Application no: R3.0138/21
Location: A linear site comprising a corridor between the A34 Milton Interchange and the B4015 north of Clifton Hampden including part of the A4130 east of the A34 Milton Interchange, land between Didcot and the former Didcot A Power Station and the Great Western Mainline, land to the north of Didcot where it crosses a private railway sidings and the River Thames to the west of Appleford-on-Thames before joining the A415 west of Culham Station, land to the south of Culham Science Centre through to a connection with the B4015 north of Clifton Hampden.

Transport Development Control

Recommendation:

Oxfordshire County Council (OCC), as the Local Highway Authority is currently recommending a holding objection to this planning application subject to the following:

- Receipt and review of additional requested technical information, prior to providing our final comments.

- The JCT audit highlighted a discrepancy in the modelling at the Ladygrove / Sires Hill junction (OFF13). The Arm names inputted by the modeller, indicate that Arm A was the WESTERN arm and Arm C was the EASTERN arm. However, as PICADY will assume Arm A is to the east and Arm C to the west, and thus the traffic flow assignment will be incorrect. OCC assume this is a labelling error and requires confirmation.

OCC Highways does not object to the principle of the HIF1 Scheme, which is supported by local, regional and national policy.

Once the further information detailed below has been received, this position will be reviewed and up-dated accordingly.

Conditions:

A list of recommended planning conditions to be imposed, will be provided with our final comments.

Comments:

1. Previous Response

1.1 In OCC Transport Development Control’s first response, dated 28th February 2022, further technical information was requested.

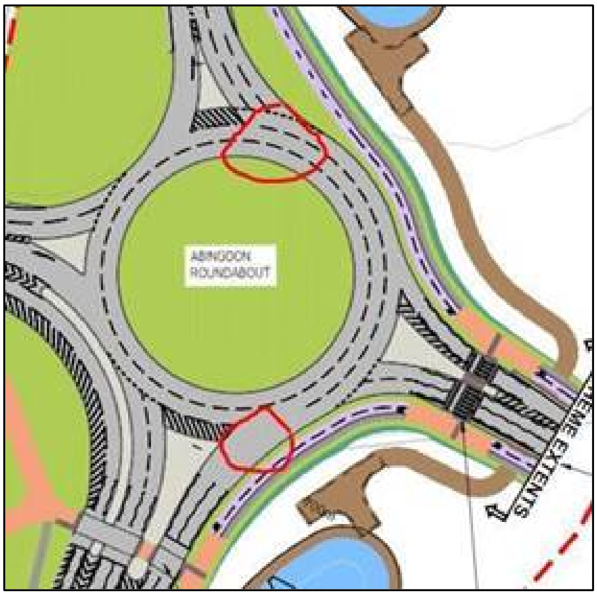
1.2 This information remains outstanding and is required to ensure that the scheme not only is compliant with The Equality Act 2010, but that it meets the necessary design standards set down in the Design Manual for Roads and

Bridges (DMRB). Therefore, to undertake a full assessment of the HIF1 Scheme, OCC Highways requires the following additional information to be submitted:

- Long sections of all the schemes within HIF1, to ensure that they are compliant with The Equality Act 2010 and where they are not, ensure there are acceptable justifications for any departures from standard.

- Swept path analysis for a coach measuring 15m in length across the scheme.

- A revised drawing of the Abingdon Roundabout, shown on GA Plan 14. The three-lane layout on only part of the roundabout, as shown below, will increase the risk of vehicle conflict at the two locations circled red. This must be resolved and/or operational clarification is required as to why only 3 lanes have been provided for part of the roundabout.



1.3 Once this additional information is received, it will be reviewed to enable our final Transport Development Control response to be issued.

1.4 The comments that follow, detail OCC Highways opinion on a range of transport related matters pertaining to this planning application.

2. Scheme Background

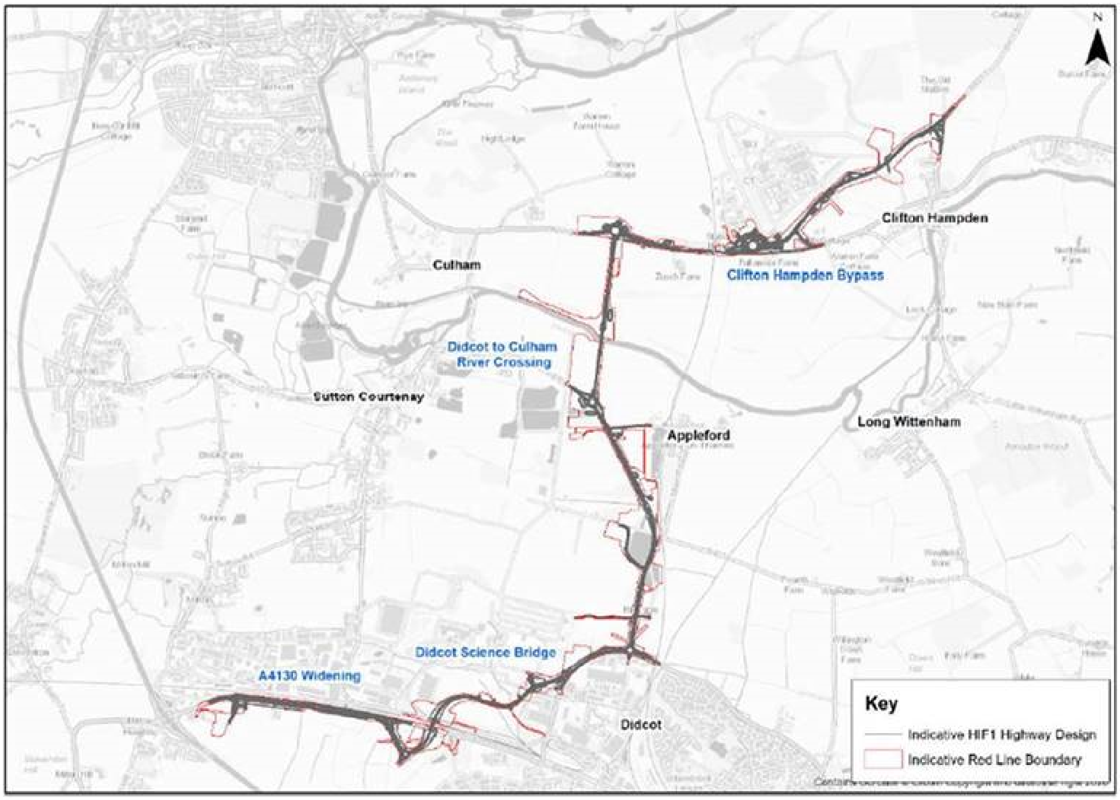
2.1 This planning application is seeking full planning permission for the dualling of the A4130 carriageway (A4130 Widening) from the Milton Gate Junction eastwards; a road bridge over the Great Western Mainline (Didcot Science Bridge); realignment of the A4130 north east of the proposed road bridge; construction of a new road between Didcot and Culham (Didcot to Culham River Crossing) including a road bridge over the River Thames; construction of a new road between the B4015 and A415 (Clifton Hampden bypass); and controlled crossings, footways and cycleways, landscaping, lighting, noise barriers and sustainable drainage systems.

2.2 The scheme package known as 'HIF1', is designed to improve access to and between future housing and employment growth in the local area, including enabling improved connectivity by walking, cycling and public transport. The scheme package is policy backed within Local Plans for both South Oxfordshire District Council (SODC) and the Vale of White Horse District Council (VoWHDC). The scheme package is also identified in OCC's Local Transport and Connectivity Plan 2022 - 2050 and is the cornerstone of mitigation for the planned growth in the area.

2.3 The HIF1 scheme package is essential for the economic and social prosperity of Science Vale UK, one of the first Enterprise Zones, in addition to other newer Enterprise Zones in the area. The HIF1 infrastructure will help to ameliorate the transport network issues resulting from historic housing and employment growth, as well as the future planned growth.

2.4 The proposed HIF1 scheme package is located in the Didcot area and runs between Milton Gate (in the west) and Clifton Hampden (to the north east) as shown in the below figure, extracted from the Transport Assessment (TA). The HIF1 scheme package is made up of four components:

- A4130 Widening;
- Didcot Science Bridge;
- Didcot to Culham River Crossing; and
- Clifton Hampden Bypass.



2.5 The HIF1 Scheme aims to address the following issues and opportunities:

1.1.1. Local and regional economy: The historic road network in Didcot and the surrounding areas is not currently fit for purpose and network pressure will be exacerbated with planned growth. There is severe congestion at key points, including where new and planned developments access the road network. The Scheme will unlock and support the delivery of circa 18,000 (including the circa 3,300 built out at Great Western Park) new homes in the area including affordable homes;

1.1.2. Local traffic issues: Didcot is a centre for distribution meaning there are more Heavy Goods Vehicles (HGVs) on the transport network than in other areas, adding to congestion and delay. There is also a need to plan now for all forms of travel, including modes that are only just starting to be tested (e.g. autonomous vehicles). Transport connectivity is poor in the area with limited and geographically constrained links making it difficult to travel between existing/ planned housing and employment sites;

1.1.3. Environment: To uphold its “Garden Town” status, developments within Didcot should positively protect and enhance the natural, built and historic environment; including making effective use of land including using brownfield sites, helping to improve biodiversity, using natural resources prudently, providing green infrastructure, addressing issues such as flood risk, climate change and minimising waste and pollution; and

1.1.4. People and local communities: There have been increasing traffic impacts on Didcot and the surrounding villages and their historic cores due to congestion, noise and air quality. The location of railway lines creates physical barriers between some housing and employment sites, including areas proposed for new development because of limited crossings, which are already reaching capacity. The River Thames is also a barrier with limited bridge/constrained historic crossings. The HIF1 Scheme will facilitate new movements across the Science Vale area. The Scheme will provide direct, safe and convenient walking cycling infrastructure across its full length and opens up opportunities for new and improved bus routes and for further improved peripheral walking and cycling connectivity.

3. ***Policy background***

3.1 The application is supported by South Oxfordshire District Council (SODC), the Vale of the White Horse District Council (VoWHDC), and Oxfordshire County Council (OCC) policies, including:

1.1.5. VoWHDC Local Plan 2031 (Part 1 and Part 2) (Core Policy 17 and 18)

1.1.6. SODC Local Plan 2035 (Policies TRANS1b and TRANS3, and the South Oxfordshire Infrastructure Delivery Plan)

1.1.7. OCC’s Local Transport and Connectivity Plan (LTCP) – Science Vale Area Strategy policy proposals SV 2.6 (Science Bridge and A4130

Widening), SV 2.13 (Clifton Hampden Bypass), and SV 2.16 (Didcot to Culham River Crossing).

3.2. The Transport Assessment (TA) also refers to a range of other policies at the local, regional and national level which further support the application.

4. Housing and employment growth

4.1. The Scheme is essential to support housing and employment growth in the area that is both already consented and planned future growth. The new infrastructure will help to alleviate both existing and forecast transport network problems in the area.

4.2. As described in the TA (paragraph 8.1.3), the railway and the River Thames create severance to effective travel movement and barriers to connectivity between homes, jobs and amenities. That coupled with existing congestion has already resulted in OCC objecting to the applications of even single dwellings. These objections have led to Local Planning Authority (LPA) refusals which have been upheld at appeal by the Planning Inspectorate. A further example is given of a VoWHDC Local Plan strategic allocation for 200 new homes that was refused planning permission on similar grounds. This demonstrates that the constrained highway network has therefore already negatively affected growth in the area and indeed new planned growth will exacerbate this.

4.3. Didcot and the surrounding area will deliver around 15,000 new homes up to 2040 in addition to circa 3,300 already built out at Great Western Park. The delivery of planned strategic residential sites will be enabled by the schemes, as well as helping to mitigate the resultant traffic generated by these new developments. The delivery of planned employment growth within Science Vale of circa 20,000 new jobs by 2031 will also be facilitated by the proposed new infrastructure.

4.4. It should also be noted that it is not appropriate that HIF1 schemes aim to address every problem on the transport network in Didcot. HIF1 is part of a wider strategy in the town and wider Science Vale area. This wider strategy also includes Didcot Northern Perimeter Road phase 3 (NPR3), Didcot Central Corridor, Golden Balls junction improvements, the Didcot Local Cycling and Walking Infrastructure Plan (LCWIP), the Science Vale Active Travel Network as well as strategic public transport enhancements, which will work together to alleviate the impacts of increased traffic generated by the large amount of growth in the area. It will also allow for more active travel focussed and public transport schemes to be delivered within Didcot itself and the wider area.

5. *Evaluation of Transport Impacts*

5.1. The Evaluation of Transport Impacts (ETI) undertaken by OCC as part of the evidence base for the VoWHDC Local Plan 2031 (Parts 1 and 2) and the SODC LP 2035 all assume that the HIF1 schemes have been delivered by the end of the applicable plan periods. As such, they are identified as a fundamental part of the mitigation strategy to address both existing and forecast transport network congestion and to facilitate the delivery of the growth allocated in these local plans. These ETIs were undertaken using the Oxfordshire Strategic (transport) Model (OSM).

5.2. Lending further weight to this, in the Inspector's Report (dated 30th November 2016) on the Examination into the VoWHDC Local Plan 2031 (Part 1), it was recognised that the package of mitigation to support the plan, which includes the HIF1 schemes, identified in the ETI (para. 144, p.39), "…would largely mitigate the impacts of the proposed new development in the district, albeit that some congestion issues would remain." This assessment was undertaken before the production of the SODC LP 2035, the subsequent identification of this additional growth helped to inform a review and update/upgrade to the HIF1 schemes as previously modelled in order to address the resultant impacts. In the Inspector's Report (dated 27th November 2020) on the Examination of the SODC LP 2035, it was recognised that the package of mitigation to support the plan, which also includes the HIF1 schemes, identified in the updated ETI (para. 214, p.214), would:

> *"…enable STRAT8 [Culham Science Centre], STRAT9 [Land Adjacent to Culham Science Centre] and STRAT10 [Berinsfield Garden Village] to proceed. They are part of a wider highway strategy to support the delivery of housing growth in the wider Didcot Garden Town area and to mitigate the impact of existing, approved and allocated developments."*

6. ***Local Plans and Five-Year Housing Land Supply***

6.1. Given the commentary provided above on the ETIs, the County Council's view of the soundness of the Local Plans is, in this respect, predicated on the assumption that the HIF1 schemes are delivered. If the progress of allocated and permitted residential developments in the area, such as 'Land Adjacent to Culham Science Centre' (3,500 dwellings) and 'Land at Berinsfield Garden Village' (1,700 dwellings), is stymied by a delay to the delivery of the HIF1 schemes or in a scenario in which they are not delivered at all, this will fundamentally undermine the delivery of the locally planned growth; five-year housing land supply will be affected.

6.2. According to the latest Housing Land Supply Statement for the VoWHDC (dated June 2021), the district council can demonstrate a 5.04 years' supply of housing land. The Housing Land Supply Statement for SODC (dated June 2021) states that the council can demonstrate a 5.33 years' supply of housing land. In both cases, this includes an assumption that developments affected by the delivery of HIF1 are delivered according to an anticipated trajectory. With this in mind, the current housing land supply position is sensitive to any delays in housing delivery and could be undermined by issues stemming from delivery of the HIF1 schemes.

6.3. It is possible that, without HIF1 schemes, other potential strategic sites that were not included in either Local Plans will present themselves as viable alternatives, or that there will be an increase in planning appeals.

7. *Housing and Growth Deal and Oxfordshire Plan 2050*

7.1. As stated in the Outline Agreement for the Oxfordshire Housing and Growth Deal, Government's commitment to provide funding to help facilitate the ambitious growth targets is contingent on Oxfordshire (i.e. the four district councils, Oxford city council, and the County Council) planning for 100,000 new homes between 2011 and 2031 and submitting and adopting a joint statutory spatial plan.

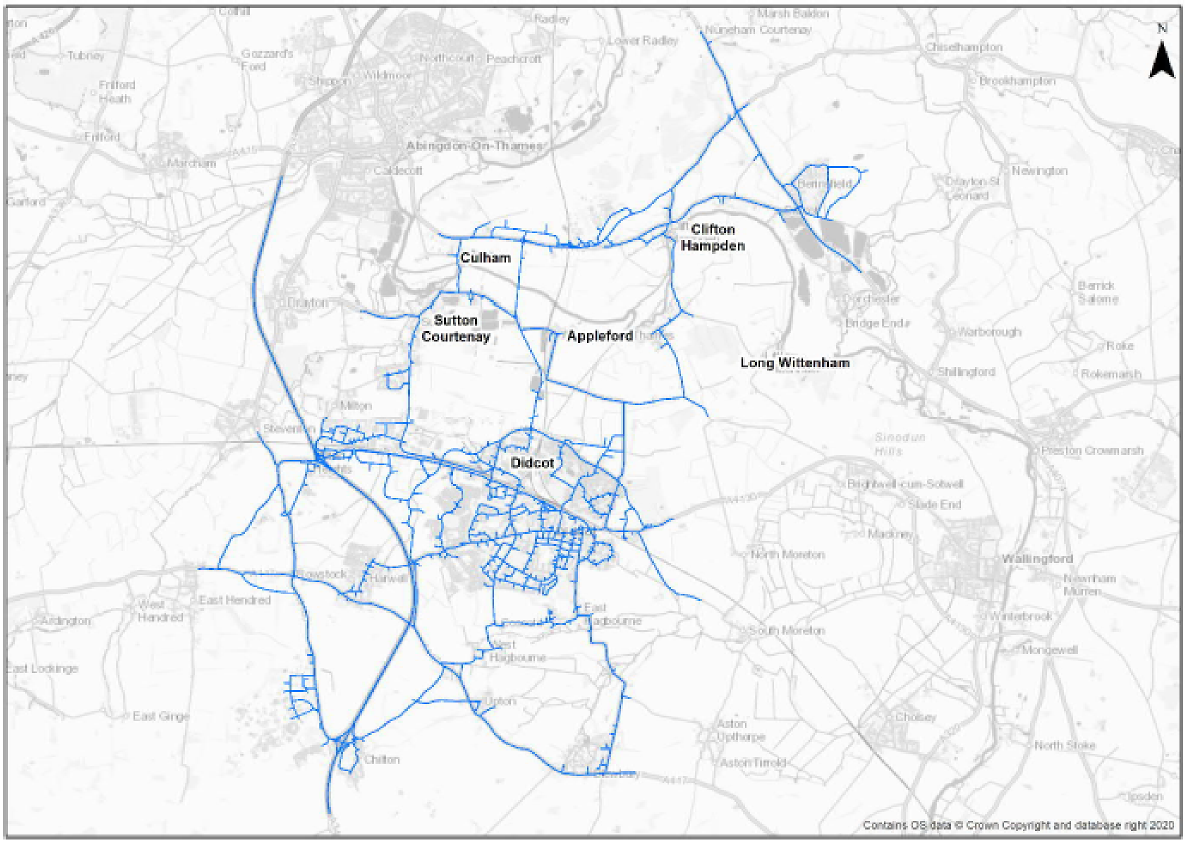
7.2. As the delivery of this housing target is dependent on the growth allocated in the adopted Local Plans across the county (plus more to be planned in the Oxfordshire Plan 2050), if the HIF1 schemes are not delivered this will render much of the growth allocated in the VoWHDC Local Plan 2031 and SODC LP 2035 undeliverable.

8. *Modelling Assessment Methodology*

8.1. In order to undertake the junction assessments, traffic data has been obtained from the Didcot Paramics microsimulation model (sometimes referred to as the Didcot Garden Town Model or DGT Model). This model is run on behalf of OCC by Systra.

8.2. Data extracted from the Didcot Paramics microsimulation model was provided to AECOM by OCC/Systra for the assessment of transport impacts on the road network.

8.3. The model area extends from the A417 east of East Hendred in the west, through to A4130 Hadden Hill in the east. The network includes the A34 (Chilton Through to Milton Interchange), and up to A4074 Golden Balls Roundabout in the North. The Paramics model extent is shown in Figure 5.1 in TA and is provided below.



8.4. OCC are satisfied that the development of the base model is robust and meets the necessary compliance, as detailed in the Systra report ‘Didcot Microsimulation Base Model Development Report’ (2018). Traffic demands were informed by data from OSM to ensure that the traffic patterns within the study area were as consistent as possible with those in the strategic model. Journey time data was utilised to validate the model against WebTAG criteria.

8.5. The model includes housing and employment completion trajectories as supplied by the relevant LPAs (VoWHDC and SODC). These were updated in June-August 2020, in preparation for the work to support this planning application. Table 5.1 and Table 5.2 in the TA show the additional residential units and employment floor area assumed to be complete over the 2017 base year for the 2020, 2024 and 2034 scenarios, all of which were agreed with OCC.

8.6. In addition to the Proposed Scheme infrastructure in the ‘with HIF scheme’ modelling, the infrastructure outlined in Table 5.3 of the TA has been included in the Paramics modelling. The infrastructure outlined in the table is cumulative and therefore once present in the modelling is also present for any future year scenarios, as agreed with OCC.

8.7. The AM and PM peak hours identified from the flow turning counts are 08:00-09:00 and 17:00 -18:00. Systra provided these flows, which have been used to inform the individual junction modelling presented in the TA.

8.8. Figure 5.2 provides a modelling approach overview. It shows how the model has been run for each of the future years and is a useful diagram, which clearly articulates the modelling steps/decisions that have been made during this assessment process.

8.9. It should be noted that the model for the 2034 scenario assumes 100% demand of existing trips present in the 2017 base (it assumes existing residents in the model area do not change travel patterns) and 80% of demand for new growth (associated with new developments). The justification for this approach was agreed with OCC for the following reasons:

8.9.1. As the model uses a generic trip rate across all development in the area, a demand reduction was required to align the trip generation with trip rates that have been recently accepted by OCC for planning applications in Didcot (as shown in table 5.4 on the TA). As shown in table 5.4, the Paramics Model trip rates for the AM and PM peak hours, is higher than those agreed for Didcot North East (P15/S2902/O), Valley Park (P14/V2873/O) and South of the A4130 (P16/S3609/O).

8.9.2. It is assumed that the Didcot Garden Town principles will continue to be enacted in this area over the next 14 years, increasing the usage of sustainable modes of travel. Modal shift from these developments later in the plan period (over a decade away) is more likely as they are coming alongside significantly improved pedestrian / cycle / public transport provisions. The Paramics model is not multi-modal so cannot automatically account for improved Non-Motorised User (NMU) infrastructure, therefore a demand reduction is used as a proxy.

8.9.3. The largest new development sites follow good spatial strategies and are in more sustainable locations near public transport hubs and / or are located nearer the growing employment areas which will have significantly improved NMU routes.

8.10. When the model was initially run, it exhibited significant congestion in 2034 with the full development demand in place. To enable results to be extracted for comparisons, in the 2034 'without HIF' scenarios, the model has been run at 70% total demand (70% of everything, after the demand reduction explained in paragraph 8.9), as this value enabled the model to run without gridlock. Modelled journeys were able to be completed, and therefore data could be extracted. This data has then been factored back up to 100% to calculate the 'factored' flow e.g. how many vehicles would have wanted to go through that junction, if the network had not been gridlocked. As shown in Figure 5.2 of the TA, the 70% factoring exercise was not undertaken for the 2034 without HIF journey time and speed data presented in the TA. This approach was agreed by OCC.

8.11. This emphasises the fact that OCC cannot plan for 100% of demand at residential development sites; it is essential to plan for growth in active travel modes such as walking and cycling, as well as increased public transport use, to help to reduce the demand on the highway network and therefore traffic levels. The information above also demonstrates the critical situation that the highways network in and around Didcot would be in without the HIF1 schemes, but with the existing and planned residential and employment growth in the area.

8.12. All major new and existing junctions along the route of the scheme have been included in the modelling assessment. For the purposes of the modelling assessment, any junctions forming part of the new scheme have been given the prefix 'SCH' and those that are off site to the scheme have been given the prefix 'OFF'.

8.13. The junctions that were agreed with OCC to be included in the junction modelling are:

Scheme Junctions:

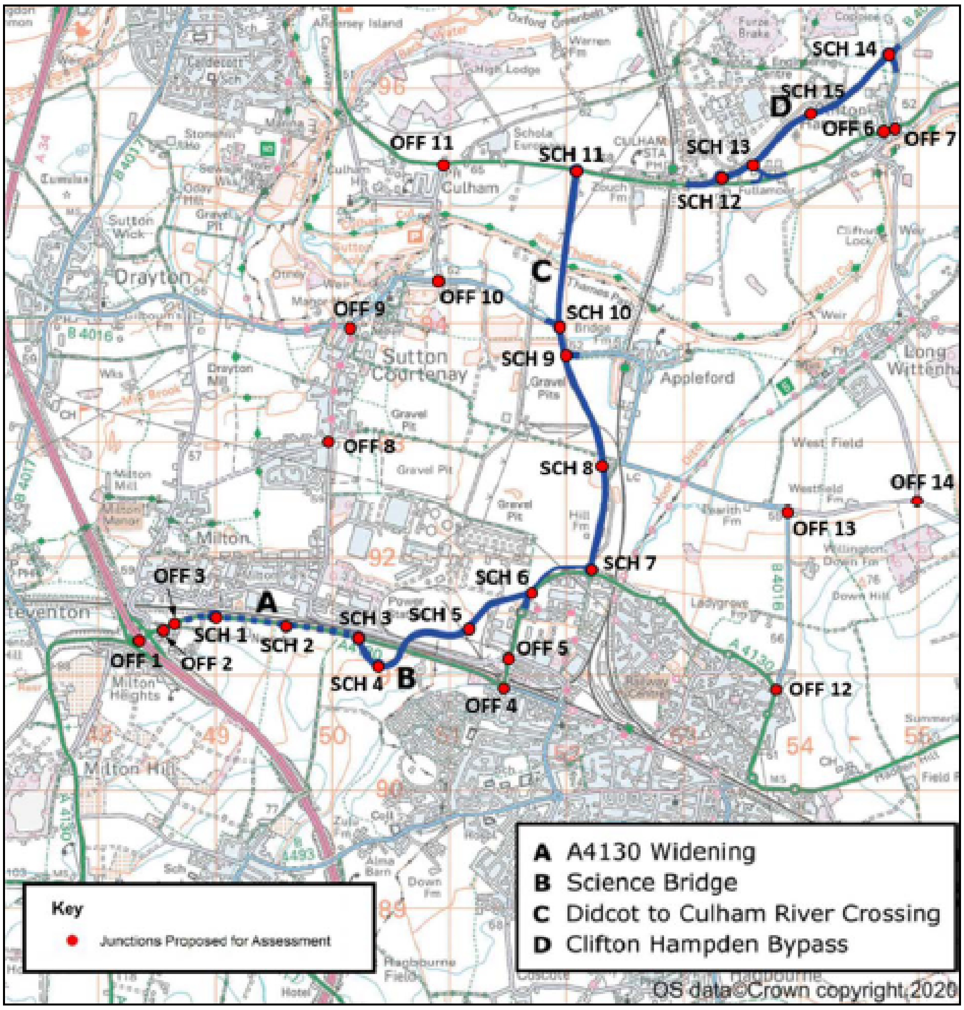
- SCH 1 A4130 / Service Area / North West Valley Park roundabout
- SCH 2 A4130 / Valley Park access signalised junction
- SCH 3 A4130 / Science Bridge Link roundabout
- SCH 4 Valley Park Spine Road / Science Bridge Link roundabout
- SCH 5 Science Bridge Link Road and New Purchas Road priority junction
- SCH 6 A4130 / Science Bridge priority junction
- SCH 7 A4130 / New Thames River Crossing / Collett roundabout
- SCH 8 New Thames River Crossing / Hanson and FCC Access Road priority junction
- SCH 9 New Thames River Crossing / B4016 priority junction
- SCH 10 New Thames River Crossing / B4016 roundabout
- SCH 11 New Thames River Crossing / A415 roundabout
- SCH 12 A415 / Clifton Hampden Bypass / Culham Science Centre roundabout
- SCH 13 Clifton Hampden Bypass / realigned A415 priority junction
- SCH 14 Clifton Hampden Bypass / B4015 priority junction
- SCH 15 Clifton Hampden Bypass / Culham Science Centre Access

Off-site Junctions:

- OFF 1 A34 / A4130 Milton interchange
- OFF 2 A4130 / Service Area priority junction
- OFF 3 A4130 / Milton Gate signalised junction
- OFF 4 A4130 / B4493 / Mendip Heights roundabout
- OFF 5 A4130 / Basil Hill Road / Milton Road (Power Station) roundabout
- OFF 6 A415 / High Street signalised junction (Clifton Hampden)
- OFF 7 A415 / B4015 Oxford Road signalised junction (Clifton Hampden)
- OFF 8 Harwell Road / Milton Road / High Street mini roundabout junction
- OFF 9 High Street / Church Street / Brook Street priority junction
- OFF 10 B4016 Appleford Road / Abingdon Road priority junction
- OFF 11 A415 / Tollgate Road signalised junction

- OFF 12 A4130 / Lady Grove priority junction / roundabout
- OFF 13 Lady Grove / Sires Hill priority junction
- OFF 14 Sires Hill / Didcot Road priority junction

8.14. The below map shows the location of the junctions:



9. *Existing Highway Network*

9.1. Junction Capacity Modelling

9.1.1. The performance of the priority junctions and roundabouts has been assessed by considering the Ratio to Flow Capacity (RFC) for each of the approach arms. An RFC value of 0.85 or below indicates that the arm is operating within design capacity. An RFC value of 0.85 to 1.00 indicates that the approach is operating above design capacity but within theoretical capacity, while an RFC value of 1.00 or more indicates that the arm is operating above theoretical capacity and significant queuing and delays may occur.

9.1.2. The performance of the signalised junctions has been assessed by considering the Degree of Saturation (DoS) for each of the approach arms.

A DoS value of 90% or below indicates that the arm is operating within design capacity. A DoS value of 90% to 100% indicates that the approach is operating above design capacity but within theoretical capacity, while a DoS value of 100% or more indicates that the arm is operating above theoretical capacity where significant queuing and delays may occur. The results for the LinSig models also present the Mean Max Queue (MMQ) in passenger car units (PCUs). The Practical Reserve Capacity (PRC) of the signalised junctions is also presented in the modelling results tables along with the cycle time for the AM and PM peak hours.

9.1.3. For the signalised junctions, information was obtained from OCC, as the local highway authority, regarding the existing signal timings including phasing, staging and intergreens. Junction operation has been optimised in LinSig, and cycle times have been set such that maximum green times for each phase as identified in the controller specification for the relevant time period are not exceeded. The input parameters for the junctions (cycle time, phase maximum, intergreens, etc) have been replicated for the 2024 and 2034 modelling without and with the Scheme, in order to provide a like-for-like comparison.

9.1.4. As stated in paragraph 8.5, the 2020 modelled flows were calculated by adding housing and employment completions from 2017 to 2020, as advised by the Local Planning Authorities, to the Paramics 2017 base model. These flows were then inputted into the junction capacity modelling software to inform the 2020 base year existing junction performances of all 'OFF' and 'SCH' junctions.

9.1.5. For the purposes of this report, each 'OFF' junction will be discussed in turn. As the 'SCH' junctions do not exist, they will be discussed in the future year modelling analysis.

9.2. OFF Junctions

9.2.1. OFF 1 Milton Interchange

9.2.1.1. This junction will be discussed separately in Section 11.

9.2.2. OFF 2 A4130 / Service Area

9.2.2.1. Table 3.5 in the TA, indicates that this junction has AM and PM RFCs at their highest of 0.60 and 0.55, meaning that the junction is operating within capacity.

9.2.3. OFF 3 A4130 / Milton Gate Signalised Junction

9.2.3.1. Table 3.6 in the TA, indicates that the junction operates within capacity in the AM peak hour with a PRC of 7.4% and a maximum DoS of 88% on the A4130 East ahead and right movement. The junction operates within theoretical capacity in the PM peak hour with a PRC of -2.0% and a maximum DoS of 92% on the A4130 ahead and east movement.

9.2.4. OFF 4 A4130 / B4493 / Mendip Heights

9.2.4.1. The ARCADY model outputs, shown in table 3.7 of the TA, indicate that the junction operates within capacity with an RFC of less than 0.85 in both peaks.

9.2.5. OFF 5 A4130 / Basil Hill Road / Milton Road (Power Station)

9.2.5.1. The results shown in table 3.8 of the TA, indicate that the A4130 (South) operates within capacity in the AM peak, with an RFC of less than 0.85. In the PM peak junction capacity is exceeded, with the RFC on the Milton Road approach at 1.16 and a queue of 77 vehicles. This results from the difficulty in turning out from Milton Road due to the high flows in the PM peak, which makes the model very sensitive to the levels of flow for this arm and the reported queue lengths become less reliable.

9.2.6. OFF 6 A415 / High Street (Clifton Hampden) and OFF 7 A415 / B4015 Oxford Road (Clifton Hampden)

9.2.6.1. These two signalised junctions have been considered together, as they operate as part of a signalised staggered junction.

9.2.6.2. The results shown in table 3.9 of the TA, indicate that the junction operates above capacity in both the AM and PM peak hours, with PRCs of -241% and 273% respectively and significant queues reported on the A415 and High Street. The maximum DoS reported is 335.8% on the A415 Dorchester East approach in the PM peak hour.

9.2.7. OFF 8 Harwell Road / Milton Road / High Street

9.2.7.1. The results shown in table 3.10 of the TA, indicate that the junction operates within capacity with a maximum RFC below 0.85 in both peaks.

9.2.8. OFF 9 High Street / Church Street / Brook Street Junction

9.2.8.1. This junction is formed out of three small priority junctions forming a triangle, and each junction has been assessed separately.

9.2.8.2. The results in table 3.11 of the TA, indicate that the junction operates within capacity with a maximum RFC of less than 0.85 in the AM peak hour. In the PM peak, the junction operates above absolute capacity with a maximum RFC of 1.19 and right turn queue of 47 vehicles. This is a result of the difficulty in turning out of the junction due to the high flows on Brook Street / Church Street and makes the model very sensitive to the levels of flow for this movement. The reported queue lengths therefore become less reliable.

9.2.9. OFF 10 B4016 Appleford Road / Abingdon Road and OFF 11 A415 / Tollgate Road Signalised junction

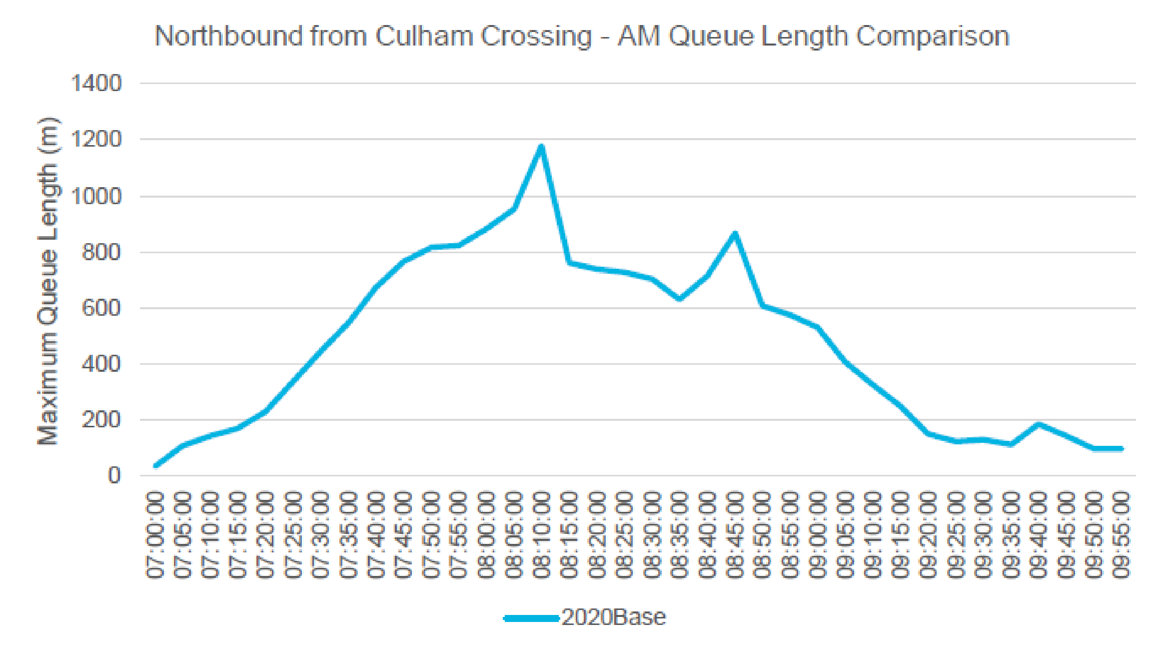
9.2.9.1. The operation of the B4016 Appleford Road/Abingdon Road junction (OFF 10) and A415 / Tollgate Road junction (OFF 11) have been assessed based on a LinSig network provided by OCC that includes both junctions, as well as the traffic signals that control single lane running across the Culham Bridges located between the two junctions.

9.2.9.2. LinSig does not allow for the effect of queuing back from one junction to an adjacent junction and the impact this can have on junction capacity. This is known to occur at the B4016 Appleford Road/Abingdon Road and A415/Tollgate Road junctions. To account for this, the model utilises the Underutilised Green Time function within LinSig.

9.2.9.3. The results in table 3.12 of the TA, indicate that the network is operating over capacity in both the AM and PM peaks, with PRCs of -22% and -14% respectively. In the AM peak long northbound queues are shown to occur at the Abingdon Road/Tollgate Road junction and at the Culham Bridges. In the PM peak queues are indicated on Abingdon Road (E) arm of the Tollgate Road junction and at the Culham Bridges in both directions.

9.2.9.4. These junctions are complex to model due to the interaction of queuing back between them, particularly the uncontrolled priority junction at the south. For example, the Culham Bridges northbound AM predicted queue is 51 PCUs which would queue back to/through Appleford Road / Abingdon Road priority junction, however LinSig does not take account of this as shown by the predicted queue of 0 PCU on the Appleford Road (W) arm. There is a known queue on this arm in the AM peak. To further interrogate this, queue lengths have been extracted from the Paramics model to compare how the junction operates across different model platforms. Paramics takes account of the whole modelled network including interaction between adjacent junctions. In Paramics, a vehicle is determined to be in a queue when the speed drops below 4.47 mph and the distance to the vehicle in front is less than 10 metres.

Figure 3.25: Culham Crossing Queue Length



9.2.9.5. Figure 3.25 from the TA, (replicated above) shows that the Paramics model indicates queue in the AM peak extending from the northbound signals before the bridge, back for 500m to 1180m across the 0800-0900 AM peak. This is known locally, with queues often extending past the George & Dragon Public House. The queueing in this area is the subject of OCC's objections to applications of single dwellings on grounds of highway safety, convenience and sustainability. These objections have led to Local Planning Authority (LPA) refusals which have been upheld at appeal by the Planning Inspectorate.

9.2.10. OFF 12 A4130 / Lady Grove Priority junction

9.2.10.1. The results in table 3.13 of the TA, indicate that the junction operates within capacity in the AM peak. In the PM peak the junction operates within capacity, although the maximum RFC exceeds the desirable maximum of 0.85 on the Lady Grove (North) arm, indicating that the junction is operating at close to its capacity.

9.2.11. OFF 13 Lady Grove / Sires Hill Priority junction

9.2.11.1. The results in table 3.14 of the TA, indicate that the junction operates within capacity in both the AM and PM peak hours. However, the maximum RFC exceeds the desirable maximum of 0.85 in the AM peak hour on the Lady Grove arm, indicating that the junction is operating at close to its capacity. The maximum RFC reported is on the Lady Grove to Sires Hill (west) movement with a maximum RFC of 0.95.

9.2.12. OFF 14 Sires Hill / Didcot Road

9.2.12.1. The results in table 3.15, indicate that the junction operates within capacity in both the AM and PM peaks, with the maximum RFC value being just 0.29.

9.3. In summary, there is evidence of a high level of congestion through parts of the highway network, most notably on the A4130, on the existing river crossings between Didcot and Culham/Clifton Hampden and within Clifton Hampden itself. The River Thames and the railway line act as barriers to connectivity and the existing infrastructure cannot keep pace with the demands being placed upon it from development in the area. As stated in paragraph 4.2, this congestion has led OCC to objecting to planning applications, leading to LPA refusals, which in turn have been upheld at appeal by the Planning Inspectorate.

9.4. The additional queue length data from the Paramics model used to support the analysis of the existing river crossing at Culham and Sutton Courtenay shows queues almost 1.2km long in the AM peak through Sutton Courtenay.

9.5. The next section of this report assesses the modelling results from the future year scenarios of 2024 and 2034, both with and without the proposed HIF Scheme infrastructure. As well as looking at the traffic impacts, importantly, non-motorised users (NMU's), who currently have to share a congested network in many locations with vehicles, will also be considered in the coming sections.

10. *Junction Capacity Analysis for 2024 and 2034.*

10.1. JCT were commissioned by OCC to audit the modelling undertaken for the purposes of the HIF1 planning application. The modelling input / output information, to be audited by JCT, was included within the appendices of the Transport Assessment. OCC also provided other related files, such as the models and junction layout drawings.

10.2. The report titled, *'Technical Note 21047: "HIF1 Scheme Package" Model Audits' (28th January 2022)* is found in Appendix A

10.3. Modelling evaluations were run for the AM / PM peak periods in 2020, 2024 (with and without scheme package) and 2034 (with and without scheme package).

10.4. Each 'OFF' junction will be considered in turn, as per Section 9 above.

10.4.1. OFF2 A4130 / Service Area

10.4.1.1. A comparison between the geometry used in the model versus the geometry measured independently by JCT, found that the kerbed reserve width used in the model was too short, as it incorrectly appeared to represent the kerbed section between westbound traffic and the right-turn bay. However, this parameter is to account for the impact on capacity for the right-turn out of the minor road. This movement is not permitted, and therefore this parameter should have no significant impact on the results.

10.4.1.2. Without the scheme, the model indicated traffic flows out of the site decreased in 2024 compared to 2020 during the AM peak, as did the right-turn into the site and eastbound traffic. However, these were all higher by the year 2034. All traffic flows increased during the PM peak by the years 2024 and 2034.

10.4.1.3. With the scheme, eastbound traffic flows increased. Westbound traffic also increased with the scheme in the year 2024 (compared to without the scheme), although the westbound flows were lower with the scheme by the year 2034, significantly so during the AM peak. Traffic flows into and out of the Service Area were lower with the scheme in 2034, with the AM RFC value decreasing from 0.60 to 0.35 for right turners into the site and 1.07 to 0.71 for the service area to the A4130.

10.4.1.4. The planning application modelling indicated that the junction would operate within capacity for all flow groups, except for the 2034 AM Peak without the scheme, in which an RFC of 1.07 was predicted on the Service Area. This was because the opposing westbound traffic flow was significantly higher in the scenario without the scheme compared to with it.

10.4.2. OFF3 A4130 / Milton Gate

10.4.2.1. The results shown in table 6.20 and 6.21 of the TA, indicate that without the HIF1 Scheme, the design capacity of the junction would be exceeded in 2024 in both peaks with a PRC between -2.4% and -4.5%, although the junction would still be operating within theoretical capacity. By 2034 junction performance would deteriorate further, with theoretical capacity exceeded in both peaks and significant queuing on both the A4130(E) and A4130(W) approaches. The PRC for the junction would decrease significantly to between -51.7% and -25.2%.

10.4.2.2. With the HIF1 Scheme, the junction is predicted to operate within theoretical capacity in 2024 and 2034, although the DoS on the A4130(W) and A4130(E) approaches is predicted to exceed 90%, indicating that the junction is approaching its theoretical capacity and resulting in PRCs of -5% and -6% in the AM and PM peaks respectively. The HIF1 Scheme creates a significant improvement in junction operation in 2034, with performance and queues similar to those in the 2020 baseline assessment.

10.4.2.3. JCT have made some recommendations to the LinSig modelling for this junction, which they say if made, the results are likely to change significantly, especially if it was assumed Stage 4 does not run each cycle and a higher cycle time is permitted.

10.4.2.4. The modelled sequence was 1-2-3-4. This would be the most robust sequence, as it assumed that Phase F (the pedestrian phase across the westbound A4130) is called every cycle (Stage 4). However, if Phase F demand was expected to be low, then the model would provide unrealistically pessimistic results due to a significant reduction to westbound traffic (i.e., if Stage 4 were not demanded, the junction would move to Stage 1 and provide green to Phase B – the westbound A4130).

10.4.2.5. The model assumes a cycle time of 66 seconds in every scenario. However, this cycle time is relatively short, especially when it is assumed Stage 4 is called every cycle. Furthermore, it is likely reasonable to assume that higher cycle times would be acceptable, especially as traffic flows increase. Therefore, it is recommended that a maximum cycle time is agreed upon, and then each scenario run using this (to provide a consistent comparison between each). A cycle time of at least 120 seconds is often considered acceptable in general.

10.4.2.6. Saturation flows were predicted using the lane geometry, as described in TRRLs (Transport and Road Research Laboratory) Research Report 67. Lanes 4/2 (Milton Gate Offside) and 6/3 (A4130 East Right-Turn) were set as offside lanes. Although geometrically correct, this provides a higher saturation flow. It can be argued that an offside lane provides a higher saturation flow as it provides an opportunity for faster vehicles to overtake slower vehicles, although this is only true if both are going to the same exit. In these cases, the offside lanes are exclusively for right-turn traffic, which could include slower moving vehicles. Therefore, a robust approach would be to set these lanes as nearside lanes in the model.

10.4.2.7. As per paragraph 10.4.2.3, these are recommendations to improve the model, which can be taken forward to the technical audit stage. Given that the modelling results indicate the junction operation in 2034, has a performance and queues similar to those in the 2020 baseline assessment, OCC are content with the outcome of the modelling for this junction and do not require anything further.

10.4.3. <u>OFF4 A4130 / B4493 / Mendip Heights Roundabout</u>

10.4.3.1. An improvement scheme, as shown in figure 6.15 of the TA, has been proposed for this junction, as S278 works related to a nearby housing site, which is currently undergoing review by OCC Road Agreements Team. The future year assessments have been based on the proposed scheme.

10.4.3.2. The modelling results shown in 6.22 and 6.23 of the TA, indicate that the junction would be over-capacity in all scenarios without the scheme, particularly by the year 2034 with RFCs between 1.27 to 1.47 on the A4130 (N) and the B4493. With the scheme in place, the junction was predicted to operate within capacity for all scenarios, with the highest RFC of 0.73 on the B4493 during the 2034 AM peak.

10.4.3.3. JCT have identified that the approach turning radii used in the model for the A4130(N), B4493 and the A3130(W) were significantly higher than measured by JCT. The ARCADY measurements used in the modelling were illustrated in a provided plan to JCT. It appears these did not include consideration of the radii extending beyond the give-way line. However, the Junctions 9 User Guide explains that the maximum radii should be measured, from a point 25m upstream of the give-way line to a point 10m downstream of the give-way line.

10.4.3.4. The approach road half-width and effective flare length for the A4130(W) used in the model were different to those measured by JCT. However, the drawing did not extend far enough upstream of the junction for JCT to measure these. However, JCT accept that the values used in the model are likely to be reasonable.

10.4.3.5. The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need to be considered as follows:

- A4130 (N): In all scenarios, the left and ahead movements are significantly higher than the right-turn and U-turn movements. Although the layout indicates traffic may go ahead from both lanes, the southbound exit appears to only be wide enough to be considered a one lane exit. Therefore, it is likely that most ahead vehicles will use the nearside lane on the approach. If all ahead traffic were to use the nearside lane, unequal lane usage may result in 74-77% of the predicted capacity across all flow scenarios. A more efficient set of lane markings may be to make the nearside lane left turn only, the impact of which could be modelled using the above lane-usage methodology.

