Highways England

A2 Bean and Ebbsfleet Junction Improvements

Technical Appraisal Report

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1 Introduction

1.1 Purpose of this report

1.1.1 This Technical Appraisal Report (TAR) is the report on the technical aspects of the existing or future highway problem and the sustainable and affordable alternative solutions for improving the A2 trunk road junctions at Bean and Ebbsfleet to support the future economic growth of the Kent Thameside area, including Ebbsfleet Garden City. The TAR brings together the traffic, economic, safety and environmental assessments, and is the basis for deciding which option(s) should be included in the Public Consultation. The purposes of the TAR are broadly to:

- Set out the physical, environmental, planning and traffic conditions of the area surrounding the junctions;
- Validate the need for the scheme under the terms of reference set out in the Client Scheme Requirements;
- Identify and evaluate sustainable options having regard to economic assessment and value for money, engineering, safety, effect on the economy, social and environmental factors;
- Describe the alternatives investigated and set out the reasons for rejection of any of those alternatives; and
- Recommend options for public consultation or recommend a single option consultation where there is the only one sustainable option, or one option is clearly the more sustainable than the others.

1.1.2 Following public consultation a Scheme Assessment Report will be produced that takes into account the comments and views expressed during the public consultation exercise and makes a recommendation, if any, for the Preferred Option. The Preferred Option will be the scheme that Highways England recommends should be taken forward into an application for statutory powers to construct.

1.2 Background

1.2.1 The A2 Bean and Ebbsfleet Junctions are adjacent grade-separated Junctions on the A2 trunk road, approximately 2km apart. The Bean Junction connects the A296 and B255, which provides access to the Bluewater regional shopping centre, to the A2. The Ebbsfleet Junction connects the A2 to the A2260 and B259 Southfleet Road. Ebbsfleet Junction was constructed in 2005 to serve the Ebbsfleet International Rail Station and the surrounding Ebbsfleet Valley and Eastern Quarry developments. Although this junction is not currently heavily trafficked, it is expected that traffic flows will increase considerably as the adjacent developments proceed.

1.2.2 The proposed improvements to the Bean and Ebbsfleet Junctions form part of the Kent Thameside Strategic Transport Programme (STP) and are considered necessary to support the level of development growth proposed for Kent Thameside, which could ultimately lead to the development of some 18,000 homes and 58,000 jobs, in the area served by the Bean and Ebbsfleet Junctions.

1.2.3 Initial Strategy Shaping and Prioritisation work on improvement options for both junctions was carried out by AECOM on behalf of the Highways Agency in 2008.

1.2.4 As a result of the Government's Comprehensive Spending Review in 2010 the funding commitment to the Kent Thameside Strategic Transport Programme by the DfT was withdrawn. The Regional Transport Programme and its funding stream was also abolished and, as the two schemes had not reached the stage where they could be considered for inclusion in the Highways Agency's Major Schemes Programme, the funding allocations were lost and no further work was undertaken by the Highways Agency until resurrection of the schemes as part of the 2013 Spending Review (SR13).

1.2.5 Traffic forecasting undertaken as part of the current improvement study has identified that by 2041 (our notional design year):

- Entry flows to the A2 Bean junctions (including the A296) in the AM and PM weekday peak periods would increase by between 50% and 60% compared to 2014;
- Entry flows to the A2 Bean junctions (including the A296) at weekend peak periods would increase by 50% compared to 2014;
- Entry flows at the A2 Ebbsfleet junctions in the AM and PM weekday peak periods would increase by between 170% and 200% compared to 2014; and

- As a consequence, improvements will be required at both junctions to improve capacity and manage these increases in traffic.

1.2.6 The locations of the Bean and Ebbsfleet Junctions are shown in Figure 1.

Figure 1 - A2 Bean & Ebbsfleet Junction Improvements – Location Plan

2 Planning Brief

2.1 Highways England Business Objectives

2.1.1 The Department for Transport's '*Road Investment Strategy: for the 2015/16 – 2019/20 Road Period*' (RIS) announced a commitment of "£15.2 billion in the enhancement and long-term maintenance of the network between 2015/16 and 2020/21 including 127 major enhancements", including the A2 Bean & Ebbsfleet junction improvements scheme which is referenced in Part 2, section 3 - *Key investments on the Strategic Road Network*.

2.1.2 Section 3 of '*Highways England Delivery Plan 2015-2020*' sets out how "at the heart of Highways England's plans for delivering the RIS for [Road Period 1] is a drive to support and encourage economic growth across England and the wider United Kingdom. [Highways England] will do this by modernising the network to relieve congestion and reduce delays, helping businesses to grow, encouraging investment, creating jobs and opening up new areas for development".

2.1.3 Sub-section 3.1.3, *Schemes announced in June 2013*, references proposals to "Provide junction improvements on the A2 in Kent to support the level of growth proposed for Kent Thameside including Ebbsfleet Garden City, supporting potential development of 50,000 homes and 20,000 jobs in the area", with an anticipated start of works in financial year 2019/20 and an anticipated opening to traffic in financial year 2022/23.

2.1.4 There is no explicit funding for the A2 Bean & Ebbsfleet scheme included within either RIS or the Delivery Plan 2015-20, this forming part of the capital allocation for "SR10 & SR13 Schemes". The RIS identifies that the schemes listed "have access to committed funding, allowing them to enter construction during this Road Period" but notes that the A2 Bean & Ebbsfleet junction improvements form part of a tranche of "Schemes committed subject to other contribution". The RIS daughter document *RIS Investment Plan: list of commitments* identifies that the scheme is expected to require central government funding of £50m to £100m. Third party funding for the scheme is described further in Section 8.4.

2.2 Planning Objectives

2.2.1 The Planning Objectives set out in the Client Scheme Requirements are as follows:

<u>Environment</u>

- Minimise environmental impact as measured in accordance with DMRB.
- Where possible, improve air quality with regard to vehicle emissions in declared Air Quality Management Areas (AQMAs).

<u>Economy</u>

- In combination with other measures (e.g. Kent Thameside Strategic Transport Programme), support economic development and housing growth in Kent Thameside.
- Minimise the impact of the developments on the performance of the A2 mainline (performance criteria to be defined).
- A scheme which achieves a BCR of at least 2.0.

<u>Safety</u>

- Reduce accident rates for all users.
- Minimise the exposure to road workers to harm during construction, operation and maintenance.

<u>Accessibility</u>

- Integrate with the wider strategic objectives of accessibility within Kent Thameside by providing infrastructure within the junction improvement that enables choices of modes of travel to existing and proposed facilities.
- Provides access to the local and sustainable transport options and public transport hubs.

3 Existing Conditions

3.1 Description of the Locality

3.1.1 The A2 Bean and Ebbsfleet junctions are on the A2 in Kent. The junctions are separated by approximately 2km and their locations are shown in Figure 1.

3.1.2 The existing junction layouts are shown on Drawing Nos HA543917-HHJV-HGN-XXXX-DR-D-0144 to 0146 in Volume 2.

3.1.3 Bean Junction is the first junction on the A2 to the east of the M25. The land south of the A296 (Watling Street and Roman Road) and south of the A2 east of the Bean Junction merge is designated as green belt in the Dartford Local Plan and consists of villages, fields and woodland. North of the green belt, the land is urban with areas of housing and employment centred on Northfleet and Swanscombe. To the north of the A2, between the junctions, is an old chalk pit.

3.1.4 Major developments accessed from the junctions are Bluewater Shopping Centre (located to the north of Bean Junction off the B255) and Ebbsfleet International Station (north of Ebbsfleet Junction off the A2260).

3.2 Existing Highway Network

A2 Dual Carriageway

3.2.1 The existing A2 highway through the study area is a 4-lane dual all-purpose road which reduces to 3-lanes through Bean Junction. The alignment generally runs in an east/west direction, with large radius curves, and follows the existing undulating topography, falling from a high point just east of Bean Junction to a low point at Pepperhill.

3.2.2 The A2 was originally constructed as a three lane dual carriageway in the mid-1960s and in the subsequent decades various improvements have been made, including the addition of hard shoulders. The eastbound carriageway of the A2 between the Bean entry slip road and Pepperhill was widened from three to four lanes in 1999 as part of the Bluewater development. The westbound carriageway was then widened in 2003 under Phase 1 of the A2 Bean to Cobham Widening Scheme. The A2 between the M25 and the A2 Bean Junction was widened to four lanes in each direction in 2008 as part of the A2/A282 Dartford Improvement Scheme.

Bean Junction

3.2.3 The Bean Junction was rebuilt in 1999 as part of the Bluewater development and comprises three roundabouts and associated slip roads. The eastbound onslip road is formed from the old A2 (now the A296 Watling Street). As part of the redesign of the junction layout significant modifications were made to the overbridge linking the east and west bound slip roads.

Ebbsfleet Junction

3.2.4 The Ebbsfleet junction connects the A2 to the A2260 Southfleet Road. The junction comprises two roundabouts joined by a short link road and associated slip roads. It was constructed in 2005 by Union Railways to serve the Ebbsfleet International Rail Station.

Highway Authority Responsibility

3.2.5 Highways England is the Highway Authority for the A2 Trunk road including the slip roads at the Bean Junction and the whole of the Ebbsfleet Junction. Kent County Council is the Highway Authority for all other public roads connecting at the junctions. Drawings HA543917-HHJV-GEN-ZZZZ-DR-D-0167 to 0170 in Volume 2 show the extent of Highways England's network at the junctions.

3.3 Existing Structures

3.3.1 The locations of existing structures are shown in Drawings HA543917-HHJV-SGN-ZZZZ-DR-Z-1700 to 1702 contained in Volume 2. The main bridge and large culverts within the vicinity of the junctions are described in the following sections. Information has been obtained following consultation with Kent County Council (KCC).

Darenth Wood Farm Bridge

3.3.2 Darenth Wood Farm Bridge carries Wood Lane over the A2 0.7km west of Bean Junction. It is a private access track with access from the A296 to the north. The bridge was constructed in 1969 and

comprises of a 3 span post-tensioned continuously supported reinforced concrete voided slab supported upon concrete leaf piers and bank seat abutments, on spread footing foundations.

3.3.3 The structure is 69.19m long and 9.29m wide, with a central span of 35.97m. The minimum head room clearance is 5.89m. It is fixed to both intermediate supports through encastre connections, and free to both abutments. Collision protection Reinforced Concrete Barriers (RCBs) were constructed on the A2 below in 2008 as part of the A2/A282 Dartford Improvement Scheme.

Bean Road Bridge

3.3.4 Bean Road Bridge carries the B255 Bean Road over the A2. It accommodates two lanes northbound and one lane southbound. Below the bridge is the A2 comprising of three lanes in each direction plus two lanes of the west bound on-slip.

3.3.5 The link is over capacity and provides a constraint to the operation of the junction. There is limited opportunity to provide additional capacity over the bridge without widening the structure.

3.3.6 Bean Road Bridge was constructed in 1969 and extensively modified in 1999 as part of improvements associated with the development of the Bluewater shopping centre, and comprises a voided post-tensioned concrete slab deck on reinforced concrete piers. It is continuously supported over three spans, with a central (voided deck) 27° skew span of 38.71m and two (solid deck) side spans of 17.07m.

3.3.7 The ends of the superstructure are supported on original reinforced concrete bankseats on spread footings. At the south, this bankseat has been underpinned with the addition of contiguous bored piles as part of the westbound on-slip construction in 1997.

3.3.8 The bridge has a total carriageway width of 9.67m, plus a 1.29m walkway on the west and 1.67m walkway on the east side. P2(80) steel parapets run the length of the bridge on either side, on parapet upstands at the edge of the deck cantilevers. These were provided in 1998.

Sandy Lane Bridge

3.3.9 Sandy Lane Bridge carries the A2 over Sandy Lane on the outskirts of Bean. The structure is a simply supported reinforced concrete deck supported on cantilever abutments which are supported on spread foundations. The entrances at the ends of the subway have reinforced concrete portal frames with their legs incorporated into the end positions of the abutments and concrete slab. The structure is 39.25m long and 5.49m wide with an internal span distance of 4.57m.

3.3.10 The subway provides access for pedestrians and cyclists across the A2, however details of any traffic regulations affecting the use of the subway and the status of Sandy Lane as a highway needs to be confirmed with Kent County Council.

Swanscombe Footbridge

3.3.11 Swanscombe Footbridge crosses over the A2 approximately 50m east of the end of the A296 east bound merge with the A2. It carries a public footpath over the A2. Swanscombe Footbridge is a Grade II listed structure.

3.3.12 The structure was constructed in 1967 and is a parabolic arch footbridge which has an overall length of 69.57m including side spans, constructed square to the A2. The clear span of the arch is 48.77m.

3.3.13 The post-tensioned concrete deck is supported on the post-tensioned concrete arch and bank seats. At each end of the bridge the foundation to the arch and the bank seat supporting the side span are combined to form an abutment.

3.3.14 Swanscombe Footbridge is a Grade II listed structure, as of May 1998. Its listing describes it as “First of several similar bridges built in Kent. An elegant example of an arch over dual carriageway. Crosses cutting at top of hill and closes notch in skyline”. Because of this heritage status of the structure, demolition for replacement would require additional planning consent from the local heritage authority.

KCC Bridge – B255 over A296

3.3.15 A bridge owned by Kent County Council carries the B255 road over the A296, approximately 250m north of Bean Junction. For the purposes of this report it is referred to as ‘KCC Bridge’. The bridge currently accommodates two lanes northbound and two lanes southbound. Below the bridge is the A296 comprised of one lane in each direction, with the eastbound widening to two lanes to join a roundabout just to the east.

3.3.16 KCC bridge was constructed in 1999 and comprises a steel girder and concrete slab composite deck on reinforced concrete bankseats. The deck is simply supported with a span length of 38.05m and 0º

skew.

3.3.17 The total width of the bridge deck is 25.10m. It is comprised of two independent superstructures with a longitudinal joint between. Each deck supports a total carriageway width of 8.30m plus 2.00m width walkways at the outer edge and 1.20m verges at the inner edge. A 0.50m wide hard strip is on either side.

3.3.18 The vertical elevation of the bridge varies along the span, with a headroom below of 6.70m at the south to 3.77m at the north abutment. The existing minimum headroom over the A296 is 6.35m at the north edge of the carriageway. BT ducts and a 91mm (36") diameter gas main are located in the verge towards the north abutment.

Park Corner Underbridge

3.3.19 Park Corner Underbridge carries the A2 over Park Corner Road/Southfleet Road at the Ebbsfleet Junction. It has a single skew span of 20.60m and width of 35.05m, with a skew of 16.7°. The deck comprises 25 post-tensioned beams with insitu diaphragms at both ends and four intermediate post tensioned diaphragms at equal spacings. The deck was originally formed of two discrete structures, however these were tied together during works in 2003-2005. The superstructure rests on rubber strip bearings and dowels at the east end and rubber pad bearings at the west end.

3.3.20 Supports to the structure are counterfort abutments and are founded upon driven cast-in place piles of 450mm diameter. During the 2003-2005 works the front counterforts of the west abutment were modified.

3.3.21 The deck is fixed at the east end with dowels, and free at the west on rubber pad bearings.

Ebbsfleet Junction Eastbound Offslip Underbridge

3.3.22 Ebbsfleet Junction Eastbound Off Slip was constructed in 2003 with the provision of Ebbsfleet Junction.

3.3.23 The structure is a single span beam and slab underbridge with a span length of 21.23m, width of 10.00m and skew of 18°. The structure carries the A2 eastbound offslip over Park Corner Road/Southfleet Road.

3.3.24 The deck is comprised of post-tensioned beams with a 200mm reinforced concrete deck, supported upon reinforced concrete cantilever wall abutments with counterfort ties. The abutments are founded on 900mm bored piles.

3.3.25 The structure has P2/113 aluminium parapets, the west expansion joint is an asphaltic plug and the east joint is buried.

Pepperhill Bridge

3.3.26 Pepperhill Bridge carries the B262 over the A2 south west of Gravesend. The structure comprises four spans of 10.39m, 21.11m, 21.11m and 10.39m. The deck is continuous (not simply supported as referenced in the assessment report) over reinforced concrete piers and skeleton abutments, all on spread footing foundations.

3.3.27 The structure is 63.82m long and 19.51m wide with no skew. The structure is fitted with P5 parapets. The north expansion joint is single element elastomeric whilst the south expansion joint is an asphaltic plug with three asphaltic plug joints spaced evenly between them.

3.3.28 The northern piers of Pepperhill Bridge are currently protected from collision by an RCB along the edge of the A2 carriageway, whereas the southern and central piers were provided with collision protection in 2008. This was provided during the A2 widening works, as there would have been inadequate working width for a standard RCB.

3.4 Traffic

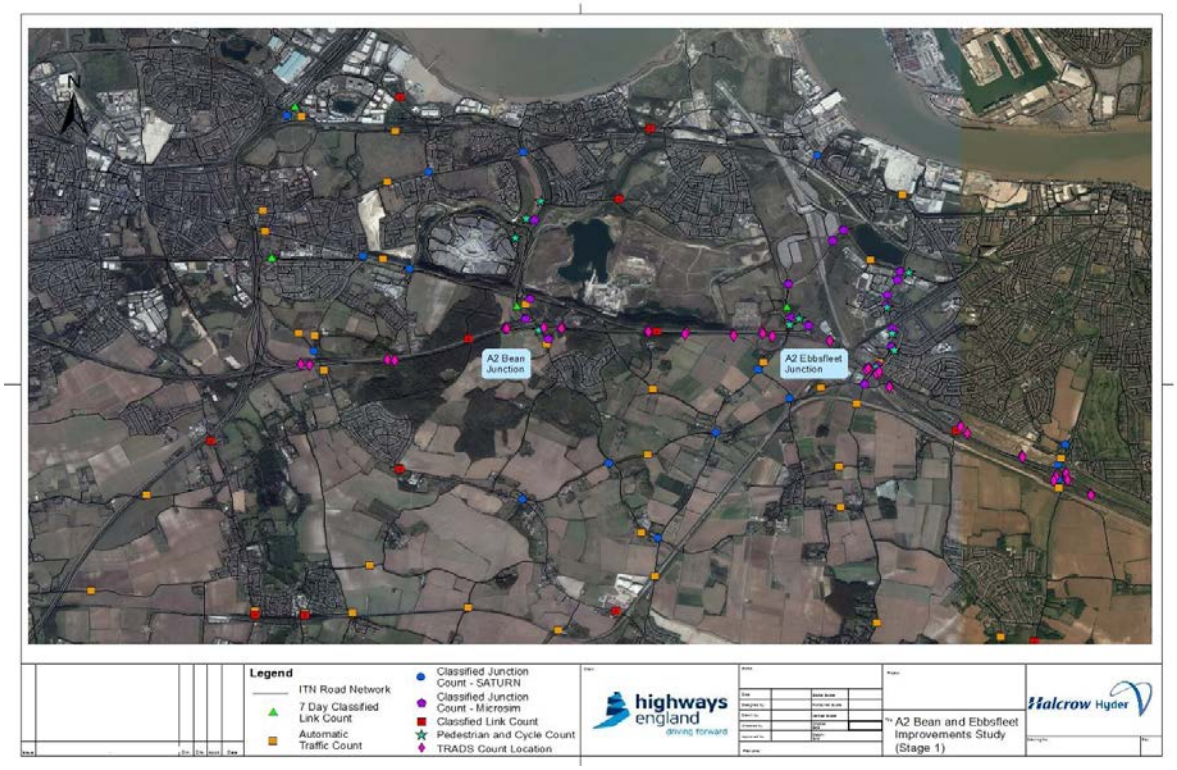
3.4.1 In order to understand and evaluate the existing traffic conditions on the A2 in the Bean and Ebbsfleet area, traffic flow data was extracted from Highways England's Traffic Information Database System (TRADS) for the section of A2 between Pepperhill Interchange to the M25 Junction 2 Interchange. Typically, recording locations were on the main A2 carriageway through the junctions and on the corresponding off-slip roads.

3.4.2 Traffic surveys were also carried out on adjacent local roads in June - July 2014 in order to establish traffic conditions on the adjacent local road network. Volumetric data was collected by a combination of two-week Automatic Traffic Counters and one day Classified Link or Junction counts.

3.4.3 The data from the TRADS was extracted for the months of June and July 2014 corresponding to the months when the local road traffic surveys were undertaken.

3.4.4 Figure 2 shows the locations of the counts, TRADS and local road network surveys.

Figure 2 - TRADS and 2014 Survey Locations



3.4.5 A review of the data was undertaken to identify where traffic volumes appeared to be approaching or exceeding the 'nominal' traffic capacities for each type of road. The results of the review are shown in Table A.1 in Appendix A.

3.4.6 Also in Appendix A, Figures A.1 to A.8 show plots of Hourly Speed vs Flow for the mainline sections of the A2 between M2 J1 and the M25 J2 for neutral periods between late March to June 2014 and September to November 2014. These show the variation in demand throughout the day, supporting the capacity analysis of the A2 undertaken in Table A1.

3.4.7 It can be seen from Table A1 that in 2014 the majority of the local road network and the slip roads at the Bean and Ebbsfleet Junctions are, for much of the time, operating within the nominal capacities, with respect to the existing demand in the area, although it should be noted that the A2 Bean eastbound on-slip is approaching capacity in the evening peak.

3.4.8 However, it is a different situation on the A2, and specifically the sections in the A2 study area incorporating the A2 Bean and A2 Ebbsfleet Junctions. For the peak directions between the B262 Hall Road Pepperhill Junction and the M25 J2 westbound in the morning peak and M25 J2 and the B262 Hall Road Pepperhill Junction eastbound in the evening peak, traffic volume to capacity ratios (V/C) range between 76% and 90% in the period of data collection late June-July 2014.

3.4.9 The purpose of the A2 Bean and Ebbsfleet Junction Improvements is therefore to support the proposed development in the area as identified in the Client Scheme Requirements.

3.4.10 The A2 mainline has little reserve capacity to support future development in the A2 study area and surrounding areas especially as new local development traffic wanting to use the A2 to access and egress the local area would have to compete with new traffic arising from development outside the A2BE area making longer distance trips.

3.4.11 The operation of the A2 Bean and Ebbsfleet Junction Improvements is affected by the available capacity of the A2 mainline and A2 junctions in conjunction with the capacity of the local road network.

3.4.12 It should be noted that addressing future congestion on the A2 arising from forecast development in the A2 study area and surrounding areas is not within the remit of the study to consider options to improvements to the A2 Bean and Ebbsfleet junctions.

3.5 Accidents

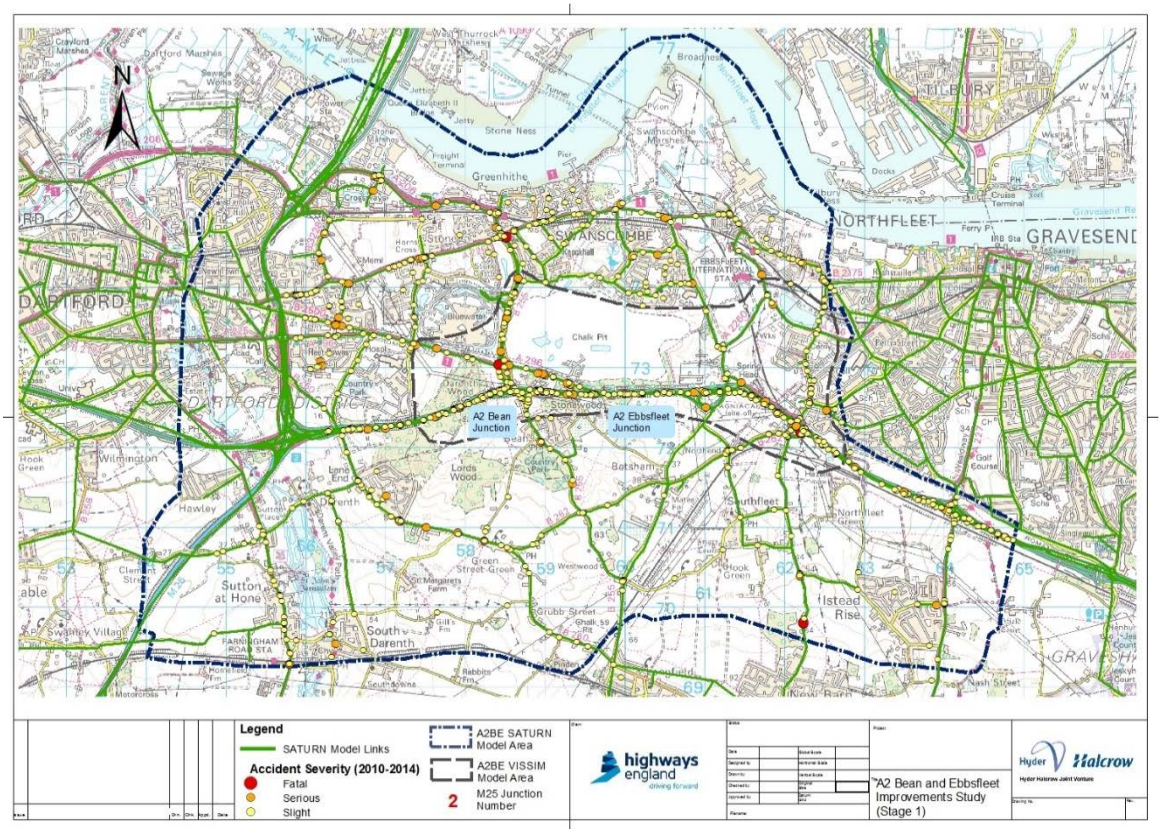
3.5.1 Accident data was analysed in order to derive local accident rates by class of road for use in the safety assessment of the scheme.

3.5.2 Personal injury accident data for the modelled area was downloaded from the www.data.gov.uk website. This data covered the five year period 2010 to 2014, this being the most recent five year period available.

3.5.3 During this period more than half of the accidents that occurred within the A2 Bean and Ebbsfleet project area, were minor accidents, and were along the A2 mainline. Four fatal accidents occurred within the project area in five years and were all located at junctions.

3.5.4 Figure 3 shows the accidents by severity for the study area.

Figure 3 - Accident Locations



3.5.5 Table 1 shows the accidents by year and severity. It can be noted that the accidents have been fluctuating over the years in the study area between 185 and 214.

Table 1 - Number of accidents by year and severity

Year	Severity			Total
	Fatal	Serious	Slight	
2010	0	23	162	185
2011	3	12	179	194
2012	0	7	168	175
2013	1	20	177	198
2014	0	20	194	214
TOTAL	**4**	**82**	**880**	**966**

3.5.6 Accident rates were calculated for three sections of the A2 separately and an average accident rate was used to compare it with the accident rate from the DfT's latest WebTAG Databook as shown in Table 2 below.

Table 2 - DfT Average Accident Rate WebTAG Databook

Combined Link / Junction: Accident Rates and Change Factors					
Road Type	**Speed Limit (mph)**	**Accident Rate**	**Beta Factor**	**Road Description**	
13	>40	0.123	0.946	Modern D3+ Roads	

3.5.7 The local accident rate calculations are shown in Table 3.

3.5.8 The local accident rate calculated for the A2 is 0.154. This is 25% higher than the national average rate of 0.123.

Table 3 - Local Accident Rate Calculations

Road Section	Year	Accidents by Severity					Length (km)	Mvkm	Accidents per year	Accident rate
		Fatal	Serious	Slight	Total	AADT (2-way)				
M25/A2 J2 – A2/B255	2010	0	3	19	22	129796	2.73	129.3357	22	0.17
	2011	0	0	21	21	132699	2.73	132.228	21	0.159
	2012	0	0	20	20	132878	2.73	132.4062	20	0.151
	2013	0	4	14	18	134921	2.73	134.4421	18	0.134
	2014	0	0	23	23	126954	2.73	126.5035	23	0.182
A2/B255 – A2/A2260	2010	0	0	22	22	135758	2.63	130.3209	22	0.169
	2011	0	1	15	16	138759	2.63	133.2014	16	0.12
	2012	0	0	16	16	138588	2.63	133.0379	16	0.12
	2013	0	3	12	15	141841	2.63	136.1602	15	0.11
	2014	0	3	26	29	145821	2.63	139.9805	29	0.207
A2/B2260 – A2/A227	2010	0	2	22	24	128718	3.26	153.1615	24	0.157
	2011	0	1	24	25	131137	3.26	156.0401	25	0.16
	2012	0	0	22	22	131476	3.26	156.4438	22	0.141
	2013	1	2	25	28	135118	3.26	160.7774	28	0.174
	2014	0	4	21	25	141290	3.26	168.1207	25	0.149
							Total	2122.16	326	0.154
							Average Accident Rate			**0.154**

3.6 Journey Time Reliability

3.6.1 Average journey times on the journey time routes for the A2 and the local road network during 2014 have been constructed using Trafficmaster data. Data was collected for the morning, inter peak and evening peak periods. Figures 4 and 5 show the 12 journey time routes for which data at 15-minutes intervals for Monday to Friday (excluding bank holidays and school holidays) has been used. Table 4 shows the data collected.

3.6.2 From the above data, it is possible to determine an indication of journey time reliability of journeys along key route corridors in the area.

3.6.3 The median journey speeds along the A2 from M25J1b to the A2/A227 in the AM, PM and Inter peak periods were 93kph, 85kph and 98kph (58mph, 53mph and 61mph) respectively. In the westbound

direction, the journey speeds in the AM, PM and Inter peak periods are 81kph, 93kph and 94kph (50mph, 58mph and 58mph) respectively, with slow sections where the A2 joins the M25/A282. Comparison of the peak period speeds with the Inter peak speeds suggests the eastbound journey times in the PM peak may be unreliable, but reasonably reliable in the AM peak. In the westbound direction the journey times in the AM peak may be unreliable, but more reliable in the PM peak.

3.6.4 Route 1 includes journeys along the A226 and B255 via the Bean Junction. With the exception of movement though the Bean Junction, where the speeds are on average 20-30kph (12mph-19mph), the median speed is just below 50kph (31mph). As the Inter peak speeds are on average 48kph (30mph) it can be assumed this route has reasonable journey time reliability.

3.6.5 Route 8 includes journeys along the B259 and A2260 via the Ebbsfleet Junction. The median journey times for this route are 47kph-51kph (29mph-32mph). As the Inter peak period has similar speeds, it is reasonable to assume the journey times along this route are currently reliable.

3.6.6 Appendix B contains plots of the journey time versus distance showing the variation in speed along the routes.

Figure 4 - Journey Time Survey Routes – 1 of 2

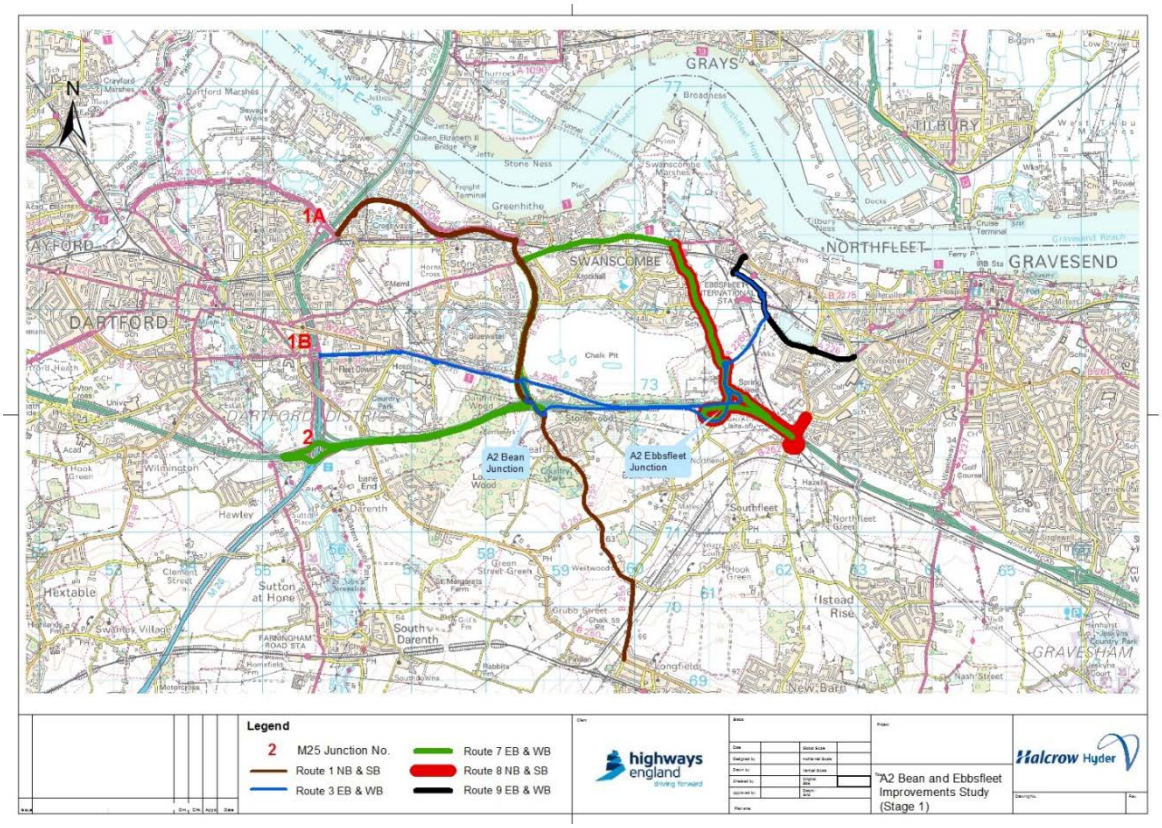


Figure 5 - Journey Time Survey Routes – 2 of 2

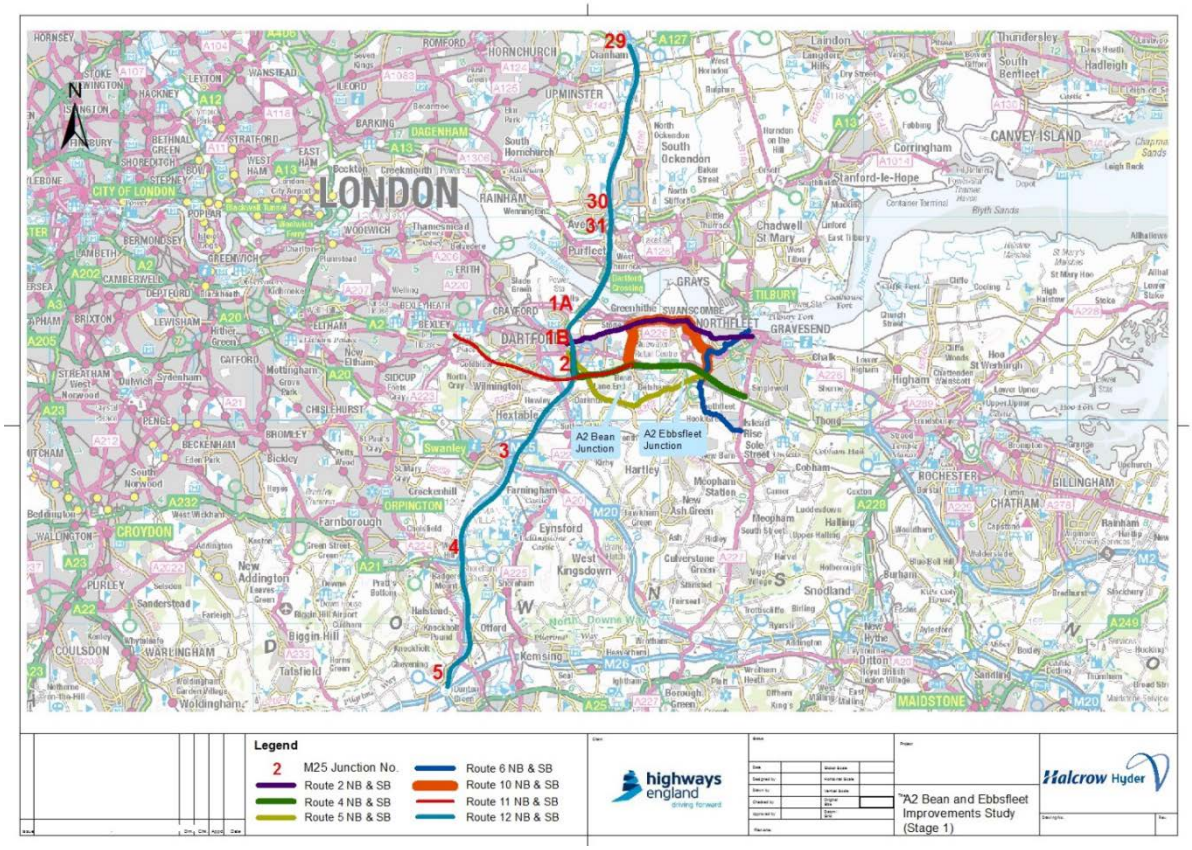


Table 4 - Trafficmaster Journey Times

Route	Location	Dir	Length (km)	Average Journey Time (mm:ss)			Average Journey Speed (kph)		
				AM	IP	PM	AM	IP	PM
1	B255 (Longfield to M25 J1a)	NB	9.0	11:15	11:06	12:08	47.70	48.40	44.22
		SB	9.3	11:46	11:30	12:41	47.39	48.46	43.96
2	A226 (Dartford to Gravesend)	EB	9.9	14:00	13:44	14:25	42.44	43.26	41.19
		WB	10.0	14:14	14:07	14:14	42.16	42.51	42.14
3	A296, A2 and B262 (M25 J1b to Ebbsfleet)	EB	8.2	09:45	08:46	10:49	50.57	56.25	45.63
		WB	8.4	09:22	08:46	08:55	54.08	57.81	56.76
4	M25 J1b to A2/A227 Junction	EB	15.7	10:06	09:34	11:07	92.95	98.12	84.54
		WB	16.0	11:50	10:13	10:19	81.13	93.85	93.00
5	M25 and A2 (M25 J1b to A2/A227 junction)	EB	8.2	09:07	09:06	10:20	53.75	53.88	47.43
		WB	8.1	10:07	09:08	09:46	48.23	53.44	49.95
6	Istead Rise to Gravesend	NB	7.2	10:10	09:13	09:27	42.43	46.78	45.59
		SB	7.1	09:30	09:15	10:15	44.56	45.82	41.30
7	M25 J2 to A2/B259	EB	11.6	13:11	12:55	13:57	53.00	54.14	58.90
		WB	13.6	16:02	14:53	15:47	50.75	54.68	51.57
8	A226 to Hall Road	NB	6.3	08:13	07:16	07:33	45.79	45.79	51.77
		SB	4.7	05:55	05:44	05:58	47.67	49.13	47.22
9	Stonebridge Rd to Hall Rd	NW	2.5	03:10	03:05	03:05	47.45	48.64	48.72
		SW	2.4	03:13	03:00	03:02	45.36	48.64	48.19
10	KTS-Pepperhill	EB	8.6	11:09	10:47	11:46	46.25	47.81	43.83
		WB	8.5	11:24	10:44	11:21	44.60	47.38	44.85
11	KTS-A2 A226 – Bean	EB	9.4	05:34	05:37	06:33	101.09	100.27	86.01
		WB	9.5	06:11	05:36	05:44	91.81	101.44	99.12
12	HATRIS-M25 J29-5	NB	34.5	21:33	22:39	25:37	96.20	91.56	80.94
		SB	34.5	25:30	21:42	25:39	81.28	95.47	80.78

3.7 Topography, Land Use, Property and Industry

Topography

3.7.1 The topography in the area of the Bean and Ebbsfleet Junctions can be split into four areas:

- Bean Junction is located on a ridge in the landscape with a valley to the west of the junction;
- The area south of the A296/A2 consists of a hilly terrain from Darenth Country Park to the west of the Ebbsfleet Junction;
- To the north of the A296, the topography is dominated by quarries. The western quarry has been developed as Bluewater Shopping Centre and the eastern quarries are planned for housing and mixed use development and
- To the west of Ebbsfleet Junction is a valley where the River Ebbsfleet is located.

Land Use, Property and Industry

3.7.2 At Bean Junction, the land south of the A296 (Watling Street and Roman Road) is designated as green belt in the Dartford Local Plan. At Ebbsfleet Junction the green belt is south of the A2. This southern area consists of villages, fields and woodland, including Bean, which is located immediately to the south of Bean Junction on the B255.

3.7.3 North of the green belt, the land is urban with areas of housing and employment centred on Northfleet and Swanscombe.

3.7.4 Major facilities in the area of Bean Junction are:

- Darenth Valley Hospital with access from the A296, approximately 1km west of Bean Junction.
- Bluewater Shopping Centre is located off the B255 immediately to the north of Bean Junction.

3.7.5 To the south of the A2 is Bean Village. Bean Bridge crosses the A2 at the junction with Hope Cottages and Ightham Cotttages located to the south and north respectively.

3.7.6 The eastern area within the junction between the A296 and A2 is known as the Bean Triangle. Within this area there are several business and residential properties.

3.7.7 There is an area of existing car parking at the corner of Bean Road and the Roman Road. There is no signage at the site concerning its usage. However, local sources believe it to be used as an interchange for commuting using coach travel and shared car use. The Kingsferry coach hire company refer to free parking at Bean for their commuter service 700.

3.7.8 Discussions with Kent County Council and Dartford Borough Council indicated that this is an unofficial site but recognised that it provides a useful facility as part of a wider public transport provision. However, the existence of this facility should not be seen as a constraint to the improvement solutions being developed at Bean.

3.7.9 Major facilities in the area of Ebbsfleet Junction are:

- Ebbsfleet International Station with access from the A2260 to the north of Ebbsfleet Junction

Future Land Use

3.7.10 There are several major planned developments in the area. Within the immediate vicinity of the junctions, these will come under the planning authority of Ebbsfleet Development Corporation.

3.7.11 The Ebbsfleet Valley and Eastern Quarry developments are located to the north of the A2 and consist of the following areas:

- Eastern Quarry;
- Station Quarter North;
- Northfleet Rise;
- Springhead; and
- Station Quarter South.

3.7.12 The final development of Ebbsfleet Valley and Eastern Quarry, which would be established over a 20 year period, would create a community with up to 10,000 homes and up to 20,000 jobs. There will also be schools, medical centres, leisure facilities and shops.

3.7.13 The Ebbsfleet Green development is located to the west of Ebbsfleet Junction. There are plans to build 950 new homes, a new primary school, hotel/pub and restaurant.

3.8 Climate

3.8.1 The climate in the project area is generally mild, with sunny summers and cold, wet winters. Snowfall is infrequent, but winter days can be frosty and clear. High pressure systems can occasionally cause very hot summer temperatures or very cold winter temperatures.

3.9 Drainage

Existing Drainage

3.9.1 The existing road network has 15 number drainage catchments within the Scheme limits. These catchments are shown on Drawing HA543917-HHJV-HDG-ZZZZ-DR-D-0001 in Volume 2 and are summarised in Table 5.

3.9.2 Thirteen of the catchments (C1 to C4 and C7 to C15) cover the Bean Junction and all discharge to the ground. The single catchment (C5) covering the Ebbsfleet Junction discharges to the River Ebbsfleet. Catchment C6 is believed to discharge towards the River Ebbsfleet although this needs to be confirmed by further survey.

Table 5 - Details of Existing Drainage Catchments Zones and Discharge Points

Catchment (Reference)	Description	Approx. impervious Area (ha)	Receiving Waterbody ./ Discharge Point
C1	A2 western scheme limit up to the eastbound off-slip at Bean Junction	3.122	Discharges to attenuation pond (WB3) then to ground via soakaway chambers
C2	A2 between eastbound off-slip to Bean Junction to Woodbine Cottage Underpass, including both eastbound and westbound slip roads to Bean Junction	4.788	Discharges to ground via attenuation / infiltration pond (WB5)
C3	A2 between Woodbine Cottage Underpass and Swancombe Footbridge	1.693	Discharges to ground via soakaway chambers
C4	Part of A296 Roman Road (Swanscombe on-slip road to A2 eastbound carriageway)	0.535	Discharges to ground via infiltration ditch
C5	A2 from Swancombe Footbridge extending eastwards including Ebbsfleet Junction. Catchment extends to Church Road Footbridge approx. 1.52km southeast of Tollgate Junction	13.562	Discharges to River Ebbsfleet (WB11)
C6	Part of A2260 north roundabout at Ebbsfleet and Northfleet West Sub-Station access road. Extent of catchment unclear, believed to extend northwards including A2260 up to roundabout with B259	0.798	Outlet pipe heads towards River Ebbsfleet but outfall destination unknown
C7	B255 Bean Lane south of A2 including Hope roundabout (near Hope cottages), extending southwards to the north of Bean village	0.579	Discharges to ground via soakaway chamber
C8	Ightham roundabout (near Ightham cottages) and part of Bean Lane north of A2	0.427	Discharges to ground via soakaway chamber

Catchment (Reference)	Description	Approx. impervious Area (ha)	Receiving Waterbody ./ Discharge Point
C9	B255 (north of A2) from Ightham roundabout up to A296 bridge	0.565	Discharges to ground via soakaway chamber
C10	A296 from roundabout with Bean Lane to side road Wood Lane	0.386	Discharges to ground via soakaway chamber
C11	Bean Lane (north of A2) including roundabout with the A296 and part of Roman Road	0.571	Discharges to ground via soakaway chamber
C12	B255 (north of A2) from A296 bridge to merger with Bean Lane	0.350	Discharges to ground via soakaway chamber
C13	B255 southbound between on-slip from Bluewater Parkway to Bean Lane	0.885	Discharges to ground via soakaway chamber
C14	B255 northbound to the east of Bluewater shopping centre up to bridge over Bluewater Parkway, including part of B255 southbound	0.729	Discharges to ground via soakaway chamber
C15	A296 Roman Road	0.976	Unknown. Believed to be soakaway chambers located at road low point approximately 285m east of roundabout with Bean Lane

Existing Flooding Incidents and Flood 'Hotspots'

3.9.3 HADMMS has been reviewed to identify existing flooding incidents and 'hotspots'. The assessment has identified 13no. flooding incidents within the Scheme limits, 7no. incidents located in the proximity of the Bean Junction and 6no. incidents at Ebbsfleet Junction. All flood incidents are given identification numbers and the data regarding the incident is recorded on HADMMS. An extract is provided in Table 6.

Table 6 - Flooding incidents from HADMMS

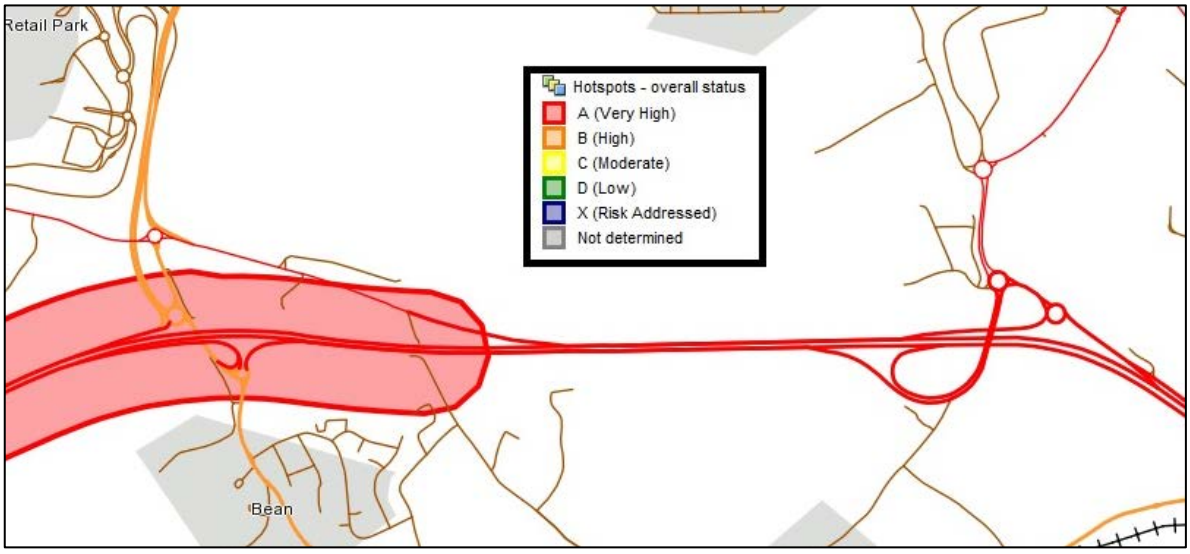
Flood ID	Date/Time Reported	Location	Description	Severity
7791	24/03/2010 @15:05	30/8	Flooding just surface water in outside lane, (no drainage seen in centre)at MP 30/8 in lane 4	6
15390	07/07/2015 @14:01	30/8	Coast bound, 30/8, Lane 1, 24 hr response arrange to clear blocked gully. Note, there is no hard shoulder at this point and grass is growing out it.	0
12704	22/10/2013 @12:35	31/0	A2, London bound, MP 31/0, outside lane, Reports of flooding	0
14360	27/08/2014 @12:08	31/4	24 hr response arrange to clear multiple blocked gullies in channel	0
14072	26/05/2014 @18:33	31/6	A2, London bound, 31/6. Flooding in Lane	0
13638	07/02/2014 @17:05	31/6	A2. Customer lives at DA2 8BB at the bottom of property is a balancing pond for water from A2 and its flooded and needs to be looked at as horses in paddock standing in the mud	0

Flood ID	Date/Time Reported	Location	Description	Severity
1335	17/01/2011 @08:35	32/1	A2 London bound Watling street 200m prior to B255 all lanes, Surface water across all lanes	0
14338	25/08/2014 @21:21	33/5	Flooding across all lanes A2 coast bound at Ebbsfleet, only found some on central reserve and lane 4	0
7790	11/10/2010 @09:25	34/4	Water running from verge across hard shoulder and carriageway	0
13353	17/01/2014 @ 00:53	34/6	A2, Coast Bound, M/post 34/6, Call originally came in from RCC saying there was flooding on the A2 London Bound, near Ebbsfleet. Martin has located flooding in lane 4 on the A2 Coast Bound at M/post 34/6. He is speaking to Wayne Rodgers, ETM closure as both Stanford and Farthing Corner MRT's are dealing with RTC's	0
14377	30/09/2014 @12:12	35/1	24 hr response arrange to clear approx. 5no blocked gullies grass growing out of them. Note hard shoulder disappears A2 coast bound mp 35.1 under Pepperhill Bridge L1	0
8308	18/08/2011 @01:22	35/1	A2 Pepper Hill, 35/1, London bound. Burst water main on centre reservation. Lanes 2.3.4 effected. Southern water attending 02.35 en-route. 04.20 confirmed that the water has been turned off. Southern water will be returning at 07.00 hrs daylight to access the burst pipe Southern water ref:3047668	0
14383	07/10/2014 @10:00	35/2	A2 coast bound slip on Pepperhill CL1 Immediate response clear flood from nearside. May be blocked gully	0

3.9.4 A review of the above incidents suggests that the majority of the flooding incidents were related to blocked gullies or filter drains becoming over grown. The incidents do not record information about the storm return and its duration, so it is not possible to confirm if the storms that resulted in the recorded incidents were greater than the allowable design return period, or if the current drainage is inadequate.

3.9.5 HADMMS flood ‘hotspots’ mapping has likewise been reviewed as it shows where flooding is considered significant within Highways England’s network. Different levels of risk have been identified as shown in Figure 6, ranging from very high to low. The A2 through Bean Junction has an overall status of very high and any works within the location must review the potential for flooding as much as practically possible.

Figure 6 - HADMMS Recorded Flood 'Hotspots' (not to scale)



Priority Outfalls and Culverts

3.9.6 In 2000 Highways England investigated the number of potentially polluting outfalls across the road network. The desk study identified 271 outfalls that potentially posed a pollution risk to the downstream watercourse. The outfalls were classified A to D according to their perceived risk, A being 'Very High' and D 'Low' risk. A review of the Priority Outfall register has confirmed that the status of the outfalls within the Scheme limits is Low (D).

3.9.7 Highways England also has a priority culverts register which identifies culverts under the road network that are undersized and could lead to flooding incidents during heavy rain. A review of the Priority Culvert register has confirmed that there are no existing priority culverts within the Scheme limits.

Aquifers and Groundwater (Source Protection Zones)

3.9.8 The Environment Agency (EA) provides groundwater mapping data for the UK. Groundwater supplies a third of the drinking water in England and Wales and within some southern areas accounts for 80% of the local drinking water supply. The EA has a duty to monitor and protect the quality of groundwater and to conserve its use for water resources as set out in their Policy and Practice for the Protection of Groundwater (1998). As a result the EA have defined Source Protection Zones (SPZs) for 2000 groundwater sources (wells, boreholes and springs) used by the public for drinking water supply. The SPZs show the risk of contamination from activities that might cause pollution in the area; the closer the activity the greater the risk.

3.9.9 The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors.

3.9.10 The maps show three main zones:

- Inner zone (Zone 1) - Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres;
- Outer zone (Zone 2) - Defined by the 400 day travel time from a point below the water table. This zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction; and
- Total catchment (Zone 3) - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

3.9.11 A 2km overview of the scheme area is shown in Figures 7 and 8, which shows that the majority of the Scheme to be within the Outer Zone (Zone 2) with one section of the A296 Roman Road, Ebbsfleet Junction and the A2260 at Ebbsfleet Junction being within the Inner Zone (Zone 1) and a small portion of the A2 being within the Total Catchment (Zone 3).

Figure 7 - EA Source Protection Zone Mapping Overview (1 in 40:000 scale)

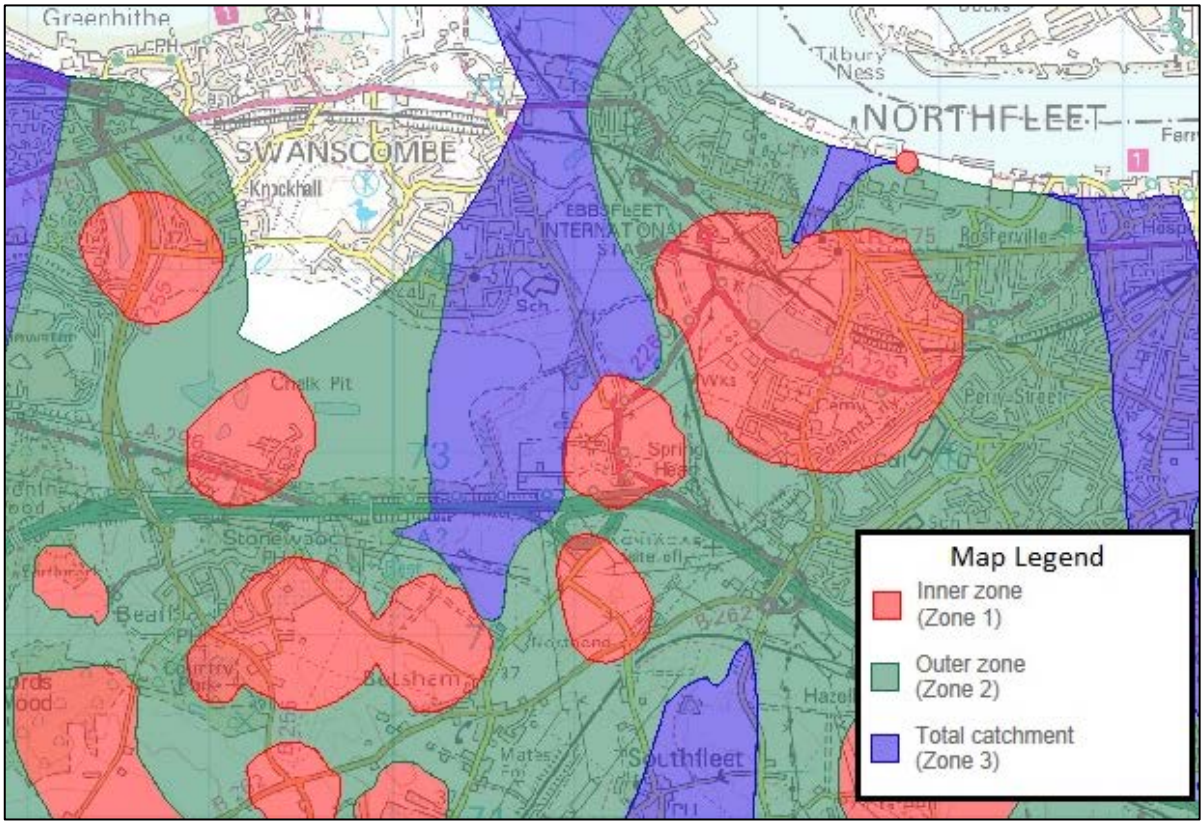
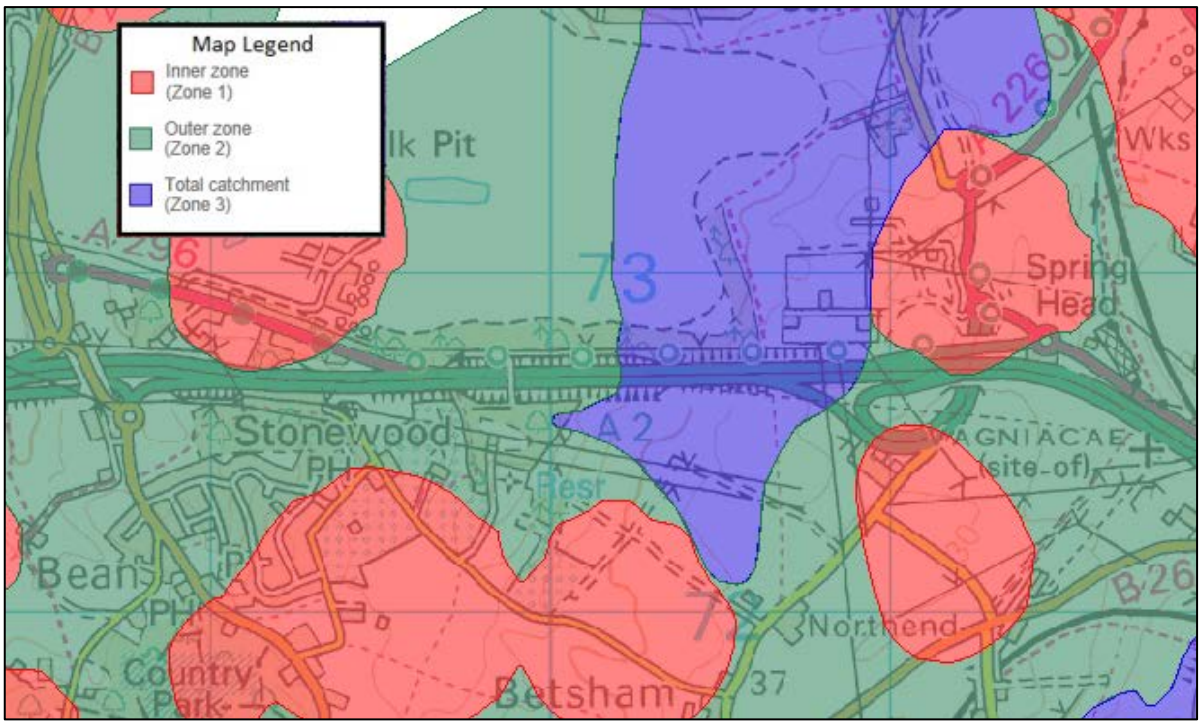
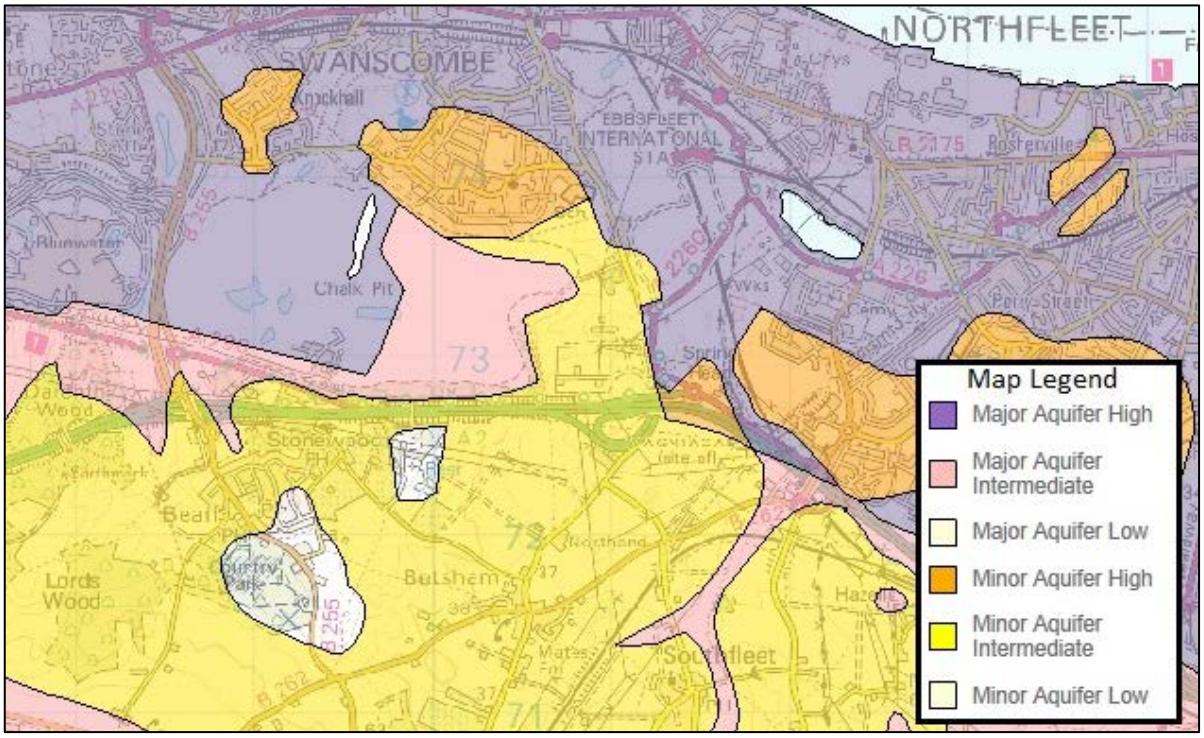


Figure 8 - EA Source Protection Zone Mapping Scheme Extents (1 in 20:000 scale)



3.9.12 A review of the Groundwater Vulnerability Mapping has also been undertaken to examine the EA's assessment of the likelihood of a pollutant discharged at ground level reaching groundwater in superficial and bedrock aquifers. The status of the aquifer shown in Figure 9 is an indication of the importance of the groundwater for drinking water supply.

Figure 9 - EA Groundwater Vulnerability Mapping Overview (1 in 40:000 scale)



3.9.13 The A2 between Bean Junction and Pepperhill Junction is underlain in parts by Chalk deposits, the principal aquifer in south-east England. The water table in this aquifer is assumed to be tens of metres below existing ground level. The distance between road level and water table becomes a minimum of approximately 10m near the River Ebbsfleet (to be confirmed via groundwater monitoring boreholes).

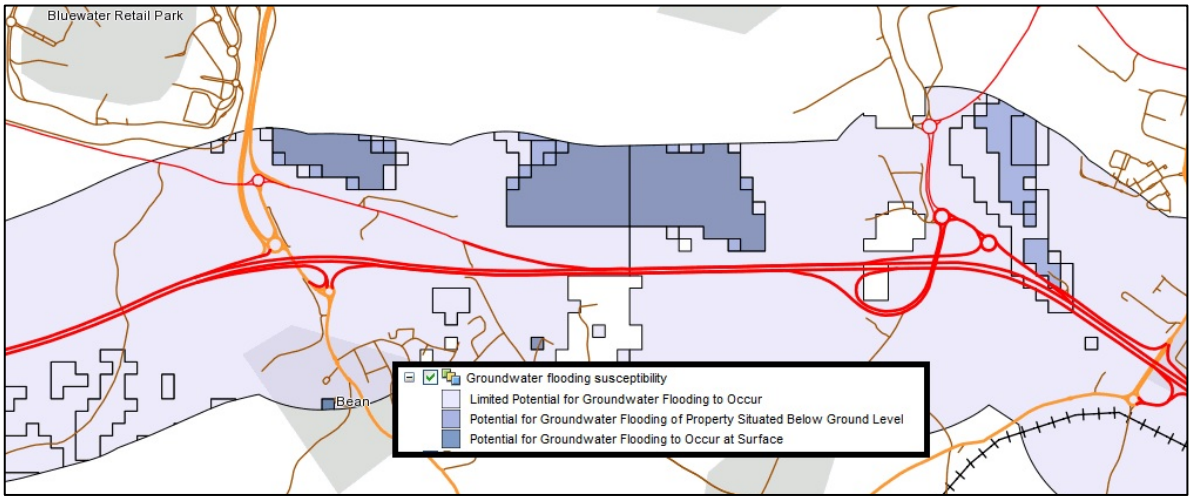
3.9.14 From a previous scheme undertaken on the A2 in 2004, eight groundwater abstraction licences exist within 1km of the Scheme extents, which include a public water supply at Southfleet and industrial or agricultural supplies.

3.9.15 It should be noted that the thickness of the unsaturated zone between the base of the attenuation / infiltration pond (WB5) and the existing level of the groundwater is believed to be more than 50m, providing protection to the groundwater aquifer.

3.9.16 The implication of any amendments to the existing drainage regime within the SPZ will require appropriate assessment to be undertaken (HD45) and discussion with the EA, which will ultimately determine the type of drainage systems used.

3.9.17 A review of the Groundwater Flooding Susceptibility Mapping (Figure 10) has shown that there is no risk to roads within the scheme limits from surface water flooding caused by groundwater.

Figure 10 - HADMMS Groundwater Flooding Susceptibility Overview



3.10 Geology

3.10.1 The generalized geological succession of the area under study is depicted in Table 7 below with the distribution of the superficial and bedrock deposits shown on drawings HA543917-HHJV-HGT-ZZZZ-DR-GE-0007 and HA543917-HHJV-HGT-ZZZZ-DR-GE-0008 respectively in Volume 2.

Table 7 - Generalised Geological Succession

System/ Period	Series	Group	Formation	General Description	Stratigraphical Thickness
Quaternary	Holocene		Alluvium	Marine and Estuarine Alluvium Silt and clay with lenses and beds of peat, and seams of sand and gravel.	Not identified
Quaternary	Pleistocene		Head Deposits Terrace Gravel	Undifferentiated, pebbly sandy clay; some gravel, sands and silts River Terrace Deposits – Gravel, sandy and clayey in part.	Up to 4m at Bean and 2m at Ebbsfleet Approximately 2m at Bean
Palaeogene	Eocene	Thames Group	London Clay Formation Harwich Formation	Dark bluish to brownish grey clay, containing variable amounts of fine-grained sand and silt. Cross-bedded shelly sand (the Oldhaven Beds) with a basal pebble bed.	Not identified Not identified
Palaeogene	Palaeocene	Lambeth Group	Woolwich Formation Reading Formation Upnor Formation Thanet Formation (Thanet Sand)	The upper beds are clay with shells, ferruginous sand, lignitic sand and lignite. The lower beds are coarse sand with pale grey clay partings and coarse gravel of black flint. Greenish to brownish grey silty, fine-grained sand, clayey and more silty in the lower part, with a conglomerate of flint pebbles and nodular flints at the base.	Not identified Up to 16m at Bean and 5m at Ebbsfleet
Cretaceous	Upper Cretaceous	White Chalk Subgroup	Seaford Chalk Formation Lewes Nodular Chalk Formation	Fossiliferous nodular chalk with bands of nodular flints, hardgrounds and marl seams. White chalk with hard nodular beds.	Up to 70m

Notes: Excludes stratigraphical units that are absent from the study area. Stratigraphical thicknesses have been taken from existing information.

3.10.2 The study areas are situated on the southern limb of the London Basin Syncline, which include the strata up to the Thames Group. The strata dip very gently to the northwest at generally less than 2 degrees. Unconformably overlying the White Chalk in the central part of the London Basin are Palaeogene deposits, which are mainly comprised of the Thanet Formation and Lambeth Group, these are dominated by sands and clays. The Thames Group (mainly the London Clay Formation) is also present generally on the higher ground to the south and east. The study area at Bean and Ebbsfleet is dominated by the Thanet Formation and White Chalk.

3.10.3 The Palaeogene and Late Cretaceous deposits are overlain in places by Quaternary deposits mainly of Alluvium, Head and Terrace Gravel. The Alluvium deposits are found locally around Ebbsfleet.

3.10.4 Naturally occurring solution features, often infilled, are common in the area such that the interface of the Thanet Sand Formation can be highly irregular. The natural cavity database (Peter Brett Associates) depicts 2 mapped solution features encountered historically within the Bean Triangle. Another two are shown to be present in close proximity to the proposed works at Bean, the first is northwest of the A296/Bean Lane roundabout, on the border of Blue Water. The second is mapped in the Swanscombe Chalk pit, it is not known whether this feature predates the quarrying.

3.10.5 The geological maps show that at Bean the White Chalk is overlain by the Thanet Formation (up to 16m in thickness) towards the south of the project area whilst the White Chalk outcrops in the north. Head deposits (up to 4m in thickness) are encountered in a finger shape running south to north, present to the west of Bean overbridge and several others occur to the east of the junction. Two areas of terrace gravels are mapped at the western end of the study area, extending beneath the A2 before the A2 enters the Swanscombe cutting.

3.10.6 The geological map at Ebbsfleet shows White Chalk is overlain by the Thanet Sand Formation (up to 5m in thickness) to the west of the junction with the white Chalk outcropping in a north south line just to the west of the HS1 rail line in the valley bottom, beyond which the Thanet Formation is again present. Running through the valley bottom head deposits (up to 2m in thickness) are encountered with an associated finger mapped as running across the existing junction. Further to the north a tract of alluvium is present.

3.10.7 Plans depicting the location of solution features and the BGS classification of the likely presence of soluble rock can be seen on drawings HA543917-HHJV-HGT-ZZZZ-DR-GE-0009 at Bean and HA543917-HHJV-HGT-ZZZZ-DR-GE-0010 at Ebbsfleet, in Volume 2.

3.11 Mining

3.11.1 Quarrying of sand and gravel for building materials and the excavation of chalk and clay for the manufacturing of cement has been extensive in the region, the majority of which has now ceased. The chalk quarries, which are numerous north of the A2, were often up to 25m deep or more. Since the cessation of manufacturing of cement the quarries have either been backfilled with waste, left as water filled lakes or been redeveloped as industrial, retail and residential developments. Two such pits, Blue Water and the Swanscombe Chalk Pits lie just to the north of Watling Street at Bean. The British Geological Society (BGS) historical mineral planning permission GIS dataset also indicates two areas of land, underlying the northern extent of the existing Ebbsfleet Junction, holding valid planning permission for surface mineral working. The BGS artificial ground GIS layer also indicates some of this land has been worked, the extent of which is not currently known.

3.11.2 Chalk extraction in the area has not just been limited to open quarries. Numerous Dene holes are present throughout the area. Dene holes comprise a small shaft excavated down to the Chalk off which small adits were driven. The chalk mined in this way was undertaken in medieval times and was used for liming agricultural fields. Some Dene holes are known to have been constructed pre Roman times. Several Dene holes are recorded West of Bean Junction and two have been mapped between the A2 and the historic electrical distribution grid in close proximity to the Ebbsfleet Junction. In addition to these, Hyder recorded the collapse of a Dene hole in the 1990s, now covered by the Ebbsfleet westbound on slip. The location of Dene holes is very difficult to predict and several unrecorded ones were also encountered during the construction of HS1.

3.11.3 A small sand and gravel pit and two small chalk pits are reported north of the existing balancing pond at Bean within the Bean Triangle, in an area where a brick works existed in the past. There is also an area recorded as general quarrying immediately north of the A2 at the Ebbsfleet Junction, adjacent to the abovementioned deneholes.

3.11.4 Plans presenting the known locations of Dene holes, the previously mentioned areas that hold planning permission for surface extraction and areas of worked ground are included in Volume 2, on drawings HA543917-HHJV-HGT-ZZZZ-DR-GE-0011 at Bean and HA543917-HHJV-HGT-ZZZZ-DR-GE-0012 at Ebbsfleet.

3.12 Public Utilities

3.12.1 C2 Enquires were made with all Statutory Undertakers through Line Search and details provided by the Area 4 MAC. All responses have been received and the following Statutory Undertakers have services within the vicinity of the scheme.

3.12.2 As outlined in Section 5.3 these services provide a significant constraint to the project. The main constraints include:

- High voltage overhead power lines at the Bean Junction with a pylon located in the middle of Ightham Cottages roundabout and a pylon immediately north of Hope Cottages roundabout. Two of the options at the Bean Junction involve the diversion of the overhead lines at the junction;
- National Grid Underground Transmission line which runs along the A296 Roman road and A2 to the Northfleet East sub-station site; and
- A high pressure gas main at the Bean Junction.

3.12.3 Outline details are provided below and more details can be found in the Statutory Undertakers Estimate report. The information received from the C2 Enquires has been collated on drawings HA543917-HHJV-VUT-ZZZZ-DR-D-0001 to 0004 in Volume 2.

BT Openreach

3.12.4 BT have the following services in the study area:

- Underground services along the A296, with some overground and underground connection to local properties;
- Underground service crossing the A2 on Bean Bridge. There is also an underground service shown at Sandy Lane underpass which will require further investigation to establish if this is at the lower level of the underpass;
- Overground services along the local service roads for Ightham Cottages and Hope Cottages;
- Underground services to the northern side of the A2 from Bean Junction eastbound onslip to A2 Ebbsfleet Junction, and
- Underground services on all routes within Ebbsfleet Junction, north on the A2260 and to the east on the A2 to Pepper Hill.

Virgin Media

3.12.5 Virgin Media have the following services in the study area:

- Northern side of A2 between the A2 eastbound offslip and Pepper Hill Junction, and.
- There is a connection crossing the A2 eastbound onslip at Ebbsfleet Junction.

Southern Gas Networks

3.12.6 Southern Gas Networks have medium pressure mains services throughout the Bean and Ebbsfleet Junctions as well as services along the northern A2 carriageway between Bean and Ebbsfleet Junctions, and the link road between Ebbsfleet and Pepper Hill Junctions:

- Crossing to the west of Bean junction passing under the west facing slip roads and A2 mainline;
- A296 Watling Street and A2 mainline between Bean and Ebbsfleet Junctions including a section in the central reserve;
- On the western side of the B259 north of Ebbsfleet Junction;
- Crossing the A2 at the underbridge for the westbound slip roads at Ebbsfleet Junction and adjacent to the slip road south of the junction;
- Around the east roundabout at the Ebbsfleet Junction, and
- Northern side of the link road from Ebbsfleet Junction to the Pepper Hill Junction including a crossing of the link road.

Atkins (Vodafone)

3.12.7 Vodafone have a service following the overhead electricity parallel and to the north of the A2 west of Northfleet West Grid Sub Station, crossing the A2260 north of Ebbsfleet Junction and to the north of Springhead Nurseries.

MBNL (H3G and EE)

3.12.8 H3G and EE have services close to Bean Junction.

Southern Water

3.12.9 At Bean Junction there is a 225mm foul water sewer crossing the junction from Bean village to the B255. The service is located to the east of the junction crossing the A2 westbound offslip and mainline. The service crosses the eastbound onslip (Watling Road) to the west of the quarry access, it then runs adjacent to the north of Watling Road to the B255, then adjacent to the B255 in the eastern verge. There is also a small section 225mm diameter foul water sewer crossing the roundabout between the B255 and the A296.

3.12.10 There are no Southern Water services at Ebbsfleet Junction.

UK Power Networks

3.12.11 There are numerous services around both junctions:

- 33kV route on the B255 to the north of the junction with A259 (underground);
- 33kV route on the A296 to the west of the junction with B255 (underground). This service continues to the north of the A2 between Bean and Ebbsfleet Junctions. The service crosses the A2 and westbound onslip at Ebbsfleet Junction;
- 400kV overhead line on the north side of the A296. This service continues to the north of the A2 between Bean and Ebbsfleet Junctions;
- There are other cables along the A296 and Bean Lane which appear to be local domestic and highway supplies. This includes services on Bean Bridge – two on the east side and one on the west;
- There are two parallel overhead 33kV services through Darenth Woods. They diverge to the west of Bean Junction and cross north and south of Bean Bridge. The northern service crosses the A2 to the east of Bean Junction where there services are again parallel and diverge from the A2;
- An underground service crosses the A2 mainline and westbound offslip at Ebbsfleet Junction;
- There are four crossings of the A2 and westbound slip roads at Ebbsfleet Junction (400kV (overhead), 2 x 132kV(overhead) and an underground route). The underground service continues adjacent and to the south of the A2. There other services on the A2 westbound slip roads including those for street lighting;
- There are underground services around the Ebbsfleet Junction roundabouts and to the west side of B259. There is also an overhead crossing of the B259 to the north of the Ebbsfleet Junction roundabouts;
- There are a further 2 overhead crossing of the A2 to the east of Ebbsfleet Junction (132kV and 33kV), and
- Additionally there are several ducts located in the area. It will need to be established whether these are abandoned or for planned future use.

National Grid Electricity and Gas

3.12.12 National Grid have:

- Underground and overground services on the A296 extending to the A2 eastbound onslip;
- Underground and overground services to the north of the A2 between Bean and Ebbsfleet Junctions;
- Underground services north of the A2 though Ebbsfleet Junction;
- Overground services which cross the A2 on the western extent of the Ebbsfleet Junction, and
- Overground services which cross the A2260 north of Ebbsfleet Junction.

Thames Water

3.12.13 There are numerous Thames Water services around both junctions including:

- A trunk main is located adjacent to the A296, on the southern side, from the western extent of the study area to Sandy Lane, where it crosses the A2 to Bean Village;
- Adjacent to the B255, there are three trunk mains and a water main. Thames Water drawings also show a private water main (not owned by Thames Water) adjacent to their own services;
- One of the trunk mains, the water main and the private water main from the B255 diverge to the north of the roundabout with the A296 and cross the A296 west of the bridge. These mains follow the bottom of the embankment and cross the A2 at the western extents of Bean Junction;
- A water main is located along Bean Lane including Bean Bridge;
- 225mm diameter foul water sewer connects Ightham Cottages to the north of the A2 and Hope Cottages to sewers in Bean village. This service crosses the A2 to the east of Bean Bridge, crossing both the westbound on and off slip roads;
- At Ebbsfleet Junction there are water mains crossing all the A2 slip roads, and
- There is a water main located adjacent to the A259 with two crossings, at the Redrow roundabout and at approximately half way between the two roundabouts.

3.13 Technology

3.13.1 The A2 is unusual for a trunk road in that it has extensive motorway technology installed including gantries equipped with EMS (MS2 with two lines of 12 characters) and lane signals capable of displaying advisory speed limits, lane control aspects and a mandatory lane closed aspects supplemented by red lanterns. Emergency Road Telephones (ERT) are also located on both carriageways of the A2.

3.13.2 In summary the existing provision of gantries, VMS and lane signals on the approaches to the Bean and Ebbsfleet junctions on both carriageways is as shown in Table 8:

Table 8 - Summary of Technology

	Gantries with technology	VMS (MS2)	Lane signals
A carriageway (eastbound)	8	7	8
B carriageway (westbound)	6	5	6
Total	14	12	14

3.13.3 A single MS3 message sign is located on the westbound carriageway within the Bean Junction for the approach to the M25 junction. There is also a M3 message sign located on the eastbound carriageway between the 2/3 mile and 1/3 mile ADS gantries. Post mounted entry signals (MS1) are located at the start of each on slip at both the Bean and Ebbsfleet Junctions.

3.13.4 A cabitent cluster is located on the Ightam Cottages roundabout where all technology elements are located. These consist of:

- Optical fibre connections to the National Roads Transmission Network;
- Service delivery cabinets for the connections of all local services;
- Closed Circuit Television mast and control outstation;
- MIDAS road monitoring equipment plus outstation, and
- Power supply interfaces.

