Dunshaughlin East Strategic Housing Development

Client: Rockture 1 Limited

Traffic & Transportation Assessment & Mobility Management Plan

DUNSGEMTIA December 2018

TRAFFIC & TRANSPORTATION ASSESSMENT & MMP

Description:

Traffic & Transportation Assessment & MMP

Author:

Ben Waite

Approved By:

Christy O'Sullivan

18th December 2018

Distribution:

Matt Farrell	**Rockture 1 Limited**
Martin Healy	**Rockture 1 Limited**
Paul Turley	**JSA**

ILTP
Head Office:
St. Albert's House
Dunboyne
Co. Meath
tel: 01-8255700
fax: 01-8255730
info@iltp.ie
www.iltp.ie

TRAFFIC & TRANSPORTATION ASSESSMENT & MMP

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1 INTRODUCTION

1.1 Purpose of Report

1.1.1 ILTP Consulting were engaged by Rockture 1 Limited to carry out a Traffic and Transport Assessment (TTA) and Mobility Management Plan (MMP) on the proposed Dunshaughlin East SHD residential housing and neighbourhood centre development in Dunshaughlin, Co. Meath.

1.1.2 The proposed scheme follows on from previously permitted development on the lands and a current live planning application. The overall proposed SHD layout therefore has full regard to these existing and proposed developments to ensure a fully integrated and sustainable development.

1.1.3 Phase 1A (planning ref. DA060537 as amended by planning ref. DA/130709), has been partly implemented and is under construction.

1.1.4 Phase 1B of the development was also recently permitted as planning ref RA/170407 and included permission for a new priority junction off the R147 and construction of a new access road. The 92 no. dwellings permitted as part of Phase 1B have also been included in the assessment.

1.1.5 The Phase 1C development, also recently permitted, (planning ref. RA171416) provides for 96 no. residential units and also includes the construction of a Childcare Facility with a GFA of 520sq.m. This facility will cater for between 130 and 170 children which will require up to 16 staff. A new access to serve this childcare facility is also proposed which allows for future access to lands to the north currently zoned for employment uses.

1.1.6 It should be noted that the applicant is in discussion with the Department of Education and Skills (DEPS) to facilitate the development of an education campus on these lands and Heads of Agreement are already in place between the parties. The delivery of an education campus on these lands would represent a very significant improvement to the overall development of the area. It would also ensure that the proposed SHD development would have very convenient education facilities immediately accessible by foot or bike from the SHD lands, which would reduce further the traffic generated by the proposed SHD development.

1.1.7 Figure 1.1 shows the development site location. The proposed development forms a natural extension to the existing urban area of Dunshaughlin.

1.1.8 Proposed SHD Development

1.1.9 It is proposed to construct 913 no. dwellings on the site, ranging in size from 4 bed to 2 bed units. Figure 1.1 shows the location of the proposed development.

1.1.10 The breakdown of unit types proposed is as follows:

- 505 no. Houses
- 186 no. Duplexes
- 222 no. Apartments

1.1.11 It is also proposed to construct of a new Neighbourhood Centre, which will include retail, community, childcare, healthcare and other facilities.

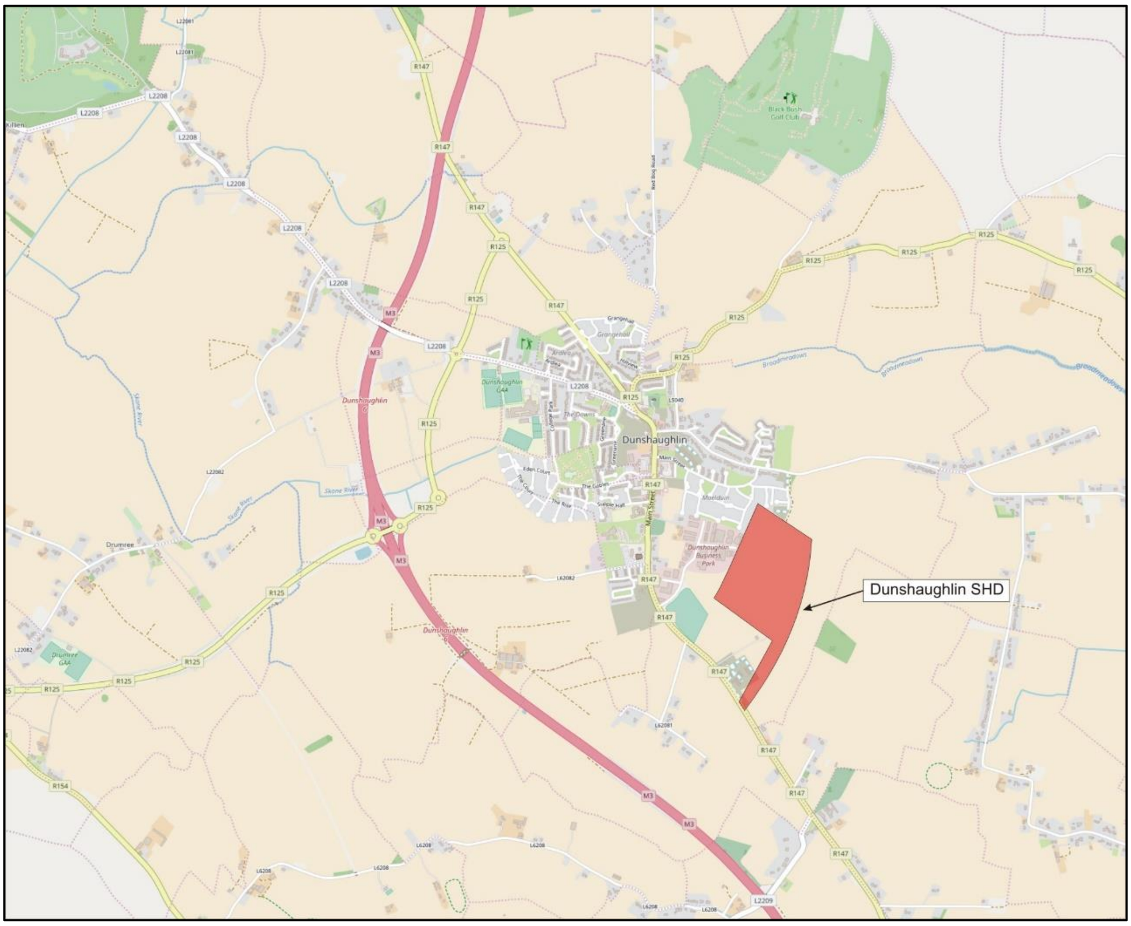


Figure 1.1: Development Site Location

1.2 Consultations with MCC

1.2.1 ILTP and the design team were in ongoing engagement with MCC on the proposed development and attended a number of meetings to discuss the overall TTA and wider traffic issues and overall design concepts. The overall approach was to ensure that the proposed SHD development forms a logical and natural extension to Dunshaughlin.

1.3 Overall Design Approach

1.3.1 Central to the overall design approach is to ensure that walking and cycling linkages are given the highest priority by ensuring high level of permeability and accessibility. In addition, all the roads and streets within the SHD development will be designed to 30kph speed limits and in accordance with DMURS guidelines.

1.3.2 Improving accessibility to existing public transport (PT) is also a major priority as is the need to provide for future PT facilities.

1.3.3 The overall design had full regard to the following range of design guidance documents to ensure that all design aspects of the scheme accorded with best practice:

- Design Standards for Urban Roads and Street – (DTTAS 2013)
- National Cycle Manual

- Traffic Management Guidelines (DoELG, DoT and DTO 2003)
- Manual for Streets – (DfT (UK) 2007)
- TII Design Geometry Standards

1.4 Layout of the Report

1.4.1 Chapter 2 contains the DMURS Compliance Statement and outlies the overall design response to the ABP Opinion. This gives an overall context to the remainder of the TTA, and the design statement is fully reflected in the final design layouts.

1.4.2 Chapter 3 provides information on relevant transport and planning policy context.

1.4.3 The proposed development is discussed in Chapter 4.

1.4.4 Chapter 5 provides details of site visits and traffic data collection.

1.4.5 Chapter 6 contains the Traffic Impact Assessment.

1.4.6 Chapter 7 contains the Mobility Management Plan for proposed development.

1.4.7 The Summary and Conclusions of this report are in Chapter 8.

2 STATEMENT ON DMURS COMPLIANCE, CYCLE MANUAL COMPLIANCE AND RESPONSE TO ABP OPINION - MOVEMENT AND TRANSPORTATION ITEMS

2.1 Overview

2.1.1 This section includes compliance statements for the proposed development in relation to:

- *Design Manual for Urban Roads and Streets* (DMURS)
- *National Cycle Manual*

2.1.2 This section also addresses the relevant Transportation issues raised in the An Bord Pleanála *Notice of Pre-Application Consultation Opinion*, dated 27th April 2018, of case reference ABP-301099-18.

2.2 DMURS Compliance

2.2.1 In developing the overall scheme ILTP had full regard to the principles as set out in the *Design Manual for Roads and Streets* (DMURS), 2013 and the *National Cycle Manual*, 2012. The final scheme design proposals are an outcome of an integrated design approach that ensure the promotion of sustainable travel modes are integrated into the overall design layout. The overall design approach sought to firstly ensure that regard was given to user priorities and subsequently to developing a street hierarchy that reinforces the overall user priority as set out in DMURS and ensuring permeability and legibility. The orderly integration of the development to the existing urban area and planned employment area was also promoted through the provision of appropriate pedestrian and cycle linkages to the town centre, adjacent residential areas and to the planned recreational and employment facilities and future education campus. The proposed development also provides direct linkage to the existing high frequency public transport (PT) network that currently serves Dunshaughlin and the wider community. This has resulted in an exemplar development that is fully consistent with the principles as set out in DMURS and the *National Cycle Manual*.

2.3 Design Approach – User Hierarchy

2.3.1 The overall design approach was fully informed by the principles as set out in DMURS. Table 2.21 of DMURS, titled *'User hierarchy that promotes and prioritises sustainable forms of transport,* reproduced as Figure 2.1, has significantly informed the design approach, which places the needs of pedestrians and cyclists at the highest order of priority amongst road users.

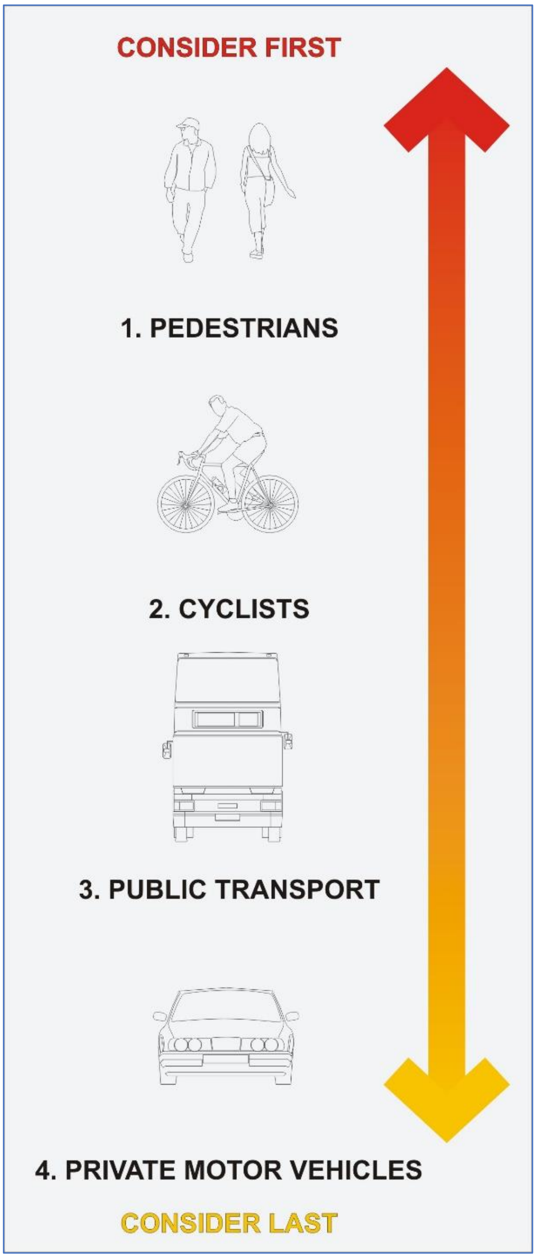


Figure 2.1 User Priorities (Source: DMURS Table 2.21)

2.3.2 The design approach therefore puts pedestrians and cyclists at the top of the user priorities, followed by access to public transport and then access to the wider road network via a street hierarchy consistent with those set out in DMURS.

2.4 Permeability, Sustainable Transport and DMURS Compliance

2.4.1 Central to the overall design approach is the need to ensure that pedestrians and cyclists are given the higher priority and more direct linkage than the private car. The proposed cycle and pedestrian networks seek to give excellent connectivity to the existing town centre and proposed neighbourhood centre to ensure that all local trips can be made using these sustainable travel modes.

2.4.2 These proposed routes will also link directly to an existing residential development to the north and permitted development to the south of the subject lands. It is also proposed to provide linkage to the planned education campus to the west as well as to planned employment lands to the east of the development. These routes will also provide excellent links to planned playing fields to the east of the site and to the existing public transport facilities to the south of the development.

2.4.3 The overall proposed development therefore will accord with best practice as set out in DMURS in terms of permeability and sustainability.

2.4.4 The portion of the primary vehicle access link road included in the SHD application will include for the future provision of bus services along this link road, with bus stops and lay-bys provided. These will be appropriately located close to the proposed new residential development and neighbourhood centre. They can also serve the future planned playing pitches and zoned employment lands to the east. Therefore, full regard will be given to the sustainable development of the wider area.

2.5 Proposed Street Hierarchy for SHD Development with regard to Permeability

2.5.1 The drawing shown in Figure 1.2 demonstrates that the proposed development will firstly ensure that there are good pedestrian and cycle linkages within the proposed SHD development and that linkage is also provided to the existing town centre and to surrounding schools, open space and recreational facilities and to existing and future employment lands.

2.5.2 The entire SHD development will be within a 30kph Slow Zone. The proposed development also includes for a number of Home Zones, where pedestrians and cyclists are given priority over motorised traffic.

2.5.3 The street hierarchy is shown in Figure 2.2. This shows a series of Home Zones, where only local traffic is accommodated. These Home Zones are connected to the Central Boulevard (a Link Street) via a number of Local Streets.

2.5.4 As shown in Figure 2.2, the Central Boulevard (Link Street) will provide a high-quality street linking the planned residential development to the planned Neighbourhood Centre and the high capacity bus route that runs along the R147.

2.5.5 A planned Arterial Route for the development, referred to as the Dunshaughlin Outer Relief Road (DORR), is a CDP objective and forms the eastern boundary to the SHD lands. This Arterial Route provides access to the SHD lands and also allows for the completion of the road which will link the Lagore Road to the R147. This Arterial Route also provides an access point to the Central Boulevard. The Arterial Route includes a central roundabout that signifies the vehicular access to the Neighbourhood Centre and to provide a future link to planned recreation and employment lands to the east.

2.5.6 In addition, there is an extensive greenway network catering for cycle and pedestrian only route. The one along the west of the proposed development, which is in a woodland setting, also provides linkage to the existing residential development to the north and the R147 to the south. The east west greenway links the neighbourhood centre and continues eastward to provide future linkage to planned future recreational and employment development lands to the east of the arterial road and to the future education campus planned to the west of the site.

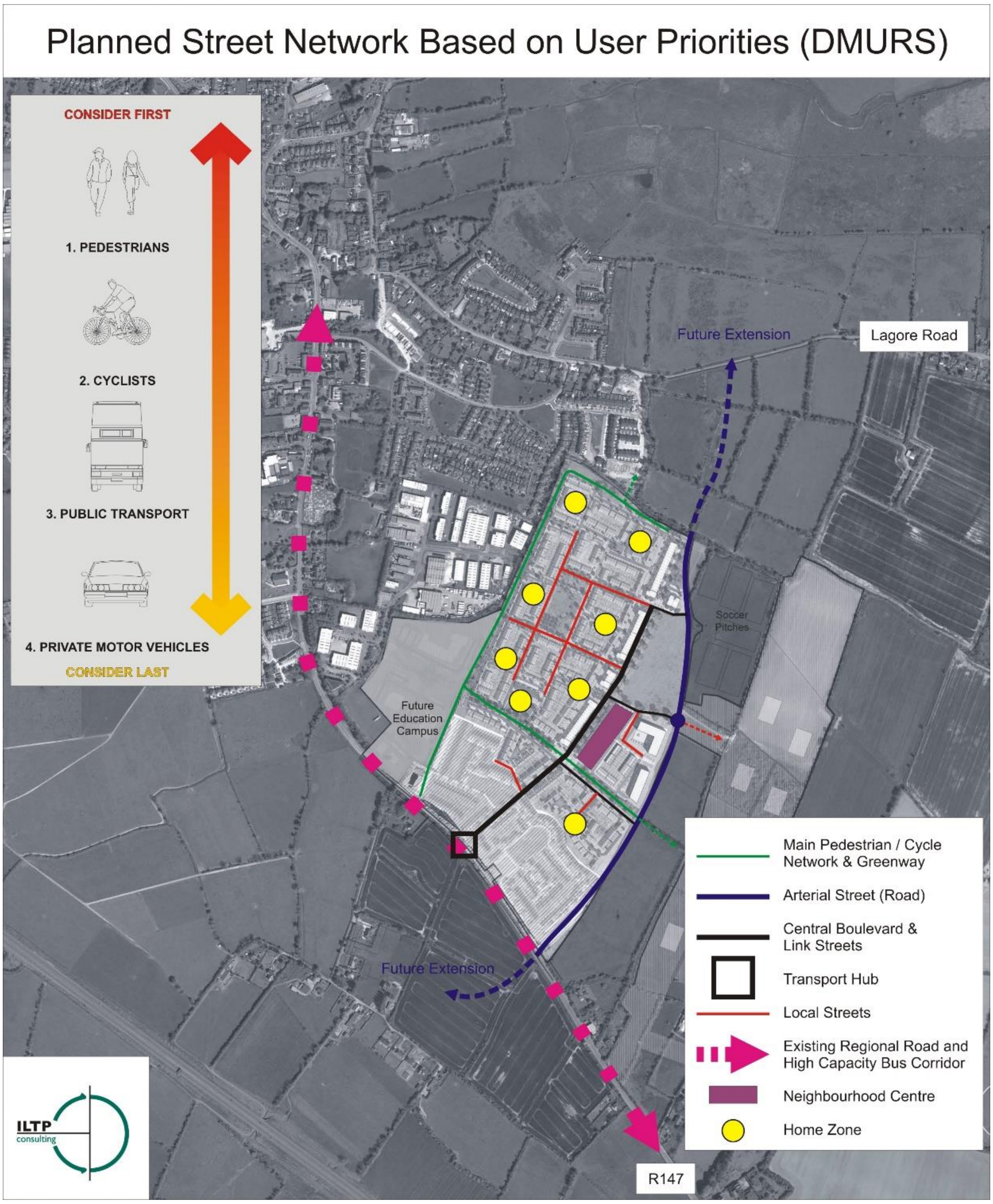


Figure 2.2 Proposed Greenways and Street Hierarchy

2.5.7 The Arterial Street (Road) joins the R147 Regional Road and High Capacity Bus Corridor to the south. The Arterial Route is part of a planned CDP road network that links with other planned link to residential zoned lands to the north and employment and education lands to the south.

2.5.8 In addition, the internal road layouts were developed in a manner that puts the car at a lower order within the overall development. This was achieved by ensuring the vehicle access points are separate from the main pedestrian and cycle routes where feasible. While the pedestrian and cycle routes provide direct linkage to all major destinations, it is proposed that car traffic will be required to take more circuitous routes to key focal points within the development. This design approach is fully in accordance with the principles set out in DMURS, but more importantly will actively promote the use of the more sustainable travel modes.

2.6 Passive Surveillance

2.6.1 A fundamental feature of the proposed development is the overlooking of the front access of residential properties onto all key pedestrian and cycle routes (green routes) and open spaces. This includes the main pedestrian and cycle route linking to Dunshaughlin town centre. This ensures a high level of passive surveillance of pedestrian and cycle movement throughout the development, which will promote a high uptake of such modes of travel.

2.6.2 In addition, the development includes the core Neighbourhood Centre and higher density residential development along the primary internal boulevard route which links to the proposed transport hub on the R147.

2.7 Proposed Cross Section of Streets DMURS Compliant

2.7.1 The proposed cross sections of the various streets within the SHD development are shown in Figure 2.3.

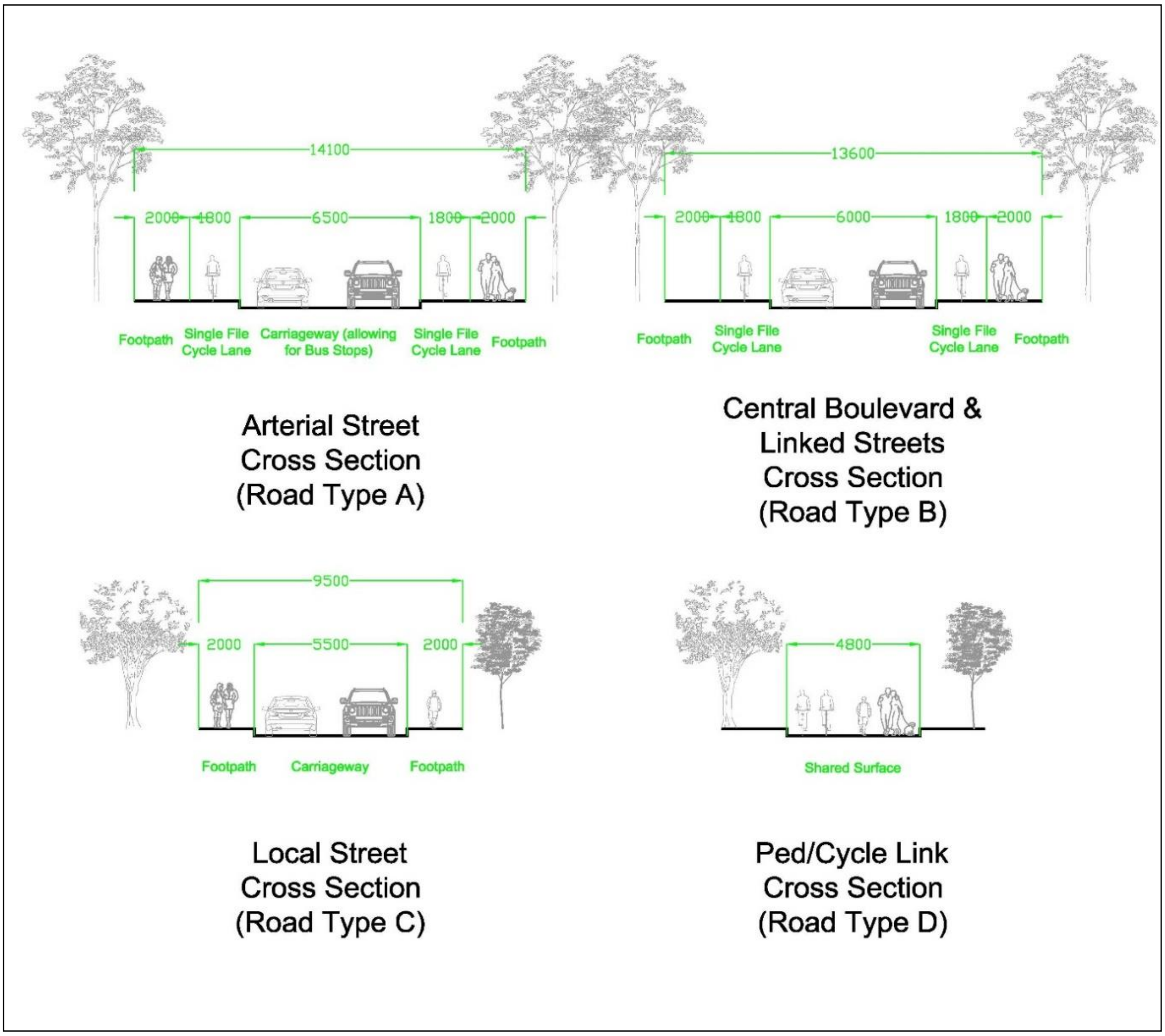


Figure 2.3: Proposed Cross Sections of Various Streets within SHD Development

2.7.2 The proposed street cross sections fully accord with DMURS.

2.8 Access to Public Transport

2.8.1 A Quality Bus Corridor has been provided along the R147 on the approach to Dunshaughlin from both the Dublin and Navan sides since the completion of the M3 motorway. This allows buses and other sustainable transport modes to pass through the town quickly during peak hours. The available public transport will ensure a modal shift towards bus transport and ensure that reliable bus services will continue to serve Dunshaughlin.

2.8.2 The frequency of these bus services ranges from 1 bus per hour off peak to 1 bus every 10 minutes during the AM peak period, as shown in Table 2.1. The 10-minute bus frequencies along the R147 at peak periods represent a very high frequency public transport service and one that can support sustainable new development.

Table 2.1: Existing Bus Frequency Serving Proposed Development

		Frequency		
Route No.	**Overview**	**Off-Peak**	**AM Peak**	**PM Peak**
109	Dublin - Dunshaughlin - Navan - Kells	1 hour	10 mins	20 mins
109A	Dublin Airport/City Centre - Ashbourne - Ratoath - Dunshaughlin - Navan - Kells	1 hour	1 hour	1 hour
109B	Dublin - Dunshaughlin - Kilmessan - Trim	2 hours	2 hours	2 hours
Sillan Coaches	Dublin - Dunshaughlin - Navan - Cootehill	4 6	Inbound Outbound	AM PM

2.8.3 The proposed SHD site is also located approximately 7.5km from the M3 Parkway railway station, where there are in excess of 1,300 Park & Ride spaces available and where there is considerable existing capacity reserves available.

2.8.4 The proposed SHD development links to this high capacity network via the adjacent permitted development, which is within the applicant ownership.

2.8.5 The locations of the existing public transport services relative to the subject lands are shown in Figure 2.4.

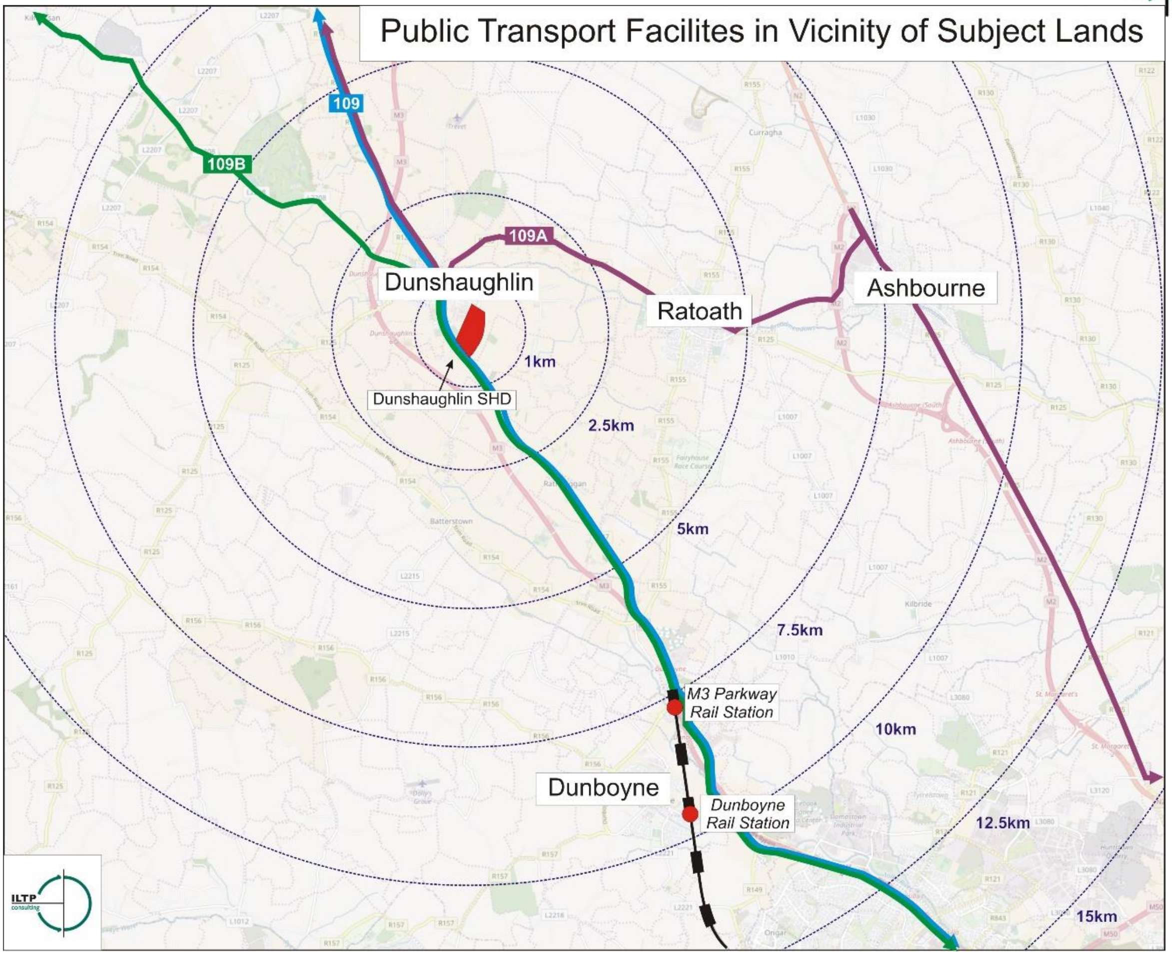


Figure 2.4: Proximity of Subject Lands to Public Transport Services

2.8.6 The existing high capacity bus routes that run along the R147 provide an opportunity for good access from the SHD lands to this important bus corridor, which links Dunshaughlin to Navan, Trim, and Dublin Airport. It also provides public transport access to the Pace Rail line and to major employment centres in south east Meath and the Dublin Enterprise Zone (Damastown).

2.8.7 In addition, bus laybys an bus stops are proposed along the R147 Quality Bus Corridor, where the Centre Boulevard (Linked Street) terminates (see Figure 1.5). The section of the Arterial Road within the SHD also has provision for future bus facilities and could in time support a local bus service for the town.

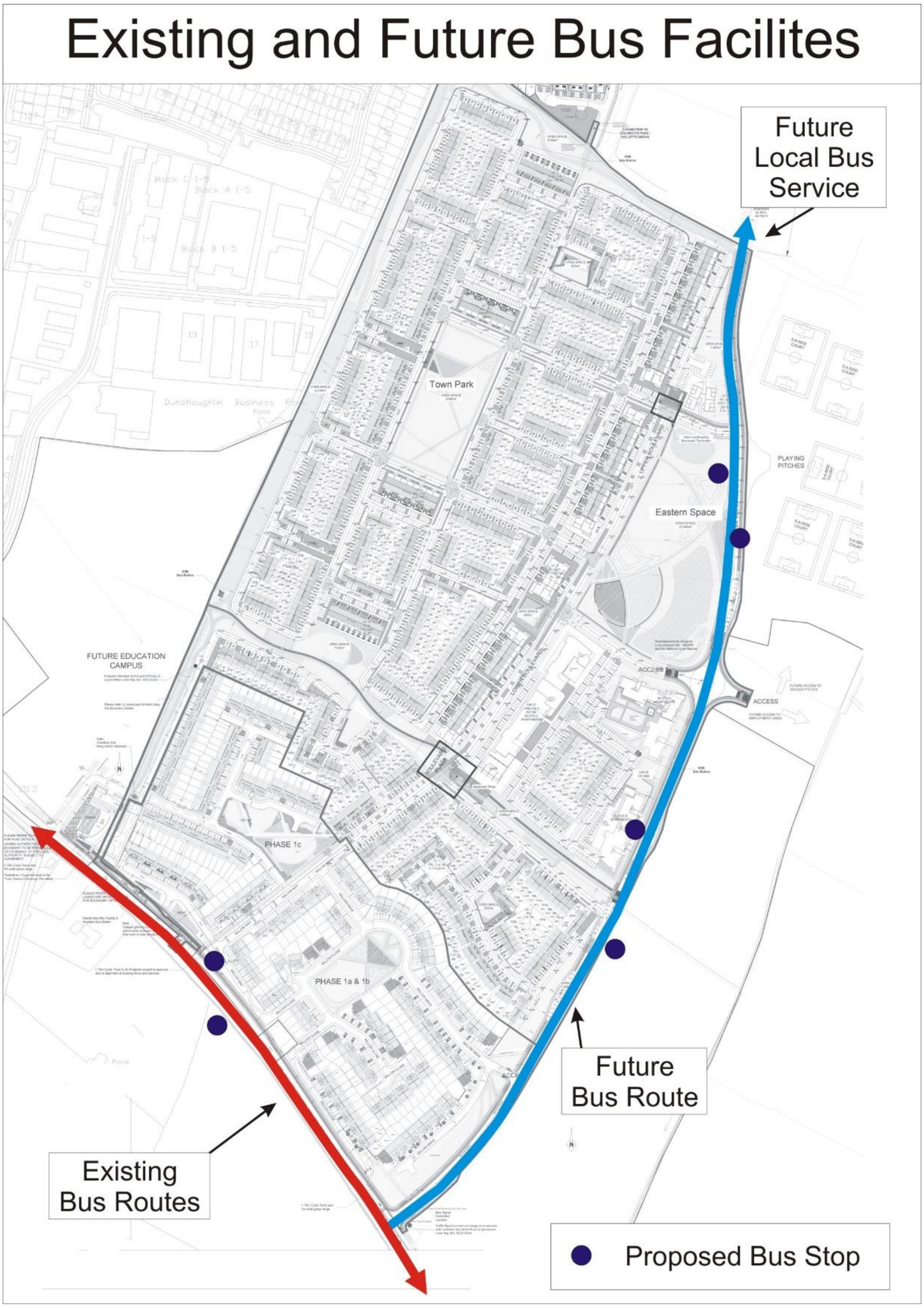


Figure 2.5: Existing and Future Bus Facilities

2.9 Wider Connectivity and Sustainable Travel

2.9.1 The overall proposed SHD development forms a natural extension to the urban area of Dunshaughlin as illustrated in Figure 2.6.

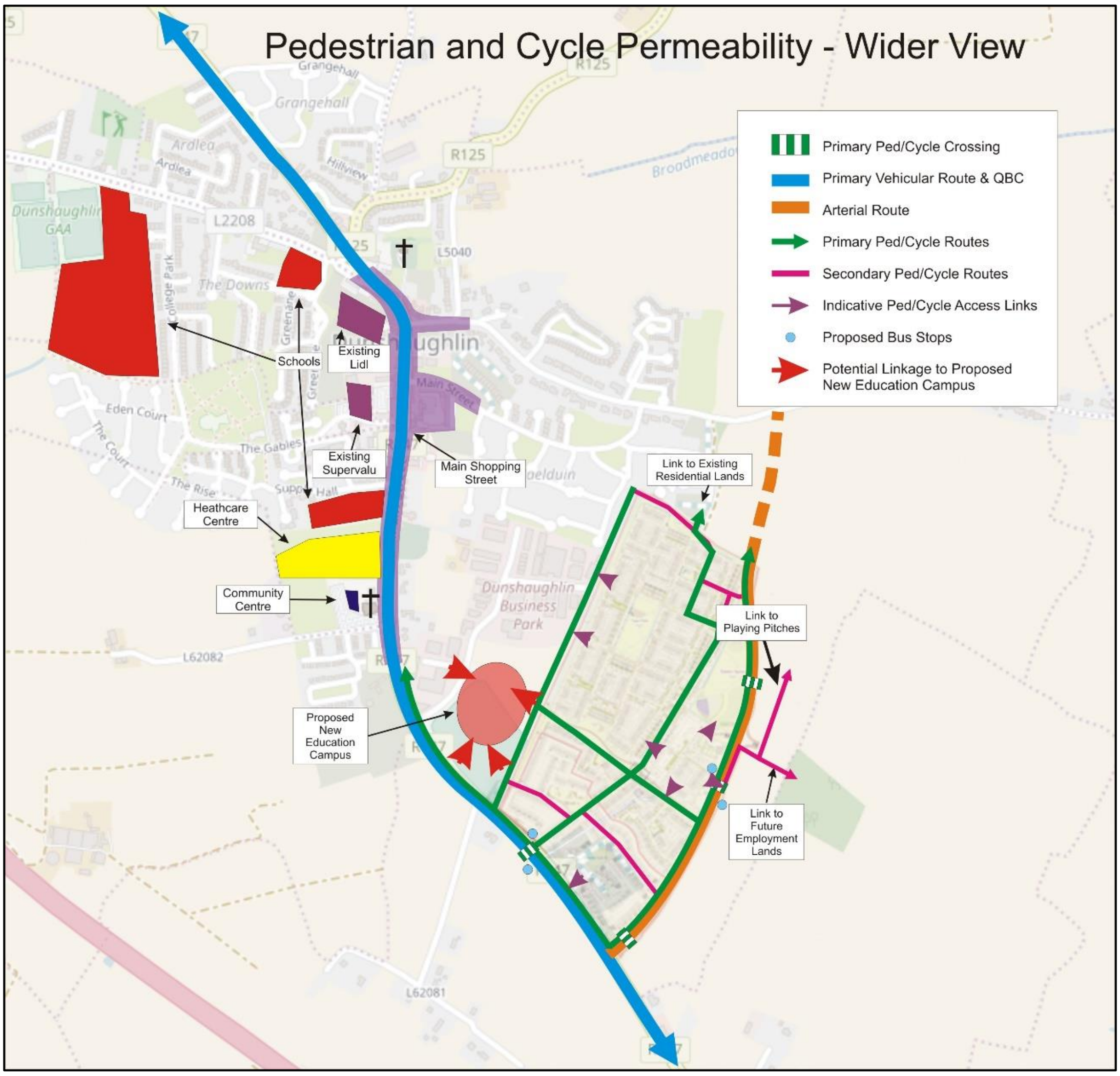


Figure 2.6 Wider SHD Context and Connectivity

2.9.2 The overall development links effortlessly to the existing town centre and to major destinations within the town. Again, the priority was to afford excellent dedicated cycle and pedestrian linkages to the town centre which in turn also connect with other planned and future development surrounding the SHD lands. The overall design philosophy to promote sustainable travel mode by first encouraging and promoting greater use of non-motorised trips, followed by excellent access to existing and future public transport link that serve Dunshaughlin, has been achieved through the design process through having full regard for the DMURS principles.

2.10 DMURS Compliance Summary

2.10.1 The proposed Dunshaughlin East SHD development is an exemplar of good design practice that fully promote the sustainable transport principles as set out in DMURS. The design process commenced with establishing User Priorities in accordance with DMURS. This was followed by developing a permeable and legible street layout and street hierarchy that minimises car traffic movement in the residential areas and provides excellent pedestrian and cycle linkages to the town centre, adjacent residential development, planned recreational areas and employment area. Direct cycle and pedestrian linkages are also provided to the high frequency bus services that already serve Dunshaughlin.

2.10.2 ILTP would commend the overall design approach as one that is fully in keeping with the DMURS principles and is an exemplar of a residential development that is appropriately integrated into the existing and planned urban fabric of Dunshaughlin.