- A4130 (W): Without the scheme, the model indicated that the left-turn was heavy in all flow groups and would therefore, be the busiest lane (with all other movements able to spread across both the middle and offside lanes). With the scheme, the ahead movement was significantly higher than all other movements from this arm, and therefore most traffic would use the middle and offside lanes. It was unlikely unequal lane usage would need to be considered during the AM peak with the scheme, although all other flow groups would likely see reductions to available capacity.

- B4493: During the AM peak scenarios, there was a heavy right-turn from this approach, resulting in a substantial proportion of traffic using the offside lane. JCT analysis of unequal lane usage indicated that a capacity drop would need to be considered during the 2034 AM peak, with the scheme, of around 92%. It was shown that capacity reductions were unlikely to need consideration in all other flow groups.

10.4.3.6. It is acknowledged that if tweaks were made to the modelling in line with the audit comments from JCT, the model results would likely get worse, however, it is also acknowledged that when the junction is modelled with the HIF schemes in place, the RFC values of 0.32, 0.73, 0.20 and 0.58 in the AM peak and 0.53, 0.54, 0.08 and 0.34 in the PM peak are still likely to remain within the threshold demonstrated by a junction that is operating within design capacity. The with scheme results are significantly better than the with scheme results for 2034 and this would remain the case if the junction was remodelled.

10.4.3.7. When comparing the 'without' and 'with' HIF scheme scenarios through the junction in 2034, the vehicle flows reduce by a significant 44% in the AM peak hour from 4409 to 2451, respectively. Of note is the fact that the vehicles through the junction in 2034 with HIF are in fact 19% lower than those for the 2024 without HIF scenario. This is despite ten years' worth of background traffic growth anticipated and shows that the HIF scheme has not only been able to mitigate this 10 years' worth of traffic growth through this junction, but it also provides a betterment to what would have otherwise been without any HIF intervention.

10.4.4. <u>OFF 5 A4130 / Basil Hill Road / Milton Road (Power Station</u>)

10.4.4.1. An improvement scheme, as shown in figure 6.16 of the TA, has been proposed for this junction as S278 works related to a nearby housing site, which is currently undergoing review by OCC Road Agreements Team. The future year assessments have been based on the proposed scheme.

10.4.4.2. The modelling results shown in tables 6.24 and 6.25 of the TA, indicate that the junction would be significantly over-capacity without the scheme by the year 2034, with the A4130(N), Basil Hill Rd and the A4130(S) congested during the AM peak (RFCs of 0.94, 38.01 and 1.10 respectively), and the A4130(S) and Milton Rd over-capacity during the PM peak (RFCs of 0.98 and 1.11 respectively). The junction was predicted to operate well within capacity with the scheme, with the worst RFC of 0.65 on Milton Rd during the 2034 PM peak.

10.4.4.3. As was the case with the OFF 4 junction above, JCT have noted where parts of the model could be revised.

10.4.4.4. The approach turning radii used in the model for the A4130(S), and the Milton Rd were higher than measured by JCT. Also, the approach road half-width for the A4130 (S) of 4.08m was higher than the 3.3m measured by JCT. Although the drawing shows a width of 4.08m upstream of the give-way line, this measurement extends beyond the nearside kerb and therefore longer than the value that would be required for ARCADY. Using this higher value for the approach road half-width may be the reason for the shorter effective flare length used in the model than measured by JCT.

10.4.4.5. The entry width used for the Access arm was significantly higher in the model than measured by JCT, with a width of 14.4m. JCT measured a much shorter entry width of 7m, which was taken from the proposed offside island to the proposed nearside kerb, perpendicular to the kerb. The entry width used in the model would have influenced the effective flare length, which was also different to that measured by JCT.

10.4.4.6. Unequal lane usage in the model has also been considered as follows:

§ A4130 (N): The nearside lane is for left-turning traffic only, although the left-turn flow is significantly lower than the total traffic flows going to all other arms. Therefore, most traffic will use the offside lane in all scenarios. This means that unequal lane usage may result in 66-67% and 79%-90% of the predicted capacity for the AM and PM peak periods respectively, with the scheme. Without the scheme, the available capacity would be 57% during the AM peak and 58% during the PM peak.

§ Milton Rd: If it were assumed that traffic going to the Power Station, A4130(N) or Basil Hill Rd used the nearside lane, then more traffic would use the nearside lane in most scenarios. Therefore, unequal lane usage may result in 76-93% of the available maximum capacity predicted by ARCADY with the scheme, and as low as 87% without the scheme.

10.4.4.7. It is acknowledged that if tweaks were made to the modelling in line with the audit comments from JCT, the model results would likely get worse, however, it is also acknowledged that when the junction is modelled with the HIF schemes in place, the 2034 RFC values of 0.26, 0.54, 0.37, 0.34 and 0.19 in the AM peak and 0.15, 0.37, 0.15, 0.65 and 0.18 in the PM peak are still likely to remain well within the threshold demonstrated by a junction that is operating within design capacity. The with scheme results are significantly better than the with scheme results for 2034 and this would remain the case if the junction was remodelled.

10.4.4.8. When comparing the 'without' and 'with' HIF scheme scenarios through the junction in 2034, the vehicle flows reduce by a significant

41% in the AM peak hour from 4222 to 2472, respectively. Of note is the fact that the vehicles through the junction in 2034 with HIF1 are in fact 18% lower than those for the 2024 without HIF scenario. This is despite ten years' worth of background traffic growth anticipated and shows that the HIF scheme has not only been able to mitigate this 10 years' worth of traffic growth through this junction, but it also provides a betterment to what would have otherwise been without any HIF1 intervention.

10.4.5. <u>OFF6&7 Abingdon Rd / Oxford Rd / High St</u>

10.4.5.1. The results shown in table 6.26 and 6.27 of the TA, indicate that this junction is forecast to operate above capacity in 2024 without the HIF1 Scheme, with significant queuing in both AM and PM peaks and a PRC of -270% in the AM peak. By 2034, without the HIF1 Scheme, the operation of the junction would deteriorate further, with a PRC of -606% in the AM peak and -348% in the PM peak.

10.4.5.2. With the HIF1 Scheme there is a significant improvement in the operation of the junction. It is forecast to operate within capacity in both 2024 and 2034 with significantly reduced queues in the village, particularly from Abingdon Road (E).

10.4.5.3. JCT have highlighted the non-blocking storage for Abingdon Rd (E), for the right-turn into Oxford Rd, which was set as zero pcus. It is true that there is no storage for the right-turn to store without blocking unopposed westbound traffic. However, as LinSig is not a microsimulation model and able to model individual vehicles, this can potentially create significantly pessimistic results. JCT suggest an approach that takes account of this observation, by providing a 0.5 pcu nonblocking storage area in the model for the right-turn.

10.4.5.4. The model assumed the sequence 1-2-3-4-5, which assumed all stages are called every cycle. This is likely to provide overly pessimistic results, unless it is expected that heavy pedestrian flows will create a demand for these stages. Stage 3 is only required when there is a demand for pedestrian Phase H, while Stage 5 is only required when there is a demand for pedestrian Phase I (or for Phase E, although the model indicates there is no traffic from Watery Lane).

10.4.5.5. All Phase minimums were set to 7 seconds in the model. However, the controller specification form indicated that Phase E should be 5 seconds, Phase H should be 8 seconds and Phase I should be 6 seconds.

10.4.5.6. The model includes many phase delays. Phase delays (in most cases) are used to allow a Phase to continue green for a specified number of seconds after the stage it runs in terminates. However, several of these do not match those within the controller specification.

Many of the intergreens used in the model were lower than those within the controller specification.

10.4.5.7. If the modelling were updated to account for the above observations, the results would likely improve compared to those shown in the TA in table 6.26 and 6.27. Given that with the HIF scheme in place the vehicle flows are shown to reduce significantly in both 2024 and 2034 future years, due to this junction serving local traffic only, OCC Highways do not believe further modelling of this junction is necessary. The presented results are robust and provide a worst-case scenario, in which the 2034 PRC's of the junction are at +12% and +3% in the AM and PM with HIF1, compared to a staggering -606% and -348% with HIF1.

10.4.6. OFF8 Harwell Rd / Milton Rd / High St Mini-Roundabout

10.4.6.1. The results shown in tables 6.28 and 6.29, indicate that without HIF1 the junction would operate within capacity in 2024 but would be reaching theoretical capacity in 2034, with RFCs exceeding the desirable maximum of 0.85 in both the AM and PM peaks and operating with an RFC of 1.00 in the PM peak without HIF1.

10.4.6.2. With the HIF1 Scheme there is a significant improvement in the operation of the junction, and it is forecast to operate well within capacity in both 2024 and 2034 with minimal queuing.

10.4.6.3. The geometric parameters measured by JCT were generally similar to those used in the model, although the entry width and effective flare length for Harwell Rd was longer than JCT could measure from Google Earth. Even if the model were updated with the slightly different geometries, it is unlikely that the change in result would be significant and the overall conclusions would remain the same for the junction.

10.4.7. OFF9 High St / Church St / Brook St

10.4.7.1. The junction was modelled in Junctions 9 using three separate files:

- The southern section with the southbound High St give-way line – MODEL A.
- The north-eastern section with the High St right-turn into Brook St – MODEL B.
- The north-western section with the High Street left-turn into Brook St was modelled – MODEL C.

10.4.7.2. The reason that this junction has been modelled using three separate files is to account for the fact that you have three priority T-junctions that make up the triangular shaped junction layout.

10.4.7.3. JCT have highlighted a few minor anomalies between the geometric parameters used in the modelling and their observations. In Model A and B, this is a discrepancy between the visibilities used, which if updated in a revised model run, would be unlikely to have any significant change in the modelling results.

10.4.7.4. In Model C, there were minor discrepancies found between the visibilities and the widths of both the minor and major lanes, however, again, if these new parameters were added to a revised model run, the impacts on the results would not be significant.

10.4.7.5. OCC Highways, therefore, is satisfied with the modelling that has been undertaken at this junction.

10.4.7.6. Without the HIF1 Scheme, the junction is forecast to operate above capacity in the AM peak and PM peak hours in 2024, and the performance of the junction deteriorates further by 2034.

10.4.7.7. With the HIF1 Scheme there is a significant improvement in junction performance. It is forecast to operate within capacity in 2024. In 2034, capacity is exceeded in the PM peak, with a maximum RFC of 1.06 on the High Street to Brook Street/Church Street movement and a maximum queue of 20 vehicles. This is low compared to the same without HIF1 scenario with a forecast RFC of 2.43 and a maximum queue of 577.

10.4.7.8. Junction performance in the 2034 With HIF1 scenario is predicted to be similar to 2020 in the AM, and better in the PM, with a maximum RFC of 1.06 and associated queue of 20 vehicles in 2034 compared to RFC of 1.19 and queue of 47 vehicles in 2020 as shown in Table 3.11 of the TA.

10.4.8. OFF10 Appleford Rd / Abingdon Rd and OFF11 Abingdon Rd / Tollgate Rd

As explained in paragraph 9.2.9.4, these junctions are complex to model due to the interaction of queuing back between them, particularly the uncontrolled priority junction at the south.

10.4.8.1. Unlike the other priority junctions included within this assessment, which were modelled using Junctions 9 (PICADY), this junction was modelled in LinSig3 as part of a network with signalled junction OFF11.

10.4.8.2. The results indicate that in 2024 without the HIF1 Scheme the junctions will operate above capacity in the AM peak and within capacity in the PM peak. Interrogation of the traffic flows for the 2024 PM peak scenario indicate that total traffic flows are lower than in the 2020 scenario. However, journey time data for the routes through this part of the network indicate higher journey times in 2024 compared to

2020. Congestion elsewhere on the network is therefore reducing the traffic flows through this part of the network, giving a false indication that network operation has improved when solely modelling this junction in a stand-alone manner.

10.4.8.3. In 2034 there is further deterioration in network performance in the AM peak. Network performance in the PM peak is indicated to be similar to the 2020 scenario, however this is related to congestion on the network elsewhere preventing traffic reaching these junctions, as for the 2024 scenario.

10.4.8.4. Unlike PICADY, the geometrical input information cannot be entered into LinSig to calculate suitable Slope and Intercept values for the give-way capacity calculations. Therefore, the user needs to enter Max Flow and Coefficients directly for each movement.

10.4.8.5. By updating the give-way parameters (or modelling within PICADY), it is likely to provide a significant difference to the modelling results. However, it would be expected that these would continue to indicate the junction to be over-capacity without the HIF1 scheme, and within capacity with the HIF1 scheme.

10.4.8.6. Of note again, is the significant reduction in traffic flows that are travelling through this junction when the HIF1 scheme is in place. When comparing the 'without' and 'with' HIF scheme scenarios through the junction in 2034, the pcus reduce by a significant 34% in the AM peak hour from 2051 to 1351, respectively. The fact that the pcus through the junction in 2034 with HIF1 are in fact 3% lower than those for the 2024 without HIF scenario. This is despite ten years' worth of background traffic growth anticipated and shows that the HIF scheme has been able to mitigate this 10 years' worth of traffic growth through this junction.

10.4.8.7. When assessing OFF11, the model also includes the shuttle junction on Tollgate Rd, which is located just over 400m south of Abingdon Rd, along with the Tollgate priority junction with Appleford Rd. Comments related to the shuttle junction are included in the below discussion about OFF11.

10.4.8.8. Saturation flows were input directly on to each lane. However, some of these values are much lower than expected, particularly on Abingdon Rd (E) and Tollgate Rd. It is unclear how these saturation flows were derived. However, it would be extremely difficult (likely impossible) to measure these on site, due to the short flares on these arms. This is because as a queue discharges during the green period, traffic will discharge across both lanes at the stop line, leaving gaps in traffic in the adjacent lane during saturation flow measurements. LinSig expects a saturation flow to represent the maximum discharging across the stop line, and it deals with the decrease in capacity due to the flare, by using the flare length directly. Therefore, it is likely that saturation flows in the model are unrealistically low.

10.4.8.9. Several negative bonus greens were applied to the model in the "No Scheme" scenarios, which would significantly reduce capacity at the junction, particularly as some of these were large. It is not clear how these were derived.

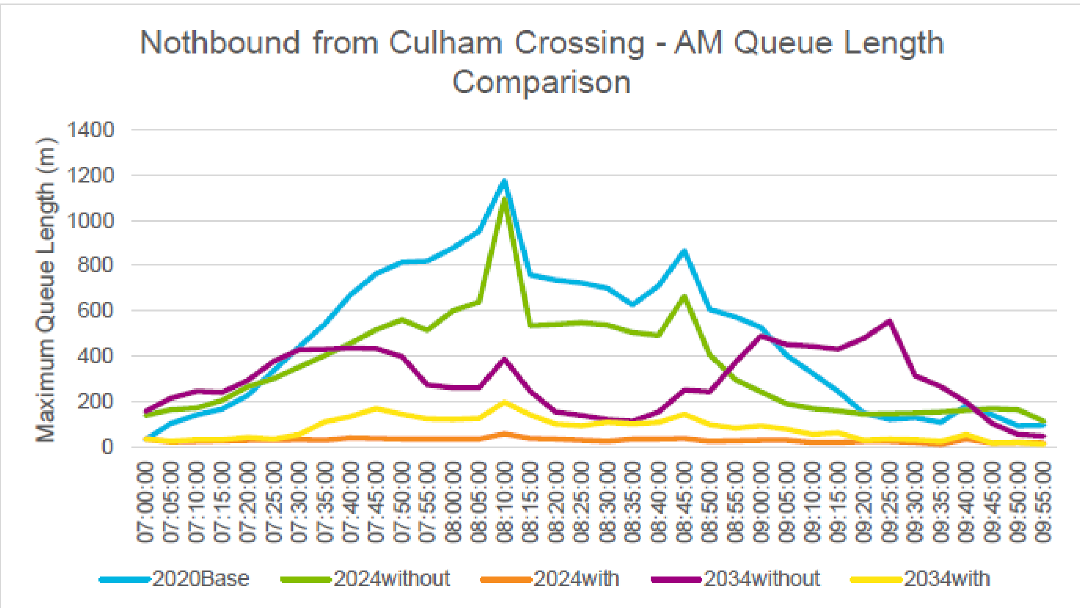
10.4.8.10. If the model was updated without the negative bonus greens and higher saturation flows, the results are likely to improve significantly. High degrees of saturation during the AM Peak (without the scheme) are partly caused by the high minimum green for southbound traffic at the shuttle, resulting in significant congestion to northbound traffic. The negative bonus greens also reduce capacity significantly.

10.4.8.11. Given the above, it is clear that the way the model has been run for this junction, provides a worst-case set of results for analysis. Therefore, OCC Highways do not require any further modelling of this junction.

10.4.8.12. In the 'with HIF1' scenarios there is a significant improvement in network operation, with all junctions operating within capacity in both 2024 and 2034 and predicted queue lengths at a level that would not block back to adjacent junctions. The forecast PRC for all junctions in 2024 is between 24.7% and 46.5% and in 2034 it is forecast to be between 6.9% and 12.9% indicating that there will be spare capacity at these junctions with the HIF1 Scheme.

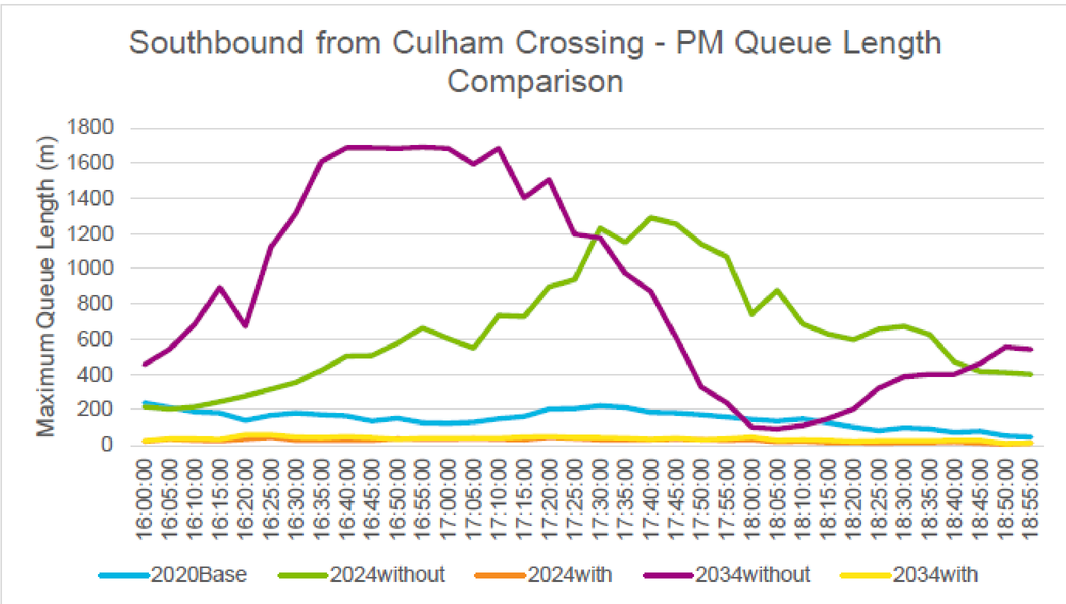
10.4.8.13. Queue length data has been extracted from the Paramics model to further understand the predicted operation of these junctions across future scenarios.

Figure 6.17: Culham Crossing Queue Comparison (Northbound)



10.4.8.14. Figure 6.17, extracted from the TA, above shows that the Paramics model indicates significant reductions in queue length from the northbound signals before the bridge as a result of the HIF1 Scheme in both 2024 and 2034 AM scenarios. There is no predicted queueing from the crossing signals that would block back to the southern Appleford Road / Abingdon Road priority junction (approximately 290m distance). This contrasts to the base, 2024 without HIF and 2034 without HIF where queuing is predicted to extend back to the junction (and further through Sutton Courtenay) for large portions of the AM peak. It should be noted that any of the shorter queue lengths in 2024 and 2034 without HIF when compared to base are not due to an improved performance at this junction, but are the result of vehicles being stuck in queues elsewhere in the model network preventing them from reaching the junction. Effectively, in the 2034 without HIF scenario, between the hours of 08:10 – 09:25, there is a queue ranging from approximately 170m to just under 600m. However, when compared to the 2034 with HIF scenario, that queue length has reduced to between approximately tens of metres to just 200m. Regardless of this, the model shows a significant improvement at this junction as a result of the HIF1 Scheme.

Figure 6.18: Culham Crossing Queue Comparison (Southbound)



10.4.8.15. Figure 6.18, also extracted from the TA, above shows that the Paramics model indicates significant reductions in queue length from the southbound signals before the bridge as a result of the HIF1 Scheme in both 2024 and 2034 PM scenarios. There is no predicted queueing from the crossing signals that would block back to the northern A415 / Tollgate Road signalised junction (approximately 430m distance). This contrasts to the base year which shows a queue approximately 200m long throughout the PM peak hour, and 2024 without HIF and 2034 without HIF where queuing is predicted to extend back to and through the northern junction (and further along the A415) for almost all of the PM peak hour. Therefore, the model shows a significant improvement at this junction as a result of the HIF1 Scheme.

10.4.8.16. It should also be noted that with the HIF1 scheme, the flow of traffic to and from Tollgate Road significantly decreases. For example, in 2034, the 609 pcus turning south onto Tollgate Lane reduce by 38% to 376 with the HIF1 scheme. Contrastingly, the pcus coming from Tollgate Road in the 2034 scenario reduce by a significant 75% from 435 to 109 pcus. This clearly demonstrates that the majority of the trips originating from the south of the River Thames wanting to travel north, are now routing along the HIF1 River Crossing scheme and not travelling through the villages of Sutton Courtenay and Appleford.

10.4.9. <u>OFF12 A4130 / Lady Grove Roundabout</u>

10.4.9.1. The capacity of the A4130 / Lady Grove roundabout has been assessed based on the proposed roundabout scheme for the junction, which is included in the Paramics model in 2024 and 2034.

10.4.9.2. Looking at the results shown in tables 6.34 and 6.35 of the TA, they indicate that without the HIF1 Scheme the junction will operate within capacity in 2024 and 2034.

10.4.9.3. With the HIF1 Scheme there are slight changes to results on each arm with some increasing and others decreasing, but it is forecast to operate within capacity in both 2024 and 2034.

10.4.9.4. Auditing of the model at this junction has highlighted an inaccuracy with the approach road half-width measurement for the Lady Grove arm and therefore, the effective flare length measurement.

10.4.9.5. The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows

- Lady Grove: It would be expected that left-turning traffic would use the nearside lane and right-turning traffic the offside lane. The modelled traffic flows indicated that both lanes are well balanced, with no capacity reductions required for most scenarios.

- Abingdon Rd: The dominant movement from this arm is the right-turn to Lady Grove in all scenarios, and therefore it would be expected most of the traffic would use the offside lane. Due to the heavy right-turn, it is likely that capacity would need to be reduced to about 77-81% of the total available capacity that ARCADY would provide with the HIF1 scheme, and to about 76-89% without the HIF1 scheme.

§ Most of the traffic from this arm goes ahead to Abingdon Rd in all scenarios. Although Abingdon Rd only provides a single lane exit, ahead vehicles might use both lanes on the approach to go ahead (as some ahead vehicles may use the offside lane if traffic in front of them are indicating left). Therefore, lane usage will be dependent on driver behaviour. If drivers going ahead only used the nearside lane, or only use the offside lane, then capacity reduction would need to be applied, as ARCADY would predict optimistic capacity. If all ahead traffic were to use the offside lane capacity reductions would be required in all flow groups, except for the year 2034 with the scheme.

10.4.9.6. If the model was updated, in particular the reduction of capacity due to unequal lane usage was addressed, then there would be a significant change to the results. Although the model is likely to continue to predict each arm to be within capacity for most scenarios, the heavy right-turn from Abingdon Rd may push this arm closer to capacity during the 2034 AM peak with the scheme.

10.4.9.7. It should be acknowledged however, that the Abingdon Road arm in the model will be the final section of the Northern Perimeter Road around Didcot and therefore, is expected to have a higher amount of trips along it, routing vehicles along the A4130 to the new River Crossing or west to the A34, along the NPR2 section of the A4130. The HIF1 package and NPR3 route, along with s106 requirements from developments in the area, are also providing significant improvements to the walking and cycling opportunities both through and in the vicinity of this junction, which also must be considered when assessing this junction. OCC Highways, do not therefore, require any further modelling of this junction.

10.4.10. OFF13 Lady Grove / Sires Hill

10.4.10.1. The JCT audit has highlighted a discrepancy in the modelling at this junction. The ‘Arms’ shown in the below figure are the assumption the model makes when assigning traffic flows. However, the modeller input Arm names, which indicate that Arm A was the WESTERN arm and Arm C was the EASTERN arm.

10.4.10.2. This may simply be a labelling error in which the modeller mixed up west and east. However, if the modeller intended Arm A to be the western arm, and Arm C to be the eastern arm, then all modelling results will be incorrect, as PICADY will not make the same assumption. This can be checked by referring to the traffic flow matrices used in the model and confirming whether the traffic flows to/from Arm A correctly represent traffic to/from the east, and traffic flows to/from Arm C correctly represent traffic to/from the west. The applicant is required to clarify the situation for this junction.

10.4.10.3. Assuming Arm A was intended to be the eastern arm, and Arm C the western arm, then the traffic flows should have assigned as expected. As such, if the model were updated to reflect the differences in lane lengths (also identified by JCT), between the original model and the JCT measurements, the results would likely become worse. Although, the general conclusions are likely to be similar, in that the junction is over-capacity in 2034 without the HIF1 scheme.

10.4.10.4. As shown in tables 6.36 and 6.37 in the TA, without the HIF1 Scheme, this junction is forecast to operate within capacity in both the AM and PM peak hour in 2024. The maximum RFC forecast of 0.79 on the Lady Grove to Sires Hill (west) movement. In 2034, junction capacity is forecast to be exceeded in both the AM and PM peaks, with long queues forming on all arms.

10.4.10.5. With the HIF1 Scheme there is a significant improvement in the operation of the junction, and it is forecast to operate within capacity in both 2024 and 2034. Junction performance in the 2034 With HIF1 scenario is better than that for 2020, where junction capacity is exceeded in the AM peak with an RFC of 0.95 as shown in Table 6.17 of the TA.

10.4.11. <u>OFF14 Sires Hill / Didcot Road Junction</u>

10.4.11.1. Some discrepancies were found in the minor arm widths that were used in the model. The model also used some higher visibilities for drivers opposed by traffic from Didcot Rd. However, the visibility is likely to be sensitive to where drivers position themselves, due to the bend on the major arm.

10.4.11.2. The minor arm was modelled as a flared approach. This is reasonable as drivers can treat this arm as such (i.e., a left and a right-turning vehicle can queue side by side at the give-way line).

10.4.11.3. Without the HIF1 Scheme, the junction is forecast to operate within capacity in 2024. In 2034 the junction is forecast to operate at close to capacity in the AM peak, and capacity is exceeded in the PM peak with long queues forming on all arms.

10.4.11.4. With the HIF1 Scheme there is a significant improvement in the operation of the junction, and it is forecast to operate within capacity in both 2024 and 2034.

10.4.11.5. Even if the minor geometric discrepancies were amended, the general conclusions described above would still be made and therefore, no further modelling is required.

10.5. Each ‘SCH’ junction’s performance in the future years, will now be considered below.

10.5.1. <u>Backhill Roundabout (SCH1)</u>

10.5.1.1. The traffic flows used in the modelling indicated that no traffic travelled to/from NW Valley Park in 2024, although this arm was utilised by traffic by 2034. Also, the modelled traffic flows indicate that the westbound traffic along the A4130 will drop between the years 2024 and 2034 in both the AM and PM peak periods.

10.5.1.2. The geometric input parameters used in the model closely reflected those measured by JCT and are therefore, likely to be considered representative of the junction layout.

10.5.1.3. The model indicated that the junction should operate significantly within capacity during all flow scenarios. The highest RFC of 0.79 was predicted on A4130 (E) during the AM 2024 flow period.

10.5.1.4. The audit identified no significant problems with the modelling input parameters. Therefore, even if slight changes were made to the modelling geometric input data to reflect subjectivity, this would unlikely have any significant impact on the modelling results.

10.5.2. <u>A4130 / Valley Park Access (SCH2)</u>

10.5.2.1. The traffic flows used in the modelling indicated the traffic flows to and from the Valley Park Access would increase by 2034, whilst there was a decrease in westbound traffic. Eastbound traffic flows increased by the year 2034.

10.5.2.2. A few issues have been highlighted in the JCT audit, the first of which relates to the pedestrian phase minimum times, which have been set at 6 seconds in the model. These will depend on the types of pedestrian facilities installed. If far-sided green man displays are used, then longer minimum times may be required on the longest crossings (up to 9 seconds across Valley Park), unless countdown timers are also used. If near-sided displays are used, then 6 seconds may be acceptable. It should be noted, however, that whatever timing is used, should not significantly make a difference to the modelling results and it will operate under capacity.

10.5.2.3. Many of the intergreens used in the model were significantly higher than those measured by JCT. This could result in the model predicting less capacity than would be expected. A comparison of the intergreens used in the model and those measured by JCT, is shown in Figure 2.15.4. of the JCT *'Technical Note 21047: "HIF1 Scheme Package" Model Audits' (28th January 2022)* found in Appendix A

10.5.2.4. As explained in the JCT audit in paragraph 2.15.8, the model contains some very long phase delays, likely to reduce lost time created by long pedestrian intergreens. However, the length of delay does not correspond with the long pedestrian intergreen. A significantly long phase delay of 11 seconds was given to Phase D from Stage 3 to 1, without any pedestrian intergreens running in that stage. These long phase delays result in significantly long interstage periods up to 24 seconds. These are likely to be undesirable, especially off peak, as they will result in much longer green times than necessary.

10.5.2.5. However, the use of phase delays can be revisited once the intergreens have been finalised. A decision should be made on whether intergreens after pedestrians will be fixed or variable using on-crossing detection. If they are fixed, phase delays can be used to reduce the lost time to traffic. If they are variable, then the expected average intergreen after pedestrians should be modelled and phase delays may not be necessary.

10.5.2.6. Bonus green time has been added to several lanes. It is assumed they were added to account for the fact that the sequence 1-2-3 was modelled, but that Stage 2 would not always be demanded, if Phase F (pedestrian phase) were not called, and Stage 4 could run instead. If that is the case, it is not clear what demand frequency was assumed, although the demand for Phase F might be expected to be low.

10.5.2.7. JCT state the model could be simplified by running scenarios in which Phase F is always called, and then repeat these for when Phase F is never called. This will provide the best and worst-case scenarios. However, JCT anticipate that if these changes were made, it would unlikely result in the model predicting the junction to be over-capacity.

10.5.2.8. Lastly, the saturation flows have been examined and some recommendations have been made in paragraph 2.15.10 of the JCT audit report.

10.5.2.9. The model indicated that all flow scenarios would operate within capacity, running a cycle time of 108 seconds. The lowest Practical Reserve Capacity (PRC) was 31.7% during the 2024 AM Peak.

10.5.2.10. Whilst the audit has raised areas that are likely to require attention, JCT anticipate that even if these recommendations are made, it would unlikely result in this junction operating over capacity and therefore, OCC Highways are satisfied that no further modelling is required at this time.

10.5.3. Old A4130 Roundabout (SCH3)

10.5.3.1. JCT have raised the issue of unequal lane usage and have made some recommendations for the Science Bridge Link and A4130(W) arms, in paragraph 2.16.5. The issue could be mitigated on the Science Bridge Link, if left turning traffic also used the offside lane. This could be encouraged by the use of lane marking.

10.5.3.2. The model indicated that the A4130(E) would be slightly over-capacity during the AM 2024 run (RFC = 0.95), although by 2034 the Science Bridge Link would be the only arm slightly over-capacity (RFC = 0.93). During the PM peak, the only arm over capacity was the A4130(W) in the year 2034 (RFC = 0.97).

10.5.3.3. Taking account of unequal lane usage, would worsen the modelled results, however, a consideration of appropriate lane markings would help to mitigate this issue.

10.5.3.4. OCC Highways accept that this junction will have some arms operating at or over capacity in the future years, however, HIF1 is part of wider strategy to mitigate the impact of growth across a wide area which can only be delivered incrementally as funding becomes available, either through government grants or developer funding. Journey times across the modelled network will be significantly reduced and the provision of new and improved pedestrian and cyclist facilities as part of the HIF1 package, will help to engender modal shift away from the private motor car, particularly for commuting purposes for employment and education, but also for important access to amenities such as retail and healthcare, and for leisure trips.

10.5.3.5. OCC Highways, therefore, do not require any further modelling of this junction.

10.5.4. Science Bridge Roundabout (SCH4)

10.5.4.1. The model indicated that all flow groups would operate within capacity. The highest RFC of 0.83 was on the Science Bridge Link during the 2034 PM peak.

10.5.4.2. The model has not accounted for unequal lane usage, as described in the JCT audit in paragraph 2.17.5.

10.5.4.3. Accounting for unequal lane usage is likely to increase some of the predicted RFC values. However, this is unlikely to result in the model predicting any arms to become overcapacity, as the largest capacity reductions would be during the year 2024, in which the model predicted significant spare capacity. The provided model used generous approach road half widths for Science Bridge and the Science Bridge Link Rd. If these values were reduced, the model may predict results approaching capacity in the 2034 PM peak.

10.5.4.4. As considered in paragraph 10.5.3.4, above, OCC Highways, do not see the justification for further modelling of this junction.

10.5.5. Science Bridge Link Rd / New Purchas Rd (SCH5)

10.5.5.1. The model was set up to assume that the right-turn into New Purchas Rd does not block ahead traffic. However, the drawing indicates that there would be no room for ahead traffic to pass stationary right-turning traffic.

10.5.5.2. The model indicated that all flow groups would operate within capacity. The highest RFC of 0.79 was reported for the right-turn from New Purchas Rd during the 2034 PM peak.

10.5.5.3. The results are likely to get worse when the lane widths are reduced on the minor arm. Furthermore, the capacity from the A4130(W) will decrease once the model accounts for the right-turn blocking the ahead traffic. It is uncertain whether this will result in the junction becoming over-capacity.

10.5.5.4. However, to mitigate any impacts from right turning vehicles, this junction could be subject to further mitigation work, if it is found that this is an issue, which causes congestion along this stretch of the A4130 in the future.

10.5.6. A4130 / Science Bridge (Old A4130) (SCH6)

10.5.6.1. The model indicated that the junction would be significantly over-capacity during all traffic flow periods modelled, particularly by the year 2034 with reported RFCs on the Old A4130 of 1.99 and 1.95 during the AM and PM peak periods respectively. However, the new Science Bridge link road operates within capacity with no queuing or delays.

10.5.6.2. Any changes made to the model based on the audit comments based on minor geometric inputs, are unlikely to have a significant impact on the modelling results.

10.5.6.3. OCC Highways accept the modelling undertaken at this junction and note the applicant's justifications for no further modelling in this location, as outlined in paragraph 6.6.15 of the TA.

10.5.7. <u>A4130 / New Thames River Crossing / Collett (SCH7)</u>

10.5.7.1. The model indicated that the junction should operate significantly within capacity during all flow scenarios. The highest RFC of 0.81 was predicted on A4130 (W) during the PM 2034 flow period.

10.5.7.2. The audit identified no significant problems with the modelling geometric input parameters. However, potential unequal lane usage on the A4130(W) could result in less capacity than the model predicts. If this were accounted for, this would likely result in the model predicting congestion on this arm during the PM peak. Although lane balancing could be improved by marking the approach so that ahead traffic had to use the offside lane, it would not eliminate the issue and therefore, the arm could remain over-capacity.

10.5.7.3. As stated above, OCC Highways accept that there will be parts of the network, which will be at or slightly over capacity in the 2034 future year, however, they are on parts of the network suitable to accommodate queuing.

10.5.7.4. The drivers from existing housing in Didcot are likely to be heading north over the new Didcot to Culham River Crossing. Without the HIF Scheme, their route north would have been through Long Wittenham / Clifton Hampden or Sutton Courtenay / Culham. Therefore, if they are queuing at SCH7 junction they are taking a different route to baseline conditions, where they would have been queuing through the villages, which is not acceptable to OCC.

10.5.8. <u>New Thames River Crossing / Hanson & FCC Access Road</u>

10.5.8.1. The model indicated that all flow groups would operate within capacity. The highest RFC of 0.75 was reported for the right-turn from the FCC Access during the 2034 AM peak.

10.5.8.2. The issues raised within JCT's audit are based on discrepancies with the lane widths at 5m intervals from the give way line on the minor arm. JCT has measured these as being wider than has been inputted into the original model. Also, the visibility to the left has also been increased in the audit, assuming that drivers can see over the grass verge.

10.5.8.3. Despite these issues, the model would produce more pessimistic capacity assessments and therefore, it would not be expected that the model would predict the junction to be over-capacity if changes were made to these parameters.

10.5.9. New Thames River Crossing / B4016 (SCH9)

10.5.9.1. The results in table 6.10 of the TA, indicate that the junction will operate within capacity in 2024. In 2034 the junction is predicted to operate at very close to capacity. Whilst RFC values are predicted to be between 0.92 and 1.00 in 2034, the maximum queue length on the B4016 is only seven vehicles.

10.5.9.2. As with the previous SCH8 junction, the audit has highlighted some minor discrepancies with the width and visibility parameters, which, if revised, would likely show a betterment within the model.

10.5.9.3. OCC do not require any further modelling at this junction and accept the justifications set down in the TA in paragraph 6.6.2. of the TA.

10.5.9.4. A priority junction in this location is justified, as it will not offer drivers leaving housing in northern and eastern Didcot too attractive a route through the village of Appleford. It will be much easier for them to access the new river crossing from Collett Roundabout, where the RFC value on the A4130 eastern arm is 0.77 with a queue length of just 3 cars in the 2034 AM peak.

10.5.10. New Thames River Crossing / B4016 Appleford Road Roundabout (SCH10)

10.5.10.1. The results in table 6.11 of the TA, indicate that the junction will operate within capacity in 2024 and 2034, although the desirable maximum RFC of 0.85 will be exceeded in the 2034 PM peak with a small queue of nine vehicles.

10.5.10.2. Unequal lane usage on the Appleford Rd (N) arm is unlikely to be a concern if the nearside lane is used by left-turning traffic and the offside lane for ahead traffic, as both movements are similar. It is recommended to provide lane marking to encourage drivers to do this.

10.5.10.3. Unequal lane usage on the New Culham Crossing arm (southbound) would result in less capacity than ARCADY predicts, which would increase the worst RFC of 0.91. If so, there may be potential to encourage southbound traffic to use both lanes on the approach by improving the exit merge.

10.5.10.4. From the Appleford Rd (S) arm, most of the traffic turns right towards New Culham Crossing, which will result in most traffic using the offside lane of the approach. There may be potential to encourage traffic to use both lanes on the approach by improving the exit merge.

10.5.11. Abingdon Roundabout (SCH11)

10.5.11.1. This roundabout is subject to further detail, as per our request in our response dated 28th February 2022, outlined in Section 1.

10.5.11.2. In its current layout, the results in table 6.12, indicate that the junction will operate within capacity in 2024 and 2034.

10.5.11.3. The JCT audit has highlighted discrepancies between some of the geometric parameters entered into the model. By updating the model to take into account revised flare lengths on the A415 (W) arm, it was found that the Intercept (maximum Capacity if circulating traffic was zero), dropped by about 2%. Whilst not a significant drop, it is worth noting here. However, JCT expect that all arms would remain within capacity after any modelling updates.

10.5.11.4. Even when uneven lane usage is taken into account, If it were expected that all the right-turn traffic from New Culham Crossing would use the offside lane, the worst RFC of 0.61 on this arm would increase, although the arm may remain within capacity. Revising the road markings to allow for both lanes to be used for right turning traffic would mitigate the issue.

10.5.12. Culham Science Centre Roundabout (SCH12)

10.5.12.1. The results shown in table 6.13 of the TA, indicate that this junction will operate within capacity in 2024. In 2034, the junction is shown to be operating within capacity in both peaks, although the desirable maximum RFC of 0.85 is exceeded on the Clifton Hampden Bypass (W) arm in the AM peak.

10.5.12.2. Despite, the JCT audit highlighting potential issues with unequal lane usage at this junction, the conclusion is reached that it is unlikely that any updates to the model, based on the audit comments, would make the ARCADY results worse than the original files.

10.5.13. Clifton Hampden Bypass / Realigned A415 (SCH13)

10.5.13.1. The results shown in table 6.14 of the TA, indicate that the junction will operate within capacity in 2024. In 2034, capacity is exceeded in both peaks with queues and delays occurring on the minor arm (realigned section of the A415). No delays are experienced on the Clifton Hampden Bypass.

10.5.13.2. The strategy for the HIF1 Scheme is to prioritise the mainline flow over side arm flows. The intention is for vehicles coming from the south of the River Thames and wishing to head north / east of SCH13 to make the journey from Collett Roundabout (SCH7). A different junction type in this location could be more attractive to drivers, reducing the rerouting benefits of the Scheme that remove trips through Long Wittenham and Clifton Hampden. Therefore, a level of queuing on the side arm in the peaks is deemed acceptable as it will operate as a village access whilst not being too attractive for through-trips.

10.5.13.3. Any drivers in a queue on this side arm are trying to travel east or west on the Clifton Hampden Bypass. Without the HIF1 Scheme, significantly more drivers would be travelling through the staggered signalised junction in Clifton Hampden Village (OFF6 and OFF7, see results in Table 6.26 and Table 6.27 of the TA). Delays at the signalised junction in the 'No HIF' scenario are significantly higher than those predicted at this junction in the 'With HIF' scenario.

10.5.13.4. Any changes made to the model based on the audit comments regarding minor lane width parameters, are unlikely to have a significant impact on the modelling results.

10.5.14. <u>Clifton Hampden Bypass / B4015 (SCH14)</u>

10.5.14.1. The results in table 6.15 of the TA, indicate that the junction will operate within capacity in 2024. In 2034 capacity is exceeded in both peaks with queues and delays occurring on the minor arm (B4015). No delays are experienced on the Clifton Hampden Bypass.

10.5.14.2. The geometric parameters used within the model were similar to those measured by JCT, although some of the visibilities used were shorter than indicated from the general arrangement plan sheet 19.

10.5.14.3. As stated above in paragraphs 10.5.13.3 and 10.5.13.4, OCC deem the delay on the minor arm to be acceptable, for the same reasons. There is also another existing alternative route via A415 through Burcot.

10.5.15. <u>Clifton Hampden Bypass / Culham Science Centre Access (SCH15)</u>

10.5.15.1. The results in table 6.16 of the TA, indicate that the junction will operate within capacity in 2024 and 2034. There is no right turn movement allowed from the bypass into this junction, resulting in 0 RFC values for that movement.

10.5.15.2. Any changes to the minor discrepancies in land widths found in the JCT audit, are unlikely to have any significant impact upon the modelling results.

10.6. After a thorough review of the HIF1 TA and the submitted audit *'Technical Note 21047: "HIF1 Scheme Package" Model Audits'* (28th January 2022) (found in Appendix A) the junction capacity modelling is accepted by OCC and no further modelling is required.

10.7. Milton Interchange and the Abingdon Road network will be discussed in the next sections.

11. ***The Milton Interchange (OFF1)***

11.1. The impact of the HIF1 scheme on the Milton Interchange has been demonstrated by comparing journey times along the A34. This was discussed and agreed with National Highways.

11.2. These were extracted from the Paramics model along the full length of the A34 covered by the model (approximately 13km), for ten-minute intervals 07:00 to 10:00 and 16:00 to 19:00, northbound and southbound, without and with HIF across the scenario years.

11.3. As demonstrated from figure 6.19 to 6.22 of the TA, the 2034 average journey time increase without the HIF1 scheme for both the north and southbound carriageways in both the AM and PM peaks, is hugely significant.

<u>Northbound</u>

11.3.1.1. The 2034 without HIF scenario shows a significant increase in journey time particularly after 09:00, with vehicles taking over two hours to complete a journey of approximately 13km.

11.3.1.2. The 2034 without HIF scenario shows a significant increase in journey time particularly after 17:30, with vehicles taking over one hour to complete a journey of approximately 13km. After 17:50 the journey time drops to zero as the network is congested and vehicles are not able to complete the journey.

<u>Southbound</u>

11.3.1.3. The 2034 without HIF scenario shows a significant increase in journey time particularly after 09:00, with vehicles taking over two hours to complete a journey of approximately 13km.

11.3.1.4. The 2034 without HIF scenario shows a significant increase in journey time particularly after 17:20, with vehicles taking over 41 minutes to complete a journey of approximately 13km. After 17:30 the journey time drops to zero as the network is congested and vehicles are not able to complete the journey.

Eastbound along the A4130

11.3.1.5. The journey times are across the following distances: 2020 base is 786 metres, 2024 without HIF is 1,032 metres, 2024 with HIF is 724 metres, 2034 without HIF is 1,032 metres, and 2034 with HIF is 717 metres. To allow further comparisons across the scenarios, Figure 6.24 and Figure 6.26 of the TA, show the average speeds across the section in each scenario, which takes into account the different section lengths.

11.3.1.6. In the 2034 AM peak hour, without HIF the journey takes 276 seconds compared to 84 seconds with HIF. This equates to approximately 8.4 mph and 19.1 mph respectively. The Scheme is allowing vehicles to travel away from Milton Interchange approximately twice as fast, at a speed similar to the 2020 base. The effect of this is seen on the A34 as shown in Figure 6.19 and Figure 6.21 of the TA, where significantly increased journey times are seen without HIF, due to the blocking back to Milton Interchange.

