Sensitivity Test Modelling Report

Land at Penllergaer Business Park, Swansea

Hydrock now Stantec

Prepared for:
Stoford Properties Ltd

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Table of Contents

Document control sheet ..... **i**
1 Introduction **2**
1.1 Commission 2
1.2 Background 2

2 Sensitivity Test Scenario **3**
2.1 Introduction 3
2.2 Outline Methodology 3
2.3 Committed Development Sites 3
2.4 Development Proposal 3
2.5 Development Trip Generation 3
2.5.1 Warehouse Staff 4
2.6 Vehicle Trip Generation and Distribution 6
2.7 Site Access 7
2.8 Mitigation Scheme 7

3 Modelling Results **8**
3.1 Introduction 8
3.2 Network Wide Model Statistics 8
3.2.1 Analysis of Network Wide Model Statistics 14
3.3 Journey Time Analysis 15
3.4 Junction Statistics 19
3.4.1 M4 Junction 47 Penllergaer Interchange 20
3.4.2 M4 Junction 46 22
3.4.3 Penllergaer Business Park Roundabout 25
3.4.4 A48 Clasemont Road / Pant Lasau Road 27
3.4.5 Analysis of Junction Statistics 28

4 Summary and Conclusion **30**
4.1 Introduction 30
4.2 Future Year Modelling 30
4.3 Conclusion 30

List of Tables

Table 1: Proposed Development Vehicle Trip Generation 6
Table 2: Network Statistics | AM Peak Period (07:00 – 10:00) 9
Table 3: Network Statistics | PM Peak Period (15:00 – 19:00) 10
Table 4: Journey Time Analysis | AM Peak | 07:00 – 10:00 17
Table 5: Journey Time Analysis | PM Peak | 15:00 – 19:00 18
Table 6: Individual Arm Statistics Description 19
Table 7: Junction Statistics | M4 Junction 47 Penllergaer Interchange | AM Peak Period 20
Table 8: Junction Statistics | M4 Junction 47 Penllergaer Interchange | PM Peak Period 21
Table 9: Junction Statistics | M4 Junction 46 | AM Peak Period 22
Table 10: Junction Statistics | M4 Junction 46 | PM Peak Period 24
Table 11: Junction Statistics | Penllergaer Business Park Roundabout | AM Peak Period 25
Table 12: Junction Statistics | Penllergaer Business Park Roundabout | PM Peak Period 26
Table 13: Junction Statistics | A48 Clasemont Road / Pant Lasau Road | AM Peak Period 27
Table 14: Junction Statistics | A48 Clasemont Road / Pant Lasau Road | PM Peak Period 28

List of Figures

Figure 1: Journey Time Routes 15

1 Introduction

1.1 Commission

Stantec has been appointed by Stoford Properties Ltd to undertake Aimsun modelling in support of a Planning Application for the development of a distribution centre on the Land at Penllergaer Business Park, Swansea. The proposed development will accommodate a floor area of 12,465sqm.

1.2 Background

An Aimsun microsimualtion base model has been calibrated and validated to meet all relevant criteria set out by TAG Unit M3.1. This is documented in full in the corresponding Model Validation Report[1].

This report sets out the modelling results from the Sensitivity Test scenario. The report is to be read in conjunction with the Transport Assessment[2] and Aimsun Modelling[3] that have been prepared to accompany the planning application and that are submitted under separate cover.

[1] *Land at Penllergaer Business Park, Swansea – Model Validation Report*, Hydrock now Stantec, 03 June 2025.
[2] *Distribution Centre, Penllergaer* - Transport Assessment, Hydrock now Stantec, 2025.
[3] *Land at Penllergaer Business Park, Swansea – Modelling Report*, Hydrock now Stantec, 2025.

2 Sensitivity Test Scenario

2.1 Introduction

In the original modelling and Transport Assessment, the operation of the warehouse was detailed which outlines how the warehouse staff movements cannot occur during peak operational movements (ie three van turnovers an hour). It was detailed how any warehouse shift change over would occur outside of the modelled periods, in line with the expected operational model for the site. However, as requested by Swansea City & County Council, a sensitivity test has been modelled to assess a scenario where a change of shift for warehouse staff occurs during the peak highway and site operation hour.

This scenario should be treated as a sensitivity test, the applicant has outlined that the peak operation of the warehouse cannot function unless the warehouse staff have been on site prior to commencement. This scenario is therefore not considered to be a realistic representation of how the site would operate, however it serves to satisfy the local highway authority in their concerns over a 'what if' scenario.

2.2 Outline Methodology

The methodology used for the sensitivity test is consistent with the core scenarios as presented in the Modelling Report. The methodology is outlined below.

2.3 Committed Development Sites

All committed development and traffic growth remains as outlined in the Modelling Report.

2.4 Development Proposal

The proposed development would seek to provide a distribution warehouse of approximately 12,465sqm. Vehicular access to the development is proposed to be provided from the existing roundabout on the A48 with small changes to the internal roundabout within Penllergaer Business Park.

2.5 Development Trip Generation

The forecast demand methodology remains as presented in the Modelling Report. The only change to the demand is the addition of warehouse staff trips in the AM and PM peak hour. A summary of development traffic demand is provided below.

2.5.1 Warehouse Staff

As requested by the local highway authority warehouse staff have been included in the peak hour assessment. Whilst it has been outlined by the applicant that warehouse staff would need to arrive onsite in advance of the site peak operation (ie a turn over of vans three times an hour), for the purposes of the sensitivity test it has been assumed that a warehouse shift change occurs in the AM and PM peak hours.

The peak network hours have been calculated using the base traffic demand within the model study area, this is presented on Figure 1 and Figure 2.

