South Wales Trunk Road Agent

Managing and Improving Motorways and Trunk Roads through South Wales

Asiant Cefnffyrdd De Cymru

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M4 Junction 38 to 42
Making Better Use Study

J41 Westbound On-Slip Peak Time Closure
Final Evaluation Report
(up to March 2015)

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

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M4 Junction 38 to 42 Making Better Use Study
M4 J41 Westbound On-Slip Peak Time Trial Closure
Final Evaluation Report
(up to March 2015)

Service Provider/Consultant Name: Atkins

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South Wales Trunk Road Agent

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Contents

Executive Summary

This report provides the results of an evaluation of the benefits and impacts of the M4 Junction 41 westbound on-slip peak time trial closure that took place from August 2014 to March 2015.

Primary Economic Evaluation

The overall monetary impact on journey times on the M4 westbound and key local roads is a **benefit** of **£179,815** per annum, representing a total annual decrease of **14,559 vehicle hours**.

The eastbound M4 is not included in the Primary Economic Evaluation as increases in eastbound traffic flows and journey times are considered to be a result of ongoing trends, and unrelated to the trial slip road closure, and would unduly influence the primary economic evaluation of the trial if included.

Journey Times and Journey Time Reliability

The peak time closures of the Junction 41 westbound on-slip has reduced average journey times on the westbound carriageway of the M4 by up to 34 seconds (a 5% improvement) between Junction 38 and a point just after Junction 42. It has also improved journey time reliability as a result of more consistent average speeds between Junctions 38 and 42.

The trial slip road closure can therefore be seen to have met two original objectives for the westbound M4 – to reduce journey time and improve journey time reliability.

In contrast, on the eastbound carriageway where no slip road closures have been undertaken, journey times have continued to be affected by the disruption to traffic flow at Junction 41 during peak times. Journey time reliability has not noticeably changed.

The key local road network routes have seen a range of increases and decreases in journey times, influenced by the slip road closures and the pre-emptive measures put in place to mitigate their impacts. Overall, there has been a positive impact.

Secondary Impacts

The pre-emptive measures put in place on the local roads to mitigate any impacts of the redistribution of traffic appear to have worked adequately, with a general improvement in journey times on the local road routes.

However, there have been localised increases in queue lengths increases in traffic queues in some locations where pre-emptive mitigation measures were not put in place. Congestion has been observed on the approach to the Sunnycroft roundabout on the A48 Pentwyn Baglan Road and local side roads, caused by traffic not following the prescribed diversion route.

The A48 Pentwyn Baglan Road approach to Sunnycroft roundabout was identified by modelling as a location where mitigation measures would be required. However, whilst some advisory measures have been implemented, the installation of the physical measures was deferred by the local highway authority Neath Port Talbot CBC pending the outcome of the trial.

Overall, there is no evidence at present of the trial slip road closures adversely affecting the majority of the key routes through Port Talbot.

Based upon analyses of car parking data and footfall surveys, there is no evidence to suggest that there has been an impact on visitor numbers to Port Talbot town centre as a result of the trial closures. Reductions in visitor numbers are consistent with the observed year-on-year trend of decreasing car park users and national shopping centre and town centre footfall.

Neath Port Talbot's Air Quality Monitoring Team have deployed nitrogen dioxide (NO_2) diffusion tubes at 19 locations in order to study the effect of the trial slip road closures. An interim assessment has been made against the government's long term air quality objective for NO_2. At present it appears that all but one site easily comply with the long term air quality objective for NO_2 (40 $\mu g/m^3$). The data collection and assessment will continue to enable an annual average over a full calendar year to be calculated.

Calculations show a **reduction of 150 tonnes of carbon per year** on the M4 westbound carriageway during the post-closure period.

1 Introduction

1.1 Purpose of this Report

This report provides the results of an evaluation of the benefits and impacts of the M4 Junction 41 westbound peak time entry slip road trial closure.

The Primary Evaluation provides a measure of the success or otherwise of the trial slip road closure in terms of monetary benefits or impacts derived from improvements in journey times on the M4 Westbound compared to the monetary benefits or impacts associated with other key local routes for the for the periods from August to March before and during the trial slip road closure.

The parameters for the Primary Evaluation are:

- Change in journey times on the motorway and number of vehicles affected
- Change in journey times on the local road network and number of vehicles affected

The impact on the operation of the M4 has also been assessed by:

- Comparing pre and post-closure average speeds along the route
- Comparing Journey Time Reliability on the M4

The same parameters have been studied for the eastbound carriageway of the M4, even though no slip road closures have been implemented in this direction. This is to provide a benchmark with which to compare the westbound carriageway, and to provide an indication of the impacts of the average speed camera system that has recently been introduced in both directions.

Other secondary indications of benefits/impacts are also provided for the following:

- Queue lengths at key junctions
- Air Quality
- Visitor numbers to Port Talbot town centre, in the form of number of car park tickets issued and the footfall in the Aberafan Shopping Centre.
- Collision and Incident numbers

1.2 Context of the Trial Slip Road Closure Closure

The M4 is a strategically important route for South Wales, providing a route between Swansea and London, via Cardiff, Newport, Bristol and Reading. Figure 1.1 shows the importance of the M4 motorway in connecting South Wales to London and the rest of the UK.

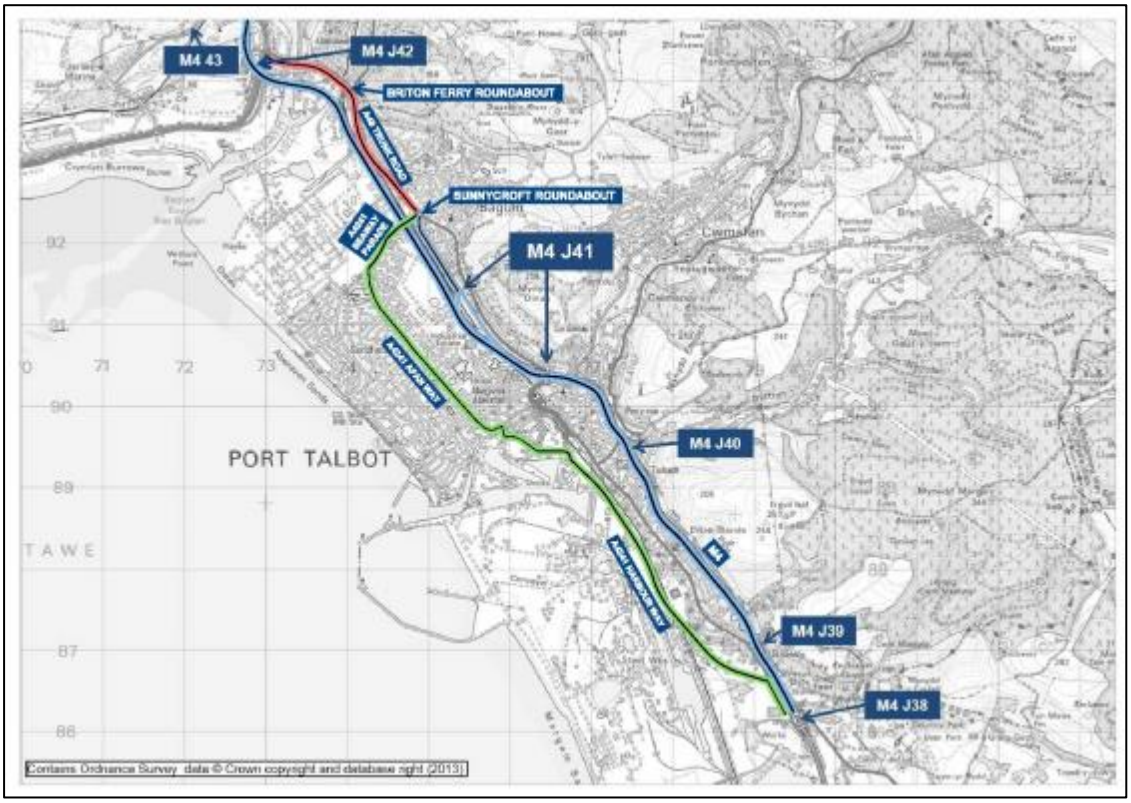
Figure 1.1 – M4 Motorway and location of Port Talbot

The M4 between Margam and Baglan was constructed in the 1960s as the Port Talbot Bypass before being renamed as the M4 in the 1970s when the section to the east was completed. The "missing link" from Baglan to Lonlas was added in 1990s, which included the bridge over the River Neath at Briton Ferry.

It is an illuminated dual 2 lane motorway (D2M) with a 50mph speed limit in force on the central section between a point approximately 600m east of Junction 40 and a point 300m west of Junction 41. The remaining length (outside of the central section) is subject to the national speed limit for motorways of 70mph. A significant length of the central section is on an elevated structure. Between Junction 41 and Junction 42, the M4 crosses the navigable River Neath on a high-level bridge and approach viaducts.

Port Talbot is well connected to the M4 motorway, with the five junctions forming Junctions 38 to 42 being within a 13km length of the M4. Given this, the M4 has long been used for short journeys by local traffic, including joining and leaving at Junction 41. Figure 1.2 shows the locations of Junctions 38 to 42 of the M4.

Figure 1.2 – M4 J38-42 through Port Talbot



Harbour Way was opened in October 2013, which completed the dual two lane all-purpose (D2AP) Port Talbot Peripheral Distributor Road (PDR) linking the M4 Junction 38 Margam with the A48 Sunnycroft Roundabout at Baglan. It is a strategic local authority road which facilitates access to the dock area of Port Talbot. It functions as a local distributor road, providing additional capacity and access to new development areas. With the A48 trunk road, it provides a dual carriageway road corridor parallel to the M4 from Junction 38 to Junction 42.

1.3 Existing Problems

1.3.1 Congestion and Queuing

It is known that congestion and queuing occurs on the M4 at Port Talbot, most often during the peak periods.

During peak periods (especially the morning peak), slow moving or stationary traffic frequently occurs in the eastbound direction in the vicinity of Junction 41, extending back towards the River Neath Bridge.

Similarly, during peak periods (especially the evening peak), congestion and queuing frequently occurs in the westbound direction in the vicinity of Junction 41, sometimes extending back to Junction 38 and beyond. The Friday evening peak can often result in the greatest levels of congestion and queuing.

The residual effects of the peak periods sometimes extend for some time after the busiest hours.

Collisions and other incidents (such as breakdowns) can also disrupt traffic in this area, and when these occur during the peak periods more pressure is added to the operation of the motorway which can lead to significant delays.

The result is motorists experience delays and increased journey times during peak hours on the M4 but with little predictability of how long the delays will last.

1.4 Factors that contribute to the Congestion and Queuing

1.4.1 Existing Layout of the M4 and its Junctions

The current standards for the layout and geometry of motorways and trunk roads are contained in the Design Manual for Roads and Bridges[1] (DMRB).

For much of the section between Junctions 38 and 42, the layout of the M4 falls below current motorway design standards. It has sub-standard radii and visibility and closely spaced junctions. Junction 41 is within the 50mph limit section, and is of an unconventional layout, where the slip roads could be considered as being the "wrong way round", with its entry slip roads occurring before its exit slip roads.

The frequency and layout of junctions results in many "weaving" movements with vehicles accelerating, decelerating and changing lanes over relatively short distances, especially between the entry and exit slip roads at Junction 41.

[1] The "Design Manual for Roads and Bridges" (DMRB) was introduced in 1992 in England and Wales, and subsequently in Scotland and Northern Ireland. It provides a comprehensive manual system which accommodates, within a set of loose-leaf volumes, current Standards, Advice Notes and other published documents relating to Motorway and Trunk Road Works. All current DMRB documents are available from the Department for Transport website at www.standardsfrohighways.co.uk

Additionally, the layout of a number of the slip road merges and diverges do not comply with the layout required by the DMRB for the current traffic flows. This includes the westbound Junction 41 entry which, according to the DMRB, should incorporate a lane gain (i.e. the number of lanes on the main carriageway should increase to 3 following the slip road entry).

1.4.2 Observed use of the M4 and its Junctions

Traffic volumes over this section of motorway are high, with average two-way flows up to 75,000 vehicles per day. The traffic volume is not evenly distributed throughout the day with pronounced increases in traffic during the morning and evening peak periods. Furthermore, the traffic appears to be tidal in nature, with higher volumes being in the eastbound direction during the morning peak and westbound during the evening peak.

The close proximity and layouts of the junctions encourages the use of the motorway as a bypass by local traffic.

1.4.3 Poor Visibility to Merging Traffic

At Junctions 40 and 41, visibility from the main M4 carriageway to merging traffic is restricted by the presence of a solid concrete parapet on the elevated structure.

Observations have shown that there are frequent instances where vehicles brake or change lanes sharply due to drivers not being aware of vehicles attempting to merge until they are virtually at the merging point. This occurs particularly on the approach to the westbound Junction 41 entry merge, which has the poorest visibility to merging traffic.

These sharp changes in speed and direction of traffic can cause a “shock wave” of braking to propagate back through the stream of traffic, contributing to a disruption of the flow.

1.5 M4 J41 Westbound Peak Time On-Slip Trial Closure

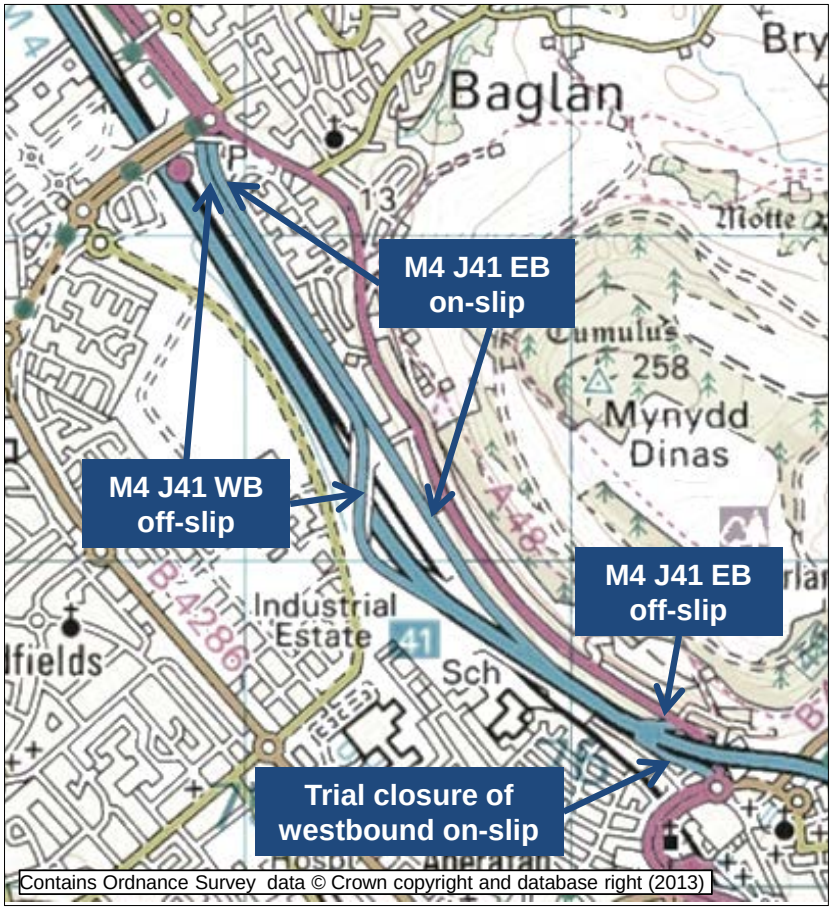
The completion of the PDR by the construction of Harbour Way allowed the Welsh Government (WG) the opportunity to review the operation of the motorway in the area. WG decided to implement trial peak-time closures of the M4 Junction 41 westbound on slip road to see if this would remove some of the contributing factors and reduce the congestion and queuing problems which are considered to originate from this location.

The trial slip road closure began on 4th August 2014 and the monitoring period continued to the end of March 2015. The closure was in place only during the peak hours of 07:00-09:00 and 16:00-18:00 weekdays. Figure 1.2 shows the locations of the slip roads at Junction 41, including the westbound on slip road which was subject to the trial peak time closure.

Pre-emptive mitigation measures on local routes were put in place before the trial, informed by traffic modelling predictions of where local traffic issues could occur The A48 Pentwyn Baglan Road approach to Sunnycroft roundabout was identified by modelling as a location where mitigation

measures would be required. However, whilst some advisory measures have been implemented, the installation of the physical measures was deferred by the local highway authority Neath Port Talbot CBC pending the outcome of the trial.

Figure 1.3 – M4 Junction 41 Entry and Exit Slip Roads



1.6 Evaluation of the Trial Slip Road Closure

1.6.1 Primary Evaluation Aims and Success Criteria

The overarching primary measure of the success of the trial slip road closure will be monetary benefits or costs derived from changes in journey times on the M4 compared to the monetary benefits or costs associated with other key local routes.

The primary parameters are:

- Change in journey times on the motorway and number of vehicles affected
- Change in journey times on the local road network and number of vehicles affected

1.6.2 Objectives of the Trial Closure

Considering the aforementioned identified problems, the following objectives were set for this trial slip road closure:

- **OBJ1** - Improve journey time reliability on the M4 between J38 and J42;
- **OBJ2** - Reduce overall journey times on the M4 between J38 and J42 during peak periods; and
- **OBJ3** - Reduce the accident rate on the M4 between J38 and J42.

The primary monetary evaluation included in this report is primarily related to OBJ2. However, a quantitative assessment of its performance against OBJ1 and OBJ2 will also be made.

The trial slip road closure's performance against OBJ3 is not included in this report. This will be a longer term assessment as Personal Injury Accident data is collected by the police and there is usually at least a six month time lag before this data is made available.

Also included in this report is an assessment of the supplementary impacts on the local area, but which do not form part of the evaluation of the success or otherwise of the trial slip road closure in terms of its performance against the objectives. Instead, the results will be used to provide an indication of the scale of any impacts and will provide additional information to the Welsh Government in its decision making process.

2 Evaluation Study Area, Methodology and Data Collection

This chapter details the methodology used to evaluate the benefits and impacts of the trial slip road closure, as well as the data collection undertaken.

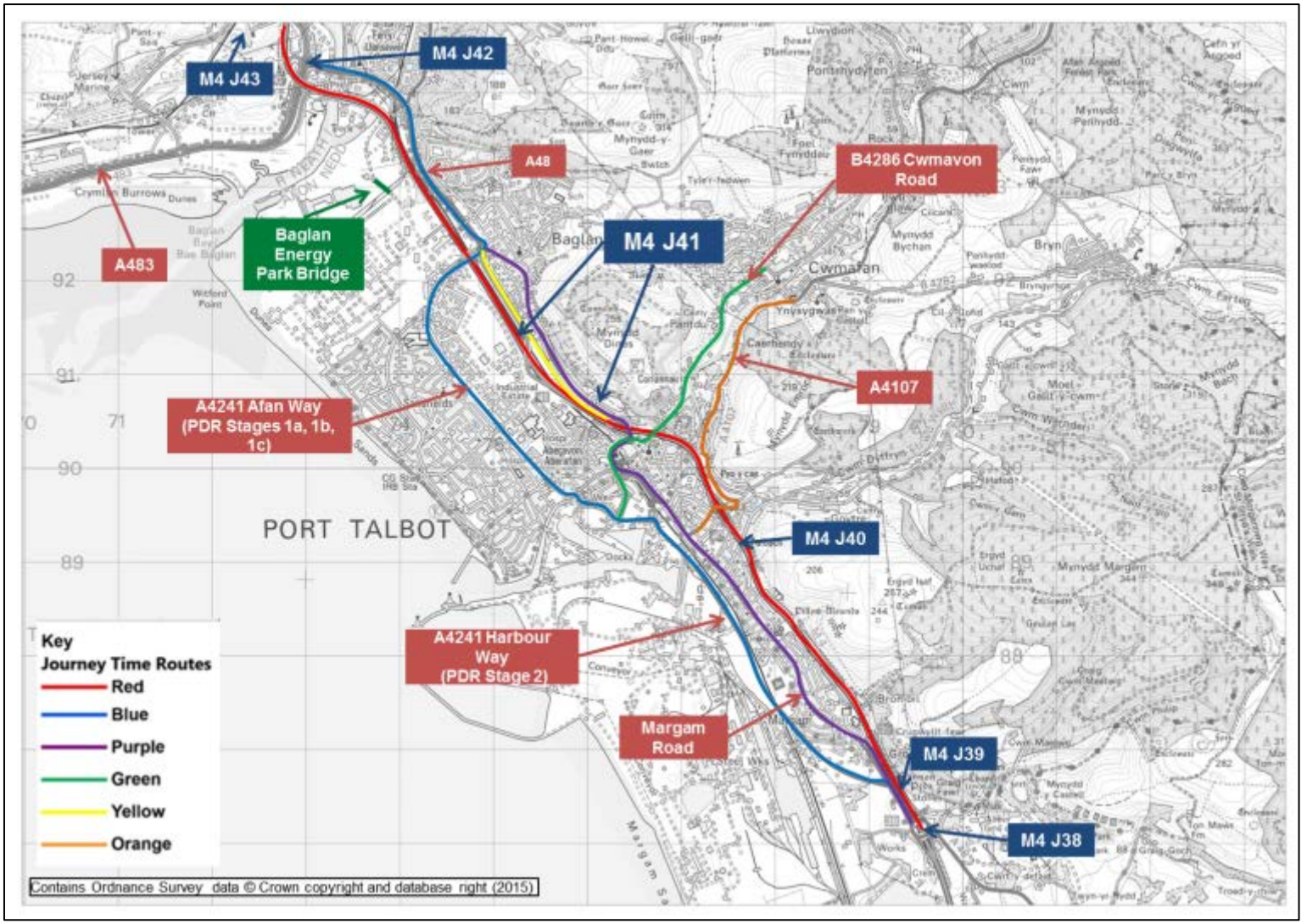
2.1 Evaluation Study Area

Table 2.1 and Figure 2.1 highlight those routes which form the study area for the Primary Evaluation. The choice of this study area was agreed with Welsh Government, South Wales Trunk Road Agent (SWTRA), and Neath Port Talbot County Borough Council as being representative of the main highway routes that would most likely be affected by the proposals. It was informed by the results of traffic modelling that was undertaken to assess a number of improvement measures as part of the scheme development.

Table 2.1 – Primary Evaluation Routes

Primary Evaluation Routes	Description
Red Route	M4 J38 to M4 J43
Blue Route	A4241 and A48 between M4 J38 and Earlswood Junction
Green Route	B4286 Cwmavon Road between Port Talbot and Cwmavon
Purple Route	M4 J38 to Sunnycroft Roundabout via A48
Orange Route	A4107 between Cwmavon and A48/Abbey Road junction.
Yellow Route	M4 J41 Westbound Off-Slip and Eastbound On-Slip

Figure 2.1 – Evaluation Study Area



2.2 Other Highway Schemes

Whilst undertaking this evaluation, consideration has been given to the following highway schemes in the Port Talbot area that could have had an impact on the evaluation results.