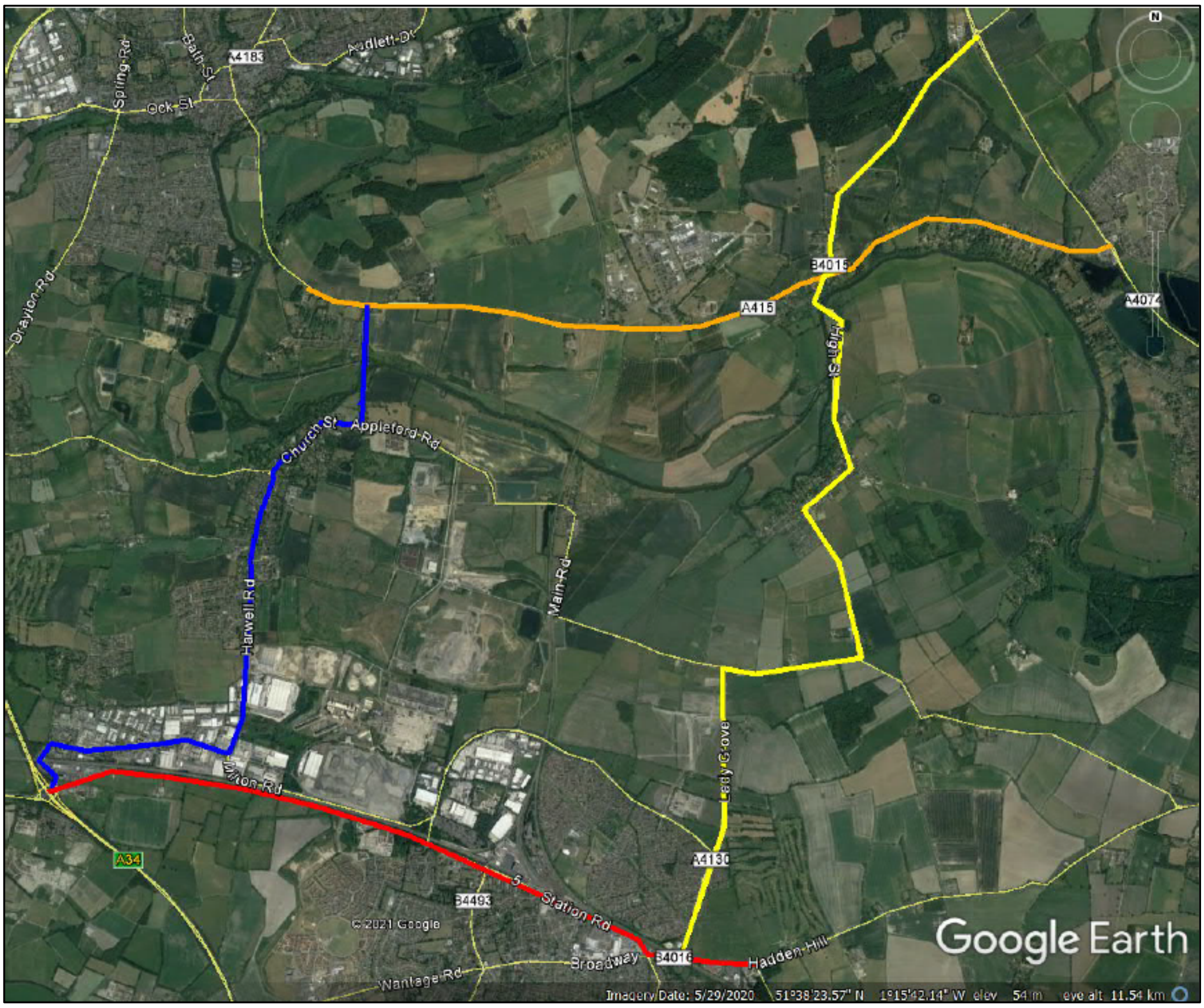
11.3.1.7. In the 2034 PM peak hour, without HIF the journey takes 684 seconds compared to 108 seconds with HIF. This equates to approximately 3.4 mph and 14.9 mph respectively. The Scheme is allowing vehicles to travel away from Milton Interchange approximately four times faster, at a speed similar to the 2020 base. The effect of this is seen on the A34 as shown in Figure 6.20 and Figure 6.22 of the TA, where significantly increased journey times are seen without HIF, due to the blocking back to Milton Interchange.

11.4. In summary, the HIF1 scheme allows the A4130 eastbound to operate more efficiently, meaning that there is a reduction in queuing back through the Milton Interchange. This in turn, reduces blocking back that causes the queuing on the A34 slip roads, thus improving A34 journey times.

12. ***Journey Times and Speeds Across the Network***

12.1. Vehicle journey time data has been extracted from the Paramics model to enable comparisons of network operation across multiple routes on the highway network.

12.2. Four routes were selected across the modelled area (as shown in figure 6.27 of the TA and replicated below), to represent a good geographic spread across the scheme area. They also cover the significant areas of existing congestion and queuing, which the HIF1 scheme intends to relieve. They also cover the north/south sections of the existing bus routes over the River Thames, routes 33 and 95.



12.3. Journey times for the 2020, 2024 and 2034 scenarios without and with the HIF1 Scheme are presented in Table 6.40 (AM peak) and Table 6.41 (PM peak) of the TA. The journey times for the '2034 No HIF1' scenario are based on the model run using 100% demand rather than 70% demand (refer to paragraph 8.9), as factoring up from the 70% demand model run would not provide reliable results for journey times. The journey times reported for the '2034 No HIF1' scenario therefore reflect the widespread congestion seen on the network in this scenario rather than predicted journey times.

12.4. Figure 6.28 in the TA, demonstrates that the total car journey time for all routes is significantly reduced with the HIF1 Scheme in both 2024 and 2034. The yellow and blue routes are used by bus services to cross the River Thames, therefore the Scheme enables lower journey times / improved journey time reliability for bus services using these routes. The significant increase in journey times seen in 2034 without HIF is caused by increases across all routes, but predominantly the orange PM eastbound route. This is created by significant delays at the Clifton Hampden staggered signalised junction and Culham Science Centre entrance. Total journey times in 2034 with the HIF1 Scheme are also slightly lower than those in 2020, showing that the HIF1 Scheme helps to enable the planned growth whilst allowing the road network to operate similarly to the base scenario.

12.5. Average vehicle speeds across the entire modelled network were also extracted from the Paramics model to represent the overall performance of the network with and without the HIF1 Scheme. Results from 2020, 2024 and 2034 scenarios without and with the HIF1 Scheme for AM and PM peaks are presented in Figure 6.29 and Figure 6.30 of the TA.

12.6. Additional growth in the model area without the HIF1 Scheme results in a slower moving network, which can be considered as a proxy for congestion. For example, four years of growth from 2020 to 2024 results in a 3.7mph reduction in the AM and 4.8mph reduction in the PM. The HIF1 Scheme in 2024 enables the network to operate more efficiently than 2020, as shown by the higher average speeds. The 2034 without HIF scenario shows a significant reduction in average speed across the network, due to the gridlock situation that develops in the model. The HIF1 Scheme enables the 2034 network to operate similarly to 2024 without HIF.

12.7. At this juncture it is important to note that the highway elements of the HIF1 Scheme are intended to be one part of a balanced transport strategy. The high-quality walking and cycling infrastructure elements of the Scheme help to offer alternative options for many journey types and routes, meaning that cycling and walking journey times are also reduced.

12.8. It is also important to stress that with vehicles being able to flow more efficiently through the network, it reduces the emissions from vehicles sat idling in queuing traffic.

12.9. Figure 6.31 in the TA, shows that in the AM peak, four years of growth from the 2020 Base, without the HIF Scheme, is modelled to increase average journey times by over two minutes (139 secs). This is significantly worsened with an additional ten years of growth to 2034, with the average journey time increasing by over 24 minutes (1,460 secs) compared to the 2020 base.

12.10. In 2024, the HIF1 Scheme reduces average journey times compared to the 2020 base by over one minute (-73 secs). In 2034, the HIF1 Scheme has enabled 14 years of growth with an average journey time increase of just over four minutes (253 secs). The average journey time with the HIF1 Scheme in 2034 is less than half of that without HIF1 (937 to 2,143). The HIF1 Scheme enables the 2034 network to operate similarly to 2024 without HIF1.

12.11. Figure 6.32 in the TA, shows that in the PM peak, four years of growth from the 2020 Base, without the HIF1 Scheme, is modelled to increase average journey times by three and a half minutes (213 secs). This is significantly worsened with an additional ten years of growth to 2034, with the average journey time increasing by almost twelve and a half minutes (743 secs) compared to the 2020 Base.

12.12. In 2024, the HIF1 Scheme reduces average journey times compared to the 2020 base by almost one minute (-44 secs). In 2034, the HIF1 Scheme has enabled 14 years of growth with an average journey time increase of just over three minutes (188 secs). The average journey time with the HIF1 Scheme in 2034 is less than two thirds of that without HIF1 (901 to 1,455). The HIF1 Scheme enables the 2034 network to operate similarly to 2024 without HIF.

13. ***Impacts upon Abingdon***

13.1. For the purposes of the HIF1 Scheme package assessment, the Paramics Model covered the highway network just to the west of the existing Culham River Crossing.

13.2. In discussions with OCC Highways, Abingdon was not included within the modelling for this planning application, the justifications for which are expanded upon below.

Changes in traffic flow to/from Abingdon

13.2.1. Any increase in traffic flow into/out of Abingdon is due to the growth in housing and employment in Didcot and surrounding areas, not due to the HIF1 scheme itself. The traffic impact on Abingdon from those housing and employment sites will be scrutinised by OCC Highways through the Transport Assessment in the planning application for each site. If mitigation is deemed necessary, which could include sustainable travel infrastructure and/or services, then OCC will secure funding or direct delivery for this from each housing/employment site. HIF1 is part of a wider strategy to mitigate the impact of growth across a wide area, which can only be delivered incrementally as funding becomes available, either through government grants or developer funding.

Walking and Cycling

13.2.2. The Scheme both directly delivers and indirectly enables a significant number of new and/or improved walking and cycling routes in the area. The provision of additional and improved Non-Motorised User (NMU) routes and crossing points will help to reduce the existing severance caused by the Great Western Mainline and River Thames. Connections to public rights of way will be provided, together with safe access to and from new bus infrastructure. This will help to engender modal shift away from the private motor car, particularly for commuting purposes for employment and education, but also for important access to amenities such as retail and healthcare, and for leisure trips. As explained below under ‘Housing Sites’, development sites in the area will be required to deliver additional NMU links which will connect with the HIF scheme NMU infrastructure, in turn linking Didcot (and surrounding areas) to Abingdon with high quality NMU routes.

Public Transport

13.2.3. The HIF1 scheme relieves queueing at Sutton Bridge and Culham Cut, which in turn improves the journey time reliability for public transport using this route to/from Abingdon e.g. bus route 33. This makes using public transport to/from Abingdon more attractive, reducing the number of people choosing to drive into Abingdon. The HIF1 scheme also provides a new route for public transport to link areas of employment with existing and new homes improving bus services and journey time reliability to increase passenger numbers.

AQMA

13.2.4. Abingdon is subject to an Air Quality Management Area (AQMA). Traffic signals are used to manage traffic flows in the town centre to prevent excessive emissions. The signals hold vehicles outside the centre of town to enable it to operate without gridlock. This, in part, creates queuing on the peripheral approaches to Abingdon, for example the A415 from Culham. Until the vehicle fleet change away from petrol/diesel vehicles is sufficient to not require the AQMA, there is little than can be done to remove the vehicle queuing on the approaches to Abingdon Town Centre.

A34 Lodge Hill

13.2.5. The A34 Lodge Hill scheme at North Abingdon will enable rerouting of trips in Abingdon, particularly those with an origin in North Abingdon wishing to head south on A34, and those from the A34 with a destination in North Abingdon. This rerouting of trips and subsequent relieving of traffic could enable OCC to investigate options for the road system in the town in the future, once the AQMA falls away due to fleet change.

Local Cycling and Walking Infrastructure Plan (LCWIP)

13.2.6. OCC is currently creating a Local Cycling and Walking Infrastructure Plan (LCWIP) for Abingdon and Didcot alongside key stakeholders, which will identify walking and cycling infrastructure improvements.

Science Vale Active Travel Network (SVATN)

13.2.7. OCC has recently completed improvements to cycle routes in / near Abingdon, Didcot and Wantage through the Science Vale Cycle Network programme. A new study, Science Vale Active Travel Network (SVATN) will soon begin to further this, with the route between Abingdon and Culham (between HIF1 and Abingdon – called route 7 is one of the routes to be studied).

Local Transport and Connectivity Plan (LTCP)

13.2.8. OCC is in the final stages of adoption of its new Local Transport and Connectivity Plan (LTCP). As part 2 of LTCP an Abingdon Town Strategy will be written.

Housing Sites

13.2.9. The housing sites allocated in/around Abingdon as part of Vale of White Horse Local Plan Part 1 are currently building out, and in different stages of delivering their offsite mitigation measures, including pedestrian and cycle routes. These sites are also obligated to pay towards improvements to bus services in Abingdon.

13.2.10. The Dalton Barracks housing site, allocated in Vale of White Horse Local Plan Part 2, will also have to deliver sustainable transport improvements in Abingdon including pedestrian and cycle infrastructure, and improved/new bus services.

13.2.11. The land adjacent to Culham housing site, allocated in South Oxfordshire District Council Local Plan, will have to assess its impact on Abingdon and the wider network and mitigate as appropriate. This will include sustainable transport improvements, including pedestrian and cycle infrastructure, and improved/new bus services. The local plan policy states for that site:

> *"All necessary infrastructure, referring to the Infrastructure Delivery Plan, which is likely to include […] provision for excellent sustainable transport facilities including, but not limited to […] provision of a new cycle bridge and associated connectivity and paths across the River Thames to connect appropriately with Abingdon on Thames to the north of the site."*

14. ***Scheme Design***

14.1. The scheme design and general layout is shown on the General arrangement plans (drawing numbers GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0001 to 0019) and described in Sections 4.2 to 4.5 of the TA.

14.2. Each component of the scheme package, as per below:

- A4130 Widening;
- Didcot Science Bridge;
- Didcot to Culham River Crossing; and
- Clifton Hampden Bypass

has been has been considered with reference to the relevant national, regional and local policies and guidance, as outlined in paragraph 2.1.1 of the TA.

14.3. In terms of layout and geometry, accordance with the following is adhered to:

- Design Manual for Roads and Bridges (2020);
- LTN 1/20 Cycle Infrastructure Design (2020)

14.4. The Design and Access Statement (DAS) Part 1 – 6 detail all the departure from standards throughout the scheme; These have been agreed through discussion with OCC.

14.5. AECOM was commissioned by OCC to complete a Stage 1 Road Safety Audit (RSA) for the four sections of the Scheme. These were undertaken between December 2019 and May 2020. The RSA reports also include the Design Organisation Response logs. The RSA reports can be found in Appendix D of the TA.

14.6. As outlined in paragraphs 1.2.1 – 1.2.3 of this report, OCC Highways are still awaiting three elements with regards to layout, to review.

15. ***Walking and Cycling***

15.1. The HIF1 schemes include high-quality dedicated off-road pedestrian and cycle (LTN 1/20 compliant) facilities along their length, which will help to increase opportunities for active travel and help the County to move closer towards its carbon reduction aspirations.

15.2. The schemes will include the direct delivery of approximately 10km (6.5miles) of new or improved walking and cycling facilities, with the vast majority of this provision being new; whilst also enabling other walking and cycle improvements in the area which will be delivered by the planned allocated housing and employment growth.

15.3. This direct provision will make active modes more attractive between various settlements and key employment locations. For example, a direct and segregated cycle route between Didcot and Culham Science Centre and, at an approximate distance of 5km, this roughly equates to a 20-minute bike ride. In the current Science Vale Cycle Network strategy - Route 8, linking Didcot to Culham Science Centre, is proposed to go through Long Wittenham and over Clifton Hampden Bridge. Parts of this route would be on carriageway or along bridleways. The new river crossing would mean a shorter Route 8 scheme is deliverable and a much-improved offer is available to active travel that reduces the overall route for users by 20%, making it even more attractive.

15.4. This will help to realise the aspirations of the forthcoming Didcot Local Cycling and Walking Infrastructure Plan (LCWIP) and the updated Science Vale Active Travel Network (SVATN) (which will supersede the Science Vale Cycle Network Plan) by providing improvements to the existing network as well as new walking / cycling links. This will offer mode choice for work and recreation, helping to encourage modal shift away from the private car.

15.5. Further to this, the HIF1 schemes are fundamental to delivering the aims of the Didcot Garden Town. By reducing the impact of existing and forecast traffic within Didcot, and with a focus on improving active travel and public transport facilities within Didcot, this will help to make walking and cycling more attractive as well as improving the placemaking potential of the town. Together with the Didcot Northern Perimeter Road 3 (NPR3), as part of an overall strategic approach in Didcot, the HIF1 Scheme will support the Didcot Central Corridor project, by helping to take through traffic out of the centre of the town, thereby making it a more attractive and appealing place to spend time as a community.

15.6. OCC Infrastructure Locality Team are undertaking a study to explore further opportunities that the HIF1 project unlocks, in relation to walking/cycling connectivity together with place making improvements to villages that benefit from reduced traffic flow as a result of the proposed HIF1 project. This project is in its early stages and will include full public engagement.

15.7. OCC note that pages 73 - 83 of the TA set out in detail the improvements for active travel that are brought about by the scheme.

16. *Public Transport*

16.1. As outlined in the TA, there are currently limited opportunities for bus routes to offer good journey time reliability north / south in this area due to the severance created by the River Thames, the Great Western Mainline and the historic road network.

16.2. The HIF1 scheme will create opportunities for better public transport access, for example across the river and railway line to Culham Science Centre, Didcot and Milton Park, which are currently constrained by congestion. It also will help to improve journey time reliability and attractiveness of bus services connecting Didcot with the local area as a result of the improvements to the existing and forecast congestion on the highway network.

16.3. At least twelve bus services connect Didcot with key destinations in the area (including Harwell Campus, Milton Park, and Culham Science Centre). The journey time reliability of all these services, and therefore their attractiveness and to some degree commercial viability, is impacted by congestion in the AM and PM peaks within the town and its surrounding area. The alleviation of these congestion issues that would result from the HIF1 Scheme would in turn bring about improvements to the journey time reliability of these bus services.

16.4. In addition, 18 new bus stops are being provided as part of the Scheme, which will increase the accessibility and catchment of the existing bus services in this area.

16.5. Further to this, the success of the new bus services that are to be introduced to serve development allocated in the SODC Local Plan 2035, and the development yet to come forward in the adopted VoWHDC Local Plan, is to a significant degree dependent on the delivery of the HIF1 schemes. For example, one of the new bus services, which is a fundamental part of the improved bus network as it would connect multiple strategic residential sites, is expected to route via the Didcot to Culham River Crossing. Without this scheme in place, it would be reliant on the existing river crossings where the existing and forecast congestion may render the service untenable. Additionally, the network of new and improved bus services is predicated on all of the planned growth in the VoWHDC and SODC Local Plans coming forward. The HIF1 schemes help to facilitate this growth which in turn helps to make the new bus network deliverable and ensure improvements to connectivity.

16.6. The HIF1 schemes also help to support planned improvements to the frequency of rail services at Culham Station, as set out in Network Rail's Oxfordshire Rail Corridor Study, as they are predicated on the residential and employment growth planned at and adjacent to Culham Science Centre.

17. *Construction*

17.1. As illuded to in paragraph 7.1.2 of the TA, OCC Highways will require a pre-commencement condition to produce a Construction Environmental Management Plan (CEMP), with Construction Traffic Management Plans (CTMP) produced as relevant ahead of each phase of construction.

17.2. The role of the CTMP will be to consider the construction activity for that phase and identify appropriate measures to minimise or mitigate significant impacts.

17.3. All of the key principles set down in section 7.2 of the TA, are noted by OCC Highways and will be scrutinised where relevant.

17.4. A total of 14 construction site access points have been identified along the Scheme and are outlined in Table 7.1 of the TA. The ECI Contractor (Grahams) has provided an estimate of the monthly vehicle movements at each access point, for both cars/LGVs and HGVs. Car/LGV movements are predominantly related to staff travelling to and from the Site, and it has been assumed that the import and export of materials is by HGV.

17.5. Paragraphs 7.4.3 and 7.4.4 of the TA describe routes to be taken when reaching all the construction access points A – L. All these routes take into account existing weight restrictions and current HGV routes and are logical assumptions for construction traffic.

17.6. OCC Highways note the assessment of the impact of construction traffic, which has been included in the Environmental Statement (Chapter 16 'Traffic and Transport'). The conclusions are summarised in paragraph 7.4.5 of the TA.

17.7. Whilst there will inevitably be an increase in HGV movements in the short term for the construction of the HIF1 package, OCC do not view these impacts as significant and will restrict the use of construction traffic to the strategic highway network for as long as possible to reduce the impact upon rural roads.

18. *Summary*

18.1. There are outstanding matters resulting in a holding objection. Three relate to requests for further technical information and the other requires clarification over a modelling discrepancy at the Ladygrove / Sires Hill junction (OFF13).

18.2. The layout and geometry have been checked against all relevant standards and are acceptable in planning terms. Any departure from standard has been agreed with OCC and Stage 1 Road Safety Audits have been undertaken. Much of the fine detail will captured, where required, at the detailed design stage.

18.3. The modelling methodology and approach was agreed with OCC and the model validates and has been used correctly. OCC are satisfied with the modelled years, data and growth figures used. The model does not identify any areas that will require further mitigation as a result of the HIF1 Schemes.

18.4. An independent model review has examined all the junctions in the scheme (Appendix A). The consistent issue which arose in the roundabout modelling, was the unequal lane balancing, however, it was concluded that even if this were refined in the modelling, the junctions in question would still operate to a level acceptable to OCC. It is also accepted that despite some junctions operating at overcapacity in the future years, HIF1 is part of wider strategy to mitigate the impact of growth across a wide area which can only be delivered incrementally as funding becomes available, either through government grants or developer funding. The report raised a discrepancy at the OFF13 junction, which must be clarified.

18.5. Journey times across the modelled network will be significantly reduced and the provision of new and improved pedestrian and cyclist facilities as part of the HIF1 package, will help to engender modal shift away from the private motor car, particularly for commuting purposes for employment and education, but also for important access to amenities such as retail and healthcare, and for leisure trips.

18.6. The walking and cycling improvements being delivered across the scheme are significant and comply with LTN 1/20, inclusive mobility and The Equalities Act 2010. OCC are satisfied that the HIF1 Scheme delivers exemplary walking and cycling connectivity and opens up further opportunities for sustainable travel across the Didcot area and beyond to key employment and leisure areas.

18.7. The HIF1 scheme will create opportunities for better public transport access, for example across the river and railway line to Culham Science Centre, Didcot and Milton Park, which are currently constrained by congestion. It also will help to improve journey time reliability and attractiveness of bus services connecting Didcot with the local area as a result of the improvements to the existing and forecast congestion on the highway network. In addition, 18 new bus stops are being provided as part of the Scheme, which will increase the accessibility and catchment of the existing bus services in this area.

18.8. The HIF1 schemes also help to support planned improvements to the frequency of rail services at Culham Station, as set out in Network Rail's Oxfordshire Rail Corridor Study, as they are predicated on the residential and employment growth planned at and adjacent to Culham Science Centre.

18.9. OCC Highways will require a pre-commencement condition to produce a Construction Environmental Management Plan (CEMP), with Construction Traffic Management Plans (CTMP) produced as relevant ahead of each phase of construction. OCC note the assessment of the impact of construction traffic and note that whilst there will inevitably be an increase in HGV movements in the short term for the construction of the HIF1 package, OCC do not view these impacts as significant and will restrict the use of construction traffic to the strategic highway network for as long as possible to reduce the impact upon rural roads.

Officer's Name: Kt Hamer
Officer's Title: Principal Development Management Engineer
Date: 27th July 2022

Technical Note 21047

"HIF1 Scheme Package" Model Audits

28th January 2022

JCT Consultancy Limited
LinSig House
Deepdale Enterprise Park
Nettleham
Lincoln LN2 2LL

Client: Oxfordshire County Council
County Hall
New Road
Oxford
OX1 1ND

Contact: Katherine Hamer
Principal Development Management Engineer (South and Vale)

Technical Note 21047
Issue: 1.0

	Prepared by:	Checked / Approved by:
Name:	Simon Swanston	Stuart Hanson
Position:	Associate Director	Assistant Engineer
Date:	28/01/2022	28/01/2022
Signature:		

Previous Issues

JCT Consultancy Ltd
LinSig House
Deepdale Enterprise Park
Nettleham
Lincoln LN2 2LL
Tel: UK 01522 751010
Fax UK 01522 751188
Email: consultancy@jctconsultancy.co.uk
Web Site: www.jctconsultancy.co.uk

CONTENTS

0.0 About this technical note

This technical note is intended for use by personnel experienced in traffic engineering and familiar with the area being analysed/designed. It is designed to help these technical personnel in the decision-making process and its contents may be subsumed into a more comprehensive report without permission. This technical note should always be read in conjunction with models, drawing and or supplementary text and documents as outlined throughout the note. This is not intended to be a comprehensive report for the consumption of a wider and potentially non-technical audience. A technical note rather than a more descriptive report has been produced at the client's request. JCT are happy to provide supplementary information to others and provide information on the tasks undertaken in alternative format on instruction.

1.0 Brief

1.0.1 JCT were commissioned by Oxfordshire County Council (OCC) to audit modelling related to a planning application for the HIF1 Didcot Garden Town infrastructure project, known as the "HIF1 Scheme Package".

1.0.2 The junctions modelled as part of the scheme are shown in **Figure 1.0.0**, and are located in the Didcot area, running from Milton Gate in the west to Clifton Hampden to the north-east.

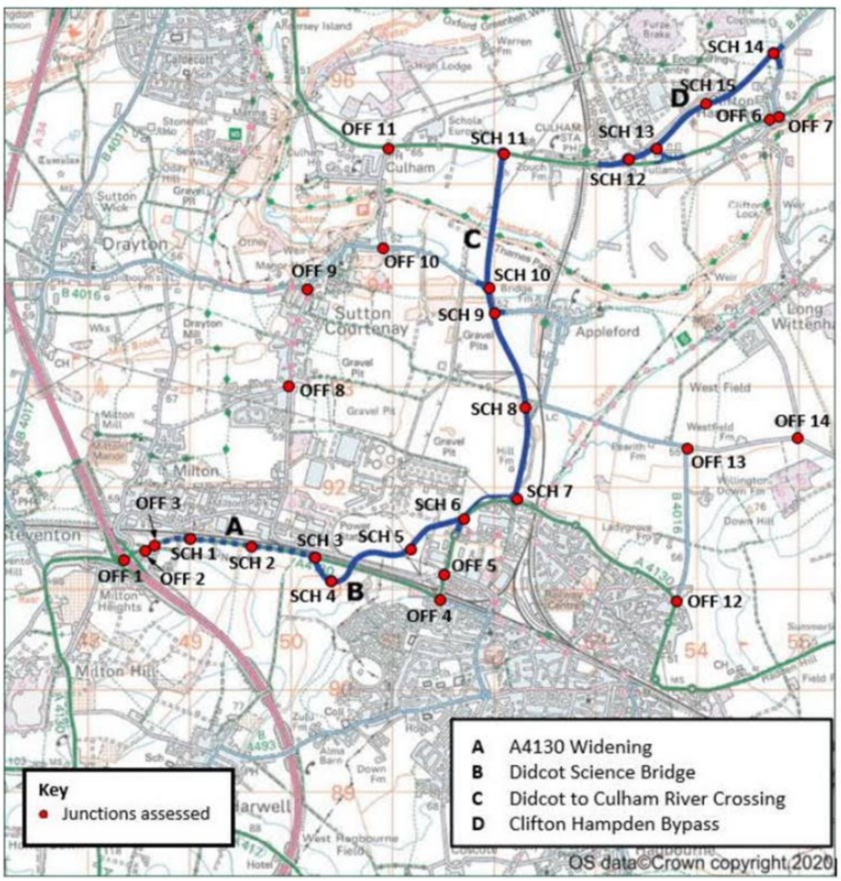


Figure 1.0.0: Junction Locations

1.0.3 The modelling was reported within the Transport Assessment "Didcot Garden Town Housing Infrastructure Fund (HIF1)" by OCC, issued in September 2021.

1.0.4 The modelling input / output information, to be audited by JCT, was included within the appendices of the Transport Assessment. OCC also provided other related files, such as the models and junction layout drawings. Each section within this technical note highlights the files available to JCT to conduct the audit for each junction.

1.0.5 The models to be audited by JCT were conducted using the software LinSig (traffic signal junctions) and Junctions 9 (i.e., ARCADY for priority roundabouts, PICADY for priority junctions).

1.0.6 Modelling evaluations were run for the AM / PM peak periods in 2020, 2024 (with and without scheme package) and 2034 (with and without scheme package).

1.0.7 Junctions with the prefix "OFF" are the off-site junctions, and most of these have been modelled assuming their current form (i.e., layout and signal constraints if applicable) with the predicted traffic flows. However, some of these have been modelled assuming proposed layouts (OFF4, 5 and 12).

1.0.8 Junctions with the prefix "SCH" are new junctions that form part of the Scheme. As expected, the WITH Scheme traffic flows have only been modelled at these junctions.

2.0 Model Audits

2.0.1 Each junction will be audited separately within the following sections, and follow the same general structure:

- Information provided to JCT
- Traffic flows used in model
- Audit comments
- Provided model results description
- Potential impact of model changes

2.0.2 Traffic flow diagrams were not included within the Transport Assessment. Therefore, the traffic flows used in the models are highlighted within this technical note, and OCC should clarify if these traffic flows are a reasonable representation of each scenario.

2.0.3 JCT independently measured Junctions 9 geometric input parameters from the provided drawing. Due to the scale of the drawing, and the subjective nature of making some of these measurements (particularly when measuring the conflict angle), it should not be expected that the JCT measurements and the values used in the models should match exactly. However, where the difference is greater than expected, these differences are highlighted within the audit.

2.0.4 It is important that unequal lane usage is considered in the modelling of roundabouts in ARCADY. If it is ignored, the results can be significantly optimistic. **Appendix A** describes methodologies that may be used to account for unequal lane usage and compares their outputs for several examples. This information may be of use in instances where the audit indicates that unequal lane usage was not considered in the original models. For each roundabout where JCT expect unequal lane usage could play a key factor, a table will be provided highlighting the potential available capacity, compared to the Junctions9 predicted capacity. These values were calculated based on the JCT measured geometry in most cases, with these assumptions also highlighted.

2.0.5 Some proposed schemes included pedestrian crossings, which were included within the Junctions 9 models (for roundabouts and priority junctions). Nominally low pedestrian flows were used in the models. This may be a reasonable assumption, if pedestrian flows are expected to be light, and have no significant impacts to the capacity of the junctions. However, including crossings in the models may limit the ability to include other inputs, such as modelling right-turn blocking or unequal lane usage at roundabouts. Therefore, if crossings are expected to have no impact to junction performance, they could be deleted to ensure other inputs can be included.

2.1 OFF1 Milton Interchange

Provided Information

2.1.1 The junction is a grade-separated, signal-controlled roundabout that links the A34 / A4130 / Park Drive. It also provides a cut-through the centre of the junction for traffic turning right from the A4130 (E) to the A34 northbound.

2.1.2 This junction was not modelled in LinSig, and therefore there was no model to audit as part of JCT's review. The modelling was restricted to Paramics microsimulation. However, LinSig could be used in the evaluation of this junction, and provide a useful tool in demonstrating the impact of each traffic flow scenario on the capacities, queues and delays at the roundabout. This can be done ensuring consistent input parameters and allowing the modeller to make timing adjustments to account for the different traffic flow volumes and turning proportions in each scenario, and setting the required progression of streams through circulating stoplines.

2.2 OFF2 A4130 / Service Area

Provided Information

2.2.1 The junction was modelled in Junctions 9, file "*OFF 2 Junction-A4130_Service Area - Final.j9*". The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.2.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.2.1**:

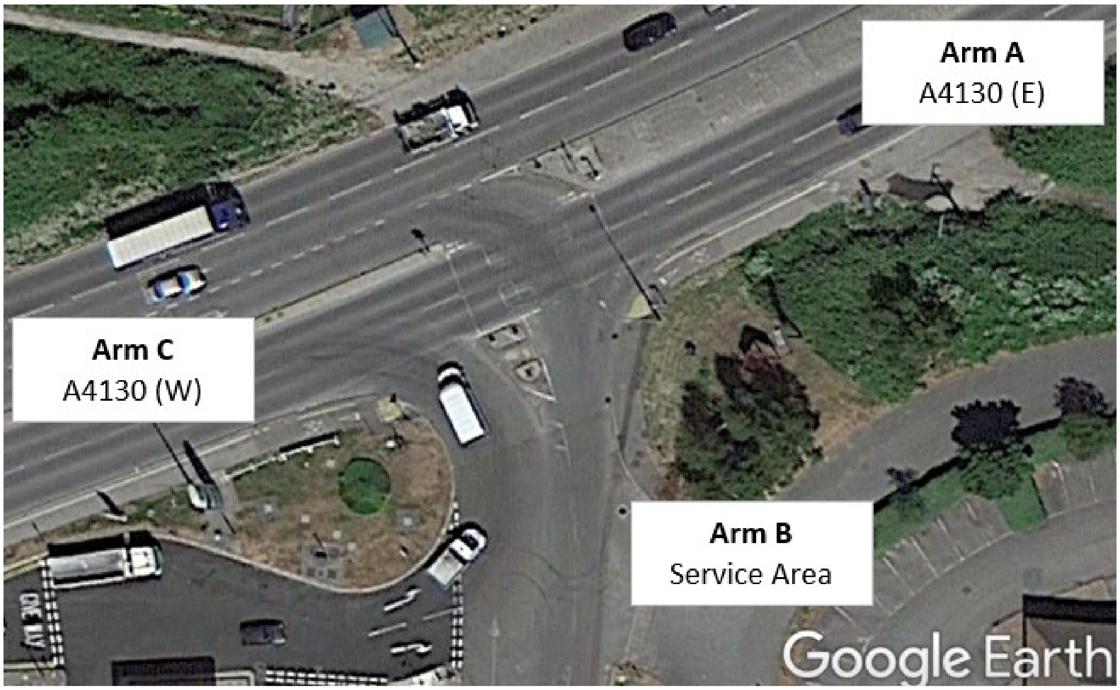


Figure 2.2.1: OFF2 A4130 / Service Area Layout

Traffic Flows Used in Model

2.2.3 The traffic flows used in the model are shown in **Figure 2.2.2.**

A **A4130 (E)** **C** **A4130 (W)**
B **Service Area**

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	78	1095	**1173**
B	0	0	263	**263**
C	1061	135	0	**1196**
Total	**1061**	**213**	**1358**	**2632**

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	108	1015	**1123**
B	0	0	257	**257**
C	773	173	0	**946**
Total	**773**	**281**	**1272**	**2326**

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	66	1444	**1510**
B	0	0	182	**182**
C	1030	128	0	**1158**
Total	**1030**	**194**	**1626**	**2850**

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	78	1511	**1589**
B	0	0	234	**234**
C	1226	155	0	**1381**
Total	**1226**	**233**	**1745**	**3204**

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	93	1317	**1410**
B	0	0	240	**240**
C	923	131	0	**1054**
Total	**923**	**224**	**1557**	**2704**

PM 2024 WITHOUT (1700 - 1800) - Vehic

	A	B	C	Total
A	0	120	1078	**1198**
B	0	0	273	**273**
C	1098	174	0	**1272**
Total	**1098**	**294**	**1351**	**2743**

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	53	1334	**1387**
B	0	0	277	**277**
C	1409	143	0	**1552**
Total	**1409**	**196**	**1611**	**3216**

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	121	1257	**1378**
B	0	0	172	**172**
C	1858	158	0	**2016**
Total	**1858**	**279**	**1429**	**3566**

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	119	2063	**2182**
B	0	0	282	**282**
C	1388	156	0	**1544**
Total	**1388**	**275**	**2345**	**4008**

PM 2034 WITHOUT (1700 - 1800) - Vehic

	A	B	C	Total
A	0	121	1420	**1541**
B	0	0	309	**309**
C	2031	178	0	**2209**
Total	**2031**	**299**	**1729**	**4059**

Figure 2.2.2: OFF2 Service Area Traffic Flows in Model

Without the scheme, the model indicated traffic flows out of the site decreased in 2024 compared to 2020 during the AM peak, as did the right-turn into the site and eastbound traffic. However, these were all higher by the year 2034. All traffic flows increased during the PM peak by the years 2024 and 2034.

With the scheme, eastbound traffic flows increased. Westbound traffic also increased with the scheme in the year 2024 (compared to without the scheme), although the westbound flows were lower with the scheme by the year 2034, significantly so during the AM peak. Traffic flows into and out of the Service Area were lower with the scheme.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.2.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.2.1**.

Table 2.2.1: OFF2 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	14.68	14.50
Kerbed Reserve (m)	1.22	4.9
Right-Turn Bay (m)	3.63	3.50
Visibility (m)	204	207
Blocks?	Yes	Yes
Blocking Queue	15	12

Minor Arm	Model	JCT
Type	One	One
Width Lane 1	5	5
Width Lane 2	n/a	n/a
Width @ 0m	n/a	n/a
Width @ 5m	n/a	n/a
Width @ 10m	n/a	n/a
Width @ 15m	n/a	n/a
Width @ 20m	n/a	n/a
Flare Length	n/a	n/a
Visibility Left	n/a	n/a
Visibility Right	46	45

The kerbed reserve width used in the model was too short, as it incorrectly appeared to represent the kerbed section between westbound traffic and the right-turn bay. However, this parameter is to account for the impact on capacity for the right-turn out of the minor road. This movement is not permitted, and therefore this parameter should have no significant impact on the results.

Potential Impact of Modelling Changes to Results

2.2.5 The original model indicated that the junction would operate within capacity for all flow groups, except for the 2034 AM Peak WITHOUT the scheme, in which an RFC of 1.07 was predicted on the Service Area. This was because the opposing westbound traffic flow was significantly higher in the scenario without the scheme compared to with it.

2.2.6 Any changes made to the model based on the audit comments are unlikely to have a significant impact on the modelling results.

2.3 OFF3 A4130 / Milton Gate

Provided Information

2.3.1 The junction was modelled in LinSig, file "*OFF 3 Milton Gate Signals_for reporting.lsg3x*". JCT audited the provided LinSig model directly.

2.3.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.3.1**:

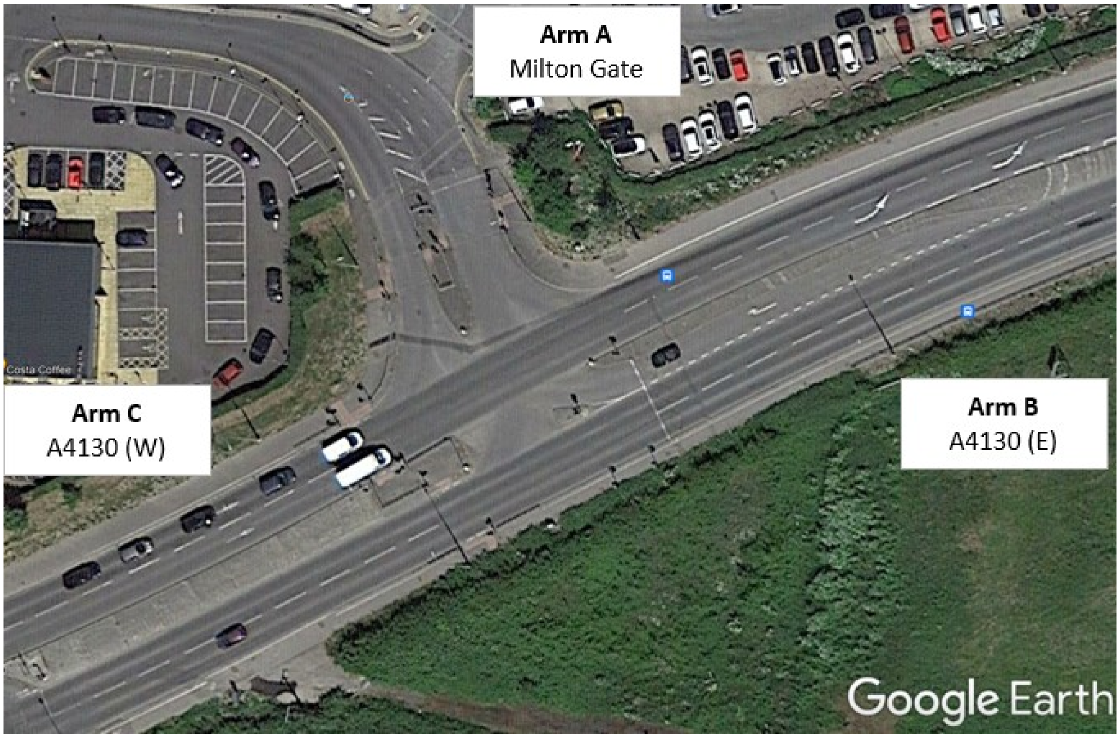


Figure 2.3.1: OFF3 A4130 / Milton Gate Layout

Traffic Flows Used in Model

2.3.3 The traffic flows used in the model are shown in **Figure 2.3.2.**

A **Milton Gate** **C** **A4130 (W)**
B **A4130 (E)**

AM 2020 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	39	68	**107**
B	44	0	1191	**1235**
C	98	1065	0	**1163**
Total	**142**	**1104**	**1259**	**2505**

PM 2020 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	31	85	**116**
B	26	0	1085	**1111**
C	43	780	0	**823**
Total	**69**	**811**	**1170**	**2050**

AM 2024 WITH (0800 - 0900) - PCUs

	A	B	C	Total
A	0	43	69	**112**
B	61	0	1553	**1614**
C	99	1035	0	**1134**
Total	**160**	**1078**	**1622**	**2860**

PM 2024 WITH (1700 - 1800) - PCUs

	A	B	C	Total
A	0	52	71	**123**
B	35	0	1316	**1351**
C	39	1209	0	**1248**
Total	**74**	**1261**	**1387**	**2722**

AM 2024 WITHOUT (0800 - 0900) - PCUs

	A	B	C	Total
A	0	35	76	**111**
B	56	0	1442	**1498**
C	98	933	0	**1031**
Total	**154**	**968**	**1518**	**2640**

PM 2024 WITHOUT (1700 - 1800) - PCUs

	A	B	C	Total
A	0	46	77	**123**
B	29	0	1162	**1191**
C	43	1107	0	**1150**
Total	**72**	**1153**	**1239**	**2464**

AM 2034 WITH (0800 - 0900) - PCUs

	A	B	C	Total
A	0	62	66	**128**
B	61	0	1435	**1496**
C	119	1396	0	**1515**
Total	**180**	**1458**	**1501**	**3139**

PM 2034 WITH (1700 - 1800) - PCUs

	A	B	C	Total
A	0	80	67	**147**
B	43	0	1342	**1385**
C	40	1852	0	**1892**
Total	**83**	**1932**	**1409**	**3424**

AM 2034 WITHOUT (0800 - 0900) - PCUs

	A	B	C	Total
A	0	53	80	**133**
B	84	0	2232	**2316**
C	110	1421	0	**1531**
Total	**194**	**1474**	**2312**	**3980**

PM 2034 WITHOUT (1700 - 1800) - PCUs

	A	B	C	Total
A	0	72	72	**144**
B	39	0	1521	**1560**
C	43	2044	0	**2087**
Total	**82**	**2116**	**1593**	**3791**

Figure 2.3.2: OFF3 Milton Gate Traffic Flows in Model

Without the scheme, the model indicated traffic flows increased on the A4130 (except between 2020-2024 during the AM peak, where eastbound flow fell from 1065 to 933 pcus). Traffic flows along the A4130 increased significantly between 2024 to 2034 in both peaks.

With the scheme, in the year 2024, traffic flows along the A4130 were shown to increase further. However, in the year 2034, the A4130 traffic flows were significantly lower compared to without the scheme.

Audit Comments

2.3.4 The right-turn flare for traffic into Milton Gate from the A4130 was set as 9 pcus. Google Earth indicates a value of 7-8 pcus may be more representative.

2.3.5 The traffic flows in the 2034 AM and PM peak periods, without the scheme, were not correctly assigned, resulting in 535 pcus and 304 pcus ADDITIONAL traffic being assigned to the junction than defined in the Desired Traffic Flow matrix, in the AM and PM peaks respectively.

2.3.6 The stages used in the model are shown in **Figure 2.3.3**.

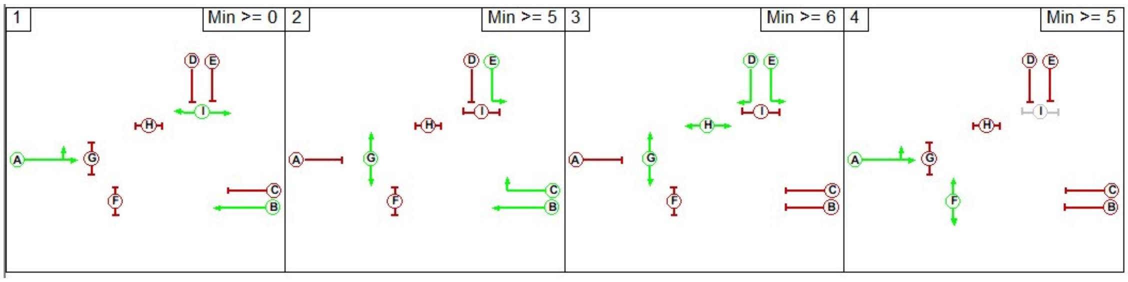


Figure 2.3.3: OFF3 Available Stages

The modelled sequence was 1-2-3-4. This would be the most robust sequence, as it assumed that Phase F is called every cycle (Stage 4). However, if Phase F demand was expected to be low, then the model would provide unrealistically pessimistic results due to a significant reduction to westbound traffic (i.e., if Stage 4 were not demanded, the junction would move to Stage 1 and provide green to Phase B).

2.3.7 Saturation flows were predicted using the lane geometry, as described in TRRLs Research Report 67.

Lanes 4/2 (Milton Gate Offside) and 6/3 (A4130 East Right-Turn) were set as offside lanes. Although geometrically correct, this provides a higher saturation flow. It can be argued that an offside lane provides a higher saturation flow as it provides an opportunity for faster vehicles to overtake slower vehicles, although this is only true if both are going to the same exit. In these cases, the offside lanes are exclusively for right-turn traffic, which could include slower moving vehicles. Therefore, a robust approach would be to set these lanes as nearside lanes in the model.

2.3.8 The model assumes a cycle time of 66 seconds in every scenario. However, this cycle time is relatively short, especially when it is assumed Stage 4 is called every cycle. Furthermore, it is likely reasonable to assume that higher cycle times would be acceptable, especially as traffic flows increase. Therefore, it is recommended that a maximum cycle time is agreed upon, and then each scenario run using this (to provide a consistent comparison between each). A cycle time of at least 120 seconds is often considered acceptable in general.

<u>Potential Impact of Modelling Changes to Results</u>

2.3.9 The original model indicated that the junction would be over-capacity in all scenarios, with negative PRCs in all 2024 and 2034 runs, with and without the scheme. Significant congestion was predicted in 2034 without the scheme, with PRCs of -51.7% and -25.2% during the AM and PM peak periods respectively.

2.3.10 If the model was updated based on the audit comments, the results are likely to change significantly, especially if it was assumed Stage 4 does not run each cycle AND a higher cycle time is permitted. Furthermore, the 2034 traffic flows without the scheme were too high in the model. JCT would expect the results to improve significantly in all scenarios.