Figure 1: Base Model Traffic Demand - AM Peak Period

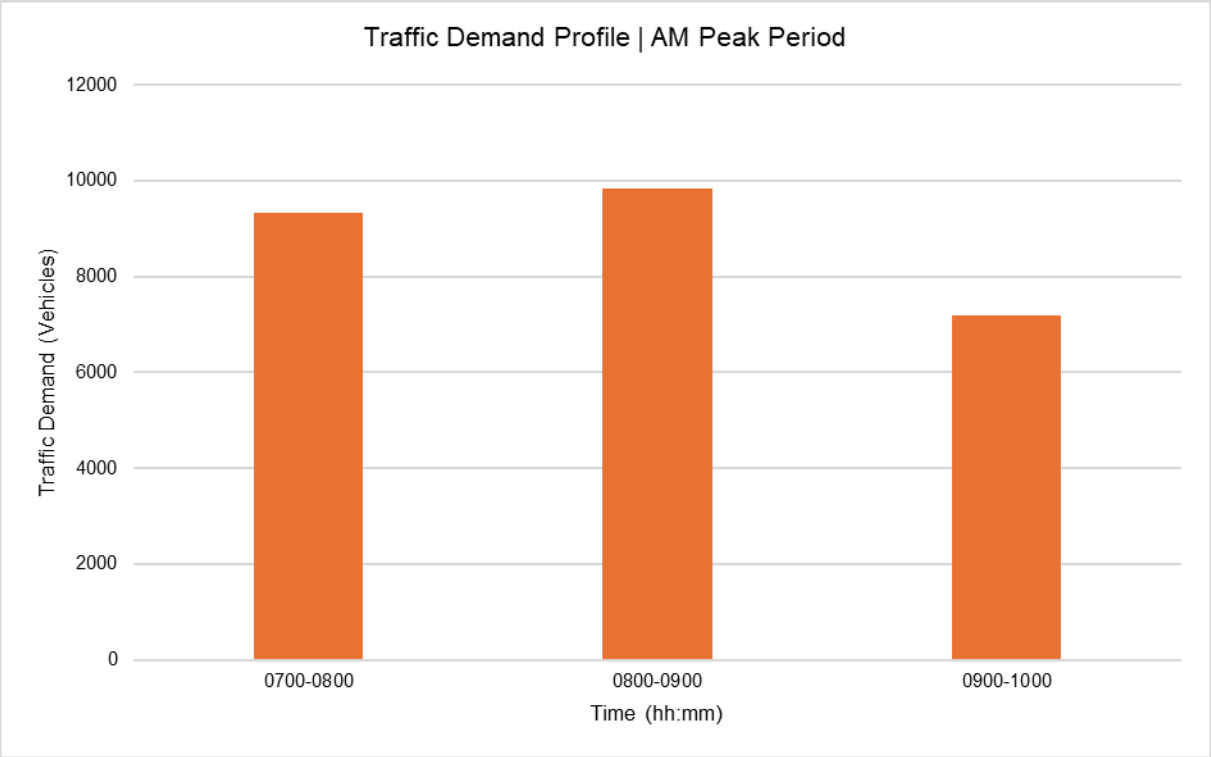
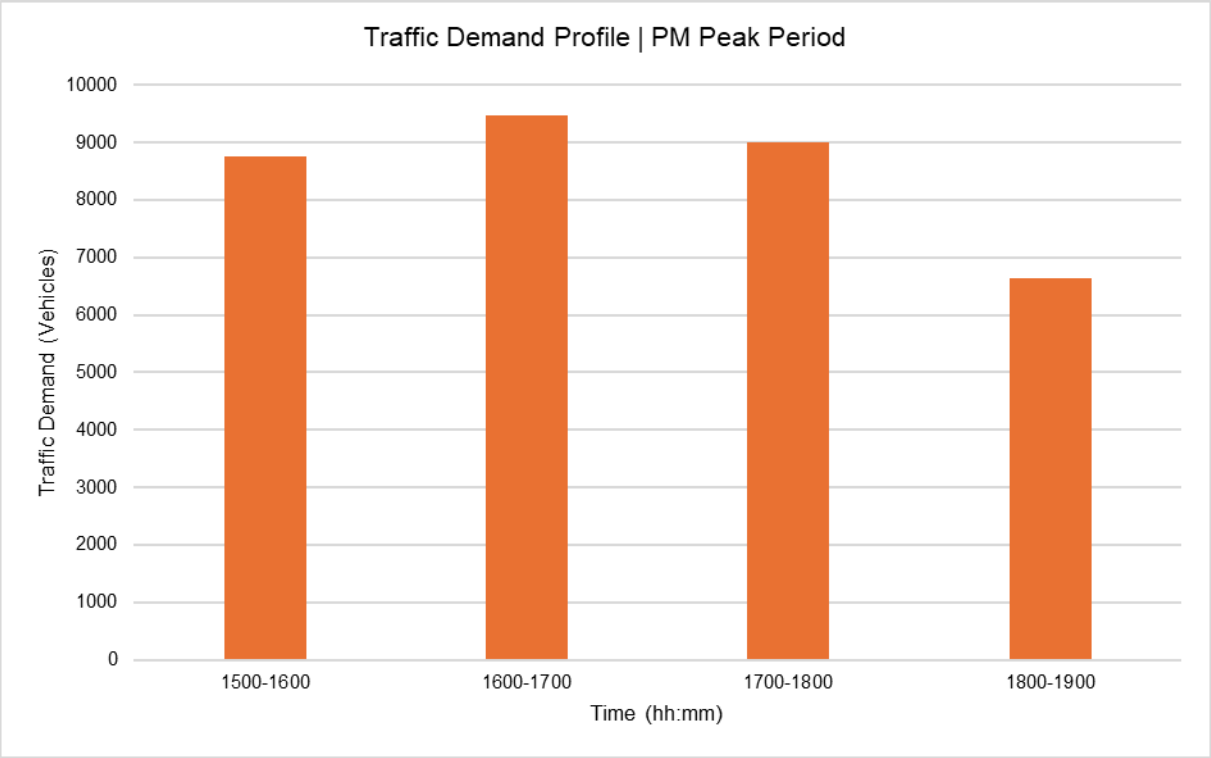


Figure 2: Base Model Traffic Demand - PM Peak Period



As shown the AM peak hour is 0800 to 0900 and the PM peak hour is 1600 to 1700. For the purposes of a robust sensitivity test it has been assumed that a warehouse staff changeover occurs during these peak hours.

With regards to trip generation there are 221 staff parking spaces, 10% of these spaces are for visitors or staff that remain on site throughout the peak periods. As such this means the remaining 90% of parking spaces are used for a staff changeover, which equates to around 200 spaces. The arrivals and departures of warehouse staff changeover occur in the peak hour meaning 100 car vehicle arrivals and departures during the AM peak (0800 to 0900) and PM peak (1600 to 1700). These trips have been included in the sensitivity test development demand matrices.

2.6 Vehicle Trip Generation and Distribution

The vehicle trip generation and distribution is outlined within the Transport assessment and broken down per trip purpose. The total trip generation per vehicle is summarised in Table 1

Table 1: Proposed Development Vehicle Trip Generation

Time Period	Car		LGV		HGV	
	Arr.	Dep.	Arr.	Dep.	Arr.	Dep.
AM Peak Period						
07:00 to 08:00	0	0	216	216	11	11
08:00 to 09:00	100	100	216	216	11	11
09:00 to 10:00	0	0	216	216	11	11
PM Peak Period						
15:00 to 16:00	0	0	216	216	11	11
16:00 to 17:00	100	100	216	216	11	11
17:00 to 18:00	0	0	216	216	11	11
18:00 to 19:00	0	0	216	216	11	11

2.7 Site Access

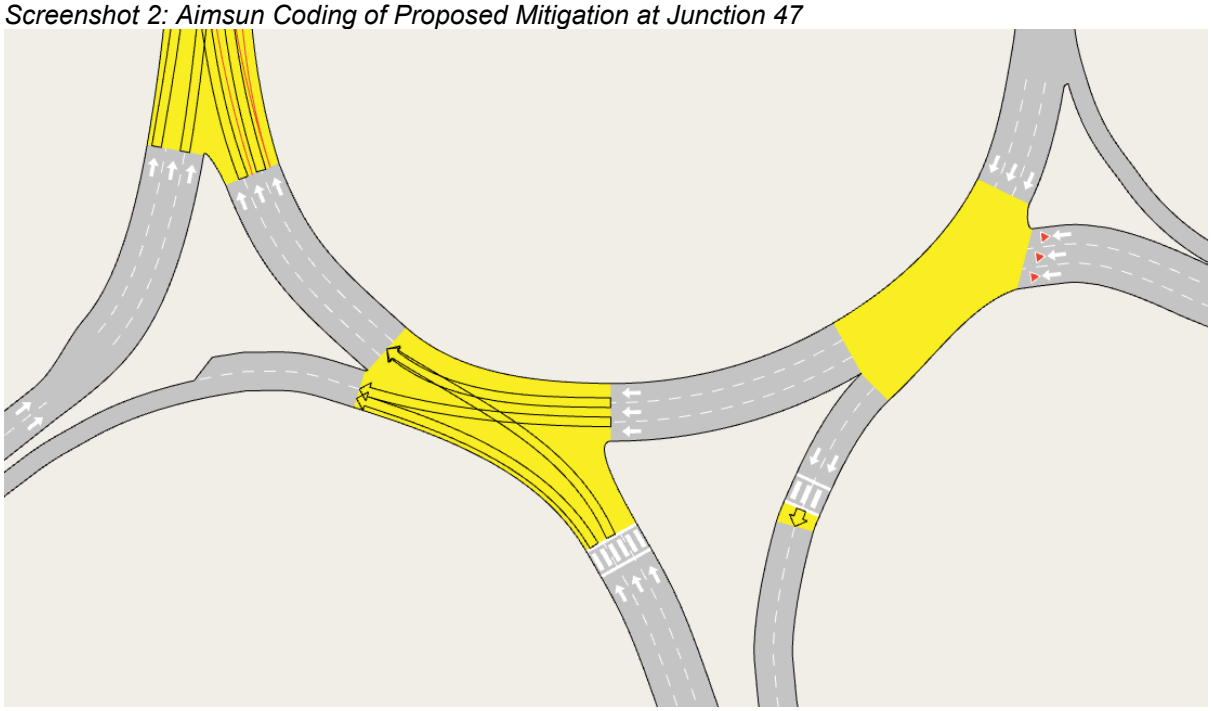
The site access proposals remain as previously modelled and detailed within the Transport assessment.

2.8 Mitigation Scheme

The mitigation scheme remains as previously modelled and detailed within the Transport assessment.

The proposed mitigation is to provide an additional lane on the southern circulatory along with a two-lane flared exit to the A48 south. The proposed layout is detailed within the Transport Assessment, whilst the model coding is shown on Screenshot 2.

Screenshot 2: Aimsun Coding of Proposed Mitigation at Junction 47



3 Modelling Results

3.1 Introduction

The following section presents the results of the Aimsun modelling.

