Jcts	-12.6			25.9	24.9	23.5	22.3
010 SL + Improved Car Parking	-3.0				33.6	31.5	28.0
002 SL + Air Quality Barriers	-4.3					30.0	28.0
009 SL + Clean Air Zone	-2.5						29.8

\*  $\mu\text{g}/\text{m}^3$  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  |
| ▪ $\geq 5\%$ - 9% of limit value | Medium Beneficial or Adverse |
| ▪ $\geq 1\%$ - 4% of limit value | Small Beneficial or Adverse  |
| ▪ <1% of limit value             | Negligible                   |



## Appraisal Summary Table

Measure No.

001

<b>Name of measure:</b>		Enforce/Reduce Speed Limit
<b>Location:</b>		A470
<b>Description of measure:</b>		The Welsh Ministers have made an Order under section 14 of the Road Traffic Regulation Act 1984 because of a likelihood of danger to the public on or near the A470 trunk road between Upper Boat and Bridge Street Interchange, Pontypridd, Rhondda Cynon Taf. The intention is that lower speed limits will reduce vehicle emissions and improve air quality, aiding compliance with NO2 limits set out in legislation. If successful in reducing NO2 levels, arrangements will be made to make the speed limits permanent.
<b>Key Criteria</b>	<b>Effectiveness:</b>	Roadside concentrations reduced by up to 4.8µg/m3
	<b>Timescales:</b>	Temporary 50mph speed limit order implemented June 2018
	<b>Deliverability:</b>	This measure has been delivered by WG Network Management Division

Impacts		Summary of key impacts	Assessment
<b>Environmental</b>	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 (southbound AM peak flows). Emissions reduced by up to 8.8%; Roadside concentrations reduced by up to 4.8µg/m3, which is 12% of the limit value.	Large Beneficial
	Noise	There are two noise important areas along the route of the A470 at this location. The A470 study corridor runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. The reduction in speed limits is likely to result in a reduction in noise levels between the source and the receptors.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. This measure is unlikely to generate any impacts on townscape.	Neutral
<b>S&amp;C</b>	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
<b>Economy</b>	Journey Time Changes	Reducing speed limits on the strategic route increases total travel time for users, with modelling showing increases of more than 130 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 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
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph will reduce the roadside concentrations by up to 4.8µg/m3, at a cost of £275,000. This measure will therefore be a cost of approximately £57,000/µg.	£57,000/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	There will be an overall reduction in NO2 emissions to air as a result of reducing the speed limit to 50mph on the A470 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.	
<b>Other Issues</b>	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

<b>Name of measure:</b>		Enforce/Reduce Speed Limit + Air Quality Barriers
<b>Location:</b>		A470
<b>Description of measure:</b>		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. Six locations along the A470 study corridor have been identified where implementation would be most effective.
<b>Key Criteria</b>	<b>Effectiveness:</b>	Roadside concentrations reduced by up to 6µg/m <sup>3</sup>
	<b>Timescales:</b>	End of 2021
	<b>Deliverability:</b>	Road network is managed by WG Network Management Division.

Impacts		Summary of key impacts	Assessment
<b>Environmental</b>	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. Combined with the speed limit, roadside pollutant concentrations on the A470 reduced by up to 6µg/m <sup>3</sup> , which is 15% of the limit value.	Large Beneficial
	Noise	There are two noise important areas along the route of the A470 at this location. The A470 study corridor runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. With a proposed reduction in traffic speeds and the installation of barriers, there will be a corresponding reduction in noise that could result in a moderate beneficial impact.	Moderate Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. The barriers would reduce natural views of the landscape; however, as they would be situated within the existing transportation corridor, the impact is likely to be reduced as a result.	Slight Adverse
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. The installation of barriers is considered to have a slight adverse impact on the setting of listed buildings.	Slight Adverse
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. This measure is unlikely to generate significant townscape impacts.	Neutral
<b>S&amp;C</b>	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
<b>Economy</b>	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. £20m for barriers, which could be provided along several sections between Upper Boat Interchange and the northern A4054 Cardiff Road bridge, although there are sections that would be excluded due to the presence of retaining walls, structures and narrow embankments (particularly in the northbound carriageway where the route runs close to the River Taff). 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.	£20,275,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and installing air quality barriers will reduce the roadside concentrations by up to 6µg/m <sup>3</sup> , at a combined cost of £20.3m. This measure will therefore be a cost of approximately £3.4m/µg.	£3.4m/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO <sub>2</sub> emissions to air	The installation of barriers is not expected to reduce overall NO <sub>2</sub> emissions over and above what is to be expected with reducing speed limits to 50mph on the A470 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.	
<b>Other Issues</b>	Acceptability	There may be some local opposition, as residents of nearby properties may argue that they reduce light levels. However, there are few businesses along the sections of A470 where barriers could be erected.	
	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. 003

<b>Name of measure:</b>		Enforce/Reduce Speed Limit + Distance Chevrons	
<b>Location:</b>		A470	
<b>Description of measure:</b>		As well as reducing the speed limit to 50mph, provide Vehicle Separation Markings (VSM) on the road surface and install supporting signs in both directions to increase buffer distances between vehicles to encourage slower, smoother, and safer driving behaviour. Two options have been modelled, to test the impact of chevrons along the whole corridor, and between Upper Boat and the Cardiff Road underbridge.	
<b>Key Criteria</b>	<b>Effectiveness:</b>	Roadside concentrations reduced by up to 6.2µg/m3	
	<b>Timescales:</b>	End of 2019	
	<b>Deliverability:</b>	Distance chevrons can be managed by WG Network Management Division.	
<b>Impacts</b>		<b>Summary of key impacts</b>	<b>Assessment</b>
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed (i.e. speeds greater than the optimal speed for minimising emissions from light duty vehicles -60 - 80 kph). The speed limit will be enforced with average speed cameras and include off-peak/inter-peak periods. It has little impact in areas of congestion (southbound AM peak flows). In both options that have been modelled, the addition of distance chevrons reduces emissions further on PCM link 40548, through smoothing traffic flows. However, due to vehicles merging at the Bridge Street and Glyntaff Interchanges, the presence of chevrons may have an adverse impact through drivers braking on seeing the chevrons causing a ripple effect. This results in a disbenefit in relation to the speed limit alone on PCM link 10548. Emissions reduced by up to 12.3%; Roadside pollutant concentration reduced by up to 6.2µg/m3, which is 16% of the limit value.	Large Beneficial
	Noise	There are two noise important areas along the route of the A470 at this location. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. With a proposed reduction in traffic speeds a corresponding reduction in noise could result in a slight beneficial effect. The addition of distance chevrons is unlikely to generate further noise impacts.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. This measure is unlikely to generate an impact upon townscape.	Neutral
<b>S&amp;C</b>	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the benefits to air quality. The addition of the complementary 'soft' measures should increase public acceptability for the measure. Although the intention for the implementation of distance chevrons is to encourage smoother driving behaviour, the congestion and vehicles merging onto the A470 results in flow breakdown causing an adverse driving experience.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of distance chevrons are intended to remind drivers to keep a safe distance from the vehicle in front and has been shown to be beneficial in reducing accidents.	Moderate Beneficial
	Access to Employment and Services	A reduction to the speed limit and distance chevrons are unlikely to have an impact on access to services, employment, or healthcare.	Neutral
<b>Economy</b>	Journey Time Changes	Reducing speed limits on the strategic route increases total travel time for users, with modelling showing increases of more than 130 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. In both options that have been modelled, due to vehicles merging at the Bridge Street and Glyntaff Interchanges, the presence of chevrons may have an adverse impact through drivers braking on seeing the chevrons causing a ripple effect. Due to this flow breakdown, chevrons cause an additional 4% increase to journey times across the peak hours.	Moderate 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. £75k for distance chevrons. To include road markings, traffic signs and potentially other associated works (safety barrier revisions etc.).	£350,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and painting distance chevrons will reduce the roadside concentrations by up to 6.2µg/m3, at a combined cost of £350,000. This measure will therefore be a cost of approximately £56,000/µg.	£56,000/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	There will be an overall reduction in NO2 emissions to air as a result of reducing the speed limit to 50mph on the A470 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 and installing distance chevrons 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 and installing distance chevrons should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. The addition of chevrons will not have any further positive impacts.	
<b>Other Issues</b>	Acceptability	None identified.	
	Technical, Operational & Financial Feasibility	None identified.	
	Deliverability & Risk	The Traffic Signs Manual states that VSM are prescribed for the use on motorways only. Given that the site is situated on a trunk road, authority's approval may be required to implement the VSM proposal on the trunk road network.	