2.11 National Cycle Manual Compliance

2.11.1 In developing the overall scheme ILTP had full regard to the principles as set out in the *National Cycle Manual*. First and foremost, the design proposals acknowledge the vulnerability of cyclists relative to motorised modes of transport as set out in the National Cycle Manual. The proposals therefore seek to ensure that cyclists generally have higher priority in accessibility and connectivity throughout the development.

2.11.2 The specific measures proposed to prioritise and facilitate safe, comfortable and efficient cycle movement in accordance with the National Cycle Manual include:

- The extensive cycle networks proposed provide a high level of connectivity throughout the proposed development.
- A low-speed environment is proposed throughout, including 50kph speed limit on main Arterial road and 30kph on other roads throughout the development.
- Inclusion of shared Home Zones throughout residential areas to prioritise movement of more vulnerable road users and reduce speed of motorised traffic.
- As also set out above, the proposed cycle network facilitates direct linkages to both existing and future employment lands, future education campus and to nearby amenities.
- Extensive greenway network proposed catering for cycle and pedestrian movement only. This includes a greenway link to the west of the development and an east-west greenway linking the existing town centre and future education campus to the neighbourhood centre which continues eastward to provide future linkage to planned future recreational and employment development lands to the east of the arterial road.
- Full visibility to be maintained at all junctions, with road user priority clearly established at potential conflict points. This includes use of 'Shared Surface' signage and road markings, Toucan crossings and segregated cycle lanes.

2.11.3 A sample detail that has been adopted from the *National Cycle Manual* is along the main Arterial Route to the east of the subject lands linking to the R147. This includes dedicated cycle tracks with cycle priority provided across junctions as shown in Figure 2.7.

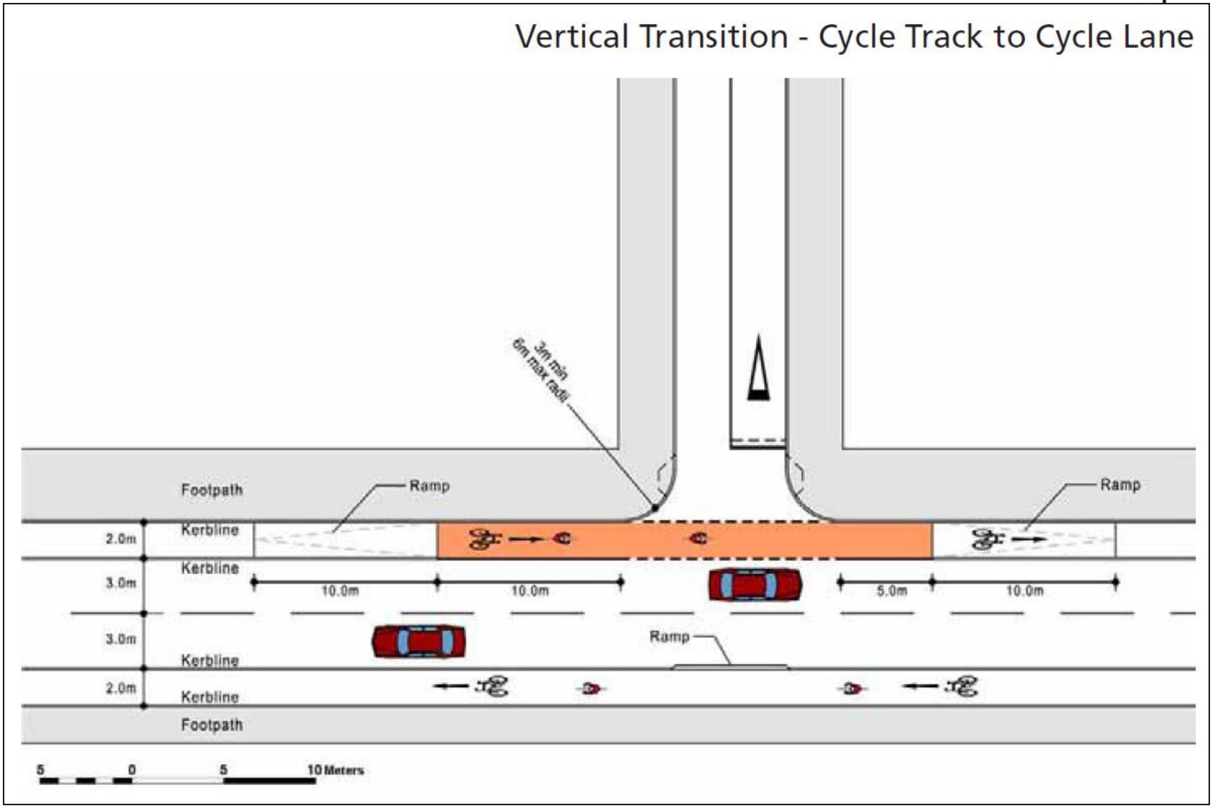


Figure 2.7 Sample *National Cycle Manual* Detail Establishing Cycle Priority across Junctions

2.11.4 The proposed cycle infrastructure set out in accordance with the *National Cycle Manual* are also to be subject to Road Safety and Accessibility Audits at Detailed Design and Post-Construction stages. The audit process emphasises safety and accessibility for vulnerable road users, including cyclists.

2.12 Incorporation of DMURS and National Cycle Manual into Overall Development

2.12.1 These DMRUS and *National Cycle Manual* principles were fully integrated into the overall SHD masterplan layout as illustrated in Figure 2.8.

Figure 2.8 Proposed SHD Development Masterplan Layout (Source: MCORM)

2.13 Complimentary Mobility Management Measures

2.13.1 Establishing sustainable travel patterns from the outset in a new development is essential. It is well recognised that achieving subsequent changes to more sustainable travel is both difficult and costly to implement and can take years to achieve. The promotion of travel mode change in favour of sustainable modes (walking and cycling) and greater PT usage is a long-standing policy objective at national and local level. However, in most areas, other than city centre locations, the outcomes have generally been disappointing as evidenced by the resent CSO data. Dunshaughlin and the proposed SHD development are fortunate to be able to link into the very good PT services already available and also to make provision for future bus routes for the town.

2.13.2 Mobility Management Plans are a transport demand management mechanism that aim to provide for the transport needs of people and goods. Mobility Management Plans seek to lessen the demand for the use of cars by increasing the attractiveness and practicality of other modes of transport.

2.13.3 The MMP sets out the complimentary measures that will support the DMURS design philosophy that underpins the overall design of the development

2.14 ABP Pre-Application Consultation Item 2 – Masterplan and Development Strategy

2.14.1 An Bord Pleanála Item 2 – 'Masterplan and development strategy' of the *Notice of Pre-Application Consultation Opinion*, dated 27th April 2018, for case reference ABP-301099-18, states:

> *"Further consideration and/or justification of the documents as they relate to the overall masterplan and development strategy of the site, which has regard to inter alia the specific site characteristics of the development lands including the existing permitted developments within the applicant's landholding contiguous to the site; access and linkages to the open space and employment generating lands within the applicants ownership which are contiguous to the development site; the 12 criteria set out in the Urban Design Manual which accompanies the Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas and the Principles of the Design Manual for Urban Roads and Streets.*
>
> *Further consideration of the overall development strategy should address the street hierarchy and how it is proposed to create a sense of place and a discernible focal point within the overall scheme. Further elaboration including illustrations of how the site analysis / context informed the proposed layout and urban design response would be useful. Further consideration of these issues may require an amendment to the documents and/or design proposal submitted."*

2.15 Summary Response to ABP Pre-Application Consultation Item 2 – Masterplan and Development Strategy

2.15.1 The above compliance statements set out the rationale, consideration and justification of the design proposals relating to high quality access and linkages to the open space and employment generating lands within the applicant's ownership and also to the principles of the design relating to the *Design Manual for Urban Roads and Streets* (DMURS) and *National Cycle Manual*.

2.15.2 The above compliance statements also set out the basis for establishing the proposed road and street hierarchy to ensure highest priority is given to pedestrians and cyclists, followed by public transport, and lastly the private car.

2.15.3 Other urban design principles are addressed under separate cover.

2.16 ABP Pre-Application Consultation Item 3 – Movement and Transportation

2.16.1 An Bord Pleanála Item 3 – 'Movement and Transportation' of the *Notice of Pre-Application Consultation Opinion*, dated 27th April 2018, for case reference ABP-301099-18, states:

> *"Further consideration and/or justification of the documents as they relate to the delivery and phasing of the Dunshaughlin Outer relief road including how this road and the proposed access arrangements are consistent with the principles of the Design Manual for Urban Roads and Streets.*
>
> *Further consideration should also be given to the documents as they relate to vehicular, cycle and pedestrian connections and permeability through the site to contiguous residential, open space and employment generating lands and connections from the development site to the urban centre of Dunshaughlin including consideration of passive surveillance. Further Consideration of this issue may require an amendment to the documents and or design proposal submitted."*

2.17 Summary Response to ABP Pre-Application Consultation Item 3 – Movement and Transportation

2.17.1 It is proposed that the development will be delivered in three phases, which have been set out on the accompanying phasing drawing prepared by MCORM.

2.17.2 The first phase of development provides for the delivery of 369 no. residential units comprising of a mix of houses, apartments and duplex units, along with the largest area of open space in the east of the site, three pocket parks, the neighbourhood centre facilities within the development, and the east-west portion of the greenway. This first phase of development will also provide the majority of the extent of the Outer Relief Road along the eastern boundary of the site.

2.17.3 The second phase of development also provides for a mix of residential typologies, totalling 337 no. units., along with areas of open space including the town park, and the remaining extent of the greenway along the western and northern boundaries of the site. The second phase of development will also provide the link to the Kellet's Grove residential area to the north.

2.17.4 The final phase of development provides for 207 no. residential units, which also includes a broad range of sizes and typologies. This final phase will also see the completion of the stretch of the Outer Relief Road to the boundary of the applicant's landholding, with the remainder to be provided by way of a Part 8 development by the Local Authority.

2.17.5 As part of the pre-planning consultation with MCC the applicant has agreed to facilitate the construction of the Outer Relief Road within their land boundary following the approval of the SHD application. This will enable MCC to deliver the full section of the DORR from the R147 to Lagore Road via a Part 8 development at an earlier stage if they so wish.

2.17.6 The proposed Outer Relief Road within the applicant's landholding, as set out in JOR Consulting Engineers drawings, is in full compliance with DMURS and the National Cycle Manual. This includes providing dedicated and segregated pedestrian and cycle track facilities, providing dedicated ped and cycle crossings at junctions, and giving cyclists priority over vehicles at junctions where possible.

2.17.7 The above compliance statements also set out the rationale and justification of the vehicular, cycle and pedestrian connections proposed, and the excellent permeability to be provided through the site to contiguous residential, open space and employment generating lands and connections from the development site to Dunshaughlin town centre. The passive surveillance aspects of the proposed development are addressed above in the DMURS Compliance Statement.

3 REVIEW OF RELEVANT TRANSPORT AND PLANNING POLICY

3.1 Relevant Planning Context

3.1.1 This study is being prepared taking into account the following policy documents:

- *Project Ireland 2040 – National Planning Framework*
- *Smarter Travel - A Sustainable Transport Future 2009 -2020*
- *Greater Dublin Area Transport Strategy 2011 – 2030 (NTA)*
- *Integrated Implementation Plan 2013 – 2018 (NTA)*
- *Regional Planning Guidelines Greater Dublin Area 2010 – 2022*
- *Greater Dublin Area Cycle Network Plan (NTA)*
- *Meath County Development Plan 2013 - 2019*

3.2 Project Ireland 2040

3.2.1 This national policy sets out an overall strategy that will guide the orderly sustainable growth and development of the state over the coming decades.

3.3 Smarter Travel 2009 - 2020

3.3.1 At the national level the most relevant Land Use and Transport Policy Document is *Smarter Travel A Sustainable Transport Future 2009-2020*.

3.3.2 In 2009 the Department of Transport published *Smarter Travel – A Sustainable Transport Future 2009-2020*. In this policy document the Government reaffirms its vision for sustainability in transport and sets out five Key Goals, Targets and Actions to achieve this vision.

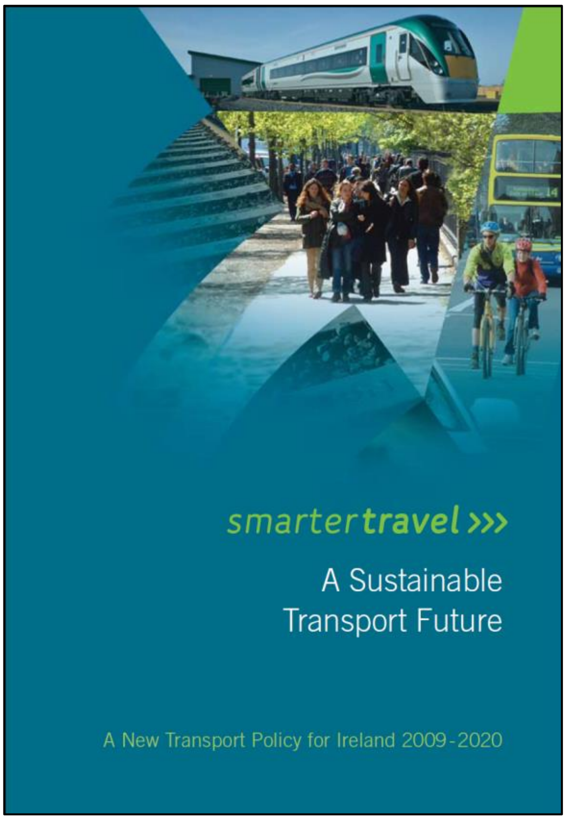


Figure 3.1: Smarter Travel – A Sustainable Transport Future 2009 - 2020

3.3.3 It is within this context of providing a transport system which facilitates and drives economic competitiveness that the five Key Goals are as follows:

- To reduce overall travel demand and commuting distances travelled by the private car
- Improve accessibility to transport for all
- Improve economic competitiveness through maximising the efficiency of the transport network and alleviating congestion and infrastructural bottlenecks
- Minimise negative impacts of transport through reducing air pollutants and greenhouse gas emissions
- Improve security of energy supply by reducing dependency on imported fossil fuels

3.3.4 There are also specific targets. These include the reduction in work-related commuting by car from the current level of 65% to 45%. Therefore, the approach adopted for this proposed eastern extension to Dunshaughlin first and foremost sought to give priority to reducing the need to travel in the first instance by developing lands immediately adjacent to the existing residential area of Dunshaughlin.

3.4 Meath County Development Plan - Dunshaughlin Zoning Map

3.4.1 The proposed development is located on land primarily zoned A2 in the Dunshaughlin map of the Meath County Development Plan 2013 - 2019. It states:

> *"A2: To provide for new residential communities with ancillary community facilities, neighbourhood facilities and employment uses as considered appropriate for the status of the centre in Settlement Hierarchy."*

3.4.2 Figure 3.2 shows the Dunshaughlin Zoning Map

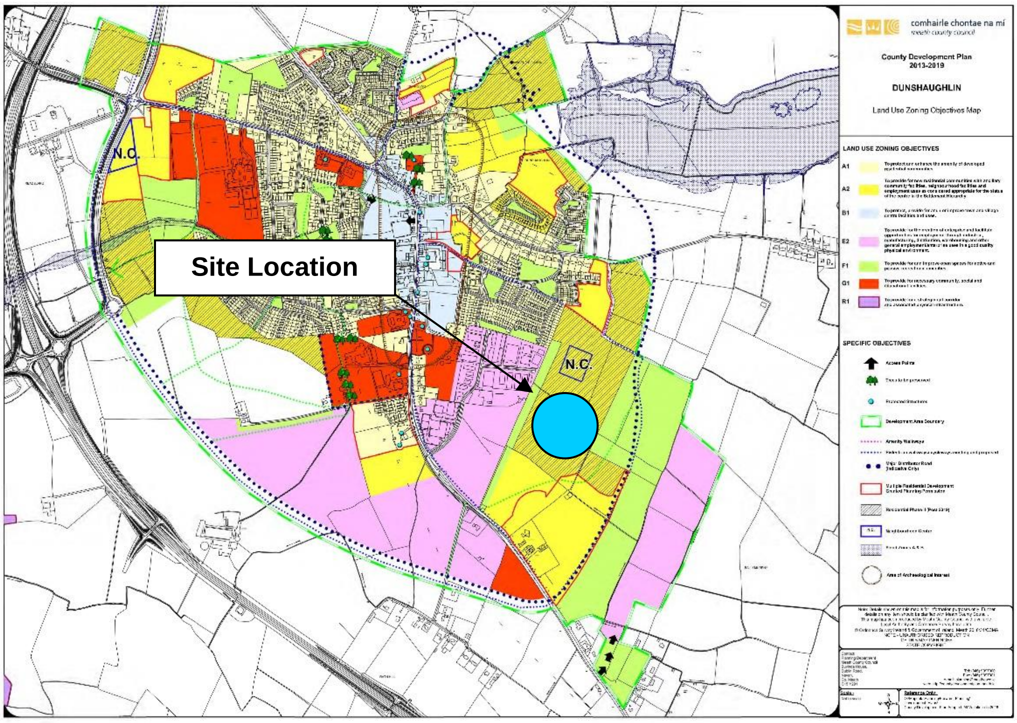


Figure 3.2: Dunshaughlin Zoning Map – Meath County Development Plan 2013 – 2019

3.4.3 The subject lands are located immediately adjacent to the existing built up area of Dunshaughlin. The lands immediately to the east are zoned for recreational and employment uses. It should be noted that the applicant owns some of these employment lands and intends to bring same forward for suitable uses in the near future. A future education campus is also now planned for lands to the west off the SHD lands.

3.4.4 In terms of overall design great care was taken towards ensuring that the proposed SHD development was suitably integrated with the existing and planned development of the town and the proposed layout incorporates very strong cycle and pedestrian linkages not just to the town and existing residential development to the north but also provides for suitable and direct cycle and pedestrian links to serve future employment and education lands.

3.5 Future Planned Sustainable Transport Upgrade Proposals - Cycling

3.5.1 Sheet N15 of the NTA's Greater Dublin Area Cycle Network plan is shown as Figure 3.3. The map shows a planned Primary-Secondary Cycle Route running along the R147.

Figure 3.3: Proposed Cycle Network Dunshaughlin, Ratoath & Ashbourne

The proposed Dunshaughlin East SHD development will connect directly to this planned overall strategic cycle network for the area and provide wider connectivity to adjacent urban settlements and employment nodes by bicycle in the future.

3.6 Future Planned Sustainable Transport Upgrade Proposals - Bus

3.6.1 Existing buses travelling to the City Centre currently provide connectivity to the Blanchardstown area via stops on the slip roads of the N3. The proposed Bus Connects scheme plans to implement a new public transport hub at Blanchardstown Shopping Centre.

3.6.2 The Blanchardstown to City Centre QBC is proposed to be upgraded to “next generation” bus corridors as part of the proposed BusConnects project as illustrated in Figure 3.5. The project, currently at consultation stage, proposes to create continuous dedicated bus lanes along the city’s busiest bus corridors

3.6.3 The BusConnects project proposed to deliver the following for passengers:

- reliable and punctual bus services;
- faster journey times for passengers;
- comfortable, modern vehicles;
- high frequency service on busy routes;
- an easy to understand network;
- universal passenger information - at roadside, on apps and on vehicles;
- simpler fare structures and easier payment; and
- seamless integration with other transport types.

3.6.4 Should this scheme be brought forward it will further improve the public transport connectivity of the proposed development site. The proposed BusConnects route map for the Blanchardstown to City Centre corridor is shown in Figure 3.4.

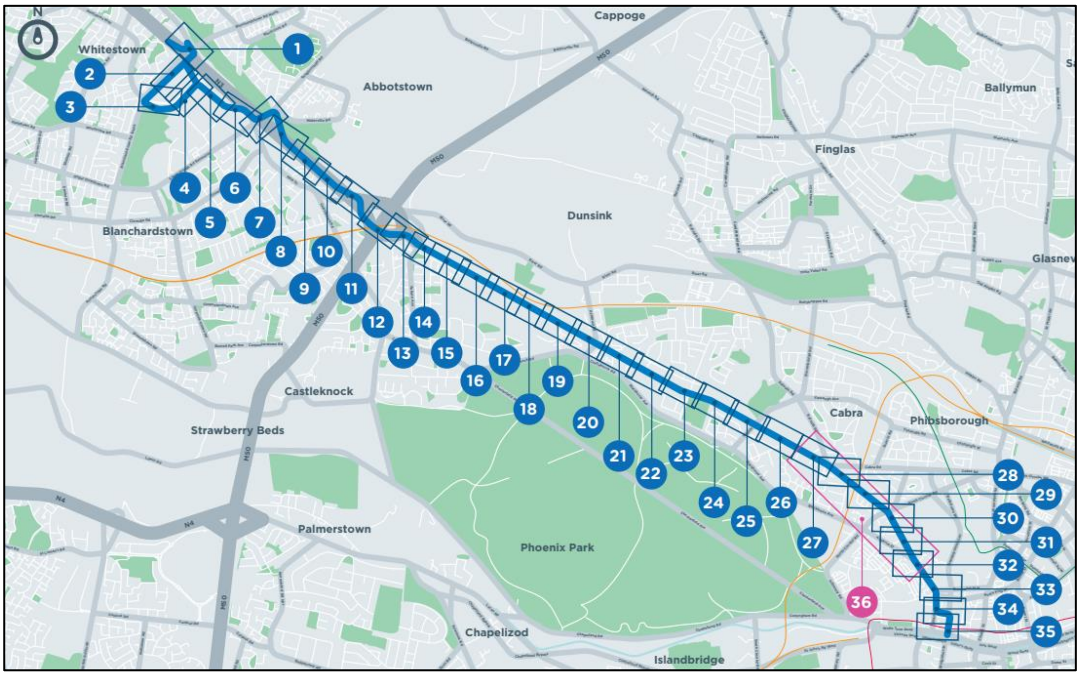


Figure 3.4: Bus Connects – Blanchardstown to City Centre Corridor

3.6.5 The Bus Connects project operates on the hub and spoke principle where local bus services can feed into a high capacity bus route. The proposed Dunshaughlin East SHD development will therefore enable new local bus services to link to the Bus Connects project providing new bus-based transport service link from Dunshaughlin to the Bus Connects network.

3.7 Future Planned Sustainable Transport Upgrade Proposals - Rail

3.7.1 In pre-planning discussions, the desire to develop a rail link to Navan with a new station a Dunshaughlin was highlighted as a desirable initiative by MCC. MCC were of the view that a rail route that would also serve Dunshaughlin could be more beneficial in both strengthening the case for the rail link and ensuring its commercial viability. The proposed SHD development by virtue of its scale, location and proximity to existing high frequency bus-based services would also strengthen the case for a rail link to Dunshaughlin in the future.

3.7.2 The recently published Draft RSES for the Midlands and East Region, now includes specific policy objective, RPO 8.6, which as illustrated in Figure 3.5. Regional Policy RPO 8.6 includes for the upgrade of the expansion of DART service to Pace rail station, providing fast, high frequency, electrified service that will integrate with the existing DART and intercity rail networks.

Major transport infrastructure investments, identified in the Project Ireland 2040 - National Development Plan have an important role in enabling the sustainable and balanced development of the Region, over the period of the RSES.

Proposals for infrastructure investment should clearly demonstrate their consistency with spatial planning objectives, at regional and national level. Such proposals will be subject to environmental assessment and feasibility where assessment has not already taken place.

The management, maintenance and improvement of existing transport infrastructure is also a key consideration, to ensure that the safety, capacity and the efficiency of the networks are maintained and factored into the capital funding process.

Rail

The primary function of the rail network in the Region is to provide commuter rail services to Dublin City, and major employment locations within the Metropolitan Area and in large towns. Intercity rail services also play a key role in offering sustainable travel alternatives for longer distance trips, providing improved interregional connectivity.

REGIONAL POLICY OBJECTIVES:

Rail Infrastructure

RPO 8.6: The RSES supports delivery of the rail projects set out in Table 8.2, subject to the outcome of appropriate environmental assessment and the planning process;

Table 8.2: Rail Projects for the Region

- Delivery of DART Expansion Programme - delivery of priority elements including investment in new train fleet, new infrastructure and electrification of existing lines. Provide fast, high-frequency electrified services to Drogheda on the Northern Line, Celbridge-Hazelhatch on the Kildare Line, Maynooth and M3 Parkway on the Maynooth/Sligo Line, while continuing to improve DART services on the South-Eastern Line as far south as Greystones
- Provide for an appropriate level of commuter rail service in the Midlands and South-East
- Complete the construction of the National Train Control Centre
- New stations to provide interchange with bus, LUAS and Metro network at including Kishoge, Heuston West, Cabra, Glasnevin, Pelletstown and Woodbrook
- A feasibility study of high-speed rail between Dublin Belfast, Dublin Limerick Junction/Cork will be carried out
- Reappraisal of the extension of the Dunboyne/ M3 Parkway line to Dunshauglin and Navan
- Support construction of Metrolink (from Swords to Sandyford)
- LUAS Green Line Capacity Enhancement in advance of Metrolink
- Undertake appraisal, planning and design of LUAS network expansion to Bray, Finglas, Lucan, Poolbeg

Figure 3.5: Extract from Eastern & Midland RSES – Regional Policy Objectives for Rail

3.7.3 In addition, RPO 8.6 provides for the reappraisal of the extension of the Pace (M3 Parkway) rail line to Dunshaughlin and Navan.

3.7.4 Therefore, as well as having excellent bus services at present the proposed Dunshaughlin East SHD development will be served by additional sustainable travel modes, including cycle, bus and rail service. The proposed development will therefore support and anchor these future sustainable transport modes.

4 PROPOSED DEVELOPMENT

4.1 Outline of Proposed Development for SHD Development

4.1.1 It is proposed to construct 913 no. dwellings, ranging in size from 4 bed to 2 bed units, on the site. Figure 4.1 shows the location of the proposed development.

4.1.2 The breakdown of unit types proposed is as follows:

- 505 no. Houses
- 186 no. Duplexes
- 222 no. Apartments

4.1.3 It is also proposed to construct a new neighbourhood centre, which will consist of a childcare facility with a GFA of 1,282 sq.m, a community facility with a GFA of 180 sq.m, 2 no. retail units with GFA of 1,000 sq.m and 190 sq.m, a café / restaurant unit with a GFA of 370 sq.m, and a primary healthcare / gym unit with a GFA of 1,040 sq.m.

4.1.4 The development includes the delivery of a section of the Dunshaughlin Outer Relief Road (DORR) from the Phase 1 site boundary to the northern site boundary, including connections to adjacent lands, improvements to a section of the Outer Relief Road delivered with the Phase 1 development to the south, a bus bay and toucan crossing on the Dublin Road, all associated open space, boundary treatment, internal roads, cycle and pedestrian infrastructure, foul and surface water drainage, a pumping station, attenuation tanks, car and cycle parking, ESB substations, other services and all other associated development.

4.1.5 It is proposed to access the development using a previously permitted priority junction onto the R147. Figure 4.1 shows the layout of the proposed development.

Figure 4.1: Proposed Development Layout (Source: MCORM)

4.1.6 Access to the development will be via the proposed access that was granted planning permission as part of planning ref. DA12019. Figure 4.2 shows the proposed access route to the development as permitted.

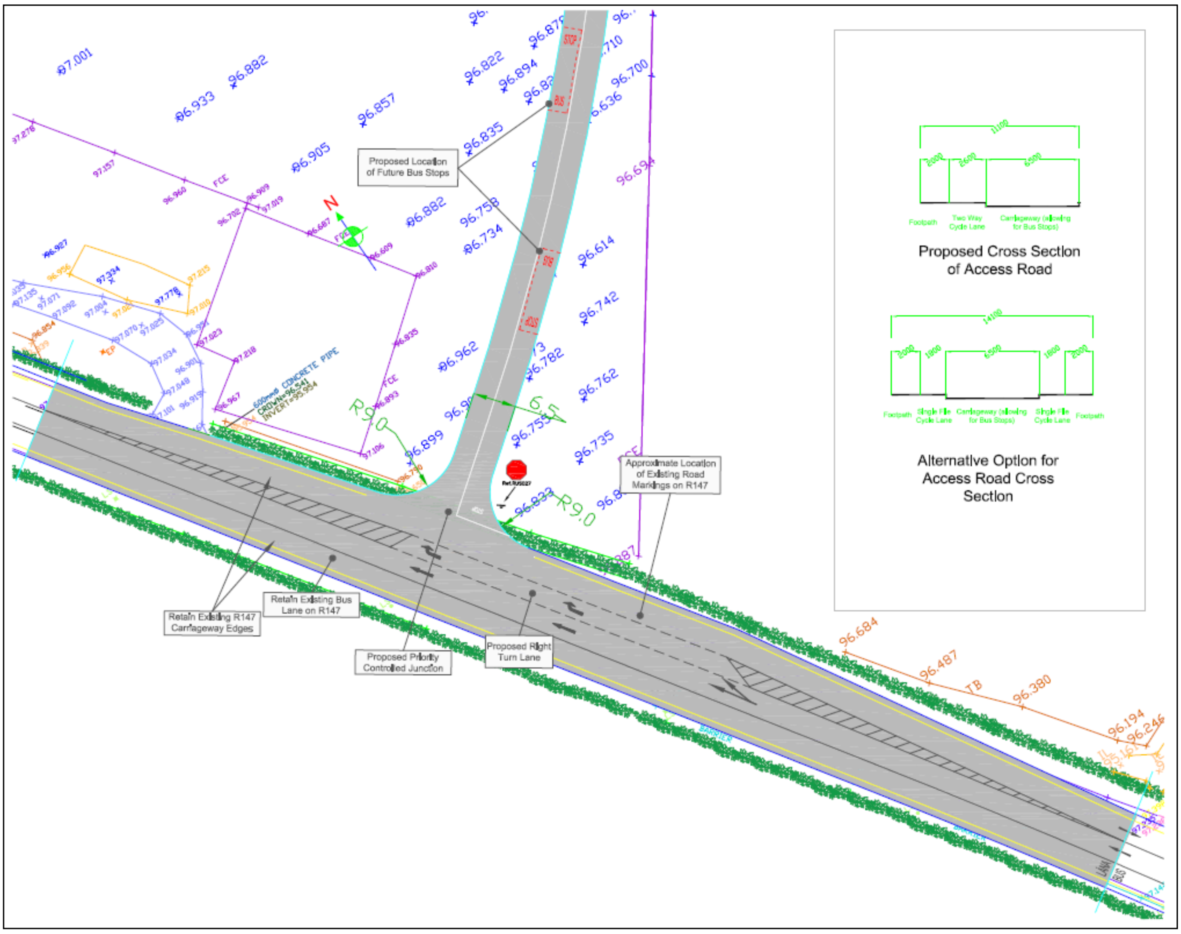


Figure 4.2: Proposed Access to Development (Previously Permitted under Planning ref. RA/170407)

4.1.7 In order to improve the capacity of the permitted access junction it is proposed to upgrade this junction to include dedicated right and left turn lane at the proposed access road. It is also proposed to include bus laybys along the proposed spine road. The proposed upgrade to the junction is shown in Figure 4.3. The timing of the proposed upgrade is discussed later on in the report.

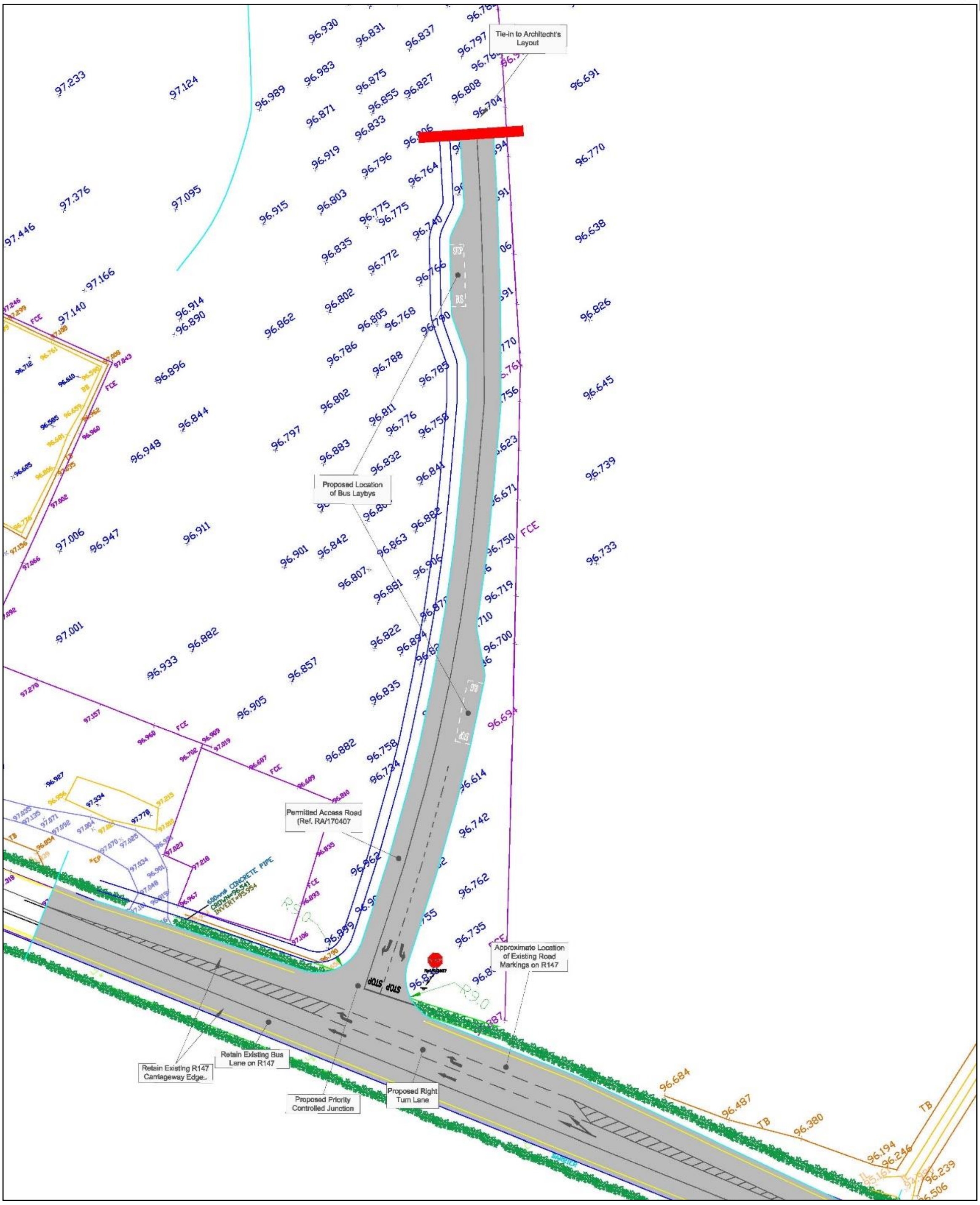


Figure 4.3: Proposed Upgrade of Previously Permitted Junction Incorporating Additional Traffic Lanes

4.1.8 The proposed layout includes a roundabout junction adjacent to the proposed Neighbourhood Centre (see Figure 4.1), as requested by MCC during pre-planning discussions. The proposed roundabout was chosen to signify the entrance to the Neighbourhood centre and to provide a suitable access point for the playing pitches and the zoned employment lands to the east. A priority junction could also be included at this location, should the Board deem this more appropriate.

4.2 Proposed Car and Cycle Parking Provision and Allocation

4.2.1 The proposed car parking is set out as Table 4.1

Table 4.1 Proposed Car Parking Allocation

Development Type	No. Of Units	Allocation		Total
Housing Units	505	2	Per Unit	1010
Duplex	186			
1 Bed	20	1	Per Unit	20
2 Bed	84	1	Per Unit	84
3 Bed	73	2	Per Unit	146
4 Bed	9	2	Per Unit	18
Visitor		1	Per 4 Units	46
Apartments	222	1	Per Unit	222
Visitor		1	Per 4 Units	54
Commercial				68
Total				1668

4.2.2 It is proposed to allocate two car parking spaces within the curtilage of each house. This is in keeping with the CDP standards and best practice.

4.2.3 Duplex parking allocation is determined by building type with the 2-bedroom units being provided with 1 no. car parking space per unit and the 3 and 4-bedroom units being provided with 2 no. car parking spaces. Visitor parking is also provided at a ratio of 1 space per 4 units.

4.2.4 For the apartment development it is proposed that car parking will be provided at a ratio of 1:1. While this is below the CDP standards it is in keeping with wider guidance on car parking and Government Guidance on apartment developments. In addition, visitor parking is also provided at a ratio of 1 space per 4 units.

4.2.5 There are also 85 no. car parking spaces being provided for the retail element of the development. While this is a reduction of the standards permitted under the County Development Plan, which would equate to 235 no. spaces, the level of parking provided is sufficient given the central location of the retail element of the development within a new residential neighbourhood and the potential for shared use given the differing peak hours of operation of the various facilities.

4.3 Cycle Parking

4.3.1 The CDP states that cycle parking should generally be provided at a rate of one space per three car parking space within a development. Each of the houses within the scheme are provided with 1 no. cycle parking spaces (located within the front curtilage of terraced houses and within the rear curtilage of end of terrace / detached / semi-detached houses.

4.3.2 1 no. cycle parking spaces are provided for each of the apartment units and duplex units within the proposed development. 30 no. cycle parking spaces are provided for the neighbourhood centre element of the scheme, located to the north and south of the retail/commercial area

5 SITE VISIT - TRAFFIC COUNT RESULTS & GROWTH RATES

5.1 Site Visit and Traffic Surveys

5.1.1 ILTP carried out a series of site visits and undertook AM & PM peak hour traffic counts in January 2018 as part of this assessment.

5.1.2 Site visits and detailed Manual Classified Traffic Counts were undertaken in January 2018 at a number of locations in Dunshaughlin to determine the existing patterns of traffic in the area following consultation with MCC. The locations of these traffic counts are shown in Figure 5.1. The results of the counts will enable ILTP to forecast the traffic changes that will also occur in Dunshaughlin once the link to the Lagore Road is completed.

