East Ayrshire Local Development Plan Transport Appraisal Report.

East Ayrshire Council

May 2022

Draft for consultation

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ATKINS
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1. Introduction

Atkins was commissioned by East Ayrshire Council (EAC) to provide consultancy services in relation to the transport appraisal of the East Ayrshire Proposed Local Development Plan (LDP). The transport appraisal was required to consider the cumulative impacts of potential development opportunity sites for inclusion in the Proposed East Ayrshire Local Development Plan 2 (LDP2) along with the effects of legacy sites contained in the adopted (2017) East Ayrshire Local Development Plan (LDP1) on the trunk and primary road network within East Ayrshire, as shown in Figure 1.1 below.

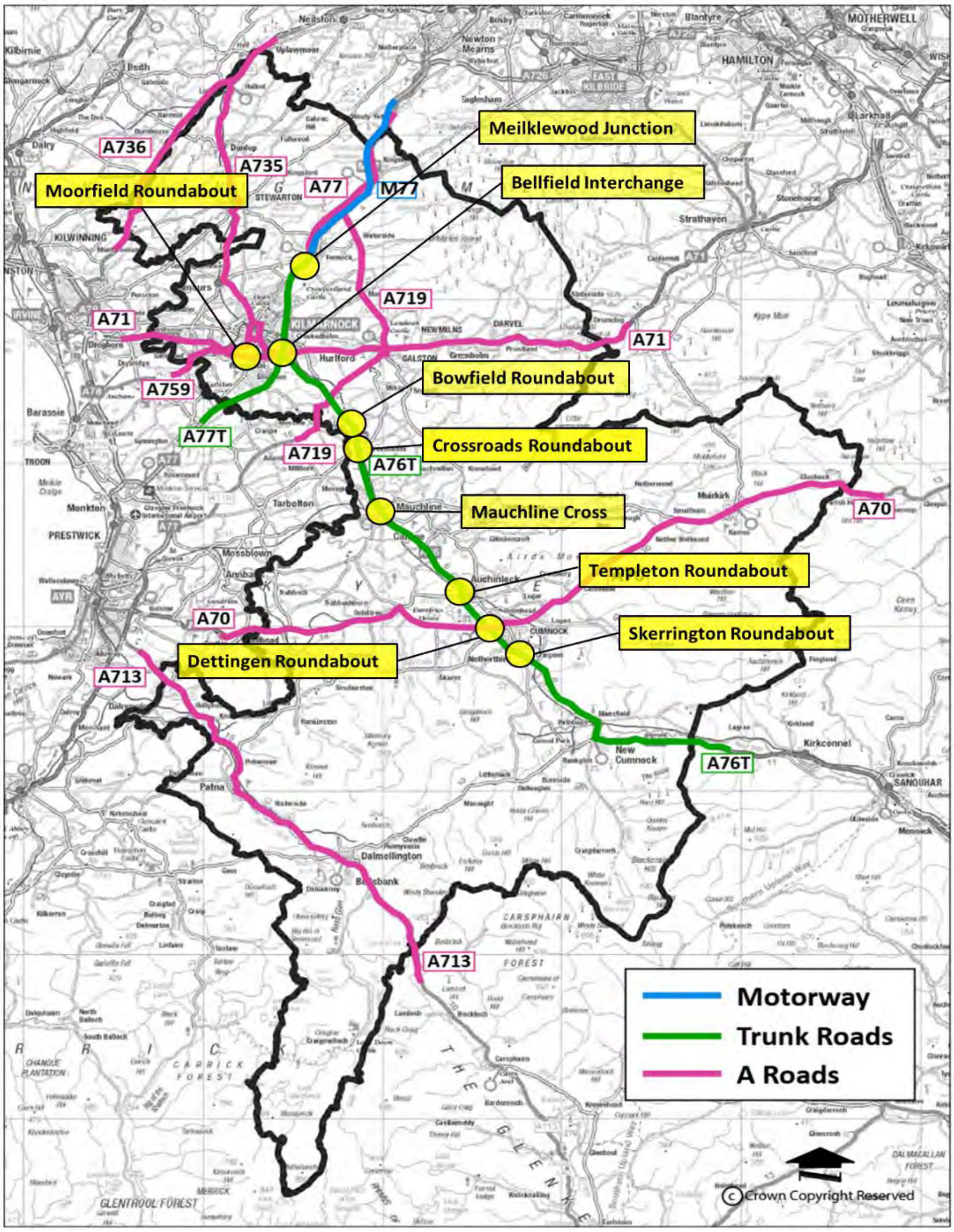

Figure 1.1 - East Ayrshire Road Network & Junctions

1.1. LDP Policy Commitments

This section discusses the context under which the appraisal has been undertaken, in particular the wider EAC commitment within the emerging LDP to enhancing sustainable travel measures to meet the goals set by the Scottish Government and support the vision of National Transport Strategy 2 (NTS2). The NTS2 vision is stated as:

Our Vision

We will have a sustainable, inclusive, safe and accessible transport system, helping deliver a healthier, fairer and more prosperous Scotland for communities, businesses and visitors.

Our Vision is underpinned by four Priorities, each with three associated Outcomes. The Vision, Priorities and Outcomes are at the heart of the Strategy and will be the basis upon which we take decisions and evaluate the success of Scotland's transport policies going forward.

- ***Reduces inequalities***
  - *Will provide fair access to services we need*
  - *Will be easy to use for all*
  - *Will be affordable for all*
- ***Takes climate action***
  - *Will help deliver our net-zero target*
  - *Will adapt to the effects of climate change*
  - *Will promote greener, cleaner choices*
- ***Helps deliver inclusive economic growth***
  - *Will get people and goods where they need to get to*
  - *Will be reliable, efficient and high quality*
  - *Will use beneficial innovation*
- ***Improves our health and wellbeing***
  - *Will be safe and secure for all*
  - *Will enable us to make healthy travel choices*
  - *Will help make our communities great places to live*

1.2. Spatial Strategy

EAC's proposed spatial strategy sets out the key priorities for promoting sustainable travel and transport. It focuses on how the plan can achieve this by:

- Supporting and enabling the creation of a robust active travel network for all;
- Allowing for better access to more sustainable modes of transport; and
- The provision of improved and safer transport infrastructure.

The following three sub-sections detail what EAC is seeking to achieve in terms of the above three points, and what its' strategy is to accomplish them.

1.2.1. Enable and support the creation of a good quality active travel network

Improving active travel networks throughout East Ayrshire will prioritise walking, cycling and wheeling, reduce unsustainable travel and in turn create safer, healthier and attractive places for people to live and work within. Delivering projects, such as the Green Infinity Loop in Kilmarnock (a 'figure of eight' network of pathways comprising of a 26km circular route around Kilmarnock with a Spinal Route from north to south through Kilmarnock town centre, linking into the circular route) will provide better connections between different communities and the wider path and cycle network, offer greater access to local facilities and public transport facilities and provide greater choice for locals and visitors using the Green Infrastructure network.

EAC's spatial strategy will support this by:

- The creation of networks of 20 minute neighbourhoods to ensure local living can be achieved;
- New development being situated in locations which offer sustainable travel choices;
- The creation of new and improved active travel routes to connect our towns and villages, in particular connecting our smaller rural communities with nearby towns;
- High quality connections for walking, cycling and wheeling being integral in the design of new development; and
- The development of good access to, and, where possible, through green and blue infrastructure.

In spatial terms, the Strategy will support:

- The implementation of the Kilmarnock Green Infinity Loop and the Council's green infrastructure and active travel strategies; and
- Improvements to the existing active travel network to ensure they can expand to make walking, wheeling and cycling an attractive, convenient, safe, and sustainable choice for everyday travel.

1.2.2. Allow for better travel choice and access to sustainable forms of transport

EAC believes it is vital to reduce the need to travel unsustainably. In order to achieve this, EAC has committed to support infrastructure and facilities that will help to contribute towards providing better travel choice and access to more sustainable forms of transport, including cycling and the use of buses and trains.

EAC's spatial strategy will support this by:

- Infrastructure and facilities that will assist in minimising the need for people to travel unsustainability for all or part of their travel journeys; and
- New development which prioritises locations that are accessible to all forms of sustainable transport.

In spatial terms, the Strategy will support:

- The investigation of a park and ride facility at West Fenwick to encourage a partial modal shift in journeys to and from Glasgow and further afield; and
- The Council will explore the feasibility of developing a park and ride facility, including cycle parking, at Glasgow Road, Kilmarnock, for the purposes of enabling an alternative to car travel between East Ayrshire and Glasgow.

Associated with park and ride, the Council will explore the potential for EV charging facilities to complement the carbon reduction of removing car trips from the network.

1.2.3. Support improved and safer transport infrastructure

It is important to ensure that East Ayrshire's transport infrastructure is robust enough to allow for future prosperity and growth. Parts of East Ayrshire's strategic road network is nearing capacity or its infrastructure is no longer fit for purpose. There is therefore a need to ensure that East Ayrshire's strategic road network can adequately support East Ayrshire's future and in particular support economic growth and regeneration.

EAC's spatial strategy will support this by:

- Improvements to East Ayrshire's strategic road network to allow for future growth.

Bellfield Interchange is the most important traffic junction in East Ayrshire being the key entry point to Kilmarnock and a key access point to and from North and South Ayrshire, Edinburgh and Glasgow. It also provides access from the strategic road network to key business and employment locations in East Ayrshire including Moorfield, Kilmarnock as well as key infrastructure, such as Crosshouse University Hospital, and to proposed new business and employment locations.

There are concerns that the regeneration and economic development of, not only East Ayrshire but, Ayrshire as a whole could be compromised due to capacity issues affecting Bellfield Interchange. Not only this, but due to the significant conflict between strategic and local traffic, there are concerns for road and pedestrian safety and journey times for all modes of transport.

There is therefore a need to improve the existing infrastructure at Bellfield Interchange to create a well-connected active travel network which is safe to use by pedestrians and cyclists, enhance traffic flow and the safety of road users and allow for future economic growth.

The Scottish Government published the second Strategic Transport Projects Review (STPR2) in January 2022 which sets out a number of recommendations to make transport in Scotland more sustainable and support people to make better, more informed choices on how they travel. Specific to East Ayrshire, STPR2 recommends that as part of improving transport assets at Stranraer and the ports at Cairnryan, a number of safety, resilience, and reliability improvements along the A77 Strategic Road Corridor are to be made. STPR2 highlights Bellfield Interchange as a location for such a scheme.

1.3. Achieving a 20% reduction in car kms travelled and modal shift

As mentioned previously, one of the three key priorities for promoting sustainable travel and transport is by enabling the creation of a good quality active travel network. This priority will be fulfilled through the creation of a network of 20 minute neighbourhoods, in locations which offer sustainable travel choices, the creation and improvement of active travel routes, with good access to and where possible through green and blue infrastructure.

1.3.1. Strategy for reducing the need to travel unsustainably and promoting compact growth

East Ayrshire's transport network should contribute to the creation of healthy, attractive and better connected places. The Plan, in principle, will support development, which minimises the need to travel unsustainably and encourages a shift in travel choice and behaviours by prioritising walking, wheeling, cycling, public transport and shared transport options in preference to single occupancy private car use for the movement of people.

This is best achieved by maximising the extent to which our local residents live in places where there is good access to everyday services and amenities and travel choices. This can be supported by allocating high value and high quality employment sites to allow skilled workers to work locally and not have to travel beyond East Ayrshire to undertake skilled employment (i.e. through road journeys to Glasgow).

Central to the delivery of the aims of the Plan is to ensure our future places, homes and neighbourhoods are healthy, vibrant, safe and pleasant, inclusive and attractive, stimulating population growth in a low-carbon, nature-positive way.

EAC will support this by:

- Directing development to sustainable locations within settlements, particularly on previously developed land to ensure that development occurs in sustainable locations or in locations that can be made more accessible and thus sustainable;
- Promoting the emergence of 20 minute neighbourhoods, by increasing the density of settlements, prioritising locations for development that are accessible by a variety of modes of public transport. Identifying an appropriate mix of uses, supporting local economies and building places that encourage active travel;
- Reducing traffic in local neighbourhoods and making streets more friendly, for example by restricting parking and introducing traffic calming measures through better street design; and

- Creating good active travel networks and public transport provision throughout East Ayrshire.

In addition to the above, the approach to promoting sustainable transport in East Ayrshire will take into account the new legislation relating to transport and climate change, the priorities of STPR2, NTS2, the emerging Regional Transport Strategy as well as the draft NPF4 but also the impacts of COVID-19 in the short, medium and long term.

Based on this, EAC will support proposals, subject to all relevant LDP policy, that:

- Contribute to a more sustainable integrated transport system that is accessible to all throughout East Ayrshire (both urban and rural communities) and better connects people, in particular to employment opportunities, local services and amenities;
- Provide well-designed, safe and convenient transport opportunities for all users;
- Contribute to developing improved sustainable transport infrastructure which has an integral active travel network;
- Support a modal shift to more sustainable forms of transport;
- Reduce the need to travel unsustainably by prioritising locations for future development that can be accessed by sustainable modes where this is appropriate i.e. in urban areas; and
- Contribute to reducing carbon emissions to assist in meeting the national emission reduction targets.

1.3.2. Policy T1: Transport requirements in new development

EAC will require developers to meet the following criteria:

- Ensure that their proposals meet with all the requisite standards of the Ayrshire Roads Alliance and align with National Transport Strategy 2, in particular the sustainable travel hierarchy and the emerging Regional and Local Transport Strategies as well as taking into consideration draft NPF4 national planning policy. Developments which do not meet these standards will not be considered acceptable and will not receive Council support.

- Fully embrace new active travel **infrastructure or public transport and multimodal hubs** in all new footfall generating uses and major residential development by incorporating new, and providing links to existing paths, cycle routes and public transport routes. Developments which prioritise sustainable transport by maximising the extent to which travel demands are met first through walking and wheeling, then cycling, then public transport, then taxis and shared transport and finally through the use of private cars will be particularly supported. In addition, new development will be supported where they can be demonstrated to be deliverable and will be effective in relation to delivering mode share targets.

- Where considered appropriate, enter into Section 75 Obligations with the Council with regard to making financial contributions towards the provision of transportation infrastructure improvements and/or public transport services which may be required as a result of their development.

- EAC will not support new significant travel generating uses at locations which would increase reliance on the car and where:
    - direct links to local facilities via walking and cycling networks are not available or cannot be made available;
    - access to local facilities via public transport networks would involve walking more than 400m;

- the Transport Assessment does not identify satisfactory ways of meeting sustainable transport requirements; or
- the performance or safety of the trunk and local road network and the measures required to mitigate any impact arising from development have not been identified.

- Although not normally acceptable, the case for a new junction on a trunk road will only be considered where significant prosperity or regeneration benefits can be demonstrated. New junctions will only be considered if they are designed in accordance with Design Manual for Roads and Bridges and where there would be no adverse impact on road safety or operational performance.

- Ensure that development proposals put people and place before unsustainable travel where appropriate and respond to characteristics of the location of the proposal.

- Development proposals should demonstrate:
  - how the development will provide for and prioritise transport in line with the sustainable travel and investment hierarchies;
  - consideration of the need to integrate transport modes;
  - the need to as far as possible facilitate access by reliable public transport, ideally supporting the use of existing services or new services that do not require on-going public sector funding.

Where a proposed new development or change of use is likely to generate a significant increase in trip numbers, a Transport Assessment will be required.

In certain circumstances, developers may also be required to produce Travel Plans which set out proposals for the delivery of more sustainable transport patterns. If required, a travel plan framework should be agreed at the planning application stage and outline measures and targets included in the transport assessment. A travel plan should be specified through a planning obligation associated with a planning consent.

Proposals for new and upgraded transport infrastructure must consider the **needs of users of all ages and abilities** in line with relevant equalities legislation.

Development proposals should consider the need to supply safe and convenient cycle parking to serve the development, sheltered where possible, unless it can be demonstrated that existing nearby provision is sufficient. **Cycle parking** should be more conveniently located than car parking serving the development. Flatted residential development should give consideration to the need to provide secure and convenient storage for a range of cycle types and sizes, depending on the type, location and accessibility of the development and the likely needs of the users.

Development proposals which are ambitious in terms of **low/no car parking** have a role to play in very accessible urban locations, well-served by sustainable transport modes. In such circumstances, consideration should be given to the type, mix and use of development, car ownership levels, the surrounding uses, and the accessibility of the development by sustainable modes.

1.3.3. Policy T2: Transportation of Freight

The Council will, wherever it is feasible and cost effective, strongly encourage the transportation of freight by rail rather than by road. In cases where this is not possible or feasible, the Council will, where appropriate, encourage and support the development and use of ‘off road’ haulage routes designed to avoid the transportation of bulk freight through the area settlements.

1.3.4. Policy T3: Development and protection of core paths and other routes

The Council will, through the East Ayrshire Recreation Plan, which incorporates the Core Path Plan, and in association with relevant bodies, landowners and tenants, seek to develop a comprehensive local and strategic path route network for access and recreational use for local residents and ensure, where possible that these routes are accessible for all.

Priority will be given to the development and promotion of new circular routes and path links between settlements and that enhance the green network, especially where these connect with existing routes, utilise existing disused railway lines, forestry access roads, minor country roads etc.

Development of new routes for core paths, other paths which form as part of the strategic path network, local footpaths, bridle paths or cycle paths should demonstrate to the Council that they will not have an adverse effect on the integrity of a Natura 2000 site and meet the requirements of all relevant LDP policy.

1.3.5. Stewarton – Active travel and mode choices pilot

EAC is working with the Key Agencies Group (KAG) as part of the '[Supporting a Green Recovery: Offer Document'] and are specifically exploring Stewarton within the context of a 20 minute neighbourhood and how its services, routes and streets provide for living locally. Using mapping and data analysis along with some community engagement exercises KAG has concluded that introducing active travel routes would be beneficial and that aspect will be further tested and explored in due course with the community and wider stakeholders. Transport Scotland (TS) is part of the Key Agencies Group and has been actively involved in exploring Stewarton as a pilot project concerning active travel and mode choices

The route map is based on the following four sustainable travel behaviours as illustrated in Figure 1.2.

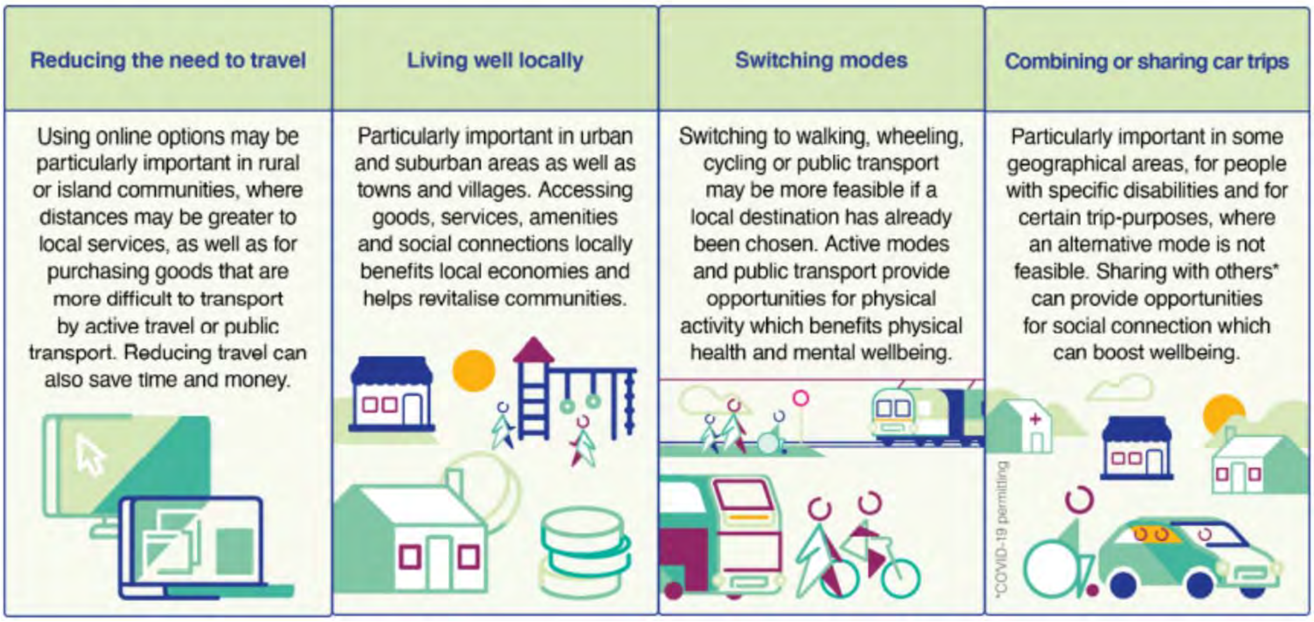

Figure 1.2 – KAG sustainable travel behaviours

The route map contains over 30 interventions. Some of these are being delivered in the short-term, including providing free bus travel for under-22s and a Broadband Programme which provides superfast broadband access for 100% of premises. Other actions will take longer, and some will also be more challenging than others, and will need a mix of infrastructure, incentivisation and regulatory actions.

KAG is committed to exploring equitable options to further discourage private car use, and is commissioning research to allow it to develop a Car Demand Management Framework by 2025, taking into account the needs of people in rural areas and people on low incomes to help ensure a just transition to net-zero. Meanwhile KAG will continue to press the UK Government for constructive dialogue on its plans for structural reform of motoring taxation, emphasising the need for urgent action so that it can design and deliver fairer solutions that best meet Scotland's needs and interests.

Figure 1.3 – Route map to achieve a 20% reduction in car kilometres by 2030

1.4. Emissions

1.4.1. Park and ride facility

As part of EAC's aim to provide greater travel choice, it has proposed to investigate with partners the potential of a park and ride facility at West Fenwick. The creation of a park and ride facility would also assist in achieving the National Planning Framework 4 action of reducing emissions by 20% by 2045 and allow for greater flexibility for residents in East Ayrshire to reduce the use of the private car, access public transport and travel to destinations outwith the area in a more sustainable manner.

EAC will explore the feasibility of developing a park and ride facility, including cycle parking, at West Fenwick, for the purposes of enabling an alternative to car travel between East Ayrshire and Glasgow. Associated with park and ride, the Council will explore the potential for EV charging facilities.

As a second phase, the Council will explore the feasibility of developing business and industrial units at this location, on the basis that the park and ride project will have made this a more accessible and sustainable location.

1.4.2. Active Travel Strategy

Alongside the LDP and other initiatives EAC have also developed their draft Active Travel Strategy (ATS) which sets out the barriers to active travel (AT) in the area and an overall approach to the delivery of an improved AT network which focusses as far as possible on delivery of segregated routes. There are a range of routes identified within Kilmarnock including the Infinity Loop which have developed designs and funding commitments and will provide a coherent, high quality AT loop serving the entire town and bringing the majority of residents to within 400m of a high quality AT route. This route is joint funded with Sustrans and is being developed to detailed design in the east of the town at present.

Alongside the commitment to new and improved cycle infrastructure the draft ATS also includes measures to improve signage, links to schools and improvement to accessibility and security of routes reviewing dropped kerb provision, lighting and visibility of the path network.

The proposal to provide a new segregated NMU link at Bellfield would align with this strategy, linking directly to the Infinity Loop and forming part of the wider aspiration for a traffic free link from Kilmarnock to Cumnock.

The LTS also sets out which elements and provision have funding in place or would be eligible for match funding for delivery. The NMU route at Bellfield would be eligible for a range of funding sources and bids to specific schemes is under development by EAC at this stage.