2.2.1 A4241 (Peripheral Distributor Road)

The Port Talbot Peripheral Distributor Road (PDR) has been designed to accommodate traffic associated with the industrial and commercial development of south west Port Talbot, to reduce local traffic on the M4 between Junction 38 and Junction 41 and provides a high standard dual carriageway route parallel to the M4 in Port Talbot. The route was opened in stages as follows:

- A4241 Afan Way - Stages 1a, 1b and 1c of the PDR construction, completed February 2007; and
- A4241 Harbour Way - Stage 2 of the PDR construction, completed August 2013 and officially opened in October 2013. (i.e. during the pre-closure data collection period)

2.2.2 Baglan Energy Park Bridge

Construction of Baglan Energy Park Bridge (location shown in Figure 2.1) was completed at the end of March 2015, after all the data for this evaluation had been collected. The new bridge improves the connectivity of the local road network in Port Talbot by linking the eastern and western areas of the Baglan Energy Park, which was previously severed by a railway line. The western area was previously accessed via Brunel Way off the Briton Ferry Roundabout. The eastern area was previously accessed from the Rutherglen Roundabout on Seaway Parade.

The bridge provides a road parallel to the A48 between Briton Ferry and Sunnycroft junctions on the A48, and could have an impact on the distribution of traffic on this route. The bridge will have had no impact on traffic during the period covered by this study, but should be taken into account in any future evaluations of the trial slip road closure.

2.2.3 M4 Average Speed Camera System

The installation of an average speed camera system along the 50mph speed limit section of the M4 took place in 2014. By regulating traffic speed, average speed cameras can improve traffic flow along a route, minimising flow break down that results from vehicles driving too fast and then braking. Enforcement of average speed violations began in January 2015.

The presence of the cameras, whether being enforced or not, will affect the speed at which drivers use the M4.

Results from the M4 eastbound carriageway (which is not subject to any slip road closures) will be used to identify any impacts that the average speed camera system may have had.

2.3 Data Collection Methodology

2.3.1 Traffic Volume Data

The volume of traffic on the M4 and the local road network in Port Talbot has been monitored in order to ascertain whether there have been any changes in flows following the implementation of the trial slip road closure. This analysis covers the following periods:

- **Pre-trial closure:** Aug 2013 to March 2014 inclusive[1]
- **Post-trial closure:** Aug 2014 to March 2015 inclusive

Week day traffic flow data for the hours of closure (07:00-09:00 and 16:00-18:00) and for the inter-peak (12:00-13:00) have been collected. The inter-peak is used as a control period to which the peak hour traffic flow changes can be compared. The following sources have been used to obtain traffic flow data:

- A combination of Motorway Incident Detection and Automatic Signalling (MIDAS), Automatic Traffic Counters (ATCs) and Radar detectors on the M4 obtained from the Welsh Transport Technology Consultancy (WTTC); and
- ATCs on the local road network in Port Talbot provided by NPT.

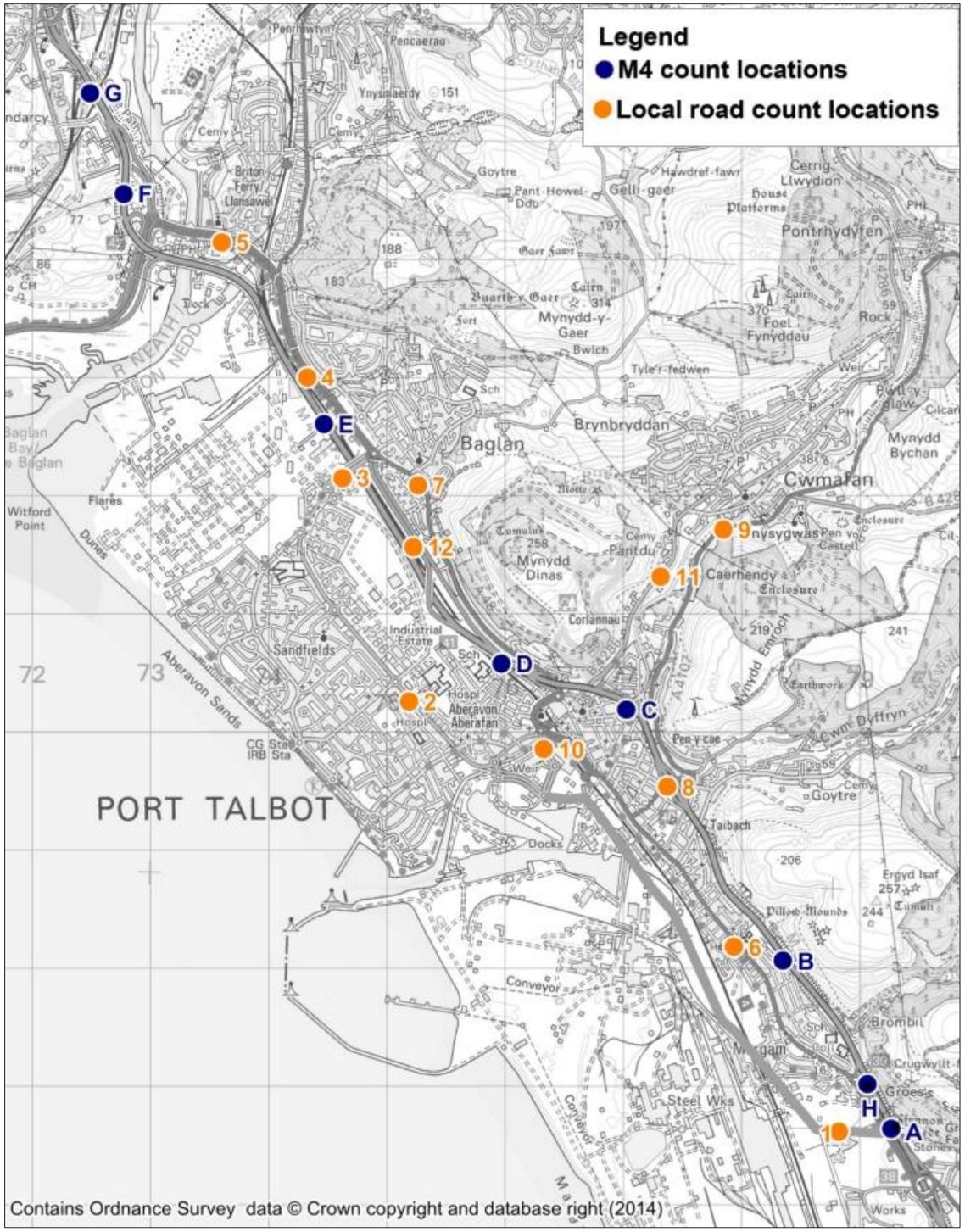
Table 2.2 and Figure 2.2 detail the locations of the counts reported on in this study.

[1] Where this full range of data was not available, the most appropriate available data has been used

Table 2.2 – Traffic Count Locations

Reference	Route	Direction	Location
A	Red	Westbound	M4 J38-J39
B	Red	Westbound	M4 J39-J40
C	Red	Eastbound	M4 J41-J40
	Red	Westbound	M4 J40-J41
D	Red	Eastbound	M4 In J41
	Red	Westbound	M4 In J41
E	Red	Eastbound	M4 J42-J41
	Red	Westbound	M4 J41-J42
F	Red	Eastbound	M4 In J42
	Red	Westbound	M4 In J42
G	Red	Eastbound	M4 J43-J42
	Red	Westbound	M4 J42-J43
H	Red	Eastbound	M4 J40 - J38
1	Blue	Eastbound	A4241 Harbour Way
	Blue	Westbound	A4241 Harbour Way
2	Blue	Eastbound	A4241 Afan Way
	Blue	Westbound	A4241 Afan Way
3	Blue	Eastbound	A4241 Seaway Parade
	Blue	Westbound	A4241 Seaway Parade
4	Blue	Eastbound	A48 Trunk Road - Briton Ferry to Sunnycroft
	Blue	Westbound	A48 Trunk Road - Sunnycroft to Briton Ferry
5	Blue	Eastbound	A48 Trunk Road - Briton Ferry Bridge
	Blue	Westbound	A48 Trunk Road - Briton Ferry Bridge
6	Purple	Eastbound	A48 Margam Road
	Purple	Westbound	A48 Margam Road
7	Purple	Eastbound	A48 Pentwyn Baglan Rd
	Purple	Westbound	A48 Pentwyn Baglan Rd
8	Orange	Northbound	A4107 Abbey Road
	Orange	Southbound	A4107 Abbey Road
9	Orange	Northbound	A4107 Afan Valley Road
	Orange	Southbound	A4107 Afan Valley Road
10	Green	Northbound	Harbour Way Roundabout to A4241/Water St Roundabout
	Green	Southbound	A4241/Water St Roundabout to Harbour Way Roundabout
11	Green	Northbound	M4 J41 to Cwmavon Rd
	Green	Southbound	Cwmavon Rd to M4 J41
12	Yellow	Eastbound	M4 J41 Slip Road - Sunnycroft Roundabout to M4 J41
	Yellow	Westbound	M4 J41 Slip Road - M4 J41 to Sunnycroft Roundabout

Figure 2.2 –Traffic Count Locations



2.3.2 Journey Time Data Collection

TomTom satellite navigation data has been used for both the pre and post-trial closure periods to determine changes in average journey times following the implementation of the trial slip road closure on the Primary Evaluation routes. TomTom holds a database of point-to-point vehicle journey times and speed, collated anonymously from users' devices. This database provides an extensive and reliable source of journey time data for use in analysing the impact of changes to the road network.

This analysis covers weekdays over the following periods:

- **Pre-trial closure:** August 2013 to March 2014 inclusive
- **Post-trial closure:** August 2014 to March 2015 inclusive

Average week-day journey time data have been collected for the four hours of closure (07:00-08:00, 08:00-09:00, 16:00-17:00 and 17:00-18:00) and for the inter-peak (12:00-13:00). The inter-peak is used as a control period to which the peak hour journey time changes can be compared.

2.3.3 Average Speed and Journey Time Reliability

The TomTom satellite navigation data has been analysed to compare the average speeds along the M4 pre and post-closure by plotting graphs of average speed against the distance along the route. This gives a visual indication of the locations along the route where changes in average speeds have occurred

It has also been used to assess the journey time reliability on the M4 by comparing the range of the pre and post-closure journey times for each of the peak hours.

2.4 Primary Economic Evaluation - Monetising Journey Time Changes Methodology

An assessment has been undertaken of the monetised impact of the change in journey times on key routes in the Port Talbot area since the trial slip road closure. The methodology for this involves calculating the vehicle hours saved between the pre and post-closure implementation periods using observed journey times and traffic flows on the M4 and the other monitored routes in Port Talbot (e.g. if 60 vehicles each experienced a journey time saving of one minute, this would be a vehicle hour saving of 1 hour).

The observed change in vehicle hours across each route has been monetised by applying the Highways England's Project Appraisal Report (PAR) average value of time (1418 pence per hour[1]) and applying a discount factor to 2010 (0.8711) to derive an annual benefit. Discounting is undertaken to convert

[1] Project Appraisal Report (PAR) Version 6.4 (most up to date as of March 2015).

monetary figures to a present value base year, which is currently set to 2010 by the Department for Transport.

Vehicle hours saved give a positive result indicating an economic benefit, while an increase in vehicle hours give a negative result indicating an economic disbenefit.

Where possible, the vehicle hours saved (a function of traffic flows and journey times) were calculated on a 'link by link' level. This was possible for the M4 where traffic flows and journey times were available for each junction to junction segment. However, for the local routes, a series of high level assumptions regarding traffic flows were required as traffic data does not exist for all sections of the route. This assumption typically involved taking a nearby observed flow to be representative of an entire section of the route.

2.5 Secondary Impacts

The trial slip road closure will potentially have had a number of other impacts, some of which are considered in this report, but others that will not be considered due to the data collection being a longer term process.

The supplementary impacts for which data is available and are presented in this report are:

- Impacts on queue lengths at junctions on the local road network in Port Talbot
- Air quality impacts with reference to the Government's long term air quality objective for nitrogen dioxide, as well as a calculation of the impact on carbon emissions on the M4 using the DMRB Air Quality Screening Method spreadsheet
- Visitor numbers to Port Talbot town centre through the analysis of changes in car park usage and footfall at Aberafan Shopping Centre following implementation of the trial slip road closure.

The supplementary impacts for which longer term data is required and therefore are not presented in this report are:

- The impact of the trial slip road closure on road safety on the M4 and local road network in Port Talbot

Personal Injury Collision data is collected by the police and there is usually at least a six month time lag before this data is made available. It could therefore be assessed when the data becomes available.

3 Traffic Volume, Journey Time and Average Speed Results

3.1 M4 Motorway J38 to J43 (Red Route)

3.1.1 M4 Traffic Volume Results

Results of the traffic volume data for the M4 are presented in Table 3.1 comparing the pre and post-closure traffic flows for each section of the M4 in both the west and eastbound directions. Traffic flows are the average of the recorded weekday hourly numbers of vehicles recorded over the pre and post-closure periods.

Table 3.1 – M4 J38 to J43 (Red Route) - Change in Traffic Flows

Site Ref	Location	07:00 - 08:00			08:00 - 09:00			12:00 - 13:00			16:00 - 17:00			17:00 - 18:00		
		Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change
A WB	M4 J38-J39	2317	2088	-229	2434	2227	-207	1837	1597	-240	2630	2493	-137	2625	2470	-155
B WB	M4 J39-J40	2643	2361	-282	2819	2591	-228	2002	1785	-217	3125	2956	-169	3124	2888	-236
C WB	M4 J40-J41	2247	2899	652	2672	3036	364	1810	1853	43	2656	3146	490	2594	3018	424
D WB	M4 In J41	3043	2869	-174	3429	3070	-359	2354	2405	51	3724	3163	-561	3535	3061	-474
E WB	M4 J41-J42	2526	2517	-9	2811	2640	-171	1898	1963	65	3127	2778	-349	2991	2680	-311
F WB	M4 In J42	1760	1719	-41	2008	1936	-72	1449	1519	70	2539	2277	-262	2437	2185	-252
G WB	M4 J42-J43	1882	2202	320	2095	2189	94	1584	1654	70	2683	2717	34	2564	2586	22
G EB	M4 J43-J42	2,450	2,487	37	2,033	2,036	3	1,606	1,617	11	1,994	2,090	96	1,931	1,980	49
F EB	M4 In J42	2,378	2,443	65	1,964	1,999	35	1,579	1,599	20	1,971	2,046	75	1,901	1,932	31
E EB	M4 J42-J41	2,885	2,876	-9	2,534	2,493	-41	2,015	2,062	47	2,681	2,775	94	2,671	2,710	39
D EB	M4 In J41	3,397	3,459	62	3,206	3,182	-24	2,508	2,504	-4	3,288	3,307	19	3,282	3,251	-31
C EB	M4 J41-J40	2,620	2,739	119	2,515	2,612	97	1,997	1,957	-40	2,647	2,759	112	2,647	2,667	20
H EB	M4 J40 - J38	3,003	2,704	-299	2,758	2,531	-227	2,115	1,968	-147	2,665	2,432	-233	2,647	2,173	-474

Figures 3.1a to 3.1e represent these figures graphically for each of the hours assessed. The effect of the closure of the westbound Junction 41 entry slip road can be seen for the four hours of the closure. There is generally a reduction in traffic to the west of the Junction 41 slip road and an increase to the east between Junction 40 and Junction 41. This illustrates the distribution of the highest traffic (usually between the slip roads at Junction 41) over a longer length, easing the pressure on the short stretch within Junction 41.

Little change can be seen during the inter-peak period and on the eastbound carriageway.

Figure 3.1a – Change in Vehicle Flows on the M4 (07:00-08:00)

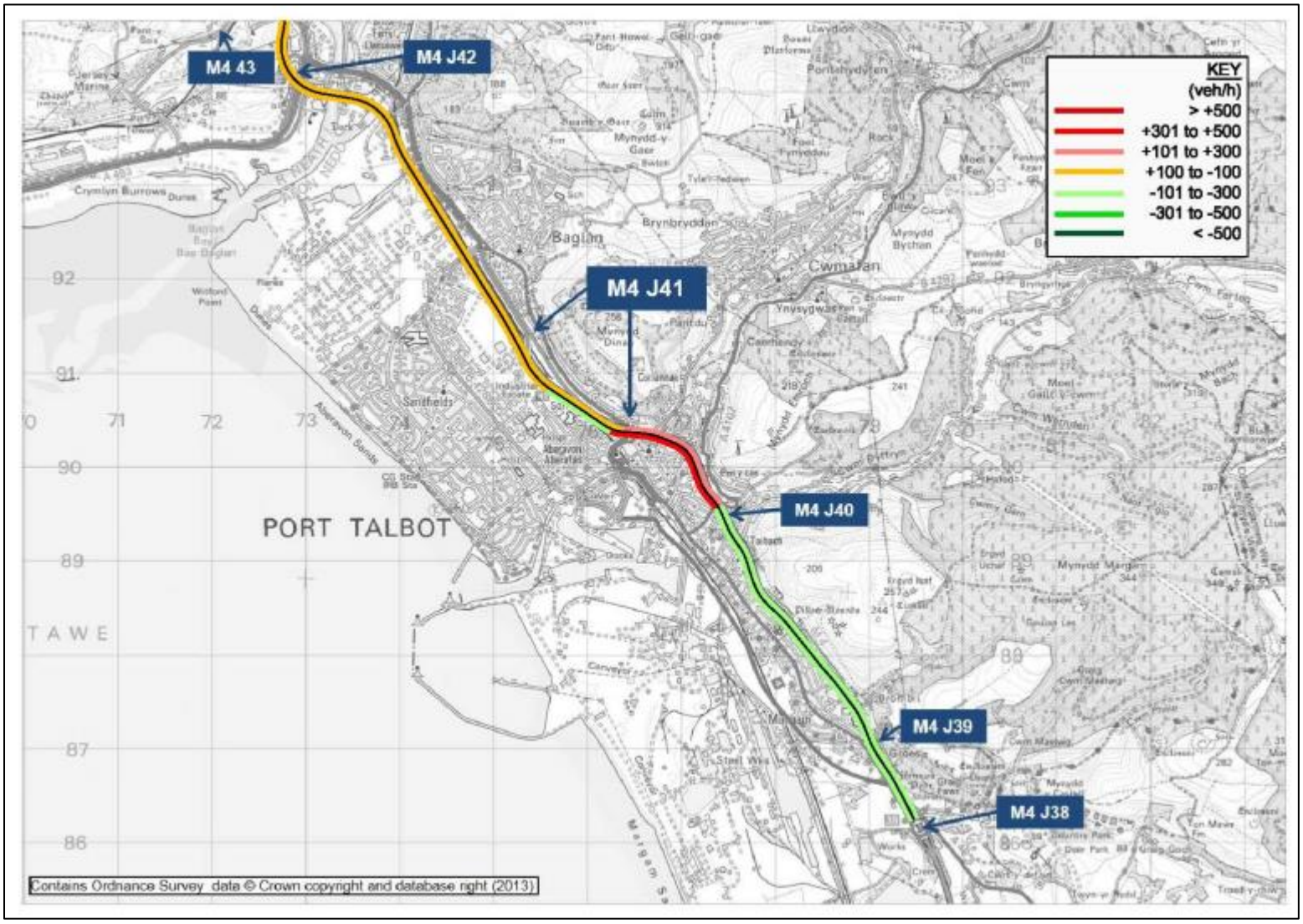


Figure 3.1b – Change in Vehicle Flows on the M4 (08:00-09:00)

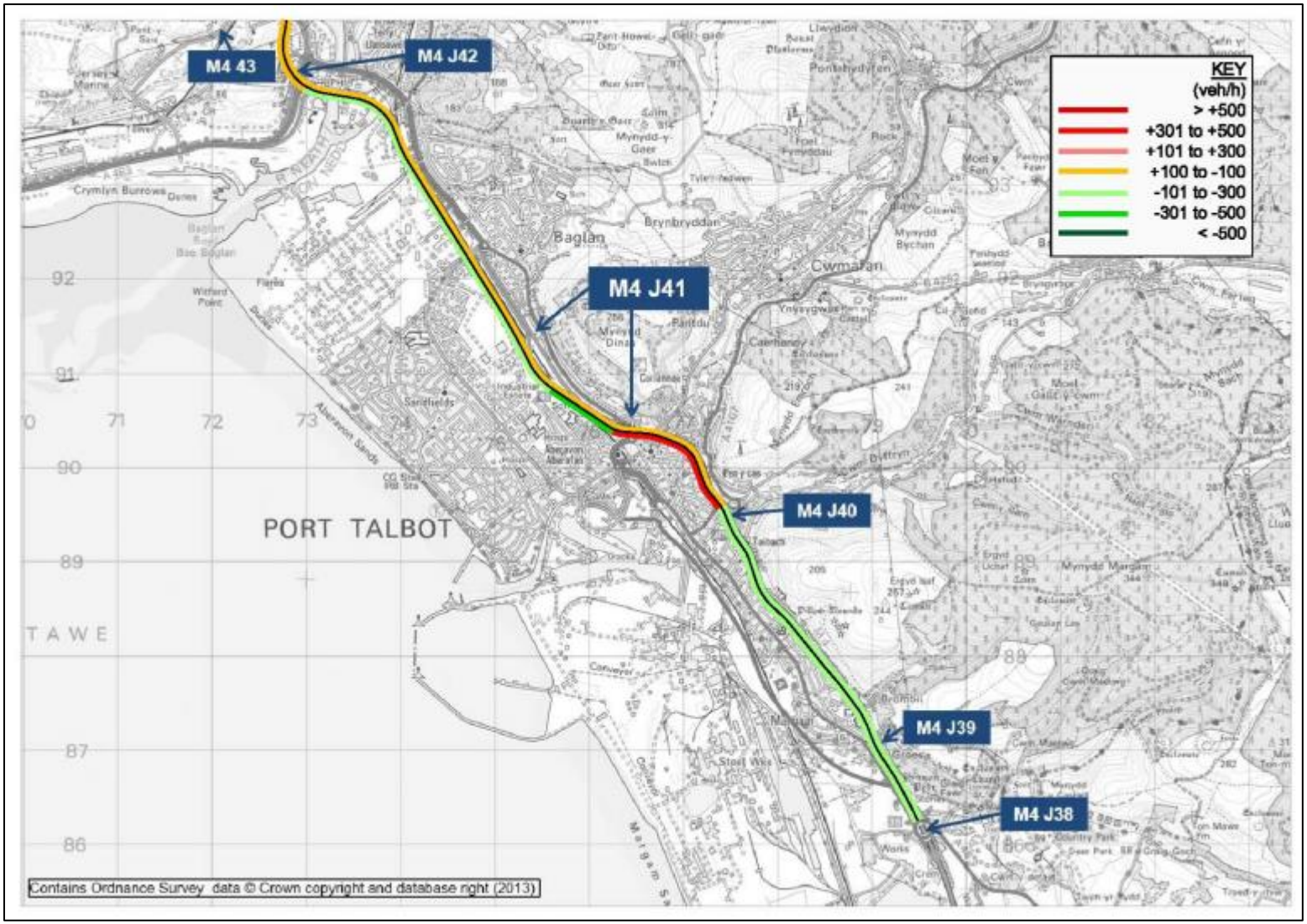


Figure 3.1c – Change in Vehicle Flows on the M4 (12:00-13:00)