<b>Name of measure:</b> Enforce/Reduce Speed Limit + Junction Closures (Option A)	
<b>Location:</b> A470	
<b>Description of measure:</b> As well as reducing the speed limit to 50mph, close southbound on-slip at Bridge Street Interchange (south of Sainsbury's)	
<b>Key Criteria</b>	<b>Effectiveness:</b> Roadside concentrations reduced by up to 10.3µg/m3 on A470, although increased by more than 10µg/m3 on Broadway AQMA.
	<b>Timescales:</b> End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)
	<b>Deliverability:</b> Junction closures can be managed by WG Network Management Division.

	Impacts	Summary of key impacts	Assessment
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closure further reduces emissions on the A470 study corridor by removing traffic from the link and is targeted at encouraging vehicles to join at Glyntaff Interchange. The measure has an effect throughout the day and is not limited to peak hours; however, it will increase flows in other areas of poor air quality. On the A470, emissions reduced by up to 23.5%; Roadside pollutant concentrations reduced by up to 10.3µg/m3, which is 26% of the limit value. Exceedance of the air quality standards within the Broadway AQMA worsened by over 10µg/m3 and new exceedances are created. Greater population exposure within AQMA results in overall adverse impacts.	Large Adverse
	Noise	There are several noise important areas along the route of the A470. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. This measure would displace traffic onto local roads, for instance the A473 and A4054, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. There is the potential for traffic flows within the town to increase due to travellers finding alternative access to the A470. However, this measure is unlikely to generate significant townscape impacts.	Neutral
<b>S&amp;C</b>	Journey Quality	With the closure of the on-slip at the Bridge Street Interchange, through traffic using the strategic network may benefit from improved journey quality due to a reduction in delay on the study corridor. However, the displacement of traffic will cause congestion on local roads and increase journey times and delay, negatively affecting overall journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the on-slip closure should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	The closure of the on-slip is likely to cause congestion on roads connecting to the strategic network as traffic diverts to other local roads. Therefore impacting on local trips to services, employment, and healthcare. Traffic currently using these junctions may experience increased journey times and find some services less accessible. The impact is considered to be moderately adverse.	Moderate Adverse
<b>Economy</b>	Journey Time Changes	The closure of the on-slip improves journey times and reliability, plus reduces delay along the strategic route for those entering north of the study corridor. However, reducing speed limits on the strategic route increases total travel time for users. Furthermore, the measure would displace traffic from Pontypridd and Treforest onto local roads, such as the A4058 and A473 Broadway to Glyntaff. This will cause congestion, which will increase journey times, delay and reliability for vehicles looking to use the strategic road network locally. Overall, this measure is considered to have a slight adverse impact.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land. It is unlikely that closing the slip-road would result in land becoming available for alternative use.	Neutral
	Capital and Revenue Costs	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £10m for junction closures, to include physical measures at the slip, but also the need for mitigation measures on the local roads. It is possible that RCT County Borough Council would either not support this measure or at minimum ask for mitigation measures on the local road network to avoid rat-running and to take into account the additional volume of traffic likely to be using the 'alternative' routes – presumed to be the A4058 and A473 Broadway to Glyntaff.	£10,275,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and closing the southbound on-slip at Bridge Street Interchange will reduce the roadside concentrations by up to 10.3µg/m3, at a combined cost of £10.3m. This measure will therefore be a cost of approximately £1m/µg.	£1m/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	Closure of the slip-road would result in reassignment of traffic onto local roads between routes of equivalent or longer length, including the Broadway AQMA. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be slight adverse impacts on journey time, journey quality, noise levels, and moderate adverse impacts on access to employment and services with the speed reduction and closure of the slip-road at the Bridge Street Interchange.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the southbound on-slip at Bridge Street Interchange 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	Junction closures will not have an overall positive impact on the wider public health and inequalities, as it will displace traffic onto local roads, causing NO2 levels to rise on more heavily populated roads and through AQMAs.	
<b>Other Issues</b>	Acceptability	SWTRA officers have commented that this slip road acts as the main slip for all traffic heading south out of Pontypridd and the Rhondda Valley. Local road users, as well as the local authority and residents, may oppose this measure.	
	Technical, Operational & Financial Feasibility	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	
	Deliverability & Risk	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	

## Appraisal Summary Table

Measure No. 005

<b>Name of measure:</b> Enforce/Reduce Speed Limit + Junction Closures (Option B)	
<b>Location:</b> A470	
<b>Description of measure:</b> As well as reducing the speed limit to 50mph, close southbound on-slip at Glyntaff Interchange	
<b>Key Criteria</b>	<b>Effectiveness:</b> Roadside concentrations reduced by up to 4.8µg/m3 on A470, although increased by more than 2µg/m3 on Broadway AQMA.
	<b>Timescales:</b> End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)
	<b>Deliverability:</b> Junction closures can be managed by WG Network Management Division.

Impacts		Summary of key impacts	Assessment
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closure further reduces emissions on the A470 study corridor by removing traffic from the link and is targeted at encouraging vehicles to join at Bridge Street Interchange or Upper Boat. The measure has an effect throughout the day and is not limited to peak hours; however, it will increase flows in other areas of poor air quality. On the A470, emissions reduced by up to 9.8%; Roadside pollutant concentrations reduced by up to 4.8µg/m3, which is 12% of the limit value. Exceedance of the air quality standards within the Broadway AQMA worsened by over 2µg/m3. Greater population exposure within AQMA results in overall adverse impacts.	Slight Adverse
	Noise	There are several noise important areas along the route of the A470. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. This measure would displace traffic onto local roads, for instance the A473 and A4054, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. There is the potential for traffic flows within the town to increase due to travellers finding alternative access to the A470. However, this measure is unlikely to generate significant townscape impacts.	Neutral
<b>S&amp;C</b>	Journey Quality	With the closure of the on-slip at the Glyntaff Interchange, through traffic using the strategic network may benefit from improved journey quality due to a reduction in delay on the study corridor. However, the displacement of traffic will cause congestion on local roads and increase journey times and delay, negatively affecting overall journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the on-slip closure should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	The closure of the on-slip is likely to cause congestion on roads connecting to the strategic network as traffic diverts to other local roads. Therefore impacting on local trips to services, employment, and healthcare. Traffic currently using these junctions may experience increased journey times and find some services less accessible. The impact is considered to be moderately adverse.	Moderate Adverse
<b>Economy</b>	Journey Time Changes	The closure of the on-slip should improve journey time reliability, plus reduces delay, along the strategic route for those entering north of the study corridor. However, reducing speed limits on the strategic route increases total travel time for users. Furthermore, the measure would displace traffic from Pontypridd and Treforest onto local roads, such as the A4054 Cardiff Road or the A473 to Tonteg to Upper Boat, or A473 Broadway and A4058 to Sainsbury's. This will cause congestion, which will increase journey times, delay and reliability for vehicles looking to use the strategic road network locally. Overall, this measure is considered to have a slight adverse impact.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land. It is unlikely that closing the slip-road would result in land becoming available for alternative use.	Neutral
	Capital and Revenue Costs	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £10m for junction closures. To include physical measures at the slip, but also the need for mitigation measures on the local roads. It is possible that RCTCBC would either not support this measure or at minimum ask for mitigation measures on the local road network to avoid rat-running and to take into account the additional volume of traffic likely to be using the 'alternative' routes – presumed to be the A4054 Cardiff Road to Upper Boat, A473 Broadway and A4058 to Sainsbury's, or the A473 to Tonteg (and on to Upper Boat via Tonteg Road).	£10,275,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and closing the southbound on-slip at Glyntaff Interchange will reduce the roadside concentrations by up to 4.8µg/m3, at a combined cost of £10.3m. This measure will therefore be a cost of approximately £2.1m/µg.	£2.1m/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	Closure of the slip-road would result in reassignment of traffic onto local roads between routes of equivalent or longer length, including the Broadway AQMA. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be slight adverse impacts on journey time, journey quality, noise levels, and moderate adverse impacts on access to employment and services with the speed reduction and closure of the slip-road at the Glyntaff Interchange.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the southbound on-slip at Glyntaff Interchange 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	Junction closures will not have an overall positive impact on the wider public health and inequalities, as it will displace traffic onto local roads, causing NO2 levels to rise on more heavily populated roads and through AQMAs.	
<b>Other Issues</b>	Acceptability	Local road users, as well as the local authority and residents may oppose this measure.	
	Technical, Operational & Financial Feasibility	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	
	Deliverability & Risk	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	

## Appraisal Summary Table

Measure No.