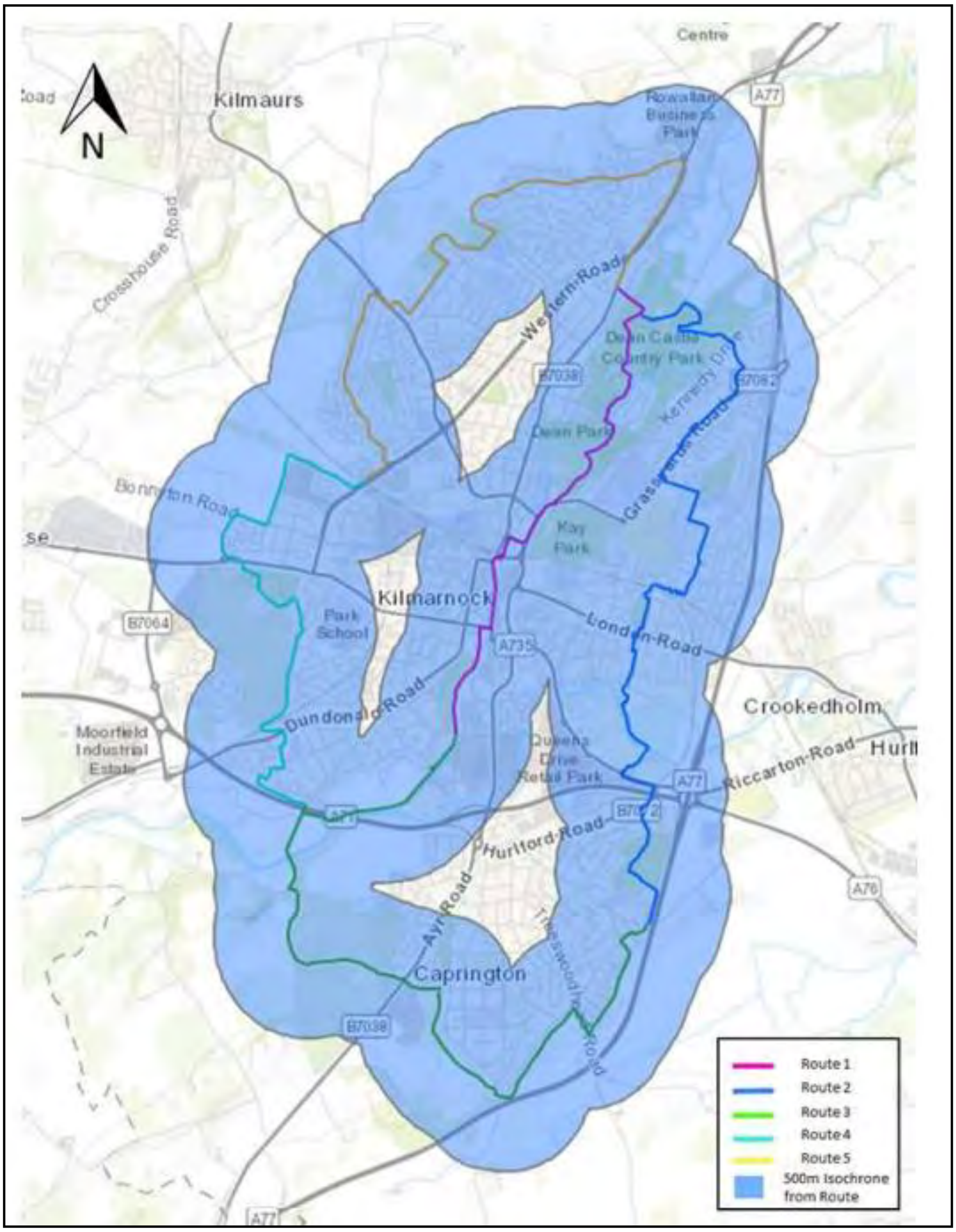

Figure 1.4 – Extract from Kilmarnock Green Infinity Loop Concept Design Study report (Sweco)

1.4.3. Proposed Emissions Policy

Development proposals for national, major, EIA development or any other development proposal that EAC deems may generate significant greenhouse gas emissions, should be accompanied by a whole-life assessment of greenhouse gas emissions from the development.

Development proposals that will generate significant emissions, on their own or cumulatively with other proposals, allocations or consented development, will not be supported unless:

- It is demonstrated that the proposed development is in the long-term public interest;
- The applicant provides evidence that the level of emissions is the minimum that can be achieved for the development to be viable, and has considered off-setting measures sequentially both on site and off site; and
- Information on viability may be requested to support applications.

1.5. Information on potential funding and delivery of any mitigation

1.5.1. How LDP2 can address potential funding and delivery of mitigation

A developer contributions policy is a key mechanism that LDP2 can use to address potential funding requirements for enhancing existing transport infrastructure. Developer contributions can only be collected on a proportionate basis in relation to development that will place pressure on infrastructure in line with the tests set out in Planning Circular 3/2012.

EAC will expect developers to implement necessary mitigation measures on site and, where relevant, the immediate surrounding environment of a site, to ensure that their development proposal will have a minimal impact on the existing active travel network and transport infrastructure. This will be addressed through planning policy.

1.6. Ayrshire Growth Deal

1.6.1. Overview

The Ayrshire Growth Deal (AGD) document was signed in March 2019 by both the UK and Scottish Governments and Ayrshire's Councils. The document sets out the detail of how the Ayrshire Economic Joint Committee (EJC) and the Ayrshire Regional Economic Partnership (REP) will implement and manage the AGD. The signed document forms part of a suite of documentation designed to provide assurance to funders, stakeholders and communities that partners are committed to ensuring investment is coordinated across the region; that processes and procedures are in place to support delivery; and that the benefits to be derived from the AGD are maximised.

The key themes identified in the Ayrshire Regional Economic Strategy as being critical to economic recovery and renewal phases are: Advanced Manufacturing; Aerospace/Space; Clean Growth; Community Wealth Building; Food and Drink; Life Sciences; Visitor Economy; Business; Connectivity; Digital; Innovation and Skills.

As part of the Ayrshire Regional Economic Strategy, the Ayrshire Growth Deal is a key element of Ayrshire's recovery and reaffirms the public sector's commitment to the region and the collective desire to support ambitious plans for renewal and long term sustainable growth. The scale of this Deal will galvanise efforts to develop key strategic sites and key sectors in Ayrshire and aims to facilitate private sector investment of more than £300m into the region and to support up to 7,000 new jobs.

1.6.2. Strategic Objectives

Ayrshire's Councils all recognise the importance of a regional approach to growing the economy and have been working together and with partners and stakeholders to develop the Ayrshire Growth Deal. It is anchored in a commitment to creating a growing, innovative, more productive and inclusive economy, developing Ayrshire's core strengths and ensuring that communities benefit from economic growth.

Collectively, the REP has identified the regional priorities which will create the best environment for people and business. This has been a robust process reflecting good practice methodologies, including analysis to understand the best interventions and projects which will facilitate a step-change for the Ayrshire and Scottish economies, while creating greater opportunity for all communities.

The vision is for Ayrshire to be ***'a vibrant, outward looking, confident region, attractive to investors and visitors, making a major contribution to Scotland's growth and local well-being, and leading the implementation of digital technologies and the next generation of manufacturing.'***

Targeted investment, coordinated throughout Ayrshire, will act as a powerful catalyst stimulating growth and resulting in increased prosperity for local people, for Scotland and for the UK as a whole.

While proposals reflect the strengths and opportunities which exist in Ayrshire, economic baseline analysis shows that the regional economy has been underperforming and recent job losses point to a loss of confidence and investment being diverted to other areas. The strategic objectives underpinning the Growth Deal projects are to:

- Attract and develop more innovative and internationally focused companies that are more likely to have higher levels of productivity through developing key infrastructure and targeted business support programmes;
- Position Ayrshire as the 'go-to' region for smart manufacturing and digital skills;
- Improve key elements of strategic transport and digital infrastructure to help businesses get goods to market and people to work (physically and virtually); and
- Work with communities to raise aspiration and ambition, provide employment and skills support, and improve access to jobs through innovative community empowerment and employability programmes.

The REP firmly believes that Ayrshire will be recognised for leading the successful implementation of key technologies in manufacturing sectors that are important to Scotland, for its world class digital and physical infrastructure and the quality of life it can provide.

This Deal will help drive inclusive economic growth across the region. The economy of Ayrshire has under-performed over a substantial period of time, leading to Ayrshire having one of the highest unemployment rates in Scotland and the UK, particularly among younger people. This has been exacerbated by the impact of the Covid-19 pandemic. This Deal will enable the creation of new high quality jobs and opportunities across Ayrshire, which will help secure the future prosperity of its many communities.

Building on the Heads of Terms signed off in March 2019, the Implementation Plan sets out how the individual projects within the Deal will be delivered and how they will contribute to a step change in Ayrshire's economy.

Project proposals and associated Outline Business Cases have been prepared, reviewed, assessed and refined following feedback received from policy leads within each government and these now form the overall programme business case.

1.6.3. AGD Projects

The Ayrshire Growth Deal is based on the achievement of economic growth and inclusive growth. There is a clear focus on addressing the issues of sub-regional inequality, relatively low rates of innovation and relatively low productivity. This Deal will tackle inequality through growing local talent, creating new connections within the business world nationally and internationally and providing new opportunities and routes into employment for people across the region.

The Deal will support innovative technologies, enhance productivity, develop skills and create jobs.

Table 1.1 below provides a summary of the projects contained within the Ayrshire Growth Deal. The projects have been specifically designed to develop key strategic sites and strategic sectors and to address the economic frailties identified above. How these projects relate to national and regional priorities is set out in more detail below and in Figure 1.5.

Table 1.1 – AGD Projects

Programme	AGD Project	Total Government Support £'000	Percentage of AGD Programme	UK & Scottish Governments £'000	Regional Partners £'000
CAPITAL					
Aerospace & Space	Spaceport Infrastructure	23,000	9.15%	23,000	0
	ASIC and Visitor Centre	11,000	4.37%	5,000	6,000
	Commercial Space - Prestwick - Industrial & Hangar	29,000	11.53%	22,000	7,000
	Prestwick Infrastructure - Roads	17,000	6.76%	12,000	5,000
Economic Infrastructure	HALO Kilmarnock	9,000	3.58%	7,000	2,000
	Ayrshire Engineering Park (Moorfield)	16,000	6.36%	12,000	4,000
	Ayrshire Manufacturing Investment Corridor	23,500	9.34%	23,500	0
	i3 Flexible Business Space	15,000	5.96%	11,000	4,000
	i3 Digital Automation & Testing Centre (DigiLab)	6,000	2.39%	5,000	1,000
Energy, Circular Economy & Environment	National Energy Research Demonstrator (NERD)	24,500	9.74%	17,000	7,500
	Hunterston Port & Resource Centre (CECE)	18,000	7.16%	18,000	0
	International Marine Science & Environmental Centre (IMSE), Ardrossan	10,500	4.17%	6,500	4,000
Tourism	Irvine Harbourside - Ardeer (The Great Harbour)	14,000	5.57%	9,000	5,000
	Marine Tourism	9,500	3.78%	9,500	0
Digital	Digital Subsea Cable	11,000	4.37%	11,000	0
	Digital Infrastructure	3,000	1.19%	3,000	0
REVENUE					
Regional Skills & Inclusion Programme	Working for a Healthy Economy	5,000	1.99%	5,000	0
	Ayrshire Skills Investment Fund	3,500	1.39%	3,500	0
Community Wealth Building	Community Wealth Building Fund	3,000	1.19%	3,000	0
TOTAL FUNDING		251,500	100.00%	206,000	45,500
Percentage of funding by contributor			100.00%	82%	18%

Figure 1.5 illustrates how the Ayrshire Growth Deal programme links to the UK and Scottish Governments' objectives of increased growth and prosperity.

The programme is based on the achievement of economic but inclusive growth with a clear focus on addressing the issues of innovation and productivity, and inequality across the regional economy.

Linking to the overall Regional Vision assessed the projects are grouped into programmes that focus on the high growth, high value sectors that Ayrshire has real opportunities in, and which link to Ayrshire's general manufacturing strength, distinctive coastal opportunities and to its communities.

The AGD aim is to marry business growth opportunities to employment progression, to developing the future workforce within existing communities, ensuring all communities benefit from economic growth.

The AGD themes reflect the strengths and opportunities of the Ayrshire economy.

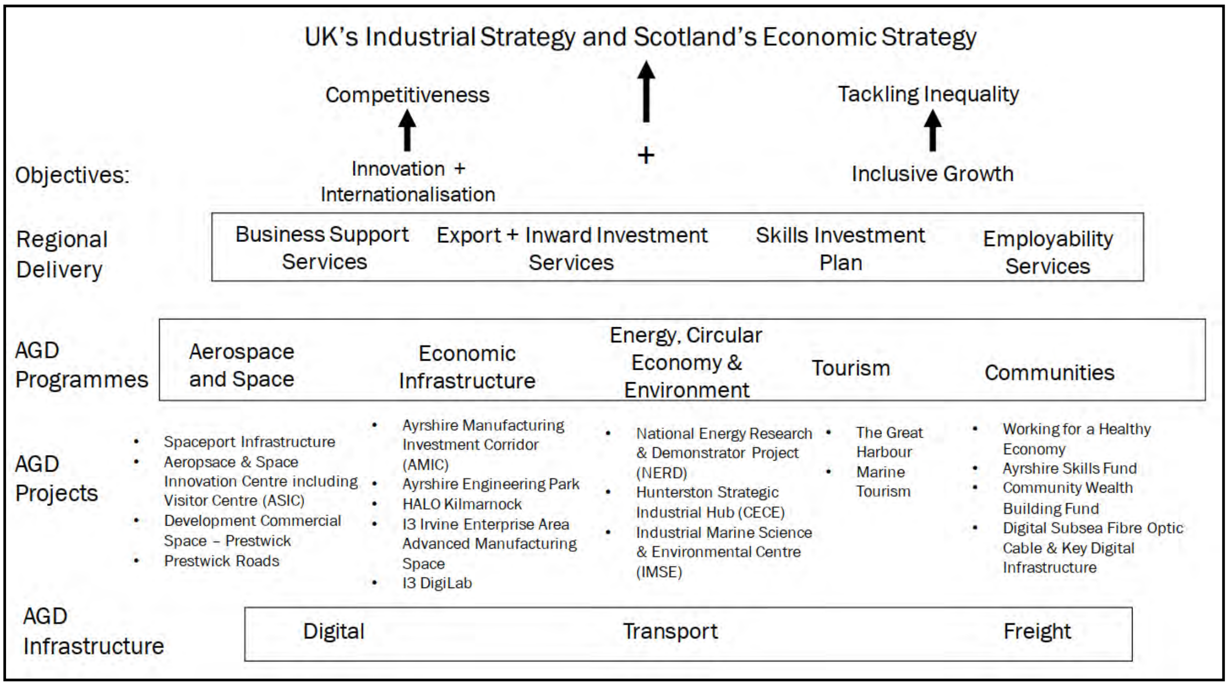

Figure 1.5 – AGD Strategic Framework

1.6.4. Suitability of Bellfield East (Kirklandside / Kaimshill) to fulfil AGD Objectives

Based on the above, the Council is of the opinion that the Kirklandside / Kaimshill area is the best location within East Ayrshire to attract innovative and internationally focussed companies which would contribute to Ayrshire achieving its full potential as envisioned within the AGD. The attractiveness of the location is due to the large amount of developable land at Kirklandside / Kaimshill which is particularly suitable for business and employment uses. Its location is highly accessibility (it is well placed within Ayrshire and to the Glasgow Conurbation and beyond - Livingston is 1 hour away, Edinburgh 1.5 hours away, Perth 1.25 hours away) and is attractive to developers. For these reasons the Council finds this location critical to fully realising East Ayrshire's economic growth potential. The Council has confidence that the AMIC development at this location would also bring positive benefits to Scotland and Ayrshire generally as well to the nearby areas, of which some have suffered deprivation.

The AGD states that both Governments will offer investment to support the delivery of the **Ayrshire Manufacturing Investment Corridor** (AMIC). The Scottish Government has ring fenced an investment of up to £13.5 million and UK Government an investment of £10 million. Expending these funds will establish a new national asset in East Ayrshire which will build on Ayrshire's proud history of manufacturing. The Council believes that the only place that such a national asset could be developed well is Kirklandside / Kaimshill.

1.6.5. Kilmarnock Development Options Stage 1 Assessment Study (Graham + Sibbald)

1.6.5.1. Background

In 2020, consultancy firm Graham + Sibbald (G+S) was appointed by EAC to undertake a Stage 1 Assessment of potential development options for land adjacent to the Bellfield Interchange, Kilmarnock.

The purpose of the Stage 1 Assessment was to identify site constraints and mitigation measures required to support development and to identify development options that would support economic growth and job creation within East Ayrshire.

The Bellfield Interchange is recognised in the adopted East Ayrshire Local Development Plan 2017 (LDP) and by the Scottish Government as being a strategically important transport hub and one of the main gateways to Kilmarnock. With EAC recognising the development potential around this area it wished to capitalise on the potential to support economic growth.

The East Ayrshire Local Development Plan (LDP) was adopted in April 2017. The LDP identifies the land to the East of Bellfield Interchange as an area for future growth, specifically for business and industrial expansion.

The G+S Stage 1 Assessment included a review of potential development options that could be delivered at the site. The following development options were considered in terms of market demand, compliance with strategic objectives and delivery of socio-economic benefits:

- General Business and Industry;
- Advanced Manufacturing;
- Energy Related Industries;
- Roadside Services;
- Transportation;
- Community Uses; and
- Tourism.

1.6.5.2. Selected Findings of the G+S Stage 1 Assessment

Some of the relevant findings included:

- In terms of potential development options, it is considered that the land at Bellfield Interchange could accommodate the Innovation Centre associated with the Ayrshire Manufacturing Investment Corridor (AMIC). The site is strategically placed to attract companies involved in this sector to East Ayrshire. The delivery of the AMIC at this location would meet the strategic vision for Ayrshire and would also be in accordance with the Local Development Plan (LDP) allocation of this area for future growth.
- The location of this facility within the former Kirklandside Hospital site would appear to be an appropriate location. The site is relatively free from physical constraints, is of a suitable scale and would re-develop an existing brownfield site.
- There is identified demand for business and industrial units within East Ayrshire. The delivery of these uses on land immediately east of the Bellfield Interchange would accord with the LDP allocation and strategic vision. This could be linked to the delivery of the AMIC. The identification of land required for the AMIC will allow an assessment of additional available land within the study area to support general business and industrial use.
- It is considered that the AMIC could be accommodated within the study area. It is recommended that an indicative layout is prepared for this use to identify the land requirements. It is then recommended that an indicative masterplan is prepared for the study area it shows the mix of uses that could be accommodated within the study area.

Therefore, due to the information provided in the AGD and the G+S Stage 1 Assessment, Kirklandside / Kaimshill is the preferred area for the development of the AMIC.

2. Modelling Approach and Methodology

2.1. Our Approach

This section of the report sets out the approach adopted in terms of the modelling of the effects of the proposed LDP allocations across the transport network. There were a number of stages to the completion of the transport modelling and the approach to each key stage of the model process is set out below. This approach has been developed in response to the requirements of this LDP modelling to facilitate adaptability and flexibility so that key assumptions can be updated easily where required. It is also intended that as much as possible results from data analysis and assessments will be presented graphically / visually which will make the outputs easy to interpret.

2.2. Base Traffic Flow Diagrams

Key Output –Development of base traffic flows diagrams for the study area.

In order to undertake the assessment, it was necessary to develop a baseline traffic network for the main study area. This drew on a mix of sources to identify appropriate (pre pandemic) traffic patterns across the East Ayrshire area as at the time the study was being developed there remained some Covid related restrictions in place and the option of undertake new traffic surveys was not considered to be representative of the long term travel patterns. Traffic count data was obtained from a mix of data held by EAC, including JTC and ATC data along with a range of counts on the Department for Transport (DfT) Road Traffic Statistics website. Data was also obtained from the TS trunk road counters on the roads within the study area.

As a result of the traffic data being obtained from various sources it was recognised that it would not be consistent in terms of the survey month and year. It was therefore necessary to establish a baseline month and year (adopted as November 2019) with appropriate growth and seasonality factors applied to data sources to achieve a consistent baseline for the base year traffic flows.

As part of the baseline review committed development, i.e. that built out since the data was gathered was added to the network using data from relevant planning consents known to East Ayrshire Council.

In accordance with EAC’s requirements the base year flows were projected forward to 2023 (when the LDP2 is to be adopted) and to 2033 (i.e. 2023 + 10 years). These assessment years form the basis for a few different scenarios to cover different levels of build-out of the LDP2 sites. The weekday AM and PM network peaks will be assessed with respect to cumulative impact on the trunk road network.

Network flow diagrams for agreed base and future years are available in Appendix A.

2.3. Modelling Approach

Key Output – Development of calibrated and validated base year models for key junctions included within the study area.

Base Models – in order to provide a consistency of approach across the study area it was proposed that all junctions within the modelled network be assessed using the VISSIM microsimulation software. The reasoning for this is that prior experience indicated that ARCADY tends to underestimate (or overestimate) levels of delay and queues and the use of microsimulation modelling was able to provide a more accurate representation of the performance of junctions (compared to ARCADY). The user of VISSUM also allowed the user to visualise the build-up of queuing on the different arms of the junction. As the Bellfield Interchange required to be modelled using microsimulation techniques the application of a consistent model approach across the study area also allows for consistent junction performance to be reported across the study network.

All models would be subject to calibration and validation, which outline the calibration and validation data used to assess the junction. These were developed using a mix of quantitative and qualitative information which was available e.g. queue data and journey times alongside the EAC officer experience and the consultants it does not appear that knowledge of the network.

All modelling assessments were undertaken with queue length analysis and comparisons between the different scenarios. Where necessary, e.g. models show congestion occurring, further analysis in the form of journey times was also undertaken. A review of the list of stand-alone junctions, no blocking back to upstream junctions was expected to occur and as such no connection between the models is currently proposed.

Scenario Testing and Modelling Outputs

Key Output – Assessment and reporting of the impact of development sites on key junctions included within the study area.

Scenario Testing – The base modelling was used to develop and assess the impact of the six proposed scenarios as set out in the brief for the proposed assessment years and network peak periods. The scenarios assessed are summarised in Table 2.1.

Table 2.1 - Scenario Testing

Scenario No.	Base Flows	Committed Development	LDP1	LDP2	AGD (Committed and Optional Sites)	Area East of Bellfield Interchange
1	✓	✓				
2	✓	✓	✓	✓		
3	✓	✓			✓	
4	✓	✓				✓
5	✓	✓	✓	✓	✓	
6	✓	✓	✓	✓	✓	✓

All scenario results will be compared with each other and the baseline, with comparison analysis provided. Key modelling results will include:

- Network performance;
- Delays; and
- Queue lengths.

The results of this assessment will provide an indication of the predicted performance of the junctions and where mitigation may be required at a junction to improve performance.

3. Trip Rates and Distribution

3.1. Introduction

EAC provided information on the proposed sites to be included in this assessment which is to cover four main plans (a copy of which is available in Appendix B):

1. LDP 1;
2. LDP 2;
3. AGD (Committed and Optional Sites); and
4. Area East of Bellfield Interchange.

The following sections of this chapter detail the trip rates used, and their application to the appropriate sites within each of the plans (thus determining the proposed trip generations). The proposed trip generations were calculated for arrivals and departures during the AM and PM peak hours (0800-0900hrs and 1700-1800hrs).

3.2. Trip Rates

Referring to the proposed use of the sites which will be included across the LDP legacy sites and the LDP sites, trip rates have been extracted from the TRICS database (TRICS 7.8.2) in a bid to apply the most appropriate TRICS land use to each site. Table 3-1 below details the trip rates that have been extracted from TRICS to be applied to the sites.

Table 3-1 - LDP Proposed Trip Rates (TRICS)

	AM Peak		PM Peak	
	Arrivals	Departures	Arrivals	Departures
02_D - Industrial Estate *(per hectare)*	11.999	4.558	3.721	11.059
03_A - Houses privately owned *(per house)*	0.129	0.382	0.353	0.178
03_C - Flats privately owned *(per flat)*	0.06	0.209	0.188	0.087
12_A - Civic Amenity Site *(per hectare)*	91.411	82.618	56.701	67.01
12_C - Landfill *(per hectare)*	0.347	0.252	0.168	0.399
07_Q - Community Centre *(per hectare)*	23.973	2.74	20.588	14.706
07_M - Country Parks *(per hectare)*	0.89	0.623	1.423	0.89

The sites included in the LDP are made up of the following four use types:

1. Business / Industry;
2. Miscellaneous;
3. Residential; and
4. Waste.

The TRICS land use applied to *Business / Industry*, *Residential* and *Waste* was straightforward and is set out as follows:

- **Business / Industry**
  - TRICS 02_D - Industrial Estate *(per hectare)*
- **Residential**

- TRICS 03_A - Houses privately owned *(per house)*
    - TRICS 03_C - Flats privately owned *(per flat)*
- **Waste**
    - TRICS 12_A - Civic Amenity Site *(per hectare)*
    - TRICS 12_C - Landfill *(per hectare)*

The TRICS land use applied to the any *Miscellaneous* sites will be more bespoke and relate specifically to the site under consideration.

3.3. Trip Distribution

Trip Distribution – Distribution patterns for each site were established using Travel to Work Census Data and illustrated in QGIS. Consideration was given to the travel to work patterns in the Middle-Layer Super Output Area (MSOA) each site is located within. The online platform "Datashine" was used to interrogate the areas travelled to, and as such the road network used to facilitate these movements. These distribution patterns were then incorporated into the network flow diagrams at the entry and exit points of the trunk road or main road network so that the proposed traffic from the various development sites are included in the transport appraisal.

