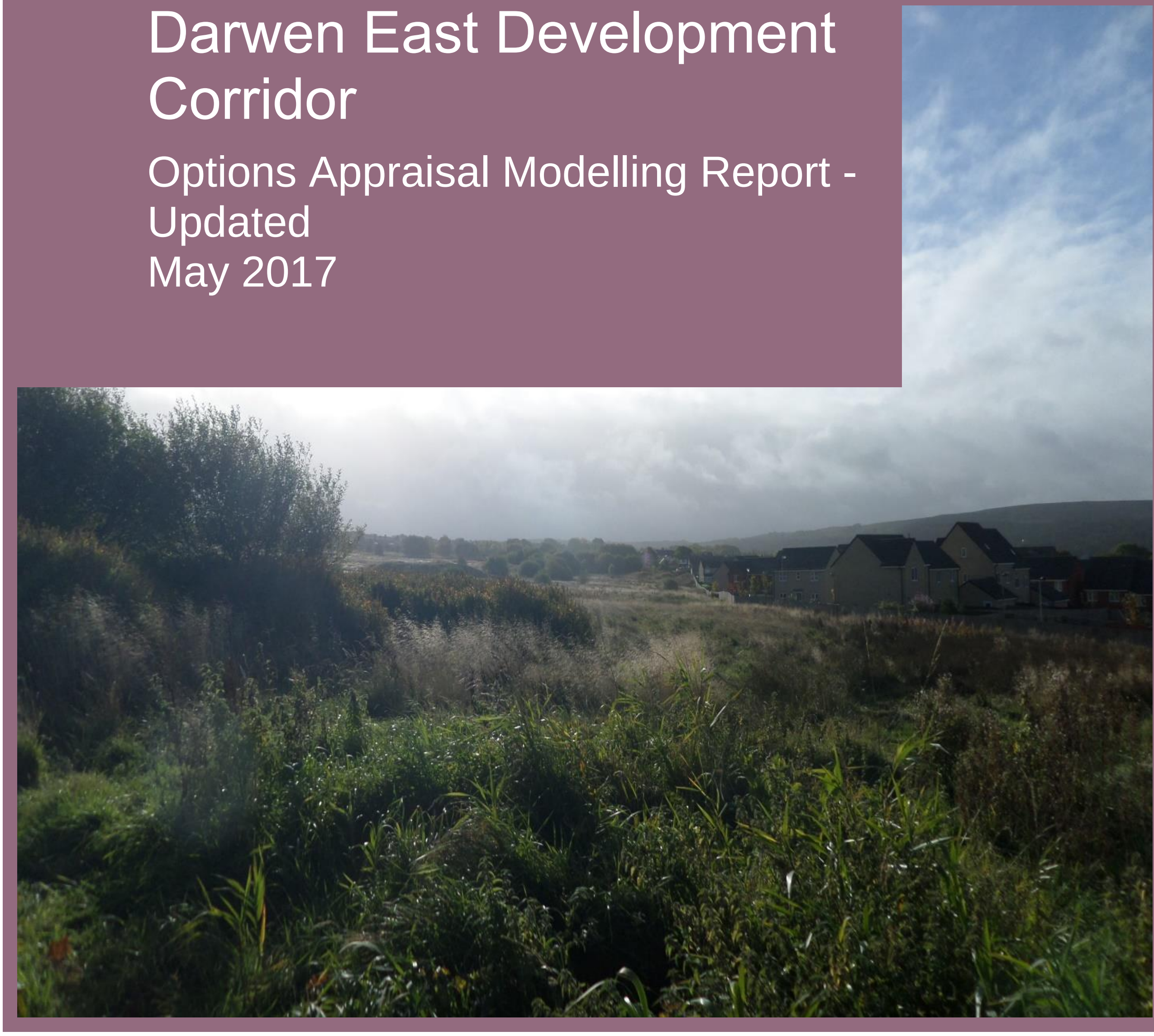
CAPITA

Darwen East Development Corridor

Options Appraisal Modelling Report - Updated

May 2017



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1. Introduction

Following detailed design a number of changes have been made to the proposed layouts to take account of site constraints, cost and deliverability. Where schemes have changed significantly updated modelling has been undertaken to check the impacts on junction performance with this report updated to show the impacts of the changes made. Details of any changes made at specific junction locations and the outputs from the post detailed design junction modelling are reported in **blue font.**

1.1 Scheme Summary

Darwen is located to the south of Blackburn, and is the second largest settlement in the borough. The town is part of the Blackburn with Darwen Unitary Authority, overseen by Blackburn with Darwen Borough Council (BwDBC).

In order to accommodate the requirement for further housing in the borough, a number of sites have been identified within Darwen for potential development. Part of the process in determining the suitability of the various identified sites involves an assessment of the surrounding highways network and the potential for connectivity, identifying infrastructure required to support the expected level of development.

The conclusions drawn from the Transport Implications on the Local Highway Network (2013) report identified that the existing highway network in the borough suffers from congestion on key routes, particularly during the peak periods.

Access to five of these allocated sites—encompassing a potential 1,024 dwellings and the majority of the allocation for Darwen— from the main highway network is via a limited number of access points across the existing Blackburn–Darwen–Bolton–Manchester railway line. The current crossing points each have their own unique constraints, and the existing local highway network has a number of junctions that have been identified as requiring improvement in order to facilitate access to the proposed development sites. The options proposed have also considered the existing constraints of the A666 and Blacksnape Road, as well as their interconnectivity.

In order to mitigate the impacts of the proposed development sites on the highway network, a package of measures is presented as the 'Darwen East Development Corridor' (DEDC).
The DEDC will ensure that any transport implications arising from the allocated development sites will be mitigated as far as possible, providing high-quality links to the M65 and the wider network as well as relieving local congestion. Through this, the DEDC will enable high-quality houses with strong connections to employment sites, boosting the region's economy.

The DEDC package includes the following improvements:

- Junction improvements at the A666/Watery Lane;
- Widening of the railway bridge crossings at Sough Road and Grimshaw Street;
- Junction Improvements at Sough Road/Grimshaw Street/Pole Lane;
- Junction Improvements at Pole Lane/Priory Drive;
- A new junction at Priory Drive/Marsh House Lane in order to facilitate a new Link Road;
- A new Link Road across the East Darwen Allocation Site between the above junction and Ivinson Road;
- A short extension to Ivinson Road to create a link to Chapels/Goose House Lane/Moor Lane; and
- A new junction at the convergence of Ivinson Road/Chapels/Goose House Lane/Moor Lane.

Following a recent review of the DEDC scheme, the following improvements are no longer taking place:

- A short extension to Ivinson Road to create a link to Chapels/Goose House Lane/Moor Lane; and
- A new junction at the convergence of Ivinson Road/Chapels/Goose House Lane/Moor Lane.

Interventions at the following junctions will now take place which were not subject to the original options appraisal process:

- Junction Improvements at Ivinson Road / Oak Grove; and
- Junction Improvements at Oak Grove / Holden Fold

The current priority arrangement at both of these junctions will be altered to create a continuous route from the new DEDC road link through Ivinson Road/ Oak Grove/ Holden Fold. Any relevant updated modelling for these junctions can be found in Section 6.5.

1.2 Purpose of the Report

This report presents the results of the modelling undertaken to identify a preferred option for each of the locations identified above.

Each junction is presented and described in its existing form, and the various options explained. The results are then presented and evaluated in order to determine which options are suitable for further appraisal.

2. A666 / Watery Lane

2.1 Existing Conditions and Proposals

This junction is currently arranged as a four-arm priority junction, with the A666 Bolton Road as the major road, and Watery Lane and Queen's Road forming the minor arms to the east and west respectively. A seldom-used vehicular access point to the local park / bowling green is also provided at the junction between the Queen's Road and A666 south arms. The junction is shown in Figure 2.1 below.

Figure 2.1 Arial Image of A666 / Watery Lane Priority Junction

It is proposed to signalise the junction, providing a dedicated short right-turn lane to accommodate an expected increase in demand for the A666 South – Watery Lane movement and incorporating appropriate lane markings to ensure turning movements are unhooked.

The signalised option also includes pedestrian provision through the inclusion of signalised crossing points along desire lines across the busiest three arms.

The proposed layout is shown in Figure 2.2 overleaf.

Figure 2.2 A666 / Watery Lane Proposed Signalised Option

2.2 Results

2.2.1 Existing Priority Layout

Full modelling outputs are available in **Appendix B. Table 2.1 and**
Table 2.2 overleaf present the results of the 2015 existing flows and the high-growth future scenario as the ‘worst case’ for comparative purposes.

Table 2.1 A666/Watery Lane Priority Arrangement 2015

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Watery Lane – A666 (s)	0.4	7.81	0.29	0.65	9.44	0.39
Watery Lane – A666 (n)	0.16	12.44	0.14	0.12	12.54	0.11
A666 (n) – Queen's Street	0.05	8.17	0.05	0.09	7.9	0.08
Queen's Road – A666 (n)	0.06	7.24	0.06	0.03	6.55	0.03
Queen's Road – A666 (s)	0.07	10.9	0.06	0.03	11.41	0.03
A666 (s) – Watery Lane	0.86	11.27	0.45	0.47	10.14	0.31

Table 2.2 A666/Watery Lane Priority Arrangement 2026

Do Something High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Watery Lane – A666 (s)	0.78	11.15	0.44	1.38	15.5	0.58
Watery Lane – A666 (n)	0.31	19.51	0.24	0.25	20.94	0.2
A666 (n) – Queen's Street	0.08	9.58	0.07	0.13	9.18	0.11
Queen's Road – A666 (n)	0.09	8.83	0.09	0.05	7.9	0.05
Queen's Road – A666 (s)	0.12	16.21	0.11	0.06	18.14	0.06
A666 (s) – Watery Lane	2.06	17.66	0.67	0.93	13.01	0.46

The results suggest that the existing arrangement has adequate capacity to support the expected maximum vehicle demands in the future year. The maximum average delay per vehicle is recorded in the 2026 PM peak period for those vehicles turning right from Watery Lane to the A666 North, and does not exceed 21 seconds. The longest average maximum queue is recorded on the A666 south approach for those waiting to turn right into Watery Lane and is approximately 2 PCUs.

2.2.2 Proposed Signalised Arrangement

Full modelling outputs are available in **Appendix B**. Table 2.3 to Table 2.6 overleaf present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 2.3 A666/Watery Lane Signalised Arrangement 2015 AM

Existing Flows (2015) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**48.00%**	**5.5**	-	-
Queen's Road	11.10%	**5.5**	22.5	0.7
A666 Bolton Rd (N)	36.90%	0.3	14	4.4
Watery Lane	47.30%	1.3	26.6	3.6
A666 Bolton Rd (S)	48.0 : 48.0%	1.6	15.9	4.3

Table 2.4 A666/Watery Lane Signalised Arrangement 2015 PM

Existing Flows (2015) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**64.00%**	**8.5**	-	-
Queen's Road	13.80%	0.4	23.9	0.9
A666 Bolton Rd (N)	46.90%	1.9	15.1	6.2
Watery Lane	62.70%	2.4	32.7	5.4
A666 Bolton Rd (S)	64.0 : 64.0%	3.9	20.3	6.8

Table 2.5 A666/Watery Lane Signalised Arrangement 2026 AM

Do Something – High Growth (2026) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**69.90%**	**9.6**	-	-
Queen's Road	15.80%	0.4	24.8	1
A666 Bolton Rd (N)	48.80%	1.9	14.9	6.8
Watery Lane	69.90%	2.8	35.8	6.1
A666 Bolton Rd (S)	69.6 : 69.6%	4.4	21.8	7.9

Table 2.6 A666/Watery Lane Signalised Arrangement 2026 PM

Do Something – High Growth (2026) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**76.50%**	**12.4**	**-**	**-**
Queen's Road	7.80%	0.2	23.4	0.6
A666 Bolton Rd (N)	74.70%	4.2	21.9	12.5
Watery Lane	74.90%	3.5	37.7	8.2
A666 Bolton Rd (S)	76.5 : 76.5%	4.5	25	9.2

The results suggest that the introduction of traffic signals increases the average delay per PCU on every arm, doubling the overall junction delay in certain scenarios.

The results also show that there will be a corresponding reduction in potential reserve capacity, and that queues on the approaches experiencing the greatest demand will average between 8 and 12 PCUs in the PM peak period.

The junction was modelled assuming an all-red pedestrian phase would be only called when demanded, and estimated to be approximately every third cycle. In reality, this will vary according to demand; the junction was tested without a pedestrian stage and with a pedestrian phase in an attempt to show the effect of this variance on junction performance. The results of the High Growth Scenario with no pedestrian cycle are shown in Table 2.7 and Table 2.8 below and overleaf, illustrating the effect of pedestrians on junction operation.

Table 2.7 A666/Watery Lane Signalised Arrangement 2026 AM (No Peds)

Do Something – High Growth (2026) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**61.1%**	**7.2**	**-**	**-**
Queen's Road	14.0%	0.4	22.5	0.9
A666 Bolton Rd (N)	43.7%	1.5	11.6	5.5
Watery Lane	61.1%	2.3	29.2	5.1
A666 Bolton Rd (S)	60.7 : 60.7%	3.0	15.0	5.5

Table 2.8 A666/Watery Lane Signalised Arrangement 2026 PM (No Peds)

Do Something – High Growth (2026) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**66.5%**	**9.1**	**-**	**-**
Queen's Road	7.0%	0.2	20.5	0.5
A666 Bolton Rd (N)	66.5%	3.1	16.4	9.5
Watery Lane	66.5%	2.7	29.4	6.5
A666 Bolton Rd (S)	58.9 : 62.4%	3.1	16.9	6.1

The results show that a higher pedestrian demand, ie every other cycle, will have a detrimental effect on junction performance. Removal of the pedestrian stage entirely increases junction performance by approximately 25%.

2.2.3 *Conclusion*

The modelling results suggest that signalising the junction is not currently necessary, and the priority arrangement has reserve capacity to accommodate the expected levels of development.