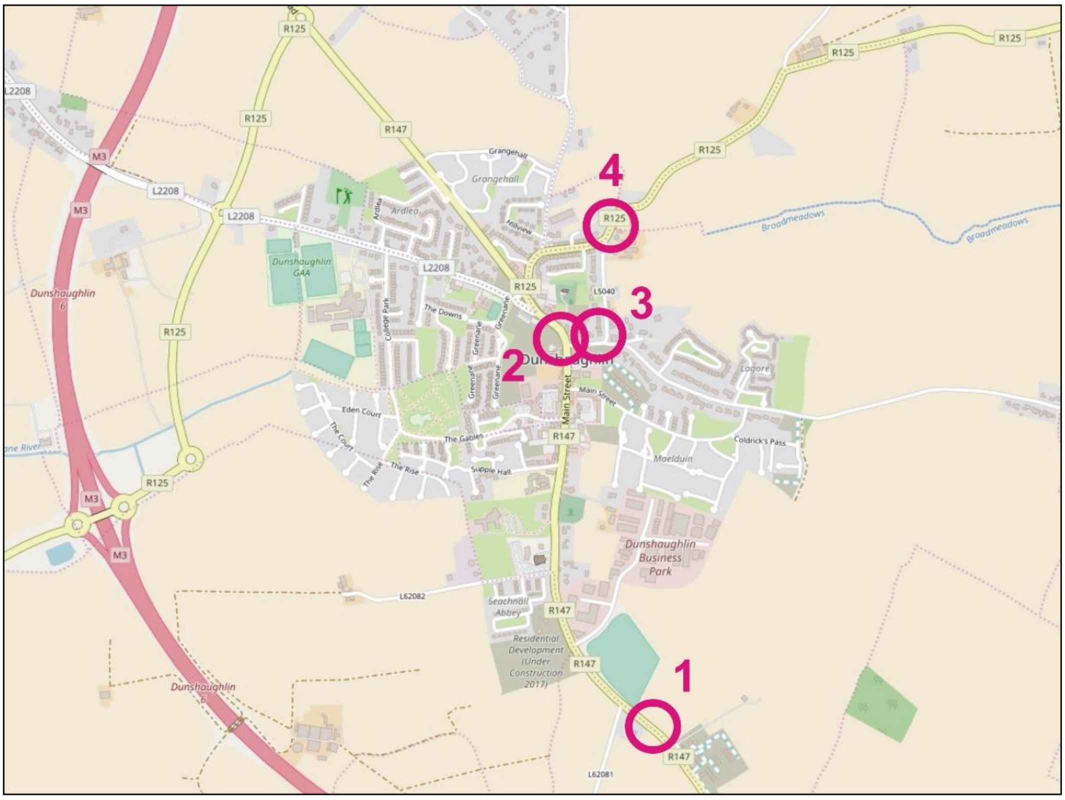


Figure 5.1: 2018 Traffic Count Locations

5.1.3 The results of the Manual Classified Traffic Counts for the AM and PM peak periods are displayed in Figures 5.2 and 5.3. The results of the survey show that the traffic flows at the site are tidal with distinct morning and evening flows.

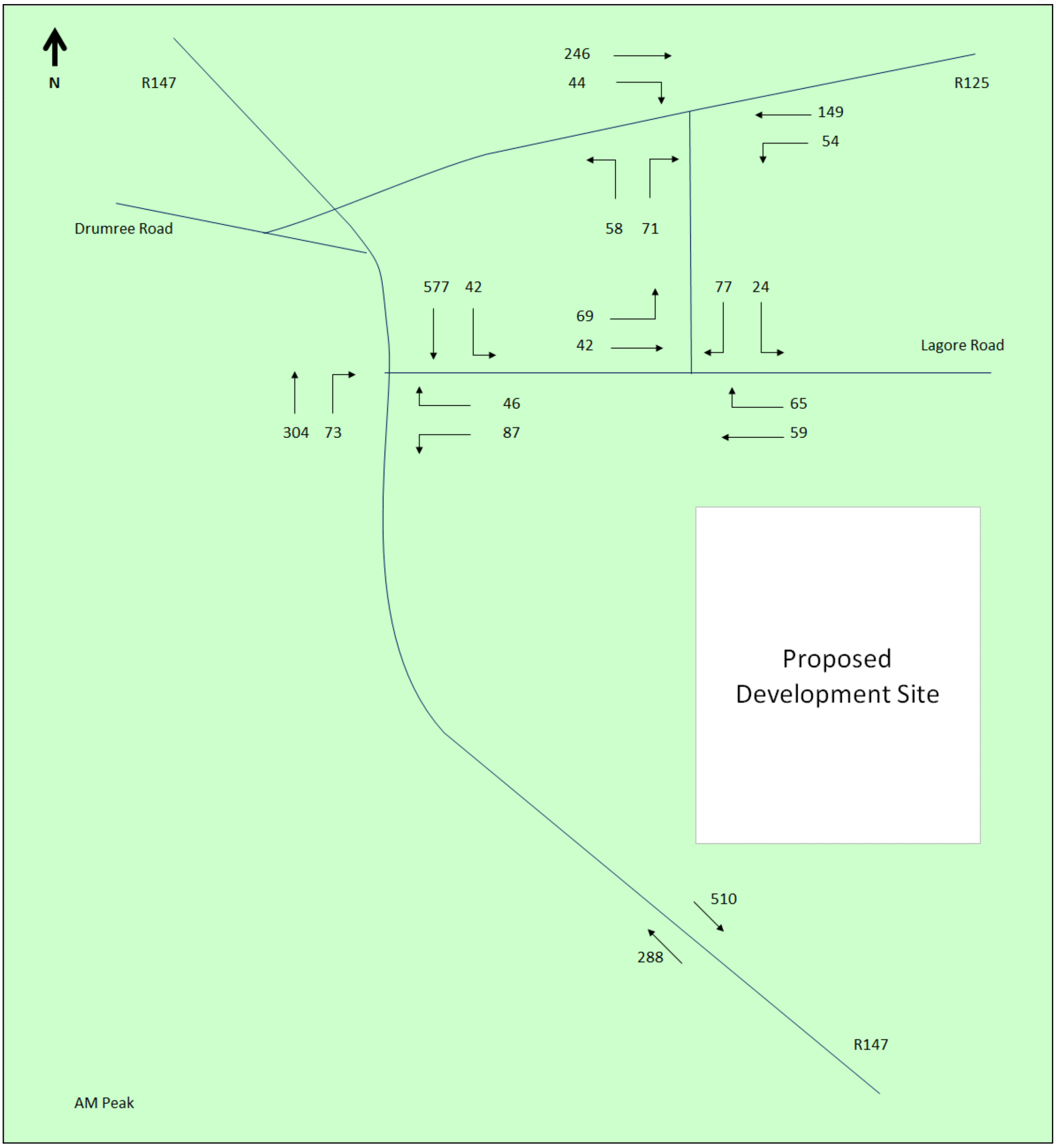


Figure 5.2: AM Peak Manual Classified Traffic Count Results January 2018

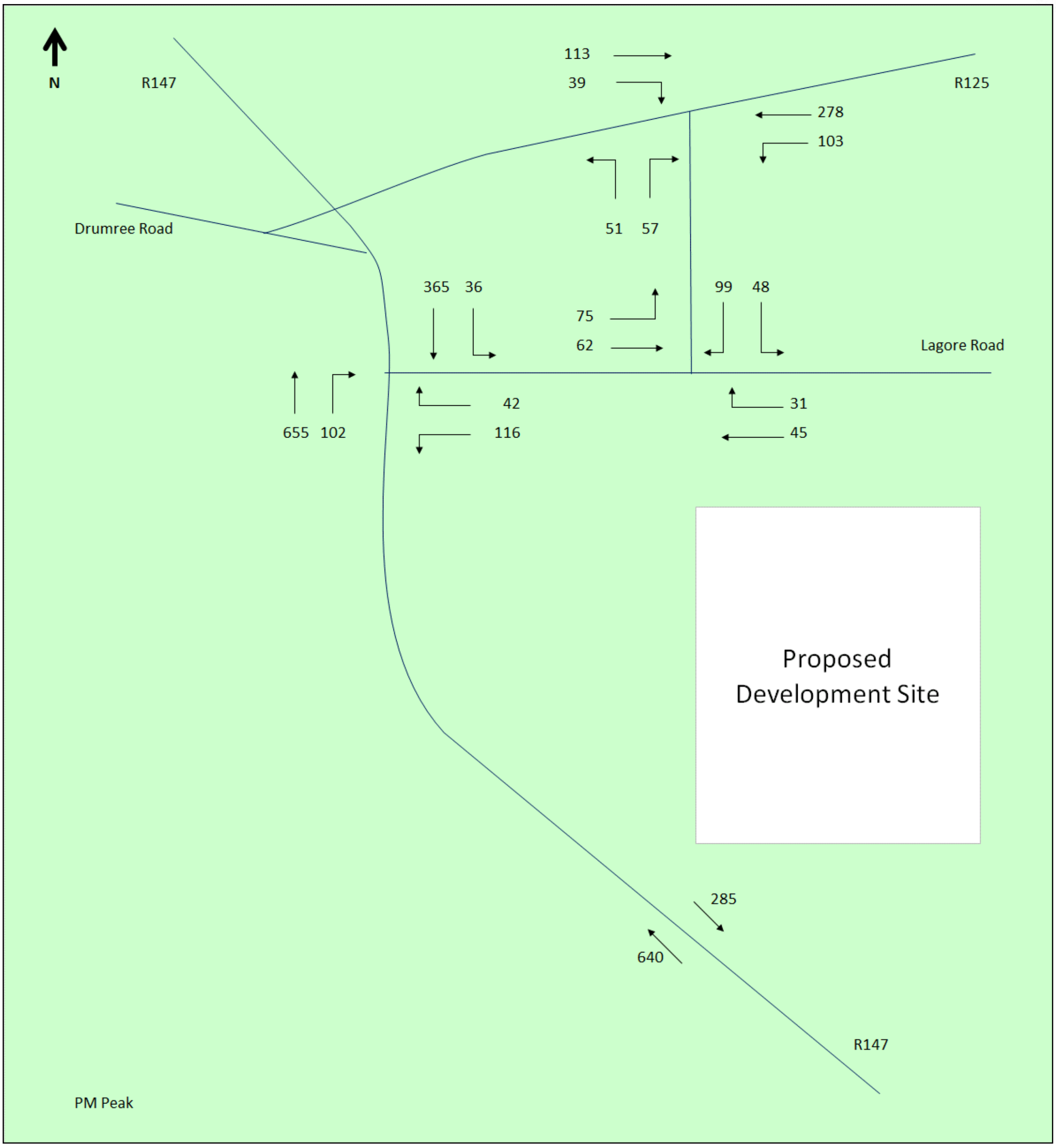


Figure 5.3: PM Peak Manual Classified Traffic Count Results January 2018

5.1.4 The level of two-way traffic recorded on the R147 is between 800 and 900 Vehicles per Hour (VPH) in the AM and PM peaks respectively. These peak traffic flows are therefore well within the overall design capacity of the R147.

5.2 Future Year Forecast Methodology

5.2.1 This TTA includes a projected Opening Year for the proposed development of 2020, with a corresponding Design Year of 2035.

5.2.2 To determine the future year forecasts ILTP used the TII medium traffic growth rates to establish the opening and design year forecasts with and without the development in place. MCC also requested a validation of these forecasts. ILTP undertook a review of recent traffic trends in the area using the TII permanent counters located on the adjacent road network. In particular MCC wanted to establish the likely wider traffic impact that may result from the proposed SHD development and were particularly interested in traffic growth patterns towards the city centre and along the R147 in particular.

5.3 TII Traffic Counter Data - Results

5.3.1 Traffic count data from the TII traffic website, which continually records traffic data, is available at a number of sites that are relevant to the development. These provide annual, monthly, daily and hourly traffic flow data. Table 5.1 summarises the traffic recorded on the R147 between Dunshaughlin and the Black Bull Interchange.

Table 5.1 – Data from TII Counter on R147 between Black Bull Interchange and Dunshaughlin, Co. Meath

	2018	2017	2016	2015	2014
AADT	8472	8512	8400	8333	8287
% HGV	2.50%	2.50%	2.50%	2.70%	2.60%

5.3.2 This table shows that between 2014 and 2018 (to date) traffic flows on this section of road has not increased significantly, despite significant development occurring in the area. The data also shows that the recent rate of growth in traffic flows has in fact reduced.

5.3.3 With regard to traffic flows on the section of the R147 between the Black Bull Interchange and the Pace Interchange, traffic flows are substantially higher as a result of traffic bound for Trim and Ratoath accessing the R147 at Black Bull, and vice-versa in the opposite direction (see Table 5.2).

Table 5.2 – Data from TII Counter on R147 South of Blackbull, Co. Meath

	2017	2016	2015	2014	2013
AADT	19232	19899	19020	19481	19339
% HGV	7.00%	6.40%	5.40%	5.30%	3.70%

5.3.4 However, the traffic flows on this section of the R147 also show that traffic flows have not increased in recent years and were at 2013 levels in 2017. Note 2018 data was not available due to the loop outages at this recording station.

5.3.5 Table 5.3 shows the traffic flows on the M3 north of the Toll Plaza for the same time period. This shows significant year on year traffic flow increases on the M3 motorway, but at a reducing rate in recent years. This suggests that the traffic flows along this corridor toward the employment centre in Blanchardstown, Ballycoolin and along the M50 are occurring on the motorway rather than the local road network.

Table 5.3 – Data from TII Counter on M3 North of Toll Plaza

	2018	2017	2016	2015	2014
AADT	20792	19458	18064	16700	15382

5.3.6 The R147 route is showing little if any traffic growth over recent years. The ILTP assessment, as set out in the next chapter, which assumed TII Medium Growth Rates occurring on the R147 up to the Opening and Design Years therefore provide a very robust assessment of the traffic impact of the proposed development. It also indicates that the excellent bus services from Dunshaughlin to the major employment centres to the south are providing alternative travel modes for many residents in Dunshaughlin.

5.4 Possible Contributions to Proposed Upgrades of Wider Road Network Resulting from the Development

5.4.1 MCC are considering that a contribution to proposed external road upgrades be levied on the proposed SHD development by way of a special contribution. While the traffic analysis shows no significant traffic growth along the R147 in recent years, the applicant has nevertheless proposed an appropriate contribution to any planned road upgrades based on a pro-rata traffic impact that the development could have on the heaviest trafficked section of the R147, which arises between the Black Bull and Pace Interchanges.

5.4.2 A report on the proposed contribution to wider road upgrades has been forwarded to the MCC Road Planning Section and this matter is currently under consideration by MCC. The report sets out the rationale behind calculating the appropriate contribution amount (circa €49,000) and is included as Appendix A of this report.

6 TRAFFIC IMPACT ASSESSMENT OF PROPOSED SHD DEVELOPMENT

6.1 Introduction and Agreed Methodology

6.1.1 ILTP met with MCC on a number of occasions to discuss and agree the study methodology for the TTA assessment of the proposed SHD development.

6.1.2 The zoned lands in the area have the capacity for circa. 1000 residential units as well as a crèche and retail facilities in the proposed neighbourhood centre. It is proposed that, once developed, these lands will be served by the future Dunshaughlin Outer Relief Route (DORR).

6.1.3 The DORR will connect the R147 to the Lagore Road when same is completed by MCC, however, this may not be completed for a number of years. Therefore, it was agreed to test a number of scenarios based on a constant road design scenario to allow for like for like comparison of results.

6.2 Assumed Access Road and R147 Layouts

6.2.1 Different junction layout designs will result in differing capacities. Also, the form of junction, (e.g. priority, roundabout or traffic signal control), will also impact on the capacity of the junction and hence different assessment models would be difficult to compare. For consistency and to allow performance comparison of the differing scenarios tested ILTP assumed that the DORR/R147 junction would be an upgraded priority junction as illustrated in Figure 6.1, with right and left turn lanes on the R147 approach and a right turn lane from the R147 to the DORR.

6.3 DORR / R147 Junction Layout used in TTA

6.3.1 Figure 6.1 shows the visibility splay triangles from the proposed upgraded DORR/R147 junction used in the TTA, which allows for a comparative assessment of the junction under differing scenarios. It should be noted that this junction will be upgraded in future to a signal controlled junction, which will further increase the capacity of the junction.

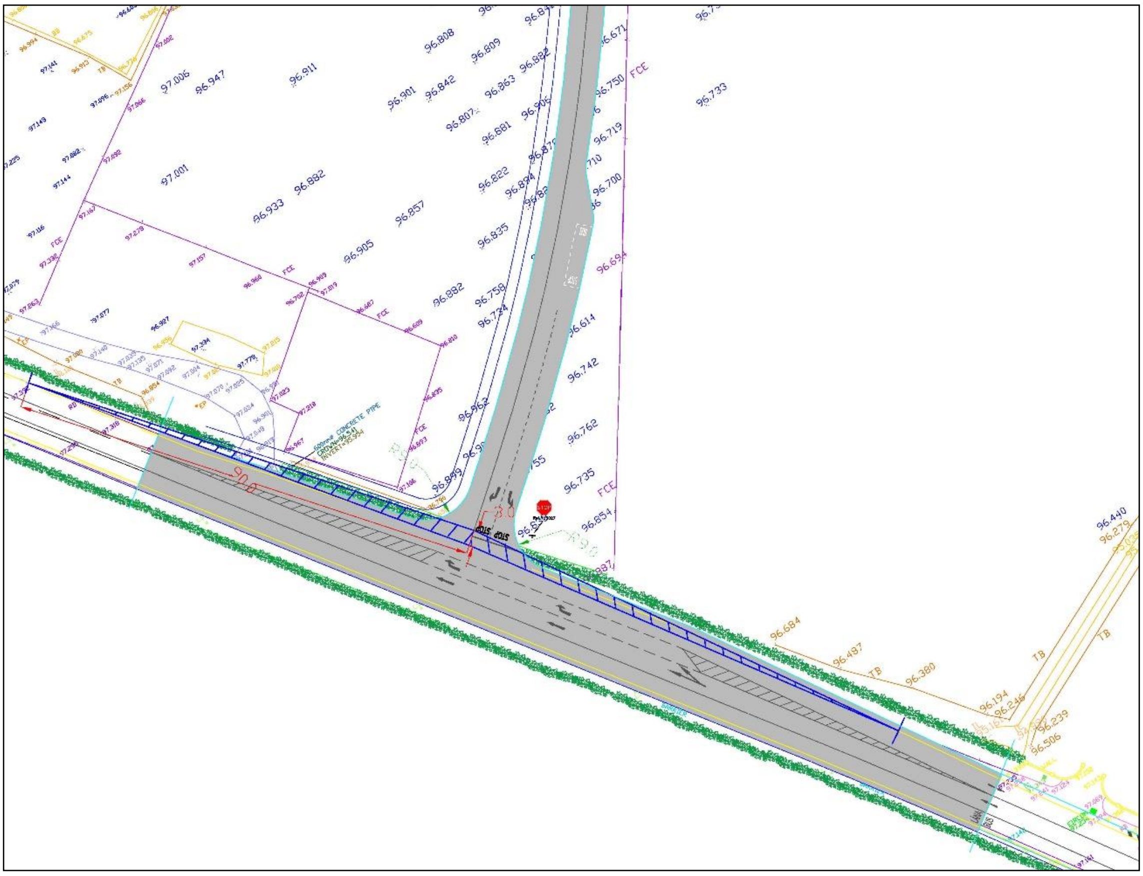


Figure 6.1: DORR/R147 Junction Layout Used in TTA Assessments.

6.3.2 Note the detailed junction layouts and designs are included on the JOR Consulting drawings, but the layouts shown in the TTA are fully consistent with these designs.

6.4 Opening and Design Year Scenarios

6.4.1 Following a number of meetings with the Roads Planning Section the following scenarios were tested to provide a robust assessment of the traffic impact on the proposed development both with and without the DORR in place. MCC were also requested that allowance be made in the assessment for additional zoned lands to the north of Dunshaughlin to be tested.

6.4.2 The following worse case scenarios were tested:

- Full SHD Developed by 2020 Opening Year without DORR Link
- Full SHD Developed by 2035 Design Year without DORR Link
- Full SHD Developed by 2020 Opening Year with DORR in Place
- Full SHD Developed by 2035 Design year with DORR in Place

6.4.3 The assessments also assume that the recently permitted Phase 1B and 1C developments will be in place in the opening year

6.5 Proposed Trip Generation Rates

6.5.1 Using comparable and TRICS software trip rates, we can anticipate the following traffic movements into and out of the development access with additional development in place for a range of uses. The estimated Trip Generation is shown in Tables 6.1 and 6.2.

Table 6.1: Proposed Trip Rates

Land Use	AM Peak Trip Rates		PM Peak Trip Rates	
	Arr	Dep	Arr	Dep
Residential (Houses & Duplex)	0.11	0.34	0.34	0.18
Residential (Apartment)	0.05	0.14	0.1	0.06
Retail	0.73	0.21	3.82	3.51
Medical	2.13	0.84	0.8	1.67

Table 6.2: Proposed Trip Generation

Land Use	Number of Units	AM Peak Trips		PM Peak Trips	
		Arr	Dep	Arr	Dep
Residential Phase 1A	100	11	34	34	18
Residential Phase 1B	92	10	31	31	17
Residential Phase 1C	96	11	33	33	17
Residential (Other Lands to North)	-	30	70	70	30
Residential SHD (Houses and Duplex)	692	76	235	235	13
Residential SHD (Apartments)	221	11	31	22	13
Retail	1750m2	13	4	67	61
Medical	1160m2	25	15	14	29
Total		**186**	**453**	**506**	**31**

6.5.2 Note the projected trip generation figures are considered a robust assessment as they have not taken into consideration the effect that the proposed development layout and design strategy will have in reducing these impacts. They should therefore be regarded as worst-case scenarios.

6.6 Traffic Flow Analysis Methodology and Results: PICADY Model

6.6.1 ILTP Consulting carried out a PICADY model assessments based on the existing permitted and future SHD development proposed. This was to determine if the increased number of dwelling units could be accommodated by the access onto the R147 and the wider road network and to assess the impact of the DORR being in place.

6.6.2 RFC data was calculated using Picady, software package.

6.6.3 The RFC (ratio of flow to capacity) factor is often used to assess highway capacity. This measures the observed flow of a link against the theoretical capacity of the link. RFC is calculated thus;-

$$\% \text{ RFC} = \frac{\text{Observed Flow}}{\text{Link capacity}} \times 100$$

6.6.4 In transport Terms, RFC values of 85% or less are considered satisfactory.

6.7 Projected Trip Distribution without DORR Link in Place

6.7.1 All traffic from the development, except internal trips, will use the purpose-built road already included as part of the existing permitted development. Therefore, all existing permitted developments and the proposed SHD development will access via the new R147 junction before the DORR is in place.

6.7.2 The traffic flows from the development are broken down into local trips and external trips to Dunshaughlin.

6.7.3 Based on an analysis of existing traffic patterns it is likely that 40% of the overall trip will be trips local to Dunshaughlin, of which 10% will be internal to the SHD development and 30% local trips within Dunshaughlin. It should be noted that these estimated vehicle trips do not assume that the planned education campus will progress, which is a worse-case scenario.

6.7.4 The TTA has assumed that as a worst case 60% of all trips will be external to Dunshaughlin and use the surrounding regional road network. Many of these trips will be to access external employment opportunities, which surround Dunshaughlin.

6.7.5 Therefore, the assumed trip distribution is as follows:

- 10% Internal to SHD development
- 30% Internal to Dunshaughlin
- 60% External Trips

6.7.6 Of the 60% external trips these are assumed to be distributed as follows on to the surrounding road network.

- 25% R147 South to Black Bull
- 10% R125 East toward Ratoath and Dublin Airport
- 15% R147 North toward Navan, county town and major employment centre
- 10% R125 West toward Trim and major employment centres

6.7.7 The resulting turning movements at the R147/Access Road without DORR are illustrated in Figure 6.2.

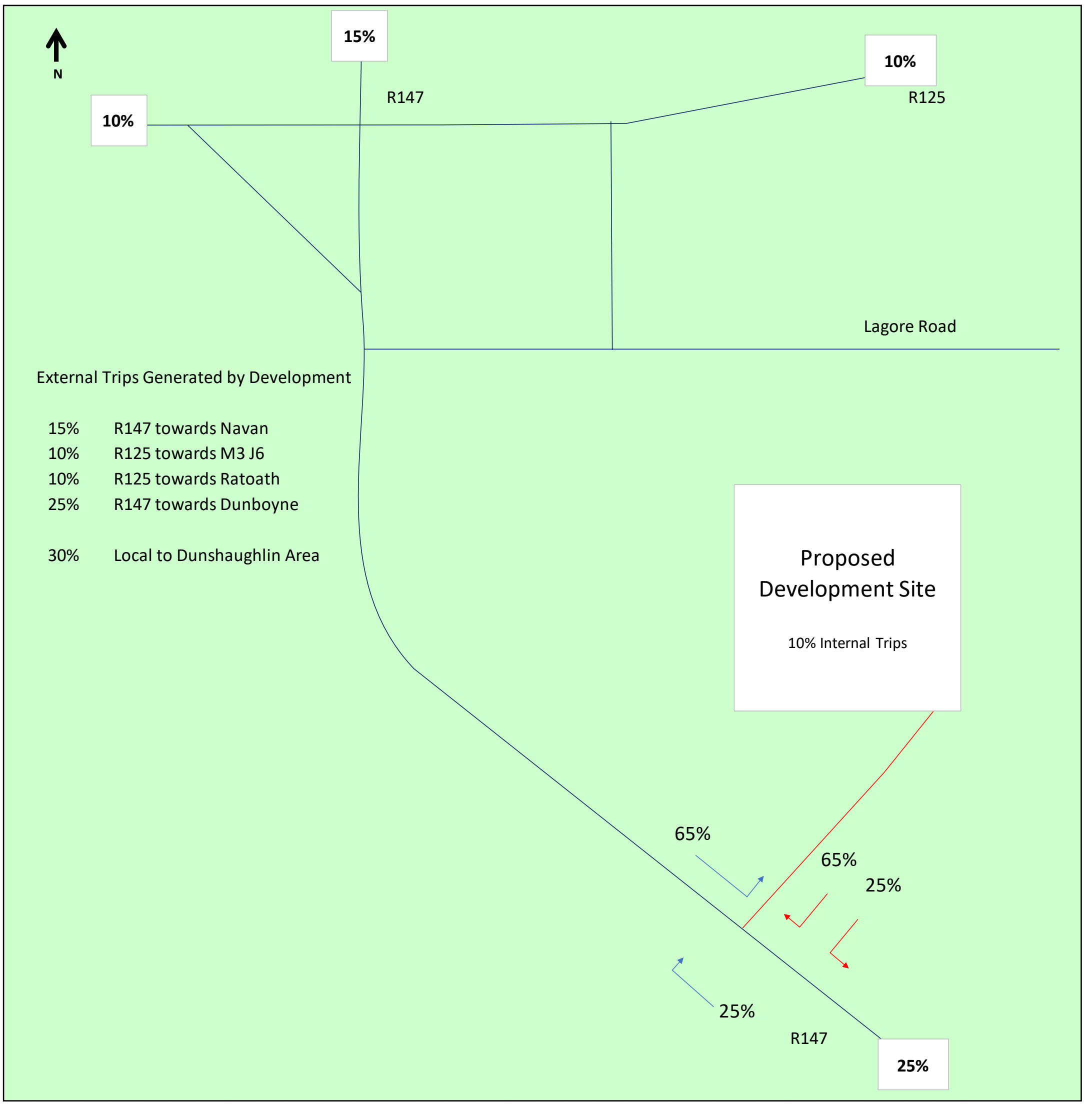


Figure 6.2 Assumed Trip Distribution – Without DORR in Place

6.8 External Only Trip Distribution

6.8.1 Four scenarios were assessed using this assumed trip distribution (DORR not in Place):

- Opening Year 2020 AM Peak Hour
- Opening Year 2020 PM Peak Hour
- Design Year 2035 AM Peak Hour
- Design Year 2035 PM Peak Hour

6.9 2020 Opening Year Scenario Estimated Traffic Flows – No DORR

6.9.1 TII medium growth rates were used to estimate the increase in background traffic for the 2020 Opening Year scenario. Figure 6.3 shows the estimated turning movements at the proposed access junction for the opening year scenario.

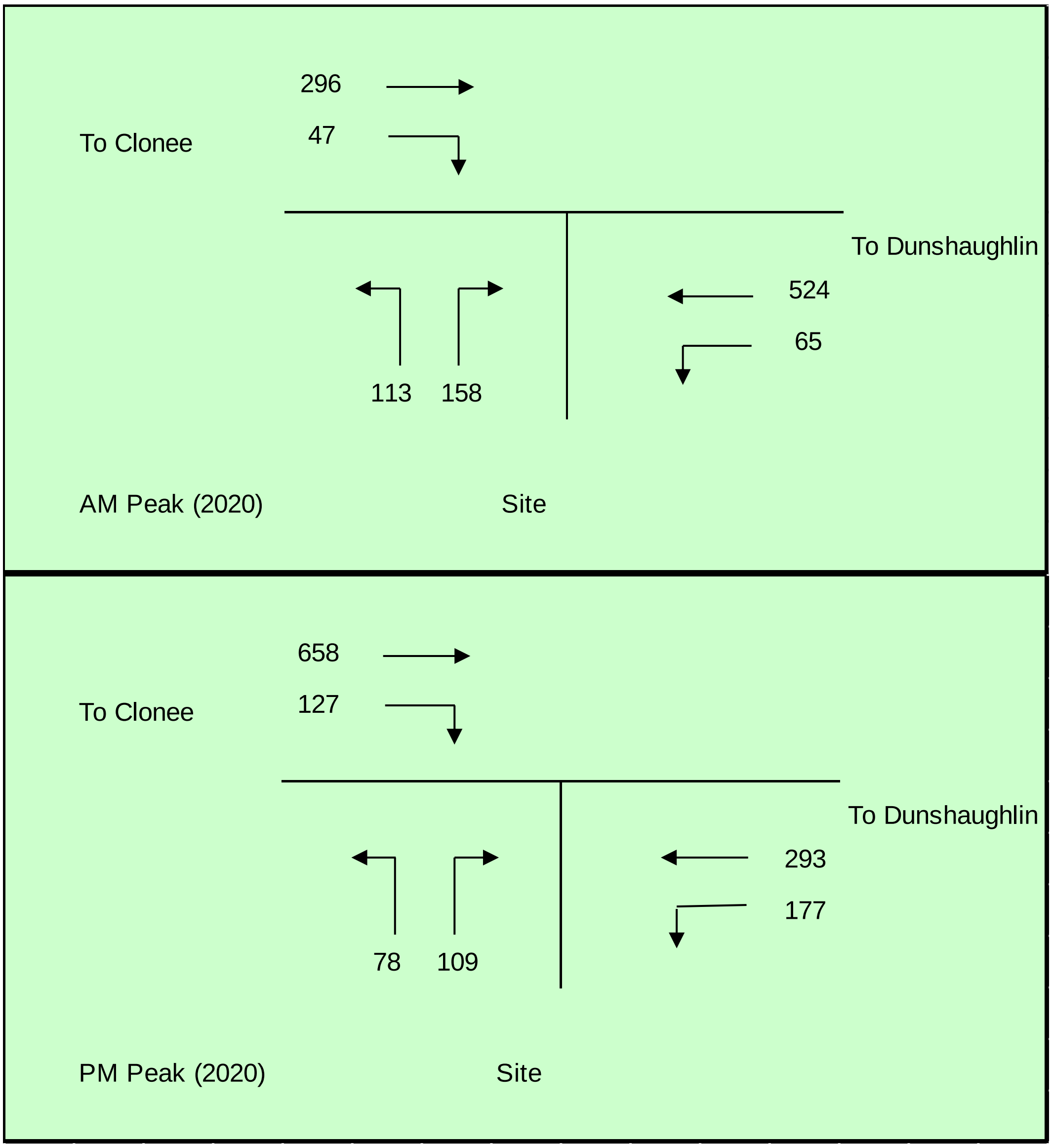


Figure 6.3: Opening Year Estimated External Traffic Flows AM and PM Peak Hour – No DORR

6.10 2020 Opening Year Scenario Results – No DORR

6.10.1 The results of the PICADY model indicate that there is adequate spare capacity at the priority-controlled junction to accommodate the full SHD traffic. An extract from the PICADY model output report is shown in Figures 6.4 & 6.5.

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-09:00	B-A	2.64	6.08	0.433	0	0.74	10.2	0.28
	B-C	1.88	8.15	0.231	0	0.3	4.3	0.16
	C-A	4.92	-	-	-	-	-	-
	C-B	0.78	9.14	0.085	0	0.09	1.3	0.12
	A-B	1.08	-	-	-	-	-	-
	A-C	8.74	-	-	-	-	-	-

Figure 6.4 2020 AM Peak Hour PICADY Results – No DORR

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:00-18:00	B-A	1.81	5.18	0.349	0.53	0.53	8	0.3
	B-C	1.29	8.81	0.147	0.17	0.17	2.6	0.13
	C-A	10.96	-	-	-	-	-	-
	C-B	2.11	9.39	0.225	0.29	0.29	4.3	0.14
	A-B	2.95	-	-	-	-	-	-
	A-C	4.88	-	-	-	-	-	-

Figure 6.5: 2020 PM Peak Hour PICADY Results – No DORR

6.10.2 It is evident from the PICADY results that the junction operated below the 85% recommended level. This indicates that the junction will operate within capacity and not cause adverse queuing or delays to vehicles at this location for the increased development quantums. The full PICADY report is included in **Appendix A** of this report.

6.11 2035 Design Year Scenario Estimated Traffic Flows – No DORR

6.11.1 TII medium growth rates were used to estimate an increase the background traffic for the design year scenario (2035). Figure 6.6 shows the estimated turning movements at the proposed access junction for the design year scenario.

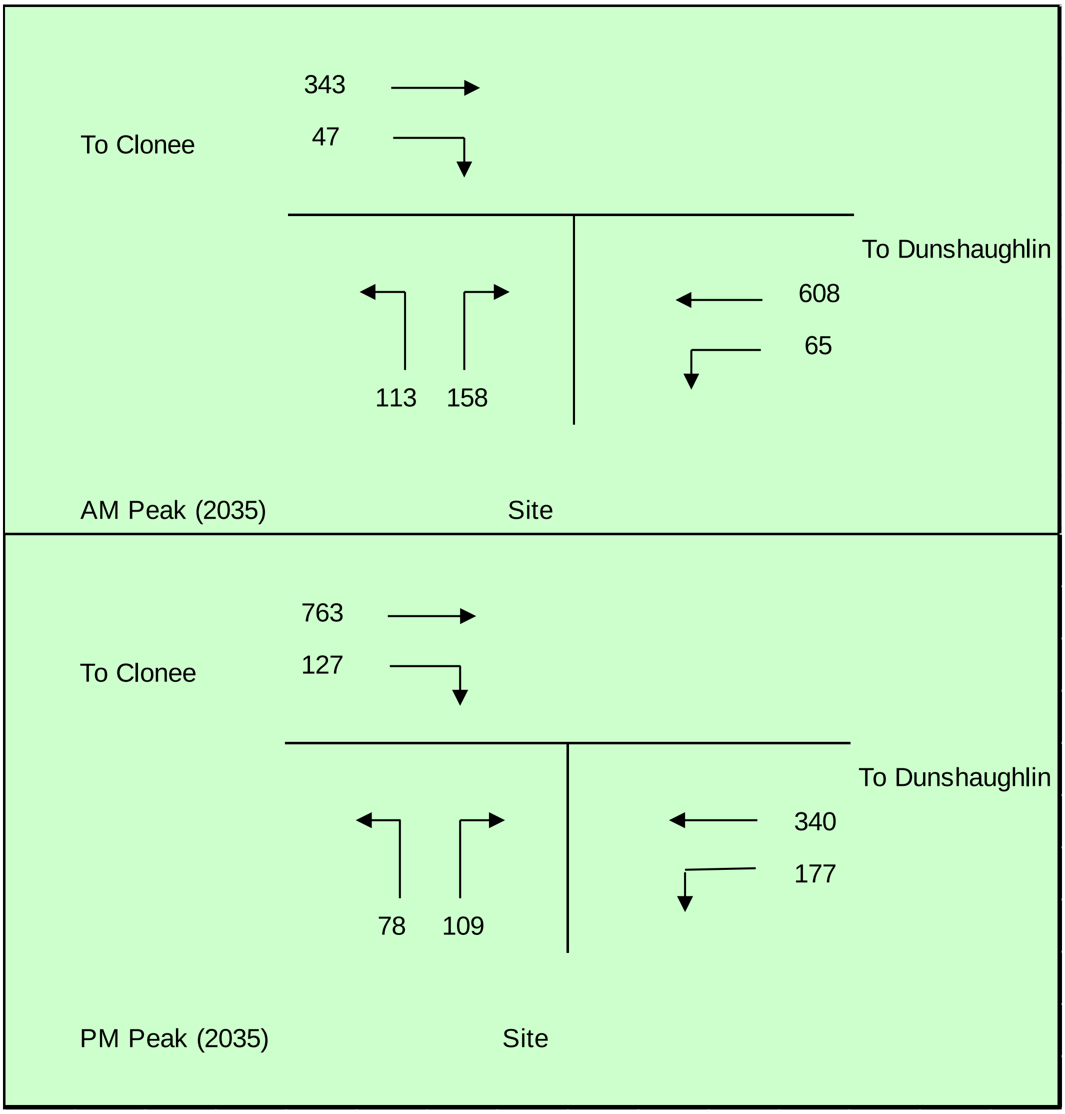


Figure 6.6: Design Year 2035 Estimated Traffic Flows

6.12 2035 Design Year Development Scenario Results – No DORR

6.12.1 The results of the PICADY model indicate that there is adequate spare capacity at the priority-controlled junction to accommodate the full development of the zoned lands even without the delivery of a vehicular link with Lagore Road to the north of the SHD site. An extract from the PICADY model report is shown in Figures 6.7 & 6.8.

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-09:00	B-A	2.64	5.62	0.469	0	0.85	11.6	0.32
	B-C	1.88	7.76	0.243	0	0.32	4.5	0.17
	C-A	5.71	-	-	-	-	-	-
	C-B	0.78	8.78	0.089	0	0.1	1.4	0.12
	A-B	1.08	-	-	-	-	-	-
	A-C	10.14	-	-	-	-	-	-

Figure 6.7: AM Peak Hour PICADY Results Design Year 2035

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:00-18:00	B-A	1.81	4.99	0.362	0	0.55	7.6	0.31
	B-C	1.29	8.85	0.146	0	0.17	2.4	0.13
	C-A	12.71	-	-	-	-	-	-
	C-B	2.12	9.45	0.224	0	0.29	4.1	0.14
	A-B	2.95	-	-	-	-	-	-
	A-C	5.67	-	-	-	-	-	-

Figure 6.8: PM Peak Hour PICADY Results Design Year 2035

6.12.2 The results show that, with the full build out of the SHD and existing permitted development, and by applying TII medium growth forecasts to background traffic, the proposed access junction off the R147 continues to operate well within the 0.85 RFC design performance.

6.13 Traffic Impact Assessment with DORR in Place

6.13.1 The DORR is outside the development site boundary but is likely to be in place during the build out of the SHD development.

6.13.2 To assess the impact of the new link a further assessment was undertaken which assumed that the DORR was in place by 2020, without any development. Due to its location the DORR is estimated to result in relatively minor changes to travel patterns in Dunshaughlin.

6.13.3 As illustrated in Figures 6.9 and 6.10, with the DORR in place the main changes in traffic patterns will be a re-routing of existing trips between the R125 to Ratoath and the R147 as the DORR will provide a more direct link for these trips. Traffic flows on the Lagore Road are very low but are likely to use the DORR also as shown in Figures 6.9 and 6.10.