The above trip distribution methodology was develop ensuring a robust methodology to test the key junction within the modelled network. In terms of the A77 therefore this directed trips to and from the Kilmarnock town centre wards primarily through the Bellfield Interchange (for those trips that had an origin or destination in the North, East and South) as this was identified as the key junction on the A77 within the study. In practice it is important to bear in mind that traffic is able to access the A77 using the Grassyards Interchange and routes to the south. This was deemed a robust methodology as only the trips to and from the East require to travel through the Bellfield Interchange as there is no other favourable route choice for these trips whereas trips travelling to the North and South have alternative options to access the A77 but have been directed to join the A77 at Bellfield in the modelling appraisal to assess a 'worst case' position.

3.4. Trip Distribution Spreadsheet Development

3.4.1. Introduction

This section outlines the methodology used to determine and assess the likely directions of travel demand during the AM and PM peaks for each site.

3.4.2. Mapping to QGIS

Using the shapefile provided by East Ayrshire Council, each of the proposed sites within the Local Development Plan were mapped on QGIS. Figure 3-1 shows the sites distributed across the county of East Ayrshire.

There were four use types that the sites had been categorised into. These were:

- Business / Industry;
- Miscellaneous;
- Residential; and
- Waste.

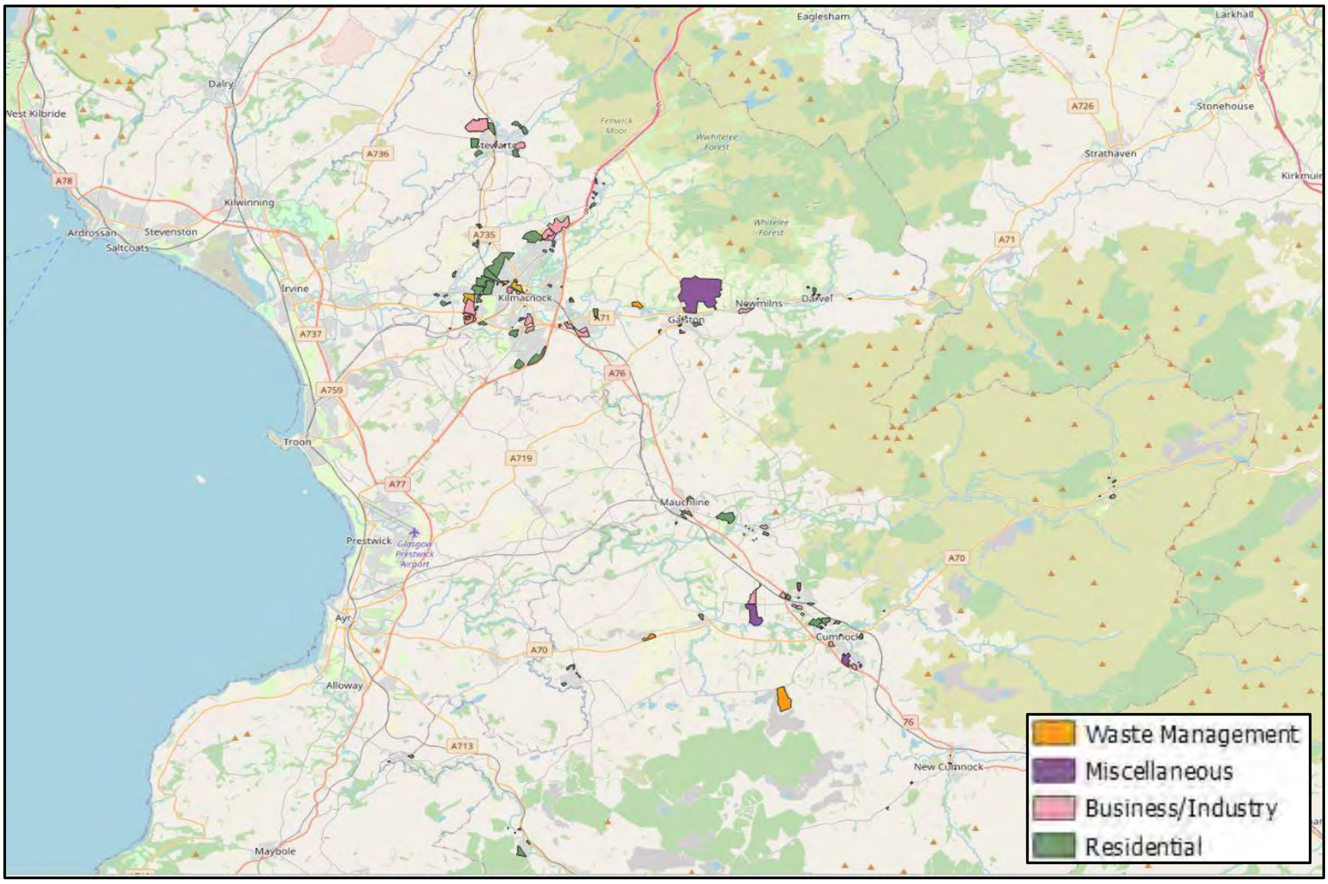

Figure 3-1 - GIS Map Showing LDP Sites

Using this data an initial Excel spreadsheet was created to list each site with its:

- Land use;
- Settlement location;
- Address;
- Number of units;
- Size in hectares; and
- Proposed number of houses and apartments (for Residential sites).

Using the above information, trip distributions / directions of travel for each of the proposed developments were determined using Datashine. In order to understand the AM / PM peaks, the TRICS database was interrogated using each site's land use and hectare size (or number of units) which identified the AM / PM peaks for arrivals and departures.

3.4.3. Data Shine Scotland

To distribute the flows for each proposed development the Datashine Scotland Commute website was used which enabled each site to be allocated to a specific electoral ward or 'Datashine Dot' to which they were closest to.

Each 'Dot' contained travel to work data from Scotland's Census, including arrivals and departures to and from other wards or 'Dots'. Each site (based on its location) within the proposed LDP was then assigned a

'Datashine Dot' and this information was used to distribute the proposed development flows onto the trunk road network. Figure 3-2 displays the 'Datashine Dots' distributed around the Kilmarnock area.

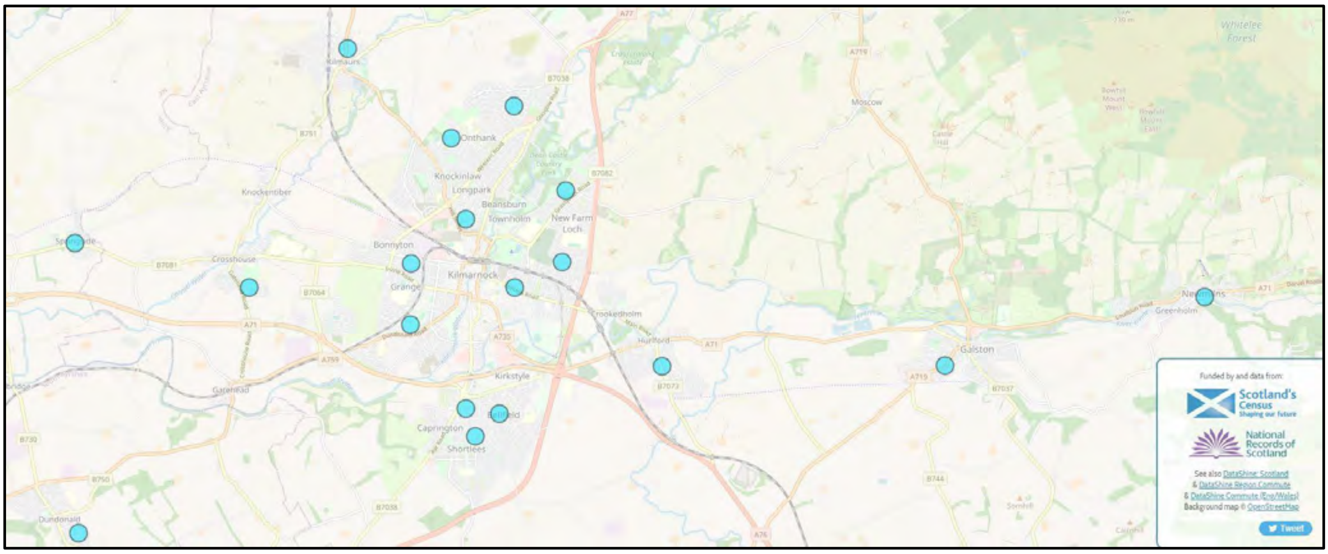

Figure 3-2 - Datashine Dots - Kilmarnock

3.4.4. Determining Overall Direction of Travel Percentages (by Ward)

There were a total of 31 wards / Datashine dots associated with the arrivals and departures of the sites. These wards are listed below in Table 3-2.

Table 3-2 - Wards / Datashine dots

No.	Ward Name
1	Altonhill North and Onthank
2	Altonhill South, Longpark and Hillhead
3	Auchinleck
4	Beith East and Rural
5	Bonnyton and Town Centre
6	Carrick North
7	Crosshouse, Gatehead and Kilmaurs Rural
8	Cumnock North
9	Cumnock Rural
10	Cumnock South and Craigens
11	Darvel
12	Dean and New Farm Loch North
13	Doon Valley North
14	Doon Valley South
15	Drongan
16	Earlston and Hurlford Rural
17	Galston
18	Grange, Howard and Gargieston

19	Kilmarnock South Central and Caprington
20	Kilmaurs
21	Mauchline
22	Mauchline Rural
23	New Cumnock
24	New Farm Loch South
25	Newmilns
26	Northern and Irvine Valley Rural
27	Piersland
28	Shortlees
29	Southcraig and Beansburn
30	Stewarton East
31	Stewarton West

Subsequently, the arrival and departure percentages (by direction) for each ward was extracted. Figure 3-3 shows the ‘Shortlees’ dot/ward as an example, which displays departure data in red and arrival data in blue. The data from the list below was used to determine a descending list of the most popular wards/dots that are travelled to and from the Shortlees area. Lines that indicated trips ‘working from home’, ‘no fixed place’, or within the selected ward, were removed to show only trips coming in or out of the area. This process was repeated for all 31 Dots / Wards.

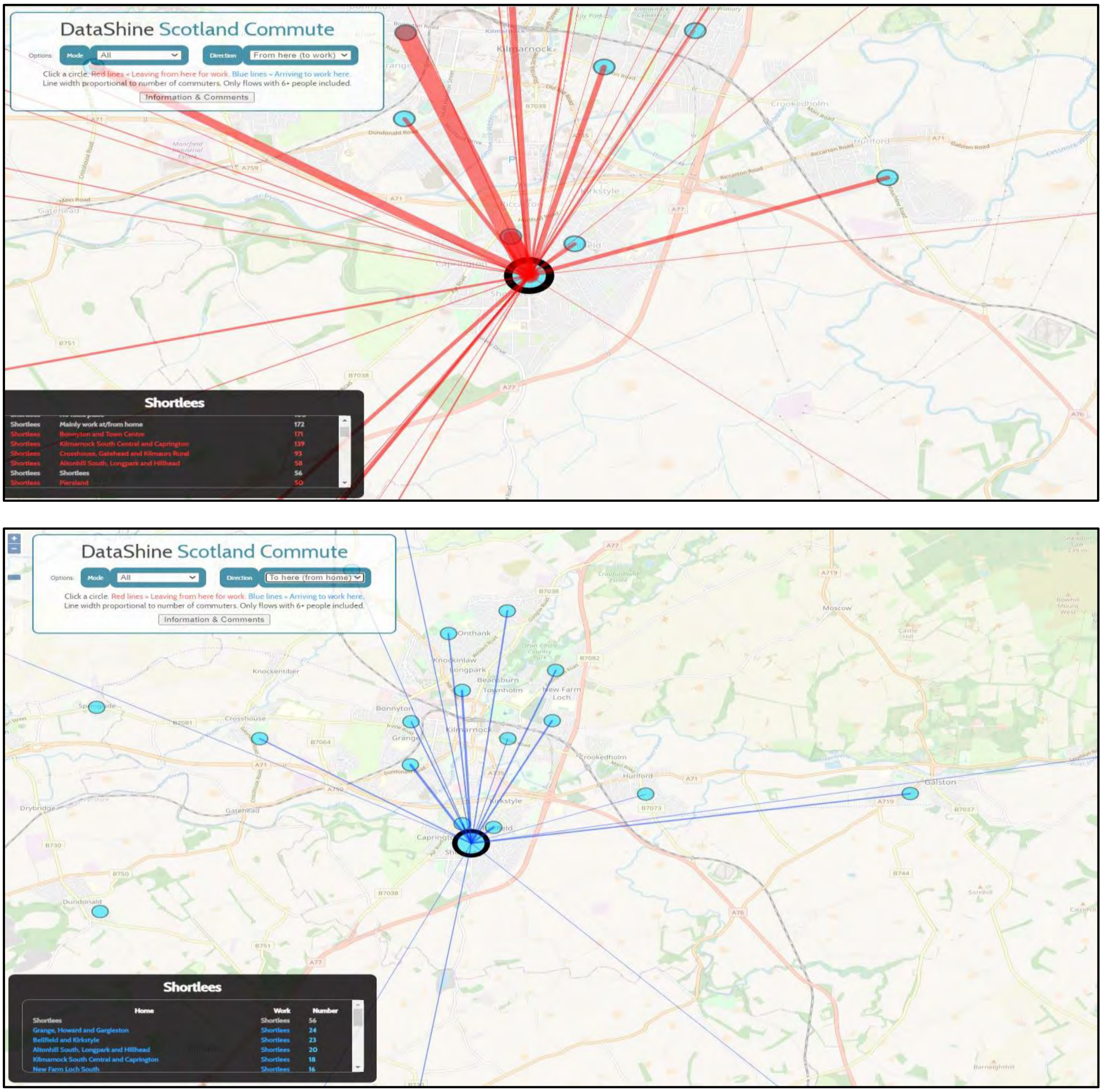

Figure 3-3 - Shortlees Departure Data (Red) and Arrival Data (Blue)

3.4.5. Finding the Direction of Travel

All 31 wards / dots have had their arrivals / departure data itemised to determine where the departing / arriving trips were travelling to and from in terms of direction on the trunk road network. For example, the first ward in alphabetical order, was Altonhill North and Onthank (North Kilmarnock). Figure 3-4 is an extract from the first three entries of the departures table for this ward / dot and it shows that the most travelled to ward for work was Bonnyton and Town Centre (also in Kilmarnock), which is located south of Altonhill North and Onthank. Departures were colour coded based on their direction of travel i.e. North (blue), East (green), South (red) and West (yellow).

Therefore, it was determined that 209 trips travelling south from this ward / dot toward Bonnyton and Town Centre. The total number of trips in each direction is then totalled at the bottom, so for Altonhill North and

Onthank, this was 1174 departure trips, which was subsequently categorised into directions. The second table in Figure 3-4 shows the total departure trips for Altonhill North and Onthank categorised into directions. Finally, the percentage direction of travel was derived as:

- North - 193 trips (16%)
- East - 87 trips (7%)
- South - 724 trips (62%)
- West - 170 trips (14%)

This process was repeated for all the 31 wards (and for arrivals) with the overall output as the percentage direction of travel for each ward, both for departures and arrivals. Once the percentages for the dots / wards were calculated they were assigned to the appropriate sites (based on the proposed sites proximity to the Datashine dots) as the assumed direction of travel.

Altonhill North and Onthank			Direction
Altonhill North and Onthank	Bonnyton and Town Centre	209	S
Altonhill North and Onthank	Kilmarnock South Central and Caprington	115	S
Altonhill North and Onthank	Crosshouse, Gatehead and Kilmaurs Rural	98	W

N	193	16%
E	87	7%
S	724	62%
W	170	14%
	1174	100%

Figure 3-4 - Extracts from Departures Spreadsheet

3.4.6. Calculating the Trip Distributions

The calculation of trip distributions was undertaken by using the assumed direction of travel percentages for each dot / ward and using each individual site's TRICS data to calculate the AM and PM peak arrivals / departures for each site. This was done by multiplying the sites TRICS peak with the percentage of trips from each direction. For example, in Figure 3-5, to find the first value – AM peak arrivals, 'Flow from North' (green) for the first site, the AM peak arrivals (127, far left) were multiplied by the percentage direction of arrivals from 'North' associated with the site's assigned Datashine Dot (16%).

This process can be summarised as – AM / PM peak arrivals directional flow = Sites TRICS peak arrivals / departures x Datashine Dot Direction %

This resulted in a calculation of 20 trips for that site, heading north, during the AM peak. This process was applied to AM / PM peak arrivals / departures for every site within the LDP.

AM Peak Arr	AM Peak Dep	PM Peak Arr	PM Peak Dep		Data Shine dot	Entry/Exit on TFD	% Direction Arrivals % N	% Direction Arrivals % S	% Direction Arrivals % E	% Direction Arrivals % W	% Direction Departures % N	% Direction Departures % S	% Direction Departures % E	% Direction Departures % W	AM Peak Arrivals Flow from N	AM Peak Arrivals Flow from S	AM Peak Arrivals Flow from E	AM Peak Arrivals Flow from W	AM Peak Departures Flow to N	AM Peak Departures Flow to S	AM Peak Departures Flow to E	AM Peak Departures Flow to W
127	376	347	175		Altonhill North and Onthank		18%	52%	0%	32%	18%	82%	7%	14%	20	66	0	41	82	232	28	54
21	2	18	13	*100% 07_Q Com	Altonhill South, Longpark and Hillhead		20%	33%	17%	24%	25%	55%	0%	15%	5	7	4	5	1	1	0	0
41	29	66	41	*100% 07_M Cour	Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	2	37	1	2	14	10	0	6
7	21	20	10		Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	0	6	0	0	10	7	0	4
14	41	38	19		Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	1	12	0	1	20	14	0	8
2	6	6	3		Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	0	2	0	0	3	2	0	1
1	1	0	1		Beith East and Rural		42%	0%	31%	27%	57%	21%	5%	16%	0	0	0	0	0	0	0	0
1	3	3	2		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	0	0	0	0	1	1	0	1
9	27	25	13		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	2	3	2	2	9	10	1	6
19	55	51	26		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	5	6	4	4	19	21	3	12
77	70	48	57	*0.85ha Civic Ame	Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	19	24	17	17	24	26	4	15
0	0	0	0		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	0	0	0	0	0	0	0	0
7	22	20	10		Carrick North		9%	72%	0%	19%	84%	14%	2%	0%	1	5	0	1	19	3	0	0
347	132	108	320		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	65	83	127	73	33	20	58	20
247	94	76	227		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	46	59	90	52	24	14	41	14
4	11	11	5		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	1	1	1	1	3	2	5	2
7	21	19	10		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	1	2	3	1	5	3	9	3
1	2	2	1		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	0	0	0	0	1	0	1	0
1	1	0	1		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	0	0	0	0	0	0	0	0
86	34	28	82		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	12	69	1	7	16	6	4	8
5	15	14	7		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	1	4	0	0	7	3	2	3
3	10	10	5		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	0	3	0	0	5	2	1	2
1	4	4	2		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	0	1	0	0	2	1	0	1
2	7	6	3		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	0	2	0	0	3	1	1	2
1	4	4	2		Cumnock Rural		11%	78%	2%	9%	38%	9%	5%	48%	0	1	0	0	2	0	0	2
4	11	10	5		Cumnock Rural		11%	78%	2%	9%	38%	9%	5%	48%	0	3	0	0	4	1	1	5
287	101	83	246	*100% 02_D Indus	Cumnock South and Craigens		11%	84%	0%	5%	63%	4%	12%	21%	31	224	0	13	64	4	12	22

Figure 3-5 – Extract from Trip Distributions

3.5. Summary

This section of the report has set out the approach and methodology used to derive the trip distribution aspect of the appraisal. This involved mapping every proposed site onto QGIS and using the Datashine Scotland Commute website to understand the likely trip distributions for each site, based on the Wards that they are located in. Finally, the trip distribution data extracted from each Ward was combined with the TRICS data for each site to estimate the amount of proposed traffic flow on the road network and its direction of travel.

4. Model Development and Calibration (exc Bellfield Interchange)

4.1. Baseline Data Gathering

Traffic survey data for the nine models was acquired from different sources. Turning movement counts were either undertaken specifically for this study or extracted from data that EAC had on file. TomTom journey times were also acquired along the appropriate sections of the A76, A71, Meiklewood and Stewarton as described later in this section.

4.1.1. Turning Movements Counts

This section summarises the junction survey data used and whether the turning movements counts were undertaken specifically for this study or if they were taken from existing TAs.

4.1.1.1. A71 Moorfield roundabout

Turning movement counts from three junctions have been utilised in the development of the A71 Moorfield roundabout VISSIM model. These three junctions are:

- J1 – B7081 Kilmarnock Road / Irvine Road roundabout (three arm priority roundabout);
- J2 – B7064 / Dumfries Drive roundabout (four arm priority roundabout); and
- J3 – A71 Moorfield roundabout (four arm priority roundabout).

The turning movement counts were taken from a local Transport Assessment provided by EAC. The traffic counts from Tuesday 25 February 2020 were undertaken between 07:00 – 09:30 and 16:00 – 18:30. The surveys indicated the following peak hour periods:

- 08:00 – 09:00 AM Peak; and
- 17:00 – 18:00 PM Peak.

In the TA the turning movement counts were presented in PCUs and so for the purpose of the VISSIM model calibration five vehicle types (Car, LGV, OGV1, OGV2 and Bus) were applied to this data based on the vehicle proportions of the Bellfield Interchange.

4.1.1.2. A76 Bowfield roundabout

Turning movement counts from one junction have been utilised in the development of the A76 Bowfield roundabout VISSIM model. This junction is:

- J1 – A76 / B7073 / HMP Kilmarnock access (four arm priority roundabout);

The turning movement counts were undertaken specifically for this study. The traffic counts from Wednesday 20 October 2021 were undertaken between 07:00 – 10:00 and 16:00 – 19:00. The surveys indicated the following peak hour periods:

- 07:30 – 08:30 AM Peak; and
- 16:30 – 17:30 PM Peak.

The classified turning movement counts included five vehicle types (Car, LGV, OGV1, OGV2 and Bus).

4.1.1.3. A76 Crossroads roundabout

Turning movement counts from one junction have been utilised in the development of the A76 Crossroads roundabout VISSIM model. This junction is:

- J1 – A76 / A719 (four arm priority roundabout);

The turning movement counts were undertaken specifically for this study. The traffic counts from Wednesday 20 October 2021 were undertaken between 07:00 – 10:00 and 16:00 – 19:00. The surveys indicated the following peak hour periods:

- 07:30 – 08:30 AM Peak; and
- 16:30 – 17:30 PM Peak.

The classified turning movement counts included five vehicle types (Car, LGV, OGV1, OGV2 and Bus).

4.1.1.4. A76 Mauchline crossroads

Turning movement counts from one junction have been utilised in the development of the A76 Mauchline crossroads VISSIM model. This junction is:

- J1 – A76 / B743 (four arm signalised junction);

The turning movement counts were taken from a local Transport Assessment provided by EAC. The traffic counts from Wednesday 21 November 2018 were undertaken between 07:15 – 09:15 and 16:15 – 18:15. The surveys indicated the following peak hour periods:

- 08:00 – 09:00 AM Peak; and
- 16:30 – 17:30 PM Peak.

In the TA the turning movement counts were presented in PCUs and so for the purpose of the VISSIM model calibration five vehicle types (Car, LGV, OGV1, OGV2 and Bus) were applied to this data based on the vehicle proportions of the A76 Crossroads roundabout.

4.1.1.5. A76 Templeton roundabout

Turning movement counts from two junctions have been utilised in the development of the A76 Templeton roundabout VISSIM model. These junctions are:

- J1 – A76 / B7083 (three arm priority roundabout); and
- J2 – B7083 / Darnlaw View (three arm priority T-junction).

The turning movement counts were taken from a local Transport Assessment provided by EAC. The traffic counts from Tuesday 1 June 2021 were undertaken between 07:00 – 10:00 and 15:30 – 18:30. The surveys indicated the following peak hour periods:

- 08:00 – 09:00 AM Peak; and
- 17:00 – 18:00 PM Peak.

The classified turning movement counts included five vehicle types (Car, LGV, OGV1, OGV2 and Bus).

4.1.1.6. A76 Dettingen roundabout

Turning movement counts from one junction have been utilised in the development of the A76 Dettingen roundabout VISSIM model. This junction is:

- J1 – A76 / A70 / Ayr Road (four arm priority roundabout);

The turning movement counts were taken from a local Transport Assessment Addendum provided by EAC. The TAA was prepared in support of the Knockroon Learning and Enterprise Centre (KLEC) which incorporated a Primary School, Secondary School, Supported Learning Centre and an Early Learning Centre. Hence the earlier evening peak hour identified below. The 2019 proposed traffic (i.e. 2016 base + development) indicated the following peak hour periods:

- 08:15 – 09:15 AM Peak; and
- 15:10 – 16:10 PM Peak.