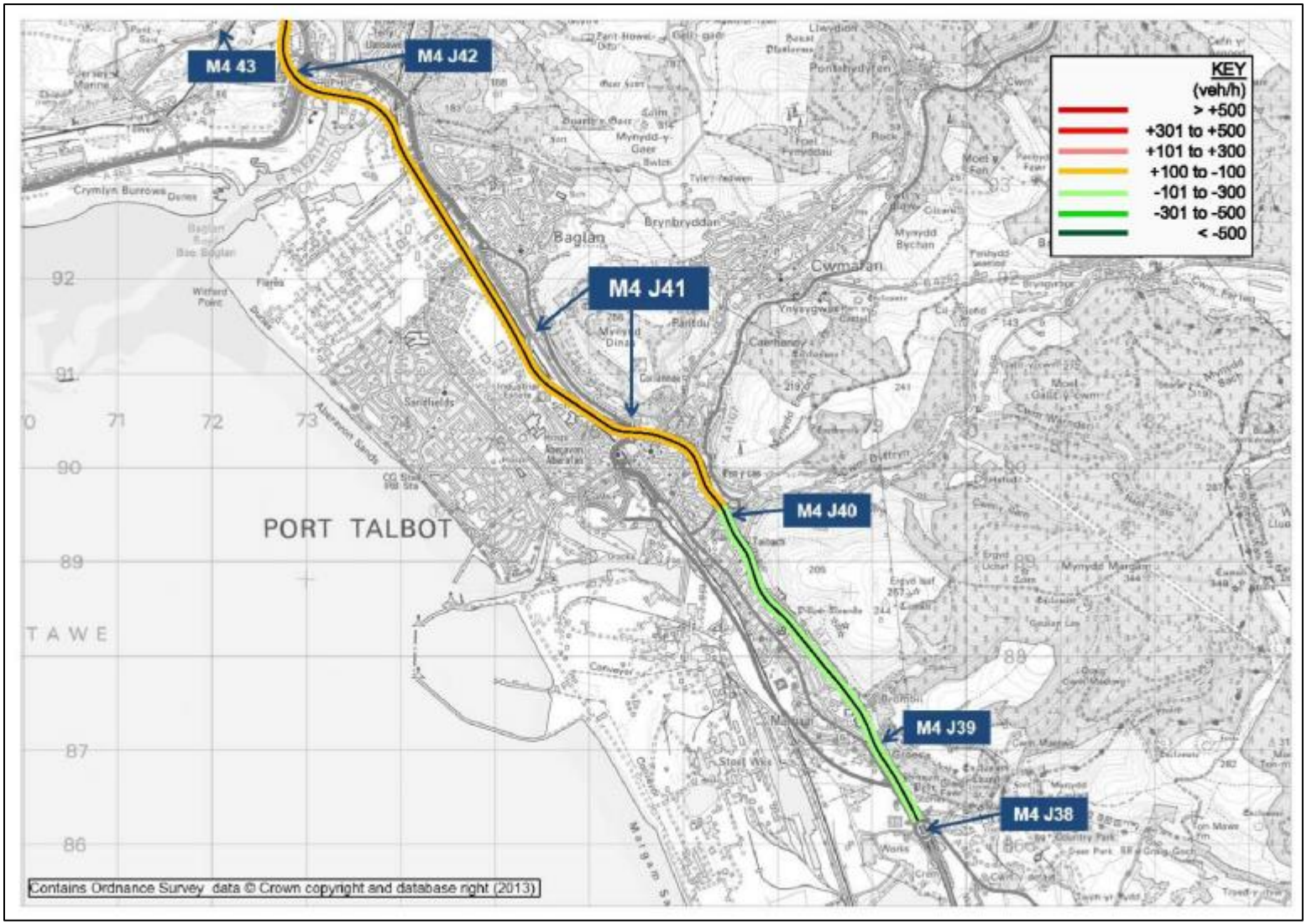


Figure 3.1d – Change in Vehicle Flows on the M4 (16:00-17:00)

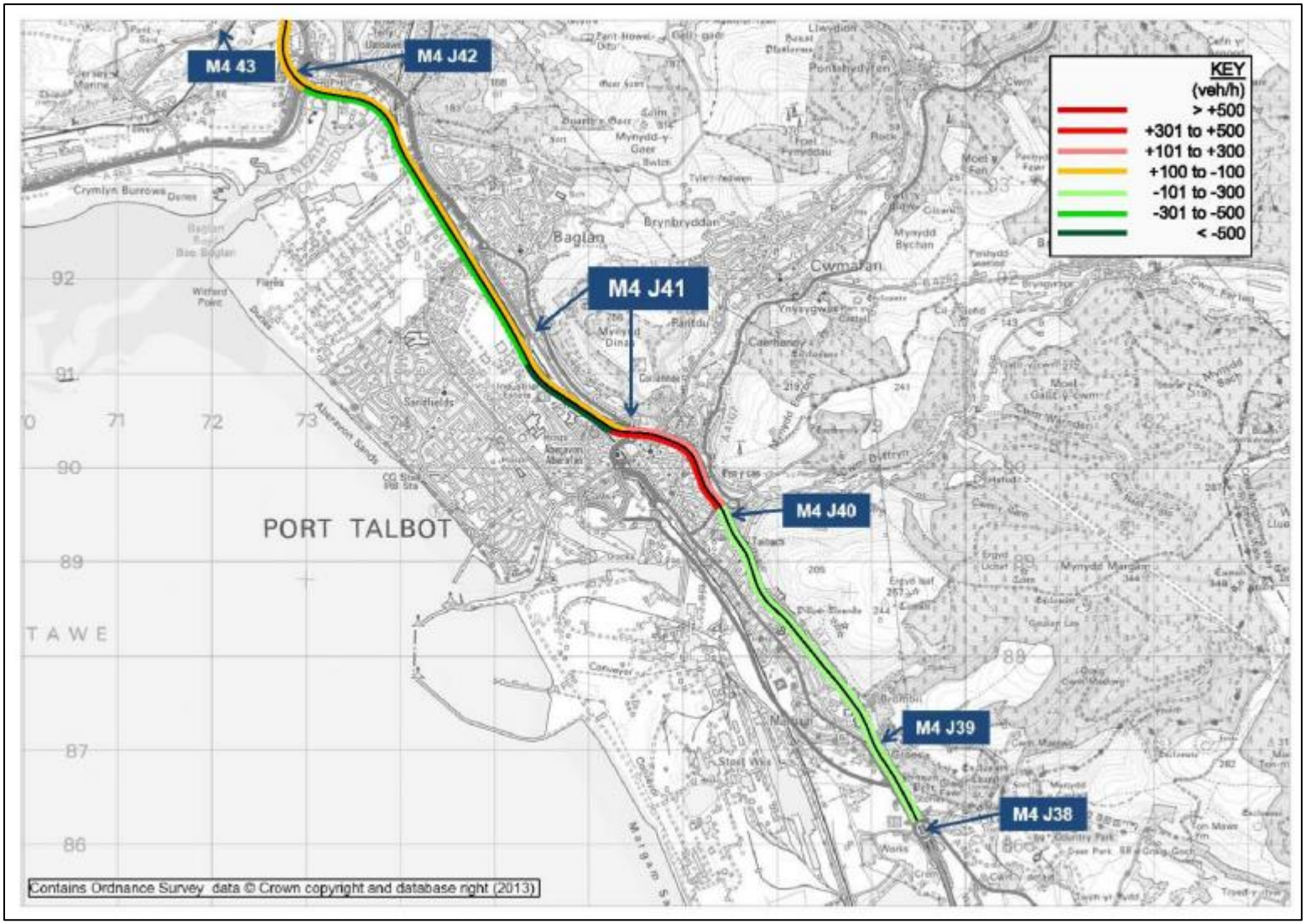
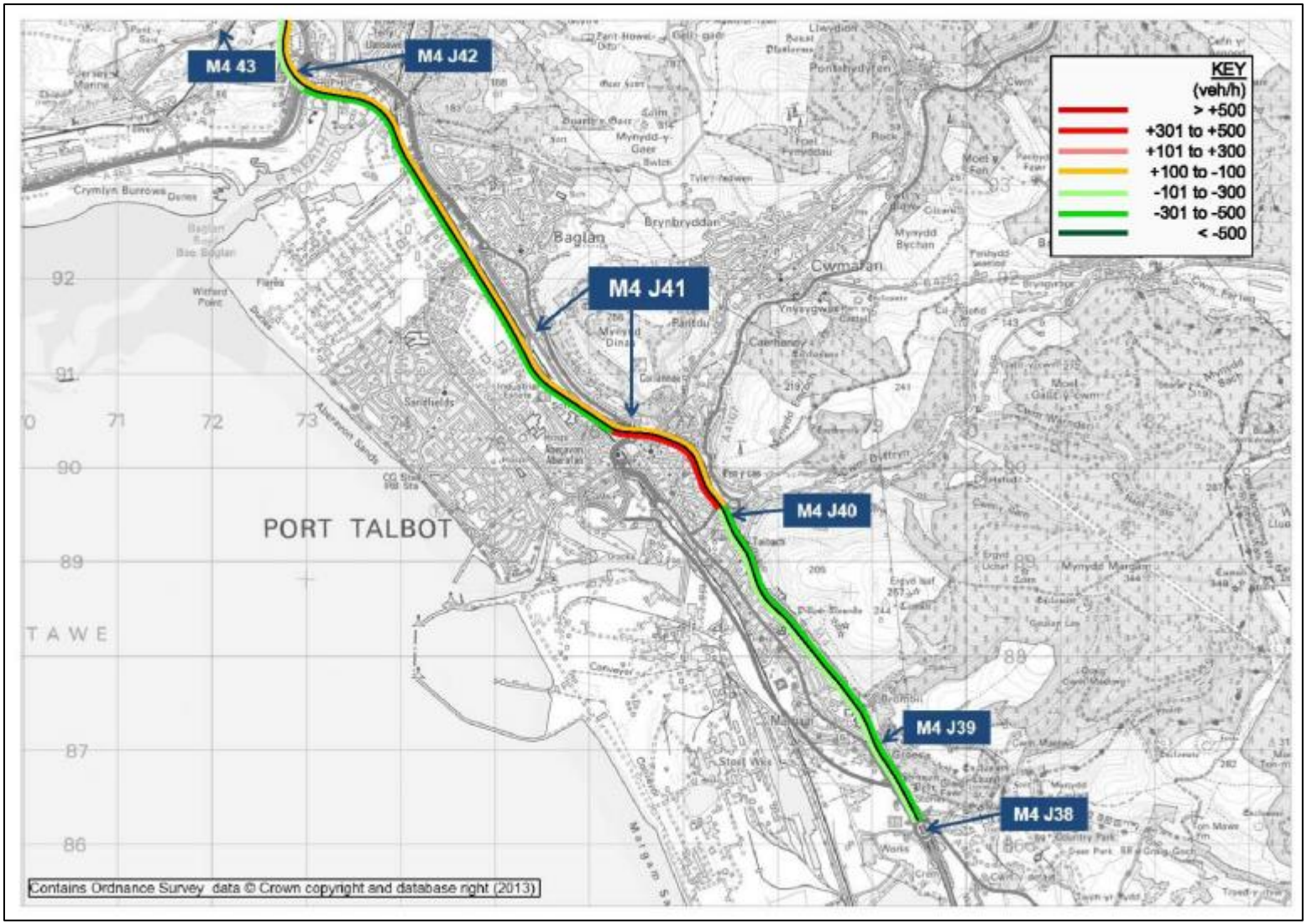


Figure 3.1e – Change in Vehicle Flows on the M4 (17:00-18:00)



3.1.2 M4 Journey Time Results

Results of the journey time impact analysis for the M4 are presented in Table 3.2, comparing the pre and post- closure journey times for both the west and eastbound directions.

Table 3.2 – M4 J38-43 Change in Journey Time (mm:ss)

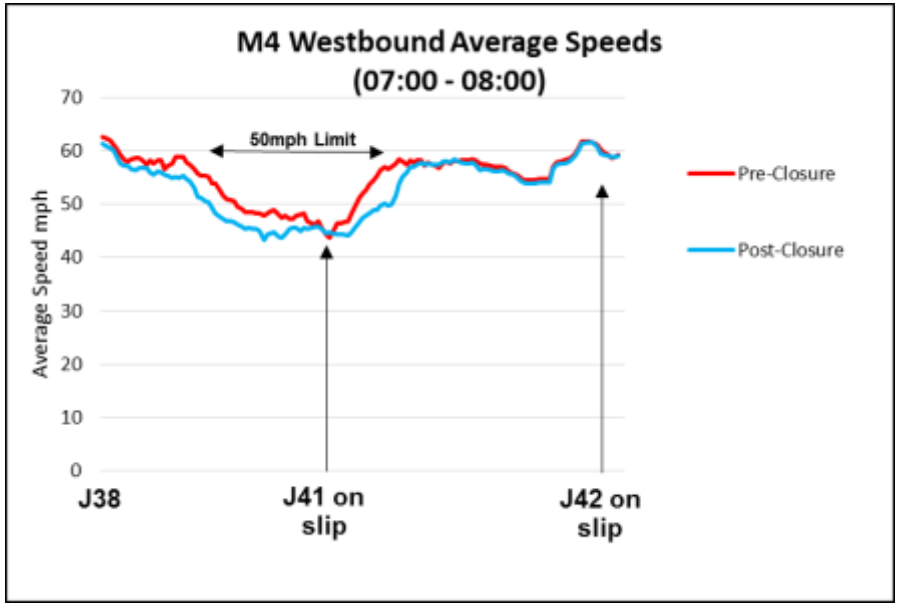
	AM Peak								Inter Peak				PM Peak							
	07:00-08:00				08:00-09:00				12:00-13:00				16:00-17:00				17:00-18:00			
	Before	After	Change secs		Before	After	Change secs		Before	After	Change secs		Before	After	Change secs		Before	After	Change secs	
M4 J38-40 WB	02:36	02:44	+8	+5%	03:06	02:56	-10	-5%	02:28	02:31	+3	+2%	03:10	03:04	-6	-3%	03:30	03:03	-27	-13%
M4 J40-J41 WB	01:40	01:46	+6	+6%	02:06	01:49	-17	-13%	01:32	01:40	+8	+9%	02:17	01:53	-24	-18%	02:41	01:57	-44	-27%
M4 J41-J43 WB	04:07	04:13	+6	+2%	04:14	04:18	+4	+2%	03:59	04:06	+7	+3%	04:22	04:41	+19	+7%	04:55	05:32	+37	+13%
Total M4 WB Journey Time	**08:23**	**08:43**	**+18**	**+4%**	**09:26**	**09:03**	**-23**	**-4%**	**07:59**	**08:17**	**+18**	**+4%**	**09:49**	**09:38**	**-11**	**-2%**	**11:06**	**10:32**	**-34**	**-5%**
M4 J43-41 EB	04:46	05:21	+35	+12%	06:24	07:01	+37	+10%	04:00	04:01	+1	+0%	04:24	04:52	+28	+11%	05:13	05:43	+30	+10%
M4 J41-40 EB	01:48	01:59	+11	+10%	01:56	02:05	+9	+8%	01:42	01:48	+6	+6%	01:50	01:57	+7	+6%	01:54	02:04	+10	+9%
M4 J40-38 EB	02:32	02:38	+6	+4%	02:34	02:37	+3	+2%	02:30	02:34	+4	+3%	02:30	02:37	+7	+5%	02:31	02:37	+6	+4%
Total M4 EB Journey Time	**09:06**	**09:58**	**+52**	**+10%**	**10:54**	**11:43**	**+49**	**+8%**	**08:12**	**08:23**	**+11**	**+2%**	**08:44**	**09:26**	**+42**	**+8%**	**09:38**	**10:24**	**+46**	**+8%**

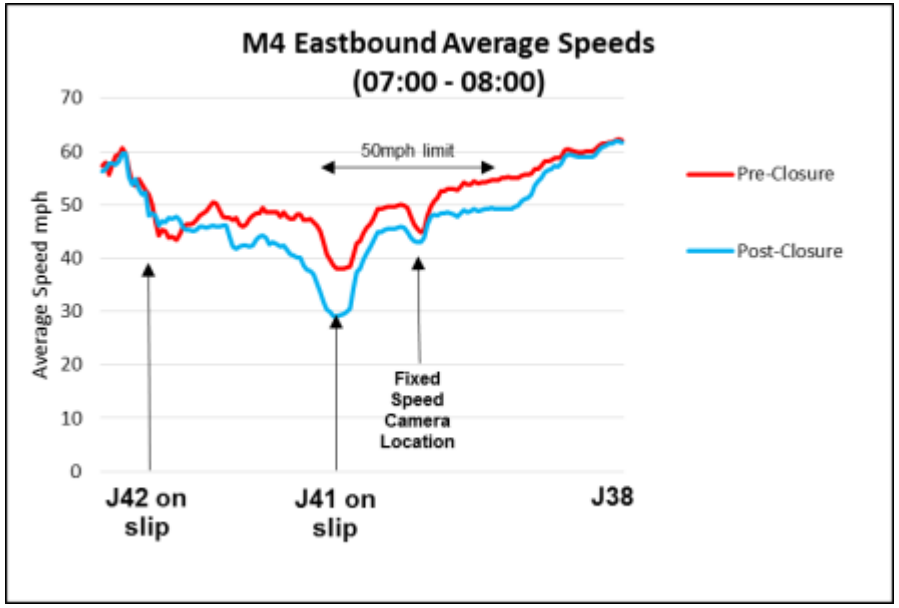
3.1.3 M4 Average Speed Results

The TomTom satellite navigation data has been analysed to compare the average speeds on the M4 in both directions pre and post-closure for each of the hours of closure as well as the inter-peak period.

The figures below show the average speeds on the westbound and eastbound carriageways for each hour considered.

Figure 3.2 - M4 Average Speeds 07:00 – 08:00





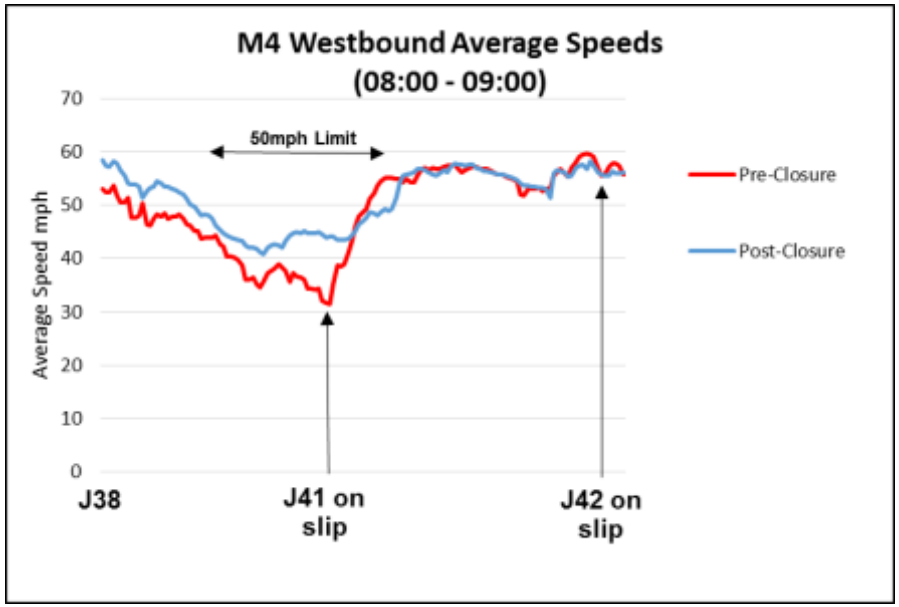
The westbound graph demonstrates that, from 07:00 to 08:00, the average speeds on the westbound carriageway on the M4 are generally similar for the pre and post-closure periods. At Junction 41, the average speed has increased slightly from 43mph to 45mph. The post-closure period shows a slight reduction in average speeds over the 50mph limit section from approximately 47mph to 44mph, possibly due to introduction of the average speed camera system.

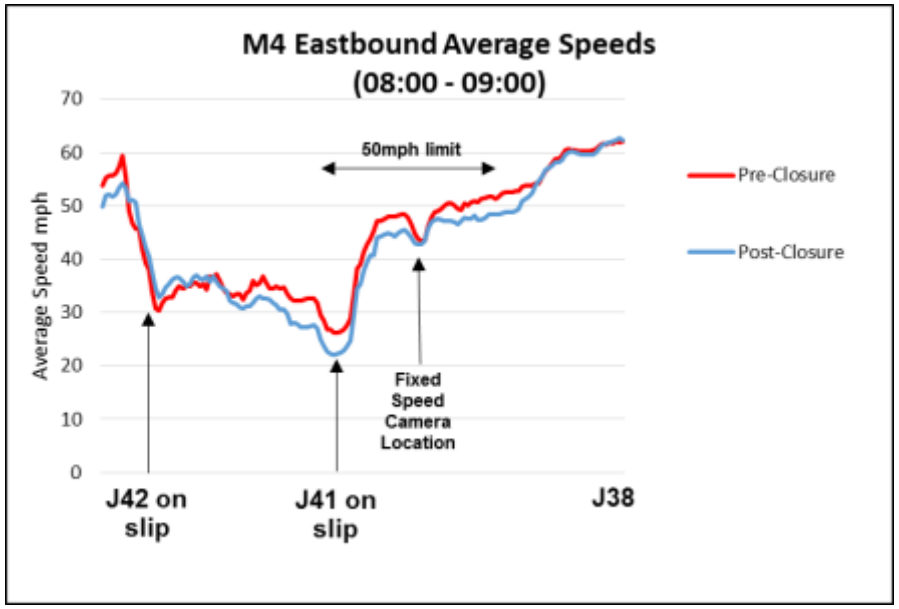
A general reduction in the average speed can be seen on the eastbound carriageway post-closure during the 07:00 to 08:00 time period.

The impact of the eastbound entry slip roads at both Junction 42 and Junction 41 can be seen. Average speeds dropped to approximately 30mph in the vicinity of Junction 41 entry slip road post-closure from approximately 39mph pre-closure.

The impact of the average speed camera system can also be seen, with the average speeds reducing from of approximately 53mph to approximately 47mph. The fixed speed camera east of Junction 41 was in operation for part of the trial period, and its impact can also be seen in reducing vehicles speeds to approximately 45 mph in its vicinity.