In line with the core scenarios the proposed sensitivity test has been undertaken using a 2027 opening year and 2037 future year. For the purposes of the sensitivity test the following scenarios have been modelled:

- 2027/2037 Do Minimum: Base traffic + consented committed developments.
- 2027/2037 With Development Mitigation: Base traffic + consented committed developments + proposed development (including warehouse staff) + mitigation.

3.2 Network Wide Model Statistics

Network statistics provide a strategic overview of the performance of the whole network. These statistics have been extracted to understand the wider network impacts across each of the modelled scenarios. The following statistics are reported:

- **Total travel time per vehicle (unit: s):** mean time it takes for vehicles to travel through the network in the modelled time period. This includes the total travel time in virtual queues.
- **Delay time (unit: s/km):** mean delay incurred by vehicles travelling through the network in the modelled time period and is calculated as the difference between actual travel time and free flow travel.
- **Speed (unit: km/h):** mean speed of vehicles in the network.
- **Stop time (unit: s/km):** mean amount of time that vehicles are stationary.
- **Density (unit: veh/km):** the mean number of vehicles per km of road space and is an indicator of queuing and congestion.
- **Mean Queue (unit: veh):** the mean number of vehicles in queuing in the model, averaged over the modelled period.
- **Flow (unit: veh/h):** mean number of vehicles that pass through the network in the modelled time period.
- **Vehicles Out (unit: veh):** number of vehicles that have left the network during the simulation period.
- **Vehicles In (unit: veh):** number of vehicles inside the network when the simulation period finishes.
- **Vehicles Waiting to Enter (unit: Veh):** number of vehicles that are waiting to enter the network.

The network wide model statistics for each future assessment year scenario are summarised in Table 2 and Table 3.

Table 2: Network Statistics | AM Peak Period (07:00 – 10:00)

Statistic	Units	2025 Base	2027 Do Minimum	2027 With Dev Mit Sens Test	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mit Sens Test	Absolute Change (% Change)
Total Travel Time	sec/km	77	81	81	+0.1 (+0.1%)	96	86	-10.1 (-10.5%)
Delay	sec/km	27	31	31	-0.3 (-0.9%)	46	36	-10.3 (-22.4%)
Density	veh/km	7	8	8	+0.1 (+1.7%)	10	8	-1.3 (-13.6%)
Mean Queue	veh	88	110	101	-9.6 (-8.7%)	209	125	-83.9 (-40.1%)
Speed	km/h	60	58	58	-0.2 (-0.4%)	53	57	+3.2 (+5.9%)
Stop Time	sec/km	17	21	21	-0.3 (-1.2%)	32	24	-7.9 (-24.5%)
Flow	veh/h	8,811	8,907	9,430	+522.3 (+5.9%)	9,077	9,663	+586.4 (+6.5%)
Vehicles Out	veh	26,433	26,722	28,289	+1566.8 (+5.9%)	27,230	28,990	+1759.3 (+6.5%)
Vehicles In	veh	360	372	392	+20.4 (+5.5%)	737	444	-293.4 (-39.8%)
Vehicles Waiting to Enter	veh	1	1	1	+0.3 (+50.0%)	234	309	+75.1 (+32.1%)

Notes: absolute difference (relative difference)

Table 3: Network Statistics | PM Peak Period (15:00 – 19:00)

Statistic	Units	2025 Base	2027 Do Minimum	2027 With Dev	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev	Absolute Change (% Change)
Total Travel Time	sec/km	76	80	79	-1.0 (-1.2%)	104	89	-15.6 (-14.9%)
Delay	sec/km	26	29	28	-1.3 (-4.3%)	53	37	-15.8 (-29.8%)
Density	veh/km	7	7	7	-0.1 (-2.0%)	10	8	-2.2 (-21.8%)
Mean Queue	veh	78	96	80	-15.6 (-16.3%)	201	123	-78.1 (-38.9%)
Speed	km/h	59	58	59	+1.0 (+1.7%)	50	56	+6.0 (+11.9%)
Stop Time	sec/km	16	18	19	+0.3 (+1.6%)	32	26	-6.0 (-18.3%)
Flow	veh/h	8,497	8,579	9,086	+506.9 (+5.9%)	8,849	9,375	+525.7 (+5.9%)
Vehicles Out	veh	33,986	34,316	36,343	+2027.4 (+5.9%)	35,398	37,500	+2102.6 (+5.9%)
Vehicles In	veh	304	310	333	+23.3 (+7.5%)	508	390	-118.5 (-23.3%)
Vehicles Waiting to Enter	veh	0	0	1	+0.2 (+50.0%)	1	11	+10.1 (+2020.0 %)

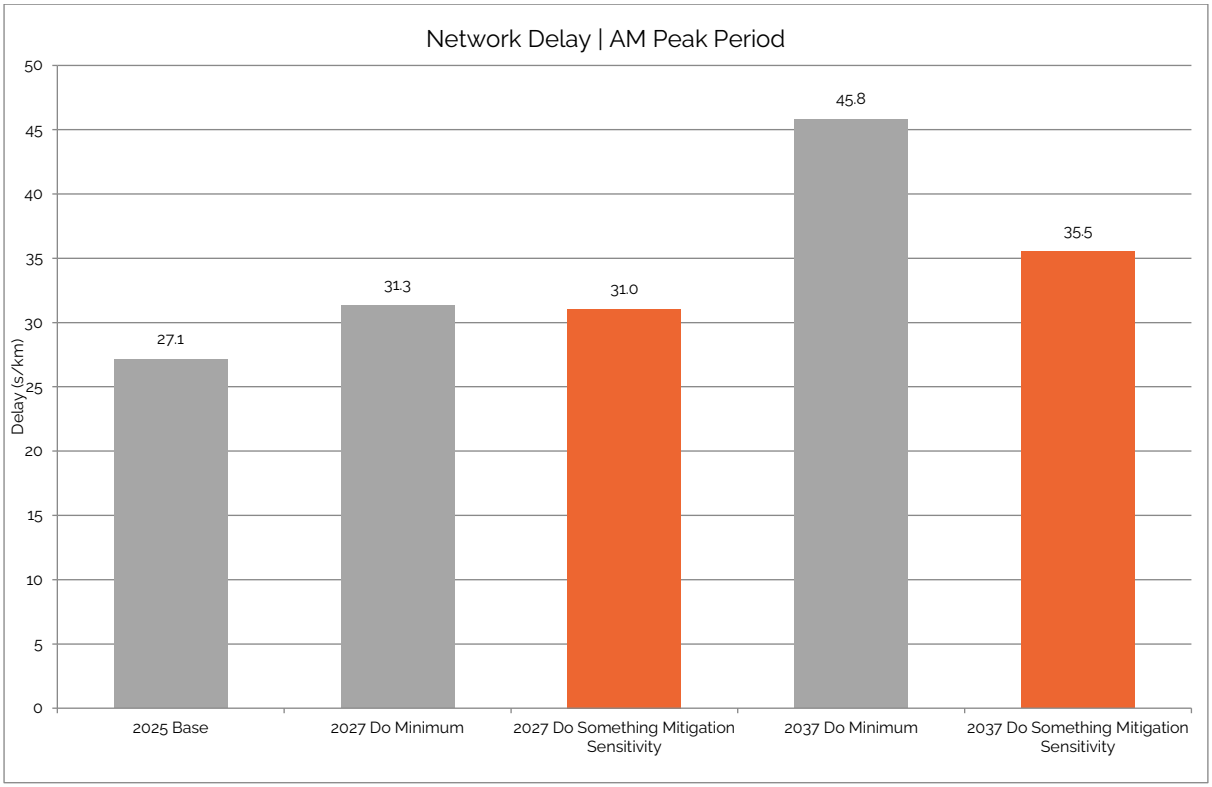
Notes: absolute difference (relative difference)

In order to better understand the network statistics some of these have been presented as graphs, as set out below:

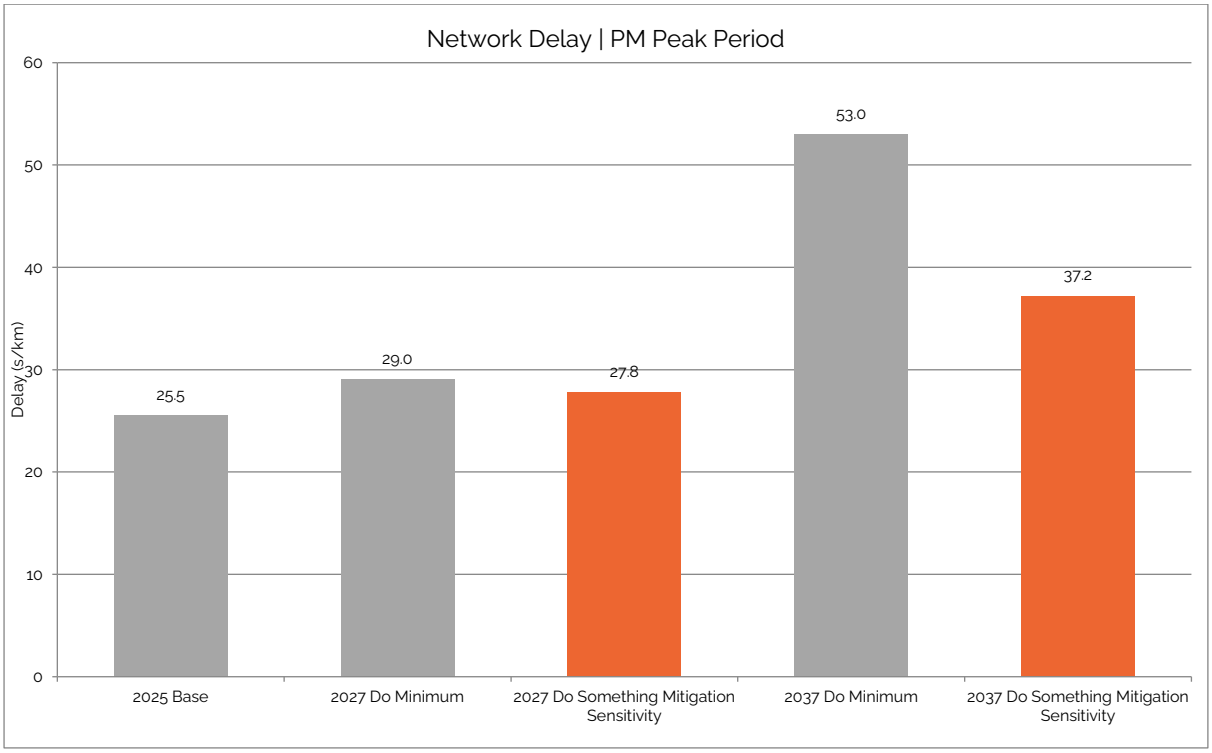
- **Delay (unit: sec / km):** Graph 1 and Graph 2 present the average delay incurred by vehicles travelling through the network in the modelled time period and is calculated as the difference between actual travel time and free flow travel. These graphs provide an overview of model performance and can be used as a general indicator of network conditions.

- **Network Throughput (unit: veh):** Graph 3 and Graph 4 present stacked bar charts showing vehicles that have passed through the model, the vehicles inside the model, and vehicles waiting to enter the model. These give an overview of the state of the network at the end of the simulation period. The sum of these statistics is equal to the overall demand, with the number of vehicles inside the network and waiting to enter the network giving an indication of whether the network is operating within capacity.