3.13.5 CCTV coverage at the junctions is limited to a single mast mounted camera located at a cabinet cluster on the Ightham Cottages roundabout. This is sufficient to monitor the whole of this junction area.

3.13.6 A summary of the equipment on the A2 at the junctions includes:

- Motorway traffic information gantries;
- Non-Enforcement Advanced Motorway Indicators (AMI);
- Enhanced Message Sign (EMS) – 2x12 Portal type;
- Ambient Light Monitor (ALM);
- MS3 Message Signs - 3x18 Cantilever type;

- Roadside Controller outstations;
- Motorway Incident Detection and Automatic Signalling (MIDAS) loops and associated MIDAS Detector outstations, and
- Emergency Roadside Telephones (ERT).

Non-Motorway technology

3.13.7 Additional equipment is located off the A2 at both junctions including traffic count loops located at the Ightham Cottages roundabout and A296 Roman Road and traffic signal controlled pedestrian crossings at both junctions. A ducted route with power and data cabling is located at the Ightham Cottages roundabout associated with the traffic loops.

Communication

3.13.8 The National Roads Telecommunications Services (NRTS) contract provides services across the Highways England roadside telecommunication network. The network links the roadside communication devices (ERT, CCTV, etc.) along the motorways and other main trunk roads in England, with the National Traffic Control Centre (NTCC) and a number of Regional Control Centre (RCC) for the Highways England Network.

3.13.9 The main ducted cable route along this section of the A2 passes along the westbound (B) carriageway. Where there is technology on the opposite eastbound (A) carriageway this is accessed via a road crossing and a local cabling network in that area.

3.14 Maintenance Operations/Maintenance Access

General

3.14.1 Maintenance on the A2 is carried out by the Asset Support Contract (ASC) team and the Regional Technology Maintenance Contractor (RTMC) on behalf of Highways England. Drawings HA543917-HHJV-GEN-ZZZZ-DR-D-0167 to 0170 in Volume 2 show the extent of Highways Englands Network at the Bean and Ebbsfleet Junctions. The maintenance on the approach roads from Ebbsfleet and Bean is carried out by Kent Highway Services, Kent County Council's highways arm which is responsible for most local highway matters including: street lighting, repairing pot holes, dropped kerb applications, grass verge cutting, road closures, highway drainage and culverts, bollards, salting roads and snow clearance and highways safety schemes.

3.14.2 At present the network is accessed via short/medium term stops on the hardshoulder on the A2 and by local traffic management measures on the local highway network following the road space booking procedure.

Access Paths and Steps

3.14.3 There are access paths, steps and hard-standing areas leading to communication equipment on the A2. These are maintained by the ASC team.

3.14.4 Wide verges exist on the local highway network where maintenance vehicles currently stop and operatives will gain access to the various assets by means of footways and verges. Existing maintenance hard stand and access points are indicated on drawings HA543917-HHJV-HGN-XXXX-DR-D-0144 to 0146 in Volume 2.

Access to Technology Assets

3.14.5 Current access to technology assets on the A2 is carried out during short/ medium term stops on the hard shoulder or under traffic management (TM) following the roadspace booking procedure.

3.14.6 Off-network access, currently used in some locations, requires liaison with the region's ASC team and third party stakeholders.

3.15 Environmental Status

3.15.1 Detailed environmental baseline conditions are presented within the Stage 1 Environmental Assessment Report (hereafter termed the EAR). Key environmental designations are summarised below (refer to Figure 11 Environmental Designations):

Public Rights of Way

3.15.2 There are a number of Public Rights of Way which pass in close proximity to both the Bean and Ebbsfleet Junctions. The following footpaths are situated on the southern side of and leading to the A2: DR18, DR19, DR20 & DR128. The following footpaths are situated on the northern side of and

leading to the A2: DR312, DS20, NU14 & NU19. There are three By-ways located within the study area: southeast of Bean Junction DR129, south of Ebbsfleet Junction DR129, east of Ebbsfleet Junction NU20. These are shown on drawings HA543917-HHJV-HGN-XXXX-DR-D-0144 to 0146 in Volume 2. The potential impacts on Rights of Way are considered in Chapter 11 People and Communities, of the EAR. The visual amenity from footpaths are considered in Chapter 6 Landscape and Visual, of the EAR.

Watercourses

3.15.3 A single watercourse, Ebbsfleet River is situated within the study area. It lies east of the Ebbsfleet Junction within the Ebbsfleet Marshes Local Wildlife Site and adjacent to the southeast extent of the Scheme. More detail on surface water and drainage can be found in Chapter 10, Road Drainage and the Water Environment, of the EAR.

Green Belt

3.15.4 The majority of the Scheme options fall within land designated as Green Belt.

Country Parks

3.15.5 Country Parks within the Landscape and Visual Impact Assessment study area include Swanscombe Heritage Park in the north (approx. 1.4 km from scheme limit), Beacon Wood in the south (approx. 0.75 km from scheme limit) and Darenth Country Park in the west (approx. 0.75 km from scheme limit).

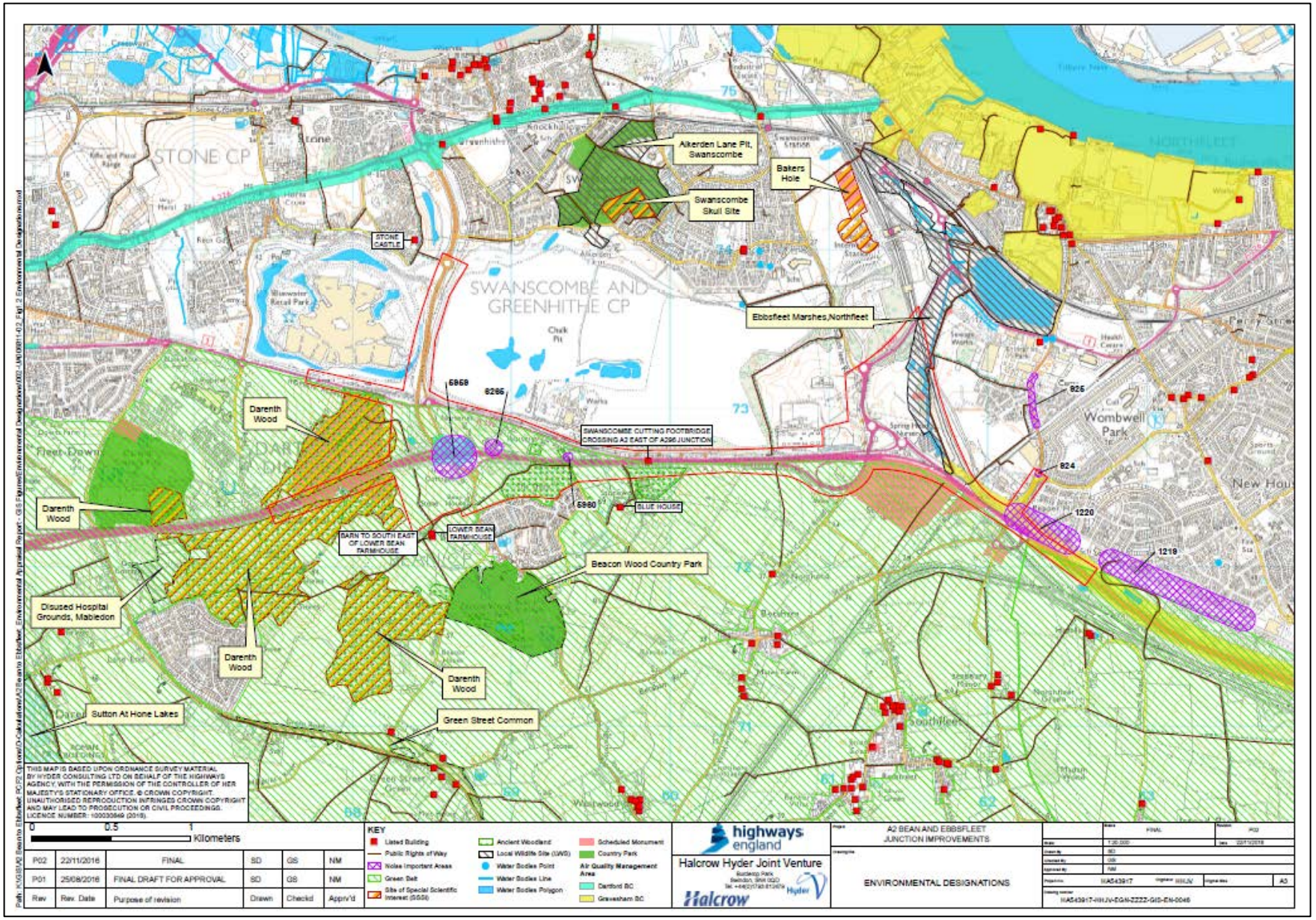
Sites of Special Scientific Interest (SSSIs)

3.15.6 There are three Sites of Special Scientific Interest (SSSIs) within 1km of the Scheme area:

- Darenth Wood SSSI - lies partially within the footprint of the Bean Option 3 design, west of the Bean Interchange;
- Swanscombe Skull Site SSSI- is approximately 900m north of the Scheme, and
- Baker's Hole SSSI - is approximately 500m north of the Scheme

3.15.7 Both Swanscombe Skull Site SSSI and Baker's Hole SSSI are designated for their geological interest.

Figure 11 - Environmental Designations



Ancient Woodland

3.15.8 Five areas of ancient woodland are situated within or adjacent to the Scheme area:

- The eastern fringes of Darenth Wood SSSI;
- The entire area of woodland known as The Thrift (south of the A2);
- Two small areas of woodland located adjacent to the east bound carriageway of the A2, within the A2/A296/Bean Lane triangle, which are possibly remnants of The Thrift; and
- The northern half of a woodland located approximately half way between the Bean Interchange and the Ebbsfleet Junction (also south of the A2).

Local Wildlife Sites (LWS)

3.15.9 Four (LWS) are located within 1km of the Scheme area:

- Ebbsfleet Marshes LWS. The southern spur of Ebbsfleet Marshes Local Wildlife Site (LWS) is situated east of the Ebbsfleet Junction;
- Disused Hospital Grounds, Mabledon LWS, located approximately 900m northeast of the Scheme;
- Alkerden Pit, Swanscombe LWS located approximately 950m northeast of the Scheme, and
- A Kent Wildlife Trust Roadside Nature Reserve (RNR) located approximately 860m north of the Scheme.

Scheduled Monuments

3.15.10 There are four scheduled monuments within 500m of the Scheme area:

- Neolithic sites near Ebbsfleet;
- Springhead Roman site;
- Roman enclosure south east of Vagniacae, and
- Medieval woodland boundary of Darenth Wood.

These are shown on Figure 11 Environmental Designations.

Listed Buildings

3.15.11 There are five Grade II listed buildings within 500m of the Scheme area

- Stone Castle;
- Lower Bean Farmhouse;
- Barn to South East of Lower Bean Farmhouse;
- Swanscombe cutting footbridge crossing A2 east of A296 junction, and
- Blue house.

These are shown on Figure 11 Environmental Designations.

Air Quality Management Areas

3.15.12 The Scheme is located within the administrative boundaries of Dartford Borough Council and Gravesham Borough Council.

3.15.13 There are four Air Quality Management Areas (AQMAs) designated within the Dartford Borough Council administrative area. These are:

- Dartford AQMA No.1 – a corridor approximately 250m wide along the A282 Dartford Tunnel Approach Road from junction 1a to 300m south of junction 1b (located approximately 2.4km north west of the Scheme at A2 Bean Junction);
- Dartford AQMA No.2 – an area encompassing London Road, Dartford (located approximately 1.7km north of the Scheme at A2 Bean Junction);
- Dartford AQMA No.3 – an area encompassing Dartford Town and a number of approach roads (located approximately 2.6km north west of the Scheme at A2 Bean Junction), and
- Dartford AQMA No.4 – an area encompassing the Bean Interchange between the A2 and A296 (overlaps with Scheme).

3.15.14 There are seven AQMAs designated within the Gravesham Borough Council administrative area. These are:

- Gravesham Parrock Street AQMA - an area encompassing Parrock Street (from the point at which it crosses the railway line, southwards to the junction of Christ Church Road), and Lord Street (from its junction with Parrock Street to its junction with Windmill Street) (located approximately 3.5km north east of the Scheme at the Ebbsfleet Junction);
- Echo Junction AQMA – on B261 Gravesend (located approximately 3.5km east of the Scheme at the Ebbsfleet Junction);
- Gravesham A227 Wrotham Road/ B261 Old Road West AQMA - an area encompassing the junction of the A227 Wrotham Road and B261 Old Road West extending south to a point just beyond the Woodlands Restaurant (located approximately 2.8km east of the Scheme at the Ebbsfleet Junction);
- Gravesham A226 One-way system AQMA - an area incorporating the entirety of the A226 One-way system in Gravesend (located approximately 3.1km north east of the Scheme at the Ebbsfleet Junction);
- Gravesham B262/B261 Pelham Arms Junction AQMA - an area encompassing the junction of the B262 Pelham Road, B262 Pelham Road South and the B261 Old Road West (located approximately 2.1km east of the Scheme at the Ebbsfleet Junction);
- Gravesham A2 AQMA - the A2 Trunk Road AQMA. An area extending either side of the length of the A2 within the borough (overlaps with the Scheme at the Ebbsfleet Junction), and
- Northfleet Industrial Area AQMA - an area encompassing the Northfleet Industrial Area in Gravesham (located approximately 1.4km north of the Scheme at the Ebbsfleet Junction).

3.16 Environment Environmental Baseline and Study Area

Noise and Vibration

3.16.1 The study for the noise assessment has been defined in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, HD 213/11 (HD213/11). The 1km study area for the noise assessment accounts for a total of 2,257 residential dwellings and 3 identified other sensitive receptors: one school, one residential home, and one care home.

3.16.2 From a review of commercial mapping and site visits, it has been concluded that road traffic noise is likely to be the dominant source of noise within the study area. This is concluded due to the presence of the busy A2 Dual Carriageway which is one of the main routes in the area linking the busy port of Dover with Canterbury, Rochester and London, and on to the wider UK. As such the predictive quantification of the prevailing baseline road traffic noise climate of the area is considered to be representative.

3.16.3 However, once a final route option has been selected a full suite of onsite noise monitoring surveys will be undertaken across the Study Area to quantify the specific baseline noise climate. Noise monitoring locations will be agreed with the Environmental Health Departments at both Gravesham and Dartford at the time, and prior to monitoring taking place.

3.16.4 There are seven Defra Noise Important Areas within the 1km of the scheme. These have been identified on stretches of the A2 between Bean and Ebbsfleet, the B262 and the Roman Road.

Air Quality

3.16.5 The study area in relation to the Scheme is defined by the changes in traffic flows on the local road network. The Scheme is located within the administrative boundaries of Dartford Borough Council (DBC) and Gravesham Borough Council (GBC).

Dartford Borough Council

3.16.6 There are four Air Quality Management Areas (AQMAs) designated within the DBC administrative area as outlined in section 3.15.13 above. All of the Dartford AQMAs have been declared for exceeding annual mean NO_2 concentrations. Dartford AQMA No.1 also declared 24-hour PM_{10} exceedances. The Scheme is located within the Dartford AQMA No.4 and therefore does have the potential to affect traffic flows within the AQMA.

3.16.7 The closest monitoring locations to the Scheme are located at the Bean Junction and include diffusion tube sites DA05 (A/B/C), DA70, DA75, DA87 and the Bean Junction automatic monitoring station. The 2014 annual mean NO_2 concentration for these sites all exceeded the AQS objectives, with the NO_2 concentration ranging from 41 to 67µg/m³.

3.16.8 Ratified annual mean NO_2 concentrations from the DBC automatic monitoring stations report NO_2 concentrations exceeding the AQS objectives at all stations from 2009 to 2014.

3.16.9 Ratified annual mean PM_{10} concentrations from the DBC automatic monitoring stations report PM10 concentrations below the AQS objectives from 2009 to 2014.

Gravesham Borough Council

3.16.10 There are seven AQMAs designated within the GBC administrative area as outlined in section 3.15.14 above.

3.16.11 All of the Gravesham AQMAs have been declared for exceeding annual mean NO_2 concentrations. The Echo Junction AQMA, Gravesham A2 AQMA and the Northfleet Industrial Area AQMA also declared 24-hour PM_{10} exceedances. The Gravesham AQMAs located within the vicinity of the study area. The Scheme is located within the Gravesham A2 AQMA and therefore does have the potential to affect traffic flows within the AQMA.

3.16.12 The closest monitoring locations to the Scheme are located near the Ebbsfleet Junction and include diffusion tubes GR92, GR109, GR104, GR08 and the Painters Ash School automatic monitoring station. The majority of 2014 annual mean NO_2 concentration for these sites exceeded the AQS objectives, with the NO_2 concentration ranging from 31.0 to 47.7µg/m³.

3.16.13 Ratified annual mean NO_2 concentrations from the Gravesham Borough Council automatic monitoring stations report NO_2 concentrations below the AQS objectives from 2009 to 2014.

3.16.14 Ratified annual mean PM_{10} concentrations from the Gravesham Borough Council automatic monitoring stations report PM_{10} concentrations below the AQS objectives from 2009 to 2014.

Overall

3.16.15 The air quality monitoring from the local authorities and Highways England illustrates that there are multiple exceedances of the air quality strategy objectives/EU limit Values for the main traffic related pollutant, NO_2. The largest exceedance was at M25J30_028 (56.6 µg/m³) which is located approximately 7.5km from the Scheme next to junction 30 of the M25. The closest exceeding tube to the Scheme is A2BN_009 (located a distance of approximately 1.5km) which measured a 2014 NO_2 concentration of 45.0µg/m³, which is located in Greenhithe immediately adjacent to the A206/A226 roundabout.

<u>Landscape & Visual</u>

3.16.16 The study area consists of a 1km corridor either side of the scheme options. The landscape resource within the study area has been characterised at a national, county and local level within the EAR. At a National level the study area lies within parts of the National Landscape Character Area:(113) – North Kent Plain.

3.16.17 The key characteristics of the National Character Area 113, relevant to the study area, include:

- An open, low and gently undulating landscape, characterised by high quality, fertile, loamy soils dominated by agricultural land uses.
- Large settlements and urban infrastructure (including lines of pylons) are often visually dominant in the landscape, with significant development around Greater London and the Medway Towns, as well as around towns further east and along the coast. Major rail and road links connect the towns with London.

3.16.18 At a regional level Kent County Council has identified a number of landscape character types and areas in its Landscape Assessment of Kent document published in 2004. The relevant character areas within the study area comprise: Dartford and Gravesend Fringes; Southfleet Arable Lands; Darenth Downs; and Southfleet Arable Lands.

3.16.19 Nine local landscape character areas within the study area were also identified, during site survey work in May 2016:

North of the A2: Within Dartford and Gravesend Fringes LCA

- A: Former Eastern Quarry
- B: Bluewater Retail Park
- D: Urban Fringe of Dartford, Greenhithe and Swanscombe
- F: Urban Fringe of Gravesend and Northfleet
- G: A2 Corridor North
- South of the A2: Southfleet Arable Lands LCA and Darenth Downs LCA
- C1 to C3 Darenth Wood and Bean Woods

- E: Southfleet Downland
- G: A2 Corridor South
- H: Bean Village

Green Belt

3.16.20 The majority of the proposed development site falls within land designated as Green Belt. The Green belt is defined as all land south of the A296 and A2.

Country Parks

3.16.21 Country Parks within the Landscape and Visual Impact Assessment study area include Swanscombe Heritage Park in the north, Beacon Wood in the south and Darenth Country Park in the west.

Ancient Woodland

3.16.22 Darenth Wood is situated within the A2 corridor, on the southern side of the A2 as well as west of Bean Junction. Thrift Wood is situated to the south of the A2 corridor, to the east of Bean Junction.

Visual Amenity

3.16.23 The approach to the visibility mapping studies and visual appraisal surveys undertaken to define the baseline visual conditions for this appraisal is outlined below.

3.16.24 The ZTV has been digitally mapped using a computer model to show areas within which the Scheme may be theoretically visible. The ZTV mapping uses elevation data to create a digital terrain model and calculate inter-visibility between points. The model does not take account of the screening effects of buildings, other structures and blocks of woodland/other areas of substantial vegetation that could influence potential visibility.

3.16.25 The ZTV mapping is used as a guide and is verified by site surveys. A final Zone of Visual Influence (ZVI), in accordance with DMRB, will be produced for the Stage 3 EAR. The initial representative viewpoints identified for this, Stage 1, appraisal are based on the May 2016 site survey. Originally, approximately 35 viewpoints have been checked during a site visit in May. Finally, the visual receptors within the study area have been considered in terms of 20 representative viewpoints.

Cultural Heritage

3.16.26 The study area encompasses an area extending 500m from the site boundary. There are nine designated heritage features within 1km of the Scheme. The study area does contain four scheduled monuments. Neolithic sites near Ebbsfleet (SM3); two monuments which date to the Roman period (SM2 and SM4) and a woodland boundary of Medieval origin (SM1).

3.16.27 The study area also contains five Grade II listed buildings. They mostly date from the post-medieval period (AD 1540 to 1901) with a single buildings originating from the medieval period (AD 1066 to 1540) Grade II listed Stone Castle (LB1) with one being modern (AD 1901-present) (LB4).

3.16.28 There is potential for currently unknown sub-surface archaeological remains to be present within the study area.

Designated Assets

3.16.29 There are no World Heritage Sites, registered parks and gardens, registered battlefields or conservation areas within the study area. As identified in Section 3.15.10 and 3.15.11 above four scheduled monuments and five Grade II listed buildings are located within the study area.

Non-designated Heritage Assets

3.16.30 The Kent Historic Environment Record lists 592 non-designated heritage assets within the study area. A number of these heritage assets relate to the designated heritage assets listed above and may cover portions of the asset that lie outside the scheduled area or designation of the listed building. In the west of the study area a handful of recorded heritage assets date to the Palaeolithic period. Later period prehistoric sites are also represented in the baseline with Mesolithic, Neolithic and Bronze Age sites recorded. Within Darenth Wood a possible causeway enclosure is recorded south of the A2.

Historic Landscape Character

3.16.31 The historic landscape character of the study area contains twenty-four defined areas, demonstrating thirteen different landscape types. There are five post-medieval agricultural landscapes whilst the remaining areas have been significantly modified in modern times.

Ecology and Nature Conservation

3.16.32 The study area for biodiversity receptors extended to 2km from the site for statutory and 1km from the site for non-statutory designated sites.

3.16.33 Survey work is required in order to establish a detailed baseline. An extended Phase 1 habitat survey was undertaken on 29 and 30 April 2014. Following an update to the survey area boundary and to visit previously inaccessible areas, a second survey was carried out between 18 and 20 May 2015.

3.16.34 There are no statutory designated sites of International or European importance to nature conservation within the study area. Furthermore, there are no Special Areas of Conservation (SACs) for which bats are a qualifying feature within 30km of the study area. A screening exercise was undertaken to assess the impact of the Scheme on European designated sites (HD 44/09 Annex D findings of no significant effects report matrix (screening)). This concluded 'no significant impact' on European designated sites. Key ecological designations are identified in section 3.15 above and include three SSSIs, five areas of ancient woodland and four local wildlife sites within 1km of the site.

3.16.35 Hazel dormouse has been recorded in several locations surrounding the study area. There are recent records from Darenth Wood SSSI; Beacon Wood Country Park; Bluewater; the Thrift ancient woodland, adjacent to the A2 at the Bean Junction.

3.16.36 There are a large number of recent terrestrial invertebrate records within 1km of the study area. Numerous records of slow-worm, common lizard and grass snake were identified during the desk study from several locations outside of the study area, but within 1km of it. There are recent records (post 2004) of nine species of bat within 1km of the study area. Dormouse has been recorded in several locations surrounding the study area; there are recent records from Darenth Wood SSSI; Beacon Wood Country Park; Bluewater; the Thrift ancient woodland, adjacent to the A2 at the Bean Junction.

3.16.37 Water vole have been recorded in the River Darenth, west of Bean and in the Ebbsfleet River, within the Ebbsfleet Marshes LWS. Records of badger were identified from Darenth Wood SSSI, Ebbsfleet Marsh LWS and from two roadside locations.

Road Drainage and the Water Environment

3.16.38 The extent of the study area comprises an area of between 0.5km and 4km radius from the project boundary, where the extension depends on the sensitivity attributed to identified receptors and the relevance to the study.

Geology and Hydrogeology

3.16.39 There are several Source Protection Zone (SPZ) 1's within the study area, including:

- Two to the north of the A2 near Bean Junction;
- One to the south west of Bean Junction;
- Two to the south east of Bean Junction;
- One 250m south of the Ebbsfleet Junction;
- One to the north east of Ebbsfleet Junction, and
- One to the south of the Ebbsfleet Junction, which is related to a large public drinking water supply borehole.

3.16.40 The remaining study area lies within a SPZ 2 or 3.

3.16.41 Groundwater flow is considered to flow generally to the north and towards the Thames. Near the Ebbsfleet Junction groundwater is likely to flows towards the River Ebbsfleet.

Surface Water

3.16.42 River Ebbsfleet is the only designated Main River within the site boundary. The River Ebbsfleet is described in the Thames River Basin Management Plan (RBMP) as being a heavily modified waterbody that has a 'Moderate' ecological status and a 'Not Requiring Assessment' chemical status, based on the WFD classifications. The Ebbsfleet also contains a section of reed bed that has been designated with UK Biodiversity Action Plan (BAP) protection. There are twenty-seven waterbodies within 500m of the study area. There are also a number of lakes in the vicinity of the site. There are also a number of attenuation/infiltration ponds that form part of the surface water drainage systems that serve the existing highways within the study area. The site and study area also contains a number of un-named surface water drains and ditches that are likely to receive local drainage and form tributaries to the main watercourses listed above.

3.16.43 The scheme is underlain by geology that is described as Seaford Chalk Formation, with small pockets of Lambeth Ground sand, clay, and London Clay.

Flood Risk

3.16.44 The EA flood map for planning, which illustrates flood risk from main rivers and the sea, indicates that the majority of the Scheme and wider study area is located in Flood Zone 1, having an annual chance of less than 1 in 1000 (0.1%) of flooding from these sources. There is a narrow area of Flood Zone 3 (greater than 1 in 100 year (1%) annual chance of flooding) along the upstream reach of the River Ebbsfleet, which intersects with the Scheme approximately 500m east of the A2 Ebbsfleet Junction. No parts of the Scheme or wider study area are within the medium (Flood Zone 2) or high (Flood Zone 3) flood risk zones associated with the River Thames. However, flooding within the River Thames may interact with the River Ebbsfleet, via backwater effects for example, and this may contribute to the predicted flood likelihood and extent for the River Ebbsfleet and the Ebbsfleet Junction area of the Scheme.

Physical Activity

3.16.45 Changes in the number of pedestrians/cyclists/equestrians or their average journey times are anticipated to be insignificant, however this has not been considered in detail at this stage and will be considered in further detail at Stage 3.

Journey Quality

3.16.46 Overall, journey quality is expected to improve as a result of the Scheme. However, this has not been considered in detail at this stage and will be considered in further detail at Stage 3.

3.17 Accessibility and Integration

Option Values

3.17.1 Option Values apply where a scheme involves the introduction of a new transport mode or loss of an existing mode.

3.17.2 The A2 Bean and Ebbsfleet Junction Improvement Schemes do not result in any changes to available transport modes and hence there is no/negligible impact on Option Values.

Access to Services

3.17.3 The Scheme is unlikely to have substantial impact on access to services. However, this has not been considered in detail at this stage and will be considered in further detail at Stage 3.

Severance

3.17.4 Public footpaths within the study area have the potential to be affected by the Scheme. This has not been considered in detail at this stage and will be considered in further detail at Stage 3.

Access to transport system

3.17.5 The measure of accessibility applies to the available access to places by public transport users.

3.17.6 Being a highway scheme, no changes are planned to public transport services or facilities so accessibility for any group or to any location will remain unaltered.

3.17.7 The A2 Bean and Ebbsfleet Junction Improvement Schemes do not include any changes to public transport infrastructure or services and hence there is no/negligible impact upon accessibility.

Transport Interchange

3.17.8 The scheme does not include passenger or freight interchange facilities and hence there is no/negligible impact upon Transport Interchange.

3.17.9 The Scheme would not affect transport mode options in the study area.

3.18 Maintenance and Repair Statement

3.18.1 Designers and delivery partners will create ‘Maintenance Philosophy Statements’ in advance of the production of a detailed Maintenance and Repair Strategy Statement to record their assumptions and requirements regarding maintenance activities.

3.18.2 Road-worker safety requires careful consideration. As phasing of the scheme will comprise implementing a mix of dual carriageway, local roads and controlled motorway works any mitigation measures adopted for this scheme will be required to consider:

- Rationalisation of planned maintenance work, and
- 40mph mandatory speed limits during setting up of traffic management.

3.18.3 Whilst planned maintenance work on network roads is already managed in order to share traffic management, many more routine maintenance operations may also require local lane or carriageway closures leading to greater opportunities to share road space with other operators. Overall, however, there will be an anticipated reduced level of direct access and maintenance on new equipment since emerging technology permits remote diagnostic ability.

3.18.4 Consideration of the residual life of assets will be considered through discussions with the ASC during the detailed design process in order to avoid replacement of significant assets within the first 5 years of operation.

3.18.5 A road-worker assessment will be undertaken during ongoing Stages of the scheme development, which will identify how the road safety objectives will be met by introducing various mitigation measures.

4 Future Developments

4.1 Core Scenario

4.1.1 The Core Scenario, as described in WebTAG[1], forms the primary basis of evidence for assessing the impact of the proposed transport scheme, as presented in the appraisal summary table (AST), and is developed using unbiased and realistic assumptions.

4.1.2 Local developments are classified according to their likelihood of proceeding and this identifies the development that will be included in the Core Scenario, for the purposes of establishing the level of forecast traffic demand the A2 Bean and Ebbsfleet Junction options are designed to accommodate. WebTAG[2] advises that local sources of uncertainty categorised as **near certain** should be included in the Core Scenario, whilst all sources categorised as **hypothetical** should be excluded. Between these two categories, an element of judgement may be required, but usually it would be expected that those inputs categorised as **more than likely** will be included in the Core Scenario, whilst those categorised as **reasonably foreseeable** will be excluded.

4.1.3 The Core Scenario for assessing the A2 Bean and Ebbsfleet junction improvements has been aligned with key stakeholders aspirations and goals for development in Kent Thameside and in line with the Client Scheme Requirements, which includes the broad aim of delivering transport improvements to enable the planned level of development associated with the growth agenda for Dartford and Gravesham Borough Councils. Therefore, all development identified within the extent of the Ebbsfleet Development Corporation area has been categorised as 'More than Likely' is included in the Core Scenario.

4.2 Lower Thames Crossing

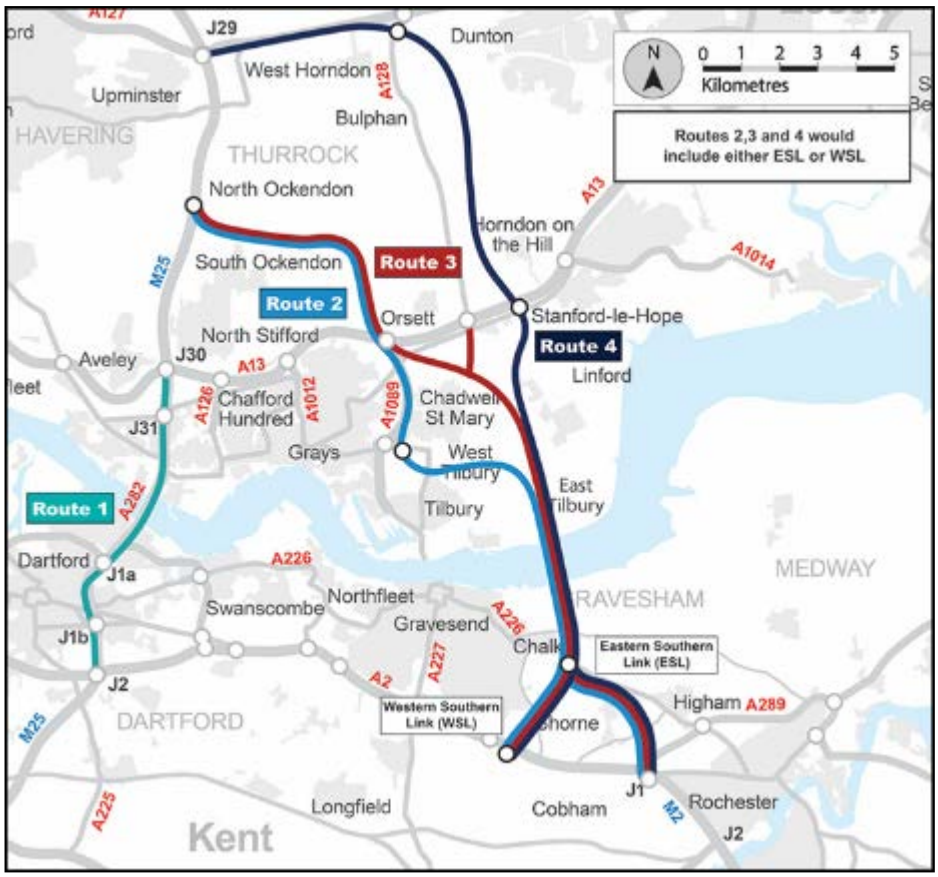
4.2.1 The Lower Thames Crossing (LTC), is a proposed new crossing of the Thames estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing. Although LTC in its current status is not a committed scheme in terms of statutory consent, it is judged by Highways England to be **more than likely**, hence is included in the Core Scenario.

4.2.2 The A2 Bean and Ebbsfleet Study takes into account LTC Location C (Route 3 Eastern Southern Link ESL (model version C2hC19) in the Core Scenario (Without and With Scheme). A location plan showing Route 3 ESL is shown in Figure 12. A Location C option is included in the Stage 1 A2 traffic model, rather than testing all of the Location A and C options examined by the LTC project team, as the Location C options would have the most impact on the A2 Bean and Ebbsfleet scheme. The Route 3 ESL option was chosen as it is the proposed scheme that was taken to public consultation held between January and March 2016 and remains so until the LTC preferred route announcement from the Secretary of State. The A2 Bean and Ebbsfleet model structure remains unchanged from the donor model including the toll choice model and charging regime.

[1] WebTAG Unit M1.1 Principles of Modelling and Forecasting January 2014 Chapter 5.3.2, p16

[2] WebTAG Unit M4 Forecasting and Uncertainty, May 2014 Ch 3.2.4, p6

Figure 12 - LTC Short List Options including LTC Location C Route 3 ESL



4.3 London Paramount Entertainment Resort (London Paramount)

4.3.1 London Paramount is a proposed major development to be located on the Swanscombe Peninsula. Whilst London Paramount will predominantly be a theme park, the development site will also include significant mixed-use development.

4.3.2 The site is being developed by London Resort Company Holdings (LRCH) and has been designated as a Nationally Significant Infrastructure Project (NSIP) by the Secretary of State for Communities and Local Government. The NSIP status of the project means that LRCH will apply directly to the Secretary of State for planning permission, rather than the local planning authorities. The site lies within the boundary of the Ebbsfleet Development Corporation.

4.3.3 The development proposals may include:

- £2 Billion project;
- 10 million visitors / year rising to 15 million after Year 5;
- 27,000 jobs, 17,000 of which will be on site;
- Bulk of the site to be designated as Leisure including 5-6000 hotel rooms, and
- Potential for a staff village of up to 2000 bed spaces.

4.3.4 As London Paramount currently has no Local Plan status (and hence does not constitute development that conforms to the objectives of the Client Scheme Requirements) and is not certain to go ahead as planned, or within the timescale planned, Highways England has decided that London Paramount should be categorised as Hypothetical and therefore not included in the Core Scenario. However, as there is planned development in the Local Plan on the land that London Paramount would occupy on Swanscombe Peninsula, the Core Scenario does include for this alternative development, as set out in Table 10.

4.4 Developments Identified

4.4.1 The A2 Bean and Ebbsfleet traffic model straddles the boundaries of Dartford Borough Council and Gravesham Borough Council within Kent County Council. The Stage 1 A2 Bean and Ebbsfleet

Uncertainty Log Stakeholder Consultation was carried out with Dartford Borough Council, Gravesham Borough Council and Kent County Council as well as with the Ebbsfleet Development Corporation to:

- Identify the planned future development, and
- Identify future network supply assumptions including proposed future transport schemes within the A2 Bean and Ebbsfleet area.

4.4.2 The A2BE Stage 1 Uncertainty Log consultation concluded in June 2015 and accordingly the Stage 1 Uncertainty Log and the Stage 1 traffic model reflects the information provided by the local authorities up to June 2015.

4.4.3 The Stage 1 A2 Bean and Ebbsfleet Stakeholder Uncertainty Log Consultation can be referred to in 0004-UA007244-UT22TN-11 A2 Bean and Ebbsfleet Uncertainty Log.

4.4.4 Development outside of Dartford and Gravesham Boroughs was included in the traffic model by making use of the Lower Thames Crossing Model (LTC2) Uncertainty Log planning data.

4.4.5 The identified development areas are shown in Figure 13 Tables 10 and 11 using the Map Ref. column.

4.4.6 A summary of the planned development classified as “near certain” or “more than likely” and included in the core scenario is provided in Table 9.

Table 9 - Core Scenario Future Development

Borough	Dwellings	GFA (m2)
Dartford	15,315	914,400
Gravesham	3,294	266,410
Total	18,609	1,180,810

Figure 13 - A2 Bean and Ebbsfleet Development Areas (With Categorisation)

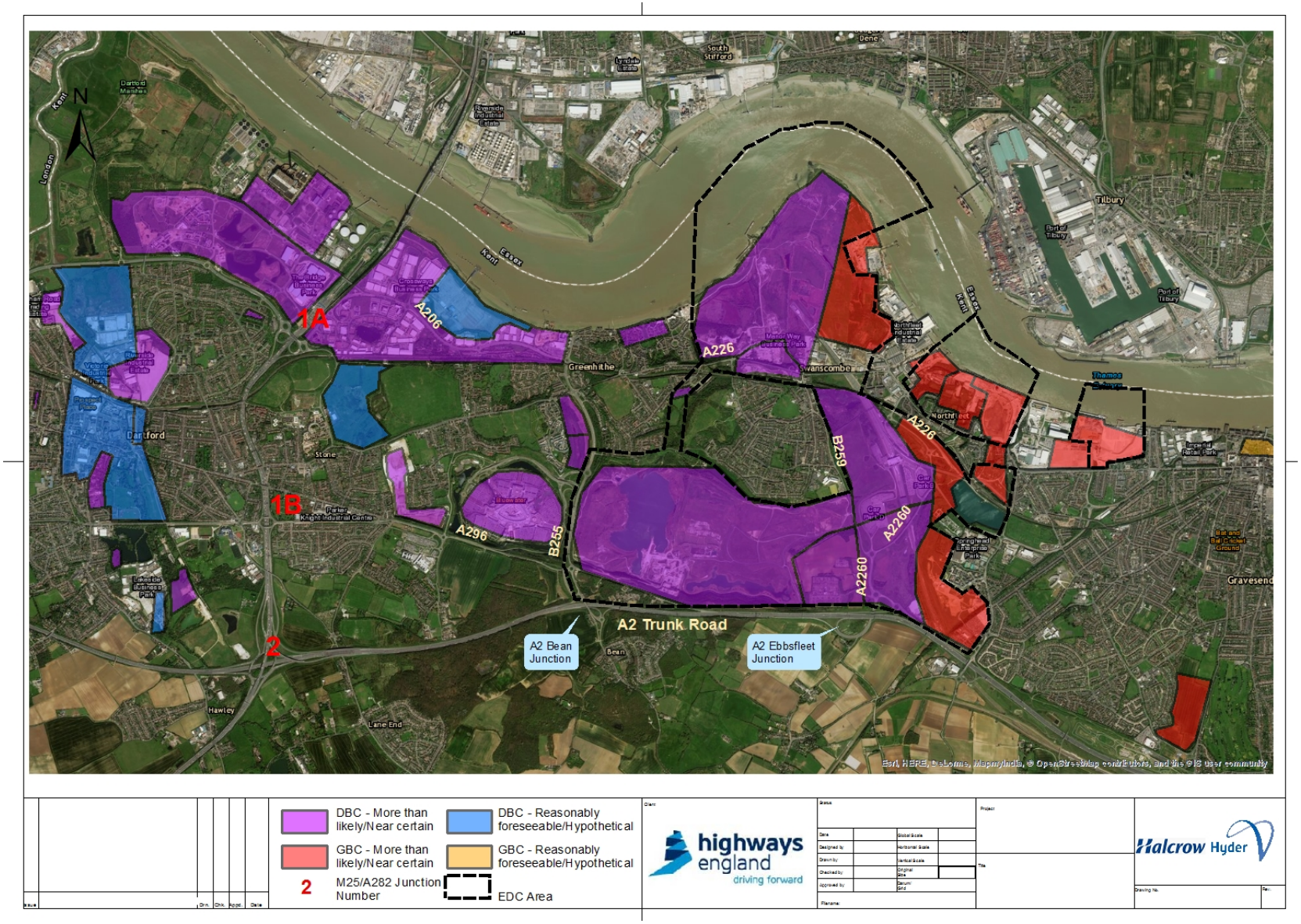


Table 10 - A2 Bean and Ebbsfleet Uncertainty Log - Dartford Borough Council

Map Ref	Development	EDC	Land Use	Total Size	Completed	Uncertainty	Source Document
D01	Dartford Town Centre and Northern Gateway	N	Residential	1,030 dwellings		Reasonably foreseeable	DBC Uncertainty Log Response – Tania Smith (05/06/15)
			Office	8,600			
D02	Northern Gateway	N	Residential	387 dwellings		Reasonably foreseeable	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D03	Bluewater	N	Retail	30,500		Near certain	West Village Bluewater, Outline Planning Application, Dec 2012, 12/01464/OUT
D04	Northern Gateway East and Mill Pond	N	Residential	1,050 dwellings		Near certain	DBC Uncertainly Log Response – Tania Smith (05/06/15)
			Retail	1,500			
			Business Park	2,500			
			Industrial	23,000			
D05	Additional Employment	N	Industrial	5,000		Reasonably foreseeable	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D06	Additional Housing	N	Residential	1,590 dwellings		Reasonably foreseeable	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D07	The Bridge	N	Residential	1,500 dwellings	580 dwellings	Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)
			Business Park	91,000	93,250 m^2		
D08	Ebbsfleet – Station Quarter North	Y	Residential	930 dwellings		Near certain	Sonia Bunn: Ebbsfleet Land-Use Quantums – Confirmation (24/06.15)
			Retail	2,500			DBC Uncertainty Log Response – Tania Smith (05/06/15)
			Office	200,000			
			Core Uses (Avg of Retail, Hotel and Leisure)	53,500			
D09	Ebbsfleet – Station Quarter South	Y	Office	93,000		Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)
			Core Uses (Avg of Retail, Hotel and Leisure)	22,000			
			Residential	1,390 dwellings			
D10	Eastern Quarry	Y	Office	120,000		Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)
			Retail	26,000			
			Leisure	50,000			
			Residential	6,250 dwellings			
			Hotel	11,000			
			Leisure	24,000			
D11	Northfleet Substation	Y	Residential	950 dwellings		Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)
			Hotel	5,000			
			Retail	2,500			
			Leisure	4,000			

Map Ref	Development	EDC	Land Use	Total Size	Completed	Uncertainty	Source Document
D12	St James Lane Pit	N	Residential	850 weellings		More than likely	Dartford Cumulative Development Information for HE – Sep 2014, 05/00221/OUT
D14	King Edward Ave	N	Residential	69 dwellings		Near certain	DBC – Major schemes at the planning/development stage – Sept 2013, 12/01151/REM
D15	St Clements Valley Stage 1	N	Residential	187 Dwellings		Near certain	Dartford Cumulative Development Information for HE – Sep 2014, 12/01404/FUL
D16	Stone	N	Residential	530 dwellings	156 dwellings	Reasonably foreseeable	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D17	Crossways	N	Industrial	102,000	177,550m^2	Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D18	Darenth Road	N	Residential	147 dwellings		Near certain	Dartford Cumulative Development Information for HE – Sep 2014, 10/00770/OUT
D19	Arjo Wiggins (North)	N	Residential	278 dwellings		More than likely	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D20	Craylands Ln	Y	Residential	110 dwellings		Near certain	Dartford Cumulative Development Information for HE – Sep 2014, 11/00778/OUT
D21	Lowfield St	N	Residential Retail	107 dwellings 4,700		More than likely	Dartford Cumulative Development Information for HE – Sep 2014,
D22	Littlebrook Power Station	N	Distribution	43,400	22,050m^2	Near certain	Dartford Cumulative Development Information for HE – Sep 2014, 10/01357/OUT
D23	Overy St	N	Residential	125 dwellings		Reasonably foreseeable	Dartford Cumulative Development Information for HE – Sep 2014,
D24	Thames Europort	N	Residential	805 dwellings		Reasonably foreseeable	Dartford Cumulative Development Information for HE – Sep 2014,
D25	Swanscombe Peninsula	Y	Residential Industrial	800 dwellings 2,300		More than likely	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D26	NG East (RBT)	N	Residential	325 dwellings		Reasonably foreseeable	Dartford Cumulative Development Information for HE – Sep 2014,
D27	The Tank, London Rd	N	Residential	200 dwellings		Reasonably foreseeable	Dartford Cumulative Development Information for HE – Sep 2014,
D28	Phase 4 Waterfront	N	Residential	367 dwellings	200 dwellings	Near certain	Dartford Cumulative Development Information for HE – Sep 2014, 08/01601/FUL
D29	Questor Riverside	N	Residential	110 dwellings		Reasonably foreseeable	Dartford Cumulative Development Information for HE – Sep 2014,
D30	St Clements Valley Stage 2	N	Residential	159 dwellings		More than likely	Dartford Cumulative Development Information for HE – Sep 2014, 14/01344/FUL
D31	Knockhall Road	N	Residential	63 dwellings		Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)

Map Ref	Development	EDC	Land Use	Total Size	Completed	Uncertainty	Source Document
D32	Coleridge Road/Shaftesbury Lane	N	Residential	51 dwellings		Near certain	DBC Uncertainty Log Response – Tania Smith (05/06/15)
D33	Powder Mill Lane	N	Residential	57 dwellings		More than likely	DBC Uncertainty Log Response – Tania Smith (05/06/15)

Table 11 - A2 Bean and Ebbsfleet Uncertainty Log - Gravesham Borough Council

Map Ref.	Development	EDC	Land Use	Total Size	Uncertainty	Source Document
G01	Northfleet Embankment: Grove Road	Y	Residential	200 dwellings	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G02	Northfleet Embankment: Old Northfleet residential Extension	Y	Residential	530 dwellings	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G03	Northfleet Embankment: Former Cement Works	Y	Business Park	46,000	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G04	Northfleet Embankment: East	Y	Industrial Residential	87,550 250 dwellings	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G05	Canal Basin	N	Retail Industrial Residential	1,850 4,650 650 dwellings	Reasonably foreseeable	Gravesham Local Plan Core Strategy, Adopted September 2014
G06	North East Gravesend	N	Industrial Residential	17,570 130 dwellings	Reasonably foreseeable	Gravesham Local Plan Core Strategy, Adopted September 2014
G07	Gravesend Town Centre: Heritage Quarter	N	Retail Office Residential	10,500 300 330 dwellings	Reasonably foreseeable	Gravesham Local Plan Core Strategy, Adopted September 2014
G08a	Ebbsfleet: Northfleet Rise Quarter	Y	Office Retail	15,000 2,060	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G08b	Ebbsfleet: Northfleet Rise Quarter-Post GBC Core Strategy	N	Office Residential	105,000 164 dwellings	More than likely	GBC Uncertainty Log Response - Tony Chadwick (10/06/15)
G09	Ebbsfleet: Springhead Quarter	N	Office Retail Residential^	5,000 750 690	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G10	Rest of Northfleet Embankment	Y	Residential	50 dwellings	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G11	Rest of Gravesend Town Centre	N	Office Residential	5,370 560 dwellings	Reasonably foreseeable	Gravesham Local Plan Core Strategy, Adopted September 2014
G12	Land at Coldharbour Rd	N	Office Residential	105,000 164 dwellings	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G13	Other sites known - Urban	N	Residential Industrial	500 dwellings 5,050	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G14	Other sites known - Rural	N	Residential	850 dwellings	More than likely	Gravesham Local Plan Core Strategy, Adopted September 2014
G15	Unallocated	N	Residential	60 dwellings	Reasonably foreseeable	Gravesham Local Plan Core Strategy, Adopted September 2014

4.5 Future Network Supply Assumptions

4.5.1 The development of the improvement schemes for the A2 Bean and Ebbsfleet junctions will be influenced by the investment in road schemes throughout the modelled period.

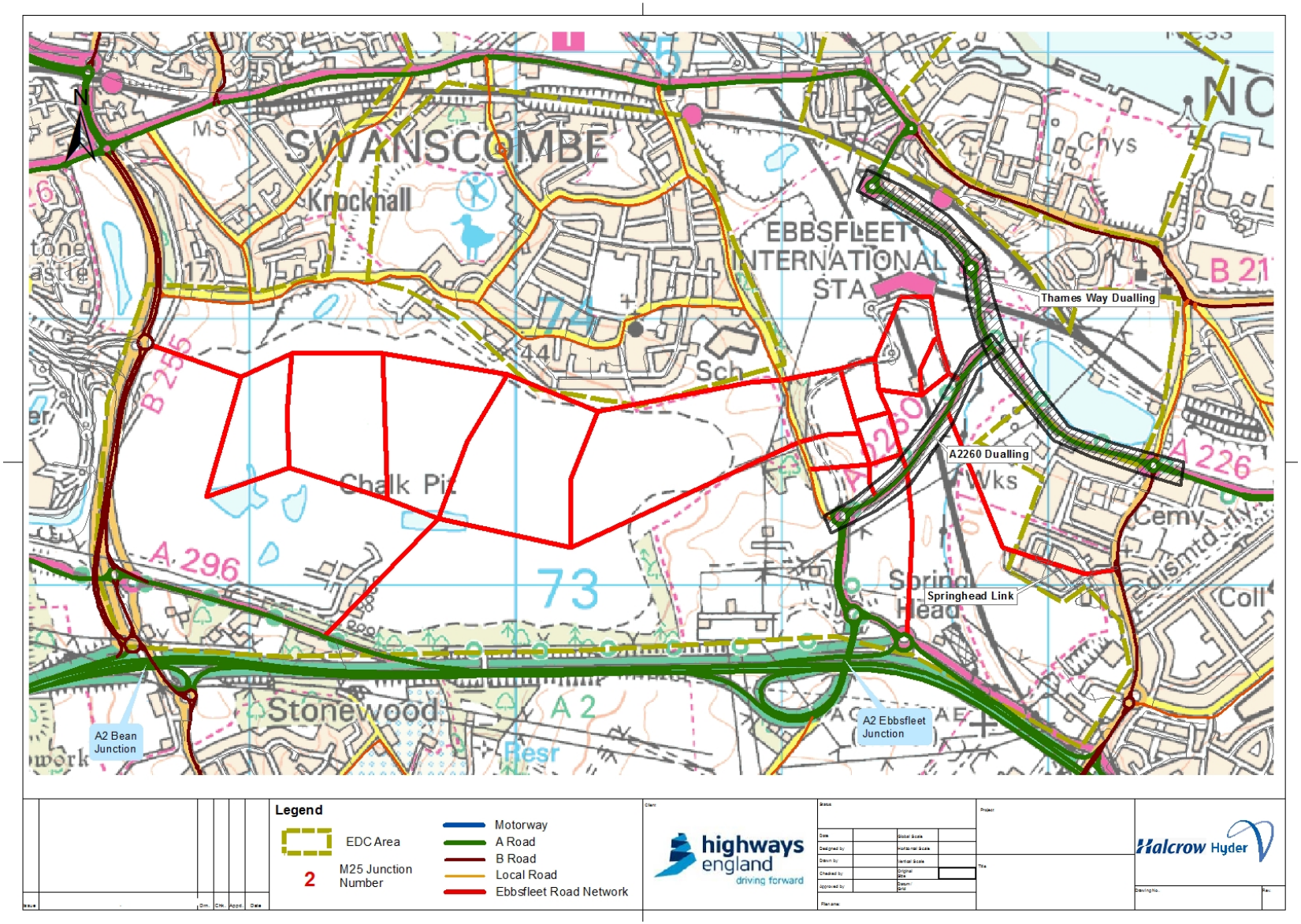
4.5.2 The committed highway improvement schemes are a mix of local, strategic and developer planned network upgrades as shown in Table 12. Figure 14 shows the planned highway improvement schemes in the A2BE area. There are no planned improvements connecting the local supply (serving the local developments) with Highways England Strategic Road Network

at A2 Bean or Ebbsfleet Junctions.

Table 12 - Stage 1 A2BE Forecast Highway Improvement Schemes

Core Scenario	Scheme	Status	Completion
Without Scheme	A127 Junction Improvements/Basildon Enterprise Corridor	Complete	2012
	A130/A13 Sadlers Farm	Complete	2012
	A13/A1014 (The Manorway) Junction Improvements	Complete	2013
	A2 Pepperhill Junction Improvement	Complete	2012
	A21 Tonbridge to Pembury Dualling	Start April 2015	Summer 2017
	A226 / B255 London Road / St. Clements Way Junction Improvements	Proposed	By 2025
	A226 Dartford Town Centre Ring Road Improvements	Complete	2011
	A226 Thames Way Dualling	Proposed	By 2025
	A2260/B259 Upgrade	Developer	By 2025
	A2260/B255/A296 Eastern Quarry Access	Developer	By 2025
	A2260/B259 Northfleet Substation Access	Developer	By 2025
	A2260/B259 Station Quarter North Access	Developer	By 2025
	A2 Ebbsfleet Junction East Gyratory/Station Quarter South Access Road	Developer	By 2025
	A23 Handcross to Warninglid	Start October 2011	2014
	A24 Horsham to Capel	Unknown	By 2025
	A289 Medway Tunnel - Four Elms Junction Improvements	Proposed	By 2025
	A3 Hindhead	Complete	2011
	A4010 Chapel Lane Junction Improvements	Complete	2014
	A414 Hastingwood Road	Complete	2011
	A421 Bedford to M1 J13	Complete	2010
	A428 Bedford Western Bypass (The Great Ouse Way)	Start Autumn 2014	2016
	A5 - M1 Dunstable Bypass	Start 2014/2015	June 2017
	A503 Finsbury Park	Under Construction	By 2025
	A505 Luton East Corridor Dualling	Complete	2009
	Canning Town Roundabout change to signals	Complete	2010
	Dartford-Thurrock River Crossing Free-flow Charging	Start April 2014	2016
	Dartford Traffic Management Cell	Start April 2014	2016
	Gravesend Transport Quarter Phase 3 - Rathmore Road Link	Proposed	By 2025
	Kender Street and Besson Street A2/A202 Sydenham Road Area Based Scheme A212	Unknown	By 2025
	Lower Thames Crossing "Option C" Route 3 Eastern Southern Link	Proposed	By 2025
	M1 J10-13 Hard Shoulder Widening	Complete	2012
	M20 J10a Improvements	Proposed	By 2025
	M20 J3 - 5 Hard Shoulder Running	Proposed	2018
	M23 J8 - 10 Hard Shoulder Running	Proposed	2019
	M25 J16 - 23 Widening	Complete	2012
	M25 J23 - J27 Widening	Complete	2014
	M25 J27 - 30/31 Widening	Complete	2012
	M25 J30	2015	By 2025
	M25 J5 - 6/7 Hard Shoulder Running	Complete	2014
	M3 J2 - 4A Hard Shoulder Running	Start February 2015	June 2017
	M4 J3 -12 Hard Shoulder Running	Start March 2017	March 2022
	West Thurrock Regeneration	Unknown	By 2025
	Springhead Link	Developer	By 2025
With Scheme	In addition to the Without Scheme Capacity enhancements described above:		
	A2 Bean and Ebbsfleet Junction Improvements	Proposed	2023

Figure 14 - Forecast Network Improvements in A2 Bean and Ebbsfleet area



5 Planning Factors

This section will focus on the environmental and physical constraints associated with the two junction locations. These are outlined below and shown on drawings HA543917-HHJV-HGN-XXXX-DR-D-0051 to 0054 in Volume 2.

5.1 Land Constraints

5.1.1 The residential properties at Ightham Cottages and Hope Cottages located next to the Bean Junction form constraints to the design of the options. Some of the options involve loss of some of the cottages while access would need to be retained to cottages that are not directly affected. The residential properties and commercial properties along the A296 Roman Road and within the Bean Triangle area also form a constraint. Springhead Nursery, located to the north east of the Ebbsfleet Junction is a constraint to the development of the options at this junction. Options for the Ebbsfleet Junction have been constrained by the need to maintain direct access to developments for Ebbsfleet Green and the Station Quarter South from the Ebbsfleet Junction.

5.2 Environmental Constraints

5.2.1 The key issues regarding the environmental constraints are highlighted below:

- Air Quality Management Areas (AQMAs), including Dartford AQMA No.3 encompassing the Bean Junction between the A2 and A296 (refer to Section 11.2). Detailed air quality assessments will be required for the scheme to ensure that effects on sensitive receptors, both human and ecological, are understood in accordance with best practice guidance.
- DEFRA Noise Important Areas (NIAs), including three NIAs (DEFRA NIA ref. 5959; 6265; 5960) along the A2 between Bean Junction and Ebbsfleet Junction (refer to Section 12.2). Detailed noise and vibration assessments will be required for the scheme to ensure that effects on sensitive receptors are understood in accordance with best practice guidance. There may be a requirement for noise mitigation such as acoustic barriers.
- There are potential impacts on Darenth Wood: including Darenth Wood SSSI, Darenth Wood ancient woodland and Darenth Wood Scheduled Monument located immediately to the west of the A2 Bean Junction. There are also potential impacts on other areas of ancient woodland, located approximately 0.5km to the east of Bean Junction.
- Swanscombe footbridge located approximately 1km to the east of the Bean Junction, and crossing the A2, is a Grade 2 listed structure. The options have been developed to retain this structure through the realignment of the A296 and use of narrow lanes on the A2 mainline.
- Bean Junction, and land to the south of the A2 and Ebbsfleet Junction, lies within the Green Belt.
- Beacon Wood Country Park lies approximately 0.75km to the south of Bean Junction and Darenth Wood Country Park lies approximately 1.75km to the west of Bean Junction.
- A number of PRoW, footways and cycleways, pass in close proximity to both the Bean and Ebbsfleet Junctions. Public Right of Way (PRoW) DR19 would be directly affected by Bean Junction Option 4b. PRoW DR19 begins approximately 170 metres to the south of Bean Junction on Bean Lane, until it runs parallel directly adjacent to the A2, for approximately 240 metres.
- Archaeological sites in the vicinity include Darenth Wood Scheduled Monument, located immediately to the west of the A2 Bean Junction. There are also well documented archaeological sites in the vicinity of the Ebbsfleet Junction, including the Vagniacae (Springhead) roman site, a Scheduled Monument, located immediately to the south of the A2 Ebbsfleet Junction.
- Listed buildings potentially affected by the scheme include Lower Bean Farmhouse (Grade II listed) and Barn to the South East of Lower Bean Farmhouse (Grade II listed), located approximately 0.5km to the south of Bean Junction.
- The junctions are underlain by a principal aquifer and there are also SPZs (Source Protection Zones) present.
- The River Ebbsfleet is the only designated Main River within the scheme boundary.

5.3 Public Utilities

5.3.1 As outlined in Section 3.12 there are significant services located at both junctions which present constraints to scheme development. The main constraints include;

- High voltage overhead power lines at the Bean Junction with a pylon located in the middle of Ightham Cottages roundabout and a pylon immediately north of Hope Cottages roundabout. Two of the options at the Bean Junction involve the diversion of the overhead lines at the junction;
- National Grid Underground Transmission line which runs along the A296 Roman road and A2 to the Northfleet East sub-station site, and
- A high pressure gas main at the Bean Junction.

5.4 Existing Structures

5.4.1 There are several width and headroom constraints posed by existing structures on the mainline A2, which have an impact on the option layout design:

- Downs Farm Overbridge has a limited clear span to accommodate additional carriageway widening resulting in potential restriction on widening of the west facing slip roads at the Bean Junction;
- Bean Road Overbridge has limited width to accommodate additional traffic lanes to improve capacity at the junction. All the options considered at the Bean Junction involved either widening the existing structure or provision of new bridge crossing;
- Swanscombe Footbridge has limited head room resulting in potential restriction on widening of the east facing slip road at the Bean Junction and widening of the A2 mainline, and
- The options at Ebbsfleet have been developed to attempt to avoid any impact on the existing structures at Pepperhill including Pepperhill Link Road gabion wall and Pepperhill Link Road soil nail wall. This includes relocating the merge nosing for the eastbound on slip at the Ebbsfleet Junction to provide the widened slip road and merge before the structures.

6 Description of Junction Options

6.1 General

6.1.1 This section explains the approach taken in developing technically feasible junction improvement options to be considered for assessment. The first step of this work was to confirm whether the previous layout options developed by AECOM (formerly Faber Maunsell) would still meet key stakeholder requirements.

Bean – long list of options

6.1.2 AECOM's proposed improvements at the Bean Junction would enlarge and signalise the two A2/B255 roundabout junctions. The proposals at the A296/B255 junction were to enlarge and signalise the existing roundabout or convert it to a signalised crossroads.

6.1.3 Two options at Bean were considered:

- Option 1a without widening of the existing Bean Road Overbridge, and
- Option 1b with widening of the Bean Road Overbridge.

Ebbsfleet – long list of options

6.1.4 The proposed improvements at the Ebbsfleet Junction would enlarge and signalise the two A2/B259 roundabouts, upgrade the connecting roundabout link to dual carriageway with two lanes provided in each direction, realign the Hall Road link and widen the westbound and eastbound merges.

6.1.5 Two options at Ebbsfleet were considered:

- Option 1 included improvements to the westbound merge, and
- Option 2 didn't include the westbound merge improvements.

6.1.6 Details of these options are included in the AECOM 2008 report "KTS Preliminary Design of Bean and Ebbsfleet Junctions on the A2".

6.2 Concept Options

6.2.1 A workshop was held on the 24 July 2014 with key stakeholders at which it was agreed that the Client Scheme Requirements for the Project should be expanded to ensure that a wider range of options were considered for the improvements. As a result, high level alternative junction arrangements were developed for both junctions. These are described in Table 13 and illustrated on drawings HA543917-HHJV-HGN-XXXX-DR-D-0147 to 0154 in Volume 2.

6.2.2 The high level concept options were presented to key stakeholders at a workshop held on 26 March 2015. At the workshop it was identified that layouts based on Bean Option 4 would not be acceptable as they would not provide for connection between the A2 and the A296. Ebbsfleet Option 3 and 4 were rejected because they removed access to development areas as indicated in the current development masterplans and relocated access to within the development area while this would greatly simplify the traffic movements at the junction it would require modification to existing masterplans for the proposed developments and so would not meet the Client Scheme Requirements as agreed with key stakeholders.

Table 13 - High Level Concept Options

	Description
Bean Option 1	The proposed improvements would enlarge and signalise the two A2/B255 roundabout junctions and enlarge and signalise, or convert to a signalised crossroads, the A296/B255 roundabout. Widening of Bean Lane Bridge might be required. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0147.
Bean Option 2	As Option 1 but with provision of a new bridge over the A2 west of Hope Cottages and link road between the two roundabouts. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0148.
Bean Option 3	Design and reconstruction of the junction as a standard "two bridge roundabout" solution. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0149.

	Description
Bean Option 4	Redesign of the junction as a free flow layout between the A2 and the B255. Access between the A2 and A296 would be via the B255. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0150. Rejected because it did not provide connections to the A296 and Bean Lane.
Ebbsfleet Option 1	Enlarge and signalise the A2/B259 roundabouts and dual the link between. Realign the Hall Road link and widen the westbound and eastbound merges. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0151.
Ebbsfleet Option 2	As Option 1 but the two roundabouts forming the junction are combined into a single large gyratory with a through-about link for the link to A2 westbound. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0152.
Ebbsfleet Option 3	Redesign of the junction with the east roundabout removed and the eastbound and westbound slip roads accessed from a single roundabout. Proposed development accesses are relocated away from the A2 junction to new access arrangements to the B259. A single large gyratory is shown. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0153. Rejected because it did not provide connections to the development areas as indicated in the development masterplans and as such would not meet the Client Scheme Requirements.
Ebbsfleet Option 4	Redesign of the junction as a free flow layout by relocating the eastbound off-slip. Proposed development accesses are relocated away from the A2 junction to new access arrangements to the B259. A single large gyratory is shown. See drawing HA543917-HHJV-HGN-XXXX-DR-D-0154. Rejected because it did not provide connections to the development areas as indicated in the development masterplans and as such would not meet the Client Scheme Requirements.

Note: All drawings referenced are contained in Volume 2.

6.3 Long List Options

6.3.1 For each of the remaining high level junction options a number of layouts were developed to accommodate initial forecast 2041 traffic flows and taking into account topography and environmental and physical constraints at the junctions.

6.3.2 The original AECOM options (Bean Option 1a and 1b) were found not to accommodate the forecast traffic flows and an alternative layout was developed (Bean Option 1c). Other layout options were identified as not feasible based on traffic operational assessment and so were not developed (Bean Option 2c). Variations to the high level concept Bean Option 4 were developed that retained connection to the A296 but provided modified slip road layouts on the Bean Eastbound carriageway. Further refinement at the Bean Junction led to the development of Bean Option 5 involving the provision of a new bridge crossing to the east of the existing Bean Road Overbridge.

6.3.3 Ebbsfleet Option 2 was rejected during the development of the long list options as traffic modelling showed that the junction could not be made to operate due to the relatively high forecast traffic movements between the A2 eastbound carriageway to the Pepperhill Link road having pass through the whole of the gyratory resulting in greater conflict with other traffic movements compared to Ebbsfleet Option 1.

6.3.4 The resulting option layouts are outlined in Table 14 and shown in Drawings HA543917-HHJV-HGN-XXXX-DR-D-0009 to HA543917-HHJV-HGN-XXXX-DR-D-0015 in Volume 2.

Table 14 - Long List Options

Option Name	Key features
Bean Junction – Option 1c HA543917-HHJV-HGN-XXXX-DR-D-0009	Retain “dumbbell” junction layout Enlarge and signalise existing roundabouts by Hope and Ightham Cottages

Option Name	Key features
	Widen existing Bean Lane Bridge to 3 lanes N/B and 2 lanes S/B Provide temporary bailey bridge crossing of A2 for N/B traffic to enable widening of Bean Lane bridge Provide three lane exit on B255 N/B Convert A296/Bean Lane roundabout to signalised junction Widen A296 to 2 lanes eastbound and 1 lane westbound plus junction access to Eastern Quarry development. Realign A296 eastbound on-slip merge onto A2 before Swanscombe footbridge (retained) This option was rejected as to enable the existing Bean Road Overbridge to be widened a temporary bridge crossing would be required to accommodate traffic diverted from the existing bridge. This would be located west of Hope Cottages requiring a temporary access road. To enable the bailey bridge to be constructed the existing Ightam Cottages roundabout would need to be modified to provide sufficient space for construction. The temporary road layout would not have sufficient capacity to accommodate traffic flows resulting in unacceptable levels of congestion during construction.
Bean Junction – Option 2a HA543917-HHJV-HGN-XXXX-DR-D-0010	Retain “dumbbell” junction layout but construct in new location to the west. Construct new permanent bridge crossing of A2 to west of existing structure providing 3 lanes N/B and 2 lanes S/B. Provide new north/south connection to west of Hope Cottages with new terminal roundabouts and slip roads to A2 Retaining existing bridge for local/NMU use Potential need to divert existing 133KV electricity pylons to accommodate new junction Provide three lane exit on B255 N/B Convert A296/Bean Lane roundabout to signalised junction Widen A296 to 2 lanes eastbound and 1 lane westbound plus junction access to Eastern Quarry development. Realign A296 eastbound on-slip merge onto A2 before Swanscombe footbridge (retained) This option was rejected in favour of Option 4b
Bean Junction – Option 3a HA543917-HHJV-HGN-XXXX-DR-D-0011	Twin-bridge signal controlled gyratory junction. Construct new permanent bridge crossing of A2 to west of existing structure providing 3 lanes N/B Retaining existing Bean Lane bridge for S/B traffic. Partial demolition of Hope Cottages. Divert existing 133KV electricity pylons to accommodate new junction Reconnect gyratory roundabout with new slip roads to A2 and connection to Bean village Provide three lane exit on B255 N/B Convert A296/Bean Lane roundabout to signalised junction Widen A296 to 2 lanes eastbound and 1 lane westbound plus junction access to Eastern Quarry development.

Option Name	Key features
	Realign A296 eastbound on-slip merge onto A2 before Swanscombe footbridge (retained)
Bean Junction – Option 4a HA543917-HHJV-HGN-XXXX-DR-D-0012	Retain “dumbbell” junction layout but construct in new location to west with double eastbound diverge off-slip. Construct new permanent bridge crossing of A2 to west of existing structure providing 3 lanes N/B and 2 lanes S/B. Provide new north/south connection to west of Hope Cottages with new terminal roundabouts and slip roads to A2 Retaining existing bridge for local/NMU use Construct double diverge off A2 eastbound to separate traffic flows to B255 N/B from other movements Widen B255 N/B to 3 lanes from Bean junction to Bluewater Divert existing 133KV electricity pylons to accommodate new junction Convert A296/Bean Lane roundabout to signalised junction Widen A296 to 2 lanes eastbound and 1 lane westbound plus junction access to Eastern Quarry development. Realign A296 eastbound on-slip merge onto A2 before Swanscombe footbridge (retained) This option was rejected as widening of the B255 north of the existing bridge over the A296 was considered beyond the scope of the project.
Bean Junction – Option 4b HA543917-HHJV-HGN-XXXX-DR-D-0013	Retain “dumbbell” junction layout but construct in new location to west with double eastbound merge slip road. Construct new permanent bridge crossing of A2 to west of existing structure providing 3 lanes N/B and 2 lanes S/B. Provide new north/south connection to west of Hope Cottages with new terminal roundabouts and slip roads to A2 Retaining existing bridge for local/NMU use Construct new A2 eastbound on-slip off the north roundabout adjacent to Ightham Cottages. Widen A2 eastbound carriageway to 4 lanes from new slip road to Swanscombe footbridge Potential need to divert existing 133KV electricity pylons to accommodate new junction Provide three lane exit on B255 N/B Convert A296/Bean Lane roundabout to signalised junction and provide Eastern Quarries junction (optional or developer works) Realign A296 eastbound on-slip merge onto A2 before Swanscombe footbridge (retained)
Bean Junction – Option 4c HA543917-HHJV-HGN-XXXX-DR-D-0014	Retain “dumbbell” junction layout but construct in new location to the west. As Bean Option 2a except widens the B255 to 3 lanes N/B from Bean junction to the Bluewater exit. This option was rejected as widening of the B255 north of the existing bridge over the A296 was considered beyond the scope of the project.
Bean Junction – Option 5	Retain two-roundabout junction layout

Option Name	Key features
	Enlarge and signalise existing roundabouts Widen link between roundabouts to dual two lane Provide access points to Ebbsfleet Green new development and Station Quarter South new development A2 westbound on-slip widened to two lanes A2 eastbound on-slip/Pepperhill link road reconfigured.
Ebbsfleet Option 1c HA543917-HHJV-HGN-XXXX-DR-D-0015	Retain two-roundabout junction layout Enlarge and signalise existing roundabouts Widen link between roundabouts to dual two lane Provide access points to Ebbsfleet Green new development and Station Quarter South new development A2 westbound on-slip widened to two lanes A2 eastbound on-slip/Pepperhill link road reconfigured.

Note: All drawings referenced are contained in Volume 2.

6.4 Short List Options

6.4.1 A preliminary appraisal of the long list layout options was undertaken and reviewed at a workshop on the 14 April 2016 with representatives of Highways England to confirm which layouts would be developed further for assessment. Layouts which involved widening of the B255 (Bean Option 4a and 4c) were considered outside of the scope of the project and so were not included in the assessment and not developed further. Bean Option 1c was rejected because the likely traffic management arrangements that would be required during construction to widen Bean Road OB would be too complex and would lead to unacceptable levels of congestion which would be unlikely to be supported by the Local Highway Authority.

6.4.2 Prior to the workshop Bean Option 5 was developed to overcome the buildability issues associated with the widening of the existing Bean Road OB required in Bean Option 1c. A new bridge crossing would be provided immediately to the east of the existing bridge. This would require widening of Ightham cottages roundabout to the east resulting in the demolition of the cottages. As a result of the demolition of the cottages sufficient space would be available to provide for a new eastbound on slip at the junction so this was also included in the Option 5 layout.

6.4.3 The rejected long list options were therefore:

- Bean Junction Option 1c;
- Bean Junction Option 2a;
- Bean Junction Option 4a, and
- Bean Junction Option 4c.

6.4.4 The resulting short list of options for assessment are:

- Bean Junction Option 3(a);
- Bean Junction Option 4(b);
- Bean Junction Option 5, and
- Ebbsfleet Junction Option 1.

6.4.5 Three options have been appraised for the Bean Junction in combination with one option at the Ebbsfleet Junction. The options are described in detail below and shown in drawings HA543917-HHJV-HGN-XXXX-DR-D-0129 to 0137 in Volume 2.

Bean Option 3 - HA543917-HHJV-HGN-XXXX-DR-D-0129-0131

6.4.6 This option replaces the existing double roundabout layout with a single large traffic signal controlled gyratory with two structures crossing the A2, the existing Bean Road Overbridge and a new bridge crossing located to the west. The existing Hope Cottages Roundabout, Ightham Cottages Roundabout, eastbound off-slip and westbound slip roads are stopped up.

6.4.7 The new gyratory is located immediately to the west of the existing junction and has full traffic signal control with three lanes on the circulatory carriageway, except on the southern section which has four lanes.

6.4.8 To connect the new gyratory with the westbound carriageway of the A2, new westbound slip roads are provided in the south west and south east quadrants of the junction in a conventional diamond layout. The westbound on-slip crosses the valley to the west of the existing junction on a high embankment and joins the A2 westbound carriageway with a ghost island merge layout at the existing Down Farm Overbridge. To widen the A2 at the new merge, Down Farm Overbridge is demolished and replaced with a new bridge with an increased span. The eastbound carriageway of the A2 is connected to the gyratory by a new slip road provided north of the existing on widened embankment. A dedicated left turn lane is provided between the eastbound off-slip and the B255 northbound carriageway. The existing arrangement with the eastbound on-slip provided at the junction via Bean Lane and the A296 Watling Street is retained.

6.4.9 A new single carriageway road, located to the west of Hope Cottages, would link the new gyratory to Bean Lane at a new junction south of Hope Cottages. The section of Bean Lane from this new junction and the existing Hope Cottages Roundabout would be stopped up.

6.4.10 The B255 is realigned at the gyratory and the northbound carriageway widened to provide three lanes at the exit from Ightham Cottages roundabout for up to 150m requiring the widening of the existing highway embankment. The widened carriageway tapers back down to tie into the existing two lanes before the existing bridge over the A296.

6.4.11 Bean Lane (north) is widened to two lanes northbound with one lane southbound with provision for right turning movements into the access road to Ightham Cottages and bus laybys to replace the existing bus stops.

6.4.12 The A296 / Bean Lane roundabout is replaced with a signal controlled junction and the A296 widened to two lanes eastbound with one lane retained westbound along is full length. A new traffic signal controlled junction to the Eastern Quarry development would be provided by the Eastern Quarry developers. This junction also provides access to a two way collector road that runs parallel to the A296 and provides access to properties located within the Bean Triangle. The collector road also provides for NMU access to Sandy Lane and the existing NMU crossing of the A2 at Sandy Lane underbridge.

6.4.13 The existing A296 eastbound on-slip is widened to provide two lanes at the merge with the A2 eastbound carriageway. The eastbound on-slip is also realigned from the access to Sandy Lane to enable the revised merge layout to be provided before Swanscombe Footbridge. The limited headroom at Swanscombe footbridge means that no further widening of the carriageway can be accommodated at the footbridge without replacement.

Bean Option 4b - HA543917-HHJV-HGN-XXXX-DR-D-0132-0134

6.4.14 This option provides a redesigned dumbbell arrangement at the existing junction comprising two new roundabouts located either side of the A2 and connected by a new dual carriageway link road located to the west of Hope Cottages. A new bridge crossing of the A2 is provided on the new link road and the existing Bean Road Overbridge is demolished. An additional slip road is provided from the north roundabout connecting the junction directly with the A2 eastbound carriageway. The existing connections with the B255, Bean Lane and the A296 (via Bean lane) are retained. The eastbound carriageway of the A2 is converted to four lanes by removing the existing hard shoulder and using narrow lanes from the end of the new slip road to the existing eastbound on-slip at the A296 which is retained but converted from a lane gain to a single auxiliary lane layout to merge with the existing four lanes east of the junction. Swanscombe footbridge is retained by continuing the narrow lanes through the structure.

6.4.15 The new roundabout on the south of the A2 is located to the south of the existing Hope Cottages. The roundabout retains a link to Bean Lane and provides access to Hope Cottages. The existing Hope Cottages roundabout and the section of Bean Lane from the existing Bean Road Overbridge to the new roundabout would be stopped up. New realigned slip roads link the new south roundabout with the A2 westbound carriageway in a similar layout to the existing slip roads.

6.4.16 The new roundabout on the north of the A2 is located to the north of the existing Ightham Cottages roundabout which is stopped up. The roundabout provides access to the A2 eastbound carriageway, the B255 and Bean Lane (north). The eastbound on-slip is realigned and a new on-slip is provided from the roundabout in the north east quadrant of the junction in a diamond layout passing through land owned by Dartford Borough Council and used as a horse sanctuary. A retaining wall would be

provided to avoid impact on the existing A2 drainage pond.

6.4.17 The B255 is realigned at the roundabout and the northbound carriageway widened to provide three lanes at the exit from Ightham Cottages roundabout for up to 150m requiring the widening of the existing highway embankment. The widened carriageway tapers back down to tie into the two lanes before the existing bridge over the A296. On the B255 southbound carriageway the slip road between the B255 and the A296 is closed. As a result traffic from the B255 travelling to the A2 eastbound carriageway and to the A296 uses Ightham Cottages roundabout rather than the A296/Bean Lane roundabout, which is converted to a three arm roundabout and the existing A296 layout is retained.

6.4.18 Bean Lane (north) is widened to two lanes northbound with one lane south bound with provision for right turning movements into the access road to Ightham Cottages and bus laybys to replace the existing bus stops.

Bean Option 5 - HA543917-HHJV-HGN-XXXX-DR-D-0135-0137

6.4.19 The option retains the existing junction layout but with the existing roundabouts enlarged and converted to full traffic signal control. A new bridge crossing of the A2 is provided immediately to the east of Bean Road Overbridge for southbound traffic. Bean Road Overbridge is retained for northbound traffic only. An additional slip road is provided from the Ightham Cottages roundabout connecting the junction directly with the A2 eastbound carriageway to serve traffic from the B255. The eastbound carriageway of the A2 is converted to four lanes by removing the existing hard shoulder and using narrow lanes from the end of the new slip road to the existing eastbound on-slip at the A296 which is retained but converted from a lane gain to a single auxiliary lane layout to merge with the existing four lanes east of the junction. Swanscombe footbridge is retained by continuing the narrow lanes through the structure.