2.4 OFF4 A4130 / BB4493 / Mendip Heights Roundabout

<u>Provided Information</u>

2.4.1 The junction was modelled in Junctions 9, file "*OFF 4 Jun Redesigned_V1.j9*". The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.4.2 The modelling represented a proposed scheme as part of S278 works, related to a nearby housing site. The drawing of the layout (**Figure 2.4.1**) was provided, Drawing Number:

1207 Rev A1 - Jubb

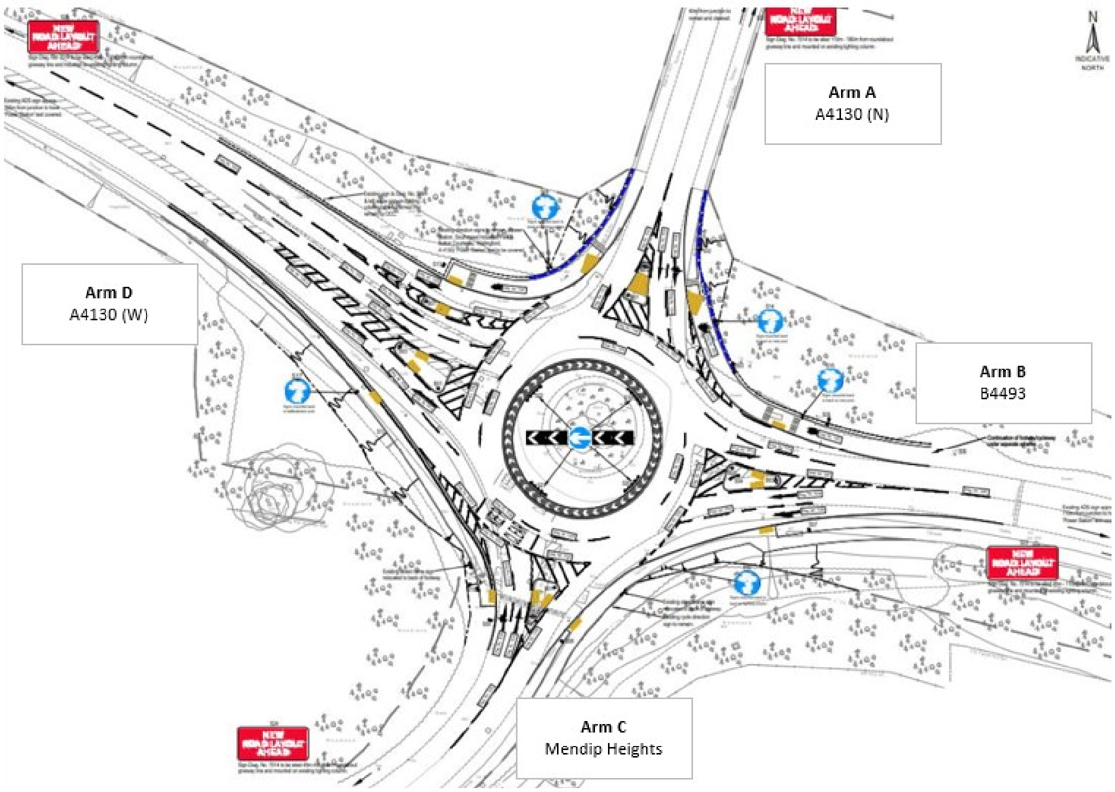


Figure 2.4.1: OFF4 Mendip Heights Rbt Layout (Jubbs Scheme)

Traffic Flows Used in Model

2.4.3 The traffic flows used in the model are shown in **Figure 2.4.2.** The 2020 traffic flows were only used in the base model, which represented the existing layout. The base model was not part of the JCT audit, as it was not used to model the impact of the scheme.

A	A4130 (N)	C	Mendip Heights
B	B4493	D	A4130 (W)

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	D	Total
A	3	116	5	259	383
B	261	0	9	390	660
C	12	22	0	22	56
D	445	631	15	0	1091
Total	721	769	29	671	2190

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	D	Total
A	12	158	28	431	629
B	116	0	22	679	817
C	13	21	0	16	50
D	294	498	24	0	816
Total	435	677	74	1126	2312

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	D	Total
A	2	151	79	7	239
B	575	0	15	537	1127
C	22	27	0	35	84
D	204	505	14	0	723
Total	803	683	108	579	2173

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	D	Total
A	1	264	283	20	568
B	267	0	35	741	1043
C	17	16	0	20	53
D	61	532	19	0	612
Total	346	812	337	781	2276

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	D	Total
A	38	296	466	9	809
B	633	3	13	566	1215
C	26	22	0	34	82
D	467	440	13	0	920
Total	1164	761	492	609	3026

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	D	Total
A	19	354	533	22	928
B	426	3	29	774	1232
C	18	14	0	19	51
D	435	537	21	0	993
Total	898	908	583	815	3204

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	D	Total
A	11	186	83	12	292
B	728	1	12	363	1104
C	66	31	0	29	126
D	287	619	23	0	929
Total	1092	837	118	404	2451

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	D	Total
A	4	338	180	29	551
B	265	1	31	492	789
C	25	25	0	19	69
D	88	594	28	0	710
Total	382	958	239	540	2119

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	D	Total
A	70	410	656	13	1149
B	973	9	21	677	1680
C	52	23	0	51	126
D	771	660	23	0	1454
Total	1866	1102	700	741	4409

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	D	Total
A	30	467	687	25	1209
B	533	6	32	1022	1593
C	32	18	0	32	82
D	811	871	34	0	1716
Total	1406	1362	753	1079	4600

Figure 2.4.2: OFF4 Mendip Heights Rbt Traffic Flows in Model

Without the scheme, the overall traffic flows increased significantly between 2020-2024, and from 2024-2034. Compared to the 2020 traffic flows, there was a significant increase in ahead traffic from the A4130(N) and Mendip Heights and right-turn traffic from the B4493 to the A4130(N). Conversely, there was a significant decrease in right-turn traffic from the A4130(N) to the A4130(W).

With the scheme, the total junction flows decreased significantly, with the largest reductions for the ahead and left-turn movements from the A4130(N), the ahead and right-turn movements from the B4493 and the ahead and left-turn movements from the A4130(W).

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.4.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.4.1**.

Table 2.4.1: OFF4 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
A4130 (N)	Model	3.58	6.59	9.0	65.6	39.0	16.0
	JCT	3.65	6.60	9.2	10.4	38.6	20.0
B4493	Model	3.73	7.16	12.7	99.0	39.0	19.0
	JCT	3.80	7.20	12.1	34.6	38.6	13.5
Mendip Heights	Model	3.21	6.56	7.9	30.6	39.0	17.0
	JCT	3.20	6.60	7.6	27.2	38.6	23.0
A4130 (W)	Model	2.66	10.12	82.3	31.5	39.0	26.0
	JCT	4.80	10.10	51.0	15.0	38.6	36.0

The approach turning radii used in the model for the A4130(N), B4493 and the A3130(W) were significantly higher than measured by JCT. The ARCADY measurements used in the original model were illustrated in a provided plan. It appears these did not include consideration of the radii extending beyond the give-way line. However, the Junctions 9 User Guide explains that the maximum radii should be measured, from a point 25m upstream of the give-way line to a point 10m downstream of the give-way line.

The approach road half-width and effective flare length for the A4130(W) used in the model were different to those measured by JCT. However, the drawing did not extend far enough upstream of the junction for JCT to measure these. JCT accept that the values used in the model are likely to be reasonable.

2.4.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need to be considered as follows:

A4130 (N): In all scenarios, the left and ahead movements are significantly higher than the right-turn and U-turn movements. Although the layout indicates traffic may go ahead from both lanes, the southbound exit appears to only be wide enough to be considered a one lane exit. Therefore, it is likely that most ahead vehicles will use the nearside lane on the approach. If all ahead traffic were to use the nearside lane, **Table 2.4.2** shows the predicted capacity available to traffic compared to the maximum approach capacity assumed by ARCADY.

Table 2.4.2: A4130 (N) (OFF4) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.65
e	6.60
l'	9.2
r	10.4
D	38.6
Ø	20.0
Int	**1531**

Busy Lane Geometry

v	3.60
e	3.60
l'	0.0
r	10.4
D	38.6
Ø	20.0
Int	**1079**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	230	269	762	1066	547	518	887	1154
Total Flow	239	292	809	1149	568	551	928	1209
Adj Int	1121	1171	1146	1163	1120	1148	1129	1130
Cap Corr	**73.23%**	**76.50%**	**74.82%**	**75.96%**	**73.18%**	**74.97%**	**73.73%**	**73.84%**

Therefore, unequal lane usage may result in 74-77% of the predicted capacity across all flow scenarios. A more efficient set of lane markings may be to make the nearside lane left-turn only, the impact of which could be modelled using the above lane-usage methodology.

B4493: During the AM peak scenarios, there was a heavy right-turn from this approach, resulting in a substantial proportion of traffic using the offside lane. **Table 2.4.3** indicates the potential available capacity compared to the maximum approach capacity predicted by ARCADY.

Table 2.4.3: B4493 (OFF4) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.80
e	7.20
l'	12.1
r	34.6
D	38.6
Ø	13.5
Int	**1826**

Busy Lane Geometry

v	3.40
e	3.40
l'	0.0
r	34.6
D	38.6
Ø	13.5
Int	**1111**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	575	729	636	982	522	395	616	797
Total Flow	1127	1104	1215	1680	1043	789	1232	1593
Adj Int	2178	1683	2122	1901	2220	2219	2222	2221
Cap Corr	119.25%	**92.14%**	116.23%	104.09%	121.57%	121.53%	121.69%	121.61%

The analysis of unequal lane usage indicated that a capacity drop would need to be considered during the 2034 AM peak, with the scheme, of around 92%. It was shown that capacity reductions were unlikely to need consideration in all other flow groups.

A4130 (W): Without the scheme, the model indicated that the left-turn was heavy in all flow groups, and would therefore be the busiest lane (with all other movements able to spread across both the middle and offside lanes). With the scheme, the ahead movement was significantly higher than all other movements from this arm, and therefore most traffic would use the middle and offside lanes. **Table 2.4.4** indicates the potential available capacity compared to the maximum approach capacity predicted by ARCADY.

Table 2.4.4: A4130 (W) (OFF4) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	2.66
e	10.12
l'	82.3
r	15.0
D	38.6
ø	36.0
Int	**2463**

Busy Lane Geometry (NS)

v	2.66
e	3.50
l'	48.0
r	15.0
D	38.6
ø	36.0
Int	**1008**

Busy Lane Geometry (Mid/OS)

v	2.66
e	6.60
l'	80.0
r	34.0
D	38.6
ø	36.0
Int	**1836**

Capacity Corrections

	WITH SCHEME		**WITHOUT SCHEME**		**WITH SCHEME**		**WITHOUT SCHEME**	
	AM 2024 OS	**AM 2034 OS**	**AM 2024 NS**	**AM 2034 NS**	**PM 2024 OS**	**PM 2034 OS**	**PM 2024 NS**	**PM 2034 NS**
Busy Flow	519	642	467	771	551	622	435	811
Total Flow	723	929	920	1454	612	710	993	1716
Adj Int	2558	2657	1986	1901	2039	2096	2301	2133
Cap Corr	103.84%	107.87%	**80.62%**	**77.18%**	**82.80%**	**85.09%**	**93.42%**	**86.59%**

It was unlikely unequal lane usage would need to be considered during the AM peak with the scheme, although all other flow groups would likely see reductions to available capacity.

Potential Impact of Modelling Changes to Results

2.4.6 The original model indicated that the junction would be over-capacity in all scenarios without the scheme, particularly by the year 2034 with RFCs between 1.27 to 1.47 on the A4130 (N) and the B4493. With the scheme in place, the junction was predicted to operate within capacity for all scenarios, with the highest RFC of 0.73 on the B4493 during the 2034 AM peak.

2.4.7 If the model were updated to account for the audit comments, in particular the reduction of several turning radii and accounting for unequal lane usage, the results would likely change significantly (get worse). However, it is possible that the junction may continue to operate within capacity with the scheme.

2.5 OFF5 Power Station Roundabout

<u>Provided Information</u>

2.5.1 The junction was modelled in Junctions 9, file "*OFF 5 JunRedesigned_V1.j9*". The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.5.2 The modelling represented a proposed scheme as part of S278 works, related to a nearby housing site. The drawing of the layout (**Figure 2.5.1**) was provided, Drawing Number:

701 Rev P7 - Jubb

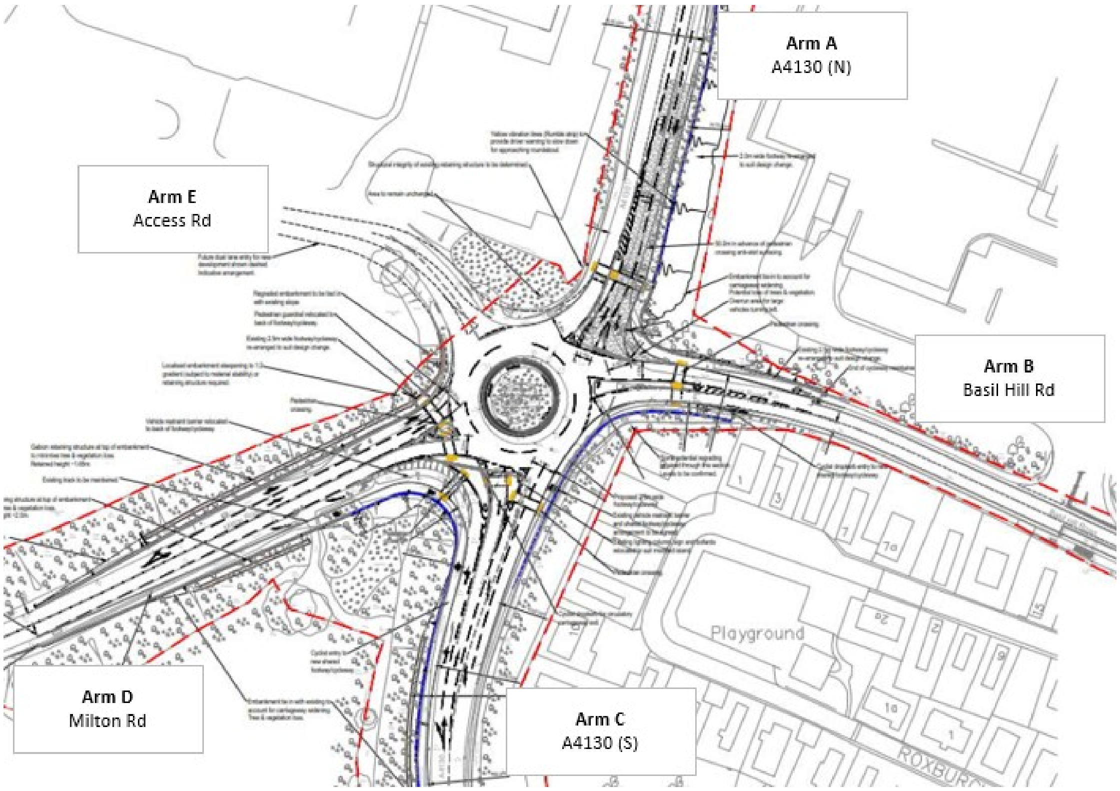


Figure 2.5.1: OFF5 Power Station Rbt Layout (Jubbs Scheme)

Traffic Flows Used in Model

2.5.3 The traffic flows used in the model are shown in **Figure 2.5.2.** The 2020 traffic flows were only used in the base model, which represented the existing layout. The base model was not part of the JCT audit, as it was not used to model the impact of the scheme.

A	A4130 (N)	C	A4130 (S)	E	Access
B	Basil Hill Rd	D	Milton Rd		

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	D	E	Total
A	0	55	258	481	10	804
B	80	0	19	238	7	344
C	368	22	0	309	16	715
D	134	105	98	0	15	352
E	8	5	11	15	0	39
Total	590	187	386	1043	48	2254

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	D	E	Total
A	0	70	340	134	5	549
B	59	0	57	197	5	318
C	260	8	0	155	10	433
D	367	299	217	0	9	892
E	6	12	15	15	0	48
Total	692	389	629	501	29	2240

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	D	E	Total
A	0	67	73	224	1	365
B	58	0	18	165	60	301
C	220	19	0	531	32	802
D	78	103	107	0	18	306
E	1	20	40	73	0	134
Total	357	209	238	993	111	1908

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	D	E	Total
A	0	111	195	53	0	359
B	35	0	27	62	47	171
C	164	8	0	159	14	345
D	263	219	306	0	25	813
E	1	18	44	26	0	89
Total	463	356	572	300	86	1777

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	D	E	Total
A	1	49	527	541	14	1132
B	64	0	29	90	5	188
C	473	16	0	632	22	1143
D	201	56	232	0	12	501
E	9	2	22	7	0	40
Total	748	123	810	1270	53	3004

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	D	E	Total
A	0	43	472	158	7	680
B	28	0	27	47	0	102
C	497	10	0	370	17	894
D	384	167	399	0	4	954
E	10	6	28	7	0	51
Total	919	226	926	582	28	2681

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	D	E	Total
A	0	72	103	228	4	407
B	62	0	20	207	61	350
C	214	21	0	798	48	1081
D	112	107	125	0	54	398
E	21	32	43	140	0	236
Total	409	232	291	1373	167	2472

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	D	E	Total
A	0	85	82	45	2	214
B	65	0	28	110	46	249
C	105	9	0	232	36	382
D	229	227	390	0	44	890
E	17	31	58	79	0	185
Total	416	352	558	466	128	1920

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	D	E	Total
A	0	57	681	599	43	1380
B	42	1	47	118	6	214
C	716	21	1	1030	98	1866
D	207	63	308	1	13	592
E	27	16	116	11	0	170
Total	992	158	1153	1759	160	4222

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	D	E	Total
A	1	61	663	235	36	996
B	28	1	31	68	1	129
C	715	12	0	567	105	1399
D	379	190	392	1	4	966
E	36	27	114	9	0	186
Total	1159	291	1200	880	146	3676

Figure 2.5.2: OFF5 Power Station Rbt Traffic Flows in Model

Without the scheme, the overall traffic flows increased significantly between 2020-2024, and from 2024-2034.

With the scheme, the total junction flows decreased significantly, particularly from the A4130 North and South arms.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.5.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.5.1**.

Table 2.5.1: OFF5 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
A4130 (N)	Model	3.65	10.08	87.8	5.3	37.0	42.5
	JCT	3.65	10.10	79.0	5.0	37.0	40.0
Basil Hill Rd	Model	2.91	4.69	4.6	19.3	37.0	16.0
	JCT	2.77	4.71	14.5	20.0	37.0	34.0
A4130 (S)	Model	4.08	4.55	11.2	26.8	37.0	26.0
	JCT	3.30	4.55	22.5	16.5	37.0	37.0
Milton Rd	Model	3.23	5.83	97.4	20.8	37.0	26.0
	JCT	3.23	6.00	97.5	12.0	37.0	25.0
Access	Model	3.65	14.40	13.0	12.0	37.0	27.0
	JCT	3.50	7.00	35.0	19.0	37.0	25.0

The approach turning radii used in the model for the A4130(S), and the Milton Rd were higher than measured by JCT (the drawing stated a turning radius of 12m for the Milton Rd approach). The ARCADY measurements used in the original model were illustrated in a provided plan. It appears these did not include consideration of the radii extending beyond the give-way line. However, the Junctions 9 User Guide explains that the maximum radii should be measured, from a point 25m upstream of the give-way line to a point 10m downstream of the give-way line.

The approach road half-width for the A4130 (S) of 4.08m was higher than the 3.3m measured by JCT. Although the drawing shows a width of 4.08m upstream of the give-way line, this measurement extends beyond the nearside kerb and therefore longer than the value that would be required for ARCADY. Using this higher value for the approach road half-width may be the reason for the shorter effective flare length used in the model than measured by JCT.

The entry width used for the Access was significantly higher in the model than measured by JCT, with a width of 14.4m (this would equate to 3-4 lanes at the give-way line). JCT measured a much shorter entry width of 7m, which was taken from the proposed offside island to the proposed nearside kerb, perpendicular to the kerb. The entry width used in the model would have influenced the effective flare length, which was also different to that measured by JCT.

2.5.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

A4130 (N): The nearside lane is for left-turning traffic only, although the left-turn flow is significantly lower than the total traffic flows going to all other arms. Therefore, most traffic will use the offside lane in all scenarios. **Table 2.5.2** shows the predicted capacity available to traffic compared to the maximum approach capacity assumed by ARCADY.

Table 2.5.2: A4130 (N) (OFF5) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.65
e	10.10
l'	79.0
r	5.0
D	37.0
ø	40.0
Int	**2174**

Busy Lane Geometry

v	3.65
e	4.10
l'	2.0
r	55.0
D	37.0
ø	40.0
Int	**1181**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	298	335	1082	1323	248	129	637	935
Total Flow	365	407	1132	1380	359	214	680	996
Adj Int	1447	1435	1236	1232	1710	1959	1261	1258
Cap Corr	**66.54%**	**66.00%**	**56.83%**	**56.66%**	**78.64%**	**90.12%**	**57.99%**	**57.87%**

Therefore, unequal lane usage may result in 66-67% of the predicted capacity and 79%-90% for the AM and PM peak periods respectively, with the scheme. Without the scheme, the available capacity would be 57% during the AM peak and 58% during the PM peak.

Milton Rd: If it were assumed that traffic going to the Power Station, A4130(N) or Basil Hill Rd used the nearside lane, then more traffic would use the nearside lane in most scenarios. If this was the case, **Table 2.5.3** shows the predicted capacity available to traffic compared to the maximum approach capacity assumed by ARCADY.

Table 2.5.3: Milton Rd (OFF5) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.23
e	6.00
l'	97.5
r	12
D	37
ø	25.0
Int	**1721**

Busy Lane Geometry

v	3.00
e	3.00
l'	0.0
r	12
D	37
ø	25.0
Int	**895**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	199	273	269	309	507	500	555	574
Total Flow	306	398	501	592	813	890	954	966
Adj Int	1376	1305	1667	1715	1435	1593	1538	1506
Cap Corr	**79.97%**	**75.82%**	**96.86%**	**99.63%**	**83.39%**	**92.57%**	**89.39%**	**87.52%**

Therefore, unequal lane usage may result in 76-93% of the available maximum capacity predicted by ARCADY with the scheme, and as low as 87% without the scheme.

Potential Impact of Modelling Changes to Results

2.5.6 The original model indicated that the junction would be significantly over-capacity without the scheme by the year 2034, with the A4130(N), Basil Hill Rd and the A4130(S) congested during the AM peak (RFCs of 0.94, 38.01 and 1.10 respectively), and the A4130(S) and Milton Rd over-capacity during the PM peak (RFCs of 0.98 and 1.11 respectively). The junction was predicted to operate well within capacity with the scheme, with the worst RFC of 0.65 on Milton Rd during the 2034 PM peak.

2.5.7 If the model were updated to account for the audit comments, the results would likely change significantly (get worse). However, it is possible that the junction may continue to operate within capacity with the scheme.

2.6 OFF6&7 Abingdon Rd / Oxford Rd / High St

Provided Information

2.6.1 The junction was modelled in LinSig, file “*OFF 6 OFF 7_Clifton Hampden Signals_v2_for reporting.lsg3x*”. JCT audited the provided LinSig model directly.

2.6.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.6.1**:

Figure 2.6.1: OFF6&7 Abingdon Rd / Oxford Rd / High St Layout

Traffic Flows Used in Model

2.6.3 The traffic flows used in the model are shown in **Figure 2.6.2.**

A	The Plough	C	Abingdon Rd (W)	E	Abingdon Rd (E)
B	High St	D	Oxford Rd		

AM 2020 (0800 - 0900) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	67	254	194	515
C	0	29	0	277	212	518
D	0	68	157	0	2	227
E	0	133	308	1	0	442
Total	0	230	532	532	408	1702

PM 2020 (1700 - 1800) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	32	149	91	272
C	0	195	0	327	201	723
D	0	188	160	0	2	350
E	0	258	219	2	0	479
Total	0	641	411	478	294	1824

AM 2024 WITH (0800 - 0900) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	29	105	110	244
C	0	48	0	36	38	122
D	0	24	20	0	18	62
E	0	63	51	12	0	126
Total	0	135	100	153	166	554

PM 2024 WITH (1700 - 1800) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	8	30	64	102
C	0	79	0	35	75	189
D	0	138	46	0	12	196
E	0	117	39	27	0	183
Total	0	334	93	92	151	670

AM 2024 WITHOUT (0800 - 0900) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	81	346	135	562
C	0	49	0	291	113	453
D	0	81	139	0	3	223
E	0	174	299	2	0	475
Total	0	304	519	639	251	1713

PM 2024 WITHOUT (1700 - 1800) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	48	208	109	365
C	0	156	0	164	86	406
D	0	246	122	0	2	370
E	0	363	181	2	0	546
Total	0	765	351	374	197	1687

AM 2034 WITH (0800 - 0900) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	61	91	154	306
C	0	47	0	12	21	80
D	0	38	7	0	18	63
E	0	46	9	13	0	68
Total	0	131	77	116	193	517

PM 2034 WITH (1700 - 1800) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	48	29	49	126
C	0	60	0	20	34	114
D	0	276	36	0	12	324
E	0	134	18	26	0	178
Total	0	470	102	75	95	742

AM 2034 WITHOUT (0800 - 0900) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	117	518	180	815
C	0	102	0	308	107	517
D	0	151	169	0	1	321
E	0	327	366	1	0	694
Total	0	580	652	827	288	2347

PM 2034 WITHOUT (1700 - 1800) - PCUs

	A	B	C	D	E	Total
A	0	0	0	0	0	0
B	0	0	65	309	132	506
C	0	147	0	132	56	335
D	0	309	184	0	1	494
E	0	624	372	2	0	998
Total	0	1080	621	443	189	2333

Figure 2.6.2: OFF6&7 Oxford Rd / High St Traffic Flows in Model

Without the scheme, the model indicated traffic flows would increase for some movements and decrease for others between 2020 and 2024. During the PM peak, the total flows dropped by the year 2024. There were larger increases in traffic by the year 2034, particularly from Abingdon RD (E).

With the scheme, the traffic flows from all arms significantly decreased compared to without the scheme.

Audit Comments

2.6.4 The right-turn for traffic from Abingdon Rd (W) to High St was modelled as being able to use a flared lane, length 2 pcus. Google Earth shows this to be a very narrow lane, and JCT are unaware if traffic can queue side by side from the stopline (for up to 2 pcus upstream). If they can, then the model should reflect this. However, if this is not possible, then the model may be optimistic.

2.6.5 The right-turn storage, downstream of the stopline, for the right-turn from Abingdon RD (W) to High St was set as 2 pcus. The layout indicates this could be increased to 3 pcus. 2 pcus was also used for the right-turn storage from the westbound internal stopline into Watery Lane, although 1 pcus would reflect the layout.

2.6.6 The non-blocking storage for Abingdon Rd (E), for the right-turn into Oxford Rd, was set as zero pcus. It is true that there is no storage for the right-turn to store without blocking unopposed westbound traffic. However, as LinSig is not a microsimulation model and able to model individual vehicles, this can potentially create significantly pessimistic results. The right-turn is small, but LinSig will assume there is a small fraction of a pcu arriving each second within the cycle. When the signals turn green, LinSig will assume a small fraction of the front of the platoon are right-turning vehicles (i.e., significantly below 1 pcu), and because non-blocking storage is set to zero, this small fraction of a pcu will block all other traffic as opposing flows are moving at saturation flow. In reality, unless the first vehicle in the queue was turning right every cycle, there would be many cycles where one or more ahead vehicles flow freely to the exit before a right-turn vehicle arrives and blocks their path. To account for this, a more reasonable approach would be to provide a 0.5 pcu non-blocking storage area in the model for the right-turn. The same would apply to the right-turn to Watery Lane, although the flow in the model was zero for all scenarios so this would have no impact.

2.6.7 The model had no traffic flows assigned for the 2034 AM peak, without the scheme. This would not have been the case for the model used for the TA, as the TA included modelling results. However, the results in Table 6.27 of the Transport Assessment do not match those in the model for the 2034 Without Scheme scenarios, AM and PM peaks.

2.6.8 The stages used in the model are shown in **Figure 2.6.3**.

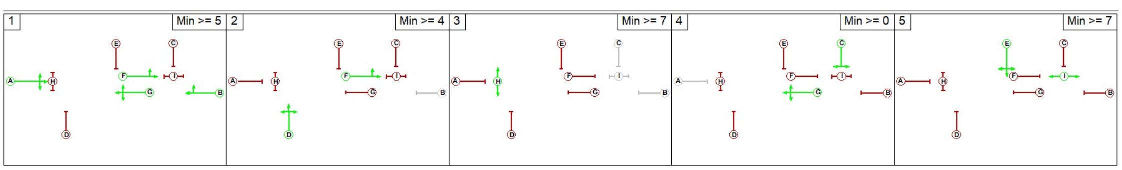


Figure 2.6.3: OFF6&7 Available Stages

The model assumed the sequence 1-2-3-4-5, which assumed all stages are called every cycle. This is likely to provide overly pessimistic results, unless it is expected that heavy pedestrian flows will create a demand for these stages. Stage 3 is only required when there is a demand for pedestrian Phase H, while Stage 5 is only required when there is a demand for pedestrian Phase I (or for Phase E, although the model indicates there is no traffic from Watery Lane).

2.6.9 All Phase minimums were set to 7 seconds in the model. However, the controller specification form indicated that Phase E should be 5 seconds, Phase H should be 8 seconds and Phase I should be 6 seconds.

2.6.10 The model includes many phase delays. Phase delays (in most cases) are used to allow a Phase to continue green for a specified number of seconds after the stage it runs in terminates. However, several of these do not match those within the controller specification.

2.6.11 Many of the intergreens used in the model were lower than those within the controller specification. A comparison between them is shown in **Figure 2.6.4**.

Intergreens in Model

	A	B	C	D	E	F	G	H	I
A	–	–	–	6	8	–	–	5	–
B	–		5	–	–	–	–	–	8
C	–	5		–	–	7	–	–	7
D	5	–	–		7	–	7	8	–
E	5	–	–	5		–	5	6	–
F	–	–	5	–	–		–	–	7
G	–	–	–	5	6	–		9	–
H	9	–	–	9	9	–	9		–
I	–	8	8	–	–	8	–	–	

From Phase

Intergreens in Specification

To Phase

From Phase	A	B	C	D	E	F	G	H	I
A				8	8			6	
B			5						9
C		7				7			6
D	6				7		7	12	
E	5			6			6	9	
F			5						8
G				5	5			9	
H	9			9	9		9		
I		8	8			8			

Figure 2.6.4: OFF6&7 Model versus Specification Intergreens

2.6.12 Saturation flows were predicted using the lane geometry, as described in TRRLs Research Report 67.

Lane 1/2 (Abingdon Rd West Offside) was set as an offside lane. Although geometrically correct, this provides a higher saturation flow. It can be argued that an offside lane provides a higher saturation flow as it provides an opportunity for faster vehicles to overtake slower vehicles, although this is only true if both are going to the same exit. In this case, the offside lane is exclusively for right-turn traffic, which could include slower moving vehicles. Therefore, a robust approach would be to set this lane as a nearside lane in the model.

Lanes 7/1 (High St), 10/1 (Watery Ln) and 12/1 (Oxford Rd) were not given any turning radii for the right-turn movements, which would result in LinSig using higher saturation flows.

2.6.13 The model assumes a cycle time of 90 seconds in every scenario. However, this cycle time is relatively short, especially when it is assumed Stages 3 and 5 are called every cycle. Furthermore, it is likely reasonable to assume that higher cycle times would be acceptable, especially as traffic flows increase. Therefore, it is recommended that a maximum cycle time is agreed upon, and then each scenario run using this (to provide a consistent comparison between each). A cycle time of at least 120 seconds is often considered acceptable in general.

<u>Potential Impact of Modelling Changes to Results</u>

2.6.14 The original model indicated that the junction would be significantly over-capacity for all scenarios without the scheme. With the scheme, the junction would operate within capacity for all scenarios.

2.6.15 If the model was updated based on the audit comments, the results are likely to change significantly. The results may improve compared to those in the original model, particularly if it were assumed Stages 3 and 5 would not be called every cycle, and a cycle time up to 120 seconds was acceptable.

2.7 OFF8 Harwell Rd / Milton Rd / High St Mini-Roundabout

<u>Provided Information</u>

2.7.1 The junction was modelled in Junctions 9, file "*OFF 8 Junction-Harwell Road_Milton Road_High Street.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.7.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.7.1**:

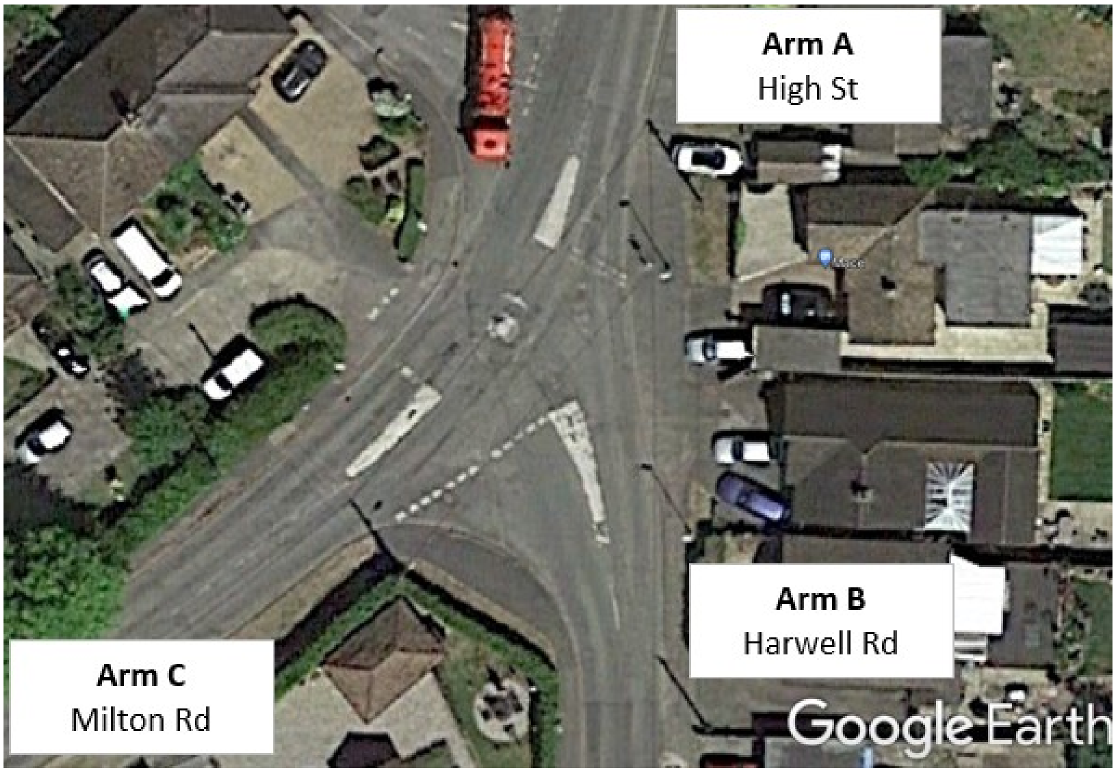


Figure 2.7.1: OFF8 Harwell Rd / Milton Rd Mini-Rbt Layout

Traffic Flows Used in Model

2.7.3 The traffic flows used in the model are shown in **Figure 2.7.2.**

A **High St** **C** **Milton Rd**
B **Harwell Rd**

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	281	45	**326**
B	177	0	26	**203**
C	81	122	0	**203**
Total	**258**	**403**	**71**	**732**

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	175	65	**240**
B	451	0	84	**535**
C	91	6	0	**97**
Total	**542**	**181**	**149**	**872**

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	272	49	**321**
B	143	0	25	**168**
C	102	108	0	**210**
Total	**245**	**380**	**74**	**699**

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	138	71	**209**
B	211	0	79	**290**
C	101	6	0	**107**
Total	**312**	**144**	**150**	**606**

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	324	45	**369**
B	440	0	25	**465**
C	96	114	0	**210**
Total	**536**	**438**	**70**	**1044**

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	223	51	**274**
B	549	0	78	**627**
C	101	6	0	**107**
Total	**650**	**229**	**129**	**1008**

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	379	47	**426**
B	206	0	26	**232**
C	107	105	0	**212**
Total	**313**	**484**	**73**	**870**

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	322	82	**404**
B	351	0	77	**428**
C	133	5	0	**138**
Total	**484**	**327**	**159**	**970**

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	403	43	**446**
B	925	0	27	**952**
C	103	113	0	**216**
Total	**1028**	**516**	**70**	**1614**

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	275	37	**312**
B	924	0	89	**1013**
C	131	6	0	**137**
Total	**1055**	**281**	**126**	**1462**

Figure 2.7.2: OFF8 Harwell RD / Milton Rd Mini-Rbt Traffic Flows in Model

Without the scheme, the model indicated traffic flows significantly increased from Harwell Rd to High St between 2020 to 2034.

With the scheme, traffic flows were significantly lower compared to without the scheme, with significant decreases in traffic volumes between Harwell Rd to High St.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.7.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.7.1**.

Table 2.7.1: OFF8 Geometric Inputs – Model versus JCT

Arm		V	V_{min}	E	l'	An	K	Grad
High St	Model	3.06	3.06	4.72	3.0	8.0	6.0	0.0
	JCT	3.00	3.00	4.60	3.5	9.9	9.8	0.0
Harwell Rd	Model	2.57	2.57	9.65	8.0	7.0	8.0	0.0
	JCT	2.30	2.30	9.30	2.0	7.3	5.0	0.0
Milton Rd	Model	3.20	3.20	3.20	0.0	11.0	10.0	0.0
	JCT	3.00	3.00	3.30	7.5	12.0	10.8	0.0

The geometric parameters measured by JCT were generally similar to those used in the model, although the entry width and effective flare length for Harwell Rd was longer than JCT could measure from Google Earth.

Potential Impact of Modelling Changes to Results

2.7.5 The original model indicated that Harwell Rd would be over-capacity in 2034 WITHOUT the scheme, with RFCs of 0.97 and 1.00 for the AM and PM peak periods respectively.

2.7.6 If the model were updated to reflect the audit comments (i.e., the geometry updated), the results would get worse, although it is unlikely this would be significant. It would be expected that the overall conclusions would remain the same for this junction.

2.8 OFF9 High St / Church St / Brook St

Provided Information

2.8.1 The junction was modelled in Junctions 9 using three separate files. The southern section (with the southbound High St give-way line) was modelled using file "*OFF 9 A Junction-High Street_High Street North.j9*" – **MODEL A**. The north-eastern section (with the High St right-turn into Brook St) was modelled using file "*OFF 9 B Junction-Brooks Street_High Street North.j9*" – **MODEL B**. The north-western section (with the High Street left-turn into Brook St) was modelled using file "*OFF 9 C Junction-Church Street_High Street.j9*" – **MODEL C**. The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.8.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.8.1**:

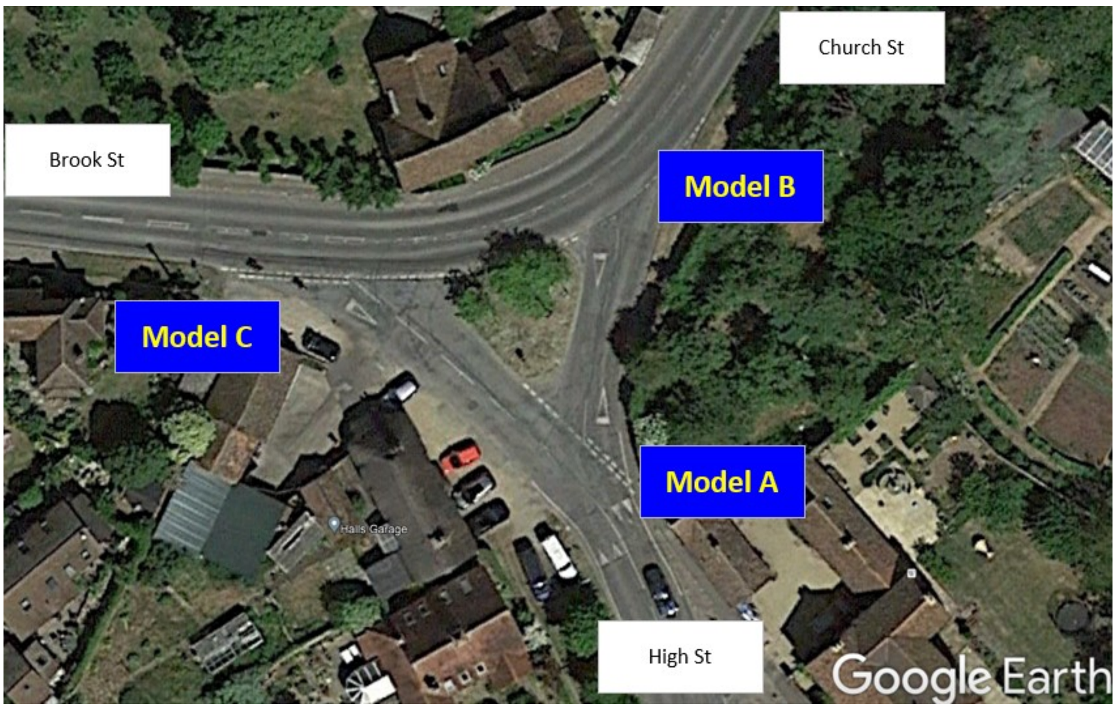


Figure 2.8.1: OFF9 High St / Church St / Brook St Layout

Traffic Flows Used in Model

2.8.3 The traffic flows used in the model for Model A are shown in **Figure 2.8.2.**

A High St (S'Bnd) C High St (S)
B High St (Give-way)

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	99	99
B	0	0	206	206
C	64	206	0	270
Total	64	206	305	575

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	33	33
B	0	0	201	201
C	93	439	0	532
Total	93	439	234	766

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	80	80
B	0	0	235	235
C	53	213	0	266
Total	53	213	315	581

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	34	34
B	0	0	167	167
C	89	222	0	311
Total	89	222	201	512

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	104	104
B	0	0	246	246
C	69	476	0	545
Total	69	476	350	895

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	46	46
B	0	0	213	213
C	105	540	0	645
Total	105	540	259	904

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	95	95
B	0	0	285	285
C	62	270	0	332
Total	62	270	380	712

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	41	41
B	0	0	349	349
C	113	339	0	452
Total	113	339	390	842

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	117	117
B	0	0	268	268
C	97	901	0	998
Total	97	901	385	1383

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	56	56
B	0	0	220	220
C	141	871	0	1012
Total	141	871	276	1288

Figure 2.8.2: OFF9A High St S'Bnd (Model A) Traffic Flows in Model

Without the scheme, the model indicated traffic flows significantly increased from High St (S) towards Church St (i.e., turning right onto the internal High St Section).

With the scheme, there was a significant decrease in traffic travelling from High St to Church St.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

2.8.4 The traffic flows used in the model for Model B are shown in **Figure 2.8.3.**

A	Church St	C	Brooks St
B	High St (Right-Turn)		

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	206	133	339
B	206	0	0	206
C	299	0	0	299
Total	505	206	133	844

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	201	239	440
B	439	0	0	439
C	154	0	0	154
Total	593	201	239	1033

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	235	188	423
B	213	0	0	213
C	345	0	0	345
Total	558	235	188	981

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	154	277	431
B	210	0	0	210
C	189	0	0	189
Total	399	154	277	830

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	246	149	395
B	476	0	0	476
C	323	0	0	323
Total	799	246	149	1194

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	213	234	447
B	540	0	0	540
C	176	0	0	176
Total	716	213	234	1163

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	285	252	537
B	270	0	0	270
C	383	0	0	383
Total	653	285	252	1190

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	349	345	694
B	339	0	0	339
C	250	0	0	250
Total	589	349	345	1283

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	268	185	453
B	901	0	0	901
C	363	0	0	363
Total	1264	268	185	1717

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	220	225	445
B	871	0	0	871
C	237	0	0	237
Total	1108	220	225	1553

Figure 2.8.3: OFF9B High St N'Bnd Right-Turn (Model B) Traffic Flows in Model

Without the scheme, the model indicated traffic flows significantly increased from High St (S) towards Church St.

With the scheme, there was a significant decrease in traffic travelling from High St to Church St.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

2.8.5 The traffic flows used in the model for Model C are shown in **Figure 2.8.4.**

A **Church St** **C** **Brooks St**
B **High St (Left-Turn)**

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	133	**133**
B	0	0	64	**64**
C	299	99	0	**398**
Total	**299**	**99**	**197**	**595**

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	239	**239**
B	0	0	93	**93**
C	154	33	0	**187**
Total	**154**	**33**	**332**	**519**

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	188	**188**
B	0	0	53	**53**
C	345	80	0	**425**
Total	**345**	**80**	**241**	**666**

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	286	**286**
B	0	0	89	**89**
C	188	34	0	**222**
Total	**188**	**34**	**375**	**597**

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	149	**149**
B	0	0	69	**69**
C	323	104	0	**427**
Total	**323**	**104**	**218**	**645**

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	234	**234**
B	0	0	105	**105**
C	176	46	0	**222**
Total	**176**	**46**	**339**	**561**

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	252	**252**
B	0	0	62	**62**
C	383	95	0	**478**
Total	**383**	**95**	**314**	**792**

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	345	**345**
B	0	0	113	**113**
C	250	41	0	**291**
Total	**250**	**41**	**458**	**749**

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	0	185	**185**
B	0	0	97	**97**
C	363	117	0	**480**
Total	**363**	**117**	**282**	**762**

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	0	225	**225**
B	0	0	141	**141**
C	237	56	0	**293**
Total	**237**	**56**	**366**	**659**

Figure 2.8.4: OFF9C High St N'Bnd Left-Turn (Model C) Traffic Flows in Model

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.8.6 A comparison between the geometry used in Model A versus the geometry measured independently by JCT is shown in **Table 2.8.1**.

Table 2.8.1: OFF9 Geometric Inputs (Model A) – Model versus JCT

Major Arm	Model	JCT
Width (m)	6.82	6.42
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	30	25
Blocks?	Yes	Yes
Blocking Queue	0	0

Minor Arm	Model	JCT
Type	One	One
Width Lane 1	2.94	3.15
Width Lane 2	n/a	n/a
Width @ 0m	n/a	n/a
Width @ 5m	n/a	n/a
Width @ 10m	n/a	n/a
Width @ 15m	n/a	n/a
Width @ 20m	n/a	n/a
Flare Length	n/a	n/a
Visibility Left	57	61
Visibility Right	22	20

The model used slightly higher widths for the main carriageway and minor arm than were measured by JCT on Google Earth.

2.8.7 A comparison between the geometry used in Model B versus the geometry measured independently by JCT is shown in **Table 2.8.2**.

Table 2.8.2: OFF9 Geometric Inputs (Model B) – Model versus JCT

Major Arm	Model	JCT
Width (m)	6.03	6.19
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	33	110
Blocks?	Yes	Yes
Blocking Queue	0	0

Minor Arm	Model	JCT
Type	One	One
Width Lane 1	3.2	3.14
Width Lane 2	n/a	n/a
Width @ 0m	n/a	n/a
Width @ 5m	n/a	n/a
Width @ 10m	n/a	n/a
Width @ 15m	n/a	n/a
Width @ 20m	n/a	n/a
Flare Length	n/a	n/a
Visibility Left	83	250
Visibility Right	17	100

The model used lower visibilities that JCT were able to measure from Google Earth (and Street View).

2.8.8 A comparison between the geometry used in Model C versus the geometry measured independently by JCT is shown in **Table 2.8.3**.

Table 2.8.3: OFF9 Geometric Inputs (Model C) – Model versus JCT

Major Arm	Model	JCT
Width (m)	5.55	6.77
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	81	34
Blocks?	Yes	Yes
Blocking Queue	0	0

Minor Arm	Model	JCT
Type	One	One
Width Lane 1	4.11	3.40
Width Lane 2	n/a	n/a
Width @ 0m	n/a	n/a
Width @ 5m	n/a	n/a
Width @ 10m	n/a	n/a
Width @ 15m	n/a	n/a
Width @ 20m	n/a	n/a
Flare Length	n/a	n/a
Visibility Left	14	58
Visibility Right	55	160

There were several geometric input parameters in the model that were different to those measured by JCT from Google Earth.

The width of the main carriageway used in the model was significantly lower than the value measured by JCT. The model also used a higher visibility for the right-turn off the main road of 81m, although the wall on the nearside is likely to reduce visibility.

Although the minor arm lane width is close to 4.11m near the give-way line, it reduces further upstream. Therefore, over 20m upstream of the give-way line, JCT measured a lower average width of 3.4m.