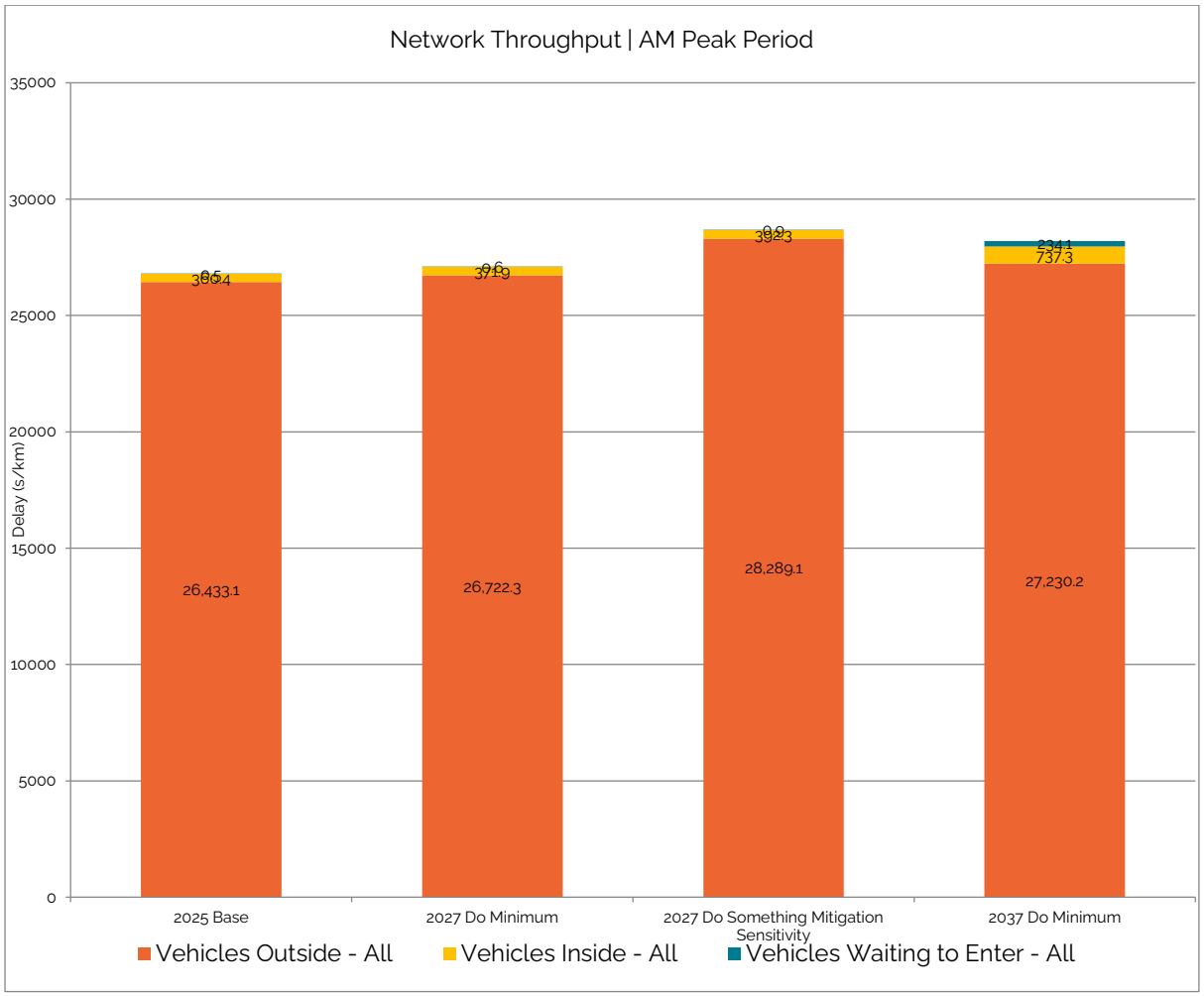
Graph 1: Network Delay - AM Peak Period



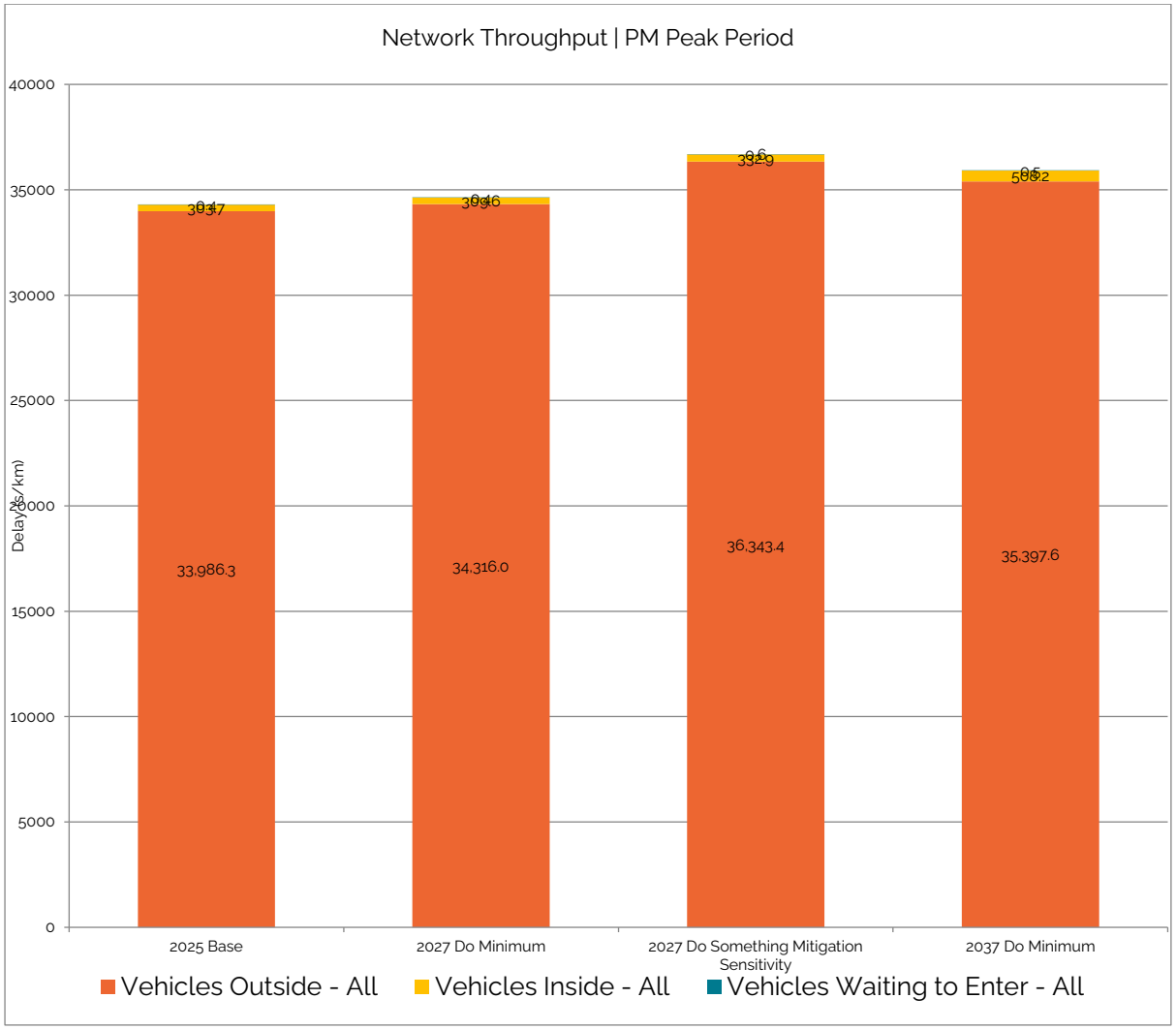
Graph 2: Network Delay - PM Peak Period



Graph 3: Network Throughput - AM Peak Period



Graph 4: Network Throughput - PM Peak Period



3.2.1 Analysis of Network Wide Model Statistics

In 2027, the modelling shows that the proposed development with mitigation is predicted to reduce network delay by -0.3s per km in the AM peak and -1.3s in the PM peak compared to the Do Minimum scenario. This equates to a reduction in network-wide mean queueing of -9.6 and -15.6 vehicles and changes in network-wide speed of -0.2km/h and +1.0km/h. In terms of network throughput (which is an indicator of network capacity), reasonably small variations in the number of vehicles either queueing inside the model (vehicles inside) and vehicles queueing outside of the model (vehicles waiting to enter) is predicted. The results show that the proposed mitigation more than offsets the impact of the proposed development.

In 2037, the modelling shows that the proposed development is predicted to reduce network delay by -10.3s per km in the AM peak and -15.8s in the PM peak. This equates to a decrease in network-wide mean queueing of -83.9 and -78.1 vehicles and an increase in network-wide speed of +3.2km/h and

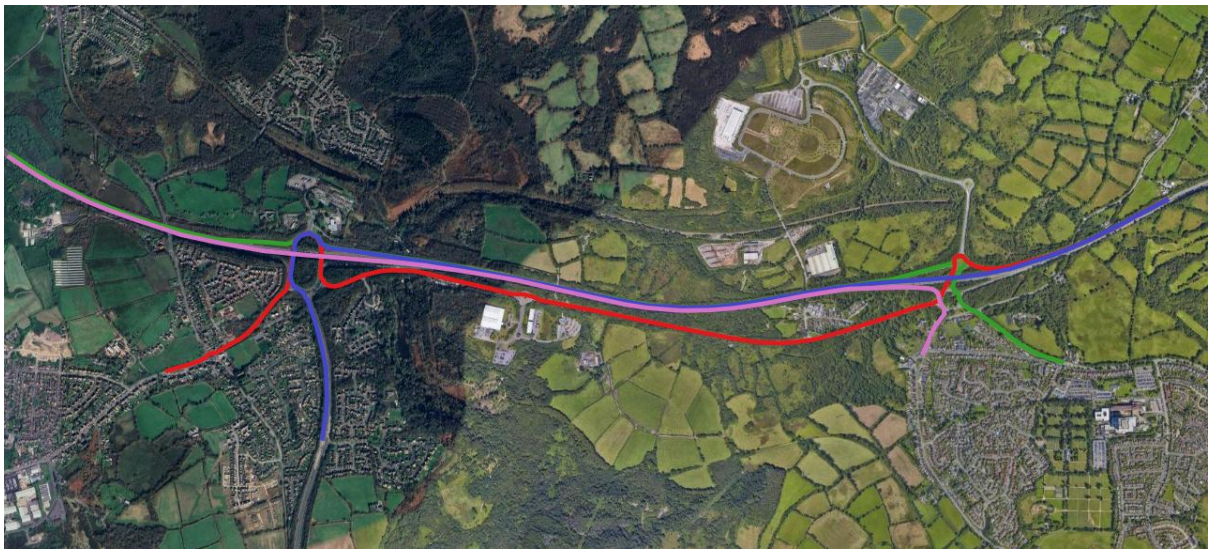
+6.0km/h. In terms of network throughput (which is an indicator of network capacity), there are noticeable increases in vehicles out and a reduction in vehicles in, which highlights that, where previously there were still vehicles inside the model at the end of the peak period due to congestion, these vehicles are now travelling through the model. The results show that the proposed mitigation more than offsets the impact of the proposed development, particularly in the 2037 scenario when there is more congestion and delay in the network due to committed developments.

3.3 Journey Time Analysis

Journey time statistics have been extracted from Aimsun for the pre-defined journey time validation routes for each future assessment year scenario in order to understand the impact of the proposed development. A total of eight journey time routes have been analysed that cover key routes and congested junctions within the model. The journey time routes defined are illustrated on Figure 3 and are listed below:

- Route 1A - M4 west to A48 east (via M4)
- Route 1B - A48 west to M4 east (via M4)
- Route 2A - A4240 Gorseinon Road to M4 east (via A48)
- Route 2B - M4 east to A4240 Gorseinon Road (via A48)
- Route 3A - A483 to M4 east (via M4)
- Route 3B - A4 east to A483 (via M4)
- Route 4A - B4489 Swansea Road to M4 west (via M4)
- Route 4B - M4 west to B4489 Swansea Road (via M4)

Figure 3: Journey Time Routes



In validating transport models, it is usual practice to consider that journey times that are modelled to within 15% of observed journey times (or within 1 minute if higher than 15%) are acceptable. This is because journey times can typically vary by 15% from day-to-day with shorter journey times

experiencing much larger relative variations. This threshold has therefore been adopted for the purpose of this analysis in order to determine whether the proposed development would give rise to a material impact on journey times.

Notwithstanding this, whilst a development may give rise to a material impact on journey times, this does not necessarily mean that it should automatically be considered to be severe. Rather it suggests that drivers would experience an increase in journey time that is beyond what they would expect to encounter on a day-to-day basis. However, it does provide a minimum threshold below which a journey time impact should not be considered to be severe. Determining the severity of an increase is subjective and should be considered on a case-by-case basis, however for the purpose of this assessment the severity of an impact is defined as:

- For journey times less than 600s (ten minutes) an impact of ≥ 180s (three minutes) is considered severe.
- For journey times more than 600s (ten minutes) an impact of ≥ 30% is considered severe.
- For journey times of exactly 600s (ten minutes) both of the criteria set out above would apply.

Table 4 and Table 5 presents the peak period journey time impact (both absolute and relative) for each future assessment year scenario, compared to the corresponding scenario with the proposed development in place. Note these statistics also include wait time in virtual queues to capture any suppressed demand outside of the model.