6.4.20 Ightham Cottages roundabout is widened to the east to provide for the new southbound link to Hope Cottages roundabout, for the new eastbound on-slip and to accommodate full traffic signal control. This results in the demolition of all the cottages. The roundabout is converted to traffic signal control.

6.4.21 Hope Cottages roundabout is widened to the west to accommodate full traffic signal control. The westbound off-slip is widened to three lanes on the approach with all three lanes provided for the right turn movement to Bean Lane (link road). The existing dedicated left turn lane from Bean Lane to the westbound on-slip is removed.

6.4.22 On the B255 southbound carriageway the slip road between the B255 and the A296 is closed. As a result traffic from the B255 travelling to the A2 eastbound carriageway and to the A296 uses Ightham Cottages roundabout rather than the A296/Bean Lane roundabout, which is converted to a three arm roundabout and the existing A296 layout is retained.

Ebbsfleet Option 1

6.4.23 This option retains the existing junction layout but with the existing roundabouts enlarged to provide for full traffic signal control. Access is provided at the junction to the Station Quarter South and Ebbsfleet Green developments. The link road between the roundabouts is widened from the existing single carriageway to a dual two lane carriageway with additional widening to three lanes on the approach to the roundabouts. The existing eastbound and westbound off-slips are retained, with the westbound off-slip converted to two lanes along its full length with provision for a ghost island merge layout onto the A2 westbound carriageway. The eastbound on-slip is widened to two lanes with provision for a ghost island merge layout onto the A2 eastbound carriageway.

6.4.24 The east roundabout is extend to the north and an additional arm added to accommodate access to the Station Quarter South development. The eastbound on-slip is widened to two lanes and separated from the one way link road to the Pepper Hill Junction. The slip road is realigned from land forming part of the old service area to enable the existing merge to be moved west. This allows the widened carriageway to be provided before the constraint to widening caused by the existing Pepperhill Underbridge and soil nail retaining wall. The eastbound off-slip is widened at the approach to the roundabout with a dedicated signal controlled two lane left turn lane.

6.4.25 The west roundabout is extended to the south. The west arm at the roundabout will provide access to the Ebbsfleet Green development currently in construction. The circulatory carriageway is widened to provide for three lanes on the south circulatory carriageway with three lanes provided on the exit from the roundabout northbound on the A2260 for 150m before tapering back to tie into the existing 2 lanes.

Combining options at Bean and Ebbsfleet

6.4.26 In the following sections of this document proposed short list options at Bean junction are combined with proposed short list options at Ebbsfleet junction to form 'pairs' for the purposes of assessment.

6.4.27 The current strategy for the A2 junction improvements at A2 Bean and A2 Ebbsfleet Junctions is for both junctions to be open to the public within the same year. Accordingly, the appraisal of each of the considered options assumed a junction improvement also in place at the other junction. As only one scheme option at Ebbsfleet has been identified for public consultation, the assessment of the A2BE Junction Improvements Study therefore comprises the following combinations of options:

- Bean Junction Option 3 with Ebbsfleet Junction Option 1b (B03E01b);
- Bean Junction Option 4b with Ebbsfleet Junction Option 1b (B04bE01b), and
- Bean Junction Option 5 with Ebbsfleet Junction Option 1b (B05E01b).

These options are shown below in Figures 15 to 18.

Figure 15 - A2 Bean Option 3

Figure 16 - A2 Bean Option 4b

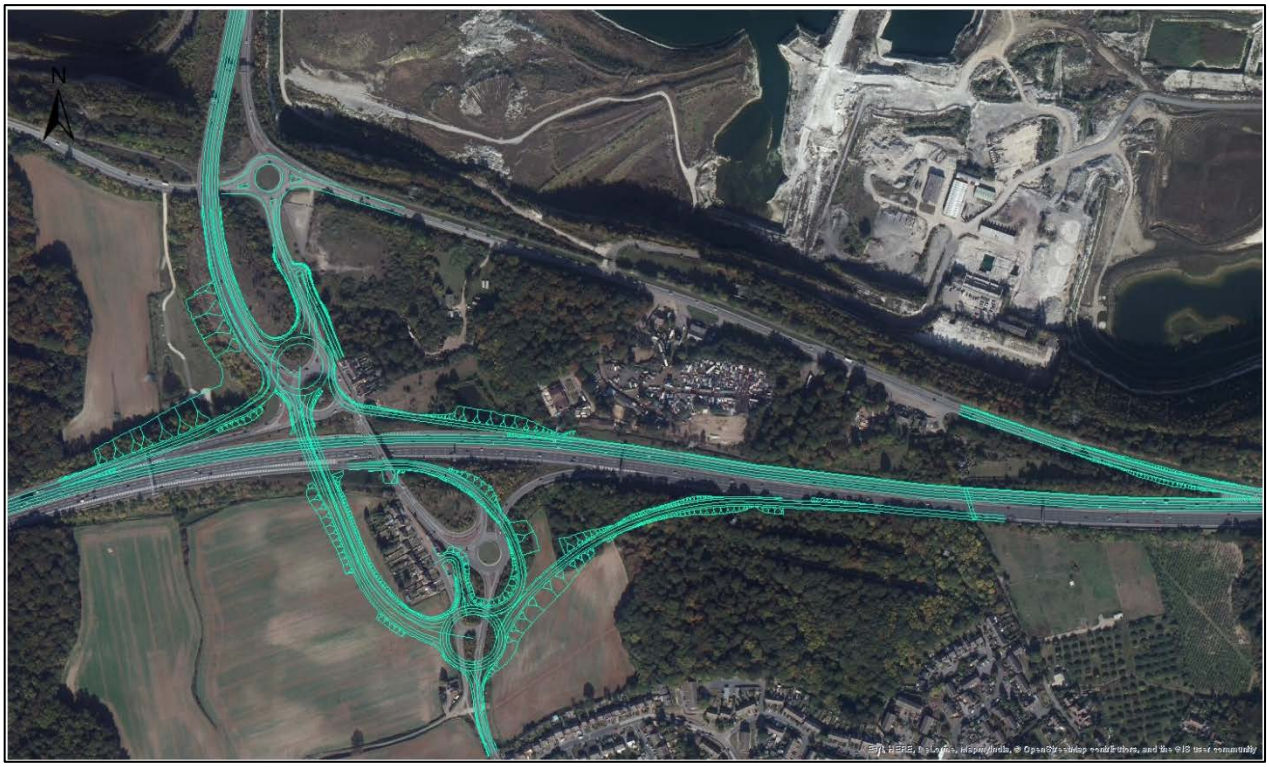
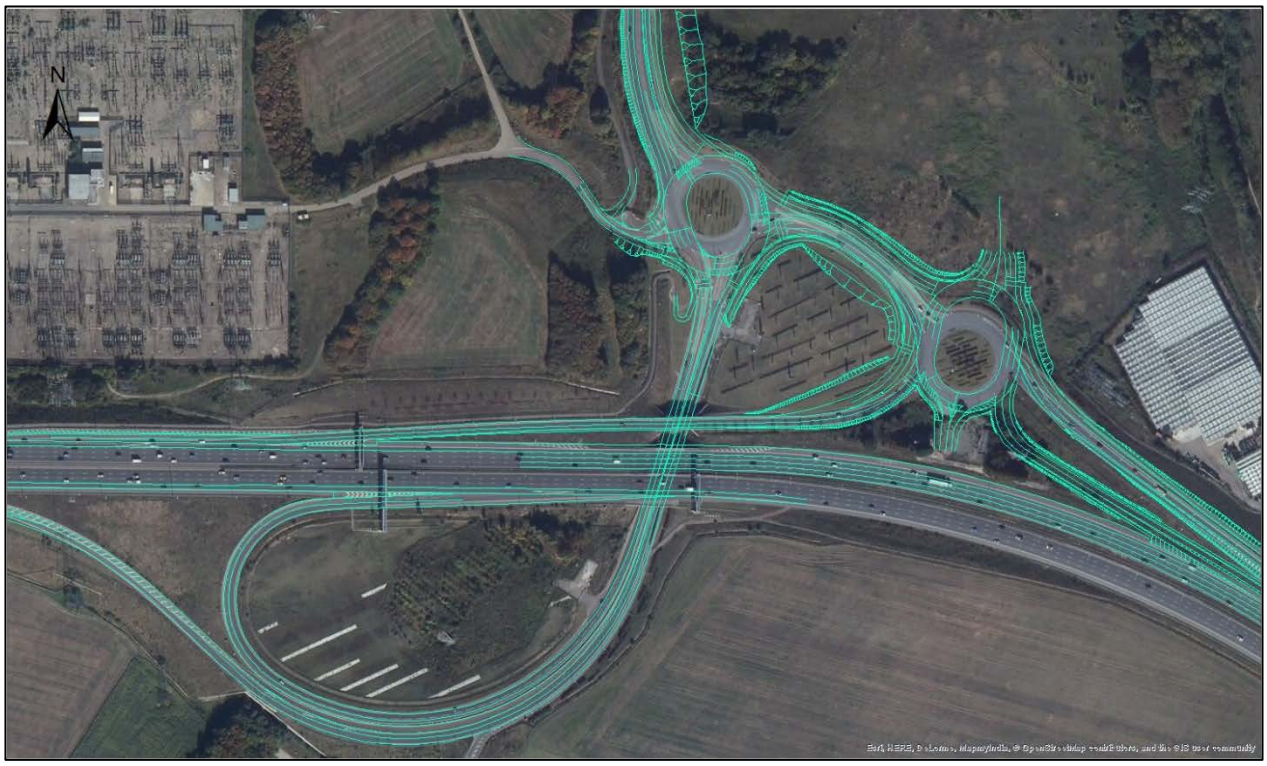


Figure 17 - A2 Bean Option 5

Figure 18 - A2 Ebbsfleet Option 1b



6.5 Drainage Assessment

Option Design Implications on Existing Drainage

6.5.1 There is existing drainage on all the roads cover by this scheme, and any changes to the road layout will have an impact on the existing drainage systems. In most cases this would involve the road side collection systems such as road gullies, but it could also impact on the conveyances systems, for example the carrier drains and chambers located on the road verge or in the case of the A2, the central reserve.

6.5.2 The drainage systems are designed in catchments with separate outfalls and discharge points. Many of the outfalls are located near Bean Junction, all of which are soakaways due to the lack of watercourses nearby. Impact on the existing outfalls could come from a direct impact from the revised road layout, but it could also be affected by the changing of the drainage networks discharging into them, such as an increase in the overall catchment area.

6.5.3 Ongoing design in subsequent stages would also review the existing drainage within the scheme and confirm its compliance with the current design standards, and it may be necessary to replace the existing assets or make improvements to the drainage systems.

6.5.4 The following summaries the design approach adopted in the proposed drainage design:

- **Retain the existing drainage system** – provided that they satisfy the required design capacity based on the revised layouts.
- **Retain the existing outfall arrangements** – the existing outfalls typically consist of pollution control facilities follow by a soakaway outfall. However, the existing assets would need to be replaced if they were found to be defective or they do not meet the current standards. This is particularly important as the scheme lies within sensitive aquafers (i.e. SPZ Zone 1 and Zone 2).
- **Replace existing soakaways** – new soakaways shall remain as close to the existing ones (being replaced) as possible. All new soakaways would need to be discussed and approved by the Environment Agency.
- **Design for buildability** – avoid new cross pipes and place new chambers and pipes outside the existing roads to allow offline construction as much as possible.
- **Provide flow attenuation** – required due to the additional flow resulting from the increased catchment areas. The design would seek to adopt SUDS (sustainable urban drainage systems) where possible to enhance the existing drainage.

- **Climate change** – all the proposed drainage would need to be designed with 20% additional capacity.

Tables 15 to 17 below provide an overview of what is proposed for the individual drainage catchments under each option:

Table 15 - Drainage Assessment - Option B03E01b

Catchment Reference	Impact existing?	Brief description of revised drainage proposal	Catchment area increased?	Flow attenuation	Pollution Control	Outfall	Extra land required?
C1	Yes	A2 E/B and W/B slip roads. New drainage on W/B off-slip connects to existing A2 mainline drainage.	Yes	Oversized pips on W/B off-slip	Replace	Retain	No
C2	Yes	A2 W/B slip roads. Connect to existing A2 mainline drainage.	No	Retain	Retain	Retain	No
C3	Yes	New linear drains at nosing. Connect to existing A2 mainline drainage.	No	Retain	Retain	Retain	No
C4	Yes	All drainage to be revised.	Slight	Enhance existing	New required	Retain	No
C5	Yes	A2 W/B slip roads. Ebbsfleet Junction roundabouts and new link road in-between. Connect to existing A2 mainline drainage.	Yes	Intermediate pond	Retain existing. Additional required	Retain	No
C5	Yes	A2 W/B slip roads. Ebbsfleet Junction roundabouts and new link road in-between. Connect to existing A2 mainline drainage.	Yes	Intermediate pond	Retain existing. Additional required	Retain	No
C6	Yes	A2260 within new layout. Connect to existing outlet pipe towards outfall.	Yes	Oversized pips on A2260 S/B	New required	Retain	No
C7	Yes	Most drainage to be revised.	Yes	Pond	Replace	Replace in new location	No
C8	Yes	All drainage to be revised.	Yes	Pond (C8+C9)	Replace	Replace in new location (C8+C9)	No
C9	Yes	Some drainage to be revised.	Yes	Pond (C8+C9)	Replace	Replace in new location (C8+C9)	No
C10	No	N/A	N/A	N/A	N/A	N/A	N/A
C11	Yes	Most drainage to be revised.	Yes	Pond	Replace	New	No
C12	No	N/A	N/A	N/A	N/A	N/A	N/A
C13	No	N/A	N/A	N/A	N/A	N/A	N/A
C14	No	N/A	N/A	N/A	N/A	N/A	N/A
C15	Yes	All drainage to be revised.	Yes	Linear SUDS feature	New required	Replace existing + New outfall at new location	No

Table 16 - Drainage Assessment - Option B04bE01b

Catchment Reference	Impact existing?	Brief description of revised drainage proposal	Catchment area increased?	Flow attenuation	Pollution Control	Outfall	Extra land required?
C1	Yes	A2 E/B off-slip. Connects from existing A2 mainline drainage.	Yes	Accommodate by existing pond	Replace	Retain	No

Catchment Reference	Impact existing?	Brief description of revised drainage proposal	Catchment area increased?	Flow attenuation	Pollution Control	Outfall	Extra land required?
C2	Yes	A2 W/B Slip connecting to existing A2 mainline drainage; A2 E/B verge; A2 E/B on-slip. Connects from existing A2 mainline drainage.	Yes	Revise existing pond	Replace	Revise existing + New outfall at new location	Yes
C3	Yes	A2 E/B verge. Connects from existing A2 mainline drainage.	Yes	Replace (oversized pipes or tank)	Replace	Relocate	Yes
C4	Yes	Some drainage to be revised.	Yes	Enhance existing	New required	Retain	No
C5	Yes	A2 W/B slip roads. Ebbsfleet Junction roundabouts and new link road in-between. Connect to existing A2 mainline drainage.	Yes	Intermediate pond	Retain existing. Additional required	Retain	No
C5	Yes	A2 W/B slip roads. Ebbsfleet Junction roundabouts and new link road in-between. Connect to existing A2 mainline drainage.	Yes	Intermediate pond	Retain existing. Additional required	Retain	No
C6	Yes	A2260 within new layout. Connect to existing outlet pipe towards outfall.	Yes	Oversized pips on A2260 S/B	New required	Retain	No
C7	Yes	All drainage to be revised.	Yes	Pond	Replace	Replace in new location	No
C8	Yes	All drainage to be revised.	Yes	Pond (C8+C9)	Replace	Replace in new location (C8+C9)	No
C9	Yes	Some drainage to be revised.	Yes	Pond (C8+C9)	Replace	Replace in new location (C8+C9)	No
C10	No	N/A	N/A	N/A	N/A	N/A	N/A
C11	Yes	Bean Lane. Some revision to the existing roundabout.	No	SUDS feature (pond)	Replace	Replace	No
C12	No	N/A	N/A	N/A	N/A	N/A	N/A
C13	Yes	B255 S/B (partial). B255 S/B off-slip. Connects to existing B255 drainage.	No	No change	Retain	Retain	No
C14	No	N/A	N/A	N/A	N/A	N/A	N/A
C15	No	N/A	N/A	N/A	N/A	N/A	N/A

Table 17 - Drainage Assessment - Option B05E01b

Catchment Reference	Impact existing?	Brief description of revised drainage proposal	Catchment area increased?	Flow attenuation	Pollution Control	Outfall	Extra land required?
C1	Yes	A2 E/B and W/B slip roads. Connects to existing A2 mainline drainage.	No	Retain	Retain	Retain	No
C2	Yes	A2 W/B slip roads connecting to existing A2 mainline drainage; A2 E/B verge; A2 E/B on-slip. Connects from existing A2 mainline drainage.	Yes	Revise existing pond	Replace	Revise	Yes
C3	Yes	A2 E/B verge. Connects from existing A2 mainline drainage.	Yes	Replace (oversized pipes or tank)	Replace	Relocate	Yes
C4	Yes	Some drainage to be revised.	Yes	Enhance existing	New required	Retain	No

Catchment Reference	Impact existing?	Brief description of revised drainage proposal	Catchment area increased?	Flow attenuation	Pollution Control	Outfall	Extra land required?
C5	Yes	A2 W/B slip roads. Ebbsfleet Junction roundabouts and new link road in-between. Connect to existing A2 mainline drainage.	Yes	Intermediate pond	Retain existing. Additional required	Retain	No
C5	Yes	A2 W/B slip roads. Ebbsfleet Junction roundabouts and new link road in-between. Connect to existing A2 mainline drainage.	Yes	Intermediate pond	Retain existing. Additional required	Retain	No
C6	Yes	A2260 within new layout. Connect to existing outlet pipe towards outfall.	Yes	Oversized pips on A2260 S/B	New required	Retain	No
C7	Yes	Most drainage to be revised.	Yes	Pond	Replace	Replace	No
C8	Yes	Most drainage to be revised.	Yes	Pond (C8+C9)	Replace	Replace in new location (C8+C9)	No
C9	Yes	Some drainage to be revised.	No	Pond (C8+C9)	Replace	Replace in new location (C8+C9)	No
C10	No	N/A	N/A	N/A	N/A	N/A	N/A
C11	Yes	Bean Lane. Some revision to the existing roundabout.	No	SUDS feature (pond)	Replace	Replace	No
C12	No	N/A	N/A	N/A	N/A	N/A	N/A
C13	Yes	B255 S/B (partial). B255 S/B off-slip. Connects to existing B255 drainage.	No	No change	Retain	Retain	No
C14	No	N/A	N/A	N/A	N/A	N/A	N/A
C15	No	N/A	N/A	N/A	N/A	N/A	N/A

6.6 Range estimates for shortlisted options

6.6.1 Options Estimates were prepared by Highways England in June 2016. The costs for the various Options are summarised below in Table 18. The base year for the estimates was January 2014.

Table 18 - Options Estimates

	Ebbsfleet Option 1		
	Bean Option 3b	Bean Option 4	Bean Option 5
Cost*	£145m	£143m	£124m

*The costs provided are the 'most likely estimates'.

7 Traffic Analysis

7.1 Traffic Data

7.1.1 A number of datasets were collected for the purpose of refining the Lower Thames Crossing Model (2009 Base Year) in the A2 Bean and Ebbsfleet area. These include:

- Automatic Traffic Counts (ATCs) from both permanent and temporary counters;
- Manual Classified Counts (MCCs) for junctions and links;
- Manual Classified Turning Counts (MCTCs);
- TrafficMaster data for routes through the model area;
- ANPR data; and
- Network Inventory Posted Speed Data.

7.1.2 A full explanation and presentation of the collected data is contained within the Traffic Data Collection Report (TDCR) and associated appendices (report reference 0001-UA007244-UT22R-06). The remainder of this section contains an outline of the data sources used.

7.1.3 Bi-directional ATCs were undertaken for a continuous two week period in June and July 2014 (commencing at 00:00 hours) and (terminating at 24:00 hours). The data provides vehicle counts for each 15 minute period. Where count sites lie on the trunk road network, data from permanent traffic counters contained within the Highways England TRADS database was used where available.

7.1.4 Manual classified link counts were carried out over a twelve hour weekday period (7am – 7pm) at the ATC sites in order to provide classification into the following vehicle categories:

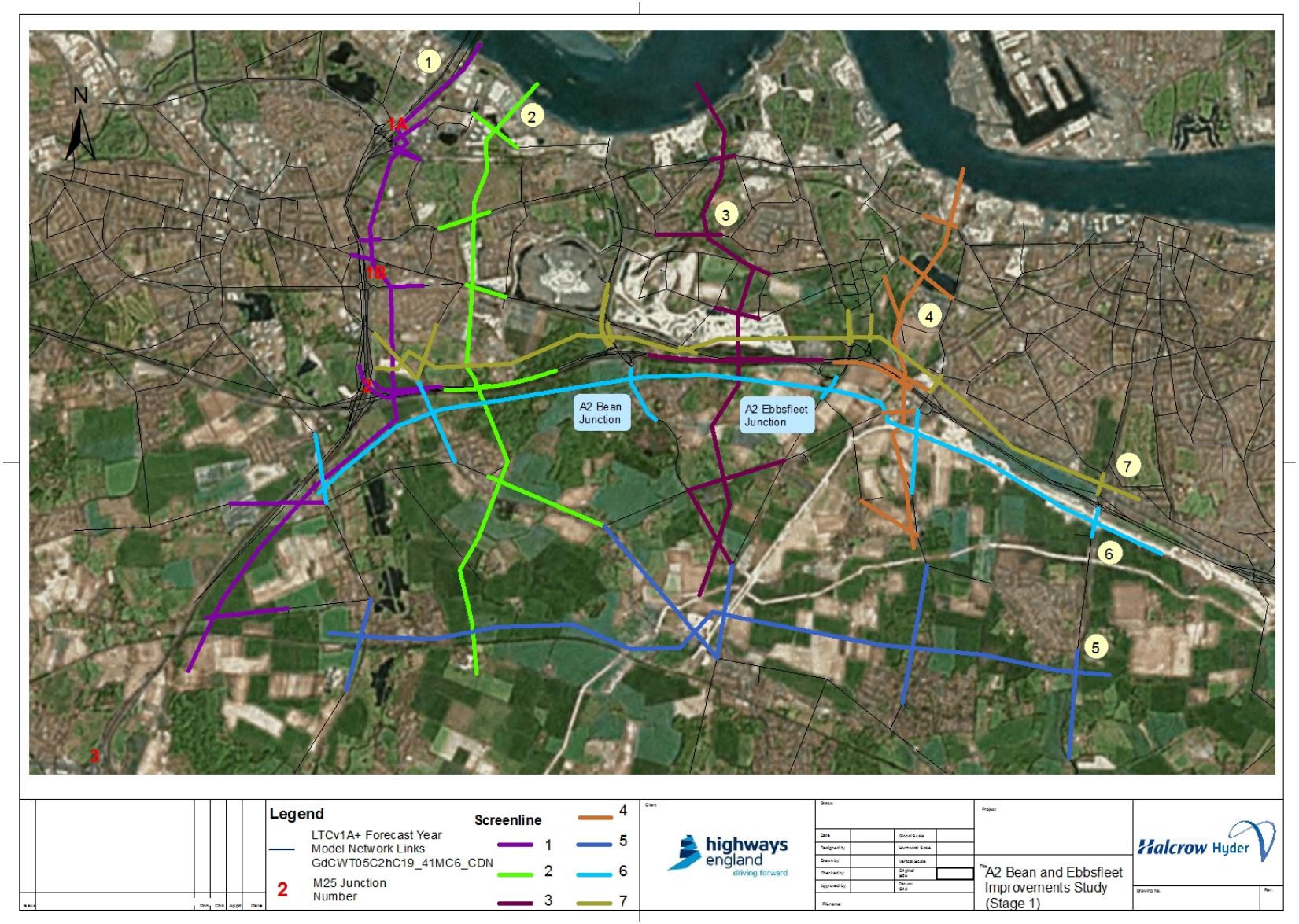
- Pedal Cycles;
- Motorcycles;
- Cars and Taxis;
- LGV (light goods vehicles i.e. delivery vans excluding vehicles with twin rear tyres);
- OGV1 (heavy goods vehicles with two axles with twin tyres, three axles (rigid), tractors, ambulances and road rollers;
- OGV2 (heavy goods vehicles with three axles (articulated), four axles or more (rigid or articulated); and
- Buses and Coaches, including non-PSV mini-buses and transit-type crew buses.

7.1.5 The data was collected by video camera with subsequent office transcription. The Without Scheme A2 Bean and Ebbsfleet forecast network and traffic screenline locations are shown in Figure 19.

7.1.6 The structure of the network was based on the Integrated Transport Network (ITN) layer. The ITN layer is produced by the Ordnance Survey (Great Britain's National mapping agency) and it is a map of Great Britain's road network. This mapping was used in the network development of the SATURN highway model for initial digitising of the location of junctions.

7.1.7 The geometry of the junctions and junction type were based on online aerial photography and an inventory of posted speed and local speed data was collected on site.

Figure 19 - A2 Bean and Ebbsfleet Screenline Locations



7.2 Traffic Analysis

7.2.1 Traffic Forecasts for the A2 Bean and Ebbsfleet Junction Improvements have been prepared using a traffic model developed for the Product Control Framework (PCF) Stage 1 based on an updated version of the Lower Thames Crossing Model comprising of a variable demand model and a SATURN based highway assignment model.

7.2.2 Highway demand matrices were derived for three weekday time periods. Traffic count data that was reported and analysed in the Traffic Data Collection Report, showed that the appropriate modelled peak periods were as follows:

- AM Peak (08:00 – 09:00);
- Inter Peak (average hour from 10:00 – 16:00); and
- PM Peak (17:00 – 18:00)

7.2.3 A Local Model Validation Report (LMVR) was produced to demonstrate that the base year traffic model satisfactorily reproduces an existing, independently observed, situation. The LMVR (0002-UA007244-UT22R-03 Stage 1 A2 Bean and Ebbsfleet Local Model Validation Report) provides a summary of the accuracy of the base from which the forecasts were prepared. The report provides evidence that the model is satisfactory for using for PCF Stage 1 forecasting, scheme assessment and public consultation.

7.2.4 The traffic forecasts were prepared in accordance with the advice set out in WebTAG[3], and were principally determined using factors obtained from TEMPRO v6.2 (NTEM 6.2). The reference forecasts represent travel demand based on the outputs from the Stage 1 A2 Bean and Ebbsfleet Uncertainty Log (0004-UA007244-UT22TN-11 A2 Bean and Ebbsfleet Uncertainty Log) and controlled to NTEM for the core scenario.

7.2.5 The A2 Bean and Ebbsfleet model forecasting matrix building procedure is based on the Lower Thames Crossing Model (LTCM) and incorporates a customised reference forecast matrix procedure which allows the production of TEMPRO equivalent forecasts using LTCM model zoning rather than NTEM level zoning.

7.2.6 The process is useful as it allows the inclusion of local planning data from the Uncertainty Log at an LTCM zone level rather than at the coarser NTEM zone level. This in turn allows for trip end forecasting to occur at the LTCM zone level rather than the NTEM level, meaning that (sub–NTEM) local variation can occur in the forecasting process which is important for the A2 Bean and Ebbsfleet study where there are pockets of significant growth within certain NTEM zones. The inputs required by the custom process to achieve this are forecast year households and employment.

7.2.7 Traffic forecasts were prepared for Central Growth Forecasts. The uncertainty of economic growth for the Pessimistic Scenario (Low Growth) and the Optimistic Scenario (High Growth) options in accordance with WebTAG[4] will be undertaken during Stage 2.

7.2.8 For actual or 'equilibrium' demand to be determined, a subsequent process known as Variable Demand Modelling (VDM) was undertaken. Further detail regarding the preparation of traffic forecasts for the Stage 1 A2 Bean and Ebbsfleet Junction Improvements Study can be referred to in 0003-UA007244-UT22R-04 Stage 1 A2 Bean and Ebbsfleet Traffic Forecasting Report.

7.2.9 A review of the major development zones within the study area highlights areas of significant demand model suppression within the morning and evening peak.

7.2.10 As there is increased trip suppression associated with local and external to local movements suggests there is increased costs associated with congestion on the local road network than the strategic road network. The demand suppression in development zones surrounding the A2 Bean and Ebbsfleet Junctions identifies that there are residual capacity problems in the network that the A2BE Junction Improvements scheme will not address.

7.2.11 Global network statistics were extracted from the forecast year assignments for the

[3] TAG Unit M1: Principles of Modelling and Forecasting, Chapter 5 Forecasting, p15, Department for Transport, January 2014

[4] TAG Unit M4: Forecasting and uncertainty, Chapter 4 Defining High and Low Growth Alternative Scenarios, p6, Department for Transport, May 2014

following criteria:

- Total transient queues (PCU-hours);
- Total over capacity queues (PCU-hours);
- Total travel time (PCU-hours);
- Total travel distance (PCU-kilometres); and
- Average network speed (kph).

7.2.12 These statistics are presented for the morning, inter peak and evening peaks (Tables 19 – 21).

7.2.13 Summary tables showing the scheme effect of the A2 Bean and Ebbsfleet Junction Improvements for each of the modelled years (2025, 2041) by time period for the Core Scenario (Central Growth) are presented in Appendices C, D and E.

7.2.14 The figures compare the model results for the With and Without Scheme models and the differences between them for each forecast year (2025 & 2041) and time period. An extract from the turn schematic is shown in Figure 20. The flows are presented for the turning movements indicated by the arrow of direction of travel. The top box represents the actual flow (total vehicles) for the option under consideration (B03E01b, B04bE01b or B05E01b) as described in 6.4.26, the second box represents the Without Scheme actual flow (total vehicles) and the third box shows the scheme effect on flow as a positive increase (shaded in black) or a reduction in flow (shaded in red).

7.2.15 As the Bean and Ebbsfleet Junctions are surrounded by a congested strategic and local road network, the additional capacity provided by the junction improvements options do not result in large increases in the volume of traffic travelling to the A2 Bean and Ebbsfleet area through the A2 Bean Junction. Also, the options do not improve journey times for all movements at the junctions when compared with the Without Scheme scenario.

7.2.16 The economic benefit of the A2 Bean and Ebbsfleet improvement schemes at the A2 Bean Junction is therefore achieved by the improving journey times through the scheme options (compared with the Without Scheme model) at specific locations.

7.2.17 The largest flow difference between the Without and With Scheme options is with Options 4b and 5 on the A296 Roman Rd. This is due to the closure of the B255 southbound offslip to the A296 Roman Rd, which re-routes B255 SB traffic to the A2 eastbound via the A2 Bean north gyratory. The purpose of the new A2 eastbound on-slip at the Bean north gyratory is to remove the congestion on the A296 Roman Rd caused by the merging of traffic from Dartford and the B255 travelling to the A2 eastbound. Option 5 is the best performing scheme option in this regard facilitating more traffic than Option 4 accessing the A2 eastbound in the evening peak.

7.2.18 It is notable that the selection of Bean option does not have a significant impact on the operation of the Ebbsfleet junction. This can be seen by the scheme effect figures for Options B03E01b, B04bE01b and B05E01b showing little differences in With Scheme traffic volumes at Ebbsfleet.

7.2.19 The improvement option at Ebbsleet E01b supports the development of the Ebbsfleet area as shown by the increase in traffic flow on the A2260 Northbound to local developments including Station Quarter North and South, Eastern Quarry and Northfleet Rise. The additional capacity provided at the Ebbsfleet East gyratory results in increases from a combination of traffic accessing the employment land uses at Ebbsfleet via the A2260 and traffic that otherwise would be travelling to these areas by rat running through the Station Quarter South development via the Station Quarter South development access road from the Ebbsfleet East gyratory.

Table 19 - Core Scenario (Central Growth) Assignment Statistics – AM Peak (Cordon Model)

Network Performance Effect	2009 Base Year	2025 Forecast Year				2041 Forecast Year			
		WT05	B03E01b	B04bE01b	B05E01b	WT05	B03E01b	B04bE01b	B05E01b
Transient Queues (pcu-hrs)	1183	1625	1616	1612	1599	1928	1982	1966	1962
Over-Capacity Queues (pcu)	5	264	127	135	135	595	365	361	364
Link Cruise Times (pcu-hrs)	6876	7467	7456	7479	7469	7970	7943	7973	7958
Average Speed (km/hr)	55	53	53	53	54	49	50	50	50
Total Delay (mins / pcu)	1.4	1.8	1.7	1.7	1.7	2.3	2.1	2.1	2.1
Congestion Index* (mins /pcu.km)	0.16	0.23	0.21	0.21	0.21	0.29	0.27	0.27	0.27
Average Trip Length (km)	9.0	8.2	8.2	8.2	8.3	8.2	8.2	8.2	8.2

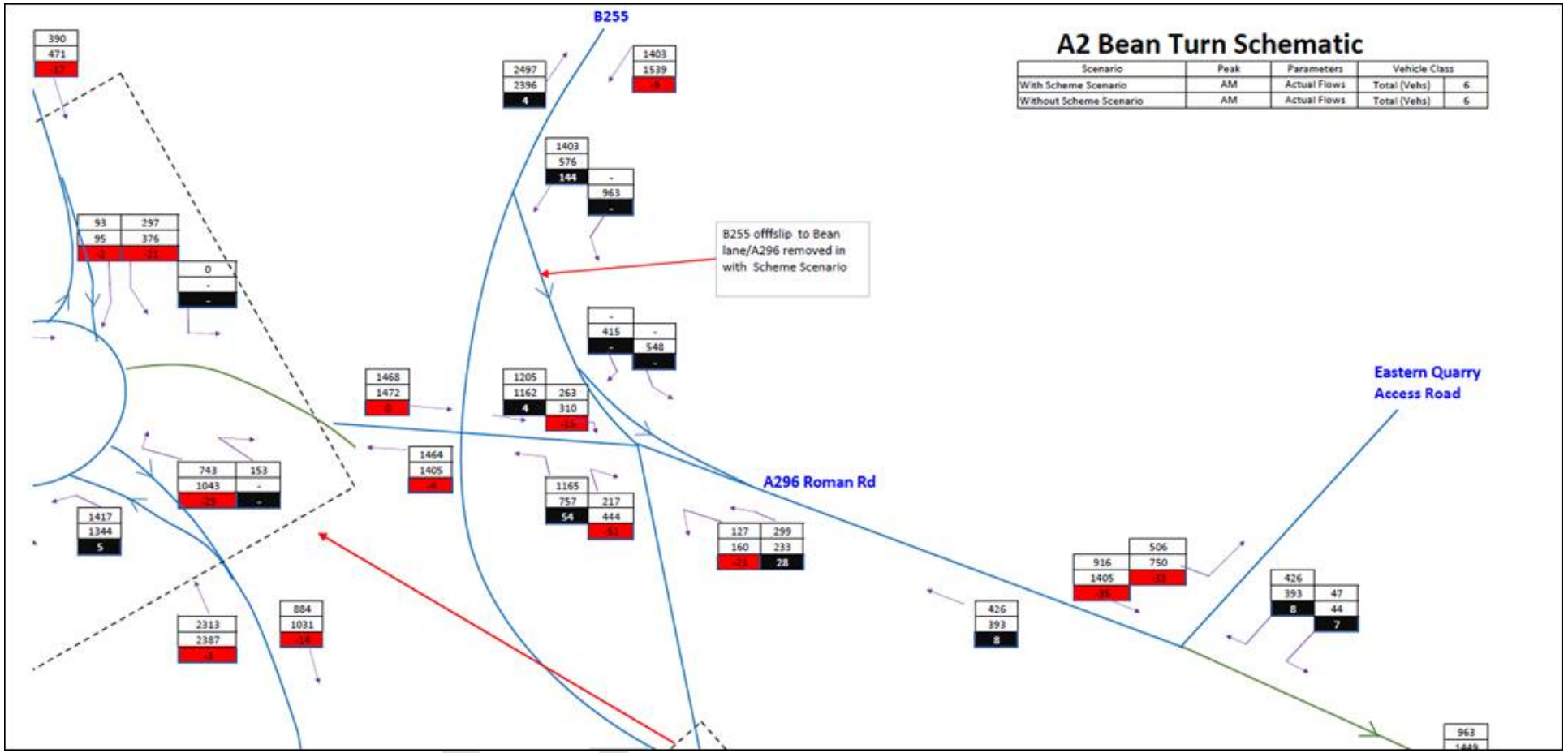
Table 20 - Core Scenario (Central Growth) Assignment Statistics – Inter Peak (Cordon Model)

Network Performance Effect	2009 Base Year	2025 Forecast Year				2041 Forecast Year			
		WT05	B03E01b	B04bE01b	B05E01b	WT05	B03E01b	B04bE01b	B05E01b
Transient Queues (pcu-hrs)	604	820	822	815	817	1009	1000	995	996
Over-Capacity Queues (pcu)	0	0	0	0	0	0	0	0	0
Link Cruise Times (pcu-hrs)	4944	5526	5520	5540	5534	6271	6260	6284	6274
Average Speed (km/hr)	63	61	61	61	61	59	60	60	60
Total Delay (mins / pcu)	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1
Congestion Index* (mins /pcu.km)	0.10	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14
Average Trip Length (km)	8.9	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1

Table 21 - Core Scenario (Central Growth) Assignment Statistics – PM Peak (Cordon Model)

Network Performance Effect	2009 Base Year	2025 Forecast Year				2041 Forecast Year			
		WT05	B03E01b	B04bE01b	B05E01b	WT05	B03E01b	B04bE01b	B05E01b
Transient Queues (pcu-hrs)	1288	1703	1709	1694	1668	2137	2126	2137	2079
Over-Capacity Queues (pcu)	311	245	240	232	158	392	255	273	193
Link Cruise Times (pcu-hrs)	7158	7651	7611	7639	7641	8310	8256	8289	8285
Average Speed (km/hr)	53	53	53	54	54	50	51	51	52
Total Delay (mins / pcu)	1.8	1.9	1.9	1.9	1.8	2.3	2.1	2.2	2.0
Congestion Index* (mins /pcu.km)	0.21	0.23	0.23	0.23	0.21	0.28	0.26	0.27	0.25
Average Trip Length (km)	9.4	8.6	8.6	8.6	8.6	8.5	8.5	8.5	8.6

Figure 20 - Forecast Turn Flow Schematic Example – Scheme Effect



7.3 Operational Modelling

Modelling Undertaken

7.3.1 Whilst the Stage 1 A2 Bean and Ebbsfleet strategic traffic model was used to produce and test future year traffic flows at a wider, more regional level and to determine the general operation of the network in terms of journey times and network capacity constraints, to ensure that proposed junction layouts are feasible in terms of network capacity and safe operation, more detailed traffic modelling analyses were undertaken using local junction models and a microsimulation model that covered both junctions, the A2 mainline and the adjacent road network.

7.3.2 Two time periods were developed for a typical weekday:

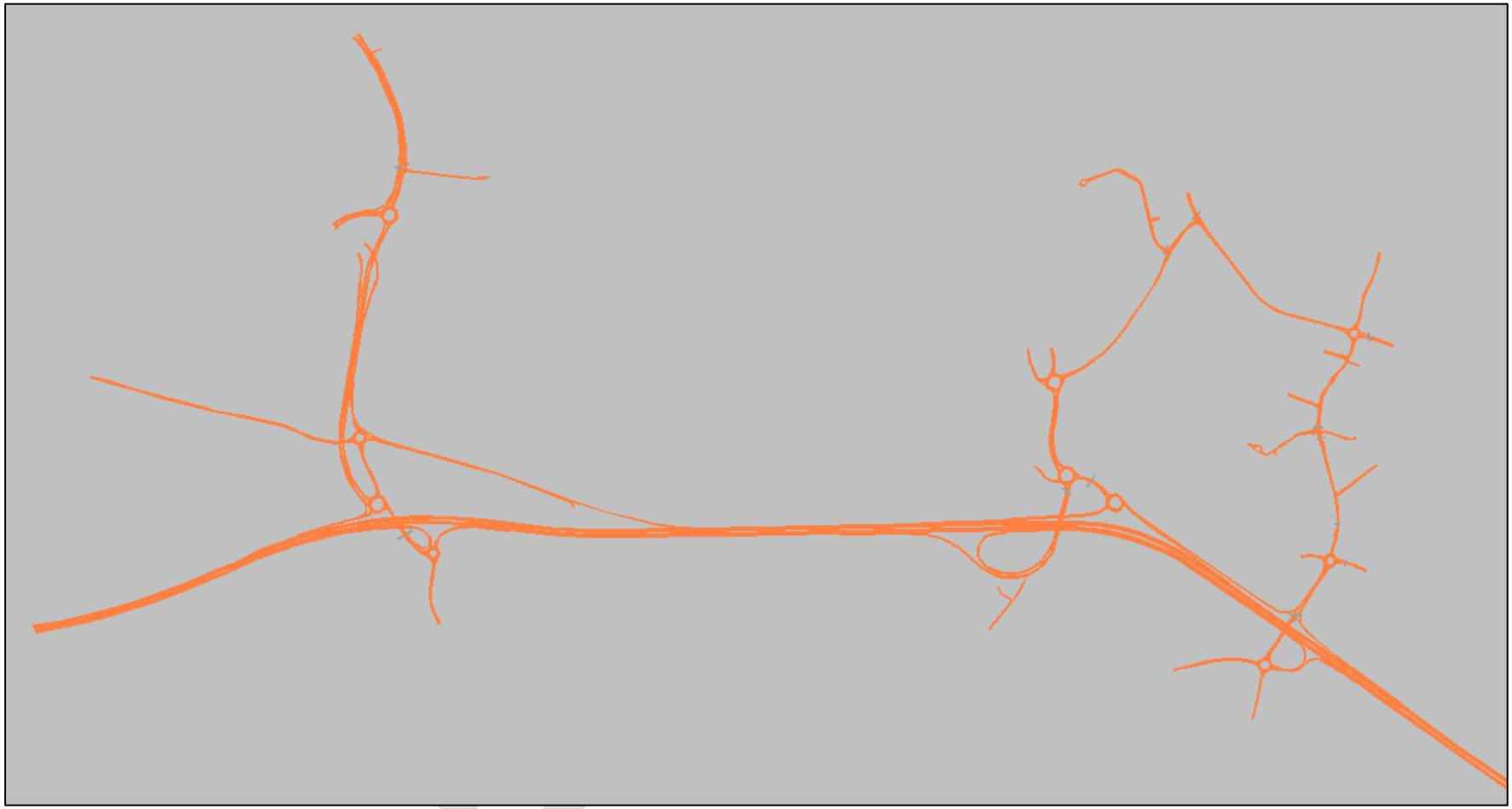
- AM peak from 08:00 to 09:00 hours, and
- PM peak from 17:00 to 18:00 hours

7.3.3 A sensitivity test was also carried out for how the junctions would operate at the weekend.

7.3.4 The network coverage of the microsimulation model is shown below in Figure 21. The benefits of undertaking microsimulation modelling is that traffic behaviour can be observed in each time period across the network. This allows observation of the build-up of traffic queues over time in each time period allowing the modeller to identify areas where there is vehicle conflict and consequently the opportunity for resolution of these conflicts and hence minimise delay and optimise network performance.

7.3.5 Traffic forecast flows were obtained from the Stage 1 A2 Bean and Ebbsfleet strategic traffic model for 2041 and tested for Option 3 (B03E01), Option 4b (B04bE01) and Bean Option 5 (B05E01). As there isn't a weekend traffic forecast model, the forecasts traffic flows for the weekend test were developed using a 'Synthetic Approach'.

Figure 21 - Network coverage of microsimulation model



Results of Operational Modelling.

7.3.6 Results of the operational modelling were extracted for the Without Scheme and With Scheme options for journey times and queue lengths, which were measured at junctions stop lines and give ways. A weaving analysis was also carried out at the merge and diverges using a Level of Service (LOS) measure[5], as interpreted from the Highways Capacity Manual.

7.3.7 The results from the Without Scheme model demonstrate that without any improvements to the Bean and Ebbsfleet Junctions the AM and PM peak periods would experience unacceptable levels of delay and congestion in 2041. The modelling indicates that blocking back onto A2 mainline would occur at Bean Junction in the AM period causing safety issues and flow breakdown on the mainline. Furthermore, the Bean and Ebbsfleet Junctions do not provide sufficient capacity for the local traffic to access the strategic road network in the PM peak, with extensive queueing and delays on the B255 and B2260, respectively.

7.3.8 In the With Scheme scenarios in 2041, each of the options were seen to operate without blocking back onto the mainline on the off-slips at each junction in the AM and Inter-peak time periods, but blocking back was shown to occur in the PM peak period in each option on the eastbound off-slip at Ebbsfleet. The reason for this occurring in the With Scheme scenario but not the Without Scheme scenario is because eastbound traffic is able to flow more freely because of the Bean Junction improvements and hence allows more traffic to reach the Ebbsfleet slip road.

7.3.9 Initial work in looking at this safety concern suggests there is enough scope to modify the lane arrangement and traffic signal control at the top of the eastbound off slip road to prevent the blocking back onto the mainline.

7.3.10 Option 5 was shown to have the best performing operation.

Conclusions

7.3.11 Option 5 has been assessed as providing the best junction performance. All options operate without blocking back onto the A2 mainline, except at the eastbound off slip in the PM peak period, which occurs in all three options. Initial work suggest this safety concern can be addressed.

[5] The Level of Service analysis demonstrates where vehicle density on the lanes is high, which could lead to weaving and merging conflicts, as well as flow breakdown on the A2 mainline with the attendant safety and throughput implications.

8 Economic Assessment

8.1 Introduction

8.1.1 The economic appraisal of the A2 Bean and Ebbsfleet options consists of the appraisal of:

- Direct economic impacts on road users and government and other related economic impacts, and
- Wider economic impacts - specifically Wider Economic Benefits.

8.1.2 DfT's standard economic appraisal tools were used to appraise these impacts. A common component for all of these impacts was the transport model described elsewhere. For each option, outputs from the model, such as traffic flows and generalised costs, provided inputs to the process of estimating impacts.

8.1.3 Further detail regarding the economic assessment of the Stage 1 A2 Bean and Ebbsfleet Junction Improvement can be referred to in 0004-UA007244-UT22R-05 Stage 1 A2 Bean and Ebbsfleet Economic Assessment Report.

8.2 Options Assessed

8.2.1 The A2 Bean and Ebbsfleet project is currently in Highways England Project Control Framework (PCF) Options Stage 1 Option Identification. This involves the identification of junction improvement options to be taken forward for public consultation.

8.2.2 Three options are proposed for the Bean Junction in combination with one option at the Ebbsfleet Junction.

8.2.3 The resulting short list of options for assessment are:

- Bean Junction
  - Option 3
  - Option 4b
  - Option 5
- Ebbsfleet Junction
  - Option 1b

8.2.4 These are shown in Figures 15 to 18 above.

8.3 Economic Appraisal and Parameters

8.3.1 Economic appraisal is an important element in the overall appraisal process. The A2 Bean and Ebbsfleet junction improvement appraisal was undertaken in line with DfT's WebTAG guidance, with all benefits and costs calculated in monetary terms and expressed as present values (PV) in 2010 prices, discounted to 2010. The work has been carried out in line with DfT's WebTAG's guidance and includes the following components:

- TUBA appraisal – for assessing travel time, vehicle operating cost and greenhouse gas benefits;
- COBALT appraisal – for assessing monetised changes in safety benefits;
- Noise appraisal, and
- Appraisal of wider impacts (WI), otherwise known as wider economic benefits (WEBs).

8.3.2 The ratio of the present value of benefits (PVB) to the present value of scheme costs (PVC) constitutes the benefit-cost ratio (BCR). Two BCRs, an Initial BCR (which excludes wider economic impacts) and an Adjusted BCR (which includes wider economic impacts), were calculated for each option.

8.3.3 In accordance with WebTAG guidance, the appraisal results for each option are presented using four standard appraisal reporting tables:

- Transport Economic Efficiency (TEE) – this reports user and provider benefits;
- Public Accounts (PA) – this reports scheme costs and revenues;
- Analysis of Monetised Costs and Benefits (AMCB) – this draws together the TEE impacts and other monetised benefits with the Public Accounts impacts and allows the initial BCR to be determined for each option, and
- Appraisal Summary Table (AST) – this is populated with selected monetised and quantitative data from the above supporting tables and other key statistics from the appraisal and also provides a qualitative narrative regarding the overall appraisal performance of the option.

These tables are included in Appendices F to I.

8.4 Grants and Subsidies

8.4.1 Based on the best information currently available, it is considered that there are no grants or subsidies applicable to the A2 Bean and Ebbsfleet scheme.

8.4.2 However, it has been advised that a developer contribution element totalling £45m is available for the scheme. It is assumed that this sum will be made available in 2020 and that it will be paid in 2020 current prices and in resource cost terms.

8.4.3 The sources have been notified as the STIP (Strategic Transport Infrastruture Programme) fund and the Ebbsfleet Development Corporation. The former source will provide £25m while the balance of £20m will come from future S106 contributions. These will be collected and underwritten by Ebbsfleet Development Corporation as a Planning Authority.

8.4.4 For this economic appraisal these amounts have been treated as private sector finance on the basis that they will originate in full from contributions by the business sector to the two funding agencies concerned.

8.4.5 After expressing this figure in 2010 prices, discounting to 2010 and converting to a market price base, the contribution will be used to reduce the PVC as it is reported in the PA table.

8.5 Appraisal Tools

Use of TUBA

8.5.1 The DfT's TUBA appraisal tool version 1.9.6, current at the time of the appraisal, was used to estimate the direct user and provider benefits from the shortlisted options in terms of travel time savings and vehicle operating cost savings.

8.5.2 TUBA provides a complete set of default economic parameters in its 'Standard Economics File'. This contains values of time, vehicle operating cost data, tax rates, economic growth rates and a range of other economic parameter values. This default file was used for the Stage 1 A2 Bean and Ebbsfleet Junction Improvements economic assessment.

8.5.3 The Scheme parameters are principally determined by the parameters used in the traffic forecasting model, as follows:

- Current Year – 2016;
- First Year – 2025 (proxy for Scheme Opening Year);
- Modelled Years – 2025, 2041, and
- Horizon Year – 2084.

8.5.4 The 'Horizon Year' has been set at the end of 2084 with the appraisal period taken as 60 years from scheme opening, in line with WebTAG (Unit A1.1 section 2.3, Appraisal periods).

8.5.5 Each modelled option in TUBA is referred to as a scenario and these are classified as either Without Scheme or With Scheme scenarios. The Without Scheme scenario is referred to as the Do Minimum in TUBA. Each With Scheme scenario was tested in TUBA against the Without Scheme scenario, producing a total of three TUBA runs.

8.5.6 Traffic growth has been accounted for within TUBA between 2025 and 2084 by automatic interpolation between the modelled years of 2025 and 2041. After the last modelled year (2041), TUBA assumes

that the traffic flows, journey times and routes remain fixed (TUBA: General Guidance and Advice, section 9).

8.5.7 The outputs from this process are used to produce Transport Economic Efficiency (TEE) tables for each option.

8.5.8 In addition, TUBA calculates and monetises greenhouse gas benefits, which are reported in the Analysis of Monetised Costs and Benefits (AMCB).

Noise Impacts

8.5.9 Noise assessment was undertaken for the scheme options. The results of this are presented in the TEE and AST tables.

Accident Benefit Appraisal using COBALT

8.5.10 Accident cost savings are an important element of the scheme appraisal. These were appraised using version 2013.2 of DfT's COBALT software program and version 2016.1 of the associated parameter file. The program also forecasts the changes in monetised accident costs over 60 years from opening, in 2010 prices discounted to 2010, for inclusion in the AMCB table.

8.5.11 In calculating monetary benefits COBALT also calculates changes in accident numbers and benefits as described in a later section.

Scheme Costs

8.5.12 Publicly funded scheme costs for the three A2 Bean options plus the Ebbsfleet option, covering preparation and construction expenditure, have been expressed in discounted present value terms using spreadsheets that are consistent with TUBA and provide the Present Value of Cost (PVC) for each option. These costs brought together with indirect tax revenues, principally VAT and fuel duty, comprise the public accounts impact, reported in the Public Accounts (PA) table.

Initial BCR

8.5.13 Taken together, the foregoing elements are reported in the AMCB tables which calculate the NPV and BCR for each option. The BCR produced here is referred to as the initial BCR, as there may be other sources of monetised benefit which are excluded from the AMCB tables.

Wider Economic Benefits and the Adjusted BCR

8.5.14 Outputs from the A2 Bean model (based on the LTC v1A model) were also used to appraise another key monetised impact, the wider economic benefits (WEBs). This appraisal covered agglomeration and labour supply impacts, using the A2 Bean Wider Impacts model, and was based on data on trip patterns and travel times and costs from the A2 Bean traffic model.

8.5.15 Incorporating these benefits permitted the calculation of an adjusted BCR.

Non-standard Procedures or Economic Parameters

8.5.16 No non-standard procedures or economic parameters were utilised in the economic appraisal of the shortlist options.

8.6 Results of the User Benefits Assessments

8.6.1 The results of the user benefit assessments for the various options are summarised in the tables which follow. All figures reported in the following paragraphs are in 2010 prices discounted to 2010. However, the figures do not include the impact of wider economic benefits, which are discussed at a later stage.

TEE Summary

8.6.2 The user and provider benefits for the options considered are reported in the TEE tables. Table 22 presents these benefits and distinguishes between the benefits to business users and to consumers.

Table 22 - User and Provider Benefits (£ PVB in 2010 prices, discounted to 2010)

£bn PVB 2010 prices		Ebbsfleet 1b		
		Option 3	Option 4b	Option 5
Commuting	Travel time	£19,026,360	£15,867,714	£22,300,191
	VOC	£1,087,725	£416,914	£53,957
	Charges	£0	£0	£0
	Construction delays	n/a	n/a	n/a
	Subtotal	£20,114,085	£16,284,628	£22,354,148
Other consumers	Travel time	£61,183,840	£40,688,805	£65,754,868
	VOC	£2,964,076	-£1,708,270	-£2,092,005
	Charges	£0	£0	£0
	Construction delays	n/a	n/a	n/a
	Subtotal	£64,147,916	£38,980,535	£63,662,863
Business	Travel time	£42,993,073	£18,899,357	£41,586,927
	VOC	£3,478,687	£97,098	£889,278
	Charges	£0	£0	£0
	Construction delays	n/a	n/a	n/a
	Subtotal	£46,471,760	£18,996,455	£42,476,205
Other Business	Developer Contributions	-£31,725,391	-£31,725,391	-£31,725,391
	Net Business Impact	£14,746,369	-£12,728,936	£10,750,814
Total		**£99,008,370**	**£42,536,227**	**£96,767,825**
Business user benefits as percentage of total user benefits		35.5%	25.6%	33.1%

VOC = vehicle operating costs

n/a = not appraised

8.6.3 The great majority of the benefits for all of the options are generated by travel time savings. The business impact of the project represents a considerable proportion of the total user and provider benefit, being 35% of the total for Option B03E01b, 26% for Option B04bE01b and 33% for Option B05E01b. These proportions would however be considerably reduced if expressed in terms of overall benefit because of the impact of the developer contribution.

PA Table Summary

8.6.4 Table 23 shows the effects of the options on public finances, taking into account the impact on the broad transport budget after allowing for the developer contribution and changes in revenues. It also includes reductions in the broader indirect tax revenues which accrue to the government.

Table 23 - Public Accounts (PVC £ 2010 prices, discounted to 2010)

Scheme Option	Ebbsfleet 1b		
	Option 3	Option 4b	Option 5
Central Government Funding			
Most likely outturn costs at 2014 prices (including inflation)	£145,900,000	£143,000,000	£123,900,000
Investment Costs (a)	£106,219,058	£104,122,959	£90,211,136
Developer Contribution (b)	-£31,725,391	-£31,725,391	-£31,725,391
Operating Costs (c)	n/a	n/a	n/a
Net Central Government Impact (a+b+c)	£74,493,667	£72,397,568	£58,485,745
Revenues (d)	£0	£0	£0
Cost to Broad Transport Budget (a+b+c+d)	£74,493,667	£72,397,568	£58,485,745
(Reduction in) Indirect Tax Revenue	£2,755,263	£315,771	£649,640

8.6.5 The discounted cost to the transport budget used in the economic analysis is £74.5m for Option B03E01b, £72.4m for Option B04Be01B and £58.5m for Option B05E01b. All figures are in 2010 prices and discounted to 2010.

8.6.6 The indirect tax revenues values shown are reductions in revenue to the wider public finances and, in accordance with WebTAG guidance, are included in the calculation of the Present Value of Benefits (PVB). The sign of the value in the PA table is therefore reversed in the AMCB table because the PA table presents costs to the public accounts as positive values.

AMCB Table Summary

8.6.7 The AMCB tables combine results from the TEE tables and the PA tables supplemented by information on accidents and environmental effects. The results from the appraisal of the accident and monetised environmental impacts are set out in Table 24 below. The AMCB tables are presented in the AST Report.

Table 24 - AMCB Summary Table for Shortlist Options (PVB £m 2010 prices, discounted to 2010)

Option at Ebbsfleet	Option 1b		
Option at Bean	**Option 3**	**Option 4b**	**Option 5**
Noise	0.04	-0.00	-0.11
Green-house Gases	1.44	0.17	0.38
Accidents	7.72	-0.16	3.15
Economic Efficiency: Commuting	20.11	16.28	22.35
Economic Efficiency: Other	64.15	38.98	63.66
Economic Efficiency: Business	14.75	-12.73	10.75
Wider Public Finances (ITR)	-2.76	-0.32	-0.65
PVB	105.45	42.23	99.54
PVC	74.49	72.40	58.49
NPV	30.95	-30.16	41.05
BCR	**1.4**	**0.6**	**1.7**

8.6.8 On the basis of these results it can be seen that Option B04BE01b represents poor value for money (its costs exceed its benefits) and Option B03E01b lies towards the top of the low value for money category. Meanwhile Option B05E01b lies towards the middle of the medium value for money range.

8.7 Wider Economic Benefits

8.7.1 Wider impacts assessment has also been undertaken.

8.7.2 This used the methodology for the appraisal of Wider Impacts published by the UK Department for Transport covering a range of welfare and GDP impacts as listed below.

Type of impacts

8.7.3 The identified wider impacts are:

- Agglomeration - a change in productivity resulting from a change in densities of employment, and therefore an alteration in access for firms to products, inputs and labour market, as well as a variation in knowledge and technology spillovers.

- Output Change in Imperfectly Competitive Markets - a change in production as a result of a change in transport accessibility. It is assumed that in the case of a positive change, the consumers' willingness to pay for the increased output will be higher than the cost of producing it.
- Tax Revenue from Labour Market Impacts - the tax implications from the labour market impacts estimated from the effects of labour supply impacts and move to more or less productive jobs impacts; these are additional impacts as commuter user benefits do not include the change in tax revenues received by the government.

8.7.4 The impact of changes in accessibility on the location of population and employment has not be calculated as part of this project as no Land Use and Transport Interaction (LUTI) model was available to forecast the employment and residential location consequences of the alternative scenario that is being appraised. Similarly, changes in residential location and their impact on the level of employment in the alternative scenario has also not be estimated as well.

8.7.5 All benefits have been assessed over a 60 year appraisal period from 2025 to 2084.

W13 Agglomeration

8.7.6 Agglomeration refers to the concentration of economic activity in an area and is measured using effective density. Where a transport scheme facilitates a reduction in journey times and therefore generalised cost, this alters the accessibility of firms in an area to other firms and workers to deliver improvement in relative agglomeration. The benefits arise as businesses and their labour are better connected, yielding additional productivity through spill-over benefits such as improved labour market matching and the sharing of ideas, technology and best practice.

8.7.7 Changes in effective economic density from the transport investment are translated into changes in productivity using an econometric relationship. Each area's change in productivity is then multiplied by its existing level of output, whereby the largest agglomeration impacts will likely occur in areas with significant decreases in generalised cost and a significant existing business base.

W12 Change in Output in Imperfectly Competitive Markets

8.7.8 A reduction in the costs of transport allows businesses to operate more efficiently - it allows them to raise their output due to a reduction in their business costs. This forms as an additional welfare impact, where in imperfectly competitive markets firms set prices above the marginal cost of production, resulting in the increased (or decreased) output being valued more highly by consumers than the cost of producing this output

8.7.9 The change in output in imperfectly competitive markets has been calculated based on the modelled value of business travel time savings. The calculations of these WI2 benefits assumes that 10% of the change in business costs is passed onto consumers as an additional welfare benefit. This Wider Impact is in addition to the business user benefits which are captured in the TUBA user benefits.

WI3 Tax Wedge on Labour Market Impacts

8.7.10 Decisions about whether to take a job are based on the combination of wages and commuting costs. As the costs of commuting change, these decision can result in a potential increase or decrease in the supply of labour. Reductions in journey time or cost will increase the returns from the combination of working and commuting and are likely to result in greater labour supply. The benefits to the individual are assumed to be captured in user benefits. However the change in tax revenues that results from the labour market impacts is what is being captured as part of W13 calculations.

Wider Impacts Results

8.7.11 As described previously, there are three categories of wider economic benefit relevant to the A2 Bean options:

- Agglomeration benefits;
- Imperfect competition effects, and
- Labour supply impacts.

8.7.12 For Option 5, agglomeration benefits are the most significant component of the total wider economic benefit, while imperfect competition impacts were found to make a negligible contribution.

8.7.13 The scale and breakdown of these wider impacts by type is summarised in Table 25. At Stage 1 of the A2 Bean and Ebbsfleet Junction Improvements economic assessment, the wider economic benefit

assessment has been carried out only for Option B05E01b, and estimates have been used for the other two options. It will be seen that agglomeration benefits account for over 80% of the total.

Table 25 - Wider Economic Benefits (£m 2010 prices, discounted to 2010)

	Ebbsfleet 1b		
	Option 3	**Option 4b**	**Option 5**
Agglomeration	£18.85m	£10.36m	£18.85m
Output in imperfectly competitive markets	£0.60m	£0.33m	£0.60m
Tax revenue from labour market impact	£3.04m	£1.67m	£3.04m
Total	**£22.49m**	**£12.36m**	**£22.49m**
Agglomeration as % of WEBs	83.8%	83.8%	83.8%

8.8 Overall Assessment

8.8.1 The effects of adding the wider impacts into the economic appraisal for the A2 Bean and Ebbsfleet options are set out in Table 26.

Table 26 - Summary of Economic Results for A2 Bean and Ebbsfleet Options (£m in 2010 prices, discounted to 2010)

Option at Ebbsfleet		**Ebbsfleet 1b**		
Option at Bean		**Option 3**	**Option 4b**	**Option 5**
Excluding WEBS	PVB	105.45	42.23	99.54
	PVC	74.49	72.40	58.49
	NPV	30.95	-30.16	41.05
	Initial BCR	**1.4**	**0.6**	**1.7**
Including WEBs	WEBs	22.49	12.36	22.49
	PVB	127.94	54.59	122.03
	NPV	53.44	-17.80	63.54
	Adjusted BCR	**1.7**	**0.8**	**2.1**
WEBs as % of total benefits		17.6%	22.6%	18.4%

8.8.2 Adding the wider economic benefits to the initial PVC for Option B05E01b has the effect of bringing that option into the high value for money category. Option B03E01b moves into the medium value for money category, but Option B04bE01b remains poor value for money.

Source and Magnitude of Benefits

8.8.3 User and Provider benefits (travel time savings, and vehicle operating cost savings) account for at least 95% of the direct economic benefits for the options. These benefits derive largely from travel time savings.

8.8.4 Direct benefits for Options B03E01b and B05E01b are fairly similar at around £100m after allowing for the developer contribution, and very much higher than for Option B04bE01b.

8.8.5 WEBs benefits for Option B05E01b are calculated at £22m and add about 18% to the initial benefit. Although WEBs were not computed for the other options, it is considered that they would at best be in proportion to the user benefits, but unlikely to exceed those for Option B05E01b. For ease of comparison of the options, the total value and breakdown of the WEBs for each of the other options has been estimated on this basis, at £22m and £12m for Options B03E01b and B04bE01b respectively.

Benefit Cost Ratios

8.8.6 The initial BCRs for Options B05E01b, B03E01b and B04bE01b are 1.7, 1.4 and 0.6 respectively. Adding in wider benefits to Option B05E01b increases the BCR to 2.1 and brings it into the high value for money (VFM) category. Adding in the estimated wider benefits for Options B03E01b and B04bE01b increases their BCRs to 1.7 (medium VFM) and 0.8 (poor VFM) respectively.

Overall Conclusions

8.8.7 In economic terms, the appraisal process indicates that Option B05E01b provides best value for money. As noted, when WEBs are taken into account, it lies within the high value for money category.

8.9 Appraisal Tables

8.9.1 Appendix I includes, for each of the Short List options, Appraisal Summary Tables included in the AST report.

9 Safety Assessment

9.1 Impact on Road Users – Strategic Safety Action Plan

9.1.1 The accident records currently show a significantly higher than average casualty rate for the A2 between Bean and Ebbsfleet and the objective of the scheme within the strategic safety action plan is to ensure that the casualties per 100 million vehicle miles does not increase on the A2 taking into account the national trend of a reduction in casualties as reported in Table 27.

Table 27 - PACTS Projection of Road Casualties in Great Britain to 2030

Year	2010	2020	2030
Casualties No.	208,648	180,000	162,000
% change from 2010		-13.73%	-22.36%

9.1.2 Whilst it may be difficult to make significant safety improvements to the A2 due to the limitations of the scheme extents, all practical measures shall be considered in order to reduce the number of casualties below the national trend rates identified above. This will subsequently contribute to the target reduction of 40% as highlighted in Highways England's 5 year plan and the current strategic outcome for a safe and serviceable network by reducing the number of people killed or seriously injured on the network to no more than 1,393 in year by the end of 2020, a 40% reduction from 2010.

9.1.3 The side roads will be low speed and by definition the severity of any incidents will therefore also be low. The strategic safety action plan for the side roads will be based on ensuring that the numbers of killed or seriously injured incidents do not increase nor the number of other injury accident and damage only incidents.

9.2 Construction Health & Safety - Construction (Design and Management) Regulations 2015

9.2.1 The A2 Bean and Ebbsfleet scheme has been assessed in accordance with the guidance in IAN191/16 as having predominantly Type A features with one Type B feature. The project has therefore been categorised as requiring a Type A SMS (Safety Management System), which equates to a basic or 'business as usual' level of safety management. This decision is documented in the Safety Plan for the scheme.

9.2.2 The health and safety information that will be provided with the for-construction design at the end of Stage 5 (Construction Preparation) will comprise the following:

- F10 Notification of Construction Project (produced at Stage 2, updated at Stage 5);
- Pre-Construction Information (produced at Stage 2, and developed during subsequent stages to reflect the design evolution and final design);
- Scheme Asbestos Management Plan (produced at Stage 3 and refined at Stage 5);
- Maintenance and Repair Strategy Statement (produced at Stage 3 and refined at Stage 5), and
- Health and Safety File (produced at Stage 2, updated at Stage 5).

Two additional PCF products, the Safety Plan and Combined Safety and Hazard Log Report, are primarily concerned with safety governance and road user safety and do not have a direct input into health and safety during the construction phase.

9.2.3 During development of the design of the A2 Bean and Ebbsfleet scheme the Construction (Design and Management) Regulations, 2015 (hereafter referred to as the CDM Regulations) require designers to apply the principles of prevention and eliminate, where possible, hazards for construction, operation, maintenance and demolition. The designers will develop the Hazard Elimination Schedule highlighting the key residual risks remaining at the end of design which need to be managed by those involved in subsequent construction works. During design evolution the designers will evaluate the constraints and identify and address any gaps in information. Buildability and clash detection and elimination will also be undertaken. Working collaboratively with the designers, the Principal Designer will ensure effective management of the health and safety risks, undertake the statutory F10 notification to the

Health and Safety Executive (HSE), support the client and oversee the development of the Pre-construction Information (PCI), Hazard Elimination Schedule (HES) and Health and Safety File.

9.2.4 Specific significant hazards and risks identified for the A2 Bean and Ebbsfleet Junction Improvement scheme which will need to be managed during construction, include:

- Working in the vicinity of high voltage overhead power lines and cable towers;
- Working in vicinity of high pressure gas mains up to 1050mm diameter;
- Working adjacent to live traffic (on A2, A296, B255), and
- Hazards to construction from unexploded ordnance (UXO).

Other potential hazards identified include contaminated materials and underground structures associated with previous site uses and these and other hazards are illustrated on Drawing Nos. HA543917-HHJV-GEN-XXXX-DR-D-0031 to 0034 in Volume 2. Further survey works will be required to assess the locations and extent of these hazards.

9.2.5 Hazards and Risks associated with maintenance activities, such as access to roadside equipment (traffic signals, traffic signal control cabinets, street lighting, feeder pillars etc), access to drainage network (for gulley cleaning, pipe jetting etc) will be identified in the Maintenance and Repair Strategy Statement.

9.2.6 The appointed Principal Contractor will be responsible for managing health and safety on site during the construction phase. The Principal Contractor is required by the CDM Regulations to draw up a suitable construction phase plan (which is required to be produced at Stage 5 and updated during Stage 6) to set out their management arrangements and site rules prior to commencement of construction. This document will be required to take into account information provided in the Pre-Construction Information and the associated documents cross-referenced from it.

9.2.7 The Principal Contractor will be responsible for reporting incidents during construction in accordance with IAN 128/15.

9.2.8 Any design changes during the construction phase are required to be referred to the Principal Designer for assessment of any health and safety implications which need to be communicated to, and managed by, the Principal Contractor.

9.2.9 The outline structure and content requirements for the Health and Safety File is developed by the Principal Designer, in association with the design team, during Stages 2 to 5, in accordance with the requirements of IAN 105/08. This skeleton document and associated electronic file structure will be passed to the Principal Contractor at the end of Stage 5 to ensure that the appropriate information is collated during the construction phase. The completed Health and Safety File will form a key element of the handover, as detailed in IAN 182/14, and will capture and document the significant and unusual residual hazards which remain at the end of construction and which will need to be taken account during subsequent operation, maintenance, alteration, refurbishment and ultimate demolition. The Principal Designer is required to pass the completed Health and Safety File to the client at the end of the project.

9.2.10 With regard to the options being appraised, the principal differences during construction to be considered are set out in Table 28 below: At this stage it is considered that the construction durations would be similar and would be accommodated within the 3 year period provided in the programme.

Table 28 - Construction Health & Safety Impacts of the Options

Option	Impact from structures	Impact from overhead services	Impact from underground services	Impact from demolition requirements	Impacts from on-line widening works
Option B03E01b	New 3 lane bridge required. Retain existing Bean Bridge.	Existing cable tower on southern cable run would require relocation/diversion. Hazard for construction from overhead power cables.	Extensive diversion of services required on Bean Lane, B255 and A296 (Roman Road).	Some demolition required (demolition of northern end of Hope Cottages).	Significant on-line widening of local roads (including the A296). Minor on-line works on A2.
Option B04E01b	New 5 lane bridge required. Option to demolish existing Bean Bridge.	Existing cable towers unaffected by works. Hazard for construction from overhead power cables.	Diversion of services required on Bean Lane and B255 (and at western end of A296).	No demolition required.	Extensive on-line works on the A2. Some on-line widening of local roads.
Option B05E01b	New 2 lane bridge required. Retain existing Bean Bridge.	Existing cable towers unaffected by works. Hazard for construction from overhead power cables.	Diversion of services required on Bean Lane and B255 (and at western end of A296).	Extensive demolition required (total demolition of Ightham Cottages).	Extensive on-line works on the A2. Some on-line widening of local roads.

10 Operational Assessment

10.1 Road Characteristics and Option Design Implications

Schemes Operating Regime

10.1.1 There are no road user technology related control features associated with the scheme and the operating regime is therefore self-determining through conventional merges and diverges and normal interchange manoeuvres.

Driver Compliance

10.1.2 There are no mandatory features that will require anything unusual with respect to driver compliance.

11 Technology Assessment

11.1 Option Design Implications for the Use of Technology

11.1.1 At this stage in the design no enhancement to the existing technology provision of the A2 is included within the Scheme. The technology requirements for the Scheme therefore would be limited to:

- Relocation of existing technology assets impacted by the new junction layouts;
- Provision of traffic counter/detector loops at the new junction layouts;
- Traffic signal installations possible with SCOOT type operation for closely located sets of signals. As required these installations would also have feed-back to the Highways England and KCC control centres. Agreement with KCC on the operation of traffic signals would be required, and
- As part of the installation of traffic signals provision of CCTV systems to give adequate coverage for the operation of all signal controlled junctions.

11.1.2 At the Bean Junction the options would result in the need to relocate existing final and confirmatory sign and signal gantries on both the eastbound and westbound carriageways. Departures from standard occur due to the retention of existing gantries for the longitudinal position of gantries outside of required tolerances to TD 46/05 where options result in changes in diverge layout and positions. The existing sign and signal gantries at the Ebbsfleet Junction would be retained, though changes in the direction signing would be required.

11.1.3 At the Bean Junction local ducting and cabling, traffic count loops, road side cabinets and the existing CCTV mast would be significantly impacted. The technology at the junction would therefore need to be redesigned. During construction of this junction, an interrupter cable would need to be installed to bypass the whole infrastructure around this junction to allow it to proceed unimpeded.

11.1.4 At the Ebbsfleet Junction existing post mounted signals at the entry slips would need to be relocated including any associated road side cabinets. Existing traffic count loops would also be affected. As part of Stage 2, Genesys will be contacted to identify changes to NRTS Services.

12 Maintenance Assessment

12.1 Maintenance and Repair Strategy for Civils Infrastructure

12.1.1 The overall purpose of inspection, testing and monitoring is to check that highway structures are safe for use and fit for purpose and to provide the data required to support effective maintenance management and planning.

12.1.2 Inspections as summarised in Table 29 and where required testing and monitoring, should:

- Observe and provide information on the current condition, performance and environment of a structure, e.g. severity and extent of defects, material strength and loading;
- Inform analyses, assessments and processes, e.g. change in condition, cause of deterioration, rate of deterioration, identification and quantification of maintenance needs, effectiveness of maintenance and structural capacity, and
- Compile, verify and maintain inventory information, e.g. structure type, dimensions and location.

Table 29 - Summary of inspection types with nominal intervals

Inspection Type	Nominal Interval	Description
Safety inspection (or routine surveillance)	At frequencies, not exceeding one month, which ensure timely identification of safety defects and reflect the importance of a particular route or asset.	Regular visual inspections to identify defects that are likely to create a danger to the public or staff or lead to unnecessarily high maintenance costs or disruption to traffic. These are carried out by cursory inspection from a slow moving vehicle or on foot.
General inspection	2 years	General inspections comprise a thorough visual inspection of representative parts of the civil infrastructure involving visual inspection from the ground level. Report on the physical condition of all civil infrastructure elements visible from the ground level
Principal inspection	6 years	A principal inspection will comprise a close and detailed examination of all accessible parts of the tunnel involving close visual examination, within touching distance, utilising as necessary, suitable inspection techniques. Report on the physical condition of all inspectable civil infrastructure parts..
Speed inspection	Programmed or when needed	Detailed investigation (including as required inspection, testing and/or monitoring) of particular areas of concern or following certain events.

12.1.3 The purpose of maintenance planning and management is to enable the maintenance manager to develop and implement cost effective and sustainable maintenance plans while delivering the required asset performance and levels of service. The maintenance

strategy would optimise opportunities presented by planned closures of the structures where needed and avoid unplanned closures where possible.

12.1.4 To keep the structure in a good state of repair and to avoid the need to replace items and employ specialist services it is necessary to frequently perform basic maintenance. Routine maintenance is minor work carried out on a regular or cyclic basis that helps to maintain the condition and functionality of the structures and reduce the need for other maintenance works.

12.1.5 Preventative maintenance (planned or unplanned) is work carried out to keep the infrastructure open and safe to use and maintain the condition of the structure by protecting it from deterioration or slowing down the rate of deterioration. By timely intervention, preventative maintenance reduces the need for essential work and/ or the likelihood of essential work arising prematurely in the future.

12.1.6 Major overhauls and refurbishment of structural elements are undertaken on a basis that ensures the long term preservation of investment by acting on the agreed recommendations of the Principal Inspection reports.

12.1.7 All of the options being considered involve some civil infrastructure and technology works and would require comprehensive monitoring, inspection and maintenance plans to be developed if they are to remain in service for their expected design life and beyond.

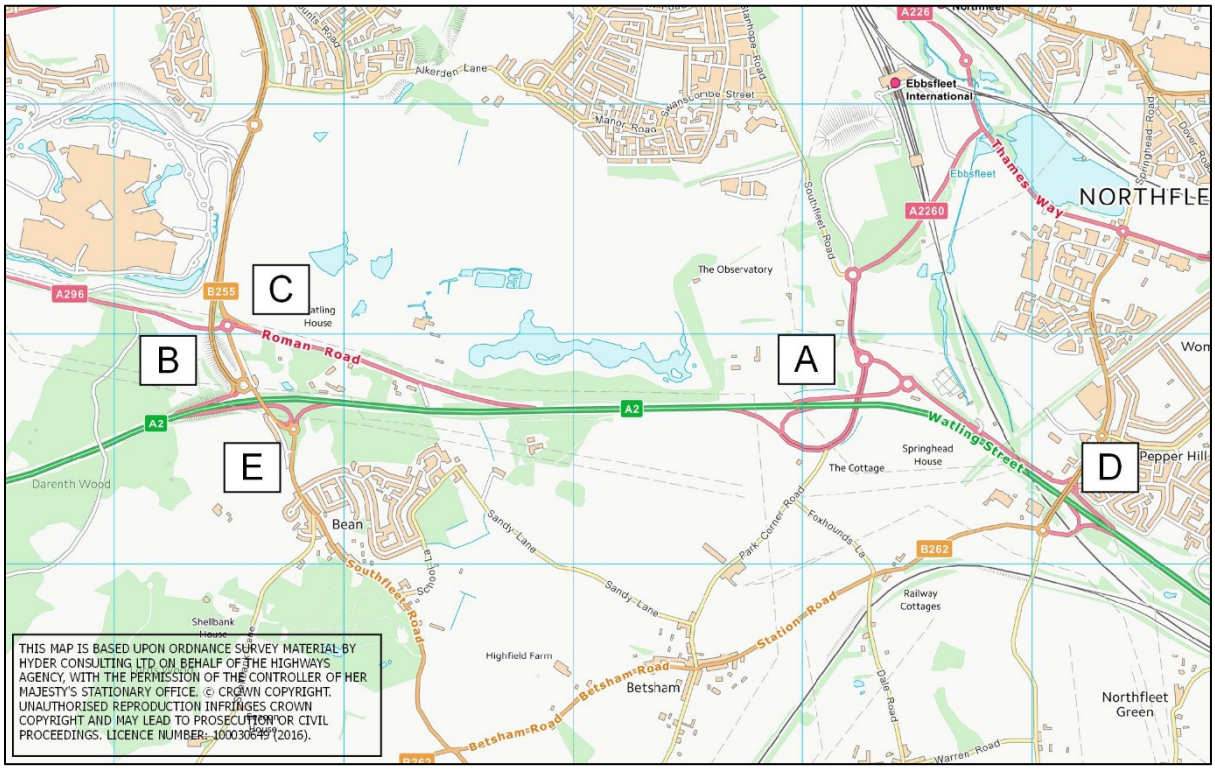
12.1.8 The route options involve lengths of new highways, junction improvements, earthworks, drainage and other items of highways infrastructure including structural and electrical systems. All of these would require a programme of maintenance and periodic renewals.