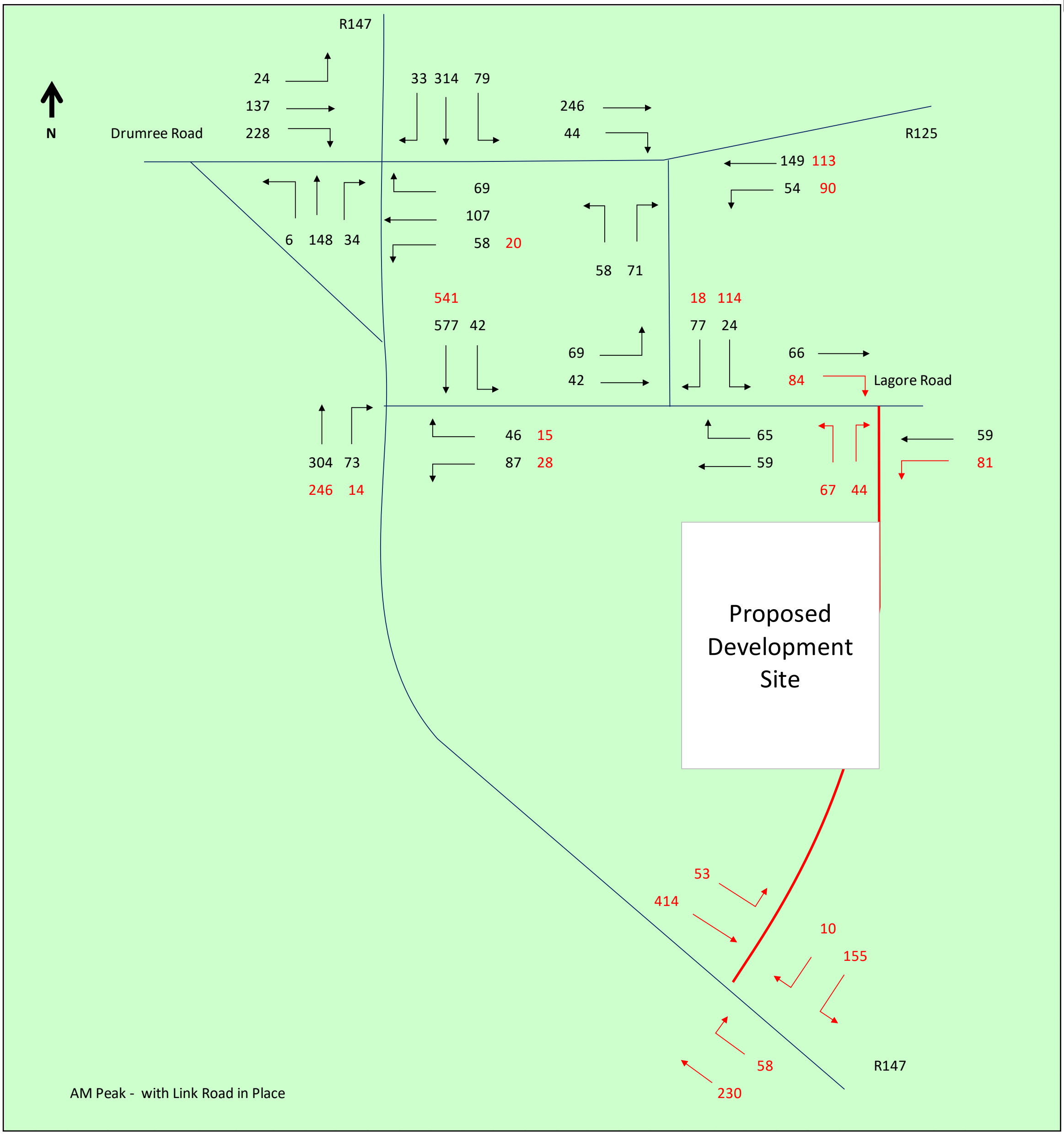


Figure 6.9: AM Traffic Flows Reassigned with Lagore Road Link in Place

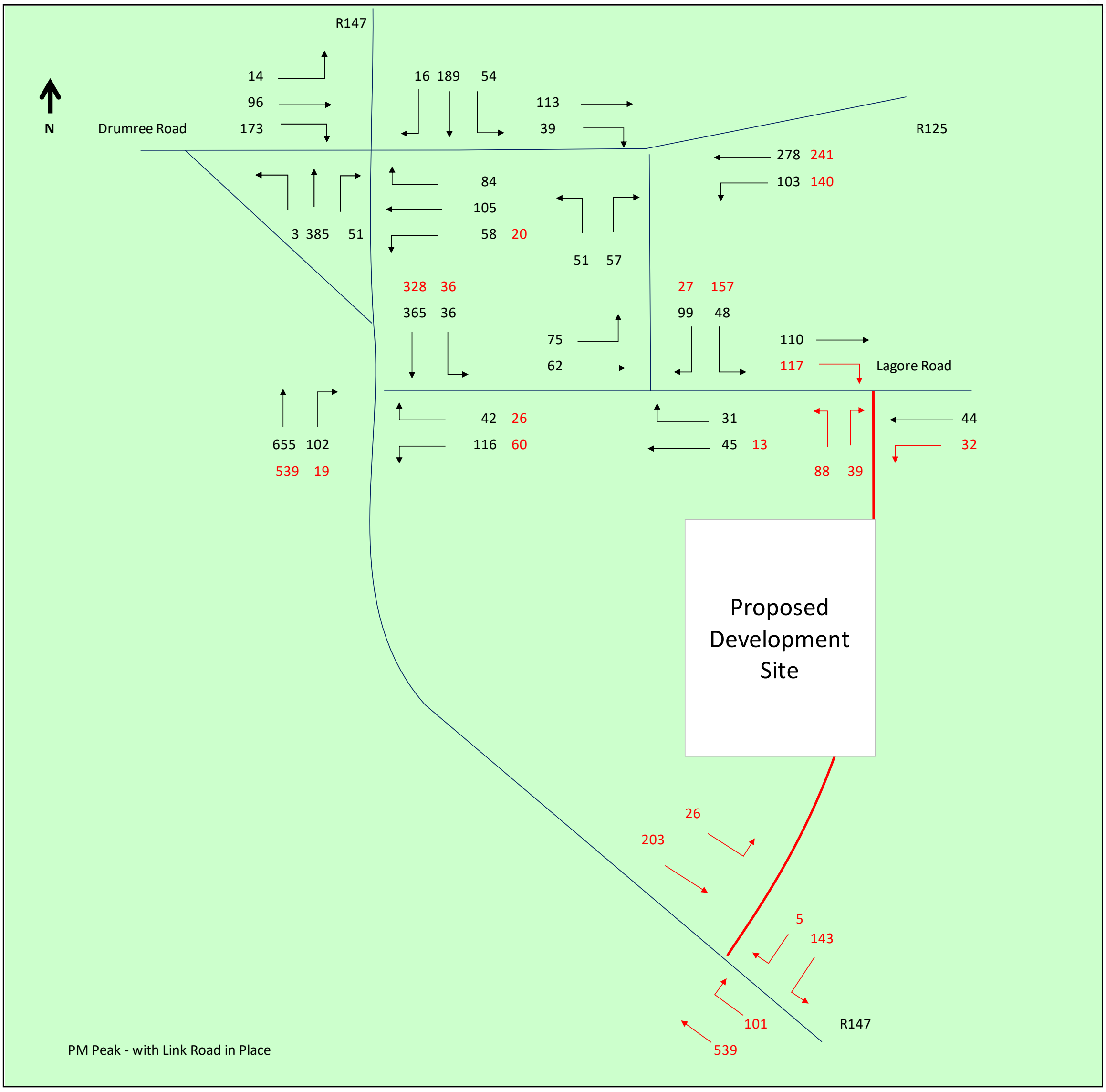


Figure 6.10: PM Traffic Flows Reassigned with Lagore Road Link in Place

6.13.4 The impact of these changes would be to reduce traffic flows in the town centre as illustrated in Figures 6.9 and 6.10 also. However, it is anticipated that the DORR would not significantly change the overall movement along the R147 or other routes that pass through Dunshaughlin as the new route would be significantly longer.

6.13.5 The analysis of the DORR suggests that the provision of this link will have a neutral if not positive overall impact in terms of traffic impact as this new link, once completed, will offer better route choice for traffic from the proposed SHD development lands and existing and future traffic in Dunshaughlin. For example, this link will give more route choice for existing traffic in Dunshaughlin to access the wider road network and avoiding the town centre. The link will also give more direct access to the R125 route to Ratoath and the Airport and thus reduce the traffic impact of the proposed SHD development on the existing town centre.

6.13.6 The results suggest that the opening of the link to the Lagore Road will in overall terms have a relatively positive impact on the traffic levels in Dunshaughlin. The traffic flow through the proposed junction with the R147 will in overall terms be largely neutral and therefore the proposed junction layout at the R147/DORR will remain largely the same.

6.14 Projected Trip Distribution with DORR in Place

6.14.1 With the DORR in place the external SHD trips will have greater route choice. The revised trip distribution of the SHD trips are illustrated in Figure 6.11 again assuming a 90% external trip rate.

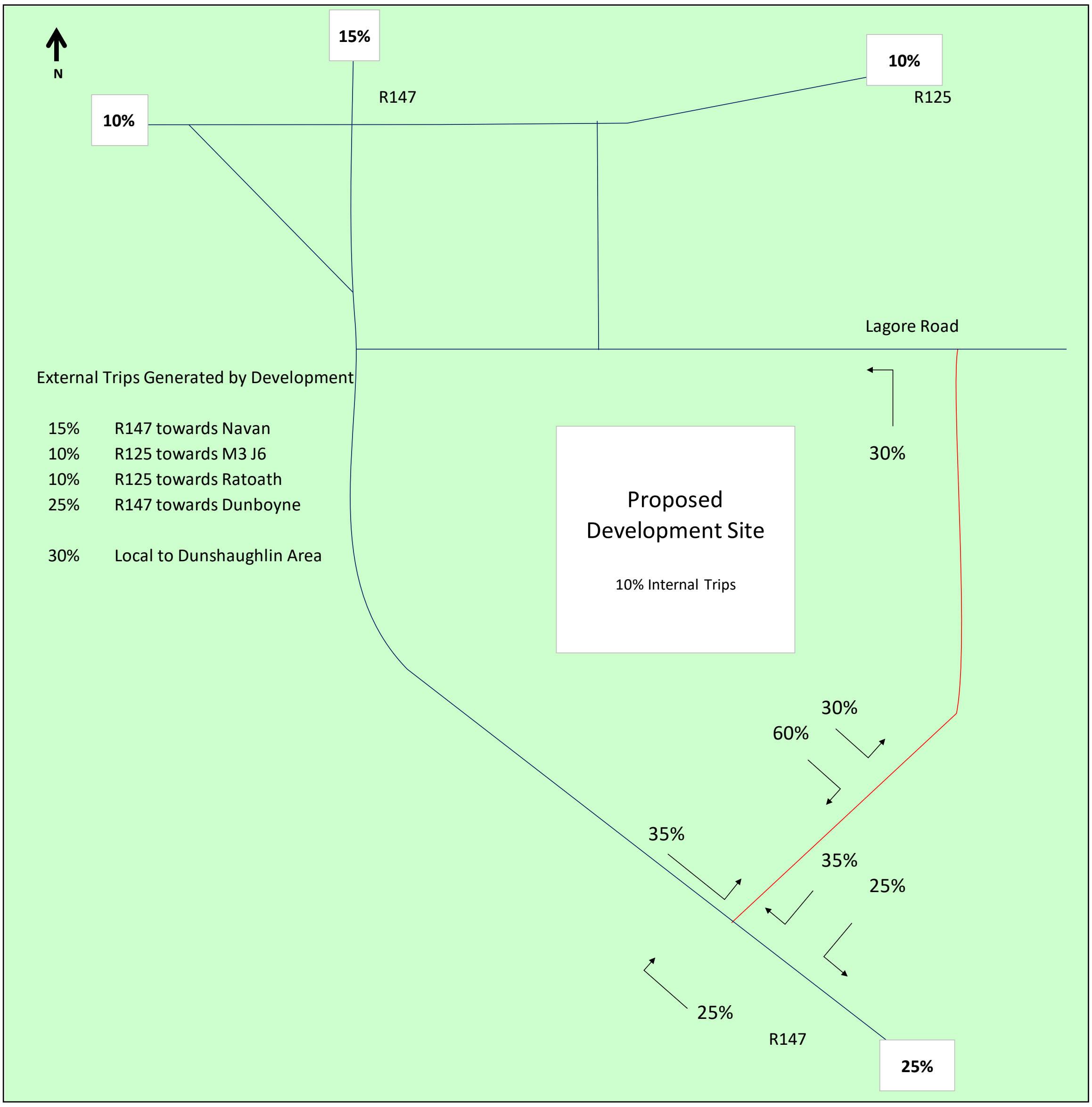
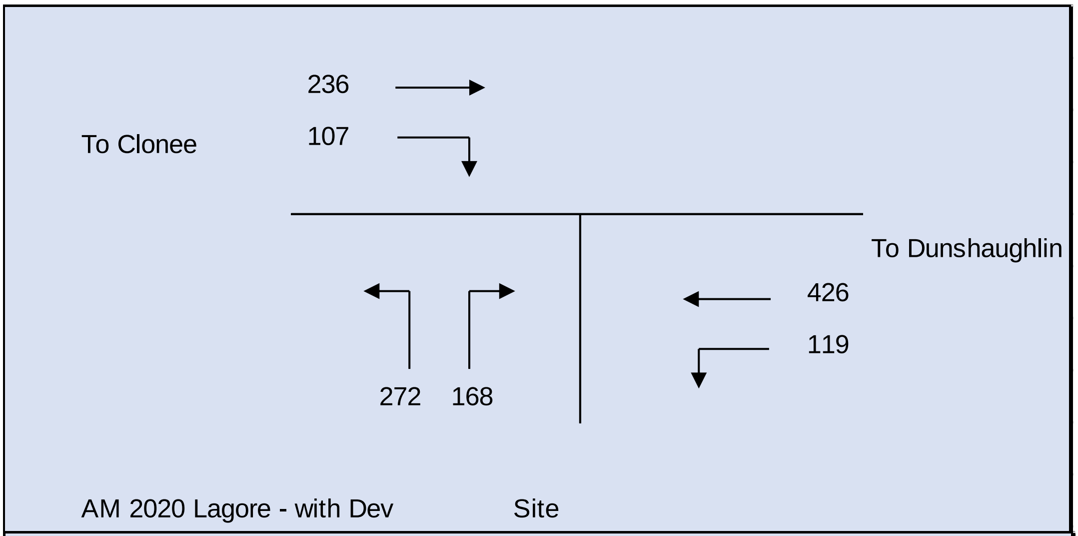


Figure 6.11: External Trip Generation with Lagore Road Link in Place

6.15 2020 Opening Year Scenario Estimated Traffic Flows with DORR

6.15.1 TII medium growth rates were used to estimate the increase to the reassigned background traffic for the 2020 Opening Year scenario. Figure 6.12 shows the estimated turning movements at the proposed R147/DORR junction for the 2020 Opening Year scenario.



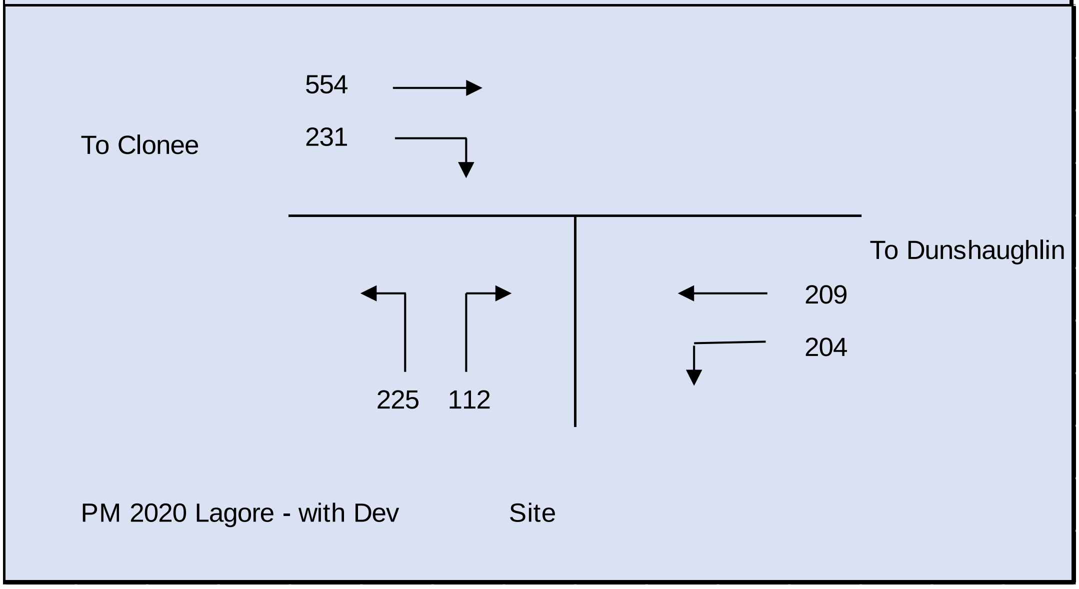


Figure 6.12: Opening Year 2020 Estimated Traffic Flows with DORR in Place and SHD Development

6.15.2 The PICADY results for the 2020 Opening Year with the full SHD development and DORR in place show that the proposed access arrangements operate satisfactorily and well within the design capacity of the junction (see Figure 6.13 and 6.14).

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-09:00	B-A	2.8	6.2	0.452	0	0.8	11	0.29
	B-C	4.54	8.39	0.541	0	1.14	15.6	0.25
	C-A	3.93	-	-	-	-	-	-
	C-B	1.78	9.33	0.191	0	0.23	3.4	0.13
	A-B	1.98	-	-	-	-	-	-
	A-C	7.11	-	-	-	-	-	-

Figure 6.13: AM Peak Hour PICADY Results Opening Year 2020 – with DORR in Place

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:00-18:00	B-A	1.86	5.41	0.344	0	0.51	7.1	0.28
	B-C	3.74	9.35	0.4	0	0.65	9.2	0.18
	C-A	9.22	-	-	-	-	-	-
	C-B	3.85	9.89	0.389	0	0.62	8.9	0.16
	A-B	3.4	-	-	-	-	-	-
	A-C	3.48	-	-	-	-	-	-

Figure 6.14: PM Peak Hour PICADY Results Opening Year 2020 – with DORR in Place

6.16 2035 Design Year Scenario Estimated Traffic Flows with DORR

6.16.1 TII medium growth rates were used to estimate the increase to the reassigned background traffic for the design year scenario (2035). Figure 6.15 shows the estimated turning movements at the proposed access junction for the design year scenarios with the DORR in place.

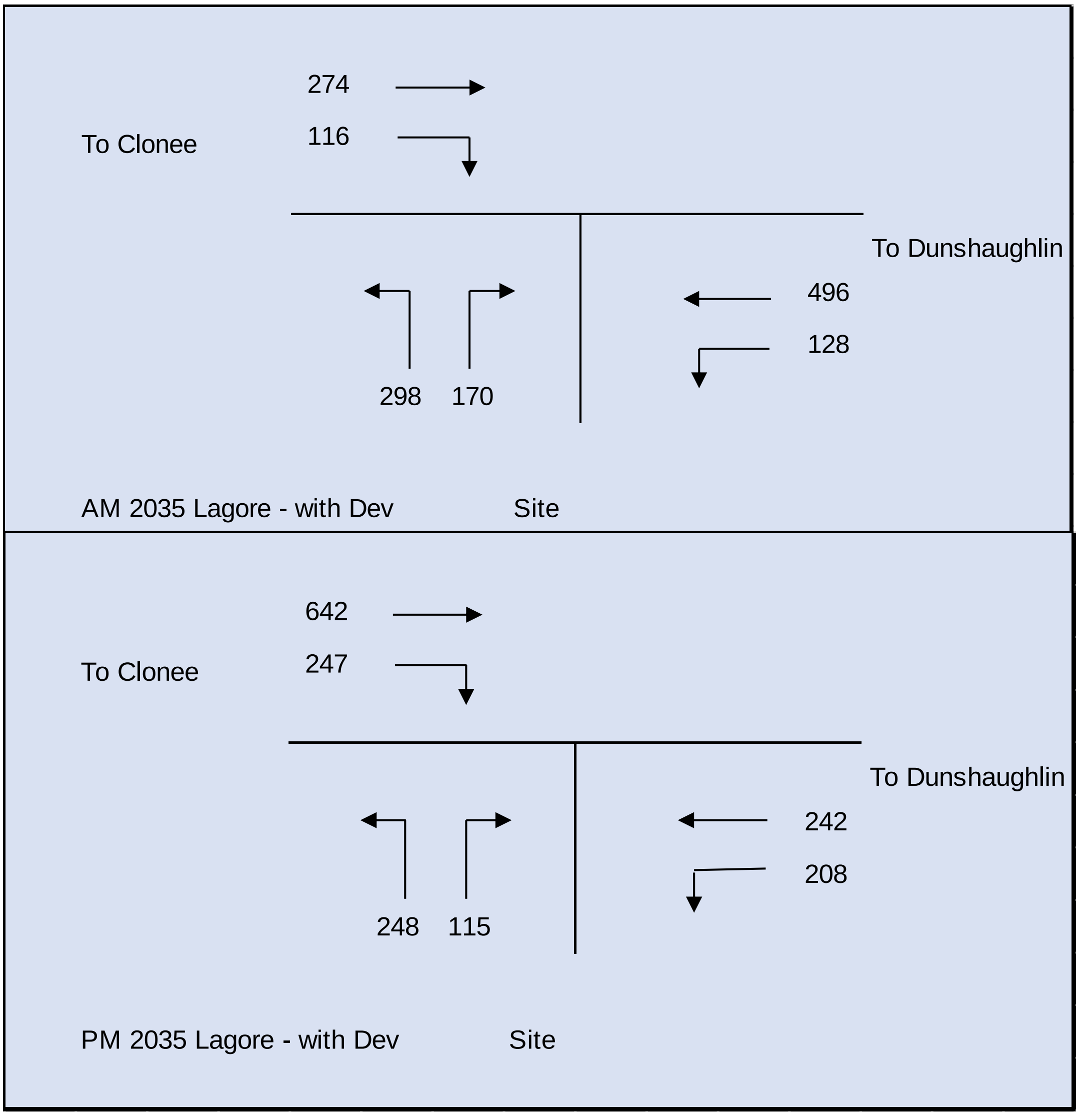


Figure 6.15: Design Year 2035 Estimated Traffic Flows with the DORR in Place

6.16.2 These traffic flows were input into the traffic model and the results are presented in Figures 6.17 and 6.18 for the AM and PM traffic peak periods.

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-09:00	B-A	2.84	5.75	0.494	0	0.93	12.7	0.33
	B-C	4.97	8.03	0.62	0	1.54	20.7	0.31
	C-A	4.56	-	-	-	-	-	-
	C-B	1.93	8.99	0.215	0	0.27	3.9	0.14
	A-B	2.13	-	-	-	-	-	-
	A-C	8.27	-	-	-	-	-	-

Figure 6.16: AM Peak Hour PICADY Results Design Year 2035 – with DORR in Place

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:00-18:00	B-A	1.91	4.95	0.386	0	0.61	8.4	0.32
	B-C	4.12	9.11	0.452	0	0.81	11.3	0.2
	C-A	10.7	-	-	-	-	-	-
	C-B	4.11	9.74	0.423	0	0.72	10.1	0.18
	A-B	3.47	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-

Figure 6.17: PM Peak Hour PICADY Results Design Year 2035 – with DORR in Place

6.16.3 This verifies that the proposed access arrangements operate satisfactorily and well within the design capacity of the junction with the DORR in place.

6.17 Further Sensitivity Test for Additional Development on Zoned Lands to North of Dunshaughlin

6.17.1 As part of the pre-planning discussion with MCC a further sensitivity test was requested to determine if the proposed DORR and SHD development could accommodate the additional zoned lands to the north of Dunshaughlin. It should be noted that the TII growth rate applied to the background traffic would account for future growth in any event.

6.17.2 In order to ensure a robust assessment a final scenario was developed with an additional 100 vehicles moving through the proposed access junction in both directions in the AM and PM peak hours along the DORR and the R147. This would represent a very significant additional development assumption for the area north of the town and when trip distribution is taken into consideration would be the equivalent traffic of an additional 600 to 700 residential units in this part of the town that might use this route. The results of the PICADY Analysis for this scenario are shown in Figures 6.18 & 6.19.

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-09:00	B-A	3.67	5.3	0.692	0	2.01	25.4	0.53
	B-C	5.8	7.43	0.78	0	3.05	37.7	0.5
	C-A	4.56	-	-	-	-	-	-
	C-B	2.77	8.57	0.323	0	0.47	6.7	0.17
	A-B	3.8	-	-	-	-	-	-
	A-C	8.26	-	-	-	-	-	-

Figure 6.18: 2035 AM Peak Sensitivity Test Results– with DORR & Additional Development in Place

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Start Queue (veh)	End Queue (veh)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:00-18:00	B-A	2.75	4.58	0.6	0	1.38	18	0.5
	B-C	4.96	8.5	0.584	0	1.34	18.3	0.27
	C-A	10.7	-	-	-	-	-	-
	C-B	4.95	9.52	0.52	0	1.05	14.6	0.21
	A-B	4.3	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-

Figure 6.19: 2035 PM Peak Sensitivity Test Results– with DORR and Additional Development in Place

6.17.3 The traffic analysis again demonstrates that the proposed DORR, with the full SHD development and assumed medium background traffic flow in place, would continue to operate within its design capacity.

6.18 Summary of TTA findings

6.18.1 A very wide and comprehensive set of scenarios have been tested. Many of the assumptions used in the assessment are very robust and represent a worst-case scenario in terms of likely traffic impacts. The results show comprehensively that the proposed road network can satisfactorily accommodate the proposed SHD development with or without the DORR in place. The impact of MMP measures or the planned school campus on the adjacent lands were not allowed for in the assessment. Therefore, the likely traffic impact of the overall SHD development is anticipated to be less than that assessed.

6.19 Wider Traffic Impacts

6.19.1 MCC as part of the pre-planning consultations, requested that ILTP consider the wider traffic impact of the proposed development, particularly in respect to a section of the R147 between Black Bull and Pace, which may be upgraded by MCC in the near future. MCC wished to ascertain the possible impact the proposed development may have on any future road upgrade plans and a possible suitable financial contribution that might be levied on the proposed development.

6.19.2 ILTP greed an assessment methodology with MCC and this is contained as Appendix A attached, which was also forwarded to MCC for their consideration. This analysis showed that, traffic flows along this section of the R147 had not increased in recent years and the proposed development would as a worse-case scenario contribute approximately an addition 7% of traffic at peak hour. The report proposed a pro-rata contribution to the planned road upgrade cost of this section of the R147.

6.20 Possible Phasing of Future Road Upgrades and Accommodation of Outer Relief Road

6.20.1 The preliminary assessment indicates that the current permitted access off the R147 has sufficient capacity to accommodate the entire development of the SHD lands. However, in order to better accommodate traffic movement to and from the SHD development it is proposed to include the proposed junction upgrade on the R147 to coincide with the occupation of Phase 2 of the SHD development.

6.20.2 In addition, the proposed access junction to the R147 is to be upgraded to a traffic signal-controlled junction in future by way of a planning condition attached to the Phase 1C permission. The layout of this traffic signal junction is currently being progressed with MCC. While the TTA analysis demonstrates that a traffic signal-controlled junction is not required at this location to facilitate the proposed SHD development it is most likely that the traffic signal junction will be constructed prior to the occupation of any of the SHD development.

6.20.3 It is proposed that the development will be delivered in three phases, which have been set out on the accompanying phasing drawing prepared by MCORM.

6.20.4 The first phase of development provides for the delivery of 369 no. residential units comprising of a mix of houses, apartments and duplex units, along with the largest area of open space in the east of the site, three pocket parks, the neighbourhood centre facilities within the development, and the east-west portion of the greenway. This first phase of development will also provide the majority of the extent of the Outer Relief Road along the eastern boundary of the site.

6.20.5 The second phase of development also provides for a mix of residential typologies, totalling 337 no. units., along with areas of open space including the town park, and the remaining extent of the greenway along the western and northern boundaries of the site. The second phase of development will also provide the link to the Kellet's Grove residential area to the north.

6.20.6 The final phase of development provides for 207 no. residential units, which also includes a broad range of sizes and typologies. This final phase will also see the completion of the stretch of the Outer Relief Road to the boundary of the applicant's landholding, with the remainder to be provided by way of a Part 8 development by the Local Authority.

6.20.7 As part of the pre-planning consultation with MCC the applicant has agreed to facilitate the construction of the Outer Relief Road within their land boundary following the approval of the SHD application. This will enable MCC to deliver the full section of the DORR from the R147 to Lagore Road via a Part 8 development at an earlier stage if they so wish.

7 MOBILITY MANAGEMENT MEASURES

7.1 Foreword

7.1.1 Technology advancements and the need to meet our legally binding international commitment on climate change means that radical changes in the way we travel are required. Also, car ownership models that exist today are set to change radically over the next decade. Unfortunately to date in Ireland we have been slow to plan for and embrace these opportunities and challenges. The penetration of EVs in just one example of where Ireland is already well behind the European norms in driving this change

7.1.2 As a nation, we are now facing significant financial penalties for failing to meet our climate change targets and if current trends continue the gap between our current emission level and 2020 targets is set to grow substantially.

7.2 Introduction to MMPs

7.2.1 A Mobility Management Plan (MMP) is a wide range of policies, programmes, services and products that influence how, why, when & where people travel to make travel behaviour more sustainable.

7.3 Overall MMP Approach

7.3.1 Figure 7.1 represents graphically the interlinking approaches and strategies utilised in the preparation of Mobility Management Plan. Within this MMP we have sought to consider transportation demand, transportation supply and land use.

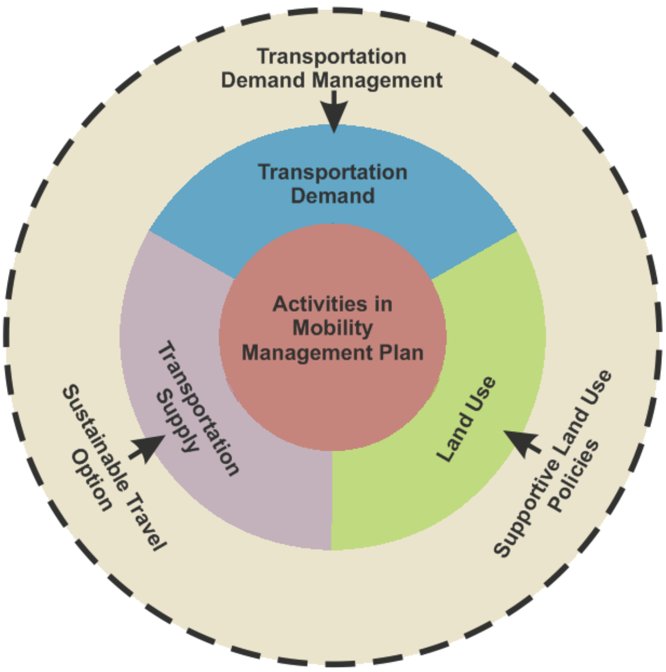


Figure 7.1: Mobility Management Plan Strategies

7.3.2 Mobility Management can be described, as a transport demand management mechanism that seeks to provide for the transportation needs of people and goods. It can be applied as a strategic demand management tool or as a site-specific tool measure. The aim is to reduce the demand for and use of cars by increasing the attractiveness and practicality of other modes of transport. Mobility Management encourages individuals, companies or institutions to satisfy their transport needs by the efficient and integrated use of available transport facilities.

7.3.3 The UK Dept. of Transport has produced a document entitled *'Making residential travel plans work – guidelines for new development'*." This document has guided the preparation and drafting of this MMP strategy. In addition, the DTO guideline document "*Route to Sustainable Commuting: an Employer's guide to travel plans*" and "*A Sustainable Transport Future*" produced by the Department of Transport have influenced the preparation of this MMP.

7.3.4 The use of MMP is an important element in meeting targets set down in the *Smarter Travel A Sustainable Transport Future.*

7.3.5 The Department of Transport published the policy document *Smarter Travel A Sustainable Transport Future – A New Transport Policy Document for Ireland 2009 –2020* in early 2009. This document sets down the policies and measures required to reduce travel demand and ensure that a far greater proportion of travel is done using sustainable modes of transport.

7.4 Objectives of Mobility Management Plan

7.4.1 A Mobility Management Plan would have the effect of reducing in overall terms both the number of trips generated by a particular development and would ensure that greater numbers use public transport. A mobility management strategy would therefore act as a form of mitigation by reducing the overall level of traffic that would be on the surrounding roads in the future.

7.4.2 This Mobility Management Plan includes provision for the appointment of a Mobility Manager, details of access to the appointed Mobility Manager by the residents in the development and a report submitted on an annual basis on the achievement of the actual travel behaviour relative to the objectives of the Mobility Management Plan

7.5 Mobility Management Plan Study Considerations

7.5.1 ILTP have undertaken a comprehensive study of the proposed future traffic management within the study area involved consideration of the following:

- Public Transport Network and future Upgrades
- Non-Motorised Transport and future Upgrades
- Car and Bicycle Parking

7.6 Preparation of Mobility Management Plan

7.6.1 Most fundamental to the ongoing success of sustainable travel initiatives is the appointment of a Mobility Manager for the apartment and retail elements of the overall development, which will ultimately come under the remit of the Management Company. This individual will be responsible for the delivery of the programme and will act as an interface between the various stakeholder groups within the development.

7.6.2 The Mobility Manager will also be involved in monitoring of the mode of travel from these developments. This ideally will be done on an annual basis. Monitoring of travel patterns will facilitate the provision of sustainable transport modes and ensure that once modal targets are met that there is no slippage and instead efforts are made to further improve the situation.

7.6.3 A Mobility Manager for the proposed residential development will be appointed after the completion and occupation of the first residential block. The Mobility Manager will have a role in promoting and monitoring the provisions of travel plans within the residential development.

7.6.4 The Mobility Manager will at the outset of the occupation of the first block of residential units implement several key measures. These will include

- Providing new residents with a Travel Welcome Pack giving full details of transport options, cycle/walking maps and information on local services
- Induction sessions for new households and follow up visits
- Instigate and regularly update a travel notice board in each of the blocks providing travel information. This may also be provided online subject to demand.
- Promote car share scheme within the development

7.7 Personalised Travel Planning

7.7.1 Alongside the roll-out of these innovative measures a travel plan will be implemented with the objective of developing a sustainable transportation and access policy for residents of the proposed development both during and after the construction.

7.7.2 The travel plan aims to create:

- Healthier, stress free and cheaper commutes to work and school for residents
- Manage travel options that provide realistic alternatives to single occupant car commuters
- More informed travel choices for residents
- Integration with other relevant initiatives such as the Green Schools Travel Programme and work-based mobility management plans

7.7.3 Central to the plan is the creation and communication of travel options available to all those accessing the proposed and planned developments.

7.7.4 Personalised Travel Planning Process. PTP is a three-stage process:

- An initial benchmark travel survey is conducted, within 12 months of first occupation;
- An Individual Marketing Campaign (IMC) is carried out;
- Finally, ongoing travel surveys to ensure that outcomes are monitored, and additional measures put in place in line with technological advancements.

7.8 Application of Personalised Travel Planning

7.8.1 In order to maximise its effectiveness, it should be implemented from the outset of the scheme in order to establish sustainable travel patterns at an early stage. A detailed PTP will need to be established and agreed between the developers of the scheme, the Council and any other relevant bodies, all of whom will have a stake in the initiative. Broadly it will include the following elements:

7.8.2 **Personalised Travel Marketing Programme -** A marketing programme that will assess the targets of the programme, the most appropriate means of delivering those targets and a system of ongoing monitoring, feedback and improvement;

7.8.3 **Information tailoring and provision -** The success of the scheme is based on the provision of tailored and relevant information to each user.

7.8.4 **Incentivisation -** As part of a marketing strategy, incentives can be organised to promote increased use of public transport and promote the financial benefits of becoming a non-car owning household.

7.8.5 **Monitoring -** In order to measure the success of the scheme entire as well as individual initiatives within the scheme, regular monitoring and evaluation against key performance indicators should be undertaken. This will be done on an annual basis.

7.8.6 **Formulation of individual initiatives -** The overall programme will be a composite of several sub-initiatives, as deemed appropriate to the local area. These may include, among others, all or some of the following: -

- Car-sharing / GoCar/ Travel Club initiatives;
- Cycle/ Walk to work initiatives;
- Walk to School initiatives;
- PT Incentivisation schemes
- Tele-working initiatives
- Cycle training
- Community Travel Forum

7.9 Evaluation and Reporting

7.9.1 The functioning of the Mobility Management Plan will be overseen on an ongoing basis. This will ensure that travel notice boards are kept up to date and that new residents are provided with travel packs and a full induction session.

7.9.2 More formal measurement of the travel behaviour will be undertaken on an annual basis. This will determine if the objectives of the Mobility Management Plan are being met. Input from the local authority and the Management Company will be sought.

7.9.3 Following on from this analysis measures required to remedy any deficiencies will be identified and implemented.

7.9.4 All new homes will also have Electric Vehicle (EV) charge points installed to promote the greater use of zero carbon travel in accordance with Government Policies on climate change and in anticipation of a major growth in EV and Plug-in Hybrid Electric Vehicles(PHEVs). The suitability of using GoCars of other car sharing initiatives will also be considered.

7.10 Conclusion

7.10.1 Establishing sustainable travel patterns from the outset in a new development in essential. It is well recognised that achieving subsequent changes to more sustainable travel is both difficult and costly to implement and can take years to achieve. The promotion of travel mode change in favour of sustainable mode and greater PT usage is a long-standing policy objective at national and local level. However, in most areas, other than city centre locations, the outcomes have generally been disappointing as evidenced by the resent CSO data due to the lack of existing public transport. Dunshaughlin and the proposed SHD development by contrast is fortunate to have very good PT service already available.

7.10.2 Mobility Management Plans are a transport demand management mechanism that aims to provide for the transport needs of people and goods. Mobility Management Plans seek to lessen the demand for and use of cars by increasing the attractiveness and practicality of other modes of transport.

7.10.3 For successful Mobility Management Plan, monitoring and updating of the plan is required from time to time. Different strategies can be adopted for the monitoring and updates of the Mobility Management Plans should occur on regular basis after occupation of the development.

7.10.4 The essential elements of a MMP are the making more sustainable travel modes more attractive, managing all the travel demands created by a development and constantly evaluating practices in search of a more efficient approach.

7.10.5 Central to this is the development of a Personalised Travel Plan for each apartment and the appointment of a Mobility Management Officer to monitor and promote sustainable travel modes and to introduce further initiatives that are emerging elsewhere.

8 SUMMARY & CONCLUSIONS

8.1 Summary

8.1.1 ILTP Consulting were engaged by Rockture 1 Limited to carry out a Traffic and Transport Assessment and Mobility Management Plan for a proposed SHD residential housing and neighbourhood centre development in Dunshaughlin, Co. Meath.

8.1.2 This scheme proposed follows on from previously permitted development on the lands and a current live planning application. The overall proposed SHD layout therefore has full regard to these existing and proposed developments to ensure a fully integrated and sustainable development.

8.1.3 The lands form part of the overall zoned lands within Dunshaughlin and are bounded to the north by existing residential development, with employment lands located immediately to the east and west of the proposed development, and a planned future education campus to the west.

8.1.4 Phase 1A (Planning ref. DA060537 as amended by Planning ref. DA/130709) has been partly implemented and is under construction.

8.1.5 Phase 1B of the development was also recently permitted as Planning ref. RA170407 and included permission for a new priority junction off the R147 and construction of a new access road. The 92 no. dwellings permitted as part of Phase 1B have also been included in the assessment.