JCT measured higher visibilities for traffic from the minor arm, although the visibility to the left is not significant as traffic does not turn right (and therefore look to the left).

Potential Impact of Modelling Changes to Results

2.8.9 The original model (Model A) indicated that High St (S) would be congested WITHOUT the scheme, with RFCs of 1.00 and 1.10 in 2024 for the AM and PM peak periods respectively, and 1.88 and 1.76 in 2034. This was due to the heavy right-turn towards Church St. All give-way movements operated within capacity WITH the scheme.

2.8.10 Any changes made to the model (Model A) based on the audit comments are unlikely to have a significant impact on the modelling results.

2.8.11 The original model (Model B) indicated that High Street would be congested for all flow groups WITHOUT the scheme, except for the AM 2020 peak. By 2034, the predicted RFCs were 2.69 and 2.43 for the AM and PM peak periods respectively. The RFC decreased significantly WITH the scheme, although the 2034 PM peak would still be over-capacity, with an RFC of 1.06.

2.8.12 Any changes made to the model (Model B) based on the audit comments are unlikely to have a significant impact on the modelling results.

2.8.13 The original model (Model C) indicated that all flow groups would run significantly within capacity, with the highest RFC being 0.49 for the High Street left-turn in the 2034 PM peak WITH the scheme.

2.8.14 Any changes made to the model (Model C) based on the audit comments are unlikely to have a significant impact on the modelling results.

2.9 OFF10 Appleford Rd / Abingdon Rd

Provided Information

2.9.1 Unlike the other priority junctions included within this project, which were modelled using Junctions 9 (PICADY), this junction was modelled in LinSig3 as part of a network with signalled junction OFF11 (about 1km to the north). The LinSig file was "*OFF 10 OFF 11_NetworkPrioritySptContValidation_aecom2.lsg3x*". JCT audited the provided LinSig model directly.

2.9.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.9.1**:

Figure 2.9.1: OFF10 Appleford Rd / Abingdon Rd Layout

Traffic Flows Used in Model

2.9.3 The traffic flows used in the model are shown in **Figure 2.9.2.**

A Appleford Rd (W) C Appleford Rd (E)
B Abingdon Rd

AM 2020 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	402	136	538
B	213	0	114	327
C	98	104	0	202
Total	311	506	250	1067

PM 2020 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	298	289	587
B	292	0	166	458
C	143	55	0	198
Total	435	353	455	1243

AM 2024 WITH (0800 - 0900) - PCUs

	A	B	C	Total
A	0	95	490	585
B	76	0	11	87
C	338	17	0	355
Total	414	112	501	1027

PM 2024 WITH (1700 - 1800) - PCUs

	A	B	C	Total
A	0	88	340	428
B	78	0	19	97
C	378	3	0	381
Total	456	91	359	906

AM 2024 WITHOUT (0800 - 0900) - PCUs

	A	B	C	Total
A	0	447	390	837
B	219	0	119	338
C	160	61	0	221
Total	379	508	509	1396

PM 2024 WITHOUT (1700 - 1800) - PCUs

	A	B	C	Total
A	0	231	479	710
B	204	0	141	345
C	231	63	0	294
Total	435	294	620	1349

AM 2034 WITH (0800 - 0900) - PCUs

	A	B	C	Total
A	0	286	418	704
B	88	0	21	109
C	448	90	0	538
Total	536	376	439	1351

PM 2034 WITH (1700 - 1800) - PCUs

	A	B	C	Total
A	0	179	433	612
B	119	0	17	136
C	597	29	0	626
Total	716	208	450	1374

AM 2034 WITHOUT (0800 - 0900) - PCUs

	A	B	C	Total
A	0	531	779	1310
B	214	0	221	435
C	228	78	0	306
Total	442	609	1000	2051

PM 2034 WITHOUT (1700 - 1800) - PCUs

	A	B	C	Total
A	0	334	700	1034
B	180	0	157	337
C	229	124	0	353
Total	409	458	857	1724

Figure 2.9.2: OFF10 Appleford Rd / Abingdon Rd Traffic Flows in Model

Without the scheme, the model indicated traffic flows would generally increase for each future year during the AM peak, although the right-turn flow from Appleford Rd (E) to Abingdon Rd dropped between 2020 and 2024. In the PM peak, several traffic movements decreased after 2020.

With the scheme, the model indicated significant decreases in traffic to and from Abingdon Rd. There was also a significant drop in eastbound traffic along Appleford Rd, except during the 2024 AM peak where this flow increased from 390 to 490 pcus. There was a significant increase in westbound traffic along Appleford Rd in all flow groups.

Audit Comments

2.9.4 Unlike PICADY, the geometrical input information can not be entered into LinSig to calculate suitable Slope and Intercept values for the give-way capacity calculations (called "Maximum Flow while Giving Way" and "Coefficient" in LinSig). Therefore, the user needs to enter Max Flow and Coefficients directly for each movement.

However, each give-way movement in the model has incorrectly been set with the default values of Maximum Flow (1439 pcu/hr) and Coefficient (1.09). These are only suitable for a right-turn opposed movement within a signal-controlled junction, not for give-ways within a priority junction.

JCT produced a draft PICADY model of the junction to estimate suitable give-way parameters for the LinSig model. These were:

Abingdon Rd Left-Turn:

Maximum Flow 692 pcu/hr

Coefficients E'Bnd = 0.27 LT = 0.11

Abingdon Rd Right-Turn:

Maximum Flow 539 pcu/hr

Coefficients E'Bnd = 0.25 LT = 0.10 W'Bnd = 0.16 RT = 0.36

Appleford Rd (E) Right-Turn:

Maximum Flow 670 pcu/hr

Coefficients E'Bnd = 0.26 LT = 0.26

2.9.5 The model was set up to ignore the impact of the left-turn into Appleford Rd on give-way traffic from Appleford Rd. Although there is no direct conflict, this traffic has an influence on give-way behaviour (hence the Slope of 0.11 if the junction had been modelled in PICADY).

2.9.6 LinSig is limited in that the user can only input one coefficient for each opposing lane, rather than per opposing movement. This limitation has an impact for entering coefficients for the left-turn out of Abingdon Rd, as the coefficients are different for the opposing eastbound and left-turn movements (from a single lane). LinSig also models a flat flow profile over the modelled period. Although this may be a reasonable assumption, it is inconsistent with the One Hour profiles used in the modelling of the other priority junctions in this study (i.e., a normal distribution flow profile). Therefore, providing a PICADY assessment of this junction could be considered for this junction.

Potential Impact of Modelling Changes to Results

2.9.7 The original model indicated that the junction would operate within capacity for all scenarios except for the 2034 AM peak, WITHOUT the scheme, where a degree of saturation of 121% was predicted on Abingdon Road.

2.9.8 Updating the give-way parameters (or modelling within PICADY) is likely to provide a significant difference to the modelling results. However, it might be expected that these would continue to indicate the junction to be over-capacity without the scheme, and within capacity with the scheme.

2.10 OFF11 Abingdon Rd / Tollgate Rd

Provided Information

2.10.1 The junction was modelled in LinSig, file "*OFF 10 OFF 11_NetworkPrioritySptContValidation_aecom2.lsg3x*". JCT audited the provided LinSig model directly.

2.10.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.10.1**:

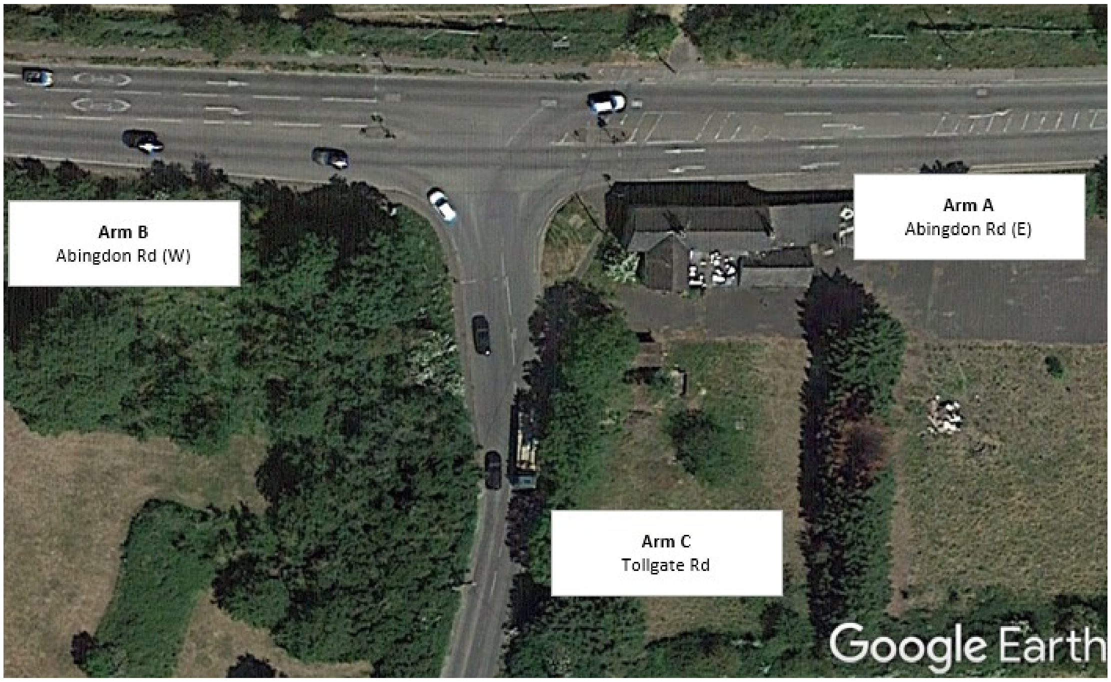


Figure 2.10.1: OFF11 Abingdon RD / Tollgate Rd Layout

The model also includes the shuttle junction on Tollgate Rd, which is located just over 400m south of Abingdon Rd, along with the Tollgate priority junction with Appleford Rd. Audit comments related to the shuttle junction are included within this section of the Technical Note, while audit comments related to the priority junction are included within Section 2.11.

Traffic Flows Used in Model

2.10.3 The traffic flows used in the model are shown in **Figure 2.10.2.**

A Abingdon Rd (E) C Tollgate Rd
B Abingdon Rd (W)

AM 2020 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	328	180	508
B	495	0	147	642
C	348	160	0	508
Total	843	488	327	1658

PM 2020 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	417	287	704
B	219	0	171	390
C	220	133	0	353
Total	439	550	458	1447

AM 2024 WITH (0800 - 0900) - PCUs

	A	B	C	Total
A	0	421	55	476
B	670	0	32	702
C	47	65	0	112
Total	717	486	87	1290

PM 2024 WITH (1700 - 1800) - PCUs

	A	B	C	Total
A	0	506	46	552
B	384	0	51	435
C	35	55	0	90
Total	419	561	97	1077

AM 2024 WITHOUT (0800 - 0900) - PCUs

	A	B	C	Total
A	0	312	171	483
B	509	0	167	676
C	359	149	0	508
Total	868	461	338	1667

PM 2024 WITHOUT (1700 - 1800) - PCUs

	A	B	C	Total
A	0	303	198	501
B	156	0	147	303
C	127	167	0	294
Total	283	470	345	1098

AM 2034 WITH (0800 - 0900) - PCUs

	A	B	C	Total
A	0	459	67	526
B	812	0	42	854
C	254	122	0	376
Total	1066	581	109	1756

PM 2034 WITH (1700 - 1800) - PCUs

	A	B	C	Total
A	0	611	63	674
B	600	0	73	673
C	93	115	0	208
Total	693	726	136	1555

AM 2034 WITHOUT (0800 - 0900) - PCUs

	A	B	C	Total
A	0	314	291	605
B	357	0	144	501
C	414	195	0	609
Total	771	509	435	1715

PM 2034 WITHOUT (1700 - 1800) - PCUs

	A	B	C	Total
A	0	170	206	376
B	94	0	131	225
C	203	255	0	458
Total	297	425	337	1059

Figure 2.10.2: OFF11Abingdon Rd / Tollgate Rd Traffic Flows in Model

Without the scheme, the model indicated traffic flows would generally decrease during the PM peak period between 2020 – 2024. During the AM peak, several movements decreased, others increased. Between 2024 – 2034 traffic flows from Abingdon Rd (W) decreased during the AM peak, while traffic flows from Abingdon Rd (W) and Abingdon Rd (E) decreased during the PM peak.

With the scheme, the traffic flows significantly increased along Abingdon Rd, and they significantly decreased to and from Tollgate Rd.

Audit Comments

2.10.4 Tollgate Lane was set as having an offside right-turn flare, length 5 pcus. Google Earth indicates the length is closer to around 2 pcus.

2.10.5 No controller specification was provided for the shuttle section on Tollgate Rd. The model assumes there are intergreens of 30 seconds between opposing greens, which should represent the average intergreen expected. Traffic needs to clear about 300m between stoplines, therefore an average intergreen of 30 seconds could be a reasonable assumption. However, the minimum green time for southbound traffic (Phase B) was set at 56 seconds. This forces the model to provide a significantly long green to southbound traffic, at the expense of northbound traffic.

2.10.6 Saturation flows were input directly on to each lane. However, some of these values are much lower than expected, particularly on Abingdon Rd (E) and Tollgate Rd. It is unclear how these saturation flows were derived. However, it would be extremely difficult (likely impossible) to measure these on site due to the short flares on these arms. This is because as a queue discharges during the green period, traffic will discharge across both lanes at the stopline, leaving gaps in traffic in the adjacent lane during saturation flow measurements. LinSig expects a saturation flow to represent the maximum discharge across the stopline, and it deals with the decrease in capacity due to the flare by using the flare length directly. Therefore, it is likely that saturation flows in the model are unrealistically low. Using the geometry is more likely to provide representative saturation flows.

2.10.7 Several negative bonus greens were applied to the model in the “No Scheme” scenarios, which would significantly reduce capacity, particularly as some of these were large. It is not clear how these were derived, however JCT would treat any results with extreme caution. Even if negative bonus greens were measured on site, the following issues are created by using them in the model:

- Are these negative bonus greens trying to model something that LinSig already models directly? If so, the model will double count the impact of this.

- If the negative bonus greens are to model the impact of downstream blocking, they are only representative of the site observations (i.e., for the traffic flows and signal timings that were in operation that day). However, they will not apply to any other scenario. For example, blocking might be expected to get worse in the future if traffic flows increase, and so the negative bonus green could be higher. However, if the green times change in the future year scenarios, this could also have an impact on the negative bonus green. Longer greens downstream (at the source of any blocking queue) may alleviate blocking. Or, shortening the green time on the upstream lane that blocking affects may require less negative bonus green (as the signals are red for longer, during some of this blocking period).

- Negative bonus greens may result in congestion on the junction they are being applied. Some may interpret these results by thinking the junction has capacity issues that need to be improved. However, without the negative bonus greens, the model may show that the junction can operate within capacity, and any queuing issues at the junction are a result of performance issues downstream of the junction.

Due to the factors above, it is likely that the negative bonus greens are not providing a consistent and representative outlook on each scenario. JCT recommend that the junction is modelled without negative bonus greens in any scenario. Although this may not directly model the impact of blocking queues from one junction to another, the results can still be evaluated to determine if blocking is likely, and what the impact may be in other scenarios with different traffic flows.

2.10.8 The Abingdon Rd junction was modelled assuming cycle times of 111 seconds, and the shuttle with cycle times of 150 seconds. These are not unreasonable, although these could be reviewed once other issues in the model are resolved.

Potential Impact of Modelling Changes to Results

2.10.9 The original model indicated that the junction would be significantly over-capacity the AM peak scenarios without the scheme, and over-capacity during the PM peak in 2034. With the scheme, all scenarios were shown to operate within capacity.

2.10.10 If the model was updated based on the audit comments, the results are likely to improve significantly. High degrees of saturation during the AM Peak (without the scheme) are partly caused by the high minimum green for southbound traffic at the shuttle, resulting in significant congestion to northbound traffic. The negative bonus greens also reduce capacity significantly.

2.11 OFF12 A4130 / Lady Grove Roundabout

<u>Provided Information</u>

2.11.1 The junction was modelled in Junctions 9, file "*OFF 12 Junction-A4130_Lady Grove_Roundabout.j9*". The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.11.2 The existing junction is a simple priority T-Junction. However, the model represented a proposed roundabout. OCC provided the layout, entitled "Didcot Perimeter Road Phase 3", as shown in **Figure 2.11.1**.

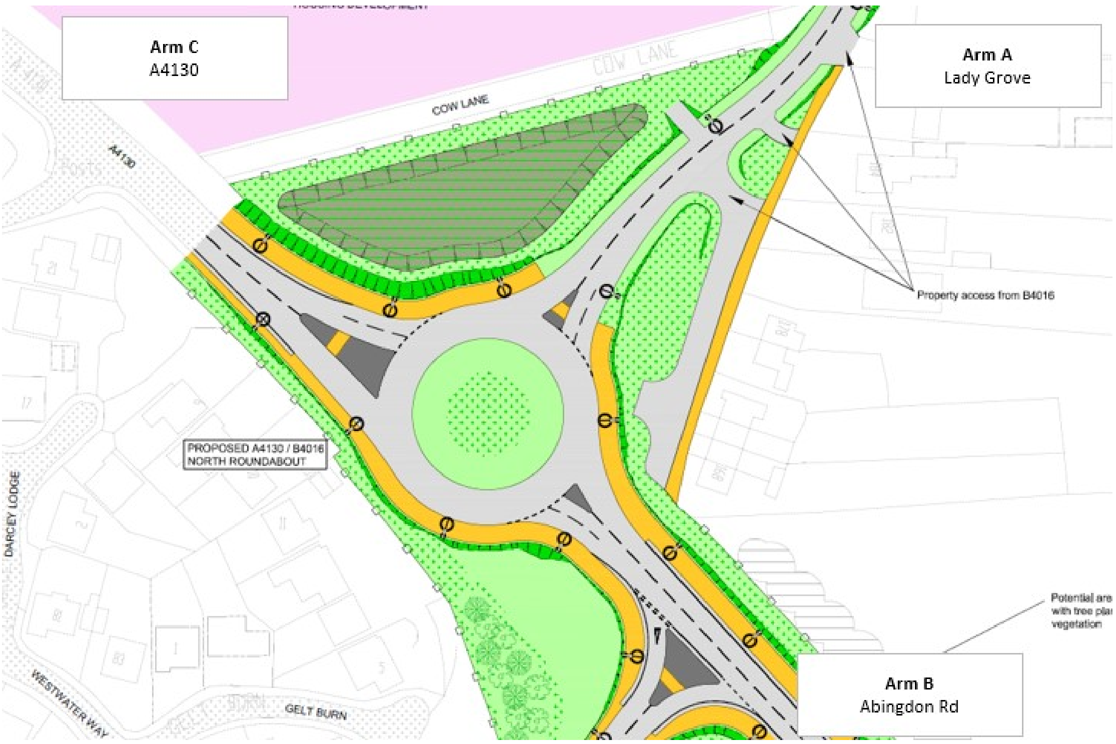


Figure 2.11.1: OFF12 A4130 / Lady Grove Rbt Layout (OCC Scheme)

Traffic Flows Used in Model

2.11.3 The traffic flows used in the model are shown in **Figure 2.11.2.**

A	Lady Grove	C	A4130
B	Abingdon Rd		

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	60	103	163
B	566	45	120	731
C	92	444	0	536
Total	658	549	223	1430

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	141	193	334
B	440	39	96	575
C	86	453	0	539
Total	526	633	289	1448

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	151	232	383
B	568	37	104	709
C	119	251	0	370
Total	687	439	336	1462

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	292	419	711
B	366	39	86	491
C	110	284	1	395
Total	476	615	506	1597

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	104	108	212
B	704	107	201	1012
C	152	493	0	645
Total	856	704	309	1869

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	307	271	578
B	555	99	129	783
C	147	515	0	662
Total	702	921	400	2023

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	304	394	698
B	492	38	183	713
C	83	133	0	216
Total	575	475	577	1627

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	431	522	953
B	325	21	133	479
C	92	126	0	218
Total	417	578	655	1650

Figure 2.11.2: OFF12 A4130 / Lady Grove Rbt Traffic Flows in Model

The traffic flows in the modelling indicated the scheme resulted in significant increases to traffic flows from the A4130 to Abingdon Rd and from Abingdon Rd to Lady Grove. The scheme resulted in significant decreases to traffic from Lady Grove.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.11.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.11.1**.

Table 2.11.1: OFF12 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
Lady Grove	Model	4.41	7.30	18.5	20.0	50.0	46.0
	JCT	3.00	7.30	27.0	21.0	50.0	40.0
Abingdon Rd	Model	3.50	7.30	17.8	20.0	50.0	46.0
	JCT	3.60	7.25	15.0	21.5	50.0	35.0
A4130	Model	3.50	7.30	20.6	20.0	50.0	52.0
	JCT	3.50	7.30	18.5	21.5	50.0	45.0

The model used a significantly higher approach road half-width of 4.41m for the Lady Grove arm, with JCT measuring 3m from the drawing. This may also explain the difference in the effective flare length measurements for this arm.

2.11.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

Lady Grove: It would be expected that left-turning traffic would use the nearside lane and right-turning traffic the offside lane. **Table 2.11.2** shows the predicted capacity available to traffic compared to the maximum approach capacity assumed by ARCADY.

Table 2.11.2: Lady Grove (OFF12) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.00
e	7.30
l'	27.0
r	21.0
D	50.0
ø	40.0
Int	**1715**

Busy Lane Geometry

v	3.00
e	3.65
l'	13.5
r	21.0
D	50.0
ø	40.0
Int	**1045**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	103	108	232	394	193	307	419	522
Total Flow	163	212	383	698	334	578	711	963
Adj Int	1654	2051	1725	1851	1808	1967	1773	1928
Cap Corr	**96.43%**	119.61%	100.59%	107.95%	105.45%	114.72%	103.40%	112.41%

The modelled traffic flows indicated that both lanes are well balanced, with no capacity reductions required for most scenarios. A minor reduction of capacity, of around 96% of total available capacity, may be required for the 2024 AM peak, with the scheme.

Abingdon Rd: The dominant movement from this arm is the right-turn to Lady Grove in all scenarios, and therefore it would be expected most of the traffic would use the offside lane. **Table 2.11.3** indicates the potential available capacity compared to the maximum approach capacity predicted by ARCADY.

Table 2.11.3: Abingdon Rd (OFF12) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.60
e	7.25
l'	15.0
r	21.5
D	50.0
ø	35.0
Int	**1689**

Busy Lane Geometry

v	3.60
e	3.60
l'	0.0
r	30.0
D	50.0
ø	35.0
Int	**1090**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	611	811	605	530	479	654	405	346
Total Flow	731	1012	709	713	575	783	491	479
Adj Int	1304	1360	1277	1466	1308	1305	1321	1509
Cap Corr	**77.21%**	**80.53%**	**75.63%**	**86.82%**	**77.47%**	**77.26%**	**78.24%**	**89.34%**

Due to the heavy right-turn, it is likely that capacity would need to be reduced to about 77-81% of the total available capacity that ARCADY would provide with the scheme, and to about 76-89% without the scheme.

A4130: Most of the traffic from this arm goes ahead to Abingdon Rd in all scenarios. Although Abingdon Rd only provides a single lane exit, ahead vehicles might use both lanes on the approach to go ahead (as some ahead vehicles may use the offside lane if traffic in front of them are indicating left). Therefore, lane usage will be dependent on driver behaviour. If drivers going ahead only used the nearside lane, or only use the offside lane, then capacity reduction would need to be applied as ARCADY would predict optimistic capacity. If all ahead traffic were to use the offside lane, **Table 2.11.4** shows the predicted capacity available to traffic compared to the maximum approach capacity assumed by ARCADY.

Table 2.11.4: A4130 (OFF12) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.50
e	7.30
l'	18.5
r	21.5
D	50.0
ø	45.0
Int	**1670**

Busy Lane Geometry

v	3.50
e	3.65
l'	9.0
r	30.0
D	50.0
ø	45.0
Int	**1064**

Capacity Corrections

	WITH SCHEME		WITHOUT SCHEME		WITH SCHEME		WITHOUT SCHEME	
	AM 2024	AM 2034	AM 2024	AM 2034	PM 2024	PM 2034	PM 2024	PM 2034
Busy Flow	444	493	251	133	453	515	284	126
Total Flow	536	645	370	216	539	662	395	218
Adj Int	1284	1392	1568	1728	1266	1368	1480	1841
Cap Corr	**76.91%**	**83.36%**	**93.92%**	103.47%	**75.81%**	**81.90%**	**88.61%**	110.23%

If all ahead traffic were to use the offside lane, capacity reductions would be required in all flow groups, except for the year 2034 with the scheme.

Potential Impact of Modelling Changes to Results

2.11.6 The original model indicated that the junction would operate within capacity for all scenarios, with the worst RFCs of 0.72 on Abingdon Rd with the scheme during the 2034 AM peak, and 0.62 on Lady Grove without the scheme during the 2034 PM peak.

2.11.7 If the model was updated to account for the audit comments, in particular the reduction of capacity due to unequal lane usage, then there would be a significant change to the results. Although the model may continue to predict each arm to be within capacity for most scenarios, the heavy right-turn from Abingdon Rd may push this arm closer to capacity during the 2034 AM peak with the scheme.

2.12 OFF13 Lady Grove / Sires Hill

Provided Information

2.12.1 The junction was modelled in Junctions 9, file "*OFF 13 Junction-Lady Grove_Sires Hill.j9*". The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.12.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.12.1**:

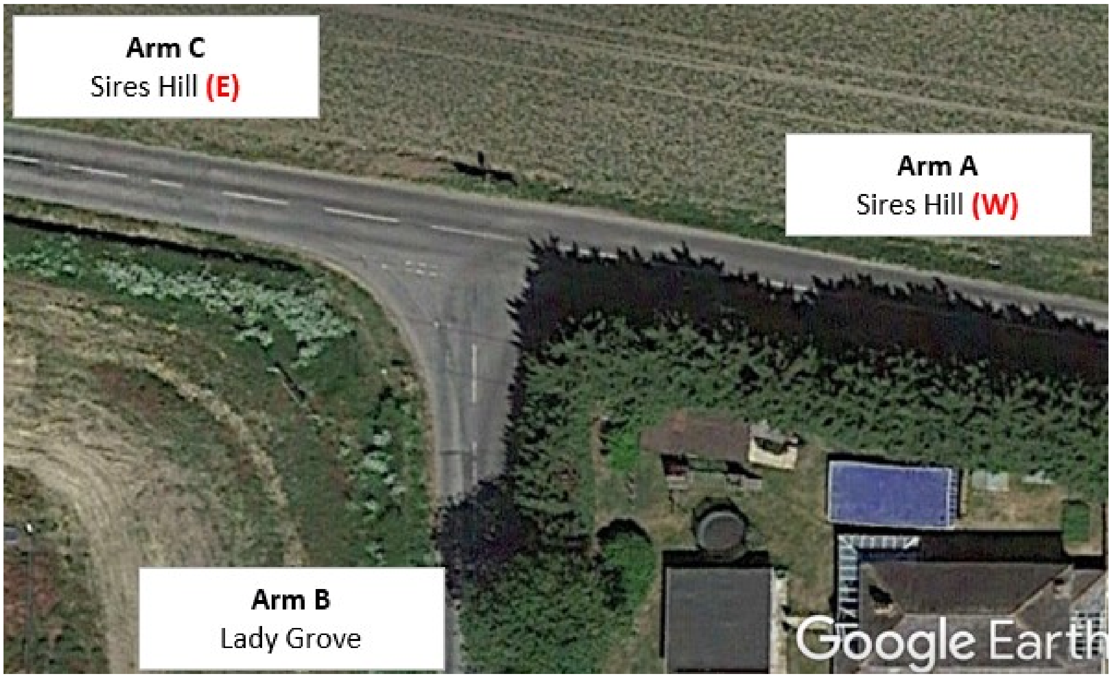


Figure 2.12.1: OFF13 Lady Grove / Sires Hill Layout

The arms shown in the above Figure are the assumption the model makes when assigning traffic flows. However, the modeller input Arm names that indicate Arm A was the WESTERN arm and Arm C was the EASTERN arm. This may simply be a labelling error in which the modeller mixed up west and east. However, if the modeller intended Arm A to be the western arm, and Arm C to be the eastern arm, then all modelling results will be incorrect, as PICADY will not make the same assumption. This can be checked by referring to the traffic flow matrices used in the model, and confirming whether the traffic flows to/from Arm A correctly represent traffic to/from the east, and traffic flows to/from Arm C correctly represent traffic to/from the west.

Traffic Flows Used in Model

2.12.3 The traffic flows used in the model for Model A are shown in **Figure 2.12.2.** Note, the arm labels indicate the arms PICADY assumes to be correct. See Paragraph 2.12.2.

A **Sires Hill (E)** **C** **Sires Hill (W)**
B **Lady Grove**

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	231	81	**312**
B	361	0	86	**447**
C	165	84	0	**249**
Total	**526**	**315**	**167**	**1008**

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	558	146	**704**
B	144	0	36	**180**
C	225	190	0	**415**
Total	**369**	**748**	**182**	**1299**

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	137	61	**198**
B	226	0	2	**228**
C	84	1	0	**85**
Total	**310**	**138**	**63**	**511**

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	297	115	**412**
B	159	0	2	**161**
C	73	54	0	**127**
Total	**232**	**351**	**117**	**700**

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	278	104	**382**
B	279	0	31	**310**
C	376	91	0	**467**
Total	**655**	**369**	**135**	**1159**

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	621	232	**853**
B	118	0	18	**136**
C	417	127	0	**544**
Total	**535**	**748**	**250**	**1533**

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	145	85	**230**
B	347	0	23	**370**
C	154	5	0	**159**
Total	**501**	**150**	**108**	**759**

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	506	104	**610**
B	190	0	2	**192**
C	157	255	0	**412**
Total	**347**	**761**	**106**	**1214**

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	523	167	**690**
B	306	0	33	**339**
C	819	142	0	**961**
Total	**1125**	**665**	**200**	**1990**

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	875	327	**1202**
B	176	0	19	**195**
C	659	166	0	**825**
Total	**835**	**1041**	**346**	**2222**

Figure 2.12.2: OFF13 Lady Grove / Sires Hill Traffic Flows in Model

Without the scheme, the model indicated traffic flows increased on most arms in future years, particularly the eastbound and westbound flows along Sires Hill, and the left-turn into Lady Grove. Other traffic flows decreased after 2020, such as traffic flows out of Lady Grove.

With the scheme, there was a significant decrease in traffic travelling along Sires Hill in both directions and the left-turn into Lady Grove. During the AM peak, there was a significant decrease in the right-turn off Sires Hill into Lady Grove as well as the 2024 PM peak, although in the 2034 PM peak this movement increased with the scheme.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.12.4 A comparison between the geometry used in Model A versus the geometry measured independently by JCT is shown in **Table 2.12.1**.

Table 2.12.1: OFF13 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	6.98	5.87
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	247	250
Blocks?	Yes	Yes
Blocking Queue	0	0

Minor Arm	Model	JCT
Type	Flare	Flare?
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	10.00
Width @ 5m	5.98	5.57
Width @ 10m	4.16	3.55
Width @ 15m	3.39	3.25
Width @ 20m	3.27	3.00
Flare Length	1	1
Visibility Left	28	27
Visibility Right	15	15

The model used higher lane widths for both the main carriageway and the minor arm. The minor arm was modelled as a flared approach. This may be reasonable if drivers treat it as such (i.e., a left and a right-turning vehicle can queue side by side at the give-way line). If not, modelling the minor arm as a single lane would be more appropriate.

Potential Impact of Modelling Changes to Results

2.12.5 The original model indicated that the junction would be significantly over-capacity in 2034 WITHOUT the scheme, with maximum RFCs of 1.37 and 1.07 on Lady Grove during the AM and PM peak periods respectively. All other flow groups operated within capacity

2.12.6 If the arm labelling was correct in the model (i.e., Arm A was the western arm and Arm C was the eastern arm), then the model results will be incorrect, as PICADY will assume Arm A is to the east and Arm C to the west, and thus the traffic flow assignment will be incorrect.

Assuming Arm A was intended to be the eastern arm, and Arm C the western arm, then the traffic flows should have assigned as expected. As such, if the model were updated to reflect the differences in lane lengths, between the original model and the JCT measurements, the results would likely become worse. Although, the general conclusions are likely to be similar, in that the junction is over-capacity in 2034 WITHOUT the scheme.

2.13 OFF14 Sires Hill / Didcot Road

Provided Information

2.13.1 The junction was modelled in Junctions 9, file "*OFF 14 Junction-Sires Hill_Didcot Road.j9*". The modelling input data was included within Appendix B of the TA, and this was audited by JCT.

2.13.2 JCT assumed the layout was as shown on Google Earth, image date 29th May 2020, which is shown in **Figure 2.13.1**:

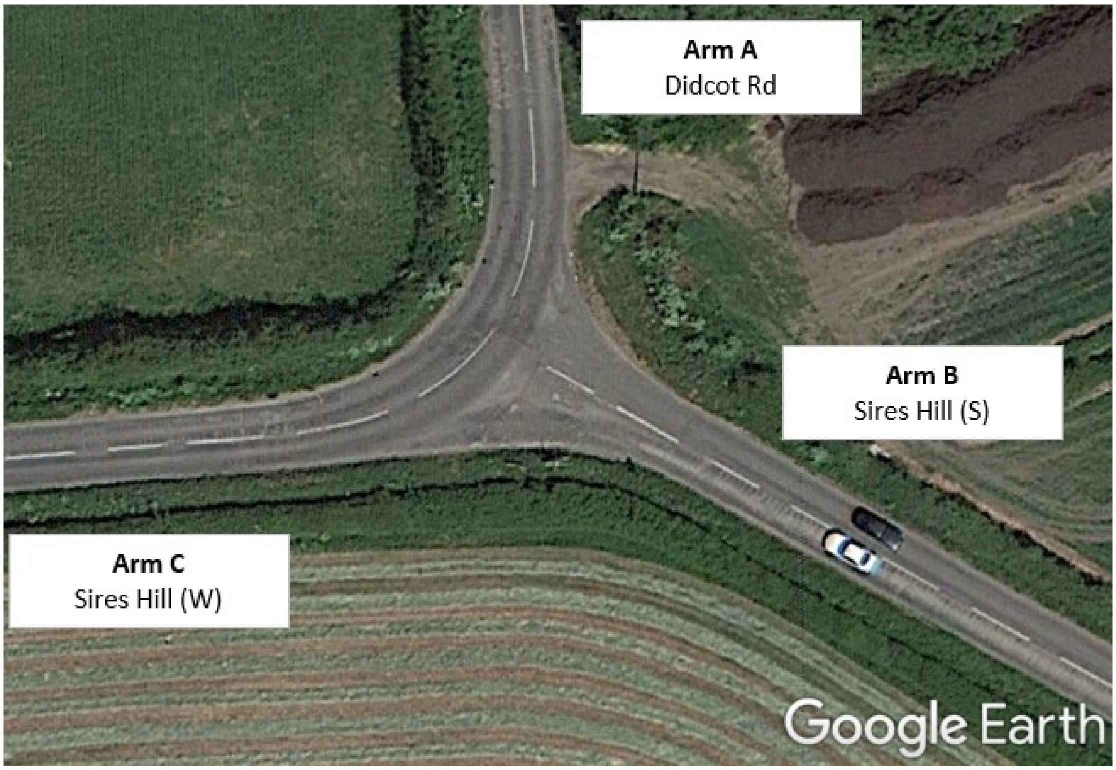


Figure 2.13.1: OFF14 Sires Hill / Didcot Rd Layout

Traffic Flows Used in Model

2.13.3 The traffic flows used in the model for Model A are shown in **Figure 2.13.2.**

A Didcot Rd
B Sires Hill (S)
C Sires Hill (W)

AM 2020 (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	17	227	244
B	67	0	85	152
C	438	90	0	528
Total	505	107	312	924

PM 2020 (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	34	557	591
B	36	0	147	183
C	299	66	0	365
Total	335	100	704	1139

AM 2024 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	19	94	113
B	66	0	104	170
C	175	137	0	312
Total	241	156	198	595

PM 2024 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	42	217	259
B	39	0	197	236
C	104	126	0	230
Total	143	168	414	725

AM 2024 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	37	300	337
B	90	0	80	170
C	548	106	0	654
Total	638	143	380	1161

PM 2024 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	47	687	734
B	71	0	166	237
C	446	84	0	530
Total	517	131	853	1501

AM 2034 WITH (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	145	85	230
B	347	0	23	370
C	154	5	0	159
Total	501	150	108	759

PM 2034 WITH (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	506	104	610
B	190	0	2	192
C	157	255	0	412
Total	347	761	106	1214

AM 2034 WITHOUT (0800 - 0900) - Vehicles

	A	B	C	Total
A	0	59	575	634
B	101	0	111	212
C	989	138	0	1127
Total	1090	197	686	1973

PM 2034 WITHOUT (1700 - 1800) - Vehicles

	A	B	C	Total
A	0	75	975	1050
B	123	0	226	349
C	717	110	0	827
Total	840	185	1201	2226

Figure 2.13.2: OFF12 Lady Grove / Sires Hill Traffic Flows in Model

Without the scheme, the model indicated traffic flows increased on most arms in future years, particularly the flows between Didcot Rd and Sires Hill (W) in both directions

With the scheme, there was a significant decrease in traffic travelling along between Didcot Rd and Sires Hill (W) in both directions. There was a significant increase in flows between Didcot Rd and Sires Hill (S) in both directions. The right-turn from Sires Hill (W) to Sires Hill (S) significantly decreased in the 2034 AM peak (138 to 5 pcus), although increased in the 2024 AM Peak and both the 2024 and 2034 PM peak periods.

The traffic flows were entered in Vehicles (not pcus), and thus the model used the HGV percentages to scale the traffic to account for heavy goods vehicles. The HGV percentages used in the model were different for each flow group, it is unclear how these were predicted for future years, or whether it would be expected the HGV percentages to be similar for each AM and each PM peak time periods.

Audit Comments

2.13.4 A comparison between the geometry used in Model A versus the geometry measured independently by JCT is shown in **Table 2.13.1**.

Table 2.13.1: OFF13 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	5.80	5.90
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	45	27
Blocks?	Yes	Yes
Blocking Queue	0	0

Minor Arm	Model	JCT
Type	Flare	Flare?
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	9.23
Width @ 5m	6.61	5.61
Width @ 10m	4.95	3.69
Width @ 15m	4.04	2.89
Width @ 20m	3.40	2.78
Flare Length	2	1
Visibility Left	250	250
Visibility Right	66	26

The model used higher lane widths for the minor arm compared to what JCT could measure from Google Earth. The model also used some higher visibilities for drivers opposed by traffic from Didcot Rd. However, the visibility is likely to be sensitive to where drivers position themselves, due to the bend on the major arm.

The minor arm was modelled as a flared approach. This may be reasonable if drivers treat it as such (i.e., a left and a right-turning vehicle can queue side by side at the give-way line). If not, modelling the minor arm as a single lane would be more appropriate.

Potential Impact of Modelling Changes to Results

2.13.5 The original model indicated that the junction would be significantly over-capacity in 2034 WITHOUT the scheme during the PM peak, with an RFC on Sires Hill (S) of 1.54. Sires Hill (W) was over-capacity during the AM peak, with an RFC of 0.96. The junction was within capacity for all other flow groups, with performance better with the scheme in place.

2.13.6 If the model were updated to reflect the audit comments, the results would likely become worse. Although, the general conclusions are likely to be similar, in that the junction is over-capacity in 2034 WITHOUT the scheme, but should work for all other flow scenarios.

2.14 SCH1 Backhill Roundabout

Provided Information

2.14.1 The junction was modelled in Junctions 9, file "*WID-01-Backhill Roundabout-PO2-v1.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.14.2 The drawing of the layout (**Figure 2.14.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0001 Rev P02

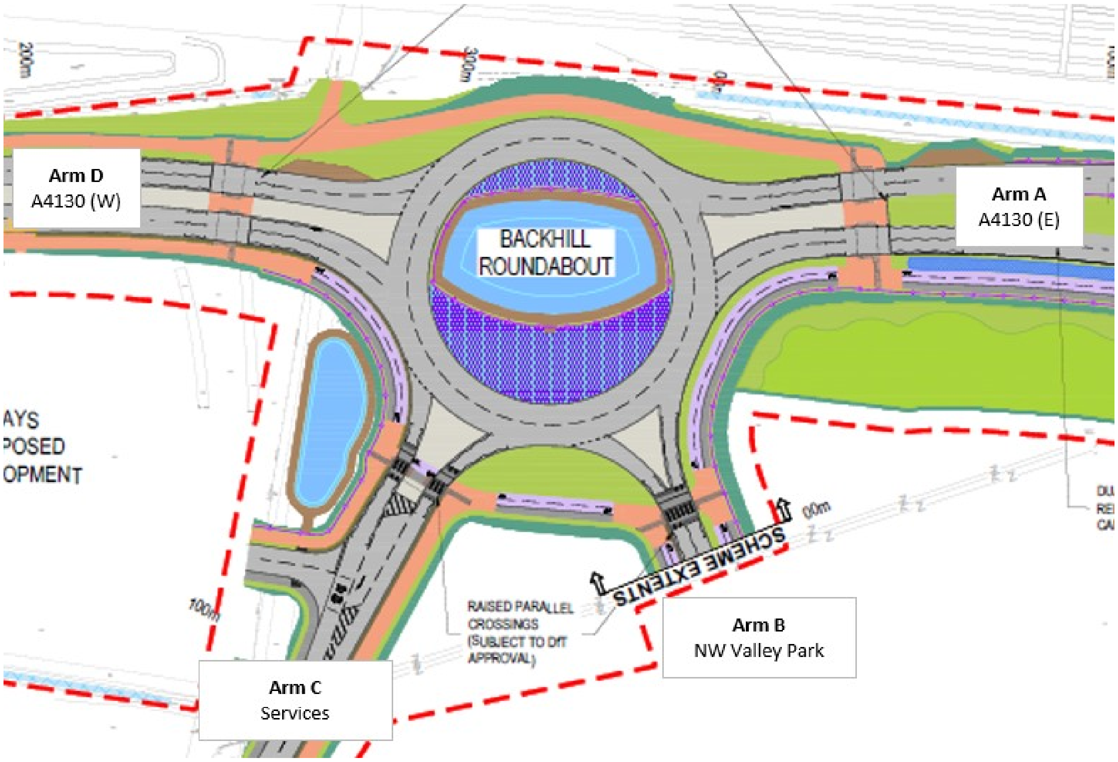


Figure 2.14.1: SCH1 Backhill Rbt Layout

Traffic Flows Used in Model

2.14.3 The traffic flows used in the model are shown in **Figure 2.14.2.**

A	**A4130 (E)**	**C**	**Services**
B	**NW Valley Park**	**D**	**A4130 (W)**

AM 2024 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	0	34	1650	**1684**
B	0	0	0	0	**0**
C	44	0	0	5	**49**
D	1076	0	0	0	**1076**
Total	**1120**	**0**	**34**	**1655**	**2809**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	0	4	1336	**1340**
B	0	0	0	0	**0**
C	65	0	0	8	**73**
D	1251	0	0	8	**1259**
Total	**1316**	**0**	**4**	**1352**	**2672**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	13	74	1438	**1525**
B	14	0	0	59	**73**
C	23	0	0	5	**28**
D	1414	47	12	2	**1475**
Total	**1451**	**60**	**86**	**1504**	**3101**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	31	33	1296	**1360**
B	18	0	0	70	**88**
C	126	0	0	33	**159**
D	1795	132	10	7	**1944**
Total	**1939**	**163**	**43**	**1406**	**3551**

Figure 2.14.2: SCH1 Backhill Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated that no traffic travelled to/from NW Valley Park in 2024, although this arm was utilised by traffic by 2034. Also, the modelled traffic flows indicated that the westbound traffic along the A4130 dropped between the years 2024 and 2034 in both the AM and PM peak periods.

Audit Comments

2.14.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.14.1**.

Table 2.14.1: SCH1 Geometric Inputs – Model versus JCT

Arm		V	E	I'	R	D	Ø
A4130 (E)	Model	6.74	9.22	10.0	29.9	80.2	43.3
	JCT	6.80	9.00	11.0	31.0	80.0	44.0
NW Valley Park	Model	3.77	5.00	3.5	28.6	80.2	34.9
	JCT	3.90	5.00	3.0	32.0	80.0	34.0
Services	Model	3.86	5.00	2.9	30.9	80.2	16.1
	JCT	3.60	5.00	2.0	36.0	80.0	27.0
A4130 (W)	Model	6.75	9.13	6.7	36.2	80.2	38.9
	JCT	6.80	9.00	5.0	43.0	80.0	33.0

The geometric input parameters used in the model closely reflected those measured by JCT, and are therefore likely to be considered representative of the junction layout.

Potential Impact of Modelling Changes to Results

2.14.5 The original model indicated that the junction should operate significantly within capacity during all flow scenarios. The highest RFC of 0.79 was predicted on A4130 (E) during the AM 2024 flow period.

2.14.6 The audit identified no significant problems with the modelling input parameters. Therefore, even if slight changes were made to the modelling geometric input data to reflect subjectivity, this would unlikely have any significant impact on the modelling results.

2.15 SCH2 A4130 / Valley Park Access

Provided Information

2.15.1 The junction was modelled in LinSig, file "*WID-02-A4130-Valley_Park-P02-v3 3 Stage DD.lsg3x*". JCT audited the provided LinSig model directly.

2.15.2 The drawing of the layout (**Figure 2.15.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-002 Rev P02

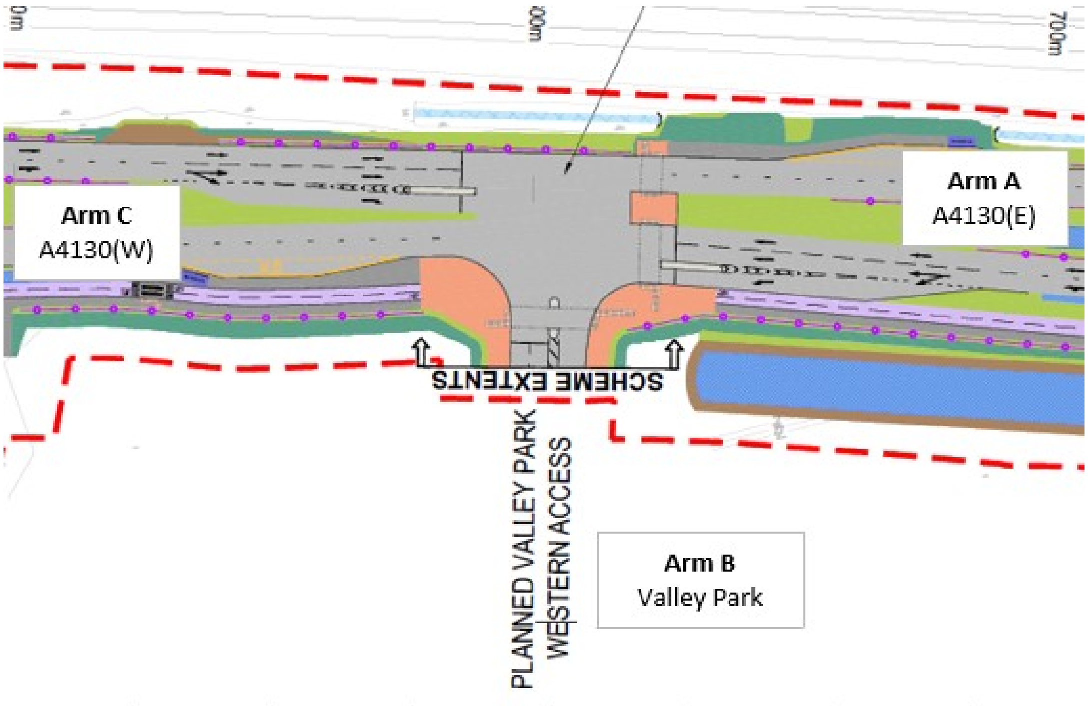


Figure 2.15.1: SCH2 Valley Park Access Layout

Traffic Flows Used in Model

2.15.3 The traffic flows used in the model are shown in **Figure 2.15.2.**

A **A4130 (E)** **C** **A4130 (W)**
B **Valley Park Access**

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	7	1672	**1679**
B	14	0	27	**41**
C	1118	7	0	**1125**
Total	**1132**	**14**	**1699**	**2845**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	14	1332	**1346**
B	8	0	9	**17**
C	1299	18	0	**1317**
Total	**1307**	**32**	**1341**	**2680**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	44	1436	**1480**
B	90	0	130	**220**
C	1387	51	0	**1438**
Total	**1477**	**95**	**1566**	**3138**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	113	1284	**1397**
B	81	0	73	**154**
C	1782	153	0	**1935**
Total	**1863**	**266**	**1357**	**3486**

Figure 2.15.2: SCH2 Valley Park Access Traffic Flows in Model

The traffic flows used in the modelling indicated the traffic flows to and from the Valley Park Access would increase by 2034, whilst there was a decrease in westbound traffic. Eastbound traffic flows increased by the year 2034.