Table 2.9 below presents a comparison of the overall delay experienced at the junction in each scenario for the existing and 'Do Something' proposals. The table clearly shows the increased delay experienced with a signalised arrangement.

Table 2.9 A666 / Watery Lane Comparison of Delay

		Delay (Hours)	
Scenario	Period	Existing	Option 1
2015	AM	3.11	5.50
	IP	1.68	3.60
	PM	3.37	6.70
2026	AM	5.27	8.50
	IP	2.42	8.50
	PM	5.68	10.30
2026 Low	AM	4.43	8.00
	IP	2.18	4.60
	PM	4.80	8.80
2026 High	AM	6.39	9.60
	IP	2.69	5.40
	PM	6.80	12.40

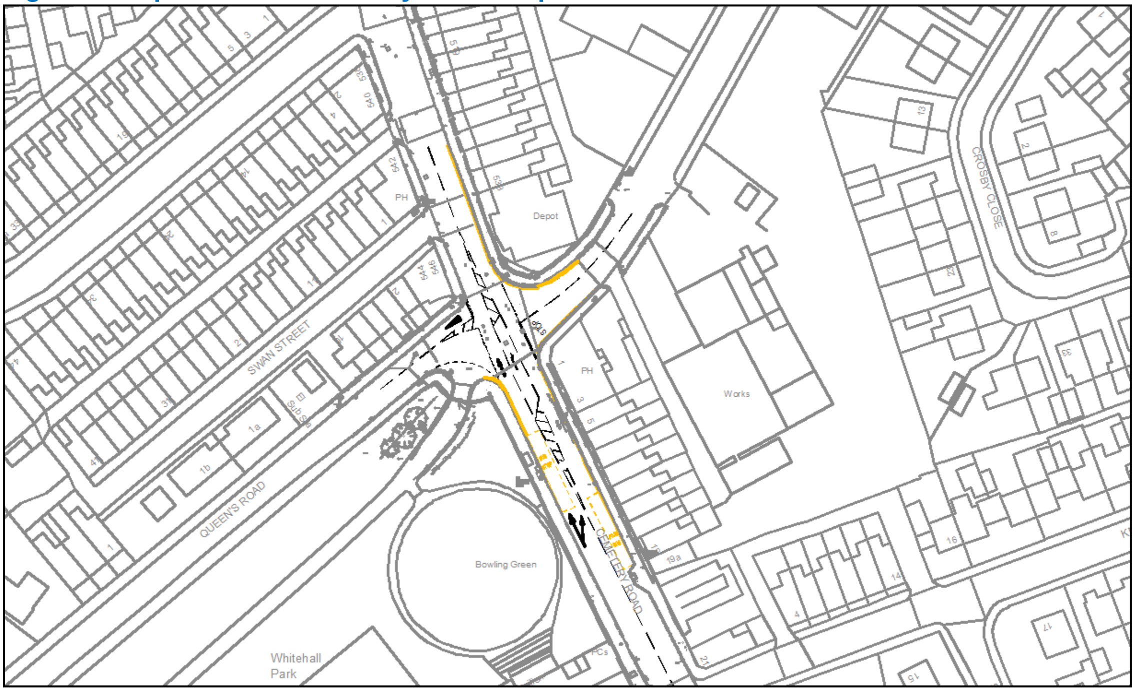
While a signalised option may have additional benefits, such as providing pedestrian crossing points and increasing road safety, these are beyond the scope of this modelling exercise.

In the event that the priority arrangement is retained the junction would benefit from improvements such as repainting of the faded markings or dedicated crossing points with dropped kerbs and tactile paving.

2.3 Design Review Update

Following a detailed design review, it was concluded that the current priority arrangement at the A666/ Watery Lane junction would be retained, with slight adjustments to the priority arrangement. As part of Do-Something proposals the provision of a dedicated right-turn lane is to be included to accommodate an expected increase in demand for the A666 NB – Watery Lane movement. The inclusion of double yellow lines has also been incorporated into the design along the A666 NB and Watery Lane in order to restrict on-street parking and widen the carriageways. The proposed layout is shown in Figure 2.3 below.

Figure 2.3 Updated A666/ Watery Lane Proposed Junction



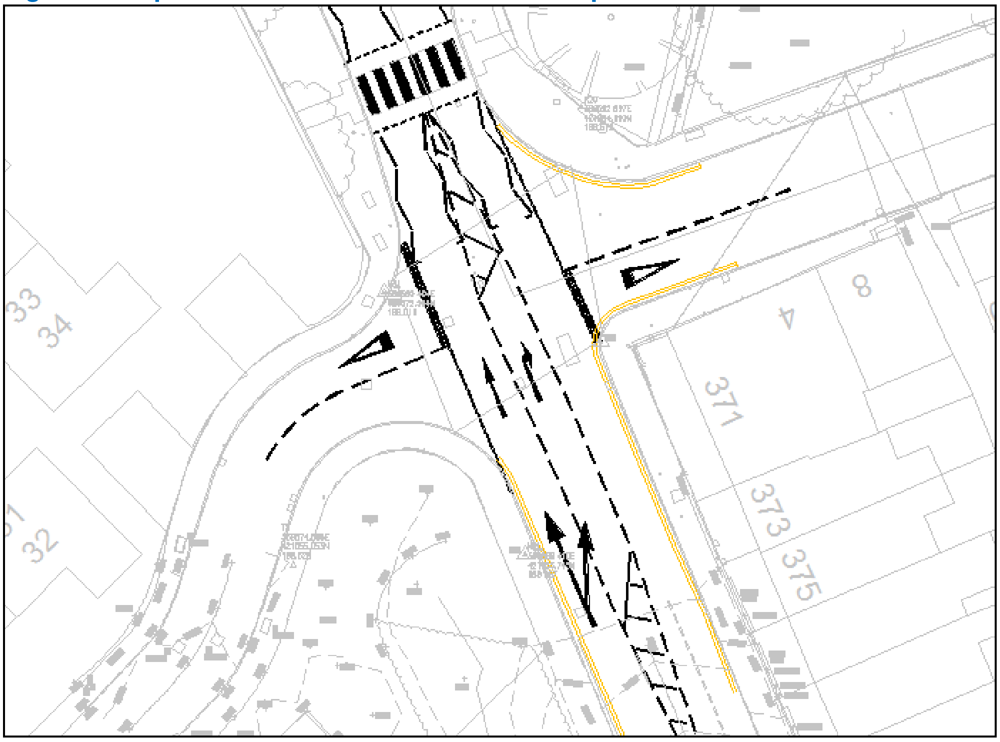
A brief comparison of the expected total junction delay across modelled scenarios can be found in Table 2.10 overleaf. Modelling of new junction proposals following detailed design review was undertaken using updated traffic flows to those using during the options appraisal process, so direct comparison is not possible. Full model output reports are available in appendix C.

Table 2.10 A666/ Watery Lane Updated Proposal Comparison

		Average Delay per PCU (S)	
Scenario	**Period**	**Existing**	**Option**
2015	AM	9.76	9.73
	IP	8.14	8.04
	PM	9.79	9.67
2019	AM	10.48	10.39
	IP	8.46	8.36
	PM	10.57	10.48
2026	AM	11.44	11.16
	IP	8.79	8.69
	PM	11.83	11.28

In addition to the A666/ Watery Lane junction, a similar intervention is now proposed for the A666/ Grimshaw Street junction, with the provision of a dedicated right-turn lane to accommodate an expected increase in demand for the A666 south – Grimshaw Street movement. The inclusion of double yellow lines has also been incorporated into the design along the A666 (NB) and Grimshaw Street in order to restrict on-street parking and widen the carriageways. New road marking will also be included throughout the junction to help vehicles navigate the junction more effectively. The proposed layout is shown in Figure 2.4 below.

Figure 2.4 Updated A666/ Grimshaw Street Proposed Junction



A brief comparison of the expected total junction delay across modelled scenarios can be found in Table 2.11 A666/ Grimshaw Street Updated Proposal Comparison below. Full model output reports are available in appendix C.

Table 2.11 A666/ Grimshaw Street Updated Proposal Comparison

		Average Delay per PCU (S)	
Scenario	**Period**	**Existing**	**Option**
2015	AM	11.07	10.73
	IP	9.84	9.57
	PM	13.53	13.22
2019	AM	11.84	11.48
	IP	10.34	10.06
	PM	15.06	14.72
2026	AM	13.89	13.46
	IP	11.22	10.88
	PM	18.56	18.06

3. Sough Rd / Grimshaw St / Pole Lane

3.1 Existing Conditions and Proposals

This junction is currently a four-arm priority arrangement, with Sough Road as the major road and Grimshaw Street and Pole Lane comprising the minor arms.

The site is relatively constrained; both Sough Road (South) and Grimshaw Street approaches are via railway bridges over the Manchester – Clitheroe line with narrow carriageways and a lack of visibility, and a number of dwellings are sited close to the junction between the Sough Road (south) and Pole Lane approaches, restricting visibility and making simple improvements to geometries less viable. The junction is shown in Figure 3.1 below.

Figure 3.1Arial Image of Sough Rd / Pole Lane / Grimshaw St Junction

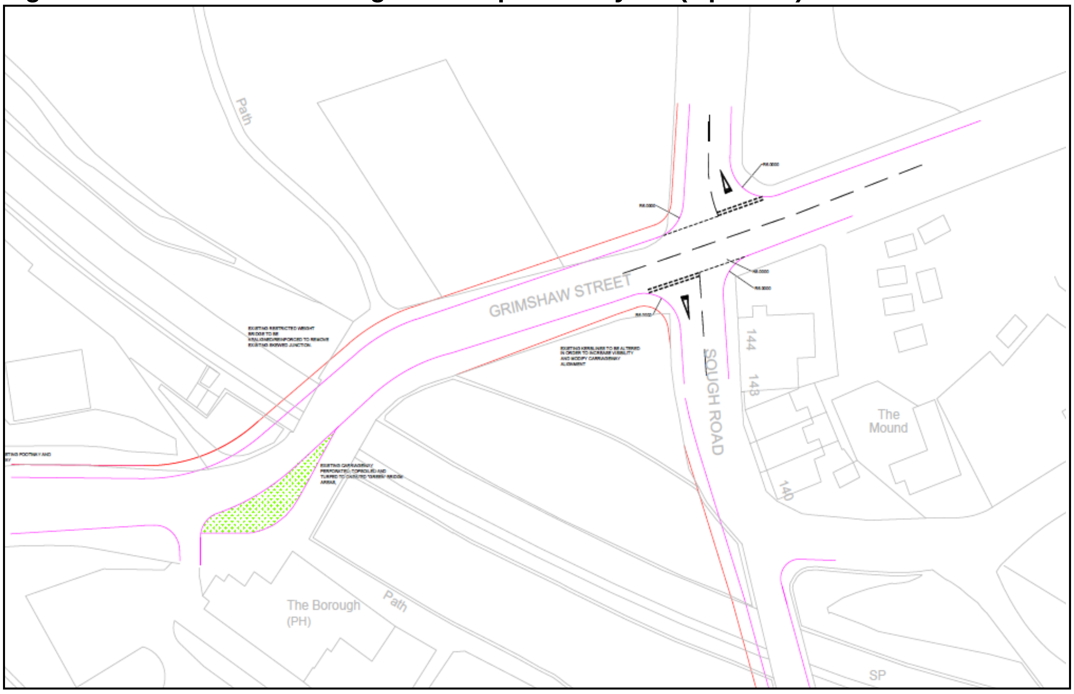
The junction is already known to have performance issues and to exceed capacity in peak periods, confirmed by recent planning applications for developments in the vicinity. A number of options have been proposed in an attempt to alleviate the issues at this junction:

3.1.1 *Option 1 - Change of Priorities*

This option involves changing the priority arrangement to make Grimshaw Street / Pole lane the major road, and the two arms of Sough Road will become the minor arms. The option also incorporates some improvements to the junction geometries and flaring of the minor arms.

Figure 3.2 below shows the proposed layout. Full drawings are available in **Appendix A**.

Figure 3.2 Grimshaw St / Sough Rd Proposed Layout (Option 1)



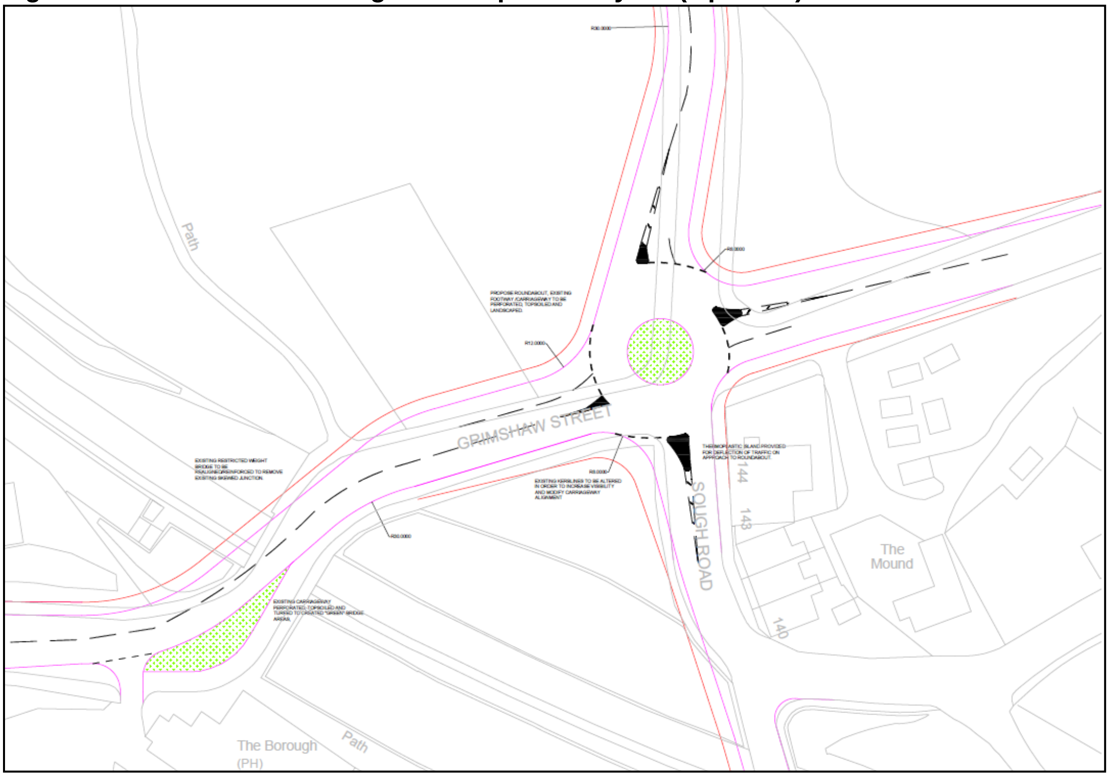
3.1.2 *Option 2 – Standard Roundabout*

This option incorporates a standard roundabout in place of the existing priority arrangement, slightly offset to the north due to the proximity of dwellings. An additional lane is provided on the Sough Road (N), Pole Lane and Grimshaw Street approaches, with considerable flaring at Grimshaw Street. Footways are provided on each side.