006

<b>Name of measure:</b>		<b>Enforce/Reduce Speed Limit + Junction Closures (Option C)</b>
<b>Location:</b>		<b>A470</b>
<b>Description of measure:</b>		<b>As well as reducing the speed limit to 50mph, close southbound on-slips at Bridge Street and Glyntaff Interchanges</b>
<b>Key Criteria</b>	<b>Effectiveness:</b>	<b>Roadside concentrations reduced by up to 18.2µg/m3, although increased by more than 10µg/m3 on Broadway AQMA.</b>
	<b>Timescales:</b>	<b>End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)</b>
	<b>Deliverability:</b>	<b>Junction closures can be managed by WG Network Management Division.</b>

	<b>Impacts</b>	<b>Summary of key impacts</b>	<b>Assessment</b>
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closures further reduces emissions on the A470 study corridor by removing traffic from the link and is targeted at encouraging vehicles to join at Upper Boat Interchange. The measure has an effect throughout the day and is not limited to peak hours; however, it will increase flows in other areas of poor air quality. On the A470, emissions reduced by up to 35%; Roadside pollutant concentrations reduced by up to 18.2µg/m3, which is 46% of the limit value. Exceedance of the air quality standards within the Broadway AQMA worsened by over 10µg/m3 and new exceedances are created. Greater population exposure within AQMA results in overall adverse impacts.	Large Adverse
	Noise	There are several noise important areas along the route of the A470. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. This measure would displace significant numbers of vehicles onto local roads, for instance the A473 and A4054, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Moderate Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway both north and south bound. There is the potential for traffic flows within the town to increase due to travellers finding alternative access to the A470. However, this measure is unlikely to generate significant townscape impacts.	Neutral
<b>S&amp;C</b>	Journey Quality	With the closure of the on-slips at the Bridge Street and Glyntaff Interchanges, through traffic using the strategic network may benefit from improved journey quality due to a reduction in delay on the study corridor. However, the displacement of traffic will cause significant congestion on local roads and increase journey times and delay, negatively affecting overall journey quality.	Moderate Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents on the strategic road network. However, the addition of the closures at both Bridge Street and Glyntaff Interchanges will displace a significant number of vehicles onto the local highway network, which has the potential to increase the number of accidents elsewhere on the network.	Neutral
	Access to Employment and Services	The closure of the on-slips are likely to cause congestion on roads connecting to the strategic network as traffic diverts to other local roads. Therefore impacting on local trips to services, employment, and healthcare. Traffic currently using these junctions may experience increased journey times and find some services less accessible.	Large Adverse
<b>Economy</b>	Journey Time Changes	The closure of the junction on-slips at Bridge Street and Glyntaff Interchanges improves journey times and reliability, plus reduces delay along the strategic route for those entering north of the study corridor. However, reducing speed limits on the strategic route increases total travel time for users. Furthermore, the measure would displace traffic from Pontypridd and Treforest onto local roads, such as the A4054 Cardiff Road to Upper Boat, or the A473 to Tonteg. This will cause significant congestion, which will increase journey times, delay and reliability for vehicles looking to use the strategic road network locally. Overall, this measure is considered to have a moderate adverse impact.	Moderate 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. It is unlikely that closing the slip-road would result in land becoming available for alternative use.	Neutral
	Capital and Revenue Costs	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £10m for junction closures. To include physical measures at the slip, but also the need for mitigation measures on the local roads. It is possible that RCTCBC would either not support this measure or at minimum ask for mitigation measures on the local road network to avoid rat-running and to take into account the additional volume of traffic likely to be using the 'alternative' routes – presumed to be the A4054 Cardiff Road to Upper Boat or the A473 to Tonteg (and on to Upper Boat via Tonteg Road).	£10,275,000
<b>VIM</b>	Value For Money	Reducing the speed limit to 50mph and closing the southbound on-slips at Bridge Street and Glyntaff Interchanges will reduce the roadside concentrations by up to 18.2µg/m3, at a combined cost of £10.3m. This measure will therefore be a cost of approximately £565,000/µg.	£565,000/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	Closure of the slip-road would result in reassignment of traffic onto local roads between routes of equivalent or longer length, including the Broadway AQMA. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be moderate adverse impacts on journey time, journey quality, noise levels, and large adverse impacts on access to employment and services with the closure of the slip roads at both the Bridge Street and Glyntaff Interchanges.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the southbound on-slips 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	Junction closures will not have an overall positive impact on the wider public health and inequalities, as it will displace traffic onto local roads, causing NO2 levels to rise on more heavily populated roads and through AQMAs.	
<b>Other Issues</b>	Acceptability	SWTRA have commented that closure of these two slips could see significant flows of traffic on the 'alternative' routes, as they would have to take up all traffic heading south out of Pontypridd and the Rhondda Valley. Local road users, businesses, as well as the local authority and residents may therefore oppose this measure.	
	Technical, Operational & Financial Feasibility	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	
	Deliverability & Risk	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	

## Appraisal Summary Table

Measure No. 007

<b>Name of measure:</b> Enforce/Reduce Speed Limit + Ramp Metering	
<b>Location:</b> A470	
<b>Description of measure:</b> As well as reducing the speed limit to 50mph, use ramp metering to control traffic merging onto the A470 at the Bridge Street and Glyntaff Interchanges (southbound on-slips) by traffic lights	
<b>Key Criteria</b>	<b>Effectiveness:</b> Roadside concentrations reduced by up to 4.6µg/m3
	<b>Timescales:</b> End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)
	<b>Deliverability:</b> Road network is managed by WG Network Management Division.

	Impacts	Summary of key impacts	Assessment
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed (i.e. speeds greater than the optimal speed for minimising emissions from light duty vehicles ~60 - 80 kph). The speed limit will be enforced with average speed cameras and include off-peak/inter-peak periods. It has little impact in areas of congestion (southbound AM peak flows). The addition of ramp metering results in the regulation of flows merging from junctions and potentially reduces lane weaving and braking/acceleration events. In areas of heavy congestion (e.g. southbound AM peak), the measure results in imperceptible disbenefits whereas in areas of moderate congestion, the measure results in imperceptible benefits. The measure has no effect outside of periods/areas of congestion. Emissions reduced by up to 9.4%; Roadside pollutant concentrations reduced by up to 4.6µg/m3, which is 12% of the limit value.	Large Beneficial
	Noise	There are two noise important areas along the route of the A470 at this location. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. With a proposed reduction in traffic speeds a corresponding reduction in noise could result in a slight beneficial effect. The addition of ramp metering is unlikely to generate further noise impacts.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. This measure is unlikely to generate significant townscape impacts.	Neutral
<b>S&amp;C</b>	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the benefits to air quality. It is considered that the installation of ramp metering is likely to improve flow on the strategic network, although this could lead to increased congestion on the local network. The addition of the complementary 'soft' measures should increase public acceptability for the measure.	Slight Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of ramp metering should contribute to smoother flows during peak hours, further decreasing the likelihood of accidents.	Slight Beneficial
	Access to Employment and Services	Ramp metering could cause congestion on roads connecting to the strategic network, however it is not considered that this would impact on local trips to services, employment, and healthcare.	Neutral
<b>Economy</b>	Journey Time Changes	Reducing speed limits on the strategic route increases total travel time for users, with modelling showing increases of more than 130 vehicle hours in total across both AM and PM peak hours. There will be further increases in travel time across the rest of the day, including the interpeak and off-peak periods, although these have not been modelled. The intention of ramp metering is to control traffic merging onto the A470, which improves the journey time on the strategic network. However, this does lead to increased journey times and delays accessing the study corridor at these locations and on the local network. The model shows a 2% increase on total journey times compared with speed limits alone in the peak hours. Combined with the speed reduction, ramp metering is considered to have a slight adverse impact.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. £800k for ramp metering, taking into account the equipment needed included possible changes to the traffic signals on both interchanges (managed/controlled by RCTCBC), ongoing maintenance and an estimate for measures that the Council may want implemented on the local road network if drivers look to avoid the signals.	£1,075,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and installing ramp metering will reduce the roadside concentrations by up to 4.6µg/m3, at a combined cost of £1.1m. This measure will therefore be a cost of approximately £230,000/µg.	£230,000/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	This measure is anticipated to result in minor overall benefits with respect to the overall reduction in NO2 emissions to air, over and above those from the imposition of speed limits alone.	
	Will the measure result in unintended consequences or other environmental impacts	As well as the a slight increase to journey times with the speed reduction, the addition of ramp metering could have a slightly adverse impact on access to local services.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and installing ramp metering should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. The addition of ramp metering will not have any further positive impacts.	
<b>Other Issues</b>	Acceptability	Given the nature of the proposals, this measure is unlikely to be opposed and if it were, it could likely be negated through education of their benefits.	
	Technical, Operational & Financial Feasibility	None identified.	
	Deliverability & Risk	Implementation of ramp metering would require collaboration with the local authority.	

