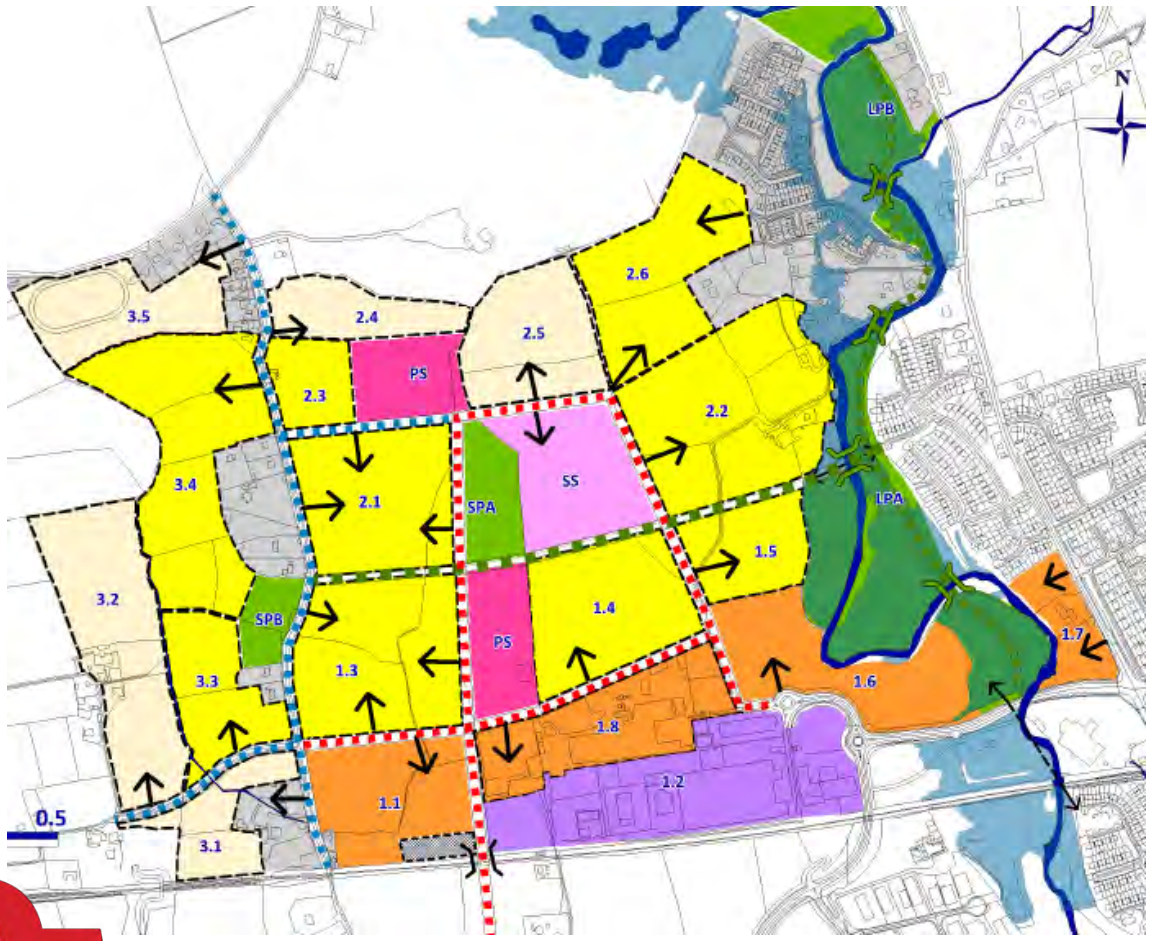
WATER ROCK STRATEGIC TRANSPORT ASSESSMENT



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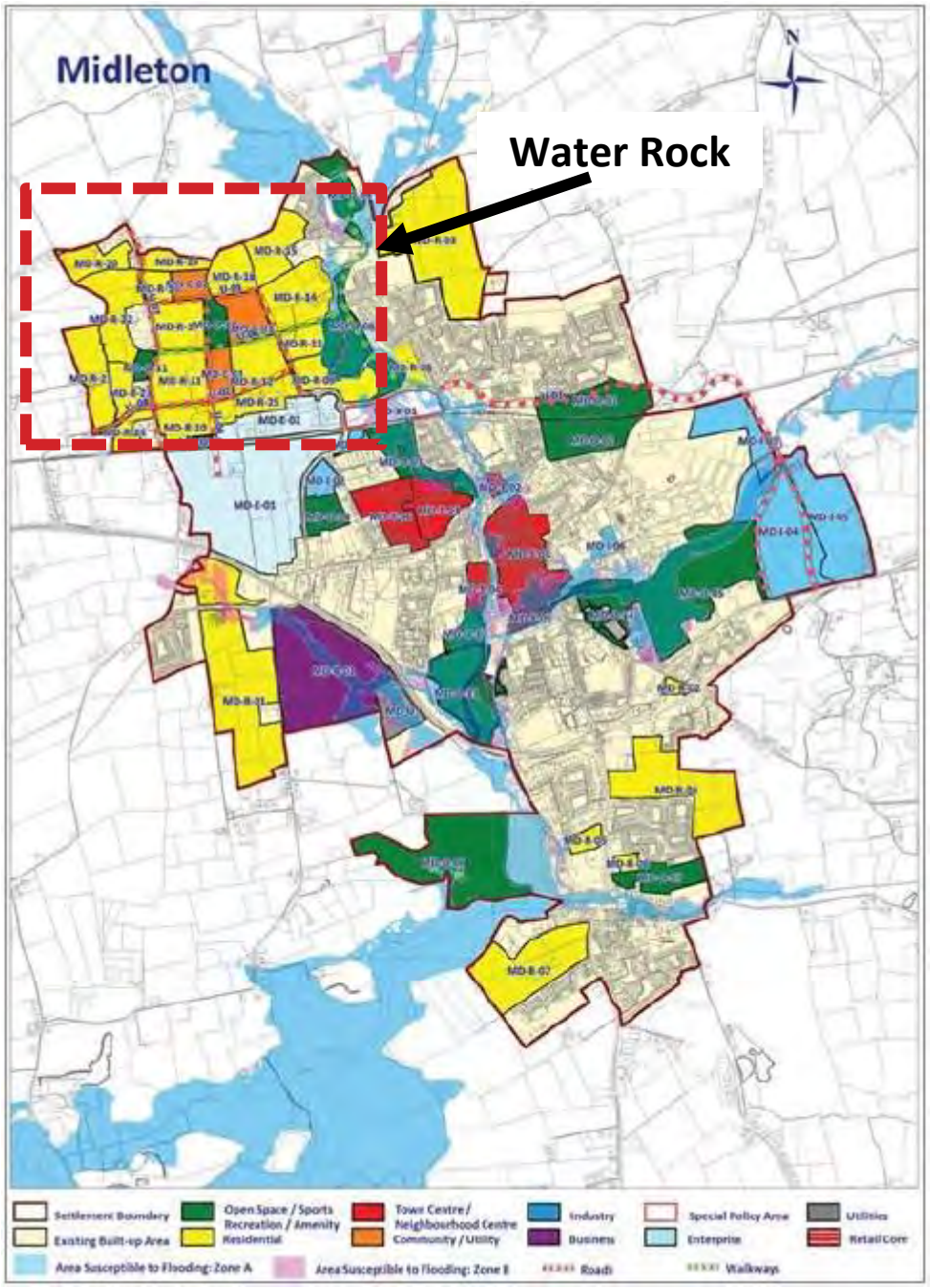
1. INTRODUCTION

1.1 Project Overview

1.1.1 Cork County Council (CCC) have published a series of draft Local Area Plans (LAPs) which set out a land use planning strategy for the development of the settlements of the county. The county has been divided into a total of 8 Municipal Districts with a LAP developed for each district. Contained within these district LAPs are 9 Urban Expansion Areas (UEAs) which will house much of the projected future population growth within the county, of which Water Rock in Midleton is one.

1.1.2 When fully developed the Water Rock UEA will accommodate a total of approximately 2,500 housing units, 10,000 m^2 of Offices, 2,000m^2 of Retail facilities, 500m^2 of Leisure facilities, 2 primary schools and 1 secondary school. Atkins and SYSTRA Ltd have been commissioned by Cork County Council to undertake a Transport Assessment of the Water Rock Urban Expansion Area in Midleton, which is scheduled to take place over four development phases (1A, 1, 2, & 3). The Water Rock Lands are located to the north-west of Midleton town centre as shown in Figure 1.1, below.

Figure 1-1 Water Rock Strategic Transport Assessment Study Area



1.2 Background of the Assessment

1.2.1 Previous transport assessments of the Water Rock UEA have been completed, however, there is a requirement to update these to consider in greater detail the impact of each phase of the development of the UEA on the road network and the requirements and timing for upgrading elements of the existing road infrastructure in conjunction with the phased development.

1.2.2 The Water Rock Masterplan: Phase 1 Transport Assessment July 2014 primarily focussed on the impacts of the development of Phase 1 of the Water Rock UEA, which consisted of approximately 1,000 housing units. A total of circa 2,500 housing units are planned for the UEA when fully completed. The Masterplan recommends updates of the Traffic and Transport Assessment for Phases 2 (for an additional approximate 800 housing units) and 3 (for the final approximate 700 housing units). In addition to the Water Rock Masterplan: Phase 1 Transport Assessment, the National Transport Authority more recently commissioned Jacobs Systra to complete the Cork Urban Expansion Area Assessment, including the Water Rock Transport Assessment. The Jacobs Systra Water Rock Transport Assessment provides a strategic analysis of the impacts of the UEA developments using the NTA South West Regional Model (SWRM). It also provides recommendations for future infrastructure improvements necessary or desirable for the development of the Water Rock UEA and to facilitate development in Midleton more generally.

1.2.3 In relation to the Water Rock Masterplan: Phase 1 Transport Assessment by AECOM, it is noted that this included an assessment of the impacts on the road network of further phases of the development, however, some of the assumptions regarding the level of development in each phase and the timing of the phases of development have subsequently been superseded. It is also noted that the background traffic demand for this assessment was taken from the NRA National Transport Model (NTpM) rather than the NTA SWRM and hence is not consistent with more recent transport assessments, including the Jacobs Systra Water Rock Transport Assessment. For example, the NRA NTpM uses forecasts based on 2006 census data, while the NTA SWRM uses 2011 census data. Furthermore, the assessments of the impacts at each phase of the development included assumptions regarding the infrastructure improvements that would be in place (notably the N25 Upgrade) but did not assess the impacts if these infrastructure improvements are not provided.

1.2.4 In relation to the Jacobs Systra Water Rock Transport Assessment, it is noted that this provides a high-level assessment of the traffic impacts of the development of the UEA. The NTA SWRM, although appropriate for a study of this nature, does not provide a sufficiently refined zoning system or representation of the local road network within the area of the UEA to be able to accurately predict traffic flows and assess the impacts on the operation of individual junctions. Furthermore, although the Jacobs Systra Water Rock Transport Assessment identifies future infrastructure improvements necessary or desirable for the development of the Water Rock UEA and to facilitate development in Midleton more generally, it does not provide any link between the timing of the provision of this infrastructure and the phasing of the development of the Water Rock UEA. Nor does the assessment include a detailed analysis of the traffic impacts on the road network at different phases of the development. The report notes that there is a need to develop local calibrated models to assess the operational performance of individual junctions.

1.3 Purpose of This Assessment

1.3.1 For the reasons outlined above, it is now proposed to complete a more comprehensive Traffic and Transportation Assessment for the development of all phases of the Water Rock UEA. The proposed study will provide a very robust assessment using a modelling approach that is consistent with the NTA SWRM and the Cork Metropolitan Area Transport Strategy (CMATS). It will include a full assessment of the capacity of the existing road network to accommodate the traffic from the UEA at the different phases of the development, will establish when and what road infrastructure improvements will be required and includes for assessment of the impact of a higher mode share of trips by rail given the new rail stop.

1.3.2 As previously mentioned, there are 9 UEAs within the county and this assessment has been undertaken within the context of the full implementation of all 9 UEA's. Given its location (6km west of Water Rock as shown below in Figure 1.2) The Carrigtwohill UEA, in particular, is likely to affect the capacity of the road network in the study area. Therefore, to represent a worst-case scenario, the likely demand from this, and all other, Urban Expansion Areas has been included in our future year travel demand estimates.

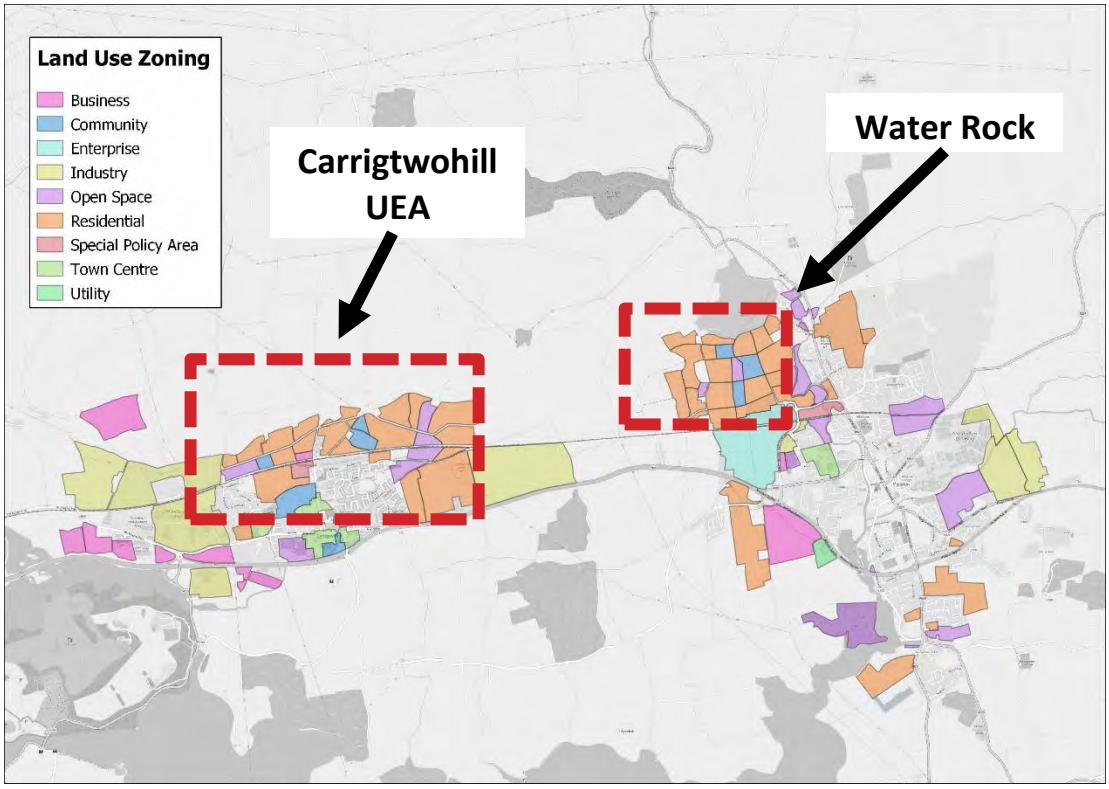


Figure 1-2 Location of All Development Proposals in Study Area

1.4 Assessment Methodology Overview

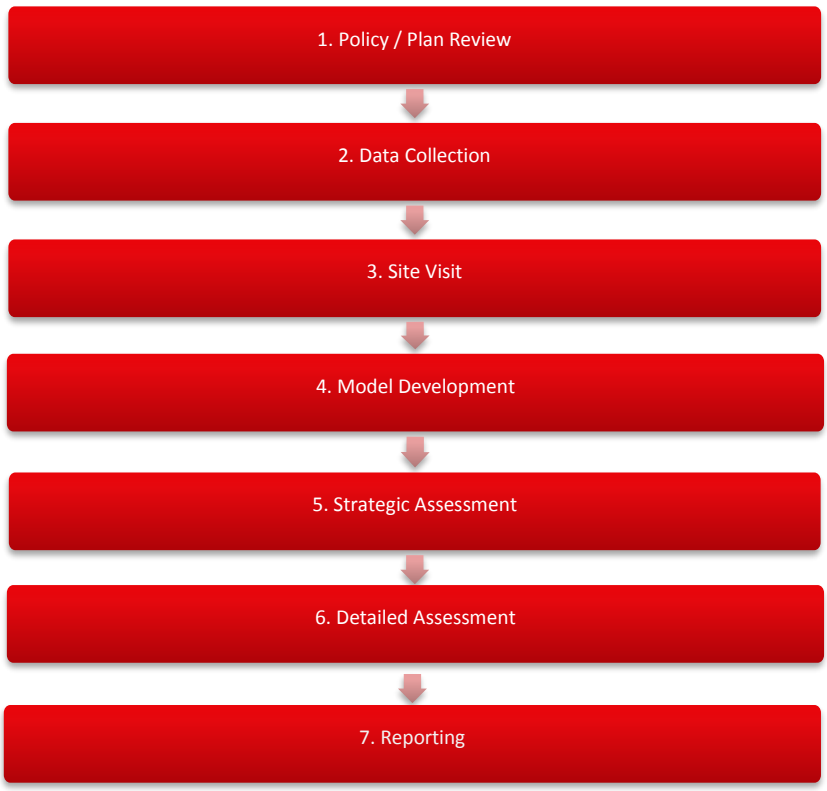
1.4.1 The first step in the assessment was a full review of existing plans and policies at a national, regional and local level to understand the context and background of the proposed development. Following this, a site visit was undertaken to better understand existing travel behaviour and patterns in the area, observe existing capacity or design issues, and identify opportunities for improving mobility in the study area based on both the policy review and site visit.

1.4.2 A strategic Local Area Model (LAM) of the study area was developed in SATURN and a Micro-simulation model of Midleton was developed using VISSIM Software. These models have been used respectively to assess the strategic and operational impacts of the proposed development.

1.4.3 Following the development of the traffic models, a strategic level assessment was then undertaken using the Water Rock LAM which modelled the impact of the development of the area in accordance with the East Cork Local Area Plan. Outputs from the strategic assessment were then used to help identify the transportation impacts of each phase of the proposed development. Following this strategic modelling assessment, a more detailed operational assessment was carried out using micro-simulation modelling. This approach is in line with best practice for assess traffic impacts for a development of this scale.

1.4.4 An overview of all the steps in the transport assessment is presented below in Figure 1.3.

Figure 1-3 Assessment Methodology



1.5 Report Structure

1.5.1 The remainder of this report will be structured as followed:

- **Chapter 2**: Policy Context
- **Chapter 3**: Existing Traffic Conditions
- **Chapter 4**: Local Area Plan(s) and Scope of Proposed Development
- **Chapter 5:** Water Rock Local Area Model Development
- **Chapter 6:** Transport Assessment Methodology
- **Chapter 7:** Trip Generation and Distribution

- **Chapter 8:** Phase 1A – Transport Assessment
- **Chapter 9:** Phase 1 – Transport Assessment
- **Chapter 10:** Phase 2 – Transport Assessment
- **Chapter 11:** Phase 3 – Transport Assessment
- **Chapter 12:** Summary and Conclusions

2. POLICY CONTEXT

2.1 National Policy Context

Project Ireland 2040: National Planning Framework (DECLG, 2018)

2.1.1 The National Planning Framework supersedes the National Spatial Strategy 2002 (NSS). Spanning 20 years, it provides a long-term central planning policy strategy which guides future development and investment decisions and informs future regional strategies and county development plans. The plan outlines a strategic approach which will promote sustainable settlement and transport strategies in both urban and rural areas. The aim of this approach is to reduce emissions and protect the environment and its amenities.

Smarter Travel

2.1.2 Smarter Travel is government policy which seeks to reduce the share of travel demand growth which is car dependant. Its main objective is to promote a significant modal shift from private transport to public transport and sustainable transport modes over the period up to 2020. It also aims for more efficient use of the existing transport network. Controlling development so that it is sustainable / public transport oriented, is identified as a mechanism by which this can be achieved.

Building on Recovery: Infrastructure and Capital Investment 2016 – 2022 (Department of Public Expenditure and Reform, 2015)

2.1.3 The *Infrastructure and Capital Investment 2016 – 2022 Plan* presents the Government's €42 billion framework for infrastructure investment in Ireland over the period 2016 to 2021. There are several strategic infrastructure schemes close to the study area identified to receive funding, including the N8/N25 Dunkettle Interchange.

2.2 Regional Policy Context

CASP Update 2008

2.2.1 Water-Rock is located within the Cork Area Strategic Plan (CASP) area. CASP recognises the need to support the use of sustainable transport modes (public transport, cycling and walking) and acknowledges that "future demand for transport must be met in a balanced way between all transport modes so that congestion can be reduced".

2.2.2 The CASP update recognises the significant potential of the Water-Rock development site (both residential and commercial) and identifies the need for a strong supporting sustainable transport network. The CASP also identifies the clear opportunity for the development site to benefit from the proximity of the Cork – Midleton railway line.

Cork County Development Plan 2014 – 2020

2.2.3 This Plan sets out an overall strategy for the proper planning and sustainable development of Cork County over a 6-year period. The objective of the strategy is to make Cork a more competitive and sustainable county through the delivery of an efficient transport system whilst encouraging balanced investment and more energy efficient sustainable modes of public and private transport. The County Development Plan provides for an enhanced

public transport network linking the large Metropolitan towns, including Water-Rock to the City Centre and wider environs.

Cork Metropolitan Cycle Network 2015 (updated 2017)

2.2.4 The aim of the Cork Metropolitan Area Cycle Network Plan is to provide a coherent, safe and attractive cycle network that will support a shift from the private car to cycling for all trip purposes. The plan recognises that Midleton benefits from segregated cycle tracks recently introduced in the Broomfield residential area as well as on the Midleton Northern Relief Road (Phase 1). However, whilst these tracks present an opportunity to encourage trips by bicycle, cycling facilities in Midleton are generally limited and they do not form a coherent cycle network.

2.2.5 The Cork Cycle Network Plan includes connections between Water-Rock and Cork City via an inter urban route which runs parallel with the Cork – Midleton railway line. This route will provide an excellent opportunity to encourage both leisure and commuter trips by bicycle. Furthermore, a strategic Greenway link is identified along the existing disused railway line between Midleton and Youghal. A Greenway link is also identified between the Water-Rock development site and the periphery of Midleton Town Centre. The Plan also indicates the potential for a direct cycle link between the Water-Rock and Carrigtwohill North UEAs. Figure 2.1 outlines the proposed cycle network local to Midleton within the plan.

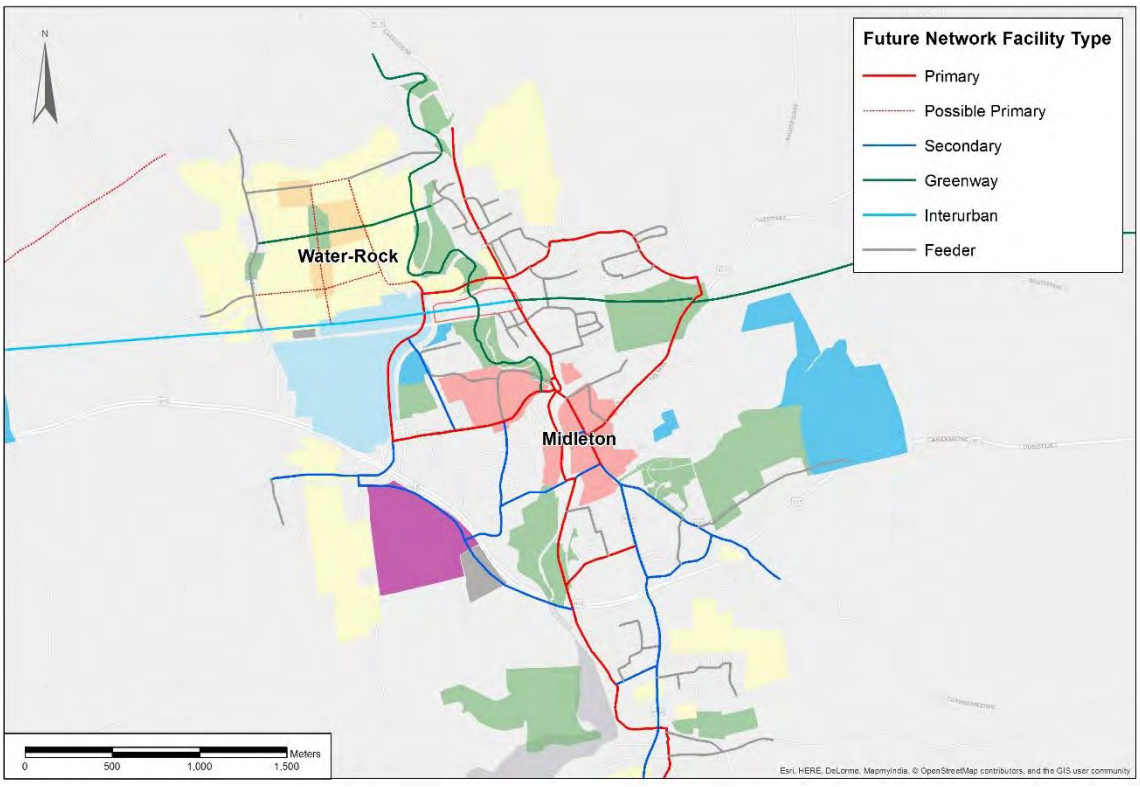


Figure 2-1 Midleton (incl. Water Rock) proposed Future Cycle Network

Cork Area Transit Study (CATS) (2010)

2.2.6 The Cork Area Transit Study (CATS) was prepared to examine strategic public transport measures that would provide for future growth in the Cork Metropolitan Area. An

integrated package of measures was identified which would provide for a state of the art public transport system to ensure that all road users can move around in a less congested environment. Recommendations included:

- Phased introduction of a BRT system linking Ballincollig and Mahon, via the City Centre and Docklands;
- Increase in capacity and frequency of rail services between Cork and the Metropolitan towns located on the Cork – Midleton railway line;
- Significantly improved bus services and priority measures on the key north-south corridor linking the Airport to the City Centre and onto Ballyvolane;
- Reconfigured bus network with improved frequencies, better linkages and improved on-street priority throughout the Cork Region;
- Revised Traffic Management arrangements to improve accessibility, and facilitate introduction of improved public transport throughout the Cork Region;
- Supportive Parking Strategies in the Cork Region to achieve the desired study outcomes, and to support investment in public transport; and
    - Implement integration measures, including: park and ride;
    - High quality bus stop infrastructure with Real Time Information and mapping;
    - Integrated ticketing/fares; and
    - Seamless interchange at Kent Station.

2.3 Local Policy Context

East Cork Municipal District Draft Local Area Plan

2.3.1 The East Cork Municipal District Local Area Plan will provide for 7,790 new dwelling units with the highest number of new dwellings planned for Midleton at 5,243 units, approximately 50% of these are to be located within the Water-Rock development site. The target population of Midleton is to be 21,576 which is an increase of 8,773 on the Census 2016 population.

2.3.2 The Draft plan mentions that the N25 runs through the south of Midleton and while a portion of the town lies to the south of the road, it functions as a by-pass. Traffic congestion and parking are stated to be significant issues in the town centre which are both required to be addressed.

2.3.3 The plan also recognises the benefits that could be realised if a modal shift from the private car to more sustainable modes of transport was achieved. Emphasis is placed on the opportunities that currently exist in Midleton to encourage cycling due to the relatively flat terrain and the proximity of the residential areas to the town centre.

2.3.4 A number of overall design principles are set out in the LAP and the key principle relating to transport is as follows:

- Support the achievement of high levels of modal shift by collaborating with other agencies to improve public transport services and influence patterns of employment based development to support use of sustainable modes and travel by public transport.

2.3.5 Whilst aiming to maximise pedestrian, cycling and public transport use, the Draft LAP acknowledges that there will remain a need to provide for car use by existing and future

residents. This includes (as well as local improvement measures) the potential provision of a new N25 Interchange between Midleton and Carrigtwohill (N25 route).

Water Rock Framework Masterplan Study

2.3.6 The Water-Rock Framework Masterplan Study was prepared to inform the amendment to the Midleton Electoral Area Local Area Plan in November 2015. The zoning proposals and infrastructure requirements set-out in the document are currently set out in the LAP for the East Cork Municipal District.

2.3.7 The Framework Masterplan Study for Water-Rock details the transport infrastructure improvements required to support the build-out of development lands. These improvement measures are detailed in the previous Transport Assessment for Water-Rock that was completed in 2014. This Transport Assessment acknowledges that the upgrade to the N25 between Midleton and Carrigtwohill is required to support the full development at Water-Rock although the timescales associated with its implementation are reliant on several factors including the level of modal shift that is achieved.

2.3.8 The Framework Masterplan Study identifies that development at Water-Rock must provide a high-quality environment for people to live which includes:

- Quality housing to meet the needs of citizens from all walks of life;
- Well-designed movement corridors (segregated where appropriate);
- Effective connectivity to public transport, high quality amenity provision;
- Attractive open space offering the opportunity for high quality of life;
- Best practice in overall design and layout;
- Sensitive integration of the development into the existing landscape providing for the protection of environmental resources including biodiversity and water.

3. EXISTING TRANSPORT CONDITIONS

3.1 Overview

3.1.1 As part of this Transport Assessment a site visit was undertaken to the Water Rock and the surrounding Midleton area. The purpose of the site visit was to understand the existing transport situation within the study area and surrounding developments and identify potential transport constraints and opportunities. In addition to this, a desktop review of the public transport network was undertaken and the following information has been collated:

- Key junctions' layout and operation;
- Key roads geometry;
- Cycling and Walking facilities;
- Pedestrian and cyclist permeability through the existing residential estates; and
- Public Transport provision.

3.2 Road Network

Existing Road Hierarchy

3.2.1 The N25 runs in an east to west direction and by-passes Midleton to the south. There are two main junctions from the N25 that serve the town; one to the west at Knockgriffin (Junction 1 Fig 3.1) and one to the south / east at Lake View Roundabout (Junction 9 Fig 3.1). There is also a junction approximately 1.4km to the east of Lake View Roundabout which provides access to Midleton Town Centre via the R907 Youghal Road.

3.2.2 An additional junction from the N25 to the Midleton area (via the Water-Rock Road) is provided approximately 600m to the west of Junction 1. However, the junction is of a very poor standard. It is currently mainly used for local access. Traffic count results indicate that it is also used by traffic using the Water Rock Road to travel between the N25 and the Carrigane Road. There is an additional junction approximately 4km to the west of this junction which again provides local access but which traffic can also use to travel between the N25 and the Carrigane Road using a very narrow country lane running north to south between the two roads.

3.2.3 The majority of the roads within the Midleton area are of an appropriate standard and reflect the typical characteristics of a medium-sized town in Ireland. The Northern Relief Road (Phase 1), which will provide vehicular access to the development, links the N25 in the south to the R626 in the east and incorporates footways and cycleways on both sides of the road. The Water-Rock Road, which is the only existing road that will be utilised by the development, is of a rural standard. The road widths and forward sight distances are below standard in places and there are no separate pedestrian or cyclist facilities.

3.2.4 Figure 3.1 outlines the road network surrounding the development site whilst Table 3.1 on the following page provides a brief description of each of the main roads outlined in the map and highlights potential constraints.

Figure 3-1 Study Area Road Hierarchy

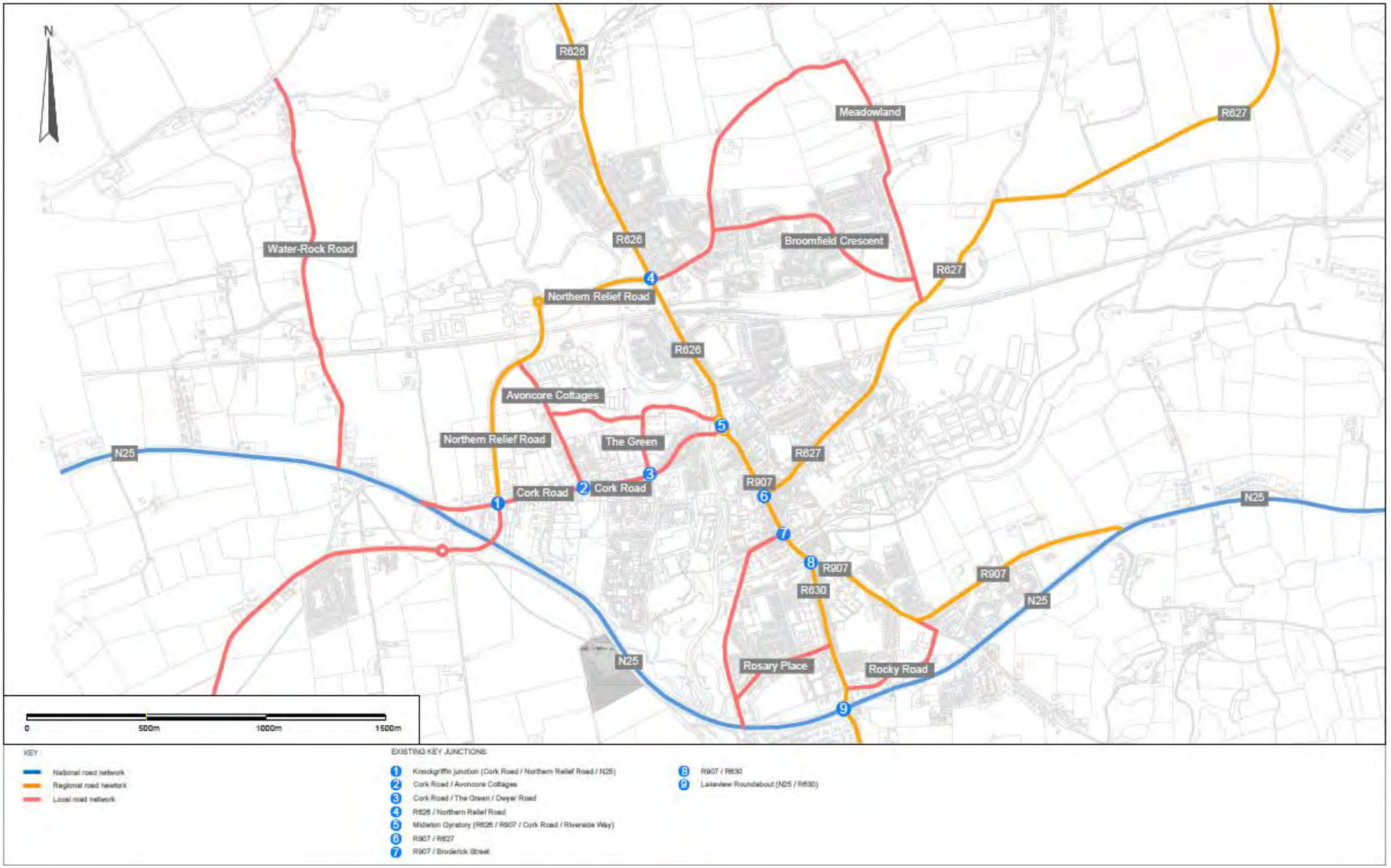


Table 3-1 Study Area Road Hierarchy

ROAD	DESCRIPTION
N25 National Road	National road which links the development site with Cork City Centre via the N8 in the west with Rosslare Harbour in the east via Waterford. The road generally runs in an east to west direction and is a dual carriageway between the interchange with the N8 and Lake View Roundabout in the south. The two main junctions from the N25 that serve Midleton are Junction 5 at Knockgriffin (in the west) and the Lake View Roundabout (in the south). To the east of Lake View Roundabout, the N25 is a single carriageway road. There are currently delays on the N25 during peak periods near Midleton, particularly on the westbound approach to Lake View Roundabout.
R626 Regional Road	The R626 runs in a north to south direction and provides a link between Midleton Gyratory in the south and the M8 motorway in the north via the R639. The road is single carriageway and is located to the east of the development. The road is generally heavily trafficked during the AM and PM commuter peak periods.
R627 Regional Road	The R627 is located to the east of the development and generally runs in a north-east to south-west direction. The R627 runs between Midleton Town Centre in the south-west to Tallow in the north-east. In the south-west, near the junction with the R907, the road is narrow and constrained by buildings at both sides of the road and by parked cars on the north-west side of the road. Beyond the build-up areas, the R627 is provided to a distributor road standard.
R630 Regional Road	The R630 provides a link between Midleton Town Centre in the north and Whitegate in the south. The R630 also links Midleton with Ballinacurra to the south. As with most of the roads within the town centre core, on-street parking activity takes place on the R630 which can impede the flow of traffic. Outside of the town, the R630 is provided to a distributor road standard.
R907 Regional Road	The R907 runs from the Midleton Gyratory in the town centre to the N25 in the east. The R907 is provided to a good a standard with no obvious constraints. The junction with the N25 is currently priority controlled with a right-turn ghost island on the N25. A diverge lane is provided for left-turners.
Northern Relief Road (Phase 1)	The Northern Relief Road is located to the south / east of the development and provides a link between the R626 in the east and the N25 in the south via the Knockgriffin junction. The road provides access to the Nordic Enterprise Park which is located at the southern boundary of the development. Signal-controlled crossroads are provided at the junction with the R626 and Avoncore Place complete with pedestrian facilities.

Water-Rock Road (Castle Rock Avenue)	Water-Rock Road runs in a north to south direction and runs through the development site. The road also provides access to the N25 although the junction is of a very poor standard and is used for local access mainly, although, traffic count results indicate that it is also used by traffic using the Water Rock Road to travel between the N25 and the Carrigane Road. A level rail crossing is provided approximately 450m to the north of the junction with the N25. The width of the road varies depending on the location and the forward visibility is below standard in places.
Carrigane Road	Carrigane Road connects Carrigtwohill to the R626 regional road just north of Midleton. There are a number of smaller local roads which connect to the Carrigane Road at priority junctions including the Water Rock Road. Numerous one-off houses have direct access to the Carrigane Road. The road is a rural single carriageway road and is bounded by rural hedges, boundary walls and trees. There are no off-road pedestrian or cyclist facilities. The road crosses over the Cork – Midleton railway line at a bridge which is approximately 1km to the east of Carrigtwohill.
Cork Road	Cork Road links the N25 Knockgriffin junction with the Midleton Gyratory and generally runs in an east to west direction. Queuing currently takes place on Cork Road in the eastbound direction at the signal-controlled crossroads junction at Knockgriffin. This is due to demand of the eastbound traffic towards Midleton Town Centre. Queuing can extend back onto the N25 which was observed during the site visit.
Avoncore Cottages	Avoncore Cottages (also referred to locally as Kennel Road) runs in a north to south direction and provides a link between the Northern Relief Road and Cork Road. The road provides access to residential properties, including properties with direct frontage access, and the Owenacurra Business Park from the east side of the road.
Market Green	Market Green provides a link between the Midleton Gyratory and Avoncore Cottages (Kennel Road) and provides access to the Market Green retail area including the retail park on the north side of the road. Speed ramps are provided to reduce the speed of traffic near the junction with Avoncore Cottages.
The Green	The Green runs in a north to south direction and links Market Green with Cork Road. The road provides access to Midleton Retail Park as well as the Tesco Superstore.
Avoncore Place	Avoncore Place forms an arm of the signal-controlled junction at the R626 / Northern Relief Road. The road runs in a north-east to south-west direction and provides access to the Broomfield residential area. To the north, the road becomes Meadowlands which is rural in nature and provides local access to residential properties.

Broomfield Crescent	Broomfield Crescent provides a link between Avoncore Place and the R627 (via Meadowlands Lane). The road acts as a spine road through the Broomfield Village residential development. Direct frontage access from the road takes place in the west near the junction with Avoncore Place.

3.3 Existing Public Transport Network

3.3.1 Water-Rock is currently poorly connected by public transport and is outside the walking catchment of existing nearby stations and stops. However, Midleton is well connected by both bus and rail to Cork City. There are four bus services which serve Midleton: the 240 Cork – Ballycotton, the 241 Cork –Trabolgan, 260 Cork –Ardmore and the 261 Cork – Ballinacurra. The 240 and 241 services provide two buses from Midleton to Cork between 07:00 – 08:00 whilst the 240 also provides a bus between 08:00 – 09:00. Both services operate at irregular intervals throughout the day. The 260 service provides three buses to Cork between 08:00 – 09:00; one of which provides a non-stop service to Cork from Midleton. The timetabled journey time on this direct bus to Cork is approximately 25 minutes. The 261 service provides seven buses to Cork between the hours of 07:00 – 09:00.

3.3.2 Each of the services above run along Cork Road and route south towards Midleton Town Centre and link with Carrigtwohill to the west. At present, there is no bus service to the north of the Midleton Gyratory. The nearest bus stops are located on the Cork Road and the R907; both of which are a 1.4km walking distance from the development.

3.3.3 A total of 21 trains operate daily each way between Cork and Midleton. Services run at 30 minute intervals during peak periods and every hour off-peak from Monday to Friday. Each train is a two-carriageway commuter train with the capacity to accommodate up to 320 passengers. A total of 283 car parking spaces are provided at the station as well as capacity to accommodate around 20 – 30 bicycles. The existing Midleton rail station is located 1.3 km from the site entrance.

3.3.4 The platform at Midleton has been designed to accommodate future expansion to four carriages and to a service frequency of every 15 minutes. This is to accommodate the intensification of development near the railway station in the future.

3.3.5 Figure 3.2 illustrates the routes of all buses that operate from Midleton and bus stop locations throughout the town. Midleton Railway Station and the Cork – Midleton rail line are also indicated on the plan.

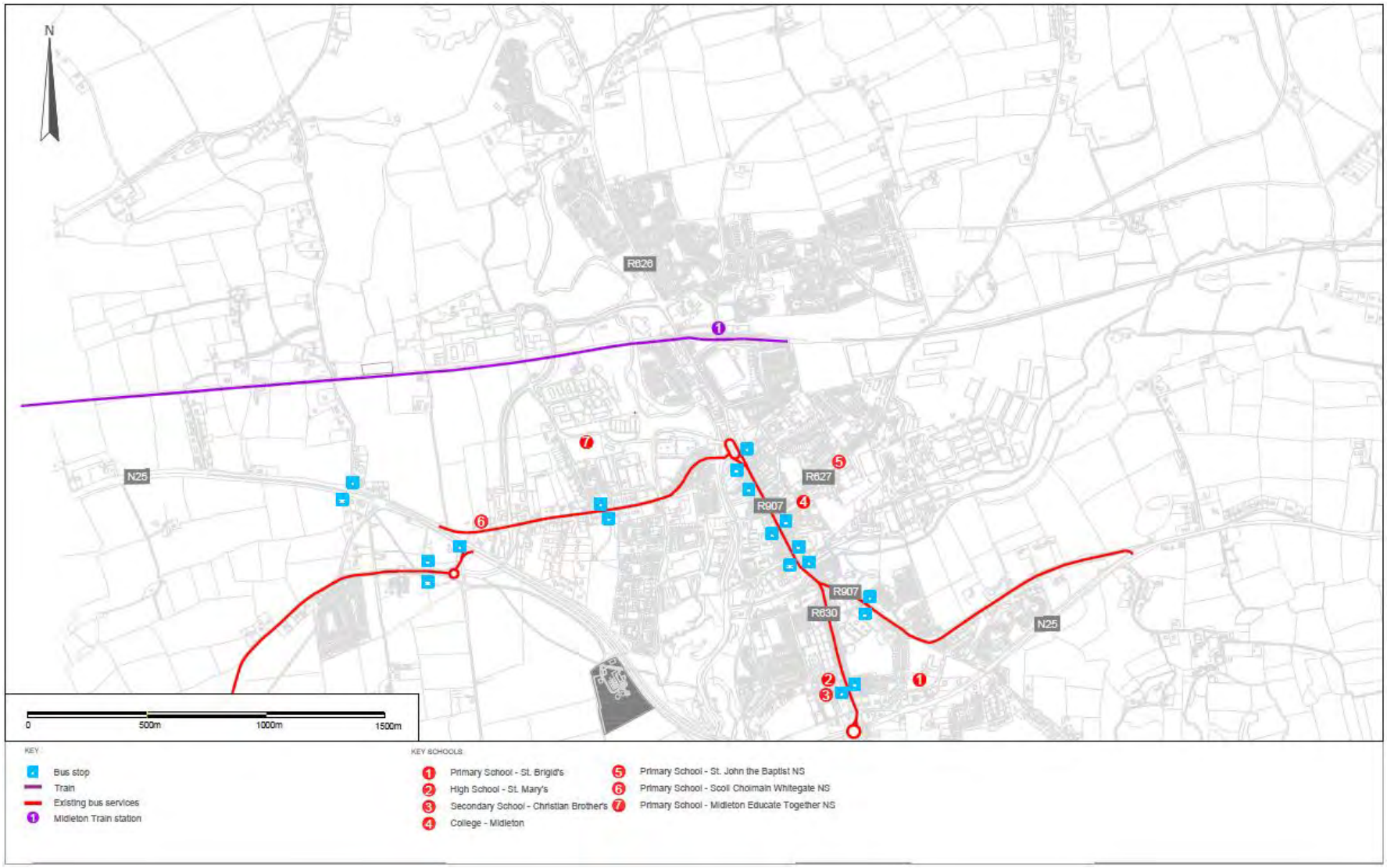


Figure 3-2 Existing Public Transport Network

3.4 Existing Walking and Cycling Network

Walking Network

3.4.1 Most the main roads within Midleton have footways on at least one side of the road. Through the town centre core (R907 Main Street), footways are provided on both sides of the road and are approximately 3m wide. Along the length of the road, which is approximately 600m long, there is one pedestrian crossing facility which is signal-controlled. This is located approximately 150m to the south of the Midleton Gyratory. Given that there are town centre facilities along the length of Main Street on both sides of the road which generate a high pedestrian crossing demand, it is considered that one crossing facility is not sufficient.

3.4.2 Pedestrian crossing facilities are integrated into the Midleton Gyratory with signal-controlled crossings provided on the southern arm of the junction on both the entry and exit arms. In addition, three signal-controlled crossings are also provided which direct pedestrians to the centre of the junction where there are footpath facilities and a public realm area.

3.4.3 There are no footways on the R626 to the north of the access to Tír Cluain. Water-Rock Road, which runs in a north to south direction through the development site, does not incorporate any footways. Figure 3.3 indicates the existing footway provision along the main links within the Midleton area.

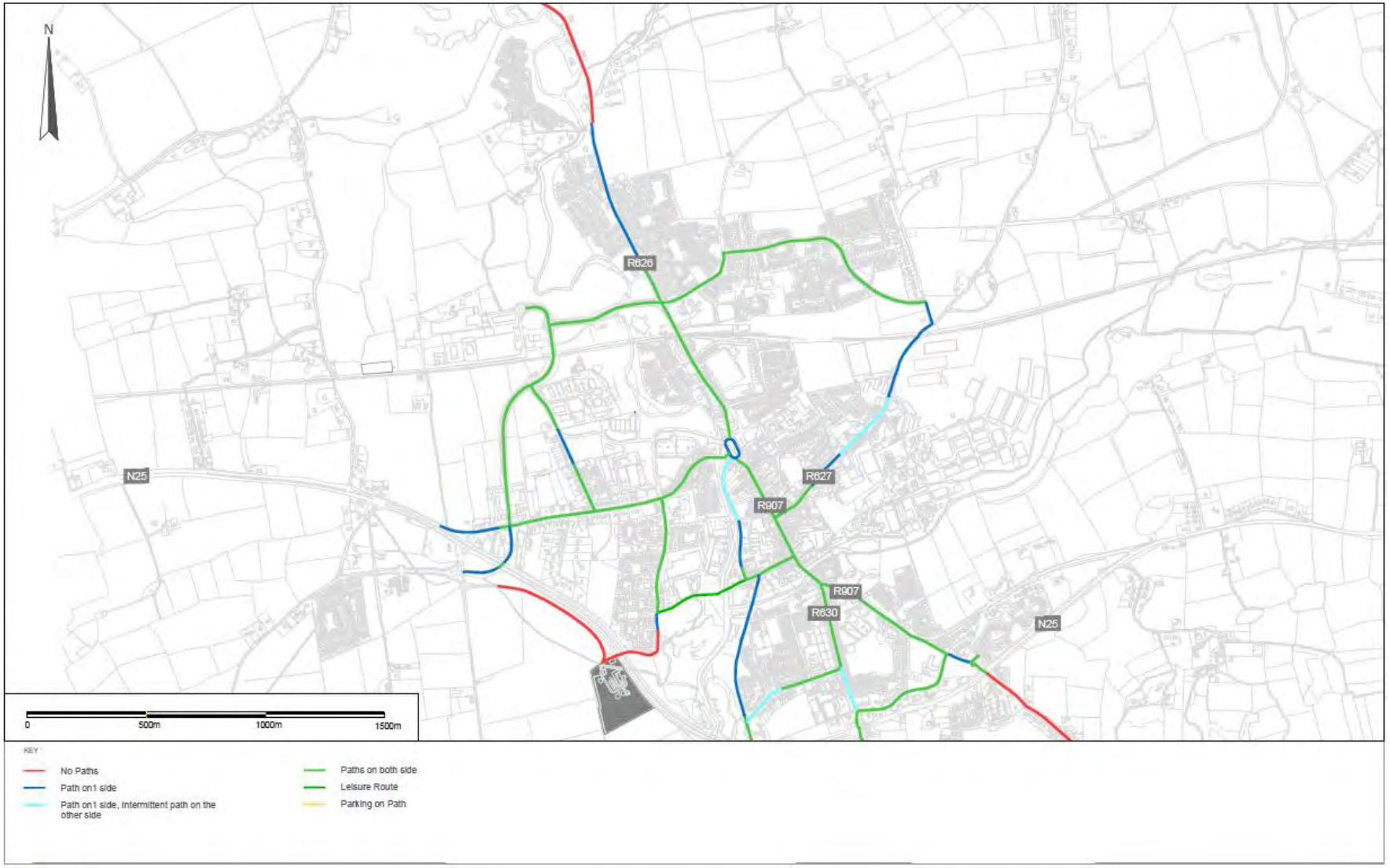


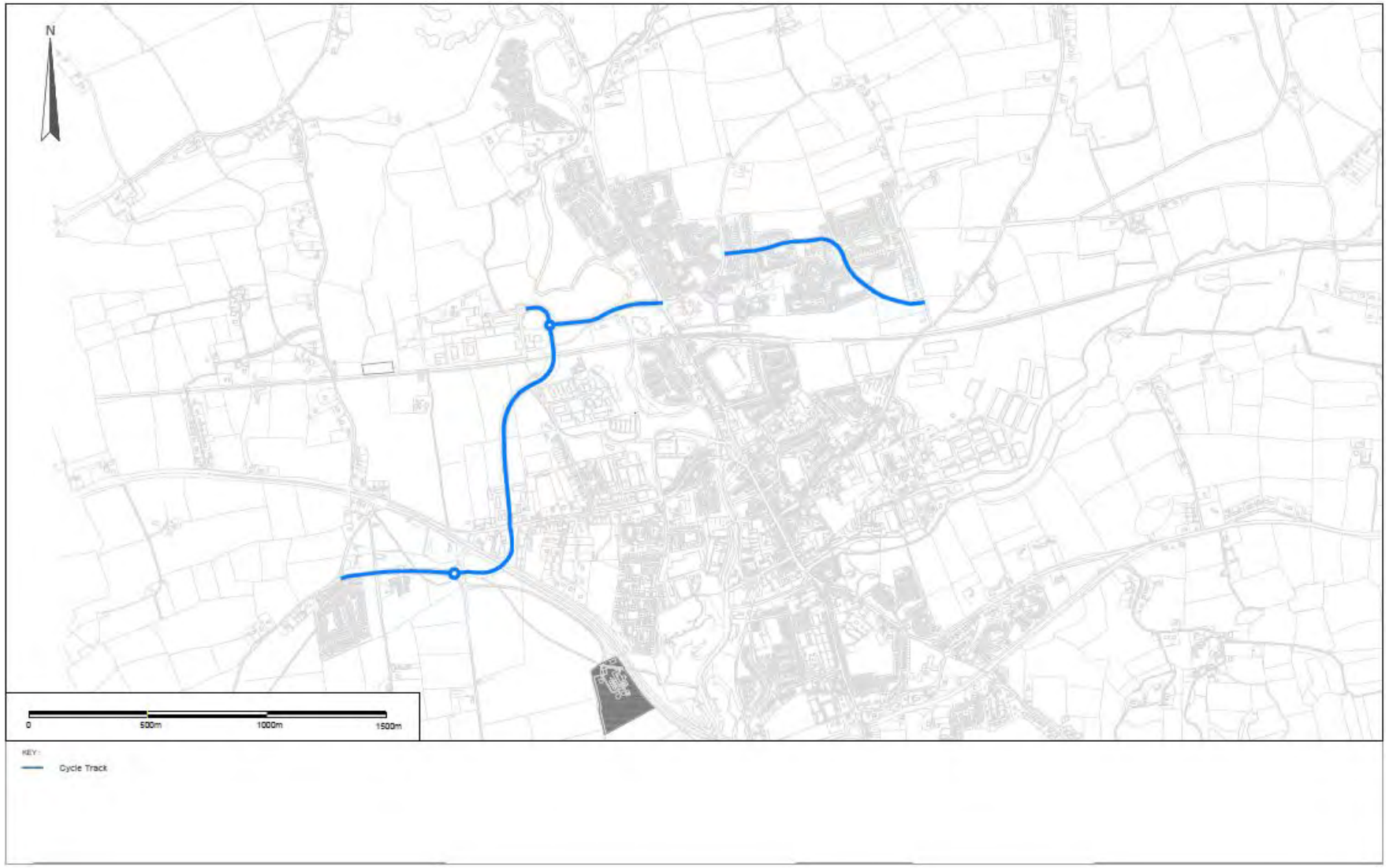
Figure 3-3 Existing Footways Provision in Water Rock

Cycling Network

3.4.4 There are not many dedicated facilities for cyclists in Midleton. However, the spine road which runs through the new residential area of Broomfield Village (Broomfield Crescent) to the east of the site provides dedicated cycleways of a good standard adjacent to the footways on both sides of the road. As indicated by Figure 3.4, cycleways are provided on both sides of the Northern Relief Road which runs from the N25 junction at Knockgriffin to the R626. A cycleway is also provided on the east / north side of the access road to the Nordic Enterprise Park which will provide access to the development site.