This option necessitates improvements to the Sough Road railway bridge.

Figure 3.3 below shows the proposed layout. Full drawings are available in **Appendix A**

Figure 3.3 Grimshaw St / Sough Rd Proposed Layout (Option 2)



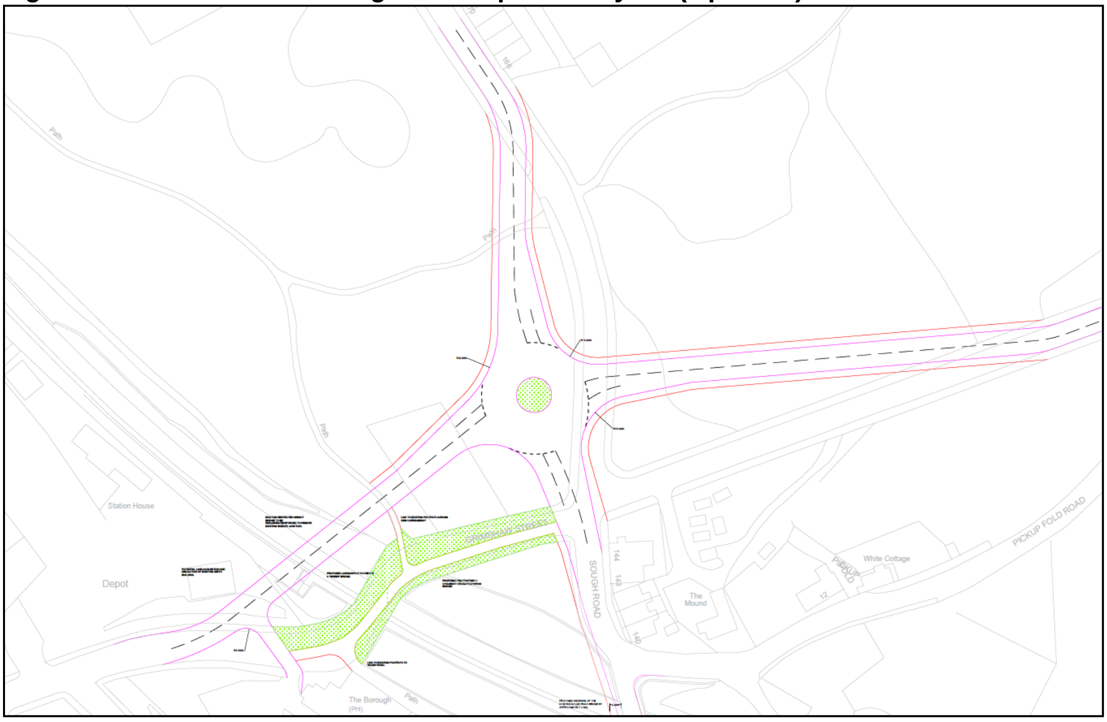
3.1.3 Option 3 – High Cost Roundabout

Option 3 is also a standard roundabout, but is set further to the north, and requires extensive realignment of the Grimshaw Street, Pole Lane and Sough Road. It also necessitates the creation of a new railway bridge to the north of the existing one to bear Grimshaw Street. The existing bridge will be used as a 'Green Bridge' to provide a crossing point for both pedestrians and wildlife. Improvements are also required to the Sough Road railway bridge.

The relocation of the junction allows the design of a roundabout tailored to the demands of the network, and should allow adequate capacity for further development.

Figure 3.4 below shows the proposed layout. Full drawings are available in **Appendix A**

Figure 3.4 Grimshaw St / Sough Rd Proposed Layout (Option 3)



3.1.4 Bridge Widening

All the options for this junction also incorporate bridge widening with associated improvements to the carriageway and footways, leading to improved visibility and safety on the approach to the junction, in addition to alleviating any issues with wide vehicles passing.

3.2 Results

3.2.1 Existing Priority Layout

Full modelling outputs are available in **Appendix B.** Table 3.1 and
Table 3.2 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 3.1 Grimshaw St / Sough Rd / Pole Ln Priority Arrangement (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Pole Lane	1.91	22.91	0.66	17.31	126.53	1.01
Sough Rd (N) – Grimshaw St	0.11	8.55	0.1	0.12	8.19	0.11
Grimshaw St	0.97	17.06	0.5	0.49	11.57	0.33
Sough Rd - Pole Lane	1.1	13.47	0.53	0.48	9.2	0.33

Table 3.2 Grimshaw St / Sough Rd / Pole Ln Priority Arrangement (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Pole Lane	19.38	161.86	1.04	153.44	1094.7	1.51
Sough Rd (N) – Grimshaw St	0.19	10.09	0.16	0.19	9.35	0.16
Grimshaw St	3.47	44.13	0.8	9.41	94.77	0.96
Sough Rd - Pole Lane	2.62	24.2	0.73	1.76	18.52	0.64

The results of the modelling indicate that the junction currently operates above capacity in the PM peak period. Vehicles exiting Pole Lane suffer delays of over 2 minutes, and the average maximum queue is approximately 17 PCUs.

The MMC surveys undertaken to acquire the base data shows that there is considerable demand for the Sough Road (s) – Pole Lane movement in the AM peak period, with a corresponding Pole Lane – Sough Road (s) movement in the PM peak period, which is reflected in the modelling results.

In the High Growth scenario the junction is over capacity in both peak periods. However, it is clear that any additional demand on this arm will exacerbate performance and mitigation is required.

3.2.2 *Option 1 – Change of Priorities*

Full modelling outputs are available in **Appendix B**. Table 3.3 and Table 3.4 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 3.3 Grimshaw St / Sough Rd / Pole Ln Option 1 (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Sough Rd (s)– Grimshaw St	1.07	30.25	0.53	0.45	21.55	0.32
Sough Rd (s) – Pole Lane	3.44	41.77	0.79	2.48	34.04	0.73
Pole Ln – Sough Rd (n)	0.11	5.3	0.07	0.28	4.98	0.13
Sough Rd (n)- Pole Lane	0.26	8.64	0.21	0.32	10.61	0.25
Sough Rd (n)– Grimshaw St	0.28	11.63	0.22	0.39	13.26	0.28
Grimshaw St – Sough Rd (s)	0.02	5.02	0.01	0.03	5.17	0.02

Table 3.4 Grimshaw St / Sough Rd / Pole Ln Option 1 (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Sough Rd (s)– Grimshaw St	20.18	402.97	1.2	8.92	303.49	1.1
Sough Rd (s) – Pole Lane	40.04	376.75	1.2	23.04	230.66	1.1
Pole Ln – Sough Rd (n)	0.19	5.12	0.09	0.48	4.78	0.18
Sough Rd (n)- Pole Lane	0.44	11.37	0.31	0.66	16.58	0.4
Sough Rd (n)– Grimshaw St	0.51	16.54	0.34	0.75	20.58	0.43
Grimshaw St – Sough Rd (s)	0.02	4.9	0.02	0.04	4.98	0.03

The results indicate that a changing of priorities will have a considerable improvement on Pole Lane, with the majority of movements becoming free-flowing. However, the demand for Sough Road (s) – Pole Lane results in the Sough Road (s) approach being close to capacity during the AM peak period, despite the improvements in geometry.

The additional demand for this movement in the High Growth future scenario results in the junction operating above capacity in both the AM and PM peak periods. In the AM peak period, a queue of 40 PCUs and delay exceeding 6 minutes per vehicle is predicted.

3.2.3 *Option 2 – Standard Roundabout*

Full modelling outputs are available in **Appendix B**. Table 3.5 and Table 3.6 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 3.5 Grimshaw St / Sough Rd / Pole Ln Option 2 (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane	0.27	3.2	0.22	0.54	3.93	0.35
Sough Rd (S)	0.81	6.54	0.45	0.57	5.9	0.37
Grimshaw St	0.19	3.27	0.16	0.22	3.26	0.18
Sough Rd (N)	0.22	4.11	0.18	0.25	4.22	0.2

Table 3.6 Grimshaw St / Sough Rd / Pole Ln Option 2 (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane	0.43	3.67	0.3	0.93	5.05	0.48
Sough Rd (S)	1.67	10.13	0.63	1.03	8.07	0.51
Grimshaw St	0.33	3.94	0.25	0.42	4	0.29
Sough Rd (N)	0.35	4.96	0.26	0.39	5.1	0.28

The results of the modelling indicate that the roundabout option would considerably improve the performance of the junction. Even in the High Growth Scenario the highest RFC recorded is on Sough Road (s) approach in the AM peak period at 0.63. Queues do not exceed 2 PCUs, and the maximum delay per PCU is approximately 10 seconds.

3.2.4 *Option 3 – High Cost Roundabout*

Full modelling outputs are available in **Appendix B**. Table 3.7 and Table 3.8 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 3.7 Grimshaw St / Sough Rd / Pole Ln Option 3 (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane	0.31	3.61	0.24	0.26	3.41	0.2
Sough Rd (S)	0.25	2.02	0.2	0.13	1.8	0.12
Grimshaw St	0.17	2.86	0.14	0.11	2.5	0.1
Sough Rd (N)	0.16	2.94	0.14	0.1	2.6	0.09

Table 3.8 Grimshaw St / Sough Rd / Pole Ln Option 3 (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane	0.5	4.23	0.33	0.39	3.83	0.28
Sough Rd (S)	0.38	2.31	0.28	0.19	1.94	0.16
Grimshaw St	0.28	3.41	0.22	0.18	2.77	0.15
Sough Rd (N)	0.24	3.41	0.19	0.14	2.83	0.12

The results suggest that the roundabout would function with no operational issues. The longest queue and delay are recorded on Pole Lane in the AM peak period, and these values do not exceed 0.5 PCUs or 5 seconds respectively.

3.3 Conclusion

The results of the modelling show that a roundabout is necessary to provide for the dominant flows across the junction. In terms of performance, Option 3 presents the best results, but it will need to be determined if the benefits over Option 2 are enough to justify the considerably higher costs.

For comparative purposes, Table 3.9 overleaf presents the total delay in each scenario for each different option.

Table 3.9 Sough Rd / Pole Ln - Comparison of Delay

		Delay (Hours)			
Scenario	Period	Existing	Option 1	Option 2	Option 3
2015	AM	5.11	8.15	1.36	0.81
	IP	2.47	2.56	0.77	0.55
	PM	22.30	1.45	1.45	1.09
2026	AM	14.60	49.64	1.84	0.98
	IP	4.46	4.38	1.08	0.75
	PM	155.93	35.97	2.23	1.65
2026 Low	AM	10.82	35.03	1.88	1.04
	IP	3.69	4.10	0.98	0.69
	PM	93.98	33.66	1.96	1.46
2026 High	AM	30.85	99.76	2.54	1.28
	IP	5.48	5.23	1.19	0.82
	PM	237.28	59.63	2.54	1.87

3.4 Design Review Update

Following design review and as detailed above, Option 2 for a standard roundabout has been taken forward as the proposed intervention, and is considered to give the greatest net benefit against proposed costs of each option. Updated model outputs detailed in Table 3.10 indicate significant benefit of the current proposed option. Full updated model output reports are available in appendix C.

Table 3.10 Sough Road/ Grimshaw Street Updated Proposal Comparison

		Average Delay per PCU (S)	
Scenario	**Period**	**Existing**	**Option**
2015	AM	14.66	6.45
	IP	11.51	5.22
	PM	36.52	6.66
2019	AM	17.16	7.02
	IP	12.67	5.46
	PM	84.57	7.29
2026	AM	23.09	7.67
	IP	14.64	5.71
	PM	209.03	7.95

4. Pole Lane / Priory Drive

4.1 Existing Conditions and Proposals

This junction is currently a 3-arm priority arrangement; Pole Lane is the major road, running from the south-west to the north-east, with Priory Drive forming the minor arm to the north. Footways are provided on either side of Pole Lane, while Priory Drive only has a footway on the eastern side. A crossing point over Priory Drive with dropped kerbs is set back from the junction, and the footway has a number of bollards on the corners to further segregate pedestrians and road traffic. The existing arrangement is shown in Figure 4.1 below.