Table 4: Journey Time Analysis | AM Peak | 07:00 – 10:00

Route	2025 Base	2027 Do Minimum	2027 With Dev Mitigation Sensitivity	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation Sensitivity	Absolute Change (% Change)
Route 01-A	04:19	04:19	04:24	00:05 (2.1%)	04:18	04:21	00:03 (1.2%)
Route 01-B	04:09	04:11	04:18	00:07 (2.9%)	05:33	04:15	-01:14 (-23.3%)
Route 02-A	07:53	10:24	11:48	01:24 (13.4%)	23:16	24:51	01:35 (6.9%)
Route 02-B	06:27	06:30	07:12	00:43 (11.0%)	06:22	06:56	00:34 (9.0%)
Route 03-A	05:12	05:34	05:16	-00:18 (-5.5%)	07:14	06:31	-00:43 (-10.0%)
Route 03-B	04:55	05:32	03:57	-01:35 (-28.5%)	09:41	03:59	-05:42 (-58.8%)
Route 04-A	03:28	03:28	03:43	00:14 (6.8%)	04:52	03:49	-01:03 (-21.5%)
Route 04-B	03:58	03:58	04:03	00:05 (2.2%)	03:58	04:01	00:03 (1.2%)

Table 5: Journey Time Analysis | PM Peak | 15:00 – 19:00

Route	2025 Base	2027 Do Minimum	2027 With Dev Mitigation Sensitivity	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation Sensitivity	Absolute Change (% Change)
Route 01-A	04:06	04:07	04:09	00:03 (1.0%)	04:07	04:10	00:02 (1.0%)
Route 01-B	04:26	04:37	04:58	00:21 (7.4%)	06:25	04:56	-01:30 (-23.3%)
Route 02-A	07:30	08:09	09:06	00:57 (11.7%)	11:52	15:23	03:31 (29.7%)
Route 02-B	07:16	08:03	06:00	-02:02 (-25.3%)	15:26	09:37	-05:49 (-37.7%)
Route 03-A	04:39	04:46	04:22	-00:24 (-8.3%)	05:51	04:45	-01:06 (-18.8%)
Route 03-B	04:45	05:30	03:58	-01:32 (-27.8%)	09:31	04:04	-05:27 (-57.3%)
Route 04-A	03:58	04:14	06:15	02:01 (47.5%)	06:06	07:19	01:14 (20.2%)
Route 04-B	03:47	03:47	03:50	00:03 (1.2%)	03:48	03:50	00:02 (1.1%)

3.3.1 Analysis of Journey Times

Across all of the time periods and scenarios assessed, the modelling suggests that in the 2027 scenario the proposed development with mitigation would overall be net neutral to the network with changes in journey time of of +6 and -4 seconds when averaged across all routes. The largest residual journey time increase occurs for Route 04-A in the PM peak period, where journey times are forecast to increase by 2 minutes and 1 second. However, this increase is offset by reductions on other routes. Similarly, in the 2037 scenario it is shown that the development with mitigation also provides an overall net benefit to the network with a reduction in total journey time when averaged across all routes of -49s and -68s in each peak period. It is noted that no journey time increases meet the thresholds, as set out in Section 3.3, which consider a severe impact.

3.4 Junction Statistics

As agreed with Swansea Council, key junctions have been identified where detailed junction statistics have been extracted for all future assessment year scenarios with and without the proposed development in place. Table 6 explains the statistics that are presented.

- Junction 47 Penllergaer Interchange
- M4 Junction 46
- Penllergaer Business Park / A48
- A48 Clasemont Road / Pant Lasau Road.

Table 6: Individual Arm Statistics Description

Statistic	Units	Analytical Use
Flow	veh/h	This shows the actual traffic flow on each arm of the junction.
Delay	S	This shows the delay experienced by each vehicle on each arm of the junction and is calculated as the difference between the actual travel time and free-flow travel time.
Mean Queue	Veh	This shows the time-averaged mean queue.
Speed	km/h	This shows the average speed on each arm of the junction.

It should be noted that the approach arms analysed are defined manually and cover multiple sections of the model on approach to the junctions assessed. These sections are usually selected based on the animated simulation of the model and cover the links where queueing and congestion would occur at the junction in consideration. In congested models, defining the assessment sections is more subjective as queues can extend well beyond the extent of the junction assessed. For this reason, it is important to consider the assessment of journey times alongside any isolated junction statistics. Individual arm statistics showing the impact (both absolute and relative) compared to the corresponding Do Minimum scenario are presented in Table 7 to Table 14.

3.4.1 M4 Junction 47 Penllergaer Interchange

Table 7: Junction Statistics | M4 Junction 47 Penllergaer Interchange | AM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: Services						
Flow	205.7	206.1	0.4 (0.2%)	205.7	206.1	0.4 (0.2%)
Delay	6.0	6.6	0.6 (9.3%)	6.4	13.7	7.4 (115.6%)
Mean Queue	0.8	0.8	0.0 (4.0%)	0.8	0.8	0.0 (3.7%)
Speed	28.4	27.7	-0.7 (-2.6%)	27.5	27.1	-0.5 (-1.7%)
Arm B: M4 East						
Flow	902.6	904.3	1.7 (0.2%)	890.0	973.6	83.6 (9.4%)
Delay	111.9	24.9	-87.1 (-77.8%)	254.2	27.0	-227.1 (-89.4%)
Mean Queue	11.5	2.2	-9.3 (-81.0%)	30.9	2.5	-28.4 (-91.9%)
Speed	10.8	11.9	1.1 (10.6%)	9.8	11.5	1.8 (18.1%)
Arm C: A48 East						
Flow	265.2	399.7	134.6 (50.7%)	265.2	396.3	131.1 (49.4%)
Delay	25.0	14.5	-10.5 (-42.1%)	27.5	16.4	-11.0 (-40.2%)
Mean Queue	0.8	0.6	-0.2 (-28.6%)	0.9	0.8	-0.1 (-15.3%)
Speed	14.9	19.0	4.1 (27.4%)	13.7	17.5	3.8 (27.9%)
Arm D: A483						
Flow	1,437.0	1,483.6	46.6 (3.2%)	1,529.8	1,566.3	36.6 (2.4%)
Delay	90.2	68.5	-21.7 (-24.0%)	94.4	70.8	-23.6 (-25.0%)
Mean Queue	6.0	4.3	-1.7 (-27.6%)	18.2	13.1	-5.1 (-27.8%)
Speed	16.5	17.1	0.6 (3.6%)	16.4	17.0	0.5 (3.2%)
Arm E: A48 Southwest						
Flow	978.9	1,019.5	40.6 (4.1%)	1,054.7	1,068.3	13.6 (1.3%)
Delay	48.0	29.1	-18.8 (-39.3%)	46.5	24.7	-21.8 (-46.9%)
Mean Queue	4.7	2.8	-1.9 (-41.1%)	4.8	2.4	-2.5 (-50.9%)

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Speed	12.9	15.8	2.9 (22.2%)	12.9	16.1	3.2 (25.0%)
Arm F: M4 West						
Flow	545.2	593.2	48.0 (8.8%)	567.6	614.5	46.9 (8.3%)
Delay	37.8	56.5	18.6 (49.2%)	41.2	65.6	24.5 (59.4%)
Mean Queue	2.5	3.8	1.4 (54.8%)	2.7	4.5	1.8 (68.7%)
Speed	9.6	8.0	-1.6 (-17.0%)	9.2	7.6	-1.6 (-17.0%)

Table 8: Junction Statistics | M4 Junction 47 Penllergaer Interchange | PM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: Services						
Flow	166.4	169.0	2.6 (1.6%)	166.4	167.6	1.3 (0.8%)
Delay	4.1	5.0	0.9 (21.3%)	4.7	5.3	0.7 (14.1%)
Mean Queue	0.7	0.7	0.0 (6.3%)	0.7	0.7	0.0 (4.6%)
Speed	32.0	29.8	-2.2 (-6.8%)	31.0	29.1	-1.9 (-6.1%)
Arm B: M4 east						
Flow	1,329.5	1,332.9	3.3 (0.3%)	1,400.4	1,412.8	12.4 (0.9%)
Delay	91.4	19.1	-72.3 (-79.1%)	172.7	20.7	-151.9 (-88.0%)
Mean Queue	13.0	2.3	-10.7 (-82.5%)	28.1	2.5	-25.6 (-91.0%)
Speed	18.4	18.1	-0.3 (-1.6%)	17.4	18.0	0.6 (3.4%)
Arm C: A48 east						
Flow	320.9	453.2	132.3 (41.2%)	295.7	449.9	154.2 (52.1%)
Delay	148.0	21.7	-126.3 (-85.4%)	496.8	165.2	-331.6 (-66.8%)
Mean Queue	9.3	1.2	-8.1 (-86.7%)	36.6	15.2	-21.4 (-58.4%)
Speed	9.7	17.9	8.2 (84.0%)	5.9	13.0	7.2 (121.5%)
Arm D: A483						
Flow	1,298.3	1,333.1	34.8 (2.7%)	1,377.0	1,418.2	41.2 (3.0%)