Figure 3.3 - M4 Average Speeds 08:00 – 09:00

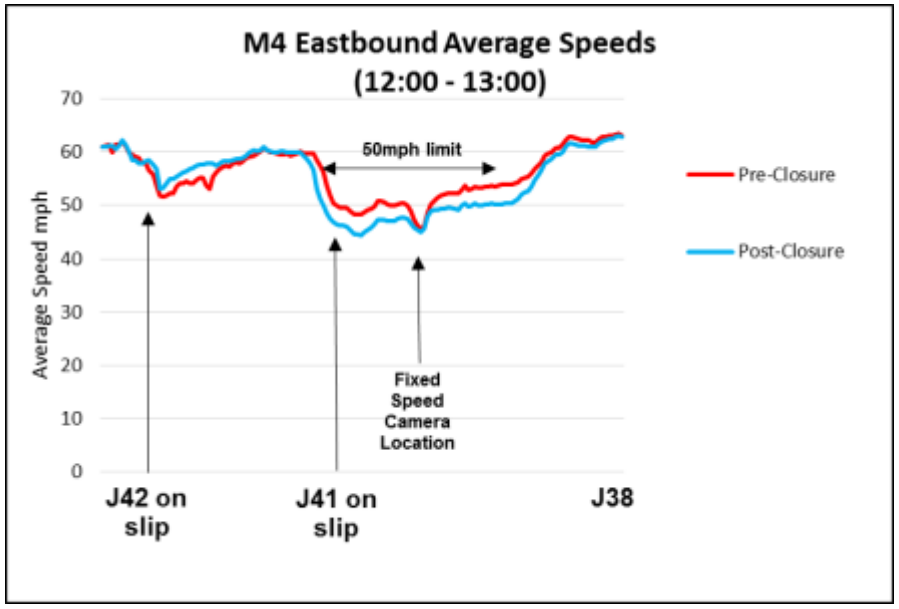




The westbound graph demonstrates that, pre-closure, average speeds dropped to approximately 32 mph at the Junction 41 slip road. Post-closure, the average speed in this location was approximately 45 mph. The knock on effects of this can be seen between Junction 38 and Junction 41, where the average speeds were consistently higher post-closure than pre-closure. The effect of the average speed camera system beyond Junction 41 can be seen by the lag in increased average speeds post-closure. Over the 50mph section average speeds were approximately 35mph pre-closure compared to approximately 45mph post-closure.

The eastbound graph demonstrates the problems that are frequently experienced during the 08:00 to 09:00 period. Average speeds at Junction 41 were approximately 27mph pre-closure and approximately 23mph post-closure, and can be seen to be low (less than 37mph during both pre and post-closure periods) stretching back from Junction 41 to Junction 42. Before and after this section, average speeds are significantly higher. This implies that the merging and weaving at the eastbound entry slip road at Junction 41 is causing congestion that extends back a considerable distance. A slight effect of the average speed camera system can also be seen with the post-closure average speeds slightly lower over the 50mph speed limit section. Over the full length of the 50mph limit average speeds reduced slightly from approximately 40mph to 39mph.

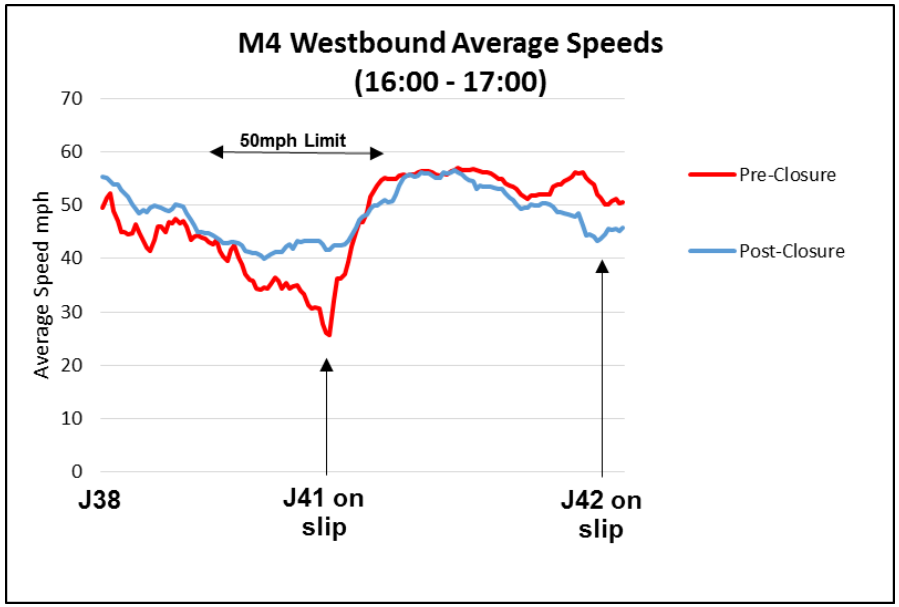
Figure 3.4 - M4 Average Speeds 12:00 –13:00

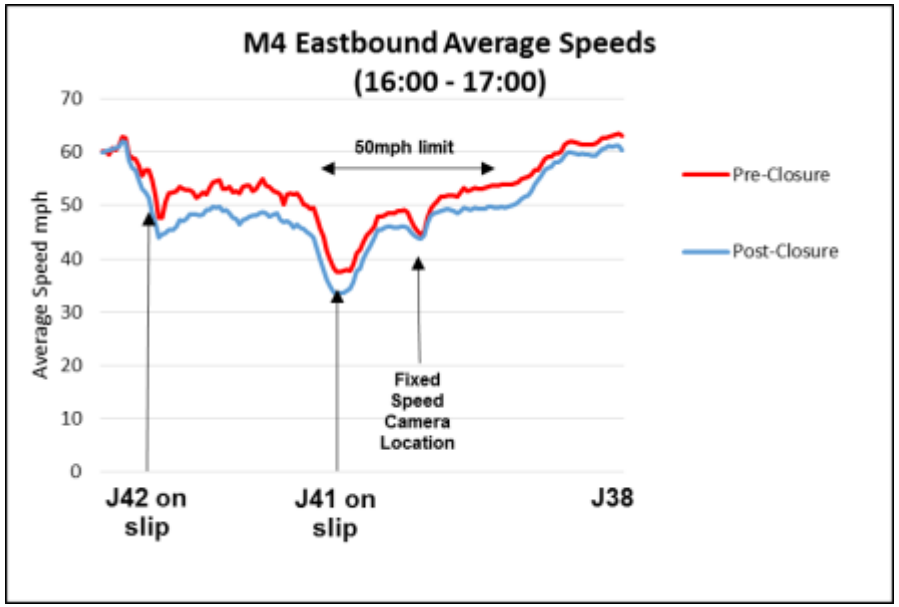


The westbound graph demonstrates that, inter-peak, the pattern of average speeds were similar pre and post-closure. However the effect of the average speed camera system can be seen over the length of the 50mph limit section where post-closure average speeds were approximately 50mph but pre-closure average speeds were approximately 55 mph. At Junction 41, pre-closure average speeds were approximately 50mph compared to approximately 48mph post-closure.

The eastbound graph demonstrates that, inter-peak, the average speed camera system has slightly reduced average speeds over the 50mph section, from approximately 52mph to approximately 48mph, with drivers still taking account of the fixed speed camera position. At Junction 41, average speeds reduced from approximately 50mph to approximately 47mphA slowing down of traffic coinciding with the Junction 42 entry slip road can also be seen.

Figure 3.5 - M4 Average Speeds 16:00 – 17:00

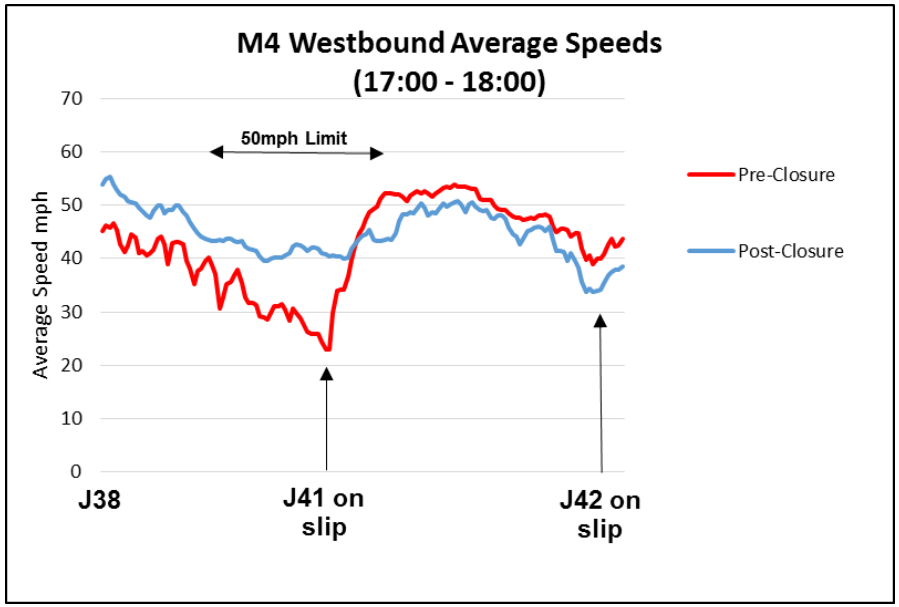


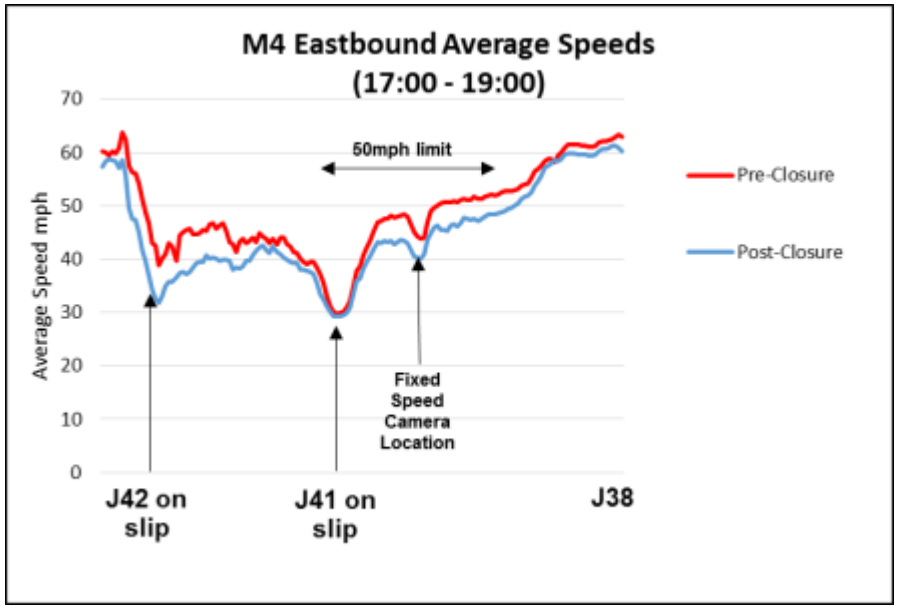


The westbound graph demonstrates that the pre-closure average speeds over the period 16:00 to 17:00 were significantly affected by the Junction 41 entry slip road, where they dropped to approximately 27 mph at this location. Post-closure, the average speeds at this location were approximately 43 mph. At Junction 42 and its approach, the post-closure average speeds dropped below those pre-closure by approximately 8 mph, but overall, it can be seen that the slip road closures have the effect of distributing the average speeds more evenly across the length of motorway under consideration. Over the 50mph section average speeds improved from approximately 35mph to approximately 43mph as a result of the slip road closure, rather than the average speed camera system.

The eastbound graph demonstrates that the average speeds follow a similar pattern pre and post-closure, but with a reduction in average speeds at Junction 41 from 38mph to 34mph. The graph also indicates that the average speed camera system has slightly reduced average speeds over the 50mph section, from an average of approximately 51mph to an average of approximately 48mph, with drivers still taking account of the fixed speed camera position.

Figure 3.6 - M4 Average Speeds 17:00 – 18:00





Westbound, for the 17:00 to 18:00 period, the impacts of the Junction 41 entry slip road can be seen on the pre-closure average speeds, where they fell to approximately 23 mph. No such problems occurred post-closure, where the average speed stayed was approximately 41mph. The effect of this can be seen as far back as Junction 38, with average speeds being higher post-closure. Again, post-closure average speeds were lower in the vicinity of Junction 42 than during the pre-closure period, indicating the re-distribution of delays caused by junctions over the wider study area. Over the 50mph section average speeds rose from approximately 32mph to approximately 44mph.

The eastbound graph demonstrates that average speeds were 30mph both pre and post-closure at Junction 41, and average speeds in the 50mph section falling from approximately 48mph to approximately 45mph.

The analysis of the average speeds along the M4 westbound carriageway shows the beneficial impacts of the peak hour Junction 41 on-slip closures on average speeds between Junction 38 and Junction 41. It also shows that a similar benefit has not been experienced on the eastbound carriageway in advance of the Junction 41 entry slip road which has remained open.

Judging by the eastbound carriageway, the introduction of the average speed camera system appears to have had the effect of decreasing average speeds along the section of the 50mph limit. However, during the peak periods, it has no effect on improving the flow in the vicinity of Junction 41, as average speeds seem to be governed by congestion at the junction itself rather than drivers observing the 50mph speed limit.

3.1.4 M4 Journey Time Reliability Results

Journey time reliability is defined as the random variation in journey times, at the same time of day, which drivers are unable to predict.

The change in journey time reliability on the M4 has been analysed by comparing pre and post-closure journey times at the 5th, 25th, 75th and 95th percentiles obtained from the TomTom satellite navigation data. This allows an understanding of whether journey time reliability has improved as a result of the closure.

The results of this analysis are presented in the following “box and whisker” plots. The size of the boxes represents the typical range in journey times (between the 25th and 75th percentiles). The smaller the box, the more reliable the journey times. The ends of the “whiskers” represent the 5th and 95th percentile journey times. Larger “whiskers” are evident when there are more extremes in journey times, and hence poorer journey time reliability.

Figures 3.7 and 3.8 show the westbound and eastbound Journey Time Reliability plots respectively.

Figure 3.7 - M4 J38-43 Westbound Journey Time Reliability

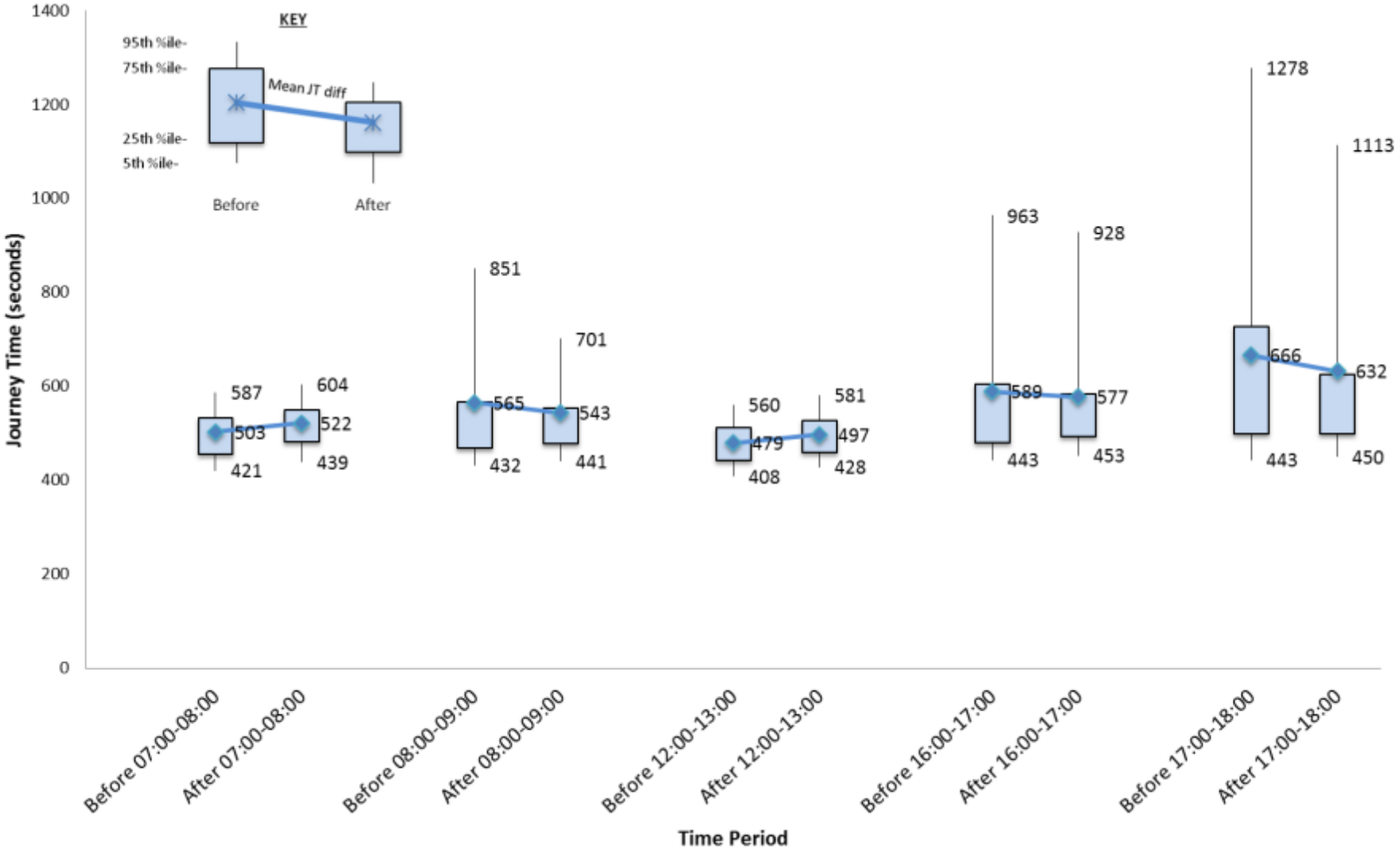
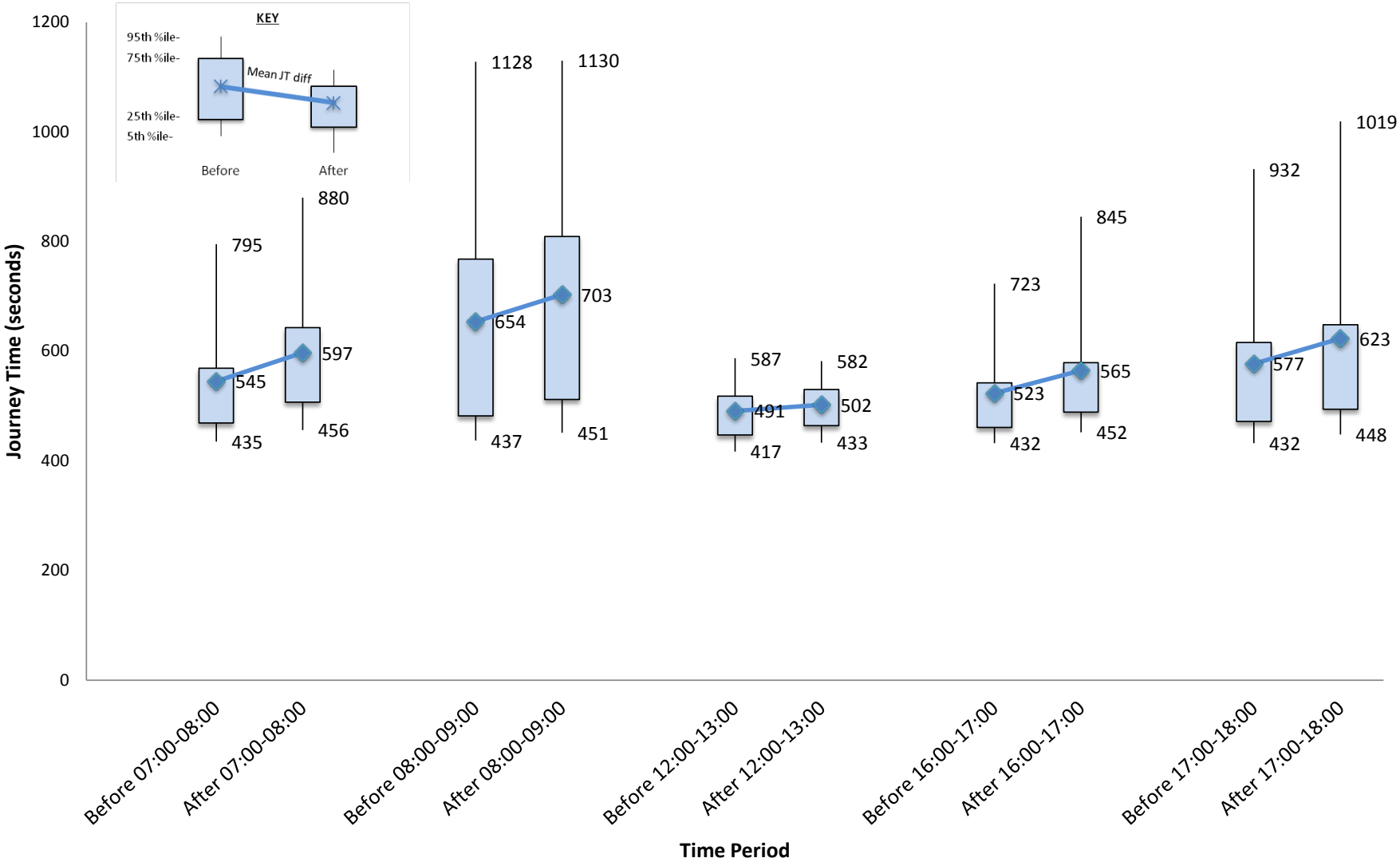


Figure 3.8 - M4 J43–38 Eastbound Journey Time Reliability



Post-closure, journey time reliability on the M4 westbound has improved considerably between 08:00 to 09:00, 16:00 to 17:00 and 17:00 to 18:00. For example, between 17:00 and 18:00, whilst the average journey time has fallen, the range between the 25th and 75th percentiles has narrowed and the 95th percentile has also fallen. This indicates that more drivers are experiencing the average journey time recorded on the route, thus an improvement in journey time reliability has occurred.

Between 07:00 and 08:00 and the inter-peak period 12:00 to 13:00, there has been no significant change in journey time reliability.

In the eastbound direction there has generally been little change in journey time reliability during the morning peak hours, but a worsening of journey time reliability during the afternoon peaks despite the introduction of the average speed camera system over the 50 mph speed limit section.

Objective OBJ1 (Improve Journey Time Reliability) can therefore be considered to have been achieved for the westbound carriageway as a result of the peak-time closure of the slip road.

3.1.5 Discussion of the Results of the M4 Data

M4 Westbound Junction 38 to 43 – Traffic Volumes

The changes in peak hour traffic volumes on the westbound M4 carriageway as a result of the trial slip road closure have broadly been as predicted by earlier modelling.

There has been an increase in traffic recorded post-closure between Junction 40 and Junction 41 during the peak periods. The peak hour increases have been in the range of approximately 360 to 650 vehicles. It was expected that a proportion of traffic that would usually use the Junction 41 westbound entry slip road would divert to join the motorway at Junction 40 instead.

Within Junction 41 (i.e. between the entry and exit slip roads), recorded traffic has decreased during the peak hours in the range of approximately 175 to 560 vehicles due to the slip road closures. This is compared to a recorded increase of approximately 50 vehicles during the inter-peak period. The largest decreases occur during the afternoon peak hours, possibly indicative of the tidal nature of people travelling to and from the centre of Port Talbot to work.

Between Junction 41 and Junction 42 traffic generally reduced by a smaller amount, up to approximately 350 vehicles, during the peak hours. Again, the greatest decreases were recorded during the afternoon peak hours. A small increase in traffic of approximately 65 vehicles was recorded during the inter-peak period, consistent with that within Junction 41 during the same period.

There is a general increase in traffic between Junction 42 and Junction 43 with recorded increases of up to approximately 320 vehicles during the morning peak hours. There have been smaller increases during the afternoon peak periods.

M4 Eastbound Junction 43 to 38 – Traffic Volumes

There does not appear to be a consistent pattern of changes in traffic since the trial slip road closure has been implemented between Junction 43 and Junction 40 on the eastbound carriageway of the M4. Across all time periods and locations, there is a mixture of relatively small increases and decreases in traffic. Taken as a whole, the average change is minimal. This indicates that, as expected, the redistribution of traffic resulting from the peak hour closure of the Junction 41 westbound entry slip road is having little effect on the eastbound M4 traffic between Junction 43 and Junction 40.