Figure 4.1 Arial Image of Pole Lane / Priory Drive Junction

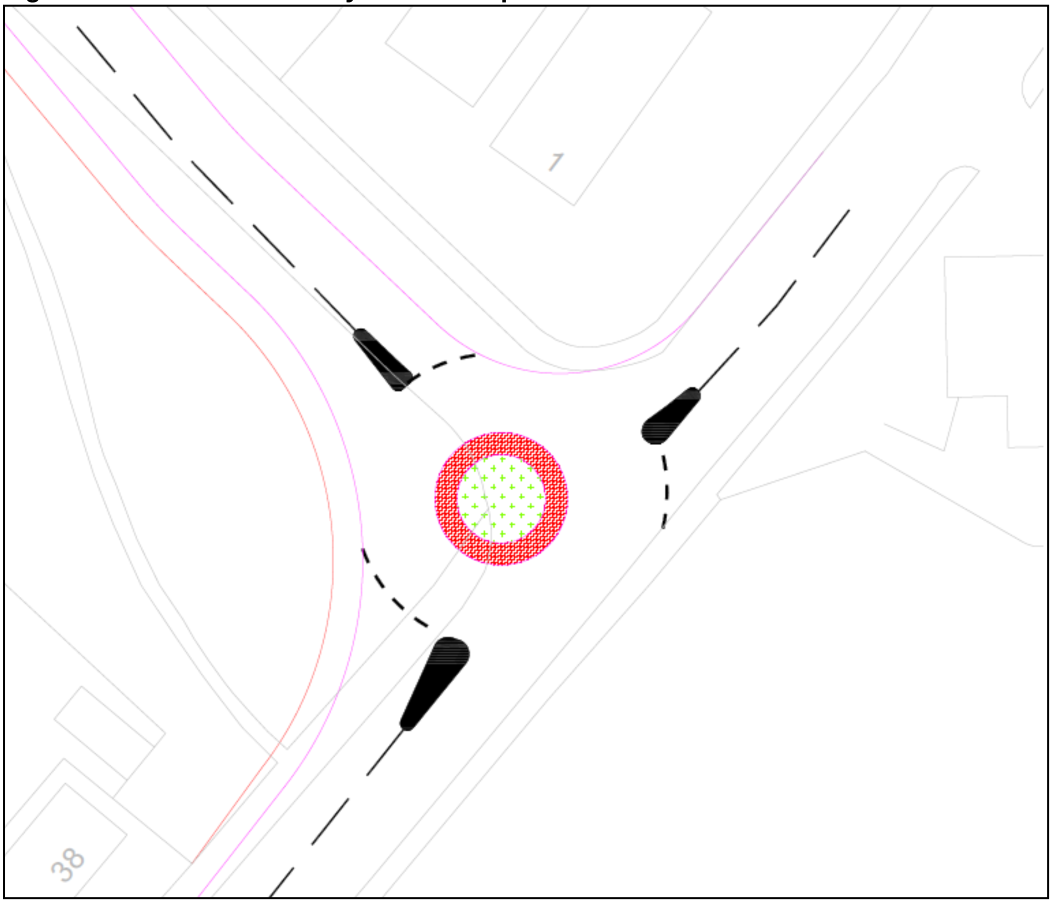
The proposals will alter the arrangement to a 3-arm roundabout, giving priority to the Priory Drive – Pole Lane (S) movement over the Pole Lane (N) – Pole Lane (S) movement. There are two options for achieving this: a mini – roundabout and a compact roundabout.

4.1.1 *Option 1 - Compact Roundabout*

This option will require slightly more land than currently utilised, and will marginally alter the alignment of Priory Drive to accommodate the roundabout. A new footway will be created on the western side of Priory Drive to enhance the route for pedestrians.

The proposed layout is shown in Figure 4.2 below. Full drawings are available in **Appendix A**.

Figure 4.2 Pole Lane / Priory Drive Compact Roundabout

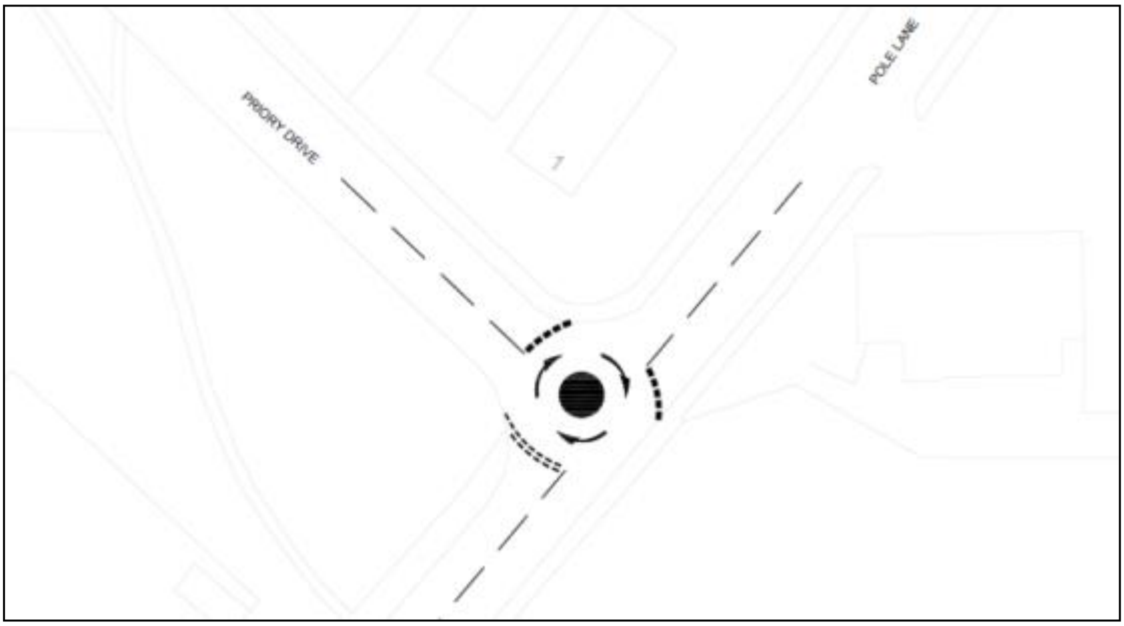


4.1.2 *Option 2 – Mini-Roundabout*

This option will not require any additional land, and simply alter the road markings to incorporate a mini-roundabout.

The proposed layout is shown in Figure 4.3 below. Full drawings are available in **Appendix A.**

Figure 4.3 Pole Lane / Priory Drive Mini-Roundabout



4.2 Results

4.2.1 *Existing Priority Layout*

Full modelling outputs are available in **Appendix B**. Table 4.1 and Table 4.2 below and overleaf present the results of the 2015 existing flows and the 2026 high-growth future scenario for comparative purposes.

Table 4.1 Pole Lane / Priory Drive Existing arrangement (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Priory Drive - Pole Lane (N)	0.14	7.62	0.12	0.14	7.51	0.13
Priory Drive - Pole Lane (S)	0.17	10.88	0.14	0.2	11.81	0.17
Pole Lane (N) –Priory Drive	0.1	5.12	0.06	0.31	4.82	0.15

Table 4.2 Pole Lane / Priory Drive Existing arrangement (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Priory Drive - Pole Lane	0.2	9.08	0.17	0.2	8.61	0.17
Priory Drive - Pole Lane	0.3	13.95	0.23	0.49	19.19	0.33
Pole Lane (N) –Priory	0.2	5.29	0.1	0.59	4.92	0.23

The results indicate that the junction currently has no operational issues, and has adequate reserve capacity to operate efficiently under the maximum expected future demand. Queues are not predicted to exceed a single PCU in any scenario, with the maximum expected delay predicted to be for those turning right from Pole Lane (N) into Priory Drive, at just under 20 seconds in the PM future scenario.

4.2.2 Option 1 - Compact Roundabout

Full modelling outputs are available in **Appendix B**. Table 4.3 and Table 4.4 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 4.3 Pole Lane / Priory Drive Compact – Roundabout (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane (N)	0.54	3.76	0.35	0.49	3.69	0.33
Priory Drive	0.41	12.22	0.29	0.42	11.63	0.3
Pole Lane (S)	0.27	3.5	0.21	0.61	4.43	0.38

Table 4.4 Pole Lane / Priory Drive Compact – Roundabout (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane (N)	0.97	4.84	0.49	0.85	4.61	0.46
Priory Drive	0.75	17.36	0.43	0.81	16.69	0.45
Pole Lane (S)	0.4	3.89	0.29	1.06	5.8	0.52

The results indicate that the proposed compact roundabout has sufficient capacity to accommodate the expected highest level of demand in 2026. The longest queues are predicted on the Pole Lane (S) approach in the 2026 PM peak period at approximately 1.5 PCUs. Priory Drive approach suffers the longest delays, at around 17 seconds per vehicle in both the AM and PM 2026 peak periods.

4.2.3 Option 2 – Mini-Roundabout

Full modelling outputs are available in **Appendix B**. Table 4.5 and Table 4.6 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 4.5 Pole Lane / Priory Drive Mini – Roundabout (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane (N)	1.04	7.26	0.51	0.93	7.02	0.48
Priory Drive	0.42	12.62	0.3	0.4	11.3	0.29
Pole Lane (S)	0.31	4.04	0.24	0.73	5.36	0.42

Table 4.6 Pole Lane / Priory Drive Mini – Roundabout (2026)

Do Something - High Growth (2026)						
	AM			PM		
	Queue	Delay (s)	RFC	Queue	Delay (s)	RFC
Pole Lane (N)	2.52	12.76	0.72	2.06	11.32	0.68
Priory Drive	0.98	22.98	0.5	0.93	19.12	0.49
Pole Lane (S)	0.47	4.63	0.32	1.4	7.69	0.59

The results indicate that the proposed mini-roundabout will have adequate capacity to accommodate the expected highest level of demand in 2026. The longest queues are predicted on the Pole Lane (N) approach in 2026, with both the AM and PM peak periods recording approximately 2 PCUs. Priory Drive approach suffers the longest delays, at around 20 seconds per vehicle in both the AM and PM 2026 peak periods.

4.3 Conclusion

The modelling outputs suggest that any option will have the capacity to support the maximum expected demand in the future year. Table 4.7 overleaf compares the total junction delay; while the existing arrangement is shown to have more reserve capacity than either roundabout, the compact roundabout still offers more than adequate capacity and total junction delay is less than the existing layout when the additional demand is taken into account.

It should be noted that a mini-roundabout provides other benefits aside from performance, and are commonly introduced as a traffic-calming or accident reduction measure. The needs of pedestrians and cyclists in a predominantly residential area should also be taken into account, as well as the turning requirements of any local bus services. These considerations are, however, outside the scope of this report.

Table 4.7 Pole Lane / Priory Drive Comparison of Delay

		Delay (Hours)		
Scenario	Period	Existing	Option 1	Option 2
2015	AM	2.40	2.08	1.43
	IP	1.17	0.89	0.69
	PM	2.03	1.89	1.38
2026	AM	2.72	3.02	1.71
	IP	1.64	1.33	0.98
	PM	3.18	3.37	2.18
2026 Low	AM	2.43	2.48	1.50
	IP	1.51	1.19	0.89
	PM	2.83	2.83	1.91
2026 High	AM	3.03	3.69	1.94
	IP	1.79	1.49	1.07
	PM	3.59	4.05	2.49

4.4 Design Review Update

Following detailed design review, the mini roundabout option detailed above was taken forward as the proposed option. Updated modelling results can be found in Table 4.8 below. Full updated model output reports are available in appendix C.

Table 4.8 Pole Lane/ Priory Drive Updated Proposal Comparison

		Average Delay per PCU (S)	
Scenario	**Period**	**Existing**	**Option**
2015	AM	8.35	8.20
	IP	7.64	7.27
	PM	9.39	12.94
2019	AM	8.73	8.93
	IP	7.89	7.73
	PM	10.04	16.19
2026	AM	8.79	10.38
	IP	7.99	8.33
	PM	10.48	21.51

Although the existing arrangement is shown to have more reserve capacity than the proposed option, it is expected that a mini-roundabout arrangement will provide additional benefits, acting as a traffic-calming and accident reduction measure. Analysis conducted using the DfTs COBALT software comparing existing and proposed junction layouts confirms that the proposed intervention will have a net monetised benefit when accidents rates are considered, and is expected to reduce the junction accident rate. Full details of this analysis are provided within the **BCR Technical Note** accompanying the main business case document.

5. Priory Drive / Marsh House Lane

5.1 Existing Conditions and Proposals

This junction is currently a 3-arm priority arrangement. Marsh House Lane extends from east to west and is the major road, with Priory Drive as the minor road adjoining from the south. The existing layout is shown in Figure 5.1 below.

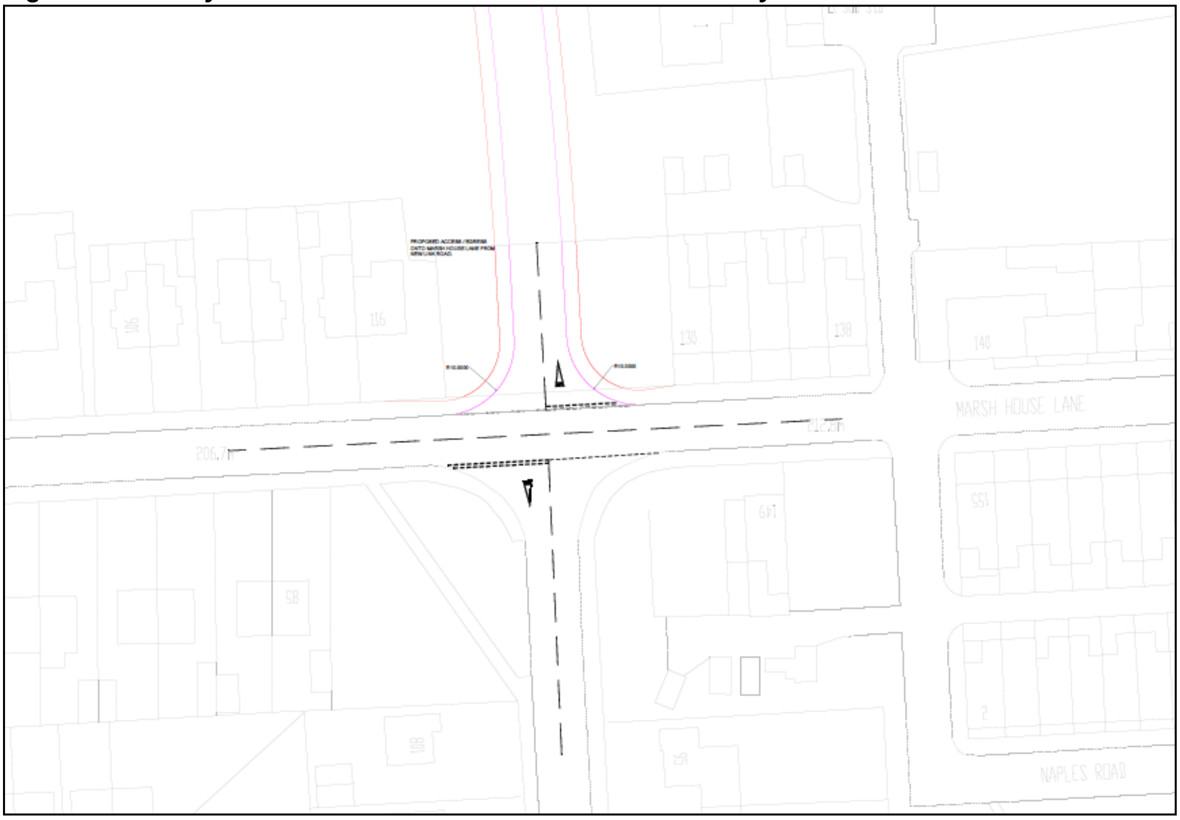
Figure 5.1 Arial Image of Priory Drive / Marsh House Lane Junction

It is proposed to create a link road from this junction to meet the southern end of Ivinson Road. This link road will pass through housing allocation site 16/14, which is anticipated to accommodate up to 400 dwellings (by 2026; 120 are expected to be delivered by 2018). This will necessitate the creation of a new 4-arm junction in place of the existing arrangement; a number of options have been considered in the development of a feasible solution.