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Delay	49.6	31.5	-18.1 (-36.4%)	55.2	51.9	-3.3 (-6.0%)
Mean Queue	2.7	1.8	-1.0 (-35.2%)	7.9	3.0	-4.8 (-61.5%)
Speed	14.5	16.2	1.8 (12.3%)	14.3	15.7	1.4 (9.7%)
Arm E: A48 Southwest						
Flow	811.1	852.2	41.1 (5.1%)	909.3	940.5	31.2 (3.4%)
Delay	25.1	22.7	-2.4 (-9.7%)	27.1	23.9	-3.3 (-12.0%)
Mean Queue	2.2	2.1	-0.1 (-5.2%)	2.6	2.3	-0.2 (-9.4%)
Speed	13.2	14.5	1.3 (10.2%)	13.0	14.4	1.3 (10.3%)
Arm F: M4 West						
Flow	462.6	508.7	46.1 (10.0%)	487.9	535.7	47.8 (9.8%)
Delay	23.6	28.7	5.1 (21.5%)	24.1	29.6	5.5 (23.1%)
Mean Queue	1.3	1.6	0.3 (25.7%)	1.3	1.8	0.4 (30.9%)
Speed	14.0	10.8	-3.2 (-22.7%)	13.8	10.6	-3.2 (-23.1%)

3.4.2 M4 Junction 46

Table 9: Junction Statistics | M4 Junction 46 | AM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: B4489 North						
Flow	142.9	143.2	0.3 (0.2%)	142.9	142.7	-0.2 (-0.2%)
Delay	2.4	2.7	0.3 (14.1%)	2.5	5.5	3.0 (121.7%)
Mean Queue	0.1	0.1	0.0 (39.6%)	0.1	0.1	0.0 (14.6%)
Speed	41.3	40.3	-1.0 (-2.4%)	41.1	40.2	-0.9 (-2.1%)
Arm B: M4 East						
Flow	529.6	580.0	50.4 (9.5%)	529.6	581.5	51.9 (9.8%)
Delay	46.6	81.6	35.0 (75.2%)	35.0	60.7	25.6 (73.1%)
Mean Queue	3.6	6.7	3.1 (86.6%)	2.7	5.0	2.2 (81.2%)

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Speed	31.8	26.9	-5.0 (-15.6%)	33.5	28.5	-5.0 (-14.9%)
Arm C: A48 Southeast						
Flow	581.7	618.2	36.5 (6.3%)	581.5	615.1	33.6 (5.8%)
Delay	2.9	4.1	1.2 (43.3%)	2.9	3.9	1.0 (33.9%)
Mean Queue	0.3	0.5	0.1 (37.6%)	0.4	0.5	0.1 (16.5%)
Speed	34.1	29.4	-4.7 (-13.8%)	34.3	30.2	-4.1 (-11.9%)
Arm D: B4489 Swansea Road						
Flow	454.6	491.9	37.3 (8.2%)	454.6	495.2	40.6 (8.9%)
Delay	6.9	13.9	7.0 (101.1%)	7.0	17.0	10.0 (141.2%)
Mean Queue	0.8	1.8	1.0 (132.8%)	0.8	2.2	1.4 (184.4%)
Speed	23.0	19.5	-3.6 (-15.4%)	22.8	18.9	-3.9 (-17.1%)
Arm E: A48 West						
Flow	262.9	387.8	124.9 (47.5%)	256.6	378.1	121.5 (47.4%)
Delay	20.2	26.6	6.3 (31.2%)	18.9	22.5	3.6 (19.1%)
Mean Queue	1.1	1.6	0.5 (52.1%)	0.9	1.4	0.4 (47.6%)
Speed	37.5	36.5	-1.0 (-2.7%)	38.6	37.6	-0.9 (-2.4%)
Arm F: M4 West						
Flow	420.3	420.1	-0.1 (0.0%)	419.5	416.5	-3.0 (-0.7%)
Delay	7.1	9.1	2.0 (27.8%)	7.0	8.7	1.8 (25.2%)
Mean Queue	0.8	0.9	0.1 (14.8%)	0.8	0.9	0.1 (11.2%)
Speed	54.7	52.3	-2.5 (-4.5%)	54.9	52.8	-2.0 (-3.7%)

Table 10: Junction Statistics | M4 Junction 46 | PM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: B4489 North						
Flow	139.7	137.7	-2.0 (-1.4%)	139.7	139.3	-0.4 (-0.3%)
Delay	3.4	3.8	0.4 (12.1%)	3.5	3.6	0.2 (5.3%)
Mean Queue	0.2	0.2	0.0 (11.2%)	0.2	0.1	-0.1 (-38.4%)
Speed	38.6	37.6	-1.0 (-2.5%)	38.3	37.8	-0.5 (-1.3%)
Arm B: M4 East						
Flow	375.8	430.8	55.0 (14.6%)	376.1	425.2	49.1 (13.1%)
Delay	6.8	8.6	1.8 (26.6%)	7.0	8.5	1.6 (22.4%)
Mean Queue	0.7	0.8	0.1 (13.2%)	0.7	0.8	0.1 (8.4%)
Speed	52.9	50.0	-2.9 (-5.5%)	52.6	50.2	-2.4 (-4.5%)
Arm C: A48 Southeast						
Flow	923.7	957.6	33.9 (3.7%)	923.2	956.3	33.1 (3.6%)
Delay	4.0	6.0	2.0 (50.3%)	4.0	6.0	2.0 (49.4%)
Mean Queue	0.7	1.0	0.3 (39.5%)	0.7	1.0	0.2 (31.4%)
Speed	30.4	25.1	-5.3 (-17.4%)	30.5	25.4	-5.1 (-16.7%)
Arm D: B4489 Swansea Road						
Flow	468.7	498.0	29.3 (6.3%)	469.0	505.3	36.4 (7.8%)
Delay	22.4	88.0	65.6 (292.5%)	23.6	119.7	96.0 (406.1%)
Mean Queue	2.9	12.3	9.4 (329.6%)	3.0	16.8	13.8 (456.2%)
Speed	17.3	11.1	-6.2 (-35.7%)	17.1	11.0	-6.1 (-35.5%)
Arm E: A48 West						
Flow	167.4	286.8	119.4 (71.3%)	167.3	289.2	121.9 (72.8%)
Delay	15.9	17.1	1.3 (7.9%)	15.6	17.6	2.0 (13.0%)
Mean Queue	0.8	1.0	0.2 (30.7%)	0.8	1.0	0.3 (36.1%)
Speed	39.9	39.0	-0.9 (-2.3%)	40.3	38.8	-1.5 (-3.7%)
Arm F: M4 West						
Flow	337.5	336.0	-1.5 (-0.4%)	337.5	336.6	-0.9 (-0.3%)

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Delay	7.5	9.2	1.7 (22.8%)	7.8	8.9	1.2 (15.2%)
Mean Queue	0.8	0.8	0.1 (9.4%)	0.8	0.8	0.0 (5.0%)
Speed	54.0	51.9	-2.1 (-3.8%)	53.6	52.2	-1.4 (-2.6%)