There is very little change in eastbound traffic volume in the vicinity of Junction 41 to explain why the delay resulting from it has increased.

Over the section covered by the average speed cameras (Junction 41 to Junction 42), the average journey times have increased between 6% during the off-peak times to 11% during the morning peak.

Journey Times and Average Speeds

Comparing the pre and post-closure average journey times for the M4 shows that in general, there is an improvement in the westbound average journey times between Junction 38 and Junction 43 of up to 34 seconds (5%) during the peak periods. The largest improvements in journey times can be seen to occur between Junction 40 and Junction 41, and are considered to be attributed to the Junction 41 entry slip road closure. However, during the 07:00 to 08:00 period journey times between Junction 38 and Junction 43 actually increased by 18 seconds (4%).

On the eastbound carriageway, where no slip road closures have been implemented, the peak period average journey times between Junction 43 and Junction 38 increased by up to 52 seconds (9%). The largest increases in journey times can be seen to occur between Junction 43 and Junction 41.

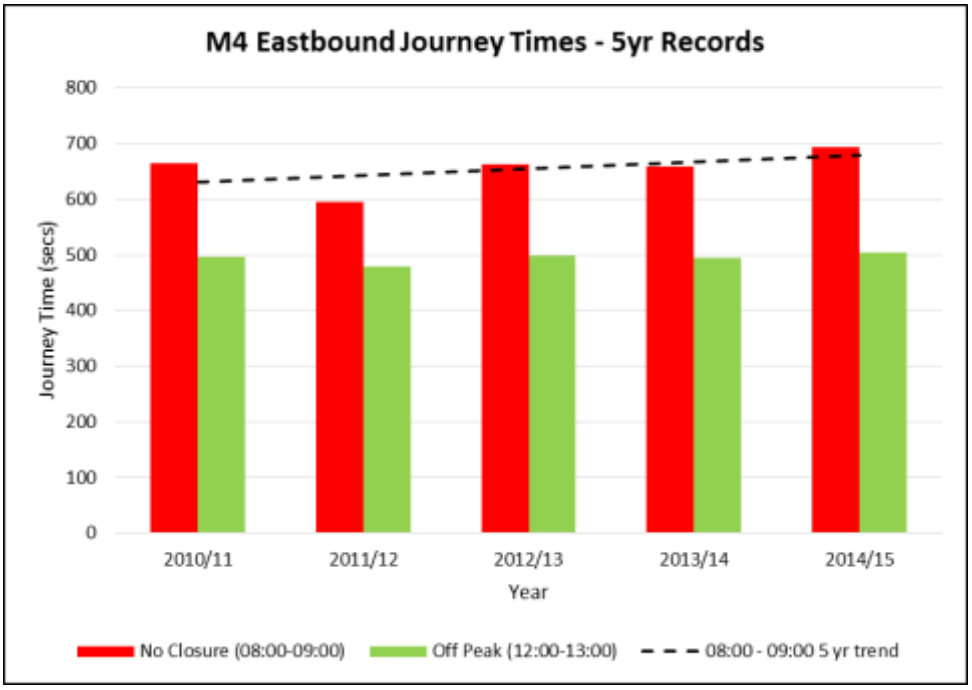
This is not considered to be attributable to the slip road closures.

In order to understand this increase, additional TomTom data for both the westbound and eastbound carriageways has been obtained for the three study periods previous to the pre and post-closure data. These periods were:

- August 2010 to January 2011
- August 2011 to January 2012
- August 2012 to January 2013

The trends in journey times over the five year period were then plotted. Figure 3.9 shows the trend in the eastbound carriageway journey time for the busiest peak hour (08:00 – 09:00). Off peak journey times have also been shown to allow a comparison with journey times under free-flow conditions.

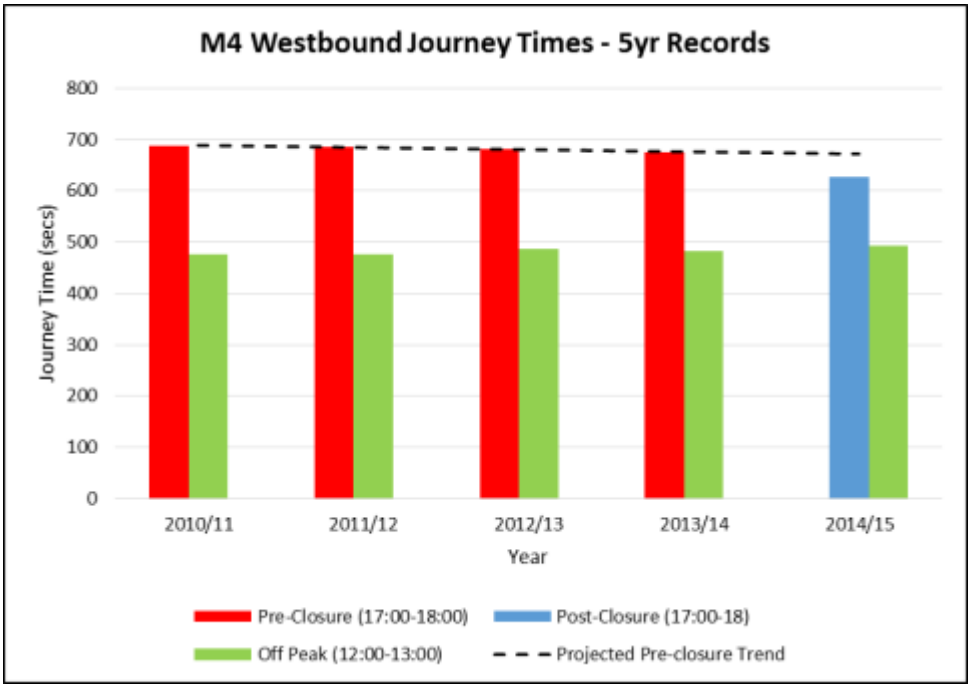
Figure 3.9 – M4 Eastbound Journey Times (Aug-Jan 08:00-09:00) over 5 Years



It can be seen that journey times on the eastbound carriageway during the most congested time period have generally been increasing over the past five years, albeit with some fluctuations between years.

Figure 3.10 similarly shows the trend in westbound journey times for the most congested period in that direction (17:00-18:00).

Figure 3.10 – M4 Westbound Journey Times (Aug-Jan 17:00-18:00) over 5 Years



This shows that the trend for the four pre-closure years is for a slight reduction in journey times. However, it also shows the impact that the slip road closure has in reducing journey times below the projected levels if no closures were implemented.

Considering all the evidence from the M4, it can be seen that the peak time closures of the Junction 41 westbound entry slip road has had the effect of relieving the pressure on the westbound carriageway in the vicinity of Junction 41 during the peak hours, by re-distributing the amount of traffic and average speeds more equally over the study length, reducing journey times and improving journey time reliability.

No such improvements have been seen on the eastbound carriageway, where the Junction 41 slip roads have not been closed. Here journey times have actually increased, seemingly as part of continuing trends, with Junction 41 continuing to be a significant constraint to the eastbound traffic flow.

As average speed cameras have been installed in both directions, the reduction in westbound journey times is likely to be caused by the slip road closure rather than the average speed camera system.

3.2 Local Roads

3.2.1 Local Roads Traffic Volume Results

Results of the local road traffic volume data are presented in Table 3.3 comparing the pre and post-trial closure traffic flows for each local route in both directions. Traffic flows are the average of the recorded weekday hourly numbers of vehicles over the pre and post-closure periods.

Table 3.3 – Local Roads - Change in Traffic Flows

Site Ref	Location	07:00 - 08:00			08:00 - 09:00			12:00 - 13:00			16:00 - 17:00			17:00 - 18:00		
		Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change
1 WB	A4241 Harbour Way	259	274	15	333	416	83	297	355	58	922	879	-43	674	548	-126
2 WB	A4241 Afan Way	314	441	127	655	817	162	573	618	45	727	1,008	281	642	853	211
3 WB	A4241 Seaway Parade	670	817	147	999	1,076	77	963	1,077	114	1,100	1,911	811	1,195	1,867	672
4 WB	A48 Trunk Road Sunnycroft to Briton Ferry	862	1,134	272	1,175	1,377	202	934	1,023	89	1,034	2,039	1,005	1,199	1,952	753
5 WB	A48 Trunk Road Briton Ferry Bridge	1,007	1,007	0	1,205	1,056	-149	814	781	-33	1,157	1,130	-27	1,160	1,193	33
5 EB	A48 Trunk Road Briton Ferry Bridge	867	1,117	250	1,042	1,286	244	808	802	-6	1,317	1,675	358	1,146	1,545	399
4 EB	A48 Trunk Road Briton Ferry to Sunnycroft	1,134	1,262	128	1,543	1,766	223	1,030	917	-113	1,261	1,195	-66	1,321	1,232	-89
3 EB	A4241 Seaway Parade	1,275	1,203	-72	1,877	1,753	-124	1,026	919	-107	1,315	978	-337	1,414	1,058	-356
2 EB	A4241 Afan Way	284	401	117	485	666	181	489	617	128	523	785	262	495	753	258
1 EB	A4241 Harbour Way	872	898	26	663	647	-16	230	294	64	246	355	109	333	468	135
6 WB	A48 Margam Road	147	139	-8	341	317	-24	285	286	1	345	339	-6	326	325	-1
7 WB	A48 Pentwyn Baglan Rd	56	208	152	141	241	100	145	147	2	226	483	257	240	459	219
7 EB	A48 Pentwyn Baglan Rd	112	112	0	259	281	22	142	139	-3	155	165	10	168	183	15
6 EB	A48 Margam Road	151	133	-18	343	308	-35	312	307	-5	367	365	-2	398	397	-1
8 NB	A4107 Abbey Road	262	394	132	368	531	163	339	354	15	429	596	167	400	583	183
9 NB	A4107 Afan Valley Road	69	79	10	115	134	19	149	135	-14	302	311	9	344	327	-17
9 SB	A4107 Afan Valley Road	299	496	197	295	485	190	162	152	-10	158	205	47	151	190	39
8 SB	A4107 Abbey Road	201	183	-18	434	357	-77	281	255	-26	343	299	-44	350	314	-36

Site Ref	Location	07:00 - 08:00			08:00 - 09:00			12:00 - 13:00			16:00 - 17:00			17:00 - 18:00		
		Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change
10 NB	Harbour Way Rbt to A4241/Water St Rbt	89	63	-26	119	80	-39	197	177	-20	469	367	-102	262	211	-51
11 NB	M4 J41 to Cwmavon Rd	189	185	-4	317	298	-19	411	419	8	766	791	25	764	769	5
11 SB	Cwmavon Rd to M4 J41	662	450	-212	601	484	-117	412	410	-2	409	340	-69	417	361	-56
10 SB	A4241/Water St Rbt to Harbour Way Rbt	706	698	-8	432	470	38	173	153	-20	110	114	4	174	196	22
12 WB	M4 Slip Road - J41 to Sunnycroft Rbt	481	331	-150	617	428	-189	444	440	-4	535	382	-153	440	378	-62
12 EB	M4 Slip Road - Sunnycroft Rbt to M4 J41	574	621	47	715	741	26	472	440	-32	625	574	-51	618	582	-36

Figures 3.9a to 3.9e represent these figures graphically for each of the hours assessed. The effect of the closure of the westbound Junction 41 entry slip road can be seen for the four hours of the closure. As would be expected, there is generally an increase on the three main alternative routes: the Afan Way/Seaway Parade/A48 trunk road corridor, the A48 Pentwyn-Baglan Road (westbound), and the routes to Junction 40.
Little change can be seen during the inter-peak period.

Figure 3.9a – Change in Vehicle Flows on the Local Roads (07:00-08:00)

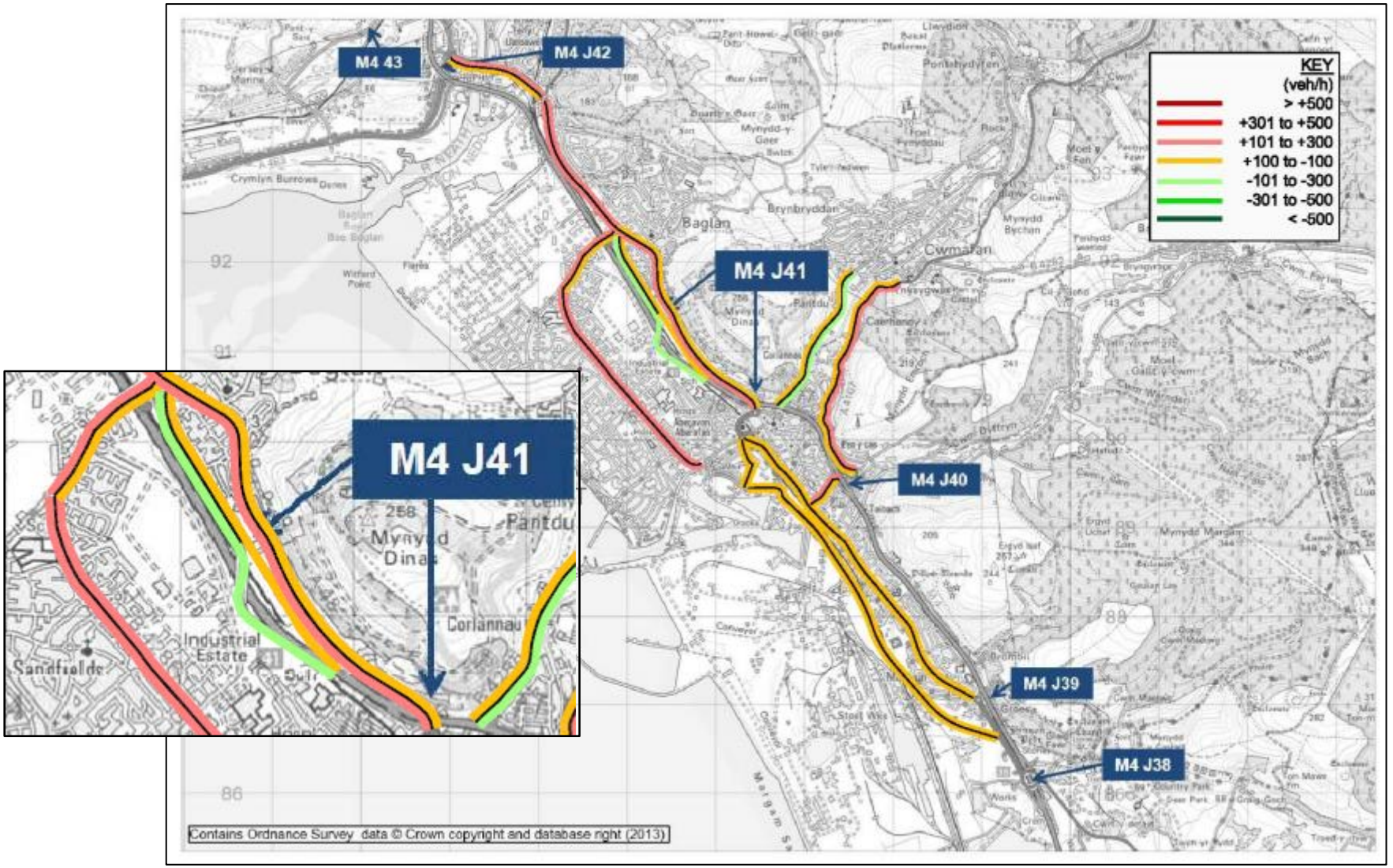


Figure 3.9b – Change in Vehicle Flows on the Local Roads (08:00-09:00)

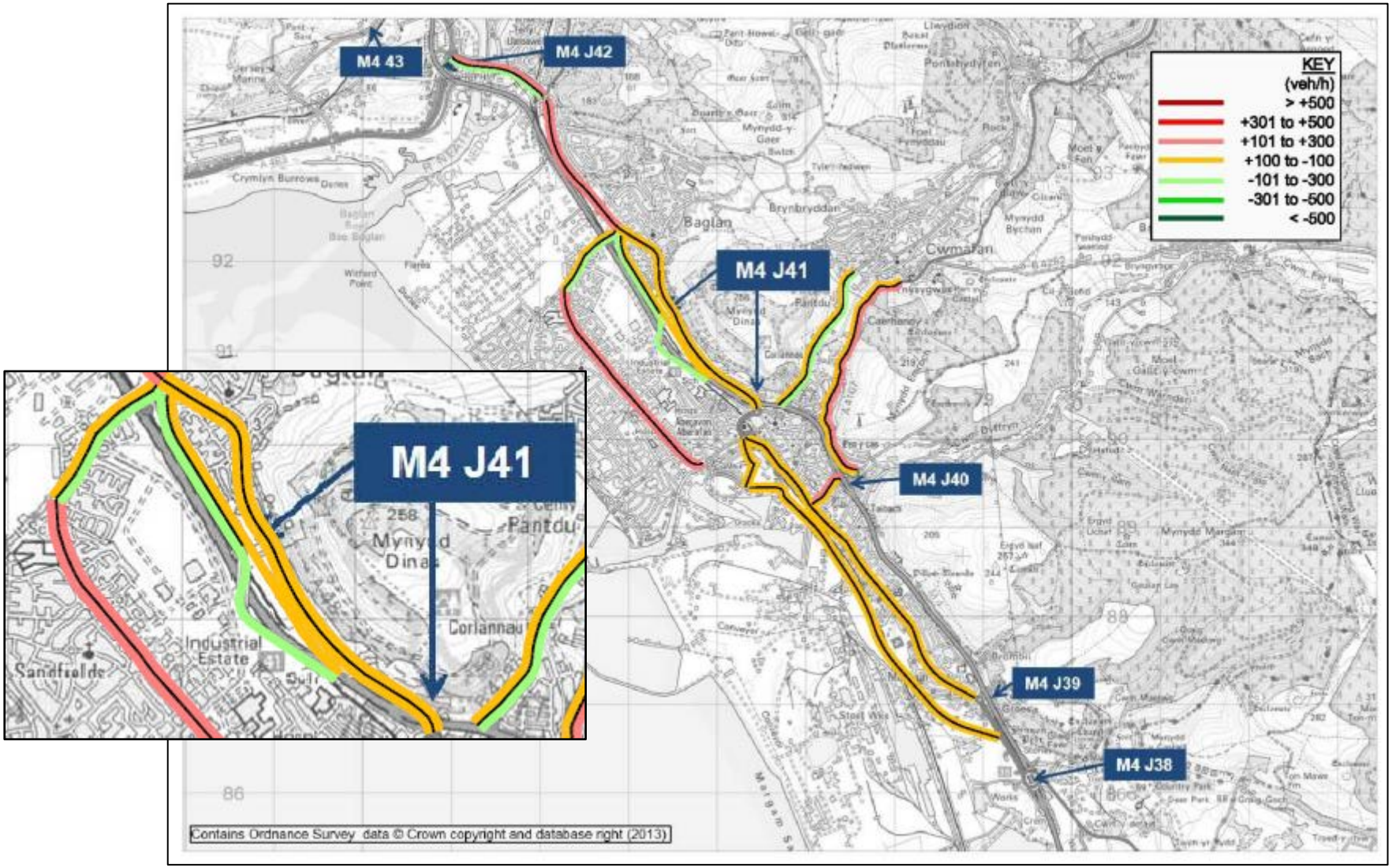


Figure 3.9c – Change in Vehicle Flows on the Local Roads (12:00-13:00)

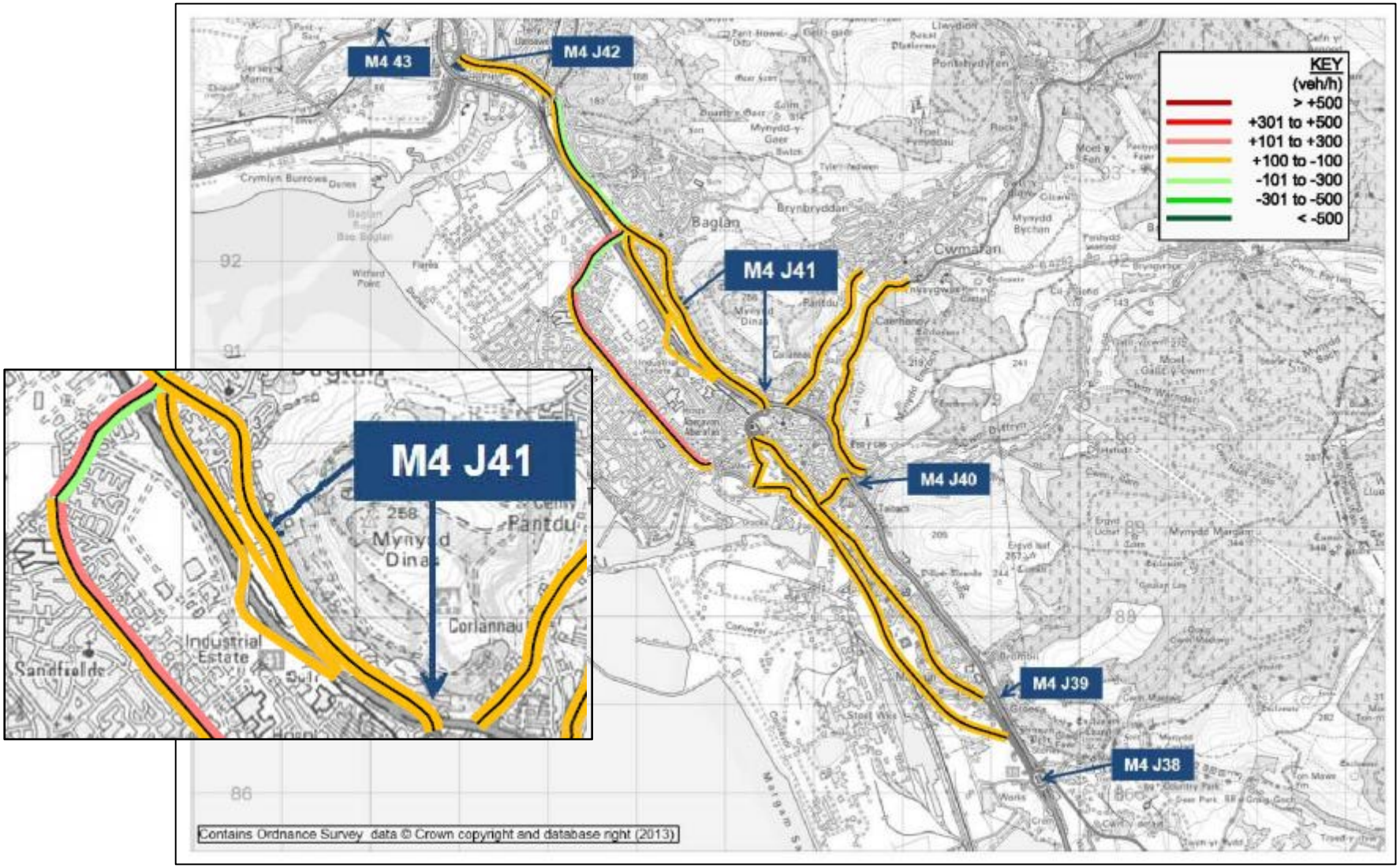


Figure 3.9d – Change in Vehicle Flows on the Local Roads (16:00-17:00)