5.1.1 Do Minimum: Priority Crossroad Junction

The creation of this junction is necessary to provide access to the proposed eastern site, and will therefore be an integral part of a ‘Do Minimum’ scenario. It is proposed that this ‘Do Minimum’ arrangement will be in the form of a priority crossroads, with Marsh House Lane as the major road, and Priory Drive and the new link road forming the minor arms. The proposed layout is shown in Figure 5.2 below; full drawings are available in **Appendix A**.

Figure 5.2 Priory Drive / Marsh House Lane Do Minimum Layout

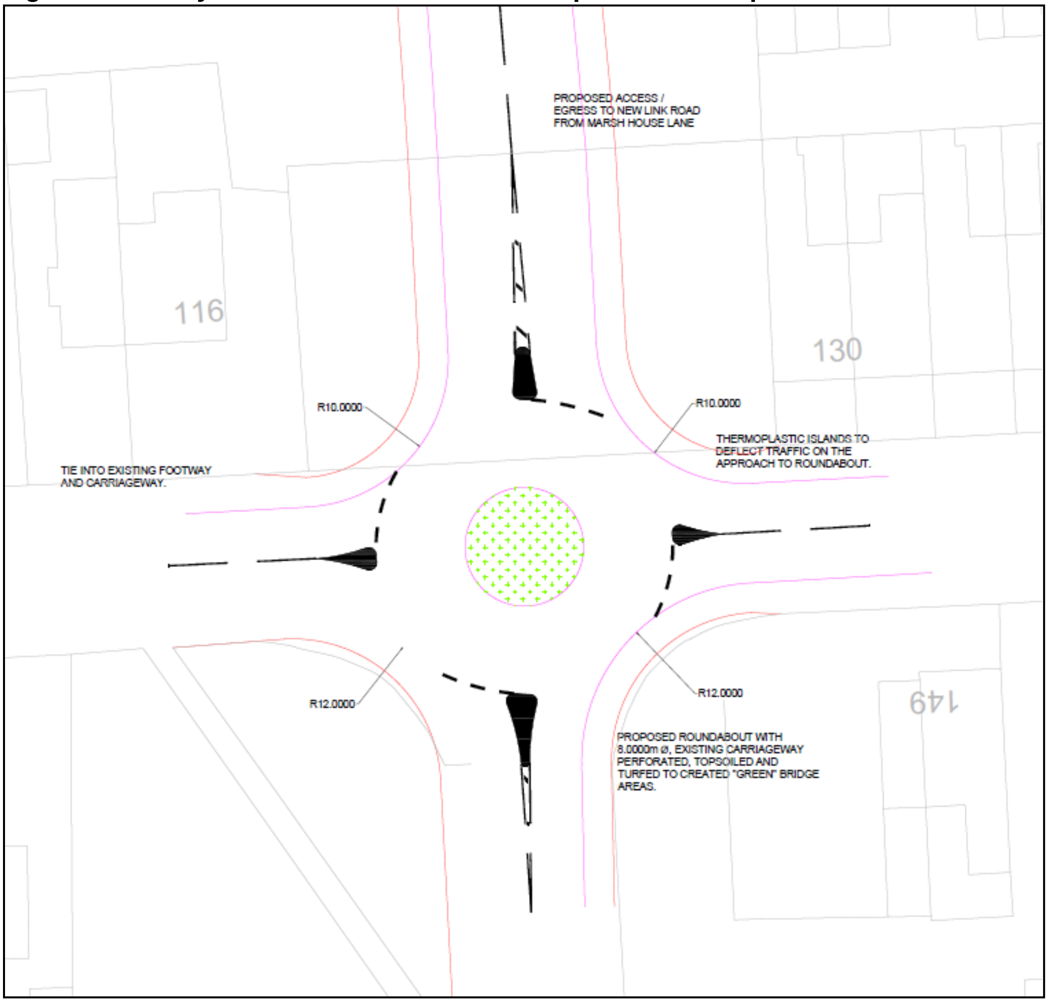


5.1.2 Option 1 – Proposed Roundabout

This option involves the creation of a compact roundabout in place of the existing priority junction. The roundabout will maintain the existing geometries, and feature footways on each side.

Figure 5.3 overleaf shows the proposed layout. Full drawings are available in **Appendix A**

Figure 5.3 Priory Drive / Marsh House Lane Option 1 – Compact Roundabout

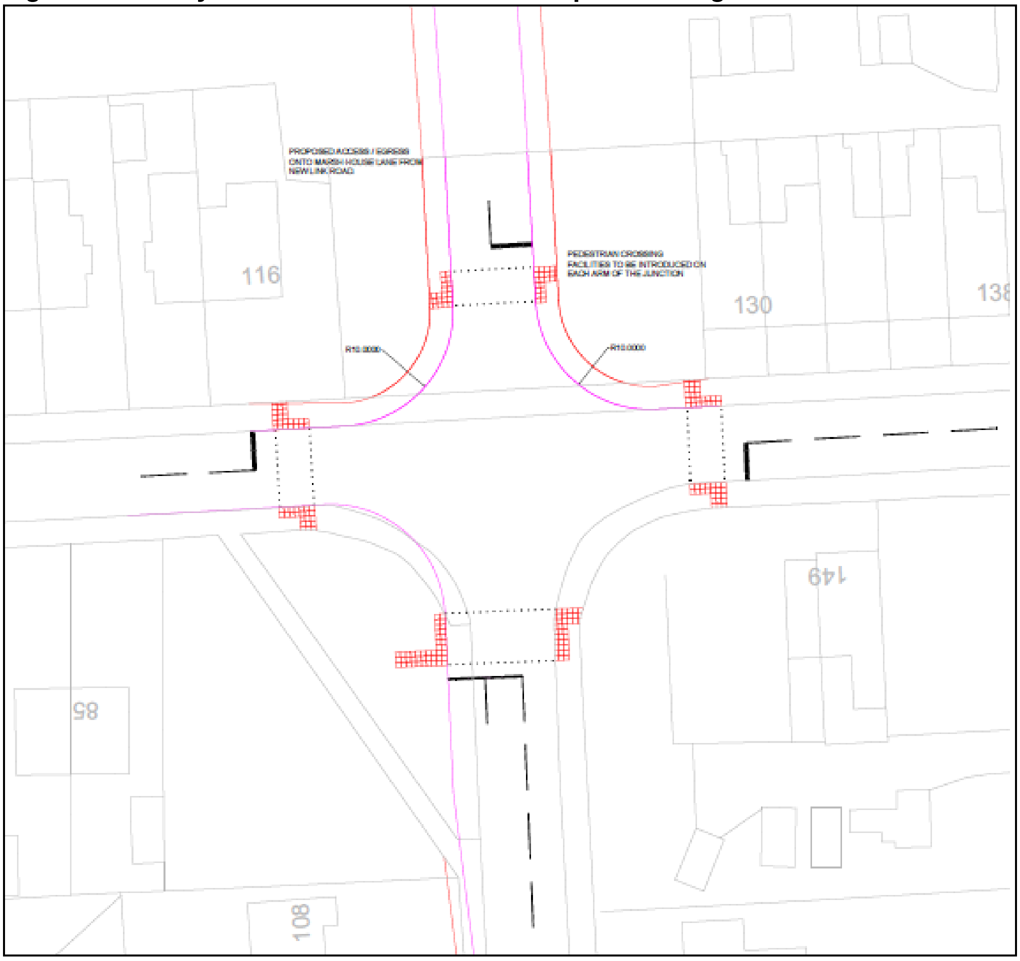


5.1.3 Option 2 – Proposed Signalised Junction

This option involves the signalisation of the 4–arm junction. The corner of Priory Drive – Marsh house Lane (W) will be tightened to accommodate a short right-turn lane along the Priory Drive approach. Footways and a signalised pedestrian crossing are provided for on each arm.

Figure 5.4 overleaf shows the proposed layout. Full drawings are available in **Appendix A**

Figure 5.4 Priory Drive / Marsh House Lane Option 2 - Signalised



5.2 Results

5.2.1 Existing Priority Junction

Full modelling outputs are available in **Appendix B**. Table 5.1 overleaf presents the results of the 2015 existing flows.

Table 5.1 Priory Drive / Marsh House Lane Existing Arrangement (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
PrioryDr - Marsh House Ln (W)	0.21	6.83	0.17	0.14	6.63	0.12
Priory Dr - Marsh House Ln (E)	0.07	9.38	0.07	0.13	10	0.12
Marsh House Ln (W) - Priory Dr	0.15	5.15	0.1	0.35	5.78	0.21

The modelling results suggest that the junction currently operates within capacity, with no operation issues. However, the creation of the link road necessary to unlock the development site requires the creation of a new junction, meaning the existing layout cannot be tested under the future scenarios.

5.2.2 *Do Minimum – Priority Crossroads*

Full modelling outputs are available in **Appendix** Table 5.2 and Table 5.3below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 5.2 Priory Drive / Marsh House Lane Do Minimum (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Priory Drive - Marsh House (W)	0.21	6.83	0.17	0.14	6.63	0.12
Priory Drive - Ahead / Marsh House (E)	0.07	9.38	0.07	0.13	10	0.12
Marsh House (E) - Link road	0	0	0	0	0	0
Link Road - Marsh House (E)	0	0	0	0	0	0
Link Road - Ahead / Marsh House (W)	0	0	0	0	0	0
Marsh House (W) - Priory	0.15	5.15	0.1	0.35	5.78	0.21

Table 5.3 Priory Drive / Marsh House Lane Do Minimum (2026)

Do Something (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Priory Drive - Marsh House (W)	0.3	7.7	0.23	0.2	7.49	0.17
Priory Drive - Ahead / Marsh House (E)	0.1	10.59	0.09	0.18	11.75	0.15
Marsh House (E) - Link road	0.04	4.77	0.03	0.07	5	0.05
Link Road - Marsh House (E)	0.14	10.76	0.12	0.07	7.47	0.07
Link Road - Ahead / Marsh House (W)	0.19	5.19	0.11	0.11	11.19	0.1
Marsh House (W) - Priory	0.06	6.89	0.06	0.53	6.06	0.27

The results indicate that priority crossroad arrangement would have sufficient capacity to accommodate the highest expected demand. Queues on any arm remain under a single PCU, while delay does not exceed 7 seconds per PCU.

5.2.3 *Option 1 – Compact Roundabout*

Full modelling outputs are available in **Appendix A**. Table 5.4 and Table 5.5below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 5.4 Priory Drive / Marsh House Lane Option 1 (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Marsh House Lane (E)	0.38	5.13	0.28	0.41	5.43	0.29
Priory Drive	0.18	4.64	0.15	0.16	4.5	0.14
Marsh House Lane (W)	0.39	5.5	0.28	0.61	6.44	0.38
Link Road	0	0	0	0	0	0

Table 5.5 Priory Drive / Marsh House Lane Option 1 (2026)

Do Something (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Marsh House Lane (E)	0.58	6.04	0.37	0.63	6.49	0.39
Priory Drive	0.25	5.3	0.2	0.21	4.99	0.17
Marsh House Lane (W)	0.51	6.06	0.34	1.01	8.19	0.5
Link Road	0.08	3.7	0.08	0.08	3.99	0.07

The modelling results indicate the compact roundabout design has adequate capacity to operate efficiently under the highest expected demand. A comparison of the existing flows under the roundabout arrangement shows that while there may be marginally longer queues (still less than 1 PCU) and slightly less reserve capacity, delay per vehicle will be decreased.

5.2.4 Option 2 – Signalised Junction

Full modelling outputs are available in **Appendix B**. Table 5.6 to Table 5.9 below and overleaf present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 5.6 Priory Drive / Marsh House Lane Option 2 (2015) AM

Existing Flows (2015) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**27.80%**	**2.6**	**-**	**-**
Marsh House Lane (W)	26.10%	0.9	13.2	2.9
Ivinson Road	0.00%	0	0	0
Marsh House Lane (E)	27.50%	0.9	12.9	3
Priory Drive	27.8 : 27.8%	0.8	24.1	1.5

Table 5.7 Priory Drive / Marsh House Lane Option 1 (2015) PM

Existing Flows (2015) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**29.80%**	**2.6**	**-**	**-**
Marsh House Lane (W)	29.80%	0.9	10.9	4
Ivinson Road	0.00%	0	0	0
Marsh House Lane (E)	24.30%	0.7	9.8	3.1
Priory Drive	29.3 : 29.3%	0.9	29.4	1.3

Table 5.8 Priory Drive / Marsh House Lane Option 2 (2026) AM

Do Something – High Growth (2026) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**35.20%**	**3.4**	**-**	**-**
Marsh House Lane (W)	30.90%	1.1	11.1	4.7
Ivinson Road	18.50%	0.5	31.3	0.9
Marsh House Lane (E)	35.20%	0.8	10	3.5
Priory Drive	34.8 : 34.8%	1	30.9	1.5

Table 5.9 Priory Drive / Marsh House Lane Option 2 (2026) PM

Do Something – High Growth (2026) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**38.30%**	**4**	**-**	**-**
Marsh House Lane (W)	38.30%	1.3	11.6	5.6
Ivinson Road	22.80%	0.6	32.7	1.2
Marsh House Lane (E)	30.50%	0.9	10.3	4.1
Priory Drive	38.3 :	1.2	32.3	1.9

The results show that the introduction of signals to the junction increases the overall delay experienced. However, the results show that a signalised option has marginally greater capacity than the compact roundabout, with a DoS of 38.3% compared to an RFC of 39% in the PM 2026 peak period.