8.1.6 The Phase 1C development, also recently permitted, (Planning ref. RA171416) comprises 96 no. residential units and also includes the construction of a Childcare Facility with a GFA of 520sq.m. A new access to serve this childcare facility is also proposed which allows for future access to lands to the north currently zoned for employment uses. The application is currently at the Further Information stage.

8.1.7 The site in question is primarily zoned A2: *"To provide for new residential communities with ancillary community facilities, neighbourhood facilities and employment uses as considered appropriate for the status of the centre in Settlement Hierarchy."*

8.1.8 Prior to undertaking the TTA detailed pre-planning discussions took place between the applicant and the planning authority. ILTP also undertook further consultations with the Roads Planning section of MCC to ensure that the proposed development fully accorded with DMURS and other design guidance in terms of overall design layout and to ensure that the development provided good permeability and fully integrated with the existing development patterns within Dunshaughlin.

8.1.9 Central to the overall design approach was firstly to ensure that the needs of pedestrians and cyclist were given priority. The proposed cycle and pedestrian network gives excellent connection to the existing town centre and proposed neighbourhood centre to ensure that all local trips can be made using these sustainable travel modes.

8.1.10 These proposed routes also link directly to an existing residential development to the north and permitted development to the south of the subject lands as well as providing linkage to existing employment lands to the east of the development. These routes will also provide excellent links to planned playing fields to the east of the site and to the existing public transport facilities to the south of the development.

8.1.11 A proposed Education campus is now planned for the lands to the west of the SHD lands and Heads of Agreement are in place with the Department of Education to deliver same. The location of the education campus would further enhance the overall SHD development and reduce the overall traffic impact of the development. The TTA however as a worst-case scenario have not allowed for this development proceeding in the immediate future.

8.1.12 The overall development will, once completed, accord with best practice in terms of permeability and sustainability.

8.1.13 There are also excellent bus facilities adjacent to the site for public transport users travelling to and from Navan, Dublin Airport, Trim, major employment centres along the R147 (e.g. Blanchardstown & Ballycoolin) and the M50/Dublin. There are currently bus frequencies of 10-minute intervals along the R147 in the AM peak, which is on a par with many major urban centres. Local bus services to Ratoath and a special bus service to Maynooth University are also available. The proposed development also proposes new bus stops on the R147 in very close proximity to this proposed development, which links with the internal cycle and walking network.

8.1.14 The Proposed SHD development has also allowed for the completion of a future link road (DORR) connecting the R147 to the Lagore Road to the north in accordance with the CDP.

8.1.15 The portion of the link road included in the SHD application also allows for the future provision of bus services along this link road, with bus stops and lay-bys provided. These are appropriately located close to the proposed new residential development and neighbourhood centre. They can also serve the future planned playing pitches and zoned employment lands to the east. Therefore, full regard was given to the sustainable development of the wider area.

8.1.16 The design layout for the proposed access and internal road layouts are in accordance with DMURS. In addition, the internal road layouts have been developed in a manner that puts the car at a lower order within the overall development. This was achieved by ensuring the access points are separate for the main pedestrian and cycle routes where feasible.

8.1.17 All the internal roads and streets will have 30kph speed limits. The proposed pedestrian and cycle routes provide direct linkage to all major destinations, while the car traffic is required to take more circuitous routes to key focal points within the development.

8.1.18 This design approach is fully in accordance with the principles set out in DMURS, the National Cycle Design Manual and other design guidance. More important is that the entire urban layout actively promote the use of the more sustainable travel modes.

8.1.19 ILTP carried out detailed manual classified traffic counts and site visits in January 2018 to determine both the existing patterns of traffic in the area and also to enable ILTP to forecast the traffic changes that will also occur in Dunshaughlin once the link to the Lagore road is completed. The results of the survey show that the traffic flows at the site are tidal with distinct morning and evening flows.

8.1.20 The final TTA will assess the traffic impact of the overall development without and with the link to the Lagore Road in place. The assessment shows that without the DORR link in place the proposed development can be satisfactorily accommodated on the adjacent road network by an upgrade of the existing permitted access on to the R147, which includes an additional widening to allow for left and right turn movements form the proposed access road.

8.1.21 The assessment impact of the development with the DORR in place demonstrates that the provision of this link will have a neutral if not positive overall impact in terms of traffic impact as this new link, once complete, will offer better route choice for traffic from the proposed SHD development lands and existing and future traffic in Dunshaughlin. For example, this link will give more route choice for existing traffic in Dunshaughlin to access the wider road network and avoiding the town centre. The link will also give more direct access to the R125 route to Ratoath and the Airport and thus reduce the traffic impact of the proposed SHD development on the existing town centre.

8.1.22 In addition, the proposed link will also offer the opportunity to introduce new local bus services to Dunshaughlin or to re-route existing services, to better serve the residents of the SHD lands and other parts of Dunshaughlin.

8.1.23 ILTP also carried out a stress test analysis on the proposed access junction using a future year scenario. The results of this stress test showed that the proposed access junction still had sufficient spare capacity to deal with the increased traffic generated by the future development of the area.

8.1.24 An MMP has also been prepared setting out the initiatives that can be implemented to foster greater use of walking, cycle and PT modes of travel. The suitability of GoCars or other car sharing initiatives will also be considered.

8.1.25 All new homes will also have Electric Vehicle (EV) charge points allowed for to promote the greater use of zero carbon travel in accordance with Government Policies on climate change and in anticipation of a major growth in EV and Plug-in Hybrid Electric Vehicles (PHEVs).

8.2 Conclusions

8.2.1 The proposed SHD development forms a logical extension to Dunshaughlin that promotes walking and cycling by virtue of its location and design. The proposed SHD development is also located along an excellent existing transport network. There are significant planned improvements to the cycle, bus and rail network as set out in the NTA current strategy for cycle and bus improvement and by the Regional Assembly in their Draft RSES as outlined in this report. This includes specific a policy objective the upgrade the Pace (M3 Parkway) rail line to a DART service and plans for a future rail link extension to Dunshaughlin and Navan.

8.2.2 The proposed SHD development has been purposely designed to promote cycle and walking as the preferred travel mode for shorter trips as well as to support existing and future planned public transport improvement for the area.

8.2.3 These networks will also provide improved connectivity from existing and planned developments to the town centre, employment lands, an adjacent planned educational campus with the proposed neighbourhood centre and future playing pitches. These will also provide improved linkage to the excellent PT services that already exist, with further improvements for future PT facilities included for, as part of the overall development concept.

8.2.4 The TTA demonstrates that the existing road network has sufficient capacity and can accommodate the proposed SHD development, both with and without the potential future Lagore Road Link (DORR) in place.

8.2.5 The internal road layout fully accords with the DMURS and other design guidance. In addition, the overall internal layout of the proposed development has been designed to ensure high levels of permeability. not just to serve the SHD development. but also to serve existing and planned development in the area.

8.2.6 The proposed SHD development will therefore significantly improve cycle and walking access for those who will live in the new development and also for existing adjacent residential areas to the town centre, to existing and future Public Transport facilities, and to future planned employment, education and recreational facilities. The proposed development therefore offers significant planning gain in terms of promoting permeability within Dunshaughlin and in improving access to Public Transport services.

A APPENDIX A - PROPOSED CONTRIBUTION TO WIDER TRAFFIC IMPACT OF PROPOSED DUNSHAUGHLIN EAST SHD DEVELOPMENT

Proposed Contribution to Wider Traffic Impact of Proposed Dunshaughlin East SHD Development

Date:

10 Dec 2018

Author:

Ben Waite

Approved By:

Christy O'Sullivan

ILTP Project Code & Reference:

DUNSGEMTIA

Distribution:

Joe McGarvey **Meath County Council**

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1 INTRODUCTION

1.1 Background to Report

1.1.1 ILTP Consulting were engaged by Rockture 1 Limited to carry out a Traffic and Transportation Assessment for a proposed residential housing development located on the R147 outside Dunshaughlin Village in Co. Meath.

1.1.2 ILTP met with the Roads Planning Section of MCC to discuss the likely wider traffic impact of the proposed development. In particular MCC wanted to establish the likely traffic impacts the scheme may have had on the section of the R147 between Black Bull and Paces roundabouts as MCC were in the process of considering upgrades to the R147 between Black Bull and Pace.

1.2 Agreed Methodology for Consideration of Possible Contribution to Wider Road Upgrades

1.2.1 ILTP set out and agreed with MCC a methodology of assessing the likely traffic impacts. This would be based on the net traffic generations that the SHD scheme would have on this heavily trafficked section of road assuming the full build out of the SHD was completed.

1.2.2 ILTP agreed to set out the general traffic growth rates on the R147 in the area and to determine the pro-rata traffic impact that the proposed development may have on the section of the R147 between Black Bull and Pace.

1.3 Site Visit and Traffic Surveys

1.3.1 ILTP carried out a series of site visits and undertook AM & PM peak hour traffic counts in January 2018 as part of this assessment.

1.3.2 Site visits and detailed Manual Classified Traffic Counts were undertaken in January 2018 at a number of locations in Dunshaughlin to determine the existing patterns of traffic in the area following consultation with MCC. The locations of these traffic counts are shown in Figure 1.1. The results of the counts enabled ILTP to forecast the traffic changes that will occur in Dunshaughlin along the R147 once the overall development is completed.

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tel: 01-8255700 fax: 01-8255730
www.iltp.ie info@iltp.ie

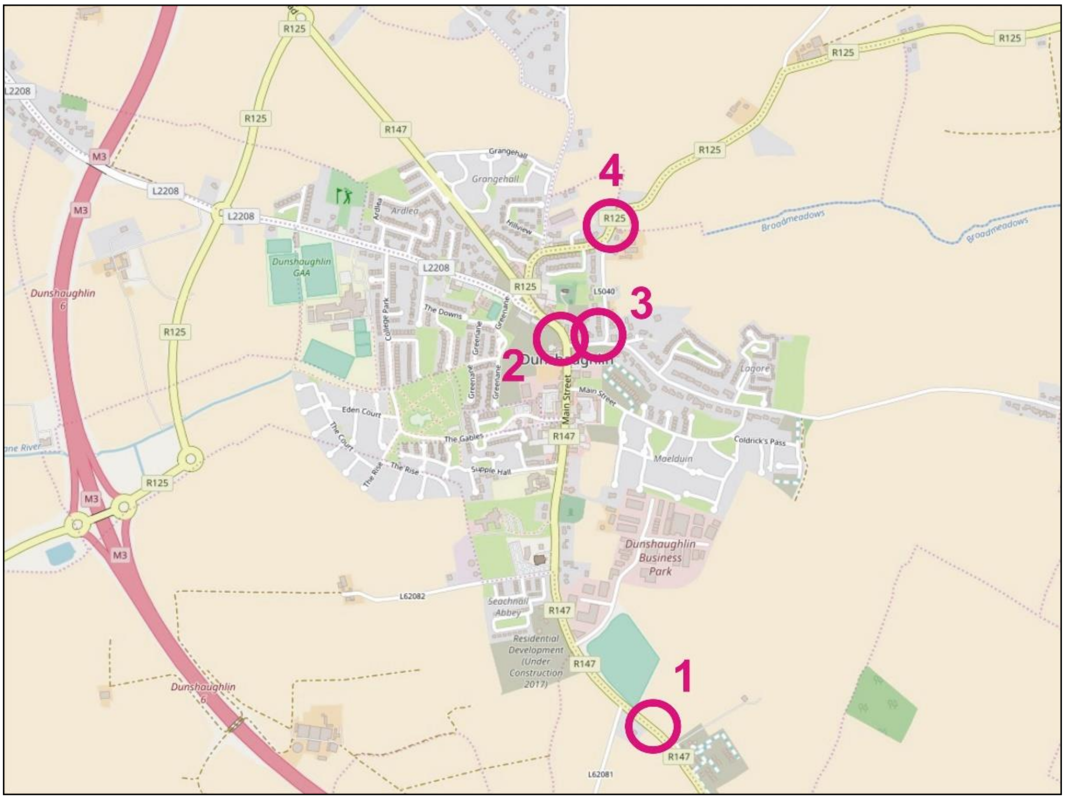

Figure 1.1: 2018 Traffic Count Locations

1.3.3 The results of the Manual Classified Traffic Counts for the AM and PM peak periods are displayed in Figures 1.2 and 1.3. The results of the survey show that the traffic flows at the site are tidal with distinct morning and evening flows.

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tel: 01-8255700 fax: 01-8255730
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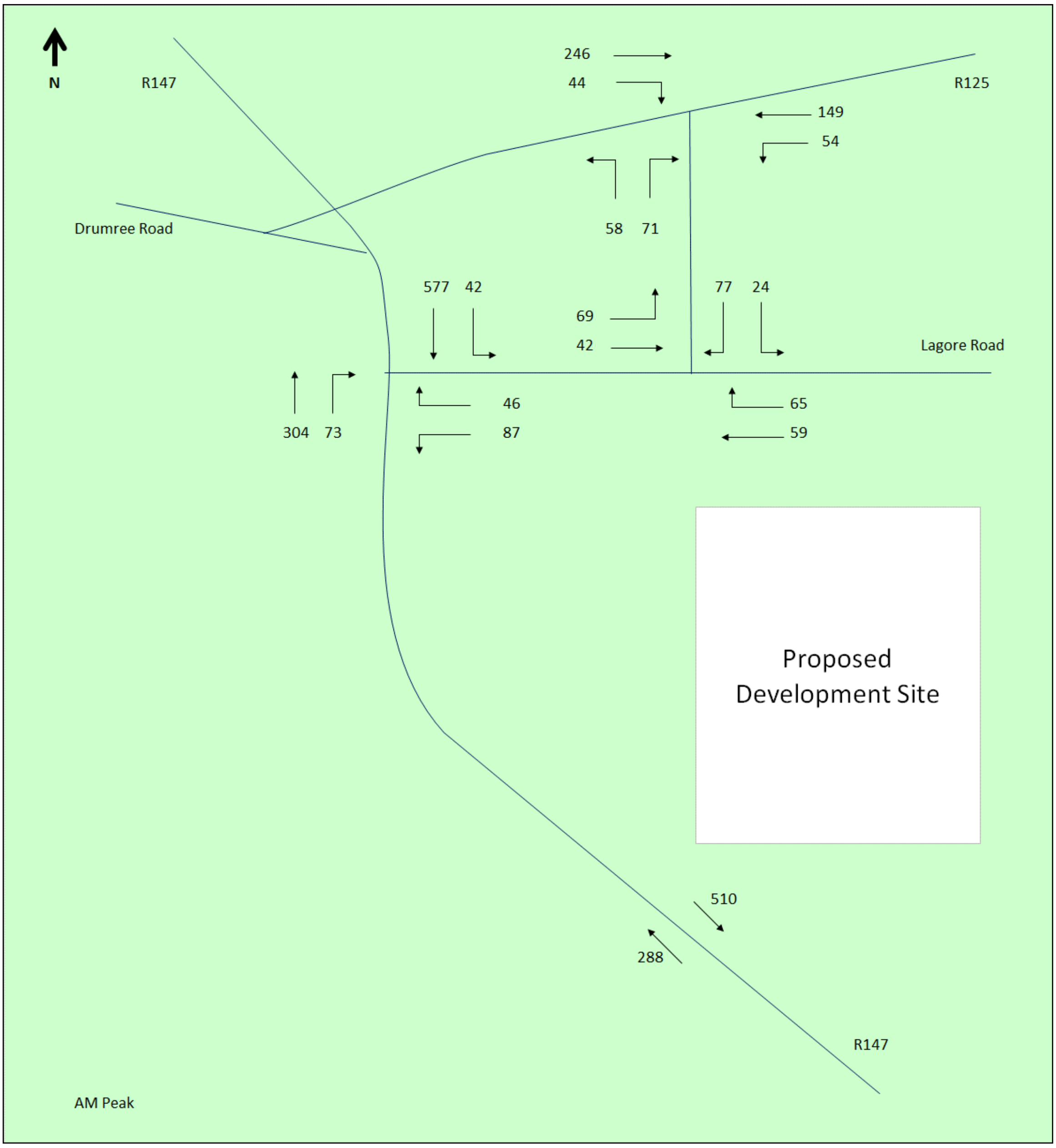

Figure 1.2: AM Peak Manual Classified Traffic Count Results January 2018

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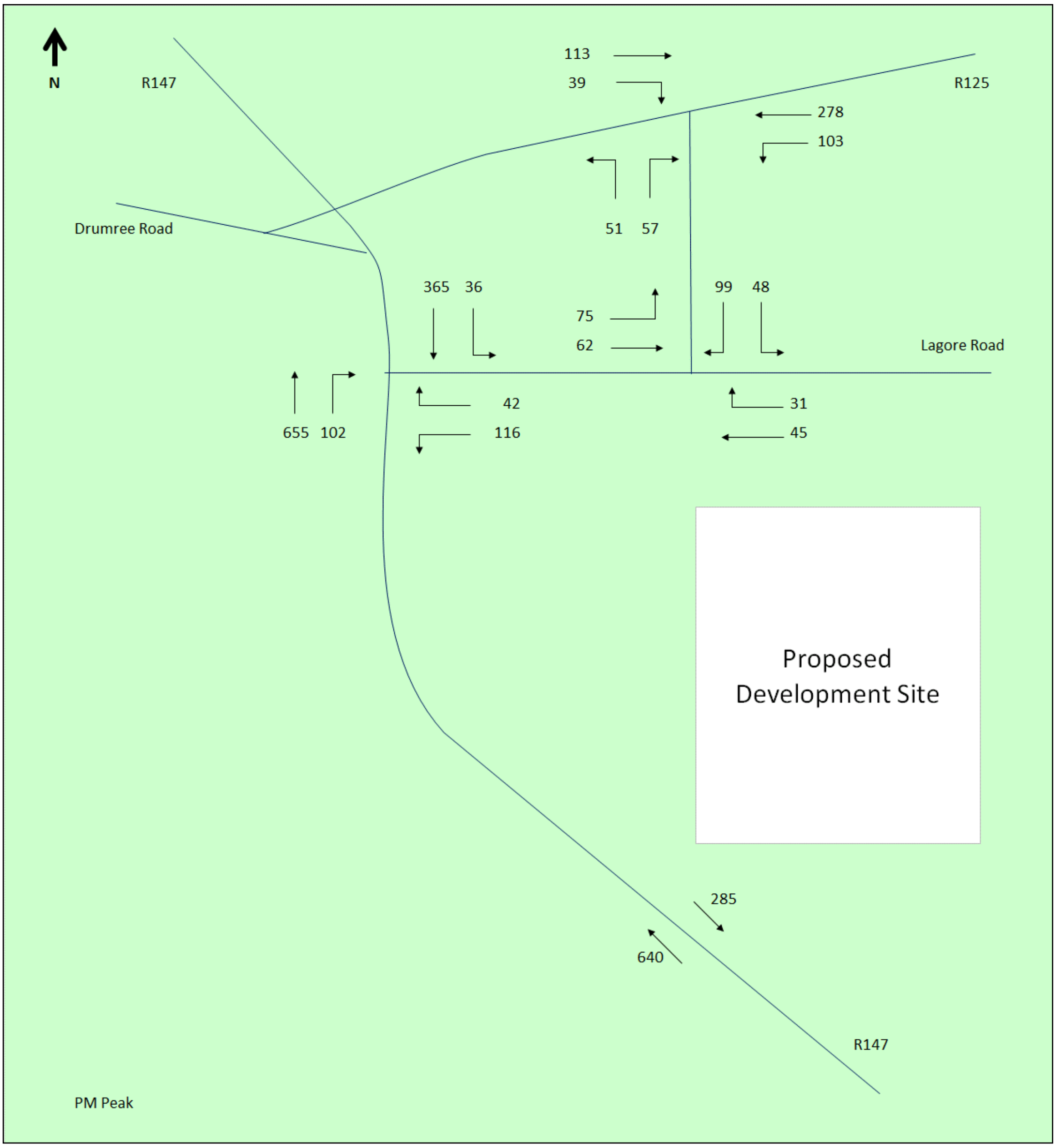

Figure 1.3: PM Peak Manual Classified Traffic Count Results January 2018

1.3.4 The level of two-way traffic recorded on the R147 is between 800 and 900 Vehicles per Hour (VPH) in the AM and PM peaks respectively. These peak traffic flows are therefore well within the overall design capacity of the R147.

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tel: 01-8255700 fax: 01-8255730
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1.4 Traffic Impact with full SHD Development in Place

1.4.1 Following a number of meetings with the Roads Planning Section the following scenarios were tested to provide a robust assessment of the traffic impact on the proposed development both with and without the DORR (Dunshaughlin Outer Relief Road) in place. The full details of the SHD assessment are set out in the TTA accompanying the application to the Board. The following is the relevant extracts from same to consideration of a possible contribution to wider traffic improvement works in the area. Note the DORR will have no material impact on the number of trips using the R147 south of the development.

1.4.2 The following worse case scenarios were tested:

- Full SHD Developed by 2020 Opening Year without DORR Link
- Existing permitted phases of development also added to traffic growth forecasts
- Note DORR has no material impact on trips south on R147

1.4.3 The resulting turning movements at the R147/Access Road, with the full development of the lands and without DORR are illustrated in Figure 1.4.

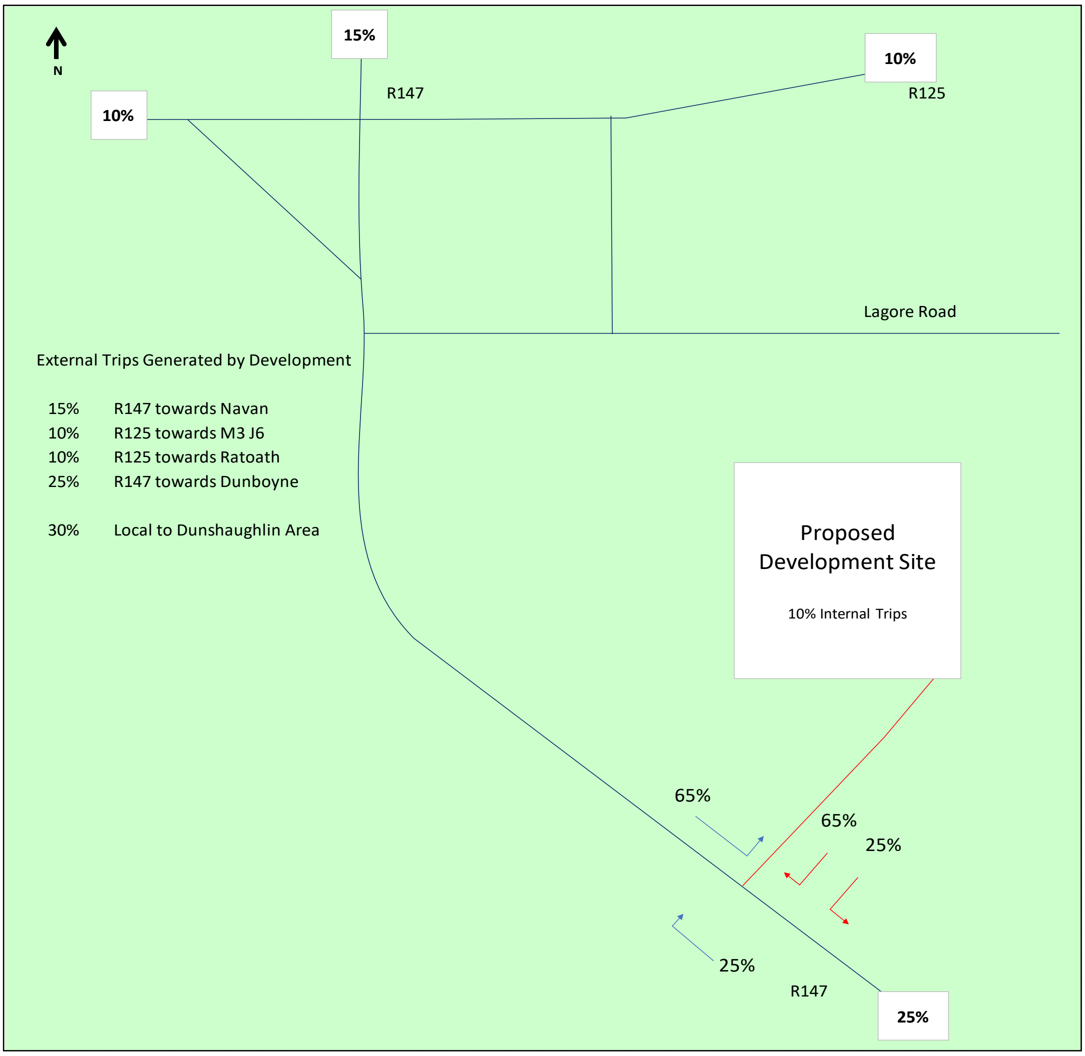

Figure 1.4 Assumed Trip Distribution – From TTA for SHD

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www.iltp.ie info@iltp.ie

1.5 External Only Trip Distribution on to R147 Southbound

1.5.1 The TTA set out the full rational for the trip distributions used in this assessment. The full TTA will accompany the SHD planning application.

1.5.2 It was conservatively assumed that 90% of all trips would be external to the development, while only 10% of trips assumed to be internal.

1.5.3 In addition, it is assumed that 30% of trips would be local to Dunshaughlin. This accounts for local school, shopping and work trips. Again, a conservative estimate.

1.5.4 The remaining 60% of trips external to Dunshaughlin are assumed to he distributed as follows:

- 15% travel to and from Navan
- 10% towards trim and M3
- 10% towards Ratoath, Ashbourne and Airport.
- 25% travel on R147 southbound.

1.5.5 Therefore, the TTA assumes that of the external, 40% of these would travel to and from the development along the R147 south of the development.

1.6 2020 Opening Year Scenario Estimated Traffic Flows – SHD and Permitted development on Client Lands

1.6.1 Figure 1.5 shows the estimated turning movements at the proposed access junction to the SHD lands/R147 for the opening year scenario assuming full build out of SHD lands and the other permitted development on client lands.

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tel: 01-8255700 fax: 01-8255730
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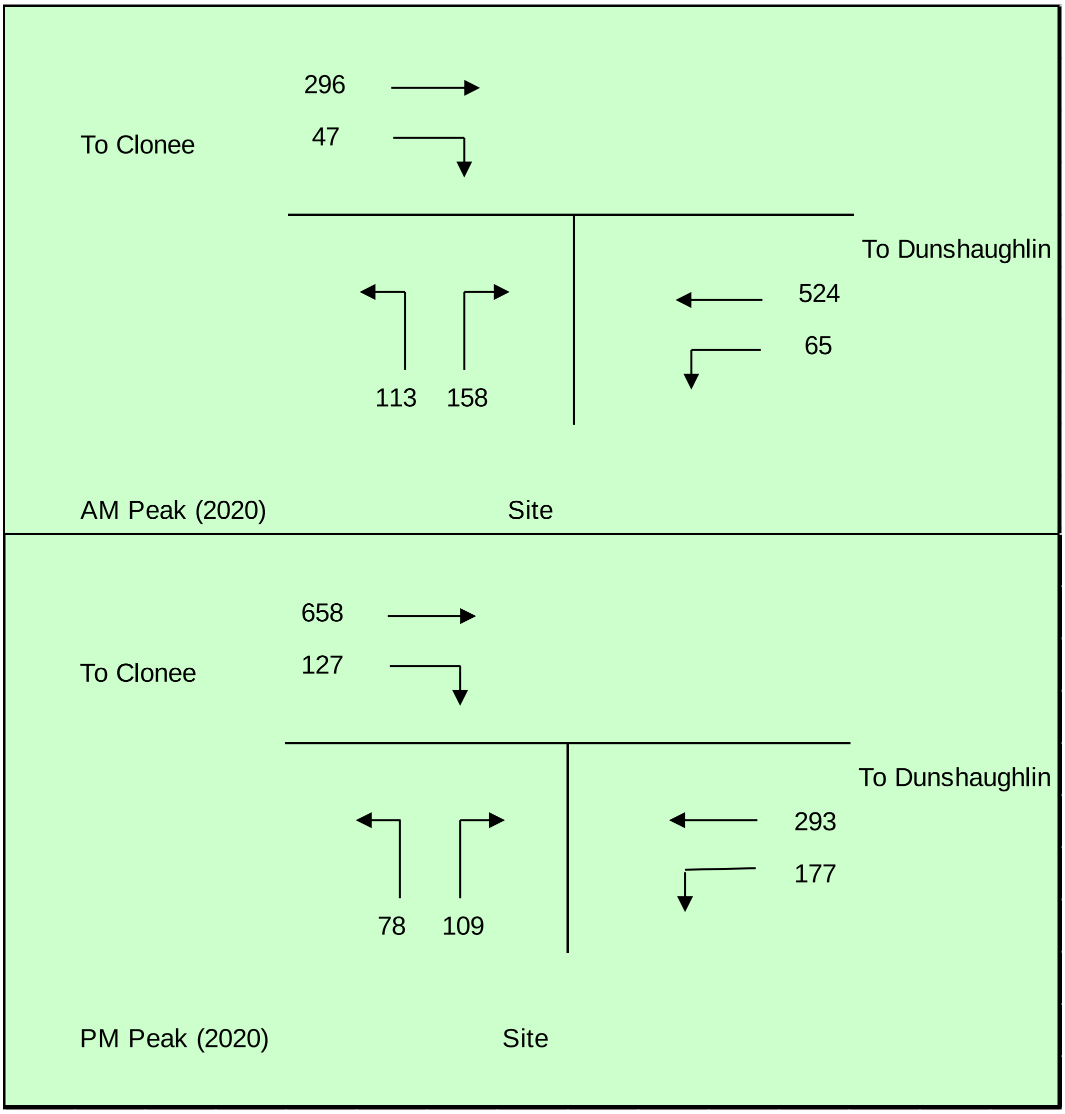

Figure 1.5: Opening Year Estimated External Traffic Flows AM and PM Peak Hour

1.6.2 The TTA sets out the overall traffic assessment methodology and results. The above traffic flows extract show two-way traffic flow increase along the R147 south of the access junction of 160VPH in the AM peak and 205VPH in the PM peak.

1.7 Traffic Impact on R147 between Blackbull and Pace – Worse - Case Scenario

1.7.1 Clearly traffic flows will dissipate as it travels south along the R147. In addition, some trips on reaching the Blackbull junction will travel towards Trim and Ratoath and not travel along the more heavily trafficked section of the R147 to Pace. As a worse case scenario it was assumed that 70% of these trips would use the section of the R147 between Blackbull and Pace.

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1.8 TII Traffic Counter Data – Results and Traffic Growth Trends in the Area

1.8.1 Traffic count data from the TII traffic website, which continually records traffic data, is available at a number of sites that are relevant to the development and the R147 in particular south of the proposed development lands. These provide annual, monthly, daily and hourly traffic flow data.

1.8.2 Table 1.1 summarises the traffic recorded on the R147 between Dunshaughlin and the Black Bull Interchange.

Table 1.1 – Data from TII Counter on R147 between Black Bull Interchange and Dunshaughlin, Co. Meath

	2018	2017	2016	2015	2014
AADT	8472	8512	8400	8333	8287
% HGV	2.50%	2.50%	2.50%	2.70%	2.60%

1.8.3 This table shows that between 2014 and 2018 (to date) traffic flows on this section of road has not increased significantly, despite significant development occurring in the area. The data also shows that in recent years the rate of growth in traffic flows has grown very slightly and has in fact shown a slight reduction on traffic along this section of the R147 in the past year.

1.8.4 With regard to traffic flows on the section of the R147 between the Black Bull Interchange and the Pace Interchange, traffic flows are substantially higher on this section of the R147 as a result of traffic for Trim and Ratoath accessing the R147 at Black Bull as set put in Table 1.2.

Table 1.2 – Data from TII Counter on R147 South of Blackbull, Co. Meath

	2017	2016	2015	2014	2013
AADT	19232	19899	19020	19481	19339
% HGV	7.00%	6.40%	5.40%	5.30%	3.70%

1.8.5 However, the traffic flows on this section of the R147 also show that traffic flows have not increased in recent years and were at 2013 levels in 2017. Note 2018 data was not available due to the loop outages at this recording station. However, it is likely that, based on the upstream traffic flows recorded along the R147, as set out in Table 1.1, that the traffic flows on the section between Blackbull and Pace have not increased by any material level during 2018 also. In overall terms traffic has shown little if any growth on this section of the R147 in recent years.

1.8.6 Table 1.3 shows the traffic flows on the M3 north of the Toll Plaza for the same time period. This shows significant year on year traffic flow increases on the M3 motorway, but at a reducing rate in recent years. This suggests that the traffic flows along this corridor toward the employment centres in Blanchardstown, Ballycoolin and along the M50 are occurring on the motorway rather than the local road network. The overall lower growth rates along the R147 is also reflective of the good public transport links available in the area that provide alternative means of travel to the private car.

St. Albert's House Dunboyne Co. Meath
tel: 01-8255700 fax: 01-8255730
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Table 1.3 – Data from TII Counter on M3 North of Toll Plaza

	2018	2017	2016	2015	2014
AADT	20792	19458	18064	16700	15382

1.8.7 This trend of traffic increasing on major new routes as opposed to the local road network is to be expected as the reserve capacity of the M3 means that this route can accommodate increased traffic without experiencing additional delays, whereas any traffic increase along the local road network tends to result in increased delays and journey time variability.

1.8.8 While the foregoing shows no traffic growth along the R147 in recent years, ILTP have assessed the impact that additional traffic from the full development might have on the R147 based on the robust assumption of 70% of traffic travelling southbound from the proposed SHD development would use the section of the R147 between Black Bull and Pace.

1.9 Contribution Methodology

1.9.1 To derive an appropriate contribution that MCC might base a levy by way of special contribution it was agreed to consider the likely external traffic impact the proposed SHD development might have on the section of the R147 between Black Bull and Pace, which is the heaviest trafficked part of the route and the section MCC are considering upgrading.

1.9.2 The 2016 TII data is the last year for which full annual data is available for this site and this was deemed a suitable base line to assess the relative increase that the proposed SHD development might have on this part of the network as a proxy of the wider traffic impact and consideration of an appropriate contribution for MCC to consider. In addition, the November 2016 traffic data was used as November is normally regarded as a neutral month in terms of recorded traffic flows. The TII recorded traffic flows on the R147 between Black Bull and Pace are shown in Table 1.4.

1.9.3 These show the hourly and daily averages for the month for both the average weekday and for average working days. In traffic terms the proposed SHD development will have the greatest traffic impact during the AM and PM Peak Hour periods during work days. Therefore, the AM peak hour on a work day was shown to occur between 07:00 and 08:00hrs with recorded flows of 1698vph. The equivalent PM figure recorded was 1948vph and occurred between 17:00 and 18:00hrs on workdays.

St. Albert's House Dunboyne Co. Meath
tel: 01-8255700 fax: 01-8255730
www.iltp.ie info@iltp.ie

Monthly Volume Report NRA 000000001037 2016-11-01 to 2016-11-30

Site Name	TMU R147 000.0 S
Site ID	000000001037
Grid	301379245340
Description	Co. Meath
Setup	N3 1037
Channel	Each Direction
Time Period	1 hour
Class	Any
Exclude data:	None

All directions			
	Average		Total
	Workday	7 Day	Count
00:00:00	112	133	3960
01:00:00	57	78	2307
02:00:00	34	50	1462
03:00:00	46	52	1562
04:00:00	102	97	2916
05:00:00	268	223	6774
06:00:00	1181	919	28105
07:00:00	1698	1333	40706
08:00:00	1680	1359	41418
09:00:00	1329	1175	35569
10:00:00	1043	1038	31153
11:00:00	1044	1110	33156
12:00:00	1094	1188	35448
13:00:00	1175	1284	38308
14:00:00	1244	1310	39167
15:00:00	1401	1382	41486
16:00:00	1775	1633	49288
17:00:00	1948	1720	52051
18:00:00	1688	1482	44866
19:00:00	1135	1035	31238
20:00:00	745	695	20953
21:00:00	551	501	15131
22:00:00	374	349	10516
23:00:00	231	224	6729
07-19	17117	16014	482616
06-22	20729	19164	578043
06-24	21334	19736	595288
00-24	21953	20370	614269
am Peak	07:00:00	08:00:00	
Peak Volume	1698	1359	
pm Peak	17:00:00	17:00:00	
Peak Volume	1948	1720	

Table 1.4: TII Traffic Count Data November 2016, between Blackbull and Pace

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tel: 01-8255700 fax: 01-8255730
www.iltp.ie info@iltp.ie

1.10 Resultant Traffic Impact and Pro Rata Contribution to Possible Road Improvements

1.10.1 MCC advised that the likely cost of roadwork upgrade that may arise in the area is estimated to be of the order of €700,000. It was agreed that an equitable contribution would be a pro-rate estimate of the cost of these upgrade works based on the likely traffic increase the proposed SDH and associated development might have on this section of road, based on the foregoing data analysis.

1.10.2 Table 1.5 sets out the relative traffic impact that could arise with 100% and 70% of the traffic traveling along the R147 south of the development. The 70% figure was agreed as the appropriate proportion if development traffic that would use the heaviest trafficked section of the R147 and the section requiring upgrade.

Table 1.5 Contribution Proposals for Proposed Upgrades of Wider Road Network Resulting from the proposed SHD Development

	Two-way Additional Flows	TII Counter November 2016	Traffic Increase at Black Bull	Percentage of Upgrade Cost (€700k)
AM Peak Hour Dev Traffic R147 South	160 VPH	1,698	9.40%	€64k
AM Assume 70% use R147 Black Bull to Pace	112 VPH	1,698	6.60%	€49k
PM Peak Hour Dev Traffic R147 South	205 VPH	1,948	9.50%	€64k
PM Assume 70% use R147 Black Bull to Pace	144 VPH	1,948	7.40%	€50k

Cost Estimate Upgrade Cost	**€700k**
Average Peak Hour Traffic via Black Bull	**7%**
Contribution	**€49k**

1.10.3 Based on the forgoing the traffic from the proposed development would have an estimated 6.6% traffic impact in the AM Peak and a 7.4% impact in the PM peak. This is an average of approximately 7% of existing AM and PM peak hour traffic flows. The suggested contribution of €49,000 would therefore provide a robust financial contribution to the cost of the road improvement work.

1.10.4 MCC are considering that a contribution to proposed external road upgrades be levied on the proposed SHD development by way of a special contribution. While the traffic analysis shows no significant traffic growth along the R147 in recent years, the applicant has nevertheless proposed an appropriate contribution to any planned road upgrades based on a pro-rata traffic impact the development could have on traffic on the heaviest trafficked section of the R147, which arises between the Black Bull and Pace Interchanges. This proposed contribution to wider road upgrades has been forwarded to the MCC Road Planning Section and this matter is currently under consideration by MCC.

St. Albert's House Dunboyne Co. Meath
tel: 01-8255700 fax: 01-8255730
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B APPENDIX B – PICADY ANALYSIS

Run Analysis

Parameter	Values
File Run	I:\ILTP Projects\DUNSGEMTIA\Data\PICADY\DUNSGEMTIA SHD OCT 18 2 lanes.vpi
Date Run	06 December 2018
Time Run	17:06:51
Driving Side	Drive On The Left

Arm Names and Flow Scaling Factors

Arm	Arm Name	Flow Scaling Factor (%)
Arm A	R147 South	100
Arm B	Propsed Site	100
Arm C	R147 North	100

Stream Labelling Convention

Stream A-B contains traffic going from A to B etc.