12.1.9 The maintenance requirement for the new Freeway system would be the largest and costliest component of the scheme. Any general maintenance assessment requirements for the different types of principle use are discussed further in the paragraphs below.

12.2 Maintenance and Repair Strategy for Road-Side Technology

12.2.1 The junction locations involve different types of road and therefore the maintenance considerations for each option have been outlined separately. The locations referenced below are shown in Figure 22.

Figure 22 - Junction locations



12.2.2 Given the timescales involved with the project, it is likely that the use of remote monitoring of roadside equipment will have become more commonplace by the time the scheme is implemented. Such systems have the potential to reduce the need for roadside working by providing greater fault diagnosis and fix capabilities to remote operators. Use of these systems should be explored as part of future phases of the project in order to minimise the need to roadside maintenance visits.

Location A - A2 at A2260 Junction

12.2.3 The implementation of proposed works at Location A includes improvements and amendments to the capacity, layout and size of existing roundabouts, as well as potential signalization control of this location. Access to related infrastructure technology and equipment at this location may require road space booking and permit to work systems for maintenance access, together with night-time working to avoid issues arising from congestion.

12.2.4 The presence of existing similar control measures elsewhere on the A2 means that the local technology maintainers are familiar with this kind of maintenance access arrangement, and as such any maintenance required as part of this project should be relatively straightforward.

12.2.5 To minimise maintenance access restrictions it may be possible to place technology equipment such as control boxes and electrical equipment provision such that it can be accessed from outside of the highway boundary. To enable this arrangement, one issue that would need to be addressed would be the responsibility for maintenance of the soft estate around cabinet and or gantry access locations. Area maintainers have a remit to undertake grass cutting and control of vegetation on the highway estate, and to allow maintenance.

Location B - A2 at B255 Junction

12.2.6 Location B comprises various options and changes to the carriageway layout around the B255 junction. These changes include for installation of a new section of dual carriageway road to realign via a new bridge under the A2; provision of improvements to the existing eastbound capacity; and also realignment of the existing carriageway into a potential bridge over the A2.

12.2.7 Access to related infrastructure technology and equipment at this location, particularly in and around the new structures will require extensive closures and diversion arrangements, road space booking and permit to work systems for maintenance access, together with night-time working to avoid issues arising from congestion.

12.2.8 The presence of existing similar control measures elsewhere on the A2 means that the local technology maintainers are familiar with this kind of maintenance access arrangement, and as such any maintenance required as part of this project should be relatively straightforward.

12.2.9 To minimise maintenance access restrictions it may be possible to arrange technology equipment (such as control boxes, gantry access and electrical equipment) provision such that it can be accessed from outside of the highways boundary. To enable this arrangement, one issue that would need to be addressed would be the responsibility for maintenance of the soft estate around cabinet and or gantry access locations. Area maintainers have a remit to undertake grass cutting and control of vegetation on the highway estate, and to allow maintenance

Location C - A2 at A296 Junction

12.2.10 The implementation of proposed works at Location C includes improvements and amendments to the capacity of the carriageway as well as potential signalization control at roundabouts in this location. Access to any related infrastructure technology and equipment at this location may require road space booking and permit to work systems for maintenance access, together with night-time working to avoid issues arising from congestion.

12.2.11 The presence of existing similar control measures elsewhere on the A2 means that the local technology maintainers are familiar with this kind of maintenance access arrangement, and as such any maintenance required as part of this project should be relatively straightforward.

12.2.12 New access requirements to the Eastern Quarry from this location are anticipated to have little immediate impact on routine or planned maintenance activities, however increased high-load vehicles and routes through the area may impact upon other requirements for maintenance throughout the scheme, particularly in and around access/egress areas.

12.2.13 To minimise maintenance access restrictions it may be possible to place technology equipment such as control boxes and electrical equipment provision such that it can be accessed from outside of the highways boundary. To enable this arrangement, one issue that would need to be addressed would be the responsibility for maintenance of the soft estate around cabinet and or gantry access locations. Area maintainers have a remit to undertake grass cutting and control of vegetation on the highway estate, and to allow maintenance.

Location D - A2 at B262 Junction

12.2.14 The implementation of proposed works at Location D includes improvements and amendments to increase the capacity of the eastbound merge and to realign the link at Pepperhill Road. Access to any altered and realigned or amended sections of the existing carriageway at this location may require road space booking and permit to work systems for maintenance access, together with night-time working to avoid issues arising from congestion.

12.2.15 The presence of existing similar control measures elsewhere on the A2 means that the local technology maintainers are familiar with this kind of maintenance access arrangement, and as such any maintenance required as part of this project should be relatively straightforward.

Location E - A2 at Bean Lane Junctions

12.2.16 The implementation of proposed works at Location E includes significant change of use with potential carriageway realignment, closures and full access/egress restriction to/from the A2, as well as proposed or alternate improvements and amendments to the capacity of the carriageway. Additional further options to amend the capacity of the existing roundabouts and implement signalised controls are also shown within the potential improvements.

12.2.17 Access to any related infrastructure technology and equipment at this location may require road space booking and permit to work systems for maintenance access, together with night-time working to avoid issues arising from congestion.

12.2.18 The presence of existing similar control measures elsewhere on the A2 means that the local technology maintainers are familiar with this kind of maintenance access arrangement, and as such any maintenance required as part of this project should be relatively straightforward.

12.2.19 New access requirements to the Eastern Quarry from this location are anticipated to have little immediate impact on routine or planned maintenance activities, however increased high-load vehicles and routes through the area may impact upon other requirements for maintenance throughout the scheme, particularly in and around access/egress areas.

12.2.20 To minimise maintenance access restrictions it may be possible, to place technology equipment such as control boxes and electrical equipment provision such that it can be accessed from outside of the highways boundary. To enable this arrangement, one issue that would need to be addressed would be the responsibility for maintenance of the soft estate around cabinet and or gantry access locations. Area maintainers have a remit to undertake grass cutting and control of vegetation on the highway estate, and to allow maintenance.

13 Environmental Assessment

13.1 Noise and Vibration

Comparison of options

13.1.1 Option B03E01b is generally beneficial. In the short term 8 receptors spread across the study area would be subject to Major adverse noise increases of over 5dB. 31 receptors are forecast to experience a Major beneficial impact in the form a reduction in excess of 5dB. In the long term 4 of the same receptors are predicted to experience Major adverse effects, these increases are focused in the west of the study area. There are 24 properties that are predicted to experience a Major beneficial reduction in noise of greater that 10dB. There are 7 DEFRA designated Noise Important Areas in the study area. None of these are predicted to experience significant effects in either scenario. In this option, 3 of the Hope cottages would be demolished and those that would remain and Ightham cottages would experience some noise increases.

13.1.2 Option B04bE01b is generally beneficial. In the short term there are 7 receptors predicted to experience a Major dis-benefit in noise, these receptors are largely focussed in Ebbsfleet with one being located in Bean. In the short term 66 receptors are predicted to benefit from a reduction in noise greater than 5dB, a change classed as Major Beneficial. In the long term 2 dwellings are forecast to be subject to Major Adverse noise increases of over 10dB, these are both in Bean Village. In the same scenario 9 dwellings are predicted to benefit from a reduction in noise greater than 10dB. Of the 7 DEFRA identified Noise Important Areas on is expected to observe a perceptible increase in the short term however in the long term they are all predicted to benefit from a decrease in noise. In this option, no cottages are demolished and all Hope and Ightham cottages would experience some noise increases.

13.1.3 Option B05E01b is generally beneficial. In the short term 7 receptors are predicted to experience an adverse increase of more than 5dB, this is classed as Major Adverse. The dwellings are spread across the study area. There are 37 receptors predicted to benefit from a decrease in excess of 5dB, this is classed as a Major Benefit. In the long term 2 receptors are predicted to suffer increases greater than 10dB, these receptors are located to the north of the Bean Junction on the A2. In the same scenario 25 receptors are predicted to experience a Major beneficial noise reduction in excess of 10dB. Similar to B04bE01b, of the 7 NIA's, one is predicted to observe an increase of over 1dB in the short term. In the long term they are all predicted to benefit from a noise reduction. With this option, all Ightham cottages are demolished. The Hope cottages would experience some noise increases.

13.1.4 Each of the three options would result in minor variations in the temporal and spatial effects. All three options are classified as beneficial in terms of a positive WebTag value, with Option B03E01b having the greatest positive NPV Value.

Mitigation

13.1.5 For all three options it is assumed that all new roads and all roads in the future year will be surfaced with low noise surfacing therefore minimising the type noise. It may also be prudent to implement noise barriers in order to protect certain groups of receptors.

13.2 Air Quality

Comparison of options

13.2.1 The Scheme is not predicted to cause any exceedances of the AQS objectives for NO_2 and PM_{10}. Additionally, there are no receptors in exceedance which increase in concentration as a result of the Scheme. All 'with Scheme' concentrations at receptors are well below the annual mean AQS objectives for NO_2 and PM_{10}. 13 receptors would have an increase in concentrations with the Scheme, and 15 receptors would have a decrease with the Scheme. No significant impacts at ecological receptors are predicted.

13.2.2 Options B03E01b and B04bE01b are not predicted to cause any exceedances of the AQS

objectives for NO_2 and PM_{10}. Additionally there are no receptors in exceedance which increase in concentration as a result of the Scheme. All 'With Scheme' concentrations at receptors are well below the annual mean AQS objectives for NO_2 and PM_{10}. 8 receptors would have an increase in concentrations with the Scheme, and 11 receptors would have a decrease with the Scheme. No significant impacts would arise at ecological receptors.

13.2.3 Option B05E01b is not predicted to cause any exceedances of the AQS objectives for NO_2 and PM_{10}. Additionally there are no receptors in exceedance which increase in concentration as a result of the Scheme. All 'with Scheme' concentrations at receptors are well below the annual mean AQS objectives for NO_2 and PM_{10}. 11 receptors would have an increase in concentrations with the Scheme, and 16 receptors would have a decrease with the Scheme. No significant impacts would arise at ecological receptors.

13.2.4 For all three of the Scheme options, none are predicted to cause any exceedances of the AQS objectives for NO2 and PM10. Additionally, there are no receptors in exceedance which increase in concentration as a result of the Scheme. All 'with Scheme' concentrations at receptors are well below the annual mean AQS objectives for NO2 and PM10. The number of receptors predicted to experience an increase in concentrations and decrease in concentrations with the Scheme does vary across the different options but not considerably. More detail can be found in the Stage 1 EAR, Chapter 7 Air Quality.

Mitigation

13.2.5 For the operational phase at this stage mitigation is unlikely as no significant impacts are predicted. The assessment would be further refined at future stages to incorporate updated traffic data etc.

13.3 Landscape & Visual

Comparison of options

13.3.1 For landscape and townscape Option B03E01b would incur Significant adverse effects on Darenth Wood Country Park and landscape character area Darenth Wood and Bean Woods, Significance adverse effect on Bean Village, residents of North Bean, and Bean Farm and significant adverse effects on residents of Hope and Ightham Cottages and Bean House. For these reasons it is the least preferred option from a landscape and townscape perspective.

13.3.2 Option B04bE01b would incur Significant adverse effects on Darenth Wood Country Park and landscape character area Darenth Wood and Bean Woods, a significant adverse effect on Bean Village, residents of North Bean and Bean Farm, and significant adverse effects on residents of Hope Cottages and Bean House

13.3.3 The most preferred option is B05E01b which would incur significant adverse effects on Hope Cottages. The least preferred option is B03E01b.

Mitigation

13.3.4 It has been considered that a reasonable level of mitigation would be in place as part of the Scheme. The following assessment will take into account appropriate mitigation and enhancement measures, listed below, to minimise the negative effects of the Scheme on the landscape and townscape resource and on the visual amenity of the study area and would include the following;

- Developing a sensitively routed and well-designed Scheme in line with DMRB Good Roads Guide to ensure good fit with the scale and character of the landscape and townscape resources;
- Developing a street lighting design strategy to minimise light pollution;
- Retaining and protecting mature and healthy trees and hedges wherever possible;
- Providing embankment planting wherever possible and match adjacent vegetation;
- Providing gap planting to enhance screening;

- Developing ecological enhancement areas;
- Retaining natural character and enhance with local species;
- Replanting of woodland edges; and
- Providing screening with vegetation or environmental barriers to help screen the Scheme in local views.

13.3.5 These measures would also be considered as part of the development of a future CEMP.

13.3.6 Standard mitigation for each of the three options would therefore be:

- Develop a sensitively routed and well-designed Scheme in line with DMRB Good Roads Guide to ensure good fit with the scale and character of the landscape and townscape resources;
- Develop a landscape strategy for external hard and soft landscaped areas for highway corridors (to include use of native species of local provenance where possible) and for screening purposes including vegetation buffer and other visual barriers;
- Develop an integrated strategy for landscape, habitat creation/enhancement and access improvement works;
- Develop lighting design strategy to minimize light pollution, and
- Divert rights of way where appropriate.

13.4 Cultural Heritage

Comparison of options

13.4.1 Option B03E01b would permanently affect 1 nationally designated site with minimal opportunity to mitigate the impact. The scheduled monument at Darenth Wood would be physically impacted, and several regionally designated and potentially nationally significant sites would be permanently affected. Setting would be minimally impacted but effects could be reduced over time with planting or fencing.

13.4.2 Option B04bE01b would result in several regionally designated and potential nationally significant sites permanently affected. These sites relate to the Roman settlement at Springfield and include a burial ground and a landing stage and other settlement activity such as a kiln, courtyard and well. The setting would be minimally impacted but effects could be reduced over time with planting or fencing. In addition, for Option B04bE01b potential impacts to the settings of two Grade II listed buildings (designated heritage assets) have been identified.

13.4.3 Option B05E01b, is the preferred option in terms of Cultural Heritage. Option B05E01b would leave several regionally designated and potential nationally significant sites permanently affected with minimal opportunity to reverse impacts. These sites relate to the Roman settlement at Springfield and include a burial ground and a landing stage and other settlement activity such as a kiln, courtyard and well. The effects could be reduced over time with planting or fencing

Mitigation

13.4.4 It may be possible to mitigate the impacts of the Scheme options to the setting of heritage assets through design measures to lessen visual intrusion such as tree planting or the installation of earthwork barriers. Direct physical impacts can also be mitigated through realignment of Scheme options resulting in ‘preservation in-situ’ or through ‘preservation by record’ (historic building recording or archaeological excavation) prior to construction works commencing.

13.4.5 Options for mitigation which are currently under consideration are as follows:

- It may be possible to mitigate the impact on SM1 through the construction of a revetment wall. In addition, archaeological recording via excavation prior to construction works or an archaeological watching brief during construction work would also help to mitigate the impacts on this asset. This would conflict with the

generally accepted practice of preservation in situ, however the extent of the preserved remains below the existing roadway is currently unknown.

- Impacts on the listed buildings could be mitigated by screening views to and from the listed buildings with fencing or planting. Fencing or planting could also be used to mitigate impacts on the other scheduled monuments within the study area.
- Impacts on buried archaeological remains could be mitigated through archaeological recording either by archaeological excavation prior to construction or archaeological watching brief during construction.
- Details of appropriate mitigation for direct physical impacts along with the methodology for carrying out this mitigation would be presented in a Written Scheme of Investigation (WSI). The WSI would be referenced in the CEMP and the key points from the WSI included in the CEMP.
- Depending on which option is selected as the preferred option, it may be necessary to review the requirements for further study at the next project stage in order to inform further mitigation. At this stage it is not possible to rule out the possible need for future intrusive evaluation surveys to further assess the possible impacts of the Scheme.

13.4.6 For Option B03E01b mitigation for directly affected sites would not be sufficient to reduce the impact to the nationally designated site. For Options B04bE01b and B05E01b however mitigation is likely to be required.

13.5 Ecology and Nature Conservation

Comparison of options

13.5.1 Option B03E01b has the greatest significance of effect on ecology and nature conservation, with reducing effect for Option B04bE01b and B05E01b.

13.5.2 Option B03E01b would cause permanent and irreversible loss of ancient woodland at Darenth Wood SSSI, significant loss to high value hazel dormouse habitat and localised loss or disturbance to other receptors, including possible loss of bat roosts and a main badger sett.

13.5.3 Option B04bE01b would result in permanent and irreversible loss of a small section of the Thrift ancient woodland, loss and permanent fragmentation of semi-natural woodland (not ancient); temporary loss of high value dormouse habitat and possible fragmentation of population and localised loss or disturbance to other receptors, including possible loss of bat roosts.

13.5.4 Option B05E01b would have the lowest significance of effect and therefore be the preferred option from a biodiversity point of view. Impacts would include the loss of a small area of high value hazel dormouse habitat and localised loss or disturbance to other receptors, including possible loss of bat roosts.

Mitigation

13.5.5 All design and construction work would be carried out in accordance with a number of generic mitigation measures and follow best practice guidelines that would prevent damage, or loss to ecological resources. It is anticipated that the following generic measures would be applied:

Design

- Adverse impacts on ecological resources would be avoided where possible. Detailed design of the selected option would aim to minimise landtake and habitat loss. This could include minor design amendments to avoid damage or loss to a valuable ecological feature and locating access tracks/haul roads and site compound/material storage areas outside of ecologically sensitive habitats;
- Spray from the road would be minimised through provision of adequate drainage to prevent water pooling on the road. Woodland habitat would be buffered from spray with landscape planting;
- The road lighting design would aim to minimise light spillage away from the road.

Construction

- Impacts arising from construction would be managed through the Construction Environmental Management Plan (CEMP). Best practice pollution prevention and control measures would be adopted to ensure that ecological resources are not adversely affected by dust created during construction, storm water runoff or accidental spillages from construction sites;
- Vegetation removal would be minimised. Land cleared of vegetation for temporary construction works would be replanted following construction, these would be native species appropriate to the local area;
- All ecological resources would be reassessed prior to construction and where necessary update surveys carried out, and
- An Ecological Clerk of Works (ECoW) would be appointed. The ECoW would be responsible for overseeing works that could, without appropriate control, cause damage or loss to an ecological resource during the construction phase; and
- Timing of site clearance works would be programmed to avoid the most sensitive seasons.

13.5.6 Ancient woodland is an irreplaceable resource. Under Option B03E01b significant compensatory planting is likely to be required. Hazel dormouse mitigation would include EPSL license, habitat manipulation and/or translocation of individuals and compensatory habitat planting and landscape planting reinstated. Bats, if found, would require mitigation and could include construction of artificial roosts. The loss of a badger sett would require an artificial sett to be constructed. Options B04bE01b and B05E01b would require hazel dormouse mitigation to include EPSL licence habitat manipulation and/or translocation. Bats, if found, would require mitigation and could include construction of artificial roosts.

13.6 Road Drainage and the Water Environment

Comparison of options

13.6.1 Development associated with Option B03E01b would take place within SPZ 1s as well as being above principal and secondary A aquifers. There are no proposed cuttings or piling. This would minimise the risk of impact to the groundwater below but there may be local ground works (gantries etc.) that could affect groundwater flows. In reference to the Ebbsfleet Junction, proposed cuttings by the SPZ 1 as well as an existing infiltration ditch currently present the greatest risk but the large depth (30 – 50 mbgl) to the water table will reduce the risk to a degree. Caution would be taken as the water table in the Ebbsfleet Junction area is very close to the ground surface. Some contaminated land identified near Option B03E01b may have implications for construction workers on site. Workers may become exposed to contaminants if contamination is present in near surface soils. Appropriate PPE and adopting a watching brief reporting any indications of contamination will mitigate risks.

13.6.2 Although development associated with Option B04bE01b would take place above a SPZ 2, an infiltration ditch would still be present above the SPZ 1 as well as being above principal and secondary A aquifers. This presents the greatest risk, though the deep water table would reduce risk to a degree. Some contaminated land identified near the option may have implications for construction workers on site. Workers may become exposed to contaminants if contamination is present in near surface soils. Appropriate PPE and adopting a watching brief reporting any indications of contamination will mitigate risks.

13.6.3 Development associated with Option B05E01b would take place within SPZ 1s as well as being above principal and secondary A aquifers. No proposed cuttings or pilings are proposed. The risk of impact to the groundwater below is probably minimised but there may be local ground works (gantries etc.) that need to be considered. There are no proposed soakaways or infiltration ditches. Caution should still be taken however as the water table in the Ebbsfleet Junction area is very close to the ground surface. Some contaminated land identified near the option may have implications for construction workers on site. Workers may become exposed to contaminants if contamination is present in near surface soils. Appropriate PPE and adopting a watching brief reporting any

indications of contamination will mitigate risks

Mitigation

13.6.4 All design, construction and operation work would be carried out in accordance with a number of generic mitigation measures and follow best practice, guidelines, including DMRB, that would prevent damage, or loss to the water environment and prevent harm to human health.

13.6.5 For each scheme option the following standard mitigation is appropriate:

- The principal aquifer is an irreplaceable resource. Mitigation would involve addition of pollution controls (if not already in place), reducing discharge volumes and/or other mitigation to be agreed with the Environment Agency at a later Stage once further surveys and assessments have been undertaken.

13.7 Physical Activity

13.7.1 Changes in the number of pedestrians/cyclists/equestrians or their average journey times are anticipated to be insignificant, however this has not been considered in detail at this stage and will be considered in further detail at Stage 3.

13.8 Journey Quality

13.8.1 Overall, journey quality is expected to improve as a result of the Scheme. However this has not been considered in detail at this stage and will be considered in further detail at Stage 3.

14 Appraisal Summary

14.1 Appraisal Summary Tables

14.1.1 Refer to Appendix I for the AST for each proposed option combination.

14.2 Summary of Consultation with Public Bodies

14.2.1 The Assessment of Implications on European Sites (AIES) PCF product was completed and issued to Natural England for consultation response on 04/11/2014. The AIES concluded that no significant effects were likely from the scheme on designated European sites and this view was confirmed by Natural England.

14.2.2 Consultation undertaken to date as part of the environmental assessment process is provided in Table 30 below:

Table 30 - Summary of Consultation with Public Bodies

Organisation	Contact Details	Date	Description
Dartford Borough Council (DBC)	Sonia Bunn, Planning (Major Projects)	1 October 2014	Obtained contact details for DBC specialist officers and electronic files from Dartford Local Plan proposals map
Gravesham Borough Council (GBC)	Tony Chadwick, Principal Planning Officer	1, 7 & 8th October 2014	Obtained contact details for GBC specialist officers and electronic files from Gravesham Local Plan proposals map
Kent County Council (KCC)	Joseph Williamson, Flood Risk Project Officer 03000 413481 Joseph.williamson@kent.gov.uk Kent County Council offices at Invicta House, Maidstone John Pelham, Public Rights of Way and Access Service 03000414132 John.pelham@kent.gov.uk	17 October 2014 16 May 2016	Confirmation that KCC has no record of flooding or groundwater abstraction sites in the vicinity. KCC has no record of KCC maintained infrastructure affecting the A2BE road or slips within the study area. Obtained Public Rights of Way (PRoW) layout from definitive map
Environment Agency	Karen Rigg, Customers and Engagement Officer 01732 223 224 kslenquiries@environment-agency.gov.uk Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH	30 October 2014	Obtained data relating to, groundwater, discharges to ground and surface water, WFD and sensitive waterbodies.
Kent Historic Environment Record	Paul Cuming, 03000 413358, heritage@kent.gov.uk, Heritage Conservation Group, Kent County Council, Maidstone, ME14 1XX	22/09/2014	Data on recorded heritage assets
English Heritage	Paul Roberts, Inspector of Ancient Monuments, 01483	06/03/2014	Confirmation of designated assets potentially impacted by the

Organisation	Contact Details	Date	Description
	252000, Eastgate Court, 195-205 High Street, Guildford, Surrey, GU1 3EH		Scheme. Emphasis on avoiding impact to heritage assets and retention of listed footbridge.
Natural England	Anita Moore, Planning Advisor, Sustainable Development Consultations Team	04/11/2014	Consulted on the screening for the Assessment of Implications on European Sites (AIES) and confirmed no significant effects were likely.
Dartford Borough Council, Gravesham Borough Council, Kent County Council, Historic England, Environment Agency, Natural England	Environmental Workshop with Statutory Environmental Bodies to provide opportunity to discuss current scheme and Environmental Constraints and Scoping Report. Action from meeting: Cultural Heritage specialist to discuss with Kent County Council (prior to end of desk based assessment) to ensure relevant information has been captured appropriately).	3/2/2016	Workshop on the current scheme (February 2016) and Environmental Constraints and Scoping Report
Kent County Council (KCC)	Lis Dyson, Heritage Conservation Manager, Kent County Council	24/05/2016	Addressing the concerns raised in statutory bodies responses

14.3 Comparison of Options

14.3.1 Table 31 below summarises the most and least preferred Scheme Option for each environmental topic based on the predicted significance of effect as determined through the environmental assessments undertaken to date. More information can be found in the Stage 1 EAR and in Section 13 above.

Table 31 - Comparison of Options from an Environmental Perspective

Environmental Topic	Preferred Scheme Option	Least Preferred Scheme Option
Noise	No significantly distinguishable differences between the three options	No significantly distinguishable differences between the three options
Local Air Quality	B05E01b	B03E01b
Landscape and Townscape	B05E01b	B03E01b
Historic Environment	B05E01b	B03E01b
Biodiversity (Ecology and Nature Conservation)	B05E01b	B03E01b
Water Environment	No significantly distinguishable differences between the three options	No significantly distinguishable differences between the three options
Physical Fitness	N/A	N/A
Journey Ambience	N/A	N/A

14.3.2 To summarise the comparison of options in relation to environment, Option B05E01b is the overall option with the fewest significant effects and is the preferred option for Air Quality, Landscape and Townscape, Historic Environment, and Ecology and Nature Conservation, with no significant distinguishable differences between the three options for Noise and Water and Road Drainage and no distinguishable differences between Option B03E01b and B05E01b for Physical Fitness and Journey

Ambience.

14.3.3 Option B03E01b has the greatest potential adverse effects across the environmental topics when taken as a whole entity.

14.3.4 Further assessment work will be undertaken in Stage 2 for Air Quality and Noise and Stage 3 for the other environmental topics, in order to advance the assessment as the options are reduced. Further scheme specific mitigation, required to minimise the impact on the environment, will also be determined as the design progresses throughout Stage 2 and 3.

14.3.5 From an economic perspective Option B05E01b has the most favourable BCR, followed by Option B03E01b and then Option B04E01b.

15 Programme

15.1 Assumption on Statutory Process

15.1.1 It is expected that each of the shortlisted options will required land acquisition and/or creation of new highways to implement the scheme. Consequently a statutory process will be required to obtain the powers to acquire land and/or create new highways. The statutory powers will be provided through either the Planning Act 2008 or the Highways Act 1980, depending on the designation of the scheme as a Nationally Significant Infrastructure Project (NSIP).

15.1.2 For the purposes of project scheduling the preferred scheme is likely to be designated as an 'alteration' to the highway and the 'area of development of the scheme' is expected to exceed the thresholds defined in *The Highway and Railway (Nationally Significant Infrastructure Project) Order 2013*. Consequently the scheme would be defined as an NSIP and would thus follow the statutory process defined in the Planning Act 2008. The designation of the scheme as an NSIP will be reviewed following preferred scheme announcement.

15.2 Outline Project Schedule to Completion

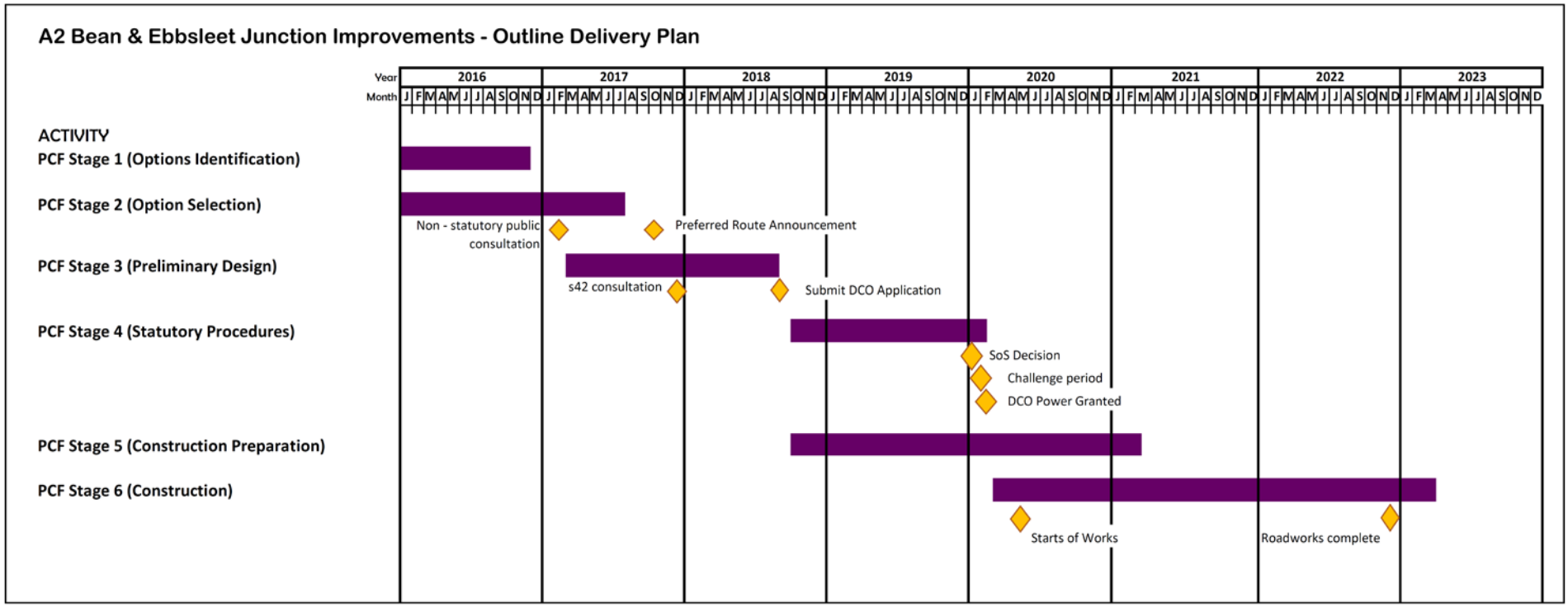
15.2.1 Figure 23 shows the indicative project schedule for the development and construction of the proposed improvements using Highways England's Project Control Framework stage definitions for reference. All indicative dates are subject to the satisfactory conclusion of all preceding stages and the availability of funding for the project.

The following key events are noted:

- Commence public consultation on options – January 2017;
- Preferred route/option announcement – Autumn 2017;
- Submission of development consent order – Summer 2018;
- Development consent order powers granted – early 2020;
- Commence construction – Spring 2020; and
- Improvements fully open to traffic – end of 2022.

15.2.2 The construction programme will be subject to further review with key stakeholders to coordinate the works around other proposed infrastructure projects in the local area to minimise impact upon the local and travelling public.

Figure 23 - Indicative project schedule



Notes

These intermediate milestones are for internal planning purposes and are not public commitments. As such, they may be brought forward, or moved back, if that achieves an earlier start of construction.

16. Stakeholder Engagements

16.1 Approach to Engagement Prior to Public Consultation

16.1.1 It is recognised that the Scheme is delivering improvements to the junctions at Bean and Ebbsfleet that support the wider economic growth in the Kent Thameside area in general and the Ebbsfleet Garden City area in particular. Consequently it has been important to regularly engage with the principal planning and delivery stakeholders early in the process to ensure that discussions informed the design of the options being proposed so they meet, as far as is possible within available budget, objectives that are acceptable to all parties.

16.1.2 The local authorities with planning responsibility who have been engaged since January 2014 during the re-commissioning and option selection stages of the project include:

- Kent County Council;
- Dartford Borough Council;
- Gravesham Borough Council, and
- Ebbsfleet Development Corporation (or its representatives prior to its formal incorporation)

16.1.3 Furthermore other stakeholders have been engaged for the purposes of gathering information and providing progress updates and feedback on the approach that Highways England is taking to addressing stakeholder issues and developing options for public consultation. Other stakeholders engaged include:

- Statutory utility companies;
- Statutory environmental bodies;
- London Paramount Entertainment Resort, and
- Bean Residents Association.

16.2 Engagement Activities Undertaken

Table 32 - Summary of principal stakeholder engagement events

Event	Date	Attended by representatives of:	Purpose
Project Planning Workshop	12/03/14	Kent County Council Gravesham Borough Council Dartford Borough Council	To set out an outline schedule for project delivery
Value management workshop 0	24/07/14	Kent County Council Gravesham Borough Council Dartford Borough Council	To review and agree the Client Scheme Requirements for the options phase.
AIES Consultation	04/11/14	Natural England	Consulted on the screening for the Assessment of Implications on European Sites (AIES) and confirmed no significant effects were likely to occur
Value management workshop 1A	26/03/15	Kent County Council Gravesham Borough Council Dartford Borough Council Ebbsfleet Development Corporation	To review the High Level Concept options (see section 6.2)
Value management workshop 1B	25/08/16	Kent County Council Gravesham Borough Council Dartford Borough Council	To review and agree the options proposed for public consultation and those which have been considered but rejected (see section 6.5)

Event	Date	Attended by representatives of:	Purpose
		Ebbsfleet Development Corporation	
Uncertainty Log Stakeholder Consultation	27/05/15	Kent County Council Gravesham Borough Council Dartford Borough Council Ebbsfleet Development Corporation	To review the assumptions being taken with respect to planned developments for inclusion as forecasting baselines for traffic modelling purposes.
Traffic Forecasting Workshop 2	26/10/15	Kent County Council Gravesham Borough Council Dartford Borough Council Ebbsfleet Development Corporation	To review the traffic impact of the proposed developments on the local road network and any improvement to the Bean and Ebbsfleet junctions. To review the development of options since Value management workshop 1A (see section 6.3 – excluding Bean option 5).
Statutory Environmental Bodies workshop	03/02/16	Dartford Borough Council Gravesham Borough Council Kent County Council Historic England Environment Agency Natural England	Workshop with Statutory Environmental Bodies to discuss and agree the approach to assessment of options as contained in the Environmental Constraints and Scoping Report and to introduce options being investigated as part of PCF Stage 1.
Long list options review meeting	16/02/16	Kent County Council	To appraise technical specialist within Kent County Council of the scope of the long list of options (see section 6.3 – excluding Bean option 5). Also discussed traffic management implications of Bean Option 1
Value management workshop 1B	25/08/16	Kent County Council Gravesham Borough Council Dartford Borough Council Ebbsfleet Development Corporation	To review and agree the options proposed for public consultation and those which have been considered but rejected (see section 6.5)
Stakeholder mapping workshop	05/12/14	Dartford Borough Council Gravesham Borough Council Kent County Council London Paramount Entertainment Resort project	To identify local stakeholders who should be engaged in the development of the scheme and their relative influence and interest
Engagement coordination meetings	26/03/15 17/07/15 26/10/15 02/12/15 24/02/16 20/04/16 06/07/16	Dartford Borough Council Gravesham Borough Council Kent County Council Ebbsfleet Development Corporation Highways England Lower Thames Crossing project London Paramount Entertainment Resort project	To share knowledge on stakeholder engagement activities undertaken or planned by other projects in the area and to coordinate a programme of consultation activities. Meetings held approximately quarterly.

Event	Date	Attended by representatives of:	Purpose
BRA Engagement	16/02/15 03/12/15	Bean Residents Association committee	To provide updates on programme and opportunity to give feedback on Highways England's approach.
BRA presentation	07/12/15	Bean Residents Association open meeting	To provide information to the residents of Bean of how Highways England is approaching investigating options to improve Bean and Ebbsfleet junctions and issues that need to be addressed. Also to receive feedback on issues of importance to the residents of Bean.
NRSWA C3 Enquiries	April 2016	Statutory Utility companies	Request for budget cost estimate for diversionary works for scheme options that may affect plant (generic option present for pricing purposes).
EDC Utility Working Group	09/08/16	Utility Organisations	Utility Co-ordination across projects
BRA Meeting	17/08/16	Bean Residents Association	Project update
Asset Management Briefing	05/09/16	Kent County Council	Project update to and presentation of Options under consideration.

17. Conclusions and Recommendations

17.1 Conclusions

17.1.1 Improvements to the Bean and Ebbsfleet Junctions on the A2 are considered necessary to support the level of development proposed for Kent Thameside. Without improvements to these junctions significant future traffic congestion will result which will have an adverse impact on the operation of the A2 and will be a constraint on economic development and housing growth in the area.

17.1.2 The schemes are committed within the Road Investment Strategy, subject to 'other contributions'.

17.1.3 The key scheme objectives captured in the Client Scheme Requirements are to:

- Support economic development and housing growth in Kent Thameside;
- Minimise the impact of developments on the performance of the A2 mainline;
- Achieve a BCR of at least 2.0;
- Minimise environmental impact;
- Reduce accident rates for all users, and
- Integrate with the wider strategic objectives of accessibility within Kent Thameside.

17.1.4 Following consideration of the objectives set out above and a close examination of the full range of existing conditions, a number of options for the improvement of the junctions were identified and sifted, resulting in an accepted recommendation that three options at Bean and one option at Ebbsfleet be taken forward for further appraisal. These were Bean Options 3, 4b and 5 and Ebbsfleet Option 1. Appraisal was undertaken for each of the Bean options in conjunction with Ebbsfleet Option 1b (i.e. B03E01b, B04bE01b and B05E01b).

17.1.5 The results of the appraisal for the identified Options at Bean (each in combination with the single option at Ebbsfleet) against the specific Scheme Objectives set out above and the various appraisal factors are as set out below in Table 33.

Table 33 - Summary of Option Appraisal

	Option 3	Option 4b	Option 5
Description	Replaces the existing double roundabout layout with a single large traffic signal controlled gyratory with two structures crossing the A2, the existing Bean Road Overbridge and a new bridge crossing located to the west.	Provides a redesigned dumbbell arrangement comprising two new roundabouts located either side of the A2. A new bridge crossing of the A2 is provided on the new link road and the existing Bean Road Overbridge is demolished.	Retains the existing junction layout but with the existing roundabouts enlarged and converted to full traffic signal control. A new bridge over the A2 for southbound traffic is provided to the east of the existing Bean Road Overbridge, retained for northbound traffic.
Performance Against Scheme Objectives			
Support Economic Development	Provides additional capacity at junctions		
Reduction in average delay per vehicle over a 12 hour period by 2041	0.1 minutes	0.075 minutes	0.125 minutes
Minimise the impact on the A2 mainline	Little difference in terms of journey times along the A2 and no blocking back onto the A2 mainline from the junctions		
Congestion by 2041			
BCR	1.4	0.6	1.7
Excluding Wider Economic Benefits			
BCR			

Including Wider Economic Benefits	1.7	0.8	2.1
Minimise Environmental Impact	(see below for specific appraisal factors)		
Safety Reduction in KSI accidents over 60 year period	25.1	5.2	11.5
Integration within Kent Thameside	Improved integration and accessibility		
Performance Against Specific Appraisal Factors			
Construction Impact	Medium	Medium	Medium
Maintenance assessment	Similar impact	Similar impact	Similar impact
Noise impact	Slightly beneficial	Slightly beneficial	Slightly beneficial
Air Quality impact	Unlikely to lead to a significant impact		
Greenhouse gases	Positive impact	Positive impact	Positive impact
Landscape impact	Moderate adverse	Moderate adverse	Slight adverse
Townscape impact	Moderate adverse	Moderate adverse	Slight adverse
Historic environment	Large adverse	Moderate adverse	Slight adverse
Biodiversity	Large adverse	Moderate adverse	Slight to moderate adverse
Water environment	Moderate adverse	Moderate adverse	Moderate adverse
Wider Economic Benefits	£22m	£12.4	£22m
Journey time savings	£123.2m	£75.5m	£129.7m
Physical activity	Neutral	Slight adverse	Neutral
Journey quality	Moderate beneficial	Moderate beneficial	Moderate beneficial
Land take – community	Negligible Adverse	Moderate Adverse	Negligible Adverse
Land take – private assets	Major Adverse [1]	Moderate Adverse [2]	Major Adverse [3]
Land take – development land	Negligible Adverse	Negligible Adverse	Negligible Adverse
Land take – agricultural land	Minor Adverse	Minor Adverse	Negligible Adverse
Scheme Cost (Most likely estimate)	£145m	£143m	£125m

[1] Three cottages at Hope Cottages would need to be demolished, with land take from three others.

[2] No direct impact on residential properties, but buildings and land at the Spirits Rest Horse Sanctuary would be required.

[3] All eleven Ightham cottages would be required, as well as buildings and land at the Spirit's Rest Horse Sanctuary.

17.2 Recommendations

17.2.1 While it is recognised that Option B05E01b requires the demolition of Ightham Cottages and the acquisition of assets at the Spirits Rest Horse Sanctuary, this Option has the best performance against the Scheme Objectives and against the majority of the appraisal factors and hence it is recommended that this Option be taken forward to public consultation.

17.2.2 It is recommended that Option B04bE01b is not taken forward to public consultation because, while it does not require the acquisition of any residential properties, it has the poorest overall performance against the assessment criteria and would have an impact on the Thrift ancient woodland. It provides very low value for money (with a BCR of less than 1.0). The cost of Bean Option 4b with Ebbsfleet Option 1b is £143m which exceeds the scheme budget.

17.2.3 It is recommended that Option B03E01b is not taken forward to public consultation because it would have an impact on Darenth Wood SSSI ancient woodland and does not provide any additional significant benefit compared to Option B05E01b whilst costing an additional £20m. The option also requires the acquisition of three properties and impacts on a further three. It provides low value for money (with a BCR of less than 1.7). The cost of Bean Option 3 with Ebbsfleet Option 1b is £145m which exceeds the scheme budget.

17.2.4 In summary, it is therefore recommended that Option B05E01b be taken forward to public consultation.

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APPENDIX A: Existing Conditions Capacity Analysis

Table A- 1 - Capacity Analysis by Road Classification

Site Details	Road Number	Road Nme	Road Class	Road Type	Dirn	No. of Lanes	Traffic Flow			Capacity			Volume to Capacity Ratio		
							AM	IP	PM	AM	IP	PM	AM	IP	PM
TRADS-30026076EB	A2	A2 Mainline M25J2-B255	M	Dual Carriageway	EB	4	3953	4127	6502	8000	7600	8400	49%	54%	77%
TRADS-30026077WB	A2	A2 Mainline M25J2-B255	M	Dual Carriageway	WB	4	5553	3564	4452	8000	7600	8400	69%	47%	53%
TRADS-30026086EB	A2	A2 Mainline Within B255	M	Dual Carriageway	EB	3	3335	3172	5684	6000	5700	6300	56%	56%	90%
TRADS-30025534WB	A2	A2 Mainline Within B255	M	Dual Carriageway	WB	3	4737	2697	3369	6000	5700	6300	79%	47%	53%
TRADS-30026097EB	A2	A2 Mainline B255-A2260	M	Dual Carriageway	EB	4	4188	4256	7253	8000	7600	8400	52%	56%	86%
TRADS-30026098WB	A2	A2 Mainline B255-A2260	M	Dual Carriageway	WB	4	6629	4073	4982	8000	7600	8400	83%	54%	59%
CJC-25DA	B255	A2 Bean B255 Onslip	M	Onslip	WB	1	508	681	857	2000	1900	2100	25%	36%	41%
CJC-25OA	B255	A2 Bean B255 Offslip	M	Offslip	WB	2	1666	1003	1246	4000	3800	4200	42%	26%	30%
TRADS-30026088EB	B255	A2 Bean B255 Offslip	M	Offslip	EB	2	605	951	1033	4000	3800	4200	15%	25%	25%
CJC-23DB	A296	A2 Bean B255 Onslip	M	Onslip	EB	1	930	1033	1604	2000	1900	2100	47%	54%	76%
TRADS-30026104EB	A2	A2 Mainline Within A2260	M	Dual Carriageway	EB	4	3242	3463	6117	8000	7600	8400	41%	46%	73%
TRADS-30026102WB	A2	A2 Mainline Within A2260	M	Dual Carriageway	WB	4	6104	3702	4437	8000	7600	8400	76%	49%	53%
TRADS-30026112EB	A2	A2 Mainline A2260-B262	M	Dual Carriageway	EB	4	3450	3622	6502	8000	7600	8400	43%	48%	77%
TRADS-30026113WB	A2	A2 Mainline A2260-B262	M	Dual Carriageway	WB	4	6576	3907	4712	8000	7600	8400	82%	51%	56%
TRADS-30026110EB	A2	A2 Ebbsfleet A2260 Onslip	M	Onslip	EB	1	221	184	511	2000	1900	2100	11%	10%	24%
CJC-27OB	A2	A2 Ebbsfleet A2260 Offslip	M	offslip	WB	2	842	792	1238	4000	3800	4200	21%	21%	29%
TRADS-30026103WB	A2	A2 Ebbsfleet A2260 Onslip	M	Onslip	WB	1	349	241	401	2000	1900	2100	17%	13%	19%
TRADS-30026107WB	A2	A2 Ebbsfleet A2260 Offslip	M	offslip	WB	2	476	205	263	4000	3800	4200	12%	5%	6%
CJC-23OD	A296	A296 Watling Street West of B255	A	Single Carriageway	EB	1	646	618	837	1800	1700	1900	36%	36%	44%
CJC-23DD	A296	A296 Watling Street West of B255	A	Single Carriageway	WB	1	987	548	714	1800	1700	1900	55%	32%	38%
CJC-28DB	A2260	Road between Ebbsfleet East and Ebbsfleet West RB	A	Single Carriageway	SB	1	292	248	588	1800	1700	1900	16%	15%	31%
CJC-28OB	A2260	Road between Ebbsfleet East and Ebbsfleet West RB	A	Single Carriageway	NB	1	331	257	276	1800	1700	1900	18%	15%	15%
CJC-28DA	A2260	A2260, North of Ebbsfleet West RB	A	Dual Carriageway	NB	2	800	421	519	3600	3400	3800	22%	12%	14%
CJC-28OA	A2260	A2260, North of Ebbsfleet West RB	A	Dual Carriageway	SB	2	637	495	1030	3600	3400	3800	18%	15%	27%
CJC-28OC	A2260	A2260 South of Ebbsfleet West RB	A	Dual Carriageway	NB	2	516	218	293	3600	3400	3800	14%	6%	8%
CJC-28DC	A2260	A2260 South of Ebbsfleet West RB	A	Dual Carriageway	SB	2	390	301	490	3600	3400	3800	11%	9%	13%
CJC-29DB	A2260	A2260 South of Access road to Ebbsfleet International	A	Single Carriageway	NB	1	434	265	239	1800	1700	1900	24%	16%	13%
CJC-29OB	A2260	A2260 South of Access road to Ebbsfleet International	A	Single Carriageway	SB	1	443	380	794	1800	1700	1900	25%	22%	42%
CJC-25OB	B255	Bean Lane, South of Bean South RB	B	Single Carriageway	NB	1	451	264	366	1600	1600	1600	28%	17%	23%
ATC-44SB	B255	Bean Lane, South of Bean South RB	B	Single Carriageway	SB	1	305	268	451	1600	1600	1600	19%	17%	28%
CJC-24OB	B255	Bean Lane, Bridge over A2 between Bean North & South RB	B	Single Carriageway	NB	2	1872	1174	1469	3200	3200	3200	59%	37%	46%
CJC-25OC	B255	Bean Lane, Bridge over A2 between Bean North & South RB	B	Single Carriageway	SB	1	661	845	1149	1600	1600	1600	41%	53%	72%
CJC-21OB	B255	B255 St Clements Way Northbound, After Bluewater exit road	B	Dual Carriageway	NB	2	937	485	763	3200	3200	3200	29%	15%	24%
CJC-24OD	B255	B255 St Clements Way, North of Bean North Junction, After Exit to Roman Road	B	Dual Carriageway	SB	2	392	709	896	3200	3200	3200	12%	22%	28%
CJC-24DA	B255	Bean lane, South of Roman Road and A296 RB	B	Dual Carriageway	NB	1	909	400	549	1600	1600	1600	57%	25%	34%
CJC-23DC	B255	B255 Bean lane Southbound	B	Dual Carriageway	SB	1	154	289	298	1600	1600	1600	10%	18%	19%
CJC-23OA	B255	offslip from B255 to Roman Road and A296 RB	B	Dual Carriageway	SB	2	485	819	1218	3200	3200	3200	15%	26%	38%
CJC-29DD	B259	B259 Southfleet Road, North of A2260 & B259 RB	B	Single Carriageway	NB	1	313	194	309	1600	1600	1600	20%	12%	19%
CJC-29OD	B259	B259 Southfleet Road, North of A2260 & B259 RB	B	Single Carriageway	SB	1	296	195	313	1600	1600	1600	19%	12%	20%

Figure A- 1 - A2 HATRIS AL1792A Observed Speed vs Flow M25 J2 to A296 Neutral Months 2014 Eastbound

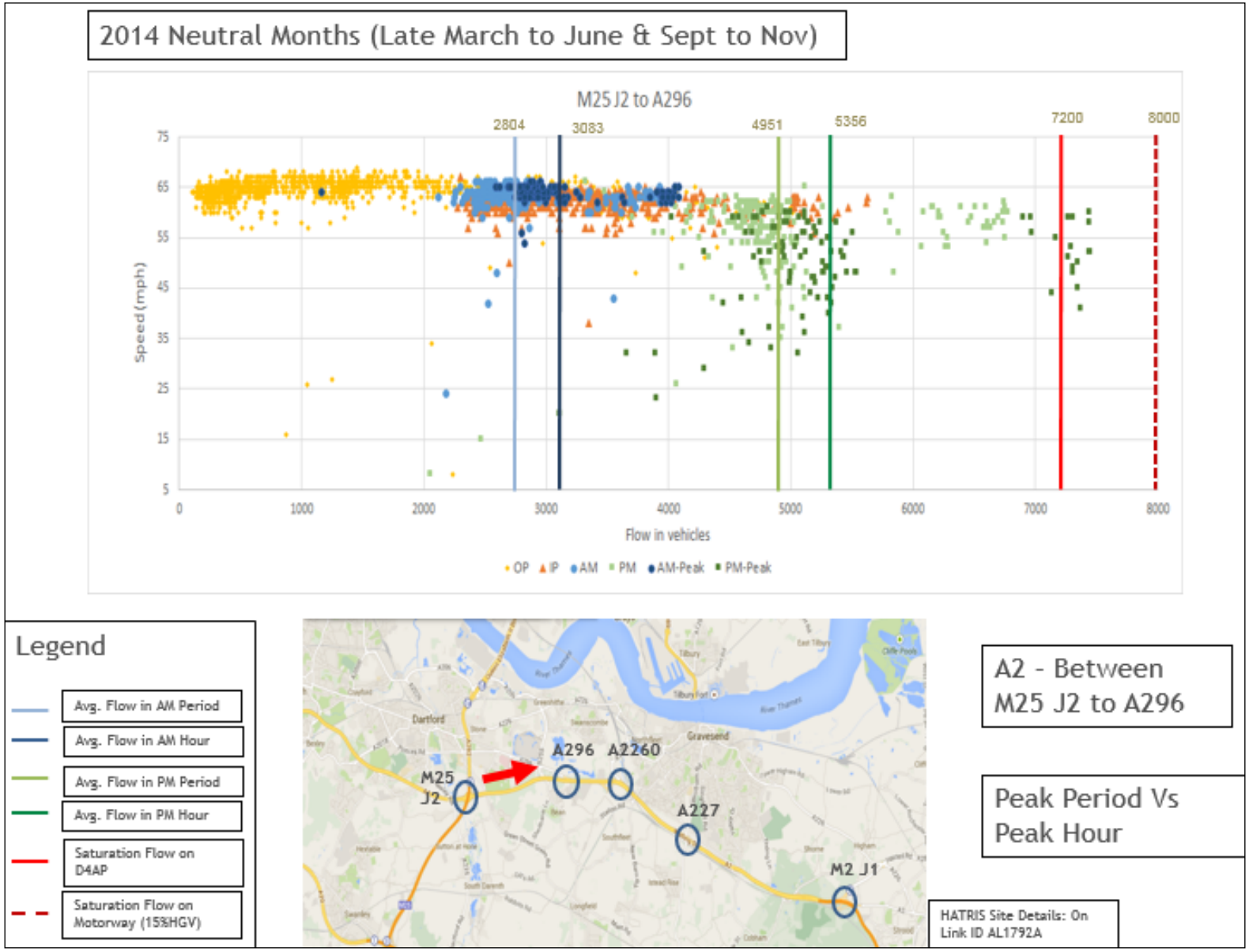


Figure A- 2 - A2 HATRIS AL1821A Observed Speed vs Flow A296 to A2260 Neutral Months 2014 Eastbound

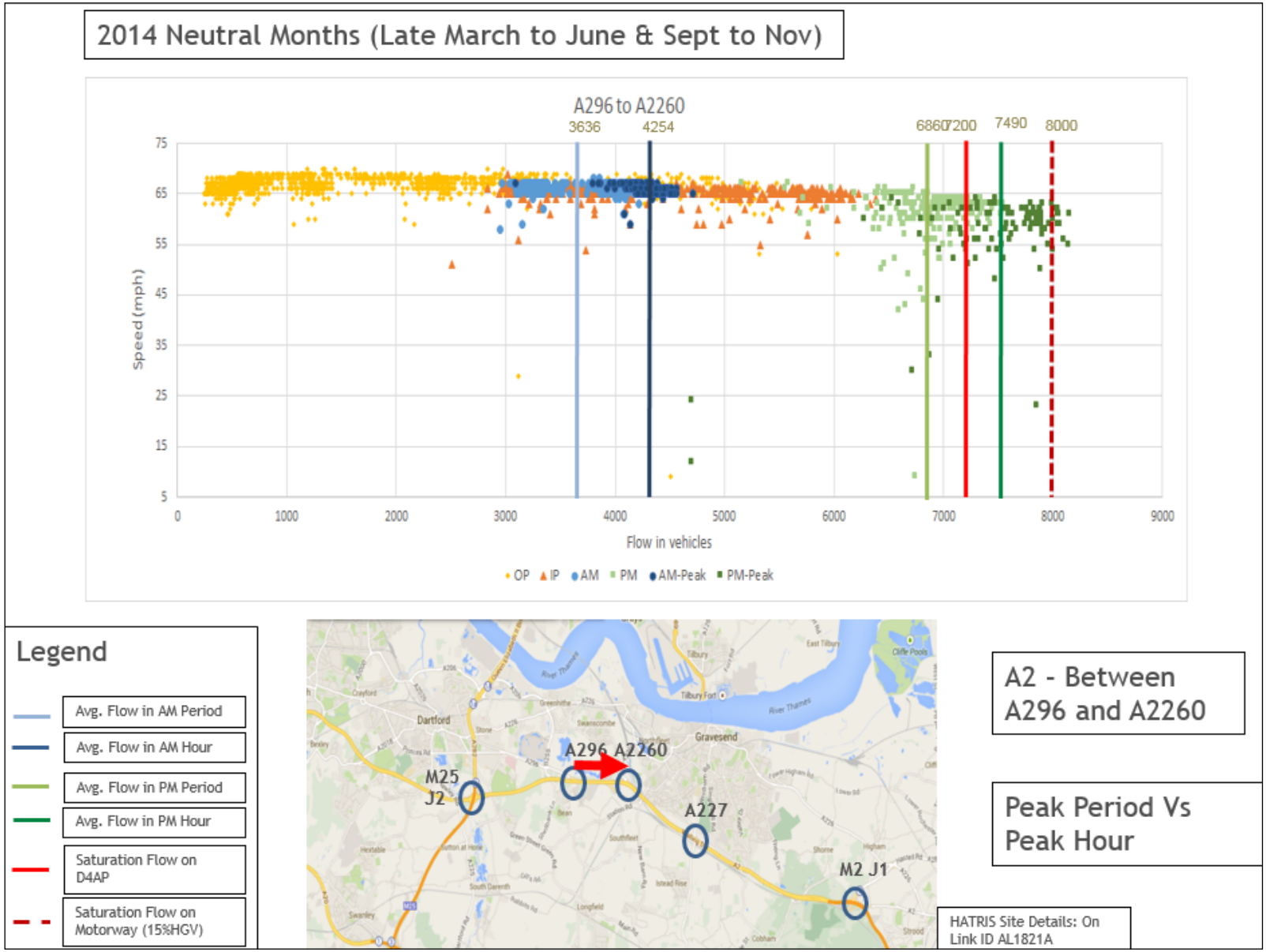


Figure A- 3 - 2 HATRIS AL1824A Observed Speed vs Flow A2260 to A227 Neutral Months 2014 Eastbound

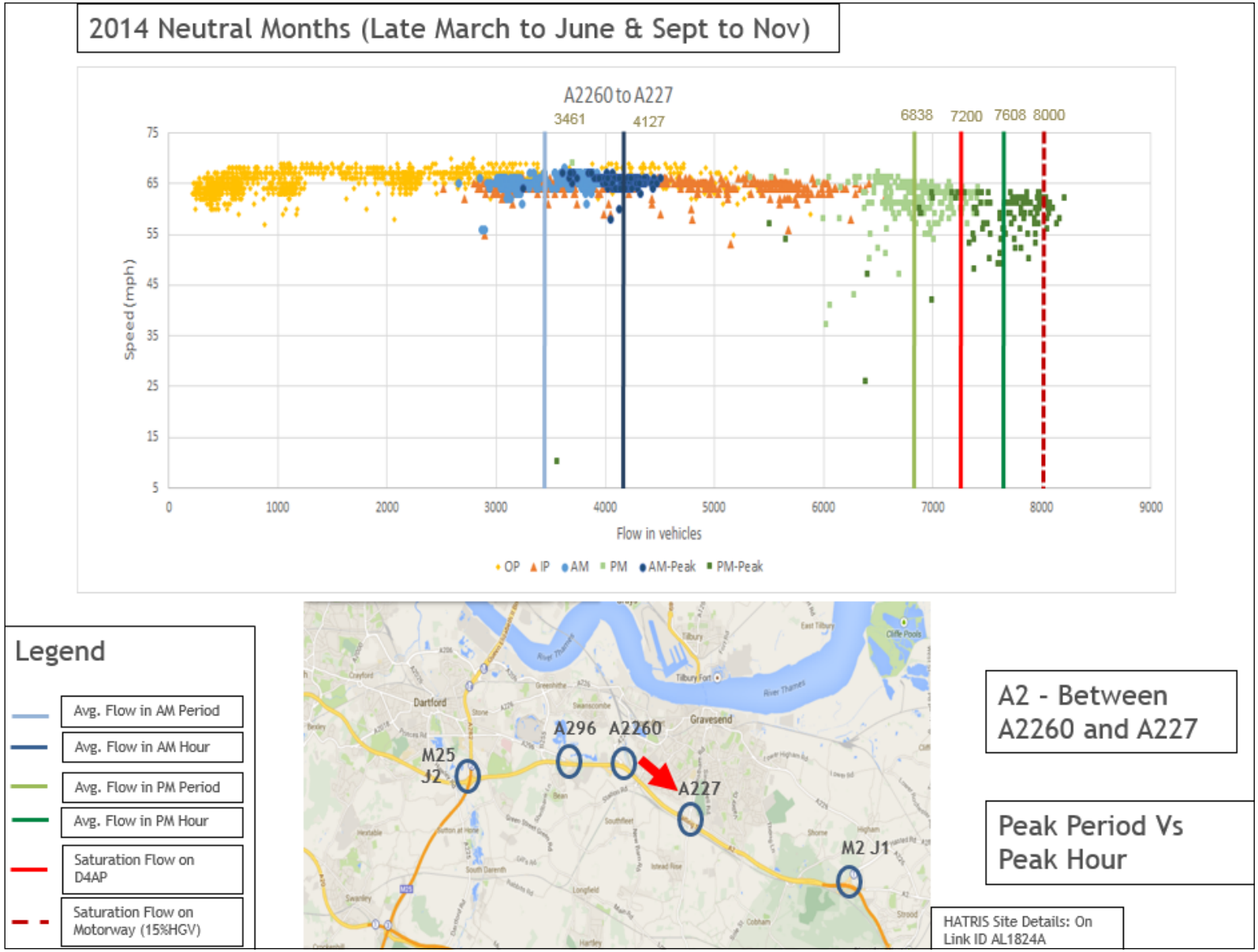


Figure A- 4 - A2 HATRIS AL1822A Observed Speed vs Flow A227 to M2 J1 Neutral Months 2014 Eastbound

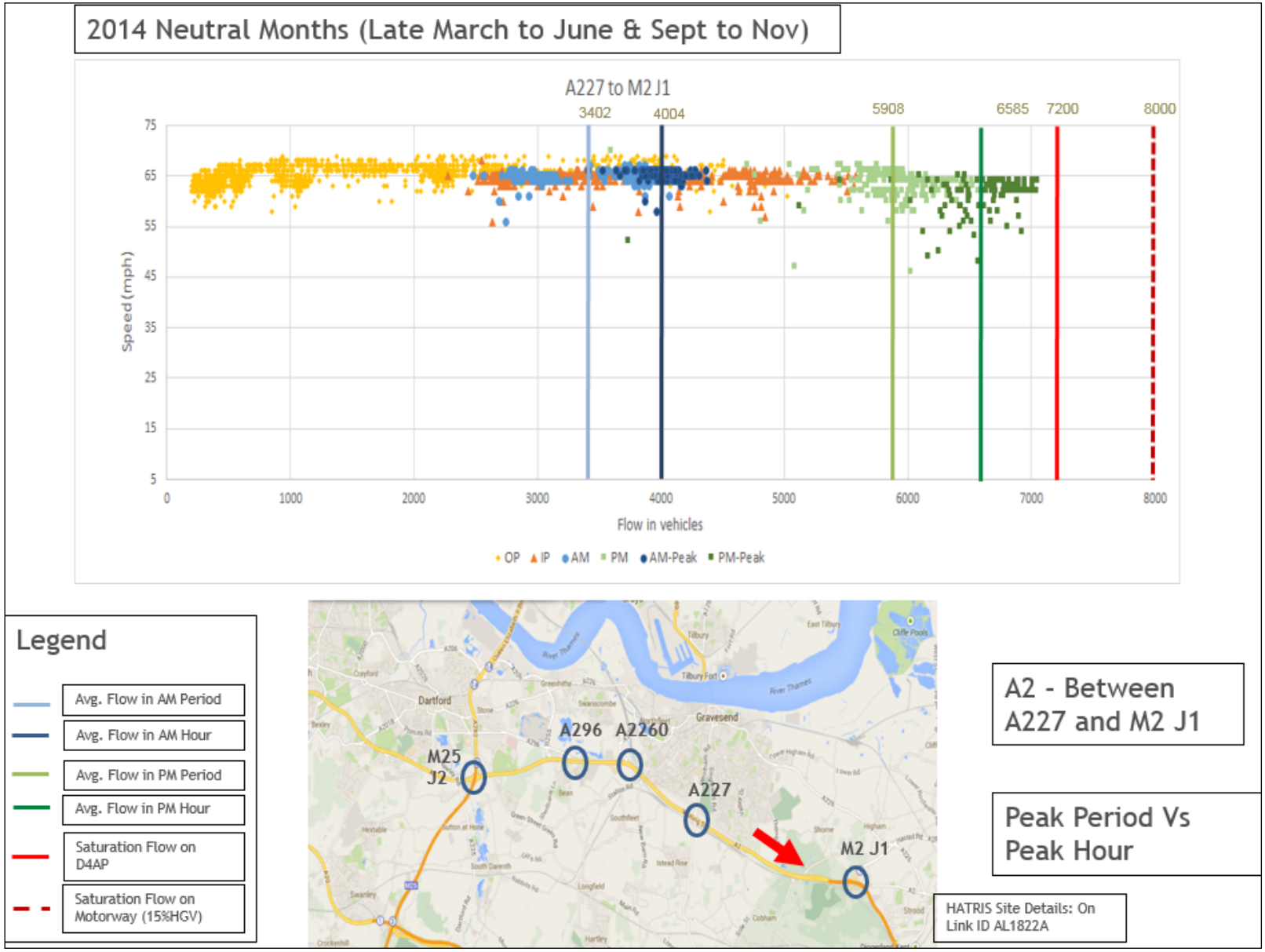


Figure A- 5 - A2 HATRIS AL2352A Observed Speed vs Flow M2 J1 to A227 Neutral Months 2014 Westbound

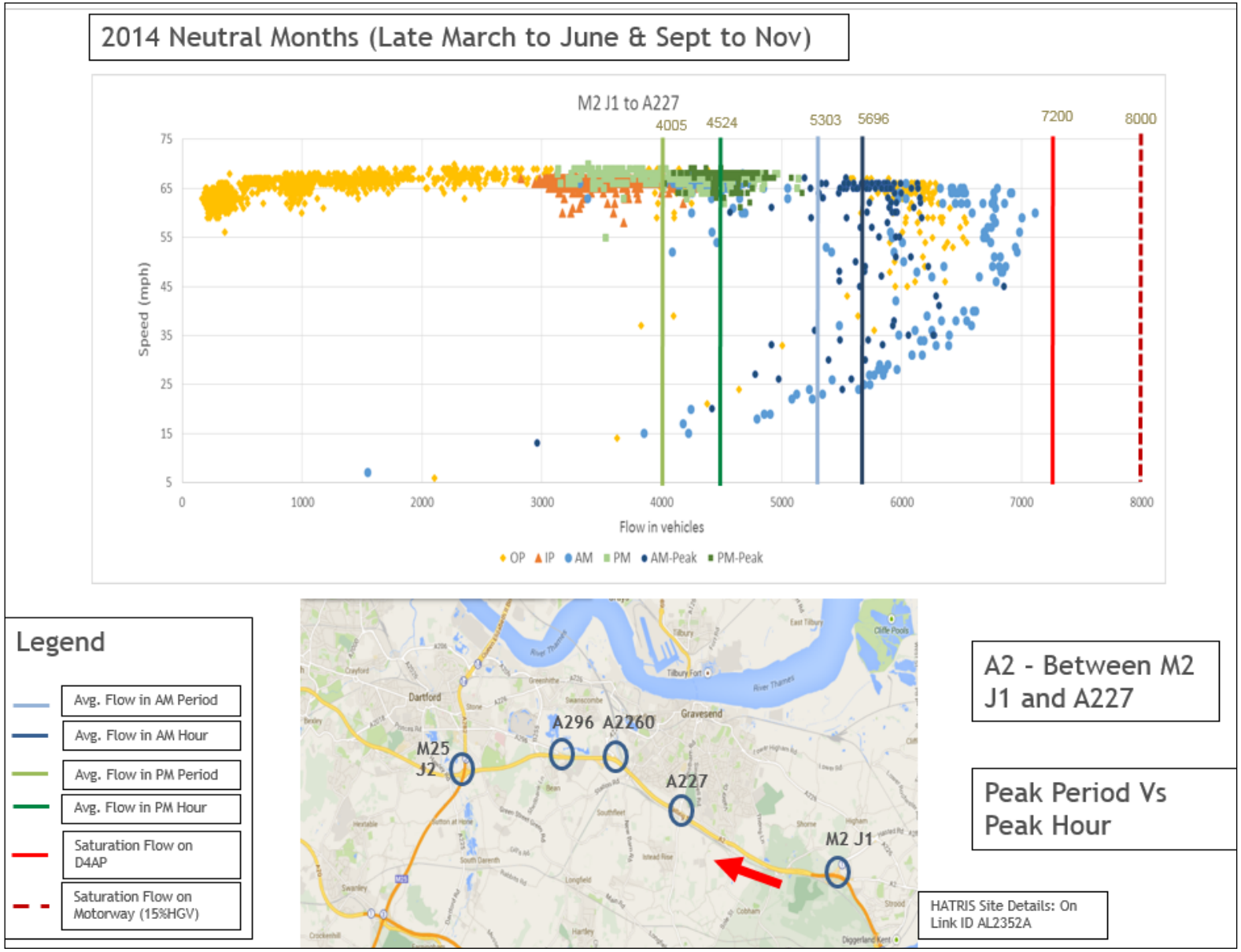


Figure A- 6 - A2 HATRIS AL1832A Observed Speed vs Flow A227 to A2260 Neutral Months 2014 Westbound

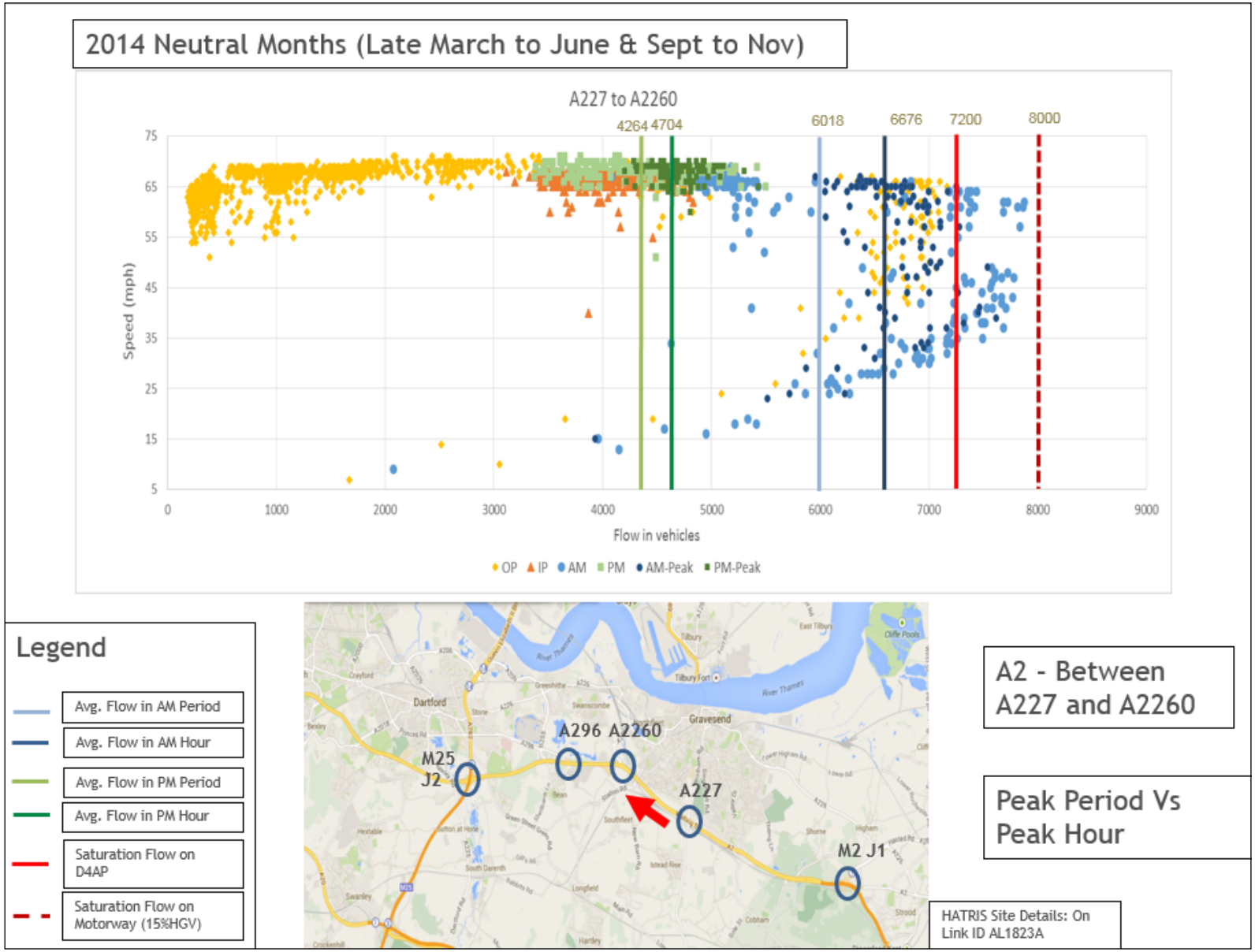


Figure A- 7 - A2 HATRIS AL1820A Observed Speed vs Flow A2260 to A296 Neutral Months 2014 Westbound

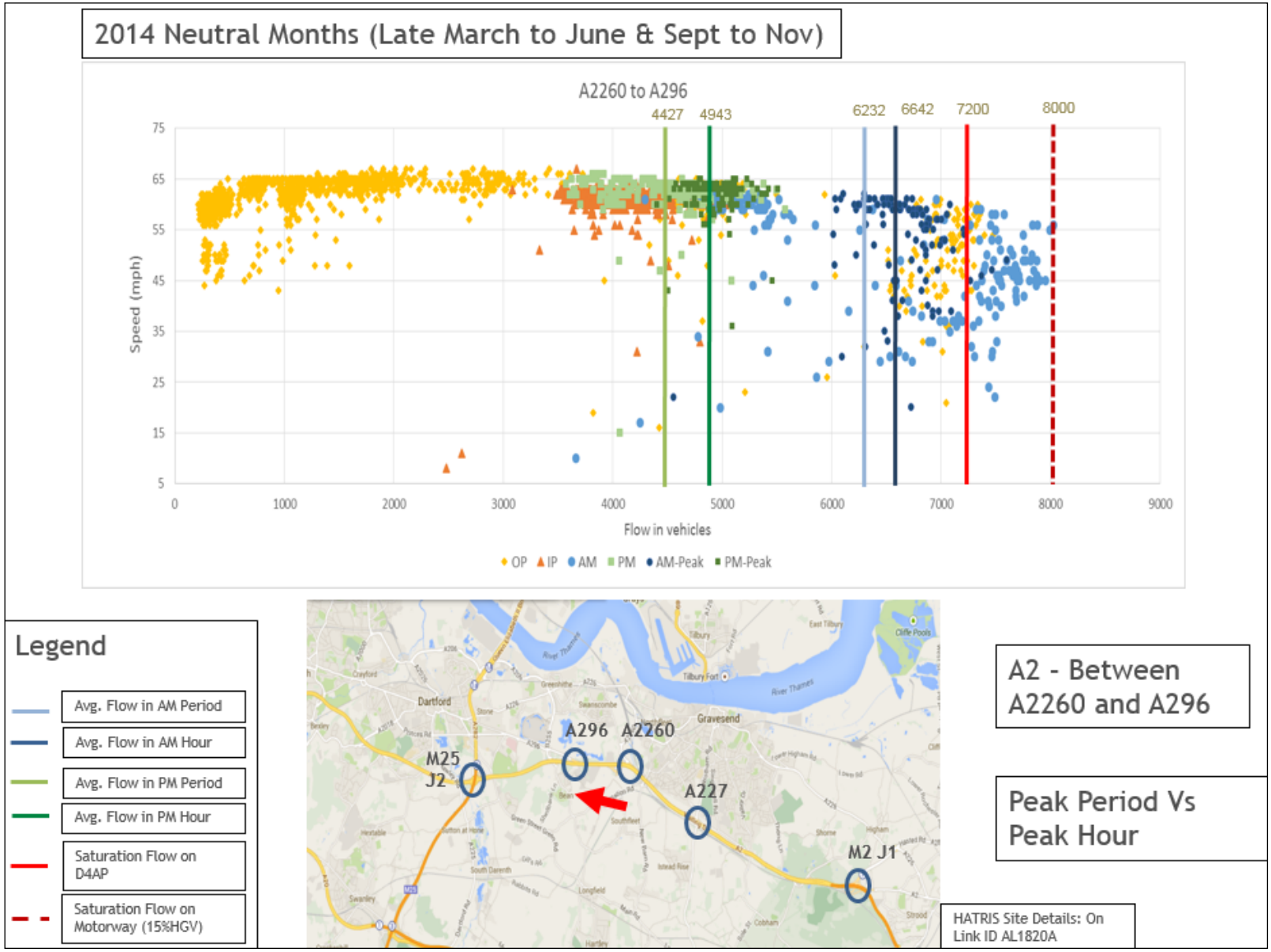
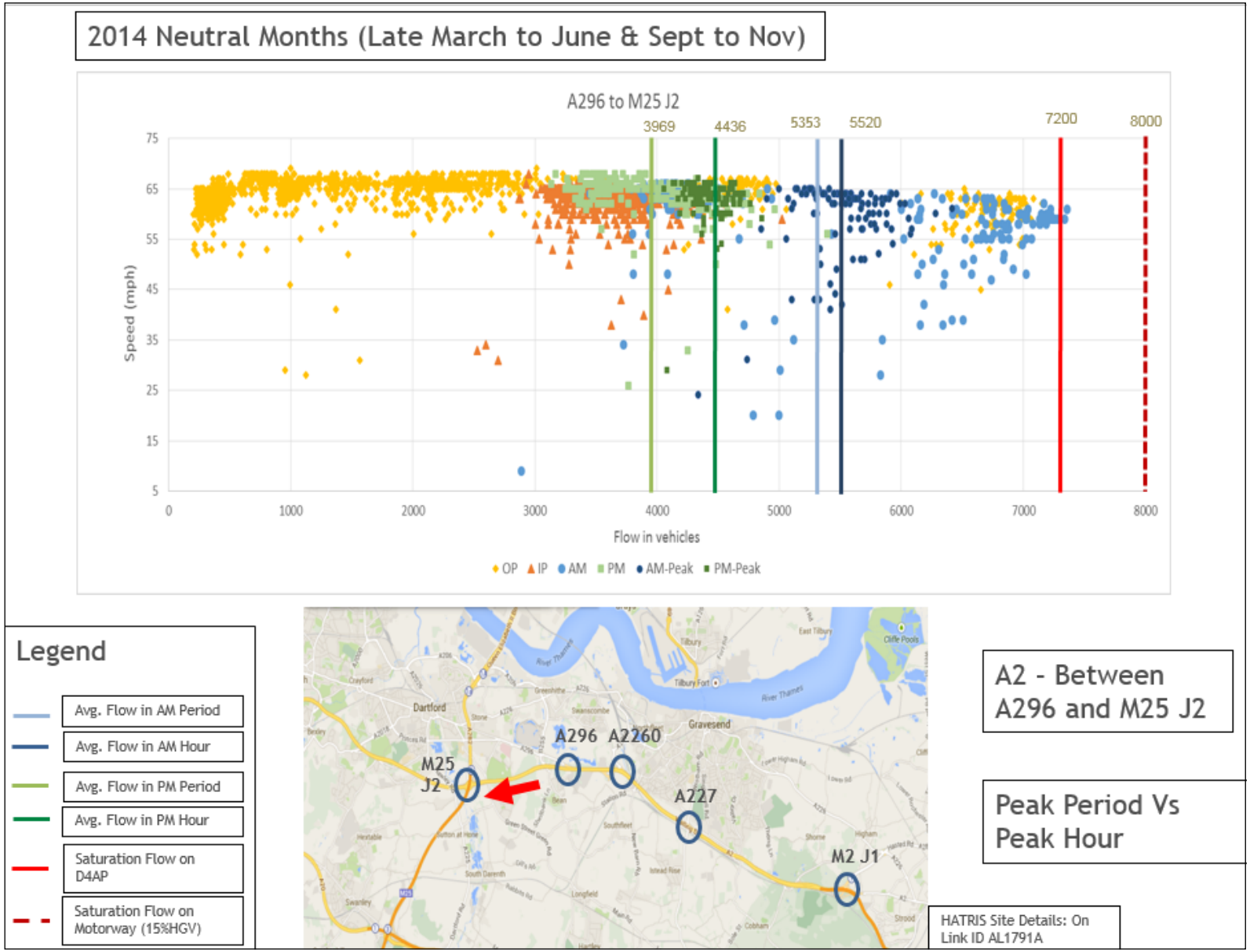
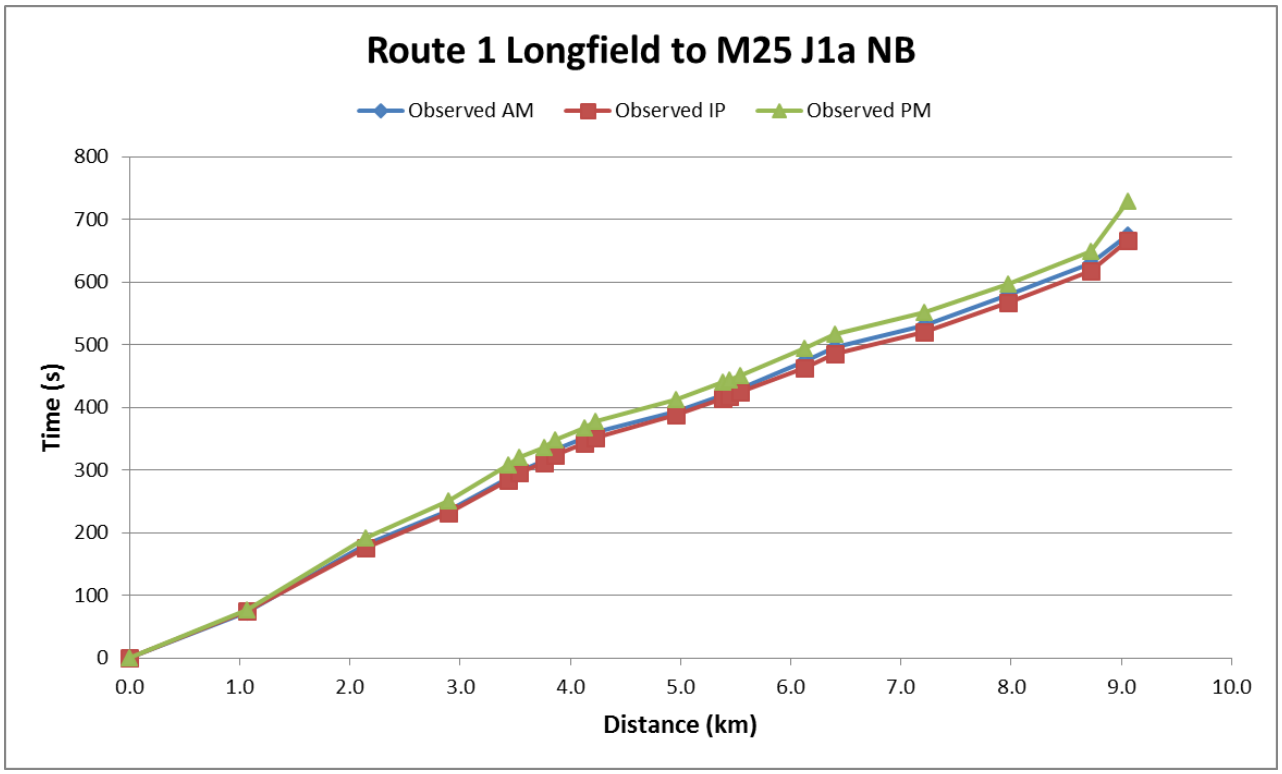