In the TA the turning movement counts were presented in PCUs and so for the purpose of the VISSIM model calibration five vehicle types (Car, LGV, OGV1, OGV2 and Bus) were applied to this data based on the vehicle proportions of the Skerrington roundabout.

4.1.1.7. A76 Skerrington roundabout

Turning movement counts from one junction have been utilised in the development of the A76 Skerrington roundabout VISSIM model. This junction is:

- J1 – A76 / B7083 / Glaisnock Road (four arm priority roundabout);

The turning movement counts were undertaken specifically for this study. The traffic counts from Wednesday 20 October 2021 were undertaken between 07:00 – 10:00 and 16:00 – 19:00. The surveys indicated the following peak hour periods:

- 07:30 – 08:30 AM Peak; and
- 16:45 – 17:45 PM Peak.

The classified turning movement counts included five vehicle types (Car, LGV, OGV1, OGV2 and Bus).

4.1.1.8. A735 / B778 / B769 Stewarton crossroads

Turning movement counts from two junctions have been utilised in the development of the Stewarton crossroads VISSIM model. These junctions are:

- J1 – A735 / B778 / B769 (four arm signalised junction); and
- J2 – Standalane / Lainshaw Street / Local Access (four arm mini-roundabout).

The turning movement counts were taken from a local Transport Assessment provided by EAC. The traffic counts from Wednesday 3 October 2018 were undertaken between 07:00 – 19:00. The 2021 proposed traffic (i.e. 2018 base + development) indicated the following peak hour periods:

- 08:00 – 09:00 AM Peak; and
- 16:30 – 17:30 PM Peak.

In the TA the turning movement counts were presented in PCUs and so for the purpose of the VISSIM model calibration five vehicle types (Car, LGV, OGV1, OGV2 and Bus) were applied to this data based on the vehicle proportions of the Bellfield Interchange.

4.1.1.9. A77 Meiklewood junction

Turning movement counts from eight junctions have been utilised in the development of the A77 Meiklewood VISSIM model. These junctions are:

- J1 – A77 NB Offslip / A77 NB Onslip / B7038 Glasgow Road (three arm priority T-junction);
- J2 – A77 SB Onslip / B7038 (three arm priority roundabout);
- J3 – M77 J8 SB Offslip / B7061 / B7038 (three arm priority roundabout);
- J4 – M77 J8 NB Offslip / A77 / B751 Kilmaurs Road (three arm priority roundabout);
- J5 – A77 / B778 Stewarton Road (four arm priority roundabout);
- J6 – M77 J7 SB Offslip / B778 Stewarton Road (four arm priority junction);
- J7 – M77 J7 NB Onslip / A77 / Ayr Road (three arm priority roundabout); and
- J8 – B7038 Glasgow Road / B751 Kilmaurs Road (three arm priority T-junction).

The turning movement counts were undertaken specifically for this study. The traffic counts from Thursday 25 November 2021 were undertaken between 07:00 – 10:00 and 16:00 – 19:00. The surveys indicated the following peak hour periods:

- 07:30 – 08:30 AM Peak; and
- 16:15 – 17:15 PM Peak.

The classified turning movement counts included five vehicle types (Car, LGV, OGV1, OGV2 and Bus).

4.1.2. TomTom Journey Time Data

Journey time data through the A76, A71, Meiklewood and Stewarton in hourly intervals based on the three month period from September to November 2019 was acquired from TomTom. Three separate TomTom routes were used in the development of the journey time validation. These are:

4.1.2.1. Route 1 - A76 (at junction with Borland Road) to A71 Corsehill Mount Roundabout

The TomTom route began on the A76 at the junction with Borland Road (approximatley 1 mile south of Skerrington roundabout just south of Cumnock). The route goes all the way to the A71 Corsehill Mount Roundabout where it U-turns and returns along the same route back to the A76 at the junction Borland Road. Each direction is approximately 21 miles. This journey time route captures the six junctions on the A76 and the A71 Moorfield roundabout. TomTom Route 1 is illustrated below in Figure 4.1.

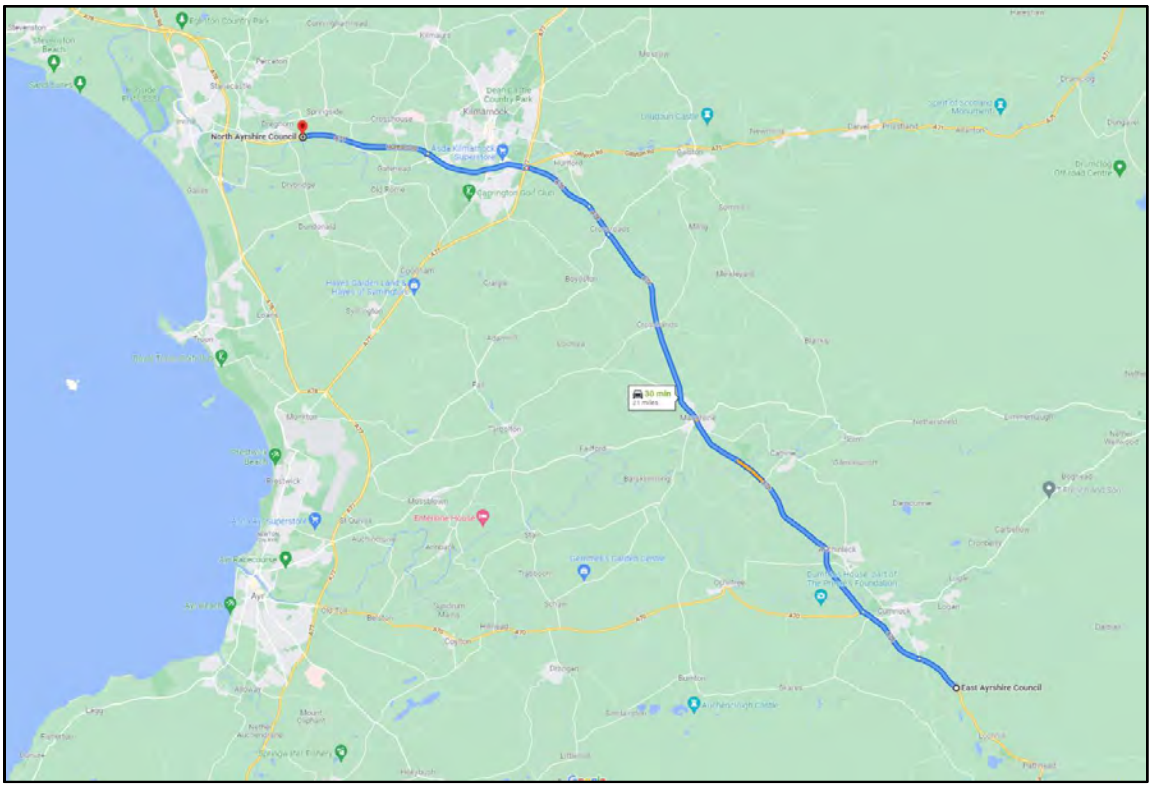

Figure 4.1 - TomTom Route 1 - A76 to A71

4.1.2.2. Route 2 - Stewarton

The TomTom route began on the B778 approximately 1.5 miles southeast of the Stewarton signalised crossroads and continued through Stewarton town centre finishing 1.5 miles north along the A735. Each direction is approximately 3 miles. TomTom Route 2 is illustrated below in Figure 4.2.

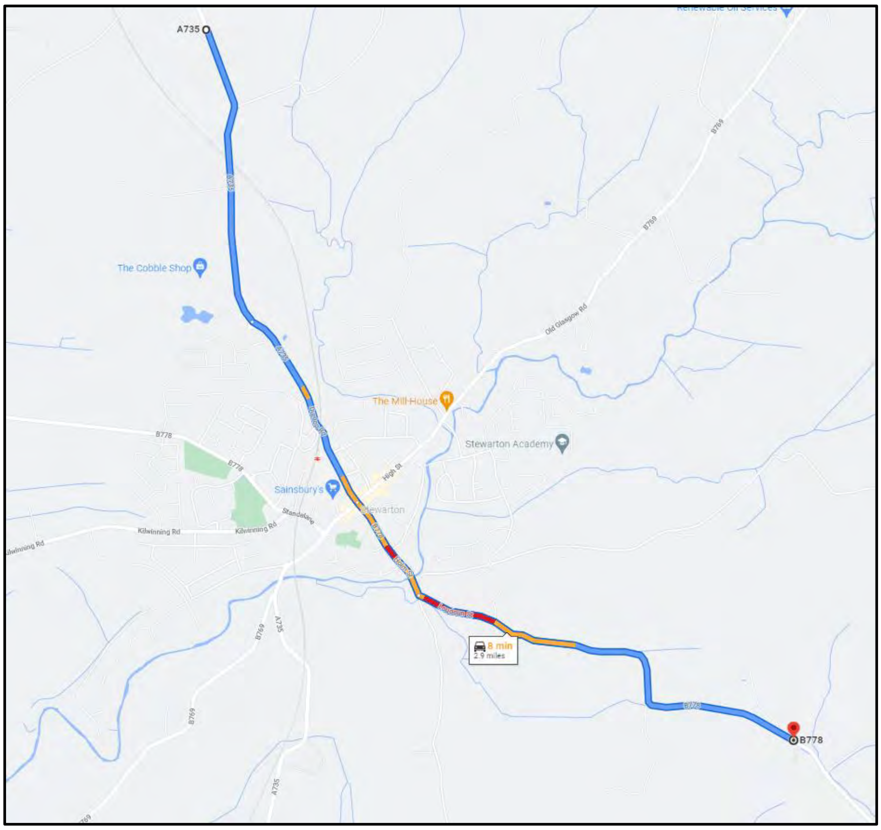

Figure 4.2 - TomTom Route 2 – Stewarton

4.1.2.3. Route 3 - Meiklewood

The TomTom route began at the north arm of the B7038 Glasgow Road / Southcraig Drive roundabout (just northeast of Kilmarnock). The route goes along the B7061 (through Fenwick village) all the way to the A77 / Ayr Road / A77 onslip roundabout where it U-turns and returns along the same route back to the B7038 Glasgow Road / Southcraig Drive roundabout. Each direction is approximately 3.1 miles. TomTom Route 3 is illustrated below in Figure 4.3.

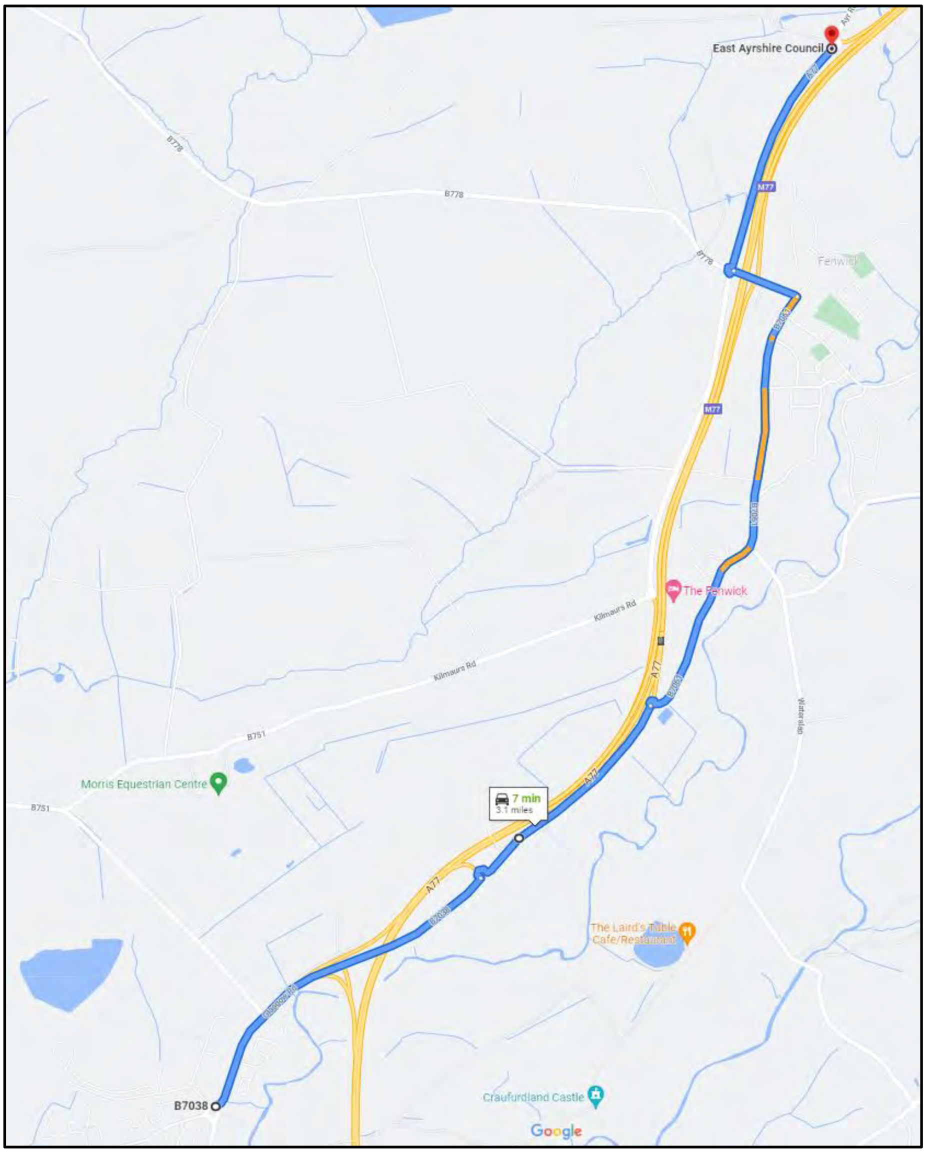

Figure 4.3 - TomTom Route 3 – Meiklewood

4.2. Model Development Overview (Excluding Bellfield Interchange)

4.2.1. Introduction

This section outlines the base traffic modelling developed to assess the likely traffic impact at nine junctions on the A71, A76, A77 corridors and in Stewarton town centre.

4.2.2. Modelling Approach

For each junction two base models were developed using PTV's VISSIM microsimulation software for the weekday AM and PM peak periods. These models were then utilised to assess the impact of a number of proposed scenarios to better understand the likely traffic impacts at each of the nine junctions during the AM and PM peak periods.

VISSIM microsimulation software models each vehicle individually, including driver behaviour characteristics, and provides a visual representation of the interaction between vehicles, assisting in the assessment of the road network operation and model calibration. PTV's VISSIM Version 2021 (SP 09) has been used. It was considered that this modelling appraisal would enable a comprehensive assessment of the various transport issues to be considered at the nine junctions.

4.2.3. Modelled Junctions

This technical note focuses on the base modelling development for the following nine junctions:

- A71 Moorfield roundabout (and additional local roads to the immediate north and south);
- A76 Bowfield roundabout;
- A76 Crossroads roundabout;
- A76 Mauchline crossroads;
- A76 Templeton roundabout;
- A76 Dettingen roundabout;
- A76 Skerrington roundabout;
- A735 / B778 / B769 Stewarton crossroads; and
- A77 Meiklewood junction.

4.2.4. Model Development Parameters

A transport model in VISSIM consists of transport supply and travel demand data. Transport supply data is represented in a network model, which includes the following network objects that can be modified interactively:

- **Links**: Links represent single or multi-lane carriageways with a specified direction of flow.
- **Connectors**: These are used to provide continuous routes between links. In order to join links together connectors are used to construct junctions and changes in road layout.
- **Vehicle Inputs**: Define the total number of vehicles which enter the network on a link (at the extremities of the model), for each defined time period.
- **Priority Rules**: Define rights of way at non-signalised junctions. Includes gap acceptance information which can be adjusted based on observed driver behaviour.
- **Desired Speed Decision**: Dictates the speed at which a vehicle wishes to travel at.
- **Reduced Speed Areas**: Dictates the speed at which the vehicle will travel at. These are used to model short areas of speed change for example on the approach to give-way junctions and at sharp bends.
- **Vehicle Classes**: Categorise the vehicle types used in the model. The vehicle classes used include light vehicles (Car and LGV) and heavy vehicles (OGV1, OGV2 and Bus). All vehicles were input to the models using vehicle volumes in 15-minute time intervals.
- **Matrix Development**: Each of the VISSIM models are static models that have used Vehicle Inputs and Static Routing Decisions which were used to calibrate the model based on the turning movements for the

junction(s) contained in the model. The models are therefore not dynamic assignment, and so no matrices have been developed.

- **Parameters**: The following model parameters have been used:
  - Average standstill distance of 2.00m
  - Additive part of safety distance of 2.00
  - Multiplic. part of safety distance of 3.00

During the development stage of the nine networks the VISSIM background mapping facility (i.e. Bing maps) was used to replicate a detailed account of the existing road layout in VISSIM. Junction layouts and markings were obtained from the in-built background mapping, on site observations and aerial photography.

Speed limits and road restrictions were gathered from site visits and online photography. Where appropriate, vehicle speeds have been restricted to ensure that the model replicates observed on site behaviour.

4.3. Model Calibration and Validation Results

Model calibration is defined within DMRB as:

Adjusting the parameters used in the various mathematical relationships within the model to reflect the data as well as is necessary to satisfy the model objectives.

The calibration of the AM and PM Bellfield Interchange base models was focused on the comparison of the turning movement counts and a review of the model network and driver behaviour.

Model validation is an essential part of the development of a base year model. Validation acts as a confirmation of the ability of the model to represent the current traffic conditions and patterns in the modelled area. A successfully validated base model substantiates the model as a robust tool for future scheme assessments allowing for proposed transport scenarios to be tested.

Previously, modelling guidelines have indicated that 85% of modelled flows and turning movements should have a GEH of less than 5.0. The GEH value is in the form of a Chi-squared statistic and incorporates both relative and absolute errors, giving an overall measure of the accuracy of the model. The formula for the statistic is presented below:

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

M = Modelled Flow
C = Observed Flow

Guideline requirements in TAG Unit M3.1 state that the modelled flows should be within one of the three parameters below for more than 85% of cases;

- Individual flows within 100 vph of counts for flows less than 700 vph;
- Individual flows within 15% of counts for flows from 700 to 2,700 vph; or
- Individual flows within 400 vph of counts for flows more than 2,700 vph.

The following calibration and validation results are based on an average of ten runs, with different random seeds, ensuring that daily variation in vehicle arrival times were replicated.

TAG Unit M3.1 sets out the criteria and acceptability guidelines for the use of journey times to validate a base model. The preferred measure for journey time validation is the percentage difference between modelled and observed journey times. The modelled journey times should be within 15% of the observed journey times (or within one minute if higher than 15%) for more than 85% of all routes.

4.4. A71 Moorfield Roundabout

4.4.1. Model Extent

A full extent of the A71 Moorfield roundabout VISSIM model is shown below in Figure 4.4.

Figure 4.4 – A71 Moorfield model extents

4.4.2. Base Model

The base year models are representative of traffic flow in the morning and evening peak periods for February 2020. The two base models simulate the following peak time periods:

- 08:00 – 09:00 AM weekday peak period (Tuesday 25 February 2020); and
- 17:00 – 18:00 PM weekday peak period (Tuesday 25 February 2020).

The periods were selected based on the busiest hour identified from a local Transport Assessment provided by EAC.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.4.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from three junctions have been utilised in the development of the A71 Moorfield roundabout VISSIM model. These three junctions are:

- J1 – B7081 Kilmarnock Road / Irvine Road roundabout (three arm priority roundabout);
- J2 – B7064 / Dumfries Drive roundabout (four arm priority roundabout); and
- J3 – A71 Moorfield roundabout (four arm priority roundabout).

At the request of EAC the model network was expanded to include two junctions immediately south of the A71 Moorfield roundabout, and the junction of the hospital access immediately to the west of the Kilmarnock Road / Irvine Road roundabout. These additional three junctions are:

- J4 – A759 / B7064 T-junction (three arm priority junction)
- J5 – A759 Dundonald Road roundabout (four arm priority roundabout)
- J6 – B7081 Kilmarnock Road / Hospital roundabout (three arm priority roundabout)

Observed turning movement counts at the six junctions in the network have been compared against the base model turning movement counts. Table 4.1 and Table 4.2 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria **(100% *'Pass'* rate)**. This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Moorfield area during the AM and PM peak periods.

Table 4.1 – A71 Moorfield AM Base Model Turning Movement Count Calibration Results

	AM Peak 0800 – 0900 (Tue 25 Feb 2020)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	Irvine Road (E) to B7081 (S)	266	58	12	12	3	352	267	59	10	13	2	351	-1	0%	0.0	Pass	Pass
	A to C	Irvine Road (E) to Kilmarnock Road (W)	243	53	11	11	3	320	240	49	10	11	2	312	-8	-3%	0.5	Pass	Pass
	A to A	Irvine Road (E) to Irvine Road (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	B7064 (S) to Kilmarnock Road (W)	493	107	23	23	6	651	482	108	21	22	6	639	-12	-2%	0.5	Pass	Pass
	B to A	B7064 (S) to Irvine Road (E)	307	67	14	14	4	405	309	64	12	11	4	400	-5	-1%	0.3	Pass	Pass
	B to B	B7064 (S) to B7081 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to A	Kilmarnock Road (W) to Irvine Road (E)	175	38	8	8	2	232	172	37	7	7	1	224	-8	-3%	0.5	Pass	Pass
	C to B	Kilmarnock Road (W) to B7081 (S)	146	32	7	7	2	193	151	30	6	5	3	195	2	1%	0.1	Pass	Pass
	C to C	Kilmarnock Road (W) to Kilmarnock Road (W)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm A	A to B	B7064 (N) to Dumfries Drive	24	5	1	1	0	31	20	4	1	1	0	26	-5	-16%	1.0	Pass	Pass
	A to C	B7064 (N) to B7064 (S)	383	83	17	18	4	506	382	80	14	15	5	496	-10	-2%	0.4	Pass	Pass
	A to D	B7064 (N) to Industrial Park (W)	14	3	1	1	0	18	13	3	1	1	0	18	0	1%	0.0	Pass	Pass
	A to A	B7064 (N) to B7064 (N)	3	1	0	0	0	4	3	1	0	0	0	4	0	6%	0.1	Pass	Pass
J2 Arm B	B to C	Dumfries Drive (E) to B7064 (S)	132	29	6	6	2	174	132	30	6	5	0	173	-1	-1%	0.1	Pass	Pass
	B to D	Dumfries Drive (E) to Industrial Park (W)	1	0	0	0	0	1	1	0	0	0	0	1	0	6%	0.1	Pass	Pass
	B to A	Dumfries Drive (E) to B7064 (N)	56	12	3	3	1	74	55	10	3	3	0	71	-3	-5%	0.4	Pass	Pass
	B to B	Dumfries Drive (E) to Dumfries Drive (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm C	C to D	B7064 (S) to Industrial Park (W)	41	9	2	2	0	55	38	8	2	3	0	51	-4	-7%	0.5	Pass	Pass
	C to A	B7064 (S) to B7064 (N)	715	156	33	33	8	945	720	158	30	30	10	948	3	0%	0.1	Pass	Pass
	C to B	B7064 (S) to Dumfries Drive (E)	27	6	1	1	0	36	26	5	2	2	0	35	-1	-2%	0.1	Pass	Pass
	C to C	B7064 (S) to B7064 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm D	D to A	Industrial Park (W) to B7064 (N)	12	3	1	1	0	16	12	4	0	0	0	16	0	0%	0.0	Pass	Pass
	D to B	Industrial Park (W) to Dumfries Drive (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	D to C	Industrial Park (W) to B7064 (S)	42	9	2	2	0	56	41	8	0	0	0	49	-7	-12%	0.9	Pass	Pass
	D to D	Industrial Park (W) to Industrial Park (W)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm A	A to B	B7064 (N) to A71 Hurlford Road (E)	194	42	9	9	2	256	193	39	7	9	2	250	-6	-2%	0.4	Pass	Pass
	A to C	B7064 (N) to B7064 (S)	151	33	7	7	2	199	146	35	4	4	1	190	-9	-4%	0.6	Pass	Pass
	A to D	B7064 (N) to A71 Hurlford Road (W)	213	46	10	10	2	281	212	45	8	7	2	274	-7	-2%	0.4	Pass	Pass
	A to A	B7064 (N) to B7064 (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm B	B to C	A71 Hurlford Road (E) to B7064 (S)	97	21	4	4	1	128	96	19	4	4	1	124	-4	-3%	0.4	Pass	Pass
	B to D	A71 Hurlford Road (E) to A71 Hurlford Road (W	735	160	34	34	8	971	733	160	33	34	6	966	-5	0%	0.1	Pass	Pass
	B to A	A71 Hurlford Road (E) to B7064 (N)	355	77	16	16	4	468	356	76	16	15	5	468	0	0%	0.0	Pass	Pass
	B to B	A71 Hurlford Road (E) to A71 Hurlford Road (E	1	0	0	0	0	2	1	0	0	0	0	1	-1	-47%	0.7	Pass	Pass
J3 Arm C	C to D	B7064 (S) to Hurlford Road (W)	97	21	4	4	1	128	96	22	3	3	1	125	-3	-2%	0.3	Pass	Pass
	C to A	B7064 (S) to B7064 (N)	145	32	7	7	2	191	142	31	4	6	2	185	-6	-3%	0.5	Pass	Pass
	C to B	B7064 (S) to Hurlford Road (E)	98	21	4	5	1	129	91	19	3	4	1	118	-11	-9%	1.0	Pass	Pass
	C to C	B7064 (S) to B7064 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm D	D to A	A71 Hurlford Road (W) to B7064 (N)	292	64	13	14	3	386	287	63	13	13	3	379	-7	-2%	0.4	Pass	Pass
	D to B	A71 Hurlford Road (W) to A71 Hurlford Road (E	536	117	24	25	6	708	543	117	22	26	4	712	4	1%	0.2	Pass	Pass
	D to C	A71 Hurlford Road (W) to B7064 (S)	111	24	5	5	1	147	110	23	5	5	1	144	-3	-2%	0.2	Pass	Pass
	D to D	A71 Hurlford Road (W) to A71 Hurlford Road (W	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J4 Arm A	A to B	B7064 (N) to B7064 (S)	323	70	15	15	4	427	315	70	11	12	3	411	-16	-4%	0.8	Pass	Pass
	A to C	B7064 (N) to A759 (W)	36	8	2	2	0	47	37	7	2	2	0	48	1	2%	0.1	Pass	Pass
J4 Arm B	B to C	B7064 (S) to A759 (W)	34	7	2	2	0	44	32	6	1	2	0	41	-3	-7%	0.5	Pass	Pass
	B to A	B7064 (S) to B7064 (N)	305	66	14	14	4	403	303	66	11	13	4	397	-6	-2%	0.3	Pass	Pass
J4 Arm C	C to A	A759 (W) to B7064 (N)	34	7	2	2	0	44	29	7	0	0	0	36	-8	-19%	1.3	Pass	Pass
	C to B	A759 (W) to B7064 (S)	36	8	2	2	0	47	38	5	0	0	0	43	-4	-9%	0.6	Pass	Pass
J5 Arm A	A to B	A759 (N) to A759 Dundonald Road (E)	359	78	16	17	4	474	352	75	11	12	3	453	-21	-4%	1.0	Pass	Pass
J5 Arm B	B to A	A759 Dundonald Road (E) to A759 (N)	339	74	15	16	4	448	335	72	12	16	4	439	-9	-2%	0.4	Pass	Pass
J6 Arm A	A to B	Hospital (N) to Kilmarnock Road (E)	32	7	1	1	0	42	34	6	1	1	0	42	0	-1%	0.1	Pass	Pass
	A to C	Hospital (N) to Kilmarnock Road (W)	73	16	3	3	1	97	70	14	3	3	0	90	-7	-7%	0.7	Pass	Pass
	A to A	Hospital (N) to Hospital (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J6 Arm B	B to C	Kilmarnock Road (E) to Kilmarnock Road (W)	662	144	30	31	8	875	647	141	27	31	7	853	-22	-2%	0.7	Pass	Pass
	B to A	Kilmarnock Road (E) to Hospital (N)	73	16	3	3	1	97	73	14	3	2	1	93	-4	-4%	0.4	Pass	Pass
	B to B	Kilmarnock Road (E) to Kilmarnock Road (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J6 Arm C	C to A	Kilmarnock Road (W) to Hospital Road (N)	32	7	1	1	0	42	33	7	1	1	0	42	0	-1%	0.1	Pass	Pass
	C to B	Kilmarnock Road (W) to Kilmarnock Road (E)	289	63	13	13	3	382	288	61	12	11	4	376	-6	-1%	0.3	Pass	Pass
	C to C	Kilmarnock Road (W) to Kilmarnock Road (W)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			8730	1899	399	405	101	11534	8656	1858	342	365	88	11309	-225				
			10630		804		101		10514		707		88						