Audit Comments

2.15.4 The Valley Park Access nearside lane was set as a flare, length 7 pcus. JCT assume this was correct, as the provided drawing did not show far enough upstream of the stopline to check this.

2.15.5 All pedestrian phase minimum times were set to 6 seconds. These will depend on the types of pedestrian facilities installed. If far-sided green man displays are used, then longer minimum times may be required on the longest crossings (up to 9 seconds across Valley Park), unless countdown timers are also used. If near-sided displays are used, then 6 seconds may be acceptable. However, this should not make a significant difference to the modelling results.

2.15.6 The stages used in the model are shown in **Figure 2.15.3**.

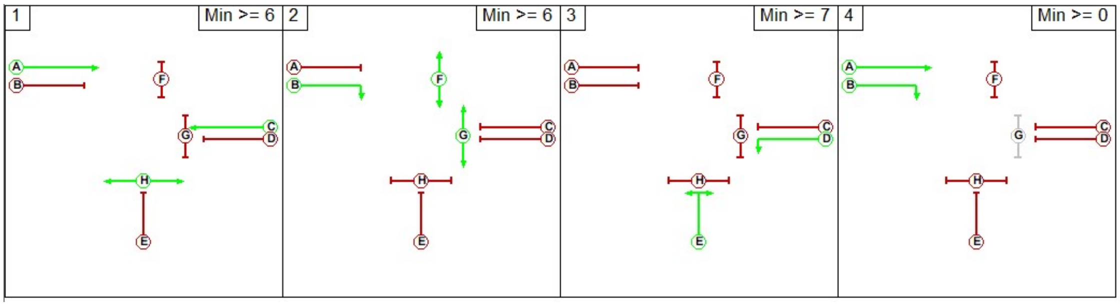


Figure 2.15.3: SCH2 Available Stages

The modelled sequence was 1-2-3 (i.e., assuming Phase F was called). Stage 4 would be an alternative to Stage 2, when there is no demand for Phase F.

2.15.7 JCT measured the intergreens using quickGreen, based on guidance in Chapter 6 of the Traffic Signs Manual. The full quickGreen output is included in Appendix B. Many of the intergreens used in the model were significantly higher than those measured by JCT. The reason for this was unknown, but could result in the model predicting less capacity than would be expected. A comparison of the intergreens is shown in **Figure 2.15.4**.

Modelled Intergreens

	A	B	C	D	E	F	G	H
A	–	–	–	–	7	11	–	–
B	–		7	7	6	–	–	12
C	–	7		–	9	–	7	–
D	–	6	–		–	–	6	9
E	5	5	5	–		11	–	5
F	11	–	–	–	11		–	–
G	–	–	15	15	–	–		–
H	–	22	–	22	22	–	–	

JCT Intergreens

	A	B	C	D	E	F	G	H
A					5	9		
B			5	6	5			9
C		5			6		5	
D		5					5	7
E	6	5	5			10		5
F	9				9			
G			12	12				
H		15		15	15			

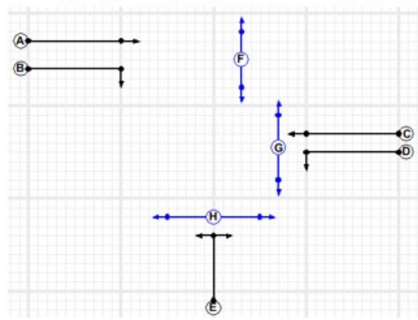


Figure 2.15.4: SCH2 Intergreen Comparison

2.15.8 The model contains several very long phase delays. It is unclear why these were used, but likely to reduce lost time created by long pedestrian intergreens. However, the length of delay does not correspond with the long pedestrian intergreen. A significantly long phase delay of 11 seconds was given to Phase D from Stage 3 to 1, without any pedestrian intergreens running in that stage . These long phase delays result in significantly long interstage periods up to 24 seconds. These are likely to be undesirable, especially off peak as they will result in much longer green times than necessary.

The use of phase delays should be revisited once the intergreens have been finalised. Furthermore, a decision should be made on whether intergreens after pedestrians will be fixed or variable using on-crossing detection. If they are fixed, phase delays can be used to reduce the lost time to traffic. If they are variable, then the expected average intergreen after pedestrians should be modelled and phase delays may not be necessary.

2.15.9 Bonus greens were added to several lanes, although no note was provided to explain why this was the case, or to explain how they were calculated. It is assumed they were added to account for the fact that the sequence 1-2-3 was modelled, but that Stage 2 would not always be demanded if Phase F were not called, and Stage 4 could run instead. If that is the case, it is not clear what demand frequency was assumed, although the demand for Phase F might be expected to be low.

The model could be simplified by running scenarios in which Phase F is always called, and then repeat these for when Phase F is never called. This will provide the best and worst-case scenarios. If the likely demand is known, bonus greens could be used, although these should only be calculated once the intergreens and phase delays are finalised. It is likely that the bonus greens need only apply to lanes controlled by Phase A, as these lanes benefit when Phase F is not called.

2.15.10 Saturation flows were predicted using the lane geometry, as described in TRRLs Research Report 67.

Lane 3/3 (A4130 East offside lane) was set as a nearside lane. This could be set as offside, which would increase the saturation flow.

Lane 5/3 (Valley Park Offside) was set as an offside lane. Although geometrically correct, this provides a higher saturation flow. It can be argued that an offside lane provides a higher saturation flow as it provides an opportunity for faster vehicles to overtake slower vehicles, although this is only true if both are going to the same exit. In this case, the offside lane is exclusively for right-turn traffic, which could include slower moving vehicles. Therefore, a robust approach would be to set this lane as a nearside lane in the model.

Potential Impact of Modelling Changes to Results

2.15.11 The original model indicated that all flow scenarios would operate within capacity, running a cycle time of 108 seconds. The lowest Practical Reserve Capacity (PRC) was 31.7% during the 2024 AM Peak.

2.15.12 The audit identified several issues that are likely to require attention. These could have a significant difference on the results. However, JCT anticipate that these changes would unlikely result in the model predicting the junction to be over-capacity.

2.16 SCH3 Old A4130 Roundabout

Provided Information

2.16.1 The junction was modelled in Junctions 9, file "*AWAITING DESIGN- WID-03-Northern Roundabout-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.16.2 The drawing of the layout (**Figure 2.16.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0003 Rev P02

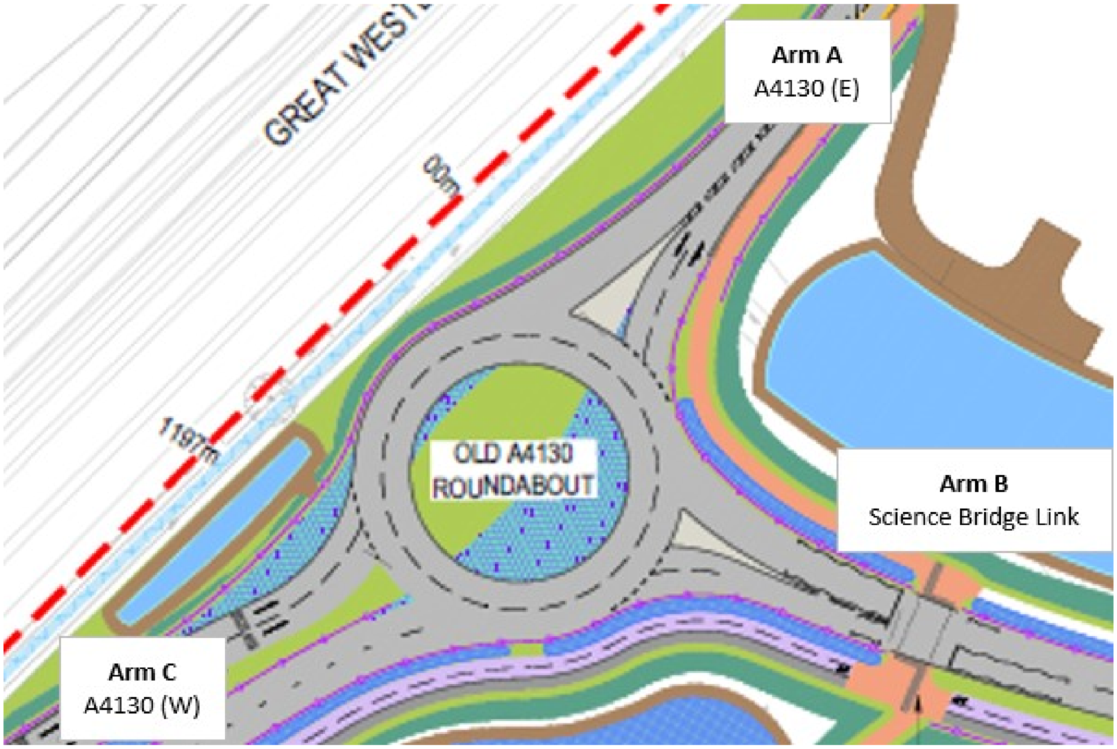


Figure 2.16.1: SCH3 Old A4130 Rbt Layout

Traffic Flows Used in Model

2.16.3 The traffic flows used in the model are shown in **Figure 2.16.2.**

A A4130 (E) **C A4130 (W)**
B Science Bridge Link

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	92	1035	**1127**
B	39	0	646	**685**
C	606	527	0	**1133**
Total	**645**	**619**	**1681**	**2945**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	74	845	**919**
B	81	1	498	**580**
C	740	567	0	**1307**
Total	**821**	**642**	**1343**	**2806**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	75	578	**653**
B	85	7	938	**1030**
C	673	805	0	**1478**
Total	**758**	**887**	**1516**	**3161**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	87	567	**654**
B	107	5	815	**927**
C	757	1072	0	**1829**
Total	**864**	**1164**	**1382**	**3410**

Figure 2.16.2: SCH3 Old A4130 Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated a significant drop in traffic from the A4130 East to West arms by the year 2034. All other movements increased by the year 2034, particularly to and from the Science Bridge Link.

Audit Comments

2.16.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.16.1**.

Table 2.16.1: SCH3 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
A4130 (E)	Model	3.88	7.03	17.2	19.9	50.0	52.7
	JCT	3.00	7.00	18.0	24.0	50.0	37.0
Science Bridge Link	Model	4.30	7.10	7.1	33.9	50.0	52.6
	JCT	3.60	7.00	6.0	34.0	50.0	28.0
A4130 (W)	Model	6.85	8.17	7.2	24.9	50.0	52.7
	JCT	7.00	7.80	3.5	26.0	50.0	37.0

The approach road half widths used in the model for the A4130(E), and Science Bridge Link were higher than JCT could measure from the drawing. The entry width used in the model for the A4130(W) was higher than JCT could measure from the drawing.

All conflict angles used in the model were significantly higher than those that JCT could measure from the drawing.

2.16.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

Science Bridge Link: In all scenarios, the left-turn is significantly higher than all other movements from this arm. Theoretically traffic could turn left from both lanes due to there being a two-lane exit. However, this is unlikely, especially due to the relatively short flare on the approach. Therefore, the model could be made more robust by assuming all left-turning traffic uses the nearside lane on the approach. **Table 2.16.2** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.16.2: Science Bridge Link (SCH3) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.60
e	7.00
l'	6.0
r	34
D	50
ø	28.0
Int	**1496**

Busy Lane Geometry

v	3.60
e	3.80
l'	1.0
r	34
D	50
ø	28.0
Int	**1158**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	646	938	498	815
Total Flow	685	1030	580	927
Adj Int	1228	1272	1349	1317
Cap Corr	**82.08%**	**85.00%**	**90.15%**	**88.04%**

Therefore, unequal lane usage may result in 82-85% of the predicted capacity during the AM peak and 88-90% of the predicted capacity during the PM peak if this was considered within the model. However, this could be mitigated if left-turning traffic also used the offside lane, which might be encouraged by lane marking.

A4130(W): Unequal lane usage will occur as drivers do not have a lane choice, with ahead traffic having to use the nearside lane and right / U-turning traffic having to use the offside lane. **Table 2.16.3** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.16.3: A4130(W) (SCH3) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	7.00
e	7.80
l'	3.5
r	26
D	50
ø	37.0
Int	**2232**

Busy Lane Geometry

v	3.50
e	3.90
l'	2.0
r	26
D	50
ø	37.0
Int	**1120**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	606	805	740	1072
Total Flow	1133	1478	1307	1829
Adj Int	2094	2056	1978	1911
Cap Corr	**93.82%**	**92.13%**	**88.63%**	**85.61%**

Therefore, unequal lane usage may result in 92-94% of the predicted capacity during the AM peak and 86-89% of the predicted capacity during the PM peak if this was considered within the model.

Potential Impact of Modelling Changes to Results

2.16.6 The original model indicated that the A4130(E) would be slightly over-capacity during the AM 2024 run (RFC = 0.95), although by 2034 the Science Bridge Link would be the only arm slightly over-capacity (RFC = 0.93). During the PM peak, the only arm over-capacity was the A4130(W) in the year 2034 (RFC = 0.97).

2.16.7 However, accounting for unequal lane usage would worsen the results predicted for the A4130(W) and Science Bridge Link. This might be mitigated on Science Bridge Link if left-turning traffic would be expected to use both lanes of the approach. Furthermore, results would worsen if the lane widths used in the original model are optimistic.

2.17 SCH4 Science Bridge Roundabout

Provided Information

2.17.1 The junction was modelled in Junctions 9, file "*AWAITING DESIGN- WID-04-Science Bridge Roundabout-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.17.2 The drawing of the layout (**Figure 2.17.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0003 Rev P02

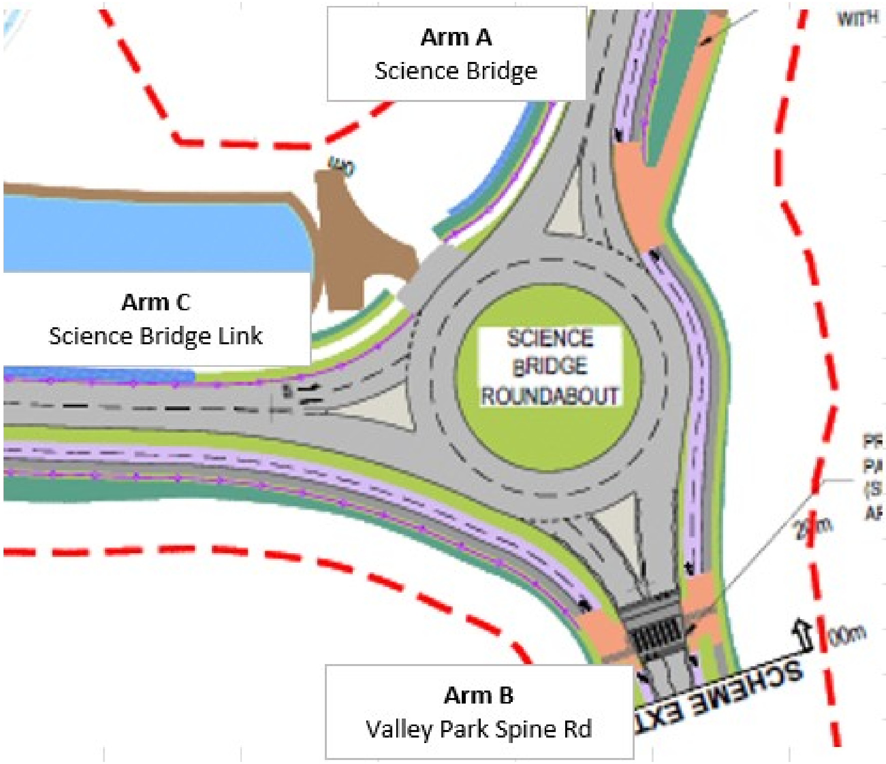


Figure 2.17.1: SCH4 Science Bridge Rbt Layout

Traffic Flows Used in Model

2.17.3 The traffic flows used in the model are shown in **Figure 2.17.2.**

SCH3 Science Bridge Rbt

A Science Bridge **C Science Bridge Link**
B Valley Park Spine Rd

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	5	617	**622**
B	17	0	65	**82**
C	594	22	2	**618**
Total	**611**	**27**	**684**	**1322**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	12	558	**570**
B	8	0	24	**32**
C	588	53	0	**641**
Total	**596**	**65**	**582**	**1243**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	277	587	**864**
B	417	1	451	**869**
C	616	268	2	**886**
Total	**1033**	**546**	**1040**	**2619**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	425	631	**1056**
B	379	0	297	**676**
C	721	428	0	**1149**
Total	**1100**	**853**	**928**	**2881**

Figure 2.17.2: SCH4 Science Bridge Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows to and from the Valley Park Spine Rd by the year 2034.

Audit Comments

2.17.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.17.1**.

Table 2.17.1: SCH4 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
Science Bridge	Model	4.80	7.31	12.1	19.9	50.0	39.0
	JCT	3.60	7.20	10.8	41.0	50.0	35.0
Valley Park Spine Rd	Model	3.35	7.03	14.8	34.9	50.0	36.1
	JCT	3.50	7.00	12.0	37.0	50.0	41.0
Science Bridge Link	Model	4.16	7.06	13.8	35.1	50.0	35.0
	JCT	3.50	7.00	13.0	36.0	50.0	39.0

The approach road half widths used in the model for Science Bridge and the Science Bridge Link were higher than JCT could measure from the drawing. The radius used in the model for Science Bridge was lower than JCT could measure from the drawing.

2.17.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

Science Bridge: In all scenarios, the right-turn is higher than the straight-ahead movement, particularly in the year 2024. Therefore, unequal lane usage is likely going to require consideration. **Table 2.17.2** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.17.2: Science Bridge (SCH4) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry	
v	3.60
e	7.20
l'	10.8
r	41
D	50
ø	35.0
Int	**1631**

Busy Lane Geometry	
v	3.60
e	3.60
l'	0.0
r	41
D	50
ø	35.0
Int	**1099**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	617	587	558	631
Total Flow	622	864	570	1056
Adj Int	1108	1618	1123	1839
Cap Corr	**67.93%**	**99.18%**	**68.83%**	112.77%

Therefore, unequal lane usage may result in about 68-69% of the predicted capacity in the year 2024 if unequal lane usage was considered within the model. Unequal lane usage is unlikely to be a significant factor by the year 2034.

Valley Park Spine Rd: Unequal lane usage may be less of a factor on this arm, as flows are light in 2024, and more evenly balanced in 2034. However, the technique described in Appendix A could still be applied as a check. **Table 2.17.3** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.17.3: Valley Park Spine Rd (SCH4) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry	
v	3.50
e	7.00
l'	12.0
r	37
D	50
ø	41.0
Int	**1584**

Busy Lane Geometry	
v	3.50
e	3.50
l'	0.0
r	37
D	50
ø	41.0
Int	**1044**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	65	451	24	379
Total Flow	82	869	32	676
Adj Int	1317	2012	1392	1862
Cap Corr	**83.15%**	127.00%	**87.88%**	117.56%

Therefore, unequal lane usage would only impact capacity in the year 2024 on Valley Spine Rd, with 83-88% of predicted capacity being available if it had been considered. However, this would not have a significant impact on results as traffic flows were light in 2024 from this arm.

Science Bridge Link: The left-turn is heavier than the right-turn in all scenarios, and therefore allowing for the impact of unequal lane usage will likely require consideration. **Table 2.17.4** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table x2.17.4: Science Bridge Link (SCH4) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.50
e	7.00
l'	13.0
r	36
D	50
ø	39.0
Int	**1615**

Busy Lane Geometry

v	3.50
e	3.50
l'	0.0
r	36
D	50
ø	39.0
Int	**1050**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	594	616	588	721
Total Flow	618	886	641	1149
Adj Int	1092	1510	1145	1673
Cap Corr	**67.64%**	**93.51%**	**70.88%**	103.61%

Therefore, unequal lane usage may result in 68-71% of the predicted capacity in 2024 and 94% of the predicted capacity in 2034 during the AM peak if this was considered within the model. Unequal lane usage is unlikely to be an issue during the PM peak in 2034.

Potential Impact of Modelling Changes to Results

2.17.6 The original model indicated that all flow groups would operate within capacity. The highest RFC of 0.83 was on the Science Bridge Link during the 2034 PM peak.

2.17.7 Accounting for unequal lane usage is likely to increase some of the predicted RFC values. However, this is unlikely to result in the model predicting any arms to become over-capacity, as the largest capacity reductions would be during the year 2024, in which the model predicted significant spare capacity. The provided model used generous approach road half widths for Science Bridge and the Science Bridge Link Rd. If these values were reduced, the model may predict results approaching capacity in the 2034 PM peak.

2.18 SCH5 Science Bridge Link Rd / New Purchas Rd

Provided Information

2.18.1 The junction was modelled in Junctions 9, file "*DSB-37-Science BridgeNew-Purchas Road-P03-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.18.2 The drawing of the layout (**Figure 2.18.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0005 Rev P02

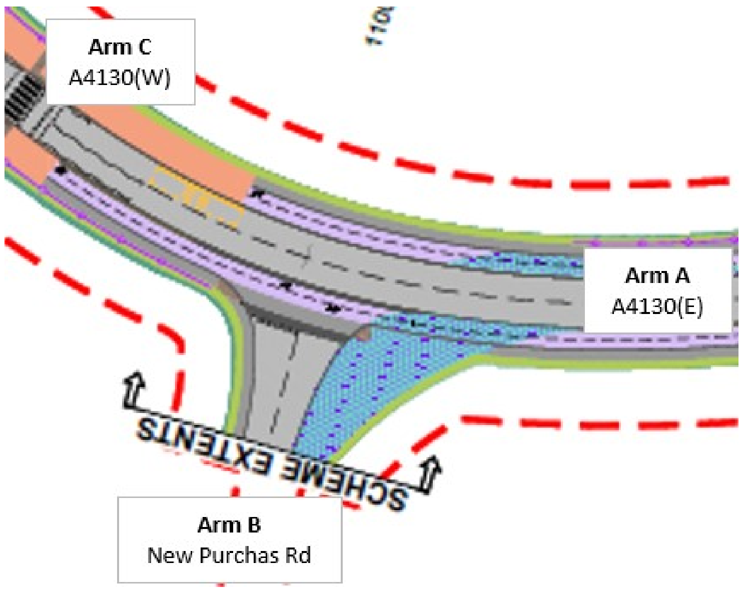


Figure 2.18.1: SCH5 New Purchas Rd Layout

Traffic Flows Used in Model

2.18.3 The traffic flows used in the model are shown in **Figure 2.18.2.**

A	A4130 (E)	C	A4130 (W)
B	New Purchas Rd		

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	96	616	712
B	84	0	20	104
C	565	54	2	621
Total	649	150	638	1437

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	38	558	596
B	64	0	25	89
C	574	41	0	615
Total	638	79	583	1300

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	107	842	949
B	101	0	86	187
C	922	112	2	1036
Total	1023	219	930	2172

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	81	1014	1095
B	60	0	54	114
C	1073	88	0	1161
Total	1133	169	1068	2370

Figure 2.18.2: SCH5 New Purchas Rd Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the A4130 by the year 2034.

Audit Comments

2.18.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.18.1**.

Table 2.18.1: SCH5 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	7.77	8.00
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	90	120
Blocks?	No	Yes
Blocking Queue	n/a	0

Minor Arm	Model	JCT
Type	Flare	Flare?
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	8.00
Width @ 5m	7.63	5.50
Width @ 10m	5.78	4.50
Width @ 15m	4.75	4.00
Width @ 20m	4.21	4.00
Flare Length	3	1
Visibility Left	19	37
Visibility Right	250	70

The model was set up to assume that the right-turn into New Purchas Rd does not block ahead traffic. However, the drawing indicates that there would be no room for ahead traffic to pass stationary right-turning traffic.

The minor arm (New Purchas Rd) was set up as a lane with a flare. The drawing indicates this may be one lane only, although it may be wide enough for traffic to utilise this as a flare. However, the five widths used in the model are higher than those that could be measured from the drawing by JCT.

There was a significant difference in visibilities from the minor arm between the model and JCT values. However, it is unclear what obstructions may exist that impede the visibility of drivers from the minor arm from the drawing. However, the visibility to the left of 19m used in the model is likely too low, as the minimum appears to be at least 32m.

Potential Impact of Modelling Changes to Results

2.18.5 The original model indicated that all flow groups would operate within capacity. The highest RFC of 0.79 was reported for the right-turn from New Purchas Rd during the 2034 PM peak.

2.18.6 The results are likely to get worse when the lane widths are reduced on the minor arm. Furthermore, the capacity from the A4130(W) will decrease once the model accounts for the right-turn blocking the ahead traffic. It is uncertain whether this will result in the junction becoming over-capacity.

2.19 SCH6 A4130 / Science Bridge (Old A4130)

Provided Information

2.19.1 The junction was modelled in Junctions 9, file "*DSB-05-Science_Bridge-A4130-P03-v1j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.19.2 The drawing of the layout (**Figure 2.19.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0006 Rev P02

Figure 2.19.1: SCH6 Old A4130 Layout

Traffic Flows Used in Model

2.19.3 The traffic flows used in the model are shown in **Figure 2.19.2.**

SCH6 Old 4130

A A4130 (E) **C A4130 (W)**
B Old A4130

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	345	692	**1037**
B	269	0	31	**300**
C	563	60	2	**625**
Total	**832**	**405**	**725**	**1962**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	337	564	**901**
B	433	0	23	**456**
C	619	30	0	**649**
Total	**1052**	**367**	**587**	**2006**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	357	910	**1267**
B	226	0	73	**299**
C	911	78	2	**991**
Total	**1137**	**435**	**985**	**2557**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	181	973	**1154**
B	174	0	100	**274**
C	1104	51	0	**1155**
Total	**1278**	**232**	**1073**	**2583**

Figure 2.19.2: SCH6 Old A4130 Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the A4130 by the year 2034. During the PM peak, the modelled flows indicate a significant decrease in traffic turning left from the Old A4130 and traffic turning left into the Old A4130.

Audit Comments

2.19.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.19.1**.

Table 2.19.1: SCH6 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	7.53	7.20
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	3.35	3.30
Visibility (m)	92	250
Blocks?	Yes	Yes
Blocking Queue	8	6

Minor Arm	Model	JCT
Type	Flare	Flare?
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	10.00
Width @ 5m	5.80	6.10
Width @ 10m	4.33	5.30
Width @ 15m	4.33	5.00
Width @ 20m	4.33	4.50
Flare Length	1	3
Visibility Left	130	180
Visibility Right	250	210

The visibility for the right-turn into the minor arm is likely to be higher than the 92m used in the model, although the storage space for right-turns is likely to be less than 8 pcus, with JCT measuring a length of about 6 pcus.

The minor arm (Old A4130) was set up as a lane with a flare. The drawing indicates this may be one lane only, although it may be wide enough for traffic to utilise this as a flare. The lane widths in the model, 10m and 15m upstream of the give-way line appeared to be lower in the model than JCT measured from the drawing.

Potential Impact of Modelling Changes to Results

2.19.5 The original model indicated that the junction would be significantly over-capacity during all traffic flow periods modelled, particularly by the year 2034 with reported RFCs on the Old A4130 of 1.99 and 1.95 during the AM and PM peak periods respectively.

2.19.6 Any changes made to the model based on the audit comments are unlikely to have a significant impact on the modelling results.

2.20 SCH7 Collett Roundabout

Provided Information

2.20.1 The junction was modelled in Junctions 9, file "*RIVX-06-A4130_New Culham Crossing_Collett-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.20.2 The drawing of the layout (**Figure 2.20.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0007 Rev P02

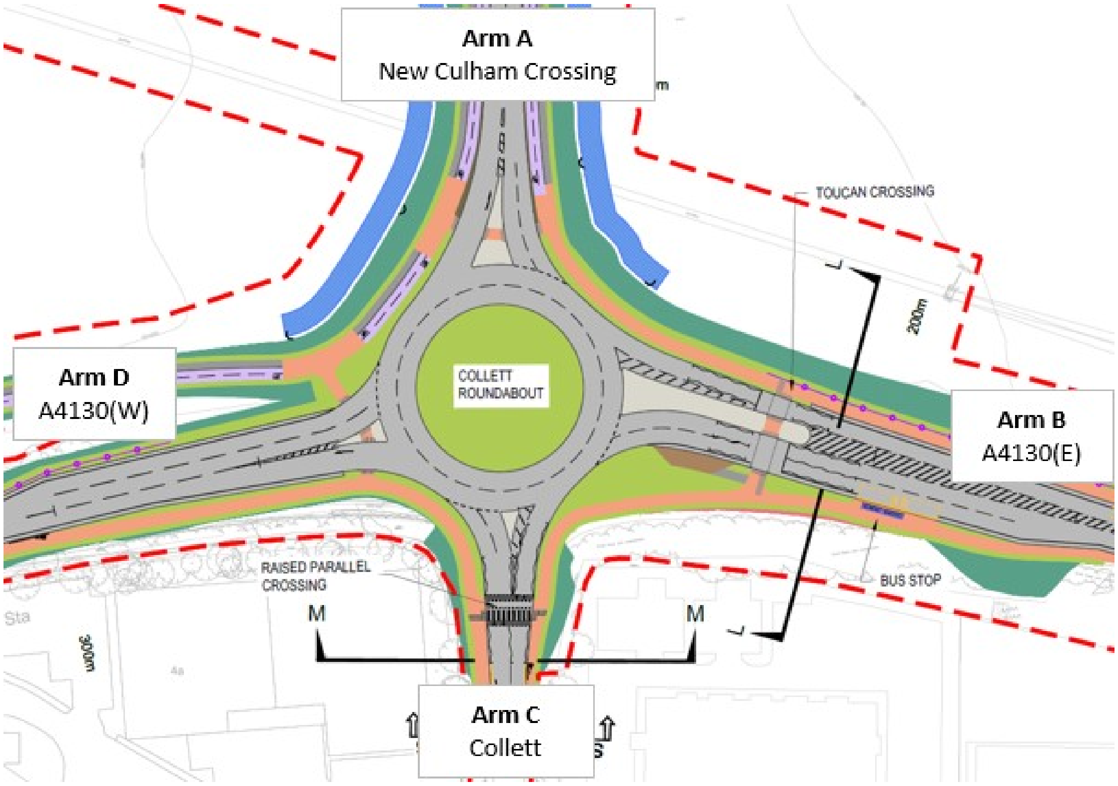


Figure 2.20.1: SCH7 Collett Rbt Layout

Traffic Flows Used in Model

2.20.3 The traffic flows used in the model are shown in **Figure 2.20.2.**

A **New Culham Crossing** **C** **Collett**
B **A4130(E)** **D** **A4130 (W)**

AM 2024 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	231	26	270	**527**
B	344	0	48	692	**1084**
C	18	49	0	75	**142**
D	380	336	118	0	**834**
Total	**742**	**616**	**192**	**1037**	**2587**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	387	22	405	**814**
B	275	0	33	425	**733**
C	18	40	0	71	**129**
D	269	735	49	0	**1053**
Total	**562**	**1162**	**104**	**901**	**2729**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	442	40	554	**1036**
B	554	0	65	642	**1261**
C	53	64	0	82	**199**
D	561	457	112	0	**1130**
Total	**1168**	**963**	**217**	**1278**	**3626**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	453	22	469	**944**
B	506	0	37	590	**1133**
C	56	137	0	95	**288**
D	451	783	46	0	**1280**
Total	**1013**	**1373**	**105**	**1154**	**3645**

Figure 2.20.2: SCH7 Collett Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated that there was a general increase in traffic by 2034 for most movements, although turning distributions varied.

Audit Comments

2.20.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.20.1**.

Table 2.20.1: SCH7 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
New Culham Crossing	Model	3.73	8.14	31.9	30.0	58.7	30.5
	JCT	3.60	8.10	25.0	34.0	59.0	27.0
A4130 (E)	Model	3.65	8.13	87.9	28.0	58.7	21.4
	JCT	3.60	8.00	103.0	25.0	59.0	26.0
Collett	Model	3.81	8.02	17.1	25.0	58.7	51.0
	JCT	3.60	8.00	26.0	28.0	59.0	35.0
A4130 (W)	Model	3.65	8.12	86.8	25.0	58.7	36.5
	JCT	3.60	8.00	84.0	28.0	59.0	37.0

The geometric input parameters used in the model generally reflected the values measured by JCT well. JCT measured a longer effective flare length for the Collett approach, although this may be due to the fact the offside section of the approach had to be estimated due to the zebra crossing. JCT also measured a smaller conflict angle on the Collett arm.

2.20.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). This may be a reasonable assumption on most arms due to the predicted traffic flows in each scenario. However, unequal lane usage could be a significant issue on the A4130(W). Most of the traffic turn left and go ahead from this approach, and the natural lane to use would be the nearside lane. This would result in a much greater volume of traffic using the nearside lane. This imbalance might be alleviated a little if some drivers travelling ahead chose to use the offside lane (e.g., to overtake a vehicle in front indicating to turn left). If unequal lane usage were accounted for, and it was assumed turning movements would use a dedicated lane on the approach, the modelling would likely indicate a more efficient lane usage would be to mark the nearside lane as left-turn only, and the offside lane as ahead and right-turn.

Table 2.20.2 gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT, assuming all ahead traffic used the nearside lane.

Table 2.20.2: A4130(W) (SCH7) – Potential Capacity Drop due to Unequal Lane Usage, Aheads Nearside Lane

Full Arm Geometry

v	3.60
e	8.00
l'	84.0
r	28
D	59
ø	37.0
Int	**2210**

Busy Lane Geometry

v	3.60
e	4.00
l'	8.0
r	28
D	59
ø	37.0
Int	**1183**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	716	1018	1004	1234
Total Flow	834	1130	1053	1280
Adj Int	1378	1313	1241	1227
Cap Corr	**62.35%**	**59.42%**	**56.14%**	**55.52%**

Table 2.20.3 gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT, assuming all ahead traffic used the offside lane.

Table 2.20.3: A4130(W) (SCH7) – Potential Capacity Drop due to Unequal Lane Usage, Aheads Offside Lane

Full Arm Geometry

v	3.60
e	8.00
l'	84.0
r	28
D	59
ø	37.0
Int	**2210**

Busy Lane Geometry

v	3.60
e	4.00
l'	8.0
r	28
D	59
ø	37.0
Int	**1183**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	454	569	784	829
Total Flow	834	1130	1053	1280
Adj Int	2173	2349	1589	1827
Cap Corr	**98.33%**	106.31%	**71.90%**	**82.65%**

If all ahead traffic used the nearside lane, then 56-62% of predicted capacity may only be available if it had been accounted for in ARCADY. However, if the junction was marked so that ahead traffic had to use the offside lane, then unequal lane usage is unlikely to be a significant issue during the AM peak. It would still need to be accounted for during the PM peak, although the available capacity would increase to 72-83% of that predicted by ARCADY, rather than only 56%.

Another method to improve balanced lane usage would be to provide an exit merge for ahead traffic, allowing them to freely use both lanes on the approach.

Potential Impact of Modelling Changes to Results

2.20.6 The original model indicated that the junction should operate significantly within capacity during all flow scenarios. The highest RFC of 0.81 was predicted on A4130 (W) during the PM 2034 flow period.

2.20.7 The audit identified no significant problems with the modelling geometric input parameters. However, potential unequal lane usage on the A4130(W) could result in less capacity than the model predicts. If this were accounted for, this would likely result in the model predicting congestion on this arm during the PM peak. Although lane balancing could be improved by marking the approach so that ahead traffic had to use the offside lane, it would not eliminate the issue and therefore the arm could remain over-capacity.

2.21 SCH8 New Thames River Crossing / Hanson & FCC Access Road

<u>Provided Information</u>

2.21.1 The junction was modelled in Junctions 9, file "*RIVX-08-New_Culham Crossing_Development-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.21.2 The drawing of the layout (**Figure 2.21.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0009 Rev P02

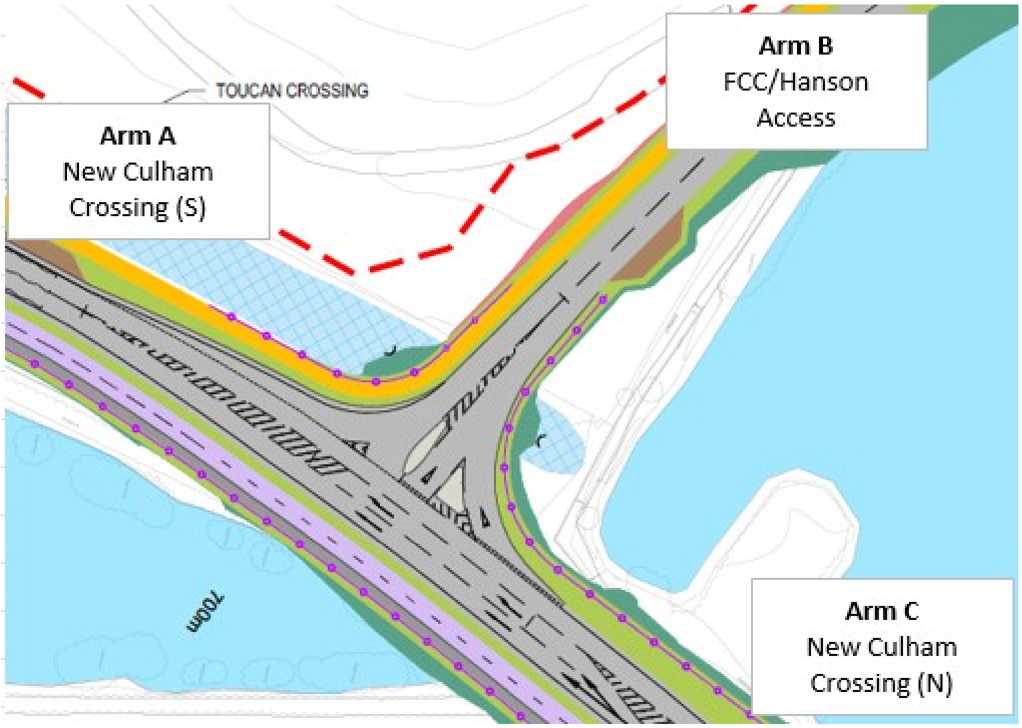


Figure 2.21.1: SCH8 FCC Access Rd Layout

Traffic Flows Used in Model

2.21.3 The traffic flows used in the model are shown in **Figure 2.21.2.**

A	New Culham Crossing (S)	C	New Culham Crossing (N)
B	FCC/Hanson Access		

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	69	669	738
B	78	0	15	93
C	449	24	0	473
Total	527	93	684	1304

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	22	545	567
B	25	0	16	41
C	761	9	0	770
Total	786	31	561	1378

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	73	1077	1150
B	78	0	13	91
C	963	26	0	989
Total	1041	99	1090	2230

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	25	992	1017
B	31	0	18	49
C	898	8	0	906
Total	929	33	1010	1972

Figure 2.21.2: SCH8 FCC Access Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the New Culham Crossing by the year 2034. Traffic flows into and out of the access arm were relatively light.

Audit Comments

2.21.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.21.1**.

Table 2.21.1: SCH8 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	7.20	7.20
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	3.72	3.60
Visibility (m)	250	250
Blocks?	Yes	Yes
Blocking Queue	9	9

Minor Arm	Model	JCT
Type	Flare	Flare
Width Lane 1		
Width Lane 2		
Width @ 0m	10.00	10.00
Width @ 5m	9.05	10.00
Width @ 10m	5.23	10.00
Width @ 15m	4.67	9.50
Width @ 20m	4.67	6.50
Flare Length	3	3
Visibility Left	56	102
Visibility Right	250	250

The model input data indicated lower lane widths on the minor arm from 5m to 20m upstream of the giveway line. The visibility to the left was also lower than measured by JCT, with JCT assuming drivers could see over the grass verge.

<u>Potential Impact of Modelling Changes to Results</u>

2.21.5 The original model indicated that all flow groups would operate within capacity. The highest RFC of 0.75 was reported for the right-turn from the FCC Access during the 2034 AM peak.

2.21.6 The issues raised within the audit indicated the original model would produce more pessimistic capacity assessments. Therefore, it would not be expected that the model would predict the junction to be over-capacity if changes were made.

2.22 SCH9 New Thames River Crossing / B4016

Provided Information

2.22.1 The junction was modelled in Junctions 9, file "*RIVX-09-New_Culham Crossing_B4016-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.22.2 The drawing of the layout (**Figure 2.22.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0011 Rev P02

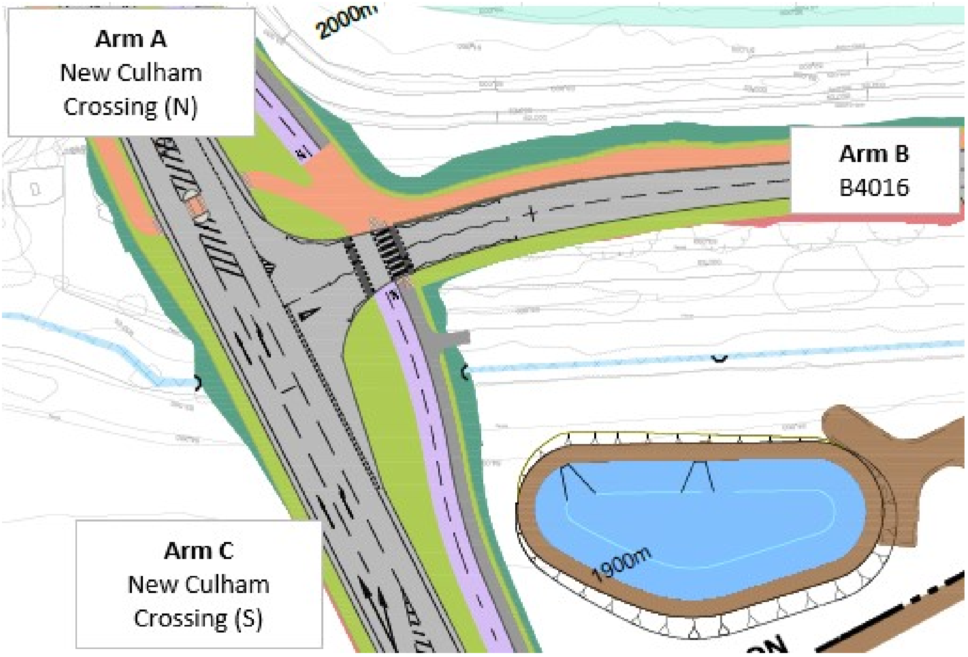


Figure 2.22.1: SCH9 B4016 Layout

<u>Traffic Flows Used in Model</u>

2.22.3 The traffic flows used in the model are shown in **Figure 2.22.2.**

A New Culham Crossing (N) **C** New Culham Crossing (S)
B B4016

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	87	469	556
B	73	0	3	76
C	661	21	0	682
Total	734	108	472	1314

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	126	763	889
B	119	0	8	127
C	550	10	0	560
Total	669	136	771	1576

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	159	982	1141
B	107	0	7	114
C	1063	26	0	1089
Total	1170	185	989	2344

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	404	920	1324
B	109	0	10	119
C	976	20	0	996
Total	1085	424	930	2439

Figure 2.22.2: SCH9 B4016 Access Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the New Culham Crossing by the year 2034. Traffic flows into and out of the B4016 were relatively light, except that there was a substantial increase in the left-turn into the B4016 by the year 2034 in the PM peak, from 126 pcus to 404 pcus.

<u>Audit Comments</u>

2.22.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.22.1**.

Table 2.22.1: SCH9 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	7.34	7.25
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	3.65	3.60
Visibility (m)	230	230
Blocks?	Yes	Yes
Blocking Queue	10	9

Minor Arm	Model	JCT
Type	Flare	Flare
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	10.00
Width @ 5m	10.00	10.00
Width @ 10m	5.67	6.20
Width @ 15m	3.83	4.10
Width @ 20m	3.69	3.80
Flare Length	2	2
Visibility Left	250	250
Visibility Right	140	230

The model input data indicated lower lane widths on the minor arm from 10m to 15m upstream of the giveway line. The visibility to the right was also lower than measured by JCT, with JCT assuming drivers could see as far as the roundabout.

Potential Impact of Modelling Changes to Results

2.22.5 The original model indicated that both peak periods in 2034 would be over-capacity, with maximum RFCs on the B4016 of 1.00 and 0.99 during the AM and PM peak periods respectively.

2.22.6 The issues raised within the audit indicated the original model would produce more pessimistic capacity assessments. However, even if those parameters were adjusted, it is likely that the model would continue to predict the B4016 to be over-capacity in the year 2034.