3.4.5 Whilst the provision of cycleways on the roads described above will help to encourage trips by bicycle, particularly in the future, the general lack of facilities in the area means that the existing cycleways are not being well utilised. A fully sheltered bicycle parking facility is currently provided at Midleton Railway Station which has the capacity to accommodate approximately 20 – 30 bicycles

Figure 3-4 Existing Cycle Network



3.5 Existing Traffic Conditions

3.5.1 A site visit, extensive surveys and a review of the available desktop resources was undertaken to establish the existing levels of traffic congestion within the study area. The traffic surveys included Junction Turning Counts (JTCs) at 33 junctions throughout the study area (locations 1 – 33 in **Error! Reference source not found.**) and Automatic Traffic Counts (ATCs) along key routes in the study area (location A – L in **Error! Reference source not found.**). This review revealed generally low levels of traffic congestion in the study area throughout the day with the exception of the junctions discussed below.

3.5.2 During the AM and PM peak periods delays were observed on the NRR and the N25 around Midleton / Water Rock, particularly at the Knockgriffin and Lakeview roundabout junctions respectively. In the evening peak period, queuing was observed on the eastern and northern arms of the Lakeview Terrace roundabout, while queuing was observed on the southern arm in the morning peak period.

3.5.3 The Midleton Gyratory is the junction of Mill Road, the accesses to car parks at Hurley's Super-Valu, Main Street, Riverside Way, New Cork Road and Market Green. Each approach to the junction operates on a give-way basis, with a one-way clockwise traffic system on the circulatory of the junction, similar to that of a roundabout. Pelican crossings are located on the eastern, western and southern sections of the circulatory and on the Main Street approach to the junction.

3.5.4 At present the junction can become congested, particularly during peak shopping periods, where there is a high demand for access to the car parks and town centre for retail purposes. On street parking and other activity on Main Street result in low traffic speeds and slow moving queues in both directions, approaching and leaving the gyratory.

Daily Traffic Profile

3.5.5 A series of ATCs were undertaken on key locations as shown below in Figure 3.5 (from the 21st of May to the 27th of May) to examine traffic volumes entering and leaving the study area.

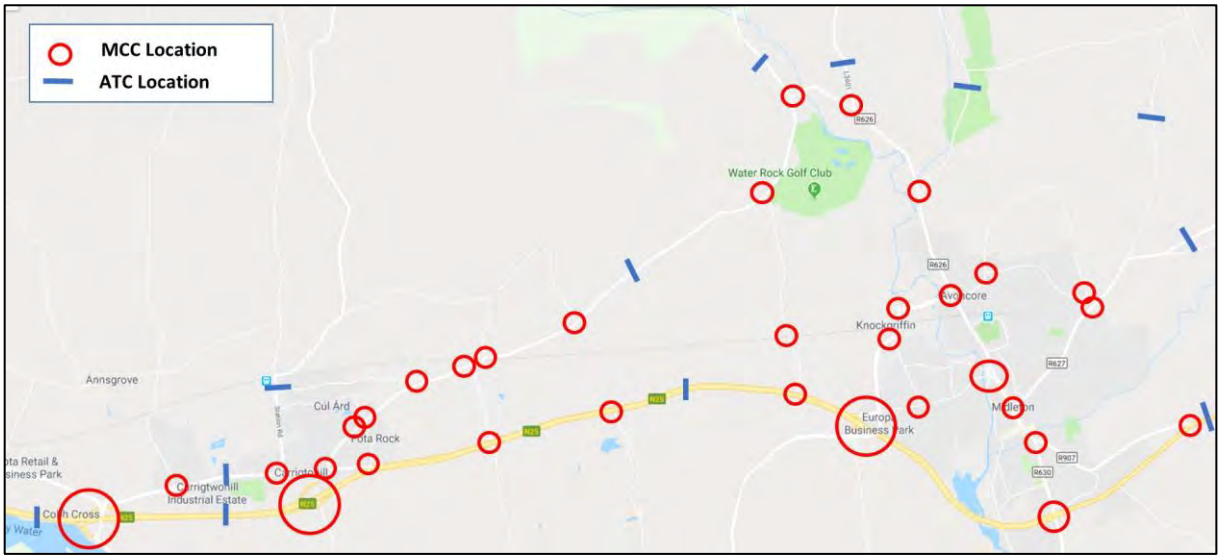


Figure 3-5 ATC surveys taken at key locations in model area

3.5.6 Analysis of the ATC survey data demonstrated that the peak traffic periods for the study area are 07:45-08:45 in the AM and 16:45-17:45 in the PM. Therefore, the AM and PM peak hour models have been developed to represent these peak periods. Figure 3.6, below, illustrates the daily traffic profile of all ATC sites combined on an average weekday.

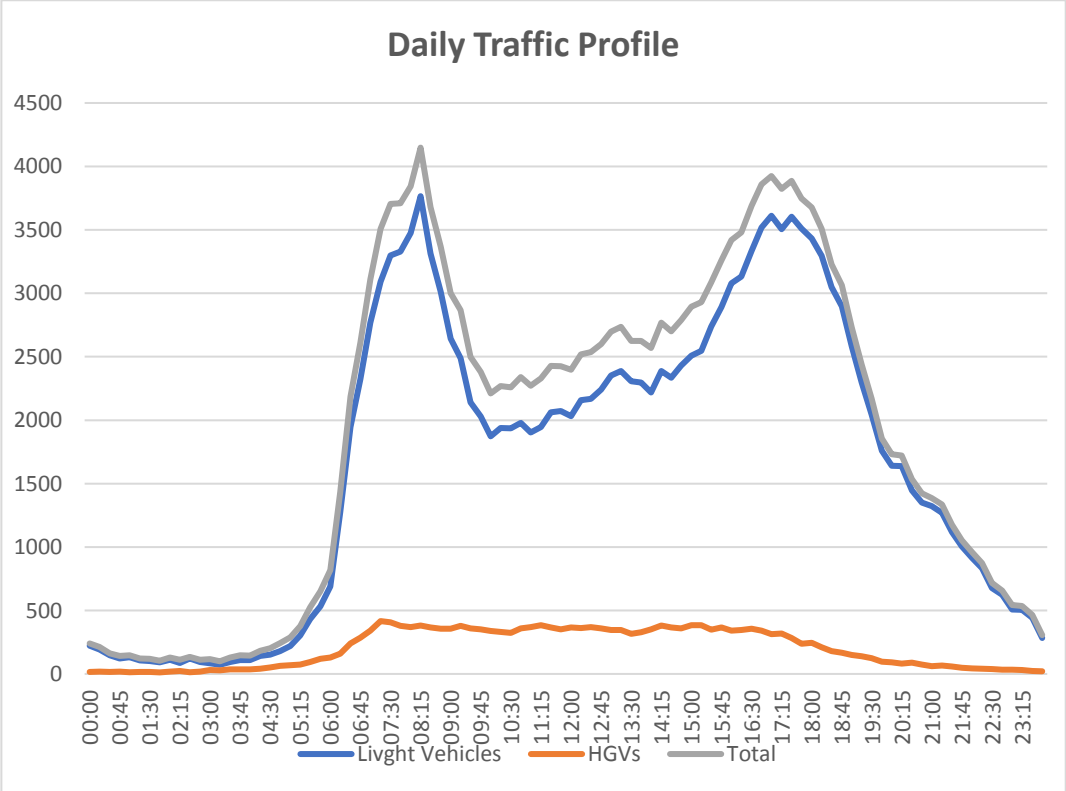


Figure 3-6 Daily Traffic Profile

3.6 Existing Mode-share

3.6.1 To establish the existing mode-share for the study area, a review of the mode share data from the 2016 census was undertaken for Midleton. Table 3.2 outlines the share of each mode for all trips to work and education from Midleton. To provide some context, these mode-share figures have been compared to those of Cork County and the Cork City + County average.

Table 3-2 Census 2016 Mode Share Comparison

Mode	Cork City & County	Cork County	Midleton
On foot	14.2%	9.4%	12.2%
Bicycle	1.4%	0.7%	1.2%
Bus, minibus or coach	8.7%	7.9%	4.9%
Train, DART or LUAS	0.7%	0.8%	3.7%
Motorcycle or scooter	0.3%	0.2%	0.3%
Car driver	51.9%	56.0%	52.1%
Car passenger	22.9%	24.9%	25.6%

3.6.2 This analysis shows that, in terms of walking, the study area is broadly in line with the City + County average while it slightly outperforms the County average.

3.6.3 In terms of public transport, the study area has a similar total mode share to both averages but with a greater rail split which is to be expected given its proximity to the station.

3.6.4 Again, car driver and car passenger mode shares (77.7%) are broadly in line with County averages. These high car mode shares are reflective of the dispersed nature of residential developments and their distance from commercial, educational and employment centres.

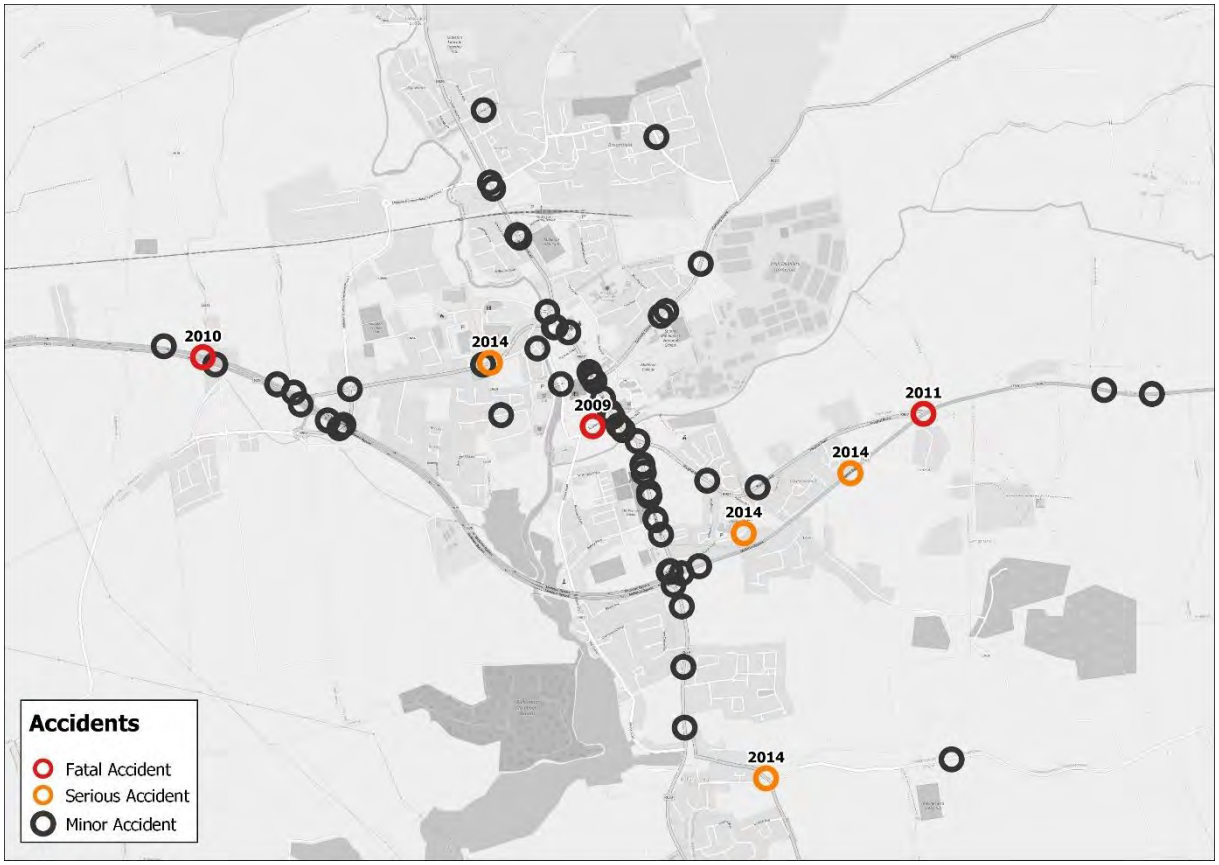
3.7 Road Accidents and Collisions

3.7.1 Analysis of available collision data reveals that, between 2009 and 2015, there were a total of 3 fatal car accidents in the study area. These accidents occurred at the following locations:

- N25 / Youghal Rd junction;
- Water Rock Rd / N25 junction; and
- On Broderick St off Midleton Main St.

3.7.2 In addition to these, there have been 4 serious injuries sustained and 68 Minor Collisions in the same period. The location of these accidents and the year in which they occurred (for fatal and serious only) are illustrated in Figure 3.5 below.

Figure 3-7 Study Area Accident Locations



4. LOCAL AREA PLAN AND SCOPE OF DEVELOPMENT

4.1 Overview

4.1.1 The strategy for Water-Rock, as set out in the East Cork Municipal District Local Area Plan 2016, provides for the population of the town to grow to 21,576, representing a growth of 8,773 people on Census 2016 figures (12,803). To accommodate this level of population growth, an additional 5,096 housing units will be required.

4.1.2 A large portion of the future housing stock will be located on the Water-Rock Urban Expansion Area Site at the north-west side of the town. As indicated by Figure 4.1, the site is located to the north of the Cork – Midleton railway line and to the west of the R626.

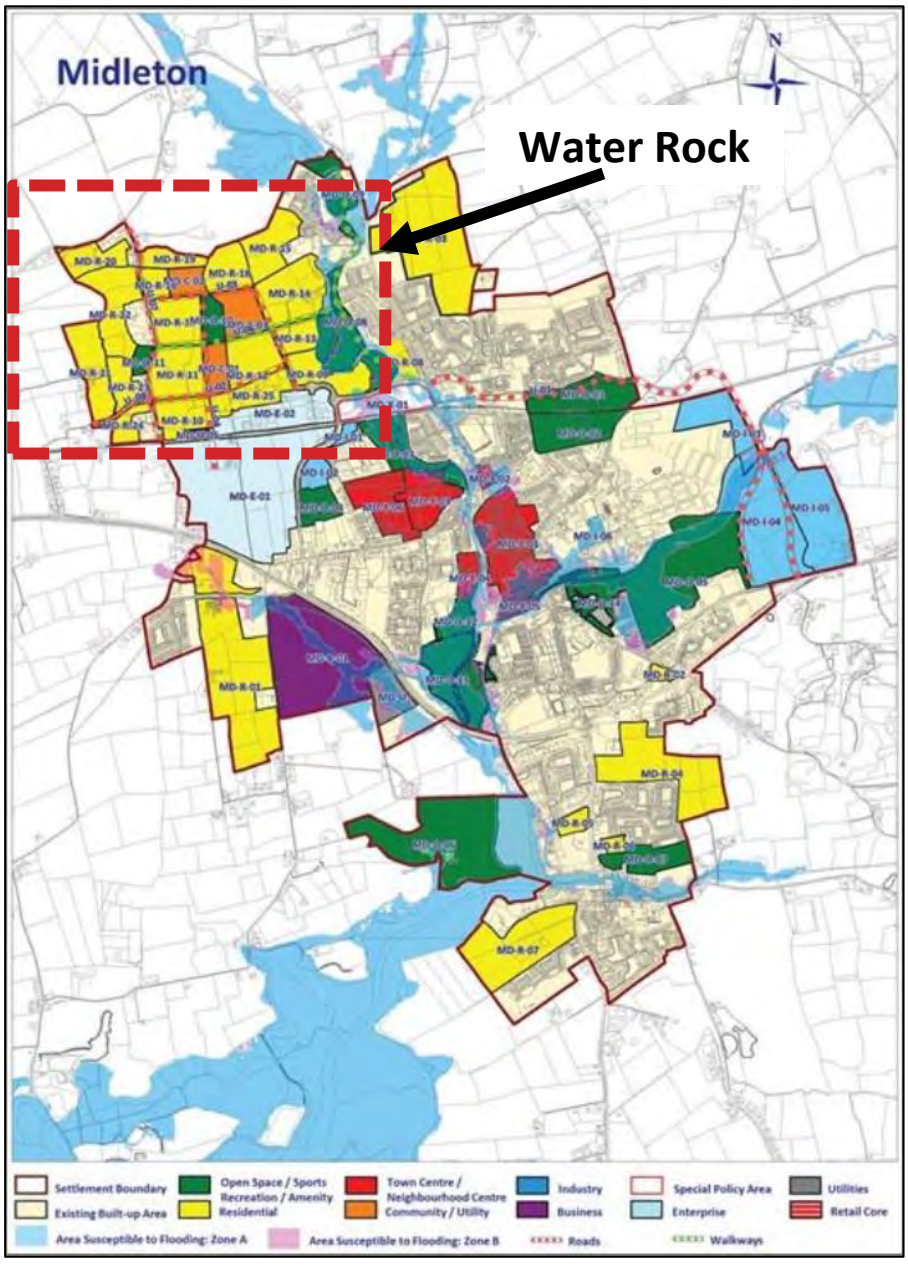


Figure 4-1 Water Rock Land Use Zoning

4.1.3 The land use proposals for this site focus on the provision of a 155-hectare mixed use neighbourhood incorporating residential, community, open space & recreation, retail, traffic and transport, water services and other infrastructure.

4.1.4 It is envisaged that the new neighbourhood would deliver up to 2500 dwelling units. 37.2 hectares of employment lands is included in the LAP (sites MD-E-01 &MD-E-02 north and south of the railway line), which is located just to the south of the expansion site boundary and bound to the east by the Northern Relief Road.

4.1.5 Based on the anticipated number of houses and resultant population increase there will be a requirement for at least 2 new primary schools and 1 new secondary school. These schools will be located on central and accessible sites adjacent to main distributor roads to ensure they are accessible by all modes. The LAP also includes provision for recreation and amenity spaces within the development. A linear park is proposed along the floodplain of the Owenacurra River. The park is proposed along the entire eastern boundary of the development and spans both sides of the river (approximate land area of 16 hectares). A primary green corridor is also proposed between the Water-Rock Road and the Linear Park running past the school sites. This will provide a well maintained and secure natural corridor within the development.

4.1.6 There is a Special Policy Area to the southwest of the Water-Rock development which is located immediately to the north of the railway line, to the south / west of the Northern Relief Road and to the west of the R626. It is envisaged that this area will comprise of mixed use development including residential and employment land uses. Provision may also be made for small scale retail units at ground floor level, with employment and / or residential at upper floor levels.

4.2 Phasing

4.2.1 It is proposed that the development of Water Rock will take place over four development phases (1A, 1, 2 and 3) with the following levels of development associated with each phase. Phase 1A represents Cork County Council's commitment under the Local Infrastructure Housing Activation Programme (LIHAF) agreement.

Table 4-1 Water Rock Phased Development

Phase	Residential (Units)	Primary (Students)	Secondary (Students)	Office (GFA m^2)	Retail (GFA m^2)	Leisure (GFA m^2)
1a	535	0	0	0	0	0
1	1,054	592	0	10,000	2,000	500
2	2,001	1,104	0	10,000	2,000	500
3	2,483	1,104	1,000	10,000	2,000	500

4.3 Infrastructure Proposals

4.3.1 The LAP and associated documents (including the Framework Masterplan) outline the transport-related infrastructure improvements that will likely be required to support the development objectives of the LAP, including Water Rock UEA. These include an upgrade of the N25 between Midleton and Carrigtwohill, the Midleton Northern Relief Road (NRR) Phases 2 and 3 and an upgrade to the Midleton Gyratory. The Table and figure below contains a full list of these local infrastructure proposals and the associated Water Rock UEA development phase when it is assumed the infrastructure proposals will be implemented.

Table 4-2 Local Infrastructure Proposals

Infrastructure Proposals	
Phase 1/A	
A	Service Corridor Link Road from NRR to Water Rock Road
B	Upgrade of Cork rd / NRR Signalised Junction to include 2 lanes on eastbound approach to junction.
C	Traffic management measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)
D	New Railway Stop on Cork - Midleton Line
Phase 2	
E	Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd
F	Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction)
G	Signalisation of L3617 and Main St Carrigtwohill
Phase 3	
H	Link Rd over Railway + distributor connecting to Midleton NRR
I	Midleton NRR phases 2 + 3
J	Upgrade Carrigane Road (single carriageway standard)
K	Upgrade of the junction at Mill Rd / NRR
L	Upgrade Midleton Gyratory. Modelled by increasing capacity on approaches (e.g. additional lanes where possible) and optimising signals.

Infrastructure Proposals	
M	New N25 Interchange east of Carrigtwohill (part of N25 Upgrade Scheme)
X	Signalisation of Station Road junction in Carrigtwohill
Y	Cobh Cross / N25 Upgrade (part of N25 Upgrade Scheme)
Z	Signalisation of Carrigtwohill Main St / N25 access road (junction on corner of Costcutter)

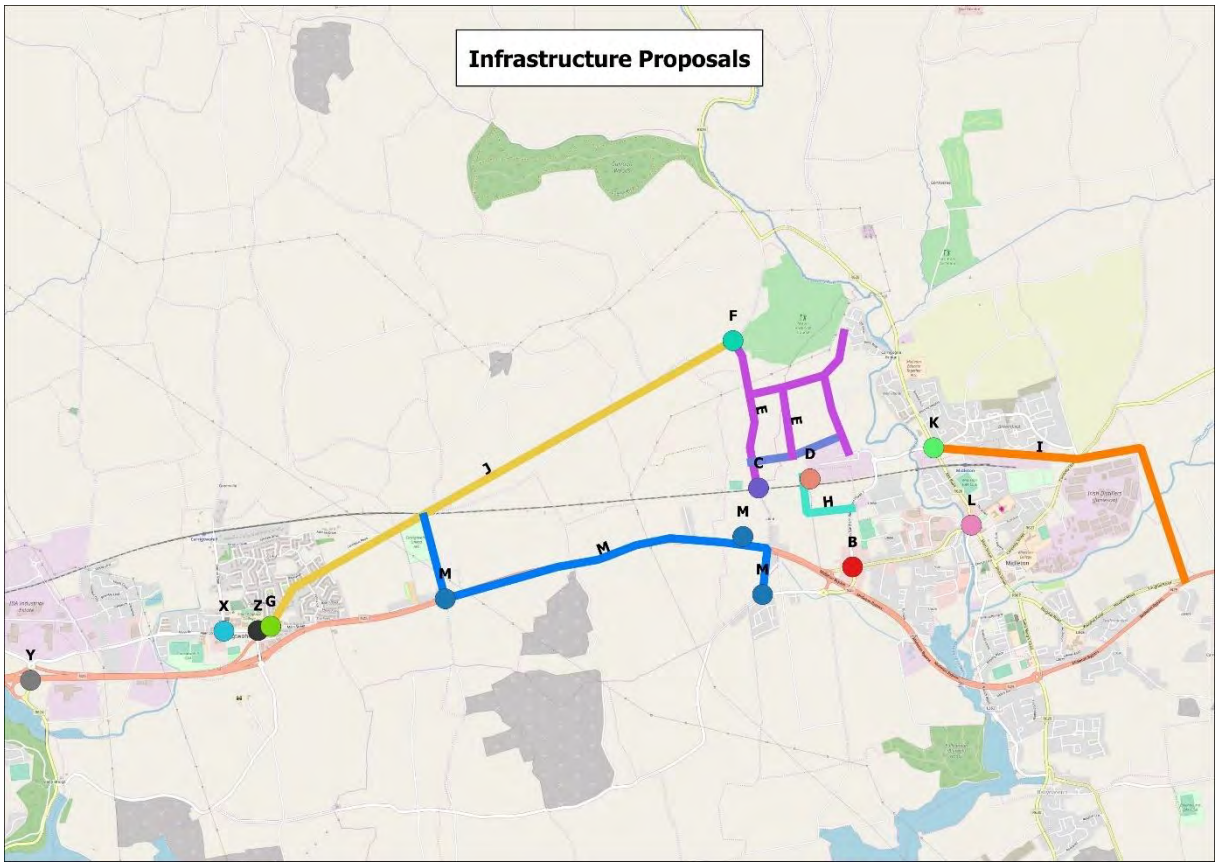


Figure 4-2 Water Rock Infrastructure Proposals

Knockgriffin Junction

4.3.2 Infrastructure Proposal B involves upgrading the Cork Road / NRR Signalised Junction (Knockgriffin junction) to include 2 straight ahead lanes on the western approach to the junction and removing the right turn flare on the eastern arm to accommodate this. These changes are illustrated in figure 4.2, below.

Traffic Management Measures for Water Rock Road

4.3.3 Infrastructure Proposal C involves the closure of the Water Rock Road level crossing to vehicular traffic. This is to ensure that the UEA development does not result in additional traffic movements at the existing Water Rock Road / N25 junction as it is unsuitable for

accommodating these additional movements. This is a phase 1 infrastructure proposal. For the purposes of the traffic model it is assumed that the closure will remain during phases 2 and 3 although it may be possible to modify the closure as part of the project to upgrade of the N25.

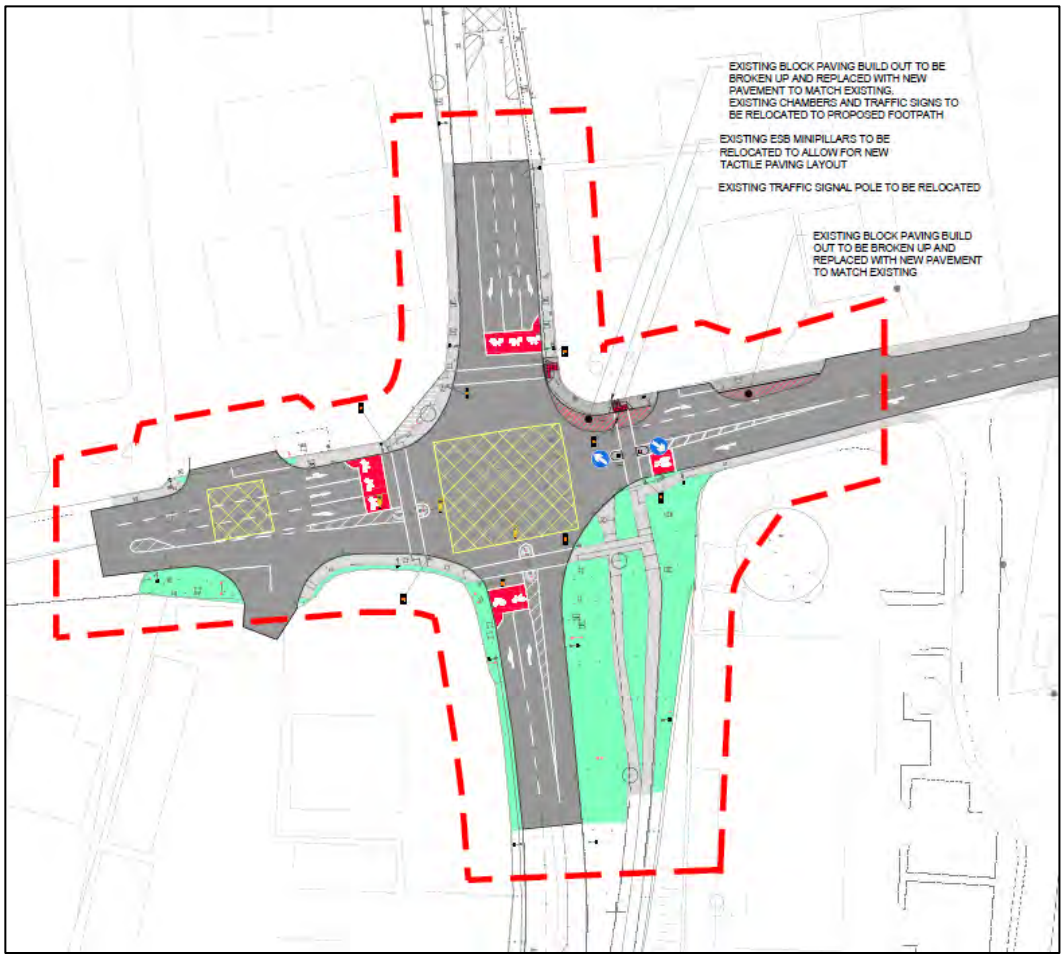


Figure 4-3 Infrastructure Proposal B

New N25 Interchange east of Carrigtwohill (Part of N25 Upgrade Scheme)

4.3.4 Infrastructure Proposal M involves adding an additional interchange on the N25 east of Carrigtwohill at the former Amgen site, which includes a link to the Carrigane Road and adding parallel local roads along the N25 in both directions between the new interchange and the existing interchange at Knockgriffin. This proposal is shown in Figure 4.4 and Figure 4.5.

Figure 4-4 Infrastructure Proposal M Part 1

Figure 4-5 Infrastructure Proposal M Part 2

4.4 Site Access

4.4.1 It is proposed that Phases 1A and Phase 1 of the Water Rock development will be accessed via the existing roundabout junction off the Northern Relief Road (NRR) at the Nordic

Enterprise Park. Further access will be provided via the Carrigane Road (to be upgraded in Phase 3) and via an additional Link road to the NRR in Phase 3. These access points are shown in the planning map presented in Figure 4.6.

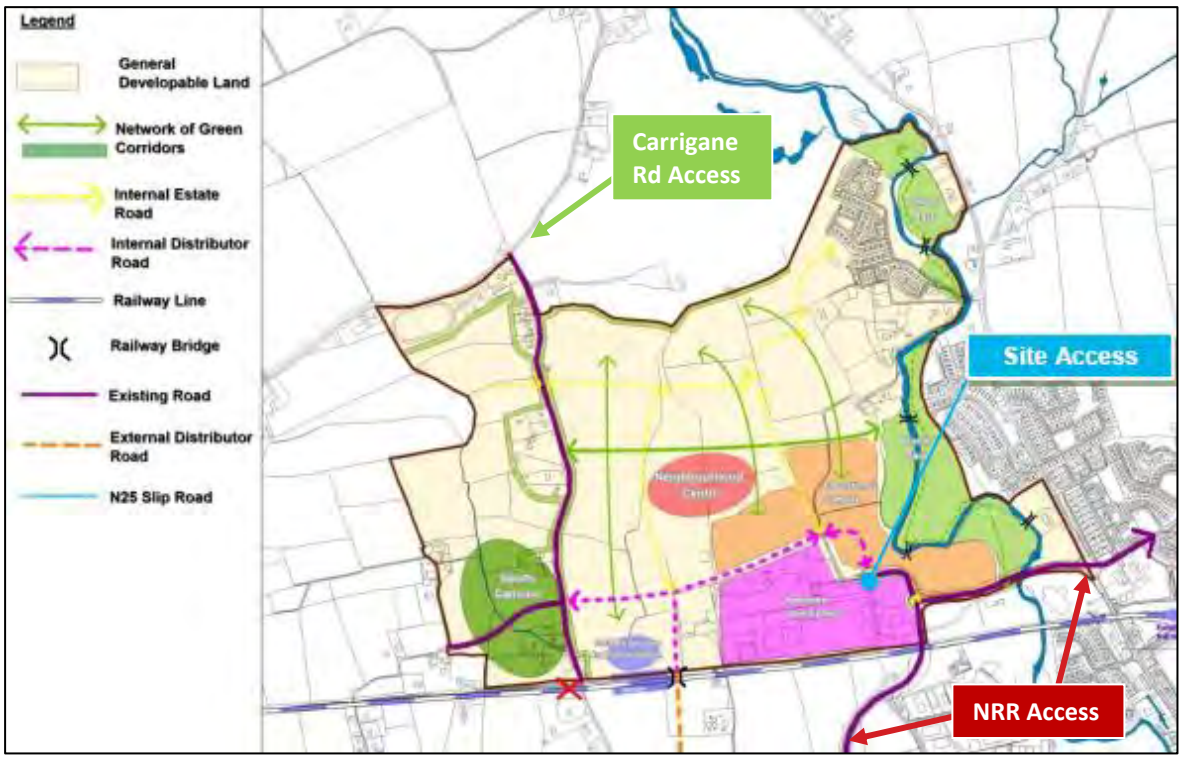


Figure 4-6 Water Rock Site Access

4.5 Walking and Cycling Provision

4.5.1 The Water Rock Masterplan contains a hierarchy of roads and streets which will encourage pedestrian and cycle movements. As mentioned in Chapter 2, the Cork Metropolitan Area Cycle Plan contains proposals for Water Rock which will provide an excellent opportunity to encourage both leisure and commuter trips by bicycle. These proposals are illustrated below.

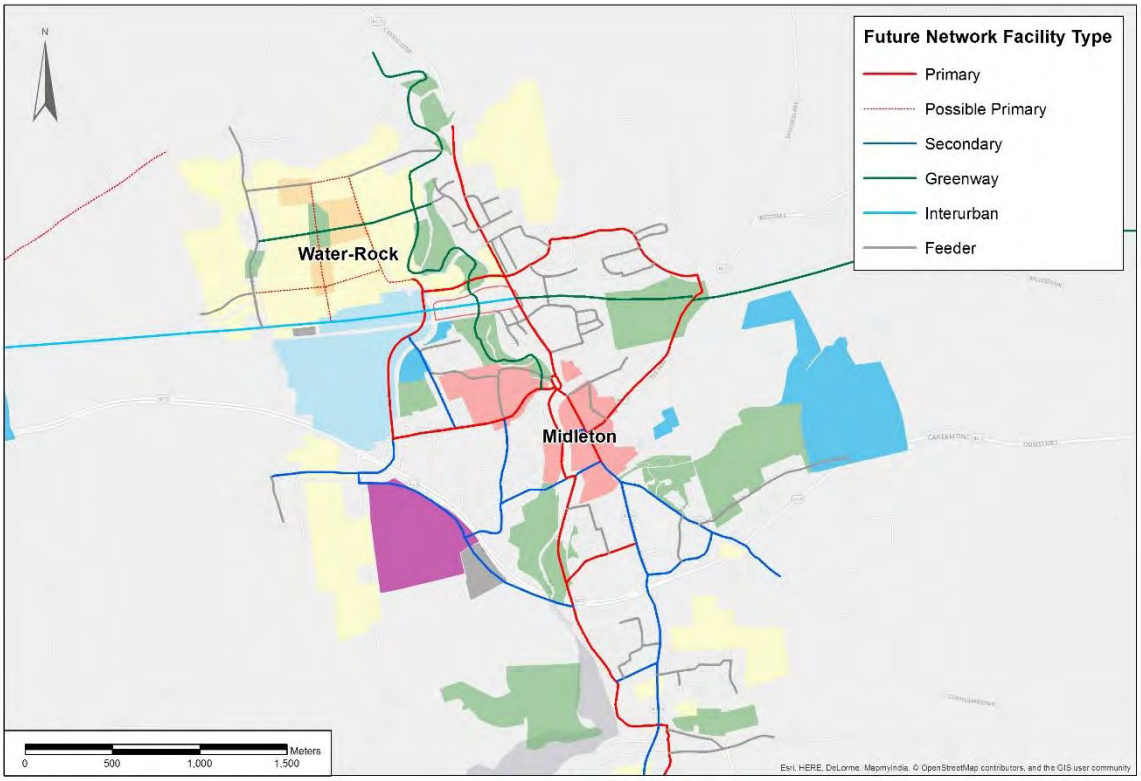


Figure 4-7 Midleton Proposed Cycling Network

4.6 Future Public Transport Provision

4.6.1 Figure 4.8 below shows the Proposed Bus route options that were developed as part of the Water Rock UEA Transport Assessment Report. These were developed to accommodate the potential demand for public transport, however they are not intended to inform or pre-empt the outcomes of the numerous studies for Cork City and County which will outline a strategy for the future public transport provision. The potential route options associated with all phases of the development are indicated on the plan and considers a situation where the N25 interchange is not provided.

4.6.2 Currently, all Midleton-bound bus services from the west exit the N25 at Knockgriffin and route east into the town centre via Cork Road and back onto the N25 via the R907 (service 260) or route south to the adjacent settlement of Ballinacurra via the R630 (services 240, 241 and 261). One (or more) of the existing bus services could be diverted through the development without a significant increase in journey time. Until the new N25 Interchange is provided, an existing service (using eastbound services as an example) could route north along the Northern Relief Road, rather than east along Cork Road, and out onto the R626. It is recognised that some areas of the initial development may be further than the recommended maximum walking distance of 500m. However, to address this, the bus could be diverted into the development from the Northern Relief Road and back out again. The internal layout of the development would therefore require accommodating buses on the key routes and potentially some of the feeder streets. This would however increase existing journey times and it may be better to create a variation of the existing route which terminates in Midleton and serves both the Water-Rock and Carrigtwohill North developments. Another option for the early stages of the development would be for the bus to route through the development via Water-Rock Road.

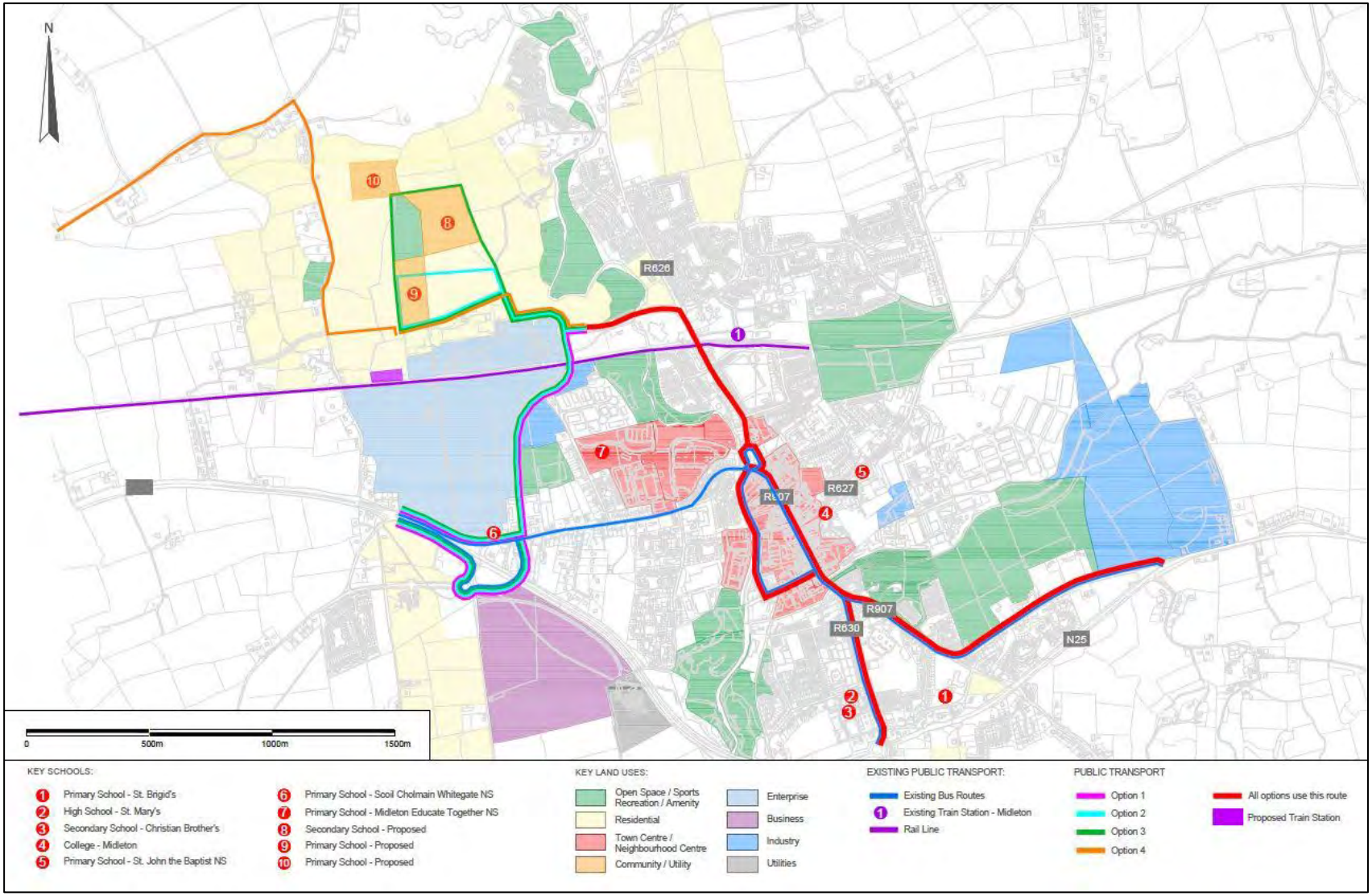


Figure 4-8 Indicative Midleton Bus Route Network

4.6.3 A new railway stop is to be provided on the Cork – Midleton Line at Water Rock which will provide a direct route into the City Centre from the Development. This will ensure that the majority of the development is within walking distance of rail. In terms of rail services and frequencies the limitation of the existing Midelton-Cork rail line is the limited destination choice offered. To address this, it is recommended that through running services from Midleton to Mallow through Kent station are introduced with new stations at Tivoli, Kilbarry, Monard & Stoneview as development progresses at these sites. In addition, the planned improvements to Kent station will allow for better interchange between rail and bus at the station.

4.7 Other Future Developments

4.7.1 As stated in Chapter 1, there are 9 UEAs within the county and this assessment has been undertaken within the context of the full implementation of all 9 UEA's. The Carrigtwohill UEA is likely to affect the capacity of the road network in the study area and therefore, to represent a worst-case scenario, the likely demand from this, and all other, Urban Expansion Areas has been included in our future year travel demand estimates. Table 4.3 and Figure 4.9 below outlines the total levels of development assumed in our analysis and the split of residential units by phase respectively. Figures 4.10 and 4.11 show the location for these developments.

Table 4-3 Full Land Use Assumption Table by Area

Area	Residential (Units)	Primary (Students)	Secondary (Students)	Office (GFA m^2)	Retail (GFA m^2)	Leisure (GFA m^2)
Water Rock	2483	1104	1000	10000	2000	500
Midleton other	2613	0	1000	0	0	0
Carrigtwohill	4032	2800	1000	7000	2500	1000

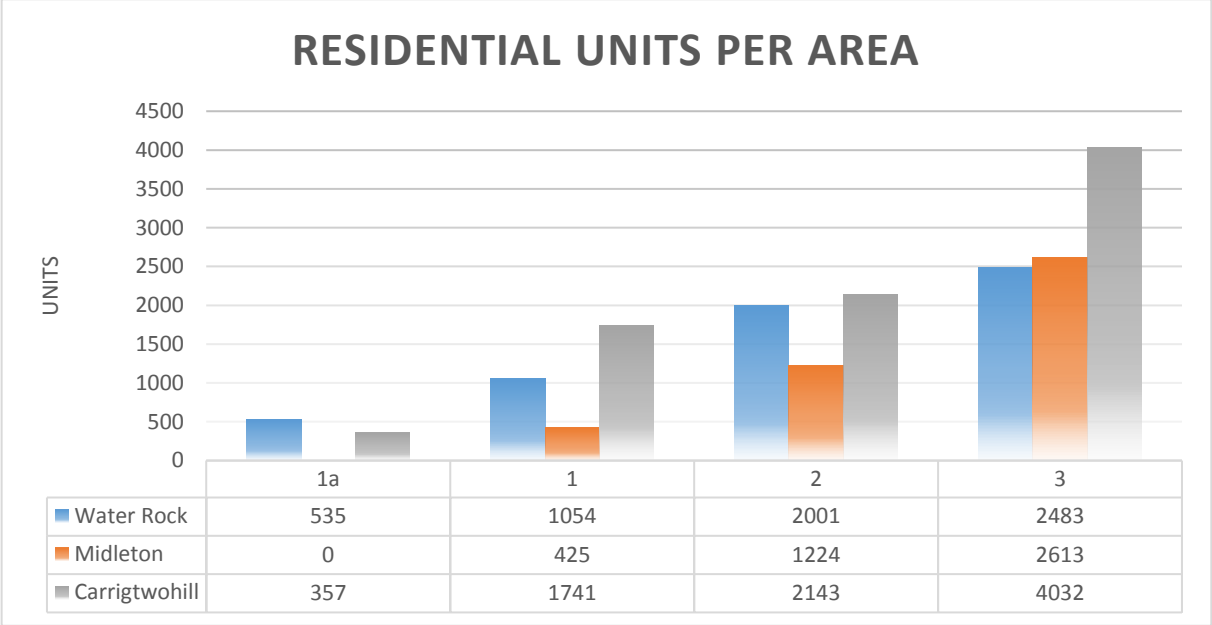


Figure 4-9 Residential Units per Area and Phase

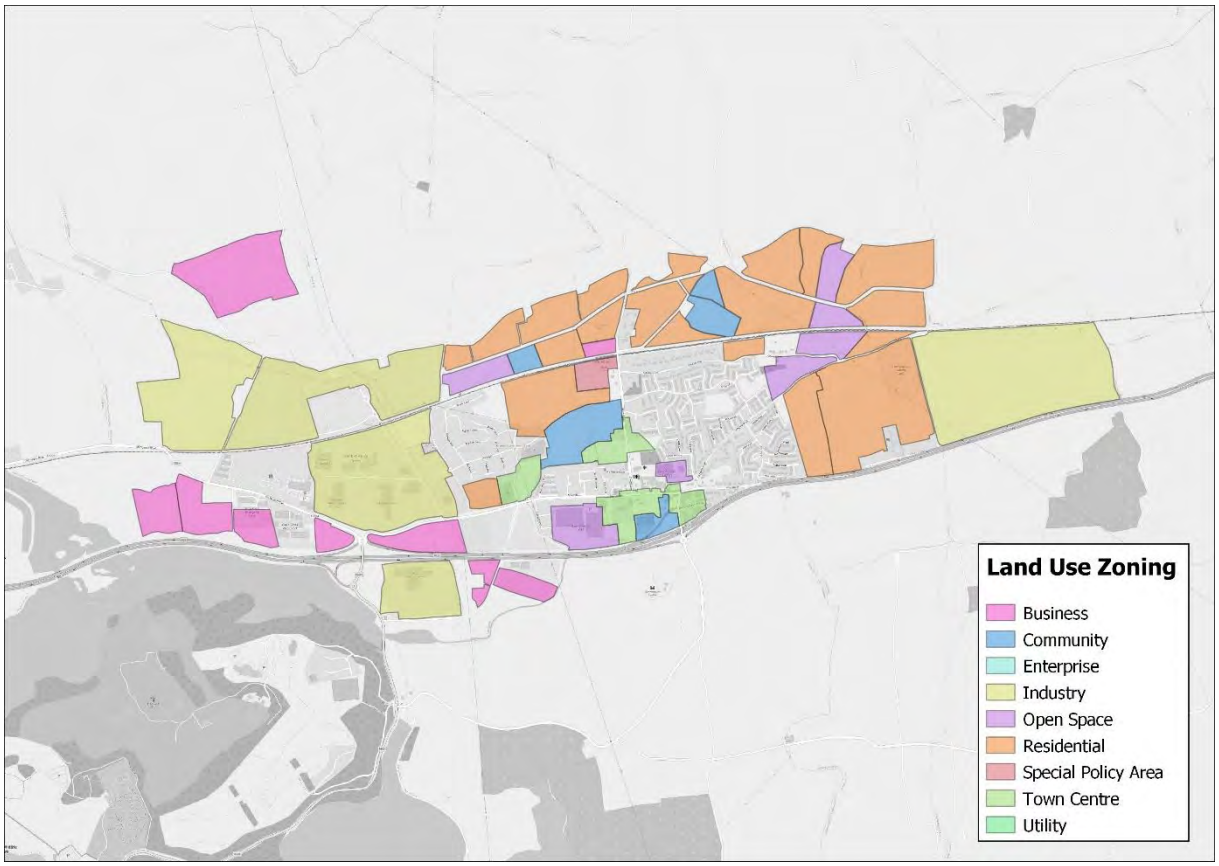


Figure 4-10 Carrigtwohill Land Use Zoning

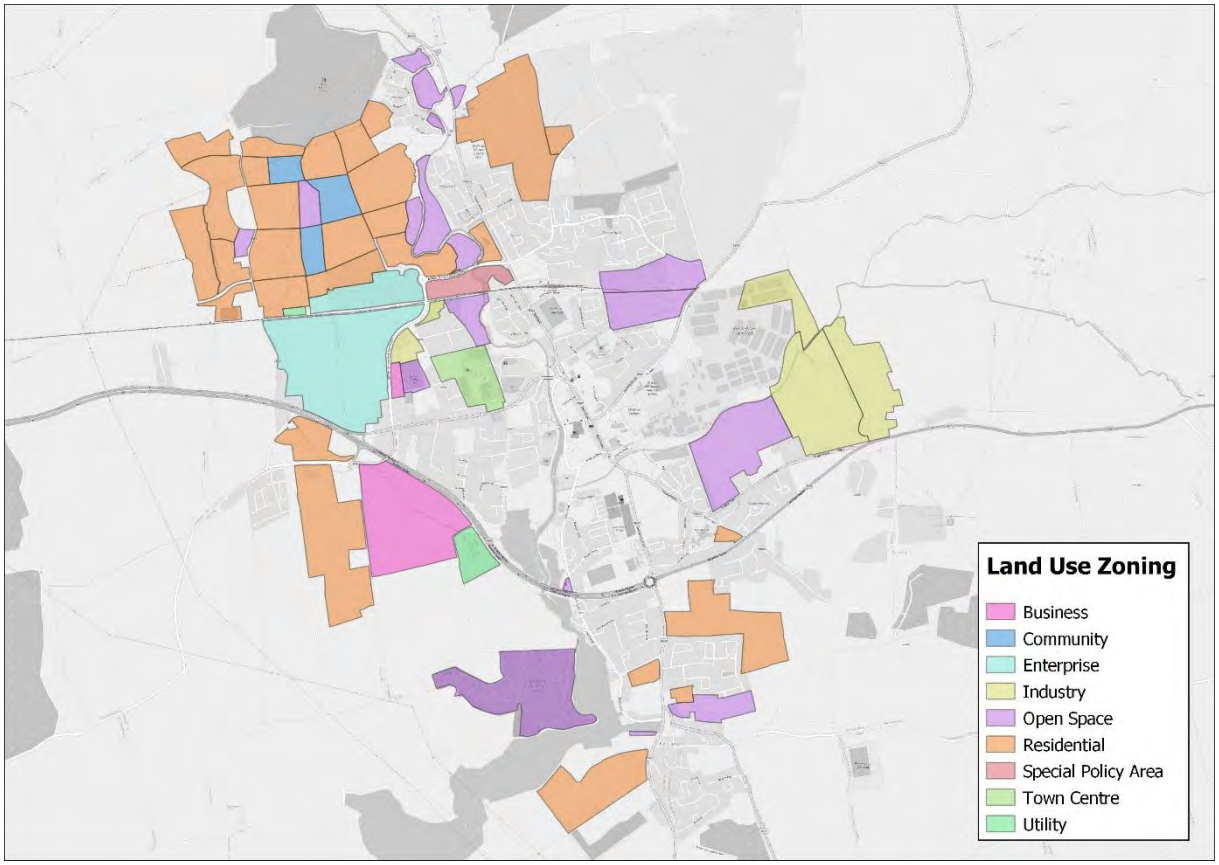


Figure 4-11 Midleton Land Use Zoning

5. WATER ROCK LOCAL AREA MODEL DEVELOPMENT

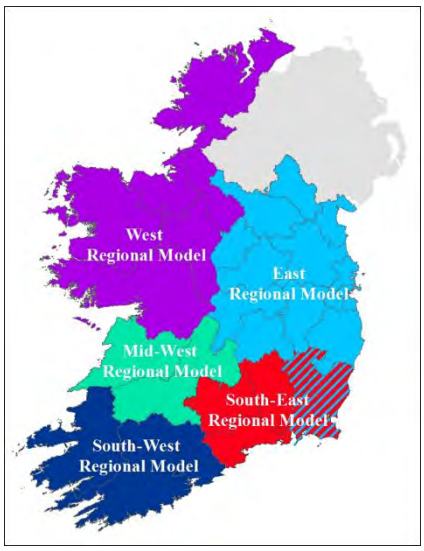
5.1 Overview

5.1.1 To adequately assess the transport impacts of the development of the study area, as set out in the East Cork Municipal Districti Local Area Plan, a strategic traffic model has been developed for Water Rock (Water Rock Traffic Model). This chapter describes the development of the base year Water Rock Traffic Model (WRTM) with reference to the following aspects:

- South West Regional Model (SWRM)
- Modelling software used;
- Model time periods; and
- Network development.