The signals incorporate a pedestrian crossing across each arm, which necessitates an all-red stage to accommodate the pedestrian movements. The junction was modelled assuming this pedestrian phase would be only called when demanded, and estimated to be approximately every third cycle. In reality, this may be more frequent in peak pedestrian times, such as school or commuting periods, and be less frequently demanded in off-peak hours.

5.3 Conclusion

If assessing the junction purely on delay, Option 1 provides the greatest benefit. Table 5.10 overleaf provides a comparison of delay in each scenario for each option, clearly showing the benefits of the compact roundabout option.

Table 5.10 Priory Drive / Marsh House Lane Comparison of Delay

		Delay (Hours)		
Scenario	**Period**	**Existing**	**Option 1**	**Option 2**
2015	AM	1.10	0.86	2.60
	IP	0.73	0.56	1.70
	PM	1.26	1.08	2.60
2026	AM	-	1.18	3.60
	IP	-	0.75	2.30
	PM	-	1.56	3.70
2026 Low	AM	-	1.06	3.30
	IP	-	0.69	2.10
	PM	-	1.39	3.40
2026 High	AM	-	1.30	3.80
	IP	-	0.82	2.50
	PM	-	1.75	4.00

However, a signalised junction has other benefits, such as the potential to cater for pedestrians through signalised crossing points or cyclists through the inclusion of Advanced Stop Lines. However, the evaluation of other benefits and disbenefits of each option is beyond the scope of this report.

5.4 Design Review Update

Following detailed design review, the compact roundabout option detailed as Option 1 above was taken forward as the proposed option. Adjustments have been made to the proposed geometry and alignment of the roundabout since option modelling was undertaken. Updated modelling results can be found in Table 5.11 overleaf. The Do-Minimum results are for the same Do-Minimum proposed priority junction outlined previously. Full updated model output reports are available in appendix C.

Table 5.11 Marsh House Lane/ Link Road/ Priory Drive Updated Proposal Comparison

		Average Delay per PCU (S)		
Scenario	**Period**	**Existing**	**Do Min**	**Option**
2015	AM	7.08	6.60	4.99
	IP	6.83	6.08	4.69
	PM	7.69	6.53	4.56
2019	AM	7.28	6.58	5.15
	IP	6.95	6.16	4.80
	PM	7.92	6.69	5.71
2026	AM	7.12	6.97	5.10
	IP	6.81	6.41	4.77
	PM	7.70	6.83	5.78

6. Ivinson Road North Options

As Noted in Section 1.1, following a detailed design review the original chosen options for Ivinson Road North outlined within this chapter are no longer being taken forward. These include:

- A short extension to Ivinson Road to create a link to Chapels/Goose House Lane/Moor Lane; and
- A new junction at the convergence of Ivinson Road/Chapels/Goose House Lane/Moor Lane.

New Proposed options being taken forward for Ivinson Road North are detailed in Section 6.5.

6.1 Existing Conditions and Proposals

It is proposed that the route of the DEDC terminates at the northern end of Ivinson Road, which will be subsumed within the proposed link road. Ivinson Road currently runs in a south-east to north-west alignment, and is connected to the wider network by Elm Grove and Anyon Street to the south and by Oak Grove to the north; Ivinson Road currently terminates in a cul-de-sac at either extent, with turning heads available. It is a primarily residential street with footways either side, a grass verge on the southern side, and a wide grassy verge to the north, with a slight gradient leading to the dwellings there. A number of trees have been planted along this verge. There are also a number of parking bays set aside from the main carriageway. The extent of Ivinson Road is shown in Figure 6.1 below.

Figure 6.1 Arial Image of Ivinson Road

Two different alignments are proposed to link Ivinson Road directly into the network at the northern end.

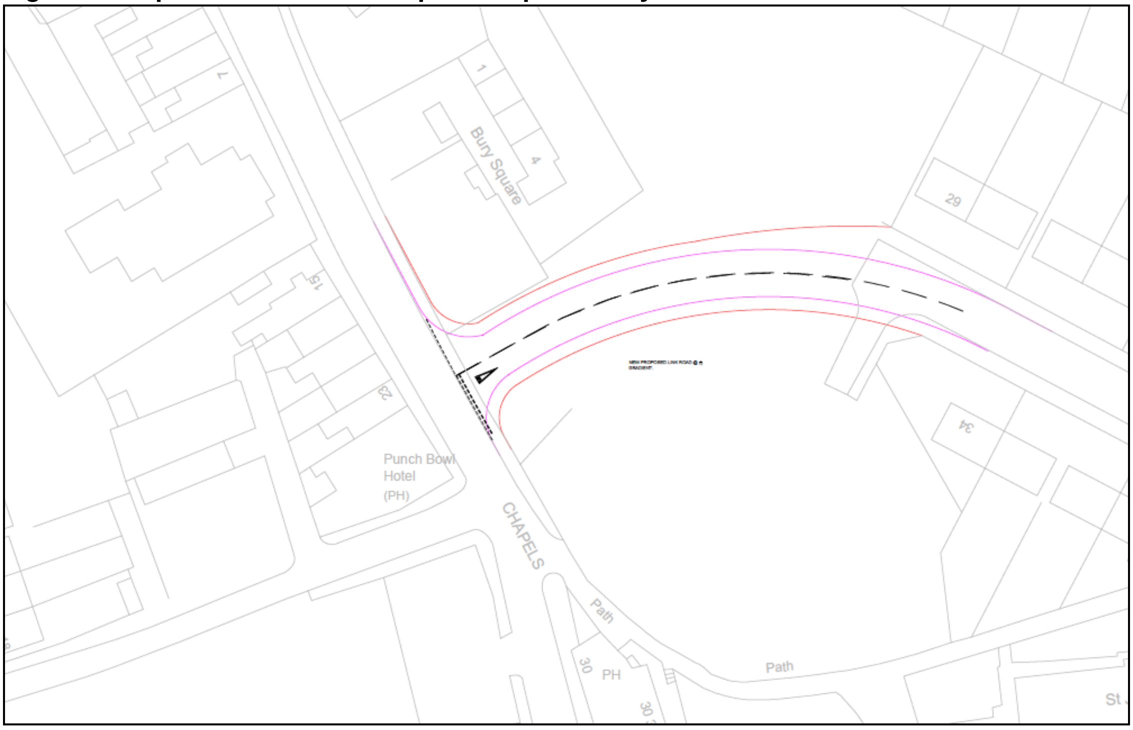
6.1.1 Option 1 – Link to Chapels

Option 1 proposes to connect the northern end of Ivinson Road into Chapels just south of the existing dwellings on the eastern side. Although this option would require the least engineering, the gradient between the two is relatively steep, estimated to be at least 1:12. The current layout is shown in Figure 6.2 below.

Figure 6.2 Arial Image of Land between Ivinson Road and Surrounding Network

The proposals would create a new priority junction, with chapels remaining as the major road and Ivinson road forming the minor arm. Figure 6.3 overleaf shows the proposed layout. Full drawings are available in **Appendix A**.

Figure 6.3 Option 1 – Link to Chapels Proposed Layout



6.1.2 *Option 2 – Chapels / Goose House Lane / Moor Lane Priority Junction*

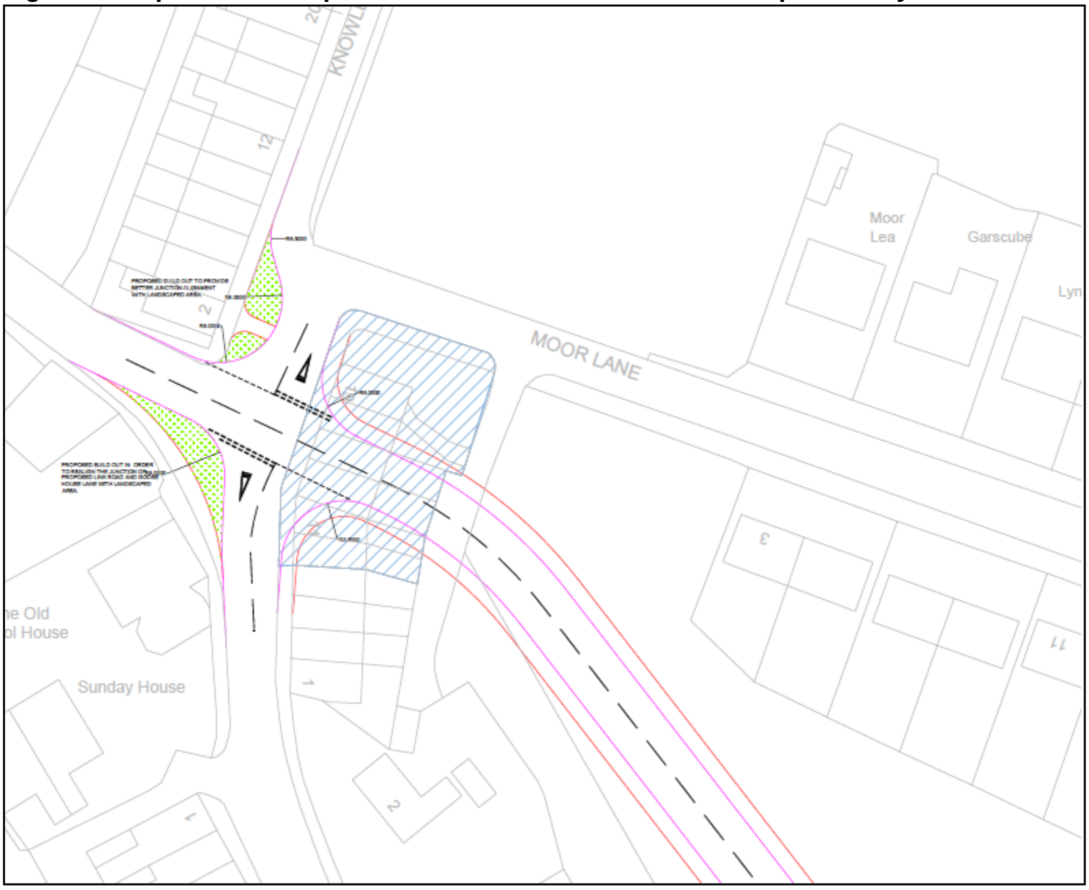
Currently, the existing Chapels / Goose House Lane / Moor Lane junction is a 3-arm priority arrangement, with Moor Lane forming the minor arm. The junction has some unusual constraints; Moor Lane adjoins abruptly after a 90 degree turn, with Knowle Lane meeting in an informal priority arrangement at the northern extent of this turn. The carriageway is wider in the vicinity of the junction, potentially allowing more room for vehicles to queue without blocking other movements. Some hatched markings have been applied to the carriageway to better delineate the junction. The current arrangement is shown in Figure 6.4 overleaf.

Figure 6.4 Arial Image of Chapels / Moor Lane / Goose House Lane

The addition of Ivinson Road as a fourth arm would mitigate any issues caused by the gradient into Chapels, but would necessitate the compulsory purchase of approximately 6 dwellings at the junction.

Option 2 proposes the creation of a priority crossroad junction. Ivinson Road leading into Goose House Lane would form the major arm, with Moor Lane to the north and Chapels to the South as the minor arms. Footways are provided, and build-outs are added to align the junction, particularly at Moor Lane / Knowle Lane. Figure 6.5 overleaf shows the proposed layout. Full drawings are available in **Appendix A**.

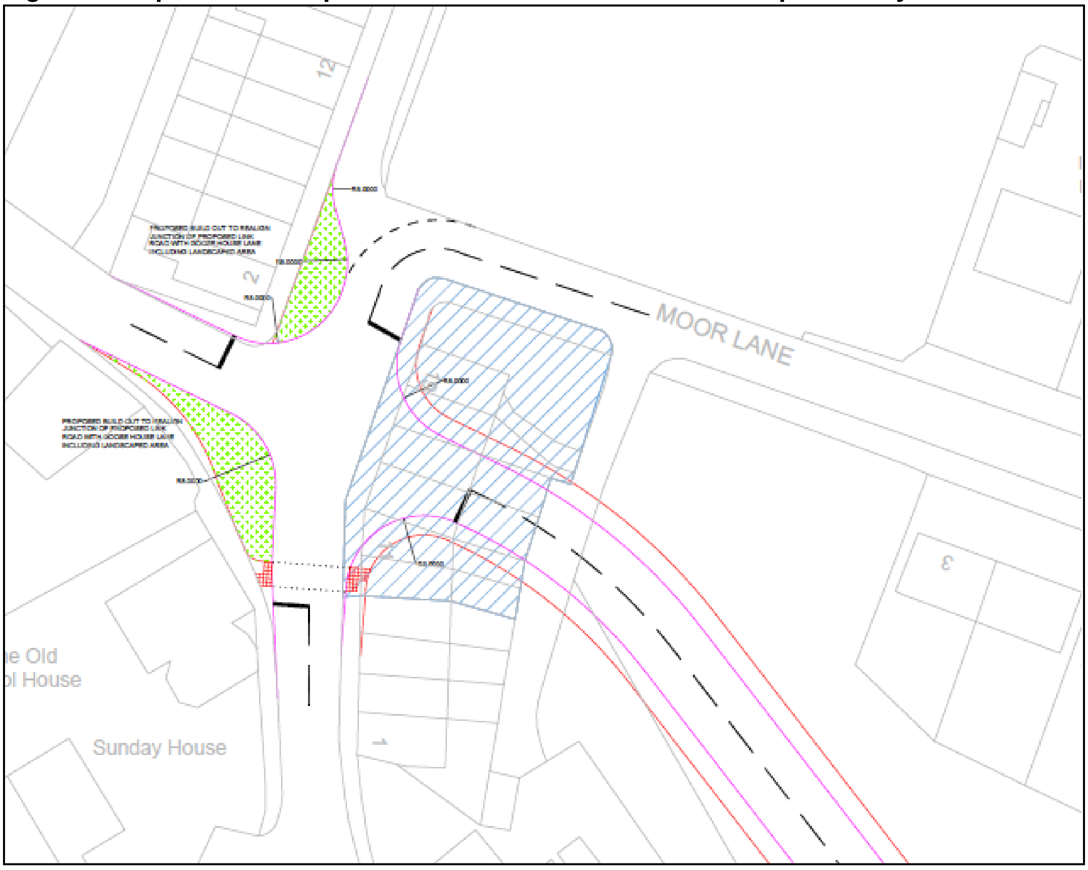
Figure 6.5 Option 2 – Chapels / Goose House / Moor Lane Proposed Layout



6.1.3 Option 3 - Chapels / Goose House Lane / Moor Lane Signalised Junction

This option has a similar layout to Option 2, but incorporates traffic signals rather than relying on a priority working. The option also includes a pedestrian crossing over the Chapels approach. Figure 6.5 overleaf shows the proposed layout. Full drawings are available in **Appendix A**.