## Appraisal Summary Table

Measure No. 008

<b>Name of measure:</b>		Enforce/Reduce Speed Limit + Variable Diversions
<b>Location:</b>		A470
<b>Description of measure:</b>		As well as reducing the speed limit to 50mph, operate advisory variable diversions within set NO2 limits, utilising the A473, through signage to reduce cars from the A470 study corridor in the AM and PM peak hours (using continuous monitoring equipment).
<b>Key Criteria</b>	<b>Effectiveness:</b>	Roadside concentrations reduced by up to 4.6µg/m3 on A470, although increased by up to 10µg/m3 on Broadway AQMA.
	<b>Timescales:</b>	End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)
	<b>Deliverability:</b>	Traffic management is within WG Network Management Division scope.

Impacts		Summary of key impacts	Assessment
<b>Environmental</b>	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 A470 study corridor in the peak hours only by removing traffic from the link. The measure will increase flows in other areas of poor air quality. Emissions reduced by up to 9.4%; Roadside pollutant concentrations on the A470 reduced by up to 4.6µg/m3, which is 12% of the limit value. Exceedance of the air quality standards within the Broadway AQMA worsened by up to 1µg/m3. Worsened exceedances in AQMA results in overall adverse impacts.	Slight Adverse
	Noise	There are several noise important areas along the route of the A470. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. This measure would advise traffic to use local roads, for instance the A473, which is closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. The variable diversion should not increase traffic flows within the town and therefore this measure is unlikely to generate significant townscape impacts.	Neutral
<b>S&amp;C</b>	Journey Quality	The advisory variable diversion route has the potential to increase journey times for road users that they affect and therefore, along with the change in speed limits, there may be a slight adverse impact on journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. Implementing variable diversions should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	Diversions on to other roads have the potential to lead to congestion; however, as they are advisory they are unlikely to have a significant impact on access to services, employment, and healthcare as traffic is likely to find an equilibrium.	Neutral
<b>Economy</b>	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 strategic road network if they wish to do so. Reducing speed limits on the A470 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. RCTCBC may have concerns over using this alternative route during periods when NO2 levels are highest, as (assuming that traffic would re-join or leave the A470 at Upper Boat) traffic on Tonteg Road is often already very heavy. 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
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and implementing variable diversions will reduce the roadside concentrations by up to 4.6µg/m3, at a combined cost of £6.3m. This measure will therefore be a cost of approximately £1.3m/µg.	£1.3m/µg
<b>Secondary Criteria of the Objective</b>	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, including the Broadway AQMA. Reducing the speed limit will reduce emissions and the diversions will result in further minor reductions in emissions on the A470, 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 noise, 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), but a variable diversion will not have an overall positive impact on the wider public health and inequalities, as it will displace traffic onto local roads and areas of poor air quality, causing NO2 levels to rise on the local road network and through AQMAs.	
<b>Other Issues</b>	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	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	
	Deliverability & Risk	Not considered in further detail following Stage Three modelling as measure has overall adverse air quality impacts.	



## Appraisal Summary Table

Measure No. 009

<b>Name of measure:</b> Enforce/Reduce Speed Limit + Clean Air Zones	
<b>Location:</b> A470	
<b>Description of measure:</b> As well as reducing the speed limit to 50mph, operate a Clean Air Zone to prevent vehicles of Euro 4 / IV or older using the A470 study corridor throughout the day, resulting in accelerated fleet turnover. The measure would be most effective if linked to road charges and scrappage scheme.	
<b>Key Criteria</b>	<b>Effectiveness:</b> Roadside concentrations reduced by up to 4.1µg/m3
	<b>Timescales:</b> End of 2022
	<b>Deliverability:</b> Measure would need to be delivered by the local authority in collaboration with WG network management division.

	Impacts	Summary of key impacts	Assessment
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. In 2022, reducing speed limits will reduce emissions by 9.6% and roadside pollutant concentrations by 3.7µg/m3. The addition of a Clean Air Zone should improve air quality through acting as a deterrent for older/more polluting vehicles to use the strategic network. The combination of the reduced speed limit and CAZ will reduce emissions by up to 10.5%; Roadside pollutant concentrations on the A470 reduced by up to 4.1µg/m3, which is 10% of the limit value.	Large Beneficial
	Noise	There are two noise important areas along the route of the A470 at this location. The A470 runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. With a proposed reduction in traffic speeds and the fleet turnover associated with a Clean Air Zone, 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. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves 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 Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. This measure is unlikely to generate an impact upon townscape.	Neutral
<b>S&amp;C</b>	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the benefits to air quality. The addition of the complementary 'soft' measures should increase public acceptability for the measure. Furthermore, it is considered that the operation of a Clean Air Zone should further improve journey quality, associated with fewer and/ or newer HGVs.	Moderate Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of a Clean Air Zone should not have any further impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	It is likely that the operation of a Clean Air Zone may impact upon journeys, in particular for local business, thus it is considered that there may be a moderate adverse impact to access to services, employment, and healthcare along the study route.	Moderate Adverse
<b>Economy</b>	Journey Time Changes	The operation of a Clean Air Zone 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. £20m to implement a Clean Air Zone. RCTCBC may have concerns about this measure, as they may not want drivers of non-permitted vehicles on 'alternative routes' on the assumption that we are looking at a charging regime or limiting classes of vehicles. Cost estimate takes into account all equipment needed, ongoing maintenance and management and an estimate for measures that the Council may want implemented on the local road network and other routes that non-permitted vehicles may seek to use.	£20,275,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and operating a Clean Air Zone will reduce the roadside concentrations by up to 4.1µg/m3, at a combined cost of £20.3m. This measure will therefore be a cost of approximately £4.9m/µg.	£4.9m/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	There may potentially be an overall reduction to NO2 though it is likely that there may be localised increases in NO2 elsewhere. The addition of a Clean Air Zone should deliver an overall reduction in NO2 emissions over and above those from the imposition of speed limits alone by the end of 2022.	
	Will the measure result in unintended consequences or other environmental impacts	Aside from a slight increase to journey times with the speed reduction, there are not considered to be any adverse consequences to environmental impacts as a consequence of operating a Clean Air Zone.	
	Will the measure impact equally across multiple vehicle classes and journey types	This measure will target older vehicles, which may unequally impact local businesses.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed and the operation of a Clean Air Zone 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.	
<b>Other Issues</b>	Acceptability	Given the nature of the proposals, this measure is anticipated to be opposed by the local authority and by some groups or individuals.	
	Technical, Operational & Financial Feasibility	A Consultation for a Clean Air Zone Framework for Wales was undertaken between 25 April 2018 to 19 June 2018. This process should help to identify the feasibility of a Clean Air Zone on the A470 study corridor.	
	Deliverability & Risk	Potential for displacement of impacts onto local roads if fleet turnover is not achieved with vehicles using local roads instead of the A470.	

## Appraisal Summary Table

Measure No. 010

<b>Name of measure:</b> Enforce/Reduce Speed Limit + Parking Improvement	
<b>Location:</b> A470	
<b>Description of measure:</b> As well as reducing the speed limit to 50mph, provide parking opportunities to encourage car sharing and use of public transport, for instance at railway stations, at key locations along the strategic road network, and on the outskirts of towns.	
<b>Key Criteria</b>	<b>Effectiveness:</b> Roadside concentrations reduced by up to 5µg/m3
	<b>Timescales:</b> End of 2020
	<b>Deliverability:</b> Measures linked to road and pedestrian transport are only able to be delivered in association with the WG Network management division. Rail transport parking outside the scope of WG Network management division.