Figure A- 8 - A2 HATRIS AL1791A Observed Speed vs Flow A296 to M25 J2 Neutral Months 2014 Westbound

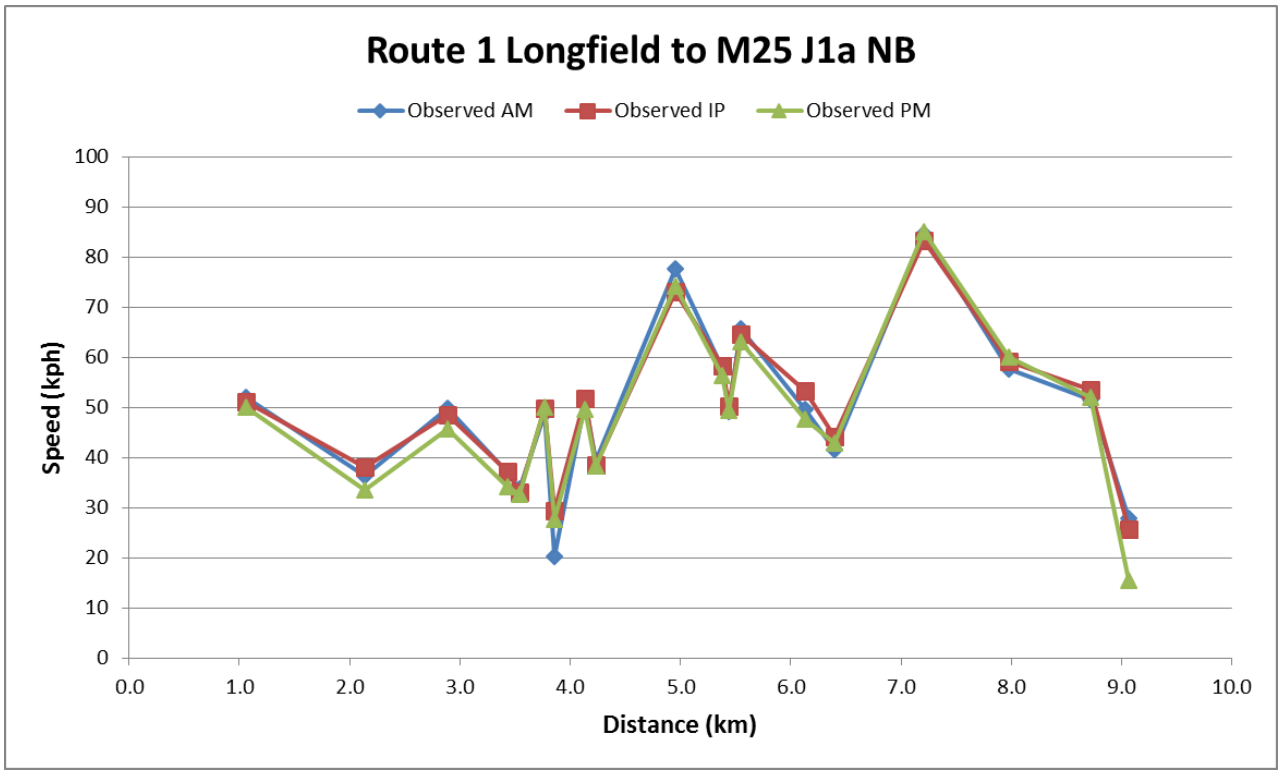


APPENDIX B: A2 Bean and Ebbsfleet Journey Time Routes

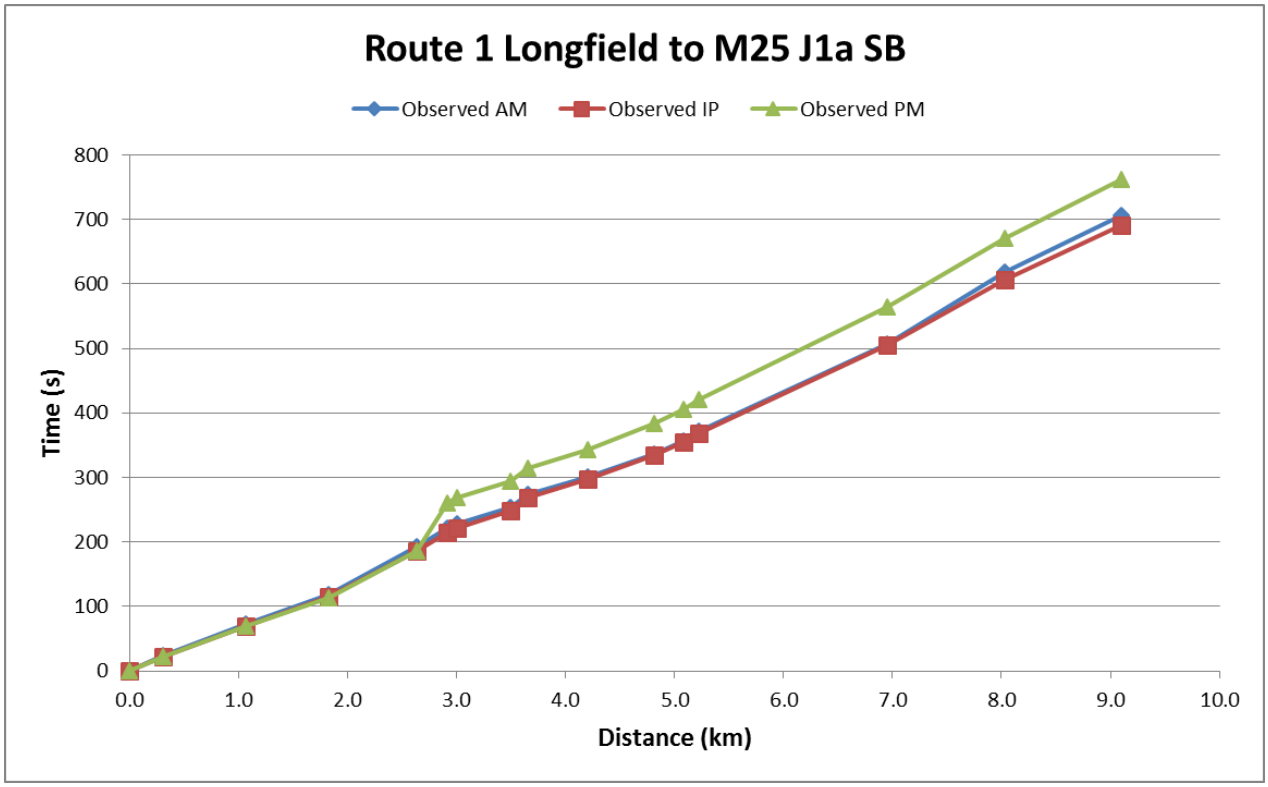
Route 1 Longfield to M25 J1a NB (B255/A206) – Journey Time Distance



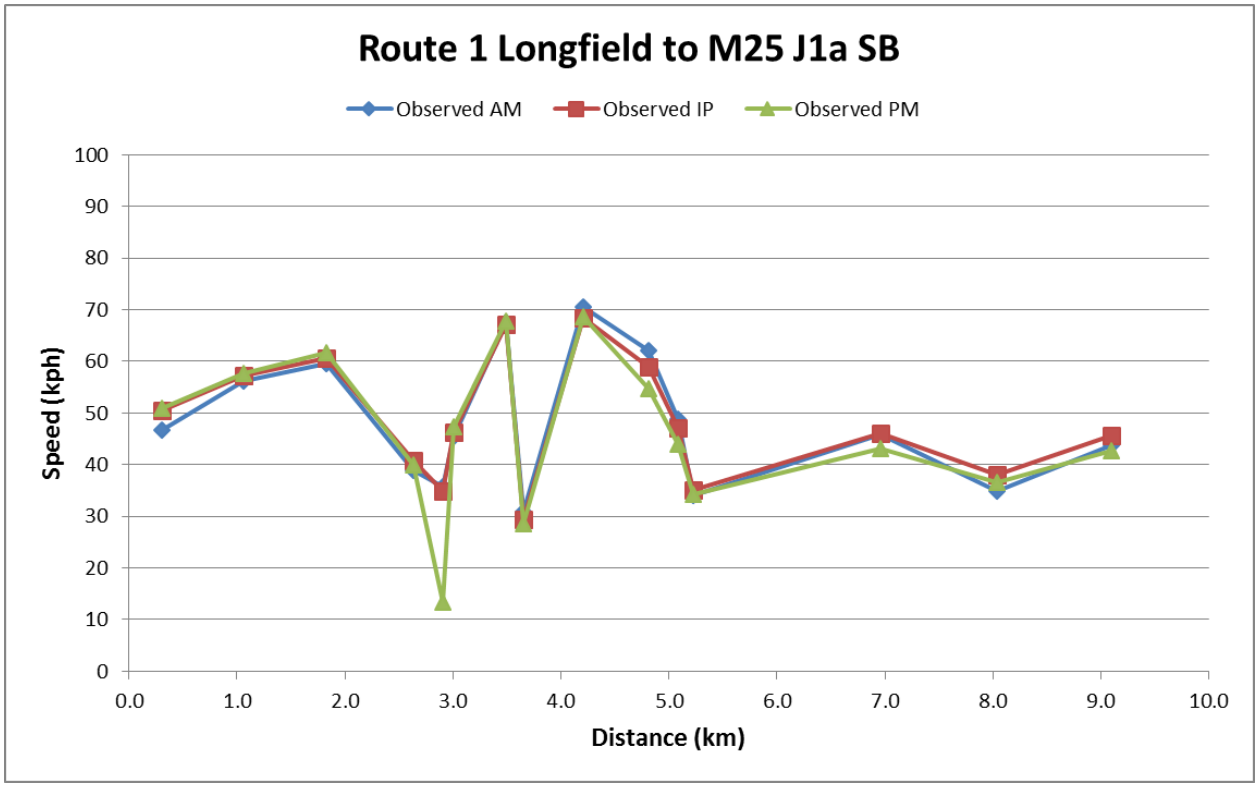
Route 1 Longfield to M25 J1a NB (B255/A206) – Journey Time Speed



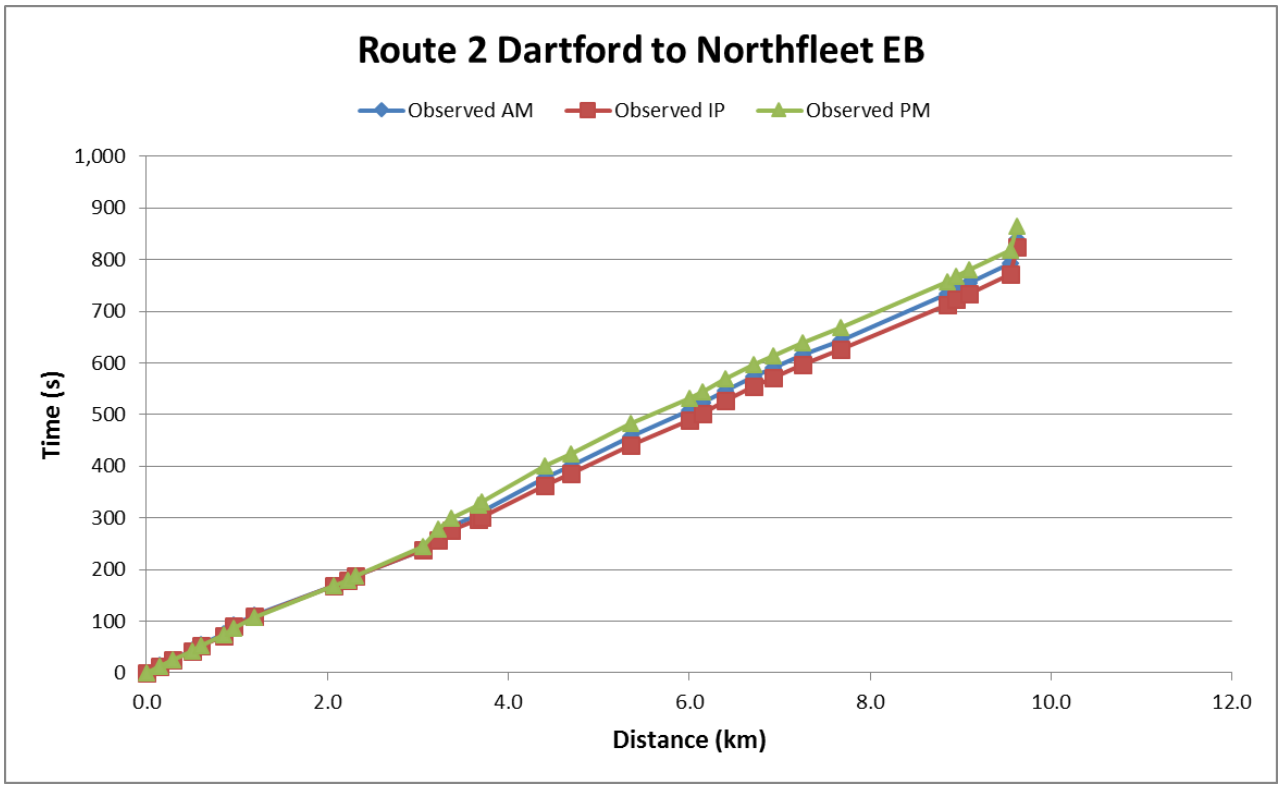
Route 1 Longfield to M25 J1a SB (A206/B255)- Journey Time Distance



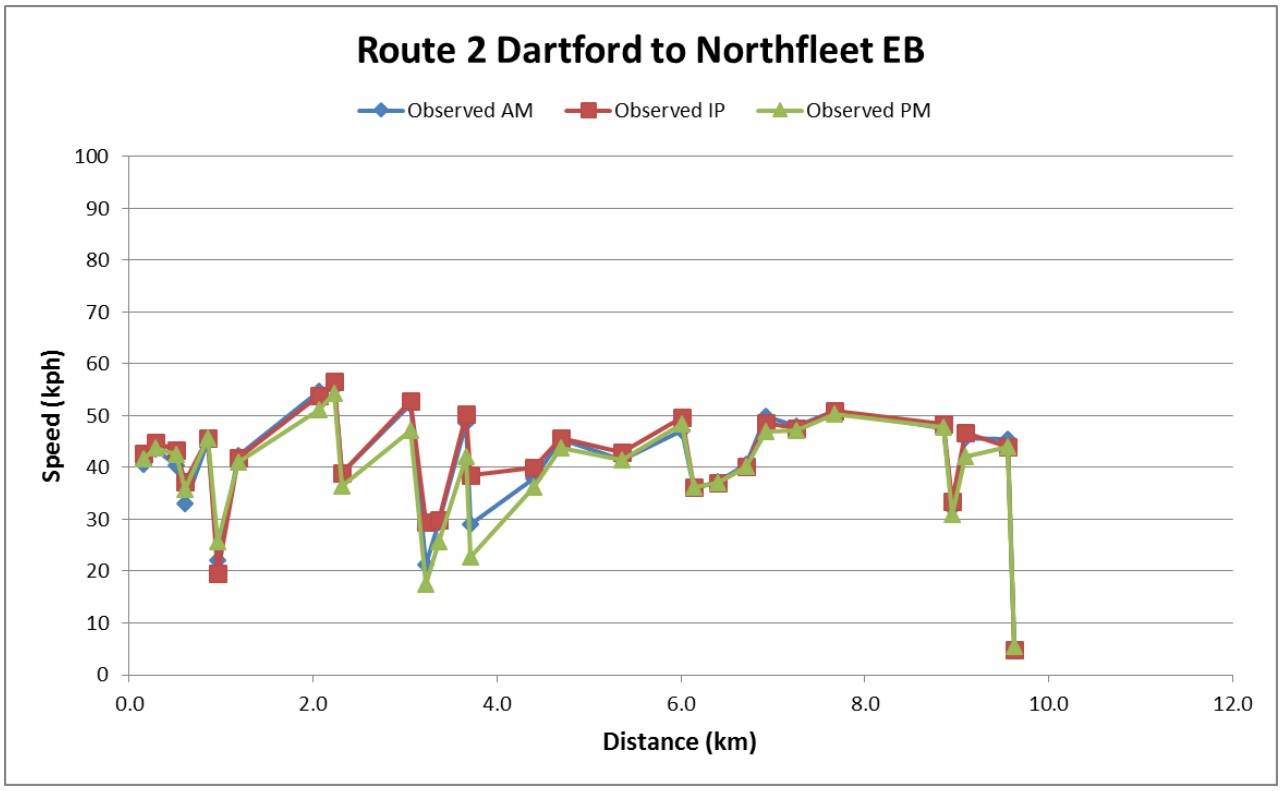
Route 1 Longfield to M25 J1a SB (A206/B255) - Journey Time Speed



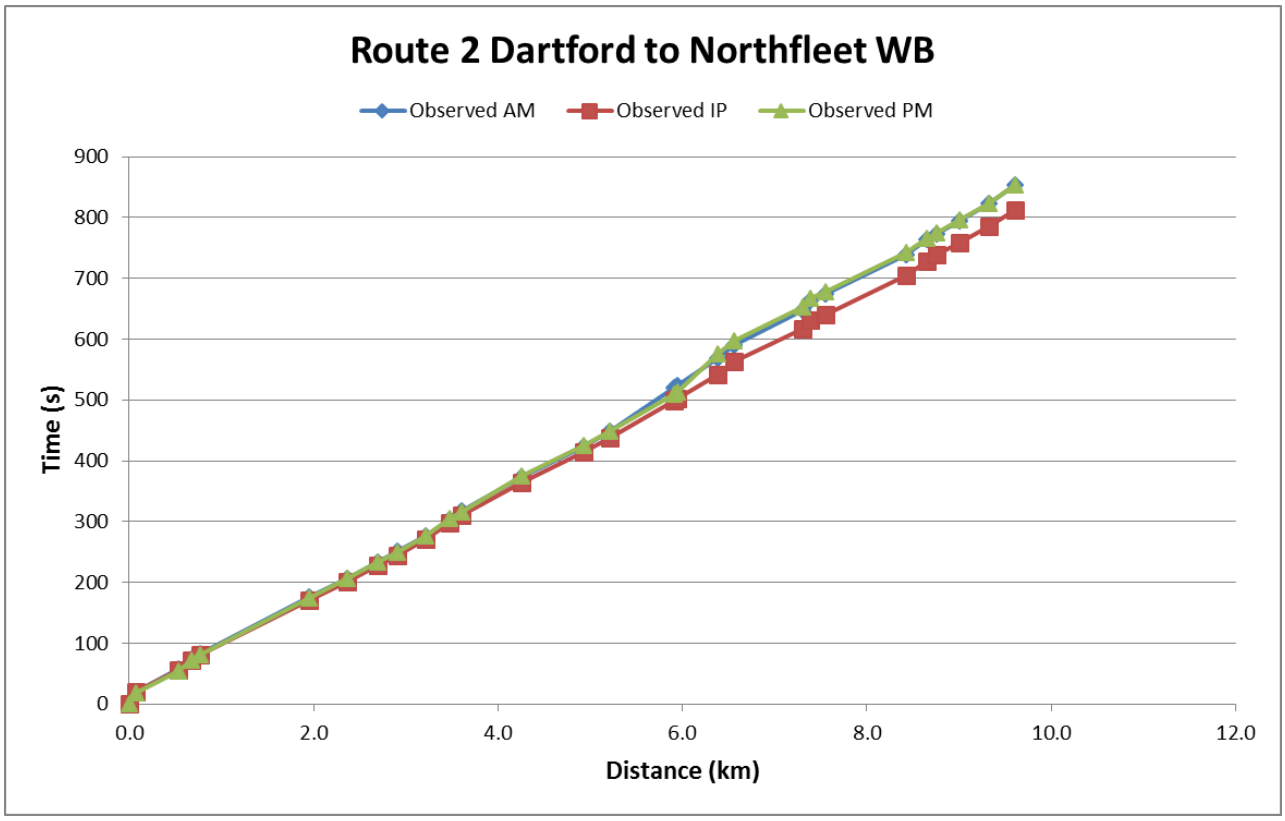
Route 2 Dartford to Northfleet EB (A226/B2175/A226) - Journey Time Distance



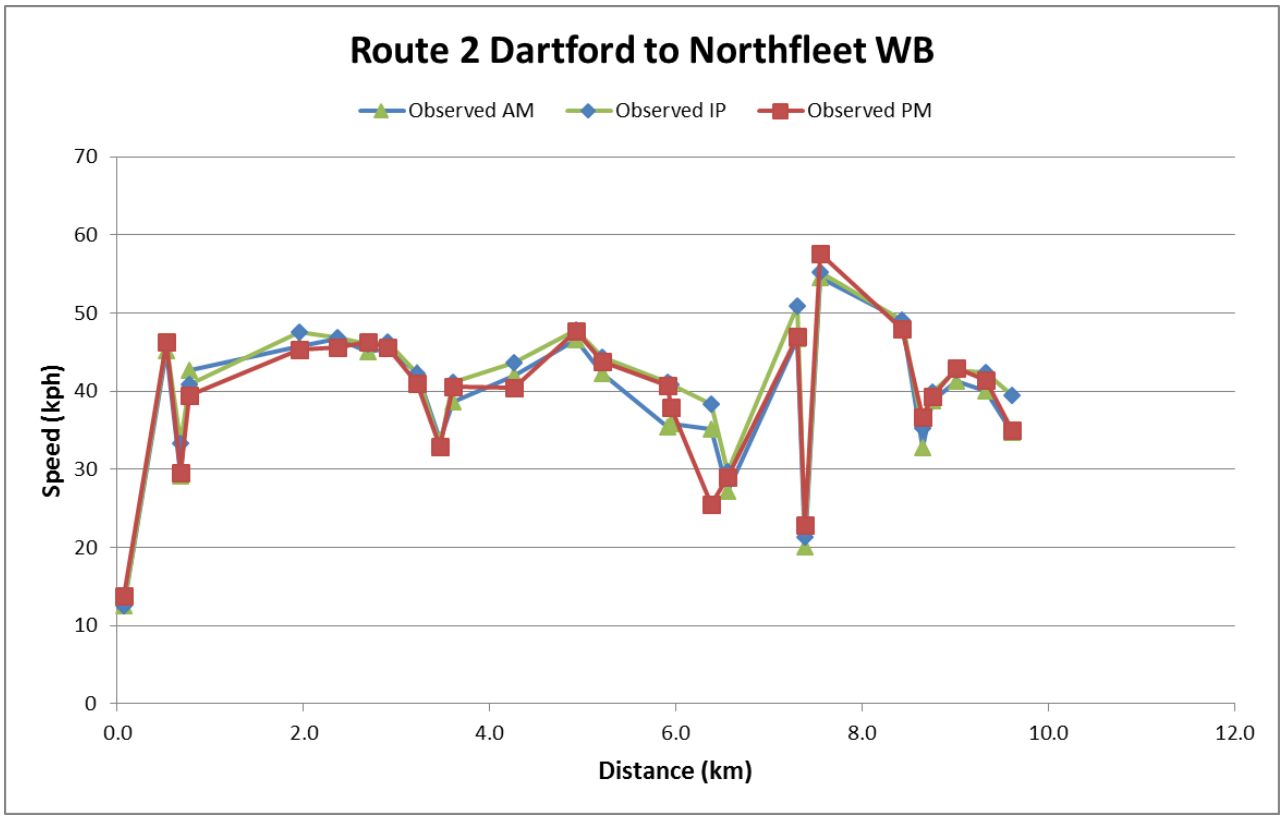
Route 2 Dartford to Northfleet EB (A226/B2175/A226) - Journey Time Speed



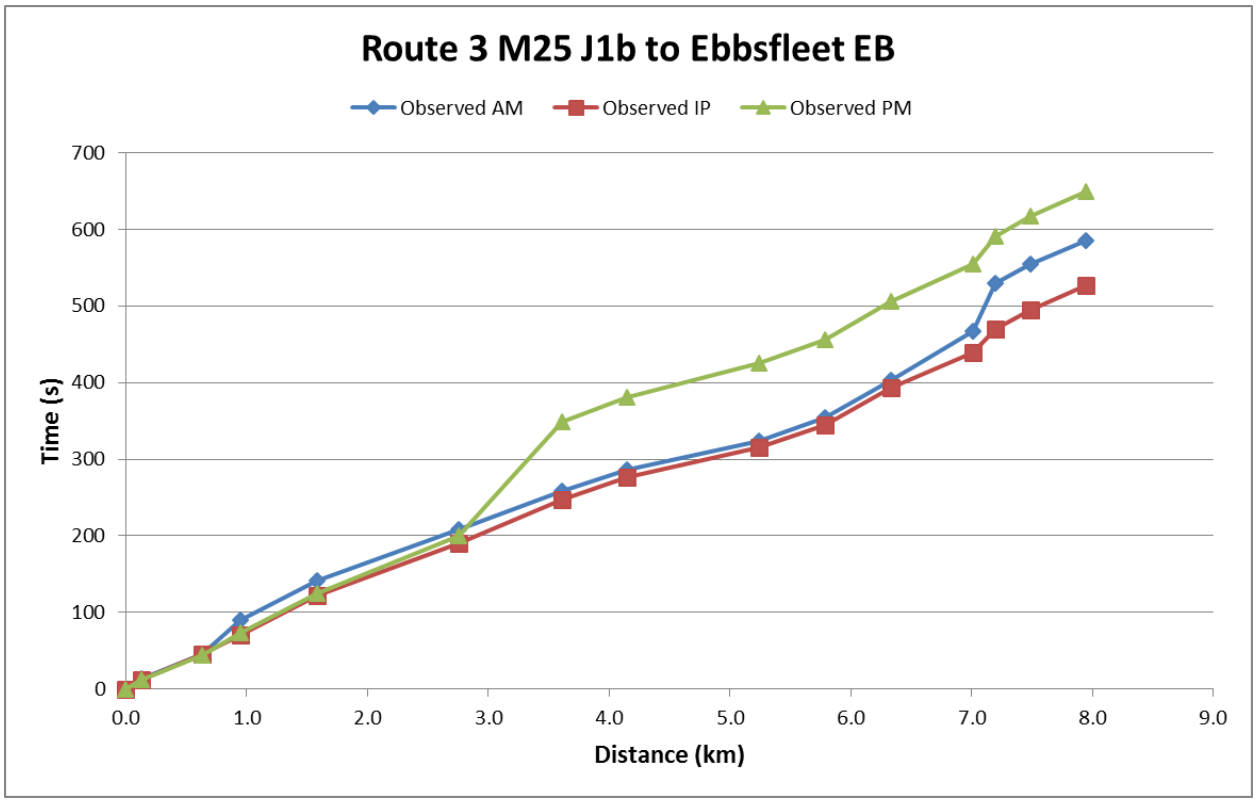
Route 2 Dartford to Northfleet WB (A226/B2175/A226) - Journey Time Distance



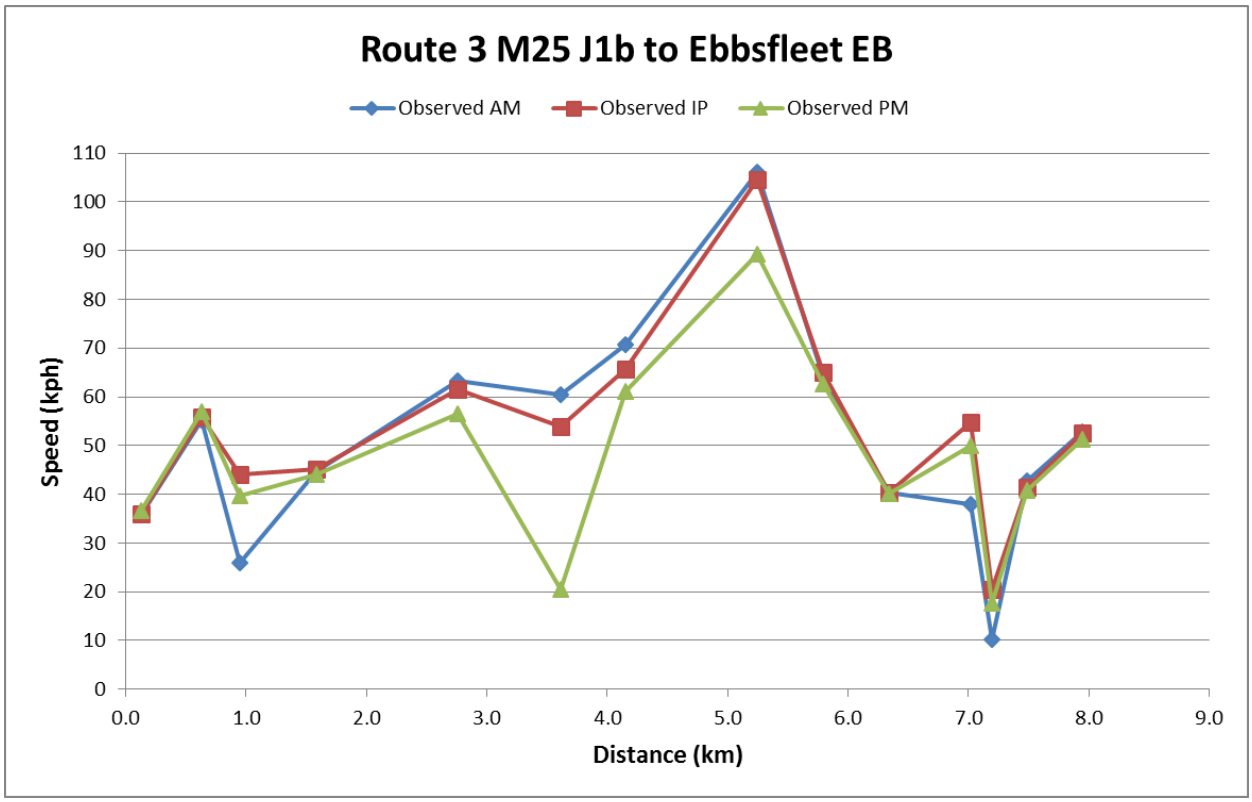
Route 2 Dartford to Northfleet WB (A226/B2175/A226) - Journey Time Speed



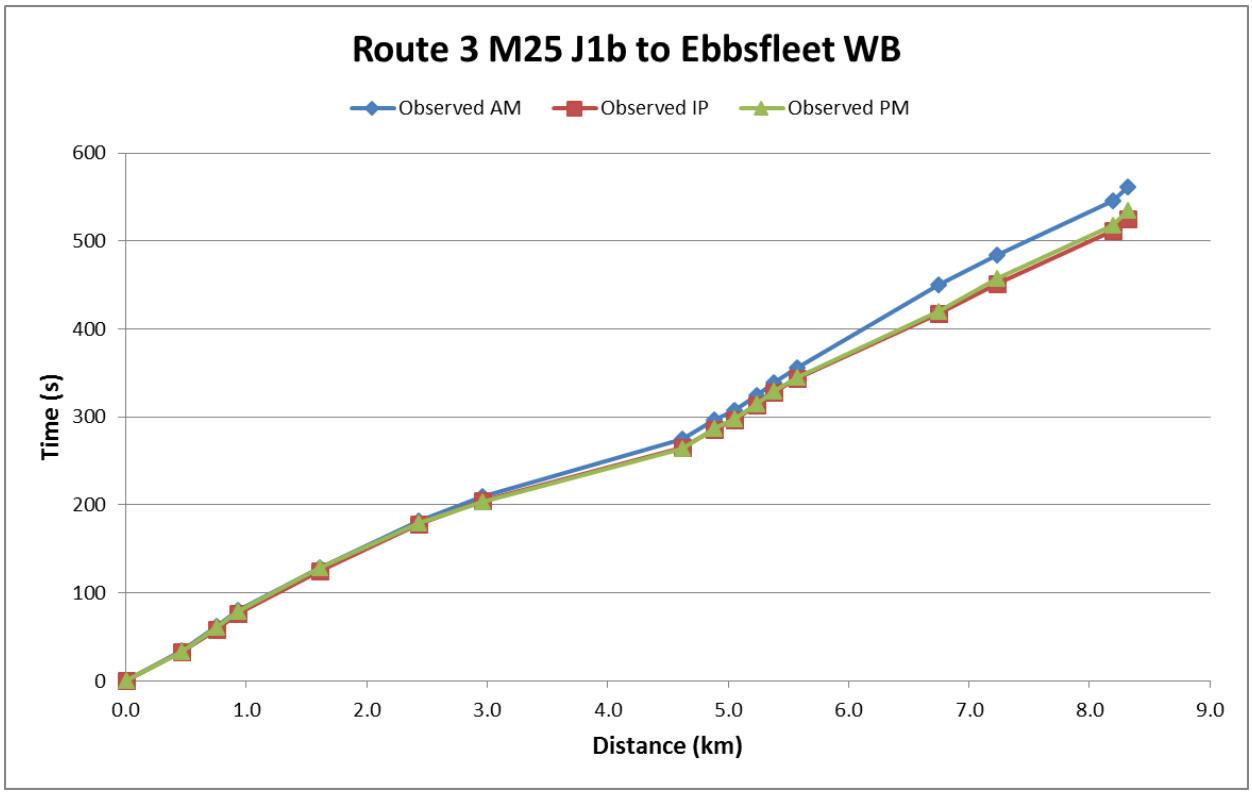
Route 3 M25 J1b to Ebbsfleet EB (A296/A2/A2260/A226) - Journey Time Distance



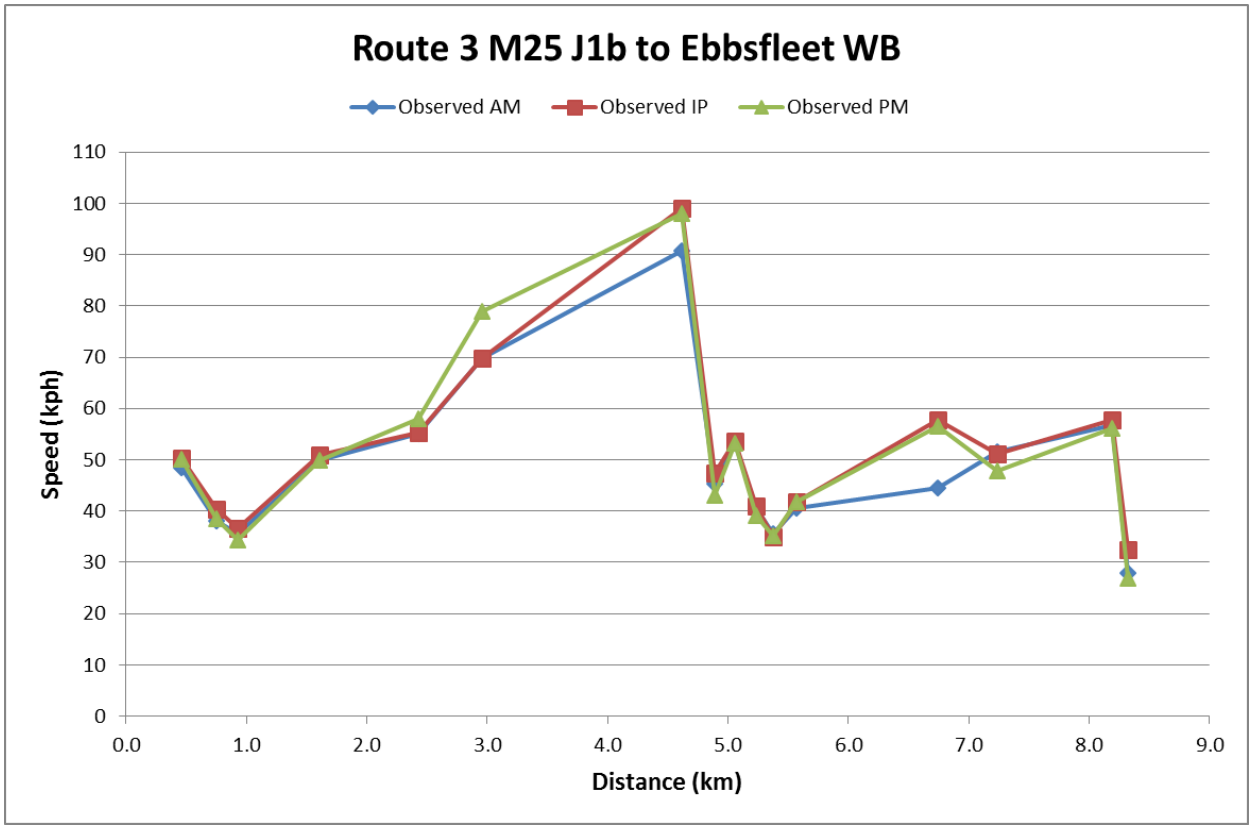
Route 3 M25 J1b to Ebbsfleet EB (A296/A2/A2260/A226) - Journey Time Speed



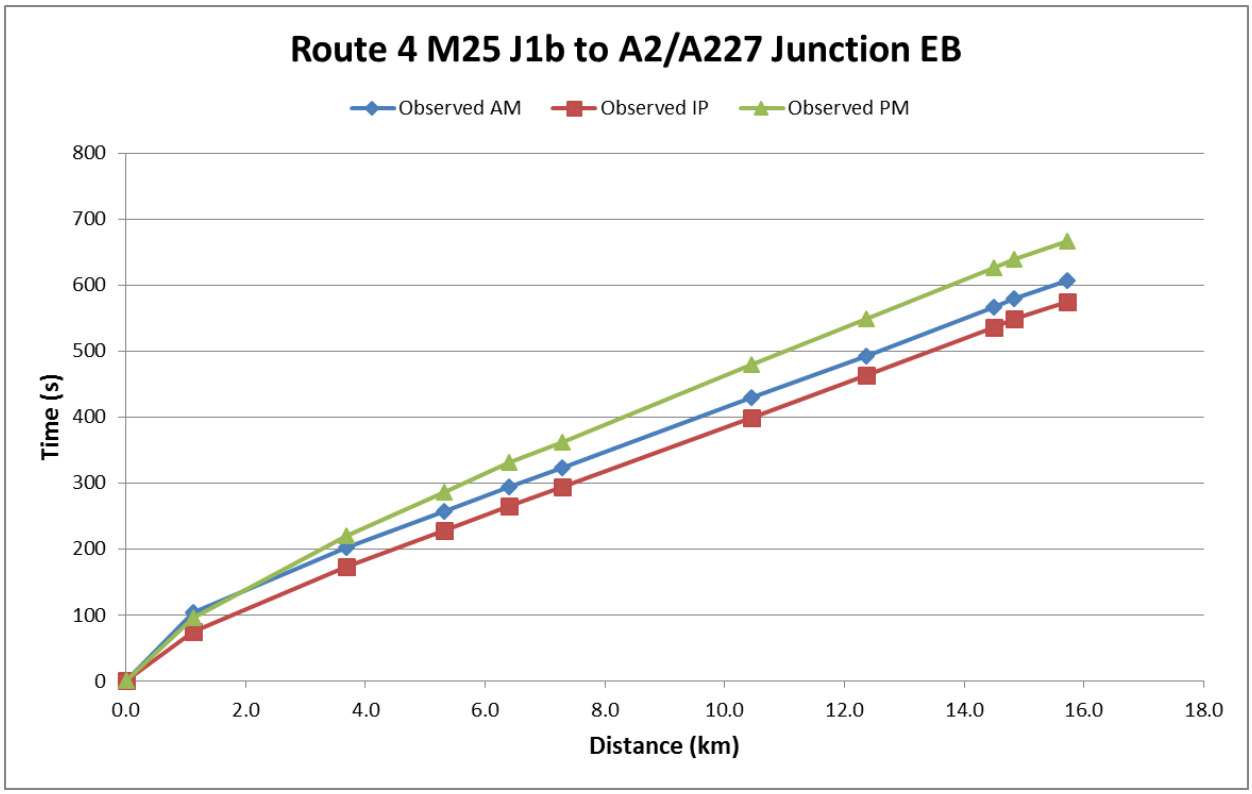
Route 3 M25 J1b to Ebbsfleet WB (A226/A2260/A2/A296) - Journey Time Distance



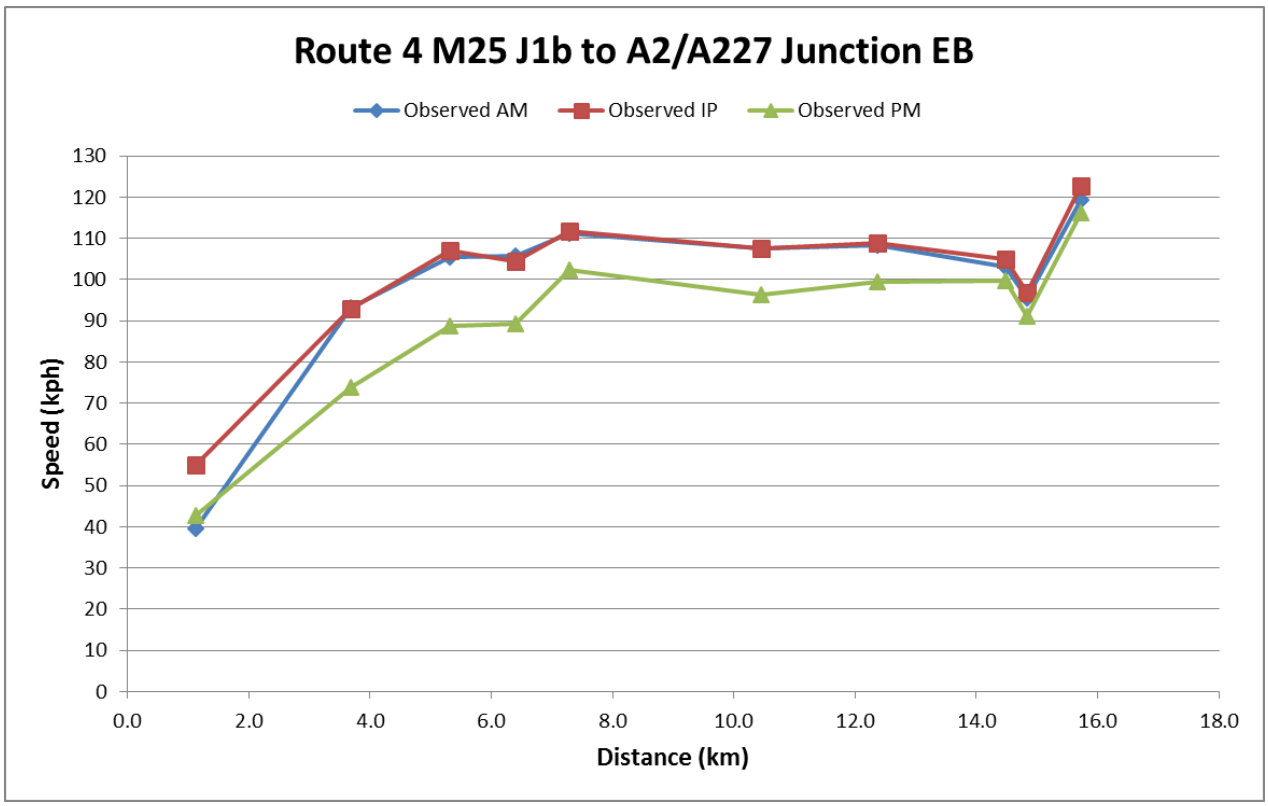
Route 3 M25 J1b to Ebbsfleet WB (A226/A2260/A2/A296) - Journey Time Speed



Route 4 M25 J1b to A2/A227 Junction EB (A2) – Journey Time Distance

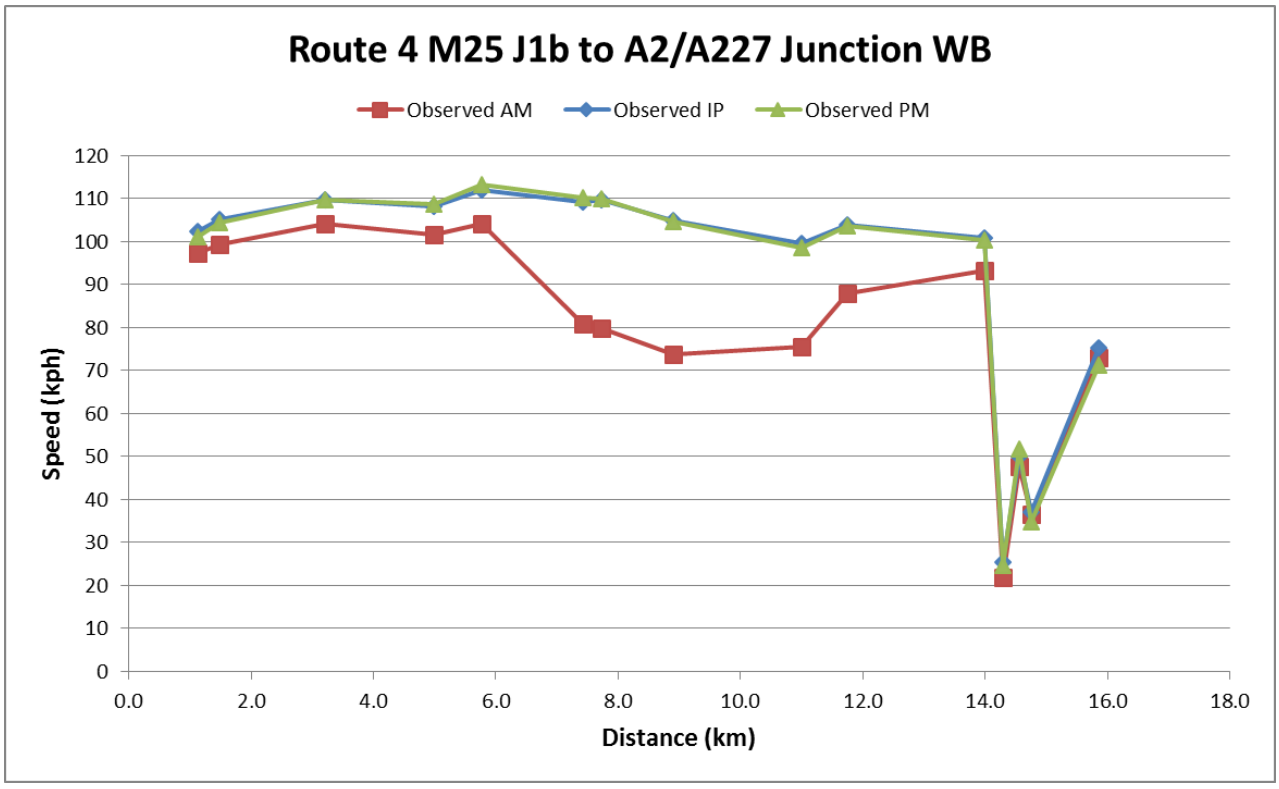


Route 4 M25 J1b to A2/A227 Junction EB (A2) - Journey Time Speed

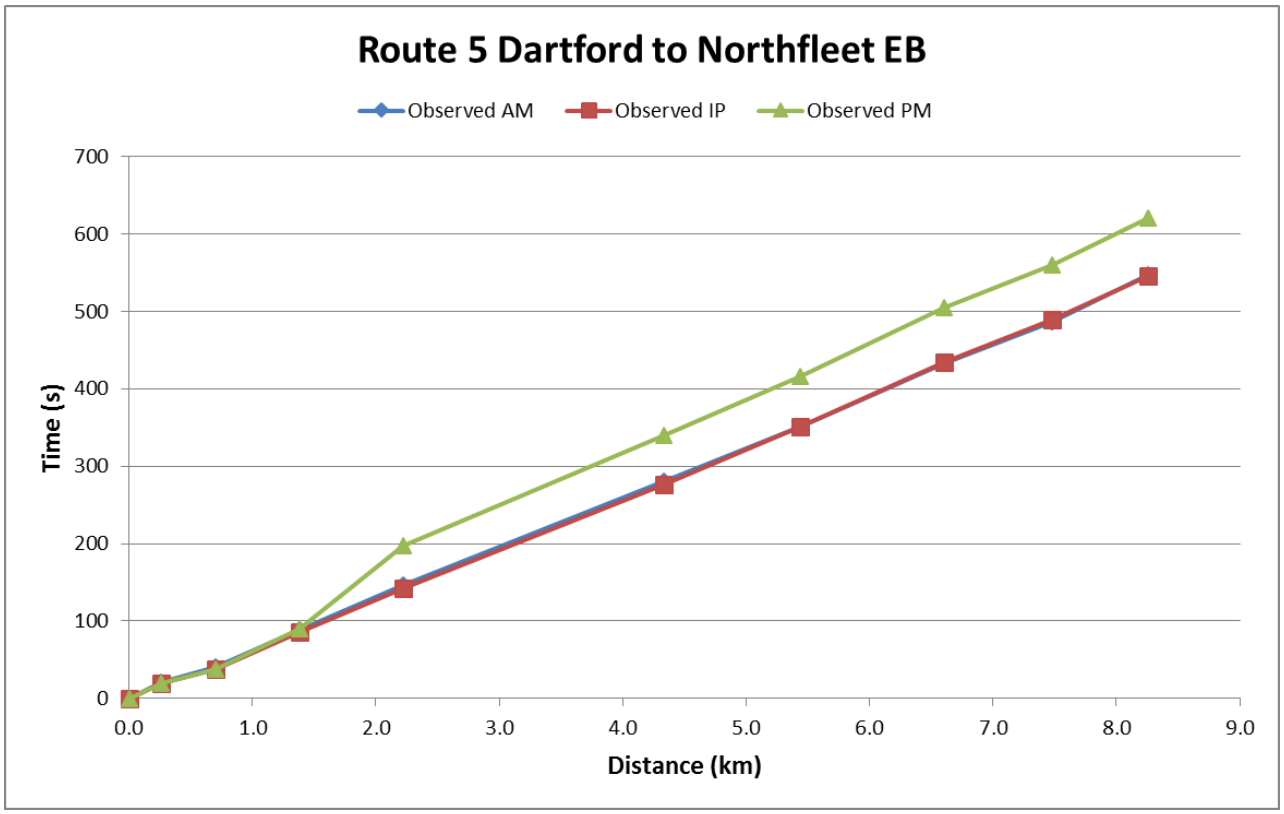


Route 4 M25 J1b to A2/A227 Junction WB (A2) - Journey Time Distance

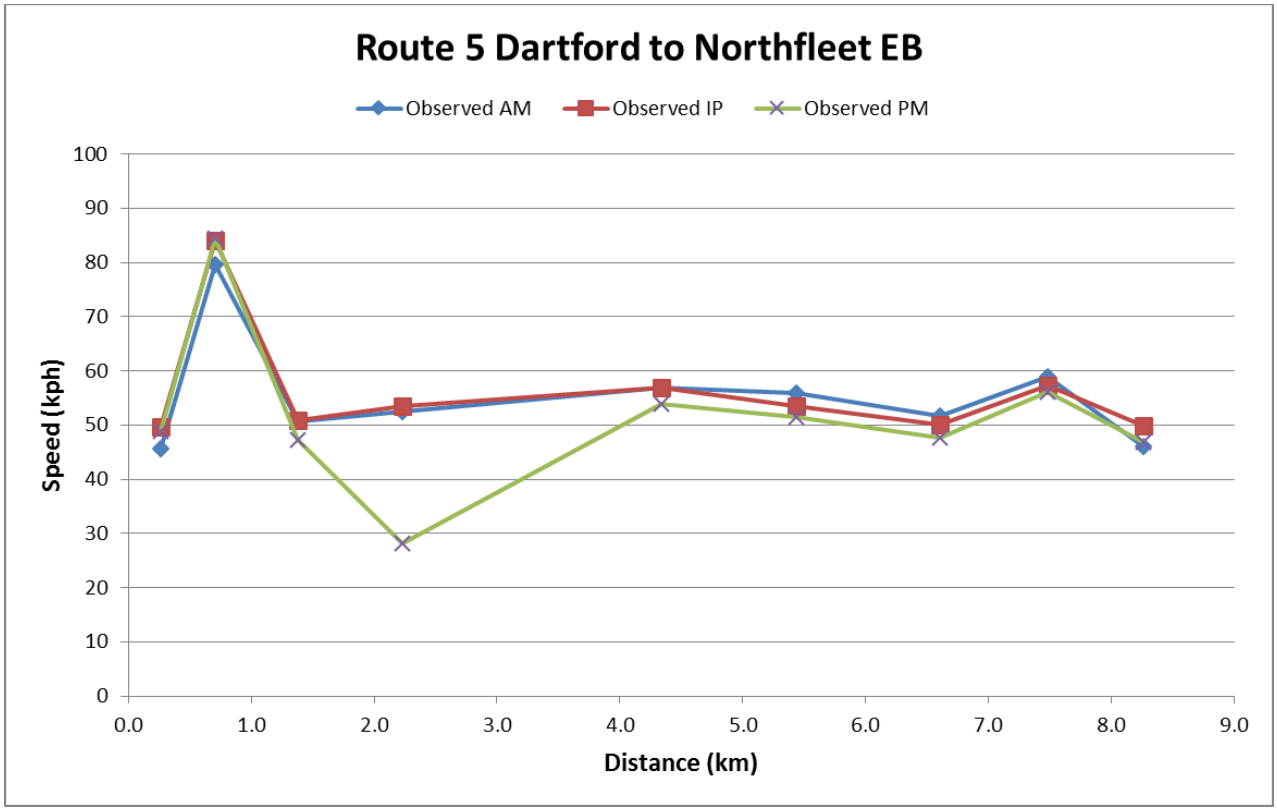
Route 4 M25 J1b to A2/A227 Junction WB (A2) - Journey Time Speed



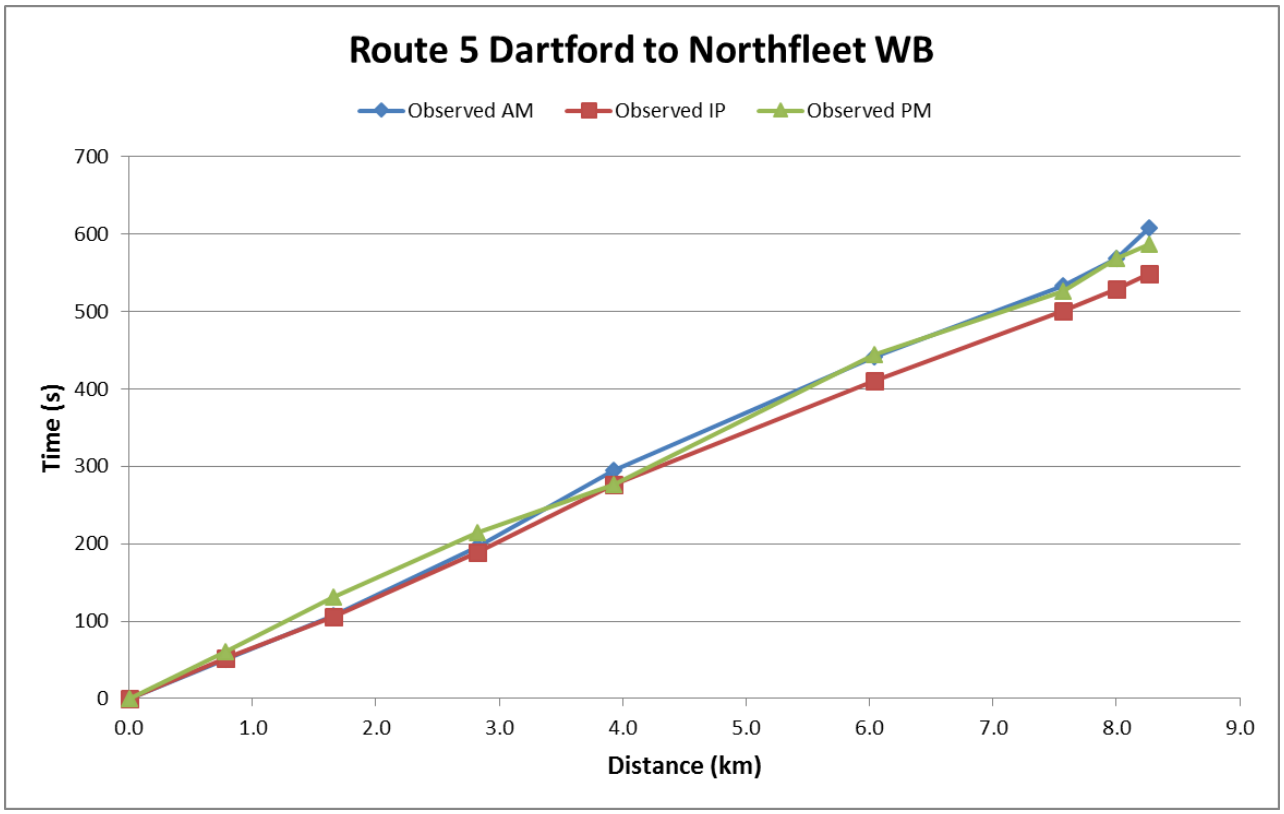
Route 5 Dartford to Northfleet EB (B260/B262) - Journey Time Distance



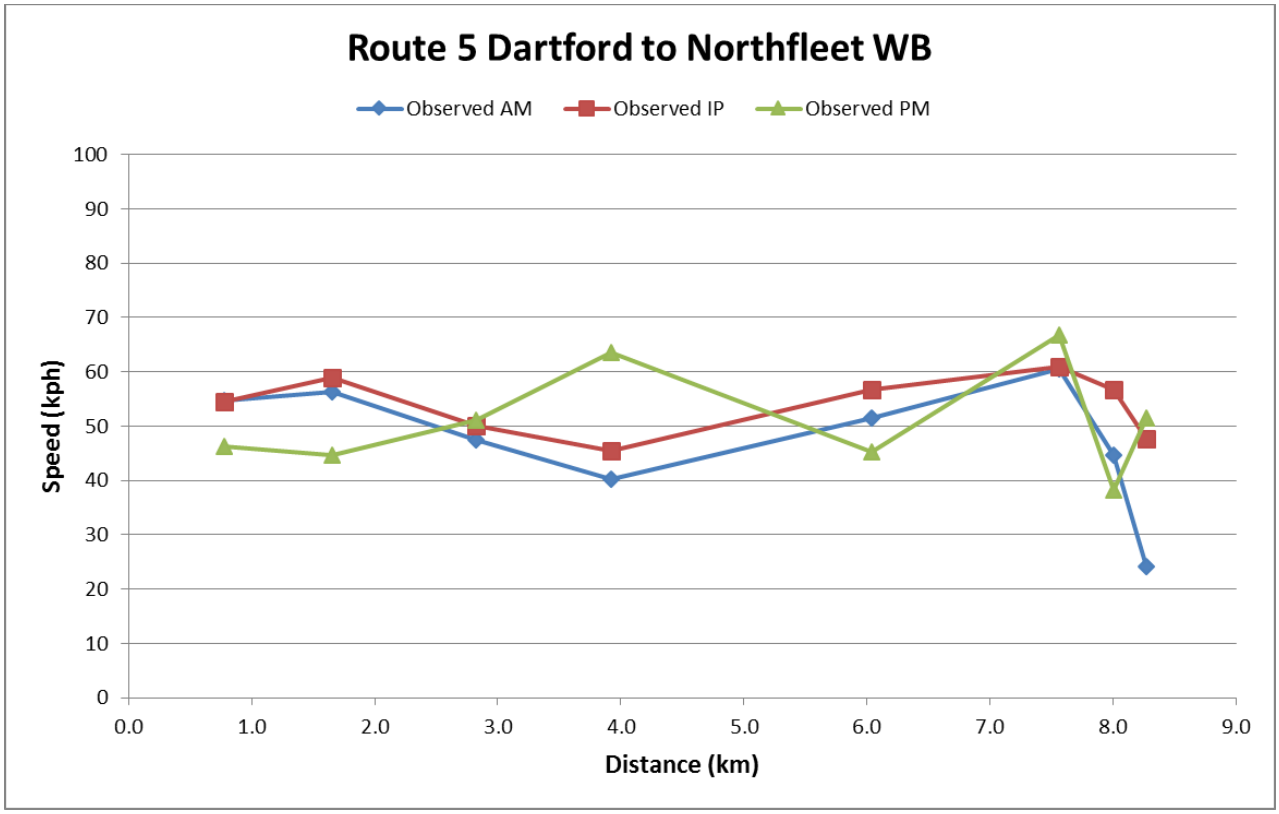
Route 5 Dartford to Northfleet EB (B260/B262) – Journey Time Speed



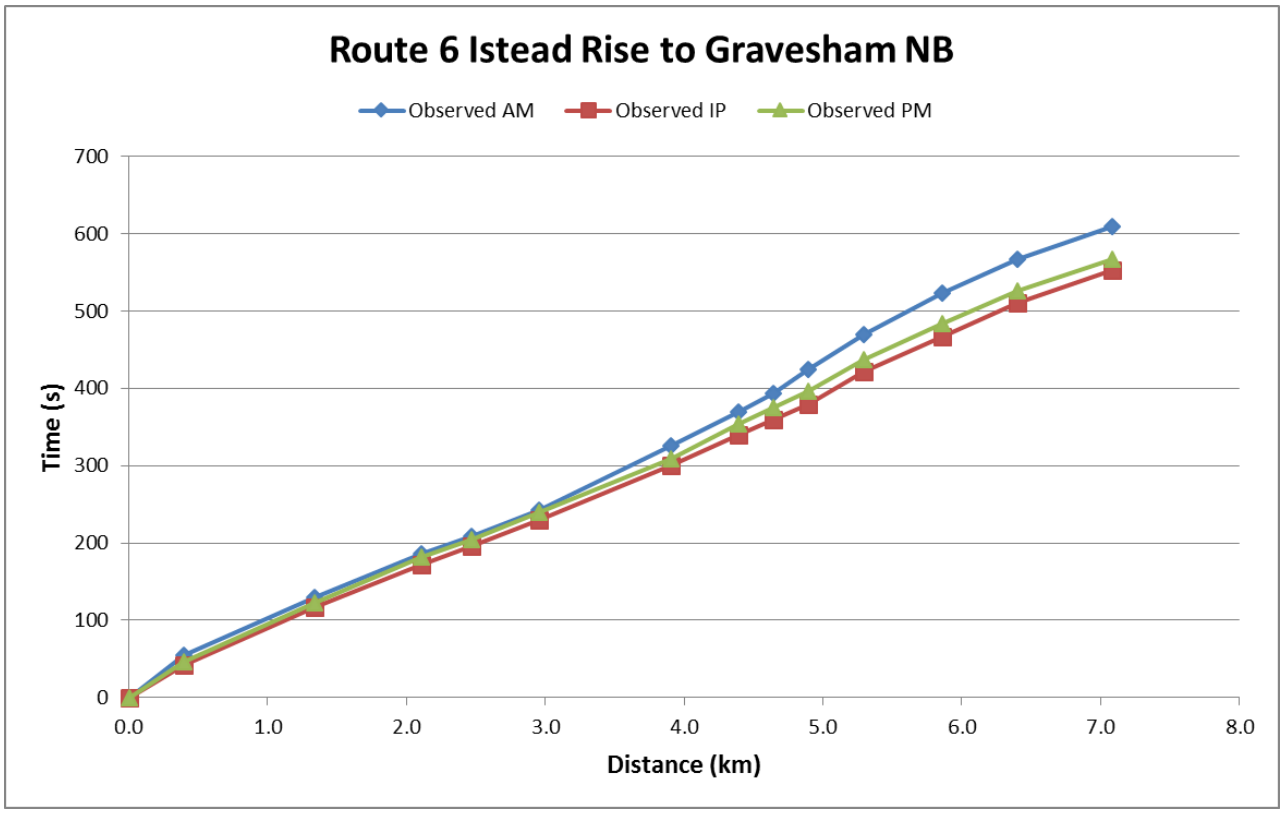
Route 5 Dartford to Northfleet WB (B262/B260) - Journey Time Distance



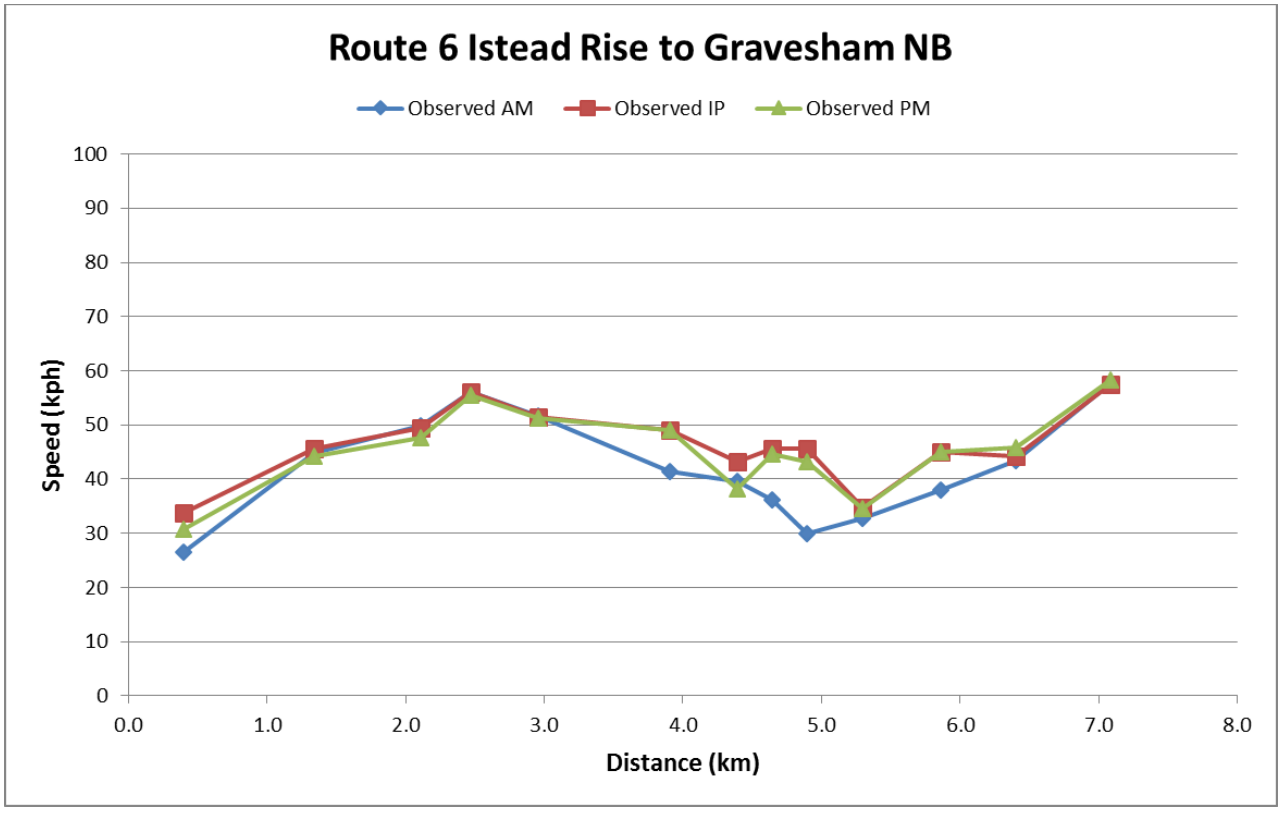
Route 5 Dartford to Northfleet WB (B262/B260) - Journey Time Speed



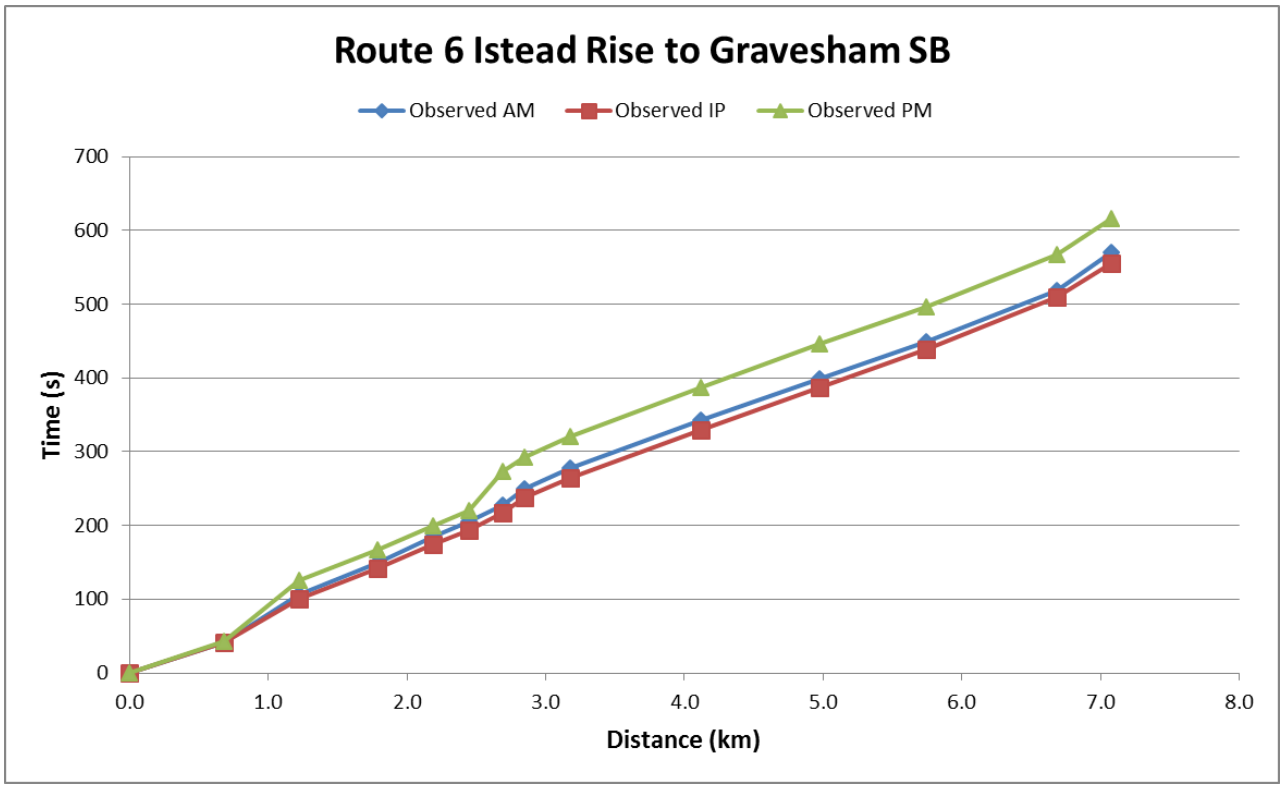
Route 6 Istead Rise to Gravesham NB (B260/B262) - Journey Time Distance



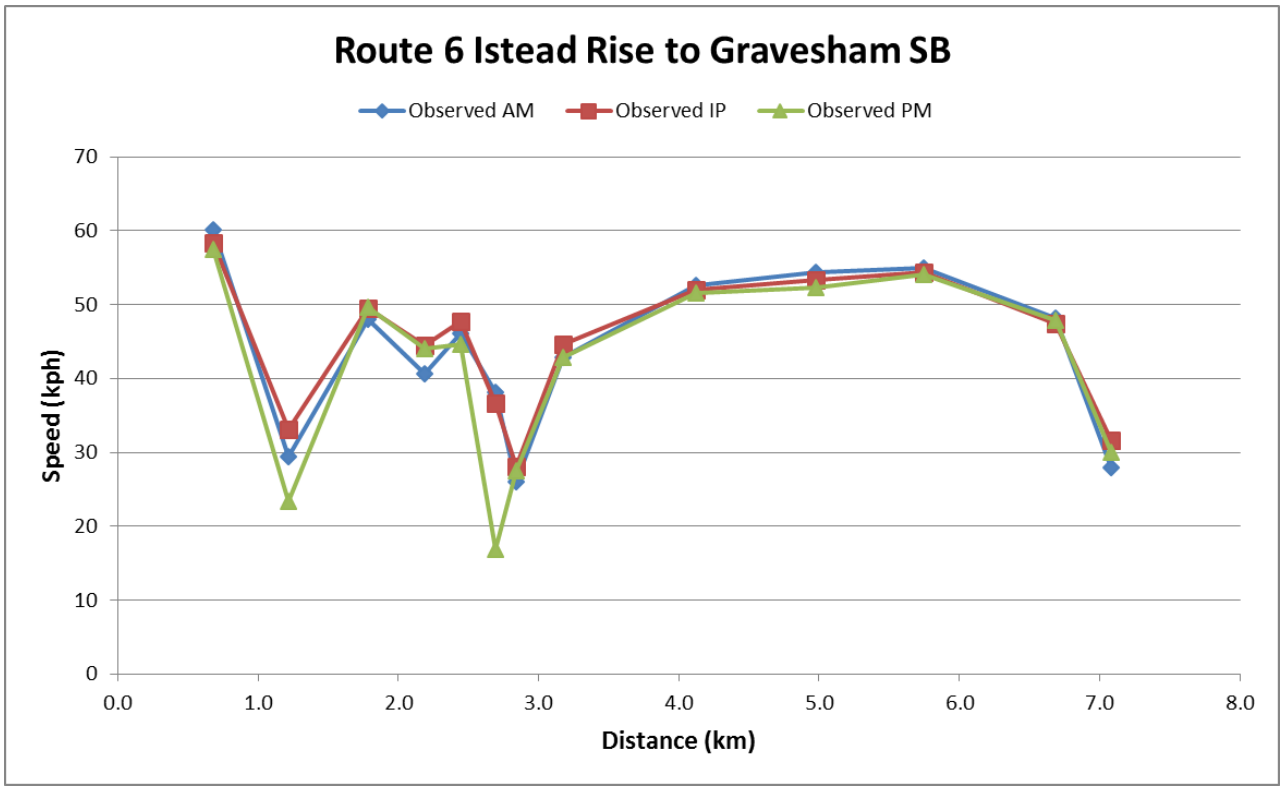
Route 6 Istead Rise to Gravesham NB (B260/B262) - Journey Time Speed



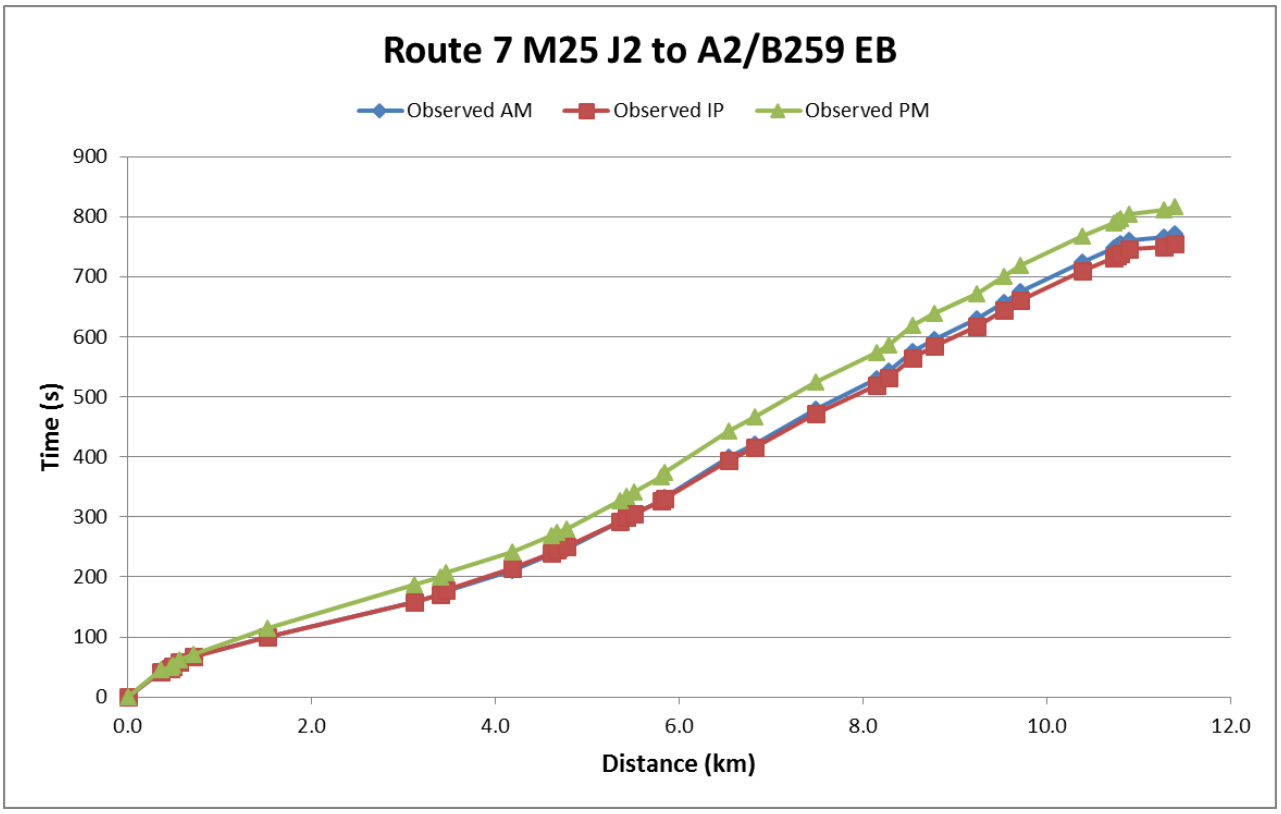
Route 6 Istead Rise to Gravesham SB (B262/B260) - Journey Time Distance