2.23 SCH10 Sutton Courtenay Roundabout

Provided Information

2.23.1 The junction was modelled in Junctions 9, file "*RIVX-10-New Culham Crossing_B4016 Appleford Road-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.23.2 The drawing of the layout (**Figure 2.23.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0012 Rev P02

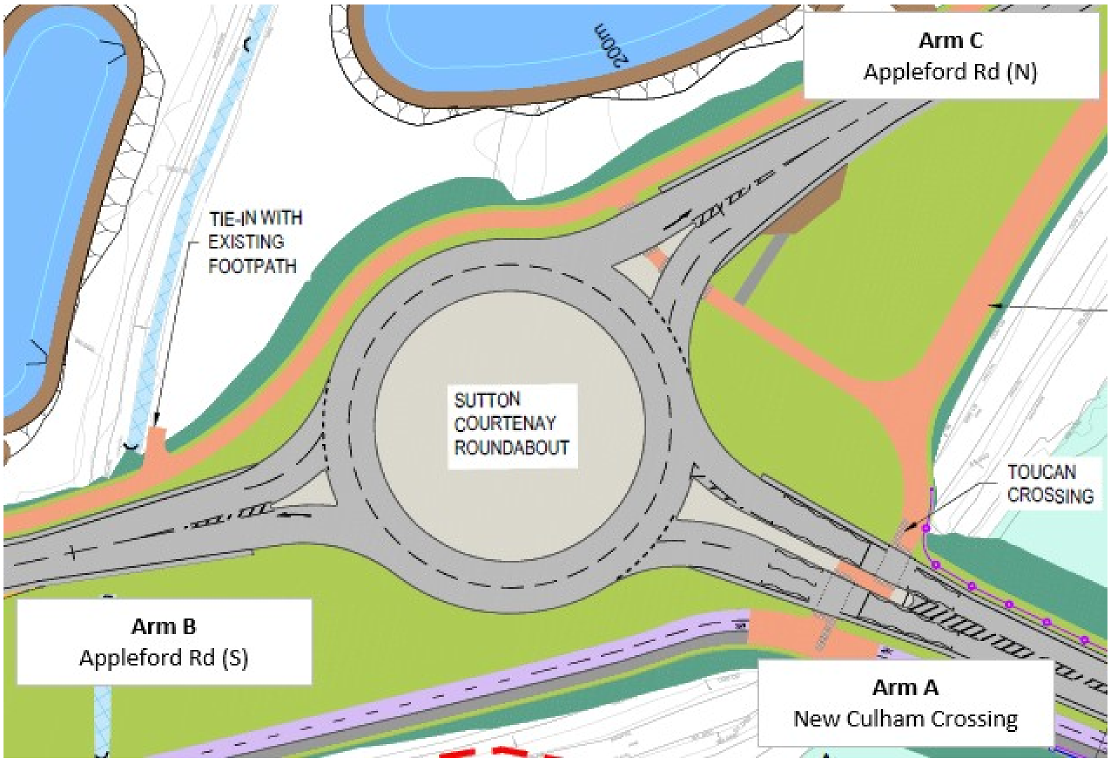


Figure 2.23.1: SCH10 Sutton Courtenay Rbt Layout

Traffic Flows Used in Model

2.23.3 The traffic flows used in the model are shown in **Figure 2.23.2.**

A **New Culham Crossing** **C** **Appleford Rd (N)**
B **Appleford Rd (S)**

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	340	187	527
B	578	0	155	733
C	368	215	0	583
Total	946	555	342	1843

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	711	217	928
B	447	0	221	668
C	189	181	0	370
Total	636	892	438	1966

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	865	259	1124
B	904	0	264	1168
C	249	275	0	524
Total	1153	1140	523	2816

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	1084	416	1500
B	819	0	265	1084
C	237	239	0	476
Total	1056	1323	681	3060

Figure 2.23.2: SCH10 Sutton Courtenay Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic between New Culham Crossing and Appleford Rd (S) from 2024 to 2034.

Audit Comments

2.23.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.23.1**.

Table 2.23.1: SCH10 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
New Culham Crossing	Model	3.48	7.99	36.5	26.0	66.4	36.6
	JCT	3.50	8.10	28.0	26.0	66.0	40.0
Appleford Rd (S)	Model	3.47	7.87	28.7	30.0	66.4	20.8
	JCT	3.60	8.20	14.0	35.0	66.0	27.0
Appleford Rd (N)	Model	3.52	8.02	29.0	26.0	66.4	42.2
	JCT	3.75	8.10	21.0	27.0	66.0	38.0

The effective flare lengths used in the model were all higher than those that could be measured by JCT from the drawing. JCT measured slightly higher lane widths, particularly the entry width for Appleford Rd (S).

2.23.5 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

New Culham Crossing: Most of the traffic from this approach go to Appleford Rd (S), which would result in imbalanced lane usage if all this traffic utilised the nearside lane. The exit width is likely to be insufficient to allow traffic to use both lanes of the approach to exit towards Appleford Rd (S) simultaneously. **Table 2.23.2** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.23.2: New Culham Crossing (SCH10) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.50
e	8.10
l'	28.0
r	26
D	66
ø	40.0
Int	**1928**

Busy Lane Geometry

v	3.50
e	4.05
l'	20.0
r	26
D	66
ø	40.0
Int	**1185**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	340	865	711	1084
Total Flow	527	1124	928	1500
Adj Int	1837	1540	1547	1640
Cap Corr	**95.27%**	**79.87%**	**80.22%**	**85.05%**

Therefore, unequal lane usage may result in 80-95% of the predicted capacity during the AM peak and 80-85% of the predicted capacity during the PM peak if this was considered within the model.

Appleford Rd (S): Most of the traffic turns right towards New Culham Crossing, which will result in most traffic using the offside lane of the approach. **Table 2.23.3** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.23.3: Appleford Rd (S) (SCH10) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.60
e	8.20
l'	14.0
r	35
D	66
ø	27.0
Int	**1826**

Busy Lane Geometry

v	3.60
e	4.10
l'	14.0
r	35
D	66
ø	27.0
Int	**1265**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	578	904	447	819
Total Flow	733	1168	668	1084
Adj Int	1604	1634	1890	1674
Cap Corr	**87.85%**	**89.51%**	103.53%	**91.69%**

Therefore, unequal lane usage may result in 88-90% of the predicted capacity during the AM peak and 92% of the predicted capacity during the 2034 PM peak if this was considered within the model. Unequal lane usage may not be an issue during the 2024 PM peak.

Appleford Rd (N): The impact of unequal lane usage on this arm is unlikely to be a concern if the nearside lane is used by left-turning traffic and the offside lane for ahead traffic, as both movements are similar. It would be recommended to provide lane marking to encourage drivers to do this.

Potential Impact of Modelling Changes to Results

2.23.6 The original model indicated most arms would be within capacity for all scenarios, except New Culham Crossing during the 2034 PM peak, which was slightly over-capacity with an RFC of 0.91.

2.23.7 Unequal lane usage on New Culham Crossing would result in less capacity than ARCADY predicts, which would increase the worst RFC of 0.91. If so, there may be potential to encourage southbound traffic to use both lanes on the approach by improving the exit merge.

2.24 SCH11 Abingdon Roundabout

Provided Information

2.24.1 The junction was modelled in Junctions 9, file "*RIVX-11-Northern Crossing Roundabout-P02-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.24.2 The drawing of the layout (**Figure 2.24.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0014 Rev P02

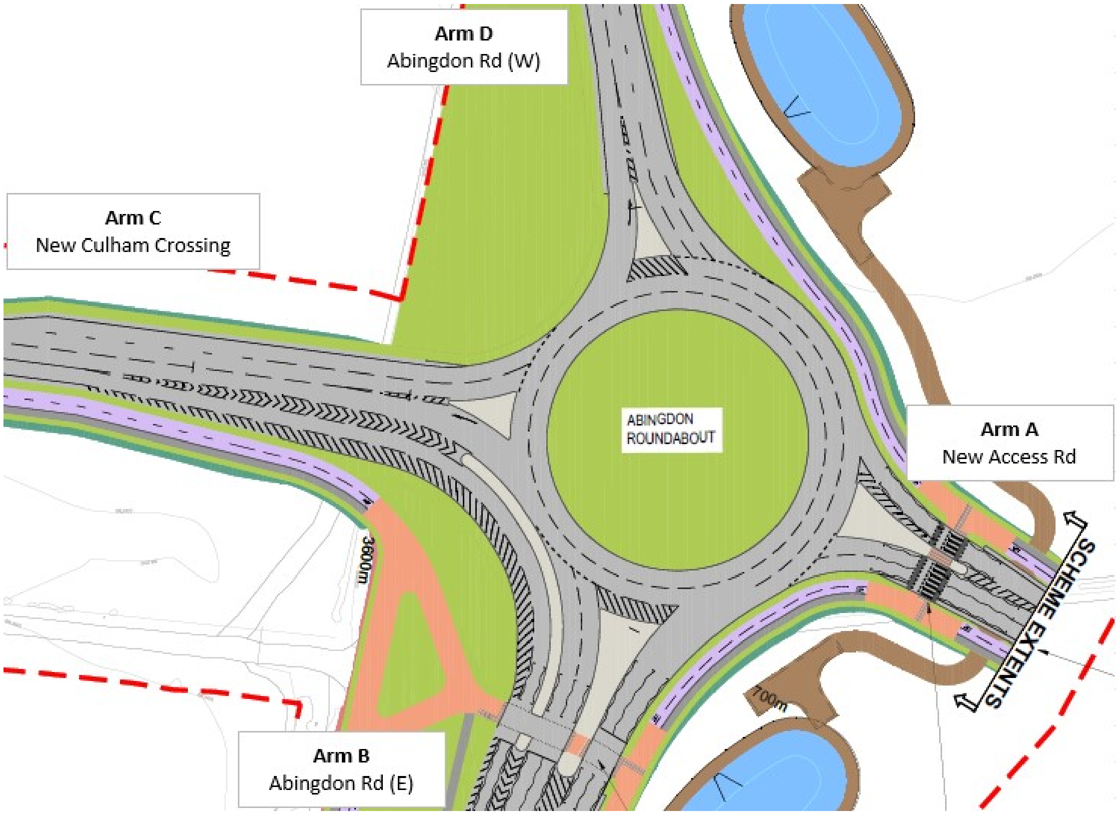


Figure 2.24.1: SCH11 Abingdon Rbt Layout

Traffic Flows Used in Model

2.24.3 The traffic flows used in the model are shown in **Figure 2.24.2.**

A	New Access Rd	C	New Culham Crossing
B	Abingdon Rd (E)	D	Abingdon Rd (W)

AM 2024 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	0	1	1	2
B	0	0	332	281	613
C	7	786	0	156	949
D	4	497	199	0	700
Total	11	1283	532	438	2264

PM 2024 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	0	7	2	9
B	0	0	700	404	1104
C	2	454	0	183	639
D	0	246	217	0	463
Total	2	700	924	589	2215

AM 2034 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	19	9	2	30
B	27	0	691	349	1067
C	43	960	0	175	1178
D	18	755	425	0	1198
Total	88	1734	1125	526	3473

PM 2034 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	25	45	9	79
B	78	0	1012	535	1625
C	63	727	0	259	1049
D	29	334	438	0	801
Total	170	1086	1495	803	3554

Figure 2.24.2: SCH11 Abingdon Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic between New Culham Crossing and Abingdon Rd (E) from 2024 to 2034, and increased between both Abingdon Rd arms. There were significant increases to and from the New Access Rd by 2034, although traffic flows remained relatively light.

Audit Comments

2.24.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.24.1**.

Table 2.24.1: SCH11 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	ø
New Access Rd	Model	7.30	10.57	7.0	40.1	80.1	42.9
	JCT	7.00	8.10	3.0	34.0	80.0	29.0
Abingdon Rd (E)	Model	3.65	8.37	268.0	42.8	80.1	27.9
	JCT	7.50	8.40	27.0	49.0	80.0	28.5
New Culham Crossing	Model	3.65	8.22	97.5	36.4	80.1	30.4
	JCT	3.60	8.10	114.0	37.0	80.0	34.0
Abingdon Rd (W)	Model	3.65	10.56	113.9	54.9	80.1	36.5
	JCT	7.10	10.60	18.0	57.0	80.0	36.0

The approach road half widths in the model for both A4130 arms were 3.65m (a single lane). On the A3130(E) JCT could not confirm this, as the drawing did not show far enough upstream (this is also the likely reason the model had a much longer effective flare length on this arm). On the A4130(W) the drawing shows the approach to be a single lane further upstream. However, after flaring to two lanes, the approach then flares to three lanes shortly before the giveway line. It is likely that the two to three lane flaring would be more critical to capacity, and therefore would be recommended to model the approach road half width at the two-lane section, and then the shorter effective flare represents the flaring from two to three lanes. Otherwise, the longer effective flare length used to represent the one to three lane flare is likely to represent the three-lane section of the approach is longer than shown. JCT assessed the impact of this, and found the Intercept (Maximum Capacity if circulating traffic was zero) dropped by about 2% if the model was updated so that the approach road half-width was measured at the two-lane section, and the effective flare length updated accordingly. This may not be a significant drop, but would provide a more robust assessment.

The entry width for New Culham Crossing was much higher in the model (10.57m) than could be measured from the drawing (8.1m). The conflict angle used in the model for this arm was also higher than measured by JCT.

2.24.5 Abingdon Rd (E) included a free left-slip for traffic to New Culham Crossing. However, the model was set up to assume only 75% of this movement would use the slip lane, with the remaining 25% turning left across the give-way line. It is unsure why this assumption was made, as it would seem reasonable to assume that all left-turning traffic would use the slip lane.

2.24.6 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

Abingdon Rd (E): Assuming all left-turning traffic utilise the free left-slip, most (if not all) traffic crossing the giveway line go ahead to Abingdon Rd (W). The exit does not appear to provide a sufficient exit merge, and therefore likely to be considered a one lane exit. As such, most traffic is likely to use the nearside lane on the approach. **Table 2.24.2** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.24.2: Abingdon Rd (E) (SCH11) – Potential Capacity Drop due to Unequal Lane Usage

Abingdon Rd (E)

Full Arm Geometry

v	7.50
e	8.40
l'	27.0
r	49
D	80
ø	28.5
Int	**2605**

Busy Lane Geometry

v	3.75
e	4.20
l'	14.0
r	49
D	80
ø	28.5
Int	**1303**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	281	349	404	535
Total Flow	281	376	404	613
Adj Int	1303	1404	1303	1493
Cap Corr	**50.02%**	**53.89%**	**50.02%**	**57.31%**

Therefore, unequal lane usage may result in 50-54% of the predicted capacity during the AM peak and 50-57% of the predicted capacity during the PM peak if this was considered within the model.

New Culham Crossing: Most of the traffic turns right towards Abingdon Rd (E). If the roundabout was marked to allow right-turn traffic to use both lanes from the approach, unequal lane usage is unlikely to be an issue. However, if all right-turning traffic used the offside lane of the approach, then unequal lane usage would result in a drop in capacity. **Table 2.24.3** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT, assuming all right-turning traffic used the offside lane.

Table 2.24.3: New Culham Crossing (SCH11) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.60
e	8.10
l'	114.0
r	37
D	80
ø	34.0
Int	**2321**

Busy Lane Geometry

v	3.60
e	4.05
l'	114.0
r	37
D	80
ø	34.0
Int	**1220**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	786	960	454	727
Total Flow	949	1178	639	1049
Adj Int	1473	1497	1717	1760
Cap Corr	**63.46%**	**64.50%**	**73.98%**	**75.84%**

Therefore, unequal lane usage may result in 63-65% of the predicted capacity during the AM peak and 74-76% of the predicted capacity during the PM peak if this was considered within the model.

Abingdon RD (W): Ahead traffic should be able to spread across the nearside and middle lanes across the give-way line, which should result in well balanced traffic flows during the AM peak period across all three lanes. During the PM peak, an imbalance may exist, with more traffic using the offside lane due to the relatively high right-turn. **Table 2.24.4** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.24.4: Abingdon Rd (W) (SCH11) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	7.10
e	10.60
l'	18.0
r	57
D	80
ø	36.0
Int	**2836**

Busy Lane Geometry

v	3.60
e	3.60
l'	0.0
r	57
D	80
ø	36.0
Int	**1220**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	199	425	217	438
Total Flow	700	1198	463	801
Adj Int	4291	3439	2603	2231
Cap Corr	151.32%	121.26%	**91.79%**	**78.67%**

Therefore, unequal lane usage may result in 79-92% of the predicted capacity during the PM peak if this was considered within the model.

Potential Impact of Modelling Changes to Results

2.24.7 The original model indicated most arms would be significantly within capacity for all scenarios, with the highest RFC being 0.61 reported for New Culham Crossing and Abingdon Rd (W) during the 2034 AM peak.

2.24.8 If it were expected that all the right-turn traffic from New Culham Crossing would use the offside lane, the worst RFC of 0.61 on this arm would increase, although the arm may remain within capacity. It is likely that all other arms would remain within capacity after any modelling updates.

2.25 SCH12 Culham Science Centre Roundabout

Provided Information

2.25.1 The junction was modelled in Junctions 9, file "*CHB-14-Culham Science Centre Roundabout-P03-v2.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.25.2 The drawing of the layout (**Figure 2.25.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0016 Rev P02

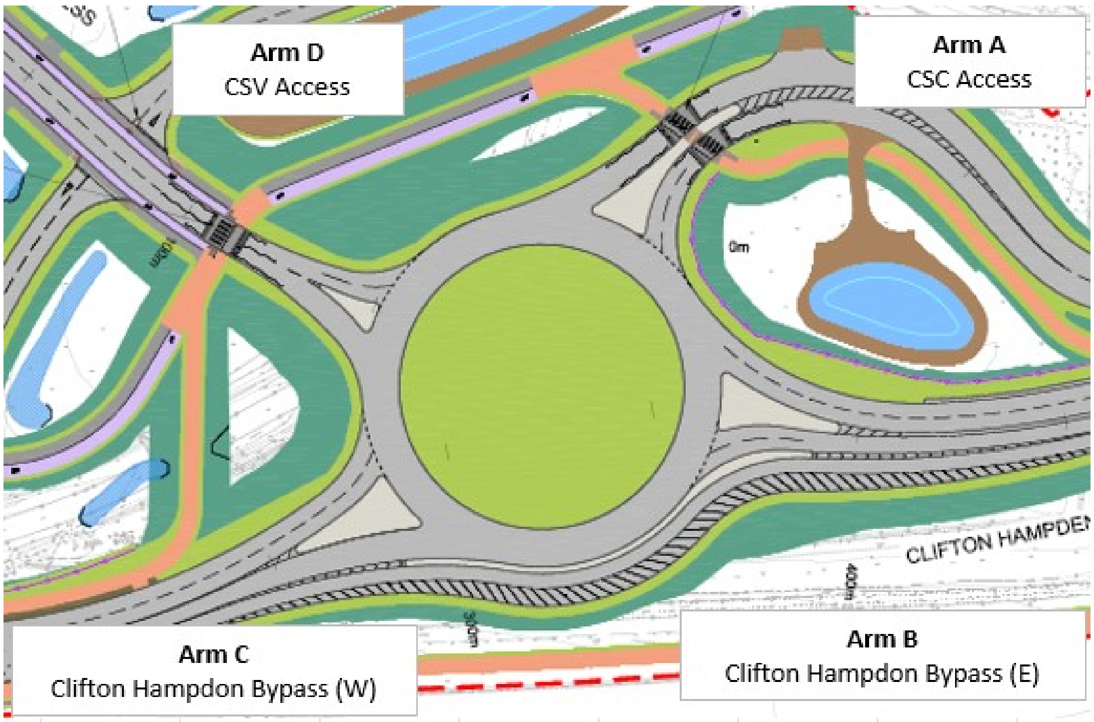


Figure 2.25.1: SCH12 Culham Science Centre Rbt Layout

Traffic Flows Used in Model

2.25.3 The traffic flows used in the model are shown in **Figure 2.25.2.**

A CSC Access
B Clifton Hampden Bypass (E)
C Clifton Hampden Bypass (W)
D CSV Access

AM 2024 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	18	42	1	**61**
B	190	0	549	17	**756**
C	367	898	0	35	**1300**
D	0	22	8	0	**30**
Total	**557**	**938**	**599**	**53**	**2147**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	69	321	5	**395**
B	17	0	696	15	**728**
C	40	622	0	45	**707**
D	0	45	25	1	**71**
Total	**57**	**736**	**1042**	**66**	**1901**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	D	Total
A	0	31	84	4	**119**
B	249	0	909	55	**1213**
C	468	1246	0	44	**1758**
D	20	152	80	3	**255**
Total	**737**	**1429**	**1073**	**106**	**3345**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	D	Total
A	0	65	391	3	**459**
B	33	0	1240	55	**1328**
C	67	1001	1	77	**1146**
D	2	78	54	0	**134**
Total	**102**	**1144**	**1686**	**135**	**3067**

Figure 2.25.2: SCH12 Culham Science Centre Rbt Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic along Clifton Hampden Bypass from 2024 to 2034, and also increased between both Abingdon Rd arms. Traffic in and out of both access arms increased.

Audit Comments

2.25.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.25.1**.

Table 2.25.1: SCH12 Geometric Inputs – Model versus JCT

Arm		V	E	l'	R	D	Ø
CSC Access	Model	5.48	7.31	10.4	25.0	85.6	41.5
	JCT	5.60	7.50	11.0	24.0	85.0	37.5
Clifton Hampden Bypass (E)	Model	3.50	7.37	12.7	28.7	85.6	39.4
	JCT	3.50	7.20	12.0	29.0	85.0	32.5
Clifton Hampden Bypass (W)	Model	3.45	7.72	170.0	27.1	85.6	33.4
	JCT	3.50	8.20	164.0	24.0	85.0	32.5
CSV Access	Model	3.52	7.04	9.4	19.1	85.6	46.1
	JCT	3.70	7.50	7.0	20.0	85.0	42.0

The geometric parameters measured by JCT were generally similar to those used in the model. The entry widths fused in the model for Clifton Hampden Bypass (W) and the CSV Access were a little smaller than those measured by JCT from the drawing.

2.25.5 Clifton Hampden Bypass (E) included a free ahead-slip for traffic to Clifton Hampden Bypass (W). However, the model was set up to assume only 81% of this movement would use the slip lane, with the remaining 19% turning left across the give-way line. It is unsure why this assumption was made, as it would seem reasonable to assume that all ahead traffic would use the slip lane.

2.25.6 The model does not account for the impact of potential unequal lane usage (i.e., it assumes traffic can balance evenly across the lanes on each arm). However, unequal lane usage may need considered as follows:

CSC Access: Unequal lane usage may not be an issue on this arm. Most of the traffic go to the Clifton Hampden Bypass (W), and the geometry of the roundabout may result in drivers using both lanes on the approach to make this movement.

Clifton Hampden Bypass (E): Assuming all the ahead traffic used the slip lane, most traffic across the give-way line would use the offside lane to reach the CSC Access during the AM Peak. The PM peak is unlikely to be an issue, as flows are light and better balanced. **Table 2.25.2** gives an indication to the approximate drop in capacity due to unequal lane usage for each flow group, using the lane geometry measured by JCT.

Table 2.25.2: Clifton Hampden Bypass (E) (SCH12) – Potential Capacity Drop due to Unequal Lane Usage

Full Arm Geometry

v	3.50
e	7.20
l'	12.0
r	29
D	85
ø	32.5
Int	**1635**

Busy Lane Geometry

v	3.50
e	3.60
l'	6.0
r	29
D	85
ø	32.5
Int	**1096**

Capacity Corrections

	AM 2024	AM 2034	PM 2024	PM 2034
Busy Flow	190	249	17	33
Total Flow	207	304	32	88
Adj Int	1194	1338	2063	2923
Cap Corr	**73.03%**	**81.84%**	126.18%	178.76%

Therefore, unequal lane usage may result in 73-82% of the predicted capacity during the AM peak.

<u>Potential Impact of Modelling Changes to Results</u>

2.25.7 The original model indicated that Clifton Hampden Bypass (W) would be slightly over-capacity during the 2034 AM peak, with an RRC of 0.94. All other reported RFC values were significantly within capacity.

2.25.8 It is unlikely that any updates to the model, based on the audit comments, would make the ARCADY results worse than the original files.

2.26 SCH13 Clifton Hampden Bypass / Realigned A415

Provided Information

2.26.1 The junction was modelled in Junctions 9, file "*CHB-15-Clifton_Hampden_Bypass-A415-P03-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.26.2 The drawing of the layout (**Figure 2.26.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0017 Rev P02

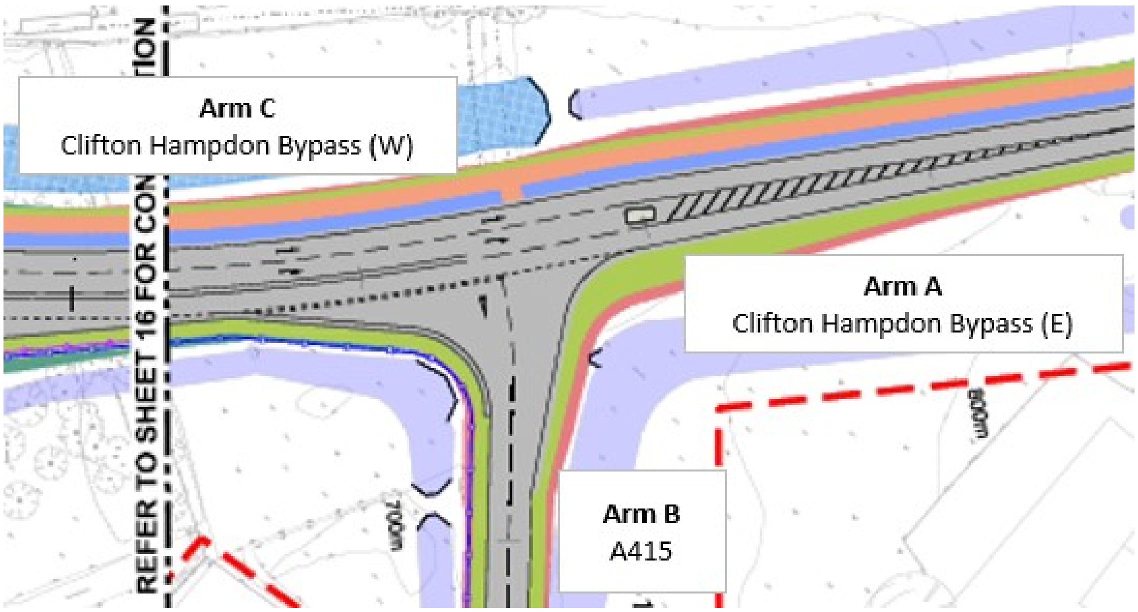


Figure 2.26.1: SCH13 Clifton Hampden Bypass / Realigned A415 Layout

Traffic Flows Used in Model

2.26.3 The traffic flows used in the model are shown in **Figure 2.26.2.**

A Clifton Hampden Bypass (E) **C** Clifton Hampden Bypass (W)
B A415

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	0	589	**589**
B	10	0	168	**178**
C	813	127	0	**940**
Total	**823**	**127**	**757**	**1707**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	1	615	**616**
B	3	0	112	**115**
C	550	183	0	**733**
Total	**553**	**184**	**727**	**1464**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	0	1107	**1107**
B	53	0	106	**159**
C	1344	84	0	**1428**
Total	**1397**	**84**	**1213**	**2694**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	9	1177	**1186**
B	29	0	152	**181**
C	1039	104	0	**1143**
Total	**1068**	**113**	**1329**	**2510**

Figure 2.26.2: SCH13 A415 Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the Clifton Hampden Bypass by the year 2034.

Audit Comments

2.26.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.26.1**.

Table 2.26.1: SCH13 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	7.10	7.00
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	3.7	3.50
Visibility (m)	250	250
Blocks?	No	No
Blocking Queue	n/a	n/a

Minor Arm	Model	JCT
Type	Flare	Flare
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	10.00
Width @ 5m	10.00	10.00
Width @ 10m	10.00	10.00
Width @ 15m	6.36	5.90
Width @ 20m	4.11	3.80
Flare Length	3	3
Visibility Left	122	210
Visibility Right	158	140

The geometric parameters used within the model were similar to those measured by JCT, although the minor lane widths used in the model, 15-20m upstream of the give-way line, were a little higher than the values measured by JCT. JCT measured a longer visibility to the left from the minor arm. However, the differences are unlikely to make a significant impact to the results.

<u>Potential Impact of Modelling Changes to Results</u>

2.26.5 The original model indicated that the junction would be significantly over-capacity during both the 2034 peak periods, with infinite RFC values on the A415 during the AM peak period and an RFC of 1.28 during the PM peak period.

2.26.6 Any changes made to the model based on the audit comments are unlikely to have a significant impact on the modelling results.

2.27 SCH14 Clifton Hampden Bypass / B4015

Provided Information

2.27.1 The junction was modelled in Junctions 9, file "*CHB-16-Clifton_Hampden_Bypass-B4015-P03-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.27.2 The drawing of the layout (**Figure 2.27.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0019 Rev P02

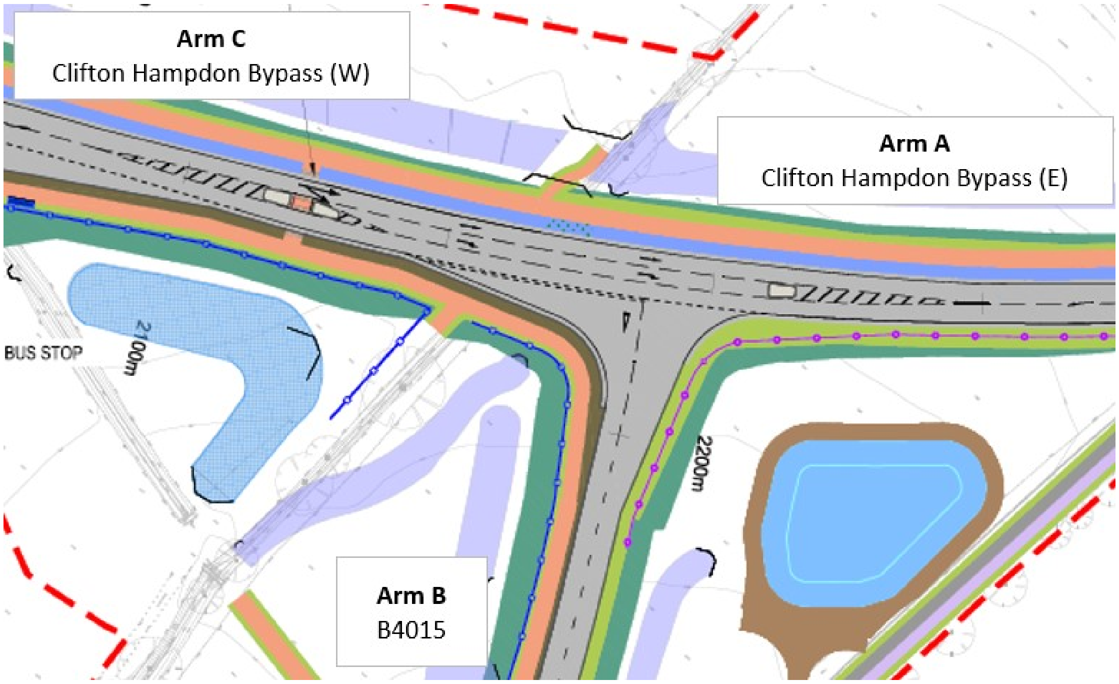


Figure 2.27.1: SCH14 Clifton Hampden Bypass / B4015 Layout

Traffic Flows Used in Model

2.27.3 The traffic flows used in the model are shown in **Figure 2.27.2.**

A Clifton Hampden Bypass (E) **C** Clifton Hampden Bypass (W)
B B4015

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	39	569	**608**
B	134	0	17	**151**
C	829	26	0	**855**
Total	**963**	**65**	**586**	**1614**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	172	591	**763**
B	67	0	28	**95**
C	615	24	0	**639**
Total	**682**	**196**	**619**	**1497**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	45	1071	**1116**
B	85	0	33	**118**
C	1414	23	0	**1437**
Total	**1499**	**68**	**1104**	**2671**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	233	1157	**1390**
B	50	0	28	**78**
C	1159	90	0	**1249**
Total	**1209**	**323**	**1185**	**2717**

Figure 2.27.2: SCH14 B4015 Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the Clifton Hampden Bypass by the year 2034.

Audit Comments

2.27.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.27.1**.

Table 2.27.1: SCH14 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	5.98	5.90
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	3.00	3.00
Visibility (m)	168	250
Blocks?	Yes	Yes
Blocking Queue	7	9

Minor Arm	Model	JCT
Type	Flare	Flare
Width Lane 1	n/a	n/a
Width Lane 2	n/a	n/a
Width @ 0m	10.00	10.00
Width @ 5m	10.00	10.00
Width @ 10m	7.85	8.00
Width @ 15m	4.78	4.80
Width @ 20m	3.70	3.80
Flare Length	2	2
Visibility Left	43	151
Visibility Right	108	130

The geometric parameters used within the model were similar to those measured by JCT, although some of the visibilities used were shorter than the drawing indicated.

<u>Potential Impact of Modelling Changes to Results</u>

2.27.5 The original model indicated that the junction would be significantly over-capacity during both the 2034 peak periods, with infinite RFC values on the B4015 during both peak periods.

2.27.6 Any changes made to the model based on the audit comments are unlikely to have a significant impact on the modelling results.

2.28 SCH15 Clifton Hampden Bypass / Culham Science Centre

Provided Information

2.28.1 The junction was modelled in Junctions 9, file "*CHB-46-Clifton_Hampden_Bypass-CSC Secondary Access-P03-v0.j9*". The modelling input data was included within Appendix H of the TA, and this was audited by JCT.

2.28.2 The drawing of the layout (**Figure 2.28.1**) was provided, Drawing Number:

GEN_PD-ACM-GEN-DGT_ZZ_ZZ_ZZ-DR-T-0018 Rev P02

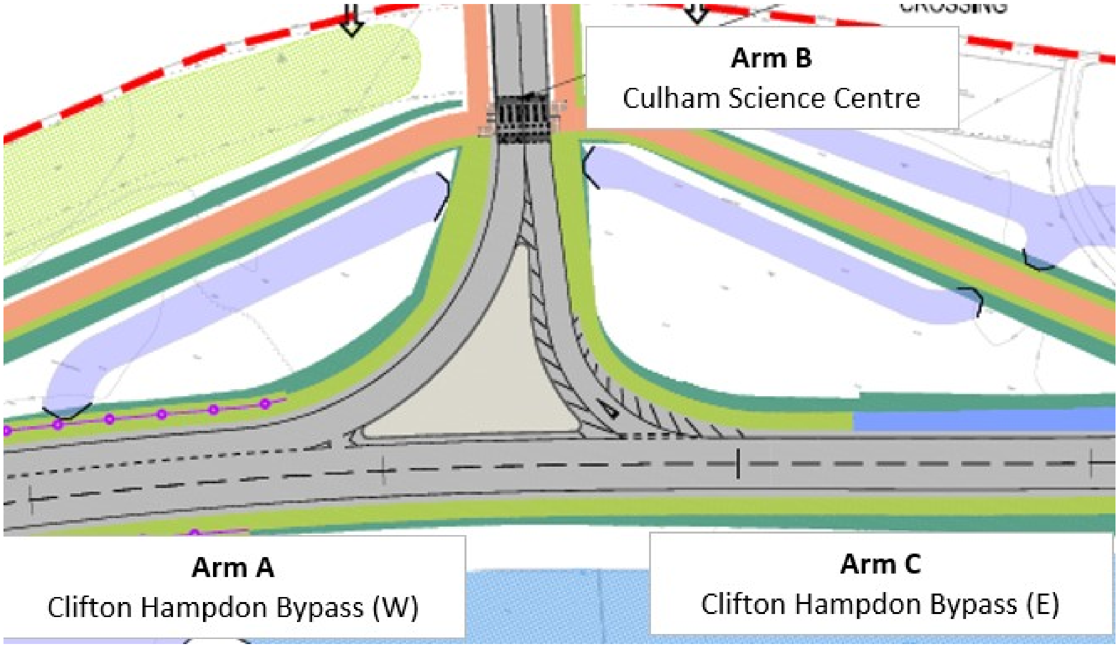


Figure 2.28.1: SCH15 Clifton Hampden Bypass / CSC Layout

Traffic Flows Used in Model

2.28.3 The traffic flows used in the model are shown in **Figure 2.28.2.**

A Clifton Hampden Bypass (W) C Clifton Hampden Bypass (E)
B Culham Science Centre

AM 2024 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	0	822	**822**
B	0	0	25	**25**
C	588	0	0	**588**
Total	**588**	**0**	**847**	**1435**

PM 2024 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	0	554	**554**
B	0	0	83	**83**
C	616	0	0	**616**
Total	**616**	**0**	**637**	**1253**

AM 2034 (0800 - 0900) - PCUs

	A	B	C	Total
A	0	0	1401	**1401**
B	0	0	36	**36**
C	1106	0	0	**1106**
Total	**1106**	**0**	**1437**	**2543**

PM 2034 (1700 - 1800) - PCUs

	A	B	C	Total
A	0	0	1069	**1069**
B	0	0	200	**200**
C	1184	0	0	**1184**
Total	**1184**	**0**	**1269**	**2453**

Figure 2.28.2: SCH15 CSC Traffic Flows in Model

The traffic flows used in the modelling indicated a significant increase in traffic flows along the Clifton Hampden Bypass by the year 2034.

Audit Comments

2.28.4 A comparison between the geometry used in the model versus the geometry measured independently by JCT is shown in **Table 2.28.1**.

Table 2.28.1: SCH15 Geometric Inputs – Model versus JCT

Major Arm	Model	JCT
Width (m)	7.30	7.25
Kerbed Reserve (m)	n/a	n/a
Right-Turn Bay (m)	n/a	n/a
Visibility (m)	n/a	n/a
Blocks?	n/a	n/a
Blocking Queue	n/a	n/a

Minor Arm	Model	JCT
Type	One	One
Width Lane 1	4.33	3.58
Width Lane 2	n/a	n/a
Width @ 0m	n/a	n/a
Width @ 5m	n/a	n/a
Width @ 10m	n/a	n/a
Width @ 15m	n/a	n/a
Width @ 20m	n/a	n/a
Flare Length	n/a	n/a
Visibility Left	n/a	n/a
Visibility Right	236	250

The geometric parameters used within the model were similar to those measured by JCT, although the minor road lane width used in the model was higher than measured by JCT. A possible explanation was that lane widths (0-20m from give-way line) were measured parallel to the give-way line, before taking an average width. However, as the offside of the lane is not perpendicular to the major road (similar to standard priority junctions), JCT measured the lane widths perpendicular to the nearside of the minor arm.

Potential Impact of Modelling Changes to Results

2.28.5 The original model indicated that the junction would be significantly within capacity for all modelled traffic flow periods, with the highest RFC of 0.44 on the Culham Science Centre during the 2034 PM peak.

2.28.6 Any changes made to the model based on the audit comments are unlikely to have a significant impact on the modelling results.

3.0 Conclusions

3.0.1 Of the 28 junctions associated with the scheme, LinSig and Junctions 9 models were produced for 27. No LinSig model was produced for OFF1 Milton Interchange, and therefore was not audited by JCT.

3.0.2 It was JCT's understanding that the traffic flows used in the models were extracted from the Paramics modelling. As no traffic flow diagrams were provided, JCT could not decipher whether the traffic flows used in the models were "correct". Therefore, JCT highlighted the traffic flows used in each model. **It is important that OCC check that these traffic flows are reasonable.** The change to traffic flow volumes and patterns between flow groups were often significant. Many of these changes were likely caused by the scheme itself, or by future developments in the area. However, it is important to ensure that these changes were not a result of assignment issues within the Paramics modelling. Otherwise, this may result in junctions being modelled assuming significantly different traffic flows than would be expected.

3.0.3 For the Junctions 9 modelling, it was noted that for the SCH junctions, all the traffic flows were entered in pcus (Passenger Car Units). Therefore, JCT assume these have been factored to account for HGV percentages? For the OFF junctions, all the traffic flows were entered as vehicles, and these were scaled to account for HGVs by the HGV percentages input into the models. JCT noted that the HGV percentages used in each flow group often changed, for example when comparing the 2024 AM peak with the 2034 AM peak. JCT assume that HGV percentages were extracted from the Paramics modelling?

3.0.4 For Junctions 9 modelling at roundabouts the model assumes that all the entry width will be used as long as there is a queue. However, this assumption does not hold if traffic flows are imbalanced across all lanes at the give-way line, and Junctions 9 will over-predict capacity if this is not accounted for. For most roundabouts within the study, unequal lane usage is likely for at least one approach, if not several, and this was not accounted for in the modelling. JCT indicate where these cases may need to be considered, and provided the approximate available capacity (compared to the Junctions 9 Capacity) for each flow group, using the methodology described in Appendix A. The models can be updated to account for unequal lane usage, and would require setting up Analysis Sets for each Demand Set, and then applying the capacity reduction for each flow group separately.

3.0.5 **Table 3.0.1** summarises the worst-case results from the original models, and the potential impact changes to the models may have on the outputs, to reflect audit comments.

PRC (Practical Reserve Capacity) is reported for signal-controlled junctions in LinSig, and based on the worst Degree of Saturation. A PRC of 0% indicates the highest degree of saturation is 90%, and less than 0% would indicate at least one degree of saturation exceeds 90%. RFC (Ratio of Flow to Capacity) is reported for each give-way movement in Junctions 9.

The final columns highlight whether JCT would expect the junction to operate within capacity after any changes were made to the models. These should be treated with caution, until models are finalised, but were included to simply highlight which junctions may be the most critical within the study.

Table 3.0.1: Audit Summary

Junction		Original Model Worst Reported PRC/ RFC		Audit	Outcome if models updated based on Audit		
		No Scheme	Scheme	Significant Issues?	Better / Worse compared to original?	Expected to be within capacity after changes? No Scheme	Scheme
OFF 1	Milton Interchange	n/a	n/a	n/a	n/a	n/a	n/a
OFF 2	A4130 Service Area	1.07	0.71	No	Insignificant	No	Yes
OFF 3	Milton Gate	-52%	-5%	YES	Better	Maybe	Yes
OFF 4	Mendip Heights	1.47	0.73	YES	Worse	No	Maybe
OFF 5	Power Station	1.10	0.54	YES	Worse	No	Maybe
OFF 6 / OFF 7	High St / Oxford Rd	-606%	34%	YES	Better	No	Yes
OFF 8	Harwell Rd	0.97	0.49	No	Insignificant	No	Yes
OFF 9	High St / Brook St	2.69	1.06	No	Insignificant	No	No
OFF 10	B4016 / Abingdon Rd	121% (DoS)*	43.6% (DoS)*	YES	Worse?	No	Yes
OFF 11	A415 / Tollgate Rd	-47%	7%	YES	Better	No	Yes
OFF 12	A4130 / Lady Grove	0.62	0.72	YES	Worse	Yes	Maybe
OFF 13	Lady Grove / Sires Hill	1.37	0.80	YES	Unknown	Unknown	Unknown
OFF 14	Sires Hill / Didcot Rd	1.54	0.70	YES	Worse	No	Yes
SCH 1	Backhill Rbt	n/a	0.94	No	n/a	n/a	No
SCH 2	Valley Park Access	n/a	32%	YES	Better	n/a	Yes
SCH 3	Old A4130 Rbt	n/a	0.97	YES	Worse	n/a	No
SCH 4	Science Bridge Rbt	n/a	0.83	YES	Worse	n/a	Maybe
SCH 5	New Purchas Rd	n/a	0.79	YES	Worse	n/a	No
SCH 6	A4130 / Science Bridge	n/a	1.99	No	Insignificant	n/a	No
SCH 7	Collett Rbt	n/a	0.81	YES	Worse	n/a	No
SCH 8	FCC Access	n/a	0.75	YES	Better	n/a	Yes
SCH 9	New Thames Crossing	n/a	1.00	No	Better	n/a	No
SCH 10	Sutton Courtenay Rbt	n/a	0.91	YES	Worse	n/a	No
SCH 11	Abingdon Rbt	n/a	0.61	YES	Worse	n/a	Maybe
SCH 12	Culham Science Centre Rbt	n/a	0.94	YES	Insignificant	n/a	No
SCH 13	Clifton / Realigned A415	n/a	Infinite	No	Insignificant	n/a	No
SCH 14	Clifton / B4015	n/a	Infinite	No	Insignificant	n/a	No
SCH 15	Clifton / Science Centre	n/a	0.44	No	Insignificant	n/a	Yes

Key: Traffic Signal-Controlled; Roundabout; Priority Junction; Mini-Roundabout

* Degree of Saturation shown as junction was modelled in LinSig, not Junctions 9

x Over-capacity (0.9 < RFC < 1.10 , 0% > PRC > 20%)

x Significantly over-capacity (RFC > 1.10 , PRC < -20%)

3.0.6 The original modelling indicated most of the OFF junctions would be over-capacity without the scheme by the year 2034. The scheme improved performance significantly at most junctions, with the modelling predicting they would all be within capacity, except for OFF 4 and 9. The audit identified significant issues for most junctions, although expect that updated models may continue to indicate the junctions operate within capacity with the scheme, or potentially slightly over-capacity.

3.0.7 JCT could not predict the outcome of changes to OFF 13, as traffic flow assignment to the junction may be incorrect due to a potential flaw in the arm labelling.

3.0.8 The original modelling predicted most of the SCH junctions would be over-capacity by the year 2034, and updated models may indicate more junctions to become over-capacity.

3.0.9 SCH 6, 13 and 14 were predicted to be significantly over-capacity, with Infinite RFCs predicted at SCH 13 and 14. Infinite RFCs occur when traffic flows on the main road are so high, there is theoretically zero capacity for traffic to exit the side road onto the main carriageway. This issue has the largest impact on right-turning traffic, who must give-way to multiple streams of traffic on the main carriageway. Not only is this a capacity issue, but it can also impact on safety, as impatient drivers from the side road may risk entering the main carriageway in unsuitably small gaps of high-speed opposing traffic.

Appendix A

Methodologies for Modelling

Unequal Lane Usage

Using Junctions 9 (ARCADY)

Unequal Lane Usage in ARCADY using Junctions 9

By Simon Swanston BEng, MSc, CEng, FIHE – JCT Consultancy

Date: August 2018

Synopsis

Modelling the performance of roundabouts, without signal-control, has traditionally been conducted using the ARCADY software in the UK, developed by the Transport Research Laboratory (TRL). The ARCADY module is now incorporated within the Junctions 9 software along with the PICADY (priority junctions) and OSCADY (signal-controlled junctions) modules.

Care must always be taken to account for unequal lane usage on entries to the roundabout, as the empirical formulae used to derive capacities / queues do not take any consideration to the number of lanes or turning directions. This was highlighted by Barbara Chard in the “ARCADY Health Warning” paper in 1997, which also provided a method to adjust the intercept to account for unequal lane usage.

Since 1997, although the empirical formulae remain essentially the same, additional features and tools are now available in Junctions 9, such as full capacity adjustments and Lane Simulation.

This paper revisits Barbara Chard’s method in accounting for unequal lane usage, and whether any of the new tools in Junction 9 can be incorporated to refine the results. It also compares this method with results from the Lane Simulation tool in Junctions 9 and identifies areas where caution is required using Lane Simulation.

Unequal Lane Usage – Barbara Chard Method

The capacity calculations used in ARCADY assume that traffic can use all of the entry width when there is a queue. However, this fact does not always hold when there is a significant imbalance of traffic across the lanes at the give-way line.

In cases were imbalance exists, an adjustment to the capacity must be considered.

A method of determining Intercept corrections for unequal lane usage was discussed by Barbara Chard in the paper "ARCADY Health Warning: Account for lane usage or risk damaging the Public Purse". This recommended the following steps:

1. Calculate the Intercept for the whole approach.
2. Determine which lane(s) will be the most heavily used.
3. Calculate the Intercept using the geometry of the busiest lane(s) only.
4. Multiply the answer from (3) by the total traffic flow on the entry, then divide this by the traffic flow using the busiest lane(s).
5. If the result from (4) is lower than (1), then (4) is the Intercept you want ARCADY to use.
6. Given that ARCADY will contain the geometry of the full entry, and therefore calculate (1) as the Intercept, a negative Intercept adjustment is required so that (4) is used instead.
7. If the result from (4) is higher than (1), then no adjustment is required.

The capacity relationship with circulating flow is shown in Figure 1, and the impact of applying an Intercept correction.