Run Information

Parameter	Values
Run Title	DUNSGEMTIA
Location	Dunshaughlin
Date	10 February 2018
Enumerator	Ben Waite
Job Number	-
Status	TIA
Client	-
Description	-

Errors and Warnings

Parameter	Values
Warning	No Errors Or Warnings

Geometric Data

Geometric Parameters

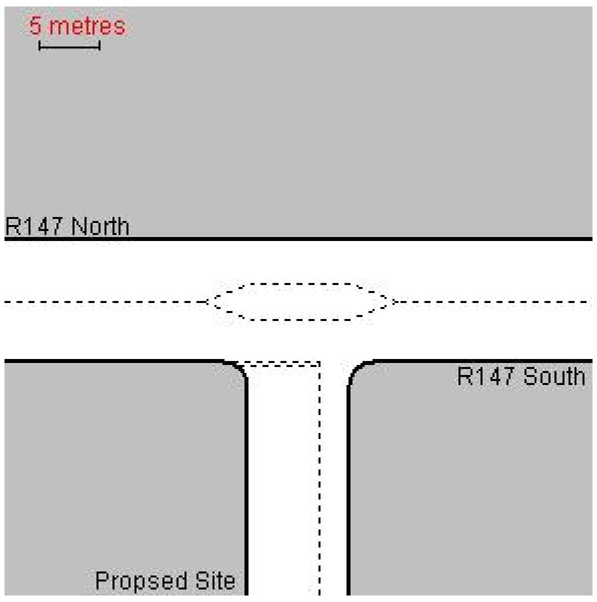
Parameter	Minor Arm B
Major Road Carriageway Width (m)	7.25
Major Road Kerbed Central Reserve Width (m)	0.00
Major Road Right Turning Lane Width (m)	3.00
Minor Road First Lane Width (m)	3.00
Minor Road Second Lane Width (m)	3.00
Minor Road Visibility To Right (m)	100
Minor Road Visibility To Left (m)	100
Major Road Right Turn Visibility (m)	120
Major Road Right Turn Blocks Traffic	No

Slope and Intercept Values

Stream	Intercept for Stream	Slope for A-B	Slope for A-C	Slope for C-A	Slope for C-B
B-A	560.751	0.097	0.244	0.154	0.349
B-C	686.890	0.100	0.252	-	-
C-B	699.480	0.256	0.256	-	-

Note: Streams may be combined in which case capacity will be adjusted
These values do not allow for any site-specific corrections

Junction Diagram



Demand Data

Modelling Periods

Parameter	Period	Duration (min)	Segment Length (min)
First Modelling Period	08:00-09:00	60	15
Second Modelling Period	17:00-18:00	60	15

Direct Entry Flows

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

Segment: 17:00-17:15

Arm	Flow (veh/min)
Arm A	7.83
Arm B	3.10
Arm C	13.07

Segment: 17:15-17:30

Arm	Flow (veh/min)
Arm A	7.83
Arm B	3.10
Arm C	13.07

Segment: 17:30-17:45

Arm	Flow (veh/min)
Arm A	7.83
Arm B	3.10
Arm C	13.07

Segment: 17:45-18:00

Arm	Flow (veh/min)
Arm A	7.83
Arm B	3.10
Arm C	13.07

Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

Segment: 08:00-08:15

Arm	Flow (veh/min)
Arm A	9.82
Arm B	4.52
Arm C	5.70

Segment: 08:15-08:30

Arm	Flow (veh/min)
Arm A	9.82
Arm B	4.52
Arm C	5.70

Segment: 08:30-08:45

Arm	Flow (veh/min)
Arm A	9.82
Arm B	4.52
Arm C	5.70

Segment: 08:45-09:00

Arm	Flow (veh/min)
Arm A	9.82
Arm B	4.52
Arm C	5.70

Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

Segment: 08:00-08:15

Arm	Flow (veh/min)
Arm A	11.22
Arm B	4.52
Arm C	6.49

Segment: 08:15-08:30

Arm	Flow (veh/min)
Arm A	11.22
Arm B	4.52
Arm C	6.49

Segment: 08:30-08:45

Arm	Flow (veh/min)
Arm A	11.22
Arm B	4.52
Arm C	6.49

Segment: 08:45-09:00

Arm	Flow (veh/min)
Arm A	11.22
Arm B	4.52
Arm C	6.49

Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

Segment: 17:00-17:15

Arm	Flow (veh/min)
Arm A	8.62
Arm B	3.10
Arm C	14.83

Segment: 17:15-17:30

Arm	Flow (veh/min)
Arm A	8.62
Arm B	3.10
Arm C	14.83

Segment: 17:30-17:45

Arm	Flow (veh/min)
Arm A	8.62
Arm B	3.10
Arm C	14.83

Segment: 17:45-18:00

Arm	Flow (veh/min)
Arm A	8.62
Arm B	3.10
Arm C	14.83

Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

Segment: 08:00-08:15

Arm	Flow (veh/min)
Arm A	9.09
Arm B	7.34
Arm C	5.71

Segment: 08:15-08:30

Arm	Flow (veh/min)
Arm A	9.09
Arm B	7.34
Arm C	5.71

Segment: 08:30-08:45

Arm	Flow (veh/min)
Arm A	9.09
Arm B	7.34
Arm C	5.71

Segment: 08:45-09:00

Arm	Flow (veh/min)
Arm A	9.09
Arm B	7.34
Arm C	5.71

Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

Segment: 08:00-08:15

Arm	Flow (veh/min)
Arm A	10.40
Arm B	7.81
Arm C	6.49

Segment: 08:15-08:30

Arm	Flow (veh/min)
Arm A	10.40
Arm B	7.81
Arm C	6.49

Segment: 08:30-08:45

Arm	Flow (veh/min)
Arm A	10.40
Arm B	7.81
Arm C	6.49

Segment: 08:45-09:00

Arm	Flow (veh/min)
Arm A	10.40
Arm B	7.81
Arm C	6.49

Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

Segment: 17:00-17:15

Arm	Flow (veh/min)
Arm A	6.88
Arm B	5.60
Arm C	13.07

Segment: 17:15-17:30

Arm	Flow (veh/min)
Arm A	6.88
Arm B	5.60
Arm C	13.07

Segment: 17:30-17:45

Arm	Flow (veh/min)
Arm A	6.88
Arm B	5.60
Arm C	13.07

Segment: 17:45-18:00

Arm	Flow (veh/min)
Arm A	6.88
Arm B	5.60
Arm C	13.07

Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

Segment: 17:00-17:15

Arm	Flow (veh/min)
Arm A	7.50
Arm B	6.03
Arm C	14.81

Segment: 17:15-17:30

Arm	Flow (veh/min)
Arm A	7.50
Arm B	6.03
Arm C	14.81

Segment: 17:30-17:45

Arm	Flow (veh/min)
Arm A	7.50
Arm B	6.03
Arm C	14.81

Segment: 17:45-18:00

Arm	Flow (veh/min)
Arm A	7.50
Arm B	6.03
Arm C	14.81

Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

Segment: 08:00-08:15

Arm	Flow (veh/min)
Arm A	12.06
Arm B	9.47
Arm C	7.33

Segment: 08:15-08:30

Arm	Flow (veh/min)
Arm A	12.06
Arm B	9.47
Arm C	7.33

Segment: 08:30-08:45

Arm	Flow (veh/min)
Arm A	12.06
Arm B	9.47
Arm C	7.33

Segment: 08:45-09:00

Arm	Flow (veh/min)
Arm A	12.06
Arm B	9.47
Arm C	7.33

Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

Segment: 17:00-17:15

Arm	Flow (veh/min)
Arm A	8.33
Arm B	7.71
Arm C	15.65

Segment: 17:15-17:30

Arm	Flow (veh/min)
Arm A	8.33
Arm B	7.71
Arm C	15.65

Segment: 17:30-17:45

Arm	Flow (veh/min)
Arm A	8.33
Arm B	7.71
Arm C	15.65

Segment: 17:45-18:00

Arm	Flow (veh/min)
Arm A	8.33
Arm B	7.71
Arm C	15.65

Turning Counts

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	177	293
Arm B	109	-	78
Arm C	658	127	-

Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	65	524
Arm B	158	-	113
Arm C	296	47	-

Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	65	608
Arm B	158	-	113
Arm C	343	47	-

Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	177	340
Arm B	109	-	78
Arm C	763	127	-

Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	119	426
Arm B	168	-	272
Arm C	236	107	-

Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	128	496
Arm B	170	-	298
Arm C	274	116	-

Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	204	209
Arm B	112	-	225
Arm C	554	231	-

Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	208	242
Arm B	115	-	248
Arm C	642	247	-

Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	228	496
Arm B	220	-	348
Arm C	274	166	-

Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	258	242
Arm B	165	-	298
Arm C	642	297	-

Turning proportions are calculated from turning count data

Turning Proportions

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.377	0.623
Arm B	0.583	0.000	0.417
Arm C	0.838	0.162	0.000

Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.110	0.890
Arm B	0.583	0.000	0.417
Arm C	0.863	0.137	0.000

Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.097	0.903
Arm B	0.583	0.000	0.417
Arm C	0.879	0.121	0.000

Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.342	0.658
Arm B	0.583	0.000	0.417
Arm C	0.857	0.143	0.000

Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.218	0.782
Arm B	0.382	0.000	0.618
Arm C	0.688	0.312	0.000

Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.205	0.795
Arm B	0.363	0.000	0.637
Arm C	0.703	0.297	0.000

Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.494	0.506
Arm B	0.332	0.000	0.668
Arm C	0.706	0.294	0.000

Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.462	0.538
Arm B	0.317	0.000	0.683
Arm C	0.722	0.278	0.000

Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.315	0.685
Arm B	0.387	0.000	0.613
Arm C	0.623	0.377	0.000

Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	0.000	0.516	0.484
Arm B	0.356	0.000	0.644
Arm C	0.684	0.316	0.000

Heavy Vehicles Percentages

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	2.0	5.0
Arm B	2.0	-	2.0
Arm C	5.0	2.0	-

Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

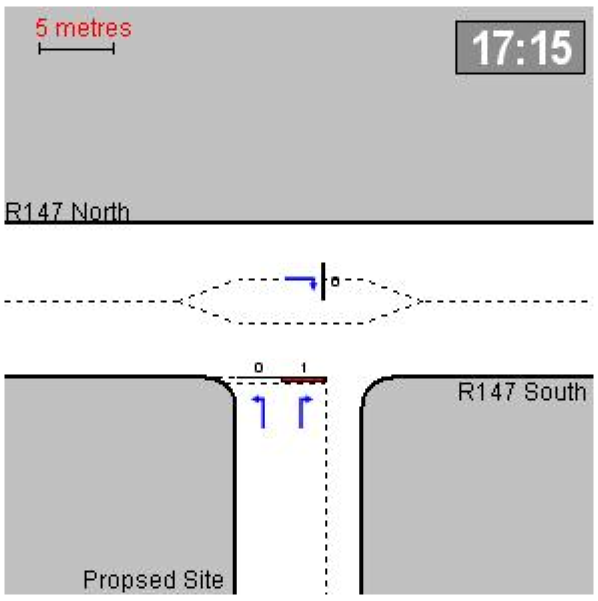
Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