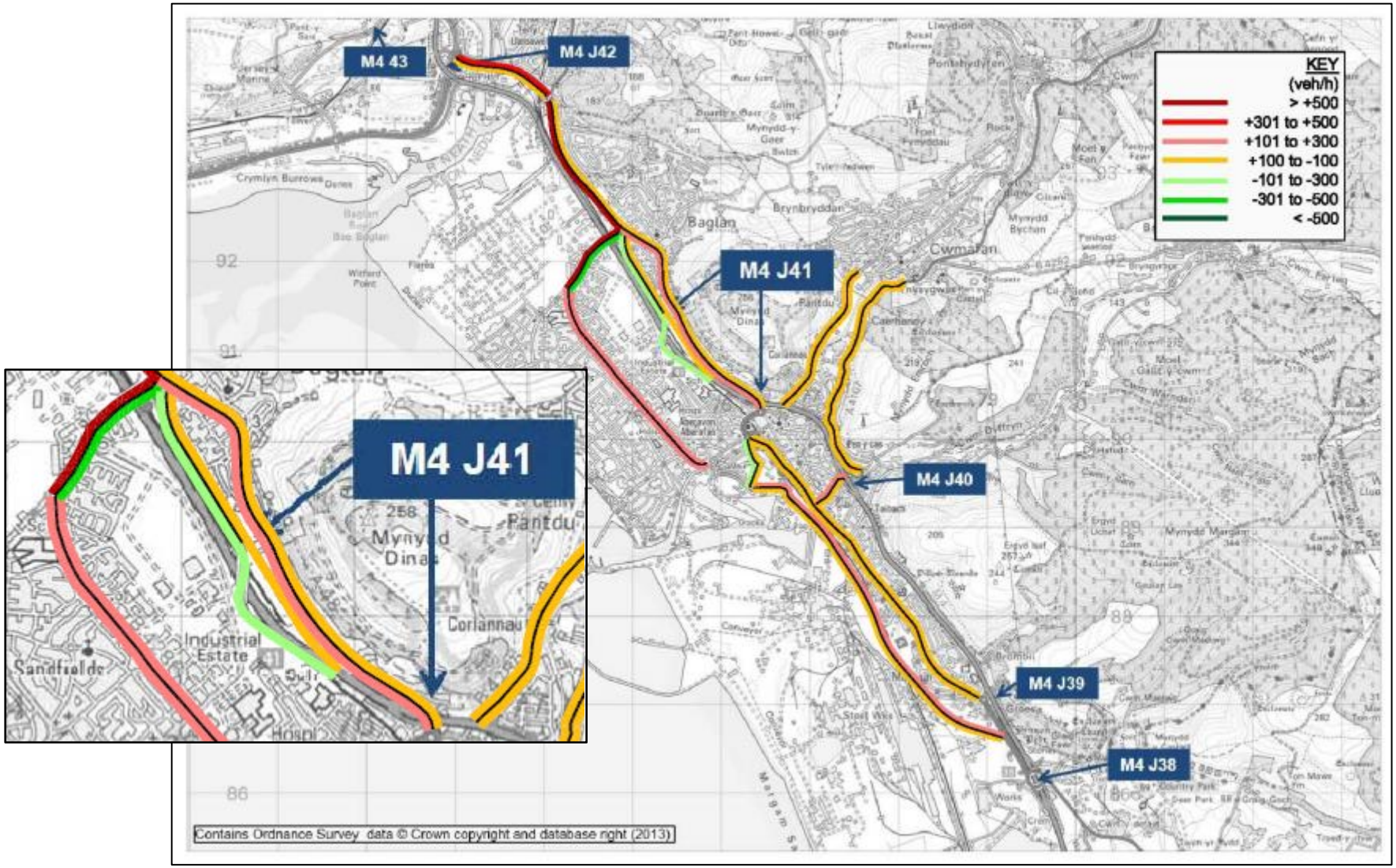
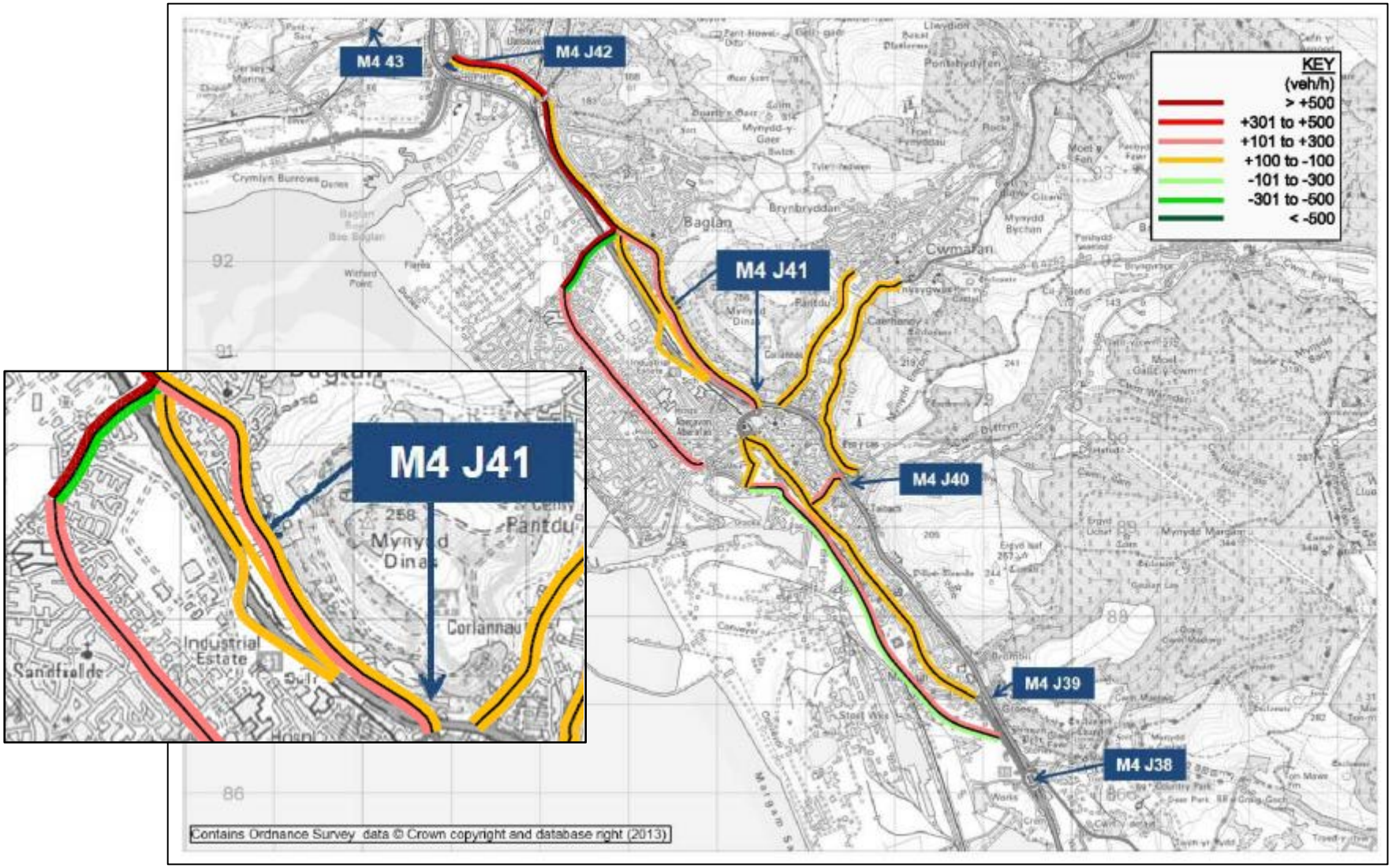


Figure 3.9e – Change in Vehicle Flows on the Local Roads (17:00-18:00)



3.2.2 *Local Roads Journey Time Results*

Results of the journey time impact analysis are presented below, comparing the pre and post-trial closure journey times for each of the local road routes.

Table 3.4 – Local Roads Change in Journey Time (mm:ss)

	AM Peak						Inter Peak				PM Peak							
	07:00-08:00				08:00-09:00				12:00-13:00				16:00-17:00				17:00-18:00			
	Before	After	Change		Before	After	Change		Before	After	Change		Before	After	Change		Before	After	Change	
Blue Route WB	13:33	12:06	-01:27	-11%	13:53	13:16	-00:37	-4%	12:52	13:07	+00:15	+2%	13:08	13:57	+00:49	+6%	13:17	14:29	+01:12	+9%
Blue Route EB	12:58	12:23	-00:35	-4%	13:32	13:57	+00:25	+3%	12:57	12:58	+00:01	+0%	14:01	13:38	-00:23	-3%	14:13	13:56	-00:17	-2%
Purple Route WB	15:55	14:21	-01:34	-10%	23:16	17:22	-05:54	-25%	15:14	15:05	-00:09	-1%	14:24	15:57	+01:33	+11%	14:03	15:53	+01:50	+13%
Purple Route EB	14:29	16:51	+02:22	+16%	16:53	15:27	-01:26	-8%	15:42	14:36	-01:06	-7%	14:35	14:07	-00:28	-3%	14:26	14:20	-00:06	-1%
Orange Route NB	05:23	06:05	+00:42	+13%	06:49	05:56	-00:53	-13%	05:26	05:40	+00:14	+4%	05:41	06:50	+01:09	+20%	06:03	05:41	-00:22	-6%
Orange Route SB	05:07	05:26	+00:19	+6%	06:08	05:52	-00:16	-4%	05:42	05:30	-00:12	-4%	05:44	06:23	+00:39	+11%	05:37	06:04	+00:27	+8%
Green Route NB	03:27	03:20	-00:07	-3%	03:34	03:23	-00:11	-5%	03:30	03:32	+00:02	+1%	04:05	03:43	-00:22	-9%	04:01	03:36	-00:25	-10%
Green Route SB	04:49	04:27	-00:22	-8%	06:06	05:15	-00:51	-14%	04:36	04:55	+00:19	+7%	04:37	05:15	+00:38	+14%	04:44	04:59	+00:15	+5%
Yellow Route WB	01:42	01:33	-00:09	-9%	01:47	01:38	-00:09	-8%	01:29	01:33	+00:04	+4%	01:53	01:31	-00:22	-19%	01:35	01:41	+00:06	+6%
Yellow Route EB	01:18	01:18	-	0%	01:24	01:32	+00:08	+10%	01:19	01:18	-00:01	-1%	01:19	01:20	+00:01	+1%	01:18	01:25	+00:07	+9%

3.2.3 Discussion of the Results of the Local Road Data

Traffic Volumes

The pattern of changes in traffic volumes on the local roads is broadly in line with expectations, in that the largest increases in traffic have occurred on the three most obvious diversionary routes for traffic that would normally use the westbound M4 Junction 41 on-slip road. These routes are:

- **Afan Way and Seaway Parade** (part of the Blue Route) – traffic following the prescribed diversion route
- **A48 Pentwyn Baglan Road** (part of the Purple Route) – traffic using a non-prescribed diversion route
- **Abbey Road** (part of the Orange Route) – traffic diverting to access the motorway at Junction 40.

(Refer to Figure 3.1 for a plan showing the route colours)

Other large increases in westbound traffic have occurred on the A48 Sunnycroft to Briton Ferry and on the A48 Briton Ferry Bridge both of which form the main alternative route to the M4 westbound for diverted traffic.

Journey Times

There generally seems to be a combination of increases and decreases in journey times on the local road routes.

The largest increases tend to be along the alternative routes to the M4 Junction 41 slip road, including 2 min 22 secs on the eastbound Purple Route during the 07:00 – 08:00 time period and 1 min 50 secs on the westbound purple route during the 17:00 - 18:00 time period. The westbound Blue Route also experiences an increase in journey times of 1 min 12 secs in the 17:00 – 18:00 time period. The Orange Route experiences increases in journey times both north and southbound during the 16:00 – 17:00 time period.

The analysis of the routes as a whole does not take into account the knock on effects on roads other than those key routes. For example, it is known that the increase in queuing and subsequent time to enter the Sunnycroft Roundabout from the A48 Pentwyn-Baglan Road has had the knock-on effect of encouraging a proportion of drivers to divert along Church Road and Sunnymount, causing some local traffic issues.

However, this problem of is a direct result of traffic diverting along a non-prescribed alternative route. This was predicted and mitigation in the form of traffic calming to discourage traffic from using the A48 was planned and funded by the Welsh Government, but not implemented following discussions within Neath Port Talbot County Borough Council, the highway authority for this road

These local issues are being monitored in order to inform the consideration of any further local works that might be required to mitigate any problems.

4 Primary Economic Evaluation

The changes in traffic volume and journey times reported in Chapter 3 have been used to undertake an economic evaluation to determine the monetary impact to road users of the change in journey times on key routes, the results of which are detailed below.

The trial consists of the part-time closure of the westbound on-slip only; the Primary Economic Evaluation is the balance of monetised journey time benefit/impact on the westbound M4 and key local roads.

The eastbound M4 monetised journey time benefit/impact is not included in the primary economic, but presented separately for the following reasons

- the M4 eastbound traffic flow is not affected by the westbound closure and hence is not relevant to the primary measure
- the M4 eastbound does not form part of the prescribed diversion route during the trial closures of the westbound on-slip
- the road layout is such that it is highly unlikely that any traffic affected by the westbound on-slip closure at Junction 41 would use the eastbound M4 as part of any non-prescribed diversion to travel westbound. Use of the A4241 and A48 travelling directly westbound would be shorter and more preferable
- the traffic flow data shows that traffic from the Afan Valley/Cwmafan affected by the closure of the westbound on-slip uses the A4107 to access Junction 40 to travel westbound
- increases in eastbound traffic flows and journey times related to ongoing trends, and unrelated to the trial slip road closure, would unduly influence the primary economic evaluation of the trial.

Data from the M4 eastbound has been used to measure the effect of the average speed enforcement system as no closure took place in this direction.

4.1 Monetised Journey Time Changes Results

Results of the monetisation of journey time changes for all relevant routes are presented in Table 4.1 (negative figures represent a disbenefit)

Table 4.1 – Monetised Vehicle Hour Savings

Route	EB	WB	NB	SB	Total
M4 J38-43 (Red Route)		£156,599			£156,599
Blue Route	£18,588	-£39,388			-£20,800
Purple Route	£16,750	£14,808			£31,558
Orange Route			-£17,881	-£9,292	-£27,173
Yellow Route	-£8,795	£11,699			£2,904
Green Route			£17,524	£19,203	£36,727
Total annual journey time impact for all routes					**£179,815**

This shows that the overall effect of the slip road closures and pre-emptive mitigation measures has resulted in an overall monetised journey time **benefit** of **£179,815** annually. This represents a total annual saving of 14,559 vehicle hours.

The changes in eastbound journey times results in an economic cost of -£378,355, representing a total annual increase of 30,634 vehicle hours. This is considered to result from the ongoing trend of increasing traffic and lower average speeds seen in the data.

5 Secondary Impacts

5.1 Queue Lengths

Queues at seven key junctions were surveyed before and after the start of the trial slip road closure. The locations of the key junctions are listed below and shown on Figure 5.1:

1. Briton Ferry roundabout
2. Sunnycroft roundabout
3. Abbey Road/Talbot Road signalised junction
4. Cwmavon Road/Heilbronn Way priority junction
5. Pentyla roundabout
6. Heilbronn Way roundabout
7. Ruthergelen roundabout

Figure 5.1 – Queue Length Survey Locations

Table 5.1 below shows the results of the queue length surveys, with an indication of where queues have increased and decreased.

Table 5.1 – Queue Length Comparison

Junction / Arm	Max Number of Vehicles in Queue					
	07:00 - 09:00			16:00 - 18:00		
	Before	After	Change	Before	After	Change
Briton Ferry Roundabout						
A474 Neath Rd	9	12	3	8	11	3
Old Rd	12	15	3	6	7	1
A48 Trunk Road NB	15	16	1	12	15	3
Brunel Way	11	5	-6	10	11	1
A48 Trunk Road SB	29	17	-12	15	16	1
Sunnycroft Roundabout Roundabout						
Sunny Mount	9	15	6	11	7	-4
A48 Pentwyn Baglan Rd	9	25	16	10	24	14
M4 J41 Slip Rd	20	13	-7	22	18	-4
A4241 Seaway Parade	20	18	-2	25	25	0
A48 Trunk Road SB	18	24	6	42	23	-19
Abbey Road / Talbot Road Signalised Junction						
Abbey Road	3	7	4	4	2	-2
Talbot Rd SB	5	6	1	3	10	7
Talbot Rd NB	4	9	5	4	4	0
Cwmavon Road / Heilbronn Way Junction						
Cwmavon Rd	45	15	-30	5	9	4
Pentyla Roundabout						
Heilbronn Way NB	3	0	-3	12	7	-5
A48 Pentyla Baglan Rd	4	0	-4	16	25	9
Heilbronn Way SB	20	15	-5	10	6	-4
Heilbronn Way Roundabout						
Heilbronn Way SB	25	20	-5	4	10	6
Heilbronn Way NB	9	4	-5	3	4	1
A4241 PDR	2	7	5	25	2	-23
Water Street	5	1	-4	30	4	-26
Rutherglen Roundabout						
A4241 Seaway Parade SB	0	7	7	3	2	-1
A4241 Seaway Parade NB	3	0	-3	5	25	20
Central Avenue	1	1	0	14	4	-10
Baglan Way	1	0	-1	0	1	1
Village Road	0	1	1	0	0	0
Between Rbts SB	0	0	0	0	0	0
Between Rbts NB	3	2	-1	3	0	-3

When considering queuing at junctions, it should be noted that the associated delay has been captured in the journey time measurements and has therefore been taken into account in the Primary Economic Evaluation. However, the information gained from these surveys is informing the need for additional mitigation measures at specific locations.

It can be seen that the largest increases in queue length occur on the A48 Pentwyn Baglan Road approach to the Sunnycroft roundabout and the northbound Seaway Parade approach to the Rutherglen roundabout.

The largest decreases in queue length have occurred on the Cwmavon Road approach to its junction with Heilbronn Way.

The pre-emptive mitigation works at Rutherglen roundabout included the introduction of traffic signals, and anticipated the potential changes in traffic following the completion of the Baglan Energy Park bridge. Egress from the Energy Park has been made much easier. Although the queue lengths on the Seaway Parade northbound approach have increased, they clear quickly when the lights are on green. Overall, it is considered that traffic now moves much more freely in this area than previously.

However, the increase in queuing on the A48 Pentwyn Baglan Road approach to Sunnycroft roundabout is more of a concern. From the Traffic Flow Impacts in Chapter 3, it can be seen that there has been an increase of up to 261 vehicles per hour on this approach during the closure periods. This is because a proportion of the traffic that would normally use the Junction 41 on-slip road is diverting to the A48 at Pentyla, and not following the prescribed diversion route.

Traffic at the give way line at the roundabout has little opportunity to enter as it is giving way to traffic entering from Sunnymount during the inter-green period of the signals on the major arms of the roundabout. Some drivers have become aware of this and are diverting via Church Road to Sunnymount, compounding the problems on the A48.

An increase in traffic at the A48 was anticipated and a number of measures to discourage traffic from using this route were proposed. These were to configure the traffic signals on the other arms of the Sunnycroft roundabout to prioritise the major arms of the M4 slip road, Seaway Parade and the A48 from Briton Ferry in conjunction with traffic calming on the A48 Pentwyn Baglan Road. These two measures would combine to make this route so unattractive to drivers that they would instead choose to follow the prescribed diversion route.

However, as noted earlier in the report NPT didn't implement traffic calming proposals on Pentwyn Baglan Road following internal discussions. The result is that it remains an attractive enough diversion route to attract a proportion of the diverted traffic, resulting in the issues seen on the approach to Sunnycroft roundabout, Church Road and Sunnymount.

It is considered that, in the absence of traffic calming, any measures to give more priority and opportunity for A48 traffic to enter the roundabout would

attract more diverted traffic along the A48, reaching the point where any benefit is negated.

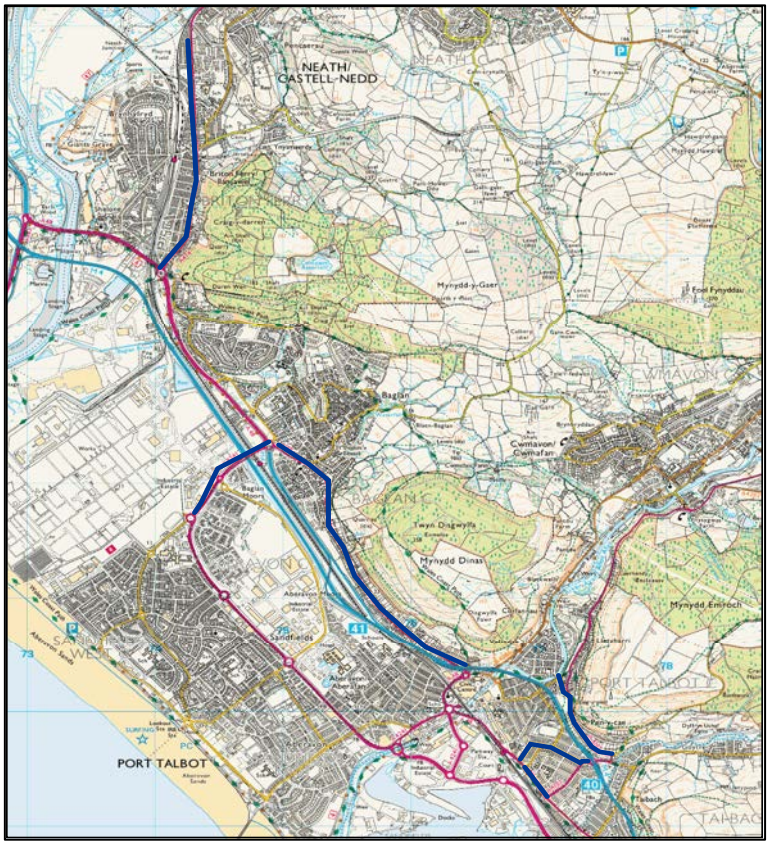
5.2 Air Quality Impacts

5.2.1 Neath Port Talbot CBC Air Quality Monitoring

NPT's Pollution Control Team have deployed nitrogen dioxide (NO_2) diffusion tubes at 19 locations in order to study the effect of the peak hour closures of the M4 Junction 41 westbound entry slip road in Port Talbot. These locations were chosen where traffic modelling suggested that traffic would increase the most and where topography suggested any pollution would be at its worst.

The roads which are subject to this monitoring are shown as dark blue in Figure 5.2 below:

Figure 5.2 – Routes subject to NO_2 Monitoring



NO_2 diffusion tubes are exposed for one month before being returned to the lab for analysis. The tubes are clipped to house downpipes or street lamp posts. Data is reported in microgrammes per cubic metre (µg/m3).

This data will allow an assessment to be made against the Government's long term air quality objective for NO_2. This states that the annual average concentration of NO_2 must not exceed 40 µg/m3 in a calendar year. Consequently results must be reported on a calendar year basis to measure compliance with this objective.

Monitoring commenced in April 2014 and 11 months' worth of data has been collected so far, up to February 2015.