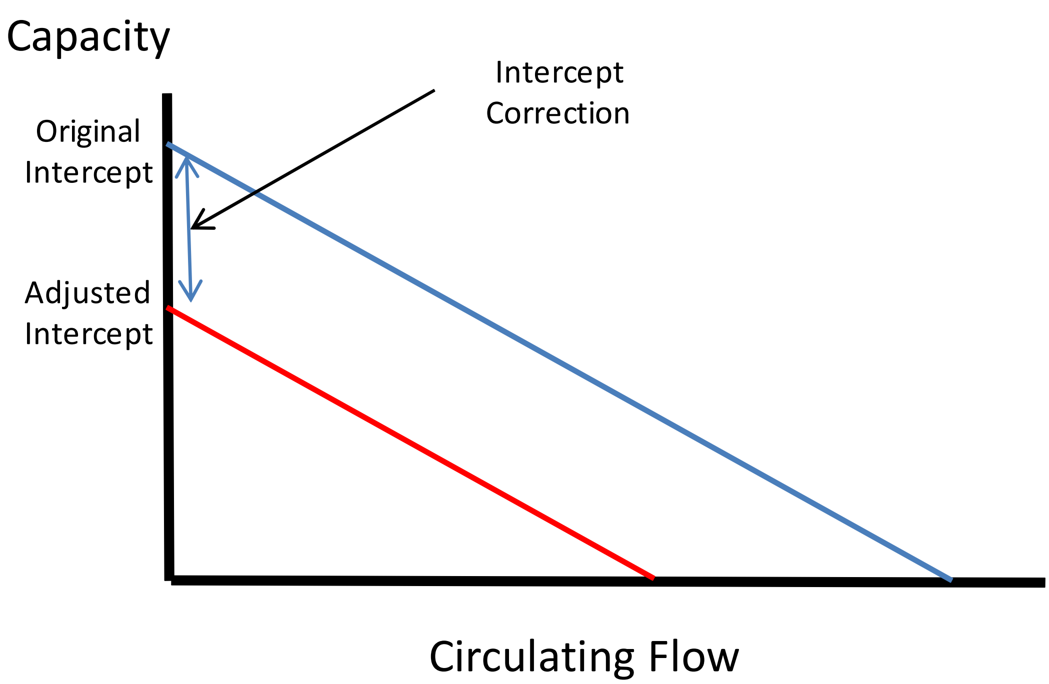


Figure 1: Impact of Intercept correction on Capacity Relationship with Circulating Flow

Limitation of the Intercept Adjustment

The paper by Barbara Chard was written at a time in which adjustments could be made to the Intercept in the software, but not the Slope. Therefore, the absolute reduction to capacity would be equal to the Intercept correction, regardless of circulating flow. However, this results in larger proportional reductions to capacity as circulating flows increase, which may result in overly pessimistic results.

Take a simple hypothetical example:

Imagine an approach consisting of two full lanes to the give-way line (i.e. no flaring). Following the measurement of geometric parameters, the Intercept for the approach is calculated as 2000 pcu/hr and the Slope as 0.6.

However, let us assume that during one peak period 100% of the total traffic flow on the approach uses one lane only. Logic indicates that as the Intercept for both lanes combined is 2000 pcu/hr, then the Intercept of each lane (and therefore the busiest lane) is 1000 pcu/hr. Therefore, an Intercept correction of -1000 pcu/hr would be required to ensure ARCADY used an Intercept of 1000 pcu/hr rather than 2000 pcu/hr during this flow period. The impact of applying this Intercept correction is shown in **Figure 2**.

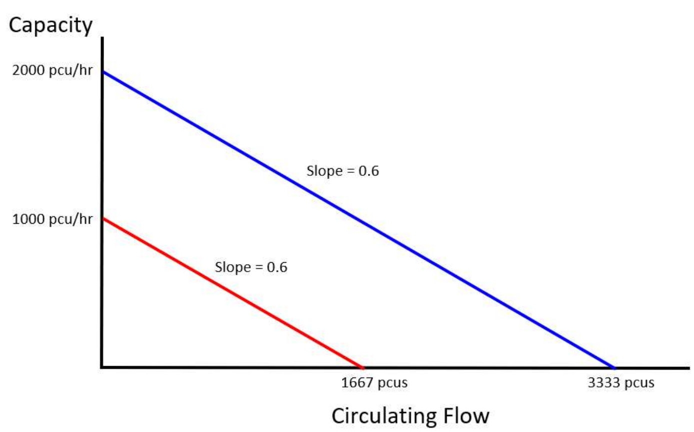


Figure 2: Intercept Correction when Only One Lane of Two Full Lane Approach Utilised

Following the application of the Intercept correction, Figure 2 shows that when circulating flow is zero, the capacity would be 1000 pcu/hr rather than 2000 pcu/hr. This would be expected given that traffic can only proceed into the roundabout from one lane rather than two, resulting in the actual capacity being 50% of the total approach.

However, as the circulating flow increases, the available capacity (red line) continually decreases below 50% of the total approach capacity (blue line). For example, if the circulating flow was 1000 pcu/hr, the capacity for both lanes of the approach would be 2000 – 0.6 x 1000 = 1400 pcu/hr. However, with the Intercept correction, the capacity would be 1000 – 0.6 x 1000 = 400 pcu/hr. Therefore, the capacity of the single lane would be 28.6% of the total capacity of both lanes. The graph also shows that capacity falls to zero when the circulating flow is 1667 pcus following the Intercept correction, whereas if both lanes were well utilised, the combined capacity of both lanes at this point would be 1000 pcu/hr.

The Solution to the Intercept Correction Problem

The latest version of ARCADY (within Junctions 9) now allows direct capacity adjustments rather than Intercept adjustments. Therefore, once a suitable Intercept is calculated using the Barbara Chard method, a calculation should be conducted to determine its percentage against the Intercept for the whole approach. For the case in Figure 2, a percentage of 50% would be calculated (i.e. 1000/2000 x 100%). Junctions 9 then enables this capacity reduction to be applied to the Analysis Set. The impact on the capacity relationship is shown in **Figure 3**.

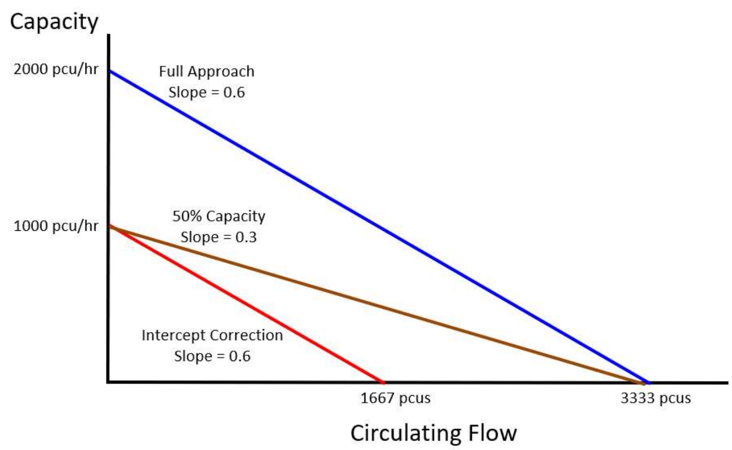


Figure 3: Application of Capacity Adjustment (Brown/Middle Line)

This adjustment to capacity ensures that the capacity reduction will always be proportionally the same (in this case 50%), regardless of circulating flow. This is also equivalent to dividing both the Intercept and Slope by the same proportion.

As described by Barbara Chard, it is still important to bear in mind the following points:

- A capacity adjustment determined using this method should only be applied if the calculated Intercept for the busy lane(s) is lower than the Intercept for the full approach (i.e. the capacity adjustment should not be over 100%).
- The capacity adjustment is dependent on traffic flow proportions and should therefore be calculated independently for each traffic Demand Set. Variable capacity adjustments can be set up in Junctions 9 by creating an Analysis Set for each Demand Set, with the capacity adjustment linked to the Analysis Set.

Demonstration of the Application of a Capacity Adjustment at a Junction

As an example, take the junction in **Figure 4**.

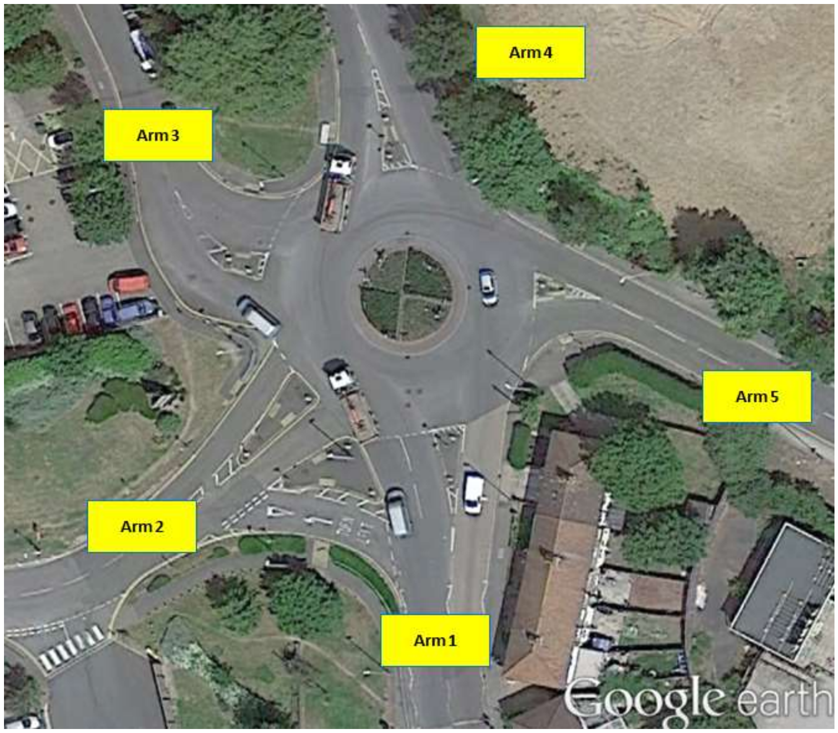


Figure 4: Capacity Adjustment on Arm 4

Arm 4 consists of two lanes. If it was assumed that left turning and ahead traffic used the nearside lane (to Arms 5 and 1) and all other traffic used the offside lane (to Arms 2 and 3), then the usage of each lane would be as follows during the AM Peak:

Nearside	=	166 (to Arm 5) + 727 (to Arm 1)	=	893
Offside	=	15 (to Arm 2) + 25 (to Arm 3)	=	40
Total Arm Flow	=	893 +40	=	933

The geometric measurements and Intercept for Arm 4 are shown below, as well as the corresponding measurements for the nearside lane only (as this was shown to be the busiest lane above).

	Full Approach	**Nearside Lane**
v	3.6	3.6
e	7.8	3.9
l’	15.8	1.0
r	11	11
D	34	34
Φ	18	18
Intercept	**1781**	**1139**

The intercept of 1781 pcu/hr would apply with reasonably balanced flows across both lanes. If the offside lane was never used, then a more appropriate intercept would be 1139 pcu/hr. Given that some traffic does use the offside lane, the Intercept will lie between 1139 pcu/hr and 1781 pcu/hr. This can be estimated as follows:

Adjusted Intercept = Busy Lane Intercept x Total Arm Flow / Busy Lane Flow

= 1139 x 933 / 893

= 1190 pcu/hr

Note, if the calculation above resulted in an answer at or above 1781 pcu/hr, this would indicate no adjustment is required. Increases to Intercepts / Capacity should not be made for unequal lane usage.

The Capacity Adjustment may be calculated as follows:

Capacity Adjustment = 1190 / 1781 x 100 = **66.82%**

Therefore, regardless of circulating flow, ARCADY would always assume a reduction of 66.82% when calculating the output parameters. In comparison, had the Intercept correction been applied only, the calculated capacities are shown for a range of circulating flows in **Table 1**.

Table 1: Capacity Comparison between Capacity Adjustment versus Intercept Adjustment

Circulating	Capacities		
	Full Approach	Capacity Reduction	Intercept Reduction
0	1781	1190	1190
500	1446	966	855
1000	1111	742	520
1500	776	519	185
2000	441	295	0
2500	106	71	0

Once the circulating flow increases beyond zero, the capacity used by ARCADY is always lower if an Intercept correction is applied in comparison to a capacity correction. This may only have a small impact when circulating flows are relatively low or the approach is well within capacity. However, as circulating flows become higher the impact on the results will become more significant, particularly on critical approaches.

Lane Simulation Tool and Comparison to the Capacity Adjustment Method

Junctions 9 includes a Lane Simulation Tool where individual lanes can be set up, the distances at which the number of lanes increases as traffic approaches the give-way line (i.e. flare lengths) and lane turning directions.

The standard ARCADY geometry is still applied to each approach. The Lane Simulation Tool can then share the calculated capacity of the standard model across the specified lanes at the give-way line. There are several stated benefits to Lane Simulation, one of these being that it can model the impact of unequal lane usage.

"Short" Flare

To investigate the results of the Lane Simulation Tool, two models were set up of the same three arm roundabout, each consisting of two lanes at the give-way line and one lane upstream of any flare. Traffic flows were kept constant from Arms B and C. However, a range of flows were tested from Arm A, from 100% (i.e. complete lane starvation of the offside) of the total flow using the nearside to 50% (i.e. balanced usage). Arm A had an approach road half width of 3.5m, entry width of 7.5m and effective flare length of 9m. The first model applied the capacity adjustment calculations, which were an extension to the Barbara Chard method (referred to as Health Warning Update). The second model used the Lane Simulation Tool. Both were modelled using Junctions version 9.5.

Lane Simulation does not provide an RFC for the approach. Therefore, the comparison of calculated delay for Arm A is shown in **Figure 5**.

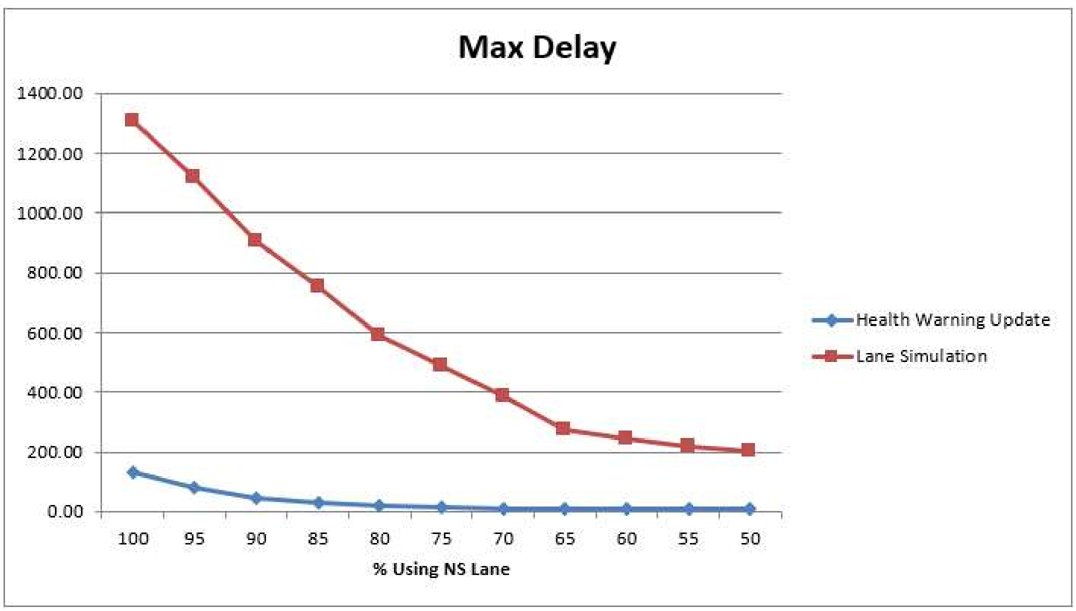


Figure 5: Capacity Adjustment versus Lane Simulation – Arm A Delay

The graph shows that Lane Simulation calculated considerably more delay than the Capacity Adjusted method. However, it is important to note that no capacity adjustment was applied when the traffic flows were balanced. In fact, no capacity adjustment was applied in this example until 75% or more traffic utilised the nearside lane. Therefore, where the nearside flow was less than 75% of the total flow (right side of graph), the Capacity Adjusted is effectively the standard ARCADY model with no corrections.

So, when traffic flows were balanced across both lanes, the standard ARCADY model calculated a delay of 11.79 seconds. However, Lane Simulation calculated a delay of 204.57 seconds, 1635% higher than the standard model. This raised concerns to the results produced by Lane Simulation and indicated that these concerns would also be applicable to where unequal lane usage did exist. For example, where 100% of traffic used the nearside lane, the capacity adjusted model predicted a delay of 130.85 seconds, whereas Lane Simulation calculated a delay of 1307.36 seconds, 899% higher than the capacity adjusted model.

Figure 6 shows the comparison of the predicted queue lengths for the same modelled runs.

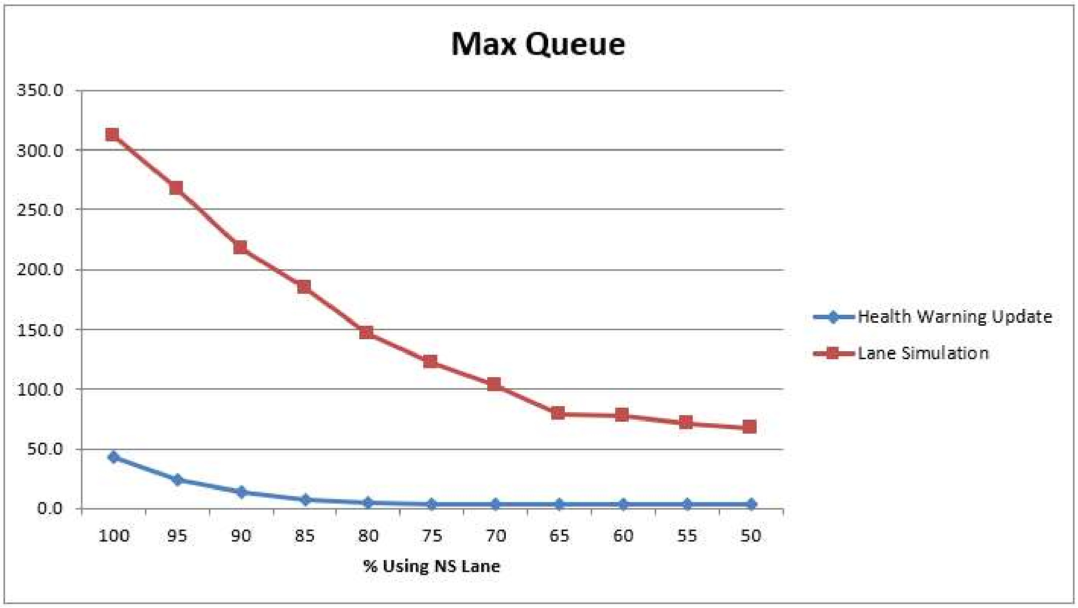


Figure 6: Capacity Adjustment versus Lane Simulation -Arm A Queue

When traffic flows were balanced across both lanes, the standard ARCADY model calculated a queue of 3.5 pcus. However, Lane Simulation calculated a queue of 67.2 pcus, 1820% higher than the standard model. Where 100% of traffic used the nearside lane, the capacity adjusted model predicted a queue of 42.6 pcus, whereas Lane Simulation calculated a queue of 311.5 pcus, 631% higher than the capacity adjusted model.

A likely explanation for the significantly worse results produced using the Lane Simulation tool is that the negative effect of any flaring on the approach is effectively double counted. Firstly, when calculating the combined capacity across all lanes, Lane Simulation will use the values calculated using the standard geometry, which incorporates the effective flare length. Secondly, when setting up the lane levels and lane lengths in Lane Simulation, this will also model the impact of the flare as simulated traffic cannot enter one lane when traffic completely fills the adjacent lane.

"Longer" Flare

Due to the relatively short effective flare length of 9m used in the evaluations above, the models were re-run with an increased flare length of 33m. It was expected that a closer match between the models could be achieved given that the impact of the flare on capacity should be less critical. The comparison of delays on Arm A is shown in **Figure 7**.

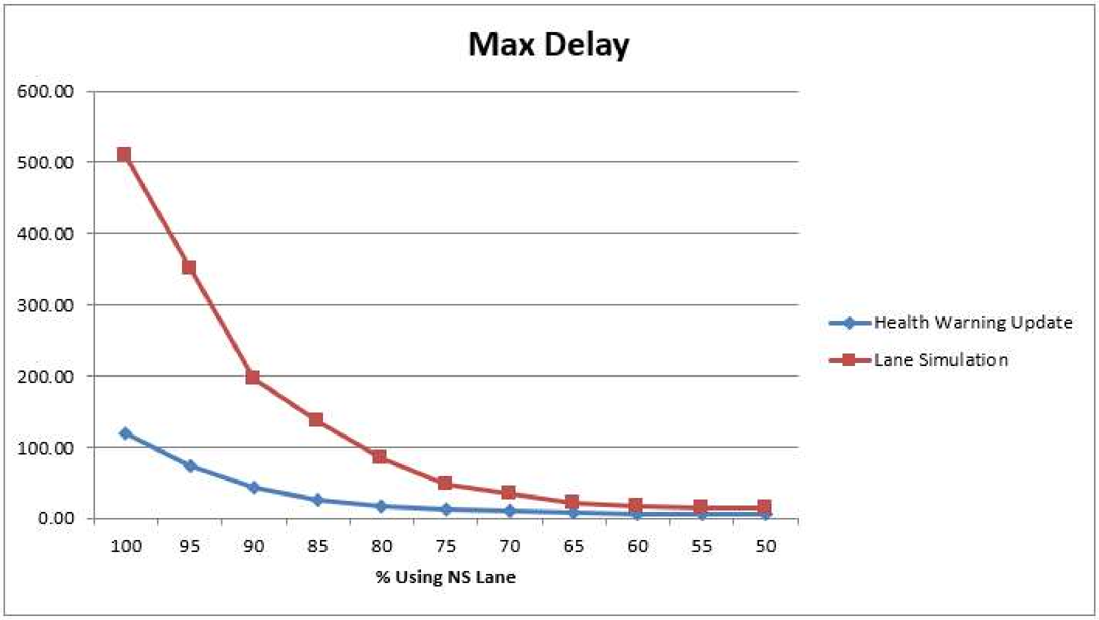


Figure 7: Capacity Adjustment versus Lane Simulation – Arm A Delay, Longer Flare

The graph shows a closer relationship between both sets of results with the increased flare length, although using Lane Simulation continued to provide longer delays, particularly where lane usage was more imbalanced. When traffic flows were balanced across both lanes, the standard ARCADY model calculated a delay of 5.64 seconds. However, Lane Simulation calculated a delay of 13.96 seconds, 148% higher than the standard model. Where 100% of traffic used the nearside lane, the capacity adjusted model predicted a delay of 120.38 seconds, whereas Lane Simulation calculated a delay of 509.06 seconds, 323% higher than the capacity adjusted model.

Figure 8 provided the queue comparison between both models.

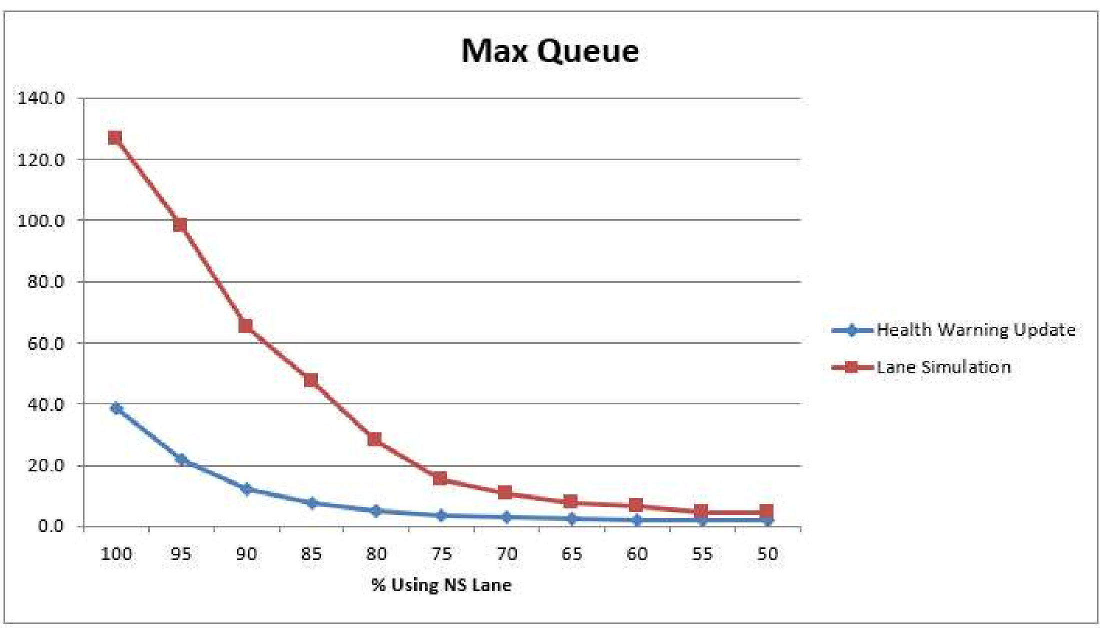


Figure 8: Capacity Adjustment versus Lane Simulation -Arm A Queue, Longer Flare

When traffic flows were balanced across both lanes, the standard ARCADY model calculated a queue of 1.7 pcus. Lane Simulation calculated a queue of 4.7 pcus, 176% higher than the standard model. Where 100% of traffic used the nearside lane, the capacity adjusted model predicted a queue of 38.8 pcus, whereas Lane Simulation calculated a queue of 126.5 pcus, 226% higher than the capacity adjusted model.

Although there was a closer match, there was still a significant difference in results with unbalanced traffic flows. This is because the Intercept of the single lane will be higher than half the Intercept of the full approach, because the full approach Intercept would be reduced due to the impact of any flare. This is taken into account using the Capacity Adjusted method, as the single lane Intercept is first calculated. The single lane Intercept is effectively the lowest Intercept that should be used, and would be used only when 100% of traffic use the busy lane. Otherwise a higher value would be used, lying between the single lane Intercept and the full approach Intercept. However, when using Lane Simulation, if 100% of traffic uses the busy lane only, it simply assumes half of the full approach Intercept. This would be too low, as the impact of any flare would have no impact on the single lane, as it would for the full approach with more balanced traffic flows. When using Lane Simulation, alternatively the capacity for each lane can be entered directly, rather than assuming a simple 50/50 split of capacity across both lanes. Although this could be applied to provide a more realistic result, it would have to be calculated independently for each flow group as variations in lane usage will impact on the capacity of each individual lane.

Modified Lane Simulation Tool and Comparison to the Capacity Adjustment Method

It was shown in the last section that results from the Lane Simulation Tool did not correspond to those from the standard ARCADY model, even when unequal lane usage did not occur. This was because the impact of the flare was effectively double counted in Lane Simulation, with the biggest differences in results occurring for shorter flare lengths. However, the differences in results were still significant for relatively long flares, especially when unequal lane usage was a factor.

Therefore, to remove double counting the impact of the flare, an alternative strategy was tested using Lane Simulation. This was to update the lane geometry to represent a full two-lane approach (i.e. increase the approach road half width to equal the entry width and reduce the effective flare length to zero). The capacity across the two lanes at the give-way line would then initially be calculated from the geometry of a 2 full lane approach, with the impact of the flare length accounted for during simulation using the lane lengths set within the Junction Diagram.

The comparison of delays on Arm A is shown in **Figure 9**, assuming the more critical short flare length. **Figure 10** compares the queue lengths.

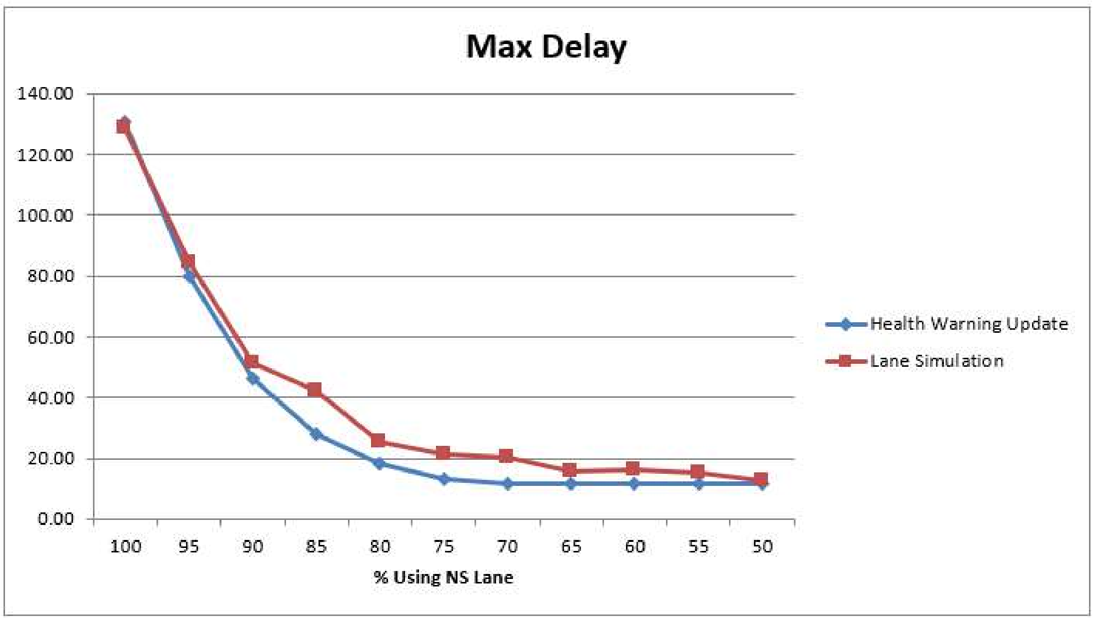


Figure 9: Capacity Adjustment versus Modified Lane Simulation – Arm A Delay, Shorter Flare

When traffic flows were balanced across both lanes, the standard ARCADY model calculated a delay of 11.79 seconds. Lane Simulation calculated a delay of 12.68 seconds, 8% higher than the standard model. Where 100% of traffic used the nearside lane, the capacity adjusted model predicted a delay of 130.85 seconds, whereas Lane Simulation calculated a delay of 128.45 seconds, 2% lower than the capacity adjusted model. Therefore, there was a good correlation between the results from both models.

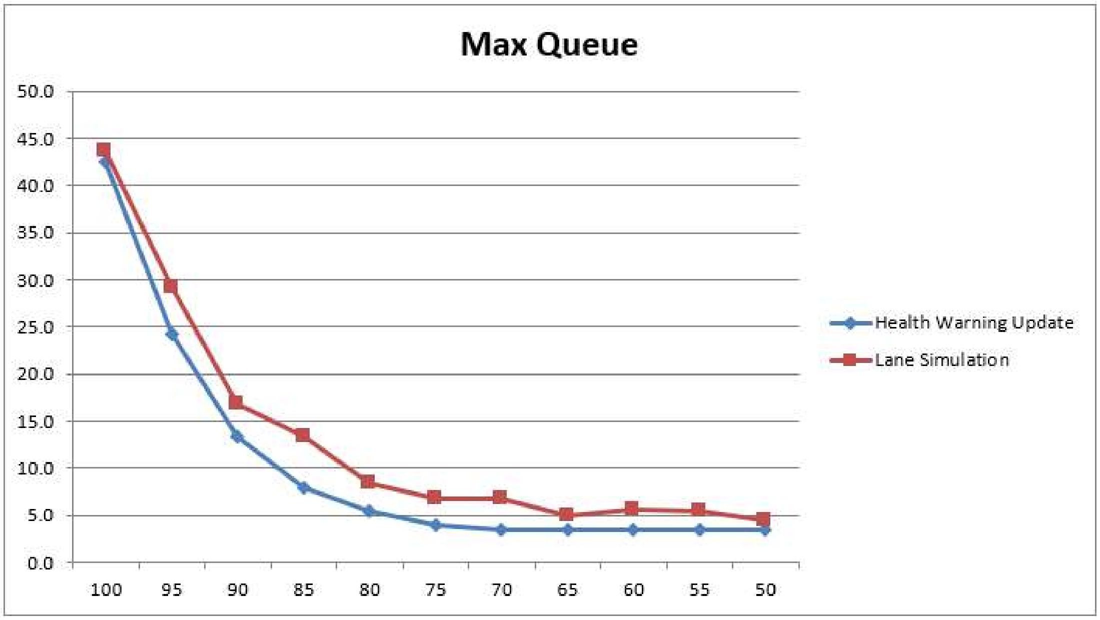


Figure 10: Capacity Adjustment versus Modified Lane Simulation – Arm A Queue, Shorter Flare

When traffic flows were balanced across both lanes, the standard ARCADY model calculated a queue of 3.5 pcus. Lane Simulation calculated a queue of 4.5 pcus, 29% higher than the standard model. Where 100% of traffic used the nearside lane, the capacity adjusted model predicted a queue of 42.6 pcus, whereas Lane Simulation calculated a queue of 43.7 pcus, 3% higher than the capacity adjusted model. Therefore, there was a good correlation between the results from both models. Although the percentage difference was higher with more evenly balanced traffic flows, this was only because the absolute queue predictions were low.

Finally, **Figures 11 and 12** provide the same results as Figures 9 and 10 respectively, but include the standard use of the Lane Simulation Tool (i.e. assuming the standard ARCADY geometry as originally tested, thus double counting the impact of the flare). This was included so that all results could be compared using the same scale in the vertical axis.

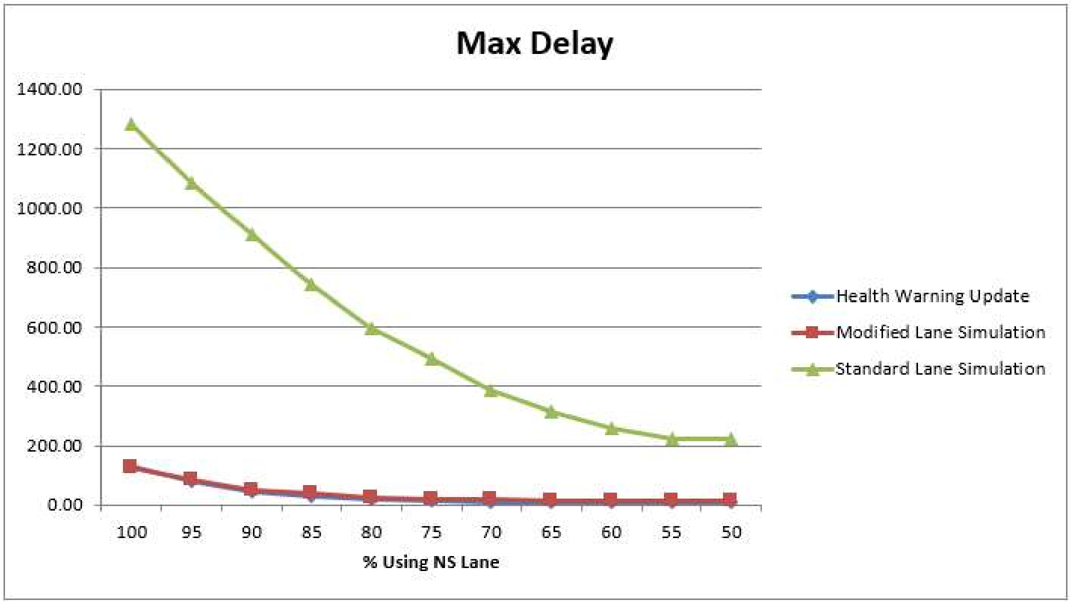


Figure 11: Capacity Adjustment versus Modified Lane Simulation versus Standard Lane Simulation – Arm A Delay, Shorter Flare

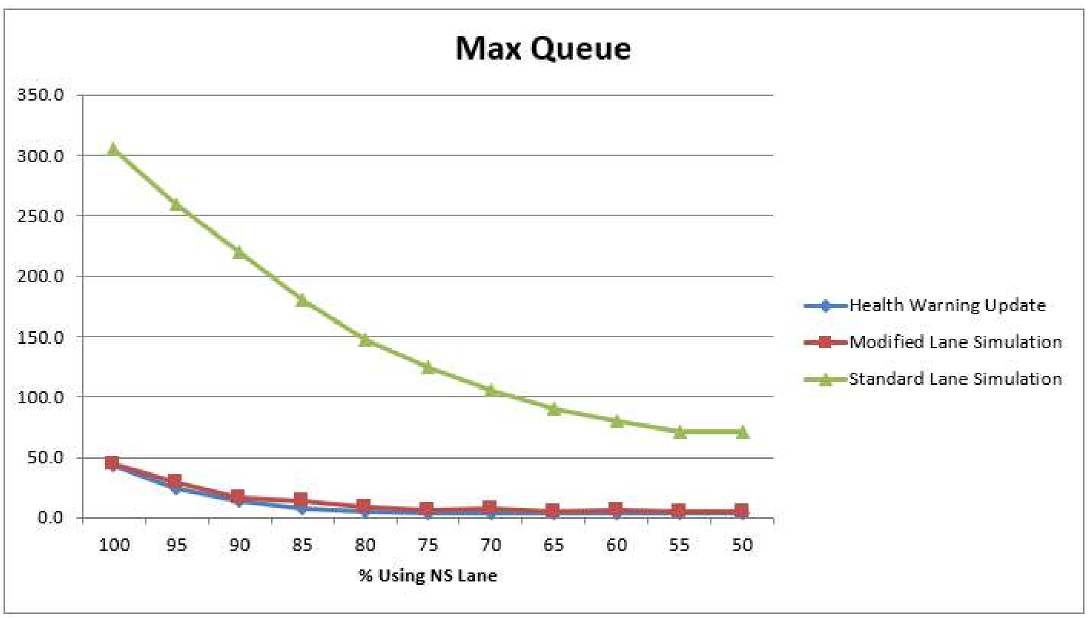


Figure 12: Capacity Adjustment versus Modified Lane Simulation versus Standard Lane Simulation – Arm A Queue, Shorter Flare

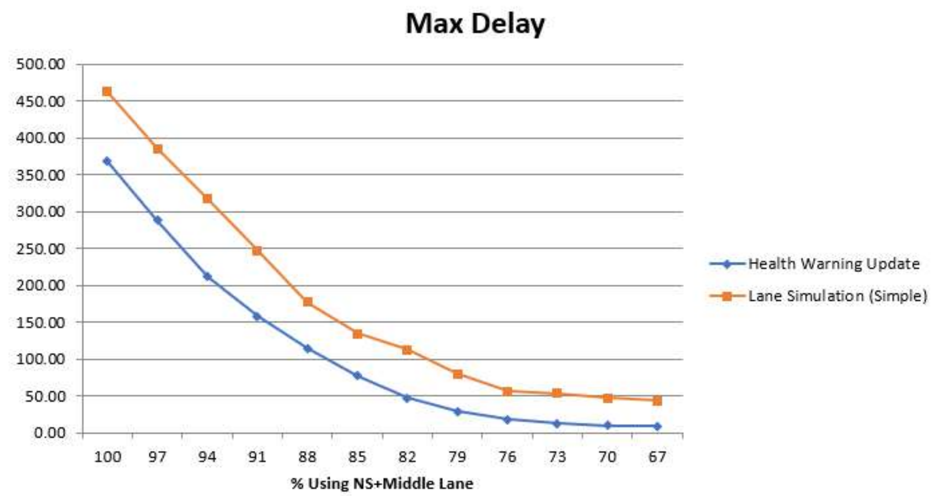
Figures 11 and 12 highlight the close relationship between the standard ARCADY model and the Lane Simulation model once the geometry is modelled to assume two full lanes. Furthermore, once unequal lane usage becomes more significant, the capacity adjustment method (Health Warning Update) also provides similar results to the modified Lane Simulation model.

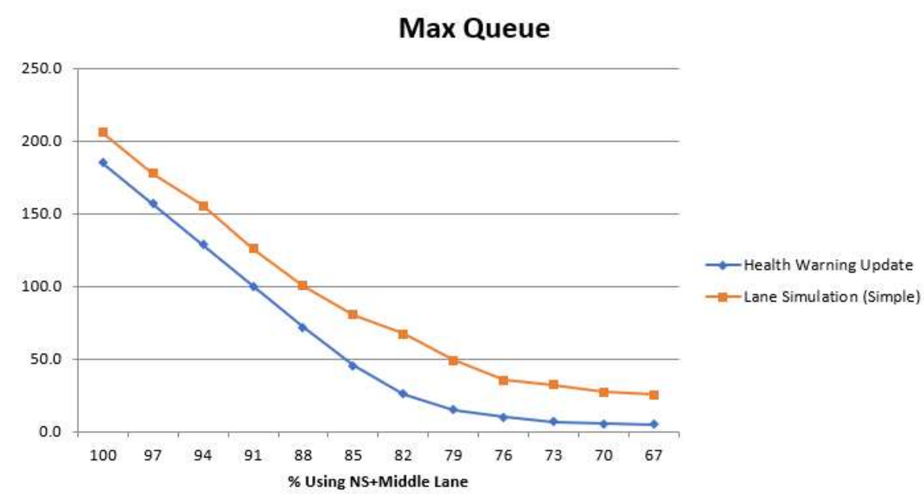
Other Examples comparing Lane Simulation with Capacity Adjustment Method

This section provides more examples, making use of models that were produced as part of Consultancy projects. Each model has been updated to allow for a variation of lane usages on a specified arm and the results compared between the capacity adjusted model and (modified) lane simulation.

Junction 1: A134 Balkerne Hill / A1124 / Southway / B1022 - Colchester

Arm:	Balkerne Hill (North)	Rbt Type:	Standard
Arm Type:	2 into 3 lane flare	Busy Lane(s):	Nearside/Middle
Flow Range:	Nearside + Middle – 100% to 67%	Capacity Adjustments:	>70%



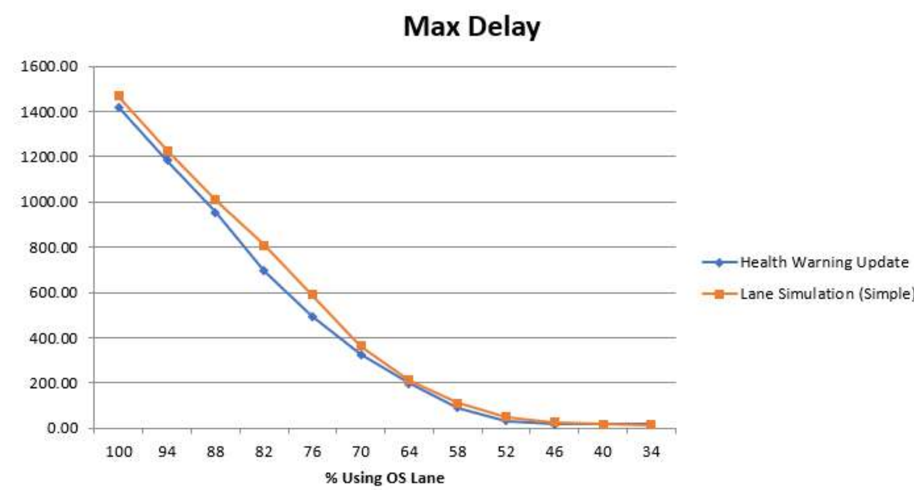


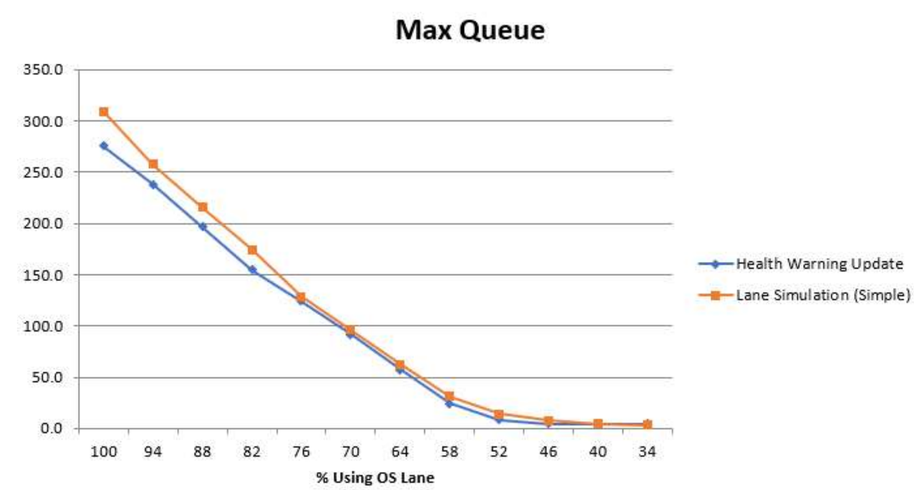
The lane simulation tool predicted higher delays and queues than the standard model with capacity adjustments, even when traffic flows were reasonably balanced across all lanes (i.e. 67% in nearside and middle lanes) and no capacity adjustments were applied to the standard model.

However, the absolute difference between queues and delay between each model were relatively consistent across all the full range of lane usage tests. There was a good correlation in how delays and queues increases as flows became more imbalanced.

Junction 2: Bearsted Rd Rbt - Maidstone

Arm:	Bearsted Rd (East)	Rbt Type:	Standard
Arm Type:	1 into 3 lane flare	Busy Lane(s):	Offside
Flow Range:	Offside – 100% to 34%	Capacity Adjustments:	>46%





There was a good correlation for delays and queues between both methods.

Conclusions

The traditional method for accounting for unequal lane usage at roundabouts was provided by Barbara Chard in the 1997 paper "ARCADY Health Warning". Although this ensured that the impact of unequal lane usage was not under-estimated in the ARCADY results, it was shown that results could be overly robust with higher circulating flows. This was due to the inability to make any adjustments to the Slope.

With the additional features that Junctions 9 (ARCADY 9) contains, the Barbara Chard method can be adapted so that higher circulating flows do not provide overly robust results. Rather than making an adjustment to the Intercept only, a full capacity adjustment can be made that is independent of circulating flows. The full capacity adjustment can be calculated once the flow group dependent Intercept is calculated using Barbara Chard's methodology.

Junctions 9 also provides the Lane Simulation Tool which can be used to test the impact of unequal lane usage. However, caution must be applied when using this. It was shown that, even when traffic flows across all lanes were relatively balanced, lane simulation provided significantly worse results in comparison to the standard ARCADY model. The reason for this was the fact that the impact of the flare was double-counted, in that it was accounted for in both the standard lane geometry and the lane length specified in each lane level used in Lane Simulation. Although the differences between Lane Simulation and the standard model were greatest with shorter flares, the difference continued to be significant for longer flares.

To avoid the double-counting of the flare in Lane Simulation, it was shown that changing the approach road half width (v) to equal the entry width (e) and changing the effective flare length (l') to zero, provided results that were more comparable to the standard ARCADY model.

A range of lane usage values were tested for several roundabouts, ranging from complete lane starvation to even balancing across all lanes. These were tested using both the Capacity Adjustment method (derived from Barbara Chard's methodology but with Capacity rather than Intercept adjustment), and the Lane Simulation Tool (where v changed to match e and l'=zero). The results showed a very good correlation between both methods.

Therefore, when accounting for unequal lane usage, using Capacity Adjustments derived using a similar process to that produced by Barbara Chard continues to provide a logical and robust assessment, without becoming overly robust at higher circulating flows. If Lane Simulation is to be used, lane geometry needs to be changed so that the impact of the flare is not double-counted. It is also recommended that when using Lane Simulation Tool, a Demand Set with balanced traffic flows across all the lanes is set up and the results compared to the standard ARCADY model. This will provide confidence that the Lane Simulation Tool is not providing radically different results to the standard ARCADY model when unequal lane usage cannot be considered the explanation.