From/To	Arm A	Arm B	Arm C
Arm A	-	0.0	0.0
Arm B	0.0	-	0.0
Arm C	0.0	0.0	-

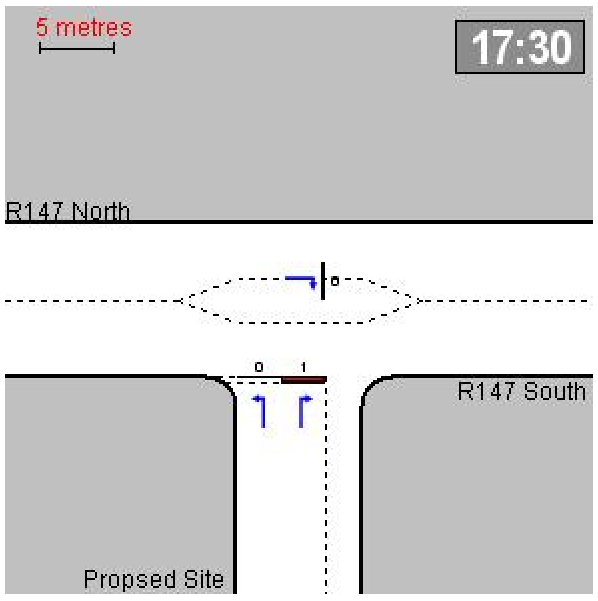
Queue Diagrams

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00
View Extent: 40m

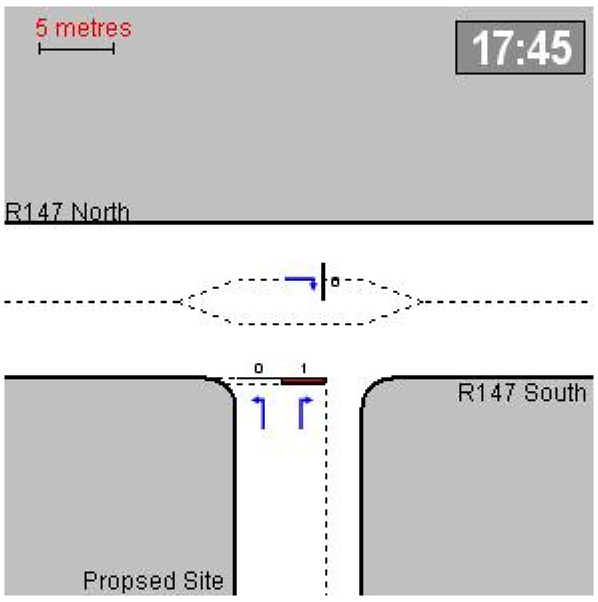
Queue Interval 1: 17:00-17:15



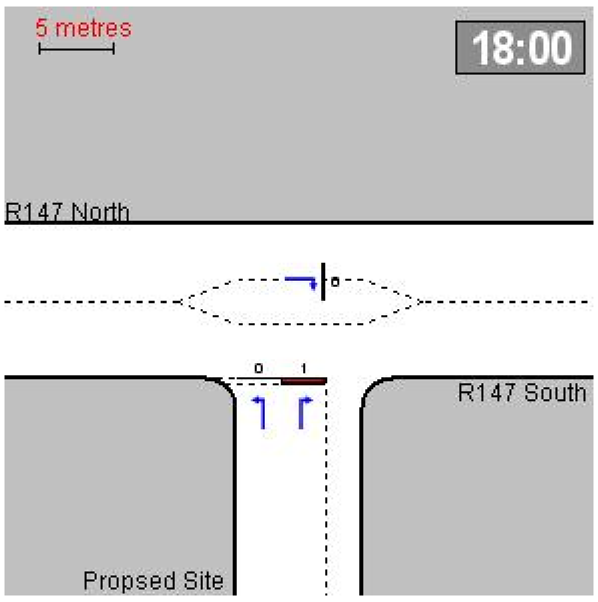
Queue Interval 2: 17:15-17:30



Queue Interval 3: 17:30-17:45

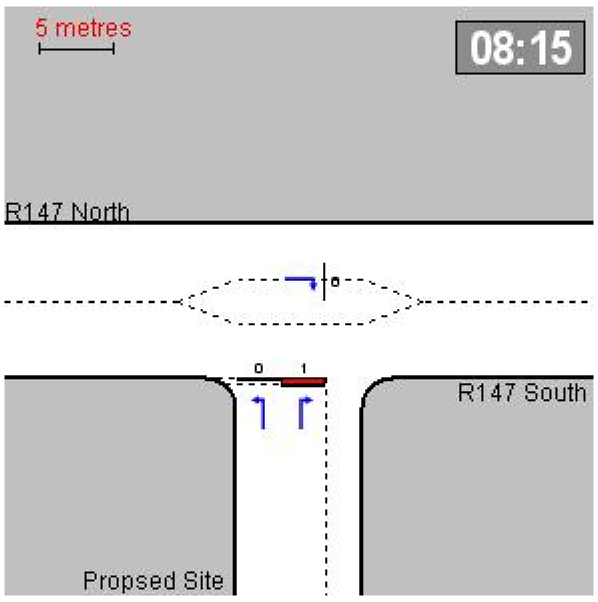


Queue Interval 4: 17:45-18:00

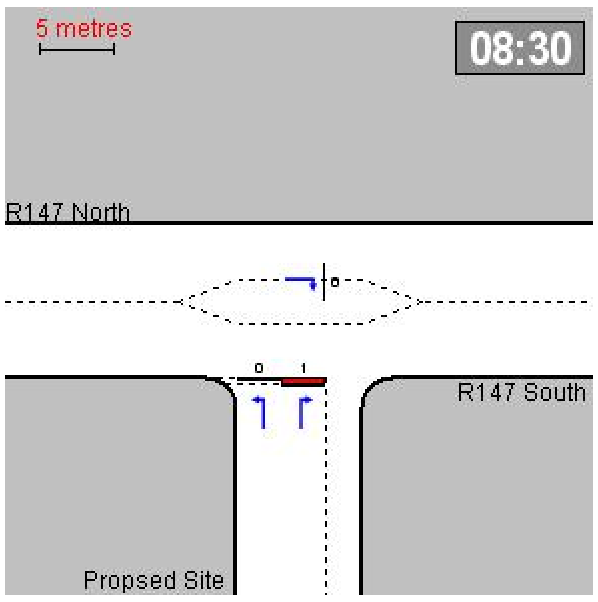


Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00
View Extent: 40m

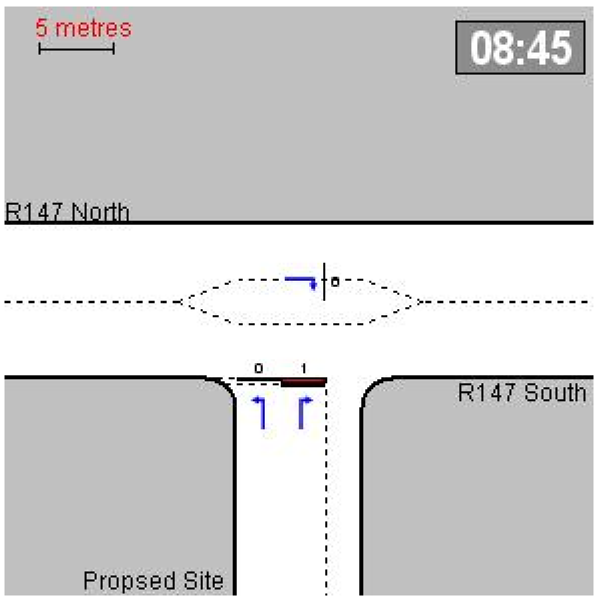
Queue Interval 1: 08:00-08:15



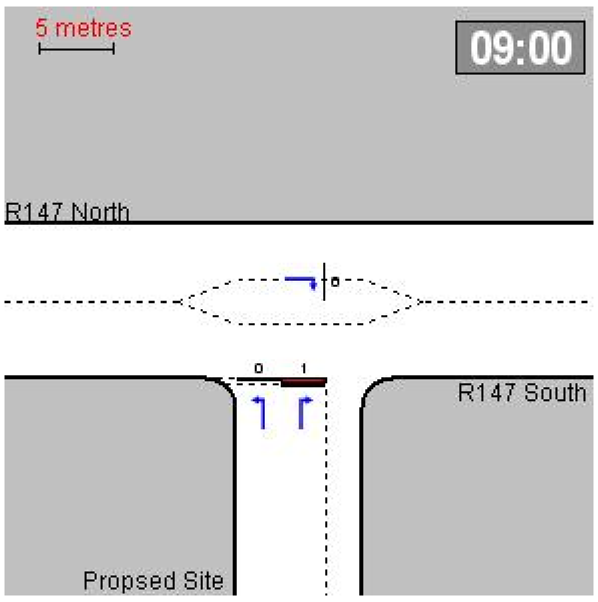
Queue Interval 2: 08:15-08:30



Queue Interval 3: 08:30-08:45

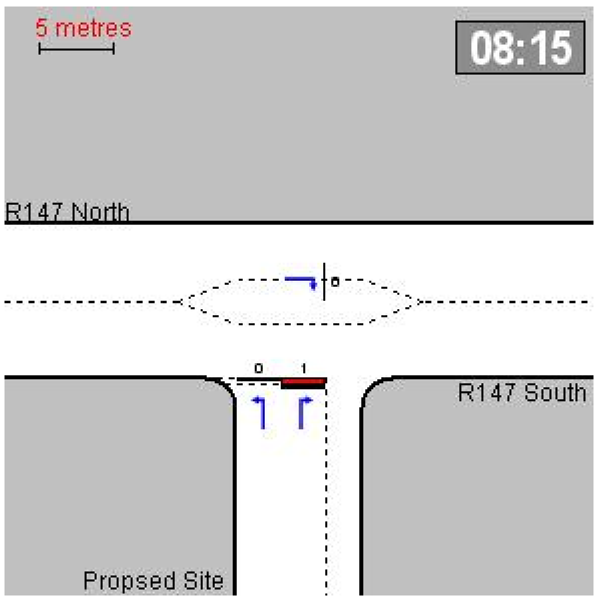


Queue Interval 4: 08:45-09:00

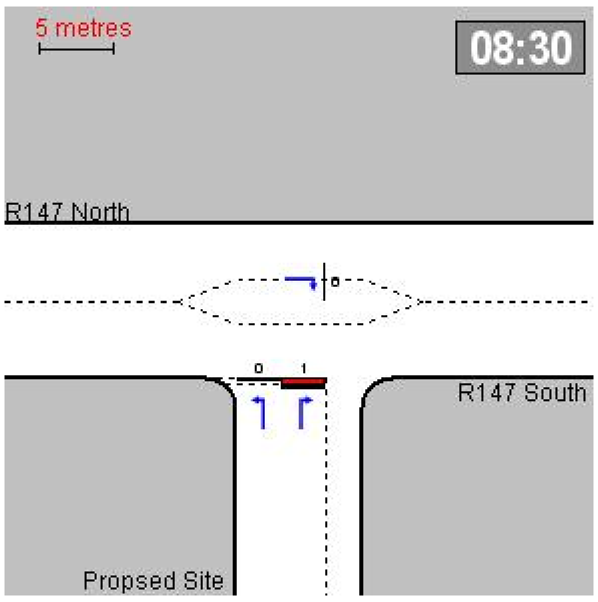


Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00
View Extent: 40m

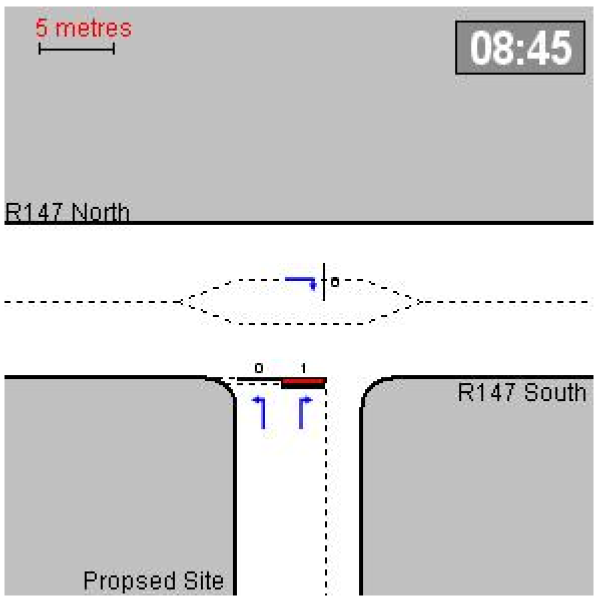
Queue Interval 1: 08:00-08:15



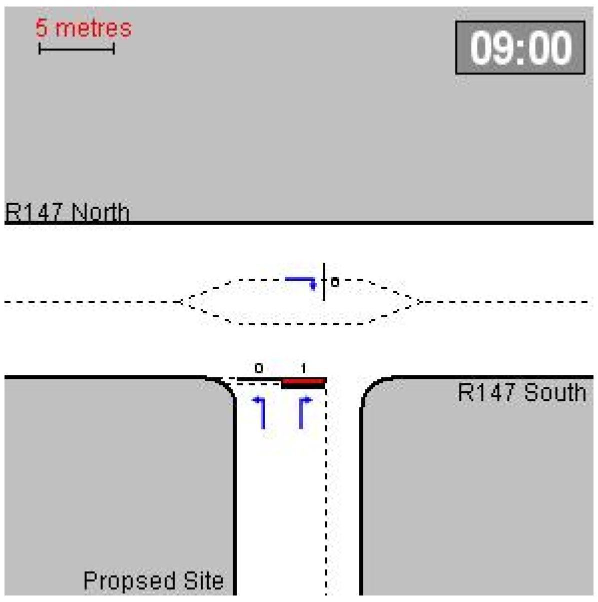
Queue Interval 2: 08:15-08:30



Queue Interval 3: 08:30-08:45

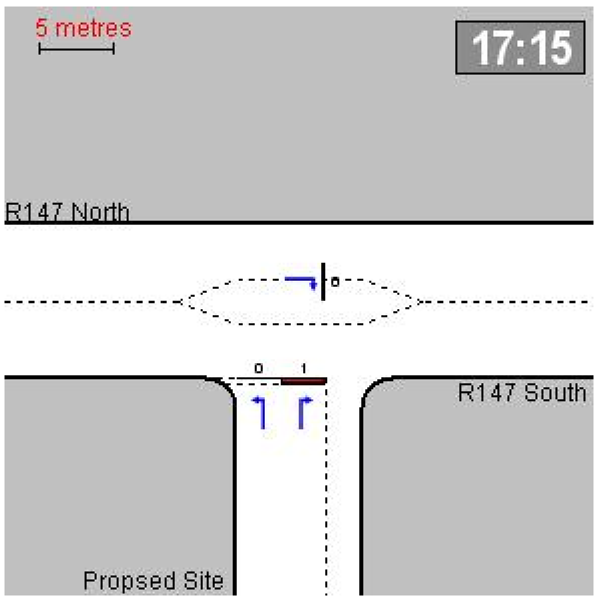


Queue Interval 4: 08:45-09:00

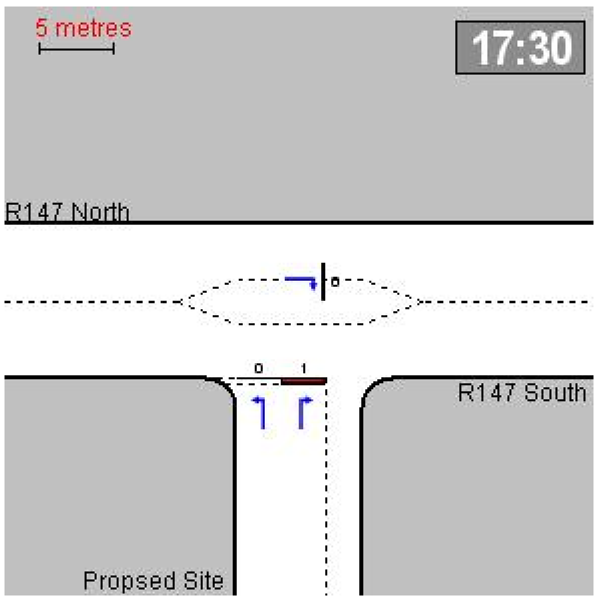


Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00
View Extent: 40m

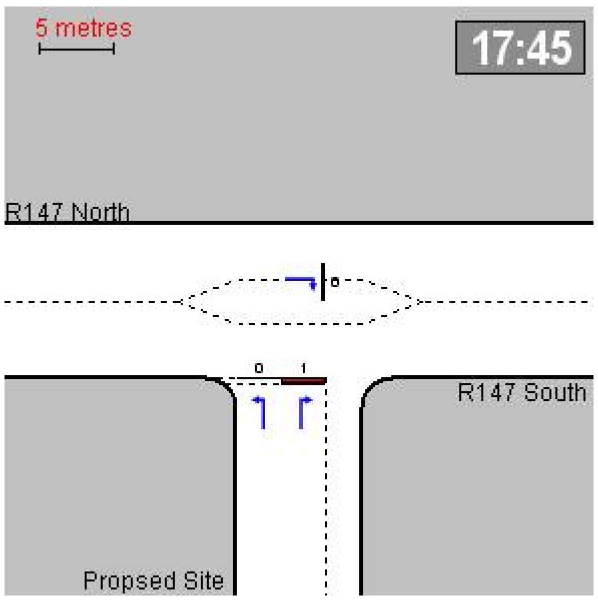
Queue Interval 1: 17:00-17:15



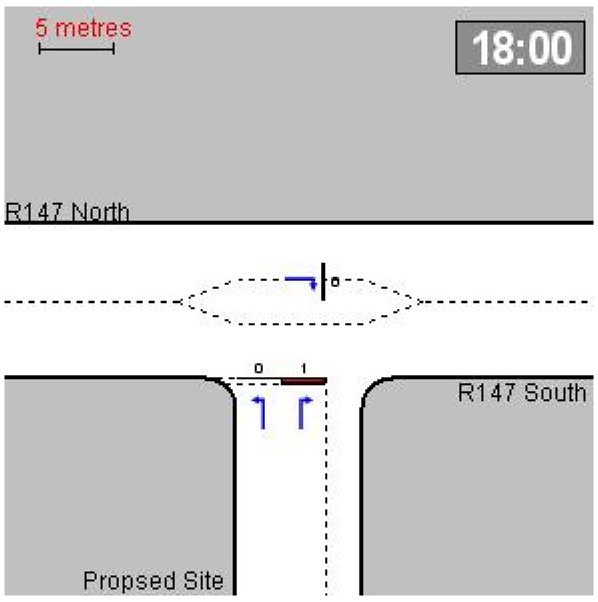
Queue Interval 2: 17:15-17:30



Queue Interval 3: 17:30-17:45

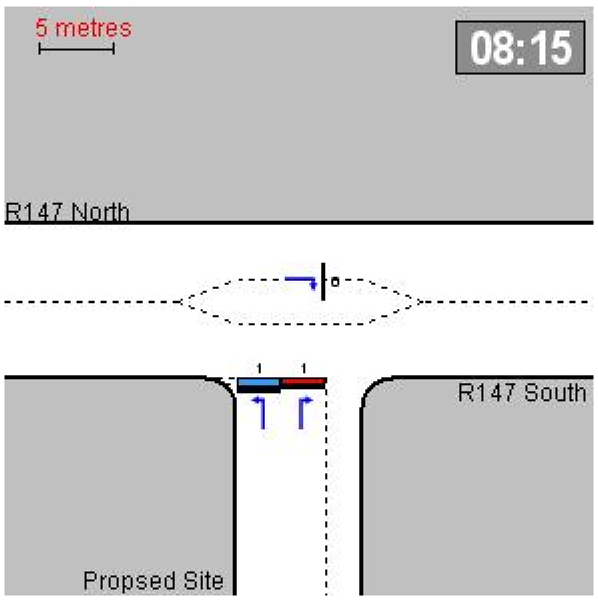


Queue Interval 4: 17:45-18:00

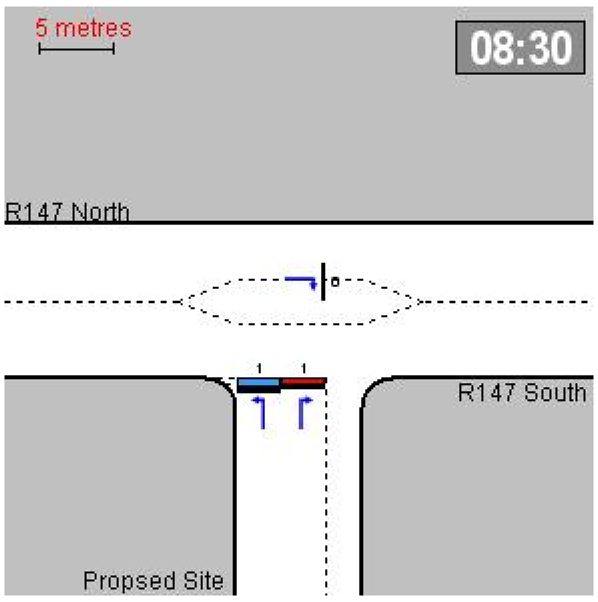


Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00
View Extent: 40m

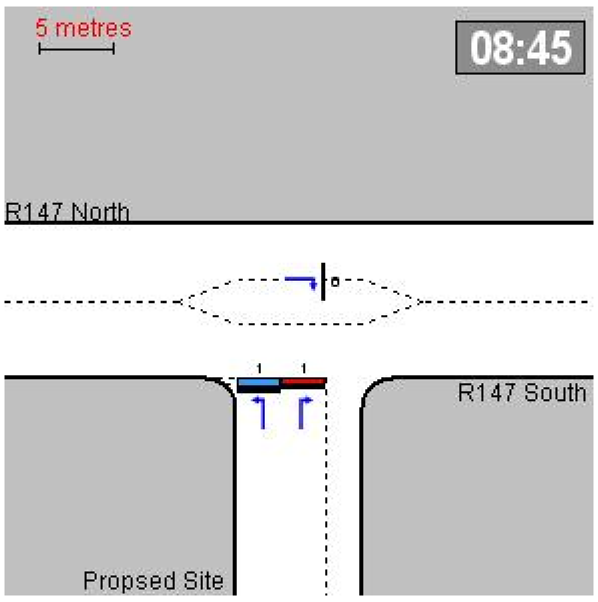
Queue Interval 1: 08:00-08:15



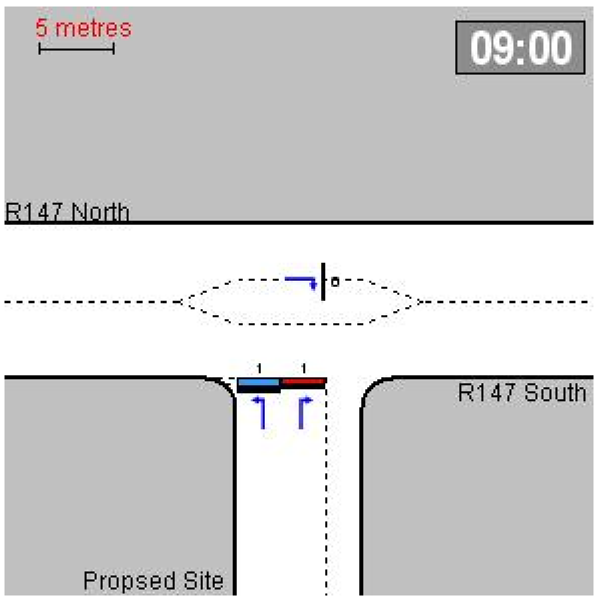
Queue Interval 2: 08:15-08:30



Queue Interval 3: 08:30-08:45

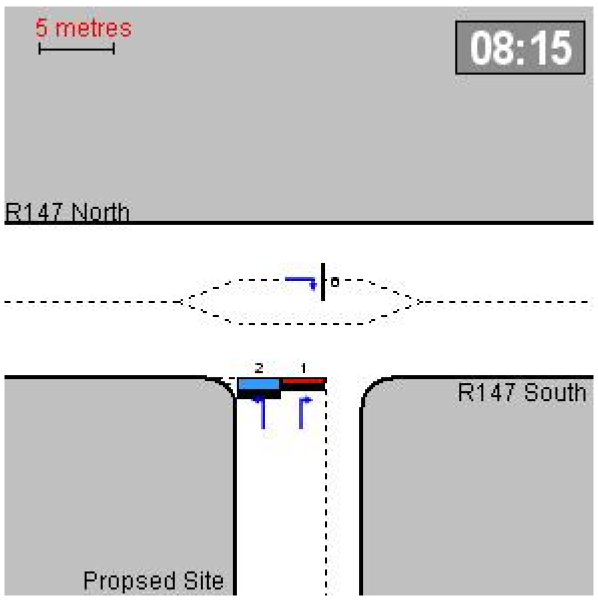


Queue Interval 4: 08:45-09:00

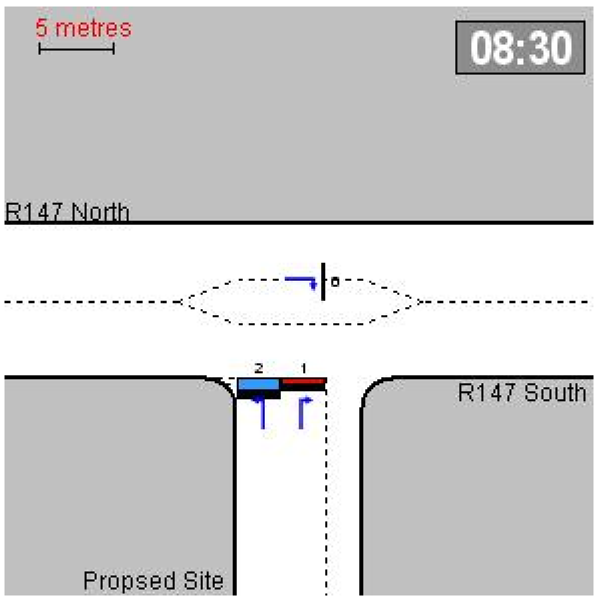


Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00
View Extent: 40m

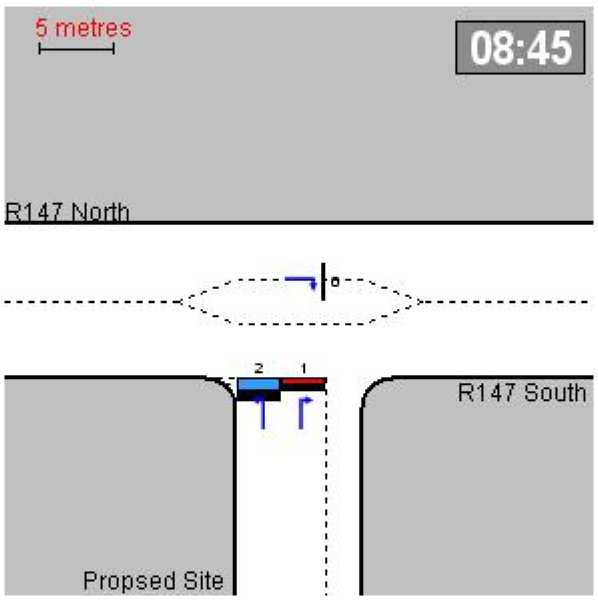
Queue Interval 1: 08:00-08:15



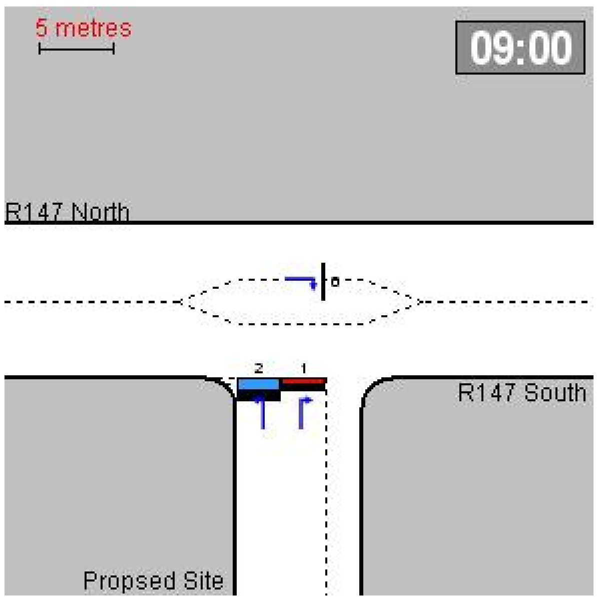
Queue Interval 2: 08:15-08:30



Queue Interval 3: 08:30-08:45

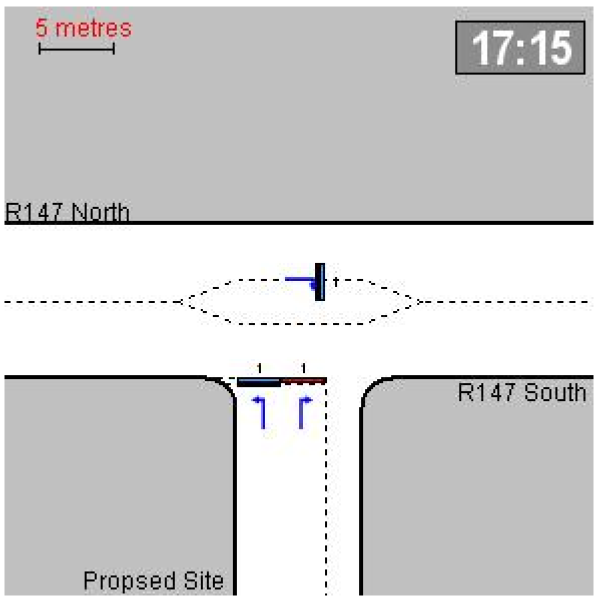


Queue Interval 4: 08:45-09:00

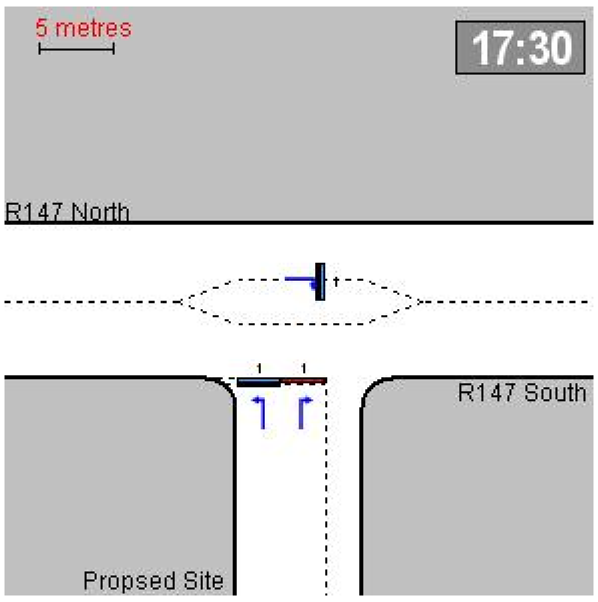


Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00
View Extent: 40m

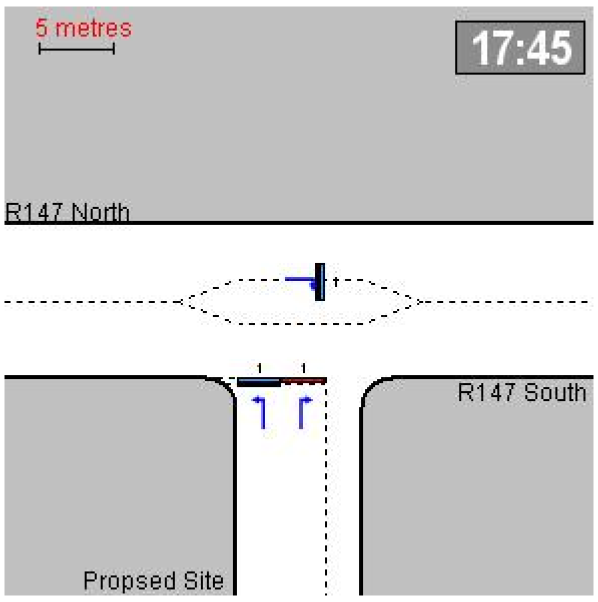
Queue Interval 1: 17:00-17:15



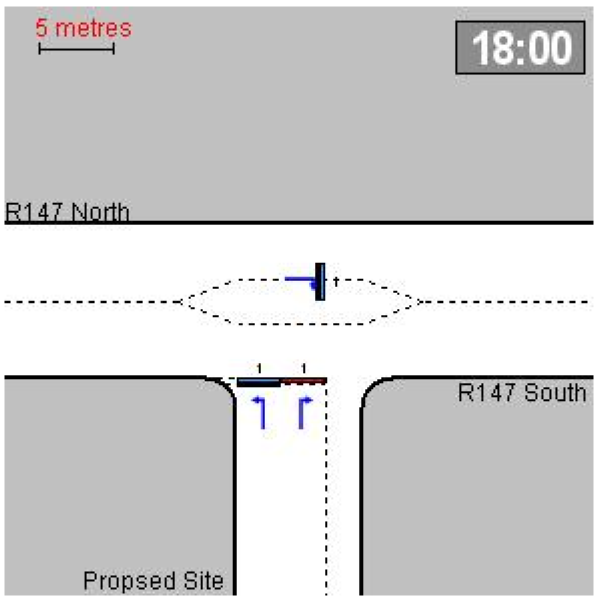
Queue Interval 2: 17:15-17:30



Queue Interval 3: 17:30-17:45

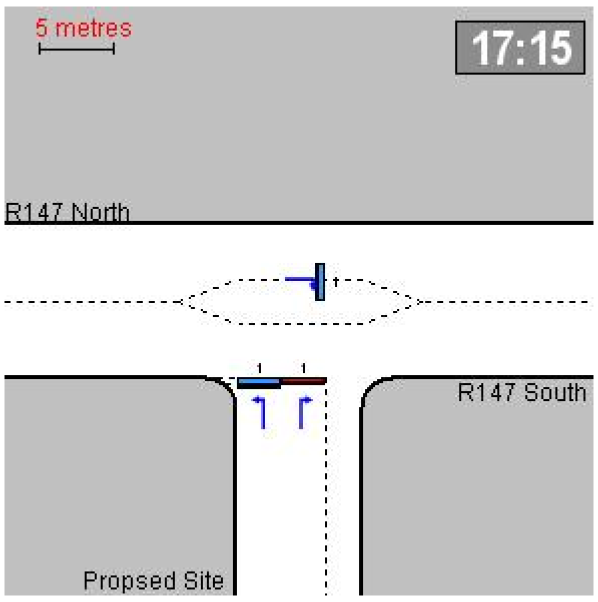


Queue Interval 4: 17:45-18:00

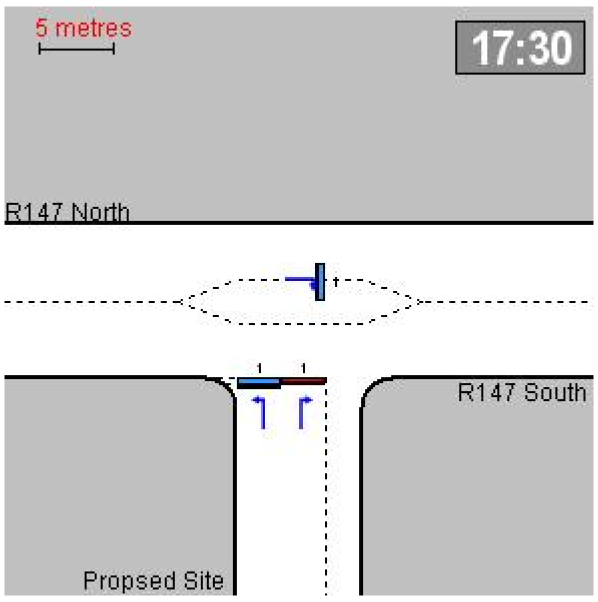


Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00
View Extent: 40m

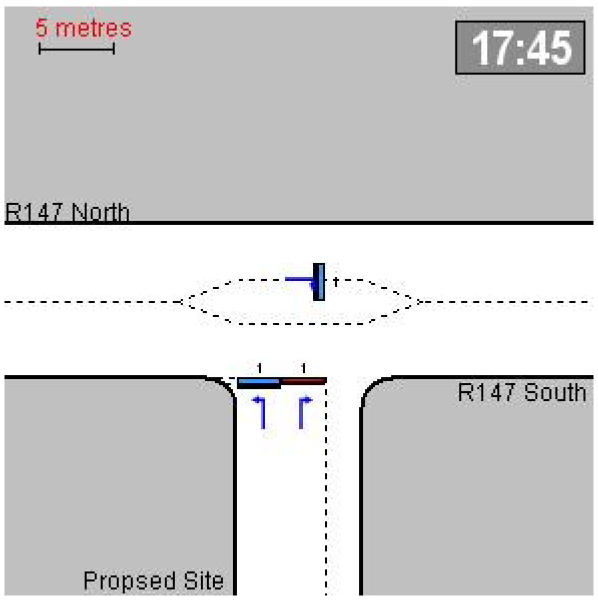
Queue Interval 1: 17:00-17:15



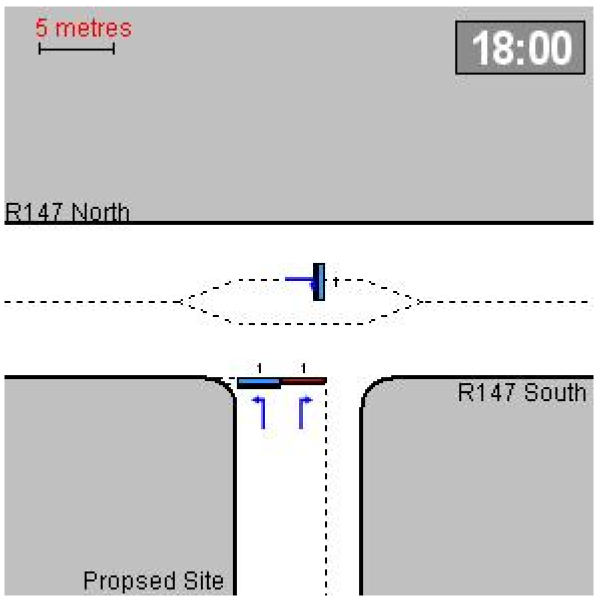
Queue Interval 2: 17:15-17:30



Queue Interval 3: 17:30-17:45

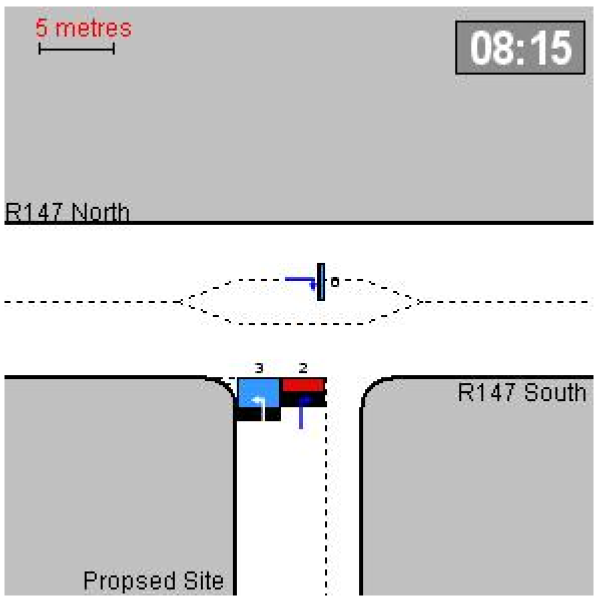


Queue Interval 4: 17:45-18:00

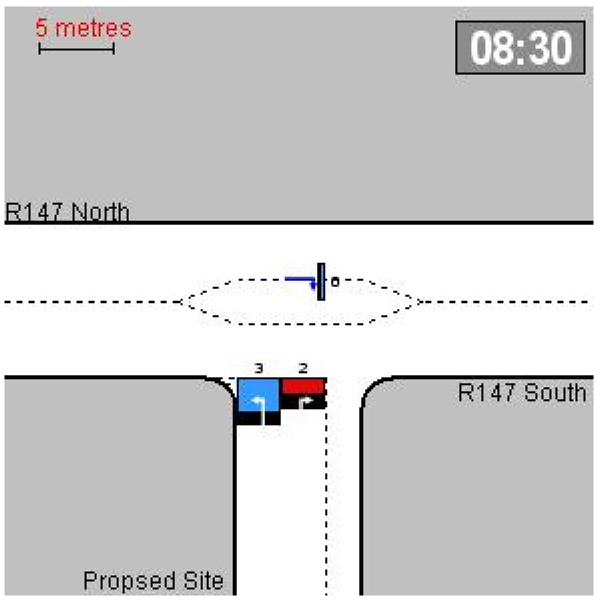


Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00
View Extent: 40m

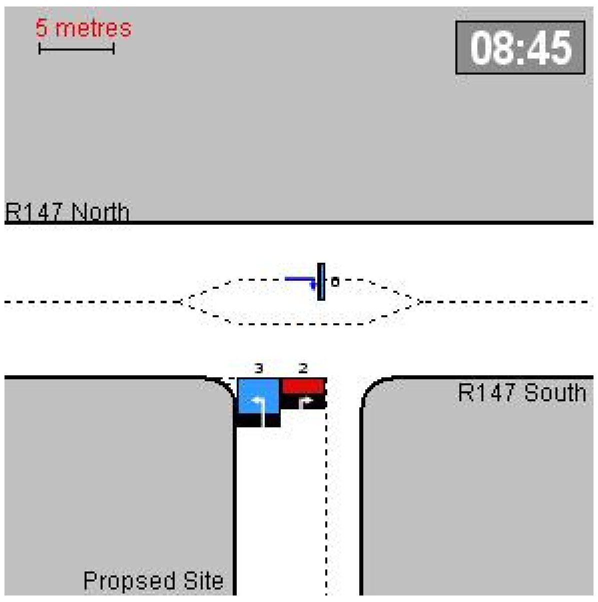
Queue Interval 1: 08:00-08:15



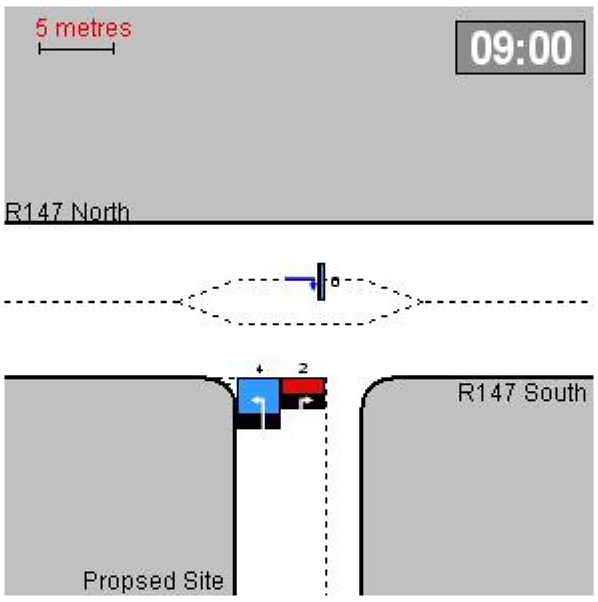
Queue Interval 2: 08:15-08:30



Queue Interval 3: 08:30-08:45

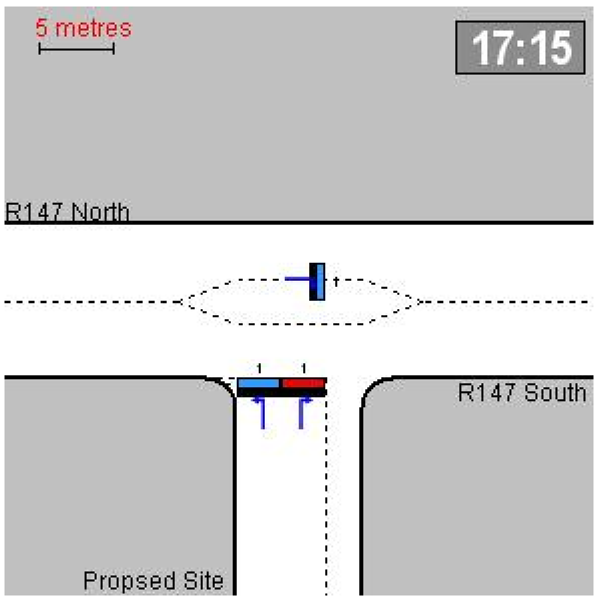


Queue Interval 4: 08:45-09:00

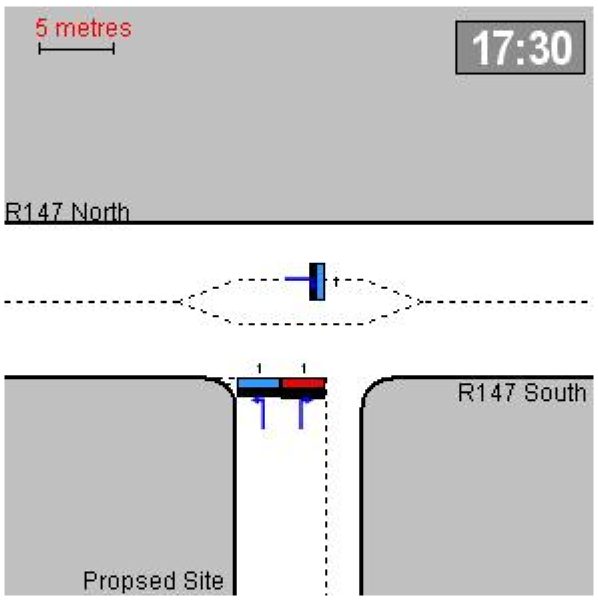


Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00
View Extent: 40m

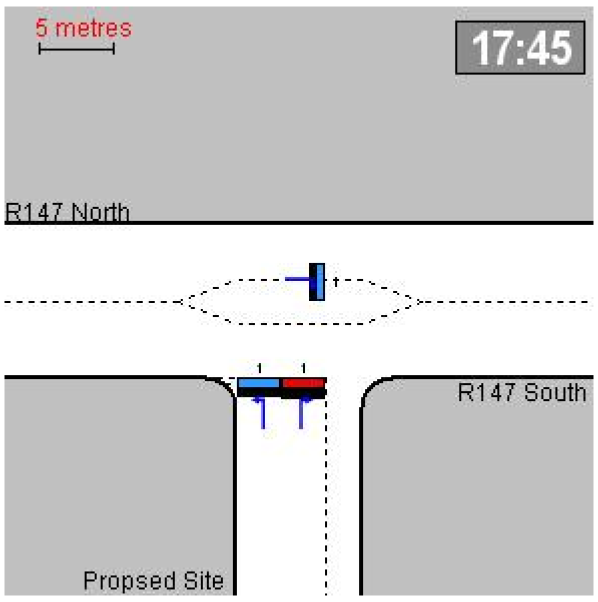
Queue Interval 1: 17:00-17:15



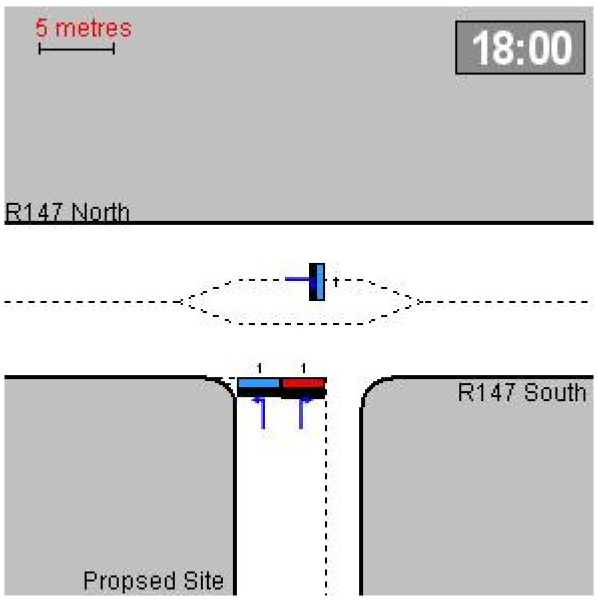
Queue Interval 2: 17:15-17:30



Queue Interval 3: 17:30-17:45

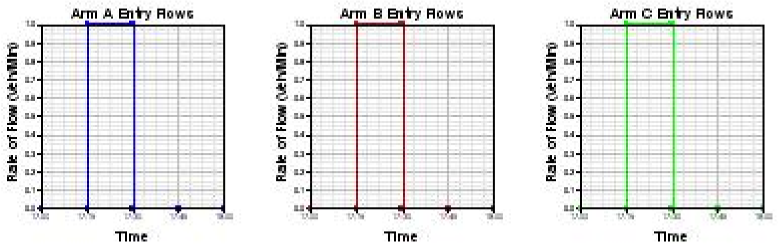


Queue Interval 4: 17:45-18:00

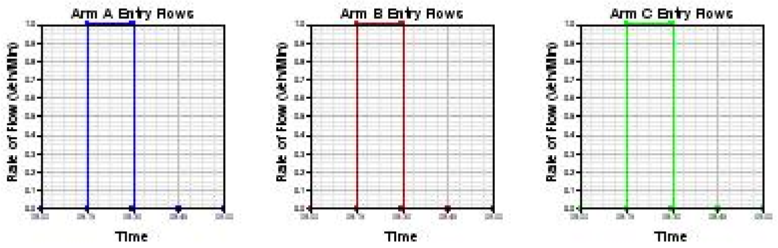


Demand Data Graph

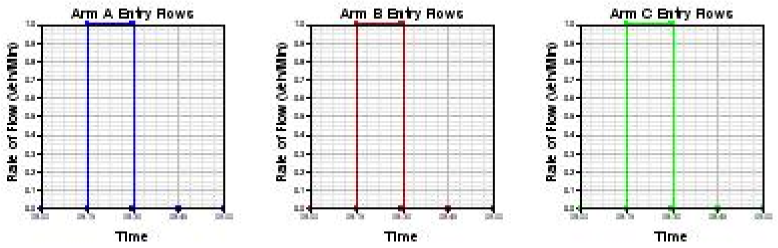
Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00



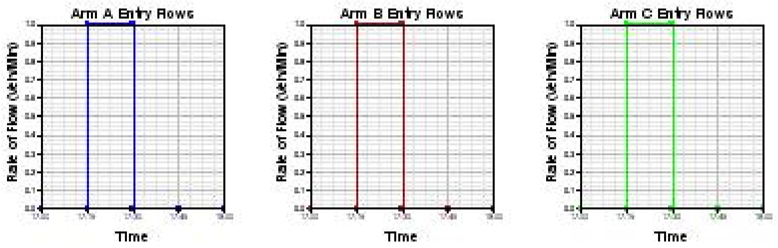
Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00



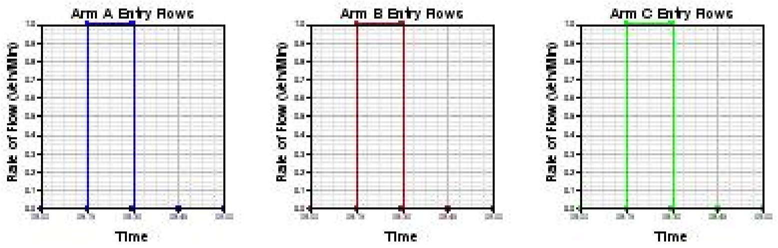
Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00



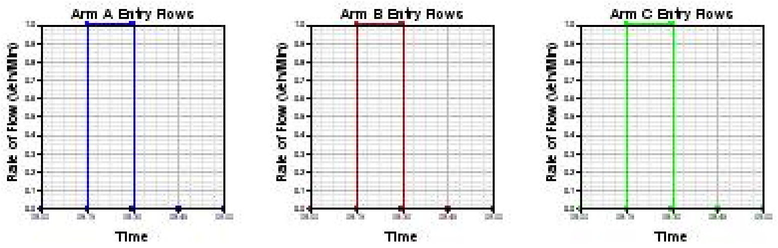
Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00



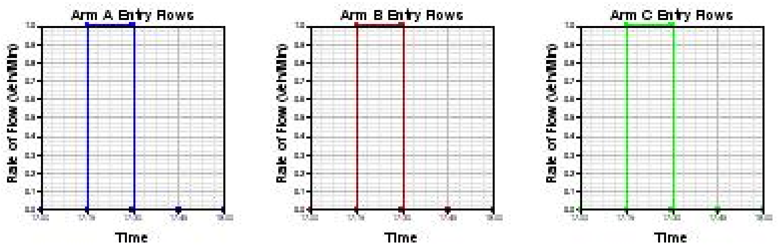
Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00



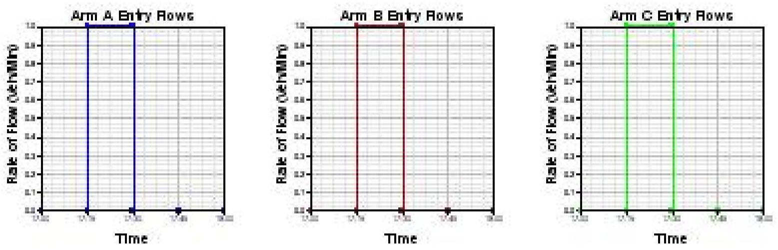
Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00



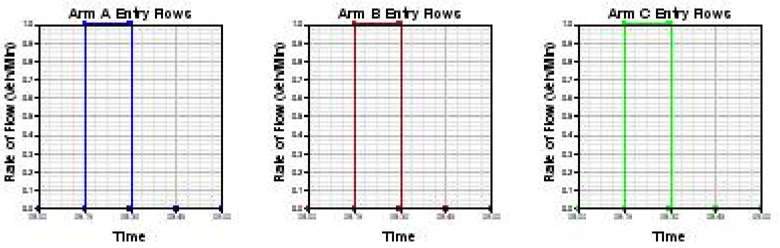
Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00



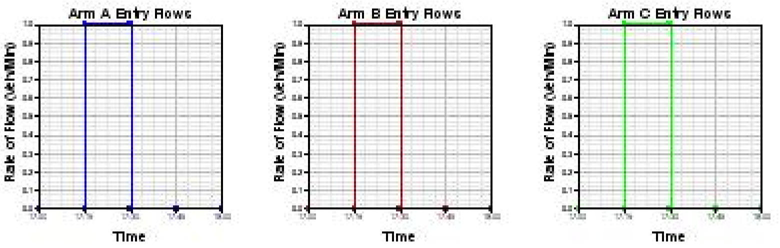
Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00



Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

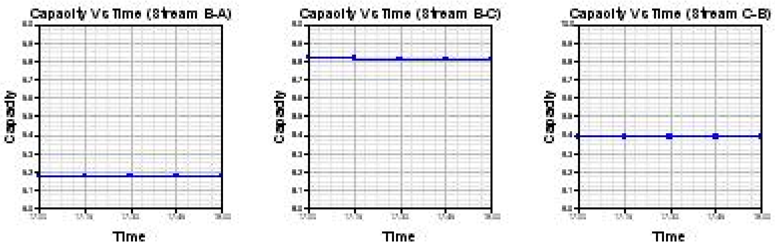


Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

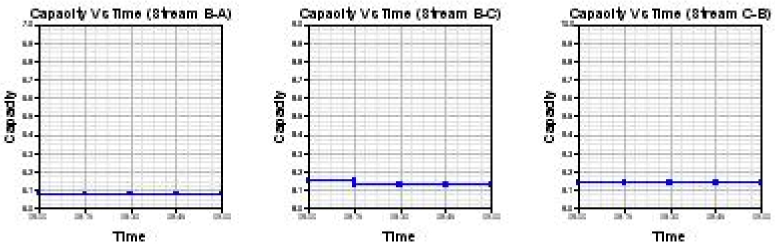


Capacity Graph

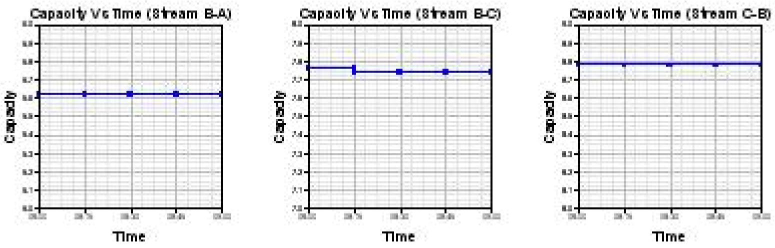
Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00



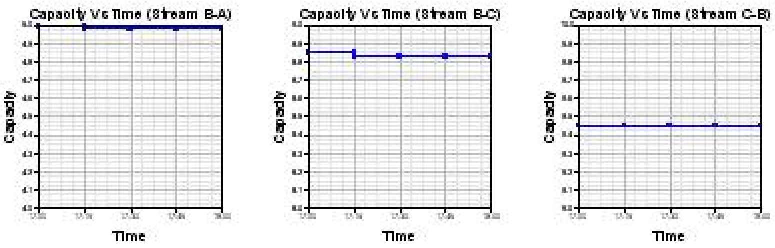
Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00



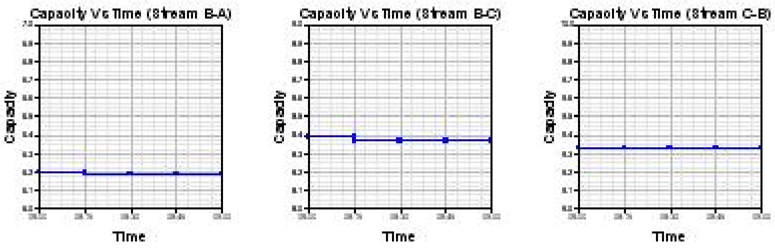
Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00



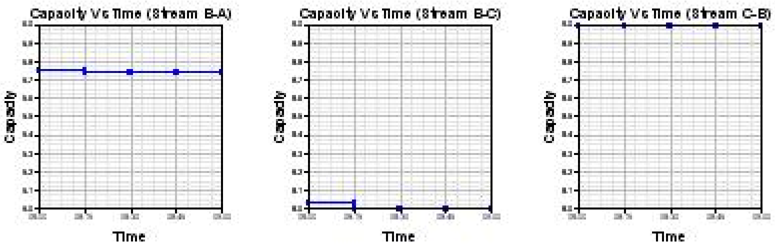
Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00



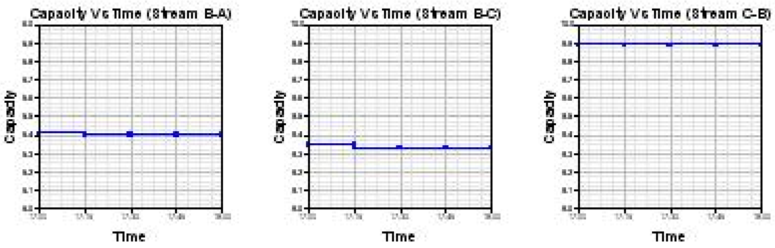
Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00



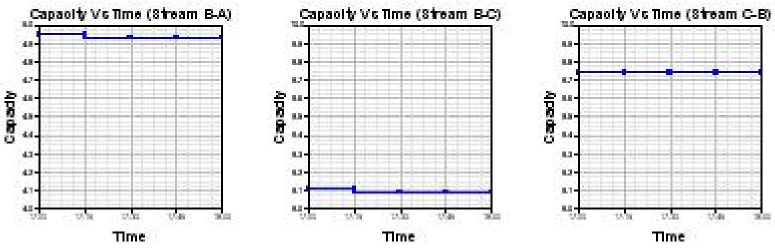
Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00



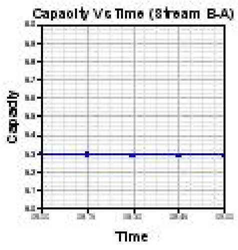
Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

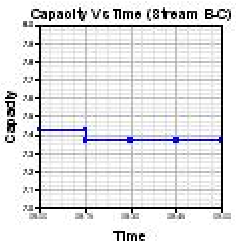


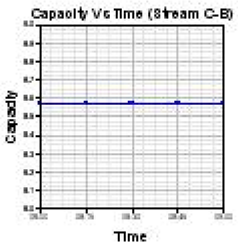
Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00



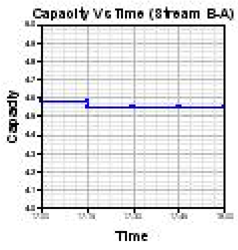
Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

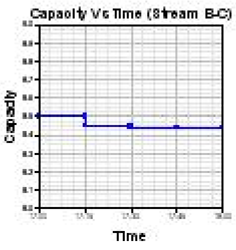


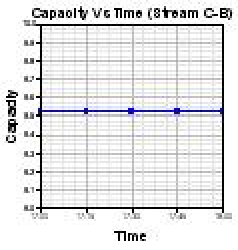




Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

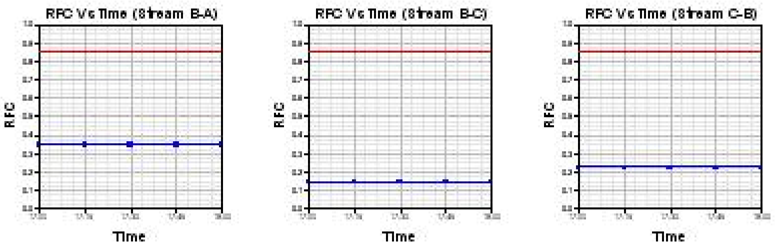




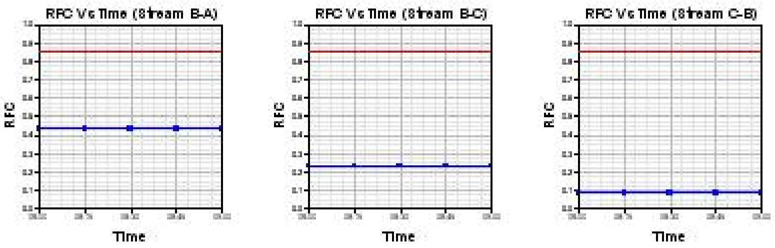


RFC Graph

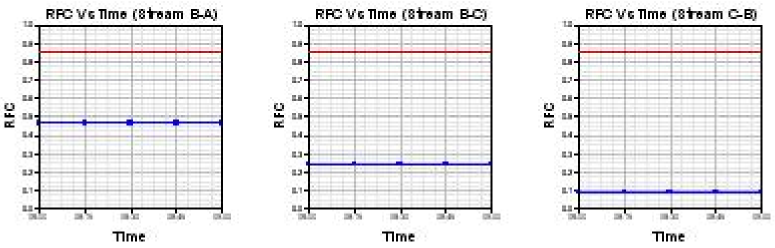
Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00



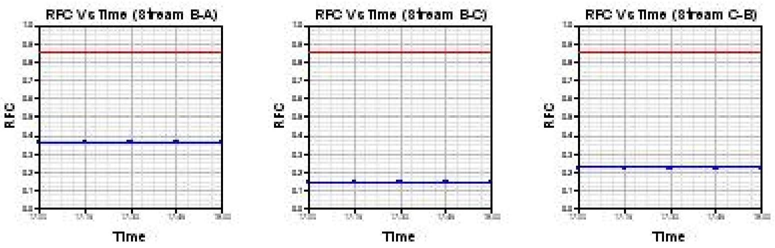
Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00



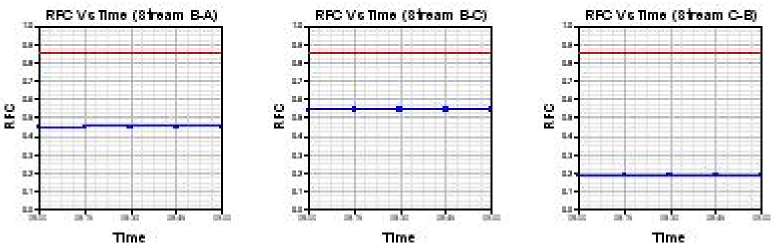
Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00



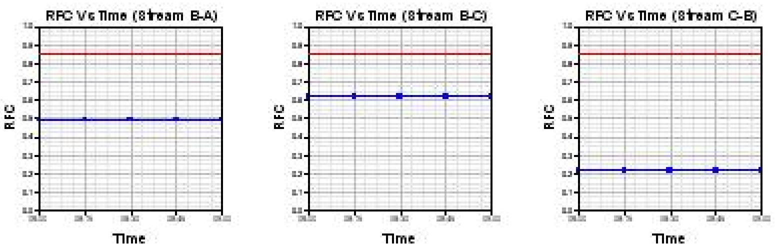
Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00



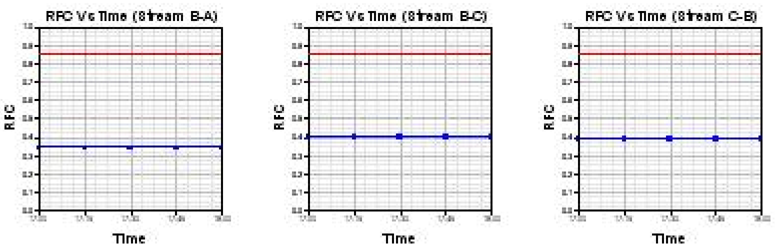
Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00



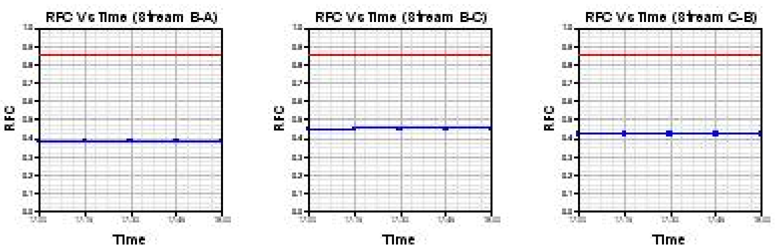
Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00



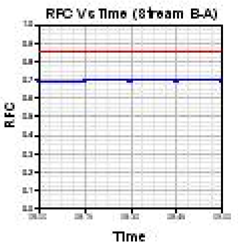
Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

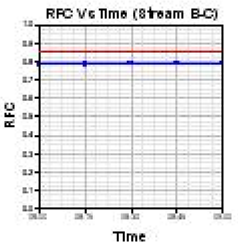


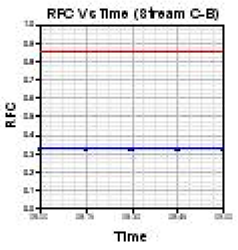
Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00



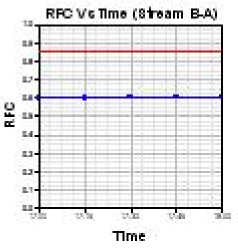
Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

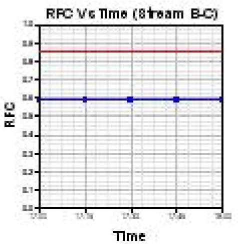


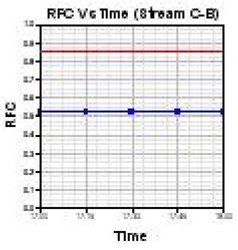




Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

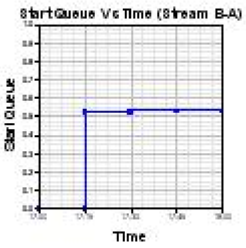


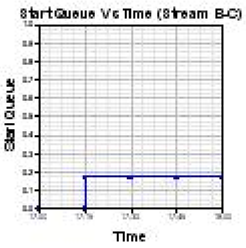


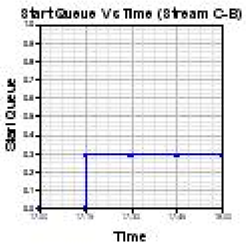


Start Queue Graph

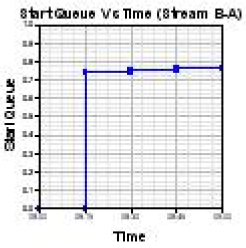
Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