5.2 SWRM Overview

5.2.1 The SWRM is a strategic multi-modal transport model representing travel by all the primary surface modes – including, walking and cycling (active modes), and travel by car, bus, rail, tram, light goods and heavy goods vehicles, and covers the counties of Kerry and Cork with less detailed representation for the rest of Ireland.



General Model Structure

5.2.2 The SWRM sits within the overall NTA Regional Modelling System which comprises of the following three main components, namely:

- The National Demand Forecasting Model (NDFM);
- 5 Regional Models (including the SWRM); and
- A suite of Appraisal Modules

5.2.3 The NDFM takes input land-use attributes such as population, no. of employees etc., and estimates the total quantity of daily travel demand produced by, and attracted to, each of the 18,488 Census Small Areas in Ireland.

5.2.4 The SWRM is then comprised of the following key elements:

- **Trip End Integration:** The Trip End Integration module converts the 24 hour trip ends output by the NDFM into the appropriate zone system and time period disaggregation for use in the Full Demand Model (FDM);
- **The Full Demand Model (FDM):** The FDM processes travel demand, carries out mode and destination choice, and outputs origin-destination travel matrices to the assignment models. The FDM and assignment models run iteratively until an equilibrium between travel demand and the cost of travel is achieved; and
- **Assignment Models:** The Road, Public Transport, and Active Modes assignment models receive the trip matrices produced by the FDM and assign them in their

respective transport networks to determine route choice and the generalised cost for each origin and destination pair.

5.2.5 Destination and mode choice parameters within the SWRM have been calibrated using two main sources: Census 2011 Place of Work, School or College - Census of Anonymised Records (2011 POWSCAR), and the Irish National Household Travel Survey (2012 NHTS). Therefore, the SWRM is the ideal tool to cordon the WRTM from, and to estimate the multi-modal impact of transport schemes within Cork. In addition, it provides the platform to forecast the future trip demand and distribution to/from the town.

5.3 Model Software Platform: SATURN

5.3.1 The model software used is the SATURN (Simulation Assignment of Traffic to Urban Road Networks) suite of transportation modelling programs. SATURN has 6 basic functions:

- As a combined traffic simulation and assignment model for the analysis of road-investment schemes ranging from traffic management schemes over relatively localised networks (typically of the order of 100 to 200 nodes) through to major infrastructure improvements where models with over 1000 junctions are not infrequent;
- As a "conventional" traffic assignment model for the analysis of much larger networks (e.g., up to 6000 links in the standard PC version, 37500 in the largest);
- As a simulation model of individual junctions;
- As a network editor, data base and analysis system;
- As a matrix manipulation package for the production of, for example, trip matrices; and
- As a trip matrix demand model covering the basic elements of trip distribution, modal split, etc.

5.4 Model Time Periods and User Classes

5.4.1 The standard model time-period for traffic simulation and assignment models is one hour and therefore model development and data collection was carried out based on this assumption.

5.4.2 Through a review of survey data, it was noted that the highest traffic flows entering and leaving the Study Area were experienced from 07:45 to 08:45 in the AM and 17:00 to 18:00 in the PM. Therefore, the LAM was developed, calibrated and validated to represent the following time periods:

- AM Morning peak period: 07:45 to 08:45
- PM Evening peak period: 17:00 to 18:00

5.4.3 The trip demand matrices for these time periods, representing a base year of 2018, were developed for the LAM using extractions from the SWRM combined with up to date traffic survey data. The demand matrices are segregated into two vehicle types (or user classes), as follows:

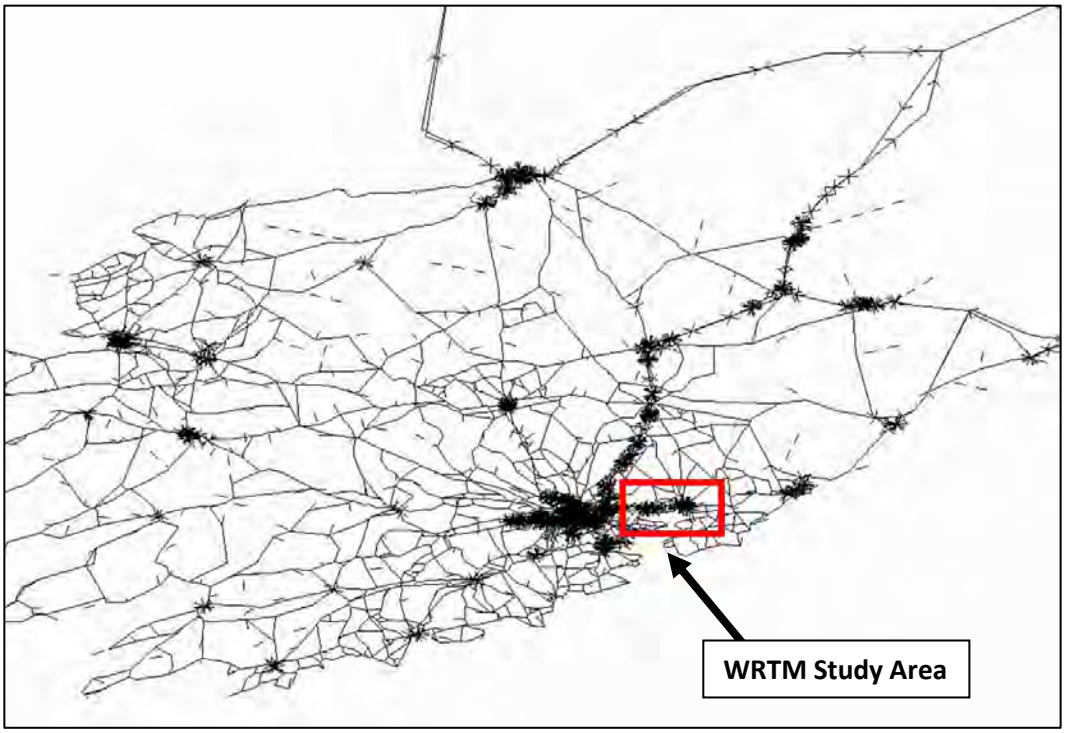
- User Class One: Cars and light Goods Vehicles (LV's). All cars and two axle trucks or other type commercial vehicles are considered LV's; and
- User Class Two: Heavy Goods Vehicles (HV's). This user class is comprised of goods vehicles with 3 or more axles.

5.5 Network Development

5.5.1 The goal in developing the WRTM was to develop a traffic model that accurately reflects current traffic conditions in the study area (and surrounding road network) for the 2018 base year, and to a sufficient level of detail to allow assessments to be made on both local and strategic interventions. To achieve this goal, the model must be defined in terms of road network and trip demand representation.

5.5.2 The SWRM developed for the NTA was utilised as a base for generating the highway network for the LAM. However, as the SWRM is primarily focused on Cork City, areas outside the city are represented in lesser detail within the model.

Figure 5-1 South West Regional Model Road Network



5.5.3 As part of the regional model development process for the NTA, SYSTRA have carried out a review of traffic modelling processes and generated a best practice approach for coding road networks, including:

- Standardised turning saturation flows at junctions;
- Standardised speeds used on different types of road;
- The use of flares for turns at junctions with sufficient space etc.

5.5.4 This best practice approach was utilised to generate the detailed traffic network for the WRTM. Digital mapping systems such as Google Earth were used to get a high-level view of the network including junction layout details, permitted or banned turns, junction priority etc., to ensure it represented, as accurately as possible, the existing road network. Figure 5.2 illustrates the finalised road network developed for the WRTM.

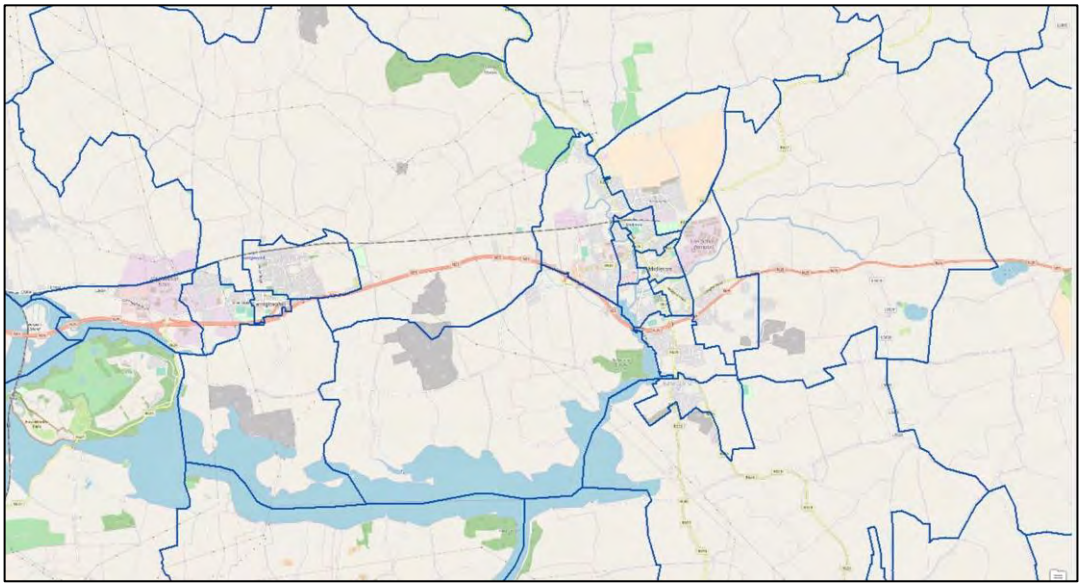
Figure 5-2 Water Rock Traffic Model Network

5.5.5 As can be seen above in Figure 5.2, a detailed highway network has been developed for the Water Rock Area. To ensure full network coverage and trip origin / destination choice, all roads have been considered, from the national primary routes to minor residential streets.

5.6 Zone System Development

5.6.1 As outlined previously, the SWRM was utilised as a basis for development of the WRTM road network. However, as the Study Area is located outside the main model area, the SWRM zone structure is at a too aggregate a level to accurately reflect loading of traffic in the Midleton and Carrigtwohill area. Figure 5.3, below, shows the SWRM zone system for the study area and shows that the Water Rock area is represented by approximately 2 model zones.

Figure 5-3 SWRM Zone System – Water Rock



5.6.2 To provide an accurate representation of traffic loading in Water Rock, a detailed zonal structure was developed for the WRTM using Census Small Areas. Census travel data is available at a Small Area level which can be linked to the WRTM zone system. Within the WRTM, some Small Areas have been disaggregated further to reflect key generators and attractors of trips such as:

- Shopping centres / retail car parks / supermarket car parks
- Schools;
- Key employers.
- Housing Estates etc.

5.6.3 Figure 5.4 illustrates the zonal system developed for the WRTM. In total, 213 zones have been created for the entire model area, along with 16 identified external zones representing traffic loading onto the model network. This level of detail ensures that traffic loads accurately onto the modelled road network.

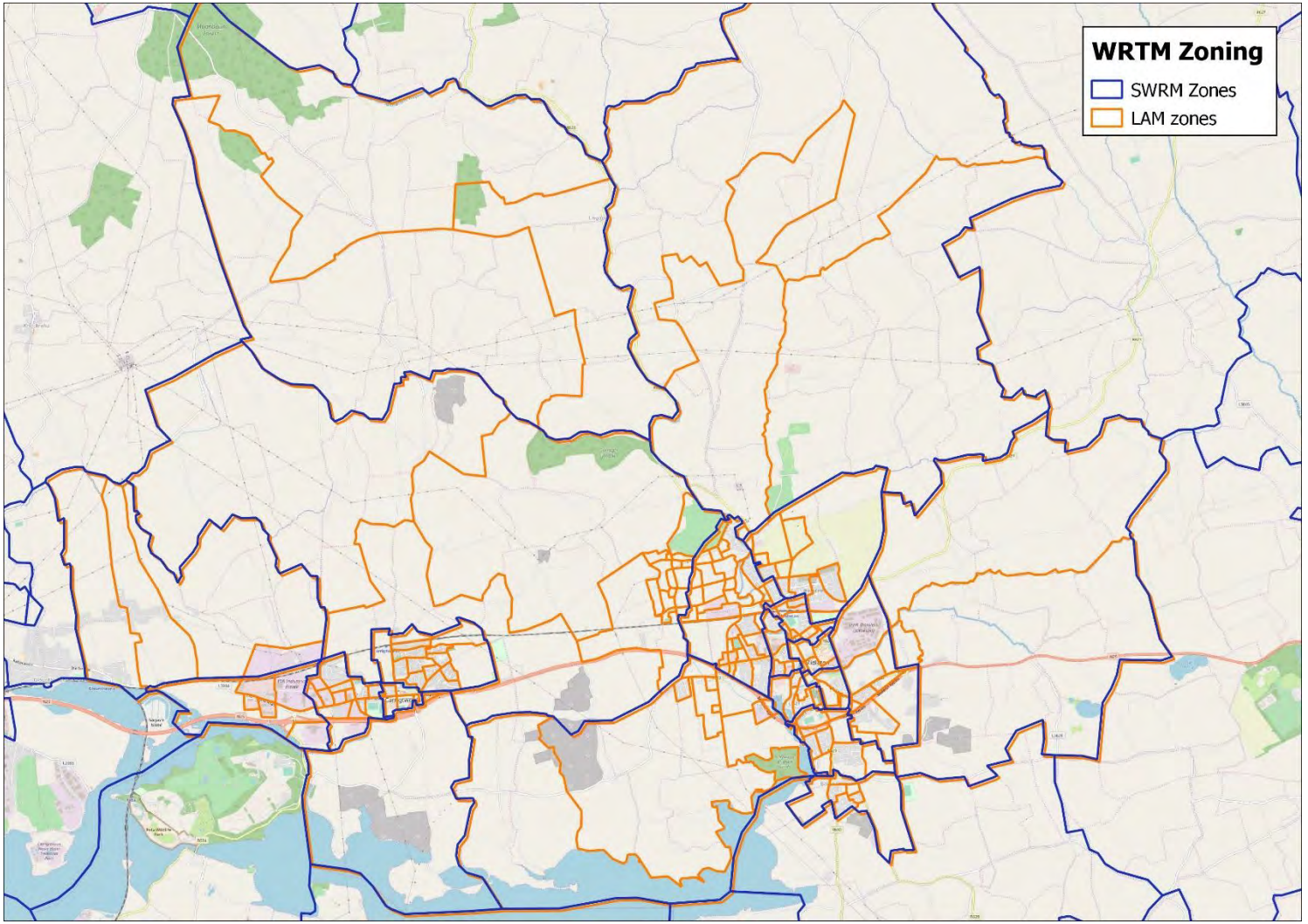


Figure 5-4 WRTM Zoning System

5.6.4 16 external zones have been developed to represent traffic outside the model area, for example traffic entering the Water Rock from the N25. To generate these external zones, Census Small Areas have been grouped together based on the key routes they are likely to utilise when accessing Water Rock. For example, all traffic accessing Water Rock from Cork City are most likely to use the N25.

5.6.5 External to external zone movements have only been included in the model if they are likely to pass through the model area. This is to ensure that non-relevant trips are not being represented in the model as passing through the Study Area.

5.7 Prior Trip Matrix Development

5.7.1 As noted previously, the Full Demand Model carries out mode and trip destination choice for all zones within the SWRM. The FDM has been calibrated using Census data, and hence, provides a robust and accurate representation of trip distributions across the model network. In order to generate prior matrices for Water Rock, a cordon was extracted from a 2018 run of the SWRM. The cordon function within SATURN, facilitates the extraction of trip matrices for a subset area of the SWRM whilst still maintaining route and destination choice from the full model.

5.7.2 As illustrated in Figure 5.4, the SWRM zone system is quite aggregate for Water Rock, with 24 zones covering the area of interest. A bespoke Excel spreadsheet tool was created to disaggregate the cordoned SWRM matrices to each of the 213 WRTM zones. This tool used available data on populations, employment, and education places by Census small area, to split trips to/from each SWRM zone between the more detailed WRTM zoning system. This allowed for a consistent split of demand within the model area, whilst maintaining consistency with the SWRM matrix.

5.8 Model Calibration

5.8.1 Once the base prior matrix is created, calibration is used to improve agreement in the model between observed and modelled traffic characteristics. Generally, the components of the model that may be adjusted on the demand side are trip distribution and trip production and generation rates. This adjustment usually involves trip matrix estimation.

5.8.2 On the supply side (network), modelled junction and link characteristics may be altered if sufficient new information is available to justify changes to the existing network.

5.8.3 The WRTM was calibrated and validated in accordance with Transport Infrastructure Ireland's (TII) *Project Appraisal Guidelines (PAG) for National Roads Unit 5.1 – Construction of Transport Models (October 2016).* This is a widely accepted standard in Ireland that provides robust calibration and validation criteria to which certain types of highway models should adhere. Additionally, the LAM development has followed guidance from the UK's Department for Transport's Transport Analysis Guidance (TAG) unit M3-1, particularly in terms of matrix estimation controls.

5.8.4 The following sections of this chapter detail the calibration process undertaken to ensure that the WRTM accurately reflects baseline conditions, including information on:

- Traffic Count Data;
- Calibration Steps;
- Matrix Estimation; and
- Calibration Statistics i.e. GEH and Linear Regression Analysis

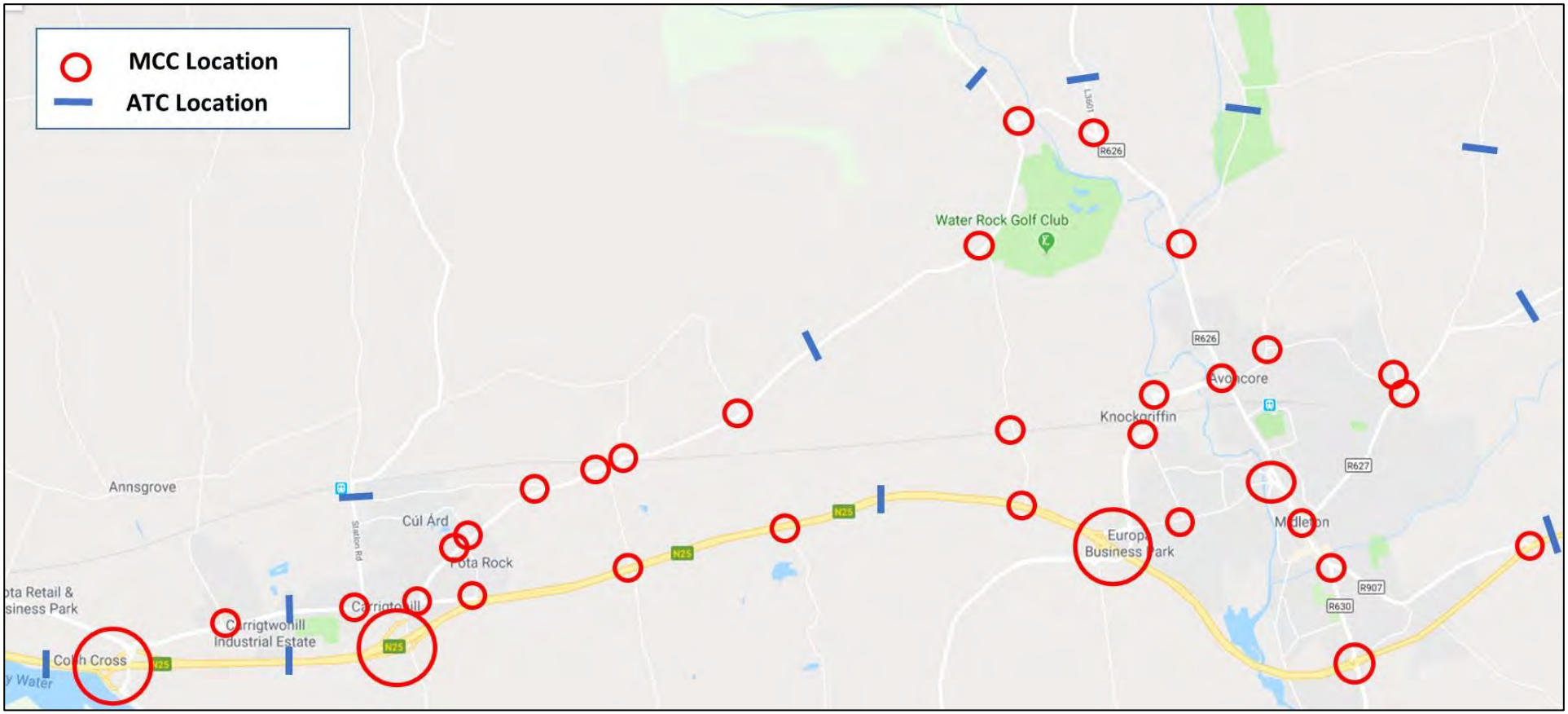
Traffic Count Data

5.8.5 To ensure the robustness of the developed strategic model, a series of traffic counts were commissioned for the model area to assist in the calibration and validation of base year model flows.

5.8.6 The MCC and ATC survey locations are illustrated in Figure 5.5, overleaf.

5.8.7 Turning counts were taken at key locations to provide an exact knowledge of movements within a specified junction. The locations of ATC surveys provide a record of traffic on the key routes entering/exiting Midleton and Carrigtwohill over an extended period (7 days). Incorporating this information enables an accurate representation of traffic flows within the model.

Figure 5-5 Midleton and Carrigtwohill Traffic Count Survey Locations



Network Calibration Steps

5.8.8 As an initial calibration step, all modelled movements with corresponding junction turning counts were examined to determine if the count exceeded modelled capacity. Remedial steps were then taken to permit realistic flows in the model.

5.8.9 Similarly, the capacity and speeds of modelled links were also checked to ensure they were broadly in line with survey information.

5.8.10 As the WRTM was coded based on best practice approaches developed during the NTA Regional Model Scoping Process, the network coded was an accurate and up-to date representation of the existing road network. If required however, the following network model parameters were adjusted if there was clear reason for doing so:

- Junction type (Priority, Signalised, Roundabout);
- Road lengths;
- Signal timings;
- Link free flow travel speed;
- The number of approach lanes at each junction arm;
- Traffic lane width per junction approach, and the lane discipline adopted (including prohibited turns);
- Saturation flow through junctions;
- Assumed road capacities;
- Link based flow-delay relationships; and
- Any other traffic management measures that may impact on capacity, such as bus lanes, traffic calming, parking controls and cycle-lanes.
- Zone co-ordinates; and
- Zone loading points (connections to the network).

Trip Demand Adjustment (Matrix Estimation)

5.8.11 Following calibration of the network, trip demand is adjusted in line with count data, so that there is an improved agreement between counts and modelled flows. The base prior matrix is fed into a SATURN programme called ME2. ME2 then adjusts origin-destination patterns to produce a trip demand matrix that better replicates counts when assigned to the network. When this replication is satisfactory the matrix is said to be calibrated.

5.8.12 The prior matrix is adjusted only after all options for improving the network are exhausted. Any matrix adjustment must significantly improve the match between observed and modelled flows, and not introduce more trips into a zone than could realistically be expected. Controls are placed on zones to ensure that the trip demand generated is sensible and in line with census population and employment statistics.

5.8.13 The algorithm driving the ME2 estimation process tends to reduce long trips in place of chains of short trips, especially when counts are spread over the entire area, which may not fully reflect reality.

5.8.14 Constraints are therefore placed on the adjustment process to protect the number of movements and distribution of the through trips contained within the original car trip matrix. By restricting such long through trips, the matrix adjustment algorithm is forced to create or re-distribute short trips.

5.8.15 Detailed constraints were developed for all zones within the study area to ensure that the ME2 process did not unrealistically alter trips entering/exiting the main areas of assessment. Census Small Area Population Statistics (SAPS) 2016 and land-use data (Geo-directory) were utilised to determine a range of the likely number of trips that would originate, or end, in each zone and these were used as constraints in the matrix estimation process. In summary, these constraints were determined as follows:

- **Residential Zones:** The trip generation values from the prior matrix (Cordoned SWRM) were utilised as minimum constraints for residential zones. Land use information identified through the creation of the WRTM zone system gave a breakdown on the approximate number of housing units in each residential zone;
- **Employment Zones:** Minimum constraints based on employment attractions, within the NTA planning sheet for the SWRM cordon run were utilised to encourage employment zones as destinations. Maximum constraints were applied to areas within the town centre to reflect the amount of on-street parking available;
- **Schools:** Minimum constraints were applied to school zones based on NTA planning sheet. For the PM peak, constraints were applied to ensure that no trips were attracted to school zones to reflect the fact that all schools would be closed at this time; and
- **Heavy Vehicles:** Constraints were applied on all residential and unsuitable zones to ensure that HV traffic was not assigned to inappropriate zones in the WRTM. For key HV generators/attractors in Water Rock, a possible range of values were defined based on the surveys carried out in the area.

Traffic Flow Accuracy Measure: GEH

5.8.16 The GEH statistic (named after its inventor, Geoffrey E. Havers) is a measure that considers both absolute and proportional differences in flows. Thus, for high levels of flow a low GEH may only be achieved if the percentage difference in flow is small. For lower flows, a low GEH may be achieved even if the percentage difference is relatively large. GEH is formulated as:

$$GEH = \sqrt{\frac{(observed - modelled)^2}{0.5 \times (observed + modelled)}}$$

5.8.17 The reason for introducing such a statistic is the inability of either the absolute difference or the relative difference to cope over a wide range of flows. For example, an absolute difference of 100 pcu/h may be considered a big difference if the flows are of the order of 100 pcu/h, but would be unimportant for flows in the order of several thousand pcu/h. Equally a 10% error in 100 pcu/h would not be important, whereas a 10% error in, say, 3000 pcu/h might mean the difference between building an extra road lane or not.

5.8.18 In general, the GEH parameter is less sensitive to the above statistical biases since a modeller would probably feel that an error of 20 in 100 would be roughly as bad as an error of 90 in 2,000, and both would have a GEH statistic of roughly 2.

5.8.19 As a rule of thumb in comparing assigned volumes with observed flows, a GEH parameter of 5 or less would be an acceptable fit, while GEH parameters greater than 10 would require closer attention.

5.8.20 The DMRB Volume 12a guidelines are a widely accepted standard in Ireland (with TII basing their guidelines on this document) that provides extremely robust validation criteria to which certain types of highway models should adhere.

5.8.21 DMRB sets a guideline that 85% of links should have a GEH less than 5 (when measured in vehicles per hour). In addition, it is commonplace to establish that 90% of assessment links have a GEH of less than 10 and that 100% of validation links have a GEH less than 20.

GEH Statistics for Calibrated Model

5.8.22 Table 5.1 and Figures 5.6 & 5.7 below summarises the GEH calibration results for the model after the matrix estimation process, for each of the two modelled time periods.

Table 5-1 Count Calibration Statistics (Post-Calibration)

GEH	AM	PM
GEH < 5	95%	95%
GEH < 10	100%	100%
GEH < 20	100%	100%

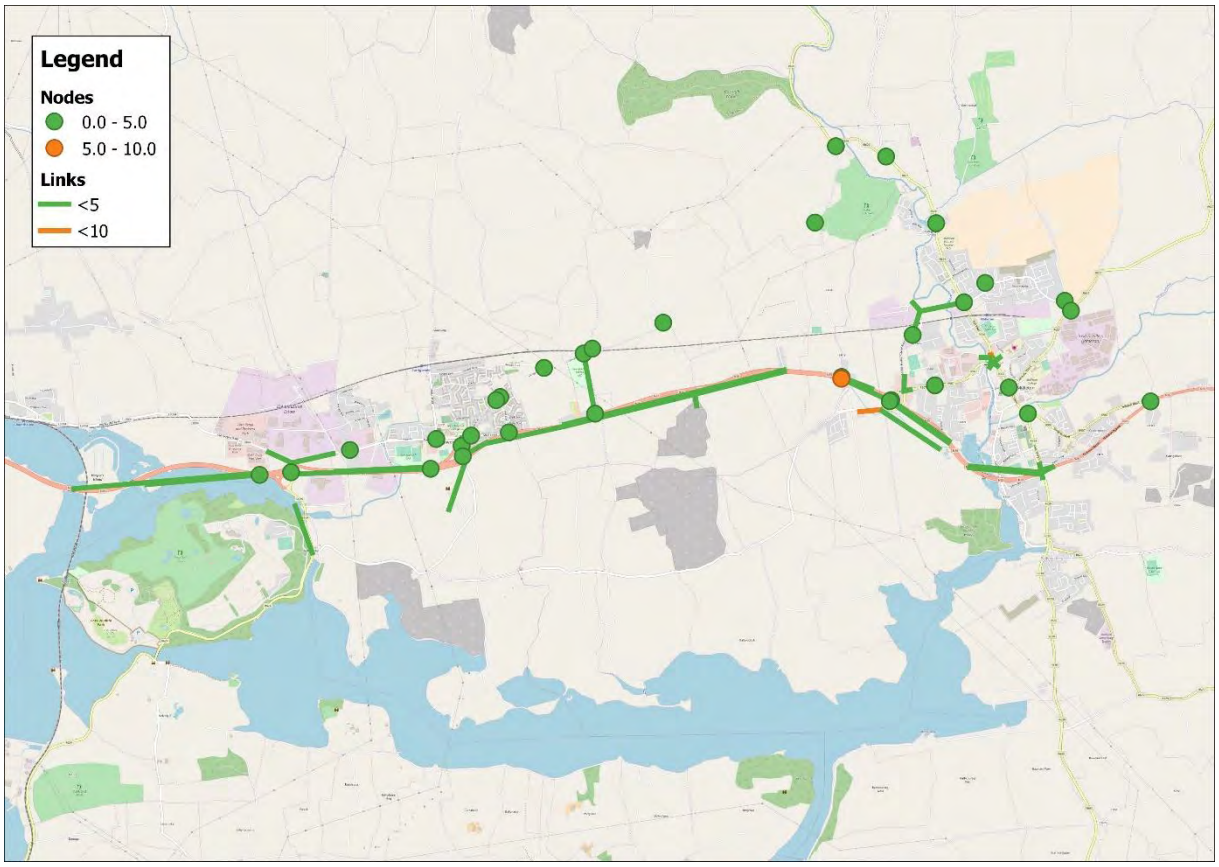


Figure 5-6 AM Calibration

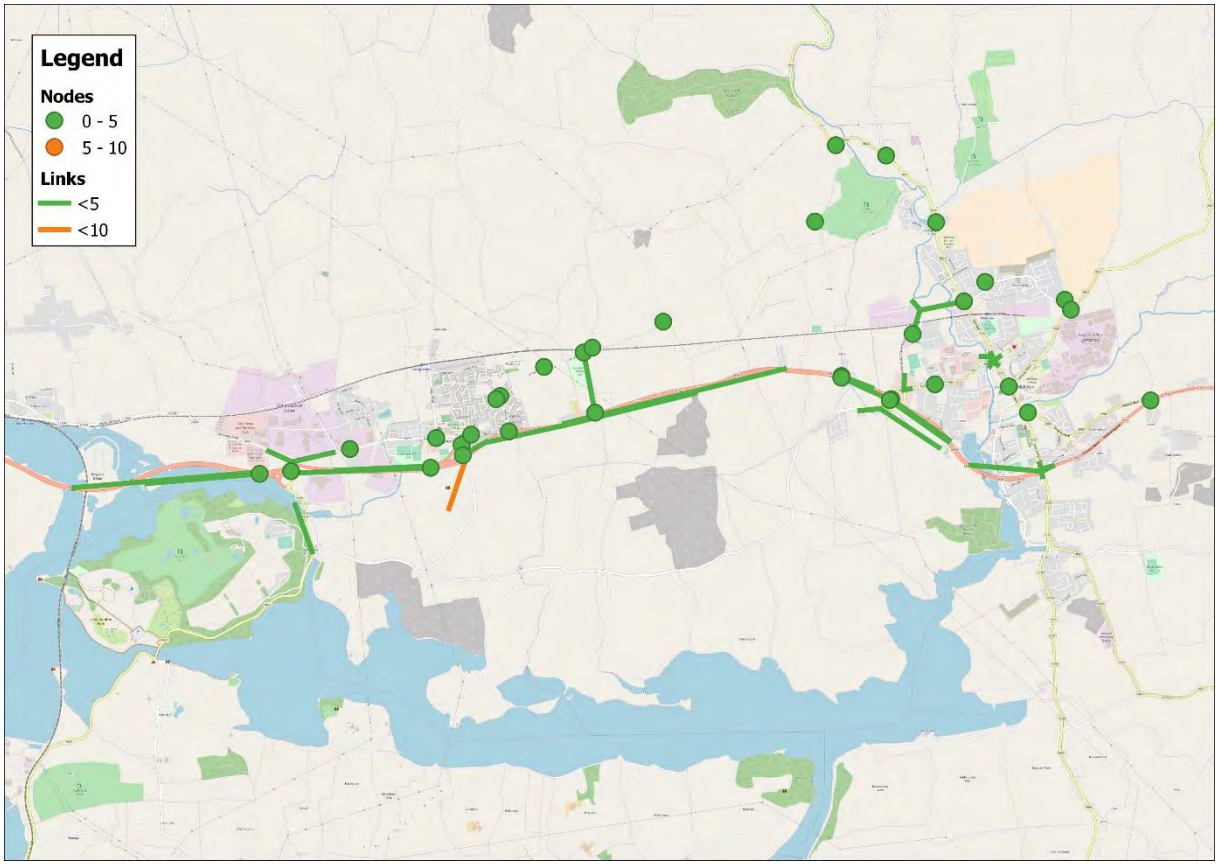


Figure 5-7 PM Calibration

5.8.23 The figures demonstrate that an excellent calibration has been achieved in the model for the morning and evening peak periods, with an overall GEH of ninety five percent which falls well within DMRB Standards.

5.9 Model Validation

5.9.1 This section sets out additional comparative measures by which the robustness of the calibrated model may be judged. The following model performance characteristics are detailed:

- Comparison of independent traffic counts to model flows;
- Comparison of modelled traffic flows to each individual survey location; and
- Comparison of modelled and observed journey times.

Independent Model Flows

5.9.2 A set of counts were excluded from the counts used in matrix estimation so they could be used to carry out an independent check on the model to see how well the model flows match the observed counts. 18 ATC counts were used for this purpose, providing full coverage of the study area.

5.9.3 Table 5.4 shows the link count validation for the independent counts excluded from matrix estimation for each modelled time-period. These tables show an excellent level of validation for all modelled time periods.

Table 5-2 Count Validation Statistics

GEH	AM	PM
GEH < 5	89%	89%
GEH < 10	100%	94%
GEH < 20	100%	94%

Individual Survey Location Validation

5.9.4 Modelled flows are compared with link flows at count locations. The junctions are chosen to provide a wide geographical spread of validation locations around the modelled area of interest.

5.9.5 DMRB presents additional guidelines for traffic flow validation, these are that 85% of links should satisfy the following criteria:

- flows within 100 for links with flow less than 700 vehicles per hour;
- flows within 15% for links with flow between 700 and 2,700 vehicles per hour; and
- flows within 400 for links with flow over 2,700 vehicles per hour.

5.9.6 The results in Table 5.3 below were obtained when testing all individual link counts throughout the model under the three criteria set out above.

Table 5-3 Turning Count Validation - % Links Satisfying Alternative DMRB Criteria

DMRB CONDITION	AM	PM
Flow < 700; modelled within 100	99.4%	98.9%
700 < Flow < 2750; modelled within 15%	100%	100%
2750 < Flow; modelled within 400	100%	100%

5.9.7 All of the alternative DMRB criteria are met for the post-calibration trip matrix.

Journey Time Validation

5.9.8 Journey Time Surveys were carried out along three routes through the study area as illustrated in Figure 5.8 and 5.9.

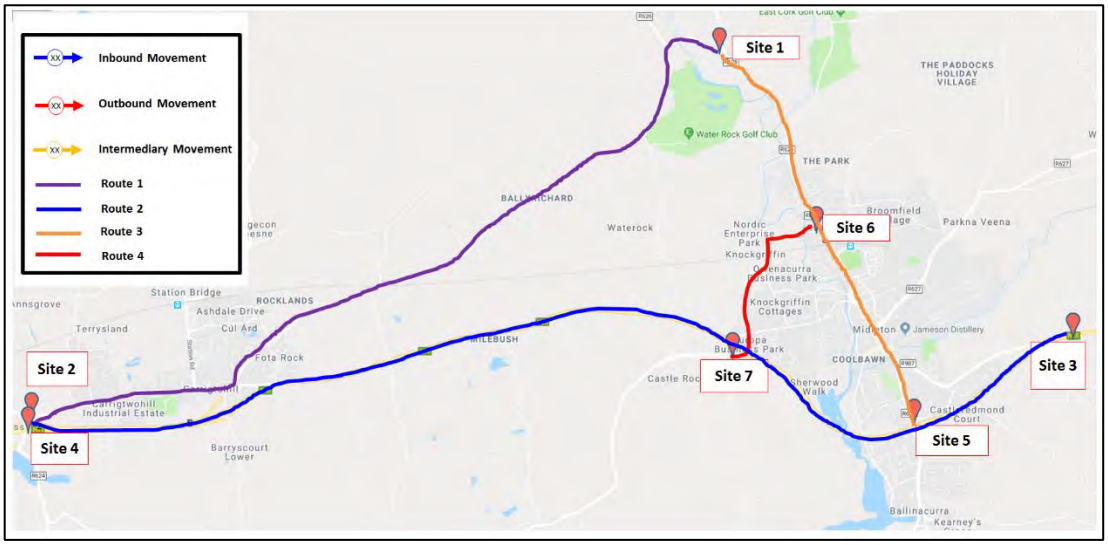


Figure 5-8 Journey Time Survey Routes

Figure 5-9 Journey Time Survey Routes – Start and End Points

5.9.9 The DMRB and TII guidelines advise that modelled journey times should be within 15% of the observed time, or within 1 minute, in more than 85% of cases. Table 5.4 below summarises the observed journey times against the model times for each of the journey time routes for the AM peak hour period.

Table 5-4 Observed Vs Modelled Journey Times during the AM Peak

ROUTE	OBSERVED TIME (SECONDS)	MODELLED TIME (SECONDS)	% DIFFERENCE
Route 1 (NB)	720	636	-12%
Route 1 (SB)	658	662	1%
Route 2 (EB)	391	424	8%
Route 2 (WB)	594	520	-12%
Route 3 (NB)	540	521	-4%
Route 3 (SB)	604	559	-7%
Route 4 (NB)	168	175	4%
Route 4 (SB)	181	198	9%

5.9.10 The results outlined in the table above indicate that all routes surveyed in the AM peak, satisfy the DMRB and TII guidelines.

5.9.11 Table 5.5 below summarises the observed and model journey times for each of the journey time routes for the PM peak period.

Table 5-5 Observed Vs Modelled Journey Times during the PM Peak

ROUTE	OBSERVED TIME (SECONDS)	MODELLED TIME (SECONDS)	% DIFFERENCE
Route 1 (NB)	779	696	-11%
Route 1 (SB)	567	625	10%
Route 2 (EB)	636	617	-3%
Route 2 (WB)	494	468	-5%
Route 3 (NB)	542	507	-6%
Route 3 (SB)	788	568	-28%
Route 4 (NB)	167	170	2%
Route 4 (SB)	158	168	6%

5.9.12 The results outlined in Table 5.5 indicate that all but one route surveyed in the PM peak satisfy the DMRB and TII guidelines.

5.9.13 Analysis of the route which fails to meet the TII criteria (Route 3SB) indicates that the observed journey time through Midleton Town Centre was slower than that in the model. Further inspection of the survey data revealed that a significant portion of this delay was experienced at the level crossing to the north of Midleton Town Centre. Given the limitations of a strategic model such as this (e.g. journey time and delays are averaged over an hour) it is not possible to accurately model the impacts of this level crossing in a One Hour Strategic Model like the N55 LAM. However, aside from this, the model is showing appropriate delay along other sections of this route and therefore it is sufficient for use. Note that the delay associated with the level crossing was included in the VISSIM micro-simulation model. This is described in Section 2.5 of that report.

5.10 Model Development Summary

5.10.1 Two peak hour, full area, models were calibrated and validated. These represent the AM peak period from 07:45 to 08:45, and the PM peak period from 17:00 to 18:00.

5.10.2 Traffic flow calibration and validation indicates that the correlation between modelled and observed flows is excellent for the Midleton and Carrigtwohill areas for both time periods.

5.10.3 The traffic flow validation of individual link flows is acceptable using both the standard guidelines and the alternative criteria outlined by the DMRB. The regression analysis also indicates that there is no strong bias in the modelled flows.

5.10.4 The highway assignment model is fit for purpose. It represents AM and PM peak period base year traffic conditions well, as demonstrated statistically in the previous sections of this Chapter. It provides a robust basis for assessing the impacts on the road network of any future infrastructure improvements/developments as:

- The model realistically represents journey times;
- The study area is covered by many counts for both calibration and validation; and
- Regression analysis indicates a high correlation between modelled and observed flows and no strong biases.

6. TRANSPORT ASSESSMENT METHODOLOGY

6.1 Overview

6.1.1 In order to assess the impact of Water Rock development, a robust methodology was designed that uses the SWRM, Water Rock Local Area Model and Midleton VISSIM model to assess the impact of phased development on the performance of the road network. This section details the steps taken to assess that impact.

6.2 Assessment Methodology

6.2.1 The Assessment Methodology adopted in this Transport Assessment includes the following key steps:

- **Step 1:** Determine the **Demand for Travel**;
- **Step 2: Assess Strategic Impacts** of future transport demand on future transport networks;
- **Step 3:** Develop required **Mitigation Measures** to improve future year transport network; and
- **Step 4: Detailed Assessment** of proposals, including mitigation measures, using Vissim.

Step 1: Demand for Travel

6.2.2 The first step undertaken was to identify the quantum of transport demand generated by the proposed development as outlined in the LAP and detailed in Chapter 4.

6.2.3 The total **Person Trips** and **Total Vehicle Trips** generated by each development site were calculated using a combination of Survey Data, Census 2016 information and the Trip Information Computer System (TRICS) database. TRICS is the national standard database system for trip generation and analysis. The database holds thousands of trip rate surveys generated by different land uses and location type across UK and Ireland. The database provides trip rates per 100m2 gross floor area or by residential unit. The resulting trip rates were applied to the forecast developments in the study area.

6.2.4 The **Trip Distribution** of these forecast trips have been established using the NTA's South West Regional Model.

6.2.5 Background Traffic Growth (i.e. increases in traffic not associated with the developments in the study area itself) has been calculated using forecasts from the National Transport Authorities South Western Regional Model (SWRM) and align with land use and population assumptions used for the development of the Cork Metropolitan Area Transport Strategy.

Step 2: Assess Strategic Transport Impacts (Using Water Rock Traffic Model)

6.2.6 To identify the impacts of development proposals and the effectiveness of proposed transport measures, the WRTM was utilised to assess the Strategic highway impacts of the proposed development (and associated infrastructure proposals) for each phase of development, focussing on the following key outputs:

- Journey Times;
- Volume / Capacity at key junctions; and
- Demand flow at key junctions

6.2.7 The above outputs are provided for 'Do Minimum' and 'Do Something' scenarios for each phase of the development. The 'Do Minimum' scenario excludes the development of the Water Rock UEA and infrastructure proposals associated with the Water Rock UEA but includes all other planned development including the other UEAs. The 'Do Something' scenario includes the development of the Water Rock UEA and infrastructure proposals associated with the Water Rock UEA as well as all other planned development.

Step 3: Develop Mitigation Measures

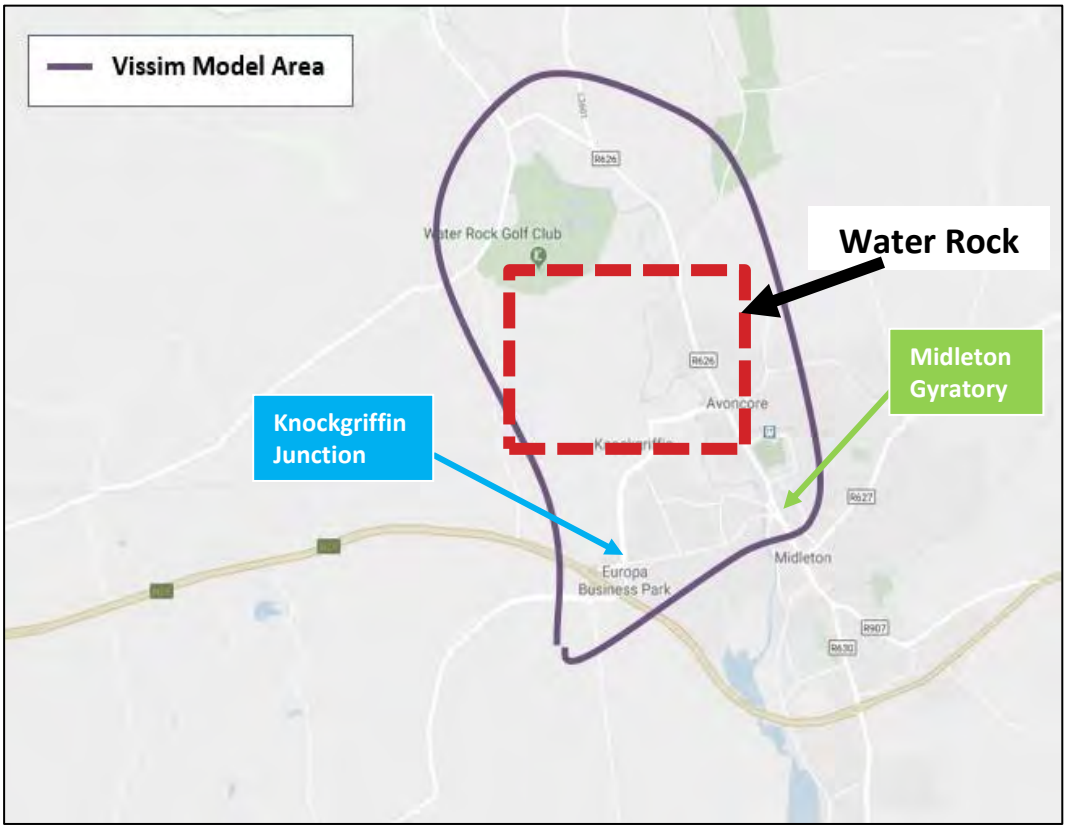
6.2.8 Based on the results from Step 2, where necessary, mitigation measures were identified to improve the performance of reducing any negative impacts on the local traffic network.

The mitigation measures identified here were fed back into Step3 for assessment in an iterative process.