Diffusion tubes are an inexpensive survey tool and cannot be expected to accurately measure NO_2 levels in the same way as expensive fixed monitors costing many thousands of pounds. Diffusion tubes are always used in the first stage of surveying and continuous monitors only where results are approaching long term objective (limit) levels. Typically, NO_2 diffusion tubes tend to slightly exaggerate the true concentration and it is therefore necessary to correct this by application of a bias adjustment factor.

In Neath Port Talbot a local bias adjustment factor is obtained by co-locating diffusion tubes with fixed monitors at three locations. The average of the relative performance of diffusion tubes at each of these sites is applied to all of the diffusion tubes in the NPT network. The bias adjustment factor for 2014 was 0.808.

In order to estimate ongoing progress, the 2014 bias adjustment factor has been applied to 2014 and 2015 raw data to give the averages shown in Table 5.2 below.

Table 5.2 Average NO_2 concentrations April to February 2015.

NO_2 Diffusion Tube Site ID (Exact Locations not provided by NPT for security of diffusion tubes)	**Average Concentration NO_2 µg/m^3**		
	4 months pre-closure	**7 months post-closure**	**11 months all**
61	31.2	42.3	39.9
54	28.2	35.2	32.6
64	25.9	33.3	30.6
67	23.9	28.1	26.6
68	22.8	27.3	25.7
58	22.0	27.4	25.4
60	19.2	27.0	24.1
57	20.1	25.9	23.8
53	21.7	24.4	23.6
66	18.3	25.8	23.1
65	17.0	22.8	20.7
52	19.0	20.3	19.8
59	16.5	20.9	19.3
56	14.4	21.8	19.1
62	15.1	21.1	18.9
63	15.2	18.4	17.3
51	16.6	17.0	16.8
55	11.6	19.3	16.5
50	11.9	17.0	15.2

The 2015 bias adjustment factor can only be applied after all of the 2015 data has been collected and ratified i.e. in April 2016.

Pollution monitoring data is reported on a calendar year basis. Where less than 12 months' worth of data is available in a calendar year the annual mean may be estimated comparing it to suitable long-term sites where a full year of data has been obtained.

Correction for short-term data collection during 2014 has made a small difference to the results.

Under the corrected results, Site 61 (39.9 µg/m3) is close to exceeding the long term air quality objective for NO_2 (40 µg/m3). However, this site is not located where there is public exposure i.e. at the frontage of a residence but on a street light on a busy road. The frontage of the nearest property is approximately 25 metres away and concentrations would be much lower at that distance. NO_2 concentrations at all other sites easily comply with the long term air quality objective.

Please note that the above results include 4 months prior to commencement of the M4 Junction 41 trial slip road closure. Estimation of the annual average from only 5 months of data post-closure is likely to be subject to a much greater degree of error.

A second year of diffusion tubes has been contracted, which will enable a full year of monitoring to be carried out for 2015, thereby avoiding the need for estimation of the annual average.

A full assessment against the Government's long term air quality objective for NO_2 will be undertaken by NPT once a full calendar year's measurements have been taken, after April 2015.

5.2.2 *Air Quality Calculations for M4*

In addition to the observed air quality monitoring, a high level air quality impact estimate has been derived for the pre and post-closure scenarios. This has been undertaken using the DMRB 11.3.1 Air Quality Screening Spreadsheet. This approach is based purely on a number of key traffic indicators as follows:

Variable	Assumption used for this assessment	
	Pre closure	Post closure
Link length	Measurement of road length	Measurement of road length
Traffic flows	Junction to junction traffic flows on M4 for 07:00-09:00 and 16:00-18:00 from Aug 13–Mar 14	Junction to junction traffic flows on M4 for 07:00-09:00 and 16:00-18:00 from Aug 14–Mar 15
Average journey speeds	Derived from the pre closure journey time data (Aug 13-Mar 14).	Derived from the post closure journey time data (Aug 14-Mar 15)
% HGV	No observed data available. Assumption taken from NPT traffic model	No observed data available. Assumption taken from NPT traffic model

It is important to note the following points/limitations of this approach before presenting the results:

- The use of average traffic speeds as part of the calculation does not consider whether vehicles are travelling at a consistent speed or experiencing stop start conditions. Clearly the latter usually has the most negative impact in terms of emissions.
- HGVs have a significant impact on air quality. For this assessment, it has been assumed that the percentage of HGV's are the same in the pre and post-closure scenarios.

The air quality spreadsheet has been run for the pre and post-closure scenarios for the following time periods:

- 07:00 to 08:00
- 08:00 to 09:00
- 16:00 to 17:00
- 17:00 to 18:00

The results show a **reduction of 150 tonnes of carbon per year** on the M4 westbound carriageway during the post-closure period.

Because the calculation method does not take into account stop-start traffic conditions it is considered that it is not suitable for applying to the eastbound M4 carriageway.

5.3 Visitor Numbers to Port Talbot Town Centre

Two data sources have been used to indicate whether the trial slip road closure has led to a change in visitor numbers into Port Talbot town centre:

- Car park ticket data in town centre car parks
- Footfall at Aberafan Shopping Centre.

NPT collect the numbers of car parking tickets issued as a matter of course and has made this data available.

Footfall surveys at the shopping centre entrances are being undertaken by NPT on a monthly basis. The November survey was carried out by a third party specialist survey company to independently validate the NPT survey results.

5.3.1 Car Parking Tickets

Car park usage in Port Talbot is one of the most appropriate indicators of whether the trial slip road closures have had an impact on visitor numbers to the town centre, because it is related directly to the mode of transport most affected by the trial.

The monthly numbers of car park tickets, split by hour, issued from machines in the local authority car parks in and around Port Talbot town centre has been supplied by NPT. The data has been provided for every month from September 2011 to March 2015.

The data has been analysed in two categories

- Total of tickets from all car parks;
- Tickets from the Port Talbot multi-storey car park (MSCP)

These categories have been chosen because they cover the whole town centre and because MSCP is located adjacent to Junction 41 and therefore could be most affected by the trial slip road closures.

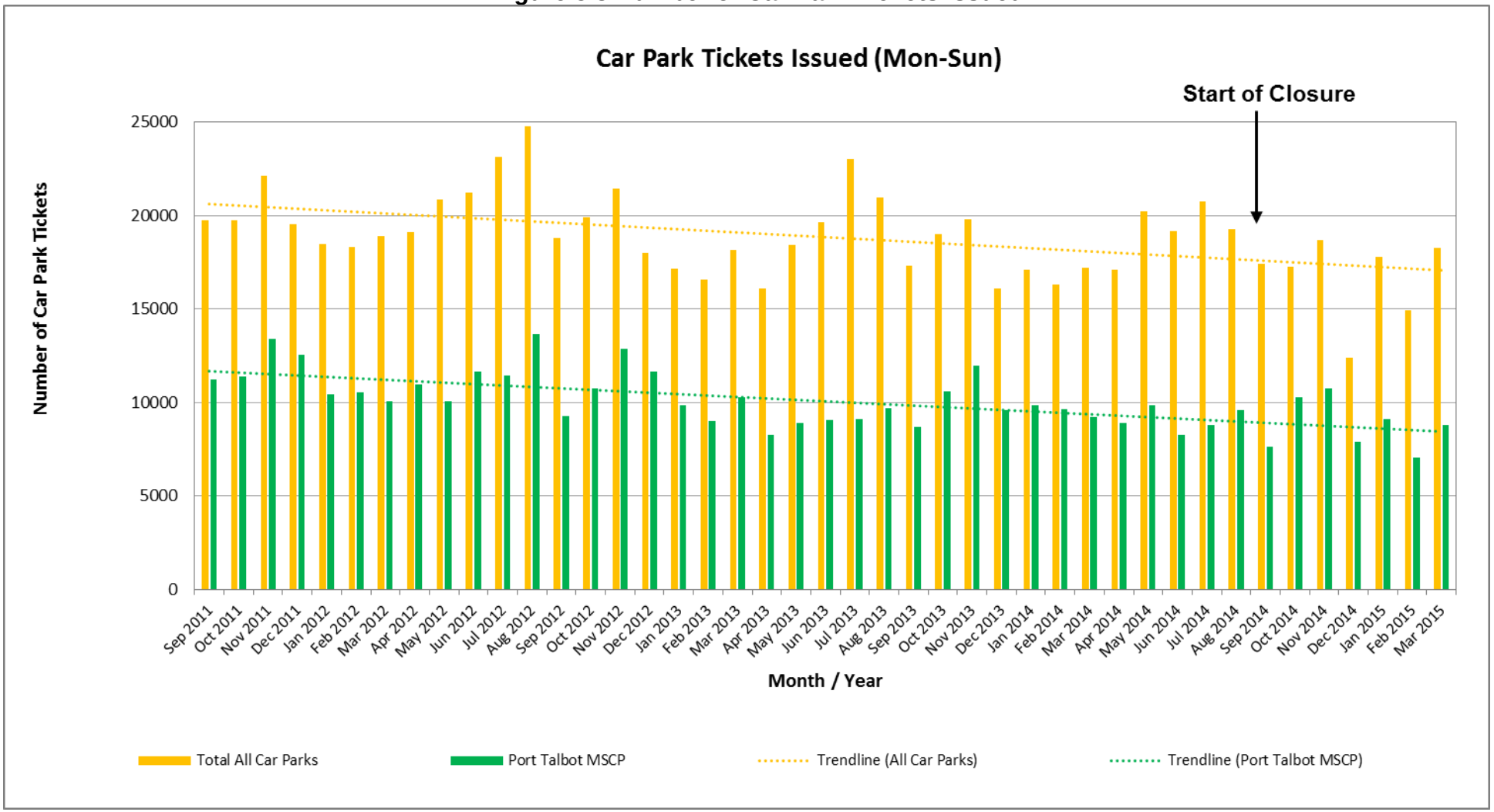
Figure 5.3 shows the monthly numbers of car parking tickets issued in all car parks and the multi-storey car park from September 2011 to March 2015.

It can be seen that there is an overall year on year downward trend in the numbers of car parking tickets issued, with a recurring monthly trend of peaks and troughs.

In order to normalise the data for seasonal trends, the car park ticket data has been analysed for the seven month periods of September to March (no August data for 2011) for each of the years 2011/12 to 2014/15. The seven monthly total number of car park tickets for all car parks and the multi storey car park are plotted on Figure 5.4.

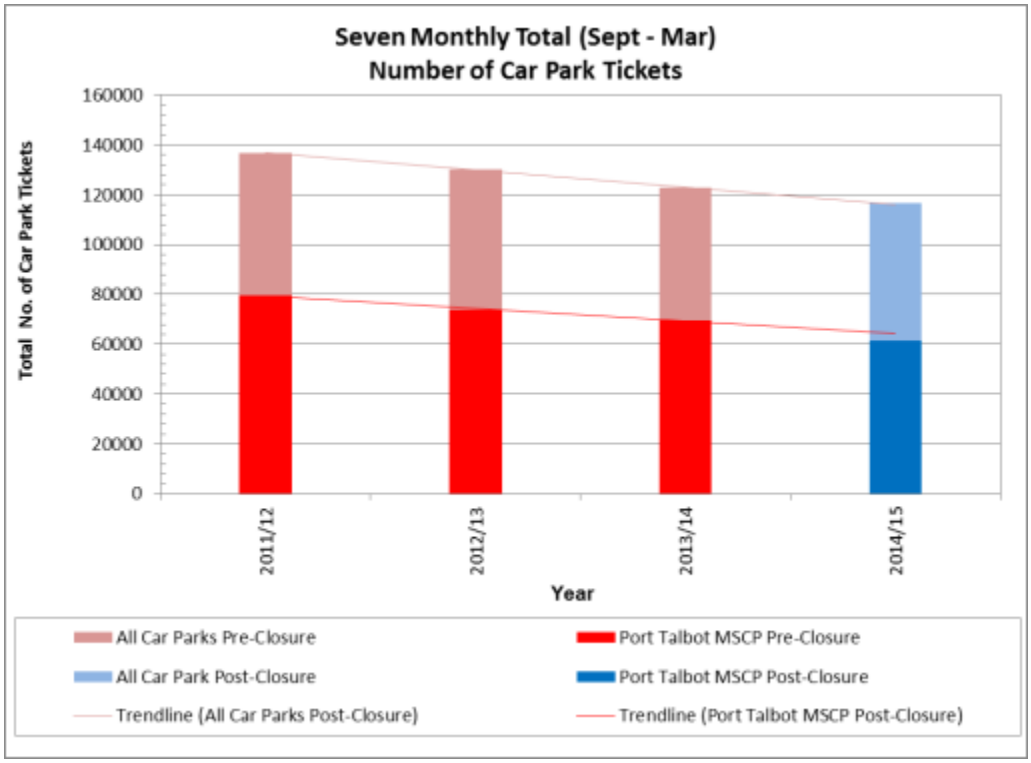
The pre-closure trends have been projected forward to 2014/15 to enable the post-closure data to be compared to the projected figures, had the closure had not taken place.

Figure 5.3 Number of Car Park Tickets Issued



Notes: 1.Tariff increases introduced during May of each year
2. Figures for December in each year are only partial, as parking is free for 10-12 days. Actual parking numbers in each December are likely to be significantly higher

Figure 5.4 Seven Monthly (Sept – Mar) Total Number of Car Park Tickets Issued



It can be seen that the post closure seven monthly total number of car parking tickets issued in all car parks is very close to the projected trend from same months in the previous three years. However the post-closure number of tickets issued in the Port Talbot Multi Story Car Park is slightly lower than the projected trend, by approximately 2950 tickets over the seven months. This equates to approximately 14 tickets per day over this period.

This indicates that the trial slip road closure has had a negligible impact on the numbers of vehicles using the car parks in Port Talbot town centre.

The hourly data over the same seven month periods has also been analysed to indicate whether the times of the car parking tickets being issued has changed. This would give an indication of a change in behaviour of motorists who use the car parks.

The slip road closures take place on weekdays between 07:00 to 09:00 and 16:00 to 18:00. For the purposes of this analysis the times of issuing car parking tickets have been split into the following three periods:

- 07:00-09:00 (morning slip road closure period);
- 09:00-16:00 (period when slip road is open); and
- 16:00-18:00 (afternoon slip road closure period).

Table 5.3 shows the relative proportions of the number of tickets issued during these three periods for all town centre car parks.

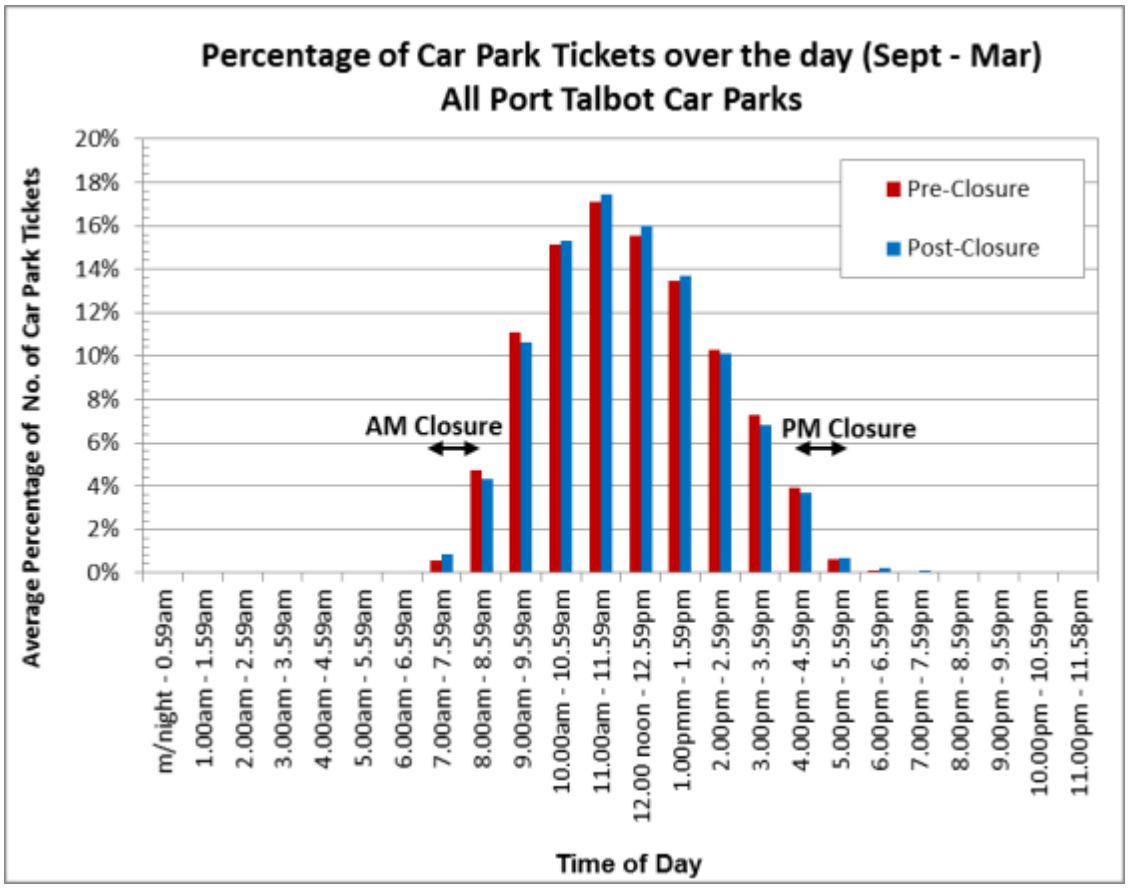
Table 5.3 – Percentage of Car Parking Tickets Issued during the Trial Closure time periods (All Car Parks)

Time Period	Pre-Closure	Post-Closure
07:00-09:00	5.3%	5.2%
09:00-16:00	90.2%	90.4%
16:00-18:00	4.5	4.4%

It can be seen that there has been negligible change in the proportion of tickets issued in each of the time periods pre and post closure, with approximately 90% of the tickets issued outside the hours of the trial slip road closures.

Figure 5.5 shows the average percentage of car park tickets issued over the day for the same seven monthly periods pre and post-closure. Although there has been a negligible shift in the proportion of tickets issued during the closure periods, it can be seen that there appears to be a slight shift in hourly proportions between the closure periods, with an increased proportion being issued during the middle of the day (11:00-14:00) and a reduced proportion between 09:00 and 11:00 and between 14:00 and 16:00. However, all changes are less than 1%.

Figure 5.5 Percentage of Car Park Tickets Issued by Hour



Conclusions of Analysis of Car Parking Tickets

From the above analysis, it can be concluded that the trial slip road closure has had a negligible effect on the numbers of car parking tickets issued compared to the same period in previous years. The reduction in the numbers of vehicles using the car parks in Port Talbot town centre that has been observed, is a result of the ongoing year on year trend of diminishing use.

The overall proportion of car parking tickets issued during the times of the closure has been seen to be negligible.

There appears to have been a slight shift in the pattern of usage, with relatively more tickets being issued during the middle of the day during the hours of 11:00 to 14:00, but the difference during each hour is less than 1%, and is therefore considered negligible.

5.3.2 Aberafan Shopping Centre Footfall

Whereas transport accessibility is undoubtedly an important factor affecting footfall for any shopping centre, there are many other factors that can cumulatively have a far greater impact. These include the state and outlook of the economy, levels of consumer confidence, availability of household disposable income, competition from other shopping centres within the same catchment area, weather conditions, and the attractiveness and offer of the shopping centre itself (including the range of shops and facilities offered, and unit vacancy levels).

Footfall numbers are also significantly affected by changing consumer preferences and habits, such as the significant growth of internet shopping.

Therefore any analysis of footfall numbers must take into consideration the above factors.

It should be noted that the car parking ticket analysis is a more robust indication of whether the slip road closures are a cause of any changes in visitors to the town centre. This is because the footfall analysis is based upon a smaller amount of available data, the lack of equivalent data over the same period in previous years, and because of the many other factors that influence shopping centre footfall mentioned above.

However, the fact that the slip road closures are taking place at specific days and times makes it easier to isolate the possible impacts of these closures, as it would be expected that any impacts would be most evident during the days and times that the closures are in operation.

Therefore this analysis compares the trends in weekday footfall (the days when the trial slip road closures are in place) to the trends in Saturday, Saturday and Sunday and whole week footfall.

Aberafan Shopping Centre Total Footfall Analysis

Seven footfall surveys have been carried out at Aberafan Shopping Centre from June 2014 to February 2015. They were each carried out over a full week, incorporating both weekdays and weekends. The time periods were 08:00-18:00 Monday to Saturday and 10:00-16:00 on Sundays, incorporating the shopping centre opening hours. No surveys were undertaken during August 2014 as it was felt that any survey should take place at least two weeks after the start of the trial closures to allow travellers to get used to the new arrangements. The only remaining week in August included a bank holiday, so was considered to be unrepresentative. No survey was possible during December 2014 as access was denied by the shopping centre.

Figures 5.6 to 5.13 show the total footfall number for each survey for weekdays, Saturdays, Saturdays and Sundays, and for the whole week respectively.