Impacts		Summary of key impacts	Assessment
<b>Environmental</b>	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of parking improvement(s) will reduce emissions through reducing traffic flows. Emissions reduced by up to 10.8%; Roadside pollutant concentration reduced by up to 5µg/m3, which is 13% of the limit value.	Large Beneficial
	Noise	There are two noise important areas along the route of the A470 at this location. The A470 study corridor runs between Pontypridd and Upper Boat adjacent to sensitive receptors including residential housing, schools, a hospital, leisure centre and caravan park. With a proposed reduction in traffic speeds and a reduction in traffic as a result of mode shift, it is considered that there would be a corresponding reduction in noise.	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. Depending on the location of the parking improvement(s), this measure is could impact upon the landscape of the surrounding area.	Slight Adverse
	Historic Environment	There are two Scheduled Ancient Monuments located at the northern extent of the study corridor namely the Ring Cairn and two standing stones at Coedpenmaen common and Y Garreg Siglo Bardic Complex. There are numerous listed buildings adjacent to the carriageway in both directions. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. Depending on the location of the parking improvement(s), this measure could have a slight adverse impact upon the historic environment.	Slight Adverse
	Biodiversity	There are no SSSIs, SPAs, SACs, RAMSAR sites or National Nature Reserves within 1km of the study corridor. Depending on the location of the parking improvement(s), this measure could involve vegetation clearance that may have a negative impact upon biodiversity.	Slight Adverse
	Water Environment	The River Taff and two unnamed streams run alongside the A470 at this location. 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 is a historic park and garden located within Pontypridd town centre. There are numerous listed buildings adjacent to the carriageway in both directions. This measure is unlikely to generate significant townscape impacts, although this may depend on the location of the parking improvement(s).	Neutral
<b>S&amp;C</b>	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown, and results in an overall better environment. Furthermore, efficiently promoting additional car parking would result in fewer vehicles on the strategic road network, and could encourage car sharing or mode shift to public transport. This has the potential to reduce driver stress, and therefore an improved journey quality would be expected.	Slight Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the car parking should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	A reduction to the speed limit and parking improvement(s) could have a direct benefit to access to services, employment, or healthcare, depending on the location of the parking.	Slight Beneficial
<b>Economy</b>	Journey Time Changes	Parking improvements are 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	It is anticipated that new car parks would be required, which could result in moderate land acquisition.	Moderate Adverse
	Capital and Revenue Costs	£275k for speed limit reduction. To include average speed enforcement cameras and equipment, traffic signs and ongoing maintenance. Cost will vary for car parks depending on the chosen location. Further investigations may be needed, but there is scope to improve parking and provide new car parks at locations such as Coryton Interchange (on WG land) and Abercynon. Improvements to existing public transport locations such as Abercynon Park and Ride at Navigation Park may also be feasible, as a lot of the land in the area is owned by WG. However, around Pontypridd, Treforest and Upper Boat there looks to be little scope in providing new or improved parking facilities that would be seen as an attractive alternative. A new car park (approx. 250 spaces) is likely to cost in the region of £500k on the basis that the land is already owned by WG or can be obtained without CPO. Improvements to existing facilities may cost in the region of £250k to £1m.	Between £525,000 and £1,275,000
<b>VfM</b>	Value For Money	Reducing the speed limit to 50mph and removing vehicles from the study corridor by making parking improvements will reduce the roadside concentrations by up to 5µg/m3, at a combined cost of between £525,000 and £1.3m. This measure will therefore be a cost of between approximately £105,000/µg and £255,000m/µg.	Between £105,000/µg and £255,000/µg
<b>Secondary Criteria of the Objective</b>	Will the measure deliver an overall reduction in NO2 emissions to air	Modal shift to sustainable travel and/or car sharing should see an overall reduction in NO2 levels, over and above those from the imposition of speed limits alone.	
	Will the measure result in unintended consequences or other environmental impacts	Making parking improvements has the potential to result in slight adverse consequences to biodiversity, historic environment, and landscape.	
	Will the measure impact equally across multiple vehicle classes and journey types	It is anticipated that parking improvements will mostly affect car drivers and public transport users.	
	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. With the addition of parking improvements, there is an opportunity for an increase in active travel, as car sharers and public transport users are more likely to walk longer distances to transport hubs than car users do to their parked vehicles.	
<b>Other Issues</b>	Acceptability	Given the nature of the proposals, this measure is unlikely to be opposed by any groups or individuals.	
	Technical, Operational & Financial Feasibility	There are concerns that, although the principle of providing additional parking provision to reduce the number of trips is sensible, there are very few practical locations close enough to the A470 to be of interest to drivers who may want to car share.	
	Deliverability & Risk	Success of this measure is dependant on the travelling public's attitude toward car sharing and/or using public transport.	

Table 9: Summary of WeITAG Stage Three Appraisals

Measures	Key Criteria			Environment							Social and Cultural			Economy			VfM	
	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	£57,000/µg	Likely Measure
002: Air Quality Barriers, plus 50mph Speed Limit	✓	=	✓	+3	+2	-1	-1	-1	0	0	0	+1	0	-1	0	£20,275,000	£3.4m/µg	Precautionary Retained Measure
003: Distance Chevrons, plus 50mph Speed Limit	✗	✓	=	+3	+1	0	0	0	0	0	-1	+2	0	-2	0	£350,000	£56,000/µg	Unlikely Measure
004: Junction Closures (Option A - SB on-slip, Bridge St), plus 50mph Speed Limit	✗	✓	✓	-3	-1	0	0	0	0	0	-1	+1	-2	-1	0	£10,275,000	£1m/µg	Unlikely Measure
005: Junction Closures (Option B - SB on-slip, Glyntaff), plus 50mph Speed Limit	✗	✓	✓	-1	-1	0	0	0	0	0	-1	+1	-2	-1	0	£10,275,000	£2.1m/µg	Unlikely Measure
006: Junction Closures (Option C - SB on-slips, Glyntaff and Bridge St.), plus 50mph Speed Limit	✗	✓	✓	-3	-2	0	0	0	0	0	-2	0	-3	-2	0	£10,275,000	£565,000/µg	Unlikely Measure
007: Ramp Metering, plus 50mph Speed Limit	✗	✓	✓	+3	+1	0	0	0	0	0	+1	+1	0	-1	0	£1,075,000	£230,000/µg	Unlikely Measure
008: Variable Diversions, plus 50mph Speed Limit	✗	✓	✓	-1	-1	0	0	0	0	0	-1	+1	0	-1	0	£6,275,000	£1.3m/µg	Unlikely Measure
009: Clean Air Zone, plus 50mph Speed Limit	✓	=	=	+3	+2	0	0	0	0	0	+2	+1	-2	-1	0	£20,275,000	£4.9m/µg	Precautionary Retained Measure
010: Improved Car Parking, plus 50mph Speed Limit	✓	✓	=	+3	+1	-1	-1	-1	0	0	+1	+1	+1	-1	-2	Between £525,000 and £1,275,000	Between £105,000/µg and £255,000/µg	Precautionary Retained 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 50mph Speed Limit**

#### **000 – Complementary Package of Soft Measures**

The Speed Limit measure, 001, is, in part, installed on the A470. The realisation of the benefits of the measure are, however, dependent on the enforcement of the measure. At the time of writing, discussions are 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:

**003 – Distance Chevrons, plus 50mph Speed Limits** – Fails on Effectiveness: The modelling (traffic and air quality) suggests that the measure is **unlikely** to be effective in reducing NO<sub>2</sub> concentrations beyond that achieved by reducing speed limits and may even offset some of the benefits of reduced speed limits alone.

**004, 005, 006 – Junction Closure Measures, plus 50mph Speed Limits** – Fail on Overall Dis-benefits: The screening of the air quality impacts of the diversion of traffic from the mainline A470 indicates that all junction closure measures will result in an **overall increase in exposure** to air pollution including at properties where concentrations exceed the air quality standards.

**007 – Ramp Metering, plus 50mph Speed Limits** – Fails on Effectiveness: The modelling (traffic and air quality) suggests that the measure is **unlikely** to be effective in reducing NO<sub>2</sub> concentrations beyond that achieved by reducing speed limits and may even offset some of the benefits of reduced speed limits alone.

**008 – Variable Diversions, plus 50mph Speed Limits** – Fails on Overall Dis-benefits: The screening of the air quality impacts of the diversion of traffic from the mainline A470 indicates that variable diversions are likely to result in an overall increase in exposure to air pollution.

### 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 A470 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 measures have 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 2020 due to the relatively long implementation timescales of the measures.

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

**002 - Air Quality Barriers, plus 50mph Speed Limits** – Six locations have been identified where there is potential exposure to air pollution above the limit value where the installation of barriers could be of benefit.

**009 - Clean Air Zone, plus 50mph Speed Limits** - Measures to consider for a Clean Air Zone were set out in Welsh Government's CAZ Framework for Wales. This measure here specifically relates to the imposition of restrictions on the most polluting vehicles, whether as absolute bans or via charging.

**010 - Improved Car Parking, plus 50mph Speed Limits** – Welsh Government are appraising options for improved parking under the South Wales Metro proposals, though could seek to bring forward implementation timeframes if required.