Table 4.2 – A71 Moorfield PM Base Model Turning Movement Count Calibration Results

	PM Peak 1700 – 1800 (Tue 25 Feb 2020)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	Irvine Road (E) to B7081 (S)	278	38	5	4	1	326	280	40	2	3	0	325	-1	0%	0.1	Pass	Pass
	A to C	Irvine Road (E) to Kilmarnock Road (W)	165	22	3	3	1	193	162	21	2	1	0	186	-7	-4%	0.5	Pass	Pass
	A to A	Irvine Road (E) to Irvine Road (E)	1	0	0	0	0	1	2	0	0	0	0	2	1	105%	0.8	Pass	Pass
J1 Arm B	B to C	B7064 (S) to Kilmarnock Road (W)	178	24	3	3	1	208	171	26	2	2	1	202	-6	-3%	0.4	Pass	Pass
	B to A	B7064 (S) to Irvine Road (E)	343	47	6	5	1	402	352	45	4	4	2	407	5	1%	0.3	Pass	Pass
	B to B	B7064 (S) to B7081 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to A	Kilmarnock Road (W) to Irvine Road (E)	276	38	5	4	1	323	268	38	3	4	0	313	-10	-3%	0.6	Pass	Pass
	C to B	Kilmarnock Road (W) to B7081 (S)	324	44	5	5	1	380	332	42	4	3	0	381	1	0%	0.0	Pass	Pass
	C to C	Kilmarnock Road (W) to Kilmarnock Road (W)	3	0	0	0	0	3	3	0	0	0	0	3	0	2%	0.0	Pass	Pass
J2 Arm A	A to B	B7064 (N) to Dumfries Drive	59	8	1	1	0	69	56	9	1	1	0	67	-2	-3%	0.3	Pass	Pass
	A to C	B7064 (N) to B7064 (S)	532	72	9	8	2	623	548	71	6	5	0	630	7	1%	0.3	Pass	Pass
	A to D	B7064 (N) to Industrial Park (W)	4	1	0	0	0	5	3	1	0	0	0	4	-1	-18%	0.4	Pass	Pass
	A to A	B7064 (N) to B7064 (N)	1	0	0	0	0	1	1	0	0	0	0	1	0	2%	0.0	Pass	Pass
J2 Arm B	B to C	Dumfries Drive (E) to B7064 (S)	68	9	1	1	0	80	68	11	0	0	0	79	-1	-1%	0.1	Pass	Pass
	B to D	Dumfries Drive (E) to Industrial Park (W)	1	0	0	0	0	1	1	0	0	0	0	1	0	2%	0.0	Pass	Pass
	B to A	Dumfries Drive (E) to B7064 (N)	48	6	1	1	0	56	47	5	0	0	0	52	-4	-7%	0.5	Pass	Pass
	B to B	Dumfries Drive (E) to Dumfries Drive (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm C	C to D	B7064 (S) to Industrial Park (W)	8	1	0	0	0	10	7	1	0	0	0	8	-2	-18%	0.6	Pass	Pass
	C to A	B7064 (S) to B7064 (N)	460	63	8	7	2	539	442	61	5	6	3	517	-22	-4%	1.0	Pass	Pass
	C to B	B7064 (S) to Dumfries Drive (E)	115	16	2	2	0	135	109	13	2	3	0	127	-8	-6%	0.7	Pass	Pass
	C to C	B7064 (S) to B7064 (S)	1	0	0	0	0	1	1	0	0	0	0	1	0	2%	0.0	Pass	Pass
J2 Arm D	D to A	Industrial Park (W) to B7064 (N)	34	5	1	1	0	40	32	6	0	0	0	38	-2	-5%	0.3	Pass	Pass
	D to B	Industrial Park (W) to Dumfries Drive (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	D to C	Industrial Park (W) to B7064 (S)	59	8	1	1	0	69	60	6	0	0	0	66	-3	-5%	0.4	Pass	Pass
	D to D	Industrial Park (W) to Industrial Park (W)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm A	A to B	B7064 (N) to A71 Hurlford Road (E)	278	38	5	4	1	325	285	34	3	3	0	325	0	0%	0.0	Pass	Pass
	A to C	B7064 (N) to B7064 (S)	126	17	2	2	0	148	126	18	1	1	0	146	-2	-1%	0.1	Pass	Pass
	A to D	B7064 (N) to A71 Hurlford Road (W)	257	35	4	4	1	301	264	35	2	2	0	303	2	1%	0.1	Pass	Pass
	A to A	B7064 (N) to B7064 (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm B	B to C	A71 Hurlford Road (E) to B7064 (S)	150	20	2	2	1	176	151	20	2	1	1	175	-1	0%	0.1	Pass	Pass
	B to D	A71 Hurlford Road (E) to A71 Hurlford Road (W	685	93	11	10	3	802	685	94	11	9	2	801	-1	0%	0.0	Pass	Pass
	B to A	A71 Hurlford Road (E) to B7064 (N)	179	24	3	3	1	210	179	23	3	2	1	208	-2	-1%	0.1	Pass	Pass
	B to B	A71 Hurlford Road (E) to A71 Hurlford Road (E)	2	0	0	0	0	2	2	0	0	0	0	2	0	2%	0.0	Pass	Pass
J3 Arm C	C to D	B7064 (S) to Hurlford Road (W)	130	18	2	2	1	152	131	19	1	1	0	152	0	0%	0.0	Pass	Pass
	C to A	B7064 (S) to B7064 (N)	133	18	2	2	1	155	132	18	1	1	0	152	-3	-2%	0.3	Pass	Pass
	C to B	B7064 (S) to Hurlford Road (E)	133	18	2	2	1	156	128	16	1	1	0	146	-10	-7%	0.8	Pass	Pass
	C to C	B7064 (S) to B7064 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm D	D to A	A71 Hurlford Road (W) to B7064 (N)	252	34	4	4	1	295	248	33	3	5	1	290	-5	-2%	0.3	Pass	Pass
	D to B	A71 Hurlford Road (W) to A71 Hurlford Road (E	655	89	11	10	3	768	662	88	11	10	3	774	6	1%	0.2	Pass	Pass
	D to C	A71 Hurlford Road (W) to B7064 (S)	112	15	2	2	0	131	109	15	1	1	0	126	-5	-4%	0.4	Pass	Pass
	D to D	A71 Hurlford Road (W) to A71 Hurlford Road (W	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J4 Arm A	A to B	B7064 (N) to B7064 (S)	349	47	6	5	1	408	343	48	4	2	1	398	-10	-3%	0.5	Pass	Pass
	A to C	B7064 (N) to A759 (W)	39	5	1	1	0	46	41	6	0	1	0	48	2	5%	0.3	Pass	Pass
J4 Arm B	B to C	B7064 (S) to A759 (W)	40	5	1	1	0	47	39	5	1	1	0	46	-1	-2%	0.1	Pass	Pass
	B to A	B7064 (S) to B7064 (N)	356	48	6	5	1	417	356	48	3	3	0	410	-7	-2%	0.4	Pass	Pass
J4 Arm C	C to A	A759 (W) to B7064 (N)	40	5	1	1	0	47	35	5	0	0	0	40	-7	-15%	1.0	Pass	Pass
	C to B	A759 (W) to B7064 (S)	39	5	1	1	0	46	41	3	0	0	0	44	-2	-4%	0.3	Pass	Pass
J5 Arm A	A to B	A759 (N) to A759 Dundonald Road (E)	388	53	6	6	2	454	384	50	4	2	1	441	-13	-3%	0.6	Pass	Pass
J5 Arm B	B to A	A759 Dundonald Road (E) to A759 (N)	396	54	7	6	2	464	395	52	4	4	0	455	-9	-2%	0.4	Pass	Pass
J6 Arm A	A to B	Hospital (N) to Kilmarnock Road (E)	60	8	1	1	0	70	62	8	0	0	0	70	0	0%	0.0	Pass	Pass
	A to C	Hospital (N) to Kilmarnock Road (W)	34	5	1	1	0	40	31	4	0	0	0	35	-5	-13%	0.8	Pass	Pass
	A to A	Hospital (N) to Hospital (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J6 Arm B	B to C	Kilmarnock Road (E) to Kilmarnock Road (W)	311	42	5	5	1	364	304	42	3	3	1	353	-11	-3%	0.6	Pass	Pass
	B to A	Kilmarnock Road (E) to Hospital (N)	34	5	1	1	0	40	32	4	1	0	0	37	-3	-8%	0.5	Pass	Pass
	B to B	Kilmarnock Road (E) to Kilmarnock Road (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J6 Arm C	C to A	Kilmarnock Road (W) to Hospital Road (N)	60	8	1	1	0	70	60	8	1	1	0	70	0	0%	0.0	Pass	Pass
	C to B	Kilmarnock Road (W) to Kilmarnock Road (E)	543	74	9	8	2	636	541	72	7	7	0	627	-9	-1%	0.4	Pass	Pass
	C to C	Kilmarnock Road (W) to Kilmarnock Road (W)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			8738	1190	145	133	34	10240	8711	1164	99	93	17	10084	-156				
			9928		278		34		9875		192		17						

4.4.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the six junctions in the network have been compared against the base model link flows. Table 4.3 and Table 4.4 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *‘Pass’* rate)**.

Table 4.3 – A71 Moorfield AM Base Model Link Flow Calibration Results

	AM Peak 0800 – 0900 (Tue 25 Feb 2020)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	Irvine Road (E)	509	111	23	24	6	672	507	108	20	24	4	663	-9	-1%	0.3	Pass	Pass
	Arm B	B7064 (S)	800	174	37	37	9	1056	791	172	33	33	10	1039	-17	-2%	0.5	Pass	Pass
	Arm C	Kilmarnock Road (W)	322	70	15	15	4	425	323	67	13	12	4	419	-6	-1%	0.3	Pass	Pass
J2	Arm A	B7064 (N)	423	92	19	20	5	559	418	88	16	17	5	544	-15	-3%	0.6	Pass	Pass
	Arm B	Dumfries Drive (E)	189	41	9	9	2	250	188	40	9	8	0	245	-5	-2%	0.3	Pass	Pass
	Arm C	B7064 (S)	784	171	36	36	9	1036	784	171	34	35	10	1034	-2	0%	0.1	Pass	Pass
	Arm D	Industrial Park (W)	54	12	2	3	1	72	53	12	0	0	0	65	-7	-9%	0.8	Pass	Pass
J3	Arm A	B7064 (N)	557	121	25	26	6	736	551	119	19	20	5	714	-22	-3%	0.8	Pass	Pass
	Arm B	A71 Hurlford Road (E)	1188	258	54	55	14	1569	1186	255	53	53	12	1559	-10	-1%	0.3	Pass	Pass
	Arm C	B7064 (S)	340	74	16	16	4	449	329	72	10	13	4	428	-21	-5%	1.0	Pass	Pass
	Arm D	A71 Hurlford Road (W)	939	204	43	44	11	1241	940	203	40	44	8	1235	-6	0%	0.2	Pass	Pass
J4	Arm A	B7064 (N)	359	78	16	17	4	474	352	77	13	14	3	459	-15	-3%	0.7	Pass	Pass
	Arm B	B7064 (S)	339	74	15	16	4	448	335	72	12	15	4	438	-10	-2%	0.5	Pass	Pass
	Arm C	A759 (W)	69	15	3	3	1	91	67	12	0	0	0	79	-12	-14%	1.3	Pass	Pass
J5	Arm A	A759 (N)	359	78	16	17	4	474	352	75	11	12	3	453	-21	-4%	1.0	Pass	Pass
	Arm B	A759 Dundonald Road (E)	339	74	15	16	4	448	335	72	12	16	4	439	-9	-2%	0.4	Pass	Pass
J6	Arm A	Hospital (N)	106	23	5	5	1	139	104	20	4	4	0	132	-7	-5%	0.6	Pass	Pass
	Arm B	Kilmarnock Road (E)	735	160	34	34	8	972	720	155	30	33	8	946	-26	-3%	0.8	Pass	Pass
	Arm C	Kilmarnock Road (W)	321	70	15	15	4	424	321	68	13	12	4	418	-6	-1%	0.3	Pass	Pass

Table 4.4 – A71 Moorfield PM Base Model Link Flow Calibration Results

	PM Peak 1700 – 1800 (Tue 25 Feb 2020)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	Irvine Road (E)	444	61	7	7	2	521	444	61	4	4	0	513	-8	-1%	0.3	Pass	Pass
	Arm B	B7064 (S)	520	71	9	8	2	610	523	71	6	6	3	609	-1	0%	0.0	Pass	Pass
	Arm C	Kilmarnock Road (W)	603	82	10	9	2	706	603	80	7	7	0	697	-9	-1%	0.4	Pass	Pass
J2	Arm A	B7064 (N)	596	81	10	9	2	699	608	81	7	6	0	702	3	0%	0.1	Pass	Pass
	Arm B	Dumfries Drive (E)	117	16	2	2	0	137	116	16	0	0	0	132	-5	-4%	0.4	Pass	Pass
	Arm C	B7064 (S)	584	80	10	9	2	685	559	75	7	9	3	653	-32	-5%	1.2	Pass	Pass
	Arm D	Industrial Park (W)	93	13	2	1	0	109	92	12	0	0	0	104	-5	-5%	0.5	Pass	Pass
J3	Arm A	B7064 (N)	660	90	11	10	3	774	675	87	6	6	0	774	0	0%	0.0	Pass	Pass
	Arm B	A71 Hurlford Road (E)	1016	138	17	15	4	1190	1017	137	16	12	4	1186	-4	0%	0.1	Pass	Pass
	Arm C	B7064 (S)	396	54	7	6	2	464	391	53	3	3	0	450	-14	-3%	0.7	Pass	Pass
	Arm D	A71 Hurlford Road (W)	1019	139	17	16	4	1194	1019	136	15	16	4	1190	-4	0%	0.1	Pass	Pass
J4	Arm A	B7064 (N)	388	53	6	6	2	454	384	54	4	3	1	446	-8	-2%	0.4	Pass	Pass
	Arm B	B7064 (S)	396	54	7	6	2	464	395	53	4	4	0	456	-8	-2%	0.4	Pass	Pass
	Arm C	A759 (W)	79	11	1	1	0	93	76	8	0	0	0	84	-9	-10%	0.9	Pass	Pass
J5	Arm A	A759 (N)	388	53	6	6	2	454	384	50	4	2	1	441	-13	-3%	0.6	Pass	Pass
	Arm B	A759 Dundonald Road (E)	396	54	7	6	2	464	395	52	4	4	0	455	-9	-2%	0.4	Pass	Pass
J6	Arm A	Hospital (N)	94	13	2	1	0	110	93	12	0	0	0	105	-5	-5%	0.5	Pass	Pass
	Arm B	Kilmarnock Road (E)	345	47	6	5	1	405	336	46	4	3	1	390	-15	-4%	0.7	Pass	Pass
	Arm C	Kilmarnock Road (W)	603	82	10	9	2	706	601	80	8	8	0	697	-9	-1%	0.4	Pass	Pass

4.4.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.5 below. These routes cover the A71 westbound and eastbound directions and travel through the A71 Moorfield roundabout.

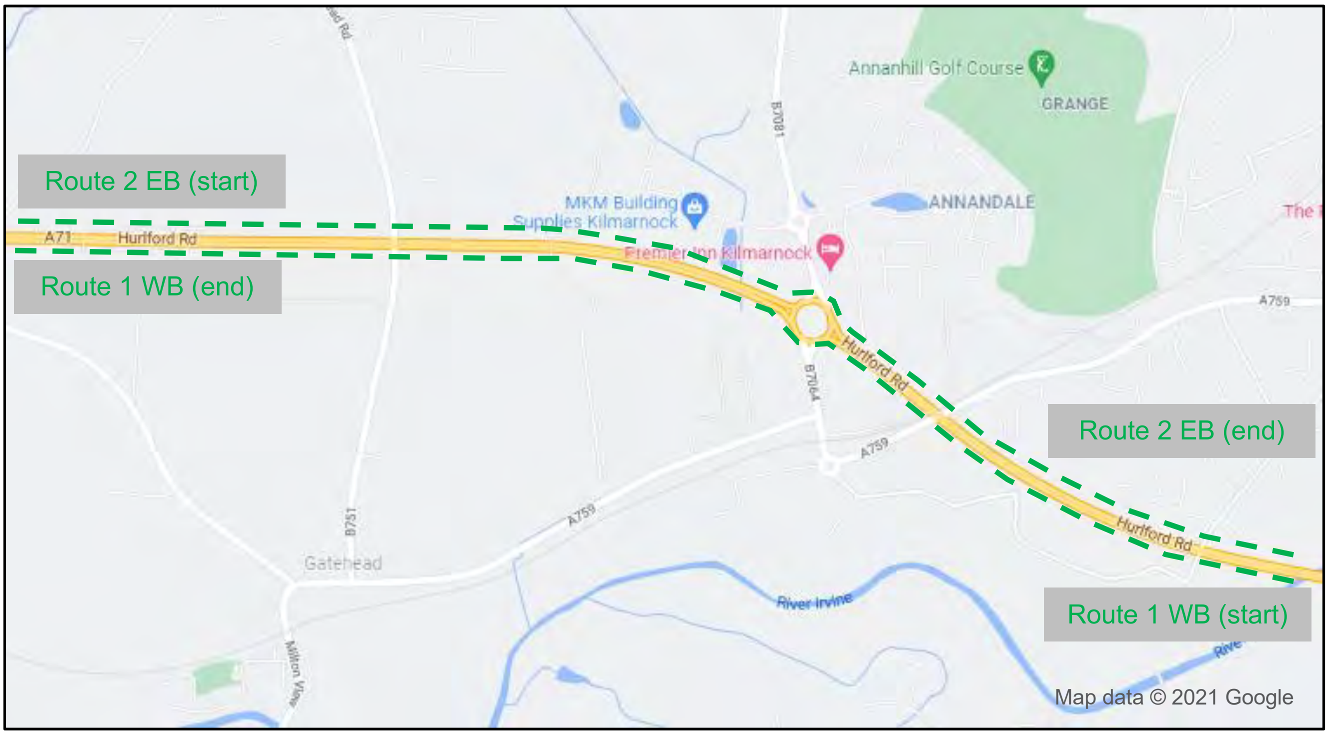

Figure 4.5 – A71 Moorfield TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Moorfield roundabout stopline and then the exit from the model.

As detailed in Table 4.5 and Table 4.6 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.5 – A71 Moorfield AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0800 - 0900		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A71 WB to stopline	1308	02:32	01:50	-42	-28%	
		Route 1b - A71 WB exit	2032	01:30	01:32	3	3%	
		A71 (E) to A71 (W)	**3340**	**04:01**	**03:22**	**-39**	**-16%**	**Pass**
	2	Route 2a - A71 EB to stopline	2002	01:25	01:27	2	2%	
		Route 2b - A71 EB exit	1468	01:26	01:25	-1	-2%	
		A71 (W) to A71 (E)	**3470**	**02:52**	**02:52**	**0**	**0%**	**Pass**

Table 4.6 – A71 Moorfield PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1700 - 1800		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A71 WB to stopline	1308	01:12	01:28	16	23%	
		Route 1b - A71 WB exit	2032	01:25	01:30	5	6%	
		A71 (E) to A71 (W)	**3340**	**02:37**	**02:58**	**21**	**13%**	**Pass**
	2	Route 2a - A71 EB to stopline	2002	01:19	01:23	4	5%	
		Route 2b - A71 EB exit	1468	01:19	01:25	6	7%	
		A71 (W) to A71 (E)	**3470**	**02:38**	**02:48**	**10**	**6%**	**Pass**

4.4.3. A71 Moorfield Base Model Queuing

On site observations have indicated that the more notable queuing at the A71 Moorfield roundabout occurs on the A71 Hurlford Road (E) and B7064 (S) arms in the AM peak. During the PM peak there is no notable queuing that occurs.

The AM and PM base model queue lengths reflect on the above junction operation of the A71 Moorfield roundabout and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.5. A76 Bowfield Roundabout

4.5.1. Model Extent

The full extent of the A76 Bowfield roundabout VISSIM model is shown below in Figure 4.6.

Figure 4.6 – A76 Bowfield roundabout model extents

4.5.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for October 2021. The two base models simulate the following peak time periods:

- 07:30 – 08:30 AM weekday peak period (Wednesday 20 October 2021); and
- 16:30 – 17:30 PM weekday peak period (Wednesday 20 October 2021).

The periods were selected based on the busiest hour identified from turning movement counts undertaken for this study.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.5.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from one junction have been utilised in the development of the A76 Bowfield roundabout VISSIM model. This junction is:

- J1 – A76 / B7073 / HMP Kilmarnock access (four arm priority roundabout).