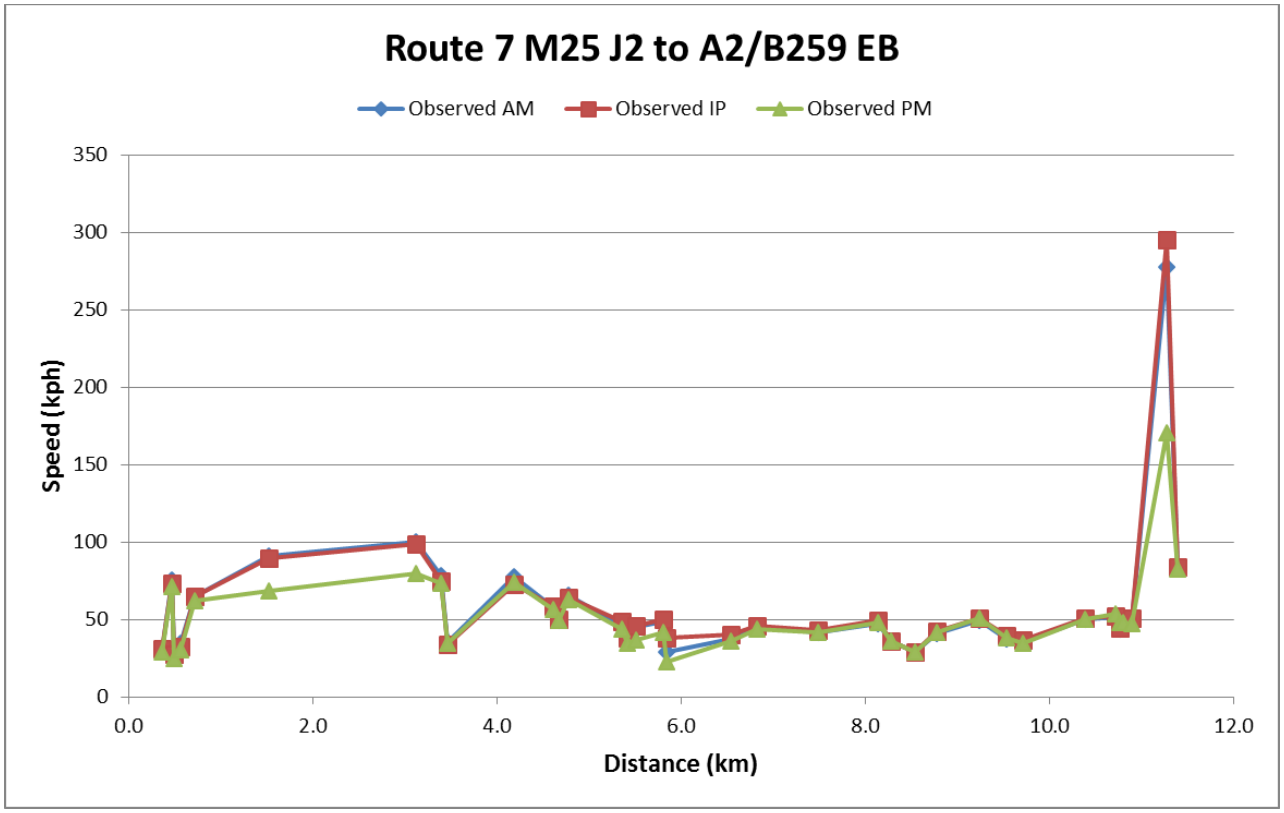
Route 6 Istead Rise to Gravesham SB (B262/B260) - Journey Time Speed



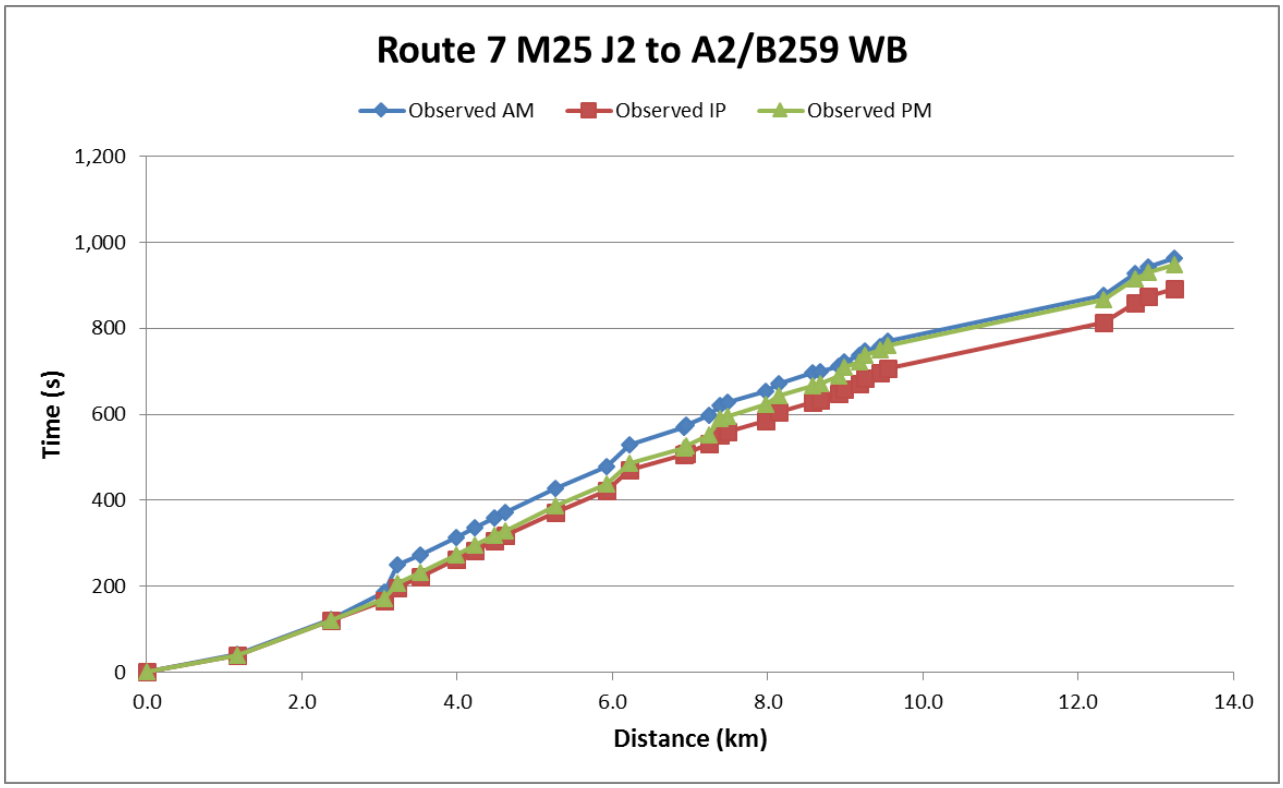
Route 7 M25 J2 to A2/B259 EB (A2/B255/A226/A2260) - Journey Time Distance



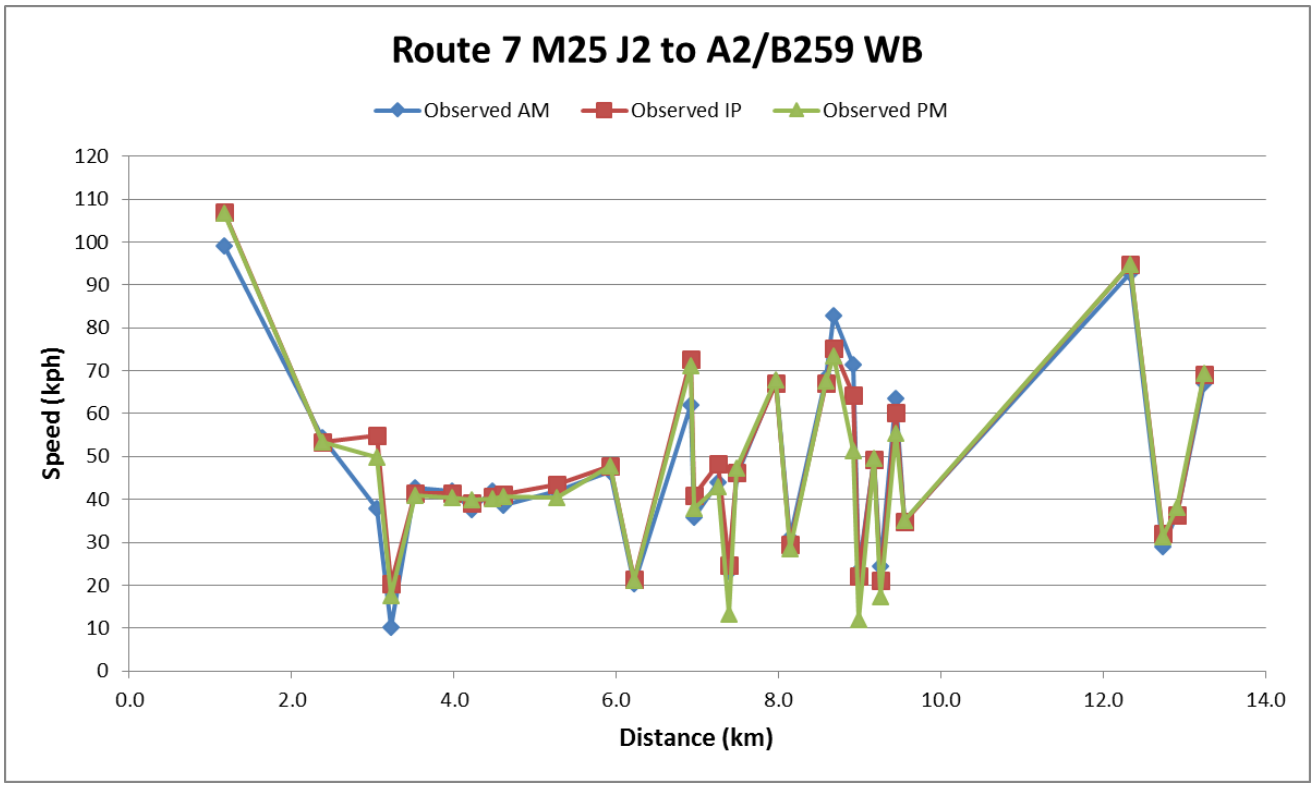
Route 7 M25 J2 to A2/B259 EB (A2/B255/A226/A2260) - Journey Time Speed



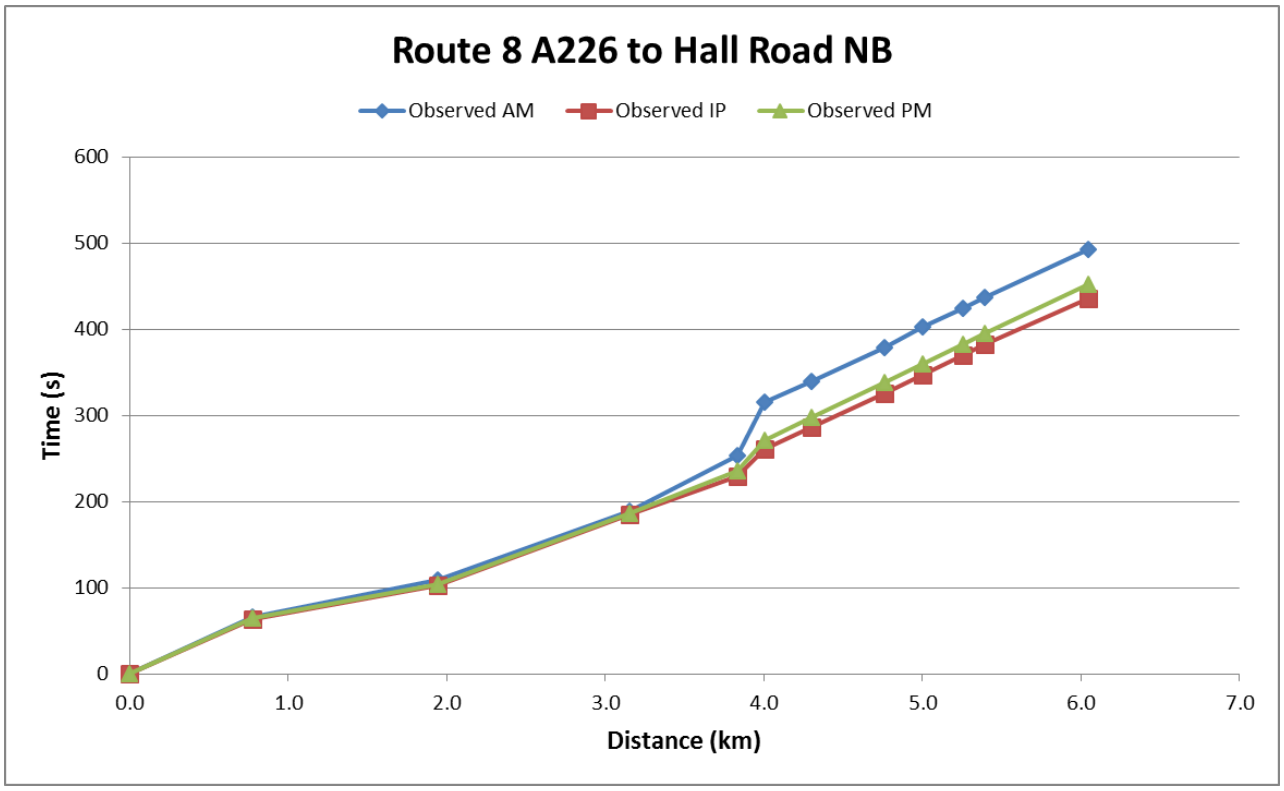
Route 7 M25 J2 to A2/B259 WB (A2260/A226/B255/A2) - Journey Time Distance



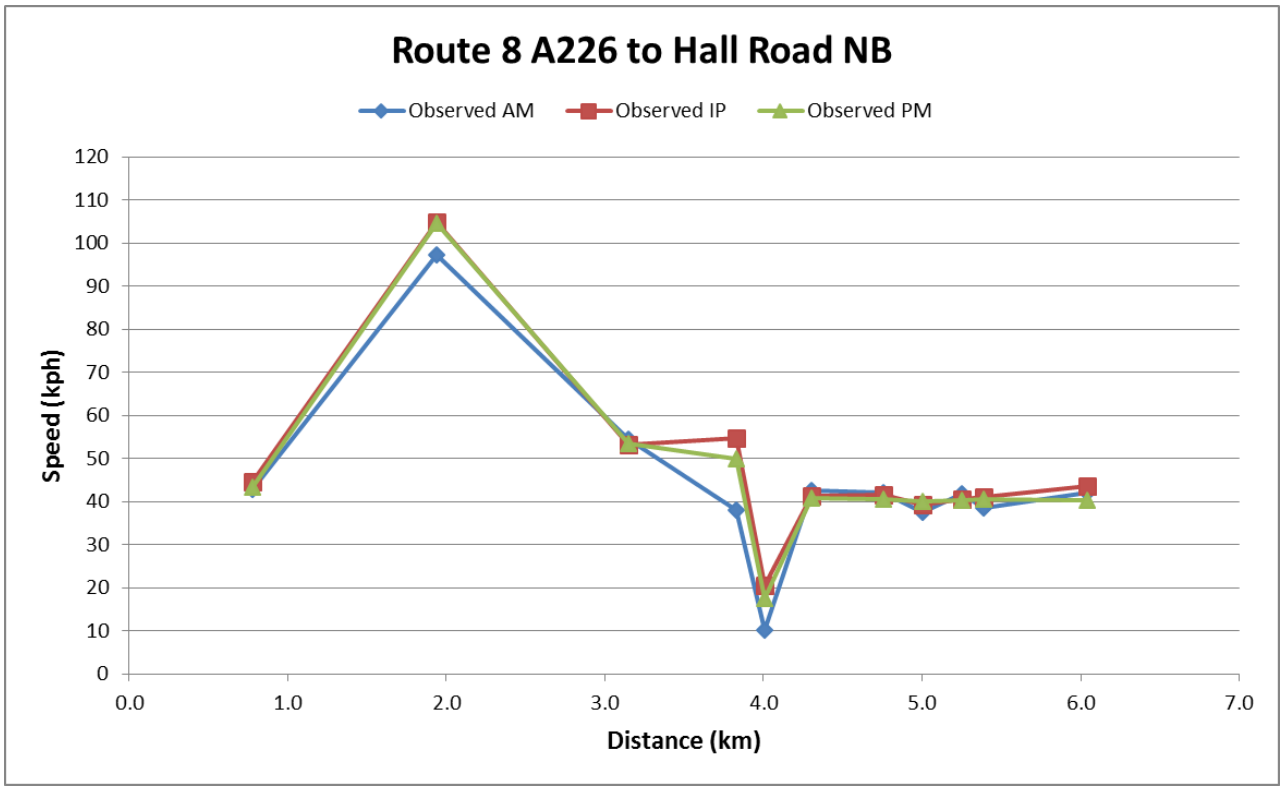
Route 7 M25 J2 to A2/B259 WB (A2260/A226/B255/A2) - Journey Time Speed



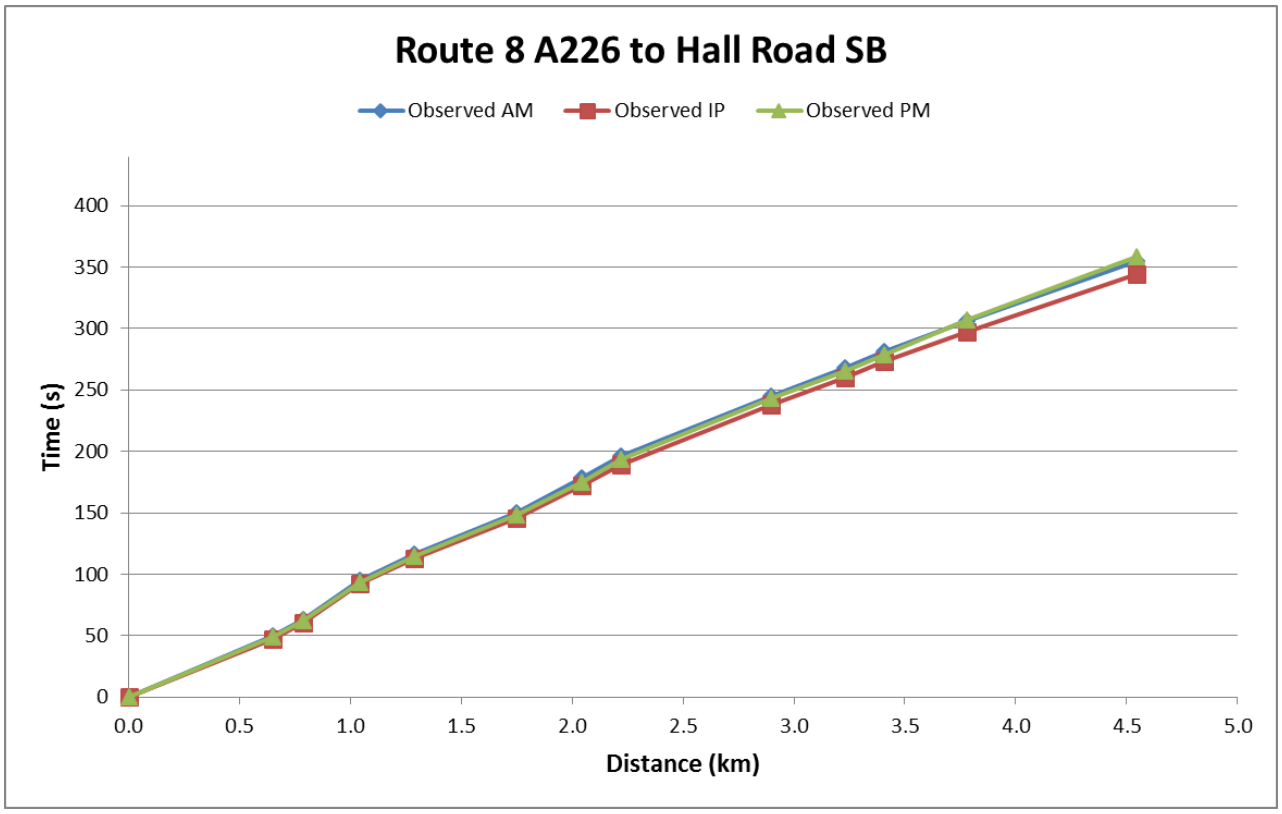
Route 8 A226 to Hall Road NB (B262/A2/A2260/B259) - Journey Time Distance



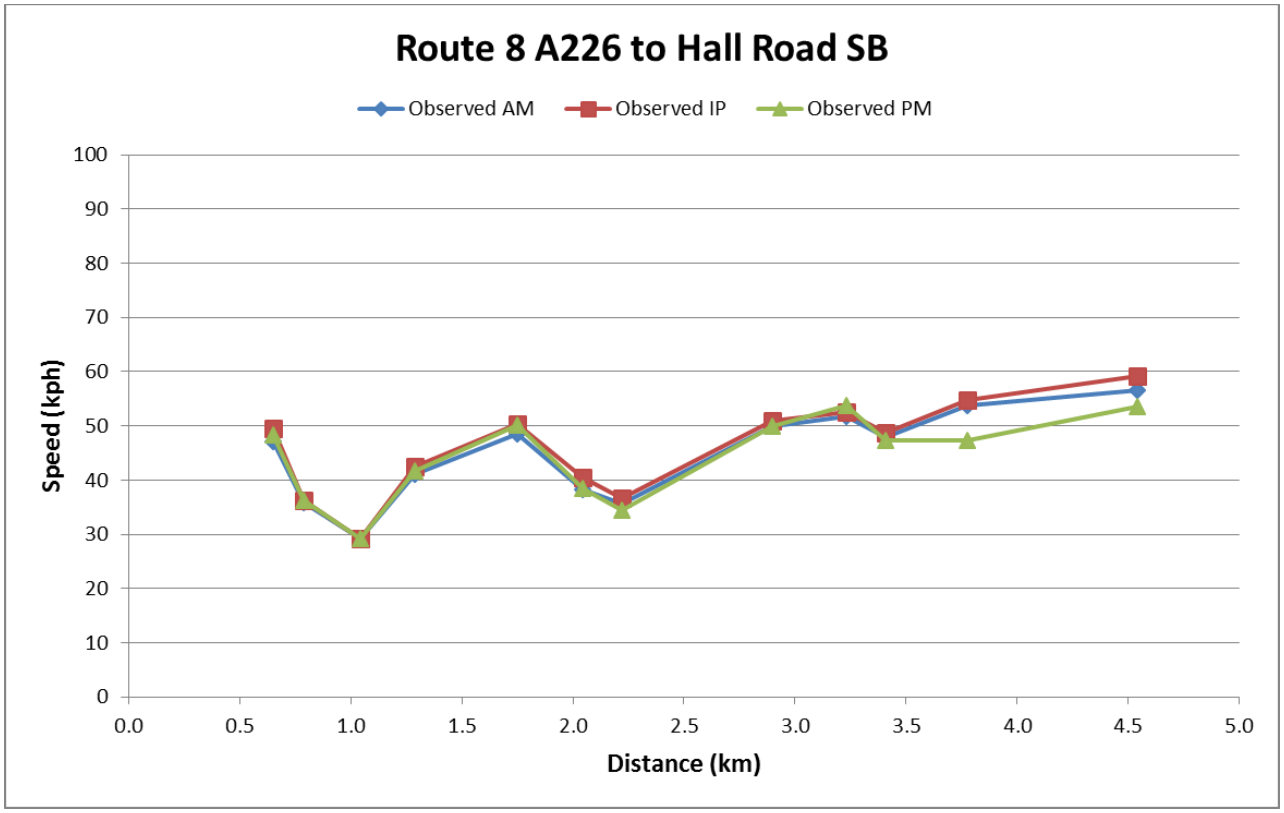
Route 8 A226 to Hall Road NB (B262/A2/A2260/B259) - Journey Time Speed



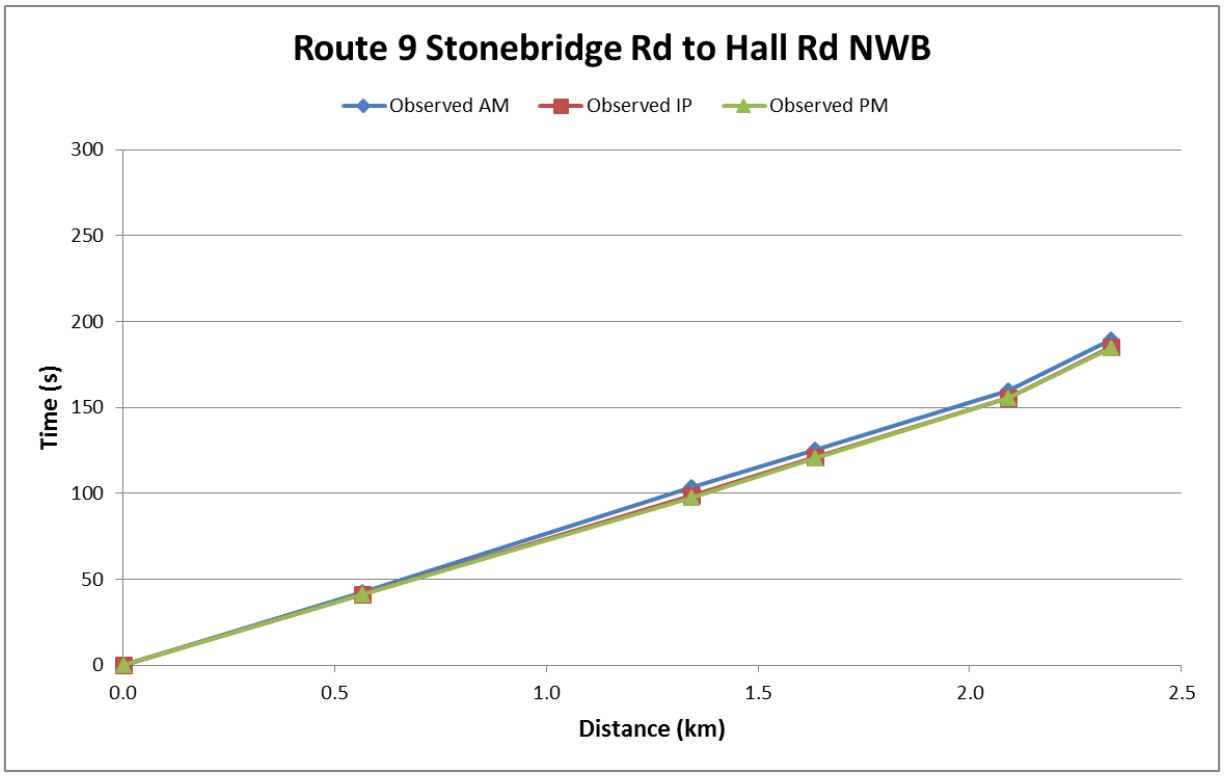
Route 8 A226 to Hall Road SB (B259/A2260/B262) - Journey Time Distance



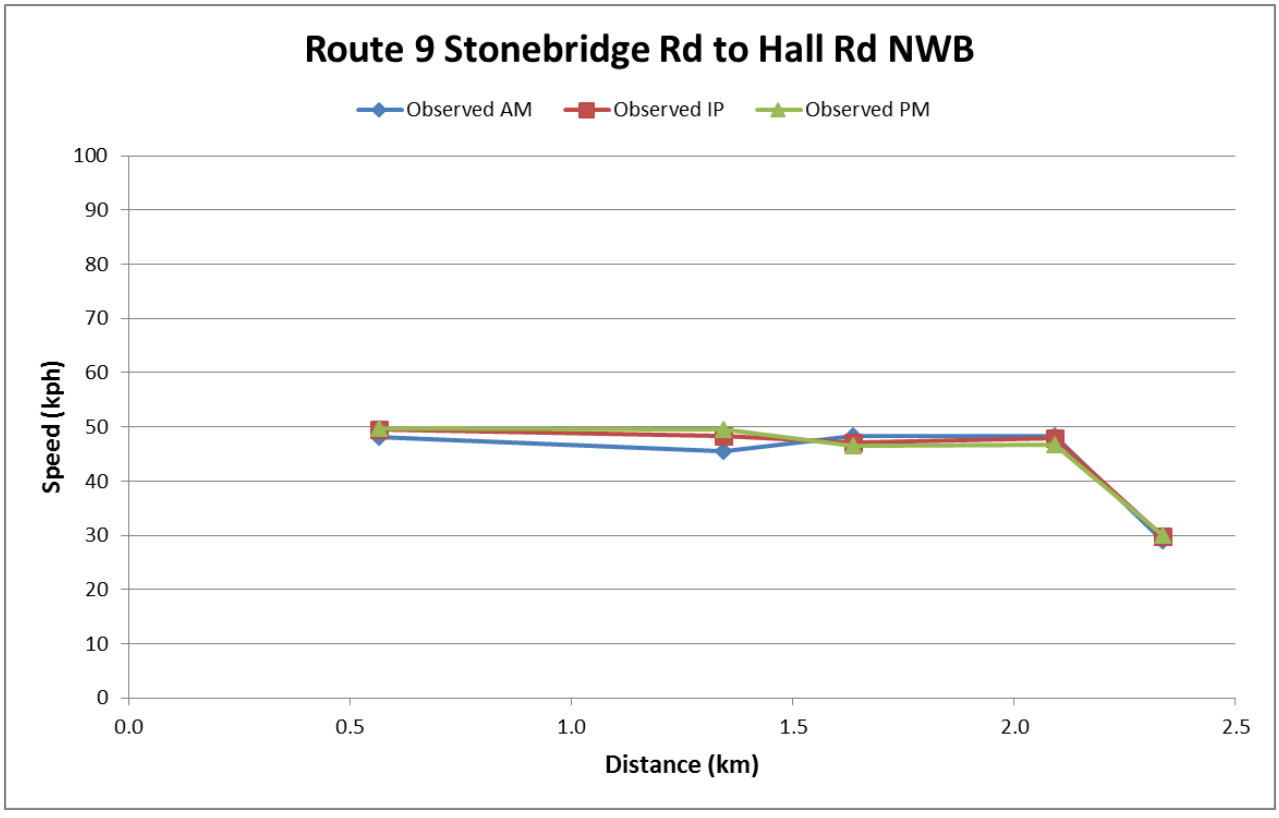
Route 8 A226 to Hall Road SB (B259/A2260/B262) – Journey Time Speed



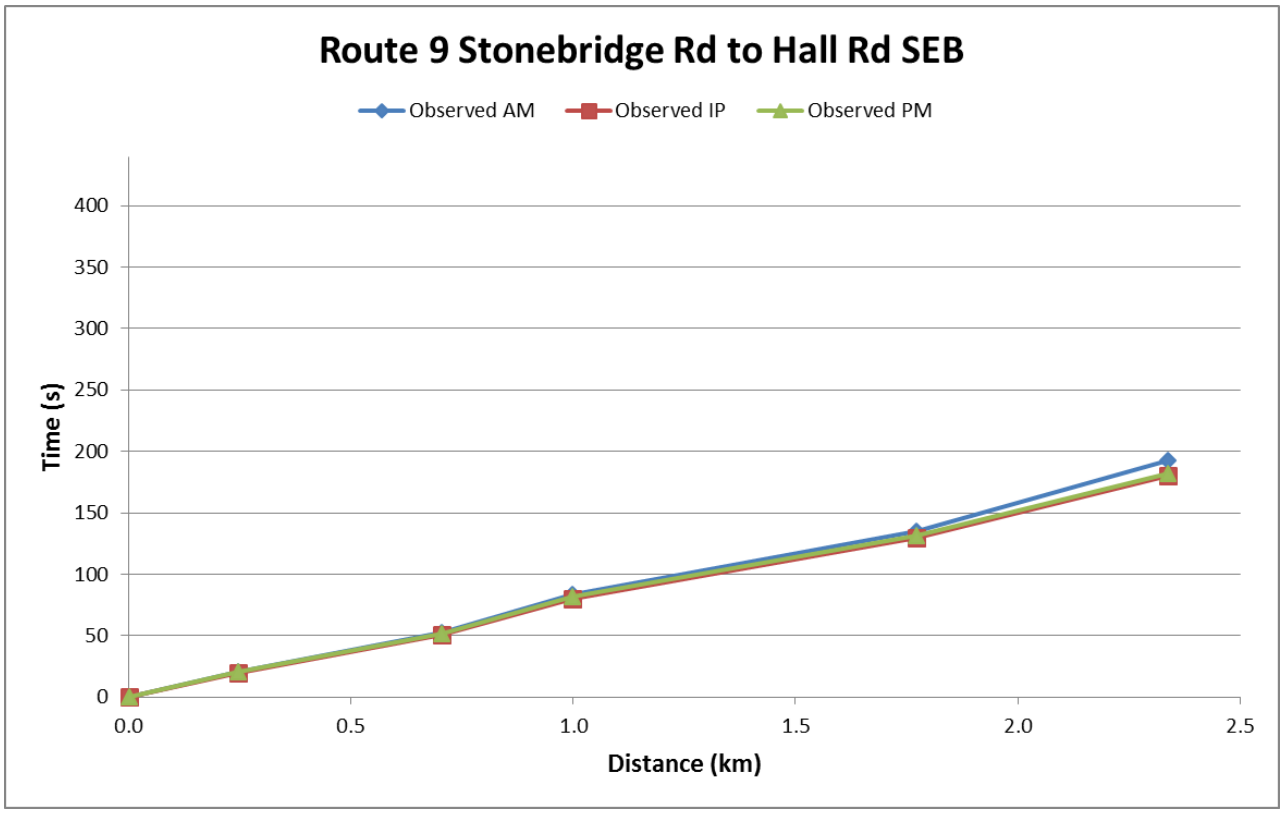
Route 9 Stonebridge Rd to Hall Rd NWB (A226) - Journey Time Distance



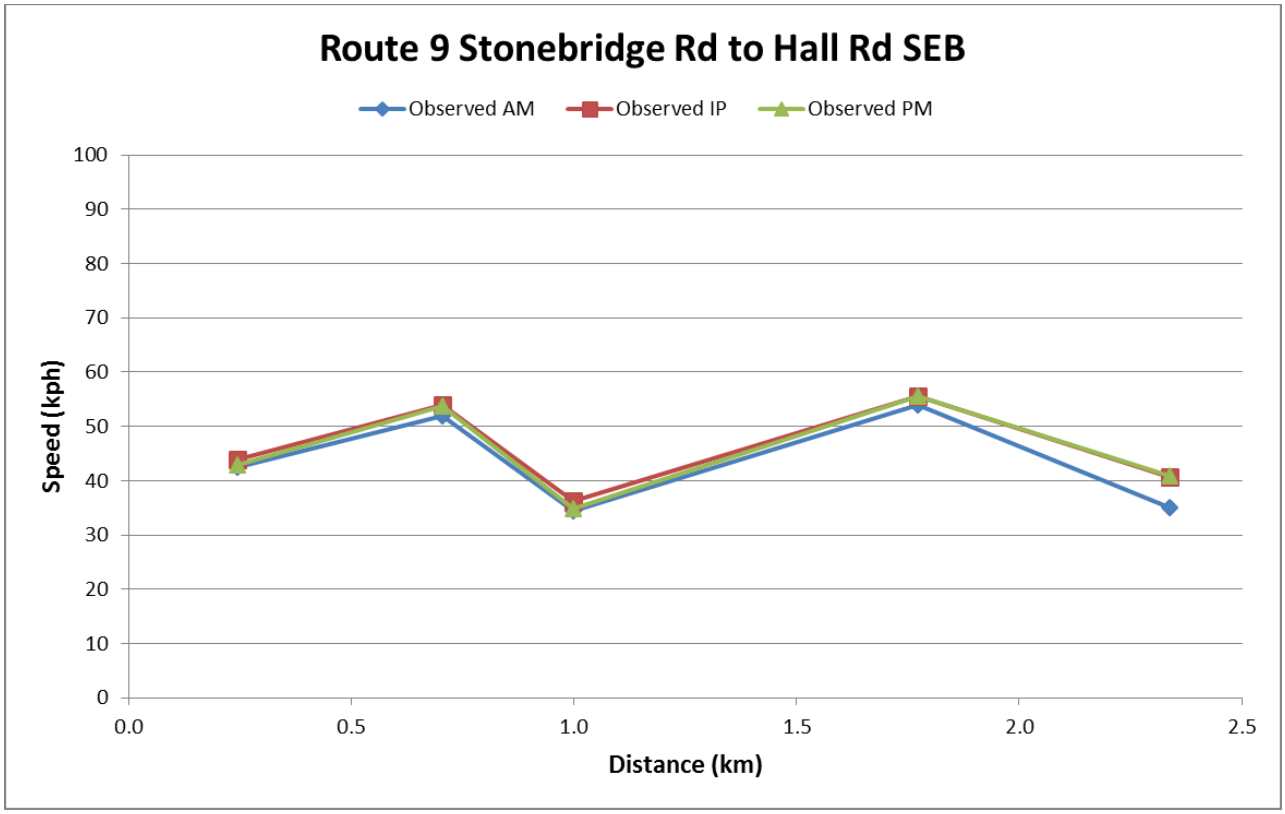
Route 9 Stonebridge Rd to Hall Rd NWB (A226) – Journey Time Speed



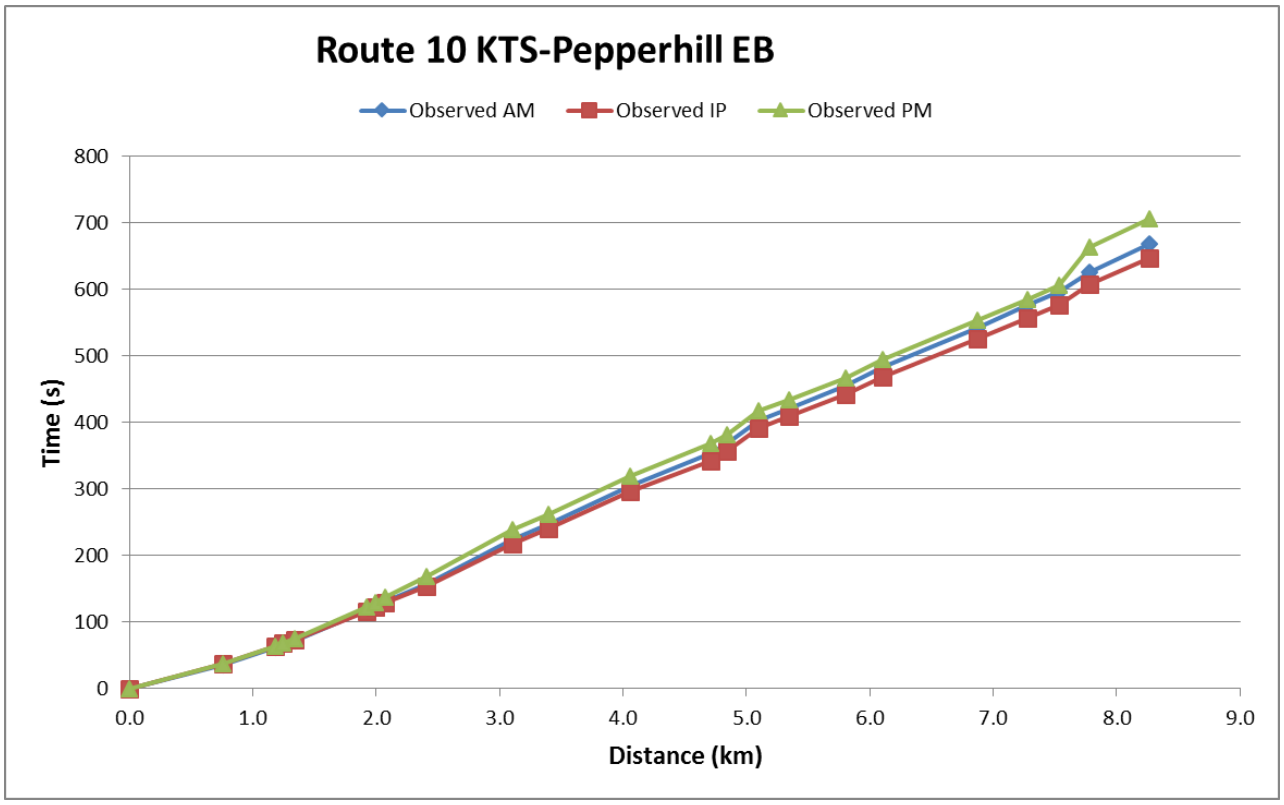
Route 9 Stonebridge Rd to Hall Rd SEB (A226) - Journey Time Distance



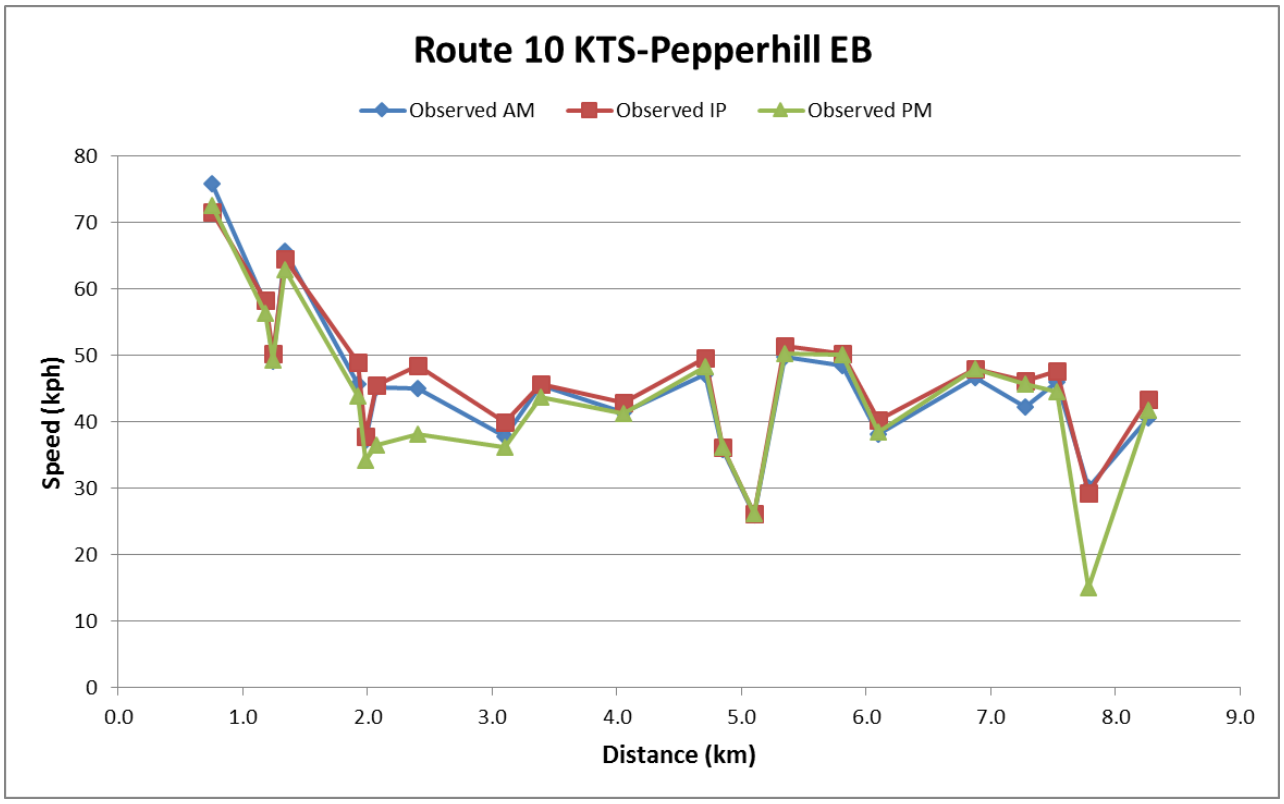
Route 9 Stonebridge Rd to Hall Rd SEB (A226) – Journey Time Speed



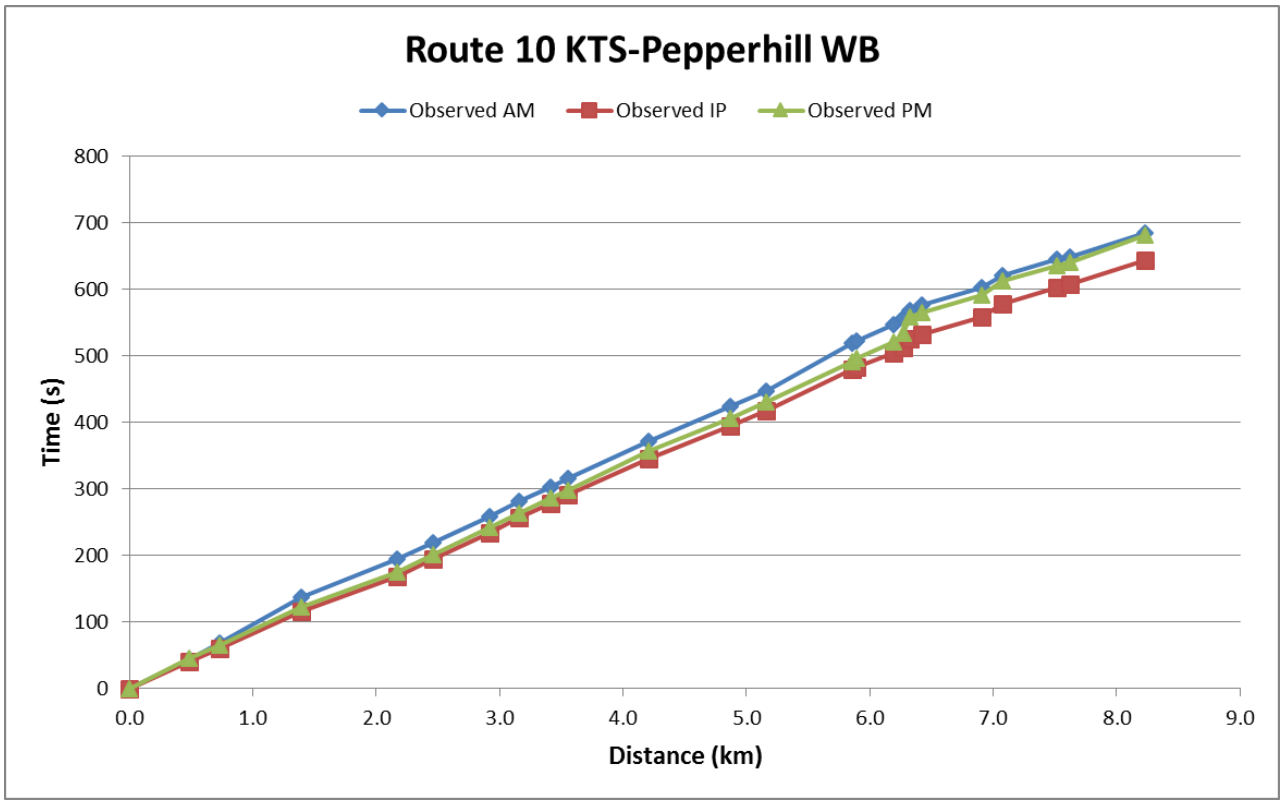
Route 10 KTS-Pepperhill EB (B255/A226/B262) – Journey Time Distance



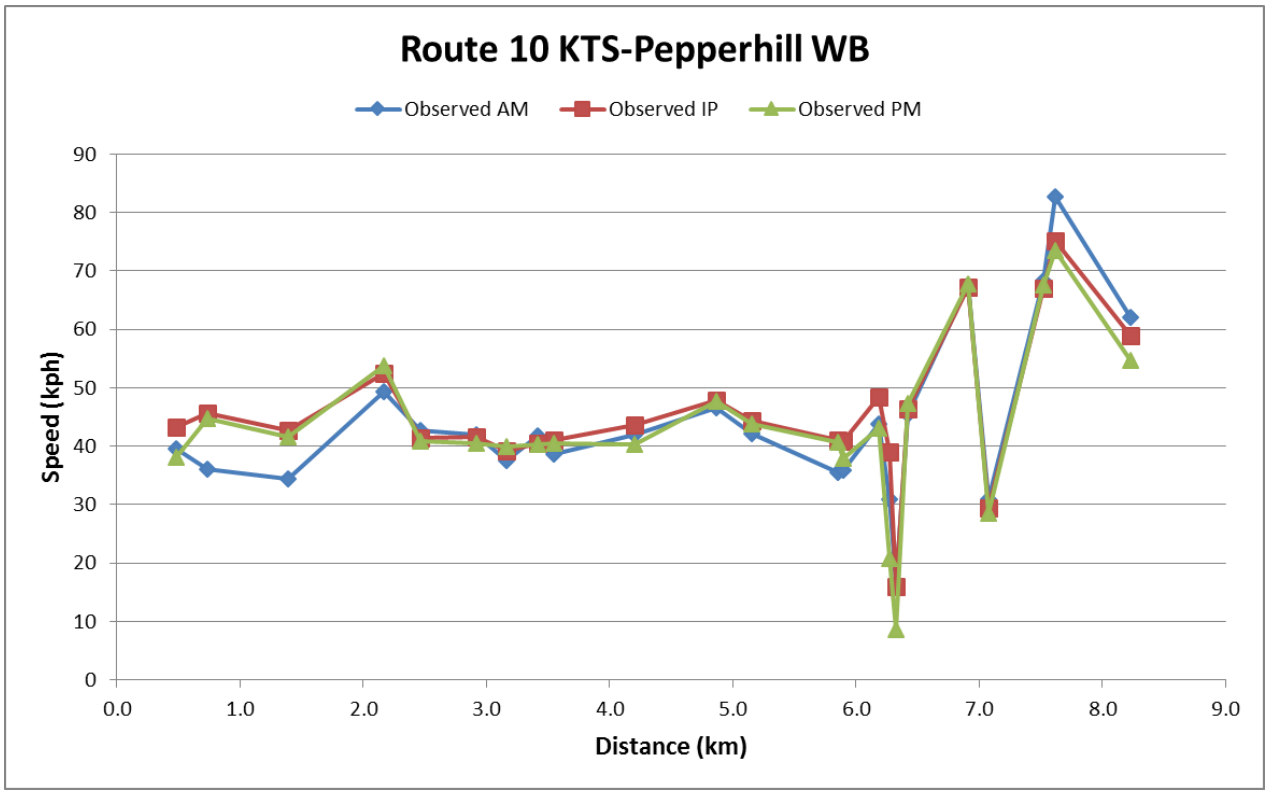
Route 10 KTS-Pepperhill EB (B255/A226/B262) – Journey Time Speed



Route 10 KTS-Pepperhill WB (B262/A226/B255) - Journey Time Distance

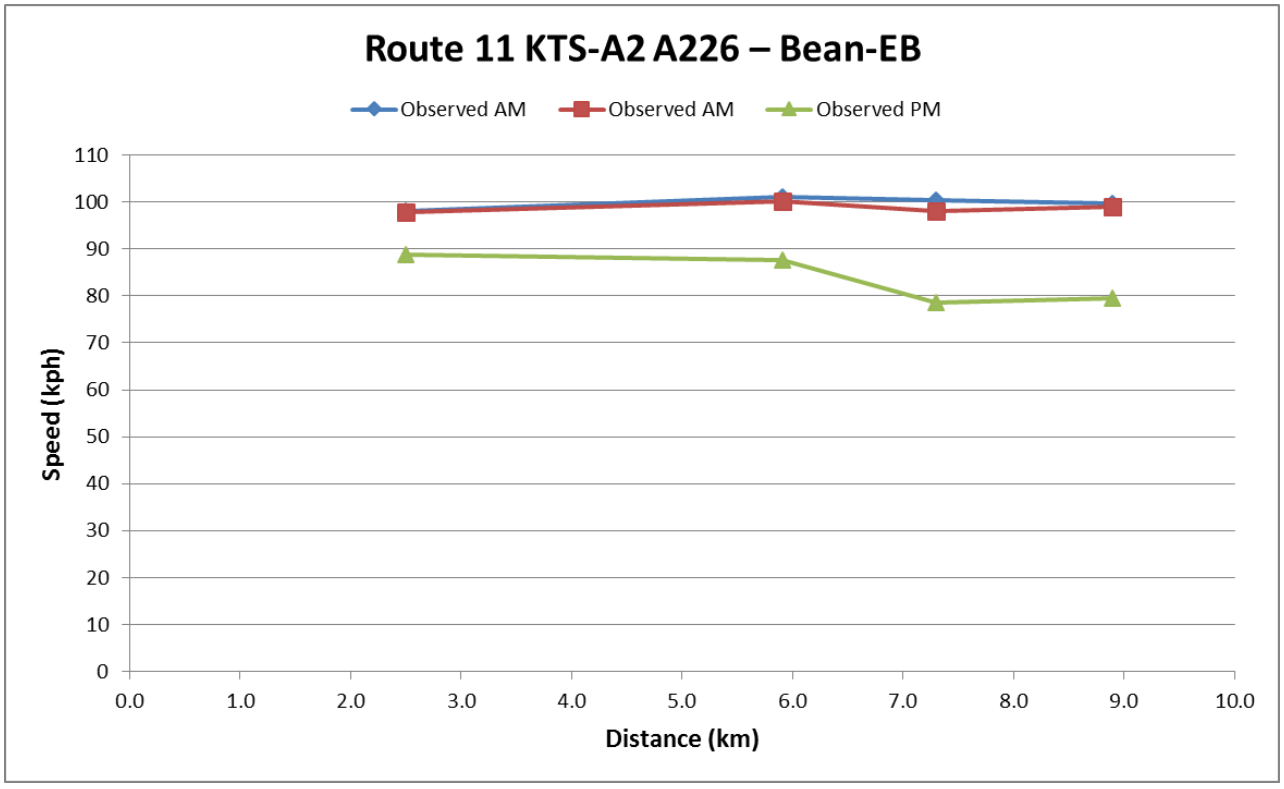


Route 10 KTS-Pepperhill WB (B262/A226/B255) – Journey Time Speed

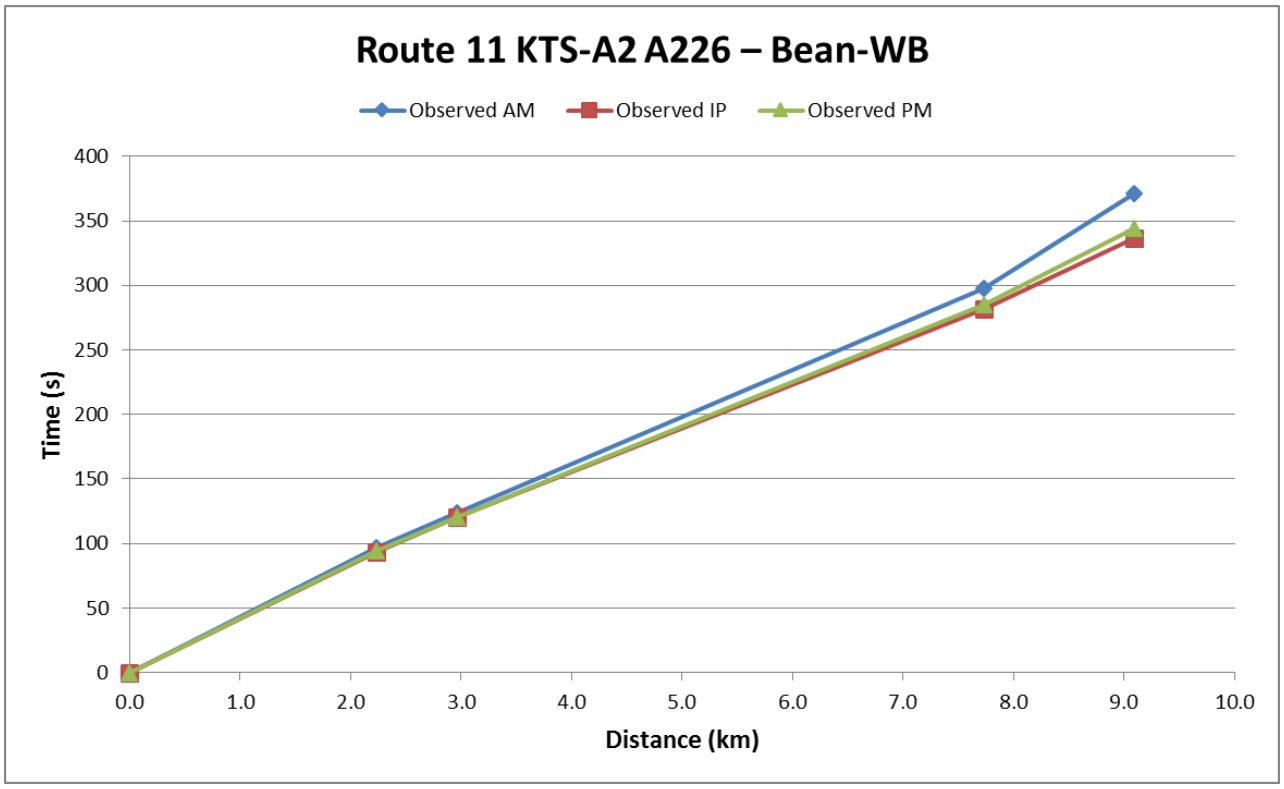


Route 11 KTS-A2 A226 – Bean-EB (A2) – Journey Time Distance

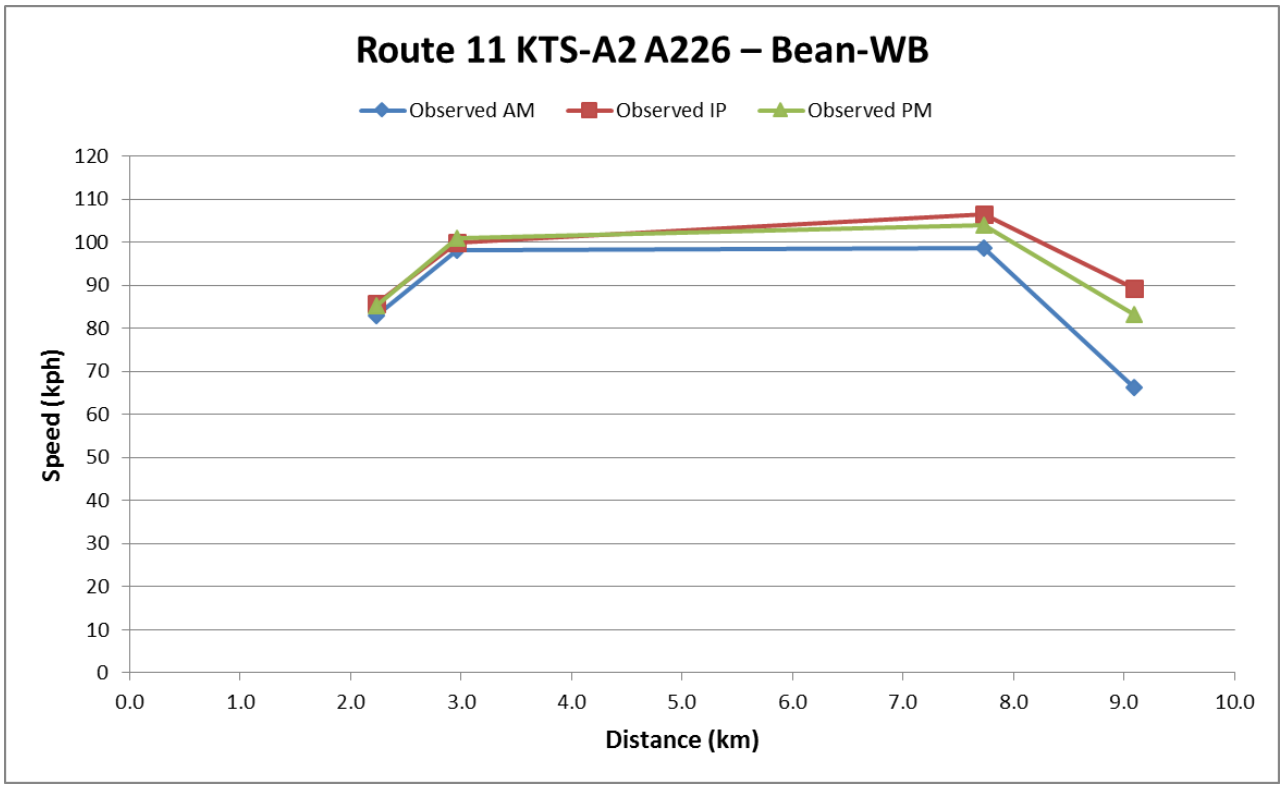
Route 11 KTS-A2 A226 – Bean-EB (A2) – Journey Time Speed



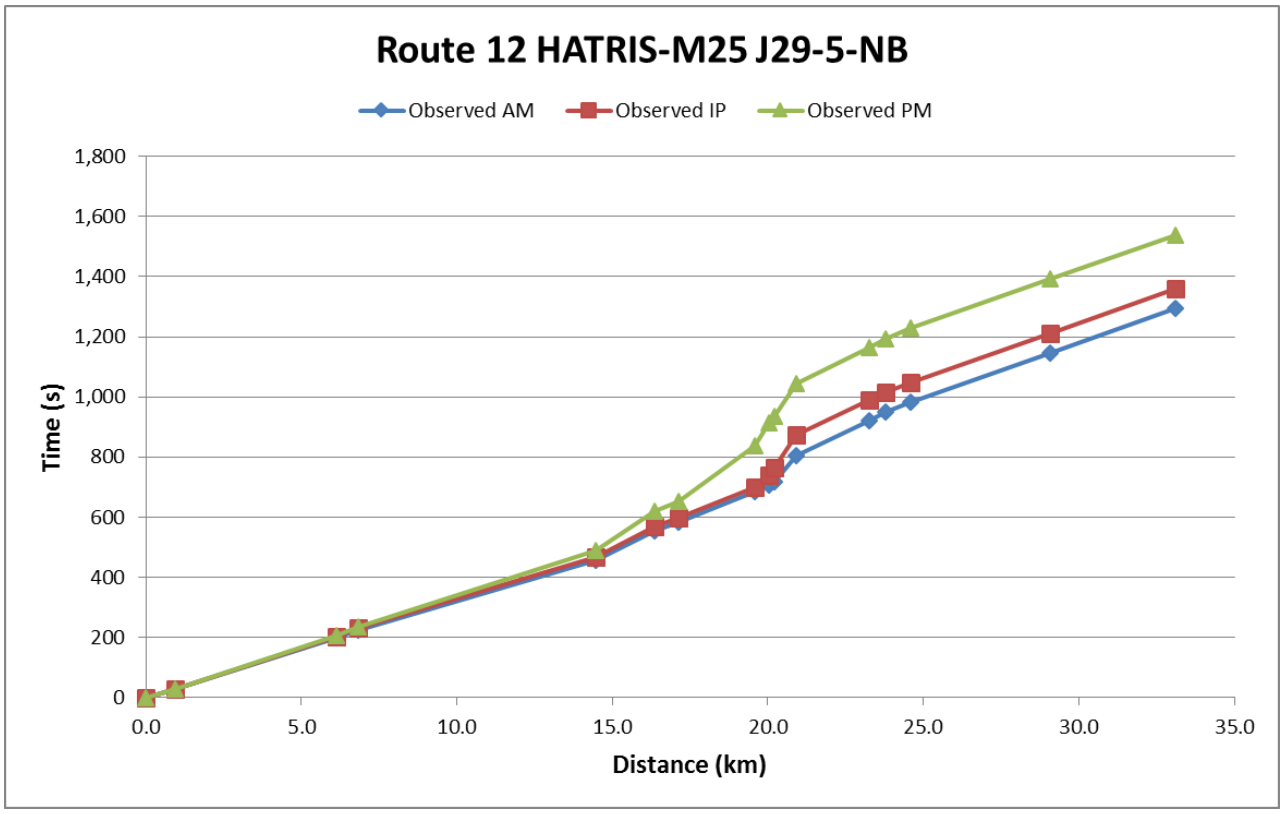
Route 11 KTS-A2 A226 – Bean-WB (A2) – Journey Time Distance



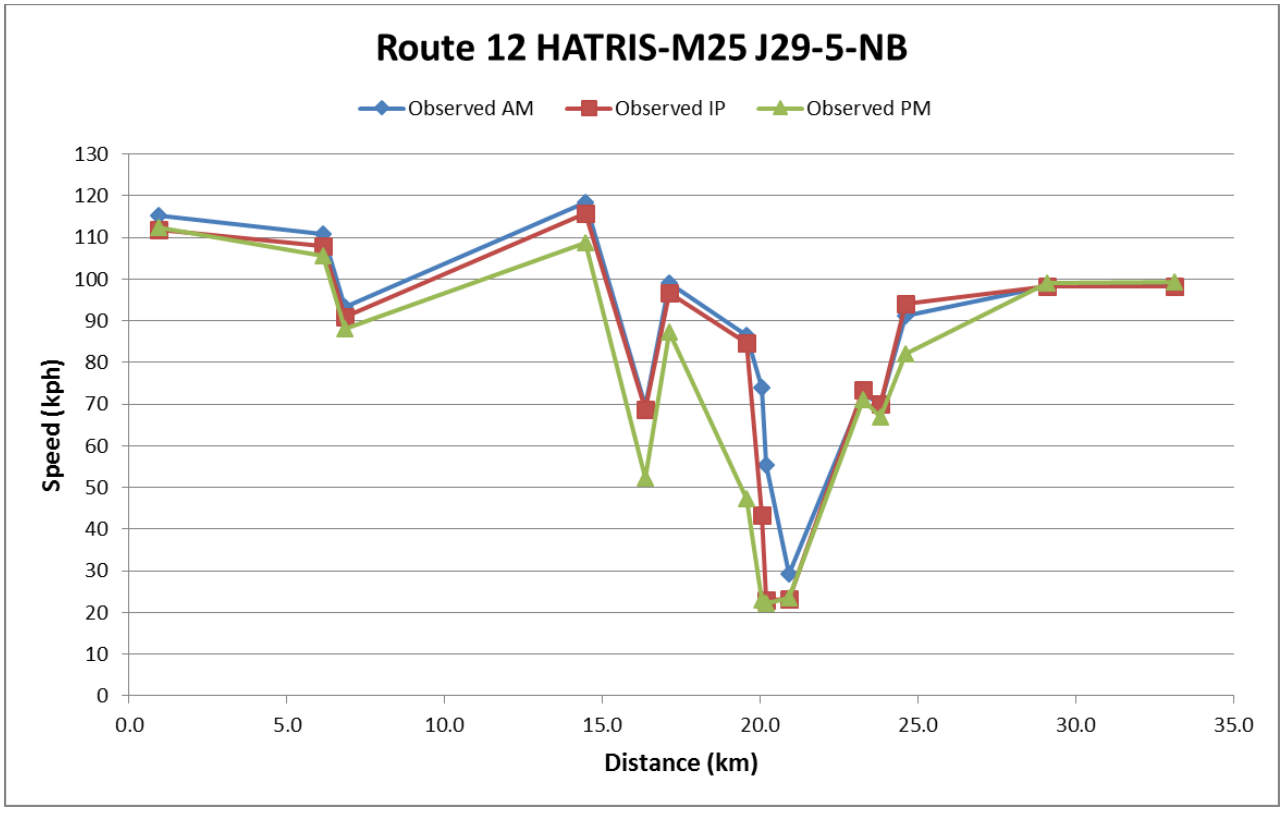
Route 11 KTS-A2 A226 – Bean-WB (A2) – Journey Time Speed



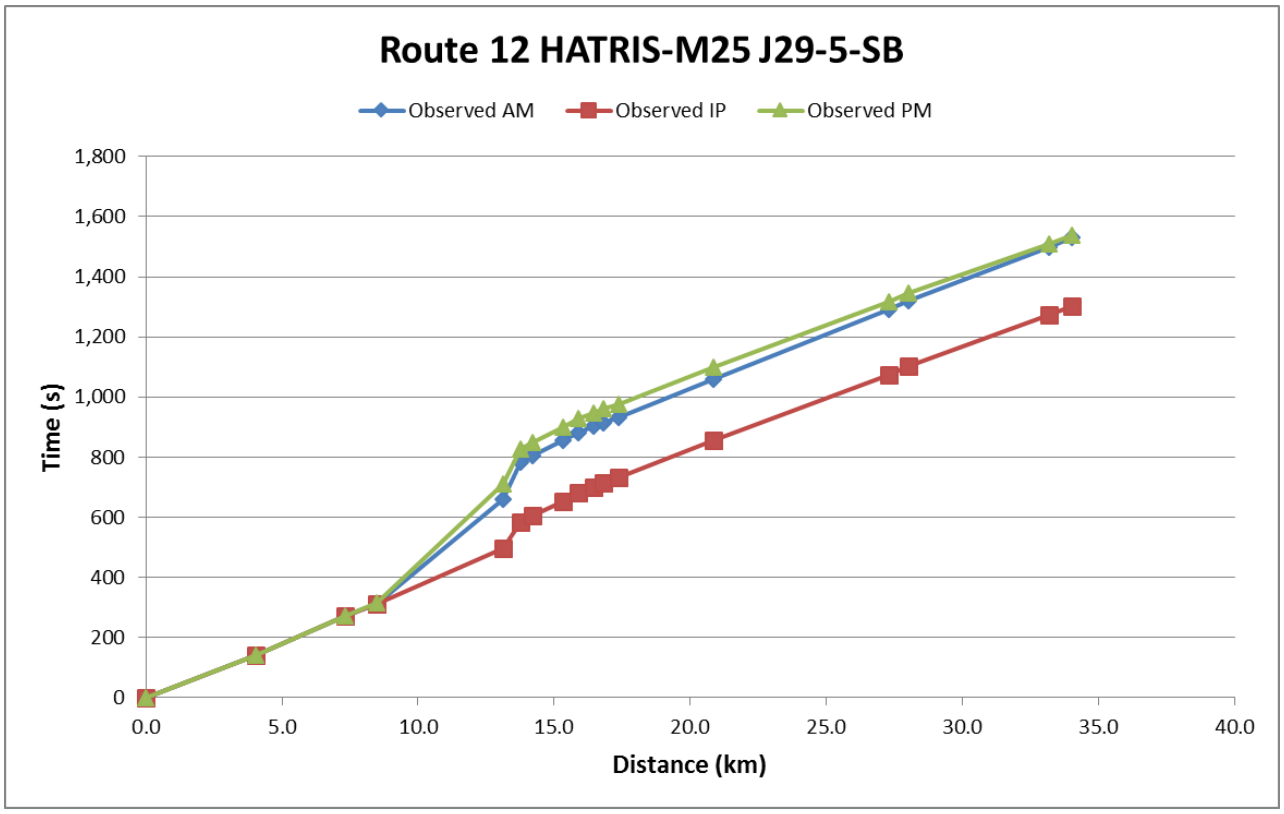
Route 12 HATRIS-M25 J29-5-NB - Journey Time Distance



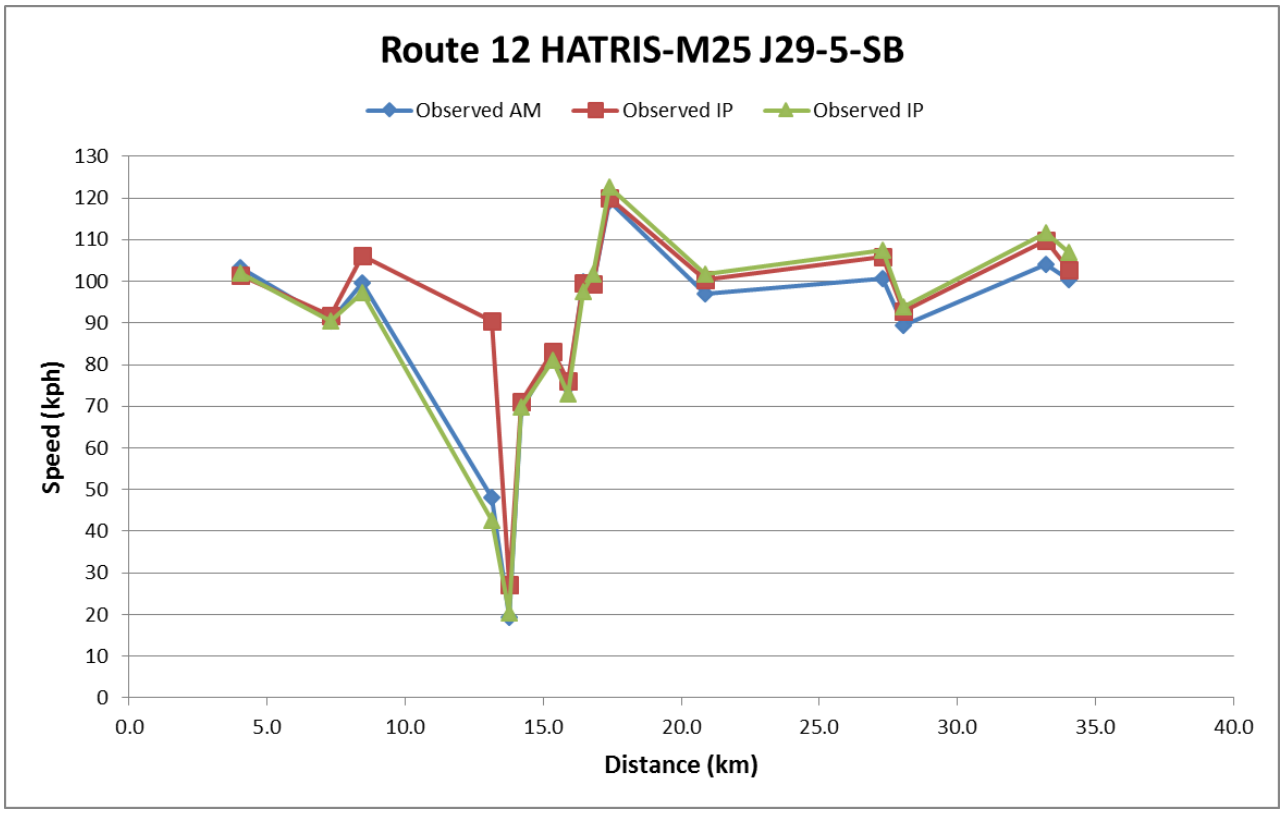
Route 12 HATRIS-M25 J29-5-NB - Journey Time Speed