## 5 FINANCIAL CASE

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### 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 A470 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**

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### **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

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### 7.1 SUMMARY OF MANAGEMENT CASE FROM STAGE ONE AND TWO

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

The WelTAG Stage One and Two reports outlined:

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

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

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

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

The Welsh Ministers accept the 2017 Plan does not, insofar as it relates to Wales, satisfy the requirements of the Ambient Air Quality Directive or the Air Quality Standards (Wales) Regulations 2010. This is because the Welsh Government did not, at the time when the 2017 Plan was drawn up, have sufficient information to properly consider what measures within their devolved competence (if any) would ensure compliance with the limit values for NO<sub>2</sub> 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 25<sup>th</sup> April 2018 (and 19<sup>th</sup> June 2018) seeking views on the Welsh Government supplemental plan to the 'UK plan for tackling roadside nitrogen dioxide concentrations 2017 ("the 2017 Plan")'. The WGSP builds on Section 7.6 (Additional Actions in Wales) of the 2017 Plan and sets out actions the Welsh Government will take to ensure compliance within the shortest possible time with the limit values for nitrogen dioxide (NO<sub>2</sub>) 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 A470 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 A470 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 A470 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 regard 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)*

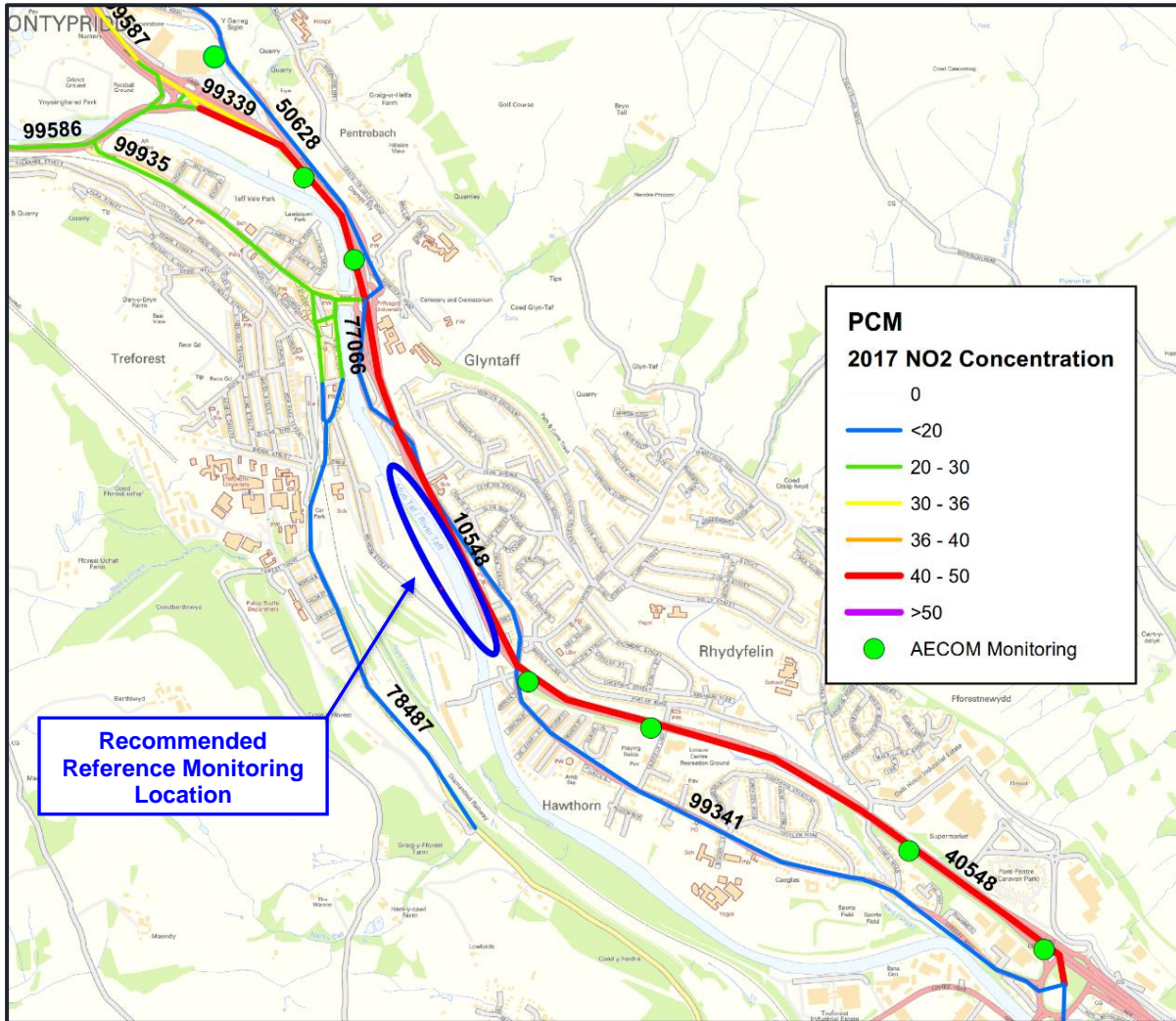
*For all pollutants, traffic-orientated sampling probes shall be at least 25 m from the edge of major junctions and no more than 10 m from the kerbside (Para C)*

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 A470 to the south of, but within 1km of, the PCM link 40548; 2 locations on the A470 to the north of, but within 1km of, the PCM Link 10548, and 2 sites that lie on the population side of the vegetation barrier on PCM Link 40548. 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 A470 lies within the South Wales zone for the purpose of the assessment of compliance with the EU Air Quality Directive. The national assessment<sup>1</sup> of roadside NO<sub>2</sub> undertaken for the South 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 South Wales zone (2026 without additional measures) is, in current projections, determined by the compliance of the A472 in Hafod-yr-Ynys.

This report has presented the Stage Three: Full Business Case of the WelTAG process for reducing the levels of NO<sub>2</sub> on the A470 dual carriageway network in South Wales. Elevated concentrations of NO<sub>2</sub> on this study corridor are due to a combination of high traffic volumes and periods of congestion.

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

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

**Table 10: Appraisal Outcome**

Measure	Outcome
<b>001: Enforce / Reduce Speed Limit (50mph)</b>	Likely Measure
<b>002: Air Quality Barriers, plus 50mph Speed Limit</b>	Precautionary Retained Measure
<b>003: Distance Chevrons, plus 50mph Speed Limit</b>	Unlikely Measure
<b>004: Junction Closures (Option A - SB on-slip, Bridge St), plus 50mph Speed Limit</b>	Unlikely Measure
<b>005: Junction Closures (Option B - SB on-slip, Glyntaff), plus 50mph Speed Limit</b>	Unlikely Measure
<b>006: Junction Closures (Option C - SB on-slips, Glyntaff and Bridge St.), plus 50mph Speed Limit</b>	Unlikely Measure
<b>007: Ramp Metering, plus 50mph Speed Limit</b>	Unlikely Measure
<b>008: Variable Diversions, plus 50mph Speed Limit</b>	Unlikely Measure
<b>009: Clean Air Zone, plus 50mph Speed Limit</b>	Precautionary Retained Measure
<b>010: Improved Car Parking, plus 50mph Speed Limit</b>	Precautionary Retained Measure

## 8.2 PREFERRED MEASURES

### 8.2.1 LIKELY MEASURES

For the A470 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
  - Car Sharing

The Speed Limit measure, 001, is, in part, installed on the A470. The realisation of the benefits of the measure are, however, dependent on enforcement. 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 A470 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 measures have 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 2020 due to the relatively long implementation timescales of the measures.

It is recommended that work on the implementation of these measures 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
- 009 Clean Air Zone, plus 50mph speed limit
- 010 Parking Improvement, plus 50mph speed limit

Taking account of the strategic nature of the A470 and measures already considered during the WelTAG process to reduce overall emissions, the specific Clean Air Zone measure considered here was a restriction on access for the most polluting vehicles. It has been modelled as the elimination of all Euro 4/IV vehicles and older. This is likely to be a conservative assessment of the potential benefits of a CAZ but further work is required to identify, amongst other things, the local fleet mix to optimise and appropriately target the potential vehicle restrictions.

## 8.3 NEXT STEPS

All likely measure 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
  - Car Sharing



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.

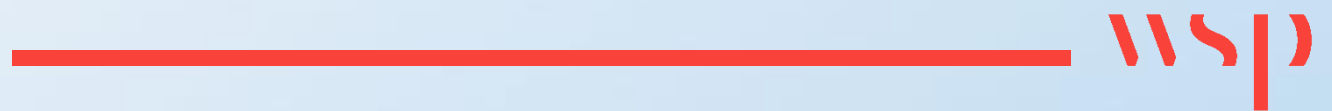
Post implementation and analysis of 12 months of monitoring data, an updated EU Directive Compliance Report will be prepared (WelTAG Stage Five) based on post implementation and analysis of 12 months of monitoring data. This will include a review of the performance of the likely measures and the requirement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

Furthermore, ANPR surveys should be undertaken to baseline and further explore the potential benefits of the retained measures, and a further study to aid the detailed development of a Clean Air Zone should be progressed.