Observed turning movement counts at the junction in the network have been compared against the base model turning movement counts. Table 4.7 and Table 4.8 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Bowfield roundabout during the AM and PM peak periods.

Table 4.7 – A76 Bowfield AM Base Model Turning Movement Count Calibration Results

	AM Peak 0730 - 0830 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to B7073	0	1	0	0	0	1	0	1	0	0	0	1	0	0%	0.0	Pass	Pass
	A to C	A76 (NW) to HMP Access	30	4	0	1	0	35	29	4	0	1	0	34	-1	-3%	0.2	Pass	Pass
	A to D	A76 (NW) to A76 (SE)	274	94	24	29	1	422	273	94	23	30	1	421	-1	0%	0.0	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	B7073 to HMP Access	9	0	0	0	0	9	10	0	0	0	0	10	1	11%	0.3	Pass	Pass
	B to D	B7073 to A76 (SE)	63	18	2	0	1	84	62	18	2	0	1	83	-1	-1%	0.1	Pass	Pass
	B to A	B7073 to A76 (NW)	1	1	1	0	0	3	1	1	1	0	0	3	0	0%	0.0	Pass	Pass
	B to B	B7073 to B7073	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	HMP Access to A76 (SE)	4	0	0	0	0	4	4	0	0	0	0	4	0	0%	0.0	Pass	Pass
	C to A	HMP Access to A76 (NW)	2	4	0	0	0	6	1	4	0	0	0	5	-1	-17%	0.4	Pass	Pass
	C to B	HMP Access to B7073	0	0	1	0	0	1	0	0	1	0	0	1	0	0%	0.0	Pass	Pass
	C to C	HMP Access to HMP Access	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	A76 (SE) to A76 (NW)	392	109	9	24	2	536	386	112	9	24	2	533	-3	-1%	0.1	Pass	Pass
	D to B	A76 (SE) to B7073	94	18	3	0	2	117	98	18	3	0	2	121	4	3%	0.4	Pass	Pass
	D to C	A76 (SE) to HMP Access	22	3	1	0	0	26	22	3	1	0	0	26	0	0%	0.0	Pass	Pass
	D to D	A76 (SE) to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			891	252	41	54	6	1244	886	255	40	55	6	1242	-2				
			1143		95		6		1141		95		6						

Table 4.8 – A76 Bowfield PM Base Model Turning Movement Count Calibration Results

	PM Peak 1630 - 1730 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to B7073	11	0	0	0	0	11	9	0	0	0	0	9	-2	-18%	0.6	Pass	Pass
	A to C	A76 (NW) to HMP Access	0	3	0	0	0	3	0	4	0	0	0	4	1	33%	0.5	Pass	Pass
	A to D	A76 (NW) to A76 (SE)	478	126	2	8	1	615	475	127	2	8	1	613	-2	0%	0.1	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	B7073 to HMP Access	1	1	0	0	0	2	1	1	0	0	0	2	0	0%	0.0	Pass	Pass
	B to D	B7073 to A76 (SE)	131	21	0	1	2	155	130	22	0	1	2	155	0	0%	0.0	Pass	Pass
	B to A	B7073 to A76 (NW)	6	4	0	0	0	10	6	3	0	0	0	9	-1	-10%	0.3	Pass	Pass
	B to B	B7073 to B7073	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	HMP Access to A76 (SE)	20	3	0	0	0	23	19	3	0	0	0	22	-1	-4%	0.2	Pass	Pass
	C to A	HMP Access to A76 (NW)	37	3	0	0	0	40	38	3	0	0	0	41	1	3%	0.2	Pass	Pass
	C to B	HMP Access to B7073	9	0	0	0	0	9	9	0	0	0	0	9	0	0%	0.0	Pass	Pass
	C to C	HMP Access to HMP Access	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	A76 (SE) to A76 (NW)	371	82	6	16	0	475	365	84	5	16	0	470	-5	-1%	0.2	Pass	Pass
	D to B	A76 (SE) to B7073	96	24	1	0	1	122	100	23	2	0	1	126	4	3%	0.4	Pass	Pass
	D to C	A76 (SE) to HMP Access	3	0	0	0	0	3	3	0	0	0	0	3	0	0%	0.0	Pass	Pass
	D to D	A76 (SE) to A76 (SE)	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
			1164	267	9	25	4	1469	1156	270	9	25	4	1464	-5				
			1431		34		4		1426		34		4						

4.5.3. Link Flows – (Calibration Results)

Observed link flows from each arm of the junction in the network have been compared against the base model link flows. Table 4.9 and Table 4.10 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 4.9 – A76 Bowfield AM Base Model Link Flow Calibration Results

	AM Peak 0730 - 0830 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	304	99	24	30	1	458	302	99	23	31	1	456	-2	0%	0.1	Pass	Pass
	Arm B	B7073	73	19	3	0	1	96	73	19	3	0	1	96	0	0%	0.0	Pass	Pass
	Arm C	HMP Access	6	4	1	0	0	11	5	4	1	0	0	10	-1	-9%	0.3	Pass	Pass
	Arm D	A76 (SE)	508	130	13	24	4	679	506	133	13	24	4	680	1	0%	0.0	Pass	Pass

Table 4.10 – A76 Bowfield PM Base Model Link Flow Calibration Results

	PM Peak 1630 - 1730 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	489	129	2	8	1	629	484	131	2	8	1	626	-3	0%	0.1	Pass	Pass
	Arm B	B7073	138	26	0	1	2	167	137	26	0	1	2	166	-1	-1%	0.1	Pass	Pass
	Arm C	HMP Access	66	6	0	0	0	72	66	6	0	0	0	72	0	0%	0.0	Pass	Pass
	Arm D	A76 (SE)	471	106	7	16	1	601	469	107	7	16	1	600	-1	0%	0.0	Pass	Pass

4.5.3.1. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.7 below. These routes cover the A76 northbound and southbound directions and travel through the A76 Bowfield roundabout.

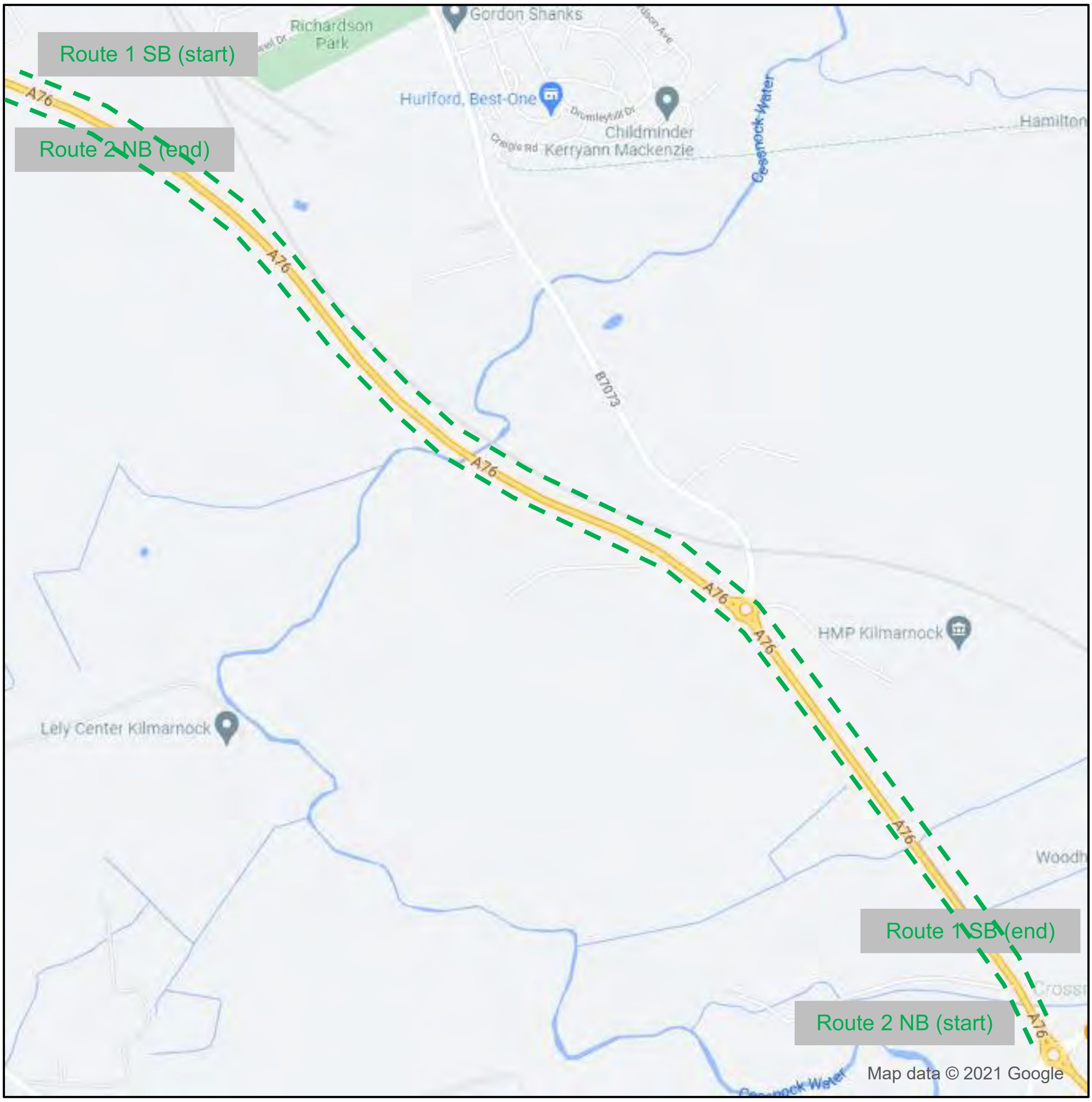

Figure 4.7 – A76 Bowfield TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Bowfield roundabout stopline and then the exit from the model.

As detailed in

Table 4.11 and Table 4.12 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.11 – A76 Bowfield AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0730 - 0830		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	**< 15%**
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A76 SB to stopline	2062	01:36	01:44	8	9%	
		Route 1b - A76 SB exit	1250	01:12	01:13	1	2%	
		A76 (N) to A76 (S)	**3312**	**02:48**	**02:57**	**10**	**6%**	Pass
	2	Route 2a - A76 NB to stopline	1193	01:07	01:03	-4	-6%	
		Route 2b - A76 NB exit	2088	02:18	02:03	-15	-11%	
		A76 (S) to A76 (N)	**3281**	**03:25**	**03:06**	**-19**	**-9%**	Pass

Table 4.12 – A76 Bowfield PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1630 - 1730		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	**< 15%**
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A76 SB to stopline	2062	01:36	01:36	0	1%	
		Route 1b - A76 SB exit	1250	01:11	01:10	-1	-1%	
		A76 (N) to A76 (S)	**3312**	**02:47**	**02:47**	**0**	**0%**	Pass
	2	Route 2a - A76 NB to stopline	1193	01:05	01:02	-3	-4%	
		Route 2b - A76 NB exit	2088	01:35	02:02	27	29%	
		A76 (S) to A76 (N)	**3281**	**02:40**	**03:04**	**24**	**15%**	Pass

4.5.4. A76 Bowfield Base Model Queuing

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On site observations have indicated that there is no notable queuing at the A76 Bowfield roundabout during the AM and PM peaks.

The AM and PM base model queue lengths reflect on the above junction operation of the A76 Bowfield roundabout and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.6. A76 Crossroads Roundabout

4.6.1. Model Extent

A full extent of the A76 Crossroads roundabout VISSIM model is shown below in Figure 4.8.

Figure 4.8 – A76 Crossroads roundabout model extents

4.7. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for October 2021. The two base models simulate the following peak time periods:

- 07:30 – 08:30 AM weekday peak period (Wednesday 20 October 2021); and
- 16:30 – 17:30 PM weekday peak period (Wednesday 20 October 2021).

The periods were selected based on the busiest hour identified from turning movement counts undertaken for this study.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.7.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from one junction have been utilised in the development of the A76 Crossroads roundabout VISSIM model. This junction is:

- J1 – A76 / A719 (four arm priority roundabout).

Observed turning movement counts at the junction in the network have been compared against the base model turning movement counts. Table 4.13 and Table 4.14 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Crossroads roundabout during the AM and PM peak periods.

Table 4.13 – A76 Crossroads AM Base Model Turning Movement Count Calibration Results

	AM Peak 0730 - 0830 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to A719 (NE)	18	9	0	2	0	29	17	10	0	2	0	29	0	0%	0.0	Pass	Pass
	A to C	A76 (NW) to A76 (SE)	303	92	25	26	2	448	302	92	24	26	2	446	-2	0%	0.1	Pass	Pass
	A to D	A76 (NW) to A719 (SW)	20	9	1	1	0	31	20	7	1	1	0	29	-2	-6%	0.4	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	A719 (NE) to A76 (SE)	24	4	4	3	0	35	26	5	4	3	0	38	3	9%	0.5	Pass	Pass
	B to D	A719 (NE) to A719 (SW)	68	28	0	6	0	102	63	28	0	7	0	98	-4	-4%	0.4	Pass	Pass
	B to A	A719 (NE) to A76 (NW)	41	7	3	0	0	51	44	6	3	0	0	53	2	4%	0.3	Pass	Pass
	B to B	A719 (NE) to A719 (NE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 (SE) to A719 (SW)	11	3	0	0	0	14	12	3	0	0	0	15	1	7%	0.3	Pass	Pass
	C to A	A76 (SE) to A76 (NW)	451	117	8	26	4	606	444	122	8	26	4	604	-2	0%	0.1	Pass	Pass
	C to B	A76 (SE) to A719 (NE)	14	4	0	0	1	19	14	3	0	0	1	18	-1	-5%	0.2	Pass	Pass
	C to C	A76 (SE) to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	A719 (SW) to A76 (NW)	23	4	2	0	0	29	26	3	2	0	0	31	2	7%	0.4	Pass	Pass
	D to B	A719 (SW) to A719 (NE)	35	17	1	2	1	56	32	18	1	2	1	54	-2	-4%	0.3	Pass	Pass
	D to C	A719 (SW) to A76 (SE)	10	3	0	1	0	14	10	3	0	1	0	14	0	0%	0.0	Pass	Pass
	D to D	A719 (SW) to A719 (SW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			1018	297	44	67	8	1434	1010	300	43	68	8	1429	-5				
			1315		111		8		1310		111		8						

Table 4.14 – A76 Crossroads PM Base Model Turning Movement Count Calibration Results

	PM Peak 1630 - 1730 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to A719 (NE)	51	3	0	0	0	54	50	3	0	0	0	53	-1	-2%	0.1	Pass	Pass
	A to C	A76 (NW) to A76 (SE)	557	138	2	9	3	709	553	141	2	9	3	708	-1	0%	0.0	Pass	Pass
	A to D	A76 (NW) to A719 (SW)	27	9	0	0	0	36	27	8	0	0	0	35	-1	-3%	0.2	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	A719 (NE) to A76 (SE)	14	6	0	0	0	20	16	6	0	0	0	22	2	10%	0.4	Pass	Pass
	B to D	A719 (NE) to A719 (SW)	38	19	0	2	0	59	35	19	0	2	0	56	-3	-5%	0.4	Pass	Pass
	B to A	A719 (NE) to A76 (NW)	26	8	0	0	0	34	28	8	0	0	0	36	2	6%	0.3	Pass	Pass
	B to B	A719 (NE) to A719 (NE)	0	1	0	0	0	1	0	1	0	0	0	1	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 (SE) to A719 (SW)	8	5	0	0	0	13	10	5	0	0	0	15	2	15%	0.5	Pass	Pass
	C to A	A76 (SE) to A76 (NW)	397	80	7	16	2	502	393	81	7	17	2	500	-2	0%	0.1	Pass	Pass
	C to B	A76 (SE) to A719 (NE)	14	2	0	2	0	18	16	3	0	1	0	20	2	11%	0.5	Pass	Pass
	C to C	A76 (SE) to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	A719 (SW) to A76 (NW)	33	18	0	0	0	51	38	17	0	0	0	55	4	8%	0.5	Pass	Pass
	D to B	A719 (SW) to A719 (NE)	66	23	3	0	0	92	61	24	3	0	0	88	-4	-4%	0.4	Pass	Pass
	D to C	A719 (SW) to A76 (SE)	4	2	0	0	0	6	4	1	0	0	0	5	-1	-17%	0.4	Pass	Pass
	D to D	A719 (SW) to A719 (SW)	1	1	0	0	0	2	1	1	0	0	0	2	0	0%	0.0	Pass	Pass
			1237	315	12	29	5	1598	1233	318	12	29	5	1597	-1				
			1552		41		5		1551		41		5						

4.7.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the junction in the network have been compared against the base model link flows.

Table 4.15 and Table 4.16 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 4.15 – A76 Crossroads AM Base Model Link Flow Calibration Results

	AM Peak 0730 - 0830 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	341	110	26	29	2	508	339	109	25	29	2	504	-4	-1%	0.2	Pass	Pass
	Arm B	A719 (NE)	133	39	7	9	0	188	133	39	7	10	0	189	1	1%	0.1	Pass	Pass
	Arm C	A76 (SE)	476	124	8	26	5	639	470	128	8	26	5	637	-2	0%	0.1	Pass	Pass
	Arm D	A719 (SW)	68	24	3	3	1	99	68	24	3	3	1	99	0	0%	0.0	Pass	Pass

Table 4.16 – A76 Crossroads PM Base Model Link Flow Calibration Results

	PM Peak 1630 - 1730 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	636	150	2	9	3	800	631	152	2	9	3	797	-3	0%	0.1	Pass	Pass
	Arm B	A719 (NE)	78	34	0	2	0	114	79	34	0	2	0	115	1	1%	0.1	Pass	Pass
	Arm C	A76 (SE)	419	87	7	18	2	533	419	89	7	18	2	535	2	0%	0.1	Pass	Pass
	Arm D	A719 (SW)	104	44	3	0	0	151	104	43	3	0	0	150	-1	-1%	0.1	Pass	Pass

4.7.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.9 below. These routes cover the A76 northbound and southbound directions and travel through the A76 Crossroads roundabout.

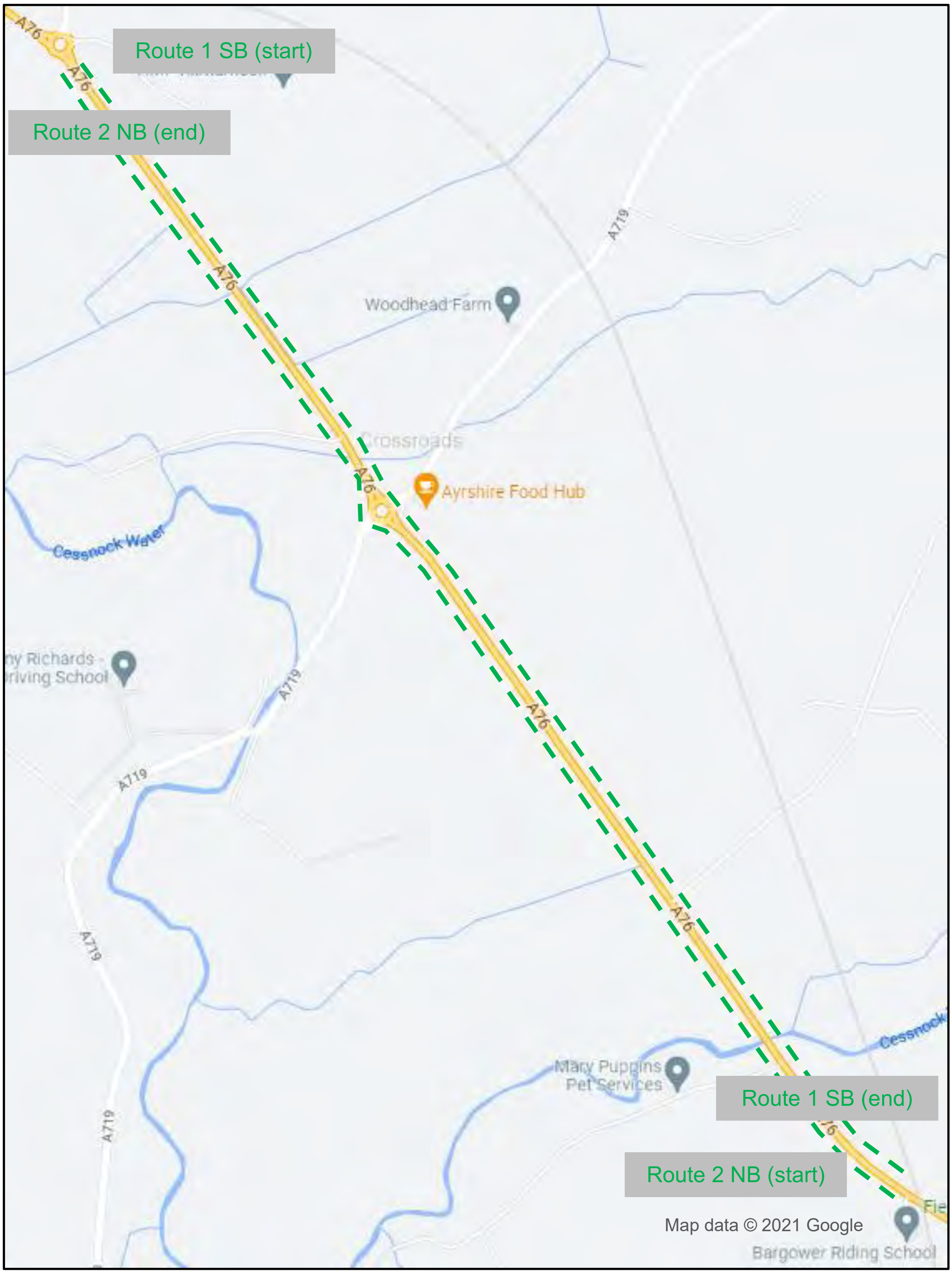


Figure 4.9 – A76 Crossroads TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Crossroads roundabout stopline and then the exit from the model.

As detailed in Table 4.17 and Table 4.18 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.17 – A76 Crossroads AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0730 - 0830		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	**< 15%**
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A76 SB to stopline	1159	01:03	01:03	0	-1%	
		Route 1b - A76 SB exit	1916	01:33	01:29	-5	-5%	
		A76 (N) to A76 (S)	**3076**	**02:36**	**02:31**	**-5**	**-3%**	Pass
	2	Route 2a - A76 NB to stopline	1875	01:39	01:34	-5	-5%	
		Route 2b - A76 NB exit	1186	01:07	01:08	1	1%	
		A76 (S) to A76 (N)	**3061**	**02:46**	**02:42**	**-4**	**-2%**	Pass

Table 4.18 – A76 Crossroads PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1630 - 1730		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	**< 15%**
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A76 SB to stopline	1159	01:03	01:02	-1	-2%	
		Route 1b - A76 SB exit	1916	01:29	01:22	-7	-8%	
		A76 (N) to A76 (S)	**3076**	**02:32**	**02:24**	**-8**	**-5%**	Pass
	2	Route 2a - A76 NB to stopline	1875	01:32	01:30	-2	-2%	
		Route 2b - A76 NB exit	1186	01:05	01:06	1	2%	
		A76 (S) to A76 (N)	**3061**	**02:36**	**02:36**	**0**	**0%**	Pass

4.7.4. A76 Crossroads Base Model Queuing

On site observations have indicated that there is no notable queuing at the A76 Crossroads roundabout during the AM and PM peaks.

The AM and PM base model queue lengths reflect on the above junction operation of the A76 Crossroads roundabout and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.8. A76 Mauchline Crossroads

4.8.1. Model Extent

A full extent of the A76 Mauchline crossroads VISSIM model is shown below in Figure 4.10.

Figure 4.10 – A76 Mauchline crossroads model extents

4.8.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for 2018. The two base models simulate the following peak time periods:

- 08:00 – 09:00 AM weekday peak period; and
- 16:30 – 17:30 PM weekday peak period.

The periods were selected based on the busiest hour identified from a local Transport Assessment provided by EAC.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.8.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from one junction have been utilised in the development of the A76 Mauchline crossroads VISSIM model. This junction is:

- J1 – A76 / B743 (four arm signalised junction).

Observed turning movement counts at the junction in the network have been compared against the base model turning movement counts. Table 4.19 and Table 4.20 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Mauchline crossroads during the AM and PM peak periods.