Step 4: Detailed Assessment

6.2.9 As Midleton Town Centre and the Knockgriffin Interchange with the N25 are critical to both the local and national highway network, a Vissim Microsimulation Model of this area has been developed to further analyse the impact of proposed development at a more local, operational, level. Strategic Model outputs from stage 3 were input to the Micro-simulation model for all phases of development to further analyse the impacts of the proposed development. Figure 6.1, below, illustrates the area covered by the Midleton Micro-Simulation Model. Details of this Microsimulation analysis are contained within Appendix C of this report.

Figure 6-1 VISSIM Model Area



7. TRIP GENERATION AND DISTRIBUTION

7.1 Trip Generation Assumptions

Development Trips

7.1.1 To determine the number of trips generated by the proposed development, a Trip generation exercise was undertaken utilising several data sources, including:

- The TRICS (Trip Rate Information Computer System) database;
- Cork County Council Trip Generation Surveys; and
- 2016 Census data.

7.1.2 The Primary source of data used to determine trip rates from residential developments was a recent survey undertake by MHL & Associates Ltd for a 224-unit housing estate in Glanmire. The remaining Land Use trip rates were taken from TRICS database (the UK and Ireland's national system of trip generation analysis) based on a comparison of comparable developments with similar characteristics.

7.1.3 For new primary and secondary schools, which are proposed for both Water Rock and Carrigtwohill UEA's, it has been assumed that 60% of students will live in the associated UEA's and the remainder of students will travel from nearby areas. Therefore, traffic generated by these schools, which impacts the existing road network, will be associated with approximately 40% of forecasts student numbers.

Background Traffic Growth

7.1.4 The NTA's Southwest Regional Model was used to determine the background traffic growth (traffic not associated with developments within the study area) for the Local Area Model. In order to present a wort case scenario, these future year runs included all proposed development for the Metropolitan area outlined in the NPF and Cork City and County Development plans (including 9 Urban Expansion Areas).

7.2 Mode Share

7.2.1 To determine the appropriate level of public transport mode share for the proposed development, an analysis was undertaken of existing mode share (as per census 2016) for residents in Midleton, and a number of other residential developments located within 1km of the suburban rail network in Cork. This analysis indicated that the likely rail mode share for Water Rock with the existing level of service (2 trains per direction per hour) was in the region of 5% - 7%. It was determined that the most appropriate rail mode share value to use was the 5% observed in Midleton and therefore it has been assumed that the rail mode share for the development will be 5% for Phases 1A and 1.

7.2.2 As outlined in Chapter 4 of this report, existing policy documents contain several public transport proposals for Midleton and Water Rock which will increase the level of PT connectivity of the development in the future. These proposals include an increase in headway on Cork – Midleton rail line to every 15 minutes during peak periods. It has

been assumed that these public transport improvements will be in place by Phase 2 of the Water Rock Development.

7.2.3 To estimate the mode share for Phases 2 and 3 of the development, future year South West Regional Model runs, including increased PT services for Water Rock, were analysed. This analysis indicated that the PT proposals would result in a circa 2% increase in the overall PT mode share for Phases 2 and 3 of Water Rock.

7.3 Trip Distribution

7.3.1 The trip distribution for the Water Rock development was estimated using the South West Regional Model. As mentioned previously, the SWRM has 3 core modelling processes (i.e. Demand Model, Road Assignment Model and Public Transport Assignment Model) which receive inputs from the National Demand Forecast Model (NDFM) and provide outputs for transport appraisal and secondary analysis. The proposed development was input to the SWRM which determined the likely distribution of trips from the development based on existing and forecast land use data combined with demographic factors such as the age and socio-economic composition of the new development. The resulting AM peak trip distribution, for phase 3 of the development, is illustrated below in Figure 7.1. Each Phase of Development will have a similar distribution to that shown below.

Figure 7.1 Water Rock Distribution of Trips

8. PHASE 1 A – TRANSPORT ASSESSMENT

8.1 Overview

8.1.1 As outlined in previous sections of this report, several development phases have been tested using the Water Rock Transport Model. This section presents the results of the modelling assessment of the impacts of Phase 1A of the proposed Water Rock development on the surrounding road network. Phase 1A represents Cork County Council's commitment under the Local Infrastructure Housing Activation Programme (LIHAF) agreement.

Land Use Assumptions

8.1.2 For each of the Phases to be tested, land use assumptions have been made relating to the additional level of housing, employment and education development likely to take place in both Midleton and Carrigtwohill. These assumptions were developed in conjunction with Cork County Council and are aligned to targets set out in the latest planning policy documents. To represent a worst-case scenario, the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, is assumed to take place in parallel to the development of the Water Rock UEA.

8.1.3 Table 8.1, below, outlines the land use assumptions which have been included in the Phase 1A modelling assessment. The Do-minimum excludes Water Rock development but includes the other development. The Do-something includes all development.

Table 8-1 Phase 1a Development

Area	Resi (Units)	Primary (Students)	2nd level (Students)	Office (GFA m^2)	Retail (GFA m^2)	Leisure (GFA m^2)
Water Rock	535	0	0	0	0	0
Midleton	0	0	0	0	0	0
Carrigtwohill	357	0	0	2000	1000	500

Do – Minimum Infrastructure Assumptions

8.1.4 In Phase 1A, the following upgrades are assumed to be in place in both the Do-minimum and Do-something scenarios as these works are currently planned for implementation in the near future:

- The Lakeview Roundabout is upgraded to include a west-bound slip road on the southern arm.

Do Something Infrastructure Assumptions

8.1.5 In addition to the land use assumptions above, a number of infrastructure projects have been assumed to coincide with Phase 1A of Water Rock. These infrastructure proposals are outlined in Table 8.2 and shown previously in Figure 4.2. Each of these measures are assumed to be in place in the Phase 1A Do-Something (with Water Rock development) scenarios only.

Table 8-2 Phase 1a Infrastructure Proposals

Infrastructure Proposals (Phase 1A)	
A	Service Corridor Link Road from NRR to Water Rock
B	Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction
C	Traffic Management Measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)
D	New Railway Stop on Cork - Midleton Line

8.2 Phase 1A Trip Generation

8.2.1 Table 8.3 below shows the final vehicle trip generation figures associated with Phase 1A of Water Rock.

Table 8-3 Phase 1a Trip Generation Figures

Area	AM Origin trips	AM Destination trips	PM Origin trips	PM Destination trips
Water Rock	276	114	168	285
Midleton	0	0	0	0
Carrigtwohill	259	157	252	341
Total	**536**	**271**	**420**	**626**

8.3 Assessment Criteria

Key Performance Indicators

8.3.1 To assess the impact of the development on the transport network, three Key Performance Indicators (KPIs) were developed. These KPIs are outlined in Table 8.4.

Table 8-4 Assessment Key Performance Indicators

Mode	Key Performance Indicator	Description
Road Network	Journey Times	Journey Times along key routes.
	Volume/Capacity	V/C ratios at key Junctions.
	Demand Flow	Changes in Demand Flow at key junctions

8.3.2 The first indicator used in the assessment was the journey time changes resulting from the proposed development and associated infrastructure. This indicator looks at the travel time impacts along the Four Routes used in Model validation, and illustrated in Figure 5.8.

8.3.3 The second indicator is Volume over capacity (V/C). This is a commonly used index to assess the performance of junctions. It measures the volume of traffic passing through a junction against the capacity for that movement. It can be reported as the maximum V/C for any movement at the junction or also as a demand weighted average V/C for the junction. In this report, we have reported the maximum V/C for every turning movement at the junction in question. Junctions operating below 85% V/C are said to be operating within capacity, between 85-100% V/C flow breakdown occurs with queuing becoming

evident. V/Cs greater than 100% indicate that a junction is operating over-capacity with significant queuing

8.3.4 Finally, the total traffic demand (sum of demand on all approaches to a junction) at certain junctions has been analysed to determine how demand at each of the junctions assessed changes because of the proposals. This is displayed alongside the Max V/C experienced at each junction and the proportion of total traffic which is generated by the Water Rock Development.

8.4 Phase 1A Highway Impacts

Journey Times along Key Routes

8.4.1 The same journey time routes that were used for validation (shown in Figure 5.8) have been used for the purposes of this analysis.

8.4.2 Tables 8.5 and 8.6 below outline the journey times along the above routes for the AM (07:45 – 08:45) and PM (17:00-18:00) peaks respectively. These tables compare the Do-Minimum (No Water Rock in Place) journey times with the Do-Something Scenario (including Phase 1A development) to ascertain the impacts that the proposed LAP development will have on Journey times.

Table 8-5 AM – Journey Times

Route	DM	DS	Difference
Route 1 NB	642	632	-2%
Route 1 SB	669	666	0%
Route 2 EB	424	424	0%
Route 2 WB	554	538	-3%
Route 3 NB	522	523	0%
Route 3 SB	559	571	2%
Route 4 NB	178	174	-2%
Route 4 SB	193	211	9%

Table 8-6 PM – Journey Times

Route	DM	DS	Difference
Route 1 NB	707	699	-1%
Route 1 SB	634	624	-2%
Route 2 EB	642	585	-9%
Route 2 WB	394	400	2%
Route 3 NB	522	517	-1%
Route 3 SB	564	575	2%
Route 4 NB	207	185	-11%
Route 4 SB	192	192	0%

8.4.3 In general, the tables above show comparable journey times in both time periods with the proposed development (and associated infrastructure upgrades) in place. The only considerable increase in the AM peak period occurs on Route 4 in the Southbound direction which sees a 9% increase in journey times along the Northern Relief Road.

8.4.4 In the PM peak, the impact of the proposed development has no significant impact with no route showing an increase greater than 2%. These results also show that the upgrade of the Cork Rd / NRR Junction in the Do-Something scenario results in Journey times northbound along the NRR improving by approximately 11% in the PM peak.

AM V/C Analysis

8.4.5 Volume over capacity (V/C) is a commonly used index to assess the performance of junctions. It measures the volume of traffic passing through a junction against the capacity for that movement. For each of the junctions in the study area the maximum turning V/C, has been calculated. Figures 8.2 – 8.5 illustrate the results of this V/C analysis for the AM Do-Minimum and Do-Something Scenarios respectively where the V/C has been assessed as greater than 70%. No dots are shown where the V/C has been assessed as less than 70%.

Figure 8-1 AM V/C Analysis – Do-Minimum Midleton

Figure 8-2 AM V/C Analysis – Do-Something Midleton

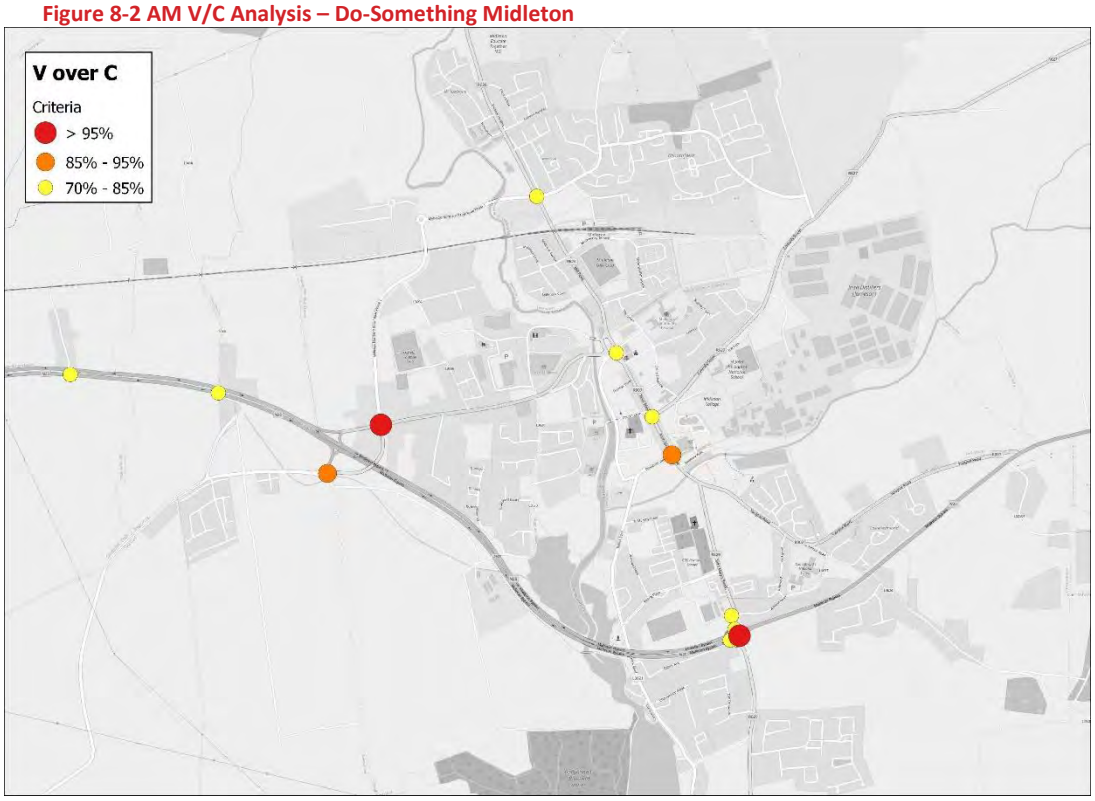


Figure 8-3 AM V/C Analysis – Do-Minimum Carrigtwohill

Figure 8-4 AM V/C Analysis – Do-Something Carrigtwohill

8.4.6 As with the journey time analysis, the figures above show a minimal impact on the traffic network as a result of the Phase 1A development.

8.4.7 It should be noted that several junctions (including the Knockgriffin junction, the Lakeview Terrace roundabout and the Southern Roundabout on the Cobh Cross interchange) are operating at over 95% V/C in the Do-minimum Scenario. These issues persist in the Do-Something scenarios, but importantly, the Water Rock development does not lead to a significant deterioration in the performance of these junctions. The performance of the Knockgriffin junction is assessed in more detail in the VISSIM micor-simulation model which is described in Appendix C.

8.4.8 Further analysis of the impact the proposed development has on these junctions in the AM and PM peaks is shown in Table 8.7, at the end of this section.

PM V/C Analysis

8.4.9 Figures 8.6 – 8.9 below show the V/C analysis for the Do-Minimum and Do-Something PM peak hour scenarios.

Figure 8-5 PM V/C Analysis – Do-Minimum Midleton

Figure 8-6 PM V/C Analysis – Do-Something Midleton

Figure 8-7 PM V/C Analysis – Do-Minimum Carrigtwohill

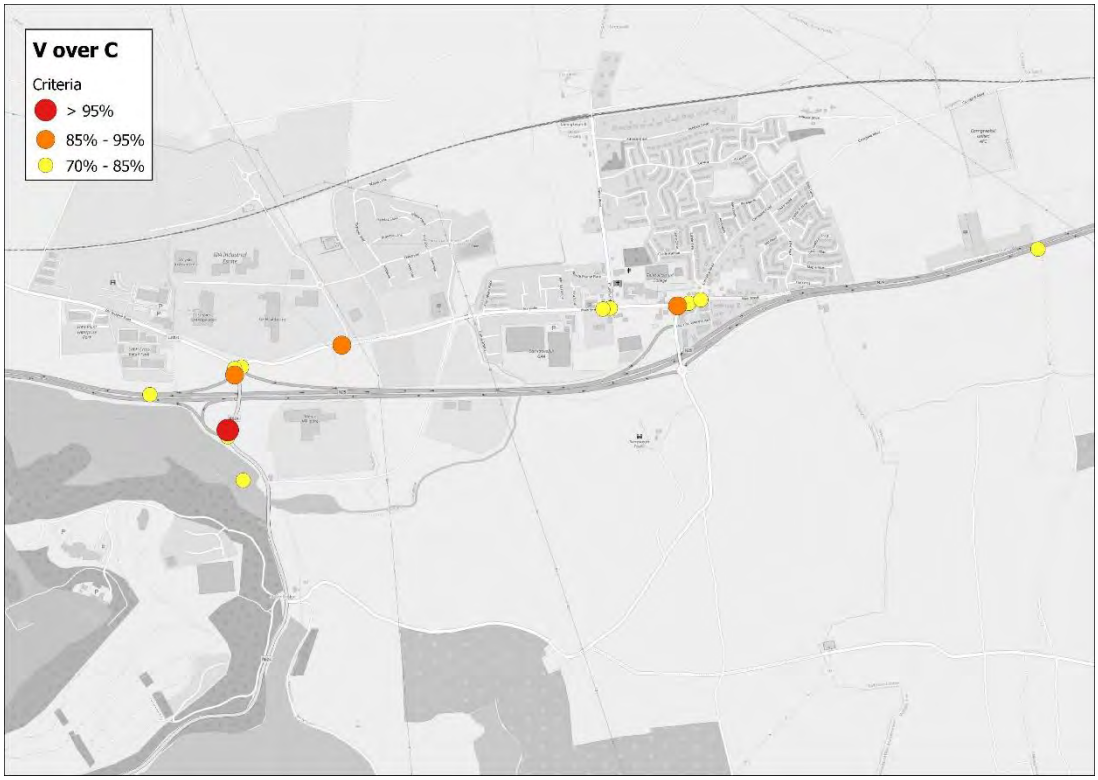


Figure 8-8 PM V/C Analysis – Do-Something Carrigtwohill

8.4.10 Again, the figures above show a minimal impact on the network because of the Phase 1A development. As with the AM Peak, several junctions in the PM peak periods are operating at over 95% V/C in the Do-Minimum Scenario. Further analysis of these

junctions revealed that there is no significant deterioration in the performance of these junctions because of the additional development in Water Rock, as outlined in Table 8.7, below.

Demand Flow at Key Junctions

8.4.11 The tables below show a comparison of the total demand flows (sum of all movements through the junction) and Max V/C (%) between the DM and DS scenarios at several key junctions, highlighting the impact of the Water Rock Development at these locations. The results show that only the Knockgriffin and NRR/R626 junctions experience significant increases in demand flow because of the proposed development.

Knockgriffin Junction

8.4.12 Examination of the max V/C (%) shows that, due to the proposed upgrade of the Knockgriffin junction which accompanies the Water Rock development (illustrated in Figure 4.2), this junction can accommodate the additional traffic without any negative impacts on junction operation. Furthermore, microsimulation analysis of this junction, detailed in Appendix C, has confirmed that the Phase 1A development can be accommodated at this junction.

Lakeview Roundabout and Cobh Cross

8.4.13 While both the Lakeview Roundabout and Cobh Cross Southern Roundabout are over capacity in both the Do-Min and Do-something scenarios, our analysis shows that the contribution of Water Rock traffic to demand at these locations is minimal (~1-3%) and the max V/C (%) for the DS scenario is the same or slightly lower than for the DM scenario.

R626 / NRR Junction

8.4.14 This analysis also shows that, even with an increase in demand in the PM peak, the NRR/ R626 junction will still operate well within capacity with the proposed development in place (max V/C at this junction is 78%). Again, the micro-simulation analysis has also confirmed that this junction will operate within capacity in Phase 1A.

Water Rock Road

8.4.15 There will only be a slight change in traffic flows along the Water Rock Road in both the AM and PM peak for the Do-something scenario because of the closure of the Water Rock Road level crossing to vehicular traffic. This closure prevents traffic travelling between the N25 and Carrigane Road in either direction. Traffic can however travel from the Northern Relief Road and the UEA to the Carrigane Road via the Water Rock Road. In the AM peak south to north vehicle numbers increase from 66 to 71 but north to south vehicle numbers decrease from 42 to 27. In the PM peak north to south traffic increases from 8 to 78 but south to north traffic decreases from 72 to 12. The additional traffic which results from the development of the UEA is offset by the decrease in traffic following the prevention of 'rat-running' between the Carrigane Road and the N25.

Table 8-7 AM Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	%Water Rock	DM	DS	Diff
Knockgriffin	1899	2124	**9%**	96%	97%	1%
Lakeview Roundabout	3502	3498	2%	104%	103%	-1%
Broderick St / Main St	1435	1421	1%	89%	92%	3%
Station Rd / Main St Carrigtwohill	934	951	1%	56%	60%	4%
NRR/R626	1570	1619	2%	82%	78%	-3%
Midleton Gyratory	1833	1874	2%	63%	62%	-2%
N25/Youghal Rd Slip	1862	1853	1%	67%	66%	-1%
Carrigane Rd/Water Rock Rd	279	276	**26%**	11%	10%	0%
Carrigtwohill Main St/N25 J4 junction	1063	1104	4%	55%	59%	4%
Cobh Cross Interchange South	2661	2669	1%	103%	103%	0%

Table 8-8 PM Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	Diff	DM	DS	Diff
Knockgriffin	1990	2416	**10%**	101%	97%	-4%
Lakeview Roundabout	3436	3457	3%	109%	106%	-3%
Broderick St / Main St	1139	1168	5%	87%	94%	7%
Station Rd / Main St Carrigtwohill	1104	1080	1%	71%	71%	0%
NRR/R626	1230	1463	**10%**	54%	73%	**19%**
Midleton Gyratory	2264	2129	4%	74%	72%	-1%

Junction	Demand Flows			Max V/C (%)		
	DM	DS	Diff	DM	DS	Diff
N25/Youghal Rd Slip	1903	1911	2%	99%	100%	0%
Carrigane Rd/Water Rock Rd	212	232	**37%**	12%	6%	-6%
Carrigtwohill Main St/N25 J4 junction	1081	1097	1%	85%	84%	-2%
Cobh Cross Interchange South	2254	2252	1%	100%	99%	-1%

8.5 Phase 1A Summary and Conclusion

Summary

8.5.1 Phase 1A of the Water Rock development includes approximately 535 residential units and development has been assumed to be accompanied by the following infrastructure proposals:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction (infrastructure proposal B);
- Traffic management measures for Water Rock Road (infrastructure proposal C); and
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D).

8.5.2 In addition to the above development it has been assumed that Phase 1A of Water Rock will take place in parallel to the development of other zoned lands in Midleton and Carrigtwohill. The total level of development assumed for these other areas includes;

- 357 residential units;
- 2,000 Sqm of Office Development;
- 1,000 Sqm of Retail; and
- 500 Sqm of Leisure;

8.5.3 The assumed level of development, and associated trip generation, therefore represents the worst-case scenario for traffic generation in the study area.

8.5.4 The analysis undertaken in this chapter demonstrated that Phase 1A of Water Rock will have only a marginal impact on Journey times and Junction operation in the study area.

8.5.5 The modelling analysis undertaken also identified that the Lakeview Roundabout, and the southern roundabout of Cobh cross operate at capacity during peak periods in the Do-Minimum Scenarios. In the Do-Something Scenario (with Water Rock Development in place) the performance of these junctions is comparable to the Do-Minimum

Scenarios, with Water Rock contributing less than 1-3% to the total demand through these junctions during peak periods. In particular the contribution of the Water Rock development to the performance of the Cobh Cross junction in Phase 1A is only 1%.

Conclusion

With the above proposals in place our modelling results indicate that Phase 1A of the proposed Water Rock UEA development, in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, will not significantly impact the performance of the local transport network

9. PHASE 1 – TRANSPORT ASSESSMENT

9.1 Overview

9.1.1 This section presents the results of transport modelling assessment of the impacts of Phase 1 of the proposed Water Rock development on the surrounding transport network.

Land Use Assumptions

9.1.2 For each of the Phases to be tested, land use assumptions have been made, relating to the additional level of housing, employment and education development likely to take place in both Midleton and Carrigtwohill. These assumptions were developed in conjunction with Cork County Council and are aligned to targets set out in the latest planning policy documents. In order to represent a worst-case scenario, the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, is assumed to take place in parallel to the development of the Water Rock UEA.

9.1.3 Table 9.1 below outlines the land use assumptions which have been included in the Phase 1 modelling assessment. The Do-minimum excludes Water Rock development but includes the other development. The Do-something includes all development.

Table 9-1 Phase 1 Development

Area	Residential (Units)	Primary (Students)	Secondary (Students)	Office (GFA m^2)	Retail (GFA m^2)	Leisure (GFA m^2)
Water Rock	1054	592	0	10000	2000	500
Midleton	425	0	0	0	0	0
Carrigtwohill	1741	2400	0	7000	2500	1000

Do – Minimum Infrastructure Assumptions

9.1.4 In Phase 1, the following upgrades are assumed to be in place in both the Do-minimum and Do-something scenarios as these works are currently planned for implementation in the near future:

- The Lakeview Roundabout is upgraded to include a west-bound slip road on the southern arm.

Do-Something Infrastructure Assumptions

9.1.5 A number of infrastructure assumptions have been assumed to coincide with Phase 1 of Water Rock. These infrastructure proposals are outlined in Table 9.2 and shown previously in Figure 4.2. Each of these measures are assumed to be in place in the Phase 1 Do-Something (with Water Rock development) scenarios only.

Table 9-2 Phase 1 Infrastructure Proposals

Infrastructure Proposals (Phase 1)	
A	Service Corridor Link Road from NRR to Water Rock
B	Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction
C	Traffic Management Measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)
D	New Railway Stop on Cork - Midleton Line

9.2 Phase 1 Trip Generation

9.2.1 Table 9.3 below shows the final vehicle trip generation figures associated with Phase 1 of Water Rock.

Table 9-3 Phase 1 Trip Generation Figures

Area	AM Origin trips	AM Destination trips	PM Origin trips	PM Destination trips
Water Rock	623	449	619	774
Midleton	220	90	133	226
Carrigtwohill	1021	653	853	1193
Total	**1864**	**1193**	**1605**	**2193**

9.3 Phase 1 Highway Impacts

Journey Times along Key Routes

9.3.1 The same journey time routes that were used for validation (shown in Figure 5.8) have been used for the purposes of this analysis.

9.3.2 Tables 9.4 and 9.5 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Minimum journey times with the Do-Something Phase 1 scenario to ascertain the impacts that the proposed Water Rock development will have on Journey times.

Table 9-4 AM Peak (07:45 to 08:45)– Journey Times

Route	DM	DS	Difference
Route 1 NB	657	646	-2%
Route 1 SB	691	709	3%
Route 2 EB	425	426	0%
Route 2 WB	565	556	-2%
Route 3 NB	527	530	1%
Route 3 SB	562	594	6%
Route 4 NB	179	181	1%
Route 4 SB	198	246	24%

Table 9-5 PM Peak (17:00 to 1800) – Journey Times

Route	DM	DS	Difference
Route 1 NB	762	753	-1%
Route 1 SB	657	649	-1%
Route 2 EB	647	596	-8%
Route 2 WB	401	411	2%
Route 3 NB	522	533	2%
Route 3 SB	583	588	1%
Route 4 NB	205	200	-2%
Route 4 SB	189	237	25%

9.3.3 In general, the tables above show comparable journey times in both time periods with the proposed development (and associated infrastructure upgrades) in place. The only significant increase in the AM period, occurs on Route 4 in the Southbound direction (a 24% increase along the Northern Relief Road).

9.3.4 In the PM peak, the only significant increase also occurs on Route 4 in the Southbound direction (a 25% increase along the Northern Relief Road).

9.3.5 These increased journey times are because of additional delays experienced on the southbound direction of the NRR, more specifically at the Knockgriffin Junction where there is an increase in demand from the Water Rock Development.

AM V/C Analysis

9.3.6 Figures 9.1 – 9.5 illustrate the results of this V/C analysis for the AM Do-Minimum and Do-Something Scenarios respectively.

Figure 9-1 AM Peak (07:45 to 08:45) V/C Analysis – Do-Minimum Midleton

Figure 9-2 AM Peak (07:45 to 08:45) V/C Analysis – Do-Something Midleton

Figure 9-3 AM Peak (07:45 to 08:45) V/C Analysis – Do-Minimum Carrigtwohill

Figure 9-4 AM Peak (07:45 to 08:45) V/C Analysis – Do-Something Carrigtwohill

9.3.7 The figures above illustrate that several junctions (including the Knockgriffin junction, the Lakeview Terrace roundabout and the Cobh Cross interchange) are operating at over 95% V/C in the AM Do-minimum Scenario. These issues persist in the Do-Something scenarios, however, as shown in Table 9.6, the Phase 1 development traffic does not lead to any significant deterioration in the operation of these junctions.

9.3.8 However, the Phase 1 development does result in a small number of additional junctions operating close to capacity, including:

- **Castle Rock (Baneshane) on/off slip roundabout to the N25** (90% V/C increases to 96% V/C with development);
- **the Broderick St/Main St junction** (89% V/C increases to 95% V/C with development); and
- **the Station Rd junction on the Carrigtwohill Main St junction** (95% V/C increases to 100% V/C with development).

PM V/C Analysis

9.3.9 Figures 9.6 – 9.9 below show the V/C analysis for the Do-Minimum and Do-Something PM peak hour scenarios.

Figure 9-5 PM Peak (17:00 to 18:00) V/C Analysis – Do-Minimum Midleton

Figure 9-6 PM Peak (17:00 to 18:00) V/C Analysis – Do-Something Midleton

Figure 9-7 PM Peak (17:00 to 18:00) V/C Analysis – Do-Minimum Carrigtwohill

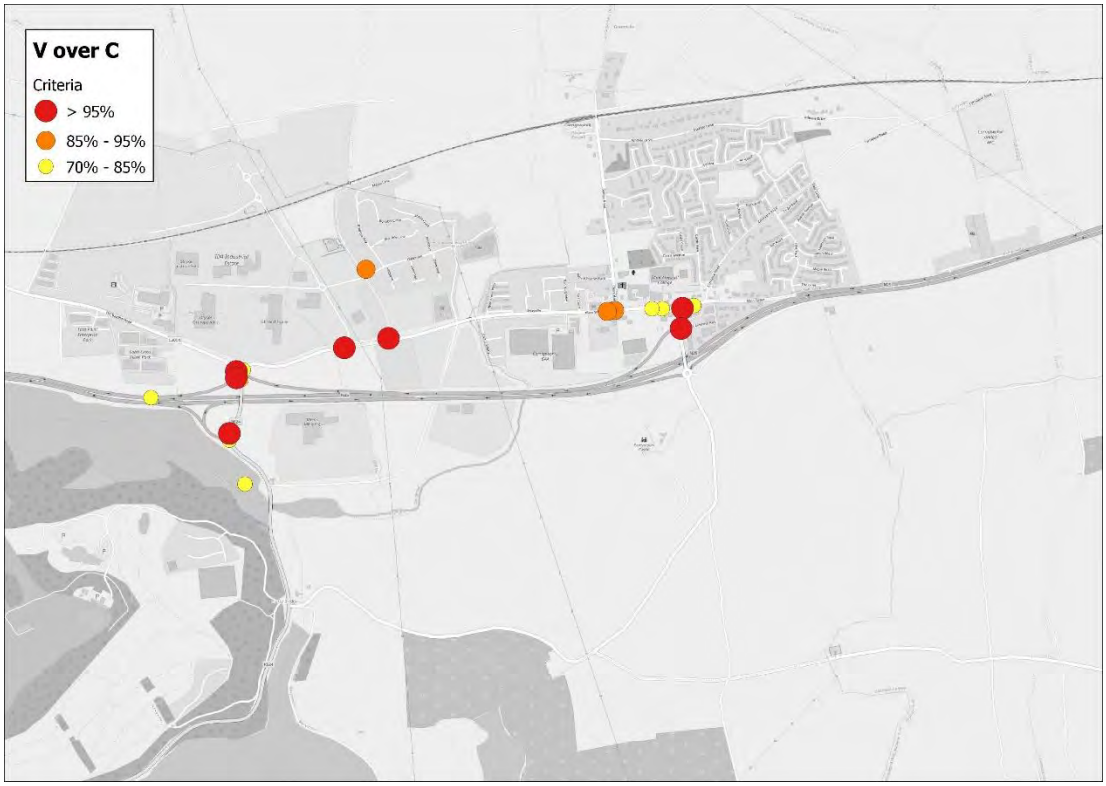


Figure 9-8 PM Peak (17:00 to 18:00) V/C Analysis – Do-Something Carrigtwohill

9.3.10 The figures above illustrate that several junctions (including the Knockgriffin junction, the Lakeview Terrace roundabout, the Cobh Cross interchange and numerous junctions along Carrigtwohill Main St) are operating at over 95% V/C in the PM Do-Minimum Scenario. The issues in the Carrigtwohill area are related to increased traffic generated by proposed developments in the Carrigtwohill UEA and other zoned lands in Carrigtwohill. These issues persist in the Do-Something scenarios, however, in general these junctions are not impacted by the proposed Water Rock development. The impacts on these junctions, and others, resulting from the Phase 1 development are assessed in more detail in Table 9.7 in the following section.

9.3.11 Analysis of the V/C results suggests that full implementation of the Phase 1 development will result in impacts at the following Junctions in the PM Peak:

- **NRR / Avoncore Cottages (Kennel Road) Junction:** (V/C increases from 40% to 100%); and
- **The Junction of Carrigtwohill Main Street and link to N25 Junction 4:** (103% V/C in both scenarios, however a proportion of Water Rock Traffic use this as access route to the N25)
- **Lakeview Roundabout:** (+106% V/C in both scenarios, however a proportion of Water Rock Traffic travels through this junction. The proposed Water Rock development will contribute in the region of 5%-6% of the total volume of traffic at this junction in Phase 1)

9.3.12 With increased traffic volumes trying to access the Water Rock development, traffic on the minor arm of the NRR / Avoncore Cottages (Kennel Road) Junction experiences

increased delays and the V/C on this arm is seen to increase to 99%. There is no significant "rat-running" along Kennel Road observed in this scenario, with the junction of Kennel Rd/ Cork Rd Junction accommodating approximately 20 extra vehicles in both the AM and PM peak periods of the Do-Something Scenario. The Max V/C experienced at this junction is 33%.

9.3.13 In the case of the Carrigtwohill Main Street / N25 link road, increased demand from the Water Rock development will have an impact at this junction, however, this junction will still experience significant delays and queueing in the absence of the Water Rock development as a result of proposals in the Carrigtwohill UEA and surrounding area.

9.3.14 Similarly, traffic generated by Water Rock will have an impact at the Lakeview Roundabout, however, this junction will still experience congestion and queueing prior to the opening of the Water Rock development and in the absence of the Water Rock development.

Demand Flow at Key Junctions

9.3.15 The tables below show a comparison of total demand flows and Max V/C (%) between the DM and DS scenarios at several key junctions to highlight the impact of the Water Rock Development. As with the V/C plots above, the table below shows that certain junctions, including Broderick Street and Station Road, will be operating close to capacity following the development of Phase 1 of Water Rock.

9.3.16 Tables 9.6 and 9.7 also show that the **Knockgriffin Junction** will experience an increase in demand because of the Phase 1 development and associated junction improvements. Examination of the max V/C (%) shows that, with the proposed upgrade (shown in Figure 4.2) of this junction in place, this junction is operating close to capacity in both the AM and PM peak periods (99% and 97% V/C respectively). As a result of the extra capacity provided by the proposed upgrade of this junction, the Max V/C reduces from 103% to 99% in the PM peak. A detailed operational analysis of this junction using microsimulation (outlined in Appendix C) has determined that this level of demand can be accommodated at the junction without queuing impacting adjoining junctions on the network.

9.3.17 The **Carrigane Road** provides an alternative route westbound towards the N25 and Cork city and allows Water Rock traffic to avoid the Knockgriffin Junction. With the Phase 1 development in place, approximately 150 additional vehicles use this route to travel westbound from the Water Rock UEA during the AM peak, thus avoiding congestion at Knockgriffin Junction and the NRR.

9.3.18 There will be an increase in traffic flows along the **Water Rock Road** in both the AM and PM peak for the Do-something scenario. In the AM peak there will be an additional 129 vehicles using this road while in the PM peak there will be an additional 131 vehicles using the road.

9.3.19 The Table below also indicates that the **Lakeview Roundabout** already operates at capacity during the peak periods, and therefore experiences similar volumes of traffic in both the DM and DS scenarios. The proposed Water Rock development will contribute in the region of 5%-6% of the total volume of traffic at this junction in Phase 1. The max V/C (%) experienced at the junction is similar in both the Do-Something and Do-Minimum Scenario.

Table 9-6 AM Peak (07:45 to 08:45) Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Knockgriffin	1976	2390	**21%**	97%	99%	2%
Lakeview Roundabout	3610	3629	5%	104%	103%	-1%
Broderick St / Main St	1466	1458	5%	89%	**95%**	7%
Station Rd / Main St Carrigtwohill	1272	1281	2%	95%	**100%**	5%
NRR/R626	1647	1685	8%	82%	75%	-7%
Midleton Gyratory	1869	1995	6%	66%	64%	-3%
Castle Rock (Baneshane) on/off Roundabout	1427	1672	**21%**	90%	**96%**	6%
NRR / Avoncore Cottages (Kennel Road)	1165	1748	**41%**	36%	77%	41%
N25/Youghal Rd Slip	1903	1910	3%	68%	70%	2%
Carrigane Rd/Water Rock Rd	353	484	**51%**	14%	24%	10%
Carrigtwohill Main St/N25 J4 junction	1282	1372	9%	81%	80%	-1%
Cobh Cross Roundabout	2850	2838	2%	105	105	0%

Table 9-7 PM Peak (17:00 to 18:00) Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Knockgriffin	1981	2531	**23%**	103%	99%	-4%
Lakeview Roundabout	3547	3665	6%	109%	106%	-3%
Broderick St / Main St	1178	1175	**13%**	92%	**95%**	3%

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Station Rd / Main St Carrigtwohill	1427	1430	1%	93%	94%	0%
NRR/R626	1381	1676	**16%**	68%	75%	7%
Midleton Gyratory	2249	2235	11%	73%	83%	10%
Castle Rock (Baneshane) on/off Roundabout	1075	1275	18%	36%	70%	34%
NRR / Avoncore Cottages (Kennel Road)	922	1898	**56%**	40%	**100%**	60%
N25/Youghal Rd Slip	1942	1953	8%	100%	98%	-2%
Carrigane Rd/Water Rock Rd	404	525	**46%**	17%	13%	-4%
Carrigtwohill Main St/N25 J4 junction	1293	1297	2%	103%	103%	-1%
Cobh Cross Southern Roundabout	2559	2544	2%	101%	100%	-1%

9.4 Phase 1 Impact Summary

9.4.1 As outlined in the sections above, The Water Rock Local Area Model indicates that the following junctions will begin to operate close to, or over, capacity following the inclusion of Water Rock Phase 1 development traffic:

- **Castle Rock (Baneshane) on/off slip roundabout to the N25** (90% v/C increases to 96% V/C with development);
- **the Broderick St/Main St junction** (a max V/C of 92% increases slightly to 95% V/C with development);
- **the Station Rd junction on the Carrigtwohill Main St junction** (95% V/C increases to 100% V/C with development);
- **The NRR / Avoncore Cottages (Kennel Road) Junction** (40% V/C increases to 100% V/C with development in the PM period);
- **Carrigtwohill Main St/N25 J4 junction**; (103 v/c in both scenarios however, additional traffic from Water Rock development uses this junction in DS Scenario).
- **Lakeview Roundabout**; (over 105% v/c in both scenarios, the proposed Water Rock development will contribute in the region of 5%-6% of the total volume of traffic at this junction in Phase 1 in DS Scenario)

9.4.2 Appendix C of this report includes a more detailed operational analysis of Midleton Town Centre using a Vissim Microsimulation model. This micro-simulation analysis demonstrates that the following junctions will operate within capacity and can accommodate the Phase 1 Water Rock Traffic:

- Castle Rock (Baneshane) on/off slip roundabout to the N25; and
- The NRR/ Avoncore Cottages (Kennel Road) Junction

9.4.3 The junction of Broderick St / Main St is not within the Vissim model area, however, the junction is operating at the limit of its capacity but is not over capacity. Therefore, based on the detailed micro-simulation analysis it has been determined that the existing infrastructure upgrade proposals are sufficient to cater for Phase 1 of the proposed Water Rock UEA development, in conjunction with the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, and no further mitigation measures are required in Midleton Town Centre.

Carrigtwohill Junctions

9.4.4 The analysis in this chapter shows that several junctions in the Carrigtwohill area will be over capacity in the Do-Minimum Scenario as a result of development in the Carrigtwohill UEA and other zoned lands in Carrigtwohill. Tables 9.6 and 9.7 demonstrate that the contribution of Water Rock Traffic to these junctions is minimal (~1% to 2%) and therefore no mitigation measures are proposed as part of the Water Rock development.

9.4.5 However, certain junction upgrades at these locations will be required as part of the proposed Carrigtwohill developments. It is recommended that the following mitigation measures are included in conjunction with the Carrigtwohill developments:

- Signalisation of Carrigtwohill Main St/N25 J4 junction (infrastructure proposal Z);
- Signalisation of the Station Rd / Main St Junction in Carrigtwohill (infrastructure proposal X);

9.4.6 Table 9.8 below shows how each of these junctions perform with the above improvements in place and compares the maximum V/C to that of the DM scenario. This table shows that these junctions will operate within capacity with the proposed improvements in place.

N25 Junctions (Lakeview Roundabout)

9.4.7 Analysis contained within this chapter shows that the **Lakeview Roundabout** will experience traffic demand in excess of capacity in both the Do-minimum (without Water Rock) and Do-Something (With Water Rock) Scenarios. In phase 1, it is estimated that Water Rock traffic will contribute approximately 5%-6% of the total traffic at this junction. To improve performance at this junction, the following localised upgrades have been tested using the strategic Local Area Model:

- 2 lanes on all approaches and exits to the Roundabout; and
- 2 circulating lanes on roundabout.

9.4.8 Table 9.8 below shows that these local upgrades are not sufficient to resolve the issues at this junction and a more significant upgrade of the Lakeview Roundabout (likely to include some element of grade separation) would be required to relieve congestion at this location.

Table 9-8 Mitigation Impacts

Junction	AM & PM Max V/C (%)			
	DM	DS	DS + Mitigation	Diff
Station Rd / Main St Carrigtwohill	95%	100%	84%	-16%
Lakeview Roundabout	109%	106%	106%	0%
Carrigtwohill Main St/ N25 J4 Link	103%	103%	56%	-47%

9.5 Phase 1 Summary and Conclusion

Summary

9.5.1 Phase 1 of the Water Rock development includes approximately 1,054 residential units, 10,000 sqm of office space, 2,000 sqm of retail, 500 sqm of leisure space and the opening of a new primary school with 592 students.

9.5.2 This development has been assumed to be accompanied by the same infrastructure proposals assumed for Phase 1A, which includes:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd/ NRR Signalised Junction (infrastructure proposal B);
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C); and
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D).

9.5.3 In addition to the above development it has been assumed that Phase 1 of Water Rock will take place in parallel to the development of other zoned lands in Midleton and Carrigtwohill, including Phase 1 of the Carrigtwohill UEA. The total level of development assumed for these areas includes;

- 2,000 residential units;
- 7,000 Sqm of Office Development;
- 2,500 Sqm of Retail;
- 1,000 Sqm of Leisure; and
- Primary Schools for an additional 2,400 Students

9.5.4 The assumed level of development in our model area, and associated trip generation, therefore represents the worst-case scenario for traffic generation in the area.

9.5.5 The modelling results outlined in this chapter indicate that at Phase 1 of the proposed development several key junctions in the study area will experience high demand, with some of these junctions experiencing levels of V/C of 95% or higher. These junctions are:

- **Castle Rock (Baneshane) on/off slip roundabout to the N25;**
- **the Broderick St/Main St junction;**
- **the Station Rd/Main St junction in Carrigtwohill;**
- **The NRR / Avoncore Cottages (Kennel Road) Junction;**
- **Carrigtwohill Main St/N25 J4 junction; and**
- **Lakeview Roundabout.**

9.5.6 However, detailed analysis of the Midleton Town Junctions, using micro-simulation modelling, revealed that the local transport network can accommodate the extra traffic generated by the Phase 1 development. In addition, the junction of Broderick St / Main St is not within the Vissim model area, however, the junction is operating at the limit of its capacity but is not over capacity. Hence no mitigation measures are proposed at the **Broderick St / Main St**, **NRR / Avoncore Cottages (Kennel Road)** or **Castle Rock (Baneshane) Roundabout Junctions**.

9.5.7 Our analysis also indicates that the junctions of **Station Road / Main St and Main St / N25 Junction 4** in Carrigtwohill experience negligible additional traffic due to the Water Rock Development. However, it is recommended that these junctions are upgraded in tandem with development proposals in Carrigtwohill (infrastructure proposals X and Z).

9.5.8 Additionally, a significant upgrade of the Lakeview Roundabout (likely to include some element of grade separation) would be required to relieve congestion at this location, which is experienced in both the Do-minimum and Do-Something Scenarios. The proposed Water Rock development will contribute in the region of 5%-6% of the total volume of traffic at this junction in Phase 1

9.5.9 The modelling analysis undertaken also identified that the southern roundabout of Cobh cross and several junctions in Carrigtwohill will operate at capacity during peak periods in the Do-Minimum Scenarios. In the Do-Something Scenario (with Water Rock Development in place) the performance of these junctions is comparable to the Do-Minimum Scenario, with Water Rock contributing less than 1% to the total demand through this junction during peak periods.

Conclusions

Modelling results indicate that, with the proposed infrastructure upgrades in place, Phase 1 of the proposed Water Rock UEA development, in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, can be accommodated without significantly impacting the local road network.

10. PHASE 2 – TRANSPORT ASSESSMENT

10.1 Overview

10.1.1 This section presents the results of transport modelling assessment of the impacts of Phase 2 of the proposed Water Rock development on the surrounding transport network.

Land Use Assumptions

10.1.2 For each of the Phases to be tested, land use assumptions have been made, relating to the additional level of housing, employment and education development likely to take place in both Midleton and Carrigtwohill. These assumptions were developed in conjunction with Cork County Council and are aligned to targets set out in the latest planning policy documents. In order to represent a worst-case scenario, the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, is assumed to take place in parallel to the development of the Water Rock UEA.

10.1.3 Table 10.1 below outlines the land use assumptions which have been included in the Phase 2 modelling assessment. It is noted that the realisation of these land use assumptions should be reassessed as development proceeds towards Phase 2. A transport assessment carried out at that stage should be based on actual land use. The Do-minimum excludes Water Rock development but includes the other development. The Do-something includes all development.

Table 10-1 Phase 2 Development

Area	Residential (Units)	Primary (Students)	Secondary (Students)	Office (GFA m^2)	Retail (GFA m^2)	Leisure (GFA m^2)
Water Rock	2001	1104	0	10000	2000	500
Midleton	1224	0	0	0	0	0
Carrigtwohill	2143	2400	400	7000	2500	1000

Do – Minimum Infrastructure Assumptions

10.1.4 In Phase 2, following upgrades are assumed to be in place in both the Do-minimum and Do-something scenarios:

- the junction of **Station Road and Carrigtwohill Main Street** is assumed to be upgraded to a signalised junction in both the Do-Minimum and Do-Something Scenarios (infrastructure proposal X);
- The Lakeview Roundabout is upgraded to include a west-bound slip road on the southern arm as these works are currently planned for implementation in the near future.

Do – Something Infrastructure Assumptions

10.1.5 In addition to the assumptions above, a number of infrastructure assumptions have been assumed to coincide with Phase 2 of Water Rock. These infrastructure proposals are outlined in Table 10.2 and shown previously in Figure 4.2. Each of these measures are assumed to be in place in the Phase 2 Do-Something (with Water Rock development) scenarios only.

Table 10-2 Phase 2 Infrastructure Proposals

Infrastructure Proposals (Phase 2)	
A	Service Corridor Link Road from NRR to Water Rock
B	Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction
C	Traffic Management Measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction
D	New Railway Stop on Cork - Midleton Line
E	Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd
F	Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction)
G	Signalisation of L3617 and Main St Carrigtwohill

10.2 Phase 2 Trip Generation

10.2.1 Table 10.3 below shows the trip generation figures associated with Phase 2 of Water Rock.

Table 10-3 Phase 2 Trip Generation Figures

Area	AM Origin trips	AM Destination trips	PM Origin trips	PM Destination trips
Water Rock	1125	680	916	1270
Midleton	626	258	380	645
Carrigtwohill	1542	884	1165	1716
Total	**3294**	**1822**	**2460**	**3631**

10.3 Phase 2 Highway Impacts

Journey Times along Key Routes

10.3.1 The same journey time routes that were used for validation (shown in Figure 5.8) have been used for the purposes of this analysis.

10.3.2 Tables 10.4 and 10.5 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Minimum journey times with the Do-Something Phase 2 journey times to determine the impacts that the proposed LAP development will have on travel times in the study area.

Table 10-4 AM Peak (07:45 to 08:45) – Journey Times

Route	DM	DS	Difference
Route 1 NB	689	764	11%
Route 1 SB	779	916	18%
Route 2 EB	427	427	0%
Route 2 WB	586	595	2%
Route 3 NB	540	533	-1%
Route 3 SB	569	657	15%
Route 4 NB	182	188	3%
Route 4 SB	207	359	73%

Table 10-5 PM Peak (17:00 to 18:00) – Journey Times

Route	DM	DS	Difference
Route 1 NB	801	868	8%
Route 1 SB	755	885	17%
Route 2 EB	644	626	-3%
Route 2 WB	416	426	2%
Route 3 NB	538	571	6%
Route 3 SB	579	635	10%
Route 4 NB	226	291	29%
Route 4 SB	192	295	54%

10.3.3 Table 10.4 above shows that, in the AM peak, the development of the area up to Phase 2 will lead to increases in Journey times along several routes and in particular along Route 4 in the Southbound direction along the NRR (a 73% increase). This increase is caused by traffic from the development trying to access the N25. Similarly, increases of up to 18% were observed on the Carrigane Road (Route 1) because of increased traffic from the proposed development. Westbound traffic on this route increases from circa 280 vehicles in the Do-Minimum Scenario to 490 vehicles in the Do-Something Scenario during the AM peak hour.

10.3.4 Table 10.5 shows that, in the PM peak, similar increases in journey times are observed, with Route 4 along the NRR in the southbound direction experiencing a 54% increase in the Southbound direction.

AM V/C Analysis

10.3.5 Figures 10.2 – 10.5 illustrate the results of the V/C analysis for the AM Do-Minimum and Do-Something Scenarios respectively.

Figure 10-1 AM Peak (07:45 to 08:45) V/C Analysis – Do-Minimum Midleton

Figure 10-2 AM Peak (07:45 to 08:45) V/C Analysis – Do-Something Midleton

Figure 10-3 AM Peak (07:45 to 08:45) V/C Analysis – Do-Minimum Carrigtwohill

Figure 10-4 AM Peak (07:45 to 08:45) V/C Analysis – Do-Something Carrigtwohill

10.3.6 The figures above illustrate that several junctions (including the Knockgriffin junction, the Lakeview Terrace Roundabout and the Cobh Cross interchange) are operating at over 95%

V/C in the AM Do-minimum Scenario. These issues persist in the Do-Something scenarios, Table 10.6 below demonstrates the level of impact the proposed development will have at these locations.