Route 12 HATRIS-M25 J29-5-SB - Journey Time Distance

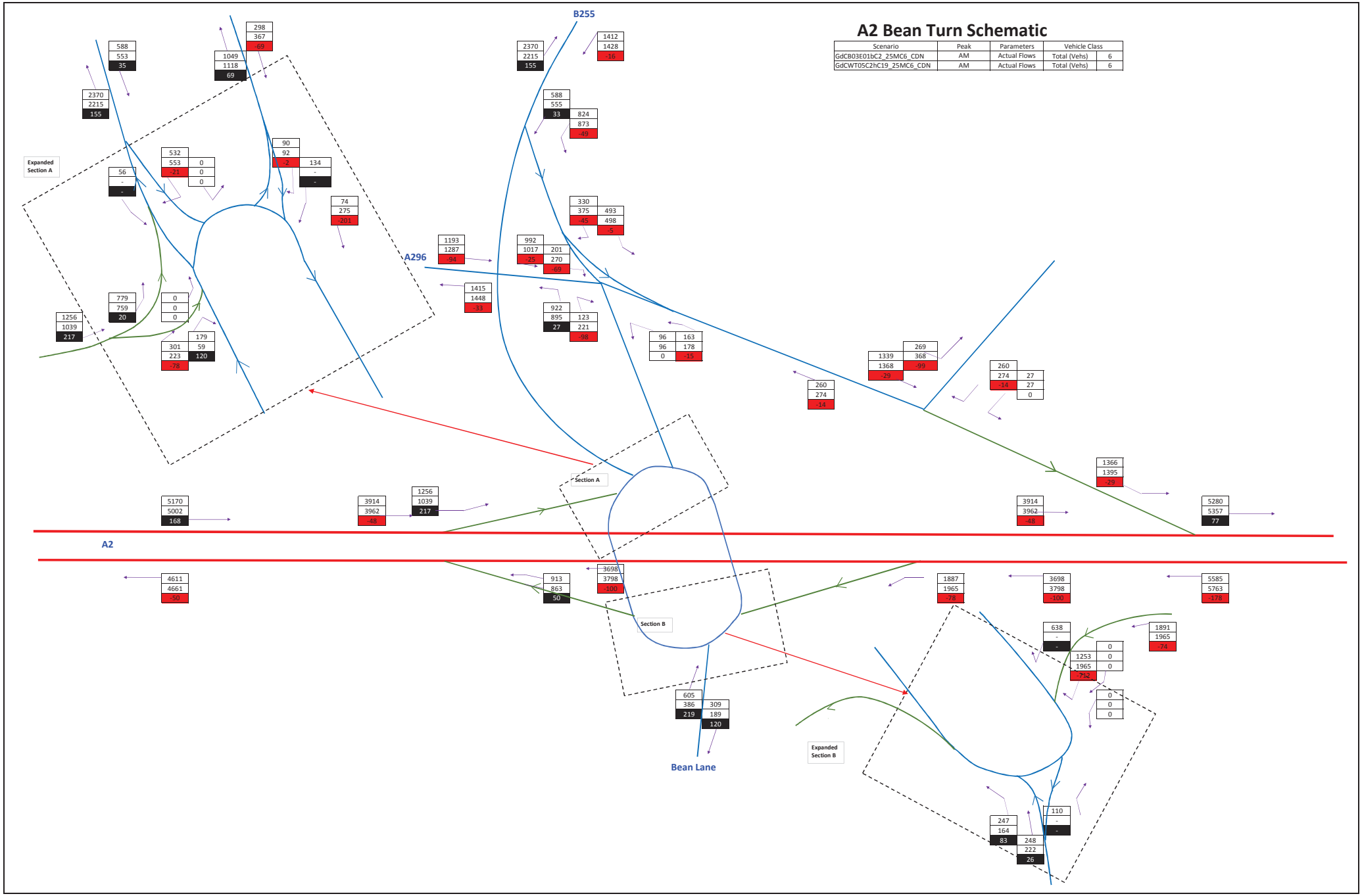


Route 12 HATRIS-M25 J29-5-SB - Journey Time Speed

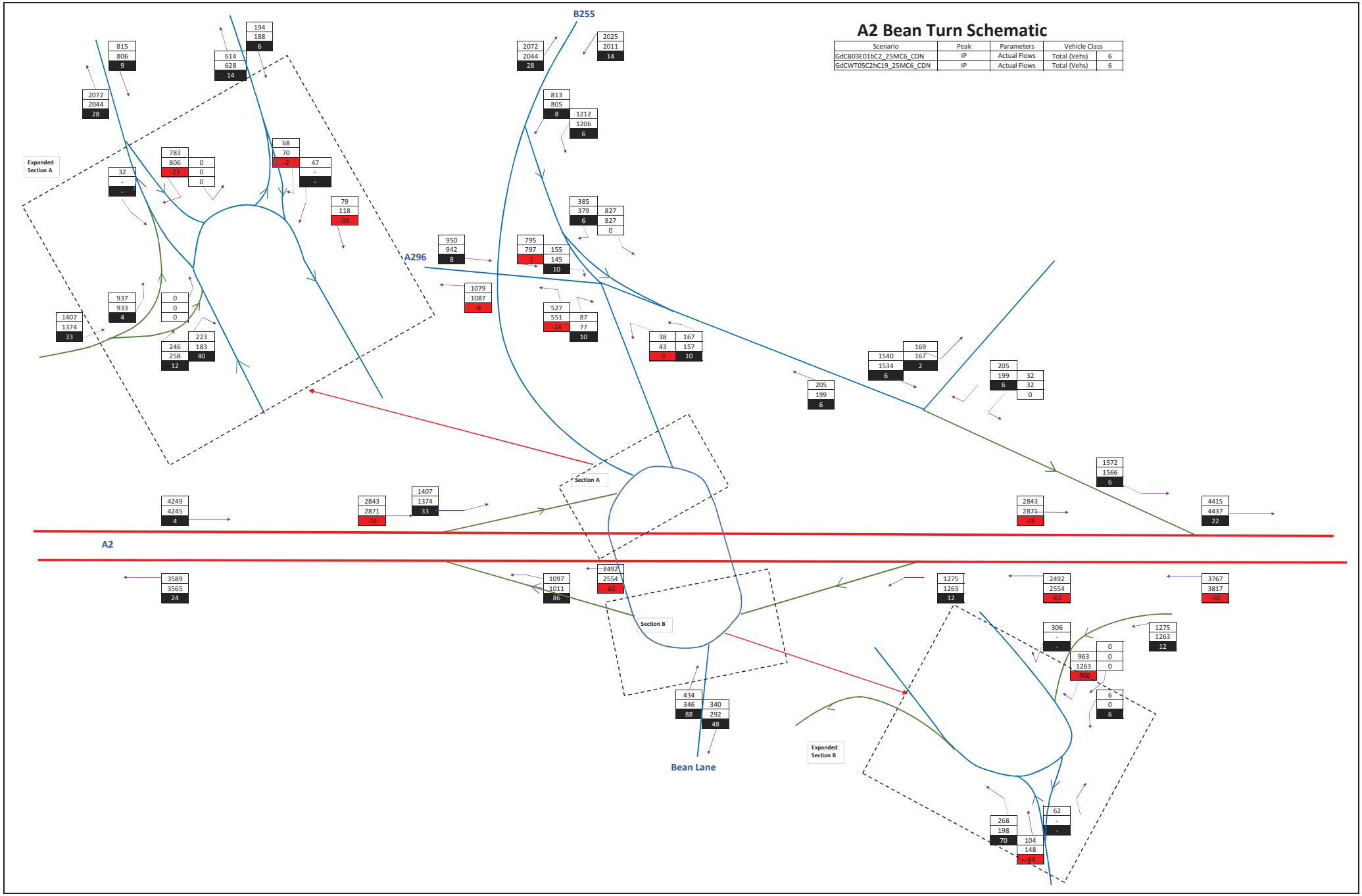


APPENDIX C: Scheme Effect B03E01b Turn Flow Schematics

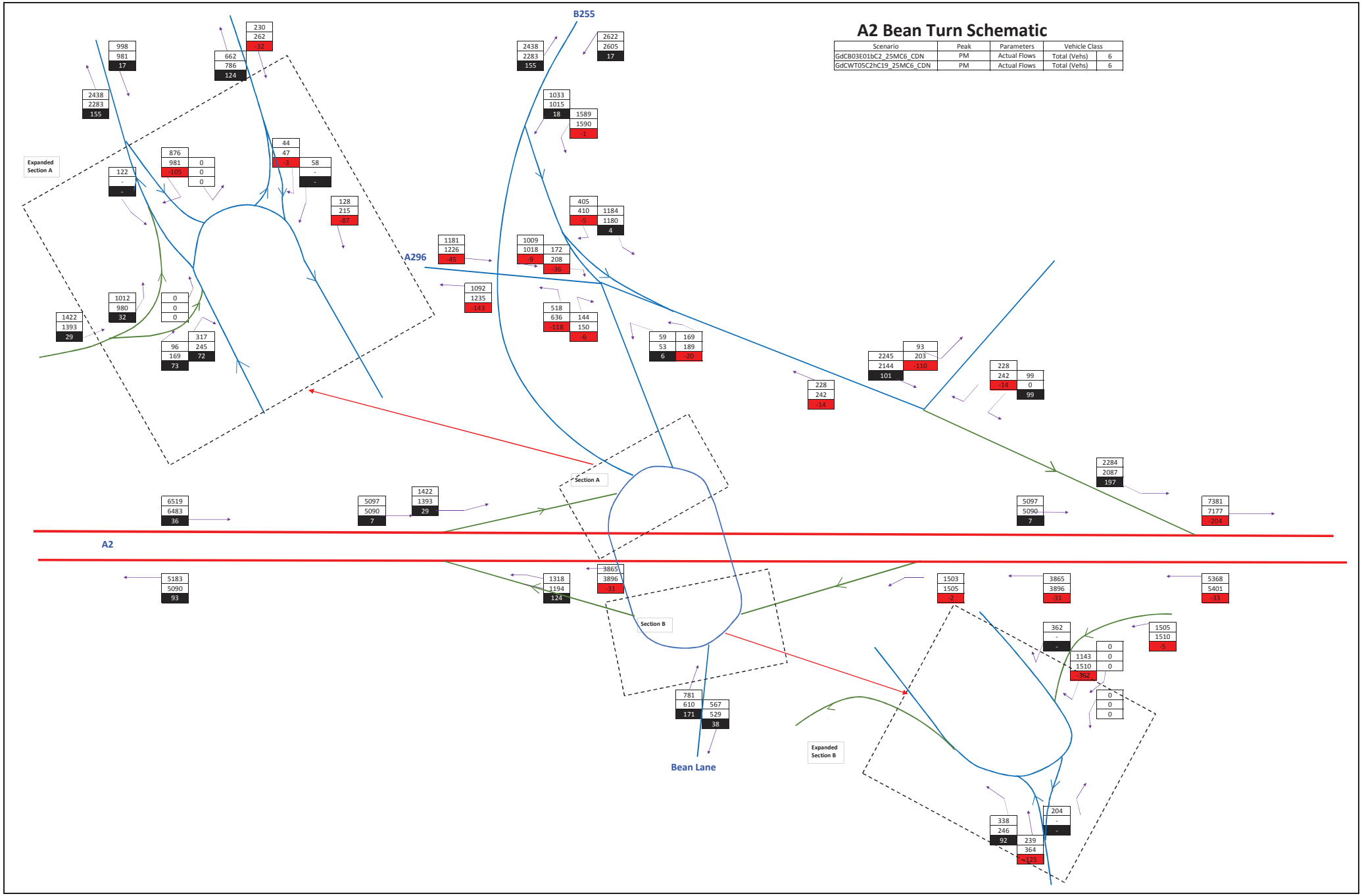
SCHEME EFFECT - B03E01b A2 BEAN JUNCTION 2025 AM PEAK - TOTAL VEHICLES



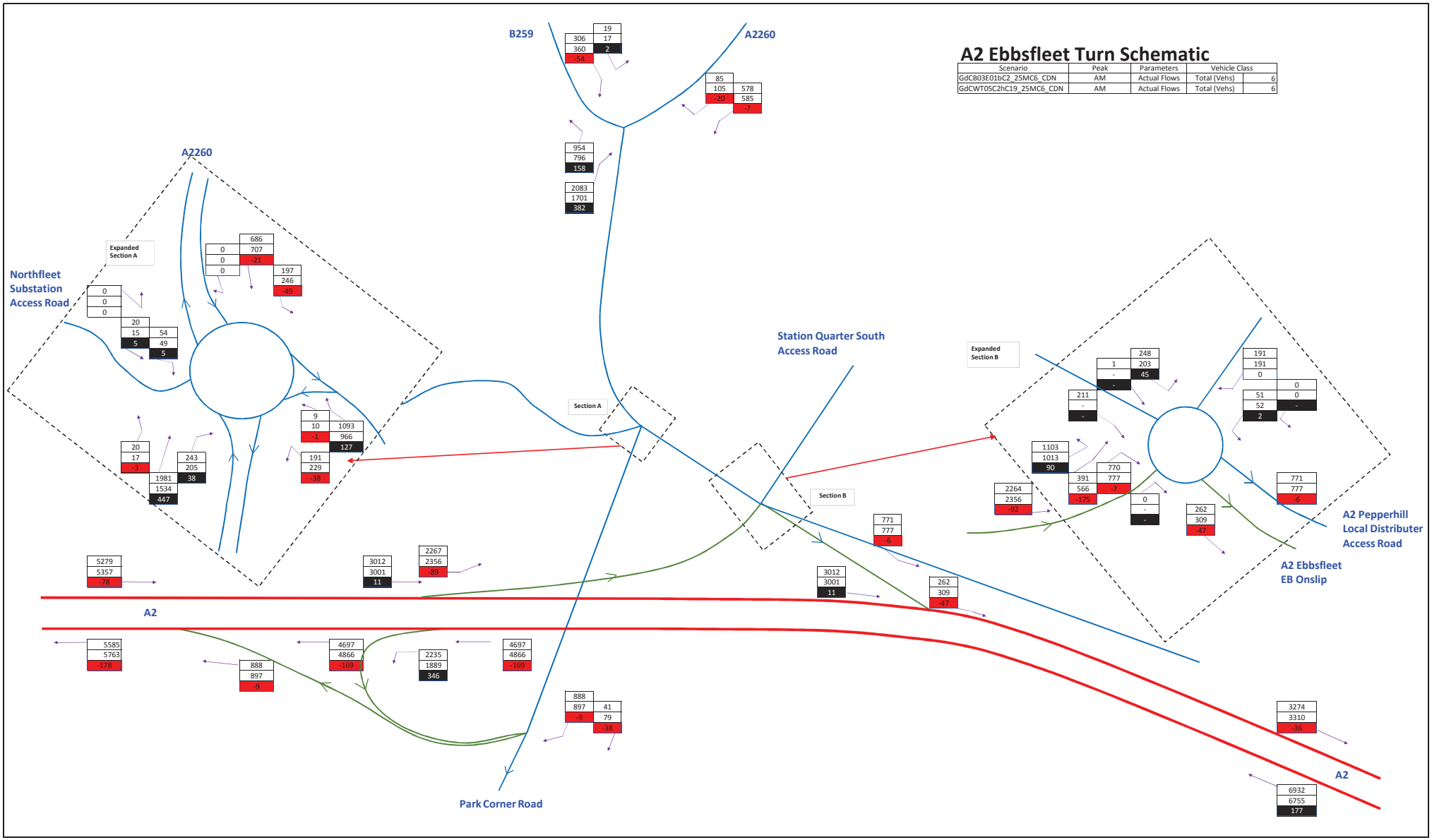
SCHEME EFFECT - B03E01b A2 BEAN JUNCTION 2025 INTER PEAK - TOTAL VEHICLES



SCHEME EFFECT B03E01b A2 BEAN JUNCTION 2025 PM PEAK TOTAL VEHICLES



SCHEME EFFECT - B03E01b A2 EBBSFLEET JUNCTION 2025 AM PEAK - TOTAL VEHICLES



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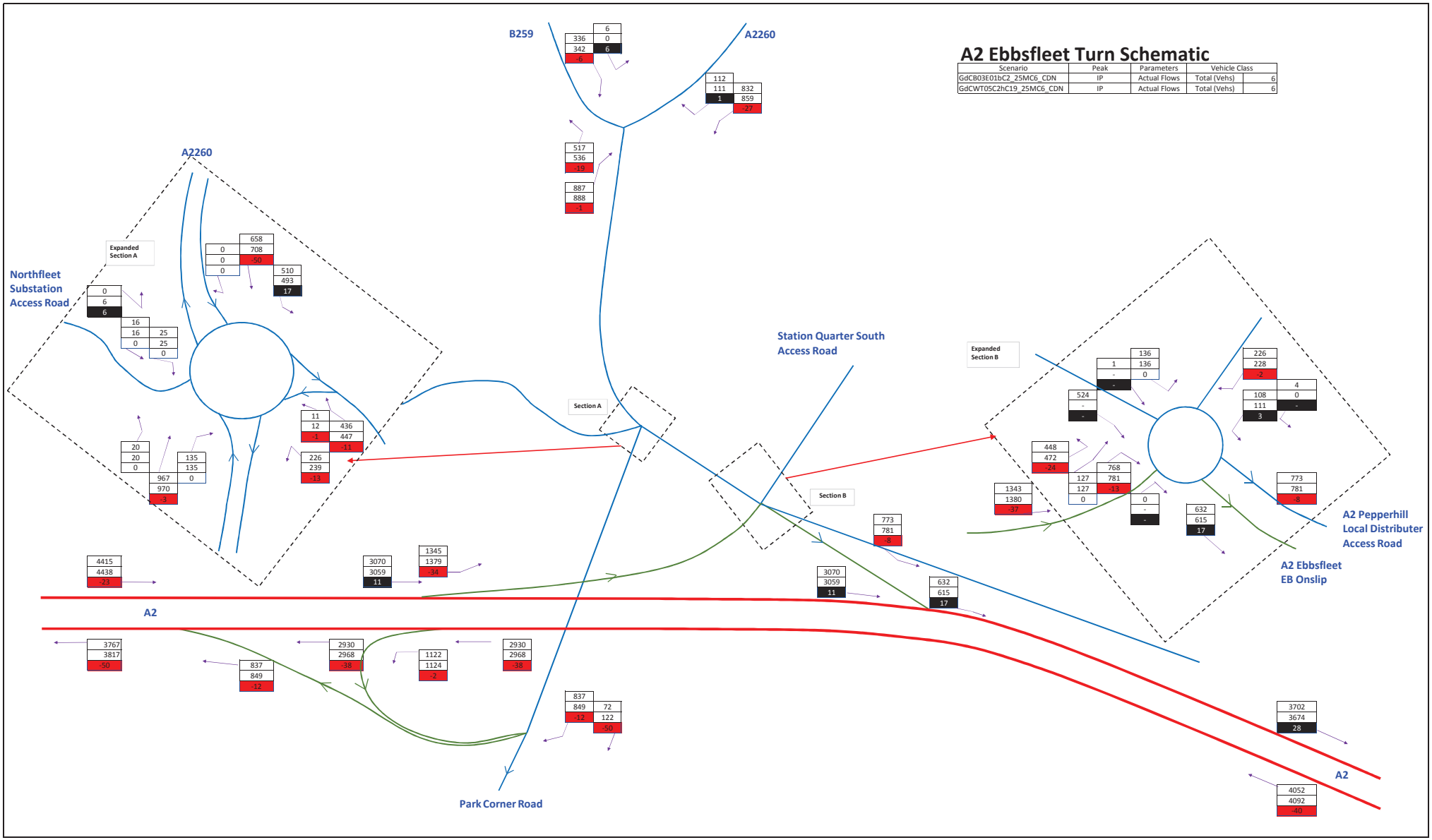

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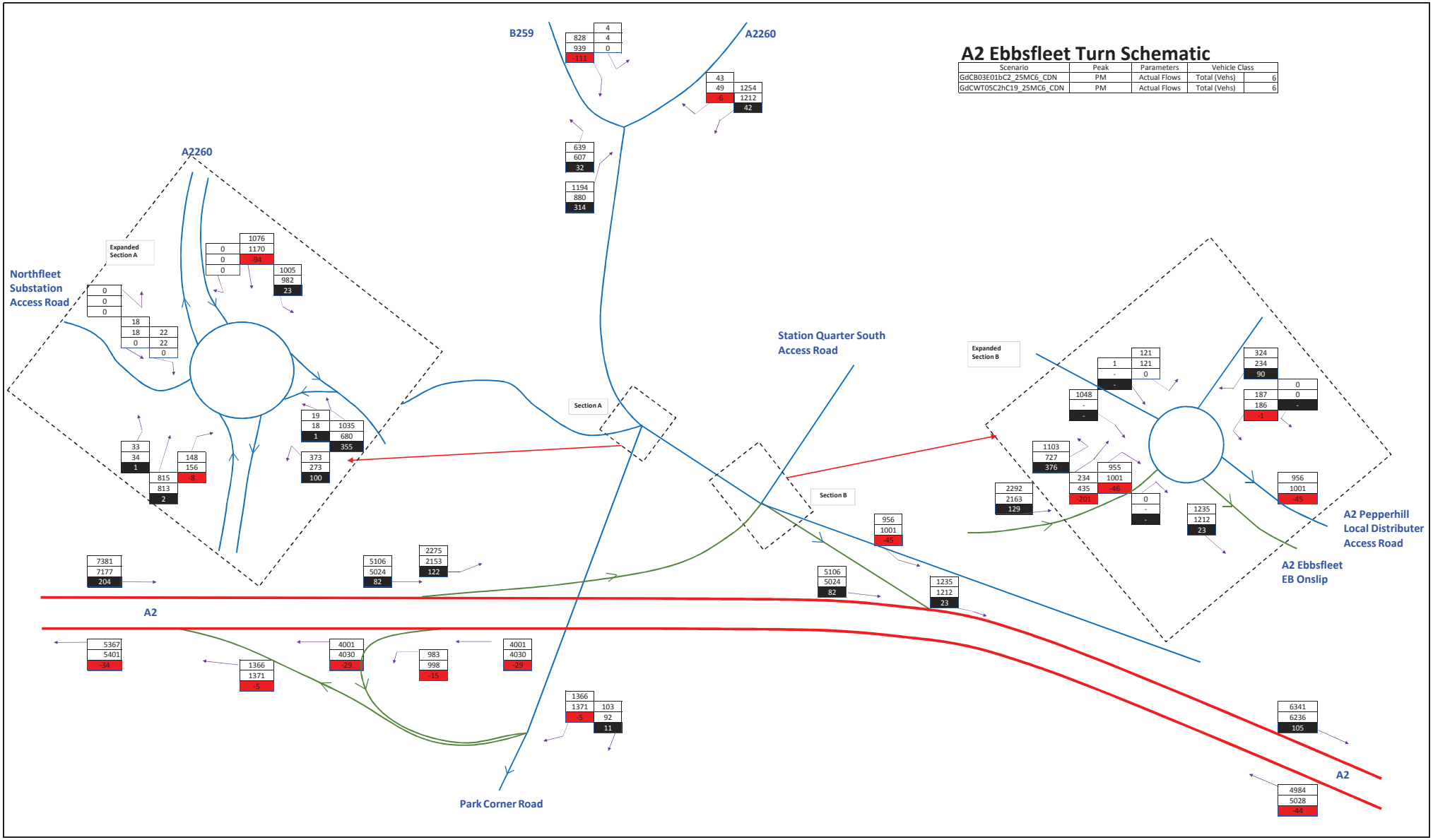

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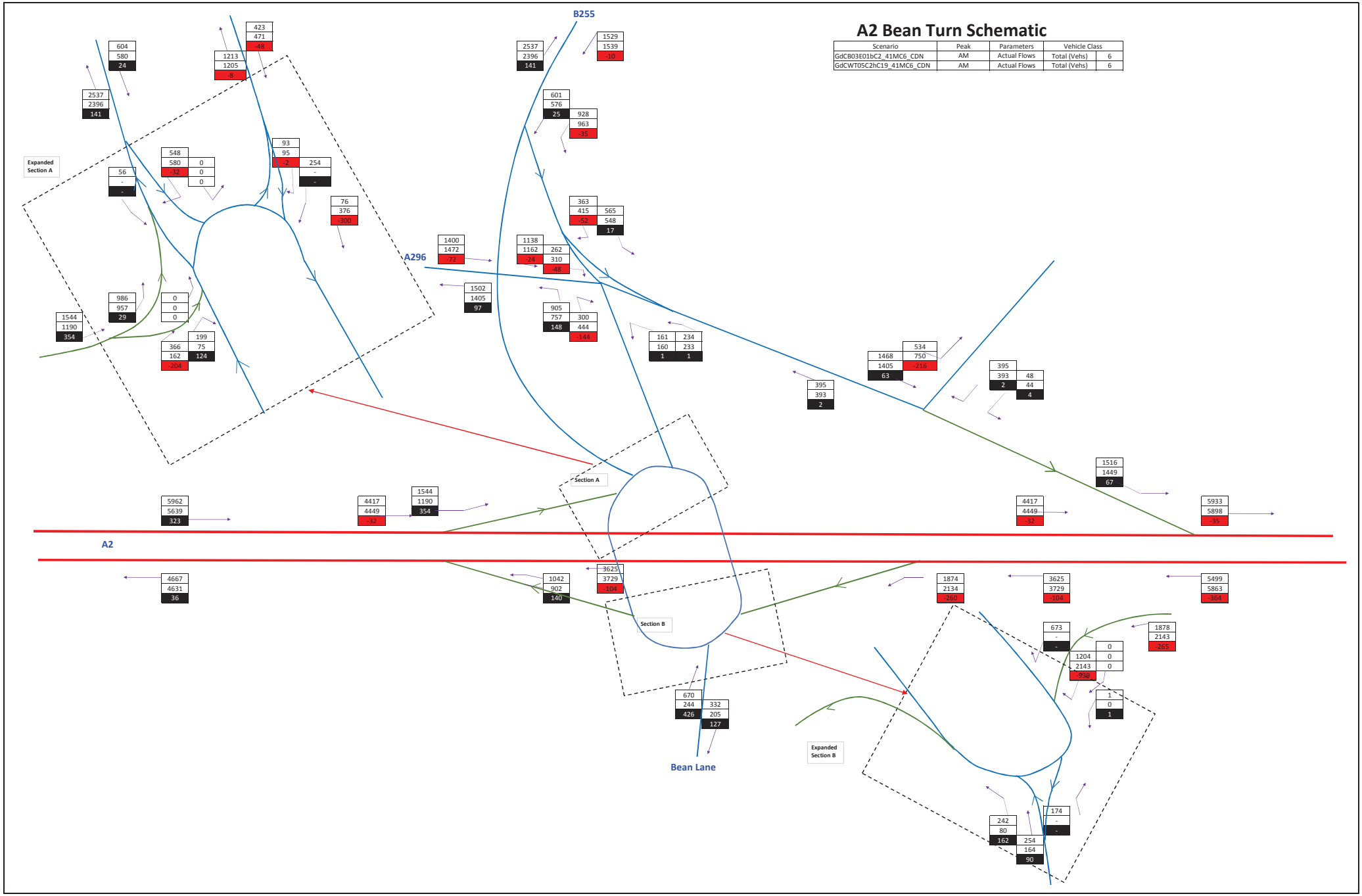

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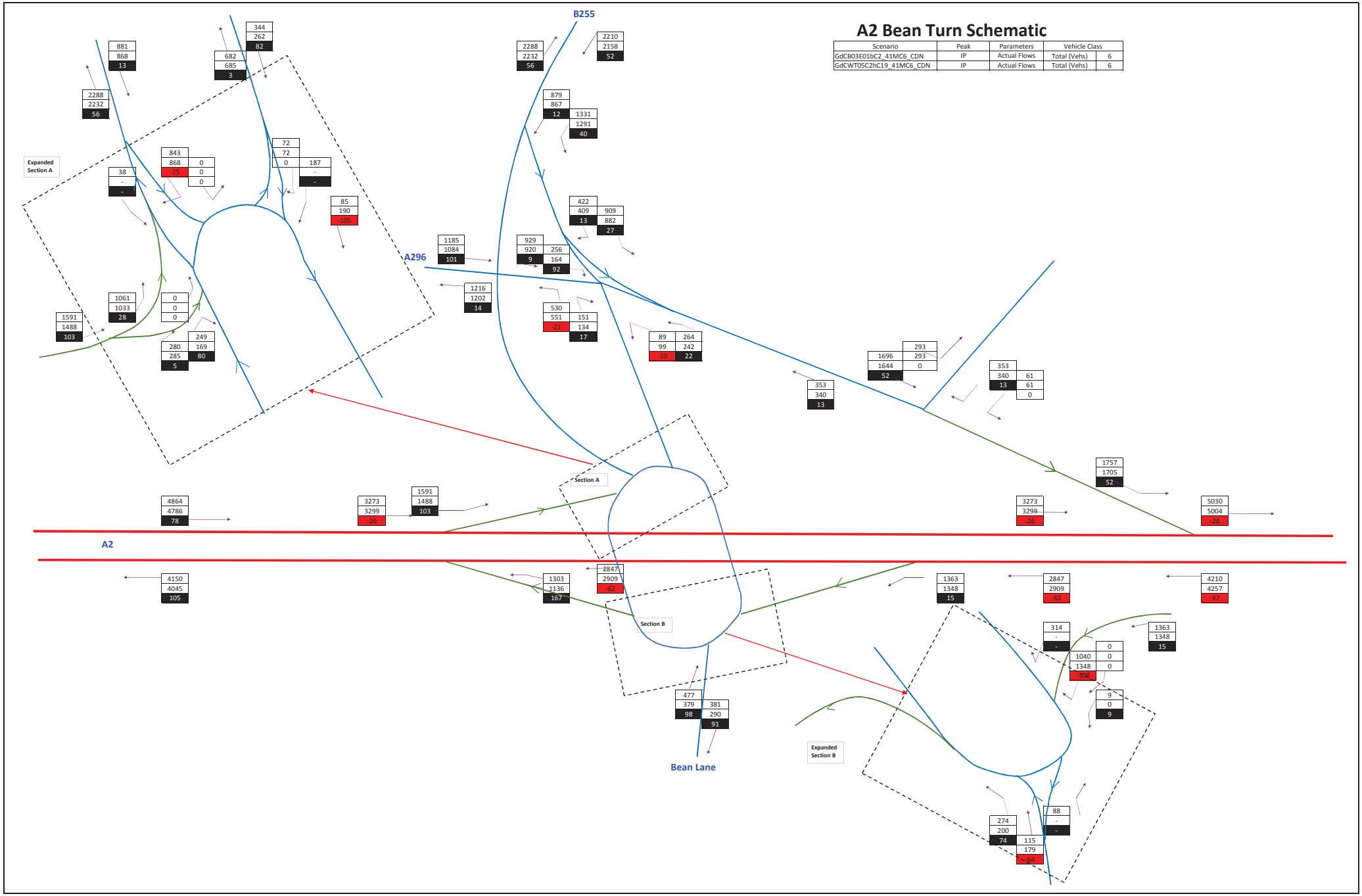

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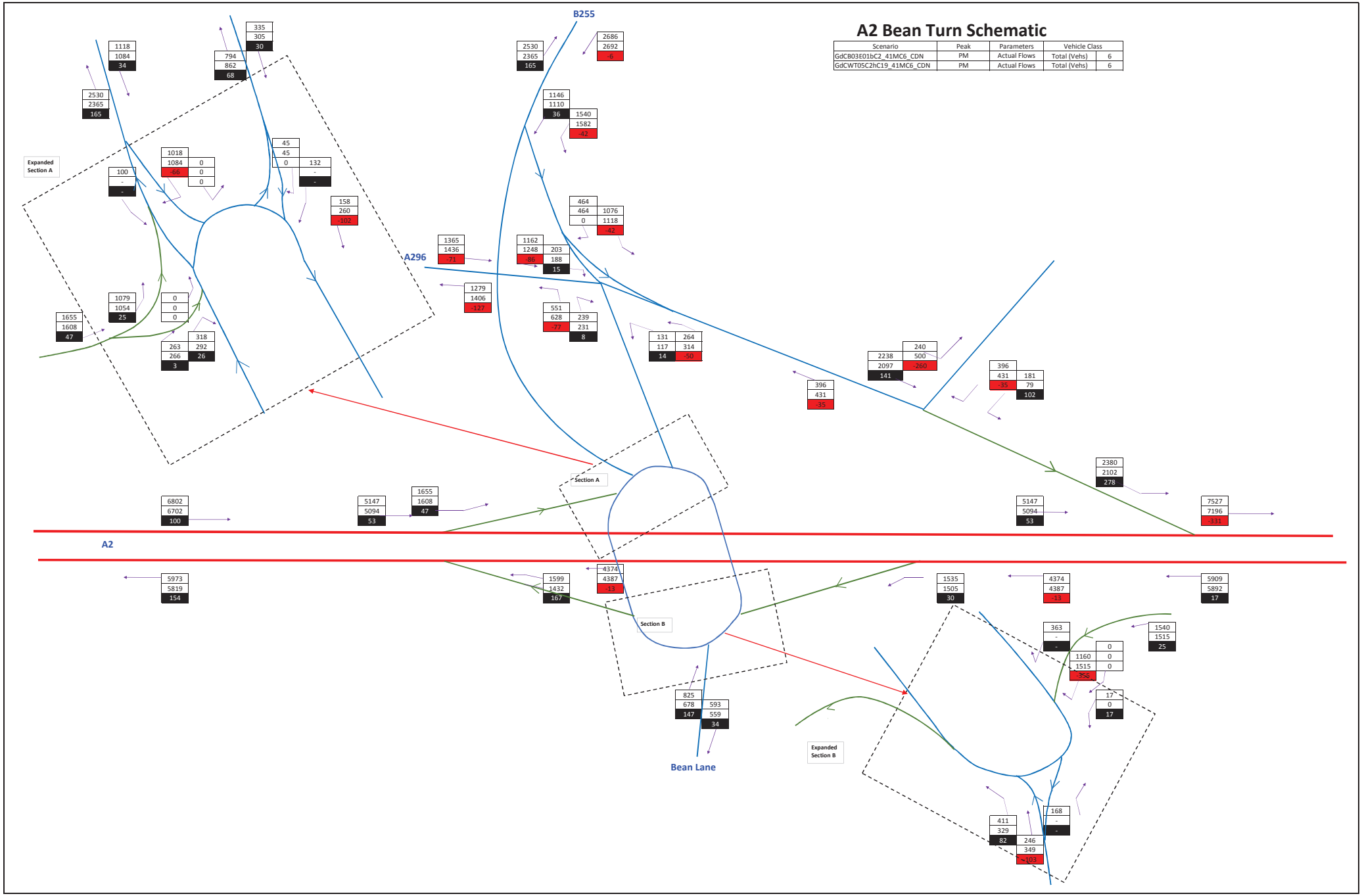

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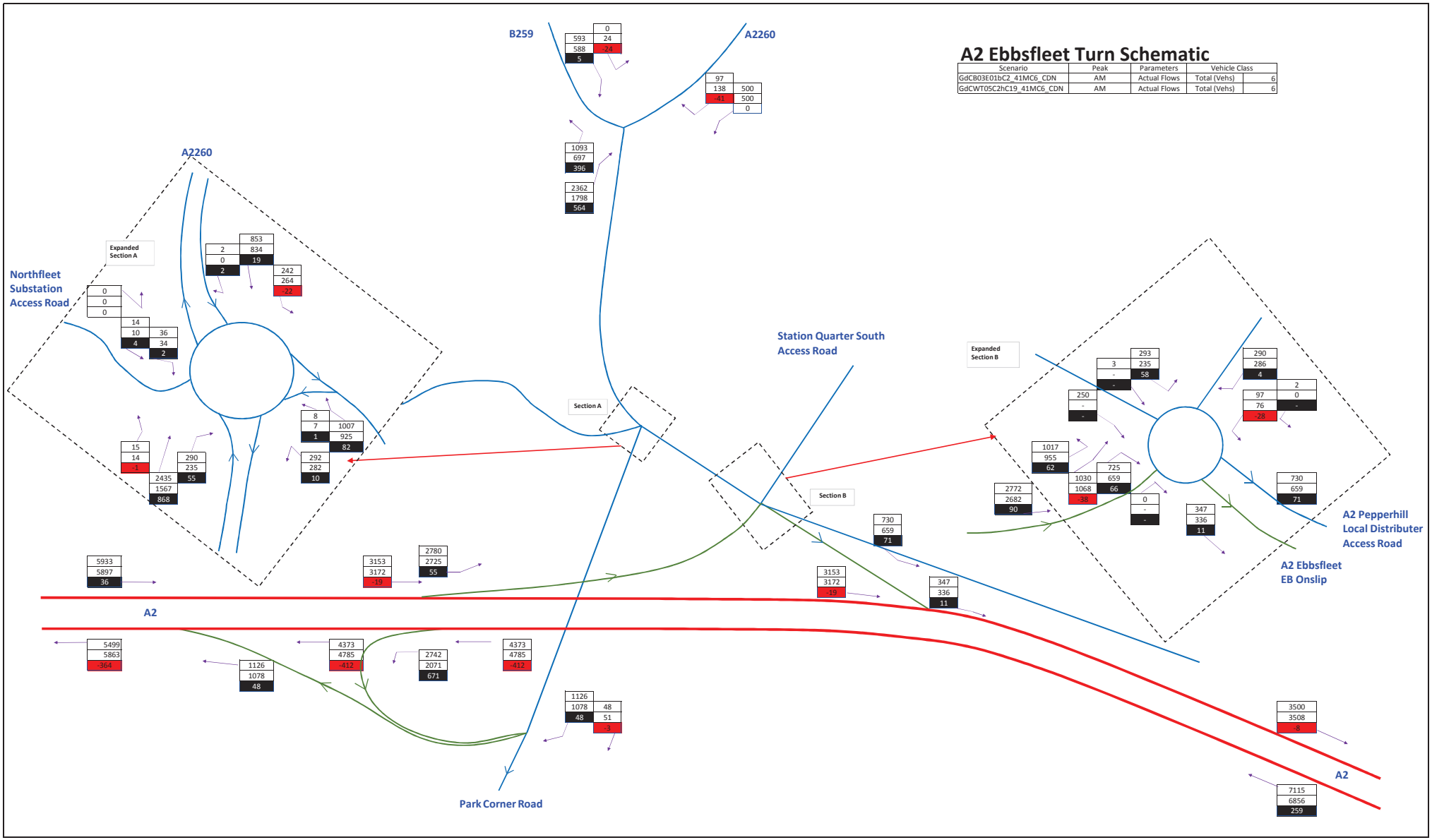

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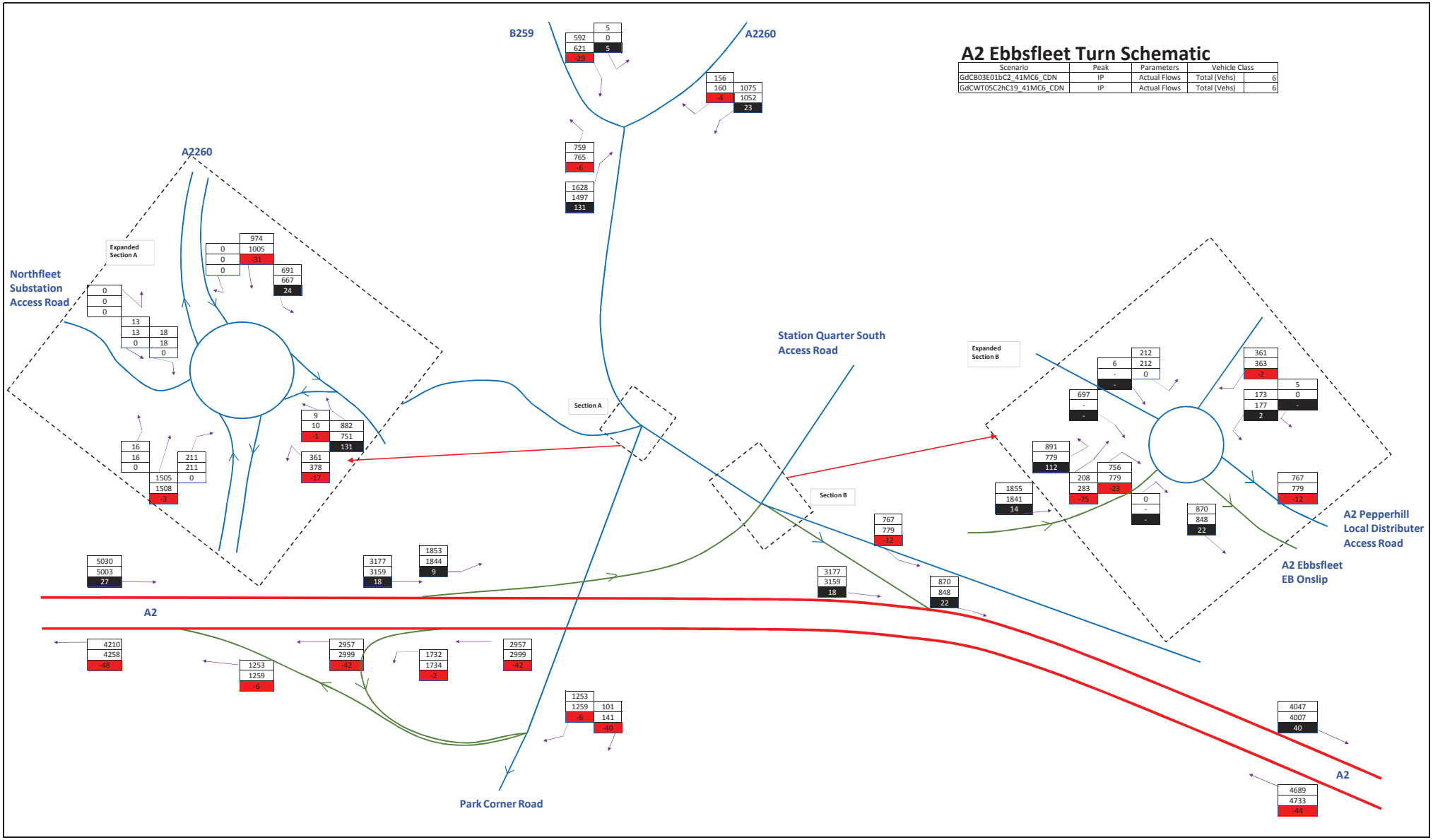
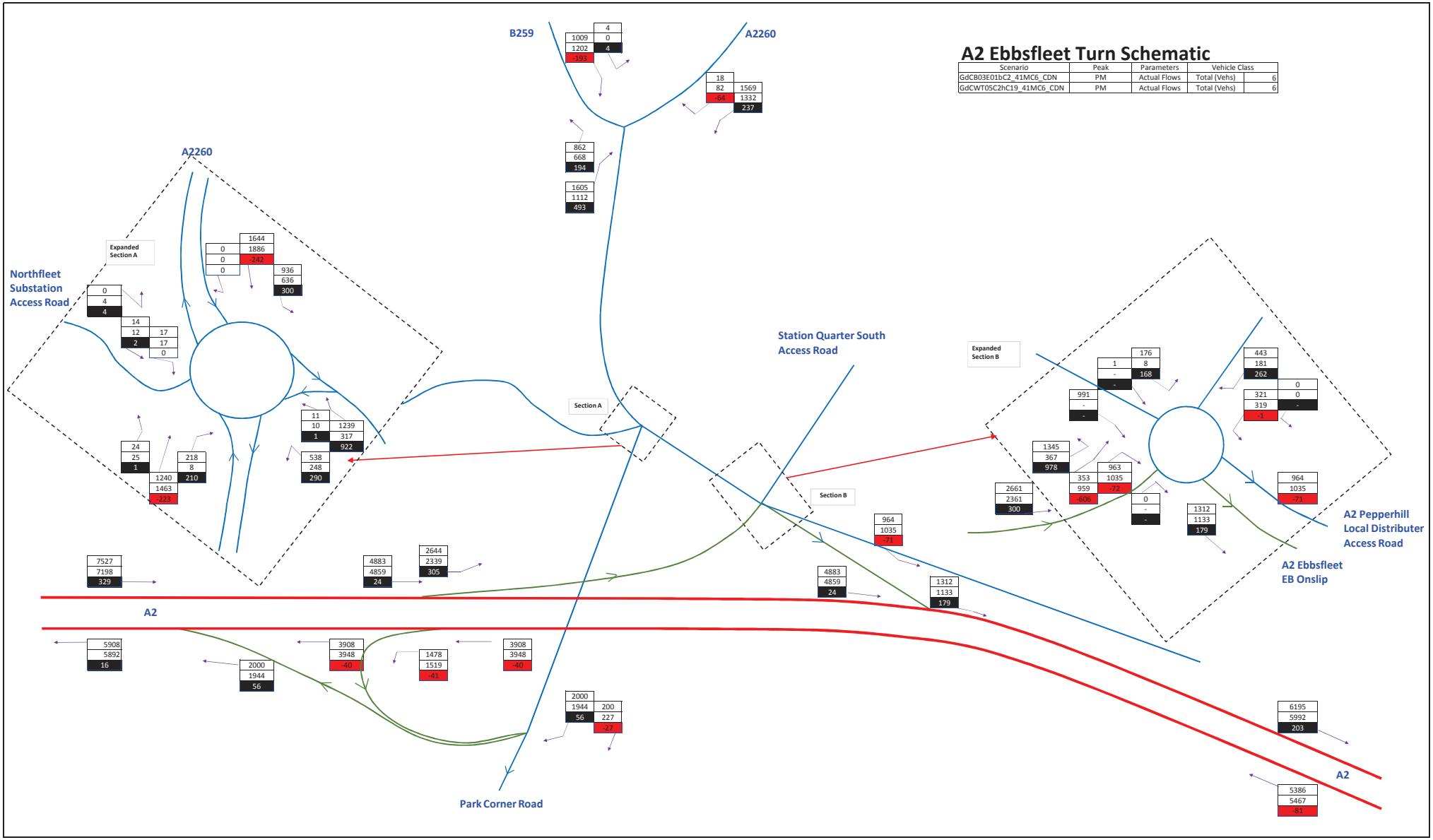
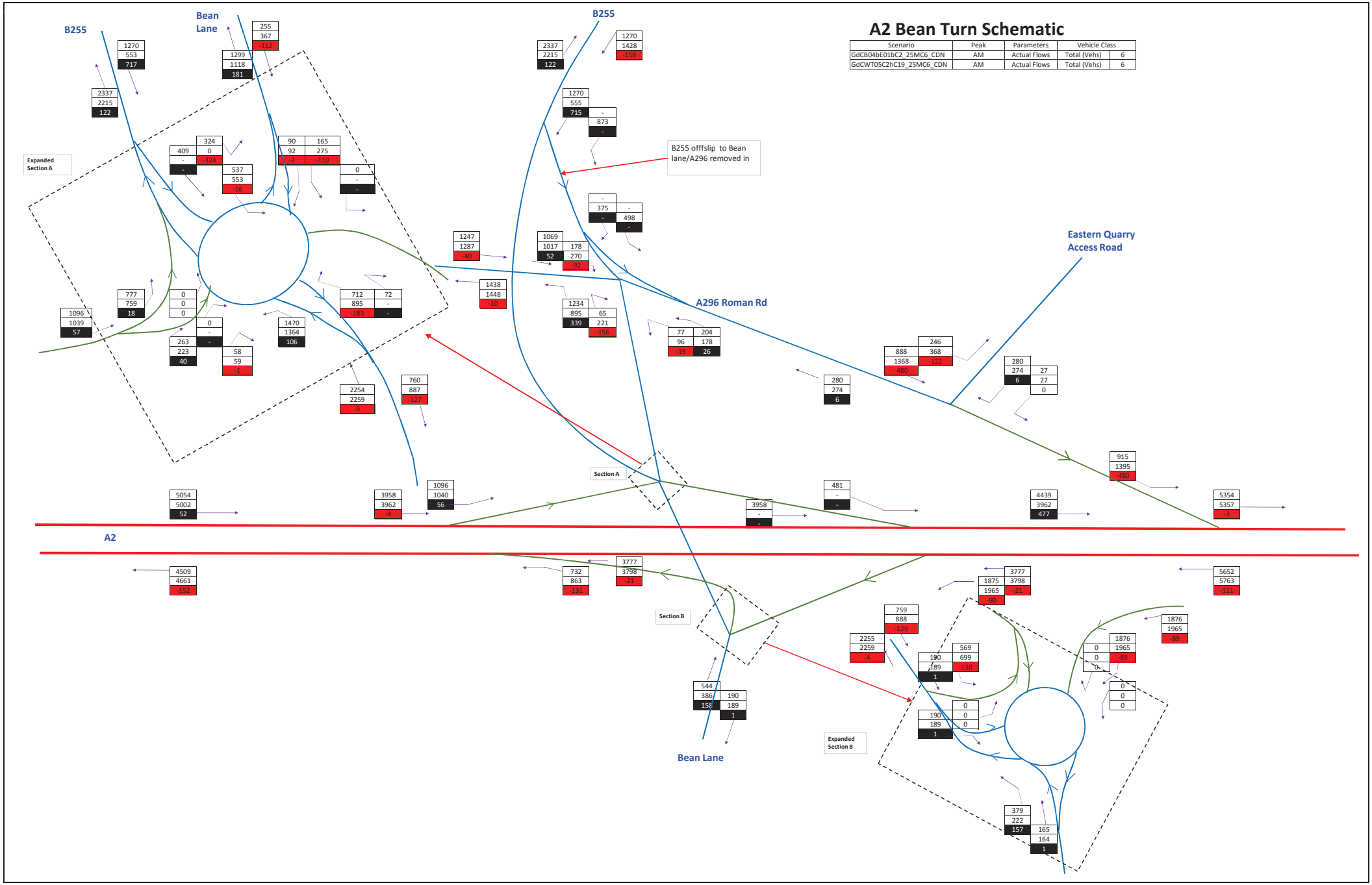


SCHEME EFFECT B03E01b A2 EBBSFLEET JUNCTION 20241 PM PEAK TOTAL VEHICLES



APPENDIX D: Scheme Effect B04E01b Turn Flow Schematics

SCHEME EFFECT B04bE01b A2 BEAN JUNCTION 2025 AM PEAK TOTAL VEHICLES



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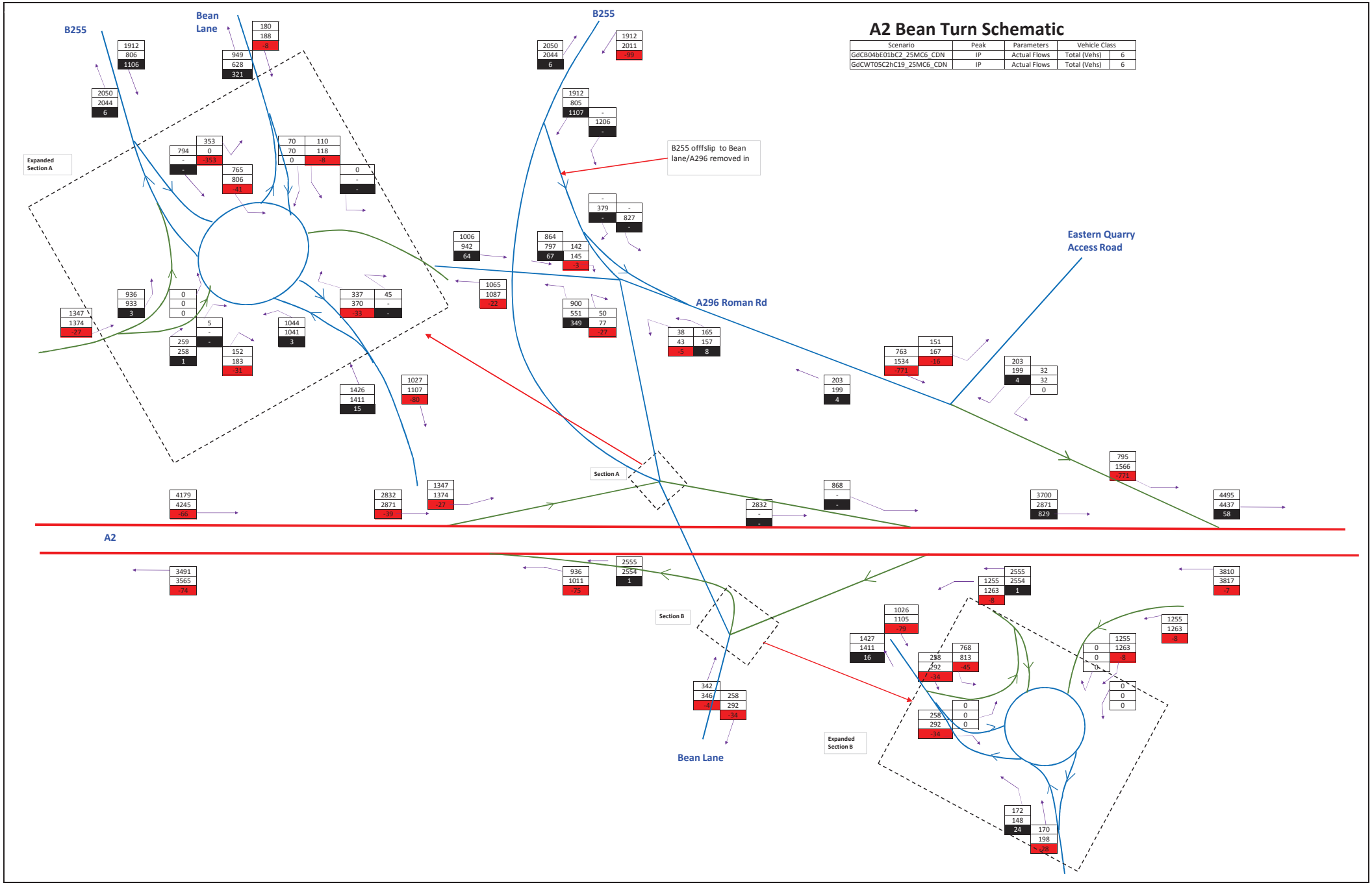
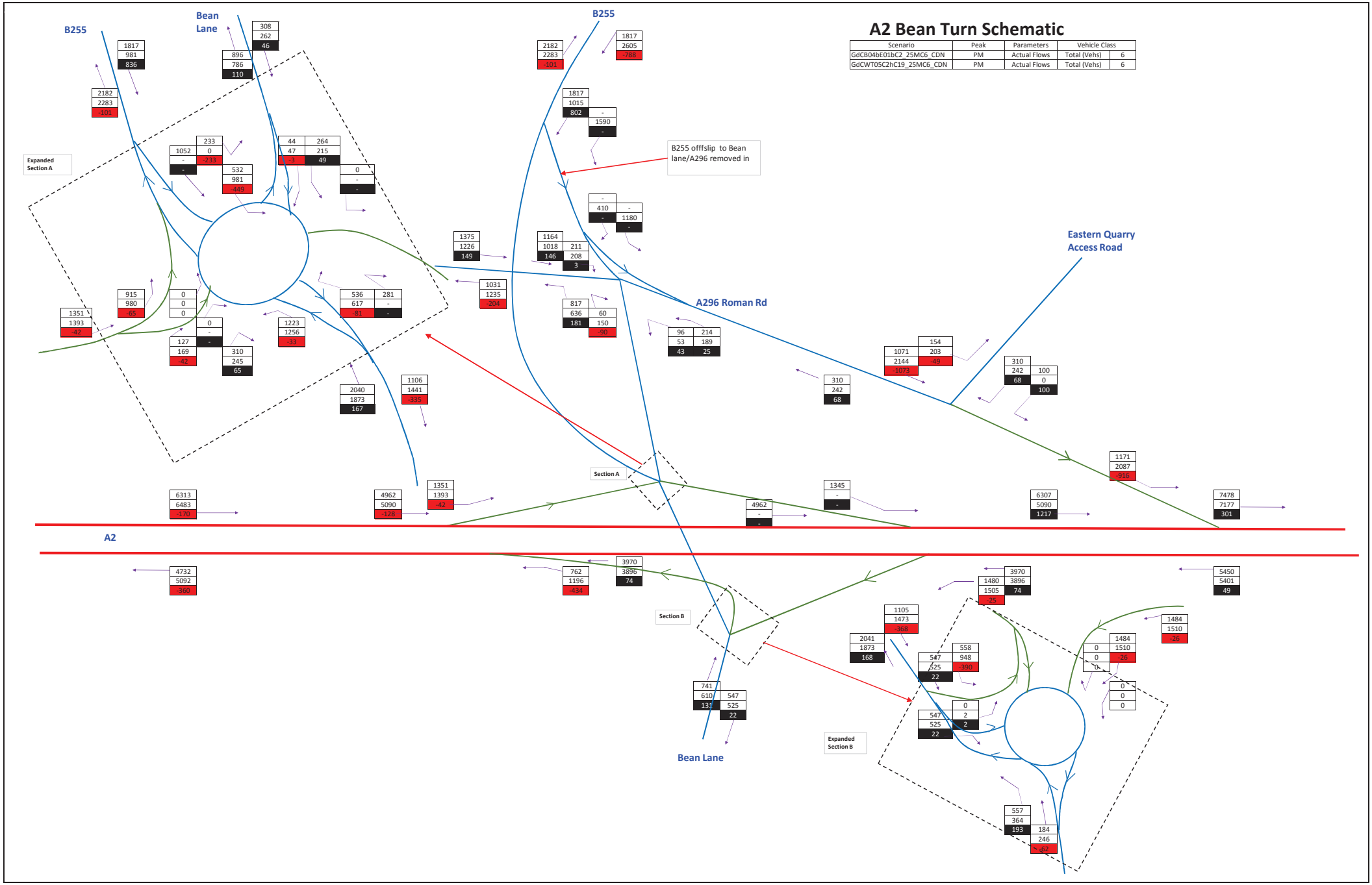
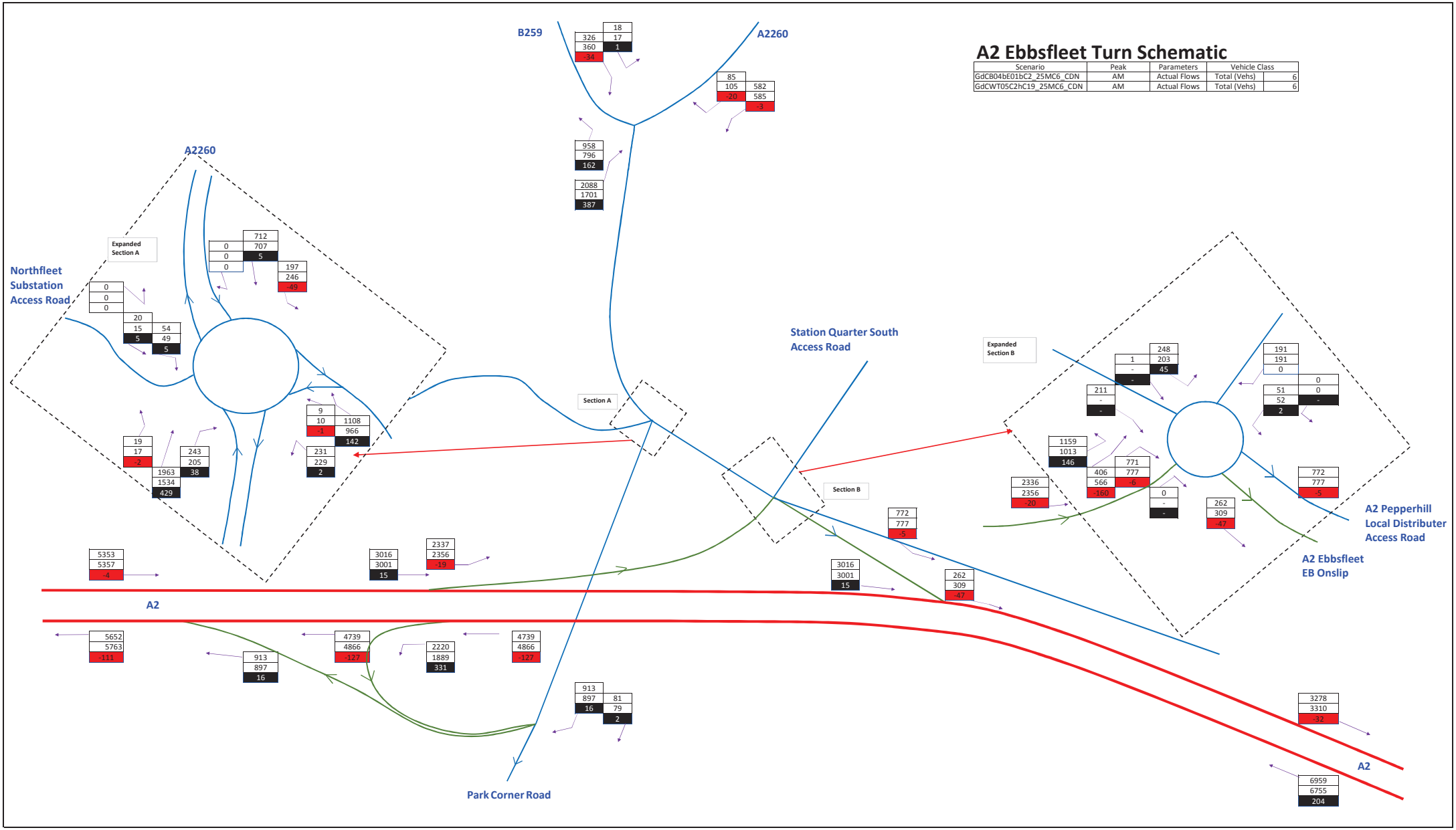


SCHEME EFFECT B04bE01b A2 BEAN JUNCTION 2025 PM PEAK TOTAL VEHICLES



SCHEME EFFECT B04bE01b A2 EBBSFLEET JUNCTION 2025 AM PEAK TOTAL VEHICLES



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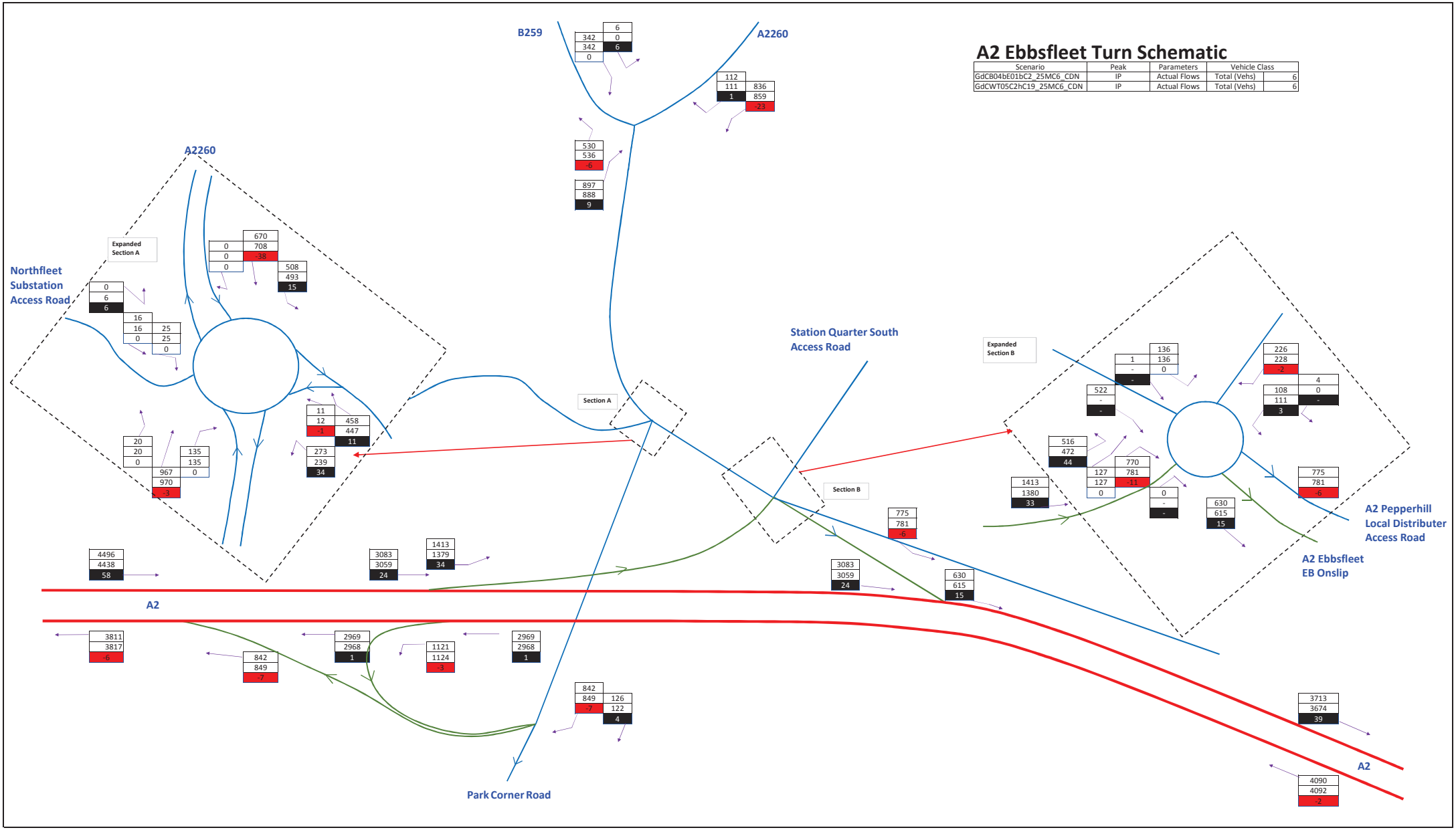

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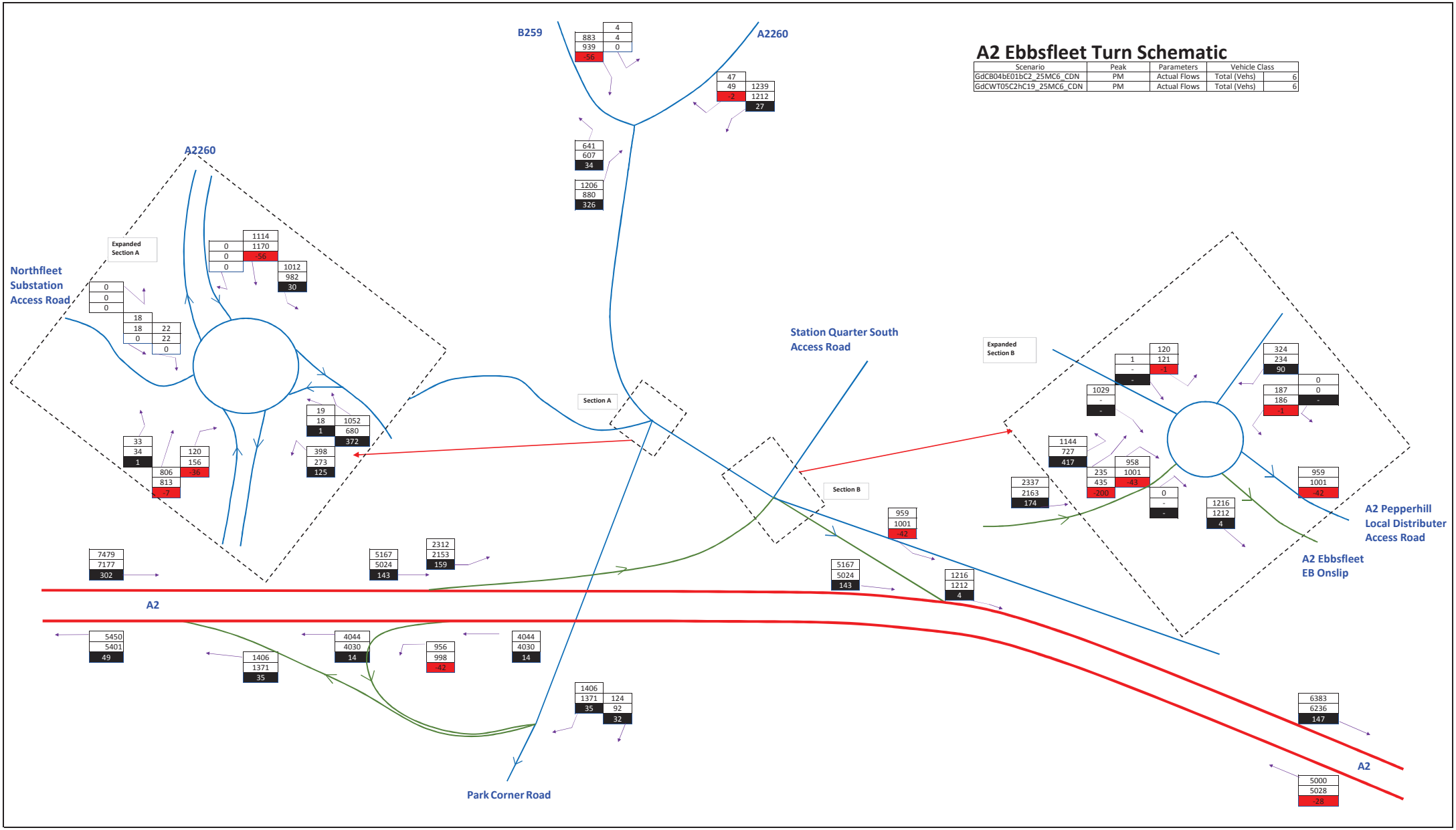

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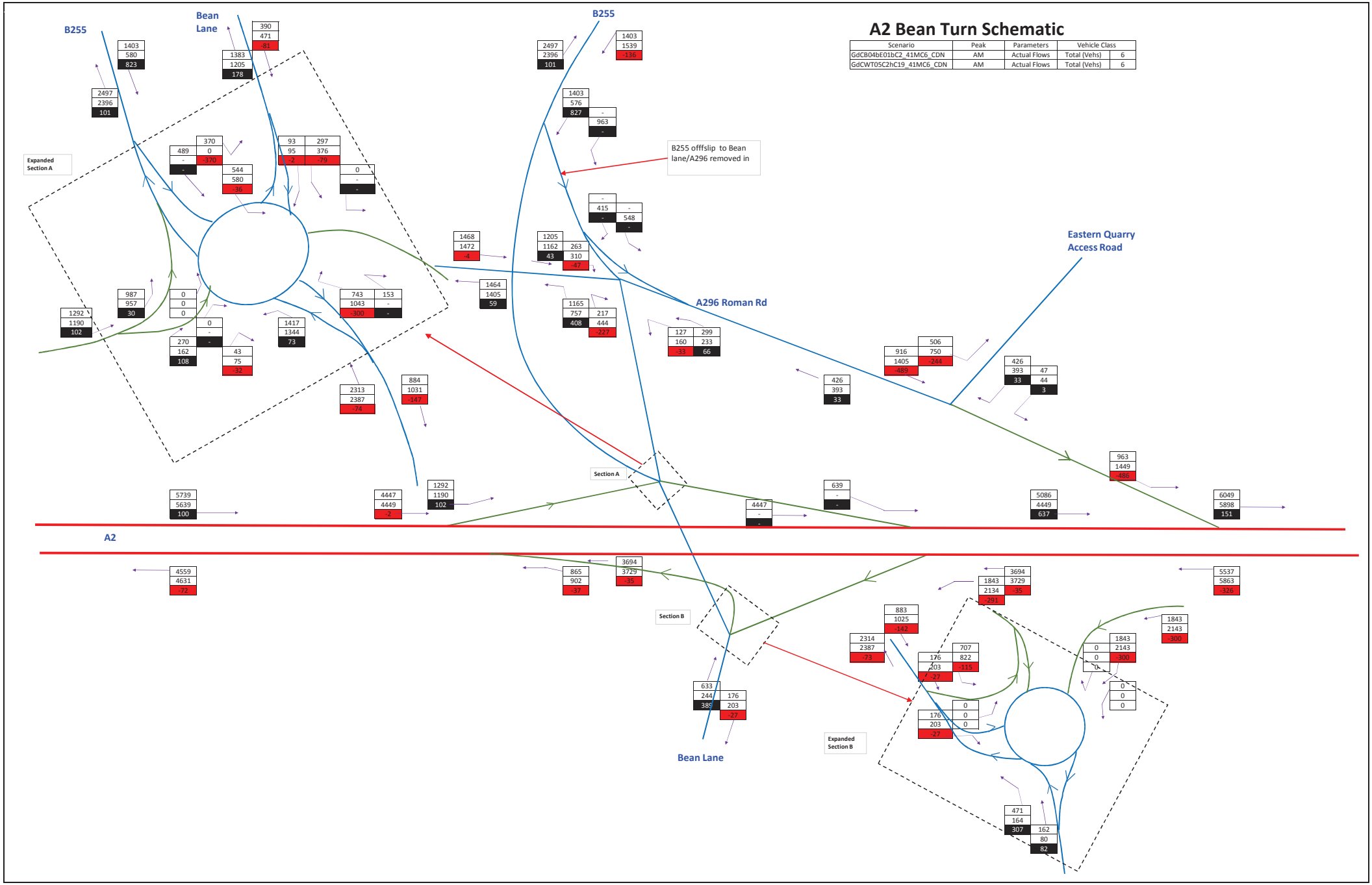

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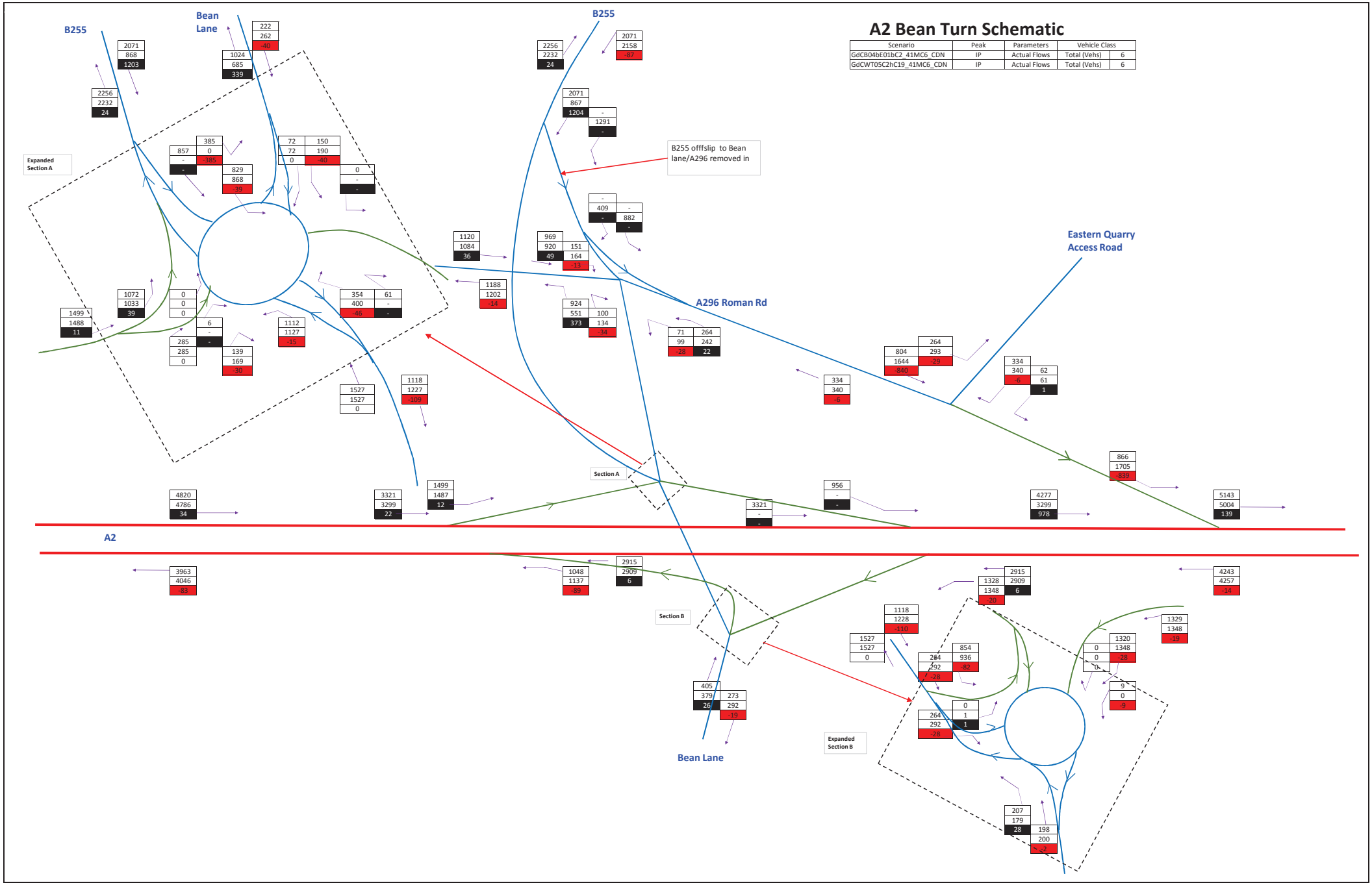

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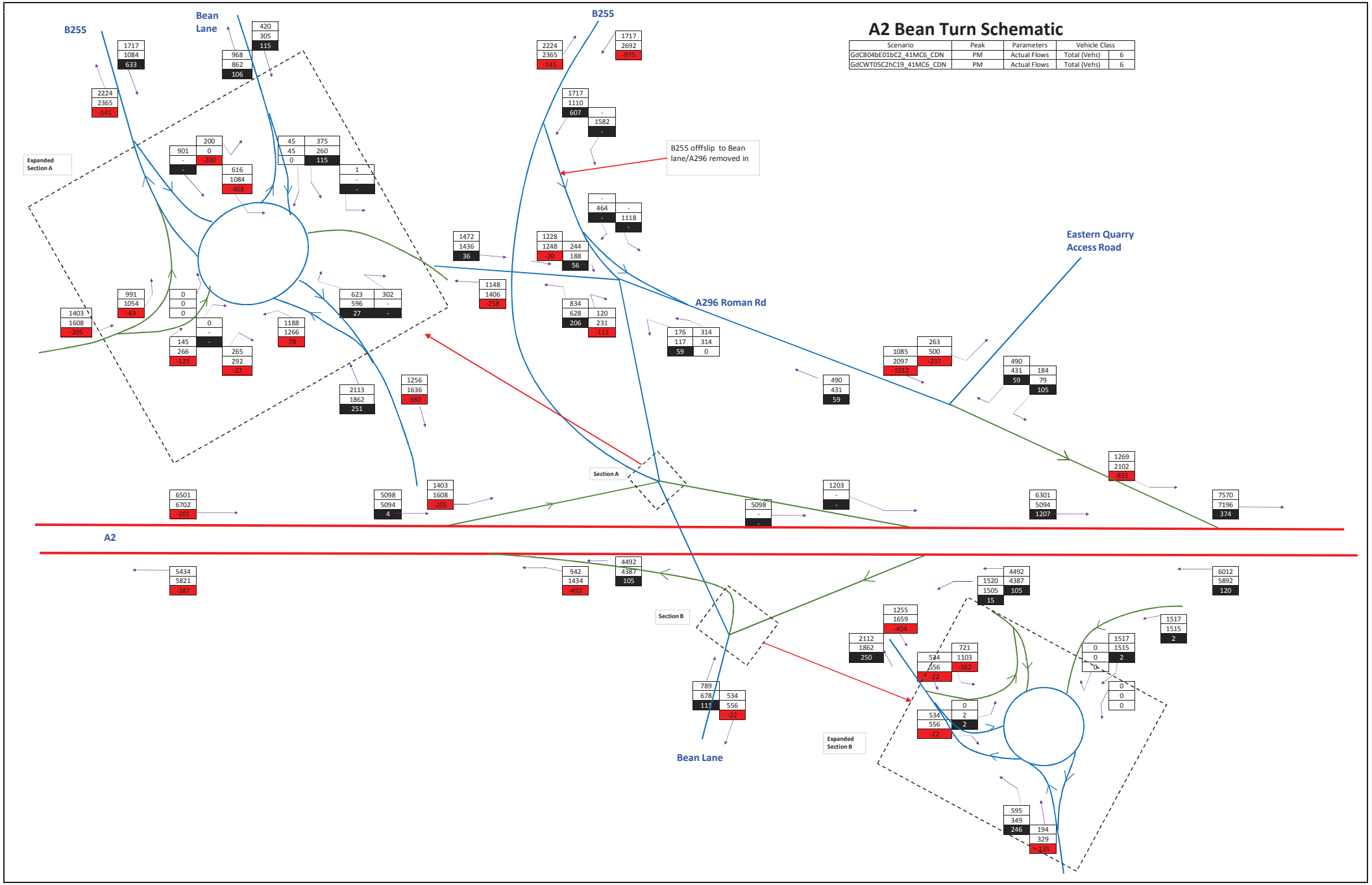

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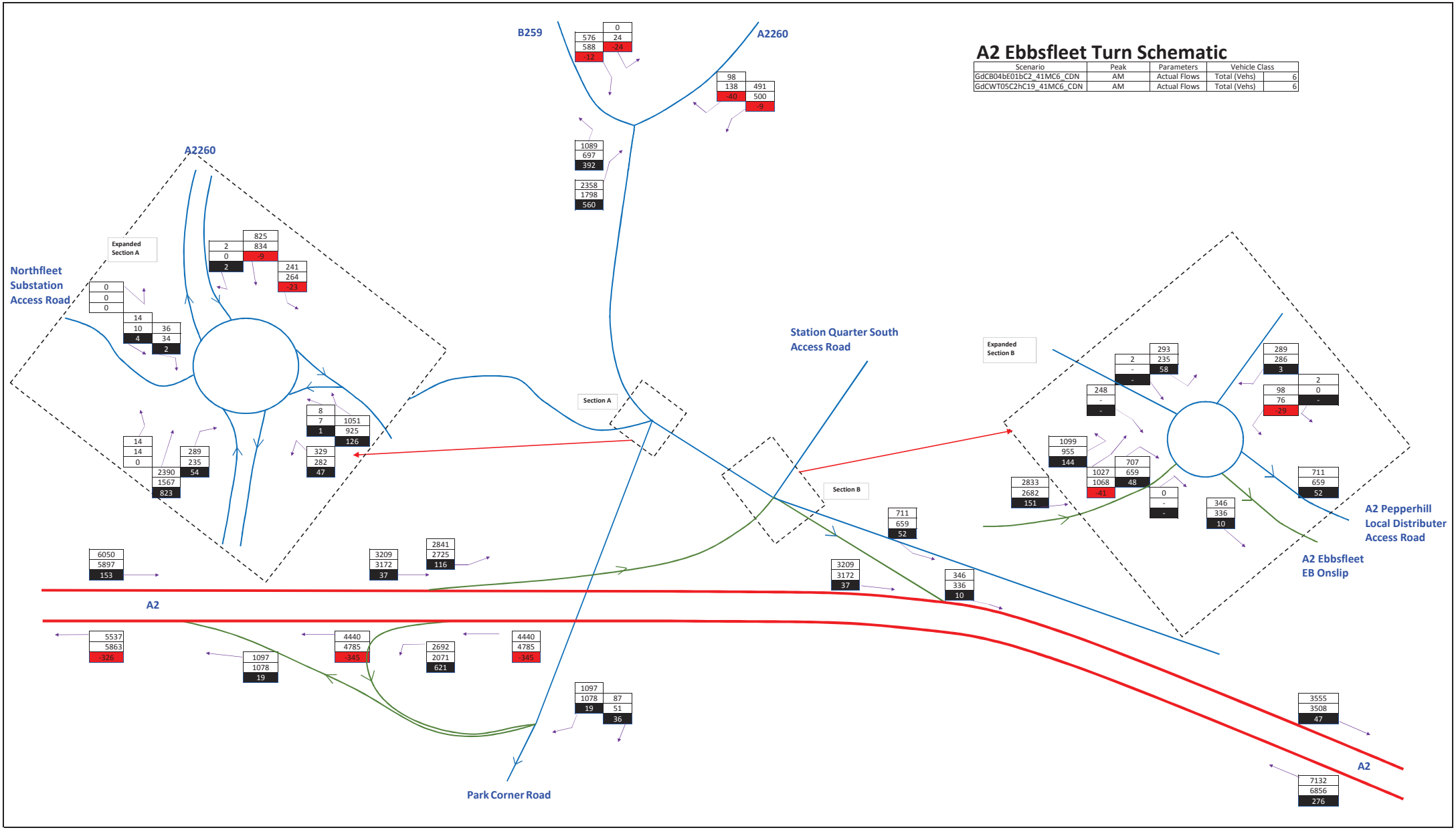