Table 4.19 – A76 Mauchline AM Base Model Turning Movement Count Calibration Results

	AM Peak 0800 - 0900		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 Kilmarnock Road to B743 High Street	33	10	1	2	0	46	37	10	0	1	0	48	2	5%	0.3	Pass	Pass
	A to C	A76 Kilmarnock Road to A76 Cumnock Road	331	97	14	22	3	466	383	98	3	9	0	493	27	6%	1.2	Pass	Pass
	A to D	A76 Kilmarnock Road to B743 Loudoun Street	74	22	3	5	1	104	84	19	1	1	0	105	1	1%	0.1	Pass	Pass
J1 Arm B	B to C	B743 High Street to A76 Cumnock Road	37	11	2	2	0	52	34	8	0	0	0	42	-10	-18%	1.4	Pass	Pass
	B to D	B743 High Street to B743 Loudoun Street	8	2	0	1	0	11	7	2	0	0	0	9	-2	-20%	0.7	Pass	Pass
	B to A	B743 High Street to A76 Kilmarnock Road	57	16	2	4	0	80	49	11	0	0	0	60	-20	-25%	2.3	Pass	Pass
J1 Arm C	C to D	A76 Cumnock Road to B743 Loudoun Street	20	6	1	1	0	28	22	5	0	1	0	28	0	0%	0.0	Pass	Pass
	C to A	A76 Cumnock Road to A76 Kilmarnock Road	340	99	15	22	3	480	353	90	3	7	0	453	-27	-6%	1.2	Pass	Pass
	C to B	A76 Cumnock Road to B743 High Street	36	10	2	2	0	51	39	9	1	0	0	49	-2	-3%	0.2	Pass	Pass
J1 Arm D	D to A	B743 Loudoun Street to A76 Kilmarnock Road	82	24	4	5	1	115	92	22	0	1	0	115	0	0%	0.0	Pass	Pass
	D to B	B743 Loudoun Street to B743 High Street	9	3	0	1	0	12	8	4	0	1	0	13	1	7%	0.2	Pass	Pass
	D to C	B743 Loudoun Street to A76 Cumnock Road	84	24	4	6	1	118	88	23	0	1	0	112	-6	-5%	0.6	Pass	Pass
			1109	324	48	73	9	1562	1196	301	8	22	0	1527	-35				
			1433		121		9		1497		30		0						

Table 4.20 – A76 Mauchline PM Base Model Turning Movement Count Calibration Results

	PM Peak 1630 - 1730		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 Kilmarnock Road to B743 High Street	27	7	0	1	0	35	25	8	0	1	0	34	-1	-3%	0.2	Pass	Pass
	A to C	A76 Kilmarnock Road to A76 Cumnock Road	418	107	4	10	2	540	412	104	4	9	0	529	-11	-2%	0.5	Pass	Pass
	A to D	A76 Kilmarnock Road to B743 Loudoun Street	67	17	1	2	0	87	65	13	1	1	0	80	-7	-8%	0.7	Pass	Pass
J1 Arm B	B to C	B743 High Street to A76 Cumnock Road	34	9	0	1	0	44	36	9	0	0	0	45	1	3%	0.2	Pass	Pass
	B to D	B743 High Street to B743 Loudoun Street	5	1	0	0	0	7	5	1	0	0	0	6	-1	-12%	0.3	Pass	Pass
	B to A	B743 High Street to A76 Kilmarnock Road	48	12	0	1	0	62	46	10	0	0	0	56	-6	-10%	0.8	Pass	Pass
J1 Arm C	C to D	A76 Cumnock Road to B743 Loudoun Street	16	4	0	0	0	20	18	4	0	0	0	22	2	7%	0.3	Pass	Pass
	C to A	A76 Cumnock Road to A76 Kilmarnock Road	371	94	4	9	1	479	366	93	4	7	0	470	-9	-2%	0.4	Pass	Pass
	C to B	A76 Cumnock Road to B743 High Street	32	8	0	1	0	42	33	8	0	0	0	41	-1	-2%	0.1	Pass	Pass
J1 Arm D	D to A	B743 Loudoun Street to A76 Kilmarnock Road	75	19	1	2	0	97	77	17	0	1	0	95	-2	-2%	0.2	Pass	Pass
	D to B	B743 Loudoun Street to B743 High Street	7	2	0	0	0	9	8	3	0	0	0	11	2	25%	0.7	Pass	Pass
	D to C	B743 Loudoun Street to A76 Cumnock Road	140	36	1	3	1	180	133	36	0	3	0	172	-8	-5%	0.6	Pass	Pass
			1241	316	12	29	5	1603	1224	306	9	22	0	1561	-42				
			1557		41		5		1530		31		0						

4.8.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the junction in the network have been compared against the base model link flows. Table 4.21 and

Table 4.22 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 4.21 – A76 Mauchline AM Base Model Link Flow Calibration Results

	AM Peak 0800 - 0900		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 Kilmarnock Road	438	128	19	29	3	616	504	127	4	11	0	646	30	5%	1.2	Pass	Pass
	Arm B	B743 High Street	101	29	4	7	1	142	90	21	0	0	0	111	-31	-22%	2.8	Pass	Pass
	Arm C	A76 Cumnock Road	396	116	17	26	3	558	414	104	4	8	0	530	-28	-5%	1.2	Pass	Pass
	Arm D	B743 Loudoun Street	174	51	8	11	1	245	188	49	0	3	0	240	-5	-2%	0.3	Pass	Pass

Table 4.22 – A76 Mauchline PM Base Model Link Flow Calibration Results

	PM Peak 1630 - 1730		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 Kilmarnock Road	513	131	5	12	2	662	502	125	5	11	0	643	-19	-3%	0.8	Pass	Pass
	Arm B	B743 High Street	88	22	1	2	0	113	87	20	0	0	0	107	-6	-5%	0.6	Pass	Pass
	Arm C	A76 Cumnock Road	419	107	4	10	2	541	417	105	4	7	0	533	-8	-2%	0.4	Pass	Pass
	Arm D	B743 Loudoun Street	221	56	2	5	1	286	218	56	0	4	0	278	-8	-3%	0.5	Pass	Pass

4.8.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.11 below. These routes cover the A76 northbound and southbound directions and travel through the A76 Mauchline crossroads.

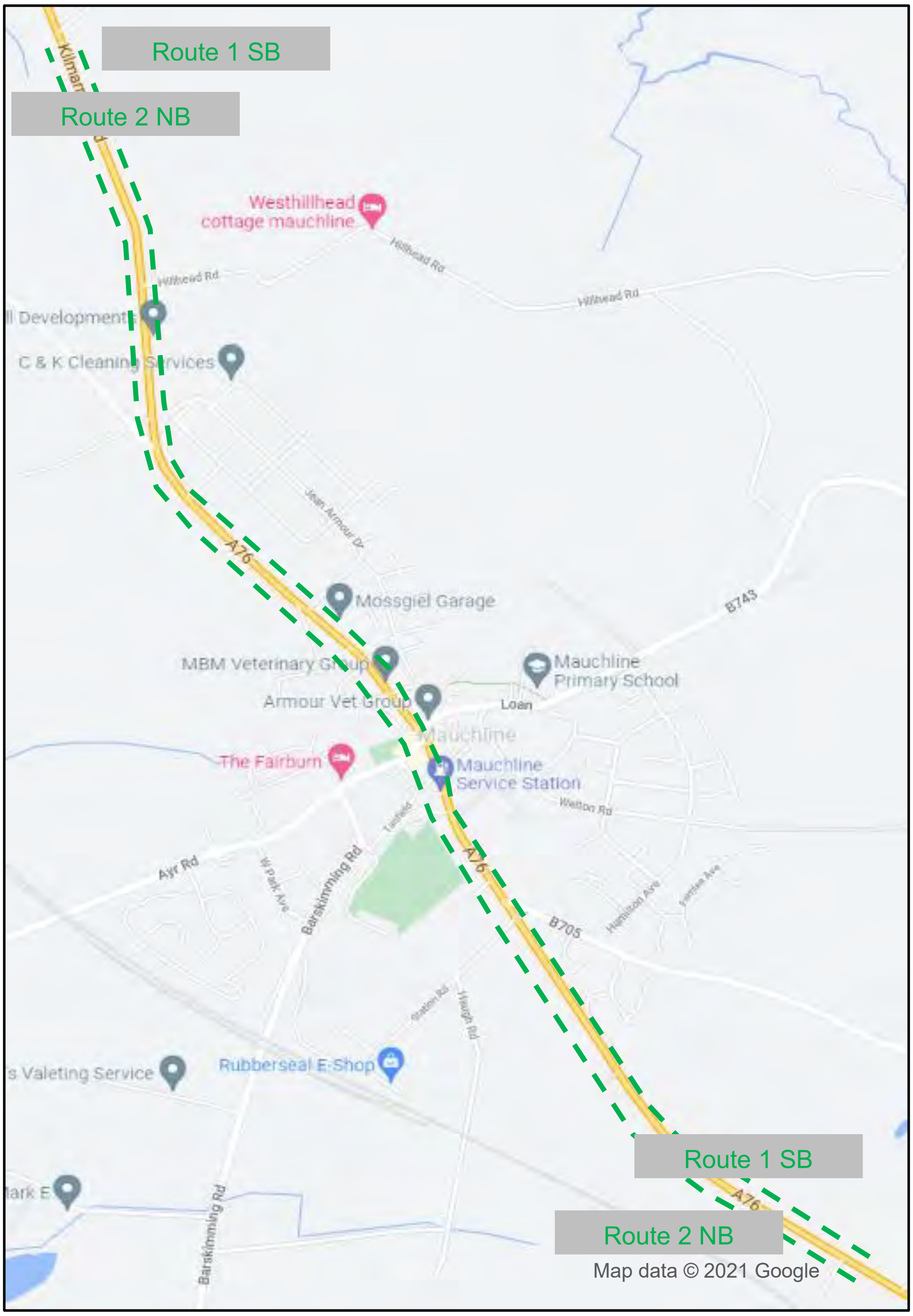


Figure 4.11 – A76 Mauchline crossroads TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Mauchline crossroads stopline and then the exit from the model.

As detailed in Table 4.23 and Table 4.24 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.23 – A76 Mauchline AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0800 - 0900		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A76 SB to stopline	1762	03:53	04:33	40	17%	
		Route 1b - A76 SB exit	1591	01:48	01:38	-9	-9%	
		A76 (N) to A76 (S)	**3352**	**05:41**	**06:11**	**31**	**9%**	Pass
	2	Route 2a - A76 NB to stopline	1591	03:10	02:37	-33	-17%	
		Route 2b - A76 NB exit	1777	02:19	02:23	4	3%	
		A76 (S) to A76 (N)	**3368**	**05:29**	**05:00**	**-29**	**-9%**	Pass

Table 4.24 – A76 Mauchline PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1630 - 1730		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A76 SB to stopline	1762	05:59	04:58	-61	-17%	
		Route 1b - A76 SB exit	1591	01:43	01:39	-5	-5%	
		A76 (N) to A76 (S)	**3352**	**07:42**	**06:37**	**-65**	**-14%**	Pass
	2	Route 2a - A76 NB to stopline	1591	02:24	02:39	15	10%	
		Route 2b - A76 NB exit	1777	02:12	02:23	11	8%	
		A76 (S) to A76 (N)	**3368**	**04:36**	**05:02**	**26**	**9%**	Pass

4.8.2.4. A76 Mauchline Base Model Queuing

On site observations have indicated that there is notable queuing on the A76 Kilmarnock Road (N) and B743 Loudoun Street (W) arms during the AM peak, while the B743 High Street (E) and A76 Cumnock Road (S) arms have a smaller level of queuing during this period. During the PM peak, it is primarily the A76 Kilmarnock Road (N) arm that suffers from notable queuing, while the remaining three arms each have lesser degrees of queuing.

The AM and PM base model queue lengths reflect on the above junction operation of the A76 Mauchline crossroads and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.9. A76 Templeton Roundabout

4.9.1. Model Extent

A full extent of the A76 Templeton roundabout VISSIM model is shown below in Figure 4.12.

Figure 4.12 – A76 Templeton roundabout model extents

4.9.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for June 2021. The two base models simulate the following peak time periods:

- 08:00 – 09:00 AM weekday peak period (Tuesday 1 June 2021); and
- 17:00 – 18:00 PM weekday peak period (Tuesday 1 June 2021).

The periods were selected based on the busiest hour identified from a local Transport Assessment provided by EAC.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.9.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from two junctions have been utilised in the development of the A76 Templeton roundabout VISSIM model. These junctions are:

- J1 – A76 / B7083 (three arm priority roundabout); and
- J2 – B7083 / Darnlaw View (three arm priority T-junction).

Observed turning movement counts at the two junctions in the network have been compared against the base model turning movement counts. Table 4.25 and Table 4.26 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Templeton roundabout during the AM and PM peak periods.

Table 4.25 – A76 Templeton AM Base Model Turning Movement Count Calibration Results

	AM Peak 0800 - 0900 (Tue 1 June 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to C	A76 (NW) to Mauchline Road	135	23	10	4	1	173	132	24	10	4	1	171	-2	-1%	0.2	Pass	Pass
	A to B	A76 (NW) to A76 (S)	174	57	16	18	1	266	176	56	16	18	1	267	1	0%	0.1	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to A	A76 (S) to A76 (NW)	152	35	16	18	6	227	148	37	16	18	6	225	-2	-1%	0.1	Pass	Pass
	B to C	A76 (S) to Mauchline Road	62	7	4	1	3	77	68	6	4	1	3	82	5	6%	0.6	Pass	Pass
	B to B	A76 (S) to A76 (S)	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
J1 Arm C	C to B	Mauchline Road to A76 (S)	56	10	1	4	2	73	50	10	1	4	2	67	-6	-8%	0.7	Pass	Pass
	C to A	Mauchline Road to A76 (NW)	136	21	15	4	5	181	138	21	16	4	5	184	3	2%	0.2	Pass	Pass
	C to C	Mauchline Road to Mauchline Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm A	A to B	Mauchline Road (W) to Darnlaw View	17	6	2	1	0	26	17	7	3	1	0	28	2	8%	0.4	Pass	Pass
	A to C	Mauchline Road (W) to Mauchline Road (E)	180	25	12	4	4	225	182	24	11	5	5	227	2	1%	0.1	Pass	Pass
J2 Arm B	B to A	Darnlaw View to Mauchline Road (W)	16	3	2	7	1	29	15	4	2	7	2	30	1	3%	0.2	Pass	Pass
	B to C	Darnlaw View to Mauchline Road (E)	38	8	1	1	4	52	39	7	1	1	3	51	-1	-2%	0.1	Pass	Pass
J2 Arm C	C to A	Mauchline Road (E) to Mauchline Road (W)	175	28	14	1	6	224	174	28	15	1	6	224	0	0%	0.0	Pass	Pass
	C to B	Mauchline Road (E) to Darnlaw View	34	8	4	0	4	50	35	9	4	0	4	52	2	4%	0.3	Pass	Pass
			1176	231	97	63	37	1604	1175	233	99	64	38	1609	5				
			1407		160		37		1408		163		38						

Table 4.26 – A76 Templeton PM Base Model Turning Movement Count Calibration Results

	PM Peak 1700 - 1800 (Tue 1 June 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to C	A76 (NW) to Mauchline Road	212	34	11	1	0	258	214	36	12	2	0	264	6	2%	0.4	Pass	Pass
	A to B	A76 (NW) to A76 (S)	189	39	4	6	2	240	189	39	4	5	2	239	-1	0%	0.1	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to A	A76 (S) to A76 (NW)	231	38	2	3	0	274	227	39	3	3	0	272	-2	-1%	0.1	Pass	Pass
	B to C	A76 (S) to Mauchline Road	88	3	1	0	0	92	92	2	1	0	0	95	3	3%	0.3	Pass	Pass
	B to B	A76 (S) to A76 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to B	Mauchline Road to A76 (S)	42	9	1	6	0	58	38	10	1	6	0	55	-3	-5%	0.4	Pass	Pass
	C to A	Mauchline Road to A76 (NW)	114	16	4	3	0	137	117	16	4	3	0	140	3	2%	0.3	Pass	Pass
	C to C	Mauchline Road to Mauchline Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm A	A to B	Mauchline Road (W) to Darnlaw View	29	4	0	1	0	34	28	4	0	2	0	34	0	0%	0.0	Pass	Pass
	A to C	Mauchline Road (W) to Mauchline Road (E)	273	33	12	0	0	318	278	34	12	0	0	324	6	2%	0.3	Pass	Pass
J2 Arm B	B to A	Darnlaw View to Mauchline Road (W)	12	2	1	8	0	23	11	2	1	8	0	22	-1	-4%	0.2	Pass	Pass
	B to C	Darnlaw View to Mauchline Road (E)	44	5	0	0	2	51	45	5	0	0	2	52	1	2%	0.1	Pass	Pass
J2 Arm C	C to A	Mauchline Road (E) to Mauchline Road (W)	142	23	4	1	0	170	144	23	4	1	0	172	2	1%	0.2	Pass	Pass
	C to B	Mauchline Road (E) to Darnlaw View	39	3	0	0	1	43	37	3	0	0	1	41	-2	-5%	0.3	Pass	Pass
			1415	209	40	29	5	1698	1420	213	42	30	5	1710	12				
			1624		69		5		1633		72		5						

4.9.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the two junctions in the network have been compared against the base model link flows. Table 4.29 and Table 4.304.28 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 4.27 – A76 Templeton AM Base Model Link Flow Calibration Results

	AM Peak 0800 - 0900 (Tue 1 June 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	309	80	26	22	2	439	308	80	26	22	2	438	-1	0%	0.0	Pass	Pass
	Arm B	A76 (S)	215	42	20	19	9	305	217	43	20	19	9	308	3	1%	0.2	Pass	Pass
	Arm C	Mauchline Road	192	31	16	8	7	254	188	31	17	8	7	251	-3	-1%	0.2	Pass	Pass
J2	Arm A	Mauchline Road (W)	197	31	14	5	4	251	199	31	14	6	5	255	4	2%	0.3	Pass	Pass
	Arm B	Darnlaw View	54	11	3	8	5	81	54	11	3	8	5	81	0	0%	0.0	Pass	Pass
	Arm C	Mauchline Road (E)	209	36	18	1	10	274	209	37	19	1	10	276	2	1%	0.1	Pass	Pass

Table 4.28 – A76 Templeton PM Base Model Link Flow Calibration Results

	PM Peak 1700 - 1800 (Tue 1 June 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	401	73	15	7	2	498	403	75	16	7	2	503	5	1%	0.2	Pass	Pass
	Arm B	A76 (S)	319	41	3	3	0	366	319	41	4	3	0	367	1	0%	0.1	Pass	Pass
	Arm C	Mauchline Road	156	25	5	9	0	195	155	26	5	9	0	195	0	0%	0.0	Pass	Pass
J2	Arm A	Mauchline Road (W)	302	37	12	1	0	352	306	38	12	2	0	358	6	2%	0.3	Pass	Pass
	Arm B	Darnlaw View	56	7	1	8	2	74	56	7	1	8	2	74	0	0%	0.0	Pass	Pass
	Arm C	Mauchline Road (E)	181	26	4	1	1	213	181	26	4	1	1	213	0	0%	0.0	Pass	Pass

4.9.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.13 below. These routes cover the A76 northbound and southbound directions and travel through the A76 Templeton roundabout.

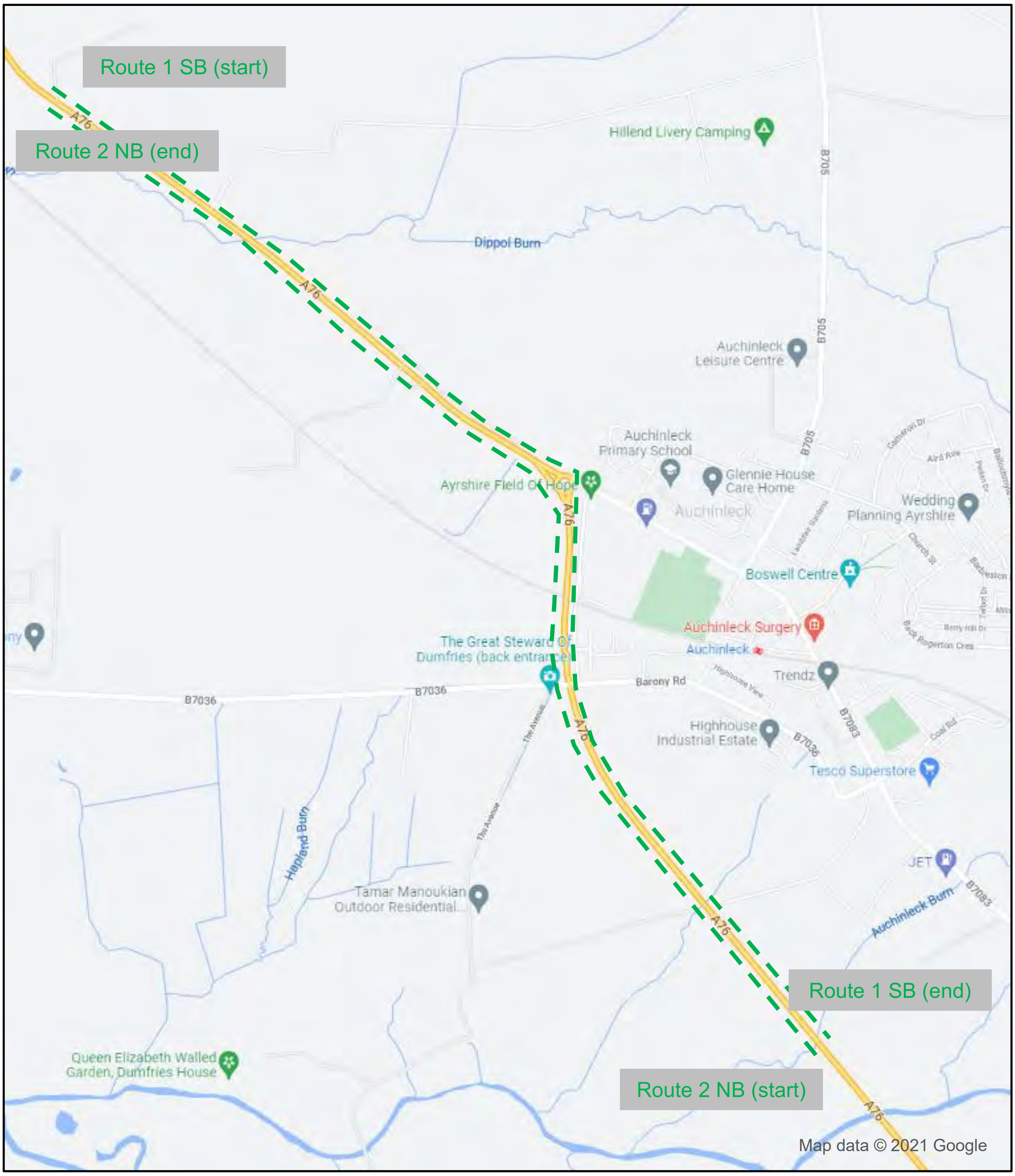


Figure 4.13 – A76 Templeton TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Templeton roundabout stopline and then the exit from the model.

As detailed in Table 4.29 and Table 4.30 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.29 – A76 Templeton AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0800 - 0900		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A76 SB to stopline	1752	01:29	01:23	-6	-7%	
		Route 1b - A76 SB exit	1832	01:30	01:30	0	0%	
		A76 (N) to A76 (S)	**3583**	**02:59**	**02:53**	**-7**	**-4%**	Pass
	2	Route 2a - A76 NB to stopline	1814	01:29	01:26	-3	-3%	
		Route 2b - A76 NB exit	1734	01:22	01:26	4	5%	
		A76 (S) to A76 (N)	**3548**	**02:51**	**02:52**	**1**	**1%**	Pass

Table 4.30 – A76 Templeton PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1700 - 1800		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A76 SB to stopline	1752	01:27	01:19	-7	-8%	
		Route 1b - A76 SB exit	1832	01:26	01:24	-2	-3%	
		A76 (N) to A76 (S)	**3583**	**02:52**	**02:43**	**-10**	**-6%**	Pass
	2	Route 2a - A76 NB to stopline	1814	01:22	01:18	-5	-6%	
		Route 2b - A76 NB exit	1734	01:16	01:17	1	2%	
		A76 (S) to A76 (N)	**3548**	**02:38**	**02:35**	**-3**	**-2%**	Pass

4.9.3. A76 Templeton Base Model Queuing

On site observations have indicated that there is no notable queuing at the A76 Templeton roundabout during the AM and PM peaks.

The AM and PM base model queue lengths reflect on the above junction operation of the A76 Templeton roundabout and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.10. A76 Dettingen Roundabout

4.10.1. Model Extent

A full extent of the A76 Dettingen roundabout VISSIM model is shown below in Figure 4.14.

Figure 4.14 – A76 Dettingen roundabout model extents

4.10.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for 2019. The two base models simulate the following peak time periods:

- 08:15 – 09:15 AM weekday peak period; and

- 15:10 – 16:10 PM weekday peak period.