3.4.3 Penllergaer Business Park Roundabout

Table 11: Junction Statistics | Penllergaer Business Park Roundabout | AM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: A48 East						
Flow	270.4	394.2	123.7 (45.8%)	270.5	391.1	120.7 (44.6%)
Delay	1.8	3.5	1.7 (93.9%)	1.8	3.3	1.5 (82.9%)
Mean Queue	0.0	0.2	0.2 (N/A)	0.0	0.0	0.0 (N/A)
Speed	48.5	39.9	-8.6 (-17.7%)	48.5	40.5	-8.0 (-16.5%)
Arm B: Penllergaer Business Park						
Flow	3.1	137.6	134.5 (4292.6%)	3.1	137.2	134.0 (4277.7%)
Delay	1.1	1.2	0.1 (7.8%)	1.0	1.2	0.2 (19.7%)
Mean Queue	0.0	0.0	0.0 (N/A)	0.0	0.0	0.0 (N/A)
Speed	39.5	38.5	-1.1 (-2.7%)	40.0	38.4	-1.6 (-3.9%)
Arm C: A48 West						
Flow	266.2	406.0	139.8 (52.5%)	258.9	390.7	131.8 (50.9%)
Delay	2.9	3.9	1.0 (33.5%)	2.9	3.8	0.9 (30.5%)
Mean Queue	0.0	0.1	0.1 (N/A)	0.0	0.1	0.1 (N/A)
Speed	49.4	45.1	-4.3 (-8.6%)	49.3	45.2	-4.0 (-8.2%)

Table 12: Junction Statistics | Penllergaer Business Park Roundabout | PM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: A48 East						
Flow	302.1	422.4	120.3 (39.8%)	302.1	424.3	122.2 (40.4%)
Delay	1.8	3.0	1.3 (72.1%)	4.3	9.7	5.4 (127.1%)
Mean Queue	0.0	0.1	0.1 (N/A)	0.2	0.7	0.5 (335.9%)
Speed	49.4	42.4	-7.0 (-14.1%)	48.7	41.3	-7.4 (-15.2%)
Arm B: Penllergaer Business Park						
Flow	15.5	148.8	133.3 (861.6%)	15.5	142.8	127.3 (822.8%)
Delay	1.2	1.3	0.0 (2.6%)	1.8	7.1	5.3 (299.6%)
Mean Queue	0.0	0.0	0.0 (N/A)	0.0	0.2	0.2 (22133.3%)
Speed	38.3	37.7	-0.6 (-1.7%)	38.1	36.6	-1.5 (-3.9%)
Arm C: A48 West						
Flow	135.2	264.1	129.0 (95.4%)	135.1	262.7	127.6 (94.4%)
Delay	2.2	3.3	1.1 (48.7%)	2.2	3.3	1.0 (47.4%)
Mean Queue	0.0	0.1	0.1 (N/A)	0.0	0.1	0.1 (N/A)
Speed	49.2	44.8	-4.4 (-8.9%)	49.2	45.0	-4.2 (-8.6%)

3.4.4 A48 Clasemont Road / Pant Lasau Road

Table 13: Junction Statistics | A48 Clasemont Road / Pant Lasau Road | AM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: Pant Lasau Road						
Flow	349.7	349.6	-0.1 (0.0%)	349.5	349.3	-0.3 (-0.1%)
Delay	16.3	19.2	2.9 (17.7%)	16.5	35.3	18.8 (114.4%)
Mean Queue	1.3	1.6	0.3 (21.1%)	1.4	1.5	0.2 (11.3%)
Speed	31.1	28.8	-2.3 (-7.5%)	31.1	29.8	-1.3 (-4.2%)
Arm B: Clasemont Road East						
Flow	392.8	429.3	36.5 (9.3%)	392.8	427.7	34.8 (8.9%)
Delay	7.6	10.2	2.6 (34.5%)	6.9	8.8	1.9 (28.2%)
Mean Queue	0.7	1.1	0.4 (51.9%)	0.6	0.9	0.3 (43.6%)
Speed	26.1	25.1	-1.0 (-4.0%)	26.4	25.5	-0.9 (-3.3%)
Arm C: Clasemont Road West						
Flow	1,039.9	1,075.0	35.1 (3.4%)	1,037.0	1,071.3	34.3 (3.3%)
Delay	4.7	5.0	0.3 (5.7%)	4.5	4.7	0.2 (4.2%)
Mean Queue	1.0	1.3	0.2 (20.9%)	1.1	1.2	0.0 (3.5%)
Speed	25.7	25.5	-0.2 (-0.8%)	25.8	25.7	-0.1 (-0.3%)

Table 14: Junction Statistics | A48 Clasemont Road / Pant Lasau Road | PM Peak Period

Statistic	2027 Do Minimum	2027 With Dev Mitigation	Absolute Change (% Change)	2037 Do Minimum	2037 With Dev Mitigation	Absolute Change (% Change)
Arm A: Pant Lasau Road						
Flow	577.5	578.4	0.9 (0.2%)	577.2	573.8	-3.4 (-0.6%)
Delay	8.4	12.9	4.5 (54.2%)	8.4	12.5	4.1 (48.3%)
Mean Queue	0.9	1.5	0.6 (73.5%)	0.9	1.4	0.6 (63.5%)
Speed	38.6	33.7	-5.0 (-12.8%)	38.6	34.2	-4.5 (-11.6%)
Arm B: Clasemont Road East						
Flow	458.8	488.1	29.3 (6.4%)	458.6	492.4	33.9 (7.4%)
Delay	12.7	26.7	14.1 (111.1%)	12.2	25.0	12.9 (105.5%)
Mean Queue	1.4	3.5	2.1 (144.7%)	1.4	3.3	1.9 (138.8%)
Speed	23.5	20.0	-3.5 (-15.0%)	23.5	20.1	-3.4 (-14.6%)
Arm C: Clasemont Road West						
Flow	627.9	663.6	35.7 (5.7%)	628.4	661.7	33.4 (5.3%)
Delay	3.6	3.6	0.0 (-1.0%)	3.5	3.7	0.2 (5.7%)
Mean Queue	1.0	1.1	0.1 (8.9%)	1.0	0.9	0.0 (-4.8%)
Speed	28.6	28.7	0.1 (0.4%)	28.6	28.5	-0.2 (-0.5%)

3.4.5 Analysis of Junction Statistics

3.4.5.1 M4 Junction 47 Penllergaer Interchange

Whilst an increase in flow is predicted on some arms of the junction, in particular the A48 East, this is not predicted to give rise a noticeable increase in mean queueing or delay. In all cases, any increase in delay is less 25s and any increase in queueing is less than two vehicles. In general, the results show significant decreases in delay of up to 431s and decreases in mean queue of up to 28 vehicles with the proposed development and mitigation in place compared to the Do Minimum scenario. These benefits are due to the proposed mitigation scheme adding capacity at the junction.

3.4.5.2 M4 Junction 46

Whilst an increase in flow is predicted on some arms of the junction, in particular the A48 West, this is not predicted to give rise to a noticeable increase in mean queuing or delay. In most cases, any increase in delay is less than 30s and any increase in queueing is less than three vehicles. Notwithstanding this, the B4489 results show a larger increase in delay of 96s in the 2037 PM peak, however this equates to an increase in mean queue of only 14 vehicles.

3.4.5.3 Penllergaer Business Park

Whilst an increase in flow is predicted on all arms of the junction as a result of the proposed development, this is not predicted to give rise to a noticeable increase in mean queuing or delay. In all cases, any increase in delay is less than 6s and any increase in queueing is less than one vehicle.

3.4.5.4 A48 Clasemont Road / Pant Lassau Road

Whilst an increase in flow is predicted on the A48 Clasemont Road, this is not predicted to give rise to a noticeable increase in mean queuing or delay. In all cases, any increase in delay is less than 20s and any increase in queueing is less than two vehicles.

4 Summary and Conclusion

4.1 Introduction

Stantec has been appointed by Stoford Properties Ltd to undertake Aimsun modelling in support of a planning application for proposals to provide a distribution centre on Land at Penllergaer Business Park, Swansea.

The proposed development will accommodate a floor area of 12,465sqm, located within Penllergaer Business Park, with vehicular access provided from the A48 as outlined within the Transport Assessment. This report has detailed the sensitivity test as requested by Swansea City & County Council.

4.2 Future Year Modelling

The following scenarios have been modelled:

- 2027/2037 Do Minimum: Base traffic + Consented committed developments.
- 2027/2037 With Development Mitigation: Base traffic + Consented committed developments + Proposed development (including warehouse staff) + Mitigation

4.3 Conclusion

The modelling demonstrates that even in the unlikely scenario of a warehouse shift changeover occurring during the peak highway hour the development can be mitigated with the proposed highway mitigation scheme. The proposed mitigation is predicted to lead to significant decreases in queueing, delay and journey times which leads to an overall general betterment of the network compared to the Do Minimum scenario.

The development would not therefore give rise to impacts that are considered to be severe and the proposed mitigation ensures the development provides a betterment to the existing highway network.

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