10.3.7 In the AM Peak, V/C at the Kennel Road Junction (NRR / Avoncore Cottages) increases from 29% to 92% with the Water Rock Development in place. During this time-period, the changes to the Knockgriffin Junction (banned right turn from Cork Road) and delays on the NRR lead to some increased demand at the Cork Road/ Kennel Road junction. The model indicates there will be 160 (an additional 115) vehicles travelling Southbound on Kennel Road at this location. The majority of these vehicles turn right onto Cork Road. Similarly, the model indicates there will be approximately 60 (an additional 30) vehicles travelling northbound on Kennel Road in the AM peak. The maximum V/C experienced at the Cork Rd/ Kennel Rd junction in the Do-Something AM peak for this Phase is 43%.

10.3.8 With the full implementation of Phase 2 of Water Rock several junctions, which were operating with some spare capacity in the DM scenario, experience demand in excess of capacity during the AM Peak period. These junctions are:

- **The Broderick St/Main St Junction** (89% V/C increases to 101% V/C with development in the AM)
- **The Station Rd/Main St Junction in Carrigtwohill** (89% V/C increases to 98% V/C with development in the AM)
- **The Castle Rock (Baneshane) Roundabout** (94% V/C increases to 96% V/C with development in the AM)

10.3.9 Figures 10.6 – 10.9 below show the V/C analysis for the Do-Minimum and Do-Something PM peak hour scenarios.

Figure 10-5 PM Peak (17:00 to 18:00) V/C Analysis – Do-Minimum Midleton

Figure 10-6 PM Peak (17:00 to 18:00) V/C Analysis – Do-Something Midleton

Figure 10-7 PM Peak (17:00 to 18:00) V/C Analysis – Do-Minimum Carrigtwohill

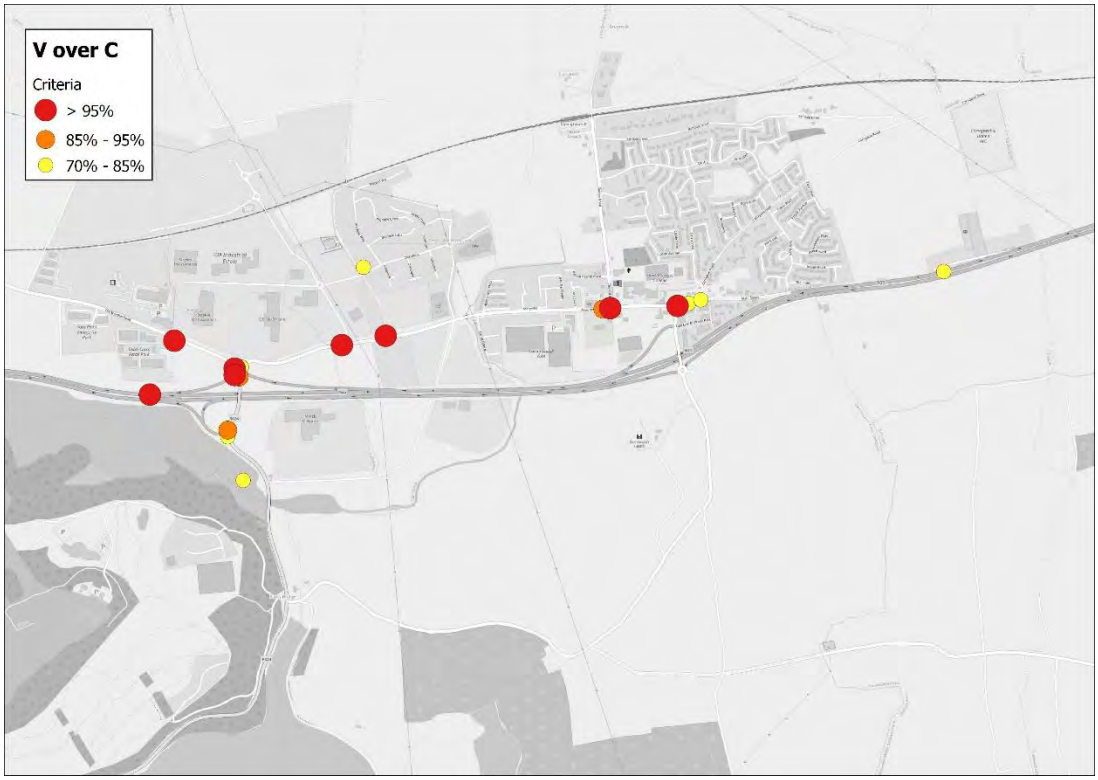


Figure 10-8 PM Peak (17:00 to 18:00) V/C Analysis – Do-Something Carrigtwohill

10.3.10 The figures above illustrate that several junctions (including the Knockgriffin junction, the Lakeview Terrace Roundabout, the Cobh Cross interchange and numerous junctions along Carrigtwohill Main St) are operating at over 95% V/C in the PM Do-Minimum Scenario. The issues in the Carrigtwohill area are largely related to increased traffic generated by proposed developments in the Carrigtwohill UEA and other zoned lands in Carrigtwohill.

10.3.11 In the PM Peak, the V/C at the Kennel Road Junction with the NRR increases from 43% to 101% with the Water Rock Development in place. During this time-period, the changes to the Knockgriffin Junction (banned right turn from Cork Road) and delays on the NRR will lead to some minor changes in traffic demand at the Cork Road/ Kennel Road junction where the model indicates there will be an additional 40 vehicles travelling Southbound (70 in total) on Kennel Road, most of which turn right onto Cork Road. Similarly, the model indicates that there will be a total of 50 vehicles travelling northbound at this location, a slight reduction on the Do-Minimum Scenario. The maximum V/C experienced in the Do-Something PM peak for this Phase is 28%.

10.3.12 The level of impact the Water Rock development traffic has at key junctions in the study area is analysed in further detail in Table 10-6 below.

10.3.13 Analysis of the V/C results suggests that full implementation of Phase 2 of Water Rock will result in impacts at the following Junctions:

- **The Broderick St/Main St Junction** (91% V/C increases to 98% V/C with development in the PM)
- **The Nordic Enterprise Park Roundabout on NRR** (46% V/C increases to 96% V/C with development in the PM)
- **The NRR/Avonmore Cottages (Kennel Road) Junction** (43% V/C increases to 101% V/C with development in the PM); and
- **The Junction of Carrigtwohill Main Street and link to N25 Junction 4:** (103% V/C in both scenarios, however, a proportion of Water Rock traffic will use this as an access route to the N25 in the DS scenario. The proposed Water Rock development will contribute approximately 10% of the total traffic at this junction during the AM peak and no more than 1% of the total volume of traffic at this junction during the PM peak in Phase 2.

Demand Flow at Key Junctions

10.3.14 The table below compares demand flows between the DM and DS scenarios at several key junctions, highlighting the impact of the Water Rock Development. These results show that the Knockgriffin junction, the Carrigane Rd/Water Rock Rd junction, Midleton Gyratory and the NRR/R626 junction (in the PM peak) all experience considerable increases in traffic with the Water Rock Phase 2 Development in place.

10.3.15 This increase in demand flow results in some of these junctions operating over capacity. Most notably, the Knockgriffin junction, which is upgraded in the Do-Something Scenario, is significantly over capacity in the AM Peak period. Similarly, the Station Road / Main St. junction in Carrigtwohill (which is signalised in both DM and DS Scenarios) experiences an increase in V/C in the AM period, with the addition of the Water Rock development traffic. As a result, these junctions are likely to experience heavy delays and queuing with the introduction of Phase 2 Water Rock.

10.3.16 There will be an increase in traffic flows along the **Water Rock Road** in both the AM and PM peak for the Do-something scenario. In the AM peak there will be an additional 271 vehicles using this road while in the PM peak there will be an additional 358 vehicles using the road.

Knockgriffin Junction

10.3.17 Tables 9.6 and 9.7 show that the **Knockgriffin Junction** will experience an increase in demand because of the Phase 2 development. Examination of the max V/C (%) shows that, even with the proposed upgrade of this junction in place, this junction is likely to be over capacity in both the AM and PM peak periods (104% and 100% V/C respectively). Microsimulation analysis of this junction, detailed in the Water Rock Vissim Modelling Report in Appendix C, also indicates that the Phase 2 level of development will result in significant queuing and delays at this junction (and others in Midleton Town Centre), particularly in the pm peak.

10.3.18 The Carrigane Road provides an alternative route westbound towards the N25 and Cork city and allows Water Rock traffic to avoid the Knockgriffin Junction. With the Phase 2 development in place, approximately 225 additional vehicles use this route to travel westbound from the Water Rock UEA during the AM peak, thus avoiding congestion at Knockgriffin Junction and the NRR.

Lakeview Roundabout

10.3.19 The Table below also indicates that the **Lakeview Roundabout** already operates at capacity during the peak periods, and therefore experiences similar volumes of traffic in both the DM and DS scenarios. The proposed Water Rock development will contribute 5%- 8% of the total volume of traffic at this junction in Phase 2.

Table 10-6 AM Peak (07:45 to 08:45) Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Knockgriffin	2066	2446	**32%**	98%	**104%**	6%
Lakeview Roundabout	3735	3749	5%	105%	105%	0%
Broderick St / Main St	1494	1484	4%	89%	**101%**	12%
Station Rd / Main St Carrigtwohill	1358	1469	2%	89%	**98%**	10%
NRR/R626	1761	1763	11%	80%	80%	-1%
Midleton Gyratory	1932	2226	12%	68%	83%	15%

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Castle Rock (Baneshane) on/off Roundabout	1577	1820	32%	90%	**96%**	6%
NRR / Avoncore Cottages (Kennel Road)	1226	2056	57%	40%	90%	50%
N25/Youghal Rd Slip	1998	1935	5%	81%	75%	-6%
Carrigane Rd/Water Rock Rd	431	660	7%	15%	72%	57%
Carrigtwohill Main St/N25 J4 junction	1515	1567	10%	90%	89%	-1%
Nordic Enterprise Roundabout (NRR)	1158	2249	61%	68%	79%	10%
Cobh Cross South Rdbt	2955	2917	4%	107%	106%	-1%
Cobh Cross WB N25 Merge	3652	3681	8%	96%	98%	+2%

Table 10-7 PM Peak (17:00 to 18:00) Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Knockgriffin	2033	2496	**32%**	99%	100%	1%
Lakeview Roundabout	3643	3733	8%	109%	108%	-1%
Broderick St / Main St	1189	1234	**15%**	91%	**98%**	7%
Station Rd / Main St Carrigtwohill	1219	1229	1%	99%	100%	0%
NRR/R626	1518	1934	**28%**	68%	**90%**	22%
Midleton Gyratory	2224	2525	**20%**	77%	**93%**	16%

Junction	Demand Flows			Max V/C (%)		
	DM	DS	% Water Rock	DM	DS	Diff
Castle Rock (Baneshane) on/off Roundabout	1184	1222	27%	79%	66%	-12%
NRR / Avoncore Cottages (Kennel Road)	960	2065	**65%**	43%	**101%**	58%
N25/Youghal Rd Slip	1983	1995	**13%**	100%	96%	-4%
Carrigane Rd/Water Rock Rd	460	683	19%	19%	58%	39%
Carrigtwohill Main St/N25 J4 junction	1483	1378	1%	104%	102%	-2%
Nordic Enterprise Roundabout (NRR)	920	2610	**72%**	46%	**96%**	51%
Cobh Cross South Rdbt	2717	2724	2%	92%	91%	-1%
Cobh Cross WB N25 Merge	1947	1928	3%	41%	41%	0%

10.4 Phase 2 Impact Summary

10.4.1 As outlined above, certain junctions begin to operate close to, or over, capacity when Phase 2 of Water Rock is fully developed. Furthermore, the development traffic will contribute to demand at some junctions operating at capacity in the Do-Minimum Scenario. This will result in marked increases in delays and queuing at the junctions impacted, which include the following:

- **Castle Rock (Baneshane) on/off slip roundabout to the N25** (90% v/C increases to 96% V/C with development);
- **the Broderick St/Main St junction** (91% V/C increases to 98% V/C with development);
- **The Nordic Enterprise Park Roundabout on NRR** (46% V/C increases to 96% V/C with development in the PM);
- **The NRR / Avoncore Cottages (Kennel Road) Junction** (40% V/C increases to 104% V/C with development in the PM period);
- **Carrigtwohill Main St/N25 J4 junction**; (102+% v/c in both scenarios however, a proportion of Water Rock traffic will use this as an access route to the N25 in the DS Scenario). The proposed Water Rock development will contribute approximately 10% of the total volume of traffic at this junction During the AM peak and 1% during the PM peak in Phase 2.

10.4.2 **Lakeview Roundabout**; (over 105% v/c in both scenarios, however, additional traffic from Water Rock development use this junction in DS Scenario. The proposed Water Rock development will contribute 5%-8% of the total volume of traffic at this junction in Phase 2)The Water Rock Vissim Modelling Report includes a detailed operational analysis of Midleton Town Centre using a Vissim micro-simulation model. This micro-simulation analysis confirms that the proposed Phase 2 level of development cannot be accommodated on the local road network, particularly in the pm peak, and significant queues and delays are experienced, including at the following junctions, suggesting further mitigation measures are required for the Phase 2 level of development:

- Broderick St / Main Street Junction;
- Nordic Enterprise Park Roundabout on the Northern Relief Road;
- The NRR/ Avoncore Cottages (Kennel Road) Junction
- Knockgriffin junction
- Midleton Gyratory
- Mill Road/Northern Relief Road junction

10.4.3 Therefore, the following local mitigation measures were tested at the above locations:

- Signalisation of the Broderick St/ Midleton Main St Junction;
- Extension of Flare Lanes on Nordic Enterprise Park Roundabout on NRR; and
- Signalisation of the NRR/ Avoncore Cottages (Kennel Road) junction;

10.4.4 Table 10.8, below, shows that while the above mitigations measures will result in some improvement at these junctions, both the Broderick St / Main St and NRR / Avoncore Cottages (Kennel Road) junctions will operate at over 95% V/C, which will likely result in significant residual impacts at these locations.

10.4.1 Furthermore, the Knockgriffin junction, which is operating over capacity in Phase 2, is assumed to have been upgraded in Phase 1A and therefore no further mitigation measures have been proposed at this location. As evidenced in the microsimulation analysis, over capacity queuing at this location in Phase 2 will result in blocking back to adjoining junctions, creating significant impacts on the local road network in Midleton.

Table 10-8 Impact of proposed Mitigation Measures

Junction		AM & PM Max V/C (%)		
	DM	DS	DS+ Mitigation	Diff
Broderick St / Main St	89%	101%	**95%**	-6%
Nordic Enterprise Roundabout (NRR)	46%	96%	84%	-12%
NRR / Avoncore Cottages (Kennel Road)	43%	101%	**96%**	-5%
Carrigtwohill Main St/ N25 J4 Link	103%	102%	77%	-25%

Junction		AM & PM Max V/C (%)		
	DM	DS	DS+ Mitigation	Diff
Lakeview Roundabout	109%	108%	108%	0%

Carrigtwohill Junctions

10.4.2 The analysis in this chapter shows that several junctions in the Carrigtwohill area will be over capacity in the Do-Minimum Scenario because of development in the Carrigtwohill UEA and other zoned lands in Carrigtwohill. Tables 10.6 and 10.7 demonstrate that the contribution of Water Rock Traffic to these junctions is minimal (~1% to 2%) and therefore no mitigation measures are necessary as part of the Water Rock development.

10.4.3 However, certain junction upgrades at these locations will be required as part of the mitigation of proposed Carrigtwohill developments. It is recommended that the **Signalisation of Carrigtwohill Main St/N25 J4 junction** is included in tandem with development proposals in Carrigtwohill (infrastructure proposal Z).

10.4.4 Table 10.8 shows that this junction will operate within capacity with the proposed upgrades in place.

N25 Junctions

10.4.5 Analysis contained within this chapter shows that the **Lakeview Roundabout** will experience traffic demand in excess of capacity in both the Do-minimum (without Water Rock) and Do-Something (with Water Rock) Scenarios. In phase 2, it is estimated that Water Rock traffic will contribute approximately 5%-8% of the total traffic at this junction. To improve performance at this junction, the following localised upgrades have been tested using the strategic Local Area Model:

- 2 lanes on all approaches and exits to the Roundabout; and
- 2 circulating lanes on roundabout.

10.4.6 Table 10.8 shows that these local upgrades are not sufficient to resolve the issues at this junction and a more significant upgrade of the Lakeview Roundabout (likely to include some element of grade separation) would be required to relieve congestion at this location in the Phase 2 scenario.

10.4.7 The V/C analysis within this chapter highlighted that a number of junctions at **Cobh Cross Interchange** will be close to capacity in phase 2. This is primarily due to the additional development at Carrigtwohill. However, traffic from Water Rock will contribute 8% of the total demand at the N25 Mainline / Westbound merge junction. Modelling results from Phase 3 (discussed in the following chapter) indicate that for this level of development to be accommodated, a large-scale upgrade of the interchange and N25 mainline will be required.

10.5 Phase 2 Summary and Conclusions

Summary

10.5.1 Phase 2 of the Water Rock development includes approximately 2,000 residential units, 10,000 sqm of office space, 2,000 sqm of retail, 500 sqm of leisure space and the opening of two new primary schools with 1,104 students.

10.5.2 This development has been assumed to be accompanied by the following infrastructure proposals:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd/ NRR Signalised Junction (infrastructure proposal B;
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C);
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D);
- Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd (infrastructure proposal E);
- Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction) (infrastructure proposal F);
- Signalisation of L3617 and Main St Carrigtwohill (infrastructure proposal G; and
- Signalisation of Station Road junction in Carrigtwohill (infrastructure proposal X).

10.5.3 In addition to the above development it has been assumed that Phase 2 of Water Rock will take place in parallel to the development of other zoned lands in Midleton and Carrigtwohill, including Phase 1 of the Carrigtwohill UEA. The total level of development assumed for these areas includes;

- 2,000 residential units;
- 7,000 Sqm of Office Development;
- 2,500 Sqm of Retail;
- 1,000 Sqm of Leisure; and
- Primary Schools for an additional 2,400 Students

10.5.4 The assumed level of development in our model area, and associated trip generation, therefore represents the worst-case scenario for traffic generation in the area.

10.5.5 Modelling results indicate that, prior to the introduction of Phase 2 of the Water Rock, the assumed Do-Minimum level of development will result in several key junctions in the study area operating close to, or over, capacity. Most notably, several junctions in the Carrigtwohill area, including the N25 Cobh Cross interchange, will be operating at capacity. Similarly, key junctions in Midleton, such as the Knockgriffin Junction and Lakeview Roundabout will be over-capacity prior to the addition of Phase 2 development traffic.

10.5.6 The introduction of the Phase 2 Development, and associated infrastructure proposals, will lead to a significant increase in demand at several junctions in the study area, with some of these junctions experiencing levels of V/C of 95% or higher as a result. These junctions are:

- **Knockgriffin Junction** (98% V/C increases to 104%);

- **Castle Rock (Baneshane) on/off slip roundabout to the N25** (90% v/C increases to 96% V/C with development);
- **the Broderick St/Main St junction** (89% V/C increases to 101% V/C with development);
- **the Station Rd junction on the Carrigtwohill Main St junction** (95% V/C increases to 100% V/C with development);
- **The Nordic Enterprise Park Roundabout on Midleton Northern Relief Road** (46% V/C increases to 96% V/C with development in the PM);
- **The NRR / Avoncore Cottages (Kennel Road) Junction** (40% V/C increases to 100% V/C with development in the PM);
- **Carrigtwohill Main St/N25 J4 junction**; (102+ v/c in both scenarios however, additional traffic from Water Rock development uses this junction in the Do Something Scenario. The proposed Water Rock development will contribute approximately 10% of the total volume of traffic at this junction During the AM peak and 1% during the PM peak in Phase 2
- **Lakeview Roundabout**; (over 105% v/c in both scenarios, however, additional traffic from Water Rock development uses this junction in DS Scenario. The proposed Water Rock development will contribute 5%-8% of the total volume of traffic at this junction in Phase 2)

10.5.7 These issues also lead to some significant increases in journey times through the study area, most notably southbound on the NRR which experiences an increase in delay of over 70% as a result of congestion at the Knockgriffin Junction.

10.5.8 With the introduction of localised mitigation measures, residual traffic impacts will remain at several junctions, which is likely to result in significant delays and queueing throughout the local road network.

10.5.9 Additionally, a significant upgrade of the N25 and Lakeview Roundabout (likely to include some element of grade separation) would be required to relieve congestion at this location in the Phase 2 scenario.

Conclusions

The results presented in this Chapter indicate that the full implementation of Phase 2 of the proposed Water Rock UEA development, in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, cannot be accommodated without considerable upgrades to the transport network. These include an upgrade of the N25/Cobh Cross interchange, a new N25 interchange east of Carrigtwohill, the completion of the NRR Phase 2 and 3 and an upgrade of the Midleton Gyratory (to relieve town centre congestion) and additional improvements to the Knockgriffin and Lakeview Roundabout Junctions. These proposals are assessed in further detail in the following chapter (Phase 3 Transport Assessment).

11. PHASE 3 – TRANSPORT ASSESSMENT

11.1 Overview

11.1.1 This section presents the results of transport modelling assessment of the impacts of Phase 3 of the proposed Water Rock development on the surrounding transport network.

Land Use Assumptions

11.1.2 For each of the Phases to be tested, land use assumptions have been made, relating to the additional level of housing, employment and education development likely to take place in both Midleton and Carrigtwohill. These assumptions were developed in conjunction with Cork County Council and are aligned to targets set out in the latest planning policy documents. In order to represent a worst-case scenario, the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, is assumed to take place in parallel to the development of the Water Rock UEA.

11.1.3 Table 11.1 below outlines the land use assumptions which have been included in the Phase 3 modelling assessment. The Do-minimum excludes Water Rock development but includes the other development. The Do-something includes all development.

Table 11-1 Phase 3 Development

Area	Residential (Units)	Primary (Students)	Secondary (Students)	Office (GFA m^2)	Retail (GFA m^2)	Leisure (GFA m^2)
Water Rock	2483	1104	1000	10000	2000	500
Midleton	2613	0	0	0	0	0
Carrigtwohill	4032	2800	1000	7000	2500	1000

Do Minimum Infrastructure Assumptions

11.1.4 As in Phase 2, the junction of Station Road and Carrigtwohill Main Street is assumed to be upgraded to a signalised junction in both the Do-Minimum and Do-Something Scenarios for Phase 3. Similarly, an additional west-bound slip road has been added to the southern arm of the Lakeview Roundabout as these works are currently planned for implementation in the near future.

11.1.5 In addition to this, the following infrastructure proposals have been assumed to be in place in both the Do-Minimum and Do-Something Scenarios for Phase 3:

- **The junction of Station Road and Carrigtwohill Main Street is assumed to be upgraded to a signalised junction (infrastructure proposal X);**
- **Upgrade of Cobh Cross / N25 Interchange (part of N25 Upgrade) (infrastructure proposal Y)**;

- **Additional N25 Interchange east of Carrigtwohill (part of N25 Upgrade) (infrastructure proposal M);**
- **Midleton NRR phases 2 + 3 (infrastructure proposal I);** and
- **Upgrade of Midleton Gyratory (infrastructure proposal L).** This has been modelled by adding additional capacity (flare lanes, etc.) where possible to the approaches to the roundabout and optimising the signals.

Do Something Infrastructure Assumptions

11.1.6 In addition to the assumptions above, a number of infrastructure proposals have been assumed to coincide with Phase 3 of Water Rock. These infrastructure proposals are outlined in Table 11.2 and shown previously in Figure 4.2. Each of these measures are assumed to be in place in the Phase 3 Do-Something (with Water Rock development) scenarios only.

Table 11-2 Phase 3 Infrastructure Proposals

Infrastructure Proposals (Phase 3)	
A	Service Corridor Link Road from NRR to Water Rock
B	Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction
C	Traffic Management Measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction
D	New Railway Stop on Cork - Midleton Line
E	Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd
F	Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction)
G	Signalisation of L3617 and Main St Carrigtwohill
H	Link rd over Railway + distributor connecting Midleton NRR to Water Rock
J	Upgrade Carrigane Road (single carriageway standard)
K	Upgrade of the junction at Mill Rd / NRR
Z	Signalisation of Carrigtwohill Main St / N25 access road (junction on corner of Costcutter)

11.2 Phase 3 Trip Generation

11.2.1 Table 11.3 below shows the final trip generation figures associated with Phase 3 of Water Rock.

Table 11-3 Phase 2 Trip Generation Figures

Area	AM Origin trips	AM Destination trips	PM Origin trips	PM Destination trips
Water Rock	1410	838	1068	1516
Midleton	1336	550	802	1361
Carrigtwohill	2232	1207	1559	2377
Total	**4979**	**2595**	**3428**	**5253**

11.3 Phase 3 Highway Impacts

Journey Times along Key Routes

11.3.1 The same journey time routes that were used for validation (shown in Figure 5.8) have been used for the purposes of this analysis.

11.3.2 Tables 11.4 and 11.5 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Minimum and Do-Something Phase 3 scenario to determine the impacts of the proposed Water Rock Development.

Table 11-4 AM – Journey Times

Route	DM (Seconds)	DS (Seconds)	Difference
Route 1 NB	815	770	-6%
Route 1 SB	799	827	4%
Route 2 EB	428	427	0%
Route 2 WB	502	502	0%
Route 3 NB	534	528	-1%
Route 3 SB	565	580	3%
Route 4 NB	191	195	2%
Route 4 SB	203	266	31%

Table 11-5 PM – Journey Times

Route	DM (Seconds)	DS (Seconds)	Difference
Route 1 NB	882	843	-4%
Route 1 SB	819	815	0%
Route 2 EB	767	666	-13%
Route 2 WB	372	383	3%
Route 3 NB	537	549	2%
Route 3 SB	581	596	3%
Route 4 NB	244	216	-11%
Route 4 SB	179	201	12%

11.3.3 Table 11.4 above shows that, in the AM and PM peaks, the development of the area up to Phase 3 causes minimal journey time impacts when compared to the Do-Min scenario on all routes except Route 4 Southbound (31% increase). This increase is caused by development traffic travelling southbound along the NRR, through Knockgriffin Junction, and accessing the N25.

AM V/C Analysis

11.3.4 Figures 11.1 – 11.5 illustrate the results of this V/C analysis for the AM Do-Minimum and Do-Something Scenarios respectively.

Figure 11-1 AM V/C Analysis – Do-Minimum Midleton

Figure 11-2 AM V/C Analysis – Do-Something Midleton

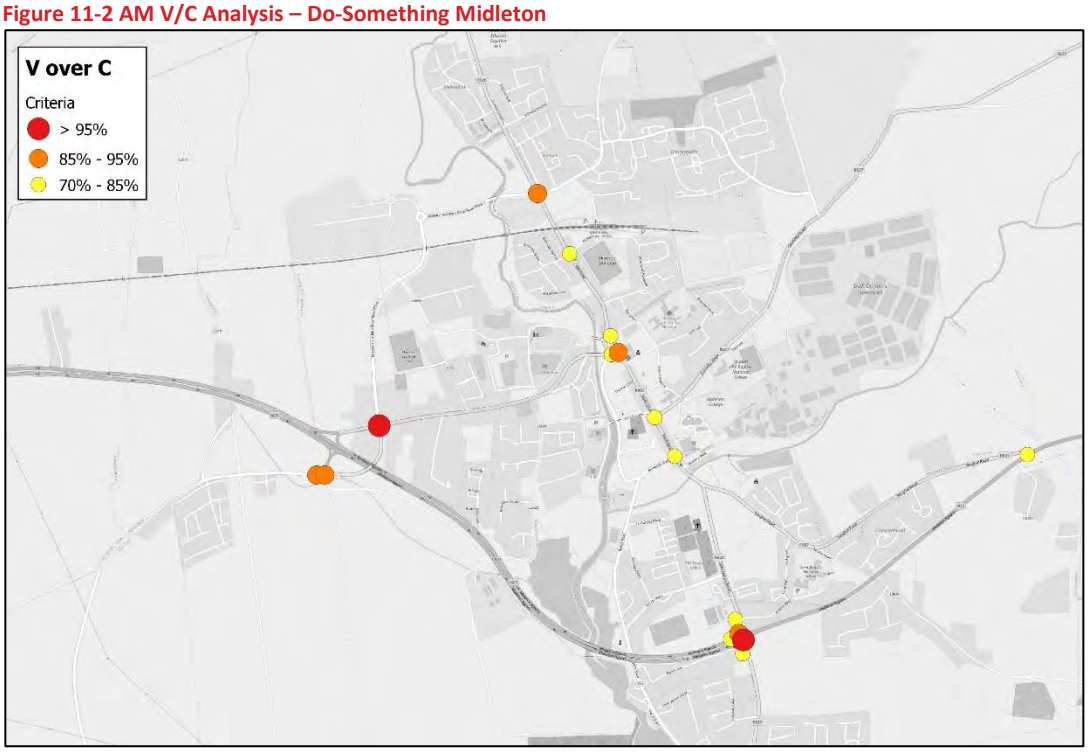


Figure 11-3 AM V/C Analysis – Do-Minimum Carrigtwohill

Figure 11-4 AM V/C Analysis – Do-Something Carrigtwohill

11.3.5 The figures above illustrate that several junctions (including the Knockgriffin junction, and the Lakeview Terrace roundabout) are operating at over 95% V/C in the AM Do-minimum

Scenario. These issues also persist in the Do-Something scenarios. The impact of the proposed development on these, and other key junctions in the study area, is detailed in Table 12.6.

11.3.6 In the AM Peak, the V/C at the Kennel Road Junction (NRR / Avoncore Cottages) increases from 25% to 66% with the Water Rock Development in place. During this time-period, the changes to the Knockgriffin Junction (banned right turn from Cork Road) and delays on the NRR lead to some increased demand at the Cork Road/ Kennel Road Junction. The model indicates there will be an additional 80 vehicles (120 in total) travelling Southbound on Kennel Road (most which turn right onto Cork Road) at this location during the AM peak hour. Similarly, there will be approximately 35 additional vehicles (65 total) travelling northbound. The maximum V/C experienced at the Cork Rd/ Kennel Rd junction in the Do-Something AM peak for this Phase is 34%.

PM V/C Analysis

11.3.7 Figures 12.6 – 12.9 below, show the V/C analysis of the Do-Minimum and Do-Something PM peak hour scenarios

Figure 11-5 PM V/C Analysis – Do-Minimum Midleton

Figure 11-6 PM V/C Analysis – Do-Something Midleton

Figure 11-7 PM V/C Analysis – Do-Minimum Carrigtwohill

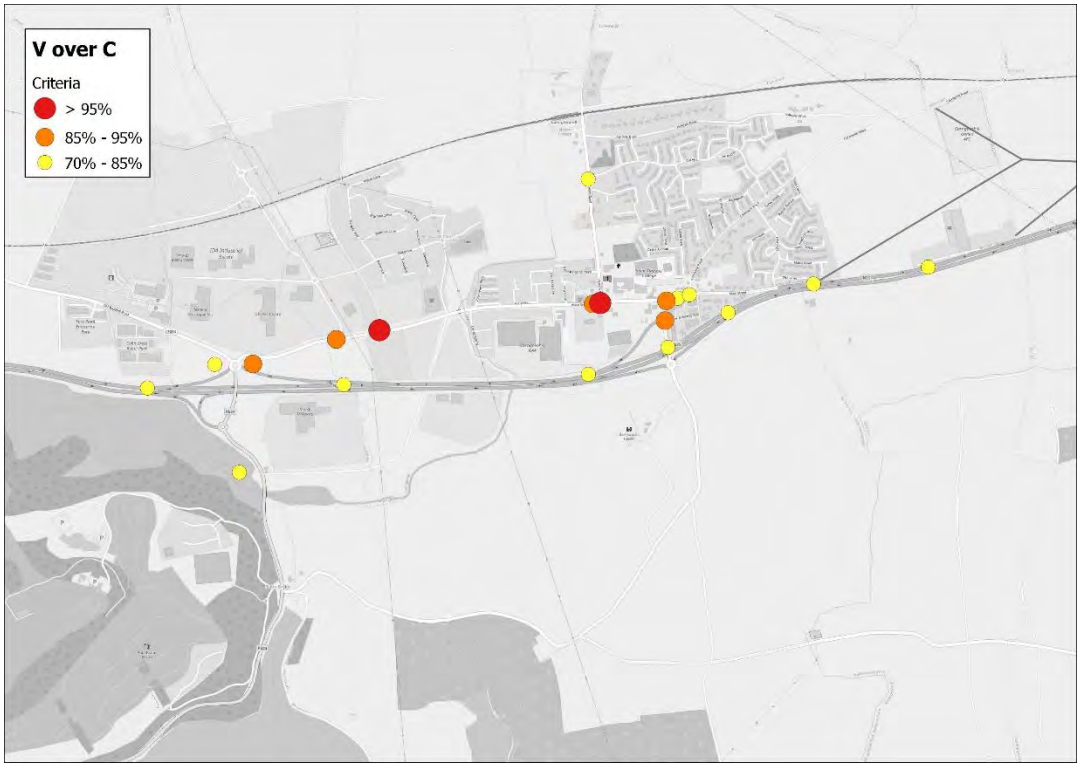
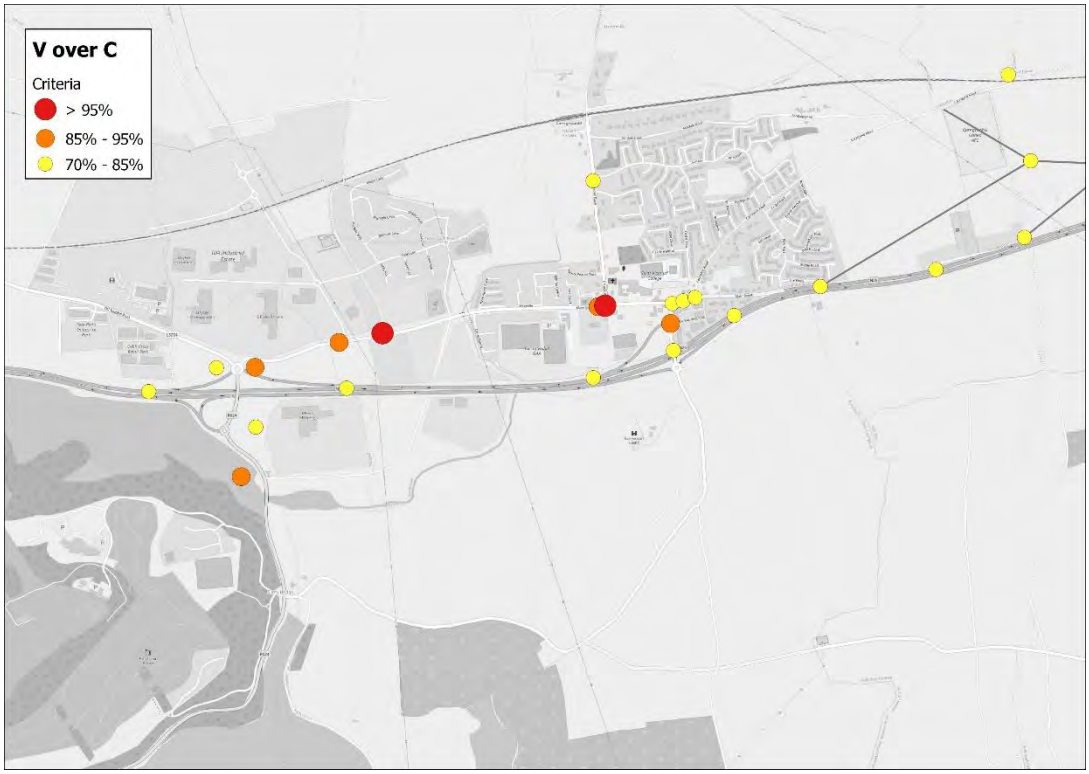


Figure 11-8 PM V/C Analysis – Do-Something Carrigtwohill



11.3.8 The figures above illustrate that several junctions (including the Knockgriffin junction, the Lakeview Terrace roundabout and the Station Rd junction) are operating at over 95% V/C in the PM Do-minimum Scenario. These issues also persist in the Do-Something scenarios. The impacted of the proposed development at these locations is analysed in more detail in Table 12.7 below.

11.3.9 The full implementation of the Phase 3 development will also result in a significant impact at the NRR/Avonmore Cottages (Kennel Road) junction in Midleton, which has a maximum V/C of 45% in the Do Minimum scenario and 102% in the Do Something Scenario. During this time-period, delays at the Kennel Road Junction and changes to the Knockgriffin Junction (banned right turn from Cork Road) do not lead to any significant changes in traffic demand at the Cork Road/ Kennel Road junction where the model indicates there will be an additional 10 vehicles (45 total) travelling Southbound on Kennel Road (most of which turn right onto Cork Road). Similarly, an additional 20 additional vehicles (60 total) travel northbound along Kennel Road at this location. The maximum V/C experienced at the Cork Rd/ Kennel Rd junction in the Do-Something PM peak for this Phase is 35%.

Demand Flow at Key Junctions

11.3.10 The table below shows a comparison of demand flows between the DM and DS scenarios at several key junctions to highlight the impact of the Water Rock Development. The results show that the Knockgriffin junction, Carrigane Rd/Water Rock Rd junction and the NRR/R626 junction (in the PM peak) all experience considerable increases in demand with the Water Rock Phase 3 development in place.

11.3.11 There will be an increase in traffic flows along the Water Rock Road in both the AM and PM peak for the Do-something scenario. In the AM Peak there will be an additional 417

vehicles using this road while in the PM peak there will be an additional 304 vehicles using the road.

Knockgriffin Junction

11.3.12 The Tables below show that the **Knockgriffin Junction** will experience a significant increase in demand because of the Phase 3 development of Water Rock. Examination of the max V/C (%) shows that, with the proposed upgrade of this junction in place, the junction is operating at capacity in both the AM and PM peak periods (100% and 101% V/C respectively). Microsimulation modelling for this junction (detailed in Appendix C) indicates that the junction performs satisfactorily in the AM peak. However, in the PM peak the junction is operating at or just beyond capacity with long average queues and delays on a number of arms. In particular, queueing can build up on the Northern Relief Road northbound, potentially affecting the Castle Rock (Banshane) roundabout and the N25 westbound. The average delay at the junction is 1 minute and 9 seconds, however, which is considered to be generally acceptable.

11.3.13 The Carrigane Road provides an alternative route westbound towards the N25 and Cork city and allows Water Rock traffic to avoid the Knockgriffin Junction. With the Phase 3 development in place, approximately 490 additional vehicles use this route to travel westbound from the Water Rock UEA during the AM peak, thus avoiding congestion at Knockgriffin Junction and the NRR.

Lakeview Roundabout

11.3.14 The Table below also indicates that the **Lakeview Roundabout** already operates over capacity during the peak periods, and therefore experiences similar volumes of traffic in both the DM and DS scenarios. The proposed development will contribute in the region of 6%-9% of the total volume of traffic at this junction in Phase 3.

Table 11-6 AM Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	Water Rock %	DM	DS	Diff
Knockgriffin	2039	2423	**35**%	96%	**100%**	4%
Lakeview Roundabout	3888	3893	6%	105%	105%	0%
Broderick St / Main St	1404	1348	4%	80%	83%	3%
Station Rd / Main St Carrigtwohill	1245	1327	0%	69%	79%	10%
NRR/R626	1952	1902	7%	89%	94%	5%
Midleton Gyratory	1907	2144	10%	82%	87%	5%

Junction	Demand Flows			Max V/C (%)		
	DM	DS	Water Rock %	DM	DS	Diff
NRR / Avoncore Cottages (Kennel Road)	1244	1671	57%	38%	65%	26%
Castle Rock (Baneshane) on/off Roundabout	1646	1937	31%	84%	93%	9%
N25/Youghal Rd Slip	2169	2093	7%	86%	77%	-9%
Carrigane Rd/Water Rock Rd	393	903	60%	12%	78%	66%
Carrigtwohill Main St/N25 J4 junction	1340	1124	1%	88%	67%	-22%
Cobh Cross	3248	3183	1%	67%	79%	12%
Nordic Enterprise Rdbt	1178	2011	63%	73%	62%	-11%

Table 11-7 PM Comparison

Junction	Demand Flows			Max V/C (%)		
	DM	DS	Water Rock %	DM	DS	Diff
Knockgriffin	2191	2779	**26%**	101%	101%	0%
Lakeview Roundabout	3764	3924	**9%**	116%	110%	-6%
Broderick St / Main Street	1110	1118	18%	80%	85%	5%
Station Rd / Main St Carrigtwohill	1183	1184	1%	99%	98%	-1%
NRR/R626	1913	2318	26%	85%	83%	-2%
Midleton Gyratory	2240	2508	17%	92%	93%	1%

Junction	Demand Flows			Max V/C (%)		
	DM	DS	Water Rock %	DM	DS	Diff
NRR / Avoncore Cottages (Kennel Road)	1181	2008	**54%**	45%	**101%**	56%
Castle Rock (Baneshane) on/off Roundabout	1451	1594	20%	72%	74%	2%
N25/Youghal Rd Slip	2172	2102	16%	102%	104%	1%
Carrigane Rd/Water Rock Rd	605	986	50%	35%	74%	39%
Carrigtwohill Main St/N25 J4 junction	1322	1185	1%	87%	84%	-3%
Cobh Cross	3732	3781	3%	88%	92%	4%
Nordic Enterprise Rdbt	1020	2611	63%	43%	88%	44%

11.4 Phase 3 Impact Summary

11.4.1 As outlined above, some junctions in Midleton will begin to operate over capacity as a result of the introduction of Phase 3 of Water Rock. The following localised additional mitigation measures have been devised to improve the operation of these junctions once the proposed development is in place:

- **Signalisation of the NRR / Avoncore Cottages (Kennel Road) junction;**
- **Addition of a new link road from Water Rock UEA to the new N25 parallel access roads linking to the proposed N25 Interchange east of Carrigtwohill, to relieve congestion at the Knockgriffin Junction.**

11.4.2 Table 11.8, below, shows how the above improvements impact the maximum V/C at these junctions.

Table 11-8 Mitigation Impacts

Junction	AM & PM Max V/C (%)			
	DM	DS	DS + Mitigation	Diff
The NRR / Avoncore Cottages (Kennel Road) Junction	43%	102%	85%	-17%
(Knockgriffin Junction): New link road from the Water Rock UEA to the new N25 parallel access roads linking to the proposed N25 Interchange east of Carrigtwohill,	101%	101%	94%	-7%
Lakeview Roundabout	116%	110%	110%	0%

11.4.3 The above table shows that, with the introduction of the proposed additional mitigation measures, the NRR / Avoncore Cottages (Kennel Road) and the Knockgriffin junctions will operate within capacity with the Phase 3 Water Rock development, in conjunction with the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, in place.

N25 Junctions

11.4.4 Analysis contained within this chapter shows that the **Lakeview Roundabout** will experience traffic demand in excess of capacity in both the Do-minimum (without Water Rock) and Do-Something (with Water Rock) Scenarios. In Phase 3, it is estimated that Water Rock traffic will contribute 6% to 9% to the total traffic at this junction. To improve performance at this junction, the following localised upgrades have been tested using the strategic Local Area Model:

- 2 lanes on all approaches and exits to the Roundabout; and
- 2 circulating lanes on roundabout.

11.4.5 Table 11.8 shows that these local upgrades are not sufficient to resolve the issues at this junction and a more significant upgrade of the Lakeview Roundabout (likely to include some element of grade separation) would be required to relieve congestion at this location in the Phase 3 scenario.

11.5 Phase 3 Summary and Conclusions

Summary

11.5.1 Phase 3 of the Water Rock development includes approximately 2,500 residential units, 10,000 sqm of office space, 2,000 sqm of retail, 500 sqm of leisure space and the opening of two new primary schools with 1,104 students and one secondary school with capacity for approximately 1,000 students.

11.5.2 This development has been assumed to be accompanied by the following infrastructure proposals:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd/ NRR Signalised Junction (infrastructure proposal B);
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C);
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D);
- Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd (infrastructure proposal E);
- Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction) (infrastructure proposal F);;
- Signalisation of L3617 and Main St Carrigtwohill (infrastructure proposal G);
- Link rd over Railway + distributor connecting Midleton NRR to N25 (infrastructure proposal H);
- Midleton NRR phases 2 + 3 (infrastructure proposal I);
- Upgrade Carrigane Road (single carriageway standard) (infrastructure proposal J);
- Upgrade of the junction at Mill Rd / NRR (infrastructure proposal K);
- Upgrade Midleton Gyratory (infrastructure proposal L);
- N25 Interchange east of Carrigtwohill (infrastructure proposal M);
- Signalisation of Station Road junction in Carrigtwohill (infrastructure proposal X);
- Cobh Cross / N25 Upgrade (infrastructure proposal Y);
- Signalisation of Carrigtwohill Main St / N25 access road (junction on corner of Costcutter) (infrastructure proposal Z).

11.5.3 In addition to the above development it has been assumed that Phase 3 of Water Rock will take place in parallel to the development of other zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA. The total level of development assumed for these areas includes;

- 4,600 residential units;
- 7,000 Sqm of Office Development;
- 2,500 Sqm of Retail;
- 1,000 Sqm of Leisure;
- Primary Schools for an additional 2,800 Students; and
- Secondary Schools for an additional 1,000 Students

11.5.4 The assumed level of development in our model area, and associated trip generation, therefore represents the worst-case scenario for traffic generation in the area.

11.5.5 Modelling results indicate that, prior to the introduction of Phase 3 of the Water Rock, the assumed Do-Minimum level of development will result in several key junctions in the study area operating over capacity. Most notably, the **Knockgriffin** and **Lakeview Roundabout** will be over-capacity prior to the addition of Water Rock development traffic.

11.5.6 The introduction of the Water Rock Phase 3 development, and associated infrastructure proposals, will lead to increased demand at several junctions in the study area, with some of these junctions experiencing levels of V/C of 95% or higher as a result. These junctions are:

- **Knockgriffin Junction** (96% V/C increases to 101%);

- **The NRR / Avoncore Cottages (Kennel Road) Junction** (43% V/C increases to 102% V/C with development in the PM)

11.5.7 These issues also lead to significant increases in Journey times southbound on the NRR, which experiences an increase in delay of over 31% as a result of congestion at the Knockgriffin Junction.

11.5.8 With the introduction of the following localised additional mitigation measures at the locations above, both junctions operate within capacity in both the AM and PM peak periods;

- **Signalisation of the NRR / Avoncore Cottages (Kennel Road) junction;**
- **Addition of a new link road from Water Rock UEA to the new N25 parallel access roads linking to the proposed N25 Interchange east of Carrigtwohill, to relieve congestion at the Knockgriffin Junction.**

11.5.9 Additionally, a significant upgrade of the Lakeview Roundabout (likely to include some element of grade separation) would be required to relieve congestion when Phase 3 of the Water Rock development, in conjunction with the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, are in place.

Conclusions

The results presented in this Chapter indicate that Phase 3 of the proposed Water Rock UEA development, in conjunction with the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, can be accommodated with considerable upgrades to the transport network. These include an upgrade of the N25/Cobh Cross interchange, a new N25 interchange east of Carrigtwohill, the completion of the NRR Phase 2 and 3 and an upgrade of the Midleton Gyratory (to relieve town centre congestion) and additional improvements to Lakeview Roundabout. In addition, a new link road from Water Rock UEA to the new N25 parallel access roads linking to the proposed N25 Interchange east of Carrigtwohill, would be required to relieve congestion at the Knockgriffin Junction.

12. SUMMARY AND CONCLUSIONS

12.1 Summary

12.1.1 Atkins and SYSTRA were appointed by Cork County Council to undertake a Transport Assessment to assess the four phases of the Water Rock Urban Expansion Area and to examine the transport impact of the proposed development on the local road network in each phase of development. The assessment aims to identify the future transport needs of the site at both a strategic and local level.

12.1.2 This chapter briefly summarises the key conclusions of the assessment, which have been presented in detail in the preceding chapters.

12.2 Conclusions

Phase 1A

12.2.1 Phase 1A of the Water Rock development includes approximately 535 residential units. This development has been assumed to be accompanied by the following infrastructure proposals:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction (infrastructure proposal B);
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C); and
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D).

12.2.2 The transport assessment for Phase 1A of the proposed Water Rock UEA development, in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, demonstrates that, with the above infrastructure upgrades in place (which will be constructed under the **Water Rock Urban Expansion Area Infrastructure Works Part 8 proposals**), the development of Phase 1a of Water Rock i.e. up to 535 housing units (the LIHAF commitment), in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, can be accommodated without significantly impacting the performance of the local transport network.

Phase 1

12.2.3 Phase 1 of the Water Rock development includes approximately 1,054 residential units, 10,000 sqm of office space, 2,000 sqm of retail, 500 sqm of leisure space and the opening of a new primary school with 592 students.

12.2.4 This development has been assumed to be accompanied by the same infrastructure proposals assumed for Phase 1A, namely:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd / NRR Signalised Junction to include an additional lane on the eastbound approach to the junction (infrastructure proposal B);
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C); and
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D).

12.2.5 The transport assessment for Phase 1 of the proposed Water Rock UEA development, in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, demonstrates that, with the above infrastructure upgrades in place

(which will be constructed under the **Water Rock Urban Expansion Area Infrastructure Works Part 8 proposals**), the development of Phase 1 of Water Rock i.e. up to approximately 1,000 housing units, in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, can be accommodated without significant impacts on the road network.

Phase 2

12.2.6 Phase 2 of the Water Rock development includes approximately 2,000 residential units, 10,000 sqm of office space, 2,000 sqm of retail, 500 sqm of leisure space and the opening of two new primary schools with 1,104 students.

12.2.7 This development has been assumed to be accompanied by the following infrastructure proposals:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd/ NRR Signalised Junction (infrastructure proposal B;
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C);
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D);
- Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd (infrastructure proposal E);
- Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction) (infrastructure proposal F);
- Signalisation of L3617 and Main St Carrigtwohill (infrastructure proposal G; and
- Signalisation of Station Road junction in Carrigtwohill (infrastructure proposal X).

12.2.8 The transport assessment for Phase 2 demonstrates that the full implementation of Phase 2 of the proposed Water Rock UEA development (i.e. up to 2,000 residential units) , in conjunction with the development of zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, cannot be accommodated without considerable upgrades to the transport network. These include an upgrade of the N25/Cobh Cross interchange, a new N25 interchange east of Carrigtwohill, the completion of the NRR Phase 2 and 3 and an upgrade of the Midleton Gyratory (to relieve town centre congestion) and additional improvements to the Knockgriffin and Lakeview Roundabout Junctions.

Phase 3

12.2.9 Phase 3 of the Water Rock development includes approximately 2,500 residential units, 10,000 sqm of office space, 2,000 sqm of retail, 500 sqm of leisure space and the opening of two new primary schools with 1,104 students and one secondary school with capacity for approximately 1,000 students.