# Appendix A

**WELTAG 2017 GUIDANCE UPDATE**







## WELTAG 2017 GUIDANCE UPDATE

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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 A470 Trunk Road (Upper Boat  
to Bridge Street Interchange,  
Pontypridd, Rhondda Cynon Taf)  
(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 A470 Trunk Road, are satisfied that traffic on specified lengths 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 A470 Trunk Road (Upper Boat to Bridge Street Interchange, Pontypridd, Rhondda Cynon Taf) (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

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(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 A470 Cardiff to Llangurig 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 lengths of the trunk road specified in the Schedule to this Order.

### **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 lengths of the trunk road described in the Schedule to this Order 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

## **SCHEDULE**

The length of the trunk road that extends from a point 320 metres south of the nosing of the northbound exit slip road at Upper Boat Interchange to a point 450 metres north of the nosing of the northbound entry slip road at Bridge Street Interchange, Pontypridd, Rhondda Cynon Taf.

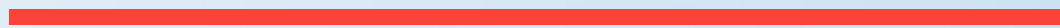
The lengths of the northbound and southbound exit and entry slip roads at Upper Boat Interchange, northbound exit and southbound entry slip roads at Glyntaff Interchange and Broadway Interchange and northbound entry and southbound exit slip roads at Bridge Street Interchange.