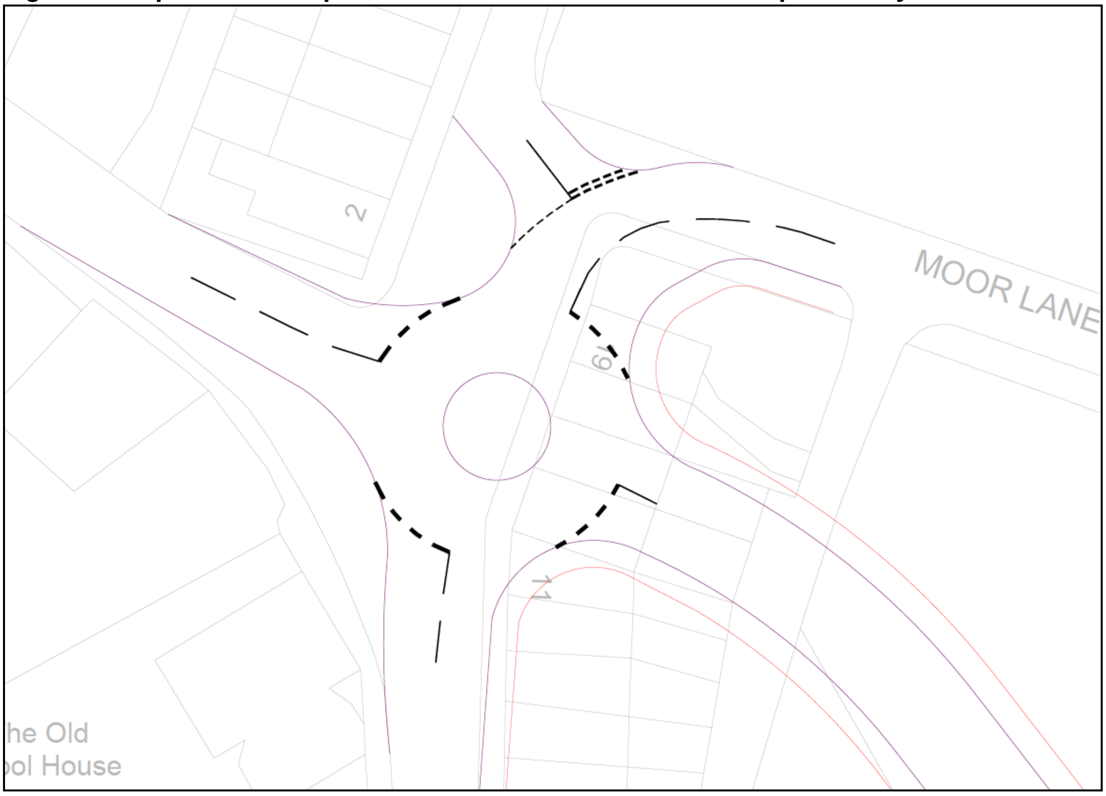
Figure 6.6 Option 3 – Chapels / Goose House / Moor Lane Proposed Layout



6.1.4 *Option 4 – Chapels / Goose House Lane / Moor Lane Roundabout*

This option utilises the same approaches as Options 1 and 2, but the junction is replaced with a roundabout. The turning radius from moor lane on the junction approach is increased in order to accommodate the required geometries and remove the 90 degree bend. A wider build out is required on the opposite side of the approach to define the priority access to Knowle Lane. Figure 6.7overleaf shows the proposed layout. Full drawings are available in **Appendix A**.

Figure 6.7 Option 4 – Chapels / Goose House / Moor Lane Proposed Layout



6.2 Results

6.2.1 Existing Priority Junction

Full modelling outputs are available in **Appendix B**. Table 6.1 and Table 6.2 below and overleaf present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 6.1 Chapels / Goose House / Moor Lane Existing Junction (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Moor lane - Chapels	0.05	10.58	0.05	0.15	15.38	0.13
Moor Lane - Goose House	1.3	21.19	0.57	2.55	42.93	0.73
Chapels - Moor Lane	0.24	7.49	0.19	1.45	12.09	0.58

The results indicate that the existing junction operates with few operational issues. The right-turn movement from Moor Lane to Goose House Lane suffers an average delay of 43 seconds per vehicle, with queues of approximately 2.5 PCUs in the PM peak period.

The junction was also tested in the future year scenario, assuming that development went ahead but that this junction remained in its current arrangement, such as would occur were Option 1 progressed. The results of the ‘high growth’ scenario are presented in Table 6.2 below.

Table 6.2 Chapels / Goose House / Moor Lane Existing Junction (2026)

Do Something – High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Moor lane - Chapels	2.42	555.38	1.1	7.48	786.23	1.44
Moor Lane - Goose House	24.12	209.26	1.08	54.75	618.2	1.42
Chapels - Moor Lane	0.27	7.5	0.2	3.07	21.98	0.78

The results suggest that the junction will be unable to accommodate the highest expected level of demand in the future year. The implication is that were the link road connected to the wider network elsewhere the resultant flows would potentially exceed this junction’s capacity, suggesting that mitigation would be required at this junction even were it not ultimately selected as the end point for Ivinson Road.

6.2.2 Option 1 – Link to Chapels

The creation of this junction is dependent on the development being undertaken, and has therefore not been modelled with the current (2015) flows. Full modelling outputs are available in **Appendix B**. Table 6.3 below presents the results of the high-growth future scenario.

Table 6.3 Ivinson / Chapels Option 1 (2026)

Do Something – High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Ivinson Rd - Chapels	0.17	10.3	0.15	0.14	13.64	0.13
Chapels (s) - Ivinson Rd	0.03	4.55	0.03	0.29	3.93	0.12

The results show that the priority arrangement would provide adequate capacity under the expected highest level of future demand. Queues do not exceed a single PCU, while the maximum average delay per PCU is approximately 14 seconds.

The junction is also expected to have considerable reserve capacity, allowing the potential for further growth without any additional mitigation.

6.2.3 *Option 2 – Chapels / Goose House Lane / Moor Lane Priority Junction*

Full modelling outputs are available in **Appendix B**. Table 6.4 and Table 6.5 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 6.4 Chapels / Goose House / Moor Lane Option 2 (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Chapels - Goose House / Moor Lane	1.35	13.66	0.58	74.65	527.92	1.27
Chapels - Ivinson	0.2	14.19	0.16	17.85	577.03	1.23
Ivinson - Moor Lane	0	0	0	0	0	0
Moor Lane	1.82	28.01	0.66	11.8	158.97	1.06
Goose House- Chapels	2.12	18.23	0.68	1.89	16.3	0.65

Table 6.5 Chapels / Goose House / Moor Lane Option 2 (2026)

Do Something – High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Moor lane - Chapels	4.3	34.25	0.83	338.24	2796.51	2.04
Moor Lane - Goose House	0.57	34.29	0.37	66.54	2882.22	1.92
Chapels - Moor Lane	0.01	6.67	0.01	0.01	7.77	0.01
Moor Lane	29.65	277.39	1.14	300.32	1E+10	1E+10
Goose House- Chapels	2.55	20.7	0.72	10.91	64.9	0.94

The results of the modelling indicate that a priority crossroads arrangement will have considerable capacity issues under existing flows, and the introduction of development traffic and background growth exacerbate these issues.

6.2.4 *Option 3 - Chapels / Goose House Lane / Moor Lane Signalised Junction*

Full modelling outputs are available in **Appendix B**. Table 6.6 to Table 6.9 overleaf present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 6.6 Chapels / Goose House / Moor Lane Option 3 (2015) AM

Existing Flows (2015) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**67.70%**	**7.6**	**-**	**-**
Goose House Lane	67.70%	3	27.9	7.6
Ivinson Road	0.00%	0	0	0
Moor Lane	66.10%	2.4	38.7	5.1
Chapels	55.80%	2.2	20.9	6.9

Table 6.7 Chapels / Goose House / Moor Lane Option 3 (2015) PM

Existing Flows (2015) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**93.70%**	**18.7**	**-**	**-**
Goose House Lane	93.70%	8.1	75.7	14.2
Ivinson Road	0.00%	0	0	0
Moor Lane	92.60%	6.2	94.9	9.4
Chapels	79.00%	4.3	22.4	13.8

Table 6.8 Chapels / Goose House / Moor Lane Option 3 (2026) AM

Do Something – High Growth (2026) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**97.60%**	**23.2**	**-**	**-**
Goose House Lane	96.80%	10.8	93.8	16.3
Ivinson Road	11.50%	0.4	22.6	1.1
Moor Lane	97.60%	9.7	103.2	14.1
Chapels	61.20%	2.4	17.9	8

Table 6.9 Chapels / Goose House / Moor Lane Option 3 (2026) PM

Do Something – High Growth (2026) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**170.90%**	**243.3**	**-**	**-**
Goose House Lane	168.10%	146.9	27.9	7.6
Ivinson Road	11.20%	0.3	0	0
Moor Lane	170.90%	88.4	38.7	5.1
Chapels	90.30%	7.7	20.9	6.9

The results show that the junction has capacity issues in the PM peak period under the current demands, and is considerably over capacity in the 2026 future scenario.

The signalised option was further tested with various alterations, including a left turn slip lane from Chapels to Goose House Lane, a right turn lane for the return movement, and the removal of the pedestrian phase, but the constraints of the site make certain variations less practicable, and the corresponding increase in capacity was still less than desirable.

6.2.5 Option 4 – Chapels / Goose House Lane / Moor Lane Roundabout Results

Full modelling outputs are available in **Appendix B**. Table 6.4 and Table 6.5 below present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 6.10 Chapels / Goose House / Moor Lane Option 4 (2018)

Do Something – Core (2018)						
	AM			**PM**		
	Queue	**Delay**	**RFC**	**Queue**	**Delay**	**RFC**
Ivinson Road	0.03	4.78	0.03	0.02	4.97	0.02
Chapels	0.66	5.05	0.4	1.76	8.28	0.64
Goose House Lane	0.6	5.38	0.37	1.13	7.87	0.53
Moor Lane	0.41	5.18	0.29	0.41	5.44	0.29

Table 6.11 Chapels / Goose House / Moor Lane Option 4 (2026)

Do Something – High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Ivinson Road	0.1	5.55	0.09	0.07	5.88	0.07
Chapels	0.94	6.28	0.49	4.5	17.83	0.83
Goose House Lane	0.76	6.04	0.43	2.05	11.96	0.68
Moor Lane	0.63	6.15	0.39	0.71	6.98	0.42

The results indicate that a four-arm roundabout will have sufficient capacity to operate successfully under the highest expected demands in 2026. However, Chapels approach is almost at practical capacity, recording an RFC of 0.83 in the 2026 high growth peak period.

6.3 Option 1 – Associated Mitigation Measures

The following section presents two options tested for mitigation measures at the existing Goose House Lane / Moor Lane / Chapels junction to complement Option 1 (Ivinson Road – Chapels).

6.3.1 Option 1a Chapels / Goose House Lane / Moor Lane Signalised

This option uses the existing layout, adding a build-out in place of the hatched markings in the vicinity of the properties at the end of Moor Lane approach. The wider carriageway at the junction allows for a number of right-turners from Chapels to Moor Lane to wait in storage and not block the ahead movements.

Full modelling outputs are available in **Appendix B**. Table 6.12 to Table 6.15 below and overleaf present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 6.12 Chapels / Ivinson Option 1a (2015) AM

Existing Flows (2015) AM				
Lane Description	Deg Sat (%)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
-	**46.90%**	**4.4**	-	-
Goose House Lane	46.40%	1.5	13.4	4.5
Moor Lane	46.90%	1.4	22.3	3.1
Chapels	45.50%	1.6	14.9	4.4

Table 6.13 Chapels / Ivinson Option 1a (2015) PM

Existing Flows (2015) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**65.70%**	**6.7**	**-**	**-**
Goose House Lane	35.30%	1	9.7	4.2
Moor Lane	65.40%	2.5	38.6	5.1
Chapels	65.70%	3.1	16	10.8

Table 6.14 Chapels / Ivinson Option 1a (2026) AM

Do Something – High Growth (2026) AM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**67.80%**	**7.4**	**-**	**-**
Goose House Lane	56.20%	2	17	5.1
Moor Lane	67.80%	2.6	24.1	5.6
Chapels	67.10%	2.8	21.2	6.6

Table 6.15 Chapels / Ivinson Option 1a (2026) PM

Do Something – High Growth (2026) PM				
Lane Description	**Deg Sat (%)**	**Total Delay (pcuHr)**	**Av. Delay Per PCU (s/pcu)**	**Mean Max Queue (pcu)**
-	**86.90%**	**14.8**	**-**	**-**
Goose House Lane	51.40%	2	12.4	8.8
Moor Lane	86.40%	5.6	59.5	10.7
Chapels	86.90%	7.2	31.3	21.8

6.3.2 *Option 1b Chapels / Goose House Lane / Moor Lane Roundabout*

The option also utilises the current layout, although a small amount of footway is lost to accommodate the appropriate geometries. The proposed layout is shown in Figure 6.8 below.