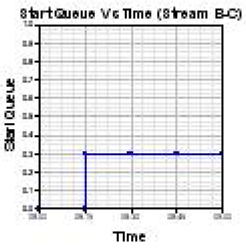


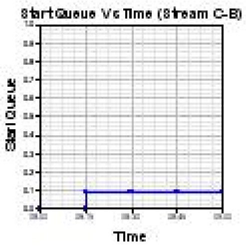




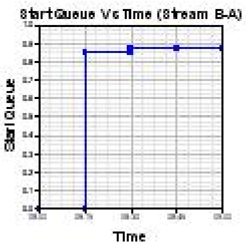
Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

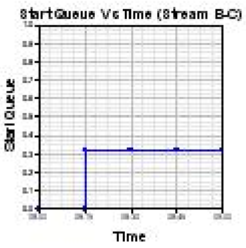


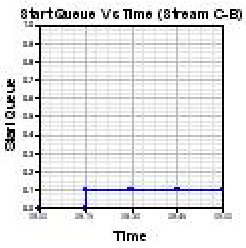




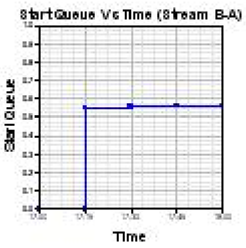
Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

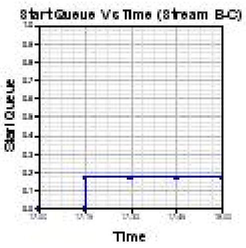


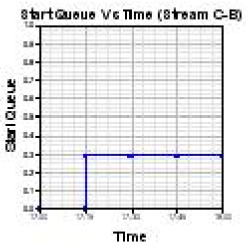




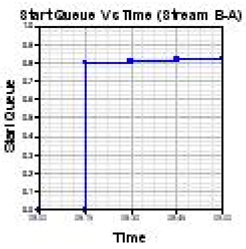
Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

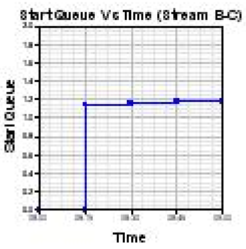


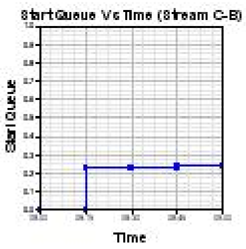




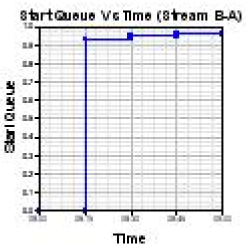
Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

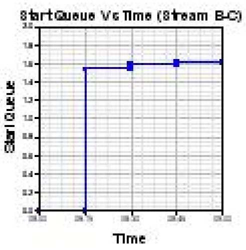


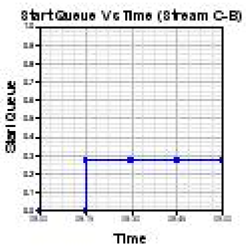




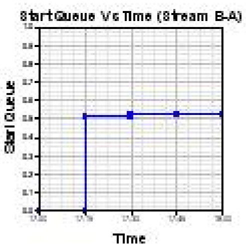
Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

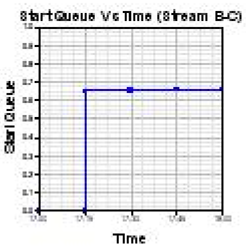


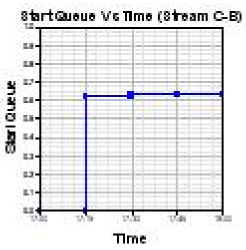




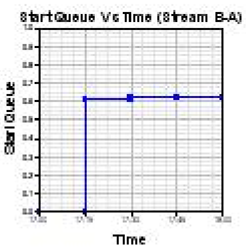
Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

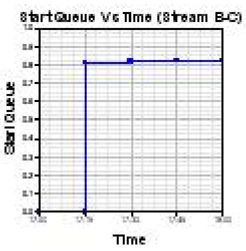


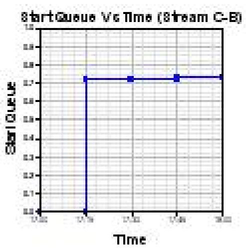




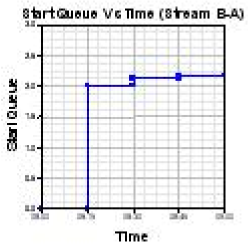
Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

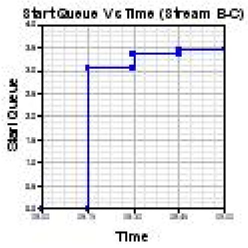


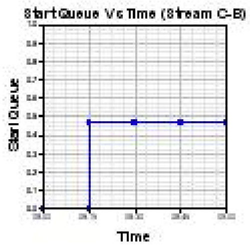




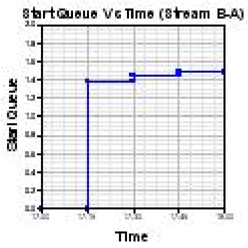
Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

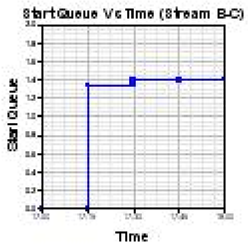


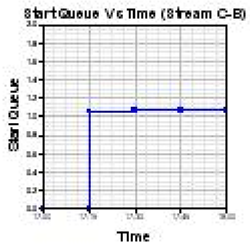




Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

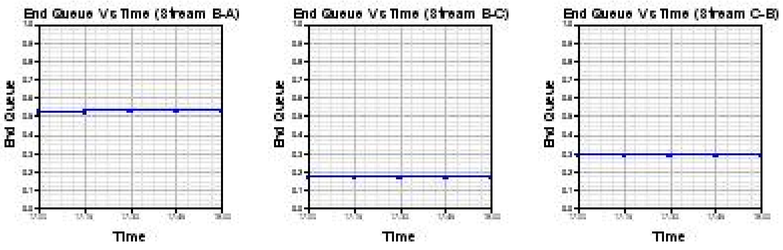




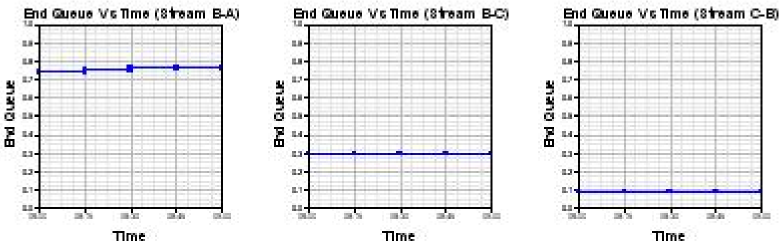


End Queue Graph

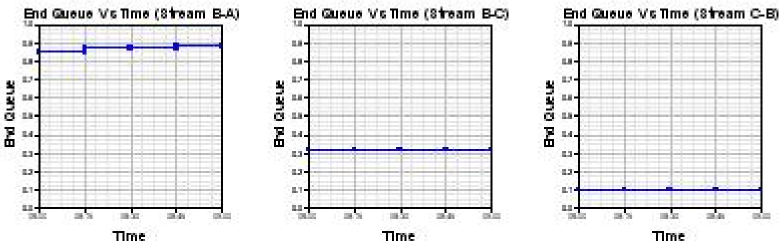
Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00



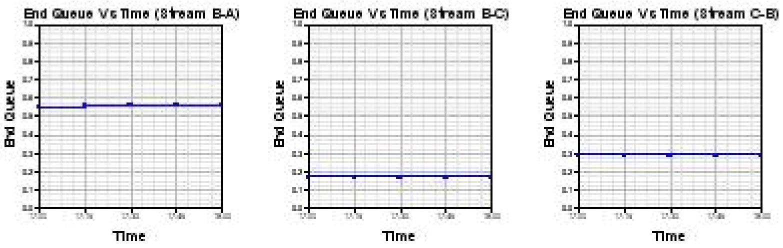
Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00



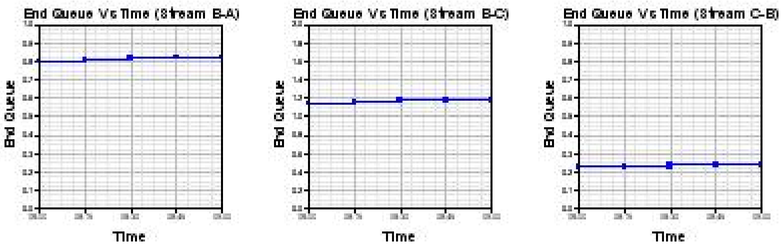
Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00



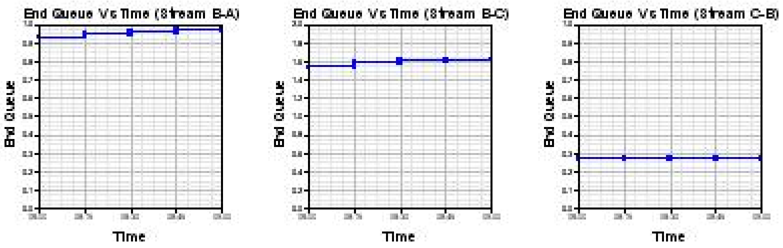
Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00



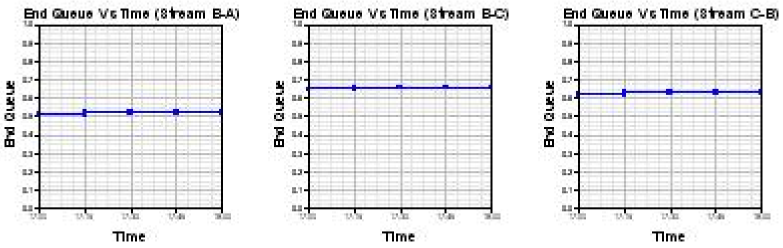
Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00



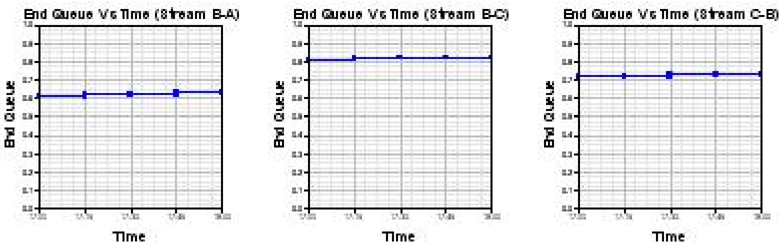
Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00



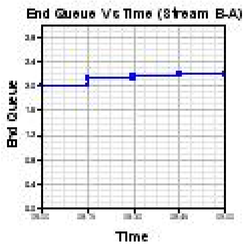
Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

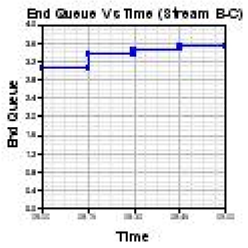


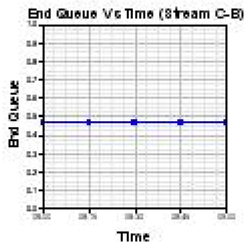
Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00



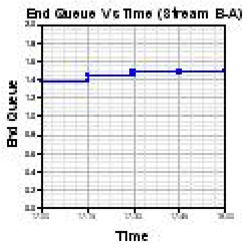
Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

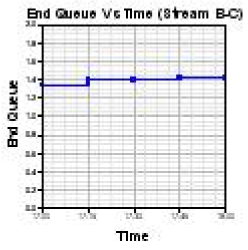


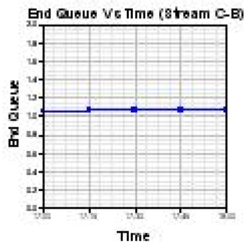




Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

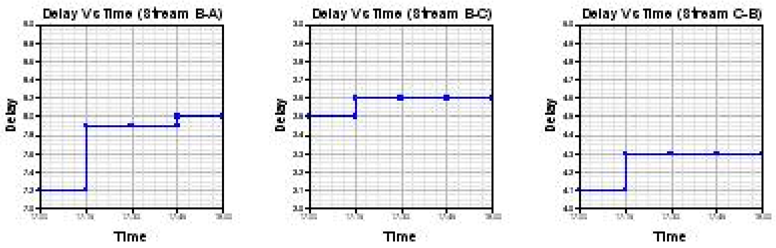




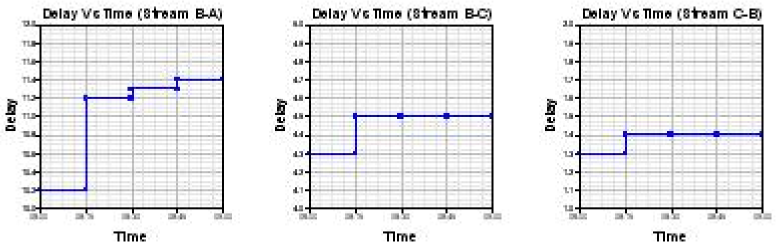


Delay Graph

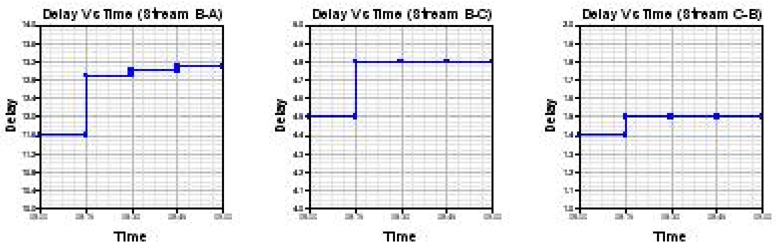
Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00



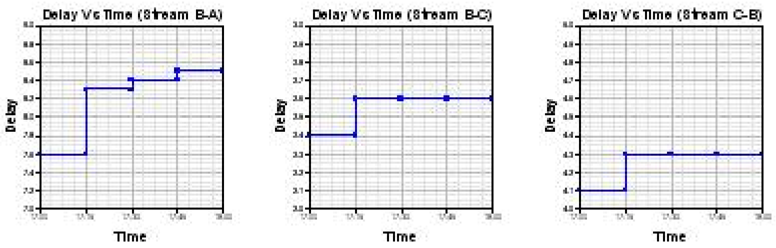
Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00



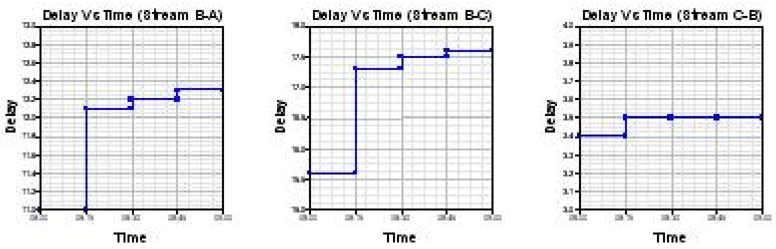
Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00



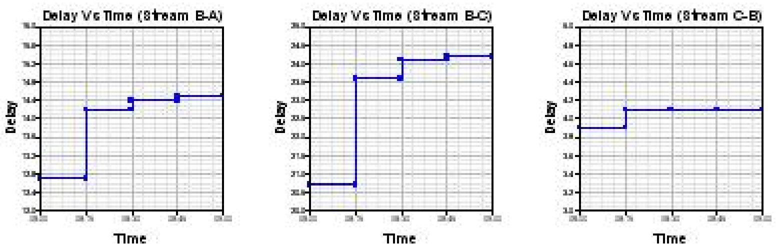
Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00



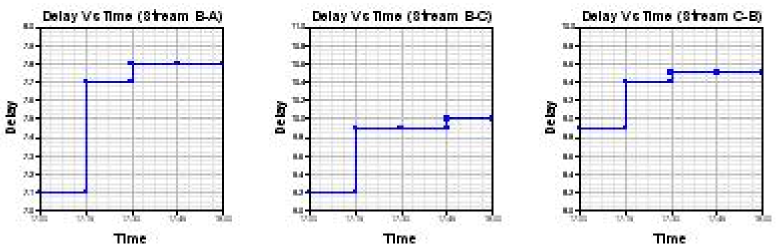
Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00



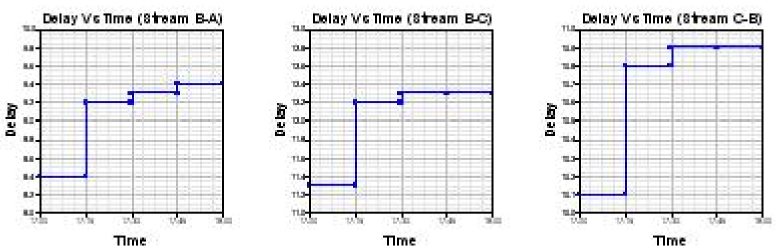
Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00



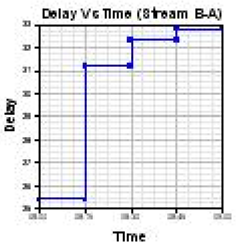
Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

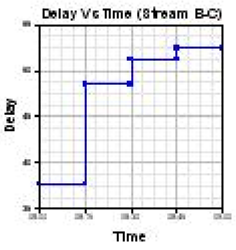


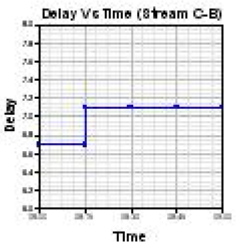
Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00



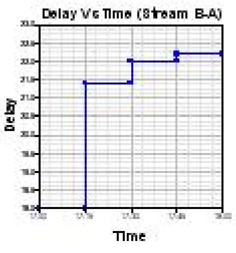
Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

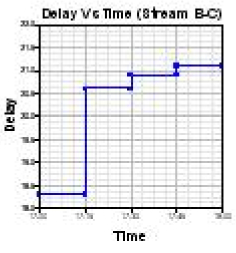


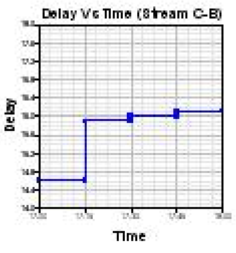




Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00







Queues & Delays

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:00-17:15	B-A	1.81	5.18	0.349	-	0.00	0.52	-	7.2	0.29
	B-C	1.29	8.82	0.147	-	0.00	0.17	-	2.5	0.13
	C-A	10.96	-	-	-	-	-	-	-	-
	C-B	2.11	9.39	0.225	-	0.00	0.29	-	4.1	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	4.88	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:15-17:30	B-A	1.81	5.18	0.349	-	0.52	0.53	-	7.9	0.30
	B-C	1.29	8.81	0.147	-	0.17	0.17	-	2.6	0.13
	C-A	10.96	-	-	-	-	-	-	-	-
	C-B	2.11	9.39	0.225	-	0.29	0.29	-	4.3	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	4.88	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:30-17:45	B-A	1.81	5.18	0.349	-	0.53	0.53	-	7.9	0.30
	B-C	1.29	8.81	0.147	-	0.17	0.17	-	2.6	0.13
	C-A	10.96	-	-	-	-	-	-	-	-
	C-B	2.11	9.39	0.225	-	0.29	0.29	-	4.3	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	4.88	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:45-18:00	B-A	1.81	5.18	0.349	-	0.53	0.53	-	8.0	0.30
	B-C	1.29	8.81	0.147	-	0.17	0.17	-	2.6	0.13
	C-A	10.96	-	-	-	-	-	-	-	-
	C-B	2.11	9.39	0.225	-	0.29	0.29	-	4.3	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	4.88	-	-	-	-	-	-	-	-

Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
08:00-08:15	B-A	2.64	6.08	0.433	-	0.00	0.74	-	10.2	0.28
	B-C	1.88	8.15	0.231	-	0.00	0.30	-	4.3	0.16
	C-A	4.92	-	-	-	-	-	-	-	-
	C-B	0.78	9.14	0.085	-	0.00	0.09	-	1.3	0.12
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	8.74	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
08:15-08:30	B-A	2.64	6.08	0.434	-	0.74	0.75	-	11.2	0.29
	B-C	1.88	8.13	0.232	-	0.30	0.30	-	4.5	0.16
	C-A	4.92	-	-	-	-	-	-	-	-
	C-B	0.78	9.14	0.085	-	0.09	0.09	-	1.4	0.12
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	8.74	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
08:30-08:45	B-A	2.64	6.08	0.434	-	0.75	0.76	-	11.3	0.29
	B-C	1.88	8.13	0.232	-	0.30	0.30	-	4.5	0.16
	C-A	4.92	-	-	-	-	-	-	-	-
	C-B	0.78	9.14	0.085	-	0.09	0.09	-	1.4	0.12
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	8.74	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
08:45-09:00	B-A	2.64	6.08	0.434	-	0.76	0.76	-	11.4	0.29
	B-C	1.88	8.13	0.232	-	0.30	0.30	-	4.5	0.16
	C-A	4.92	-	-	-	-	-	-	-	-
	C-B	0.78	9.14	0.085	-	0.09	0.09	-	1.4	0.12
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	8.74	-	-	-	-	-	-	-	-

Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-08:15	B-A	2.64	5.62	0.469	-	0.00	0.85	-	11.6	0.32
	B-C	1.88	7.76	0.243	-	0.00	0.32	-	4.5	0.17
	C-A	5.71	-	-	-	-	-	-	-	-
	C-B	0.78	8.78	0.089	-	0.00	0.10	-	1.4	0.12
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	10.14	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:15-08:30	B-A	2.64	5.62	0.469	-	0.85	0.87	-	12.9	0.33
	B-C	1.88	7.74	0.244	-	0.32	0.32	-	4.8	0.17
	C-A	5.71	-	-	-	-	-	-	-	-
	C-B	0.78	8.78	0.089	-	0.10	0.10	-	1.5	0.13
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	10.14	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:30-08:45	B-A	2.64	5.62	0.469	-	0.87	0.87	-	13.0	0.33
	B-C	1.88	7.74	0.244	-	0.32	0.32	-	4.8	0.17
	C-A	5.71	-	-	-	-	-	-	-	-
	C-B	0.78	8.78	0.089	-	0.10	0.10	-	1.5	0.13
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	10.14	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:45-09:00	B-A	2.64	5.62	0.469	-	0.87	0.88	-	13.1	0.33
	B-C	1.88	7.74	0.244	-	0.32	0.32	-	4.8	0.17
	C-A	5.71	-	-	-	-	-	-	-	-
	C-B	0.78	8.78	0.089	-	0.10	0.10	-	1.5	0.13
	A-B	1.08	-	-	-	-	-	-	-	-
	A-C	10.14	-	-	-	-	-	-	-	-

Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:00-17:15	B-A	1.81	4.99	0.362	-	0.00	0.55	-	7.6	0.31
	B-C	1.29	8.85	0.146	-	0.00	0.17	-	2.4	0.13
	C-A	12.71	-	-	-	-	-	-	-	-
	C-B	2.12	9.45	0.224	-	0.00	0.29	-	4.1	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	5.67	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:15-17:30	B-A	1.81	4.98	0.363	-	0.55	0.56	-	8.3	0.31
	B-C	1.29	8.83	0.146	-	0.17	0.17	-	2.6	0.13
	C-A	12.71	-	-	-	-	-	-	-	-
	C-B	2.12	9.45	0.224	-	0.29	0.29	-	4.3	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	5.67	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:30-17:45	B-A	1.81	4.98	0.363	-	0.56	0.56	-	8.4	0.32
	B-C	1.29	8.83	0.146	-	0.17	0.17	-	2.6	0.13
	C-A	12.71	-	-	-	-	-	-	-	-
	C-B	2.12	9.45	0.224	-	0.29	0.29	-	4.3	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	5.67	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:45-18:00	B-A	1.81	4.98	0.363	-	0.56	0.56	-	8.5	0.32
	B-C	1.29	8.83	0.146	-	0.17	0.17	-	2.6	0.13
	C-A	12.71	-	-	-	-	-	-	-	-
	C-B	2.12	9.45	0.224	-	0.29	0.29	-	4.3	0.14
	A-B	2.95	-	-	-	-	-	-	-	-
	A-C	5.67	-	-	-	-	-	-	-	-

Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-08:15	B-A	2.80	6.20	0.452	-	0.00	0.80	-	11.0	0.29
	B-C	4.54	8.39	0.541	-	0.00	1.14	-	15.6	0.25
	C-A	3.93	-	-	-	-	-	-	-	-
	C-B	1.78	9.33	0.191	-	0.00	0.23	-	3.4	0.13
	A-B	1.98	-	-	-	-	-	-	-	-
	A-C	7.11	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:15-08:30	B-A	2.80	6.19	0.453	-	0.80	0.81	-	12.1	0.30
	B-C	4.54	8.37	0.542	-	1.14	1.16	-	17.3	0.26
	C-A	3.93	-	-	-	-	-	-	-	-
	C-B	1.78	9.33	0.191	-	0.23	0.23	-	3.5	0.13
	A-B	1.98	-	-	-	-	-	-	-	-
	A-C	7.11	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:30-08:45	B-A	2.80	6.19	0.453	-	0.81	0.82	-	12.2	0.30
	B-C	4.54	8.37	0.542	-	1.16	1.17	-	17.5	0.26
	C-A	3.93	-	-	-	-	-	-	-	-
	C-B	1.78	9.33	0.191	-	0.23	0.24	-	3.5	0.13
	A-B	1.98	-	-	-	-	-	-	-	-
	A-C	7.11	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:45-09:00	B-A	2.80	6.19	0.453	-	0.82	0.82	-	12.3	0.30
	B-C	4.54	8.37	0.542	-	1.17	1.17	-	17.6	0.26
	C-A	3.93	-	-	-	-	-	-	-	-
	C-B	1.78	9.33	0.191	-	0.24	0.24	-	3.5	0.13
	A-B	1.98	-	-	-	-	-	-	-	-
	A-C	7.11	-	-	-	-	-	-	-	-

Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-08:15	B-A	2.84	5.75	0.494	-	0.00	0.93	-	12.7	0.33
	B-C	4.97	8.03	0.620	-	0.00	1.54	-	20.7	0.31
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	1.93	8.99	0.215	-	0.00	0.27	-	3.9	0.14
	A-B	2.13	-	-	-	-	-	-	-	-
	A-C	8.27	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:15-08:30	B-A	2.84	5.74	0.494	-	0.93	0.95	-	14.2	0.34
	B-C	4.97	8.00	0.622	-	1.54	1.59	-	23.6	0.33
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	1.93	8.99	0.215	-	0.27	0.27	-	4.1	0.14
	A-B	2.13	-	-	-	-	-	-	-	-
	A-C	8.27	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:30-08:45	B-A	2.84	5.74	0.494	-	0.95	0.96	-	14.4	0.34
	B-C	4.97	8.00	0.622	-	1.59	1.61	-	24.1	0.33
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	1.93	8.99	0.215	-	0.27	0.27	-	4.1	0.14
	A-B	2.13	-	-	-	-	-	-	-	-
	A-C	8.27	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:45-09:00	B-A	2.84	5.74	0.494	-	0.96	0.97	-	14.5	0.34
	B-C	4.97	8.00	0.622	-	1.61	1.62	-	24.2	0.33
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	1.93	8.99	0.215	-	0.27	0.27	-	4.1	0.14
	A-B	2.13	-	-	-	-	-	-	-	-
	A-C	8.27	-	-	-	-	-	-	-	-

Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:00-17:15	B-A	1.86	5.41	0.344	-	0.00	0.51	-	7.1	0.28
	B-C	3.74	9.35	0.400	-	0.00	0.65	-	9.2	0.18
	C-A	9.22	-	-	-	-	-	-	-	-
	C-B	3.85	9.89	0.389	-	0.00	0.62	-	8.9	0.16
	A-B	3.40	-	-	-	-	-	-	-	-
	A-C	3.48	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:15-17:30	B-A	1.86	5.40	0.345	-	0.51	0.52	-	7.7	0.28
	B-C	3.74	9.33	0.401	-	0.65	0.66	-	9.9	0.18
	C-A	9.22	-	-	-	-	-	-	-	-
	C-B	3.85	9.89	0.389	-	0.62	0.63	-	9.4	0.17
	A-B	3.40	-	-	-	-	-	-	-	-
	A-C	3.48	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:30-17:45	B-A	1.86	5.40	0.345	-	0.52	0.52	-	7.8	0.28
	B-C	3.74	9.33	0.401	-	0.66	0.66	-	9.9	0.18
	C-A	9.22	-	-	-	-	-	-	-	-
	C-B	3.85	9.89	0.389	-	0.63	0.63	-	9.5	0.17
	A-B	3.40	-	-	-	-	-	-	-	-
	A-C	3.48	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:45-18:00	B-A	1.86	5.40	0.345	-	0.52	0.52	-	7.8	0.28
	B-C	3.74	9.33	0.401	-	0.66	0.66	-	10.0	0.18
	C-A	9.22	-	-	-	-	-	-	-	-
	C-B	3.85	9.89	0.389	-	0.63	0.63	-	9.5	0.17
	A-B	3.40	-	-	-	-	-	-	-	-
	A-C	3.48	-	-	-	-	-	-	-	-

Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:00-17:15	B-A	1.91	4.95	0.386	-	0.00	0.61	-	8.4	0.32
	B-C	4.12	9.11	0.452	-	0.00	0.81	-	11.3	0.20
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.11	9.74	0.423	-	0.00	0.72	-	10.1	0.18
	A-B	3.47	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:15-17:30	B-A	1.91	4.93	0.387	-	0.61	0.62	-	9.2	0.33
	B-C	4.12	9.09	0.453	-	0.81	0.82	-	12.2	0.20
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.11	9.74	0.423	-	0.72	0.72	-	10.8	0.18
	A-B	3.47	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:30-17:45	B-A	1.91	4.93	0.387	-	0.62	0.62	-	9.3	0.33
	B-C	4.12	9.09	0.453	-	0.82	0.82	-	12.3	0.20
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.11	9.74	0.423	-	0.72	0.73	-	10.9	0.18
	A-B	3.47	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
17:45-18:00	B-A	1.91	4.93	0.387	-	0.62	0.63	-	9.4	0.33
	B-C	4.12	9.09	0.453	-	0.82	0.82	-	12.3	0.20
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.11	9.74	0.423	-	0.73	0.73	-	10.9	0.18
	A-B	3.47	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:00-08:15	B-A	3.67	5.30	0.692	-	0.00	2.01	-	25.4	0.53
	B-C	5.80	7.43	0.780	-	0.00	3.05	-	37.7	0.50
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	2.77	8.57	0.323	-	0.00	0.47	-	6.7	0.17
	A-B	3.80	-	-	-	-	-	-	-	-
	A-C	8.26	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:15-08:30	B-A	3.67	5.29	0.694	-	2.01	2.13	-	31.2	0.61
	B-C	5.80	7.37	0.787	-	3.05	3.35	-	48.5	0.61
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	2.77	8.57	0.323	-	0.47	0.47	-	7.1	0.17
	A-B	3.80	-	-	-	-	-	-	-	-
	A-C	8.26	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:30-08:45	B-A	3.67	5.29	0.694	-	2.13	2.17	-	32.3	0.61
	B-C	5.80	7.37	0.787	-	3.35	3.46	-	51.2	0.62
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	2.77	8.57	0.323	-	0.47	0.47	-	7.1	0.17
	A-B	3.80	-	-	-	-	-	-	-	-
	A-C	8.26	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/ segment)	Delay (veh.min/ segment)	Mean Arriving Vehicle Delay (min)
08:45-09:00	B-A	3.67	5.29	0.694	-	2.17	2.19	-	32.8	0.61
	B-C	5.80	7.37	0.787	-	3.46	3.52	-	52.4	0.63
	C-A	4.56	-	-	-	-	-	-	-	-
	C-B	2.77	8.57	0.323	-	0.47	0.47	-	7.1	0.17
	A-B	3.80	-	-	-	-	-	-	-	-
	A-C	8.26	-	-	-	-	-	-	-	-

Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:00-17:15	B-A	2.75	4.58	0.600	-	0.00	1.38	-	18.0	0.50
	B-C	4.96	8.50	0.584	-	0.00	1.34	-	18.3	0.27
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.95	9.52	0.520	-	0.00	1.05	-	14.6	0.21
	A-B	4.30	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:15-17:30	B-A	2.75	4.55	0.604	-	1.38	1.45	-	21.4	0.55
	B-C	4.96	8.45	0.588	-	1.34	1.39	-	20.6	0.29
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.95	9.52	0.520	-	1.05	1.07	-	15.9	0.22
	A-B	4.30	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:30-17:45	B-A	2.75	4.55	0.604	-	1.45	1.48	-	22.0	0.55
	B-C	4.96	8.44	0.588	-	1.39	1.40	-	20.9	0.29
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.95	9.52	0.520	-	1.07	1.07	-	16.0	0.22
	A-B	4.30	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Segment	Stream	Demand (veh/min)	Capacity (veh/min)	RFC	Ped. Flow (ped/min)	Start Queue (veh)	End Queue (veh)	Geometric Delay (veh.min/segment)	Delay (veh.min/segment)	Mean Arriving Vehicle Delay (min)
17:45-18:00	B-A	2.75	4.55	0.604	-	1.48	1.49	-	22.2	0.55
	B-C	4.96	8.44	0.588	-	1.40	1.41	-	21.1	0.29
	C-A	10.70	-	-	-	-	-	-	-	-
	C-B	4.95	9.52	0.520	-	1.07	1.07	-	16.1	0.22
	A-B	4.30	-	-	-	-	-	-	-	-
	A-C	4.03	-	-	-	-	-	-	-	-

Entry capacities marked with an '(X)' are dominated by a pedestrian crossing in that time segment.
In time segments marked with a '(B)', traffic leaving the junction may block back from a crossing so impairing normal operation of the junction.
Delays marked with '##' could not be calculated.

Overall Queues & Delays

Queueing Delay Information Over Whole Period

Demand Set: Opening Year PM (Full Dev)
Modelling Period: 17:00-18:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	108.4	108.4	31.0	0.3	31.0	0.3
B-C	77.6	77.6	10.2	0.1	10.2	0.1
C-A	657.3	657.3	-	-	-	-
C-B	126.9	126.9	17.2	0.1	17.2	0.1
A-B	176.9	176.9	-	-	-	-
A-C	292.9	292.9	-	-	-	-
All	1440.0	1440.0	58.3	0.0	58.4	0.0

Demand Set: Opening Year AM (Full Dev)
Modelling Period: 08:00-09:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	158.1	158.1	44.1	0.3	44.2	0.3
B-C	113.1	113.1	17.7	0.2	17.7	0.2
C-A	295.1	295.1	-	-	-	-
C-B	46.9	46.9	5.5	0.1	5.5	0.1
A-B	65.0	65.0	-	-	-	-
A-C	524.2	524.2	-	-	-	-
All	1202.4	1202.4	67.4	0.1	67.4	0.1

Demand Set: Design Year AM (Full Dev)
Modelling Period: 08:00-09:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	158.1	158.1	50.6	0.3	50.7	0.3
B-C	113.1	113.1	18.9	0.2	18.9	0.2
C-A	342.5	342.5	-	-	-	-
C-B	46.9	46.9	5.8	0.1	5.8	0.1
A-B	65.0	65.0	-	-	-	-
A-C	608.2	608.2	-	-	-	-
All	1333.8	1333.8	75.3	0.1	75.4	0.1

Demand Set: Design Year PM (Full Dev)
Modelling Period: 17:00-18:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	108.4	108.4	32.8	0.3	32.9	0.3
B-C	77.6	77.6	10.1	0.1	10.1	0.1
C-A	762.8	762.8	-	-	-	-
C-B	127.0	127.0	17.0	0.1	17.0	0.1
A-B	177.1	177.1	-	-	-	-
A-C	340.1	340.1	-	-	-	-
All	1593.0	1593.0	60.0	0.0	60.0	0.0

Demand Set: Opening Year AM LRL
Modelling Period: 08:00-09:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	168.2	168.2	47.6	0.3	47.7	0.3
B-C	272.2	272.2	67.9	0.2	68.0	0.2
C-A	235.7	235.7	-	-	-	-
C-B	106.9	106.9	13.9	0.1	13.9	0.1
A-B	119.1	119.1	-	-	-	-
A-C	426.3	426.3	-	-	-	-
All	1328.4	1328.4	129.5	0.1	129.6	0.1

Demand Set: Design Year AM LRL
Modelling Period: 08:00-09:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	170.2	170.2	55.7	0.3	55.8	0.3
B-C	298.4	298.4	92.6	0.3	92.8	0.3
C-A	273.6	273.6	-	-	-	-
C-B	115.8	115.8	16.1	0.1	16.1	0.1
A-B	128.0	128.0	-	-	-	-
A-C	496.0	496.0	-	-	-	-
All	1482.0	1482.0	164.5	0.1	164.7	0.1

Demand Set: Opening Year PM LRL
Modelling Period: 17:00-18:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	111.7	111.7	30.5	0.3	30.5	0.3
B-C	224.3	224.3	39.0	0.2	39.0	0.2
C-A	553.4	553.4	-	-	-	-
C-B	230.8	230.8	37.3	0.2	37.3	0.2
A-B	203.9	203.9	-	-	-	-
A-C	208.9	208.9	-	-	-	-
All	1533.0	1533.0	106.7	0.1	106.8	0.1

Demand Set: Design Year PM LRL
Modelling Period: 17:00-18:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	114.6	114.6	36.3	0.3	36.3	0.3
B-C	247.2	247.2	48.2	0.2	48.2	0.2
C-A	641.7	641.7	-	-	-	-
C-B	246.9	246.9	42.8	0.2	42.8	0.2
A-B	208.0	208.0	-	-	-	-
A-C	242.0	242.0	-	-	-	-
All	1700.4	1700.4	127.2	0.1	127.3	0.1

Demand Set: Sensitivity Test AM
Modelling Period: 08:00-09:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	220.1	220.1	121.6	0.6	122.0	0.6
B-C	348.1	348.1	189.8	0.5	190.7	0.5
C-A	273.9	273.9	-	-	-	-
C-B	165.9	165.9	28.0	0.2	28.0	0.2
A-B	227.9	227.9	-	-	-	-
A-C	495.7	495.7	-	-	-	-
All	1731.6	1731.6	339.4	0.2	340.7	0.2

Demand Set: Sensitivity Test PM
Modelling Period: 17:00-18:00

Stream	Total Demand (veh)	Total Demand (veh/h)	Queueing Delay (min)	Queueing Delay (min/veh)	Inclusive Delay (min)	Inclusive Delay (min/veh)
B-A	164.9	164.9	83.5	0.5	83.8	0.5
B-C	297.7	297.7	80.9	0.3	81.0	0.3
C-A	642.0	642.0	-	-	-	-
C-B	297.0	297.0	62.7	0.2	62.7	0.2
A-B	257.9	257.9	-	-	-	-
A-C	241.9	241.9	-	-	-	-
All	1901.4	1901.4	227.1	0.1	227.5	0.1

Delay is that occurring only within the time period.
Inclusive delay includes delay suffered by vehicles which are still queuing after the end of the time period.
These will only be significantly different if there is a large queue remaining at the end of the time period.

PICADY 5 Run Successful