12.2.10 This development has been assumed to be accompanied by considerable infrastructure proposals, including:

- Service Corridor Link Road from NRR to Water Rock Road (infrastructure proposal A);
- Upgrade of Cork Rd/ NRR Signalised Junction (infrastructure proposal B);
- Closure of Water Rock Rd / N25 Junction (infrastructure proposal C);
- New Railway Stop on Cork - Midleton Line (infrastructure proposal D);
- Upgrade of Water Rock Road Within UEA+ Loop Road connecting to Link Rd and Water Rock Rd (infrastructure proposal E);
- Upgrade of Water Rock Rd junction with Carrigane Rd (including signalisation of Water Rock Road / Carrigane Road junction) (infrastructure proposal F);;
- Signalisation of L3617 and Main St Carrigtwohill (infrastructure proposal G);
- Link rd over Railway + distributor connecting Midleton NRR to N25 (infrastructure proposal H);
- Midleton NRR phases 2 + 3 (infrastructure proposal I);

- Upgrade Carrigane Road (single carriageway standard) (infrastructure proposal J);
- Upgrade of the junction at Mill Rd / NRR (infrastructure proposal K);
- Upgrade Midleton Gyratory (infrastructure proposal L);
- N25 Interchange east of Carrigtwohill (infrastructure proposal M);
- Signalisation of Station Road junction in Carrigtwohill (infrastructure proposal X);
- Cobh Cross / N25 Upgrade (infrastructure proposal Y);
- Signalisation of Carrigtwohill Main St / N25 access road (junction on corner of Costcutter) (infrastructure proposal Z).

12.2.11 The transport assessment for Phase 3 demonstrates that, Phase 3 of the proposed Water Rock UEA development, in conjunction with the development of all zoned lands in Midleton and Carrigtwohill, including the Carrigtwohill UEA, can be accommodated with considerable upgrades to the transport network. These include an upgrade of the N25/Cobh Cross interchange, a new N25 interchange east of Carrigtwohill, the completion of the NRR Phase 2 and 3 and an upgrade of the Midleton Gyratory (to relieve town centre congestion) and additional improvements to Lakeview Roundabout. In addition, a new link road from Water Rock UEA to the new N25 parallel access roads linking to the proposed N25 Interchange east of Carrigtwohill, would be required to relieve congestion at the Knockgriffin Junction.

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SYSTRA

Appendix A

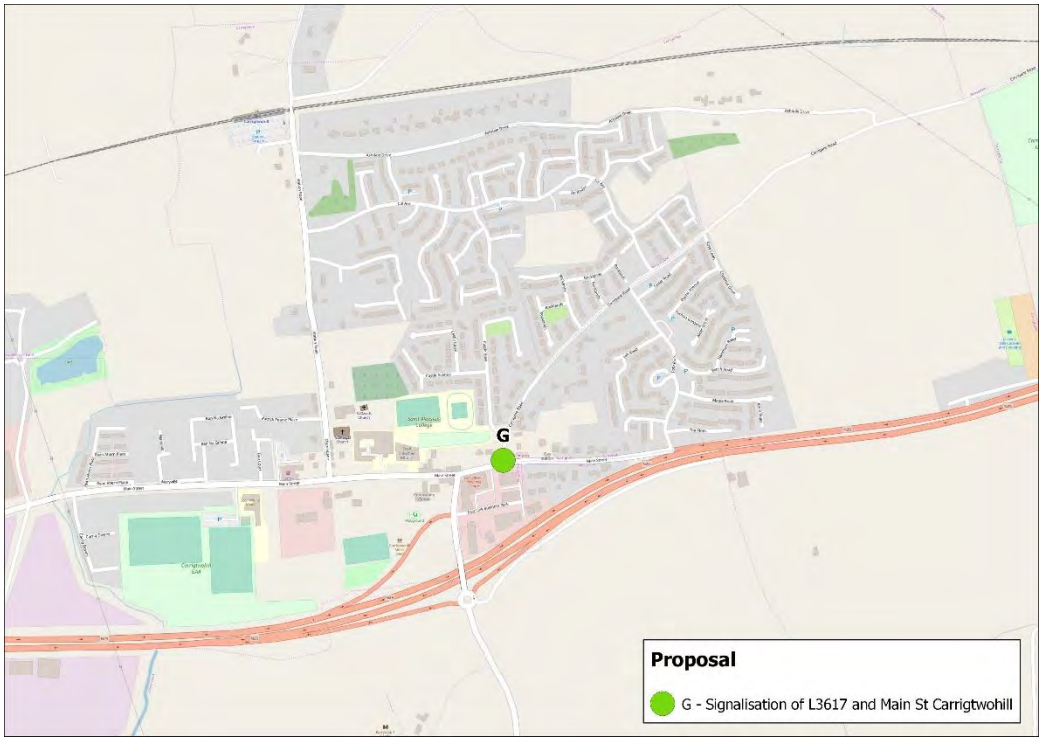
Infrastructure Test Results

PHASE 2 INFRASTRUCTURE TEST G (SIGNALISATION OF L3617/ CARRIGTWOHILL MAIN STREET)

Overview

The purpose of this Sensitivity test is to determine the impacts of the inclusion of Infrastructure Proposal G (Signalisation of L3617 / Carrigtwohill Main St) during Phase 2 of the proposed Water Rock development.

Figure 1 Proposal G – Signalisation of L3617 / Carrigtwohill Main St



Phase 2 Highway Impacts

Journey Times along affected Routes

Journey time route 1 (shown in Figure 5.8 in the main report) is the only route which uses this junction and therefore our Journey Time Analysis focuses on this route.

Tables 1 and 2 below outline the journey times along the above route for the AM and PM peaks respectively. These tables compare the Do-Something journey times with Proposal G in place and the Do-Something journey times without Proposal G in place to ascertain the impacts that the proposal will have on Journey times.

Table 0 AM – Journey Times

Route	DS	G Test	Difference
Route 1 NB	764	723	-5%
Route 1 SB	916	902	-2%

Table 2 PM – Journey Times

Route	DS	G Test	Difference
Route 1 NB	868	852	-2%
Route 1 SB	885	773	-13%

Table 1 above indicates that, in the AM peak, removing Proposal G from the network will result in negligible effects on Journey times when compared to the DS journey times which include a signalisation of this junction.

PM Journey Time Results show that journey times reduce somewhat with the removal of signals at this junction.

It should be noted however, that in the AM peak, less traffic use the junction as it is no longer signalised and thus has less priority. Traffic instead turns off the Carrigane Rd at the Fota Rock housing estate and accesses Carrigtwohill Main St and the N25 through the estate's residential road. In the PM peak, similar issues are evident with more traffic using the Fota Rock residential road when the junction is not signalised. So, while modelling indicates negligible effects in journey times when the junction is not signalised, there is more rat running through Fota Rock's residential road which could have a negative impact on safety throughout the estate.

Volume / Capacity at Key Junctions

Figures 2 – 5 illustrate the results of this V/C analysis for the AM with and without Proposal G in place Scenarios respectively.

Figure 2 AM V/C Analysis – With Proposal G Midleton

Figure 3 AM V/C Analysis – Without Proposal G Midleton

Figure 4 AM V/C Analysis – With Proposal G Carrigtwohill

Figure 5 AM V/C Analysis – Without Proposal G Carrigtwohill

The figures above illustrate that removing Proposal G from the network will impact the Fota Rock / Carrigtwohill Main St junction and the L3617/ Carrigtwohill Main street (proposal G junction). Both junctions become more congested as a result of the removal of the signals at this location. In the AM Peak, Water Rock Development Traffic Accounts for approximately 14% of total traffic at the L3617/ Carrigtwohill Main St Junction.

Figures 6 – 9 below show the V/C analysis for the PM with and without Proposal G in place Scenarios respectively

Figure 6 PM V/C Analysis – With Proposal G Midleton

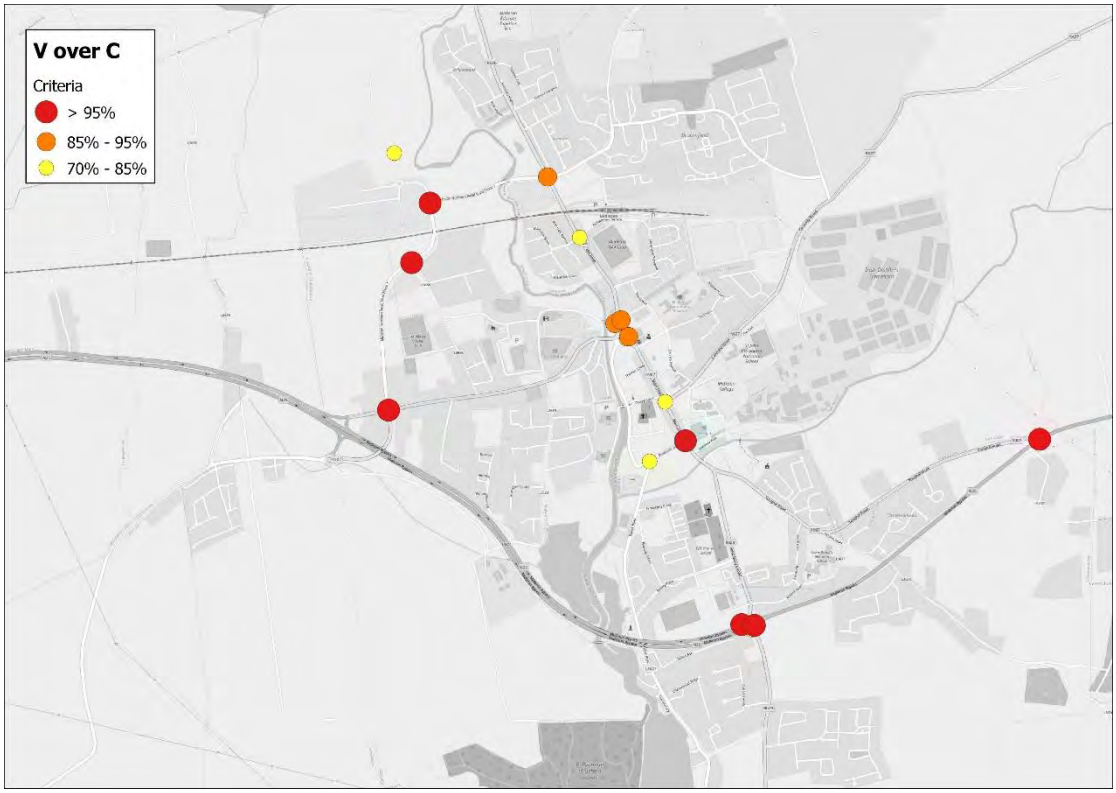


Figure 7 PM V/C Analysis – Without Proposal G Midleton

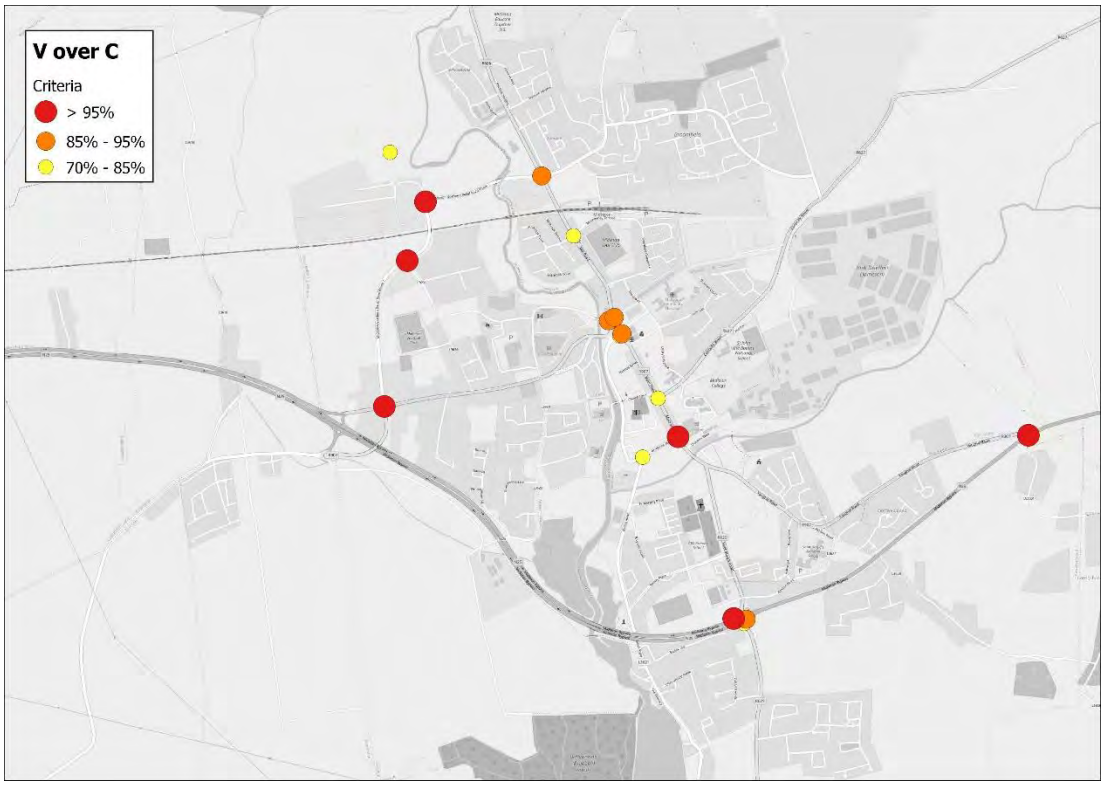


Figure 8 PM V/C Analysis – With Proposal G Carrigtwohill

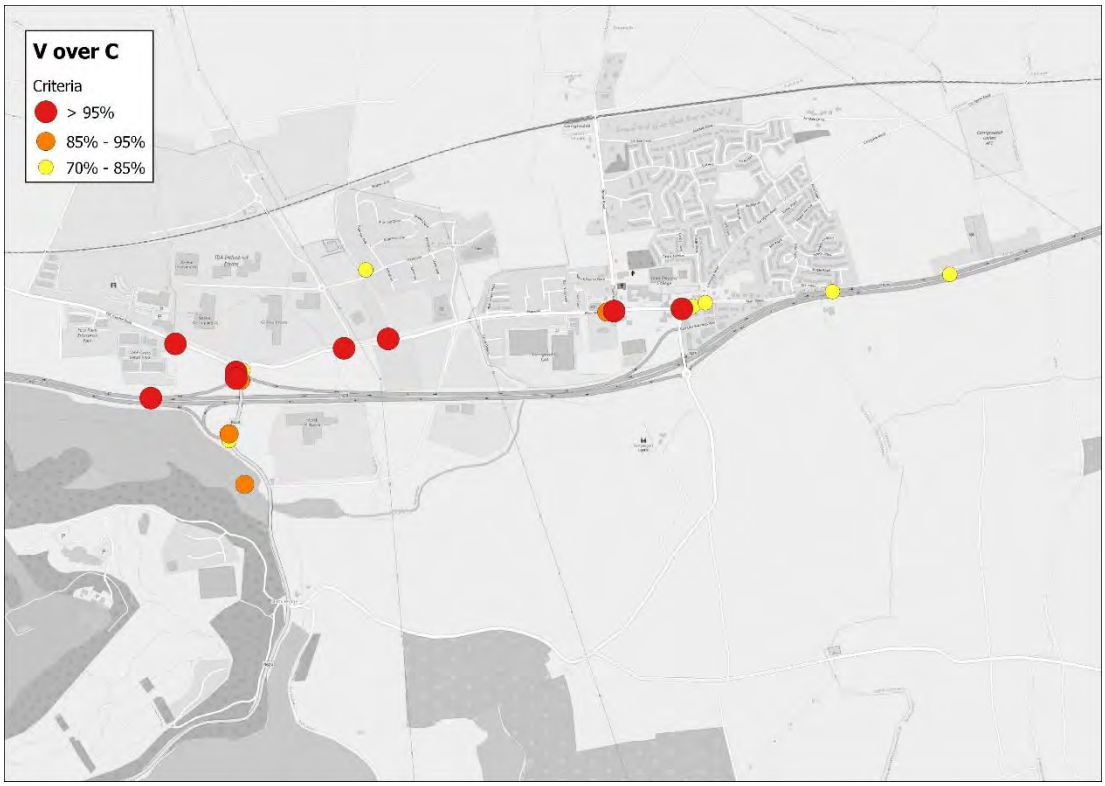
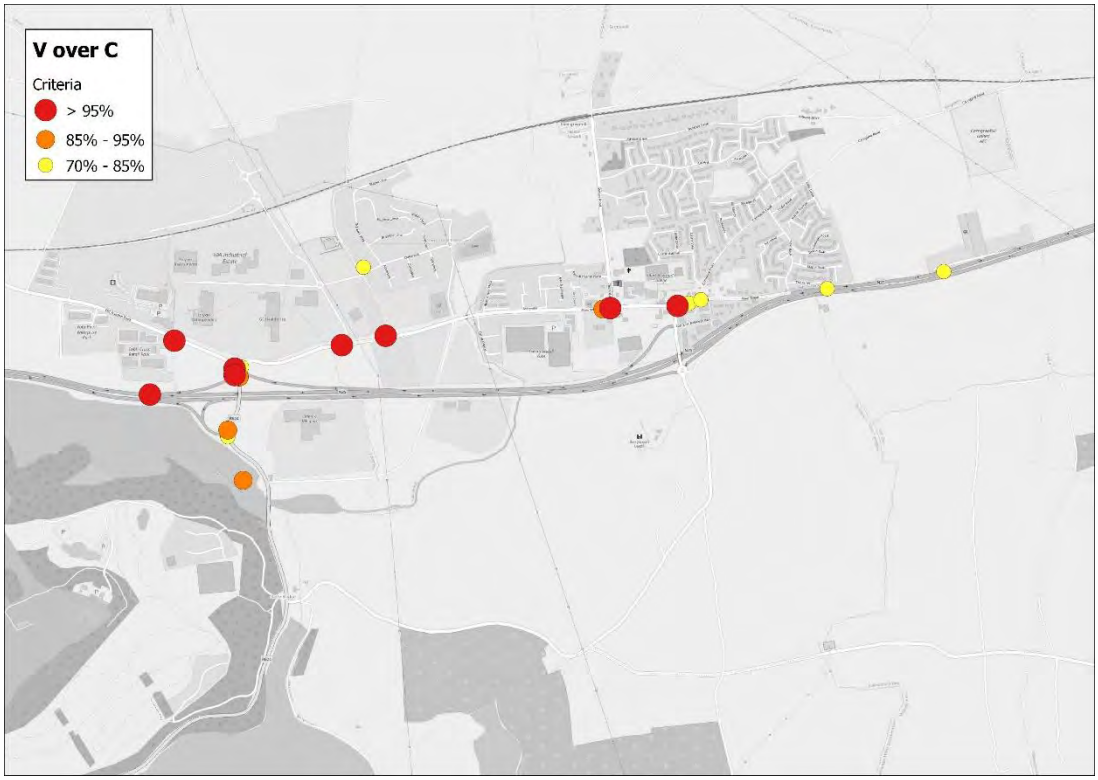


Figure 9 PM V/C Analysis – Without Proposal G Carrigtwohill



In the PM peak, the L3617/ Carrigtwohill Main street junction will be operating at capacity in both scenarios, however with the signalisation a greater volume of traffic can get through the junction and therefore "rat running" through other junctions is minimised. In the PM Peak, Water Rock Development Traffic Accounts for approximately 3% of total traffic at the L3617/ Carrigtwohill Main St Junction.

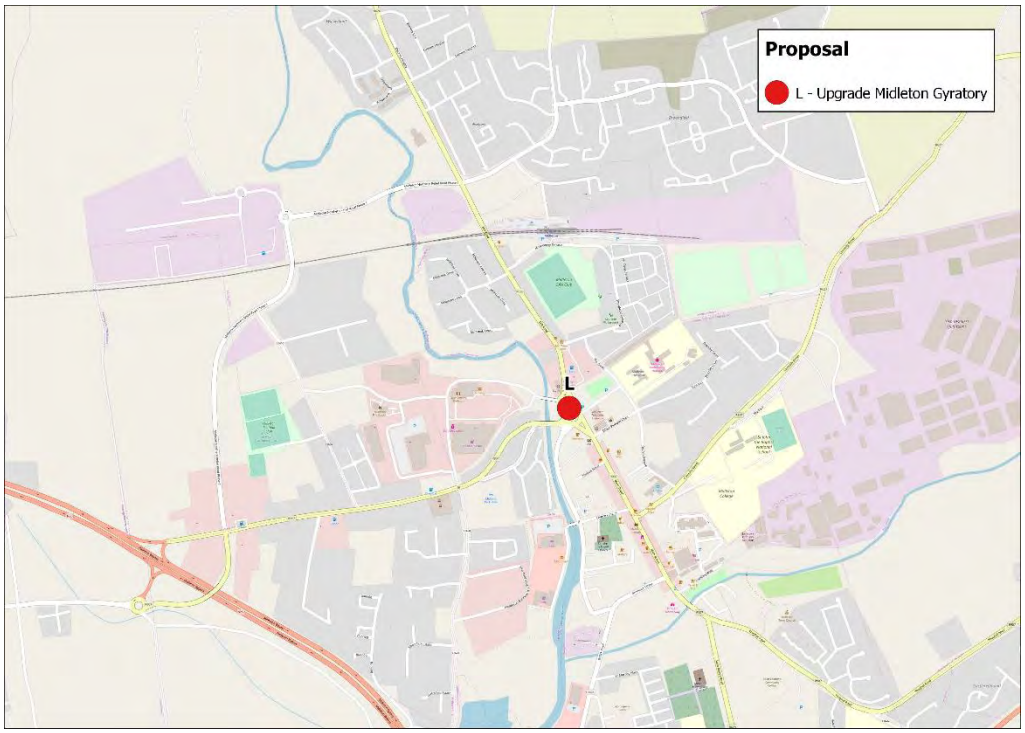
Infrastructure Proposal G Summary

The modelling results outlined in this chapter show that the signalisation of the junction will allow it to cater for a much greater level of traffic and also minimises the level of "rat running" through alternative, less desirable, routes (e.g. Fota Rock residential estate). Therefore, it is recommended that the signalisation of the L3617/ Carrigtwohill Main street (Proposal G) remain part of the Phase 2 proposals.

PHASE 3 INFRASTRUCTURE TEST L – TRANSPORT ASSESSMENT

Overview

The purpose of this assessment is to determine the impacts of removing a proposed upgrade of the Midleton Gyratory in Phase 3 of the proposed Water Rock development. The location of the Midleton Gyratory is shown in the Figure below.



Phase 3 Highway Impacts

Journey Times along Key Routes

The same journey time routes that were used for validation (shown in Figure 5.8 in the main report) have been used for the purposes of this analysis.

Tables 4 and 5 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Something journey times with Proposal L in place (DS) and the Do-Something journey times without Proposal L in place (L Test) to ascertain the impacts that the proposal will have on Journey times.

Table 4 AM – Journey Times

Route	DS	L Test	Difference
Route 1 NB	770	770	0.0%
Route 1 SB	827	828	0.1%
Route 2 EB	427	427	0.0%
Route 2 WB	502	502	0.0%
Route 3 NB	528	522	-1.1%
Route 3 SB	580	581	0.2%
Route 4 NB	195	195	0.0%
Route 4 SB	266	266	0.0%

Table 5 PM – Journey Times

Route	DS	L Test	Difference
Route 1 NB	843	899	6.6%
Route 1 SB	815	835	2.5%
Route 2 EB	666	669	0.5%
Route 2 WB	383	383	0.0%
Route 3 NB	549	549	0.0%
Route 3 SB	596	597	0.2%
Route 4 NB	216	216	0.0%
Route 4 SB	201	220	9.5%

Table 4 above shows that, in the AM peak, the removal of Proposal L has no effect in comparison to the DS journey times. While Table 5 shows that in the PM peak, the journey times are mostly comparable with only Route 1 in the NB direction (along

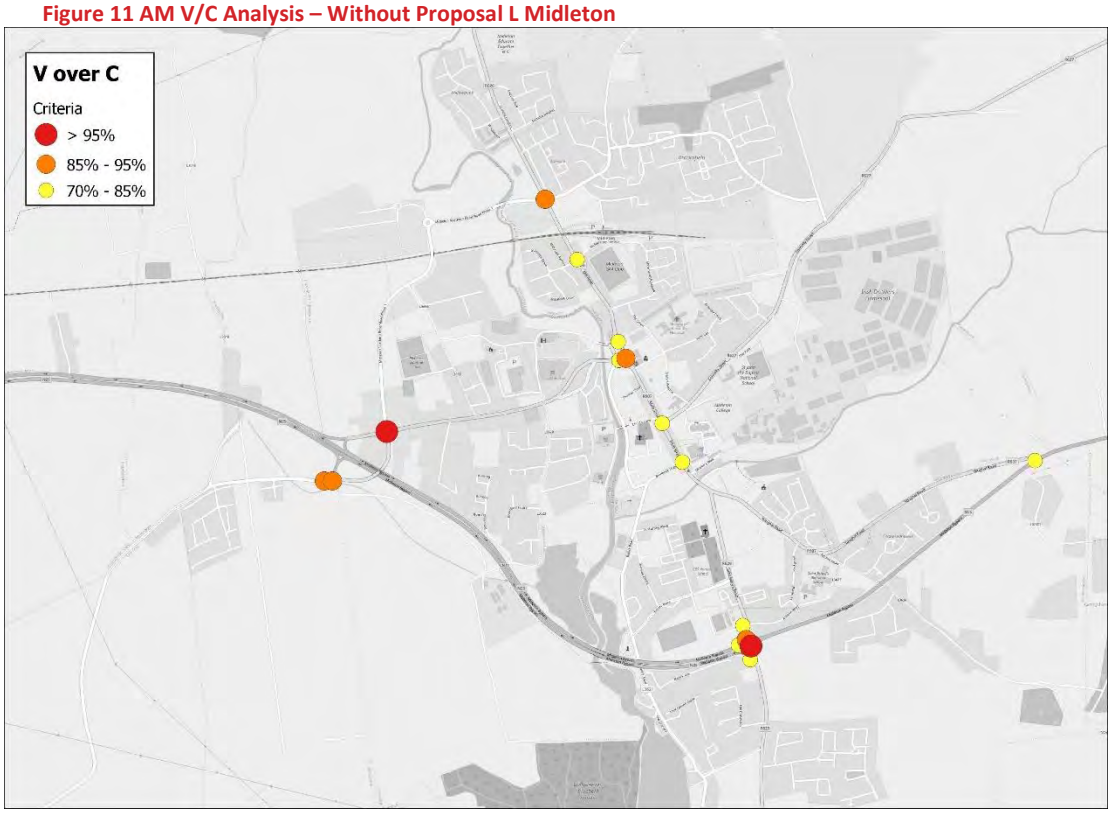
Carrigane Rd) and Route 4 in the SB direction showing slight increases (6.6% and 9.5% respectively).

Volume / Capacity at Key Junctions

Figures 10 – 11 illustrate the results of this V/C analysis for the AM with and without Proposal L in place respectively.

Figure 10 AM V/C Analysis – With Proposal L Midleton

Figure 11 AM V/C Analysis – Without Proposal L Midleton



The figures above illustrate that removing Proposal L in Phase 3 will have a minimal effect on V/C's in the network in the AM peak.

Figures 12 – 13 below show the V/C analysis for the Do-Minimum and Do-Something PM peak hour scenarios.

Figure 12 PM V/C Analysis – With Proposal L Midleton

Figure 13 PM V/C Analysis – Without Proposal L Midleton

Again, similar to the AM peak, our strategic analysis shows that removing Proposal L from Phase 3 will have a minimal impact on V/C's in the network in the PM peak.

Demand Flow at Key Junctions

The tables below shows a comparison of demand flows between the with and without Proposal L scenarios at several key junctions to show the impact of not upgrading the Midleton Gyratory. The results show that the demand flows are mostly unchanged at each of the junctions below.

Table 6 AM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	L Test	Diff	DS	L Test	Diff
Knockgriffin	2439	2439	0%	99%	99%	0%
Lakeview Rdbt	3901	3888	0%	104%	104%	0%
Broderick St	1344	1347	0%	81%	81%	0%
Station Rd	1330	1330	0%	81%	81%	0%
NRR/R626	1971	1959	-1%	93%	93%	0%
Midleton Gyratory	2155	2162	0%	86%	87%	0%
N25/Youghal Rd Slip	2096	2091	0%	78%	77%	-2%
Carrigane Rd/Water Rock Rd	907	911	0%	80%	81%	1%
Carrigtwohill Main St/N25 J4 junction	1116	1116	0%	66%	66%	0%

Table 7 PM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	L Test	Diff	DS	L Test	Diff
Knockgriffin	2778	2779	0%	101%	101%	0%
Lakeview Rdbt	3931	3933	0%	110%	110%	0%
Broderick St	1122	1125	0%	85%	86%	1%
Station Rd	1186	1183	0%	99%	98%	-1%
NRR/R626	2340	2353	1%	83%	84%	0%
Midleton Gyratory	2501	2506	0%	93%	94%	1%
N25/Youghal Rd Slip	2104	2104	0%	104%	104%	0%
Carrigane Rd/Water Rock Rd	986	986	0%	74%	74%	0%
Carrigtwohill Main St/N25 J4 junction	1149	1147	0%	80%	80%	0%

Infrastructure Proposal L Summary

The strategic modelling analysis outlined in this section demonstrates that that the upgrade of the Midleton Gyratory will have a minimal impact on the local transport network in Phase 3. This is likely a result of the fact that other infrastructure proposals which are assumed to be present in phase 3 (including the new N25 interchange and NRR phases 2 & 3) have led to a decrease in traffic using the Midleton Gyratory.

Furthermore, the nature of this junction (which includes several linked signalised junctions) means that it is difficult to accurately assess operational impacts using a strategic, one hour, local area model. Therefore, it is recommended that further analysis of this infrastructure proposal, using micro-simulation modelling, is undertaken to more accurately assess upgrade proposals.

PHASE 3 INFRASTRUCTURE TEST M – TRANSPORT ASSESSMENT

Overview

This section presents the results of a modelling assessment of the impacts of infrastructure proposal M – N25 Interchange at Amgen during Phase 3 of the proposed Water Rock development. This proposed interchange is shown in Figure 14 below.

Figure 14 Proposal M – M25 Interchange at Amgen

Phase 3 Highway Impacts

Journey Times along Key Routes

The same journey time routes that were used for validation (shown in Figure 5.8 in the main report) have been used for the purposes of this analysis.

Tables 8 and 9 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Something journey times with Proposal M in place (DS) and the Do-Something journey times without Proposal M in place (M Test) to ascertain the impacts that the proposal will have on Journey times.

Table 8 AM – Journey Times

Route	DS	M Test	Difference
Route 1 NB	770	712	-8%
Route 1 SB	827	989	20%
Route 2 EB	427	431	1%
Route 2 WB	502	503	0%
Route 3 NB	528	529	0%
Route 3 SB	580	593	2%
Route 4 NB	195	196	1%
Route 4 SB	266	314	18%

Table 9 PM – Journey Times

Route	DM	DS	Difference
Route 1 NB	843	1012	20%
Route 1 SB	815	874	7%
Route 2 EB	666	706	6%
Route 2 WB	383	360	-6%
Route 3 NB	549	599	9%
Route 3 SB	596	605	2%
Route 4 NB	216	399	85%
Route 4 SB	201	244	21%

Table 8 above shows that, in the AM peak, removing Proposal M from the network causes increased journey times on Route 1 in the Southbound direction along Carrigane Rd (20% increase) and on Route 4 also in the Southbound direction (an 18% increase).

Table 9 above shows that, in the PM peak, removing Proposal M from the network causes increased journey times on Route 4 in the both directions along the NRR (85% in the NB direction and 21% in the SB direction) while a 20% increase is also observed on Route 1 in the Northbound direction along Carrigane Rd.

Volume / Capacity at Key Junctions

Figures 15 – 18 illustrate the results of this V/C analysis for the AM with and without Proposal M in place respectively.

Figure 15 AM V/C Analysis – With Proposal M Midleton

Figure 16 AM V/C Analysis – Without Proposal M Midleton

Figure 17 AM V/C Analysis – With Proposal M Carrigtwohill

Figure 18 AM V/C Analysis – Without Proposal M Carrigtwohill

The figures above illustrate how removing Proposal M in Phase 3 has some significant effects on junction performance in the AM peak. Several junctions along the NRR (including the Avonmore Cottages and R626 junction), the Castle Rock roundabout, the Cobh Cross Interchange and along Carrigtwohill Main St (Station Rd and Carrigane Rd junction) are operating close to or above capacity when the Interchange is removed.

Figures 19 – 22 below show the V/C analysis for the PM with and without Proposal M in place respectively.

Figure 19 PM V/C Analysis – With Proposal M Midleton

Figure 20 PM V/C Analysis – Without Proposal M Midleton

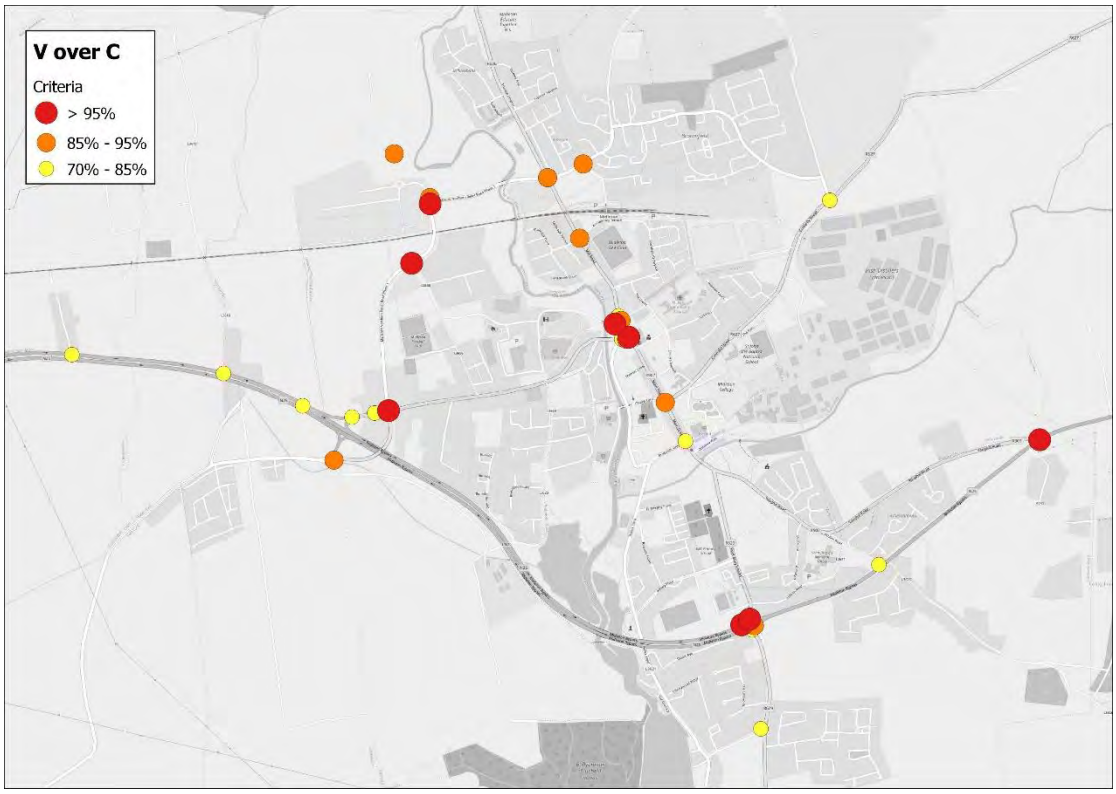


Figure 21 PM V/C Analysis – With Proposal M Carrigtwohill

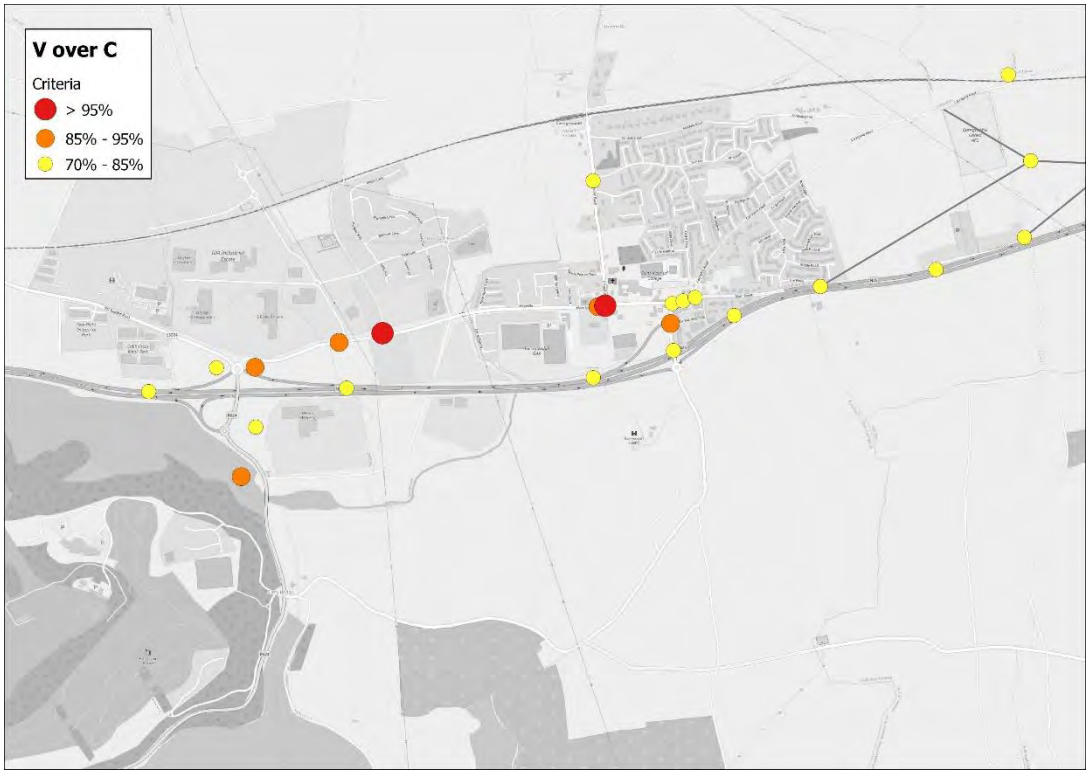
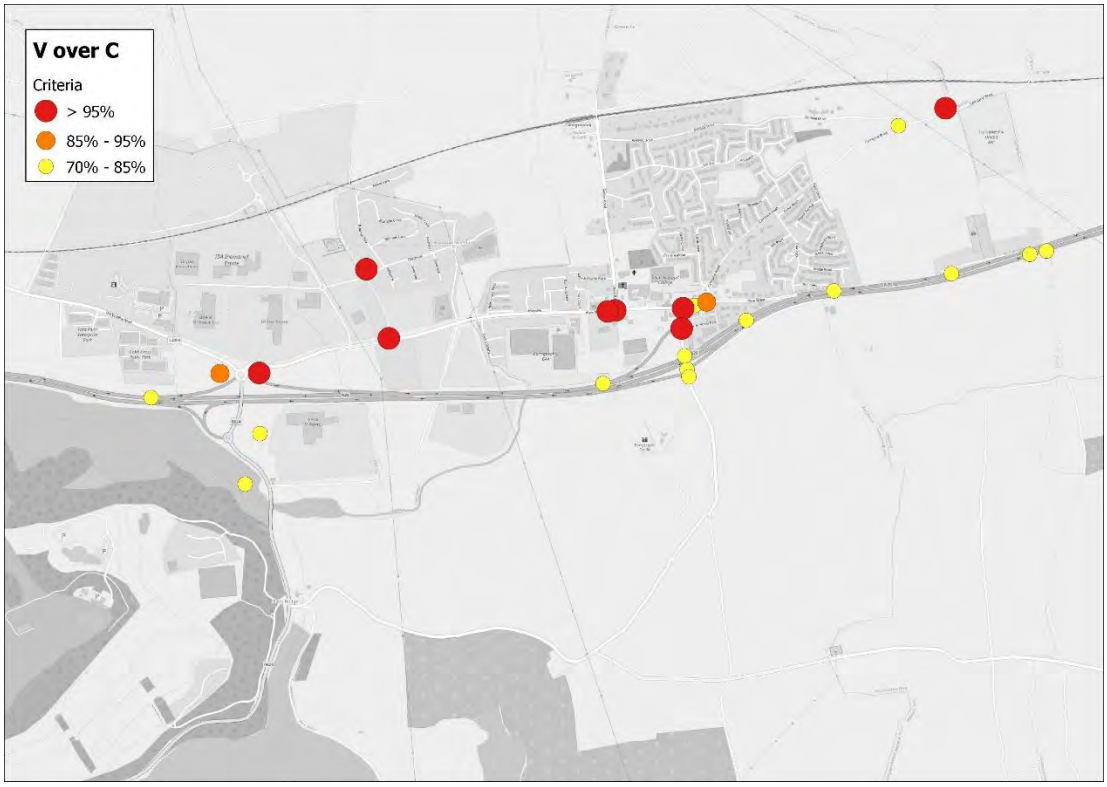


Figure 22 PM V/C Analysis – Without Proposal M Carrigtwohill



Again, as with the AM peak, the figures above illustrate how removing Proposal M from Phase 3 has some significant effects on junction performance in the PM peak. Several junctions including the Midleton Gyratory, the Cobh Cross Interchange, along the NRR (including the Nordic Enterprise junction) and Carrigtwohill Main St (Station Rd and N25 J4 slip junction) are operating at or above capacity when the proposed interchange is removed.

Demand Flow at Key Junctions

The tables below show a comparison of demand flows between the with and without Proposal M scenarios at several key junctions to show the impact of not implementing the N25 Interchange at Amgen. The results show an increase in demand flows at several junctions including the Station Rd, Carrigtwohill Main ST/N25 J4 and the NRR/R626 junction.

Table 10 AM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	M Test	Diff	DS	M Test	Diff
Knockgriffin	2439	2504	3%	99%	101%	1%
Lakeview Rdbt	3901	3836	-2%	104%	105%	1%
Broderick St	1344	1354	1%	81%	83%	1%
Station Rd	1330	1499	13%	81%	106%	25%
NRR/R626	1971	2010	2%	93%	97%	3%
Midleton Gyratory	2155	2186	1%	86%	94%	8%
N25/Youghal Rd Slip	2096	2094	0%	78%	77%	-1%

Junction	Demand Flows			Max V/C (%)		
	DS	M Test	Diff	DS	M Test	Diff
Carrigane Rd/Water Rock Rd	907	902	-1%	80%	79%	-1%
Carrigtwohill Main St/N25 J4 junction	1116	1724	55%	66%	102%	37%
NRR/Avonmore Cottages junction	1717	2086	21%	65%	96%	31%

Table 11 PM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	M Test	Diff	DS	M Test	Diff
Knockgriffin	2778	2900	4%	101%	104%	3%
Lakeview Rdbt	3931	3676	-6%	110%	111%	0%
Broderick St	1122	1127	1%	85%	84%	-1%
Station Rd	1186	1335	13%	99%	100%	1%
NRR/R626	2340	2702	15%	83%	89%	6%
Midleton Gyratory	2501	2622	5%	93%	98%	5%
N25/Youghal Rd Slip	2104	2108	0%	104%	106%	2%
Carrigane Rd/Water Rock Rd	986	804	-18%	74%	66%	-8%
Carrigtwohill Main St/N25 J4 junction	1149	1534	33%	80%	104%	24%
NRR/Avonmore Cottages junction	1976	2060	4%	101%	104%	2%

Infrastructure Proposal M Summary

The modelling results outlined in this section indicate that removing Proposal M in phase 3 will lead to a significant increase in demand at several junctions in the study area, with some of these junctions experiencing levels of V/C of 95% or higher as a result. These junctions are:

- The Station Rd junction (81% V/C increases to 106% V/C in the AM)
- The Carrigtwohill Main St/N25 J4 junction (66% V/C increases to 102% V/C in the AM)
- The NRR/Avonmore Cottages junction (65% V/C increases to 96% V/C with development in the AM)
- The Midleton Gyratory (93% V/C increases to 98% V/C in the PM)
- The Carrigtwohill Main St/N25 J4 junction (80% V/C increases to 104% V/C in the PM)

Therefore, it is recommended that Proposal M is in place prior to the implementation of the Phase 3 development.

Appendix B

Rail Sensitivity Test Results

PHASE 2 RAIL SENSITIVITY TEST – TRANSPORT ASSESSMENT

Overview

The objective of this sensitivity test is to assess what impact an increase in the Rail Mode share of the Water Rock development would have on the local traffic network in Phase 2. This higher rail mode share assumption will reduce car use in the area and thus reduce the number of car trips on the local road network. For the purposes of this sensitivity test the total PT mode share of the development was assumed to increase from 6% to 12.5**%.**

Phase 2 Trip Generation

Table 1 below shows the final resulting car trip generation figures associated with Phase 2 of Water Rock when the higher rail mode share is applied.

Table 1 Phase 2 Trip Generation Figures

Area	AM Origin trips	AM Destination trips	PM Origin trips	PM Destination trips
Water Rock	1054	680	916	1198
Midleton	583	258	380	600
Carrigtwohill	1445	884	1165	1616
Total	**3082**	**1822**	**2460**	**3414**

Phase 2 Highway Impacts

Journey Times along Key Routes

The same journey time routes that were used for validation (shown in Figure 5.8 of the main report) have been used for the purposes of this analysis.

Tables 2 and 3 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Something journey times with the Rail Sensitivity scenario to ascertain the impacts that the proposed additional mode shift will have on Journey times.

Table 2 AM – Journey Times

Route	DS	Rail Test	Difference
Route 1 NB	764	779	2%
Route 1 SB	916	904	-1%
Route 2 EB	427	427	0%
Route 2 WB	595	598	1%
Route 3 NB	533	531	0%
Route 3 SB	657	651	-1%
Route 4 NB	188	188	0%
Route 4 SB	359	327	-9%

Table 3 PM – Journey Times

Route	DS	Rail Test	Difference
Route 1 NB	868	862	-1%
Route 1 SB	885	960	8%
Route 2 EB	626	651	4%
Route 2 WB	426	419	-2%
Route 3 NB	571	569	0%
Route 3 SB	635	618	-3%
Route 4 NB	291	263	-10%
Route 4 SB	295	294	0%

Table 2 above shows that, in the AM peak, the higher mode share assumption in Phase 2 has only a marginal impact on the majority of Journey time routes with only Route 4,

in the Southbound direction (along the NRR), showing a significant decrease (9%). This is similar to the results in the PM peak where only Route 4 in the Northbound direction (along the NRR) shows a significant decrease (10%).

Volume / Capacity at Key Junctions

Figures 1 – 4 illustrate the results of this V/C analysis for the AM Do Something and Rail Sensitivity Scenarios respectively.

Figure 1 AM V/C Analysis – Do Something Midleton

Figure 2 AM V/C Analysis – Rail Test Midleton

Figure 3 AM V/C Analysis – Do Something Carrigtwohill

Figure 4 AM V/C Analysis – Rail Test Carrigtwohill

The figures above illustrate that the higher rail mode share has minor effects on the network with only junctions along Carrigtwohill Main St showing small reductions. These results are analysed further in Table 4 below.

Figures 5 – 8 below show the V/C analysis for the PM Do Something and Rail Sensitivity Scenarios respectively.

Figure 5 PM V/C Analysis – Do Something Midleton

Figure 6 PM V/C Analysis – Rail Test Midleton

Figure 7 PM V/C Analysis – Do Something Carrigtwohill

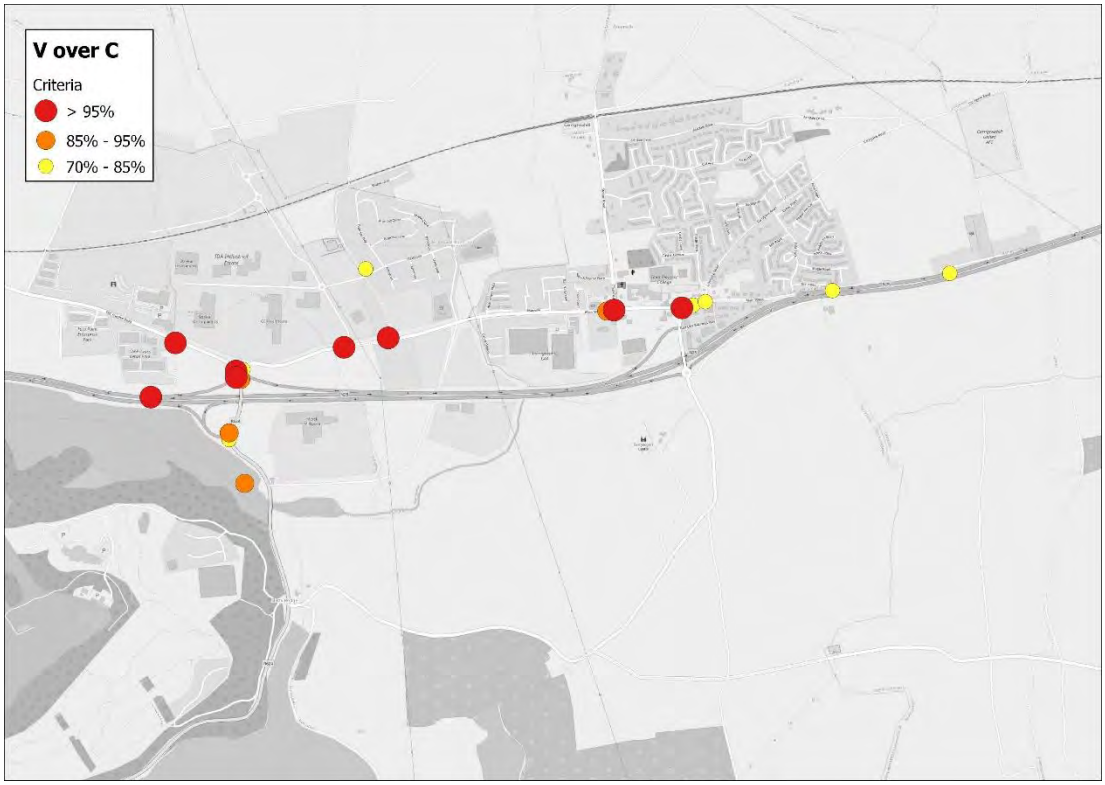


Figure 8 PM V/C Analysis – Rail Test Carrigtwohill

Again, the figures above illustrate that the higher rail mode share has minimal impact on the network with only the Nordic Enterprise Park roundabout showing a notable reduction in V/C. These results are further analysed in Table 5 below.

Demand Flow at Key Junctions

1.1.1 The table below shows a comparison of demand flows between the Do Something and Rail Test scenarios at several key junctions to show the impact of the higher rail mode share.