Figure 5.6 –Total Footfall Numbers, Mondays to Fridays 8:00-18:00

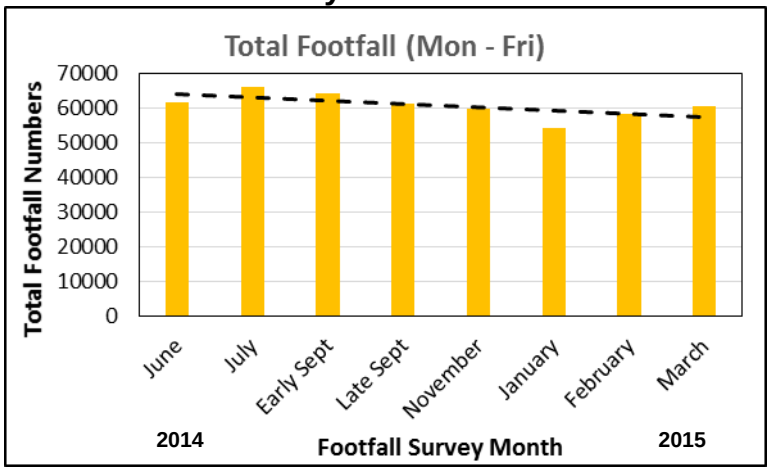


Figure 5.7– Total Footfall Numbers, Saturdays 8:00-18:00

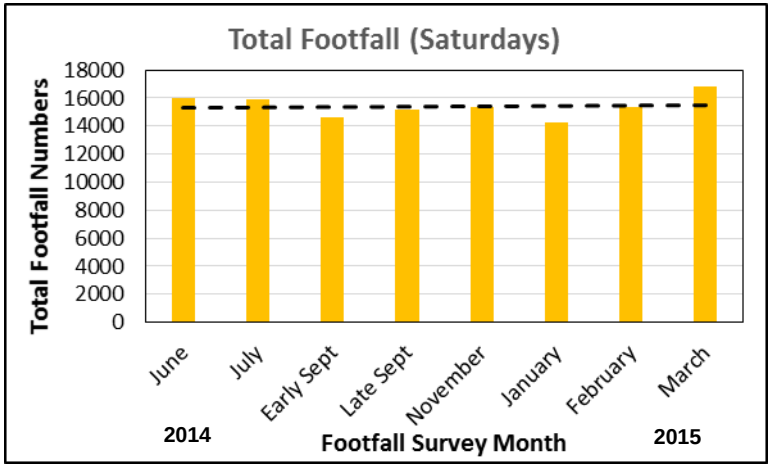


Figure 5.8 –Total Footfall Numbers, Saturdays and Sundays 8:00-18:00

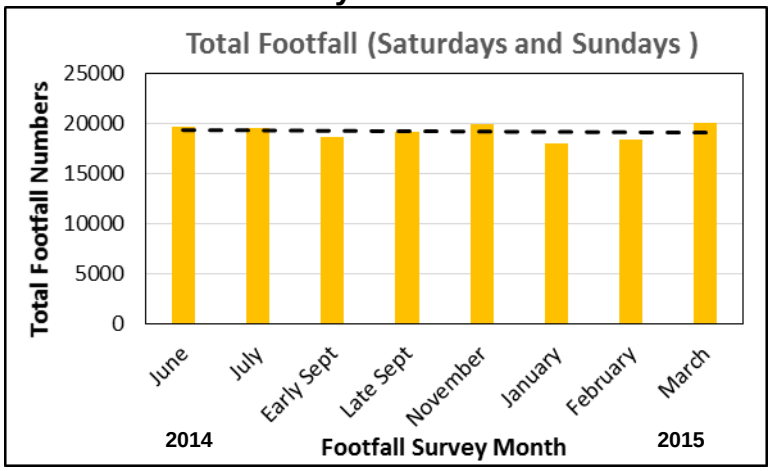
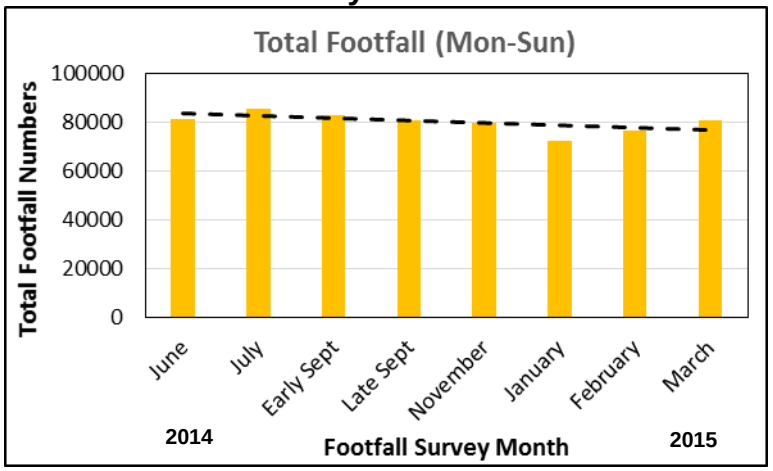


Figure 5.9–Total Footfall Numbers, Mondays to Sundays 8:00-18:00



The analysis of footfall data collected over the period June 2014 to February 2015 shows that footfall numbers at Aberafan Shopping Centre have generally declined since July 2014. This decline is observed during weekdays and when considering the week as a whole.

The decline has not been experienced on Saturdays, resulting from a significant increase in footfall during March. A small decline can be seen when the weekend as a whole is considered

It should be noted that January footfall numbers are usually the lowest of the year for high streets and shopping centres across the United Kingdom. Therefore any observed decline in January footfall counts (compared to earlier months, not year on year) is considered normal and in line with expectations. It therefore follows that increases will be expected during February and March.

It should also be noted no data from December 2014 is included, which would be expected to be the busiest month during the trial period.

Aberafan Shopping Centre Footfall Analysis by Time of Day

For the purposes of this analysis the shopping centre's opening hours have been split into the following three periods to coincide with the times of the slip road closures:

- 08:00-09:00 (morning slip road closure period);
- 09:00-16:00 (period when slip road is open); and
- 16:00-18:00 (afternoon slip road closure period).

Table 5.4 shows the relative proportions of footfall numbers recorded for these three periods during each survey.

Table 5.4 – Proportion of Footfall Numbers by Time Period (Monday to Friday)

Time period	June 2014	July 2014	Early Sept 2014	Late Sept 2014	Nov 2014	Jan2015	Feb 2015	Mar 2015
08:00-09:00	5%	4%	5%	5%	5%	5%	5%	5%
09:00-16:00	84%	86%	84%	84%	85%	84%	84%	85%
16:00-18:00	11%	11%	11%	11%	10%	11%	11%	10%

The data show that there has been no noticeable decline in the proportion of people visiting the shopping centre during the times when the slip road closures have been in place.

Figures 5.10 to 5.12 below show the footfall numbers during the weekdays for the three time periods

Figure 5.10 – Footfall Numbers (Mondays to Fridays 08:00-09:00)

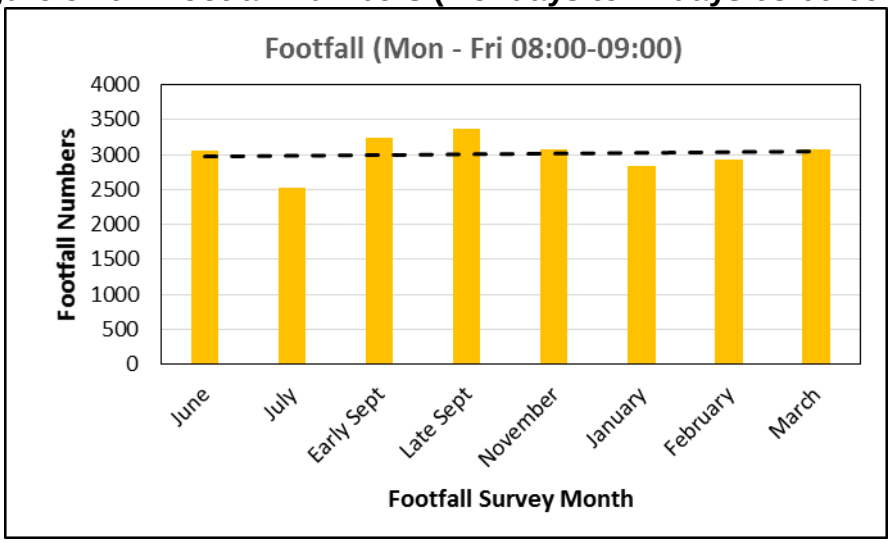


Figure 5.11– Footfall Numbers (Mondays to Fridays 09:00-16:00)

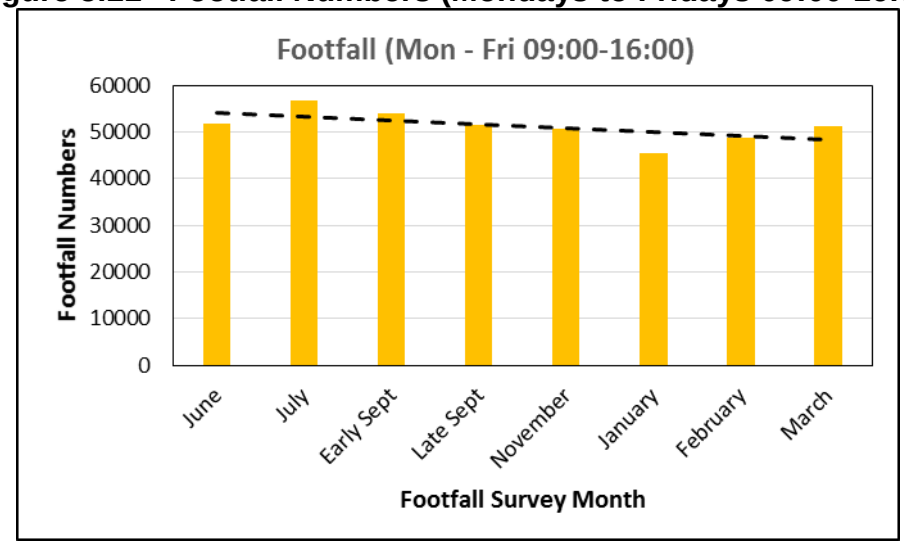
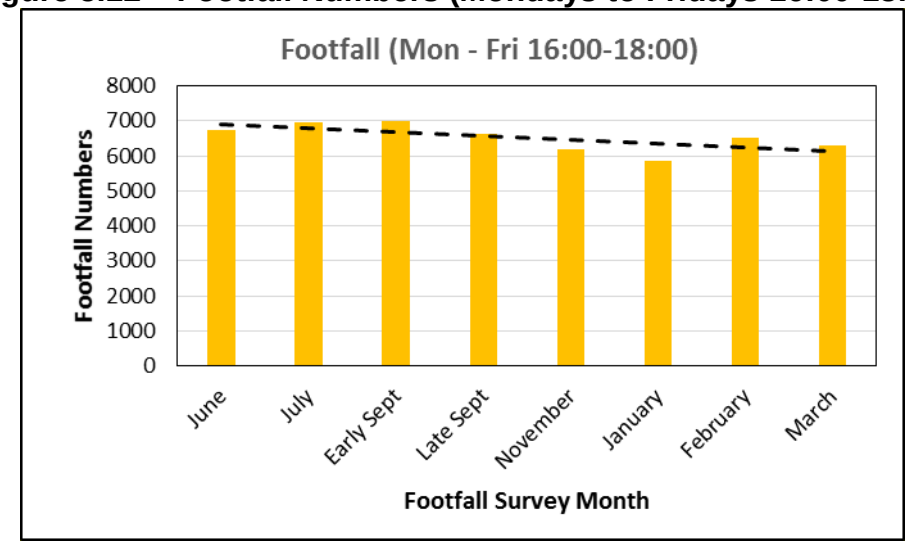


Figure 5.12 – Footfall Numbers (Mondays to Fridays 16:00-18:00)

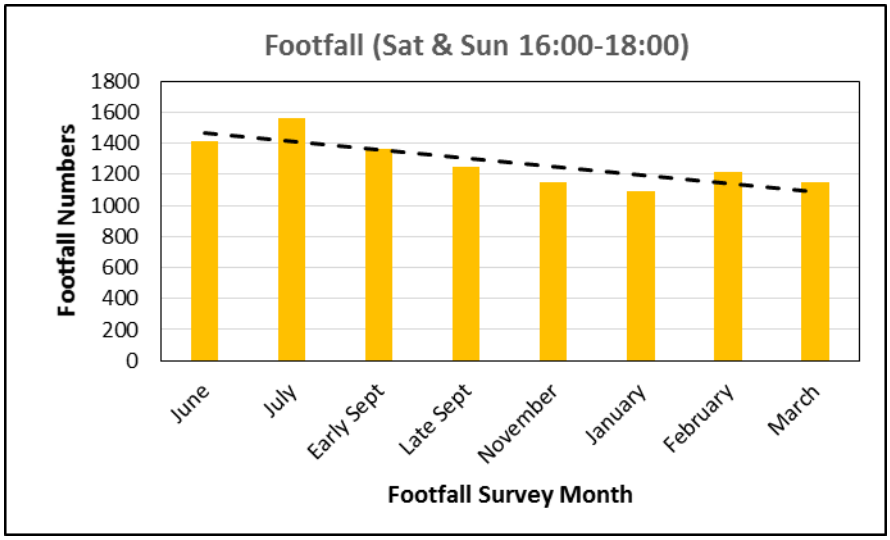


As Figures 5.10 to 5.12 illustrate, the decline in weekday footfall counts has not been restricted to the morning and afternoon periods when the slip road closures have been in place. In fact, the morning peak period has seen a slight increase in footfall when the slip road closures are in place, and a decline has been recorded between 09:00 and 16:00, a time period that should not be affected by the slip road closures.

It is reasonable to assume that if the slip road closures had a significant impact on footfall counts during the morning and afternoon peak periods, then the proportion of people visiting during these periods would decline in comparison to the inter-peak period. This does not appear to be the case however, as footfall numbers have been declining throughout the day and throughout the week.

Finally, Figure 5.13 shows the footfall numbers during the 16:00 to 18:00 period for the weekends (when there are no closures)

Figure 5.13 – Footfall Numbers (Weekends 16:00-18:00)



As Figure 5.13 illustrates, there has been a noticeable decline on weekends during the 16:00 to 18:00 time period. Furthermore, the decline on weekends has been greater than on weekdays.

Weekend footfall numbers for the 16:00-18:00 period were 26% lower in March 2015 than they were in July 2014. In comparison, weekday footfall numbers for the same period were only 10% lower in March 2015 than they were in July 2014. This shows a much greater decline in footfall numbers on weekends than weekdays, which cannot be attributed to the slip road closures.

The evidence therefore suggests that footfall numbers have been declining outside the hours of the trial's operation and no obvious link can be made between declining footfall numbers and the slip road closures. As discussed in the following section, this declining trend reflects wider UK and Wales footfall trends.

Welsh and UK footfall trends

According to the Welsh Retail Consortium / Springboard Footfall Monitor, December 2014[1], Welsh footfall numbers have been in continuous decline for the previous 11 months. Footfall in December 2014 was 0.4% lower than in December 2013, November recorded a 3.9% year on year fall, and October saw a decline of 3.1% on year on year footfall numbers.

Across the UK, footfall in December 2014 was 0.7% lower than a year ago, with a 2.4% fall in November.

More recently, on 13th March 2015 the BBC reported "February footfall saw a 2.3% drop compared to 12 months earlier; Scotland and Northern Ireland saw an increase of 1.2% and 1.3% respectively. The UK average saw a 0.8% drop."

The British Retail Consortium has observed a long term downward trend in footfall in high streets and shopping centres across the UK, in contrast to retail parks and out-of-town locations which have exhibited steady growth. According to the Welsh Retail Consortium, however, footfall in Wales declined across high streets, shopping centres and out of town locations for most of 2014.

According to Experian and Eurostat data, UK year on year footfall numbers declined for 11 consecutive months between February 2014 and December 2014 (Table 5.5). This shows a clear, declining trend in UK footfall which can be attributed to a range of factors including a lack in real term wage growth, relatively low levels of consumer confidence and the continued growth of internet shopping.

Table 5.5 – UK year on year footfall change, January 2014 – December 2014

Month	Year on year footfall change %
January 2014	3.4%
February 2014	-2.4%
March 2014	-0.3%
April 2014	-0.8%
May 2014	-1.0%
June 2014	-0.8%
July 2014	-0.2%
August 2014	-0.5%
September 2014	-1.7%
October 2014	-1.3%
November 2014	-1.5%

[1] Published on 16 January 2015

December 2014	-2.1%

As detailed in an article on Wales Online dated 8 December 2014[1] research undertaken by S4C's Y Byd ar Bedwar current affairs television programme, showed that traditional high streets and shopping centres in Wales face increasing competition from internet shopping as more consumers choose to shop online rather than visit physical stores. The research showed that over 50% of shoppers would do some of their Christmas shopping online.

Llyr Roberts, Senior Lecturer in Business, Marketing and Events at the University of South Wales, said that ten years ago that percentage would have been closer to 10%. This demonstrates the rapid rise in internet shopping, which threatens footfall numbers and expenditure levels at high streets and shopping centres as people move their custom onto the internet.

5.3.3 Conclusions of Footfall Analysis

The analysis of footfall numbers at Aberafan Shopping Centre shows a general decline that is in line with falling Welsh and UK footfall trends. The decline in footfall numbers is not restricted to the days and times of the slip road closures but is also evident in weekday inter-peak times and at weekends.

Footfall counts by themselves cannot identify the factors influencing any growth or decline in visitor numbers. And while transport is an important factor influencing footfall, the fact that footfall levels at Aberafan have seen a declining trend across all times and days of the week suggests there is no obvious direct link between the slip road closures and footfall levels.

[1] "Poll reveals the scale of the challenge facing Wales' high streets in the face of online retailers" by Martin Shipton

6 Conclusions

Primary Monetary Evaluation

The changes in traffic volume and journey times have been used to undertake an economic evaluation to determine the monetary impact to road users of the change in journey times as a result of the trial slip road closures.

The overall monetary impact on journey times on the M4 westbound and key local roads is a **benefit** of **£179,815** per annum, representing a total annual decrease of **14,559 vehicle hours**.

The eastbound M4 is not included in the Primary Economic Evaluation as increases in eastbound traffic flows and journey times are considered to be a result of ongoing trends, and unrelated to the trial slip road closure, and would unduly influence the primary economic evaluation of the trial if included.

Performance Against Objectives

The following Objectives were set for this trial slip road closure:

- **OBJ1** - Improve journey time reliability on the M4 between J38 and J42;
- **OBJ2** - Reduce overall journey times on the M4 between J38 and J42 during peak periods; and
- **OBJ3** - Reduce the accident rate on the M4 between J38 and J42.

The trial closure's performance against OBJ3 has not been assessed in this report. This will be a longer term assessment as Personal Injury Accident data is collected by the police and there is usually at least a six month time lag before this data is made available.

OBJ1 – Journey Time Reliability

Against OBJ1, journey time reliability has been shown to have improved in the westbound direction improved with a narrower range of speeds more closely grouped around the average.

This indicates that more drivers are experiencing the average journey time recorded on the route, thus an improvement in journey time reliability has occurred.

In the eastbound direction there has generally been little change in journey time reliability during the morning peak hours, but a worsening of journey time reliability during the afternoon peaks despite the introduction of the average speed camera system over the 50 mph speed limit section.

Objective OBJ1 can therefore be considered to have been achieved for the M4 in the westbound direction as a result of the peak-time closure of the slip road.

OBJ2 – Journey Times

The peak hour closure of the Junction 41 westbound entry slip road has reduced overall journey times on the westbound carriageway of the M4 by up

to 34 seconds (a 5% improvement) between Junction 38 and a point just after Junction 42.

In contrast, on the eastbound carriageway where no slip road closures have been undertaken, journey times have continued to be affected by the disruption in traffic flow at Junction 41 during peak times. Journey time reliability has not changed.

The trial slip road closure can therefore be considered to have met Objective OBJ2 for the M4 in the westbound direction.

The key local road network routes have seen a range of increases and decreases in journey times, influenced by the slip road closures and the pre-emptive measures put in place to mitigate their impacts.

Secondary Impacts

The pre-emptive measures put in place on the local roads to mitigate any impacts of the redistribution of traffic appear to have worked adequately, with a general improvement in journey times on the local road routes.

However, there have been localised increases in queue lengths increases in traffic queues in some locations where pre-emptive mitigation measures were not put in place. Congestion has been observed on the approach to the Sunnycroft roundabout on the A48 Pentwyn Baglan Road and local side roads, caused by traffic not following the prescribed diversion route. The A48 Pentwyn Baglan Road approach to Sunnycroft roundabout was identified by the modelling as a location where mitigation measures would be required, but they were not implemented following discussions within Neath Port Talbot County Borough Council (NPT), the highway authority for this road.

Overall, there is no evidence at present of the trial slip road closures adversely affecting the majority of the key routes through Port Talbot.

Based upon analyses of car parking data and footfall surveys, there is no evidence to suggest that there has been an impact on visitor numbers to Port Talbot town centre as a result of the trial closures. Reductions in visitor numbers are consistent with the observed year-on-year trend of decreasing car park users and national shopping centre and town centre footfall.

Neath Port Talbot's Air Quality Monitoring Team have deployed nitrogen dioxide (NO_2) diffusion tubes at 19 locations in order to study the effect of the trial slip road closures. An interim assessment has been made against the government's long term air quality objective for NO_2. At present it appears that all but one sites easily comply with the long term air quality objective for NO_2 (40 $\mu g/m^3$). The data collection and assessment will continue to enable an annual average over a full calendar year to be calculated.

Calculations show a **reduction of 150 tonnes of carbon per year** on the M4 westbound carriageway during the post-closure period.

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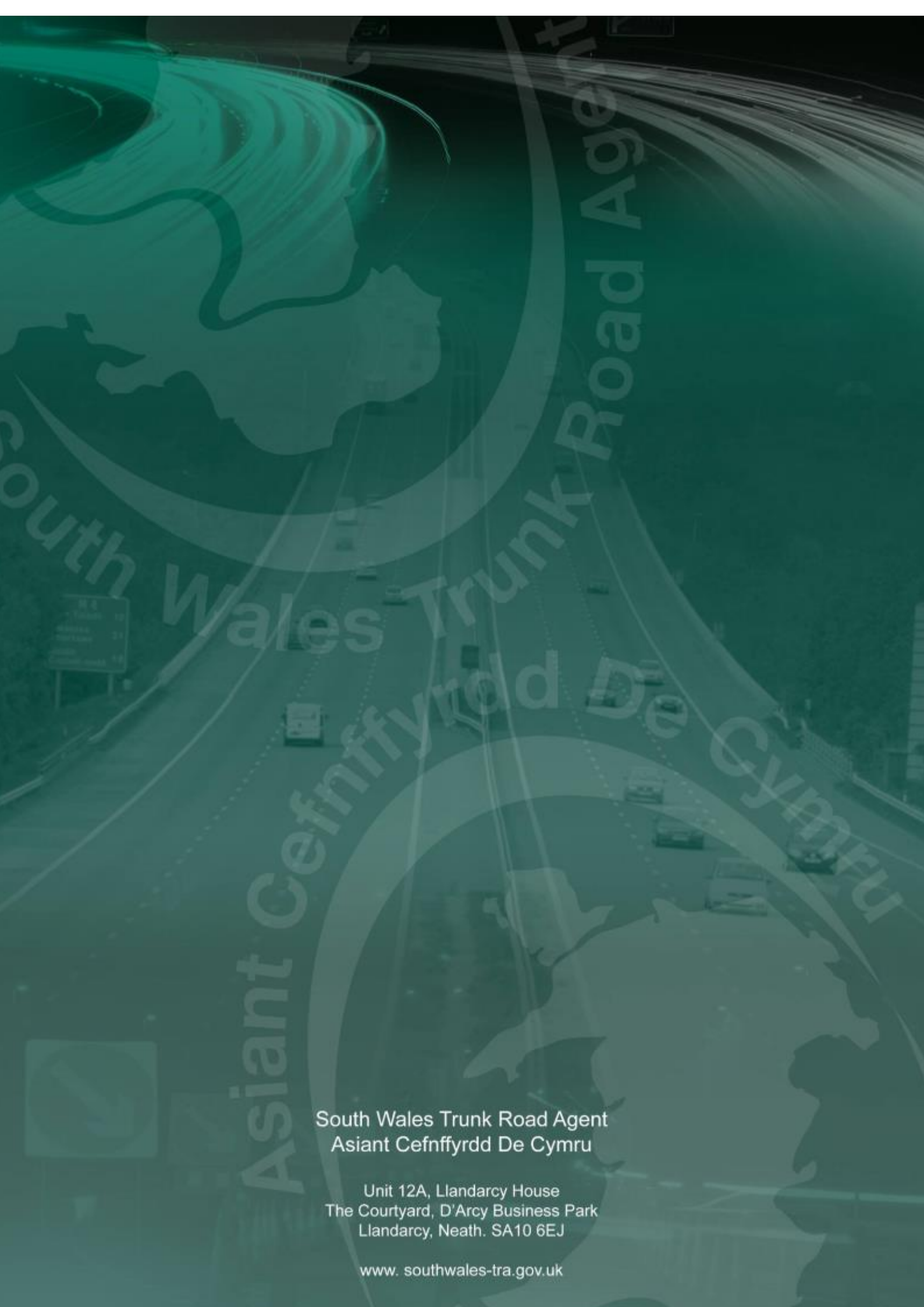

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