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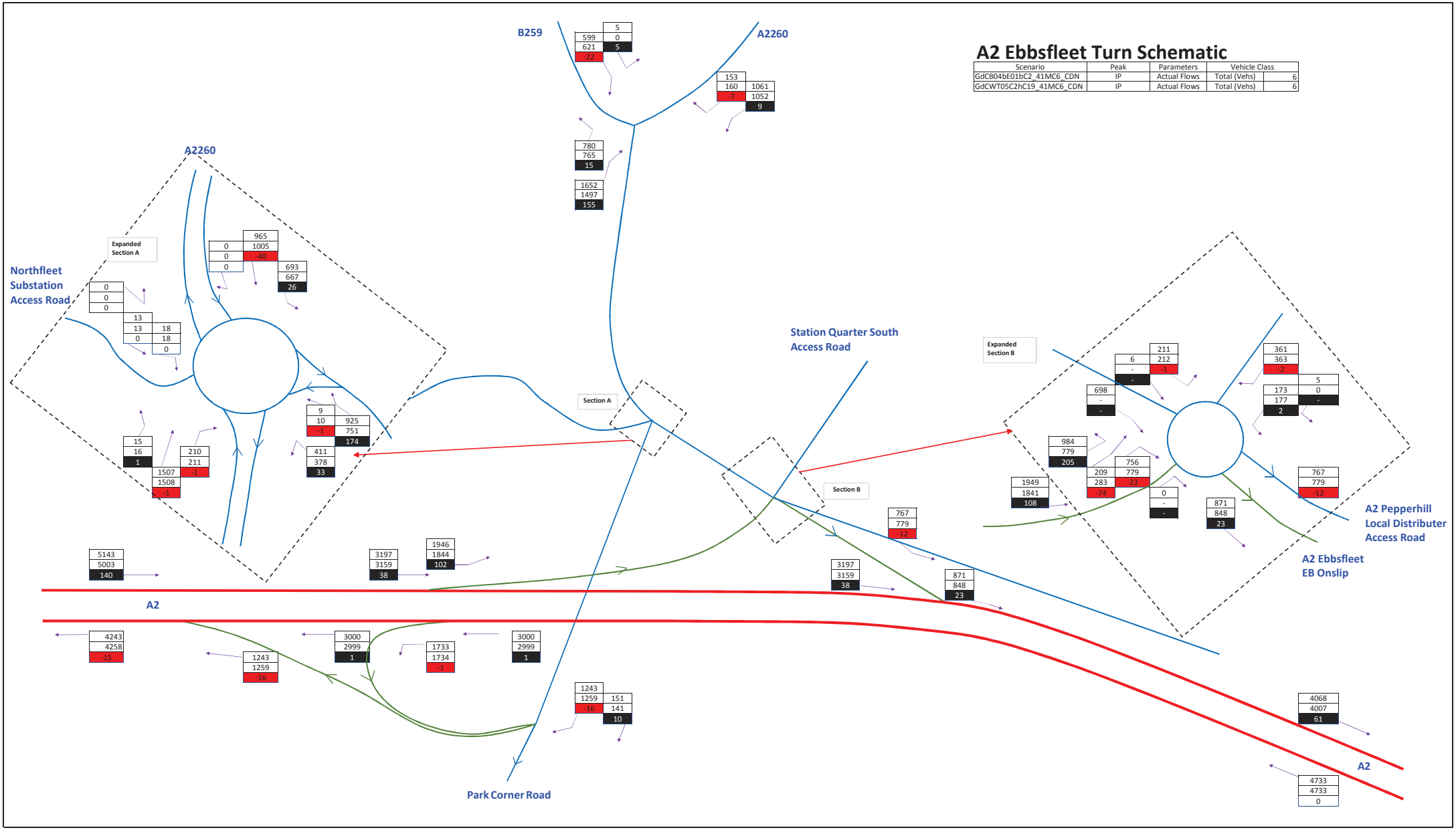

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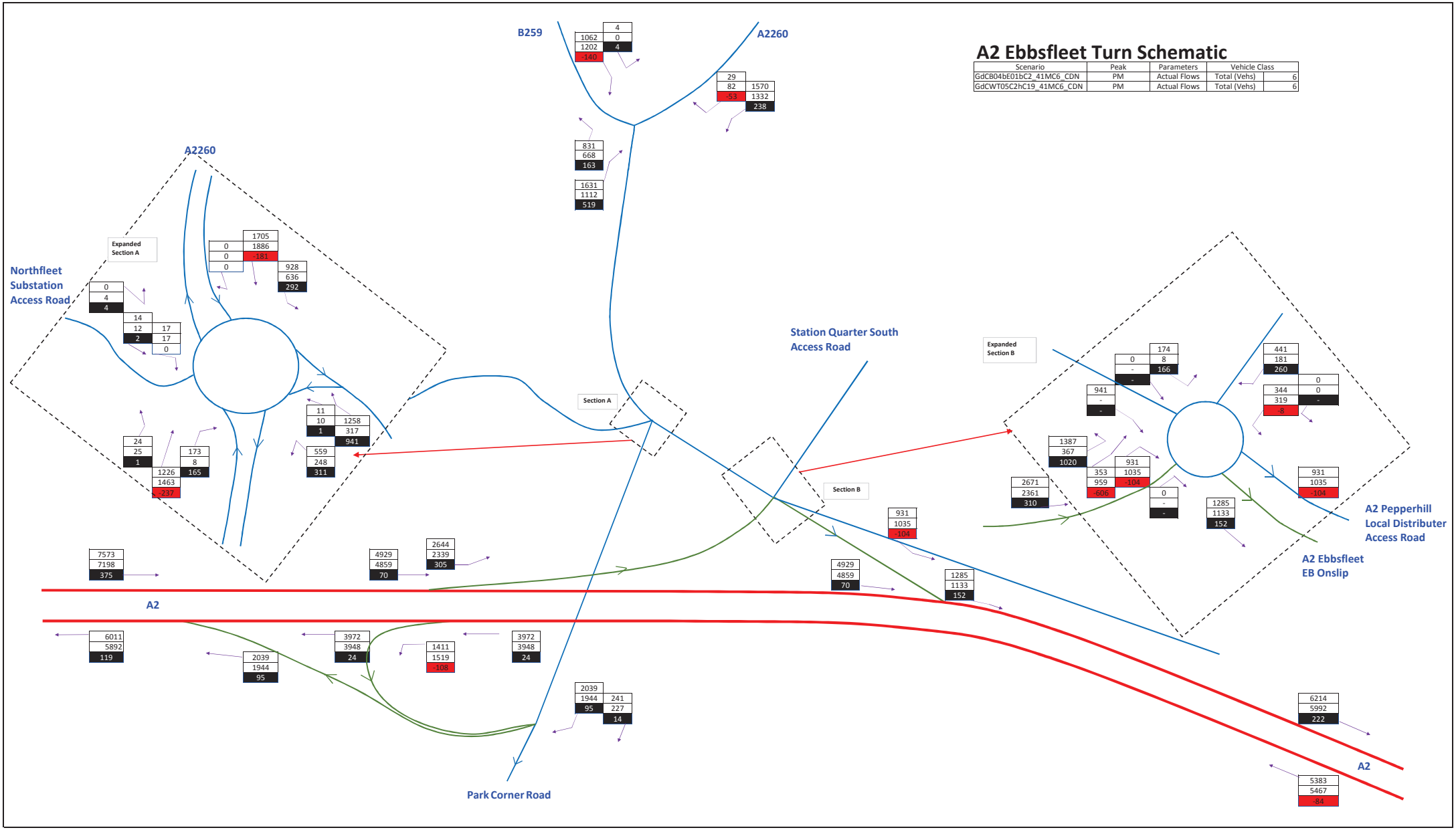
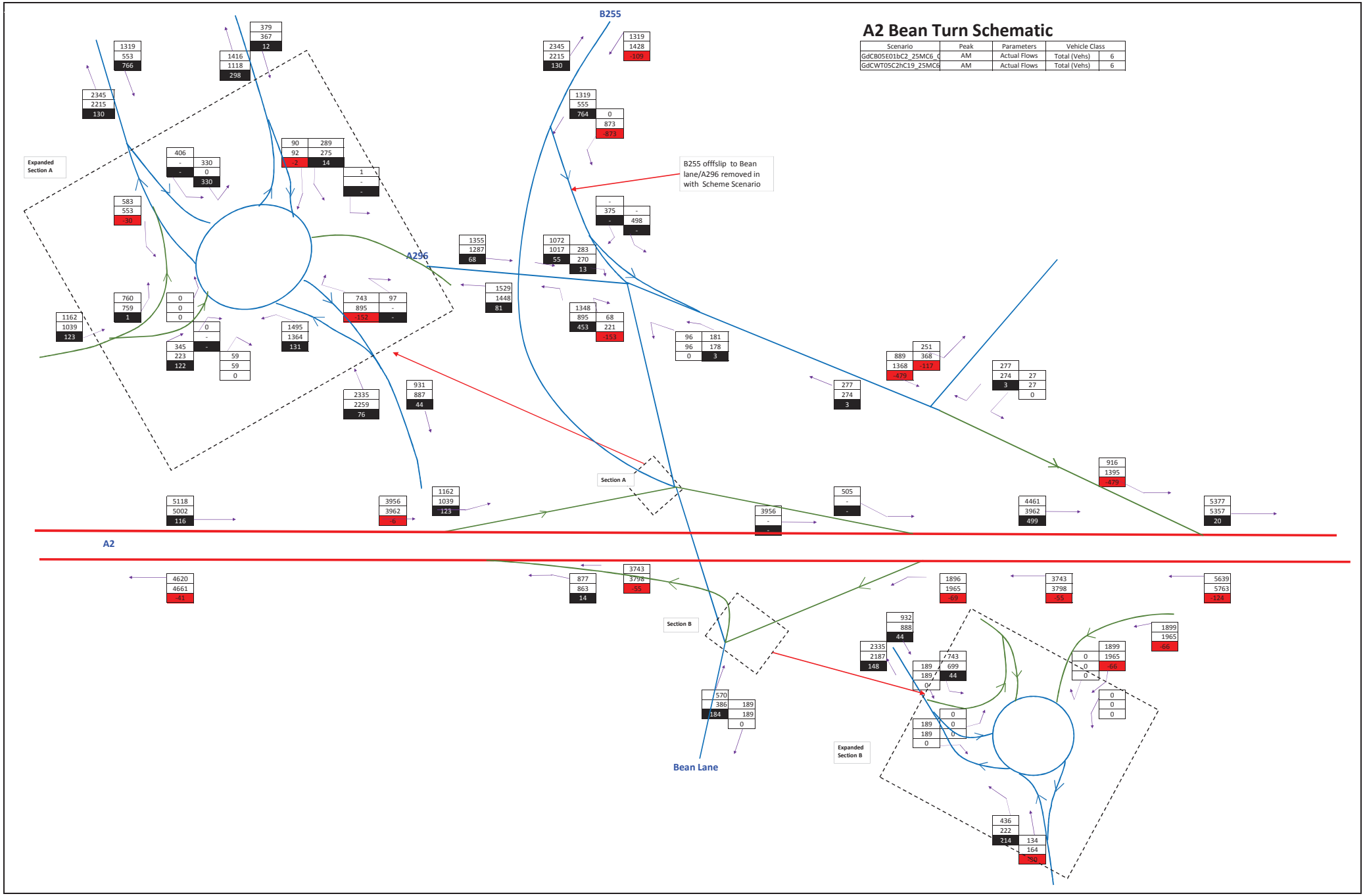


APPENDIX E: Scheme Effect B05E01b Turn Flow Schematics

SCHEME EFFECT B05E01b A2 BEAN JUNCTION 2025 AM PEAK TOTAL VEHICLES



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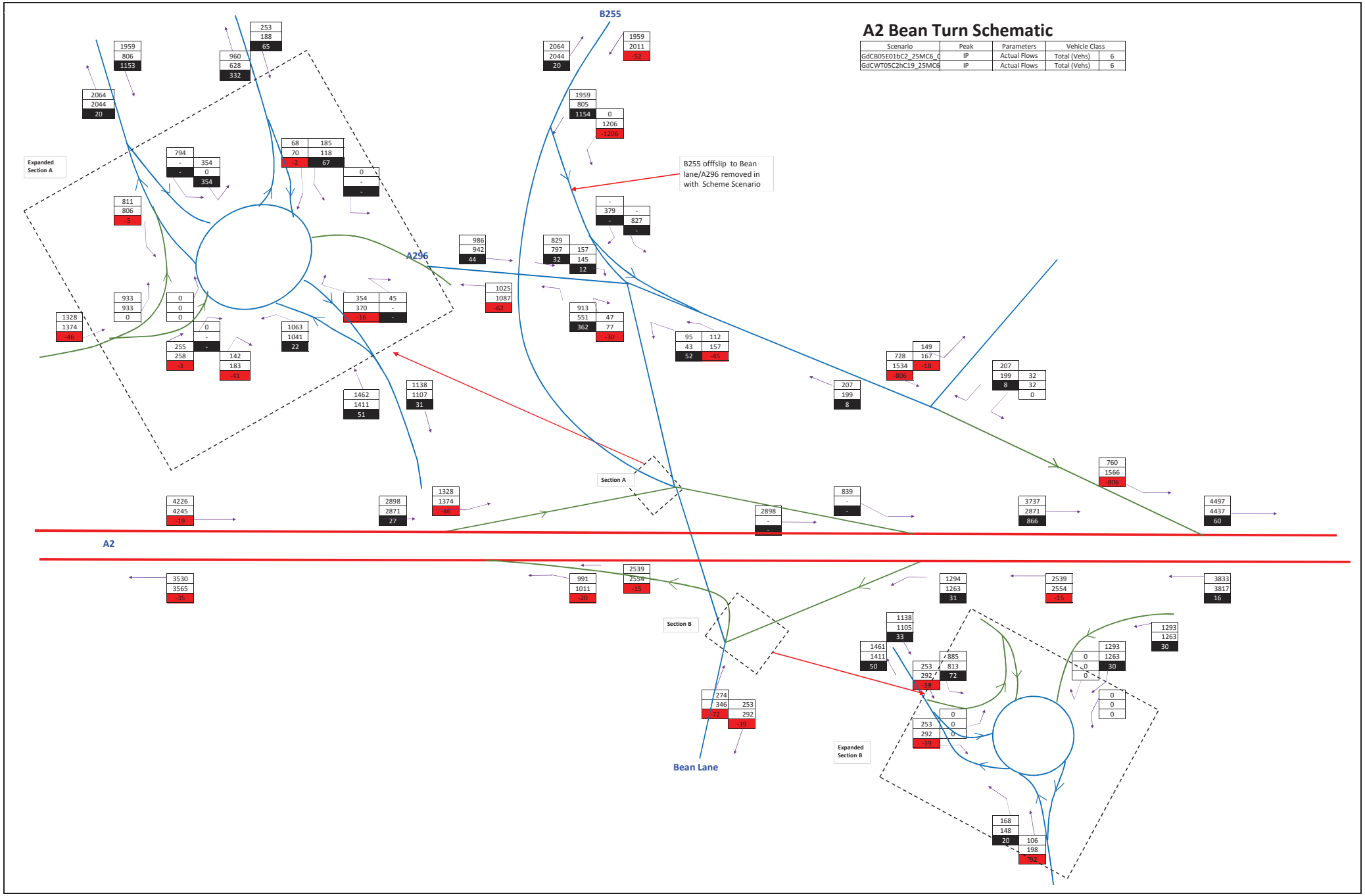

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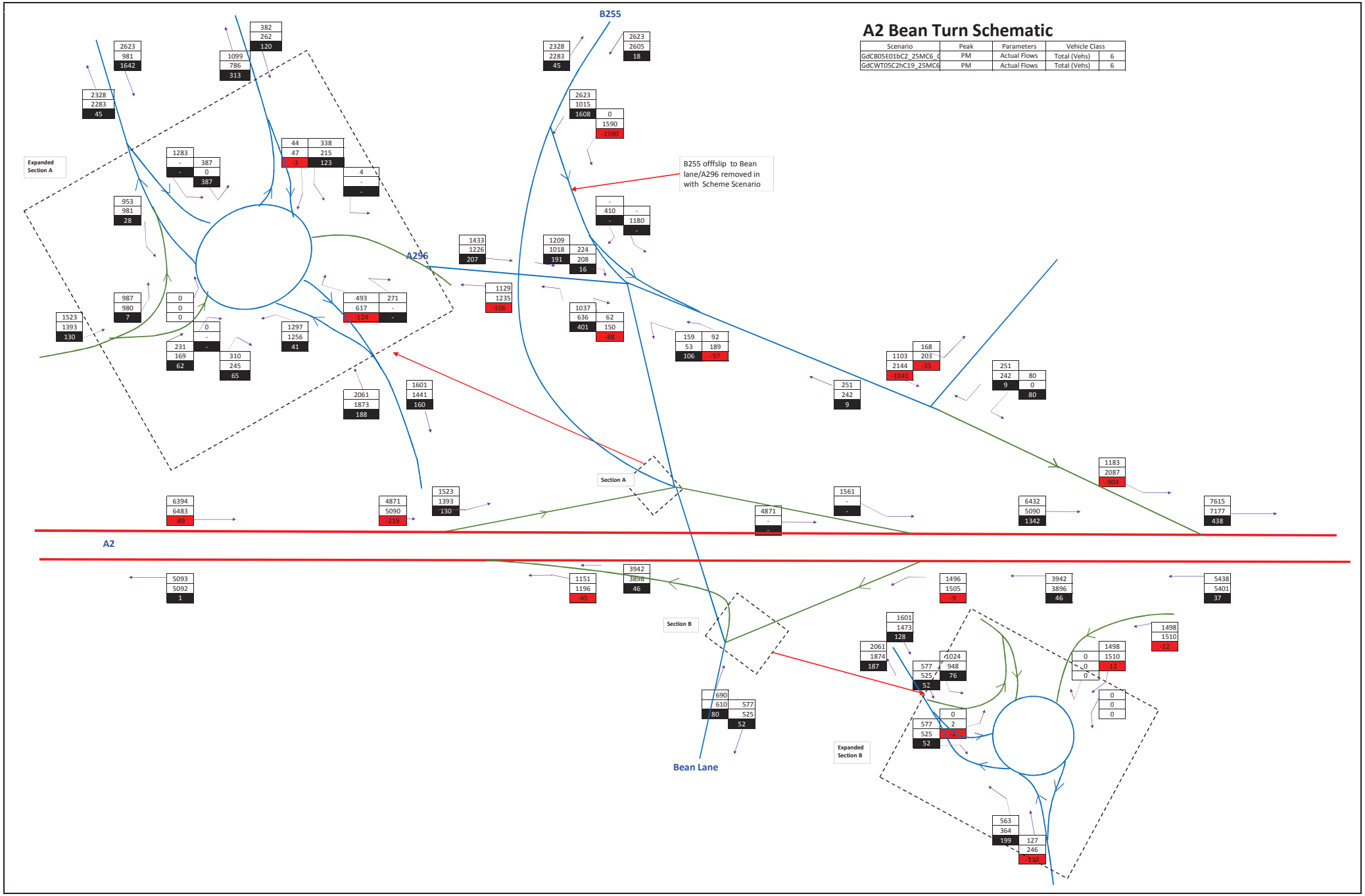

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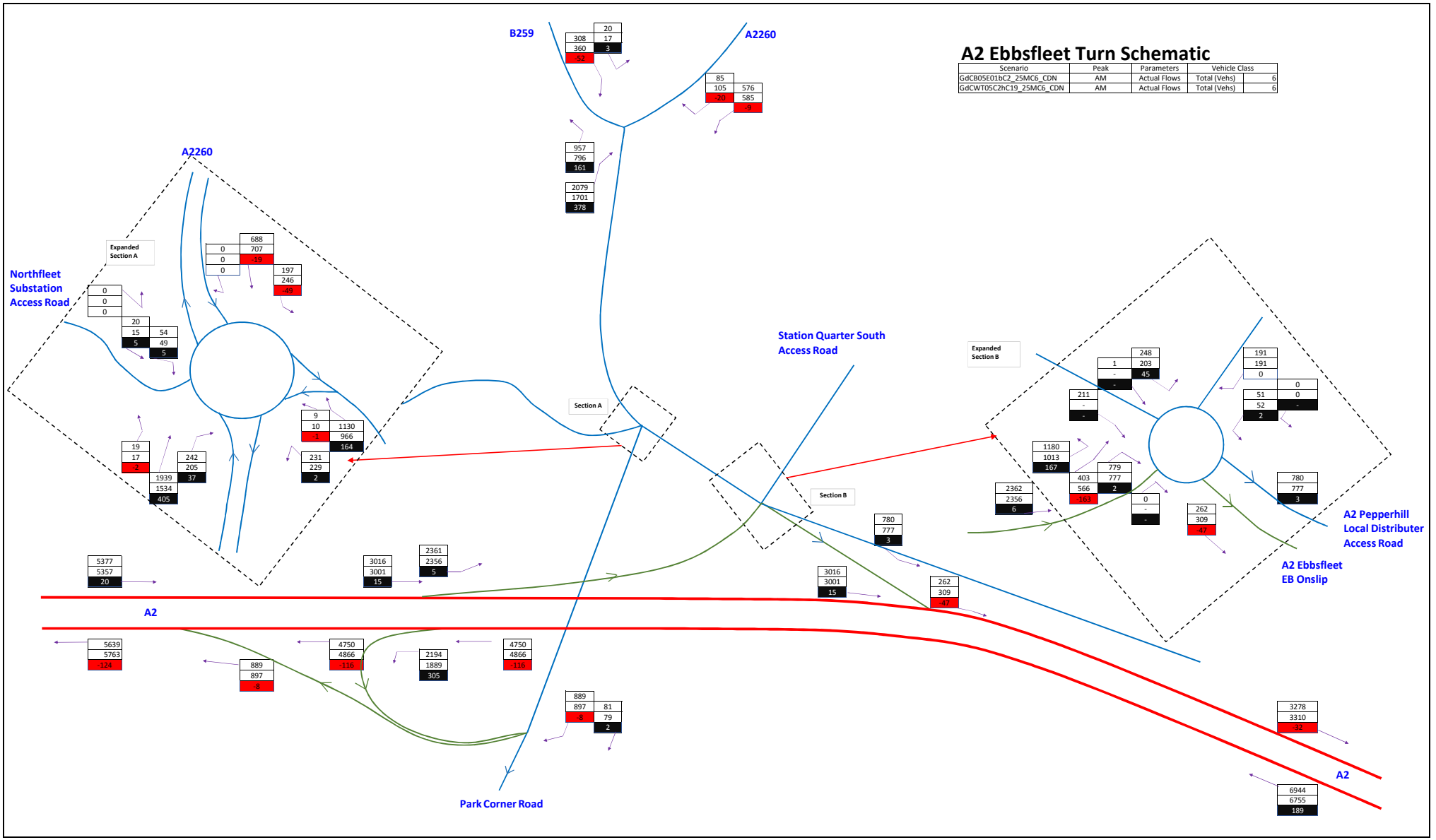

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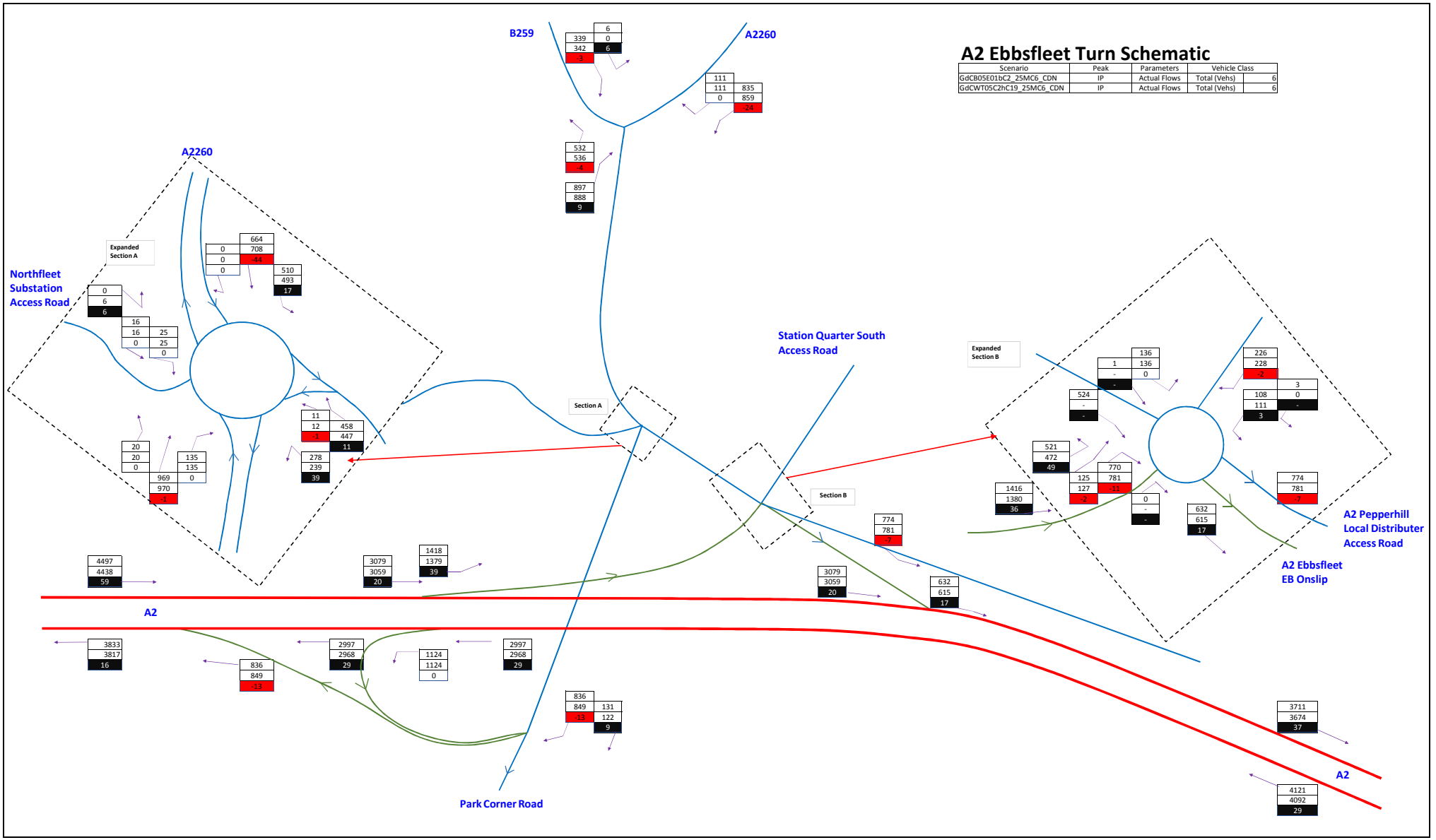

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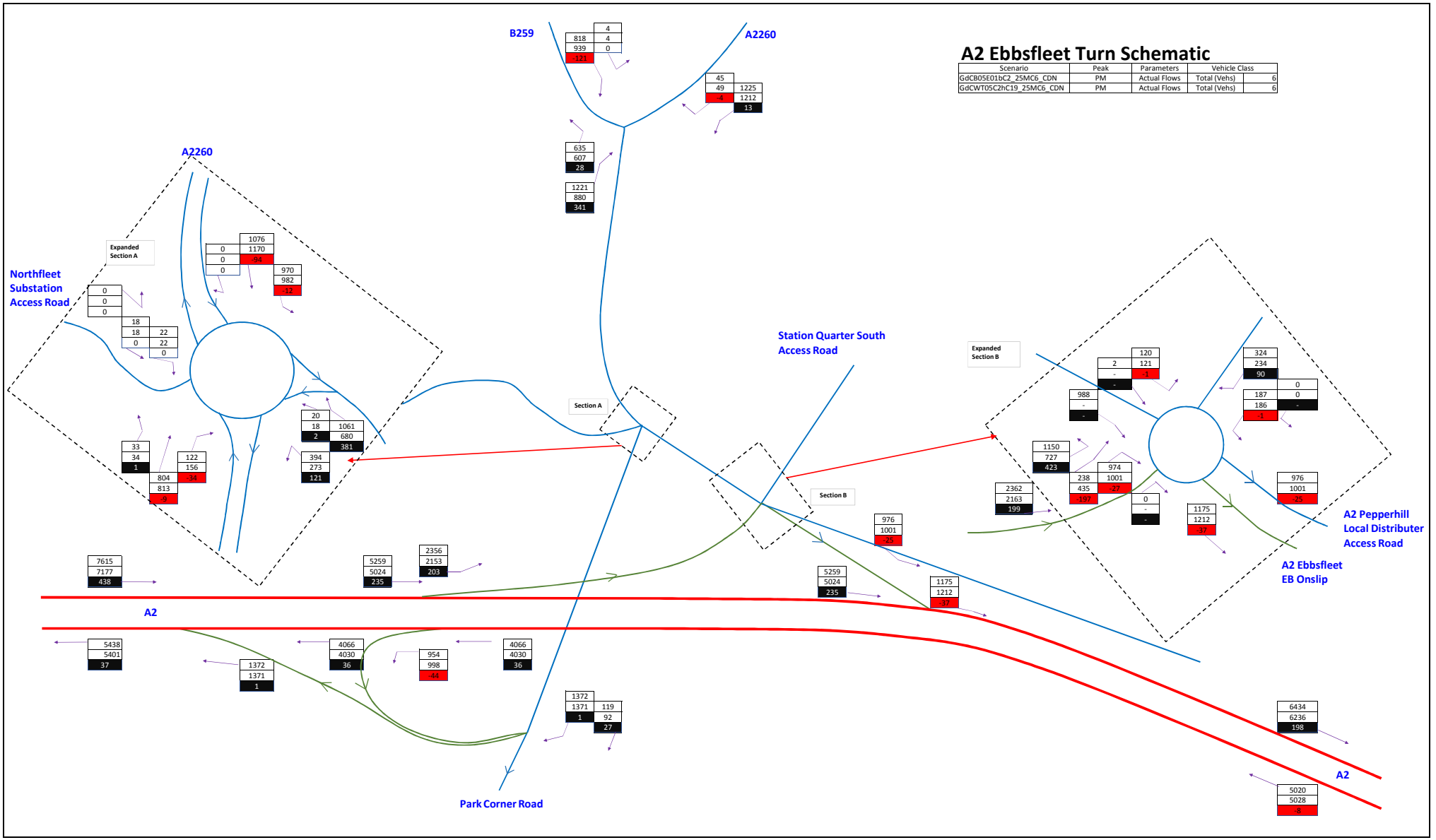

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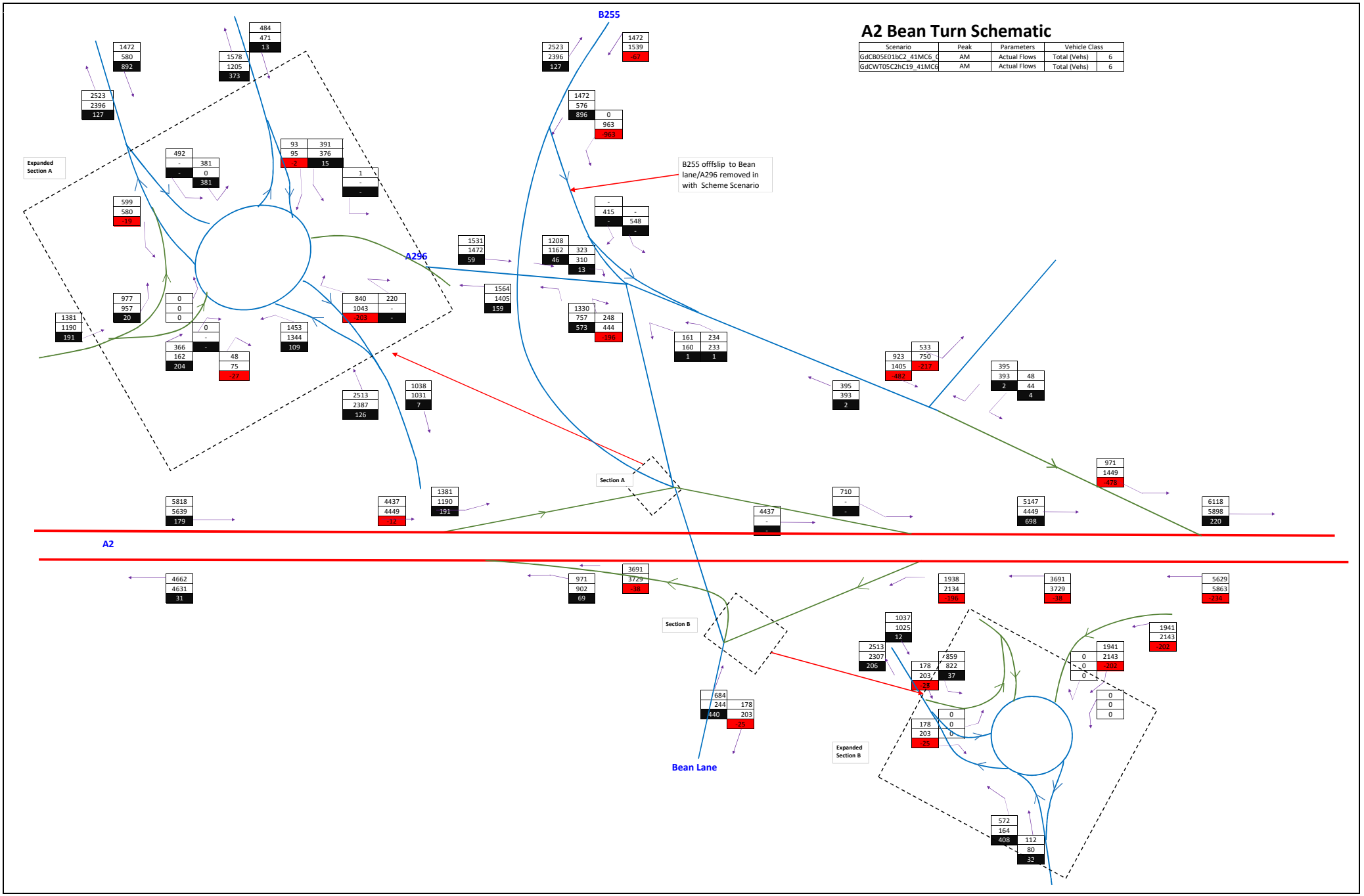

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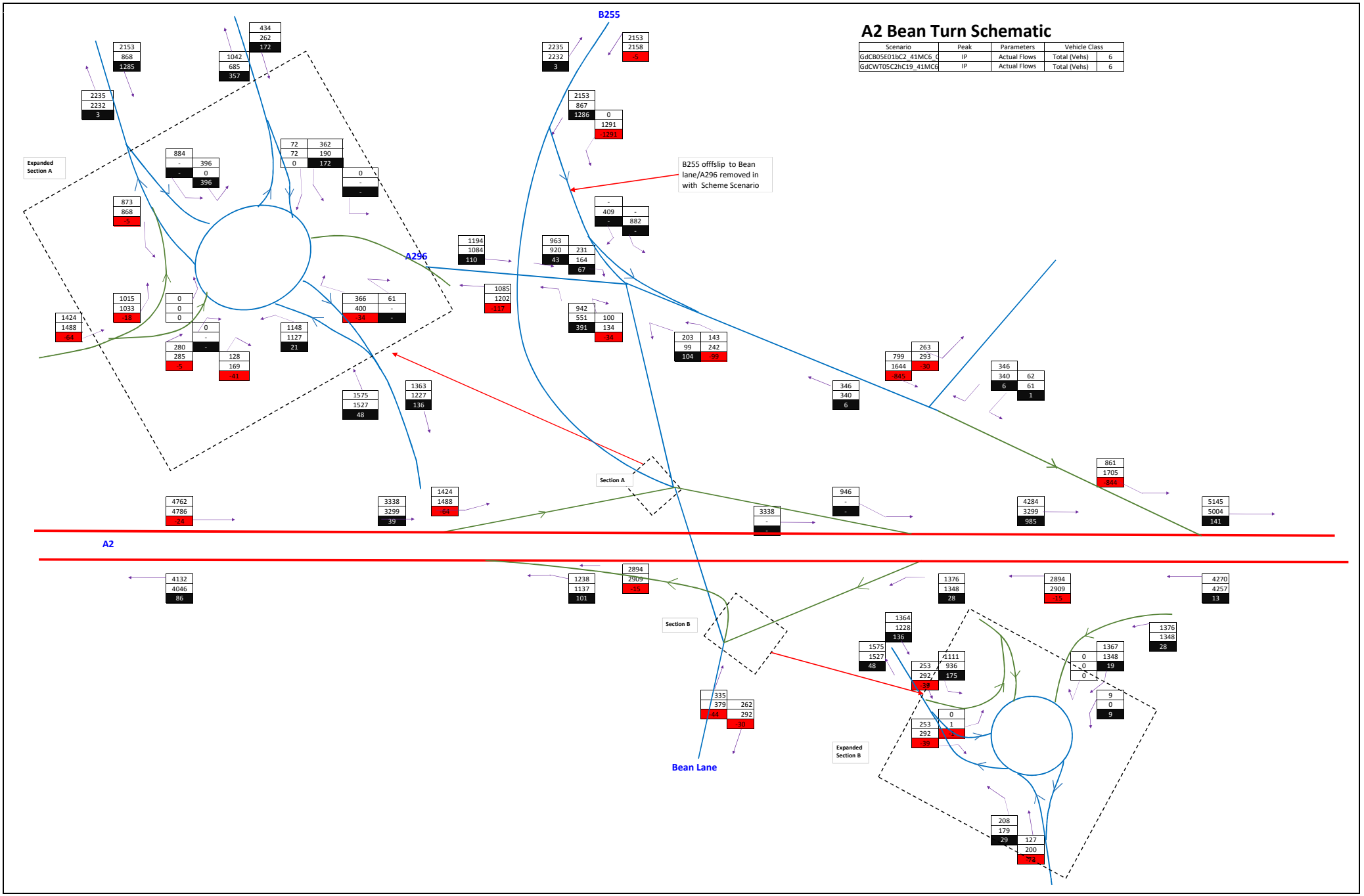

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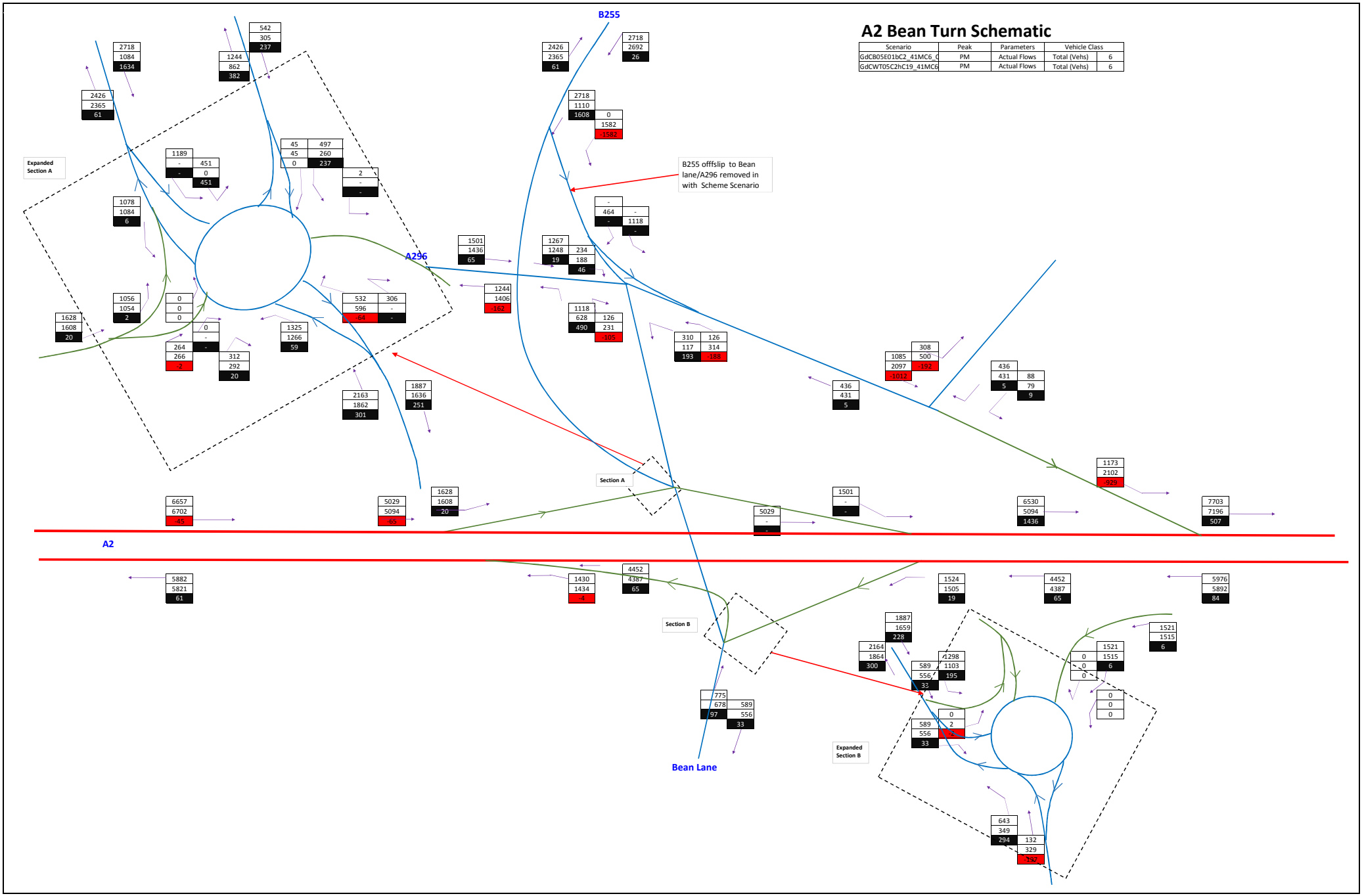

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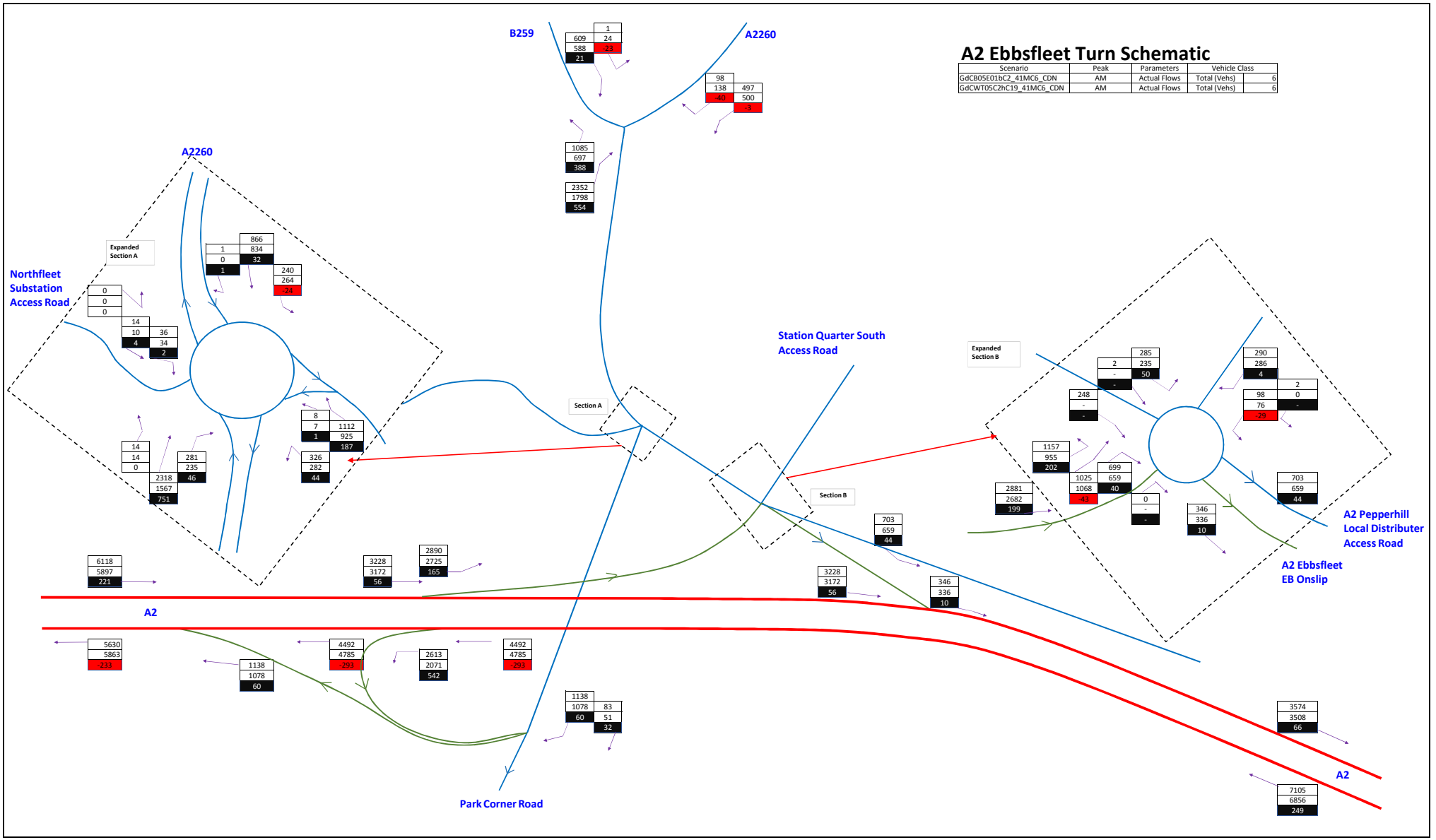
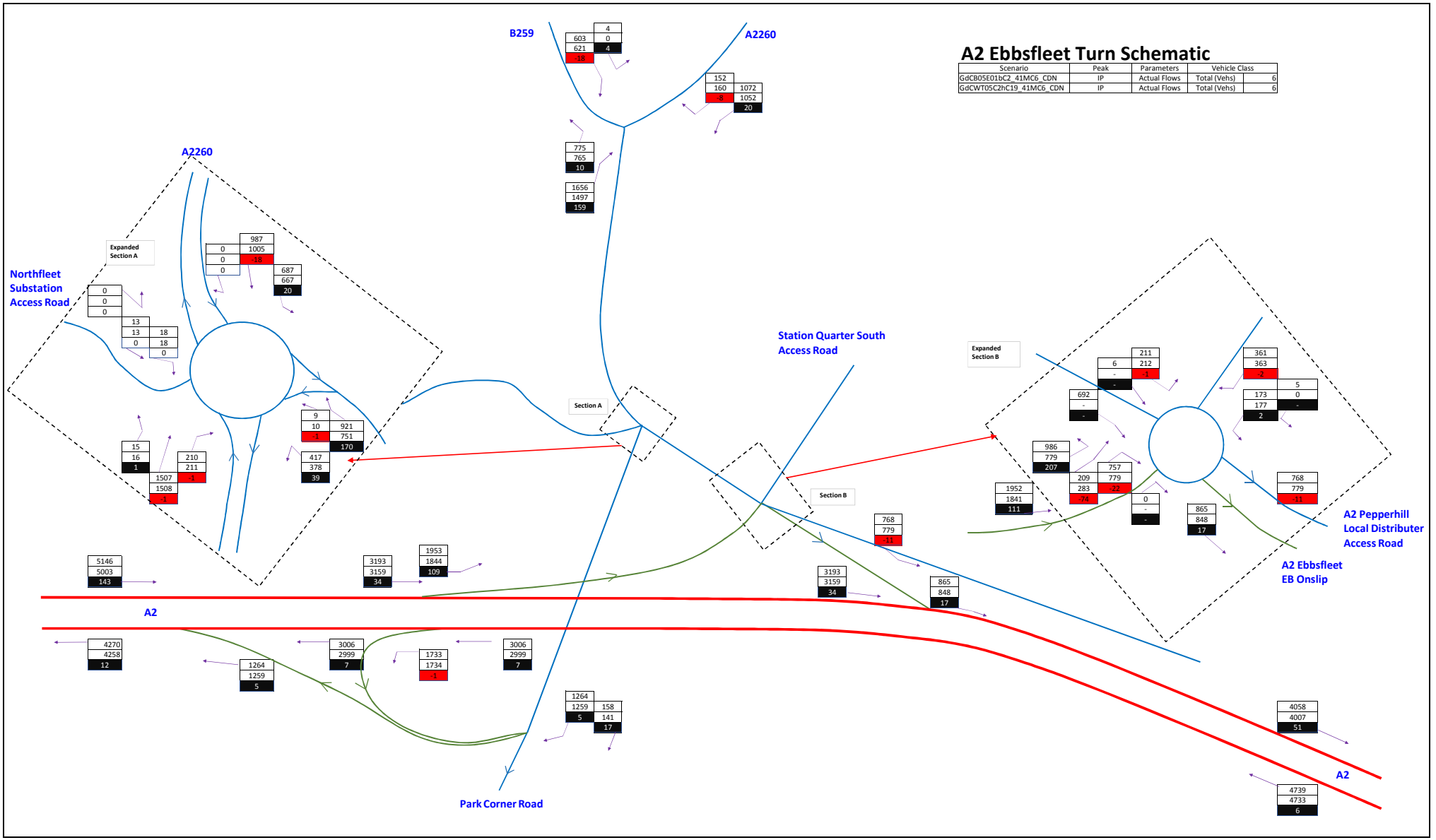
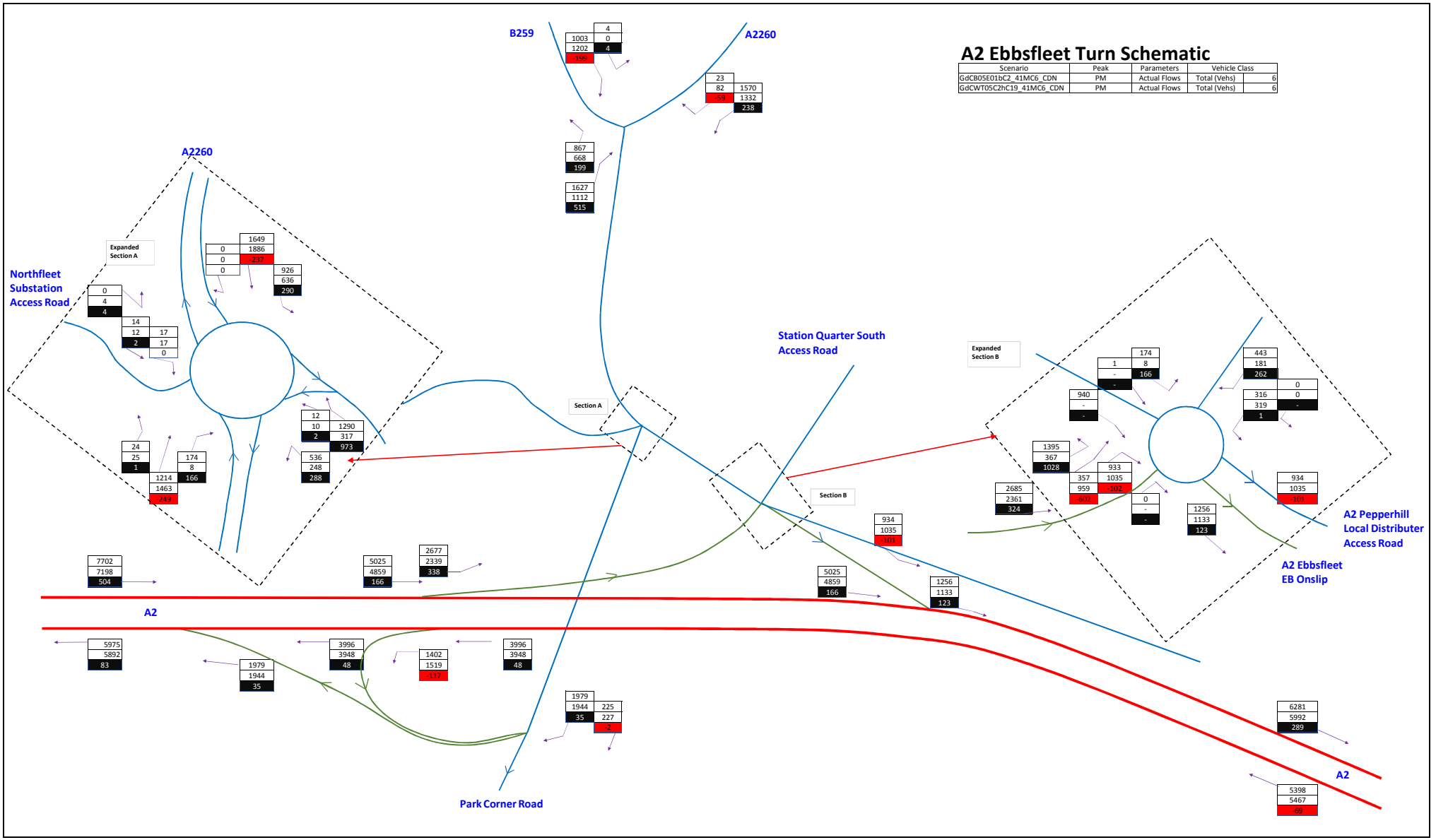


SCHEME EFFECT B05E01b A2 EBBSFLEET JUNCTION 2041 INTER PEAK TOTAL VEHICLES



SCHEME EFFECT B05E01b A2 EBBSFLEET JUNCTION 2041 PM PEAK TOTAL VEHICLES



APPENDIX F: Stage 1 Scenario Bean 03 + Ebbsfleet 01b (B03E01b) TEE, PA & AMCB Tables

Table F.1 TEE A2BE Stage 1 : Scenario Bean 03 + Ebbsfleet 01b (B03E01b)

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£19,026,360		£19,026,360					
Vehicle operating costs	£1,087,725		£1,087,725					
User charges	£0		£0					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: COMMUTING	£20,114,085	*(1a)*	£20,114,085					
Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£61,183,840		£61,183,840					
Vehicle operating costs	£2,964,076		£2,964,076					
User charges	£0		£0					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£64,147,916	*(1b)*	£64,147,916					
Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£42,993,073		£2,509,690	£40,483,383				
Vehicle operating costs	£3,478,687		£1,451,819	£2,026,868				
User charges	£0		£0	£0				
During Construction & Maintenance	£0							
Subtotal	£46,471,760	*(2)*	£3,961,509	£42,510,251				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions	-£31,725,391	*(4)*	-£31,725,391					
NET BUSINESS IMPACT	£14,746,369	*(5) = (2) + (3) + (4)*						
TOTAL								
Efficiency Benefits (TEE)	£99,008,370	*(6) = (1a) + (1b) + (5)*						
	Notes: Benefits appear as positive numbers, while costs appear as negative numbers.							
	All entries are discounted present values, in 2010 prices and values							

Table F.2 PA A2BE Stage 1 : Scenario Bean 03 + Ebbsfleet 01b (B03E01b)

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL		INFRASTRUCTURE			
Revenue						
Operating Costs						
Investment Costs	£0					
Developer and Other Contributions	£0					
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	£0		£0			
Operating costs	£0					
Investment Costs	£106,219,058		£106,219,058			
Developer and Other Contributions	-£31,725,391		-£31,725,391			
Grant/Subsidy Payments						
NET IMPACT	£74,493,667	*(8)*	£74,493,667			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	£2,755,263	*(9)*	£2,755,263			
TOTALS						
Broad Transport Budget	£74,493,667	*(10) = (7) + (8)*				
Wider Public Finances	£2,755,263	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Table F.3 AMCB A2BE Stage 1 : Scenario Bean 03 + Ebbsfleet 01b (B03E01b)

Analysis of Monetised Costs and Benefits

Noise	£39,439	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	£1,439,000	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	£7,715,300	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£20,114,085	*(1a)*
Economic Efficiency: Consumer Users (Other)	£64,147,916	*(1b)*
Economic Efficiency: Business Users and Providers	£14,746,369	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-£2,755,263	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£105,446,846	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£74,493,667	*(10)*
Present Value of Costs (see notes) (PVC)	£74,493,667	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£30,953,179	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.42	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

APPENDIX G: Stage 1 Scenario Bean 04b + Ebbsfleet 01b (B04bE01b) TEE, PA & AMCB Tables

Table G.1 TEE A2BE Stage 1 : Scenario Bean 04b + Ebbsfleet 01b (B04bE01b)

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£15,867,714		£15,867,714					
Vehicle operating costs	£416,914		£416,914					
User charges	£0		£0					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: COMMUTING	£16,284,628	*(1a)*	£16,284,628					
Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£40,688,805		£40,688,805					
Vehicle operating costs	-£1,708,270		-£1,708,270					
User charges	£0		£0					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£38,980,535	*(1b)*	£38,980,535					
Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£18,899,357		£1,072,404	£17,826,953				
Vehicle operating costs	£97,098		£429,641	-£332,543				
User charges	£0		£0	£0				
During Construction & Maintenance	£0							
Subtotal	£18,996,455	*(2)*	£1,502,045	£17,494,410				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions	-£31,725,391	*(4)*	-£31,725,391					
NET BUSINESS IMPACT	-£12,728,936	*(5) = (2) + (3) + (4)*						
TOTAL								
Efficiency Benefits (TEE)	£42,536,227	*(6) = (1a) + (1b) + (5)*						
	Notes: Benefits appear as positive numbers, while costs appear as negative numbers.							
	All entries are discounted present values, in 2010 prices and values							

Table G.2 PA A2BE Stage 1 : Scenario Bean 04b + Ebbsfleet 01b (B04bE01b)

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	**TOTAL**		**INFRASTRUCTURE**			
Revenue						
Operating Costs						
Investment Costs	£0					
Developer and Other Contributions	£0					
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	£0		£0			
Operating costs	£0					
Investment Costs	£104,122,959		£104,122,959			
Developer and Other Contributions	-£31,725,391		-£31,725,391			
Grant/Subsidy Payments						
NET IMPACT	£72,397,568	*(8)*	£72,397,568			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	£315,771	*(9)*	£315,771			
TOTALS						
Broad Transport Budget	£72,397,568	*(10) = (7) + (8)*				
Wider Public Finances	£315,771	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Table G.3 AMCB A2BE Stage 1 : Scenario Bean 04b + Ebbsfleet 01b (B04bE01b)

Analysis of Monetised Costs and Benefits

Noise	-£2,552	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	£174,000	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	-£159,000	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£16,284,628	*(1a)*
Economic Efficiency: Consumer Users (Other)	£38,980,535	*(1b)*
Economic Efficiency: Business Users and Providers	-£12,728,936	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-£315,771	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£42,232,904	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£72,397,568	*(10)*
Present Value of Costs (see notes) (PVC)	£72,397,568	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	-£30,164,665	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	0.58	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

APPENDIX H: Stage 1 Scenario Bean 05 + Ebbsfleet 01b (B05E01b) TEE, PA & AMCB Tables

Table H.1 TEE A2BE Stage 1 : Scenario Bean 05 + Ebbsfleet 01b (B05E01b)

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£22,300,191		£22,300,191					
Vehicle operating costs	£53,957		£53,957					
User charges	£0		£0					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: COMMUTING	£22,354,148	*(1a)*	£22,354,148					
Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**		**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**		
Travel time	£65,754,868		£65,754,868					
Vehicle operating costs	-£2,092,005		-£2,092,005					
User charges	£0		£0					
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£63,662,863	*(1b)*	£63,662,863					
Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	£41,586,927		£1,727,290	£39,859,637				
Vehicle operating costs	£889,278		£824,511	£64,767				
User charges	£0		£0	£0				
During Construction & Maintenance	£0							
Subtotal	£42,476,205	*(2)*	£2,551,801	£39,924,404				
Private sector provider impacts						**Freight**	**Passengers**	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	*(3)*						
Other business impacts								
Developer contributions	-£31,725,391	*(4)*	-£31,725,391					
NET BUSINESS IMPACT	£10,750,814	*(5) = (2) + (3) + (4)*						
TOTAL								
Efficiency Benefits (TEE)	£96,767,825	*(6) = (1a) + (1b) + (5)*						
	Notes: Benefits appear as positive numbers, while costs appear as negative numbers.							
	All entries are discounted present values, in 2010 prices and values							

Table H.2 PA A2BE Stage 1 : Scenario Bean 05 + Ebbsfleet 01b (B05E01b)

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL		INFRASTRUCTURE			
Revenue						
Operating Costs						
Investment Costs	£0					
Developer and Other Contributions	£0					
Grant/Subsidy Payments						
NET IMPACT	£0	*(7)*				
Central Government Funding: Transport						
Revenue	£0		£0			
Operating costs	£0					
Investment Costs	£90,211,136		£90,211,136			
Developer and Other Contributions	-£31,725,391		-£31,725,391			
Grant/Subsidy Payments						
NET IMPACT	£58,485,745	*(8)*	£58,485,745			
Central Government Funding: Non-Transport						
Indirect Tax Revenues	£649,640	*(9)*	£649,640			
TOTALS						
Broad Transport Budget	£58,485,745	*(10) = (7) + (8)*				
Wider Public Finances	£649,640	*(11) = (9)*				

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.
All entries are discounted present values in 2010 prices and values.

Table H.3 AMCB A2BE Stage 1 : Scenario Bean 05 + Ebbsfleet 01b (B05E01b)

Analysis of Monetised Costs and Benefits

Noise	-£108,508	*(12)*
Local Air Quality		*(13)*
Greenhouse Gases	£376,000	
Journey Quality		*(15)*
Physical Activity		*(16)*
Accidents	£3,153,200	*(17)*
Economic Efficiency: Consumer Users (Commuting)	£22,354,148	*(1a)*
Economic Efficiency: Consumer Users (Other)	£63,662,863	*(1b)*
Economic Efficiency: Business Users and Providers	£10,750,814	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-£649,640	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Present Value of Benefits (see notes) (PVB)	£99,538,877	*(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)*
Broad Transport Budget	£58,485,745	*(10)*
Present Value of Costs (see notes) (PVC)	£58,485,745	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	£41,053,132	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.70	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

APPENDIX I: Appraisal Summary Tables

Appraisal Summary Table

Date produced:	25 Nov 2016

Contact:	
Name	Hugh Coakley
Organisation	Highways England
Role	Project Manager

Name of scheme:	A2 Bean and Ebbsfleet Junction Improvements
Description of scheme:	Bean Option 3 combined with Ebbsfleet Option 1b

Impacts		Summary of key impacts	Assessment					
			Quantitative				Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The scheme will benefit business users. About 1/3 of the journey time benefits occur to this group.	**Value of journey time changes(£)** £42.99m **Net journey time changes (£)** 0 to 2min: £25.59m; 2 to 5min: £13.12m; > 5min: £4.28m					£46.47m	
	Reliability impact on Business users	Quantative assessment not carried out at Stage 1. In view of the improved journey time, can be assumed at this stage to be slightly beneficial.					Moderate beneficial		
	Regeneration	Quantative assessment not carried out at Stage 1. In view of the low journey time benefits, can be assumed at this stage to be neutral.					Beneficial		
	Wider Impacts	A qualitative assessment suggests that the Wider Impact benefits would be similar to those identified in the Option 5 quantitative assessment. This would raise the BCR from 1.4 to 1.7.	Agglomeration £18.85m Imperfectly Competitive Markets £0.60m Tax Revenue from Labour Market £3.04m					£22.49m	
Environmental	Noise	With 87 households experiencing increased daytime Noise and 79 Households experiencing decreased daytime nosie the impacts are broadly inline with the benefits. Due to the positive effect on health criteria there is a positive NPV valus.	Benefits outweigh the disbenefits resulting in a positive NPV value.				Minor beneficial	£107,150	
	Air Quality	Predicted NO2 and PM10 concentrations are well below the AQS Objectives. Multiple AQMA's have been declared by Dartford (AQMA's No. 1-4) and Gravesham Borough Council (A2 AQMA) within the vicinity of the option. Based on current traffic flows, the highest modelled NO2 concentration is 32.9µg/m³, therefore the option is unlikely to lead to a significant impact on air quality. There is also unlikely to be a risk with regards to compliance with the EU Limit Values.	Local air quality modelling has been completed for worst case receptor locations using the DMRB screening tool at PCF Stage 1.				N/A	Not undertaken for PCF Stage 1.	Not required during PCF Stage 1.
	Greenhouse gases	Positive impact. The scheme will reduce greenhouse gas emissions.	Change in non-traded carbon over 60y (CO2e), tonnes -31,555 Change in traded carbon over 60y (CO2e), tonnes -23					£1.44m	
	Landscape	The scheme would have moderate adverse change on landscape features and character, which are typical of the regional and local landscape character areas, such as Darenth Wood Country Park, Darenth Wood, Bean Wood and on visual settings such as of Bean Village, North Bean, Bean Farm, Hope and Ightham Cottages and Bean House.					Moderate adverse		
	Townscape	The scheme would have moderate adverse change on townscape features and character, which are typical of the regional and local townscape character areas, such as Bean Village, North Bean, Bean Farm, Hope and Ightham Cottages and Bean House.					Moderate adverse		
	Historic Environment	There is the potential for: large adverse physical impact to a scheduled monument; slight adverse impacts to the settings of two listed buildings; three scheduled monuments; a number of undesignated heritage assets and potential for slight adverse physical impacts to a number of undesignated heritage assets.					Large adverse		
	Biodiversity	Permanent and irreversible loss of 0.54ha ancient woodland at Darenth Wood SSSI. Significant loss to high value dormouse habitat. Localised loss or disturbance to other receptors, including possible loss of bat roosts and a main badger sett.					Large adverse		
	Water Environment	The large majority of the Scheme is in the low risk flood zone (FZ1) and there would result in no increase in surface water or fluvial flood risk, nor any signficant effects on surface water quality. Potentially, large impacts to groundwater quality could occur due to proposed continued use of a drainage water infiltration ditch which lies on a SPZ1 at Bean junction. Pollution control measures would be added if not already in place. Additional mitigation may be required which would serve to reduce this level of significance from large adverse as the design develops. In this location the groundwater level is deep (30 - 50 m bgl) so this minimises the risk to a degree. Two closed fuel stations (both within 500 m) pose a risk due to potential for residual contamination.					Moderate adverse		
Social	Commuting and Other users	The scheme will benefit commuting and other users. About 2/3 of the benefits for this group come from reducing the travel time.	**Value of journey time changes(£)** £80.21m **Net journey time changes (£)** 0 to 2min: £35.19m; 2 to 5min: £26.36m; > 5min: £18.66m					£84.26m	
	Reliability impact on Commuting and Other users	Not assessed at Stage 1, but will be assessed at Stage 2.					N/A		
	Physical activity	Changes in the number of pedestrians/cyclists/equestrians or their average journey times are anticipated to be insignificant.					Neutral		
	Journey quality	Traveller care, together with the nature and extent of travellers' views, would not alter significantly. Traveller stress would reduce. Journey quality is expected to improve, overall.					Moderate beneficial		
	Accidents	It is estimated that 107 accidents will be saved over 60 year period of assessment. The casualities saved by scheme are 4.2 fatal, 20.9 serious and 134.0 slight accidents.						£7.72m	
	Security	Scheme will have no impact on security					Neutral		
	Access to services	Scheme is unlikely to have substantial impact on access to services.					Neutral		
	Affordability	An initial assessment screening suggests improved personal affordability that is evenly distributed amongst income groups.					Beneficial		
	Severance	There would be little or no hindrance to pedestrian movement.					Neutral		
	Option and non-use values	Scheme would not affect transport mode options in the study area.					Neutral		
Public Accounts	Cost to Broad Transport Budget	The total construction cost is likely to be £106.2 million, in 2010 prices, discounted to 2010. This cost will be reduced by a developer contribution of £31.7 million on the same price basis (contribution of £45.0 million, assumed to be in 2020 prices and to fall in 2020).						-£74.49m	
	Indirect Tax Revenues	Disbenefit to government. Due to a reduction in travel time fuel consumption gets reduced (less time in queuing), thereby decreasing indirect tax revenues.						-£2.76m	

Appraisal Summary Table

Date produced:	25 Nov 2016

Contact:	
Name	Hugh Coakley
Organisation	Highways England
Role	Project Manager

Name of scheme:	A2 Bean and Ebbsfleet Junction Improvements
Description of scheme:	Bean Option 4b combined with Ebbsfleet Option 1b

Impacts		Summary of key impacts	Assessment					
			Quantitative				Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The scheme will benefit business users. About 1/4 of the journey time benefits occur to this group.	**Value of journey time changes(£)** £18.90m **Net journey time changes (£)** 0 to 2min: £5.69m; 2 to 5min: £8.86m; > 5min: £4.35m					£19.00m	
	Reliability impact on Business users	Quantative assessment not carried out at Stage 1. In view of the improved journey time, can be assumed at this stage to be slightly beneficial.					Slightly beneficial		
	Regeneration	Quantative assessment not carried out at Stage 1. In view of the low journey time benefits, can be assumed at this stage to be neutral.					Beneficial		
	Wider Impacts	A qualitative assessment based on the Option 5 quantitative assessment suggests that the Wider Impact benefits would be approximately £12.4m (15% of the PVB).	Agglomeration £10.36m Imperfectly Competitive Markets £0.33m Tax Revenue from Labour Market £1.67m				Moderately beneficial	£12.36m	
Environmental	Noise	With 76 households experiencing increased daytime Noise and 61 Households experiencing decreased daytime nosie the impacts are broadly inline with the benefits. Due to the positive effect on health criteria there is a positive NPV valus.	Benefits and disbenefits almost cancel each other out resulting in a small NPV value.				Slightly benefical	£31,788	
	Air Quality	Predicted NO2 and PM10 concentrations well below the AQS Objectives. Multiple AQMA's have been declared by Dartford (AQMA's No. 1-4) and Gravesham Borough Council (A2 AQMA) within the vicinity of the option. Based on current traffic flows, the highest modelled NO2 concentration is 33.4µg/m³ , therefore the option is unlikely to lead to a significant impact on air quality. There is also unlikely to be a risk with regards to compliance with the EU Limit Values.	Local air quality modelling has been completed for worst case receptor locations using the DMRB screening tool at PCF Stage 1.				N/A	Not undertaken for PCF Stage 1.	Not required during PCF Stage 1.
	Greenhouse gases	Positive impact. The scheme will reduce greenhouse gas emissions.	Change in non-traded carbon over 60y (CO2e), tonnes: -3,783 Change in traded carbon over 60y (CO2e), tonnes: 46					£0.17m	
	Landscape	The scheme would have moderate adverse change on landscape features and character, which are typical of the regional and local landscape character areas, such as Darenth Wood Country Park, Darenth Wood, Bean Wood and on visual settings such as of Bean Village, North Bean, Bean Farm, Hope Cottages and Bean House.					Moderate adverse		
	Townscape	The scheme would have moderate adverse change on townscape features and character, which are typical of the regional and local townscape character areas, such as Bean Village, North Bean, Bean Farm, Hope Cottages and Bean House.					Moderate adverse		
	Historic Environment	There is the potential for: moderate adverse impacts to the settings of two listed buildings; slight adverse impacts to the settings of three scheduled monuments and a number of undesignated heritage assets and the potential for slight adverse physical impacts to a number of undesignated heritage assets.					Moderate adverse		
	Biodiversity	Small loss of ancient woodland (less than 0.05ha). Loss and permanent fragmentation of 0.4ha lowland mixed deciduous woodland (not ancient). Temporary loss of high value dormouse habitat and possible fragmentation of population . Localised loss or disturbance to other receptors, including possible loss of bat roosts.					Moderate adverse		
	Water Environment	The large majority of the Scheme is in the low risk flood zone (FZ1) and there would result in no increase in surface water flood risk. Potentially, large impacts to groundwater quality could occur due to proposed continued use of a drainage water infiltration ditch which lies on a SPZ1 at Bean junction. Pollution control measures would be added if not already in place. Additional mitigation may be required which would serve to reduce this level of significance from large adverse as the design develops. In this location the groundwater level is deep (30 - 50 m bgl) so this minimises the risk to a degree. Two closed fuel stations (both within 500 m) pose a risk due to potential for residual contamination.					Moderate Adverse		
Social	Commuting and Other users	The scheme will benefit commuting and other users. About 3/4 of the benefits for this group come from reducing the travel time.	**Value of journey time changes(£)** £56.56m **Net journey time changes (£)** 0 to 2min: £13.27m; 2 to 5min: £24.78m; > 5min: £18.50m					£55.27m	
	Reliability impact on Commuting and Other users	Not assessed at Stage 1, but will be assessed at Stage 2.							
	Physical activity	There may be a slight reduction in the number of pedestrians due to footpath removal.					Slight adverse		
	Journey quality	Traveller care, together with the nature and extent of travellers' views, would not alter significantly. Traveller stress would reduce. Journey quality is expected to improve, overall.					Moderate beneficial		
	Accidents	The number of accidents will increase by 53.7 over 60 years. However, the scheme option is likely to save 2.6 fatal, 2.6 serious accidents. But, the slight accidents are expected to be increased by 63.3, resulting in overall negative benefit value of -£0.16m.					N/A	-£0.16m	
	Security	Scheme will have no impact on security					Neutral		
	Access to services	Scheme is unlikely to have substantial impact on access to services					Neutral		
	Affordability	An initial assessment screening suggests improved personal affordability overall, but negative affordability for middle income groups.					Moderate beneficial		
	Severance	Pedestrian journeys will be longer or less attractive, and some people are likely to be dissuaded from making some journeys on foot, as a result of footpath loss.					Moderate adverse		
	Option and non-use values	Scheme would not affect transport mode options in the study area					Neutral		
Public Accounts	Cost to Broad Transport Budget	The total construction cost is likely to be £104.1 million, in 2010 prices, discounted to 2010. This cost will be reduced by a developer contribution of £31.7 million on the same price basis (contribution of £45.0 million, assumed to be in 2020 prices and to fall in 2020).						-£72.40m	
	Indirect Tax Revenues	Disbenefit to government. Due to a reduction in travel time fuel consumption gets reduced (less time in queuing), thereby decreasing indirect tax revenues.						-£0.32m	

Appraisal Summary Table

Date produced:	25 Nov 2016

Contact:	
Name	Hugh Coakley
Organisation	Highways England
Role	Project Manager

Name of scheme:	A2 Bean and Ebbsfleet Junction Improvements
Description of scheme:	Bean Option 5 combined with Ebbsfleet Option 1b

Impacts		Summary of key impacts	Assessment								
			Quantitative						Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The scheme will benefit business users. About 1/3 of the journey time benefits occur to this group.	Value of journey time changes(£)			£41.59m				£42.48m	
			Net journey time changes (£)								
			0 to 2min		2 to 5min		> 5min				
			£22.59m		£14.66m		£4.33m				
	Reliability impact on Business users	Quantative assessment not carried out at Stage 1. In view of the improved journey times, can be assumed at this stage to be moderately beneficial.							Moderate beneficial		
	Regeneration	Quantative assessment not carried out at Stage 1. In view of the low journey time benefits, can be assumed at this stage to be neutral.							Beneficial		
	Wider Impacts	Wider Impacts have been assessed at £22.5m, which raises the BCR from 1.7 to 2.1.	Agglomeration			£18.85m				£22.49m	
			Imperfectly Competitive Markets			£0.60m					
			Tax Revenue from Labour Market			£3.04m					
Environmental	Noise	In the long term there will be no significant effect however in the short term one IA will percieve a noticible increase in noise. With 80 Households experiencing increased daytime noise and 57 experiencing decreased daytime nosie there is a significant difference however as there is an overall improvement in health benefits the NPV valus is returned as a positive.	Benfits outweigh the Disbenefits resulting in a positive NPV Value						Slightly benefical	£58,823	
	Air Quality	Predicted NO2 and PM10 concentrations well below the AQS Objectives. Multiple AQMA's have been declared by Dartford (AQMA's No. 1-4) and Gravesham Borough Council (A2 AQMA) within the vicinity of the option. Based on current traffic flows, the highest modelled NO2 concentration is 33.3µg/m³ , therefore the option is unlikely to lead to a significant impact on air quality. There is also unlikely to be a risk with regards to compliance with the EU Limit Values.	Local air quality modelling has been completed for worst case receptor locations using the DMRB screening tool at PCF Stage 1.						N/A	Not undertaken for PCF Stage 1.	Not required during PCF Stage 1.
	Greenhouse gases	Positive impact. The scheme will reduce greenhouse gas emissions.	Change in non-traded carbon over 60y (CO2e), tonnes			-8,100				£0.38m	
			Change in traded carbon over 60y (CO2e), tonnes			70					
	Landscape	The scheme would have minor adverse change on landscape features and character, which are typical of the regional and local landscape character areas, such on visual setting as of Hope Cottages.							Slight adverse		
	Townscape	The scheme would have slight adverse change on townscape features and character, which are typical of the regional and local townscape character areas, such as Hope Cottages.							Slight adverse		
	Historic Environment	There is the potential for slight adverse impacts to the setting of three scheduled monuments and a number of undesignated heritage assets. There is also the potential for slight sdverse physical impacts to a number of undesignated heritage assets.							Slight adverse		
	Biodiversity	Loss of small area of high value dormouse habitat. Localised loss or disturbance to other receptors, including possible loss of bat roosts.							Slight to moderate adverse		
	Water Environment	The large majority of the Scheme is in the low risk flood zone (FZ1) and there would result in no increase in surface water flood risk. Potentially, large impacts to groundwater quality could occur due to proposed continued use of a drainage water infiltration ditch which lies on a SPZ1 at Bean junction. Pollution control measures would be added if not already in place. Additional mitigation may be required which would serve to reduce this level of significance from large adverse as the design develops. In this location the groundwater level is deep (30 - 50 m bgl) so this minimises the risk to a degree. Two closed fuel stations (both within 500 m) pose a risk due to potential for residual contamination.							Moderate adverse		
Social	Commuting and Other users	The scheme will benefit commuting and other users. About 2/3 of the benefits for this group come from reducing the travel time.	Value of journey time changes(£)			£88.06m				£86.02m	
			Net journey time changes (£)								
			0 to 2min		2 to 5min		> 5min				
			£39.25m		£30.47m		£18.33m				
	Reliability impact on Commuting and Other users	Not assessed at Stage 1, but will be assessed at Stage 2.							N/A		
	Physical activity	Changes in the number of pedestrians/cyclists/equestrians or their average journey times are anticipated to be insignificant.							Neutral		
	Journey quality	Traveller care, together with the nature and extent of travellers' views, would not alter significantly. Traveller stress would reduce. Journey quality is expected to improve, overall.							Moderate beneficial		
	Accidents	It is estimated that 35 accidents will be saved over 60 year period of assessment. The causalities saved by scheme are 2.3 fatal, 9.2 serious and 43.2 slight accidents.								£3.15m	
	Security	Scheme will have no impact on security							Neutral		
	Access to services	Scheme is unlikely to have substantial impact on access to services.							Neutral		
	Affordability	An initial assessment screening suggests neutral personal affordability overall with postive affordability for low income groups but negative affordability for middle to high income groups.							Neutral		
	Severance	There would be little or no hindrance to pedestrian movement.							Neutral		
	Option and non-use values	Scheme would not affect transport mode options in the study area.							Neutral		
Public Accounts	Cost to Broad Transport Budget	The total construction cost is likely to be £90.2 million, in 2010 prices, discounted to 2010. This cost will be reduced by a developer contribution of £31.7 million on the same price basis (contribution of £45.0 million, assumed to be in 2020 prices and to fall in 2020).								-£58.49m	
	Indirect Tax Revenues	Disbenefit to government. Due to a reduction in travel time fuel consumption gets reduced (less time in queuing), thereby decreasing indirect tax revenues.								-£0.65m	