# Appendix C

**INRIX TRAFFIC DATA**



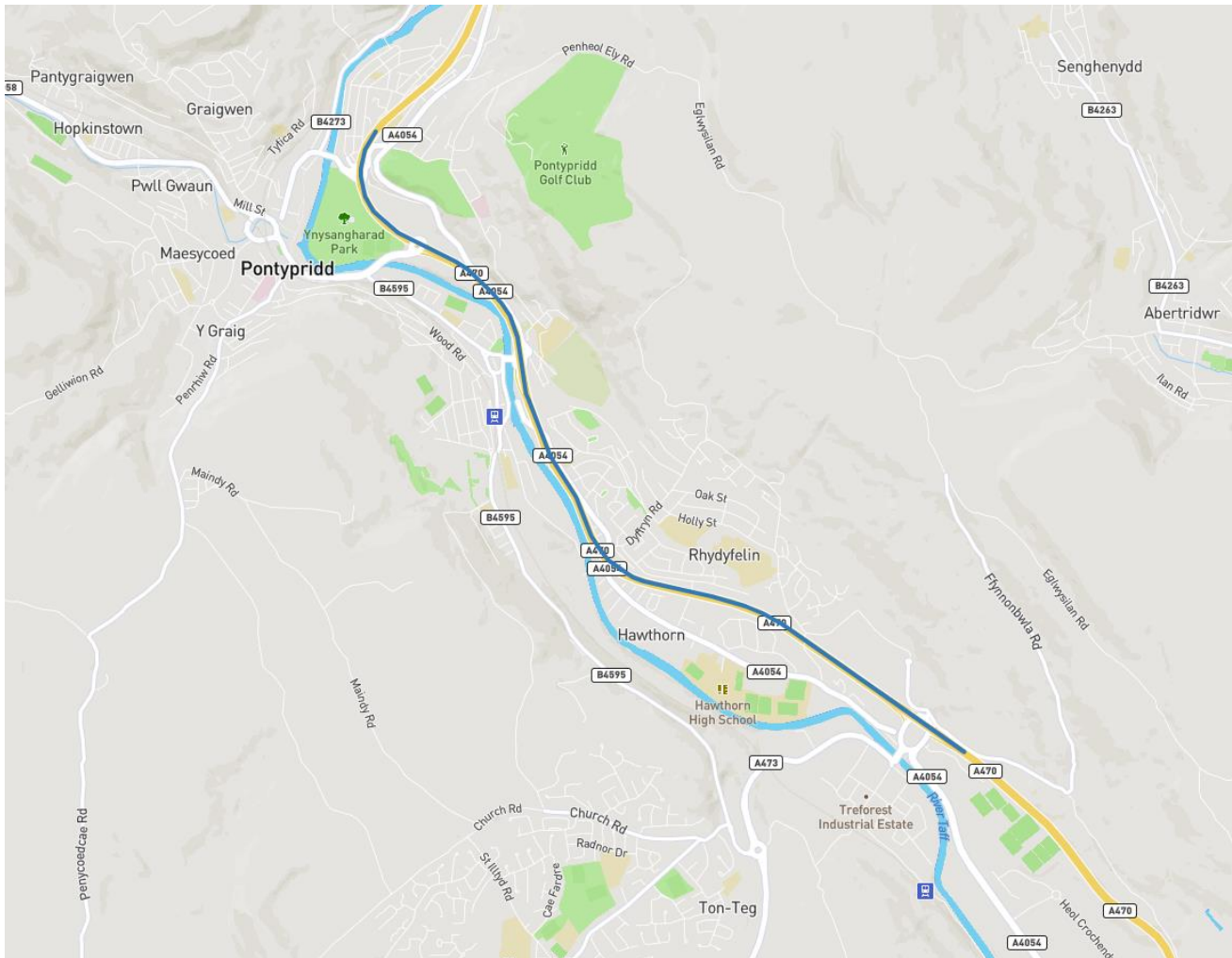


# INRIX - TRAFFIC SPEED DATA

## 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 A470 study corridor as possible.

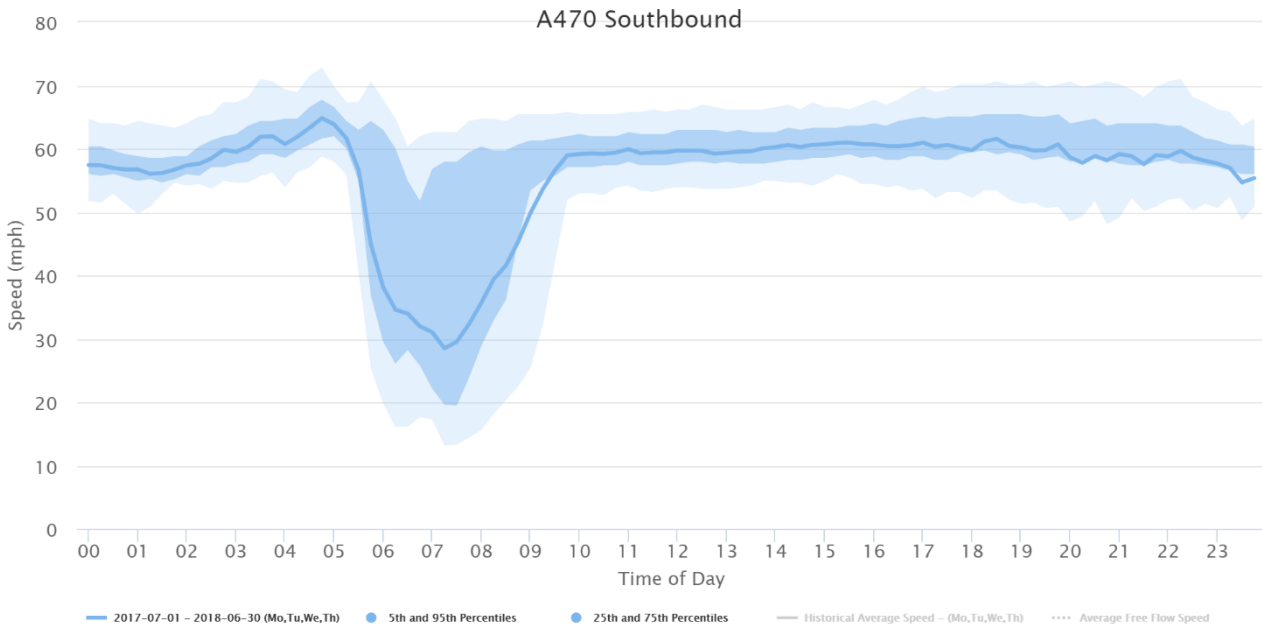
### INRIX A470 Corridor





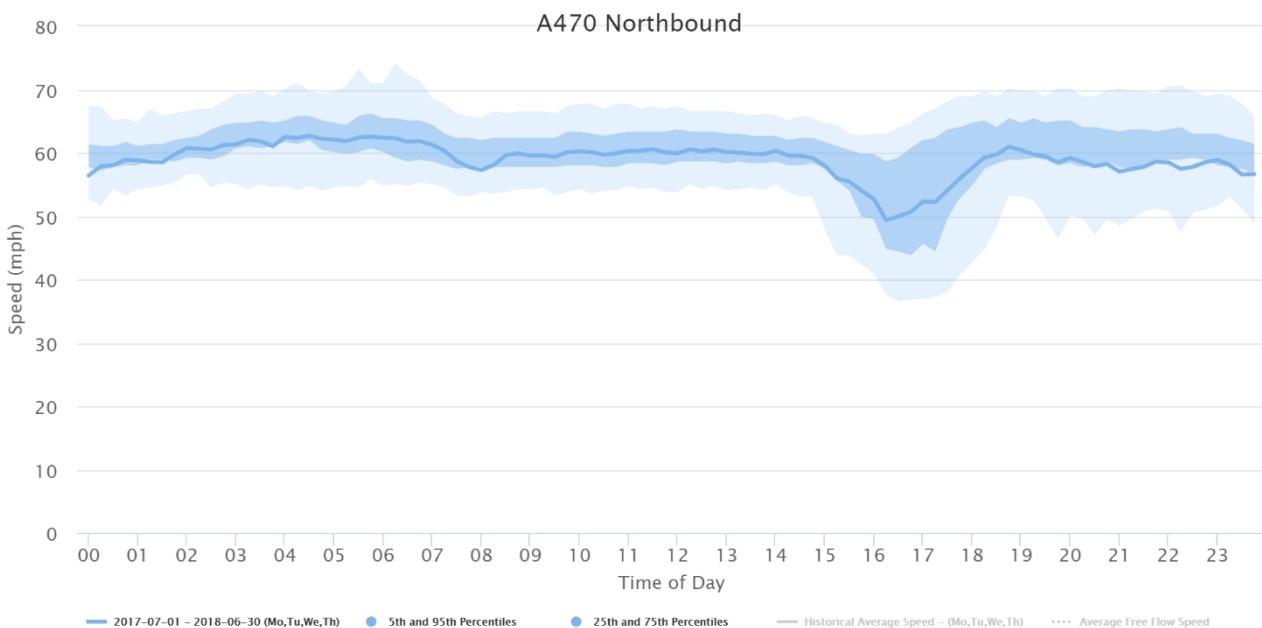
Speed data has been extracted for the A470 southbound and northbound directions for the period 1<sup>st</sup> July 2017 to 30<sup>th</sup> June 2018 (Monday-Thursday), as shown in Figure 1 and Figure 2, respectively.

**Figure 1: A470 Southbound Speeds (mph)**



The data shows that speeds drastically reduce for vehicles travelling southbound during the AM peak period from approximately 05:30 to 09:30, with the lowest average speed of 28mph recorded at 07:15. There is no noticeable reduction in speeds during the PM peak, with speeds averaging approximately 60mph across all other times of the day.

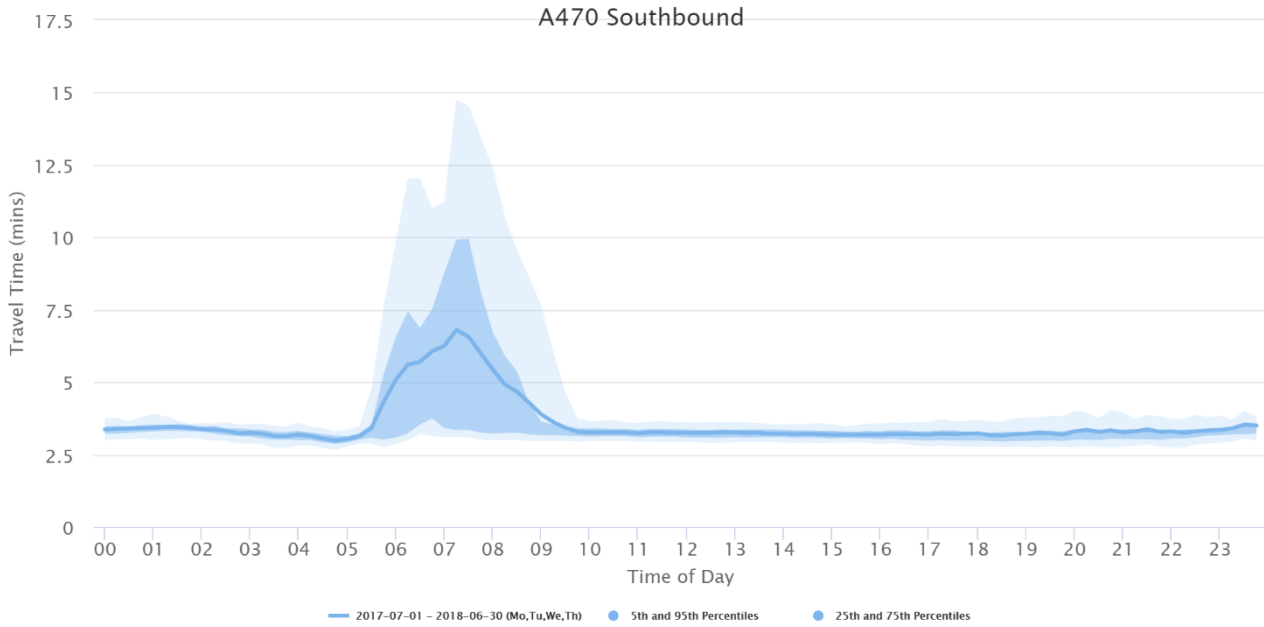
**Figure 2: A470 Northbound Speeds (mph)**



For vehicles travelling northbound on the A470, speeds average approximately 60mph throughout most of the day, with a small reduction during the PM period. The lowest average speed of 49mph occurs at 16:15.

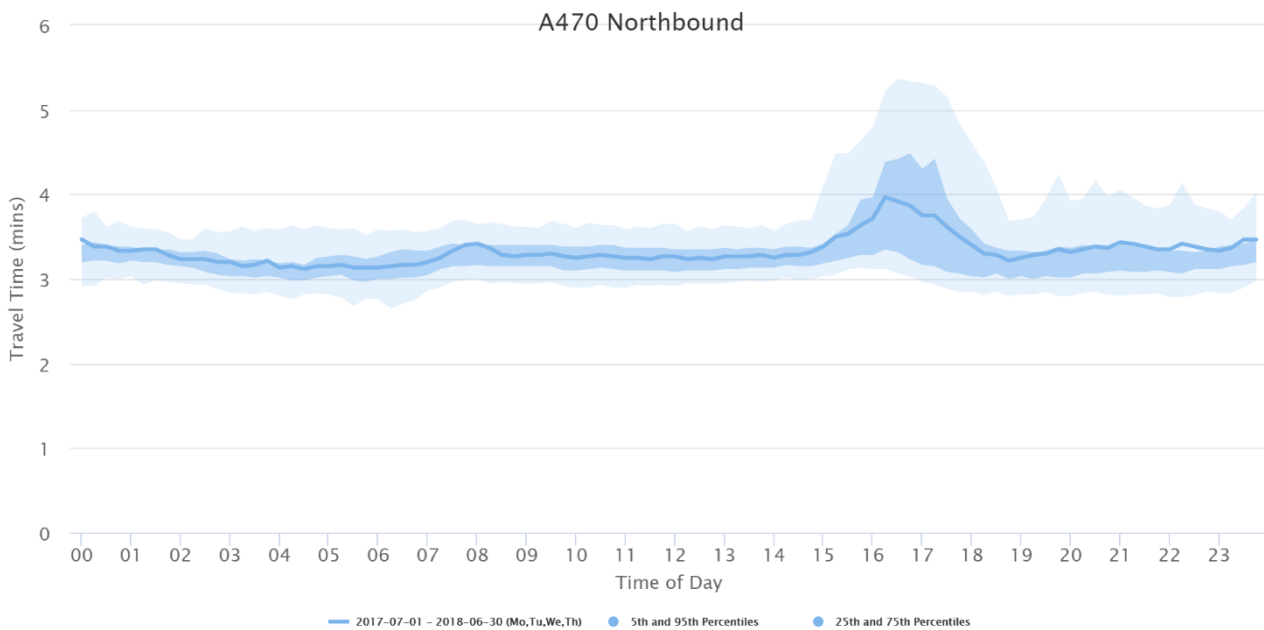
Travel times have also been extracted from INRIX for the A470 corridor for the same period, as shown in Figure 3 and Figure 4.

**Figure 3: A470 Southbound Travel Time (mins)**



Travel time on the southbound carriageway significantly increases during the AM peak period, from an approximate free-flow time of 3 minutes to an average of 7 minutes at 07:15. Delay in this direction on this corridor can therefore be inferred as approximately 4 minutes during the AM peak.

**Figure 4: A470 Northbound Travel Time (mins)**



For the A470 northbound corridor, INRIX shows that free-flow travel time is approximately 3 minutes 15 seconds, which increases to 4 minutes at 16:15. Delay in this direction on this corridor can therefore be inferred as approximately less than 1 minute during the PM peak.



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