Figure 6.8 Option 1b Chapels / Goose House / Moor Lane proposed Layout

Full modelling outputs are available in **Appendix B**. Table 6.16 and Table 6.17 below and overleaf present the results of the 2015 existing flows and the high-growth future scenario for comparative purposes.

Table 6.16 Chapels / Ivinson Option 1b (2015)

Existing Flows (2015)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Goose House Lane	0.78	6.52	0.44	0.9	7.65	0.48
Moor Lane	0.19	2.86	0.16	0.21	2.87	0.17
Chapels	0.57	5.03	0.37	2.09	9.94	0.68

Table 6.17 Chapels / Ivinson Option 1b (2026)

Do Something – High Growth (2026)						
	AM			PM		
	Queue	Delay	RFC	Queue	Delay	RFC
Goose House Lane	0.86	6.86	0.46	2.47	14.51	0.72
Moor Lane	0.39	3.36	0.28	0.36	3.46	0.26
Chapels	1.06	7.27	0.52	5.53	22.88	0.86

The results indicate that the proposed roundabout will have sufficient capacity to accommodate the current demands. Under the highest expected future demand (2026 'High Growth' scenario) the junction is approaching capacity, with Chapels approach recording an RFC of 0.86 in the PM peak period, and delays of over 20 seconds per vehicle.

6.4 Conclusion

The results of the modelling clearly suggest that 'Option 1 – Link to Chapels' is the most appropriate option in terms of modelling outputs. Table 6.18 overleaf compares the delay associated with each option, highlighting the considerable benefits of Option 1.

Additionally, the other proposed options all necessitate the compulsory purchase of a number of properties in the vicinity in order to accommodate a 4 – arm arrangement. Utilising Option 1 would remove this requirement and the considerable associated costs.

However, the modelling is also clear that mitigation measures will be required at the upstream Moor Lane / Chapels / Goose House Lane junction if Option 1 progressed.

Table 6.18 Ivinson / Chapels / Goose House / Moor Lane Comparison of Delay

		Junction Delay (Hours)				
Scenario	**Period**	**Existing**	**Option 1**	**Option 2**	**Option 3**	**Option 4**
2015	AM	4.51	-	-	-	
	IP	2.24	-	-	-	
	PM	8.55	-	-	-	
2026	AM	35.31	2.01	19.70	13.70	1.95
	IP	4.12	1.41	4.79	6.80	1.34
	PM	84.52	2.31	1578.73	185.90	5.16
2026 Low	AM	16.78	1.81	11.24	10.20	1.71
	IP	3.43	1.31	3.89	5.90	1.20
	PM	44.66	2.14	489.14	114.30	4.03
2026 High	AM	63.02	2.20	34.71	23.20	2.21
	IP	5.02	1.52	6.07	7.90	1.49
	PM	137.53	2.52	954643289.85	243.30	6.86

Both options proposed for this mitigation are shown to be approaching capacity under the highest expected levels of demand. Table 6.19 overleaf compares the overall delay of the two options, clearly showing the roundabout option creates the least delay.

However, the signalised option includes additional benefits such as a pedestrian crossing, which is responsible for a certain amount of delay in the model. Additionally, a MOVA system could further improve the junction performance and provide additional flexibility, although this would increase the cost.

Table 6.19 Ivinson / Chapels Mitigation Comparison of Delay

		Delay (Hours)	
Scenario	**Period**	**Compact**	**Signals**
2015	AM	1.41	4.40
	IP	0.96	3.00
	PM	2.94	6.70
2026	AM	1.86	6.60
	IP	1.30	4.30
	PM	5.64	12.40
2026 Low	AM	1.63	5.90
	IP	1.16	3.90
	PM	4.27	9.90
2026 High	AM	2.12	7.40
	IP	1.45	4.70
	PM	7.90	14.80

Further analysis of the two options should be undertaken to determine the preferred arrangement.

6.5 Design Review Update - Ivinson Road North Proposed Options

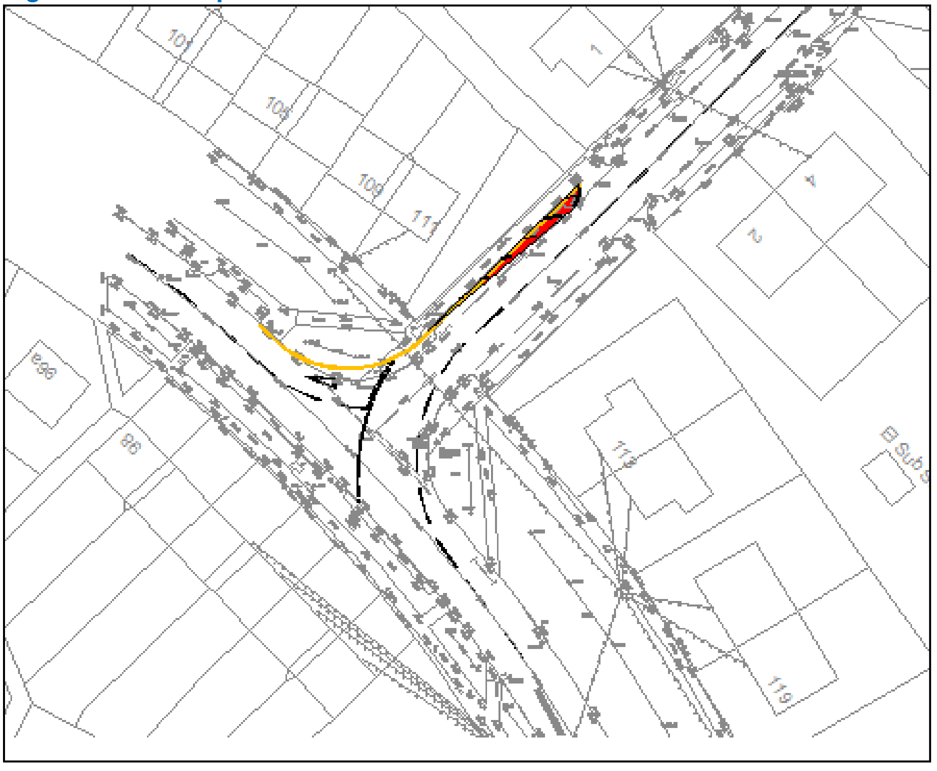
The proposed options are a change in priority at the Ivinson Road / Oak Grove junction and the Oak Grove / Holden Fold junction to create a continuous and unrestricted route through the residential area from the new Link Road. This route is illustrated in Figure 6.9 overleaf.

In order to provide the continuous route through Ivinson Road/ Oak Grove/ Holden Fold, the proposed option includes a change of priority, with Ivinson Road (west) forming the minor arm and Oak Grove/ Ivinson Road (east) forming the priority route. Double yellow lines will be incorporated into the design on the north kerb line of Ivinson Road west and Oak Grove.

The Ivinson Road/ Oak Grove junction is only expected to host low levels of local residential traffic in both baseline and future scenarios. As a result, no modelling has been performed for this junction, as traffic flows were not deemed to be sufficiently high for any junction intervention to have a perceptible impact on junction performance. Figure 6.10 overleaf indicates the proposed junction layout.

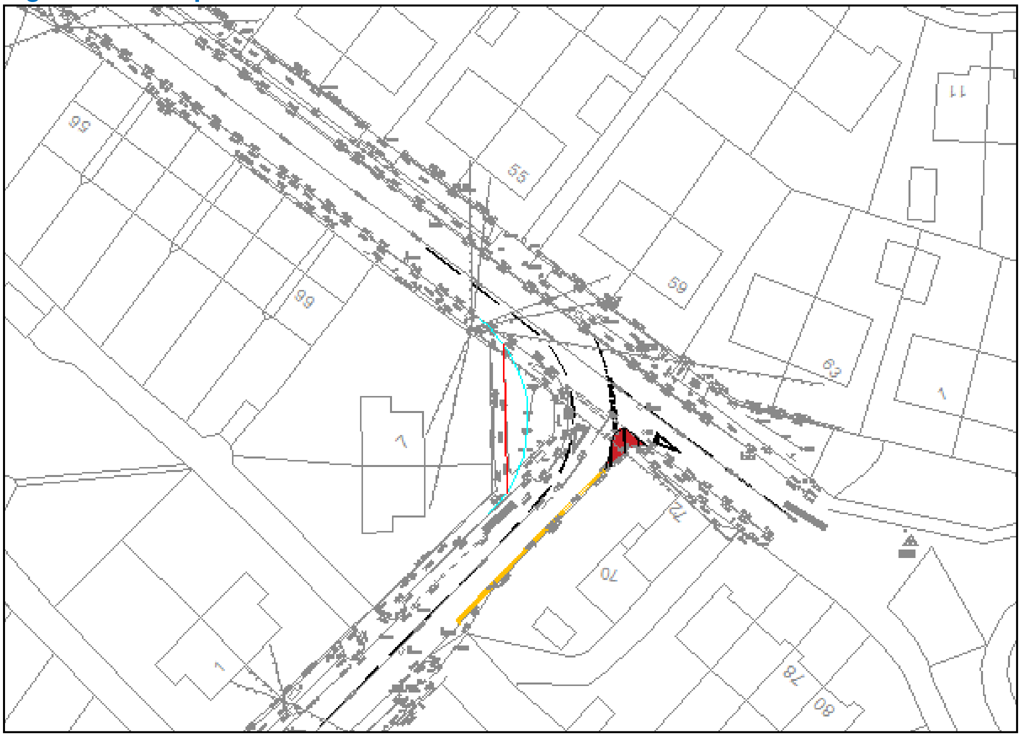
Figure 6.9 – Proposed DEDC Priority Route

Figure 6.10 – Proposed Ivinson Road/ Oak Grove Junction



The Proposed Oak Grove/ Holden Fold junction includes a change of priority from Oak Grove as the minor arm to Holden Fold west as the minor arm. The removal of a boundary wall at Oak Grove / Holden Fold (E) to improve visibility, with double yellow lines will be incorporated into the design to restrict on street parking. Figure 6.11 below details the proposed junction layout.

Figure 6.11 Proposed Oak Grove/ Holden Fold Junction



Model outputs for the proposed Oak Grove/ Holden fold junction can be found in Table 6.20 overleaf. Full updated model output reports are available in appendix C.

Through discussions with key stakeholders, a decision has been made to prioritise the main DEDC route through this section of the road network. It is acknowledged the chosen option has a detrimental impact on junction performance as compared to the existing arrangement. It has been agreed that following scheme implementation there will be a period of monitoring and evaluation after which priority arrangements and road markings will be reviewed and altered as necessary.

Table 6.20 Oak Grove/ Holden Fold Updated Proposal Comparison

		Average Delay per PCU (S)	
Scenario	**Period**	**Existing**	**Option**
2015	AM	7.45	12.02
	IP	7.18	10.19
	PM	7.69	13.74
2019	AM	7.56	13.08
	IP	7.27	10.73
	PM	7.84	15.29
2026	AM	8.06	13.46
	IP	7.72	10.87
	PM	8.81	16.43

7. Scheme Summary

Table 7.1 overleaf presents a summary of the junction layout options for each location with a preferred option identified where possible for further consideration within the development of a Strategic Outline Business Case for the Darwen East Development Corridor.

Table 7.1 Scheme Summary Table

Junction	Current Arrangement	Current Preferred Option	Further Analysis Required?	Additional Comments
A666 / Watery Lane + A666 Grimshaw Street	Priority	None (both priority)	No	Associated improvements to the junction could be carried out: Line painting, dropped kerbs and tactile paving, improve kerb line around park access. Following detailed design review, the existing priority arrangement is to be retained at both the Watery Lane and Grimshaw Street, with the addition of a dedicated right turn lane on the A666 at both junctions to accommodate an expected increase in demand for this movement in future years.
Grimshaw Street / Sough Lane / Pole Lane	Priority	Option 2 - Roundabout	Yes	Option 2 carried forward following detailed design review.
Pole Lane / Priory Drive	Priority	Compact Roundabout Mini-roundabout Final Preferred Option	Yes	Although the junction has adequate capacity, a roundabout could potentially create additional reserve capacity, and the consistency in junction design may reinforce the corridor as a distinct route. Mini roundabout Option chosen following detailed design review, identified to provide the most cost effective intervention. Additional benefit is expected following COBALT analysis of relative accident rates between junction types.
Marsh House Lane / Priory Drive / Link Road	Priority	Option 1 - Compact Roundabout	Yes	Although Option 1 has the lowest overall delay, Option 2 may offer slightly more capacity and additional benefits for cyclists and pedestrians. Roundabout option taken forward following design review with adjustments made to geometry and alignment of the proposed junction.
Ivinson Road/ Oak Grove Holden Fold Junctions	Priority Arrangement	-	-	Intervention involves a reversal of the current priority arrangement to provide a continuous priority route from the proposed road link through Ivinson Road/ Oak Grove/ Holden Fold.

Ivinson Road Northern Junction	N/A	Option 1 – Chapels / Ivinson Road Priority	Yes	This Option is no longer being taken forward.
Associated Mitigation – Chapels / goose House Lane / Moor Lane	Priority	Option 1b – Compact Roundabout	Yes	Option 1b creates the least overall delay, although the modelling suggests neither option has sufficient capacity to wholly accommodate the expected potential highest level of demand. A signalised option has additional benefits for pedestrians and cyclists, while a roundabout may contribute to traffic calming and road safety. This Option is no longer being taken forward.

Appendix A - Drawings

(Original Scheme Drawings Available on Request)

Appendix B – Modelling Outputs

(Original Model Outputs Available on Request)

Appendix C – Updated Modelling Outputs

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