Table 4 AM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	Rail Test	Diff	DS	Rail Test	Diff
Knockgriffin	2446	2500	2%	104%	103%	-1%
Lakeview Roundabout	3749	3788	1%	105%	105%	0%
Broderick St	1484	1486	0%	101%	101%	0%
Station Rd	1469	1464	0%	98%	98%	0%
NRR/R626	1763	1772	1%	80%	78%	-1%
Midleton Gyratory	2226	2168	-3%	83%	76%	-7%
N25/Youghal Rd Slip	1935	1947	1%	75%	81%	6%
Carrigane Rd/Water Rock Rd	660	661	0%	84%	85%	0%
Carrigtwohill Main St/N25 J4 junction	1567	1501	-4%	89%	84%	-5%

Table 5 PM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	Rail Test	Diff	DS	Rail Test	Diff
Knockgriffin	2496	2537	2%	100%	100%	0%
Lakeview Roundabout	3733	3713	-1%	108%	109%	1%
Broderick St	1234	1223	-1%	98%	96%	-2%
Station Rd	1229	1238	1%	100%	100%	1%
NRR/R626	1934	1949	1%	90%	89%	0%
Midleton Gyratory	2525	2516	0%	93%	93%	0%
N25/Youghal Rd Slip	1995	1996	0%	96%	98%	1%
Carrigane Rd/Water Rock Rd	683	665	-3%	58%	56%	-2%
Carrigtwohill Main St/N25 J4 junction	1378	1382	0%	102%	102%	0%

Phase 2 Rail Sensitivity Summary

The modelling results outlined in this section show that, in phase 2, even if a PT mode share of 12.5% can be achieved, it will result in only minor improvements to the operation of several junctions in the study area.

PHASE 3 RAIL SENSITIVITY TEST – TRANSPORT ASSESSMENT

Overview

The objective of this sensitivity test is to assess what impact an increase in the Rail Mode share of the Water Rock development would have on the local traffic network in Phase 3. This higher rail mode share assumption will reduce car use in the area and thus reduce the number of car trips on the local road network. For the purposes of this sensitivity test the total PT mode share of the development was assumed to increase from 6% to 12.5**%.**

Phase 3 Trip Generation

Table 6 below shows the final car trip generation figures associated with Phase 3 of Water Rock with the above mode share assumptions in place.

Table 6 Phase 3 Trip Generation Figures

Area	AM Origin trips	AM Destination trips	PM Origin trips	PM Destination trips
Water Rock	1322	838	1068	1425
Midleton	1244	550	802	1266
Carrigtwohill	2089	1207	1559	2229
Total	**4655**	**2595**	**3428**	**4920**

Phase 3 Highway Impacts

Journey Times along Key Routes

1.1.2 The same journey time routes that were used for validation (shown in Figure 5.8 in the main report) have been used for the purposes of this analysis.

1.1.3 Tables 7 and 8 below outline the journey times along the above routes for the AM and PM peaks respectively. These tables compare the Do-Something journey times with the Rail Sensitivity scenario to ascertain the impacts that the increased mode share will have on Journey times.

Table 7 AM – Journey Times

Route	DM	DS	Difference
Route 1 NB	770	769	0%
Route 1 SB	827	819	-1%
Route 2 EB	427	427	0%
Route 2 WB	502	501	0%
Route 3 NB	528	527	0%
Route 3 SB	580	576	-1%
Route 4 NB	195	195	0%
Route 4 SB	266	255	-4%

Table 8 PM – Journey Times

Route	DM	DS	Difference
Route 1 NB	843	872	3%
Route 1 SB	815	833	2%
Route 2 EB	666	669	0%
Route 2 WB	383	380	-1%
Route 3 NB	549	550	0%
Route 3 SB	596	598	0%
Route 4 NB	216	214	-1%
Route 4 SB	201	207	3%

Table 7 above shows that, in the AM peak, the higher mode share assumption in Phase 3 causes negligible effects on Journey times in comparison to the DS journey times with none of the routes showing any significant changes. These results are also reflected in

the PM peak where the journey times are comparable with and without the additional rail mode share assumptions in place.

Volume / Capacity at Key Junctions

Figures 9 – 12 illustrate the results of a V/C analysis for the AM Do Something and Rail Sensitivity Scenarios respectively.

Figure 9 AM V/C Analysis – Do Something Midleton

Figure 10 AM V/C Analysis – Rail Sensitivity Midleton

Figure 11 AM V/C Analysis – Do Something Carrigtwohill

Figure 12 AM V/C Analysis – Rail Sensitivity Carrigtwohill

The figures above illustrate the minor differences between the Do Something and Rail Sensitivity scenarios in the AM peak.

Figures 13 – 16 below illustrate the results of this V/C analysis for the PM Do Something and Rail Sensitivity Scenarios respectively.

Figure 13 PM V/C Analysis – Do Something Midleton

Figure 14 PM V/C Analysis – Rail Sensitivity Midleton

Figure 15 PM V/C Analysis – Do Something Carrigtwohill

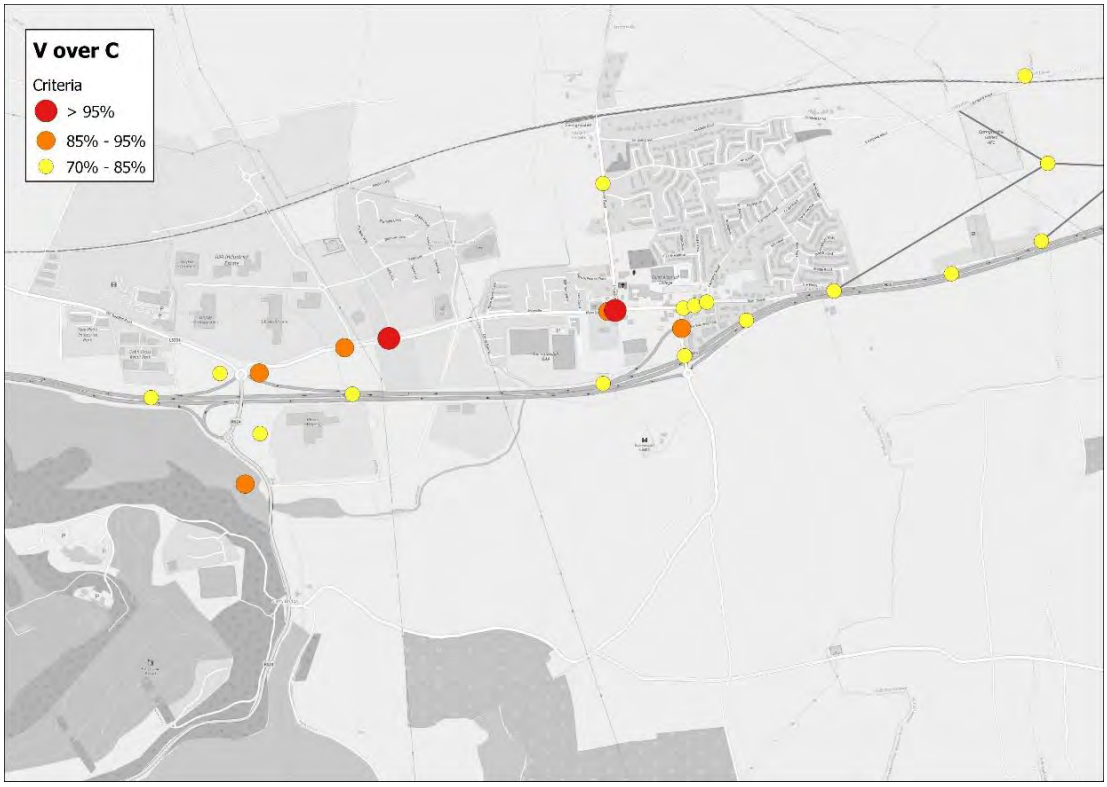


Figure 16 PM V/C Analysis – Rail Sensitivity Carrigtwohill

Again, similar to the AM peak, the figures above illustrate the minor differences between the Do Something and Rail Sensitivity scenarios in the PM peak, with only the Chestnut Crescent junction showing an improvement. The Table below provides further details on the impacts of the rail sensitivity test on individual junctions.

Demand Flow at Key Junctions

The table below shows a comparison of demand flows between the Do Something and Rail Test scenarios at several key junctions to highlight the impact of the higher rail mode share.

Table 9 AM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	Rail Test	Diff	DS	Rail Test	Diff
Knockgriffin	2439	2425	-1%	99%	99%	0%
Lakeview Roundabout	3901	3890	0%	104%	104%	0%
Broderick St	1344	1351	1%	81%	81%	0%
Station Rd	1330	1314	-1%	81%	77%	-4%
NRR/R626	1971	1889	-4%	93%	95%	1%
Midleton Gyratory	2155	2137	-1%	86%	81%	-5%
N25/Youghal Rd Slip	2096	2096	0%	78%	79%	1%
Carrigane Rd/Water Rock Rd	907	883	-3%	80%	79%	-1%
Carrigtwohill Main St/N25 J4 junction	1116	1116	0%	66%	65%	-1%

Table 10 PM Comparison

Junction	Demand Flows			Max V/C (%)		
	DS	Rail Test	Diff	DS	Rail Test	Diff
Knockgriffin	2778	2826	2%	101%	101%	0%
Lakeview Roundabout	3931	3931	0%	110%	111%	0%
Broderick St	1122	1128	1%	85%	86%	1%
Station Rd	1186	1188	0%	99%	100%	1%
NRR/R626	2340	2318	-1%	83%	83%	-1%
Midleton Gyratory	2501	2484	-1%	93%	92%	-1%
N25/Youghal Rd Slip	2104	2099	0%	104%	104%	0%
Carrigane Rd/Water Rock Rd	986	885	-10%	74%	72%	-2%
Carrigtwohill Main St/N25 J4 junction	1149	1178	3%	80%	80%	0%

Phase 3 Rail Sensitivity Summary

The modelling results outlined in this section demonstrate that the increased rail mode share in Phase 3 is likely to result in only minimal improvements on the local road network. Improvements in the performance of the local road network, brought about through the introduction of significant infrastructure proposals in phase 3, mean that the reduction in car trip demand will have less of an impact in Phase 3 than in Phase 2.

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Member of the SNC-Lavalin Group

Water Rock LIHAF Initiative

Water Rock Vissim Modelling Report

Cork County Council

December 2018

Notice

This document and its contents have been prepared and are intended solely as information for Cork County Council and use in relation to Water Rock LIHAF Initiative.

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This document has 53 pages including the cover.

Document history

Revision	Purpose description	Origin-ated	Checked	Reviewed	Author-ised	Date
Rev 0	Draft	SW	KB	JOC	RN	31/10/18
Rev 1	Final	JOC	SW	JOC	RN	18/12/18

Client signoff

Client	Cork County Council
Project	Water Rock LIHAF Initiative
Job number	5163809
Client signature / date	

Contents

Tables

Figures

1. Introduction

Atkins was appointed by Cork County Council to undertake a Transport Assessment to assess the four phases of the Water Rock Urban Expansion Area and to examine the transport impact of the proposed development on the local road network in each phase of development. The assessment aims to identify the future transport needs of the site at both a strategic and local level.

Atkins developed a micro simulation traffic model of the Midleton area as part of the overall Water Rock Strategic Transport Assessment.

The VISSIM model was developed by updating an existing model previously developed by AECOM Consulting Engineers in 2014 as part of the Water Rock Masterplan Phase 1 Transport Assessment. This model updating included recoding of some links and junctions to match current traffic patterns and behaviour more closely along with a calibration and validation exercise.

20 scenarios were included in the model with various new infrastructure coded into the model to match the infrastructure proposals as set out in the Water Rock Strategic Transport Assessment. The full results from these scenarios are included in Appendix A and are summarised in the following sections.

This report forms part of the overall Water Rock Strategic Transport Assessment and should be read in conjunction with the Water Rock Strategic Transport Assessment Report prepared by Systra.

2. Methodology

2.1. Model Coding and Geometry

The entry and exit points to the VISSIM model were coded to match the zones within the wider Local Area Model. This ensures consistency between the inputs and outputs of the VISSIM model and the wider LAM developed using Saturn software.

2.2. Traffic Generation and Distribution

Traffic generation was extracted from a cordoned section of the Local Area Model. An Origin-Destination matrix was generated for both Light Vehicles and Heavy Vehicles for all scenarios. This Origin-Destination matrix was distributed throughout the network using Dynamic Assignment in VISSIM.

The model was run multiple times using the same random seed number. VISSIM uses a random seed at the start of each simulation to determine the stochastic distribution of traffic volumes, platoons, lane change decisions etc. Using the same random seed during dynamic assignment ensures that all other parameters are equal other the distribution of traffic to varying routes between O-D pairs. During each iteration, new routes are found between each OD pair with obvious detours and costly routes being avoided. For all model runs, 15-minute warm-up and warm-down periods were included at either side of the peak hour to ensure that a realistic build up and release of traffic was achieved.

During each run the cost of each route, based on both time and financial costs, was calculated by VISSIM at regular intervals. Traffic was then distributed to varying routes based on how costly they are with more costly routes receiving less traffic and less costly routes received more. As the costs are calculated multiple times during the model run, the distribution of traffic responds to the actual network conditions, more accurately modelling reality.

The model was run repeatedly with the same random seed and O-D matrix until convergence was reached. Convergence is considered to be reached when travel times on all paths are within 20% between model runs for 95% of paths, indicating that the distribution is stable. The above process was carried out for each of the 20 scenarios that were modelled.

2.3. Traffic Signals

In all scenarios, signalised junctions were optimised using Linsig. This ensures that the results in all scenarios can be compared fairly, on a like for like basis, as they are all using an optimised traffic signal programme.

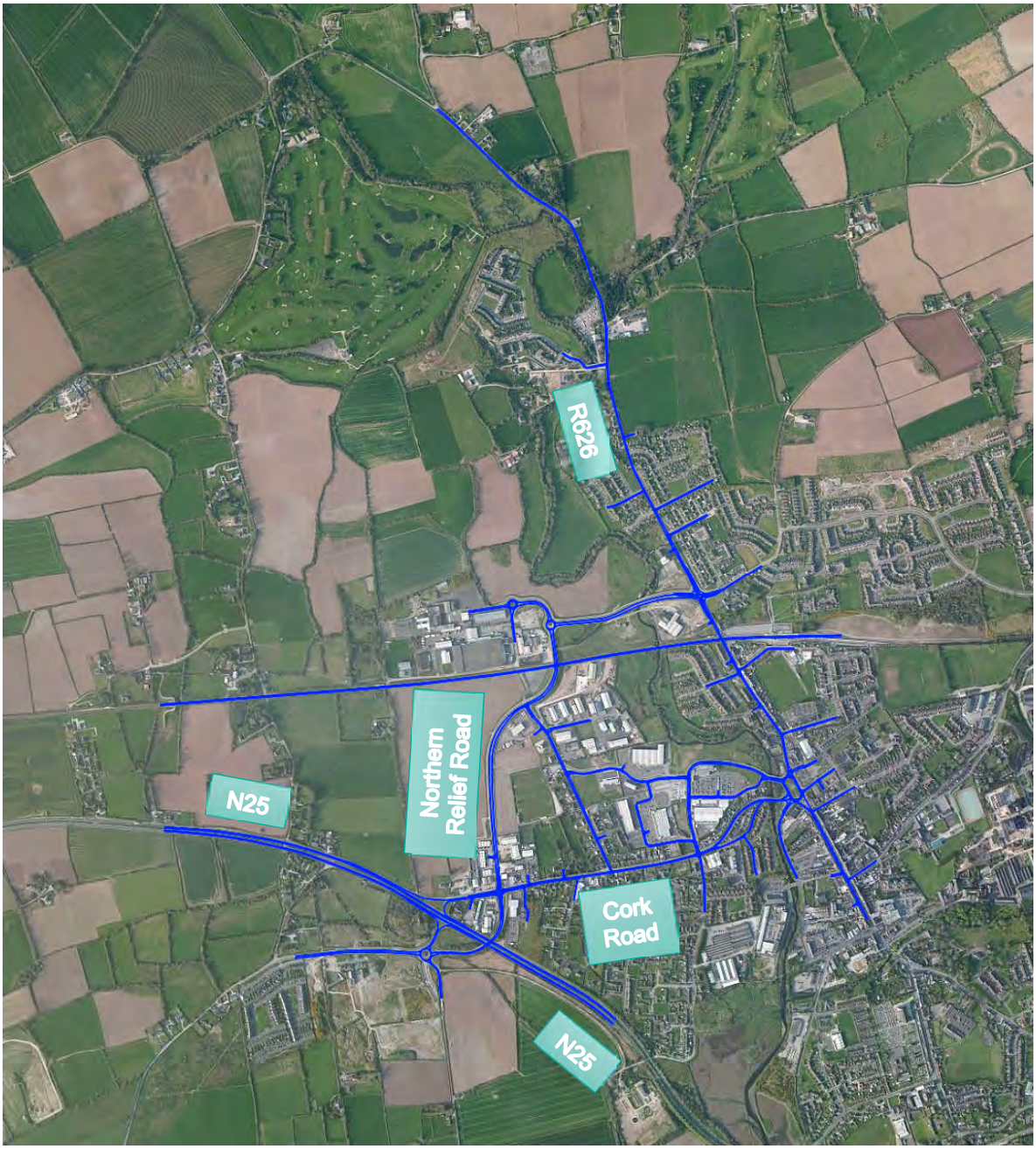
2.4. Model Calibration and Validation

Surcharges were applied to various links in both the AM and PM Peak Base Year scenarios in order to calibrate the model to match traffic survey data. The addition of surcharges to links changes the attractiveness of those links to traffic and can be used to account for such things as residential roads, on-street parking, high pedestrian activity and other issues that may make a route less attractive to traffic. Surcharges were added, and the model run until convergence in an iterative process until it was calibrated based on turning counts and travel times as discussed below.

2.4.1. Extent of Base Model

The extent of the base model is shown in the figure below:

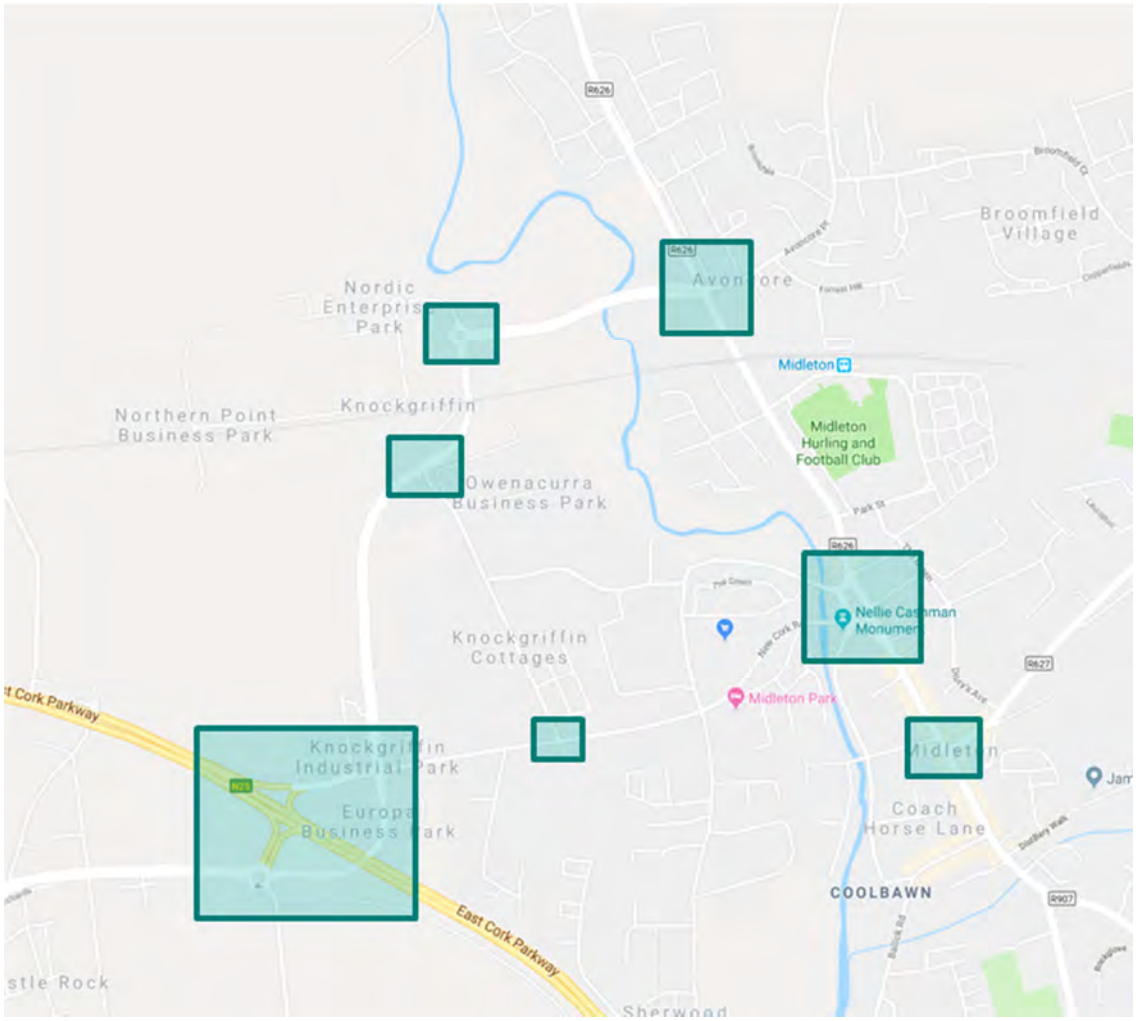
Figure 2-1 - Extent of Base Year Models



2.4.2. Traffic Count Calibration

Traffic turning counts at 7 no. junctions were used to calibrate the model. These turning counts were carried out in early 2018 on a neutral weekday and are, therefore, considered to be typical of traffic patterns in the area. The junctions in question are shown shaded in the figure below:

Figure 2-2 - Junction Turning Counts for Calibration



The modelled and observed turning counts for all movements at each of the junctions above were compared using the GEH statistic, as defined below:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where:

M = modelled count and C = observed count

The UK Transport Analysis Guidance (WebTAG) criteria for a valid traffic model is for 85% of turning movements to have a GEH value less than 5. Values between 5 – 10 may warrant further investigation while values greater than 10 can indicate an issue with traffic generation and distribution. The results the AM and PM Base Year scenarios are shown below

Table 1 - Base Year GEH Results

	AM Peak Base Year	PM Peak Base Year
GEH < 5	87% of movements	85% of movements
GEH < 7	98% of movements	94% of movements

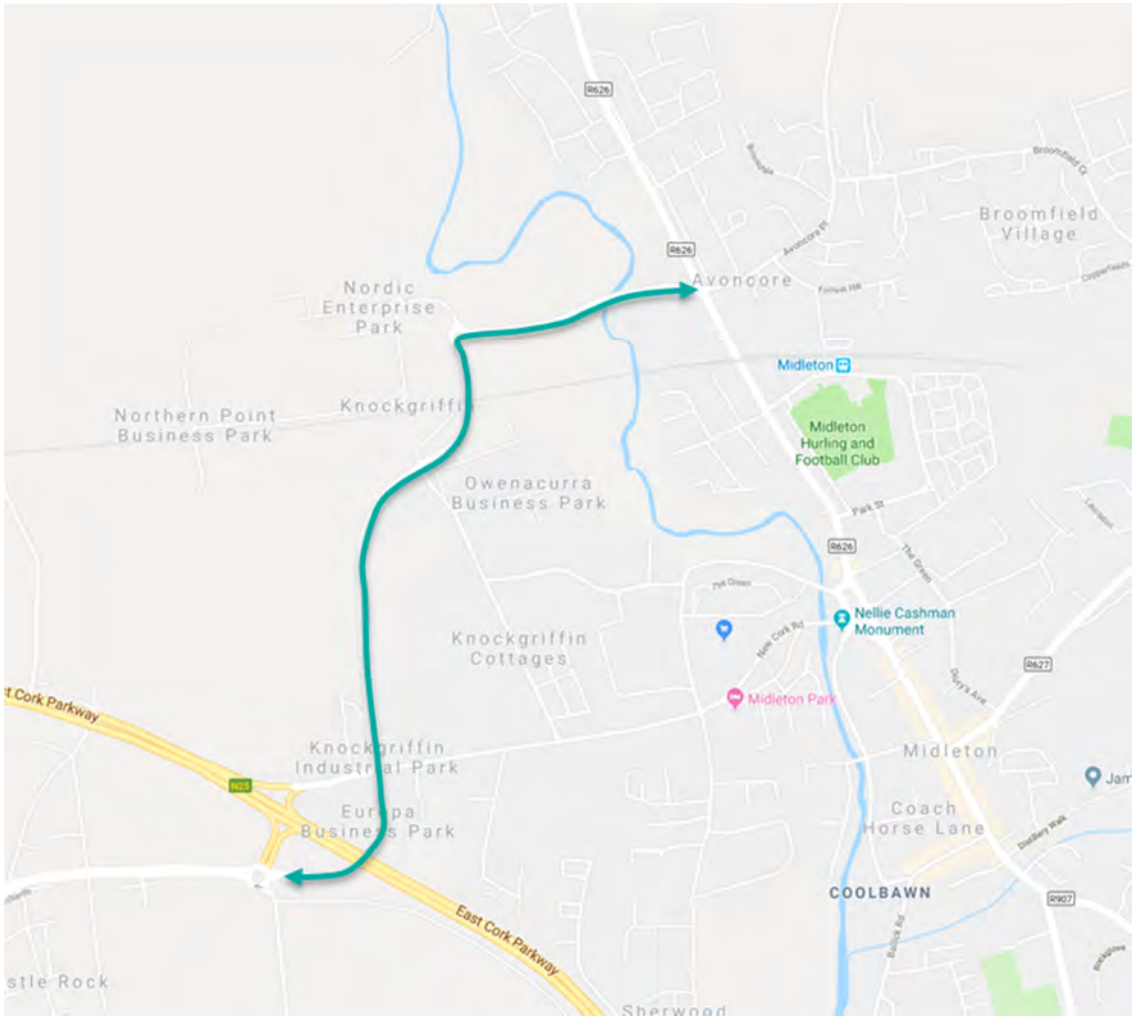
Both the AM and the PM Peak Base Year models have more than 85% of movements with a GEH value of 5 or less, while the percentage of movements with a GEH of less than 7 is in the mid to high nighties for both. This indicates that the model is a good fit for the real-world data. The

surcharges and coding for the existing network was then carried forward for each of the future year scenarios.

2.4.3. Journey Time Calibration

There was only two complete journey time survey routes within the VISSIM model study area. These were northbound and southbound on the Northern Relief Road as shown in the figure below:

Figure 2-3 - Journey Time Surveys



The WebTAG criteria for journey time validation is that modelled time along routes should be within 15% of surveyed times for greater than 85% of routes. As there is only surveyed data for one route within the VISSIM study area, only that route can be used for the purposes of journey time validation. The results for the AM and PM Peak Base Year scenarios are shown below:

Table 2 - Journey Time Validation

Scenario	Observed Time	Modelled Time	Percentage Difference
AM Southbound	196s	178s	-10.04%
AM Northbound	164s	169s	+2.73%
PM Southbound	211s	213s	+0.89%
PM Northbound	237s	222s	-6.92%

From the table above, it is clear that the model meets with the guidance for journey time validation. This coupled with the turning movement comparison indicates that the model is valid and a good fit for real world conditions.

2.5. Additional Assumptions

Other assumptions used within the model building process are set out below:

- Signalised junctions use a 10s all-red pedestrian phase allowing for pedestrian phase being called 2 out of every 3 cycles in reality
- AM Peak is from 07:45 to 08:45 as in the Local Area Model
- PM Peak is from 17:00 – 18:00 as in the Local Area Model
- Level crossing on R626 is closed for 2 mins 30s 4 time per hour for the base year, Phase 1a and Phase 1 scenarios. The closure times are as per current Irish Rail timetable.
- Level crossing closed for 2 mins 30s 8 times per hour for Phases 2 and 3

3. Results

3.1. General

The complete results are included in tabulated format in Appendix A. These include results for the Base Year Scenario as well as Do Minimum and Do Something Scenarios for each phase. The 'Do Minimum' scenario excludes the development of Water Rock and associated infrastructure but includes all other planned development. The 'Do Something' scenario includes the development of the Water Rock UEA and infrastructure proposals associated with the Water Rock UEA as well as all other planned development. Refer to the transport assessment for each phase of the development in the WRSTA (section 8 to 11) for further information on the Do Something and Do Minimum scenarios. AM and PM Peak hour results are given for each scenario. The following section summarises the key issues for each phase of development within the Water Rock UEA.

3.2. Phase 1a

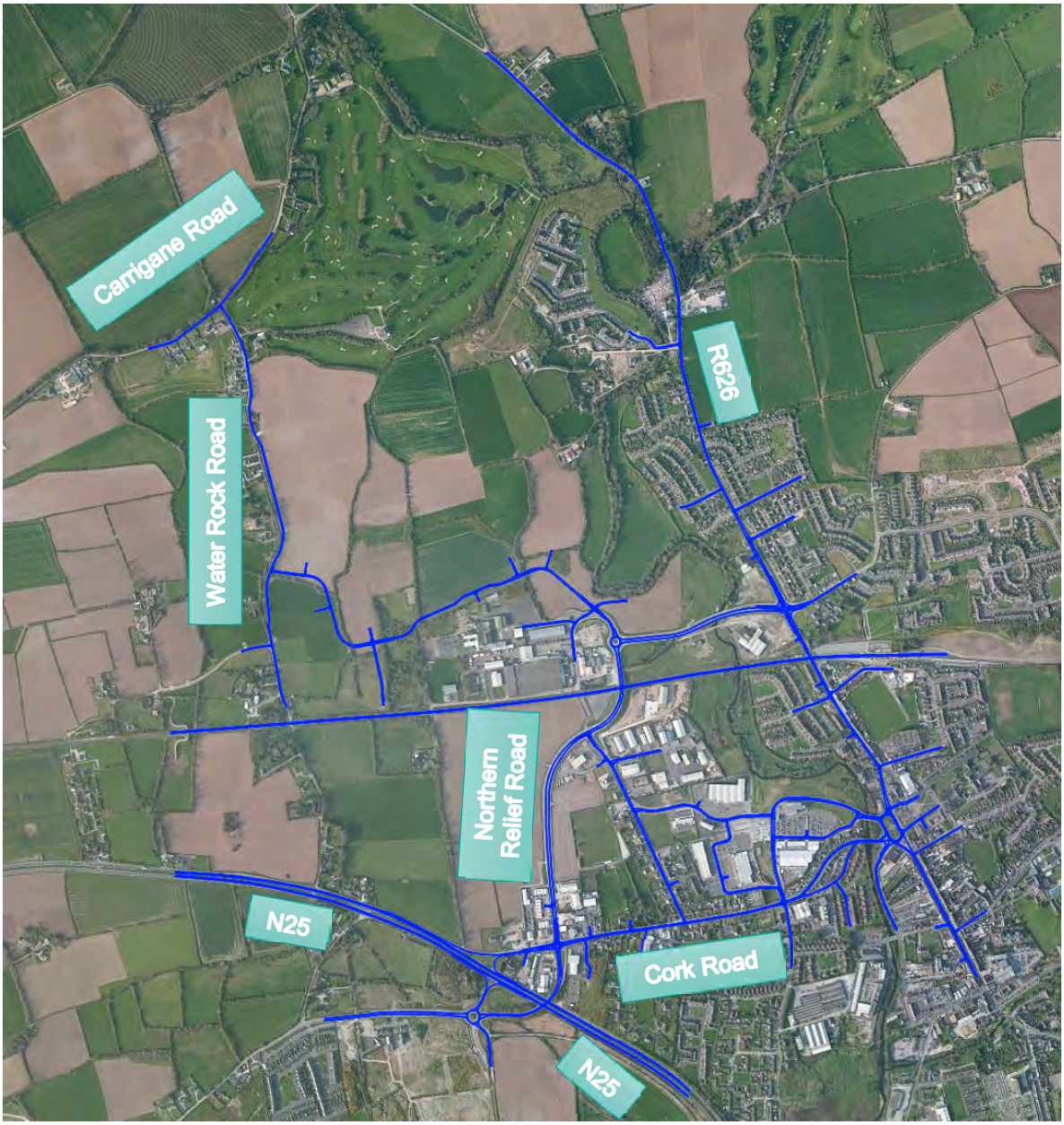
For Phase 1a the Do Minimum scenarios retain the existing Base Year network layout. The following additions and changes were made for the Do Something scenarios:

- Addition of Services Corridor Link Road with 3 new signalised junctions
- New signalised junction between Services Corridor Link Road and Water Rock Road
- Upgrade of Knockgriffin junction
- Traffic management measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)

The upgrade of the Knockgriffin junction included two options, one with the right turn from Cork Road to the Northern Relief Road northbound removed and one with it retained. Both scenarios were included in the analysis for Phase 1a.

The extent of the Do Something network is shown in the figure below.

Figure 3-1 - Phase 1a Do Something Model Extent



3.2.1. Do Minimum Scenarios

The network performs well in the Do Minimum scenarios for both the AM and PM peak hours. Average queues and delays are generally small across the network.

3.2.2. AM Peak Do Something Scenario

There is little difference between the options of allowing or banning the right turn at the Knockgriffin junction in the AM Peak with delays and queues broadly similar across the network.

In general, the network performs well in the AM peak with average delays of only 53 to 54s experienced network wide.

3.2.3. PM Peak Do Something Scenario

The network performs better in the PM Peak with the right turn ban in place with average delays reduced across the network. In particular, the average delay at the Knockgriffin junction is 17s less with the right turn ban in place, while the average queues are significantly reduced on all arms. This results in traffic, on average, queueing further away from the N25 with the right turn ban in place,

reducing instances of tailbacks onto the national road. The average queues are shown in yellow on the figures below for both scenarios:

Figure 3-2 - Phase 1a Knockgriffin Average Queue with Right Turn Banned

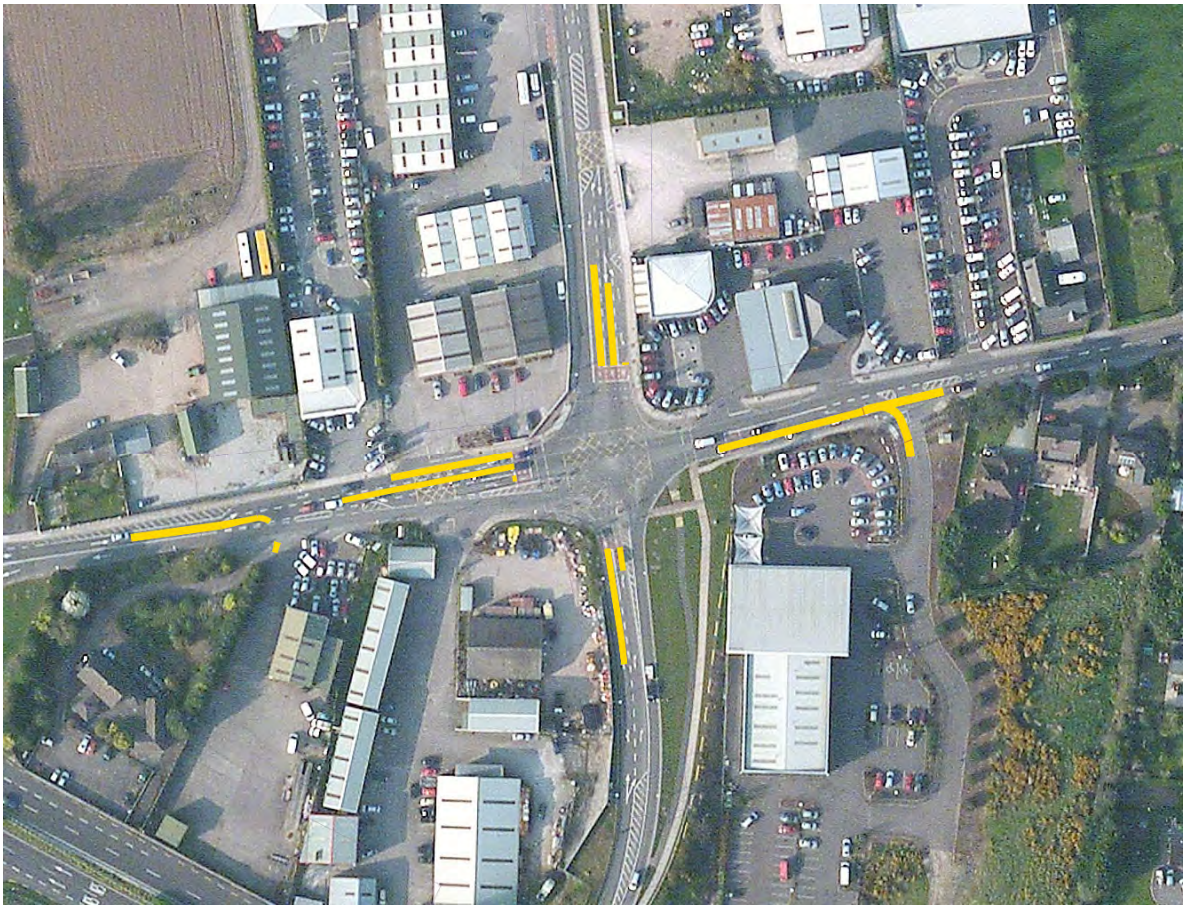


Figure 3-3 - Phase 1a Knockgriffin Average Queue with Right Turn Allowed

As a result of traffic moving more freely through the Knockgriffin junction in the Phase 1a With Right Turn Banned scenario, more congestion is experienced at the Midleton Gyratory than in the Right

Turn Allowed scenario. This is because, in effect, the queue has been moved from the N25 to the Cork Road. There is 17s average delay experienced by drivers at the Gyratory in the Right Turn Banned scenario while average queues on the Cork Road are longer in the PM Peak. This is shown in the figures below:

Figure 3-4 - Phase 1a Gyratory Average Queue with Right Turn Banned at Knockgriffin

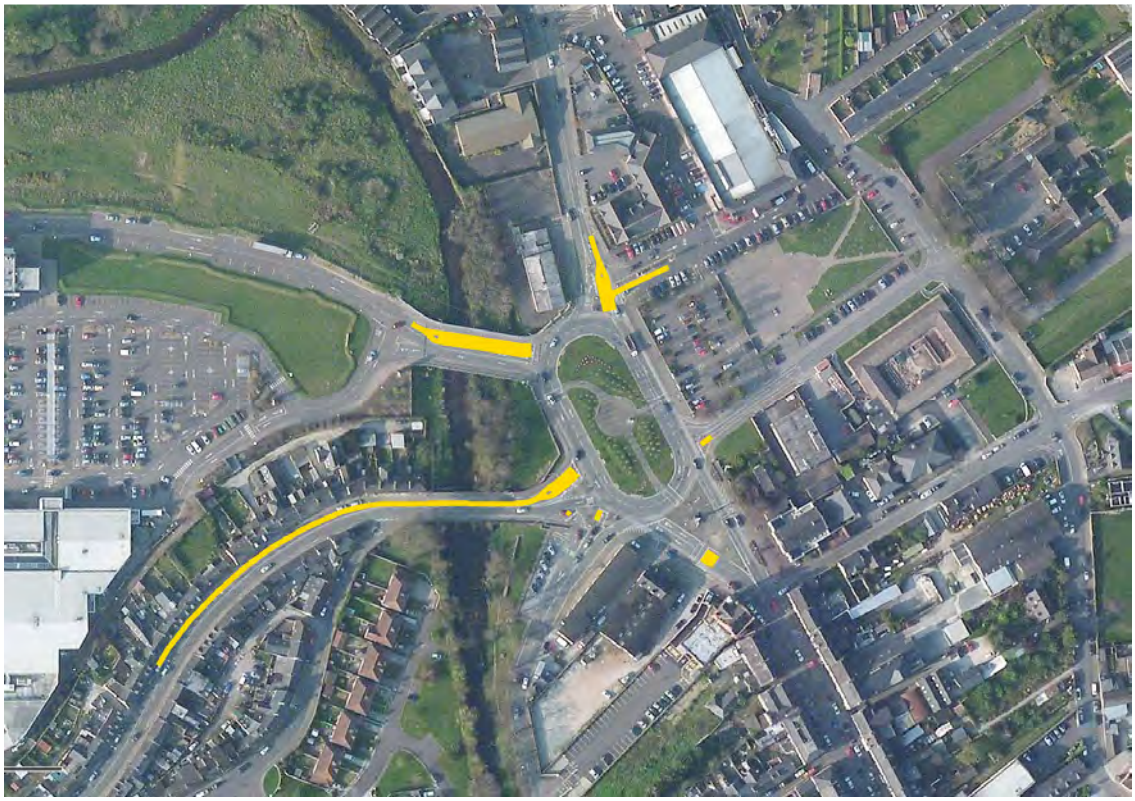


Figure 3-5 - Phase 1a Gyratory Average Queue with Right Turn Allowed at Knockgriffin

Despite the above, the overall network performance is better in the Right Turn Banned scenario with average delays 16s less than in the Right Turn Allowed scenario and with 29 hours less total delay across the network. Average travel times are similar in both scenarios with only a small increase of 20s travelling from the N25 to the Gyratory in the Right Turn Banned scenario.

3.2.4. Summary

Given that the network performs better with the right turn ban, and queueing is removed from the N25, a high speed traffic environment, it is recommended that the right turn from Cork Road to Northern Relief Road at the Knockgriffin junction is removed. The Base Year traffic counts and future modelled predictions suggest that the volume of vehicles making this movement is small and could be accommodated on other routes. Junctions which re-routed traffic use, i.e. junction of Cork Road and Avoncore Cottages (Kennel Road) and junction of Avoncore Cottages (Kennel Road) and the Midleton Northern Relief Road, continue to function well without mitigation.

The average queues and delays at other junctions throughout the network are small and suggest that the network is functioning well. Average delays of 1 minute and 4 seconds in the PM peak are considered to be very acceptable given the suburban/town nature of the network. These results suggest that no additional mitigation measures would be required to accommodate Phase 1a.

3.3. Phase 1

For Phase 1 the Do Minimum scenarios retain the existing Base Year network layout. The following additions and changes were made for the Do Something scenarios:

- Addition of Services Corridor Link Road with 3 new signalised junctions
- New signalised junction between Services Corridor Link Road and Water Rock Road
- Upgrade of Knockgriffin junction
- Traffic management measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)

As per the recommendations arising from the Phase 1a analysis, the right turn from Cork Road to Northern Relief Road at the Knockgriffin junction is assumed to be banned in Phases 1, 2 and 3 and these scenarios have been modelled only.

The extent of the Phase 1 model is as the Phase 1a model.

3.3.1. Do Minimum Scenarios

The network performs well in the Do Minimum scenarios for both the AM and PM peak hours. Average queues and delays are generally small across the network.

3.3.2. AM Peak Do Something Scenario

The network generally performs relatively well in the AM Peak Do Something scenario. Average delays across the network are 1 minute and 7 seconds. While this is an increase of 23s over the Do Minimum scenario it is still considered to be acceptable for traffic in the area.

Much of the delays are attributable to the Knockgriffin junction where there is an increase of 10s in the average delay over the Do Minimum scenario. Average queues on the Northern Relief Road Southbound and the Cork Road Westbound are relatively long at 30pcus and 36pcus respectively, as shown in the figure below. However, this is to be expected as large volumes of traffic try to access the N25 in the AM Peak.

No issues were observed at the Baneshane Roundabout in the modelling outputs with average queues and delays both very small.

Figure 3-6 - Phase 1 AM Peak Do Something Knockgriffin Junction Average Queues

Queues and delays across the rest of the network are all acceptable. The figures below show the average speed across the network for the AM Peak hour, indicating that it is generally performing well.

Figure 3-7 - Phase 1 AM Peak Do Something Average Speeds Southern Section

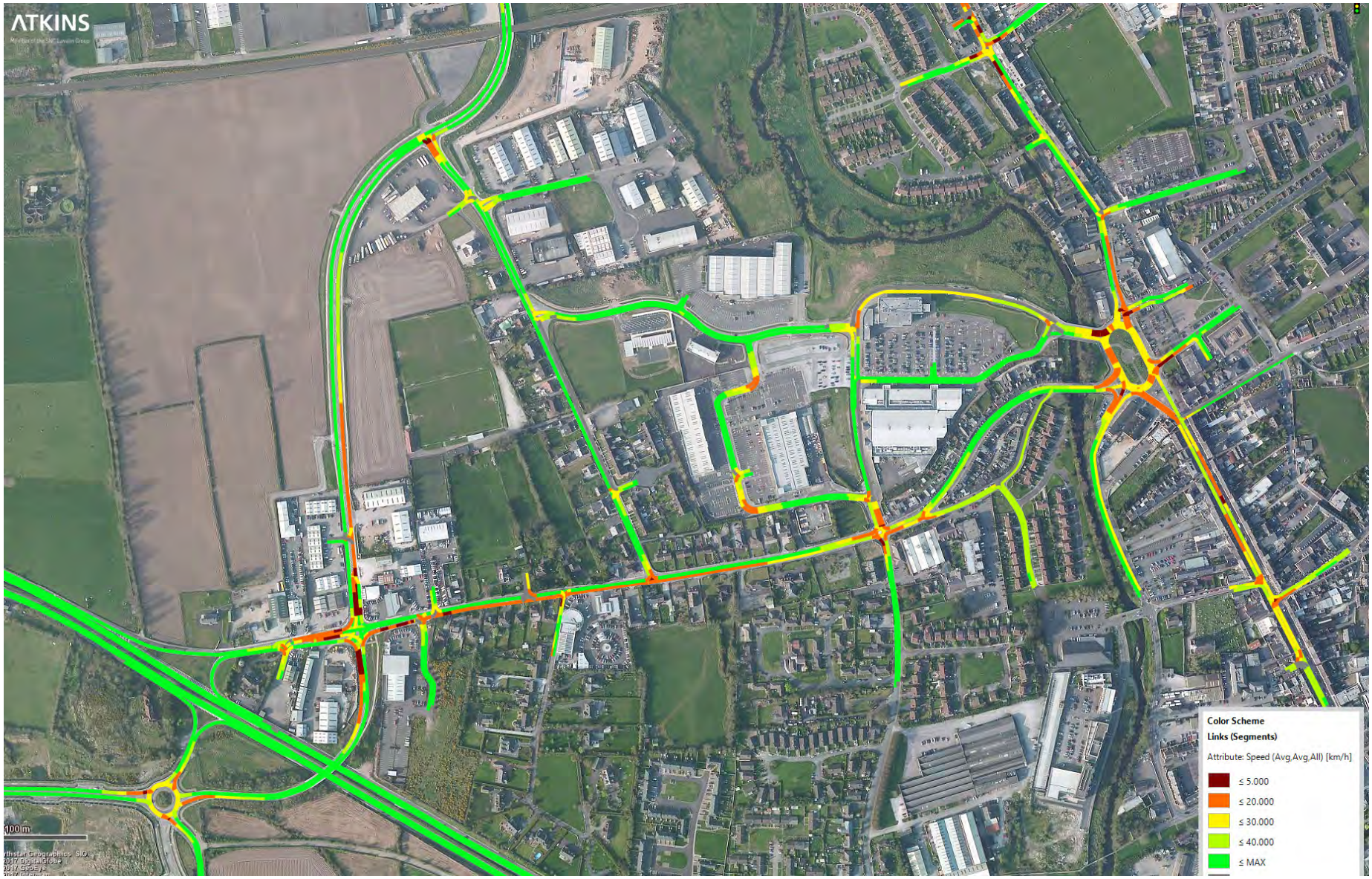


Figure 3-8 - Phase 1 AM Peak Do Something Average Speeds Northern Section

3.3.3. PM Peak Do Something Scenario

There is more congestion experienced in the PM Peak Do Something Scenario, with average delays of 1 minute and 34 seconds across the network.

As with the AM Peak, much of this delay is experienced at the Knockgriffin junction where there is an increase of 36s in average delay compared to the Do Minimum Scenario. There is also approximately 15s of additional average delay at the Mill Road/Northern Relief Road, Gyratory and Northern Relief Road junctions.

The average delay for this scenario at the Knockgriffin junction is 1 minute and 13 second, which is still considered to be acceptable for an urban area. The average queues remain manageable and queues do not typically extend onto the N25, as shown in the figure below.

Figure 3-9 - Phase 1 PM Peak Do Something Scenario Knockgriffin Average Queues

The average queues across the rest of the network are shown on the figure below. In general, they are all of acceptable length and do not cause undue delays.

Figure 3-10 - Phase 1 PM Peak Do Something Scenario Network Average Queues

The average queue on the Cork Road at the Gyratory is reduced compared to Phase 1a as traffic does not move as freely through the Knockgriffin junction.

There is an average queue of approximately 7pcus at the Avoncore Cottages/Northern Relief Road junction, which may back up along Avoncore Cottages from time to time. However, the average delay at this junction is only 12s which would suggest that signalisation of this priority junction is not required at this stage.

Occasionally, traffic travelling southbound backs up on the Services Corridor Link Road from the Northern Relief Road Roundabout through the signalised junction to the north of the roundabout. This is largely as a result of the roundabout capacity and the volume of traffic turning right at it to stay on the Northern Relief Road. However, the average delays at the junctions are 30s and 19s, suggesting that this is only an occasional issue and clears quickly.

Queues and delays across the rest of the network are all acceptable. The figures below show the average speed across the network for the PM Peak hour, indicating that it is generally performing acceptably.

Figure 3-11 - Phase 1 PM Peak Do Something Average Speeds Southern Section

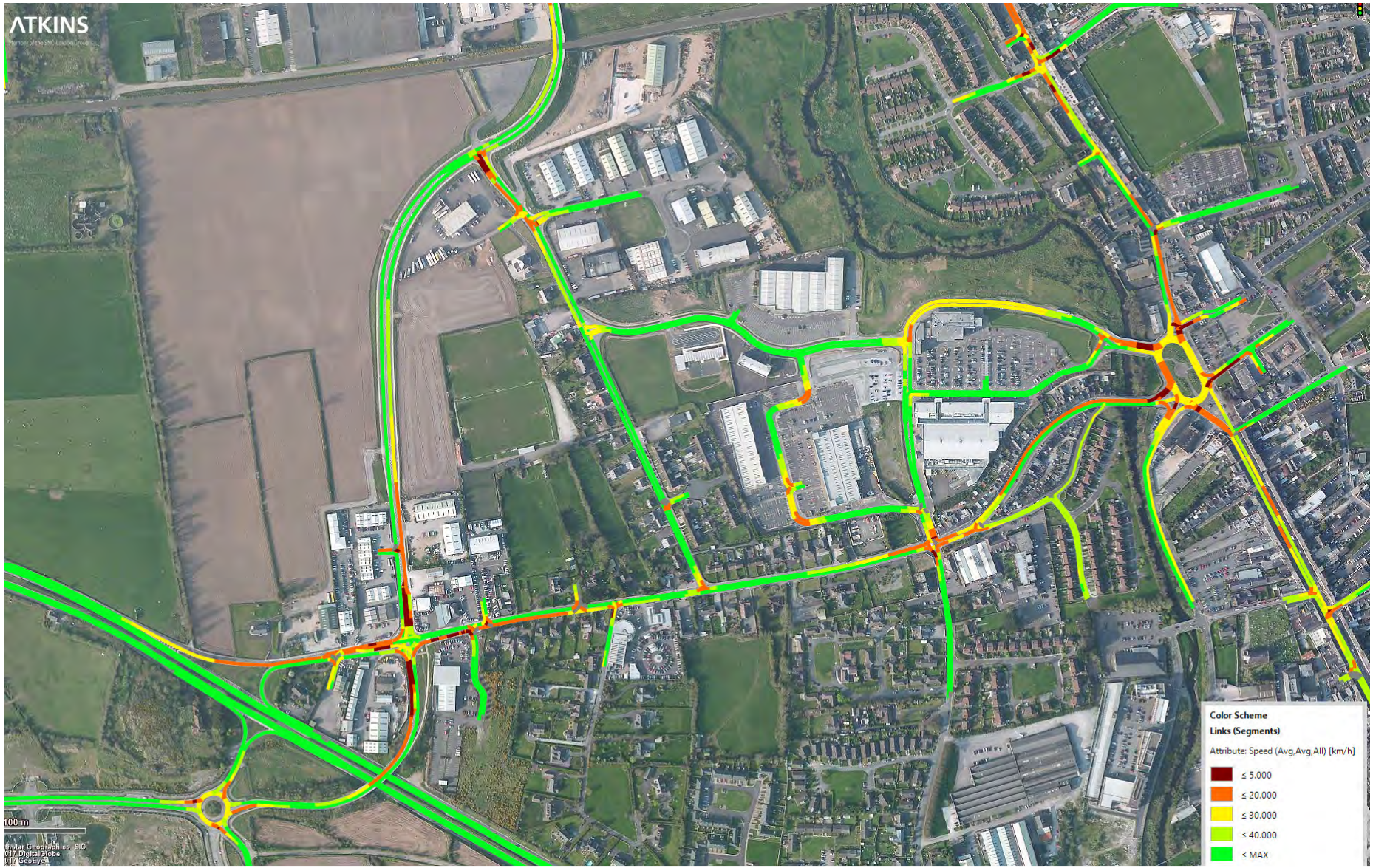


Figure 3-12 - Phase 1 PM Peak Do Something Average Speeds Northern Section

3.3.4. Summary

Average queues and delays in the AM and PM Peaks suggest that the network generally has adequate capacity for Phase 1 of the Water Rock UEA development. However, the Knockgriffin junction is operating close to capacity in these peak hours while it is likely that queues and delays will be experienced at the Gyratory from time to time.

There is some queueing on Avoncore Cottages (Kennel Road) at its junction with the Northern Relief Road. However, these are of an acceptable length and the average delays at the junction suggest that mitigation measures are not required at this stage. The modelling does not indicate queuing or delays at the junction of the Cork Road and Avoncore Cottages (Kennel Road) and mitigation measures are not required at this junction.

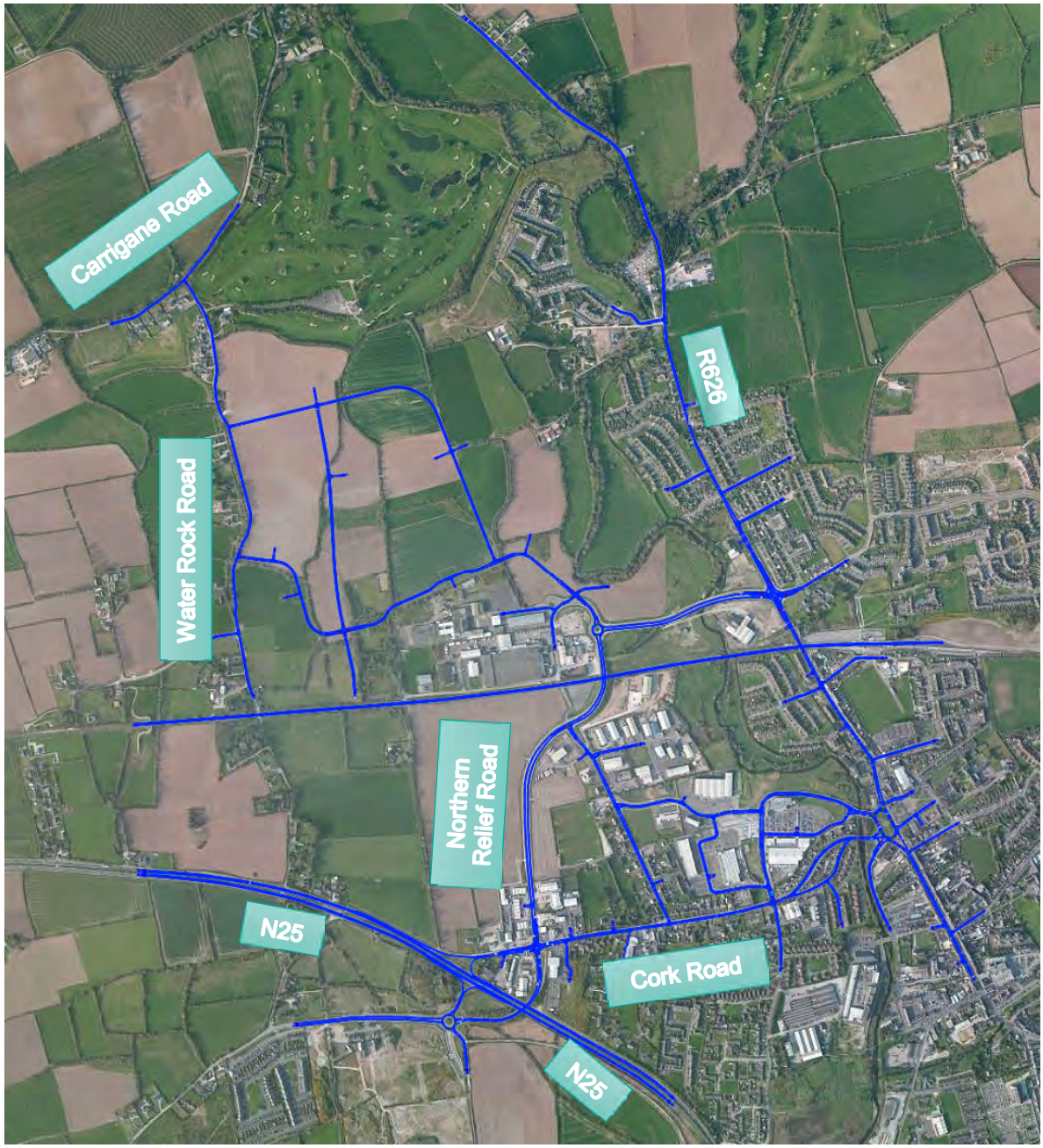
3.4. Phase 2

For Phase 2 the Do Minimum scenarios retain the existing Base Year network layout. The following additions and changes were made for the Do Something scenarios:

- Addition of Services Corridor Link Road with 3 new signalised junctions
- New signalised junction between Services Corridor Link Road and Water Rock Road
- Upgrade of Knockgriffin junction
- Traffic management measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)
- New Loop Road within UEA
- New signalised junction between Loop Road and Water Rock Road
- Signalisation of existing priority junction between Water Rock Road and Carrigane Road

The extent of the Phase 2 Do Something network is shown in the figure below.

Figure 3-13 - Phase 2 Do Something Model Extent



3.4.1. Do Minimum Scenarios

The network performs within capacity for both the AM and PM Peak Do Minimum Scenarios with average delays of around 50 to 60s across the network. Average queues and delays at all junctions are acceptable.

3.4.2. AM Peak Do Something Scenario

There is a relatively large increase in the average delay of approximately 50s across the network for the AM Peak in this Phase compared to Phase 1. Average delays of 1 minute and 57 seconds coupled with total delay across the network of 293 hours suggest that the network is congested.

This can be seen most obviously at the Mill Road/Northern Relief Road junction where average delays have increased from 51s in the Do Minimum scenario to 1 minute and 53 seconds. Average queues have also increase significantly from 3pcus to 32pcus.

There is also a large increase in average delays and queues at the Northern Relief Road roundabout and an increase in average queues at the Mill Road arm of the Gyratory.

3.4.3. PM Peak Do Something Scenario

The average delay across the network for the PM Peak is 6 minutes and 32 seconds with total delay of 813 hours experienced. Both of these results suggest that the network is operating far beyond capacity in this phase.

Significant queues and delays are seen at the Knockgriffin junction, Midleton Gyratory, Mill Road/Northern Relief Road junction and the Northern Relief Road Roundabout. The queue at Knockgriffin junction can back up onto the N25 in both directions resulting in reductions of capacity.

Travel times are also significantly increased with the average travel time from the N25 to the Gyratory being 14 minutes and 11 seconds.

3.4.4. Summary

While the network performs just about within capacity for the AM Peak Do Something scenario, it is far over capacity in the PM Peak, with gridlock effectively occurring throughout the network.

The increase of frequency of the level crossing being closed has a significant impact on the road network with increased queues on Mill Road and the Northern Relief Road resulting in both the AM and PM peaks. This is more important in the AM Peak where this has the most direct impacts, while the PM Peak is over capacity regardless.

Given the results for this Phase, it is likely that the infrastructure improvements included in Phase 3 would be required at this earlier stage.

3.5. Phase 3

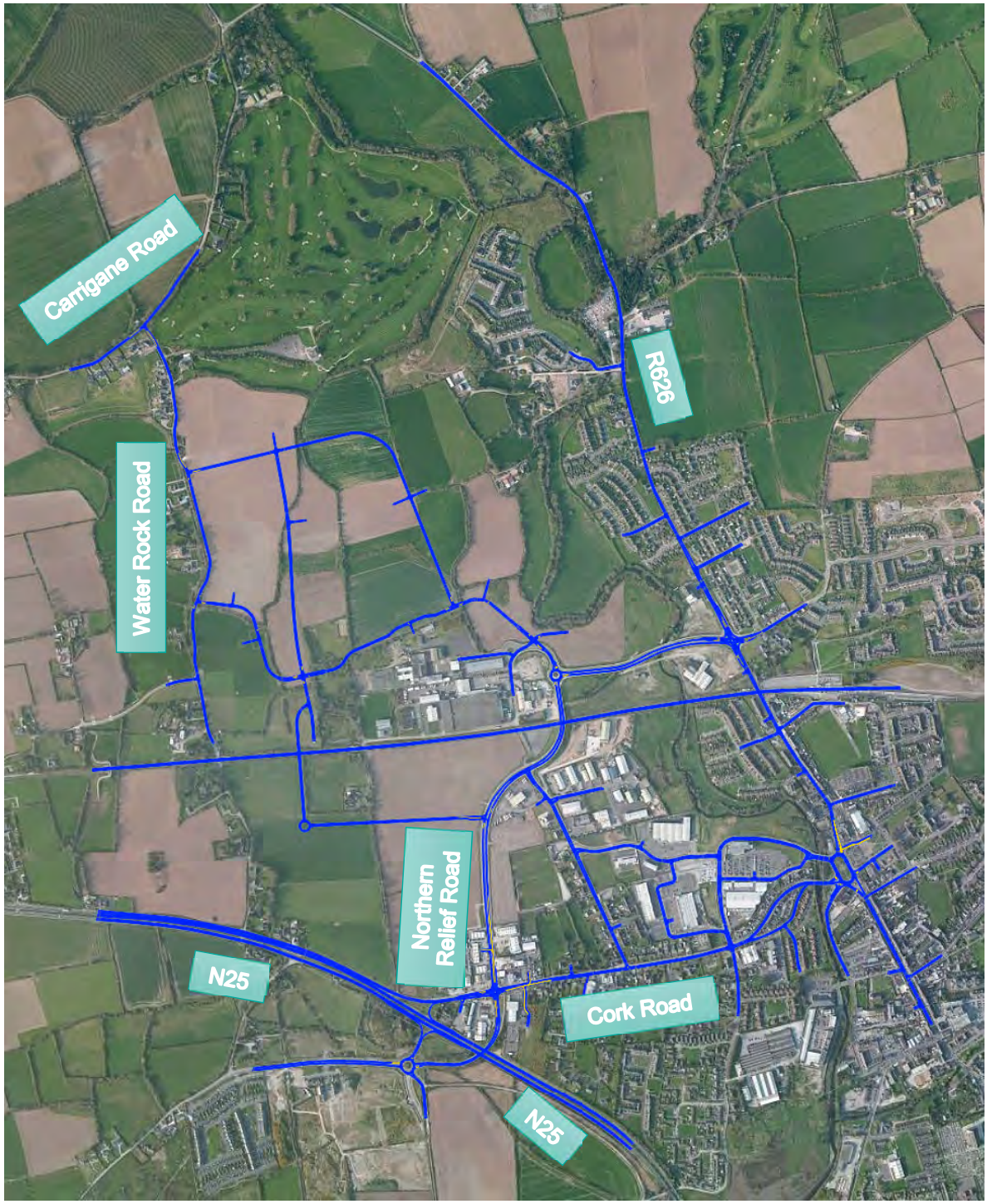
For Phase 3 the Do Minimum scenarios retain the existing Base Year network layout but with the addition of a parallel road to the N25 accessing the Knockgriffin junction eastbound, rather than traffic accessing directly from the N25.

The following additions and changes were made for the Do Something scenarios:

- Addition of Services Corridor Link Road with 3 new signalised junctions
- New signalised junction between Services Corridor Link Road and Water Rock Road
- Upgrade of Knockgriffin junction
- Traffic management measures for Water Rock Road (Closure of Water Rock Rd to vehicular traffic at railway level crossing of Water Rock Road to prevent increase in traffic using Water Rock Road / N25 Junction)
- New Loop Road within UEA
- New signalised junction between Loop Road and Water Rock Road
- Signalisation of existing priority junction between Water Rock Road and Carrigane Road
- Parallel road as part of N25 upgrade as for Do Minimum scenario
- New bridge over railway to link Services Corridor Link Road to Northern Relief Road including new signalised junction on Northern Relief Road
- Upgrade of the Midleton Gyratory

The extent of the Phase 3 Do Something network is shown in the figure below.

Figure 3-14 - Phase 3 Do Something Model Extent



For the purposes of this assessment, the impacts of a notional upgrade of the Midleton Gyratory were modelled by coding very small gap times and reducing conflict areas to increase capacity and reduce queues. It should be noted that this is not a practical solution for the upgrade scheme. The development of options for upgrading the Midleton Gyratory is outside the scope of this study. It is recommended that a further study should be completed to develop and assess options for upgrading the Gyratory to determine the preferred upgrade scheme and to assess the effects on traffic flows throughout Midleton town centre.

3.5.1. Do Minimum Scenarios

The network is generally operating just at capacity in the AM Peak Do Minimum scenario while it is over capacity in the PM Peak where the average delay across the network is 2 minutes and 28 seconds and travel time from the N25 to the Gyratory is almost 13 minutes.

Long delays and queues are experienced at the Knockgriffin junction, Mill Road/Northern Relief Road and Gyratory in the PM Peak.

3.5.2. AM Peak Do Something Scenario

The AM Peak in this Phase performs better than in Phase 2 as the proposed infrastructure increases the network capacity. Average delays across the network are at 1 minute and 21 seconds but are still within an acceptable range. Additionally, travel times are reasonable across the network.

The junctions function relatively well in the AM Peak with acceptable delays and queues as seen in the figure below.

Figure 3-15 - Phase 3 AM Peak Average Queues

Similar to previous phases the largest delays and queues are experienced at the Knockgriffin junction which is operating just at capacity despite the upgrade of the N25 with the parallel road.

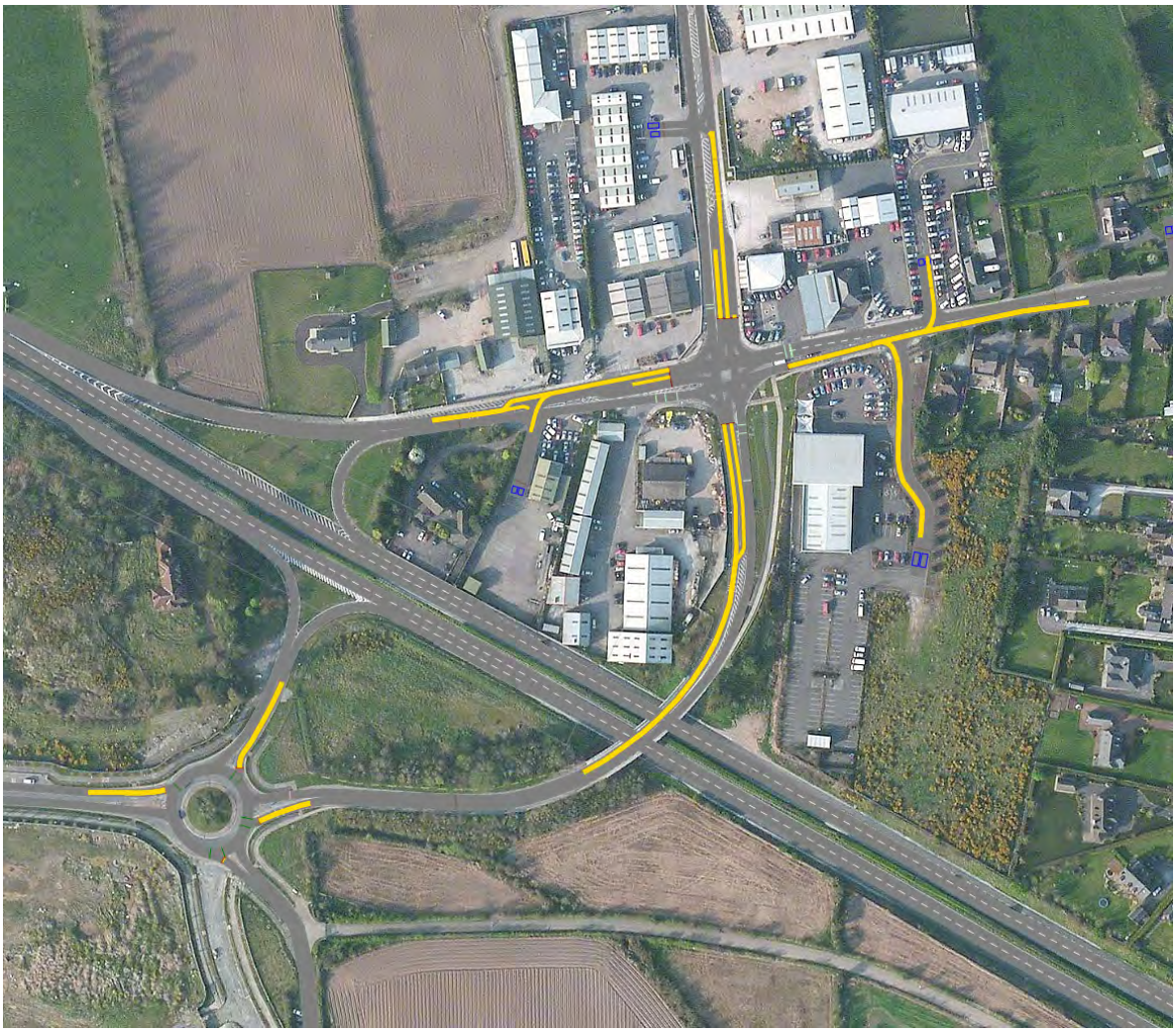
3.5.3. PM Peak Do Something Scenario

As with the AM Peak, the network in Phase 3 performs much better in the PM Peak compared to Phase 2. However, there are a number of issues across the network that lead to the average delay being just over 3 minutes with total delays over 470 hours.

The Knockgriffin junction is operating at or just beyond capacity in the PM Peak with long average queues and delays on a number of arms. In particular, queueing can build up on the Northern Relief Road northbound, potentially affecting the Baneshane roundabout and the N25 westbound. The

average delay at the junction is 1 minute and 9 seconds, however, which is considered to be generally acceptable. The average queues are shown in the figure below;

Figure 3-16 - Phase 3 PM Peak Knockgriffin Junction Average Queues



The upgrade of the Midleton Gyratory allows traffic to move efficiently through that portion of the network and does not contribute much to the network delay.

However, there are long delays experienced towards the northern part of the network at the Mill Road/Northern Relief Road junction and the Northern Relief Road Roundabout as seen in the figure below.

At the Mill Road/Northern Relief Road junction there are considerable delays and queues at all arms. While some of this can be attributed to the impact of the level crossing on Mill Road, the Linsig analysis of the junction suggests that it is operating beyond capacity with a Practical Reserve Capacity of -14.7%.

There are long average queues at the Northern Relief Roundabout also, which back up through adjacent junctions causing additional delays and queues, particularly along the Services Corridor Link Road. This is as a result of the roundabout being over capacity at this stage with a very large volume of vehicles turning right to stay on the Northern Relief Road being unopposed and the roundabout itself being relatively small.

The junction at Avoncore Cottages and the Northern Relief Road also sees long average queues and delays as a result of the volume of traffic on the Northern Relief Road and the length of the queue formed at the roundabout. The delays and queues at this location would not be considered acceptable and could cause issues to surrounding junctions.

Figure 3-17 - Phase 3 PM Peak Average Queues Northern Section

3.5.4. Summary

The PM Peak in the Do Minimum scenario is over capacity, primarily at the Gyratory. This suggests that mitigation measures at this junction will be required in the future regardless of the development of the Water Rock UEA.

The network performs acceptably in the AM Peak Do Something scenario although the impacts of the level crossing closure frequency and the capacity of the Knockgriffin junction need to be considered.

There are a number of issues with the network in the PM Peak Do Something scenario even with the proposed infrastructure improvements. It is likely that the below mitigation measures will also be required to ensure that the network can meet demand:

- Upgrade of the Knockgriffin junction, e.g. extending right turn lanes on Northern Relief Road in both directions, providing additional lanes etc. A survey of the arms of the junction is required to assess the feasibility of extending lanes or providing additional lanes at this junction.
- Signalisation of the existing priority junction at Avoncore Cottages and the Northern Relief Road
- Signalisation of the Northern Relief Road Roundabout and linking to signalised junction on Services Corridor Link Road
- Upgrade of the Mill Road/Northern Relief Road junction, e.g. lengthening of lanes on all approaches

The above measures in conjunction with those set out previously would allow the network to meet the demand as a result of the development of the Water Rock UEA. However, the impact of the level crossing may still cause issues at the northern end of the network.

4. Conclusions and Recommendations

The conclusions and recommendations arising from the analysis described above and the full results available in Appendix A are set out below.

- There is more than adequate capacity in the network to accommodate Phase 1a with the proposed infrastructure.
- The right turn from the Cork Road westbound to Northern Relief Road northbound at the Knockgriffin junction should be banned as this improves the overall network performance and removes queues from the N25.
- There is adequate capacity in the network to cater for the development of Phase 1 with the proposed infrastructure. However, a number of junctions, particularly the Knockgriffin junction will operate at or very close to capacity. No additional mitigation measures are required for this phase.
- The network does not have sufficient capacity, particularly in the PM Peak, to cater for Phase 2 with the infrastructure proposed. Infrastructure currently proposed for Phase 3 would be required in Phase 2. This includes the upgrade of the N25.
- Additional mitigation measures are required to provide adequate capacity in the PM Peak for Phase 3 including:
  - Upgrade of the Knockgriffin junction, e.g. extending right turn lanes on Northern Relief Road in both directions, providing additional lanes etc.
  - Signalisation of the existing priority junction at Avoncore Cottages and the Northern Relief Road
  - Signalisation of the Northern Relief Road Roundabout and linking to signalised junction on Services Corridor Link Road
  - Upgrade of the Mill Road/Northern Relief Road junction, e.g. lengthening of lanes on all approaches
- The increased frequency of the level crossing closure has significant impacts on the surrounding road network. This should be carefully considered as part of future planning.
- The Midleton Gyratory is over capacity in the future even without the development of the Water Rock UEA. The development of options for upgrading the Midleton Gyratory is outside the scope of this study. It is recommended that a further study should be completed to develop and assess options for upgrading the Gyratory to determine the preferred upgrade scheme and to assess the effects on traffic flows throughout Midleton town centre.

Appendices

Appendix A. Model Results

A.1. Knockgriffin Junction

Table 3 - Knockgriffin AM Peak Average Delays

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Northern Relief Road Southbound										
Left Turn	1 m 8 s	38 s	1 m 15 s	1 m 2 s	1 m 5 s	1 m 16 s	43 s	1 m 19 s	1 m 41 s	1 m 13 s
Straight	40 s	37 s	1 m 27 s	1 m 4 s	59 s	1 m 21 s	54 s	1 m 11 s	1 m 34 s	1 m 13 s
Right Turn	1 m 3 s	1 m 23 s	1 m 47 s	1 m 32 s	1 m 29 s	1 m 37 s	1 m 32 s	1 m 39 s	1 m 51 s	1 m 26 s
Cork Road Westbound										
Straight/Left Turn	1 m 1 s	57 s	1 m 1 s	1 m 11 s	1 m 0 s	1 m 23 s	1 m 5 s	51 s	57 s	1 m 23 s
Right Turn	1 m 6 s	1 m 7 s	N/A	1 m 3 s	1 m 3 s	N/A	1 m 23 s	N/A	56 s	N/A
Northern Relief Road Northbound										
Left/Straight	43 s	49 s	49 s	53 s	52 s	49 s	52 s	40 s	52 s	1 m 31 s
Right Turn	1 m 5 s	1 m 2 s	1 m 8 s	1 m 15 s	1 m 9 s	1 m 22 s	1 m 19 s	1 m 37 s	1 m 26 s	1 m 17 s
Cork Road Eastbound										
Left Turn	33 s	24 s	18 s	26 s	26 s	26 s	28 s	31 s	31 s	30 s
Straight	32 s	29 s	20 s	26 s	26 s	25 s	29 s	30 s	36 s	35 s
Right Turn	1 m 24 s	1 m 28 s	1 m 16 s	1 m 5 s	1 m 18 s	1 m 21 s	1 m 31 s	1 m 21 s	1 m 45 s	27 s
Junction Average	**45 s**	**47 s**	**57 s**	**56 s**	**51 s**	**1 m 1 s**	**54 s**	**53 s**	**1 m 6 s**	**1 m 1 s**

Table 4 - Knockgriffin AM Peak Average Queues (pcus)

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Northern Relief Road Southbound										
Left Turn	0.04	0.00	0.01	0.05	0.02	0.07	0.03	0.12	0.03	0.06
Straight	7.32	4.20	24.69	7.35	8.46	30.14	7.62	38.89	33.85	31.50
Right Turn	1.94	2.27	24.69	3.55	3.68	30.14	3.62	38.89	33.85	31.50
Cork Road Westbound										
Straight/Left Turn	11.83	20.59	20.80	35.24	17.33	36.49	26.49	7.28	9.69	21.74
Right Turn	0.14	0.09	N/A	0.03	0.59	N/A	0.09	N/A	0.06	N/A
Northern Relief Road Northbound										
Left Turn	1.44	2.87	3.31	4.21	3.33	6.42	4.05	10.45	5.12	7.68
Right Turn	1.40	1.24	1.49	1.79	1.60	1.65	2.53	2.42	4.67	4.02
Cork Road Eastbound										
Left Turn	1.53	0.93	1.13	2.95	1.09	2.14	1.28	7.98	1.37	2.85
Straight	4.78	3.30	1.51	2.01	3.03	2.53	3.09	5.33	3.49	1.94
Right Turn	0.80	1.02	0.94	0.70	0.83	1.10	1.45	1.37	0.41	0.04

Table 5 - Knockgriffin PM Peak Average Delays

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Northern Relief Road Southbound										
Left Turn	1 m 24 s	1 m 9 s	1 m 3 s	1 m 7 s	1 m 7 s	1 m 51 s	1 m 7 s	1 m 4 s	2 m 52 s	1 m 9 s
Straight	1 m 17 s	58 s	52 s	56 s	1 m 1 s	1 m 42 s	54 s	51 s	2 m 52 s	1 m 5 s
Right Turn	1 m 22 s	1 m 6 s	1 m 11 s	1 m 11 s	1 m 7 s	2 m 0 s	1 m 12 s	1 m 12 s	3 m 8 s	1 m 16 s
Cork Road Westbound										
Straight/Left Turn	43 s	41 s	51 s	1 m 7 s	44 s	1 m 14 s	39 s	59 s	1 m 1 s	1 m 31 s
Right Turn	1 m 6 s	1 m 7 s	N/A	1 m 25 s	1 m 4 s	N/A	N/A	N/A	N/A	N/A
Northern Relief Road Northbound										
Left Turn	1 m 25 s	1 m 3 s	1 m 2 s	57 s	1 m 12 s	1 m 37 s	1 m 7 s	3 m 6 s	2 m 14 s	1 m 35 s
Right Turn	1 m 12 s	1 m 1 s	1 m 13 s	1 m 15 s	59 s	2 m 8 s	1 m 12 s	2 m 46 s	3 m 59 s	2 m 26 s
Cork Road Eastbound										
Left Turn	52 s	22 s	31 s	1 m 0 s	22 s	53 s	22 s	2 m 19 s	1 m 7 s	46 s
Straight	51 s	24 s	31 s	1 m 0 s	22 s	48 s	22 s	1 m 38 s	2 m 19 s	49 s
Right Turn	2 m 3 s	1 m 32 s	1 m 36 s	1 m 59 s	1 m 9 s	1 m 42 s	1 m 17 s	2 m 15 s	4 m 2 s	36 s
Junction Average	**1 m 0 s**	**36 s**	**45 s**	**1 m 2 s**	**37 s**	**1 m 13 s**	**39 s**	**1 m 46 s**	**2 m 2 s**	**1 m 9 s**

Table 6 - Knockgriffin PM Peak Average Queues (pcus)

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Northern Relief Road Southbound										
Left Turn	0.26	0.14	0.13	0.12	0.14	0.11	0.13	0.09	43.04	0.26
Straight	11.16	3.20	3.77	4.87	3.41	20.38	3.38	2.15	43.04	14.80
Right Turn	4.35	2.12	4.62	4.87	1.97	20.38	1.75	6.95	43.04	5.45
Cork Road Westbound										
Straight/Left Turn	8.96	7.05	10.55	17.50	8.32	17.28	9.55	7.22	14.67	24.26
Right Turn	0.49	0.65	N/A	1.27	0.48	N/A	N/A	N/A	N/A	N/A
Northern Relief Road Northbound										
Left Turn	5.18	2.00	5.30	4.18	3.07	15.30	3.85	37.09	39.79	32.34
Right Turn	0.86	1.21	1.09	1.92	1.20	1.82	1.83	0.94	39.79	32.34
Cork Road Eastbound										
Left Turn	10.02	1.33	5.64	42.75	1.64	28.01	2.19	69.96	38.12	19.30
Straight	40.15	5.51	8.00	42.75	4.11	28.01	3.64	69.96	38.12	19.30
Right Turn	40.15	0.10	0.21	0.20	0.08	0.46	0.21	69.96	38.12	19.30

A.2. Mill Road/Northern Relief Road Junction

Table 7 – Mill Road/Northern Relief Road AM Peak Average Delays

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
R626 Southbound										
Left Turn	28 s	30 s	32 s	31 s	37 s	32 s	28 s	1 m 13 s	31 s	40 s
Straight	37 s	38 s	40 s	37 s	44 s	47 s	47 s	2 m 38 s	56 s	1 m 10 s
Right Turn	45 s	47 s	43 s	45 s	47 s	47 s	52 s	1 m 40 s	46 s	57 s
Avoncore Westbound										
Left Turn	45 s	39 s	41 s	40 s	43 s	54 s	56 s	2 m 6 s	1 m 11 s	1 m 17 s
Straight	44 s	38 s	39 s	41 s	42 s	45 s	47 s	1 m 30 s	58 s	59 s
Right Turn	1 m 2 s	59 s	1 m 5 s	1 m 4 s	1 m 5 s	1 m 11 s	1 m 6 s	1 m 44 s	1 m 4 s	1 m 23 s
R626 Northbound										
Left Turn	54 s	51 s	59 s	50 s	50 s	51 s	59 s	1 m 21 s	1 m 13 s	1 m 23 s
Straight	54 s	1 m 1 s	1 m 3 s	53 s	1 m 6 s	52 s	1 m 10 s	1 m 26 s	1 m 24 s	1 m 22 s
Right Turn	1 m 16 s	1 m 16 s	1 m 13 s	1 m 8 s	1 m 14 s	1 m 5 s	1 m 21 s	1 m 54 s	1 m 21 s	1 m 27 s
Northern Relief Road Eastbound										
Left Turn	40 s	18 s	27 s	25 s	18 s	31 s	19 s	1 m 22 s	27 s	27 s
Straight	57 s	42 s	45 s	44 s	42 s	43 s	54 s	1 m 22 s	50 s	32 s
Right Turn	1 m 14 s	1 m 15 s	1 m 12 s	1 m 10 s	1 m 19 s	1 m 30 s	1 m 25 s	2 m 57 s	1 m 9 s	1 m 10 s
Junction Average	**46 s**	**42 s**	**44 s**	**43 s**	**46 s**	**49 s**	**51 s**	**1 m 53 s**	**55 s**	**1 m 1 s**

Table 8 – Mill Road/Northern Relief Road AM Peak Average Queues (pcus)

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
R626 Southbound										
Left Turn	0.45	0.46	0.44	0.42	0.54	0.43	0.44	0.41	0.52	0.67
Straight	2.37	2.46	2.72	2.69	3.05	3.85	2.93	32.34	4.73	5.34
Right Turn	3.11	3.35	2.80	2.89	3.98	3.26	5.07	32.34	5.26	3.47
Avoncore Westbound										
Straight/Left Turn	0.70	0.52	0.71	0.30	0.52	0.97	0.53	1.54	0.97	1.60
Straight	5.64	5.00	4.55	5.41	5.47	5.25	5.92	11.24	9.27	9.57
Right Turn	0.97	0.83	1.21	0.84	1.14	1.61	1.52	1.57	3.74	3.10
R626 Northbound										
Left Turn	0.96	0.40	0.35	1.65	0.31	0.97	0.35	2.31	0.66	1.40
Straight	3.85	2.84	3.13	2.76	3.63	2.54	4.64	8.64	4.74	5.48
Right Turn	0.55	0.53	0.56	0.39	0.63	0.59	0.49	0.91	0.50	0.16
Northern Relief Road Eastbound										
Left Turn	1.11	0.66	1.33	1.29	0.68	1.82	0.78	6.92	1.38	1.30
Straight	1.45	0.81	1.49	1.05	0.95	1.80	1.59	20.97	0.85	1.29
Right Turn	0.09	0.05	0.63	0.54	0.06	1.98	0.14	20.97	0.07	3.11

Table 9 – Mill Road/Northern Relief Road PM Peak Average Delays

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
R626 Southbound										
Left Turn	39 s	26 s	37 s	37 s	29 s	41 s	27 s	36 s	31 s	2 m 37 s
Straight	43 s	34 s	41 s	45 s	40 s	1 m 3 s	45 s	1 m 12 s	41 s	2 m 47 s
Right Turn	1 m 0 s	55 s	58 s	1 m 3 s	54 s	1 m 34 s	58 s	2 m 47 s	59 s	6 m 58 s
Avoncore Westbound										
Straight/Left Turn	38 s	39 s	35 s	34 s	42 s	1 m 5 s	52 s	3 m 2 s	1 m 6 s	1 m 48 s
	38 s	40 s	37 s	40 s	40 s	59 s	43 s	2 m 36 s	58 s	1 m 33 s
Right Turn	54 s	52 s	50 s	52 s	51 s	1 m 2 s	55 s	2 m 36 s	1 m 12 s	1 m 54 s
R626 Northbound										
Left Turn	28 s	40 s	59 s	39 s	35 s	1 m 19 s	1 m 5 s	1 m 12 s	1 m 10 s	1 m 38 s
Straight	34 s	40 s	51 s	47 s	42 s	1 m 15 s	1 m 6 s	1 m 11 s	1 m 10 s	1 m 48 s
Right Turn	44 s	56 s	1 m 12 s	1 m 1 s	56 s	1 m 26 s	1 m 30 s	1 m 24 s	1 m 23 s	1 m 45 s
Northern Relief Road Eastbound										
Left Turn	29 s	28 s	23 s	21 s	28 s	39 s	32 s	1 m 33 s	32 s	56 s
Straight	53 s	45 s	40 s	40 s	48 s	45 s	48 s	1 m 39 s	42 s	53 s
Right Turn	1 m 9 s	1 m 12 s	1 m 0 s	58 s	1 m 20 s	1 m 3 s	1 m 20 s	2 m 28 s	1 m 8 s	1 m 22 s
Junction Average	**42 s**	**44 s**	**44 s**	**43 s**	**46 s**	**1 m 1 s**	**55 s**	**1 m 50 s**	**54 s**	**1 m 49 s**

Table 10 – Mill Road/Northern Relief Road PM Peak Average Queues (pcus)

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
R626 Southbound										
Left Turn	0.38	0.27	0.31	0.31	0.47	0.35	0.31	0.24	1.76	1.85
Straight	2.02	1.40	1.88	2.21	1.93	2.58	2.15	3.64	1.59	3.71
Right Turn	1.62	2.03	1.92	1.74	2.27	4.11	2.90	8.93	3.33	48.28
Avoncore Westbound										
Straight/Left Turn	0.41	0.44	0.38	0.35	0.49	0.58	0.43	1.30	0.85	1.07
Straight	1.23	0.74	1.40	1.49	0.61	2.81	1.45	8.20	2.70	12.82
Right Turn	0.39	0.38	0.37	0.39	0.51	0.67	0.64	0.79	2.58	1.34
R626 Northbound										
Left Turn	0.59	0.02	0.32	0.25	0.08	0.19	0.02	68.08	0.68	17.77
Straight	2.31	3.70	4.07	3.60	3.96	7.65	11.62	68.08	14.37	17.77
Right Turn	0.86	0.88	1.30	1.12	0.90	0.81	2.38	0.29	0.77	0.46
Northern Relief Road Eastbound										
Left Turn	0.93	0.62	0.73	0.77	0.70	1.76	1.03	0.47	0.74	7.95
Straight	4.49	2.71	4.11	3.80	3.47	13.69	3.75	49.64	3.00	32.80
Right Turn	1.05	2.29	1.71	2.06	2.39	13.69	2.72	49.64	1.79	32.80

A.3. Gyratory

Table 11 – Gyratory AM Peak Average Delays

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Mill Road Southbound	20 s	23 s	26 s	28 s	24 s	36 s	28 s	52 s	25 s	35 s
The Green Westbound	23 s	19 s	29 s	29 s	33 s	40 s	24 s	30 s	37 s	47 s
Main Street Northbound	15 s	17 s	19 s	16 s	17 s	19 s	15 s	23 s	12 s	16 s
Riverside Way Northbound	19 s	15 s	15 s	12 s	14 s	14 s	17 s	15 s	16 s	11 s
Cork Road Westbound	19 s	13 s	14 s	16 s	12 s	15 s	13 s	20 s	18 s	12 s
Shopping Centre Westbound	18 s	13 s	21 s	17 s	28 s	19 s	20 s	23 s	16 s	15 s
Junction Average	**16 s**	**15 s**	**18 s**	**15 s**	**16 s**	**22 s**	**18 s**	**28 s**	**17 s**	**20 s**

Table 12 – Gyratory AM Peak Average Queues (pcus)

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Mill Road Southbound	2.14	2.48	4.24	1.41	2.86	8.24	4.11	49.67	3.55	15.33
The Green Westbound	0.80	0.83	1.15	1.13	0.83	1.91	0.93	0.23	1.10	1.16
Main Street Northbound	0.66	0.69	0.74	0.47	0.69	1.07	0.77	1.97	0.50	0.51
Riverside Way Northbound	1.69	0.85	0.82	0.53	0.87	0.73	1.21	1.09	1.25	0.67
Cork Road Westbound	1.32	0.91	1.13	0.79	0.89	1.28	1.06	1.88	1.03	0.58
Shopping Centre Westbound	0.08	0.08	0.08	0.09	0.10	0.08	0.12	0.11	0.08	0.06

Table 13 – Gyratory PM Peak Average Delays

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Mill Road Southbound	42 s	1 m 1 s	48 s	49 s	59 s	1 m 0 s	1 m 4 s	1 m 40 s	51 s	1 m 35 s
The Green Westbound	35 s	52 s	44 s	1 m 20 s	42 s	1 m 46 s	1 m 58 s	2 m 53 s	39 s	49 s
Main Street Northbound	21 s	21 s	20 s	17 s	31 s	26 s	25 s	3 m 10 s	19 s	1 m 26 s
Riverside Way Northbound	14 s	19 s	18 s	13 s	19 s	13 s	24 s	2 m 33 s	21 s	1 m 3 s
Cork Road Westbound	1 m 34 s	1 m 19 s	1 m 26 s	36 s	1 m 0 s	1 m 20 s	1 m 10 s	5 m 34 s	2 m 30 s	1 m 8 s
Shopping Centre Westbound	42 s	1 m 5 s	1 m 31 s	40 s	58 s	48 s	1 m 21 s	4 m 1 s	1 m 10 s	22 s
Junction Average	**19 s**	**45 s**	**48 s**	**30 s**	**37 s**	**47 s**	**49 s**	**2 m 18 s**	**50 s**	**59 s**

Table 14 – Gyratory PM Peak Average Queues (pcus)

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Mill Road Southbound	2.31	6.78	5.59	5.09	7.77	16.99	9.76	48.53	4.33	25.18
The Green Westbound	0.72	1.14	0.93	3.10	0.99	4.31	4.60	4.17	0.63	2.35
Main Street Northbound	0.94	1.41	0.95	0.59	1.96	1.11	1.42	31.13	0.97	18.07
Riverside Way Northbound	0.71	1.42	0.78	0.70	1.41	0.70	2.27	27.63	1.68	7.57
Cork Road Westbound	26.29	20.00	35.23	4.43	9.85	22.95	13.52	56.27	69.65	22.19
Shopping Centre Westbound	3.12	5.72	8.87	1.57	3.84	3.11	6.96	8.56	5.72	8.40

A.4. Services Corridor Link Road Southern Signalised Junction

Table 15 – Services Corridor Link Road Southern Signalised Junction AM Peak Average Delay

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound										
Left Turn/Straight	N/A	N/A	20 s	22 s	N/A	9 s	N/A	23 s	N/A	6 s
Right Turn	N/A	N/A	0 s	0 s	N/A	9 s	N/A	0 s	N/A	3 s
Residential Access Westbound										
Left/Straight/Right	N/A	N/A	47 s	39 s	N/A	1 m 2 s	N/A	1 m 20 s	N/A	1 m 1 s
Services Corridor Link Road Northbound										
Left Turn/Straight	N/A	N/A	22 s	21 s	N/A	19 s	N/A	15 s	N/A	16 s
Right Turn	N/A	N/A	19 s	19 s	N/A	19 s	N/A	25 s	N/A	21 s
Commercial Access Eastbound										
Left/Straight/Right	N/A	N/A	57 s	40 s	N/A	50 s	N/A	2 m 38 s	N/A	59 s
Junction Average	**N/A**	**N/A**	**25 s**	**24 s**	**N/A**	**17 s**	**N/A**	**22 s**	**N/A**	**14 s**

Table 16 – Services Corridor Link Road Southern Signalised Junction AM Peak Average Queues (pcus)

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound										
Left Turn/Straight	N/A	N/A	0.73	0.78	N/A	0.86	N/A	4.99	N/A	0.71
Right Turn	N/A	N/A	0.00	0.01	N/A	0.00	N/A	0.00	N/A	0.00
Residential Access Westbound										
Left/Straight/Right	N/A	N/A	0.71	0.71	N/A	0.98	N/A	1.42	N/A	0.94
Services Corridor Link Road Northbound										
Left Turn/Straight	N/A	N/A	0.71	0.69	N/A	2.93	N/A	3.78	N/A	2.71
Right Turn	N/A	N/A	0.14	0.10	N/A	0.13	N/A	0.09	N/A	0.15
Commercial Access Eastbound										
Left/Straight/Right	N/A	N/A	0.22	0.15	N/A	0.18	N/A	0.02	N/A	0.01

Table 17 – Services Corridor Link Road Southern Signalised Junction PM Peak Average Delays

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound										
Left Turn/Straight	N/A	N/A	20 s	23 s	N/A	32 s	N/A	1 m 10 s	N/A	1 m 3 s
Right Turn	N/A	N/A	0 s	0 s	N/A	0 s	N/A	0 s	N/A	1 m 13 s
Residential Access Westbound										
Left/Straight/Right	N/A	N/A	53 s	54 s	N/A	1 m 11 s	N/A	1 m 25 s	N/A	1 m 19 s
Services Corridor Link Road Northbound										
Left Turn/Straight	N/A	N/A	20 s	24 s	N/A	15 s	N/A	19 s	N/A	19 s
Right Turn	N/A	N/A	18 s	19 s	N/A	21 s	N/A	30 s	N/A	35 s
Commercial Access Eastbound										
Left/Straight/Right	N/A	N/A	43 s	48 s	N/A	2 m 7 s	N/A	3 m 35 s	N/A	2 m 24 s
Junction Average	**N/A**	**N/A**	**24 s**	**27 s**	**N/A**	**29 s**	**N/A**	**51 s**	**N/A**	**48 s**

Table 18 – Services Corridor Link Road Southern Signalised Junction PM Peak Average Queues (pcus)

Movement	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound										
Left Turn/Straight	N/A	N/A	0.55	0.62	N/A	4.16	N/A	19.76	N/A	17.02
Right Turn	N/A	N/A	0.00	0.00	N/A	0.00	N/A	0.00	N/A	0.01
Residential Access Westbound										
Left/Straight/Right	N/A	N/A	0.57	0.56	N/A	0.65	N/A	0.94	N/A	0.72
Services Corridor Link Road Northbound										
Left Turn/Straight	N/A	N/A	1.24	1.44	N/A	3.51	N/A	7.12	N/A	6.60
Right Turn	N/A	N/A	0.35	0.36	N/A	0.43	N/A	0.51	N/A	0.80
Commercial Access Eastbound										
Left/Straight/Right	N/A	N/A	1.26	1.32	N/A	4.88	N/A	12.12	N/A	10.65

A.5. Northern Relief Road Roundabout

Table 19 – Northern Relief Road Roundabout AM Peak Average Delays

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound	5 s	4 s	7 s	7 s	5 s	11 s	6 s	20 s	6 s	9 s
Northern Relief Road Westbound	2 s	2 s	6 s	5 s	3 s	15 s	3 s	35 s	4 s	13 s
Northern Relief Road Northbound	2 s	2 s	4 s	4 s	2 s	11 s	2 s	28 s	2 s	14 s
Junction Average	**2 s**	**2 s**	**5 s**	**5 s**	**2 s**	**11 s**	**3 s**	**26 s**	**3 s**	**11 s**

Table 20 – Northern Relief Road Roundabout AM Peak Average Queues (pcus)

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound	0.00	0.00	0.11	0.00	0.00	0.55	0.00	4.88	0.00	0.65
Northern Relief Road Westbound	0.05	0.04	0.61	0.05	0.05	2.84	0.05	10.35	0.40	2.76
Northern Relief Road Northbound	0.01	0.01	0.11	0.01	0.01	1.73	0.01	8.60	0.02	1.26

Table 21 – Northern Relief Road Roundabout PM Peak Average Delays

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound	6 s	5 s	10 s	9 s	6 s	28 s	7 s	32 s	9 s	26 s
Northern Relief Road Westbound	3 s	2 s	6 s	5 s	3 s	13 s	3 s	43 s	3 s	18 s
Northern Relief Road Northbound	3 s	2 s	4 s	4 s	2 s	15 s	2 s	1 m 27 s	2 s	43 s
Junction Average	**3 s**	**2 s**	**6 s**	**5 s**	**3 s**	**18 s**	**3 s**	**46 s**	**3 s**	**29 s**

Table 22 – Northern Relief Road Roundabout PM Peak Average Queues (pcus)

Arm	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Services Corridor Link Road Southbound	0.05	0.04	0.37	0.39	0.06	7.02	0.07	10.35	0.05	9.63
Northern Relief Road Westbound	0.07	0.03	0.30	0.24	0.06	0.98	0.06	10.24	0.16	2.27
Northern Relief Road Northbound	0.07	0.00	0.37	0.22	0.01	6.43	0.01	42.73	0.02	20.43

A.6. Overall Network Performance

Table 23 – Overall Network Performance AM Peak

Performance Measure	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Average Speed (km/h)	41.04	41.88	38.69	38.46	41.42	34.9	39.36	27.05	34.97	31.8
Average Delay (mins)	45 s	43 s	53 s	54 s	44 s	1 m 7 s	52 s	1 m 57 s	1 m 10 s	1 m 21 s
Total Delay (h)	83h 59m	83h 17m	108h 24m	111h 18m	89h 46m	156h 25m	108h 6m	293h 32m	147h 6m	206h 33m

Table 24 – Overall Network Performance PM Peak

Performance Measure	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
Average Speed (km/h)	35.35	39.59	36.51	33.26	40.36	30.43	37.67	11.27	22.63	20.7
Average Delay (mins)	1 m 10 s	52 s	1 m 4 s	1 m 20 s	49 s	1 m 34 s	52 s	6 m 32 s	2 m 28 s	3 m 3 s
Total Delay (h)	131h 41m	98h 2m	128h 40m	157h 29m	95h 37m	219h 46m	121h 53m	813h 20m	310h 52m	470h 42m

A.7. Travel Times

Table 25 – Travel Times AM Peak

Route	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
N25 to Gyratory	2 m 58 s	2 m 50 s	2 m 43 s	2 m 48 s	2 m 52 s	2 m 50 s	2 m 53 s	2 m 58 s	3 m 13 s	3 m 0 s
Northern Relief Road Southbound	2 m 57 s	3 m 14 s	4 m 20 s	3 m 32 s	3 m 27 s	4 m 43 s	3 m 32 s	4 m 50 s	5 m 51 s	4 m 55 s
Mill St/NRR Junction to Gyratory	1 m 58 s	1 m 56 s	2 m 4 s	1 m 57 s	1 m 56 s	2 m 30 s	2 m 27 s	4 m 30 s	2 m 33 s	2 m 31 s

Table 26 – Travel Times PM Peak

Route	Base	Phase 1a DM	Phase 1a Right Turn Banned	Phase 1a Right Turn Allowed	Phase 1 DM	Phase 1 DS	Phase 2 DM	Phase 2 DS	Phase 3 DM	Phase 3 DS
N25 to Gyratory	5 m 57 s	4 m 30 s	5 m 21 s	5 m 1 s	3 m 44 s	5 m 38 s	4 m 1 s	14 m 11 s	12 m 55 s	4 m 13 s
Northern Relief Road Southbound	3 m 32 s	3 m 4 s	3 m 7 s	3 m 10 s	3 m 11 s	4 m 36 s	3 m 5 s	3 m 36 s	6 m 56 s	3 m 39 s
Mill St/NRR Junction to Gyratory	2 m 8 s	2 m 41 s	2 m 14 s	2 m 17 s	2 m 50 s	3 m 52 s	3 m 21 s	3 m 42 s	2 m 50 s	2 m 58 s

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