The periods were selected based on the busiest hour identified from a local Transport Assessment provided by EAC.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.10.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from one junction have been utilised in the development of the A76 Dettingen roundabout VISSIM model. This junction is:

- J1 – A76 / A70 / Ayr Road (four arm priority roundabout).

Observed turning movement counts at the two junctions in the network have been compared against the base model turning movement counts. Table 4.31 and Table 4.32 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Dettingen roundabout during the AM and PM peak periods.

Table 4.31 – A76 Dettingen AM Base Model Turning Movement Count Calibration Results

	AM Peak 0815 - 0915		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to Ayr Road	220	61	7	19	6	321	224	60	5	19	6	314	-7	-2%	0.4	Pass	Pass
	A to C	A76 (NW) to A76 (SE)	101	27	3	8	3	142	105	25	3	8	2	143	1	0%	0.0	Pass	Pass
	A to D	A76 (NW) to A70	11	3	0	1	0	16	11	3	0	1	0	15	-1	-4%	0.2	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	Ayr Road to A76 (SE)	27	7	1	2	1	38	29	8	1	1	0	39	1	4%	0.2	Pass	Pass
	B to D	Ayr Road to A70	63	17	2	5	2	88	58	18	2	6	1	85	-3	-4%	0.3	Pass	Pass
	B to A	Ayr Road to A76 (NW)	152	40	5	13	4	213	153	38	6	12	3	212	-1	-1%	0.1	Pass	Pass
	B to B	Ayr Road to Ayr Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 (SE) to A70	45	12	1	4	1	63	43	12	0	5	1	61	-2	-4%	0.3	Pass	Pass
	C to A	A76 (SE) to A76 (NW)	118	31	4	10	3	165	118	32	3	9	3	165	0	0%	0.0	Pass	Pass
	C to B	A76 (SE) to Ayr Road	31	8	1	3	1	44	31	8	1	2	1	43	-1	-3%	0.2	Pass	Pass
	C to C	A76 (SE) to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	A70 to A76 (NW)	3	1	0	0	0	4	4	1	0	0	0	5	1	36%	0.6	Pass	Pass
	D to B	A70 to Ayr Road	89	24	3	7	2	125	88	21	2	4	0	115	-10	-8%	0.9	Pass	Pass
	D to C	A70 to A76 (SE)	42	11	1	3	1	59	40	10	2	4	0	56	-3	-5%	0.4	Pass	Pass
	D to D	A70 to A70	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			910	241	29	75	23	1278	904	236	25	71	17	1253	25				
			1151		104		23		1140		96		17						

Table 4.32 – A76 Dettingen PM Base Model Turning Movement Count Calibration Results

	PM Peak 1510 - 1610		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to Ayr Road	130	27	1	6	1	165	126	27	0	6	0	159	-6	-4%	0.5	Pass	Pass
	A to C	A76 (NW) to A76 (SE)	126	26	1	6	1	159	126	26	0	6	0	158	-1	-1%	0.1	Pass	Pass
	A to D	A76 (NW) to A70	15	3	0	1	0	19	16	3	0	0	0	19	0	-1%	0.0	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	Ayr Road to A76 (SE)	37	8	0	2	0	47	37	8	0	1	0	46	-1	-2%	0.1	Pass	Pass
	B to D	Ayr Road to A70	83	17	0	4	1	105	77	19	0	3	0	99	-6	-6%	0.6	Pass	Pass
	B to A	Ayr Road to A76 (NW)	229	48	1	10	2	290	234	45	0	8	0	287	-3	-1%	0.2	Pass	Pass
	B to B	Ayr Road to Ayr Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 (SE) to A70	52	11	0	2	0	65	49	10	0	2	0	61	-4	-6%	0.5	Pass	Pass
	C to A	A76 (SE) to A76 (NW)	136	28	1	6	1	173	136	26	0	5	0	167	-6	-3%	0.4	Pass	Pass
	C to B	A76 (SE) to Ayr Road	19	4	0	1	0	24	19	4	0	1	0	24	0	0%	0.0	Pass	Pass
	C to C	A76 (SE) to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	A70 to A76 (NW)	17	4	0	1	0	22	17	4	0	1	0	22	0	0%	0.0	Pass	Pass
	D to B	A70 to Ayr Road	105	22	1	5	1	132	106	21	0	3	0	130	-2	-2%	0.2	Pass	Pass
	D to C	A70 to A76 (SE)	77	16	0	3	1	97	74	15	0	4	0	93	-4	-4%	0.4	Pass	Pass
	D to D	A70 to A70	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			1026	214	6	45	7	1298	1017	208	0	40	0	1265	-33				
			1240		51		7		1225		40		0						

4.10.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the junction in the network have been compared against the base model link flows. Table 4.33 and

Table 4.34 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria (100% 'Pass' rate).

Table 4.33 – A76 Dettingen AM Base Model Link Flow Calibration Results

	AM Peak 0815 - 0915		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	341	90	11	28	9	479	340	88	8	28	8	472	-7	-1%	0.3	Pass	Pass
	Arm B	Ayr Road	241	64	8	20	6	339	240	64	9	19	4	336	-3	-1%	0.2	Pass	Pass
	Arm C	A76 (SE)	194	52	6	16	5	273	192	52	4	16	5	269	-4	-1%	0.2	Pass	Pass
	Arm D	A70	133	35	4	11	3	187	132	32	4	8	0	176	-11	-6%	0.9	Pass	Pass

Table 4.34 – A76 Dettingen PM Base Model Link Flow Calibration Results

	PM Peak 1510 - 1610		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	271	57	2	12	2	343	268	56	0	12	0	336	-7	-2%	0.4	Pass	Pass
	Arm B	Ayr Road	349	73	2	15	2	442	348	72	0	12	0	432	-10	-2%	0.5	Pass	Pass
	Arm C	A76 (SE)	207	43	1	9	1	262	204	40	0	8	0	252	-10	-4%	0.6	Pass	Pass
	Arm D	A70	199	41	1	9	1	251	197	40	0	8	0	245	-6	-2%	0.4	Pass	Pass

4.10.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.15 below. These routes cover the A76 northbound and southbound directions and travel through the A76 Dettingen roundabout.

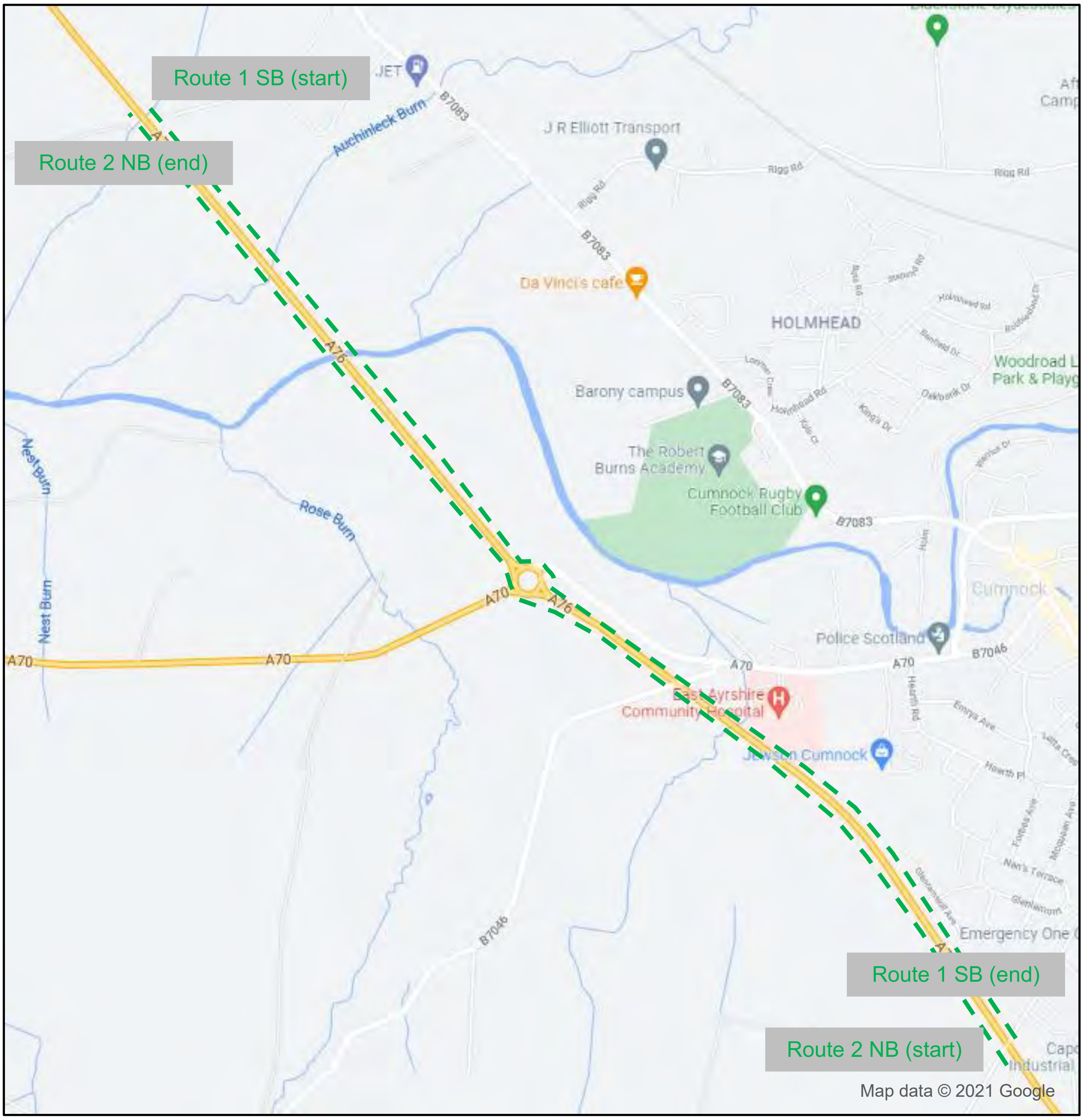


Figure 4.15 – A76 Dettingen TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Dettingen roundabout stopline and then the exit from the model.

As detailed in Table 4.35 and Table 4.36 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.35 – A76 Dettingen AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0815 - 0915		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A76 SB to stopline	1538	01:19	01:28	9	11%	
		Route 1b - A76 SB exit	1661	01:20	01:14	-6	-7%	
		A76 (N) to A76 (S)	**3200**	**02:39**	**02:43**	**3**	**2%**	**Pass**
	2	Route 2a - A76 NB to stopline	1652	01:19	01:17	-2	-3%	
		Route 2b - A76 NB exit	1554	01:13	01:13	0	0%	
		A76 (S) to A76 (N)	**3206**	**02:32**	**02:30**	**-2**	**-1%**	**Pass**

Table 4.36 – A76 Dettingen PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1510 - 1610		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A76 SB to stopline	1538	01:15	01:26	11	15%	
		Route 1b - A76 SB exit	1661	01:16	01:13	-4	-5%	
		A76 (N) to A76 (S)	**3200**	**02:31**	**02:39**	**7**	**5%**	**Pass**
	2	Route 2a - A76 NB to stopline	1652	01:15	01:14	-2	-2%	
		Route 2b - A76 NB exit	1554	01:09	01:10	2	2%	
		A76 (S) to A76 (N)	**3206**	**02:24**	**02:24**	**0**	**0%**	**Pass**

4.10.3. A76 Dettingen Base Model Queuing

On site observations have indicated that there is no notable queuing at the A76 Dettingen roundabout during the AM and PM peaks.

The AM and PM base model queue lengths reflect on the above junction operation of the A76 Dettingen roundabout and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.11. A76 Skerrington Roundabout

4.11.1.1. Model Extent

A full extent of the A76 Skerrington roundabout VISSIM model is shown below in Figure 4.16.

Figure 4.16 – A76 Skerrington roundabout model extents

4.11.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for October 2021. The two base models simulate the following peak time periods:

- 07:30 – 08:30 AM weekday peak period (Wednesday 20 October 2021); and
- 16:45 – 17:45 PM weekday peak period (Wednesday 20 October 2021).

The periods were selected based on the busiest hour identified from turning movement counts undertaken for this study.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.11.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from one junction have been utilised in the development of the A76 Skerrington roundabout VISSIM model. This junction is:

- J1 – A76 / B7083 / Glaisnock Road (four arm priority roundabout).

Observed turning movement counts at the two junctions in the network have been compared against the base model turning movement counts. Table 4.37 and Table 4.38 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Skerrington roundabout during the AM and PM peak periods.

Table 4.37 – A76 Skerrington AM Base Model Turning Movement Count Calibration Results

	AM Peak 0730 - 0830 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to B7073	105	14	0	2	5	126	104	15	0	2	6	127	1	1%	0.1	Pass	Pass
	A to C	A76 (NW) to A76 (SE)	71	31	4	12	1	119	72	31	4	12	1	120	1	1%	0.1	Pass	Pass
	A to D	A76 (NW) to Glaisnock Road	16	6	3	5	2	32	17	5	3	5	1	31	-1	-3%	0.2	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	1	0	0	1	0	0	1	0	0	1	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	B7073 to A76 (SE)	28	10	2	1	2	43	31	11	2	1	2	47	4	9%	0.6	Pass	Pass
	B to D	B7073 to Glaisnock Road	14	2	0	0	0	16	13	2	0	0	0	15	-1	-6%	0.3	Pass	Pass
	B to A	B7073 to A76 (NW)	102	17	0	2	1	122	100	17	0	2	1	120	-2	-2%	0.2	Pass	Pass
	B to B	B7073 to B7073	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 (SE) to Glaisnock Road	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
	C to A	A76 (SE) to A76 (NW)	90	33	2	12	1	138	88	34	2	13	1	138	0	0%	0.0	Pass	Pass
	C to B	A76 (SE) to B7073	40	14	2	3	1	60	40	14	2	2	1	59	-1	-2%	0.1	Pass	Pass
	C to C	A76 (SE) to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	Glaisnock Road to A76 (NW)	27	7	2	5	0	41	28	7	2	5	0	42	1	2%	0.2	Pass	Pass
	D to B	Glaisnock Road to B7073	14	1	0	0	0	15	13	1	0	0	0	14	-1	-7%	0.3	Pass	Pass
	D to C	Glaisnock Road to A76 (SE)	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
	D to D	Glaisnock Road to Glaisnock Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			509	135	16	42	13	715	508	137	16	42	13	716	1				
			644		58		13		645		58		13						

Table 4.38 – A76 Skerrington PM Base Model Turning Movement Count Calibration Results

	PM Peak 1645 - 1745 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A76 (NW) to B7073	83	16	0	3	0	102	81	17	0	3	0	101	-1	-1%	0.1	Pass	Pass
	A to C	A76 (NW) to A76 (SE)	156	43	2	13	0	214	155	43	2	12	0	212	-2	-1%	0.1	Pass	Pass
	A to D	A76 (NW) to Glaisnock Road	17	3	0	0	0	20	19	3	0	0	0	22	2	10%	0.4	Pass	Pass
	A to A	A76 (NW) to A76 (NW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	B7073 to A76 (SE)	74	15	0	2	3	94	75	15	0	2	3	95	1	1%	0.1	Pass	Pass
	B to D	B7073 to Glaisnock Road	16	4	0	0	0	20	13	4	0	0	0	17	-3	-15%	0.7	Pass	Pass
	B to A	B7073 to A76 (NW)	132	18	1	0	0	151	134	18	1	0	0	153	2	1%	0.2	Pass	Pass
	B to B	B7073 to B7073	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 (SE) to Glaisnock Road	1	1	0	0	0	2	2	1	0	0	0	3	1	50%	0.6	Pass	Pass
	C to A	A76 (SE) to A76 (NW)	123	34	1	11	0	169	120	35	1	10	0	166	-3	-2%	0.2	Pass	Pass
	C to B	A76 (SE) to B7073	61	6	0	1	2	70	61	6	0	1	2	70	0	0%	0.0	Pass	Pass
	C to C	A76 (SE) to A76 (SE)	1	0	0	0	0	1	2	0	0	0	0	2	1	100%	0.8	Pass	Pass
J1 Arm D	D to A	Glaisnock Road to A76 (NW)	21	5	0	1	0	27	23	4	0	1	0	28	1	4%	0.2	Pass	Pass
	D to B	Glaisnock Road to B7073	16	1	0	0	0	17	14	2	0	0	0	16	-1	-6%	0.2	Pass	Pass
	D to C	Glaisnock Road to A76 (SE)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	D to D	Glaisnock Road to Glaisnock Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
			701	146	4	31	5	887	699	148	4	29	5	885	-2				
			847		35		5		847		33		5						

4.11.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the junction in the network have been compared against the base model link flows. Table 4.39 and Table 4.40 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 4.39 – A76 Skerrington AM Base Model Link Flow Calibration Results

	AM Peak 0730 - 0830 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	192	51	8	19	8	278	193	51	8	19	8	279	1	0%	0.1	Pass	Pass
	Arm B	B7073	144	29	2	3	3	181	144	30	2	3	3	182	1	1%	0.1	Pass	Pass
	Arm C	A76 (SE)	131	47	4	15	2	199	129	48	4	15	2	198	-1	-1%	0.1	Pass	Pass
	Arm D	Glaisnock Road	42	8	2	5	0	57	42	8	2	5	0	57	0	0%	0.0	Pass	Pass

Table 4.40 – A76 Skerrington PM Base Model Link Flow Calibration Results

	PM Peak 1645 - 1745 (Wed 20 Oct 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A76 (NW)	256	62	2	16	0	336	255	63	2	15	0	335	-1	0%	0.1	Pass	Pass
	Arm B	B7073	222	37	1	2	3	265	222	37	1	2	3	265	0	0%	0.0	Pass	Pass
	Arm C	A76 (SE)	186	41	1	12	2	242	185	42	1	11	2	241	-1	0%	0.1	Pass	Pass
	Arm D	Glaisnock Road	37	6	0	1	0	44	37	6	0	1	0	44	0	0%	0.0	Pass	Pass

4.11.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.17 below. These routes cover the A76 northbound and southbound directions and travel through the A76 Skerrington roundabout.

Figure 4.17 – A76 Skerrington TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Skerrington roundabout stopline and then the exit from the model.

As detailed in Table 4.41 and Table 4.42 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.41 – A76 Skerrington AM Base Model Journey Time Validation Results

	Route No.	Route Name	Distance (metres)	Observed TomTom (mins)	Modelled Journey Time (mins)	Difference (secs)	Difference (%)	< 15%
	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only) – AM Peak 0730 - 0830							
AM Routes	1	Route 1a - A76 SB to stopline	1428	01:11	01:08	-3	-4%	
		Route 1b - A76 SB exit	1735	01:30	01:21	-9	-10%	
		A76 (N) to A76 (S)	**3163**	**02:41**	**02:29**	**-12**	**-8%**	**Pass**
	2	Route 2a - A76 NB to stopline	1736	01:26	01:19	-6	-7%	
		Route 2b - A76 NB exit	1427	01:06	01:05	0	-1%	
		A76 (S) to A76 (N)	**3163**	**02:31**	**02:25**	**-7**	**-4%**	**Pass**

Table 4.42 – A76 Skerrington PM Base Model Journey Time Validation Results

	Route No.	Route Name	Distance (metres)	Observed TomTom (mins)	Modelled Journey Time (mins)	Difference (secs)	Difference (%)	< 15%
	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only) – PM Peak 1645 - 1745							
PM Routes	1	Route 1a - A76 SB to stopline	1428	01:09	01:06	-4	-5%	
		Route 1b - A76 SB exit	1735	01:26	01:19	-7	-8%	
		A76 (N) to A76 (S)	**3163**	**02:36**	**02:25**	**-11**	**-7%**	**Pass**
	2	Route 2a - A76 NB to stopline	1736	01:22	01:17	-4	-5%	
		Route 2b - A76 NB exit	1427	01:02	01:04	2	3%	
		A76 (S) to A76 (N)	**3163**	**02:24**	**02:21**	**-3**	**-2%**	**Pass**

4.11.2.4. A76 Skerrington Base Model Queuing

On site observations have indicated that there is no notable queuing at the A76 Skerrington roundabout during the AM and PM peaks.

The AM and PM base model queue lengths reflect on the above junction operation of the A76 Skerrington roundabout and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.12. Stewarton Crossroads

4.12.1. Model Extent

A full extent of the Stewarton crossroads VISSIM model is shown below in Figure 4.18.

Figure 4.18 – Stewarton crossroads model extents

4.12.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for 2021. The two base models simulate the following peak time periods:

- 08:00 – 09:00 AM weekday peak period; and
- 16:30 – 17:30 PM weekday peak period.

The periods were selected based on the busiest hour identified from a local Transport Assessment provided by EAC.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.12.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from two junctions have been utilised in the development of the Stewarton crossroads VISSIM model. These junctions are:

- J1 – A735 / B778 / B769 (four arm signalised junction); and
- J2 – Standalane / Lainshaw Street / Local Access (four arm mini-roundabout).

Observed turning movement counts at the two junctions in the network have been compared against the base model turning movement counts.

Table 4.43 and

Table 4.44 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% ‘Pass’ rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the Stewarton crossroads during the AM and PM peak periods.

Table 4.43 – Stewarton crossroads AM Base Model Turning Movement Count Calibration Results

	AM Peak 0800 - 0900		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	Rigg Street to Main Street	26	6	1	1	0	34	27	6	1	2	0	36	2	6%	0.4	Pass	Pass
	A to C	Rigg Street to Vennel Street	152	33	7	7	2	201	145	33	4	8	0	190	-11	-5%	0.8	Pass	Pass
	A to D	Rigg Street to Lainshaw Street	72	16	3	3	1	95	75	13	3	2	0	93	-2	-2%	0.2	Pass	Pass
J1 Arm B	B to C	Main Street to Vennel Street	34	7	2	2	0	44	37	8	1	1	0	47	3	6%	0.4	Pass	Pass
	B to D	Main Street to Lainshaw Street	151	33	7	7	2	199	145	32	7	6	0	190	-9	-4%	0.6	Pass	Pass
	B to A	Main Street to Rigg Street	26	6	1	1	0	34	27	4	1	1	0	33	-1	-3%	0.2	Pass	Pass
J1 Arm C	C to D	Vennel Street to Lainshaw Street	93	20	4	4	1	123	89	18	3	3	0	113	-10	-8%	1.0	Pass	Pass
	C to A	Vennel Street to Rigg Street	119	26	5	6	1	157	117	24	4	4	0	149	-8	-5%	0.7	Pass	Pass
	C to B	Vennel Street to Main Street	34	7	2	2	0	44	34	6	1	1	0	42	-2	-5%	0.3	Pass	Pass
J1 Arm D	D to A	Lainshaw Street to Rigg Street	70	15	3	3	1	92	70	15	3	2	0	90	-2	-3%	0.2	Pass	Pass
	D to B	Lainshaw Street to Main Street	153	33	7	7	2	202	148	35	6	6	0	195	-7	-3%	0.5	Pass	Pass
	D to C	Lainshaw Street to Vennel Street	108	24	5	5	1	143	111	24	5	6	0	146	3	2%	0.2	Pass	Pass
J2 Arm A	A to B	Standalane to Lainshaw Street (E)	123	27	6	6	1	162	125	27	6	5	0	163	1	1%	0.1	Pass	Pass
	A to C	Standalane to Local Access	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	A to D	Standalane to Lainshaw Street (W)	74	16	3	3	1	98	72	13	3	3	0	91	-7	-7%	0.7	Pass	Pass
J2 Arm B	B to C	Lainshaw Street (E) to Local Access	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	B to D	Lainshaw Street (E) to Lainshaw Street (W)	229	50	10	11	3	303	223	44	8	7	0	282	-21	-7%	1.2	Pass	Pass
	B to A	Lainshaw Street (E) to Standalane	91	20	4	4	1	121	86	19	4	5	0	114	-7	-5%	0.6	Pass	Pass
J2 Arm C	C to D	Local Access to Lainshaw Street (W)	1	0	0	0	0	1	0	0	0	0	0	0	-1	-100%	1.4	Pass	Pass
	C to A	Local Access to Standalane	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	C to B	Local Access to Lainshaw Street (E)	1	0	0	0	0	1	0	0	0	0	0	0	-1	-100%	1.4	Pass	Pass
J2 Arm D	D to A	Lainshaw Street (W) to Standalane	51	11	2	2	1	67	51	10	2	3	0	66	-1	-1%	0.1	Pass	Pass
	D to B	Lainshaw Street (W) to Lainshaw Street (E)	210	46	10	10	2	278	208	46	9	8	0	271	-7	-3%	0.4	Pass	Pass
	D to C	Lainshaw Street (W) to Local Access	1	0	0	0	0	1	1	1	1	1	0	4	3	324%	1.9	Pass	Pass
			1817	395	83	84	21	2400	1791	378	72	74	0	2315	-85				
			2212		167		21		2169		146		0						

Table 4.44 – Stewarton crossroads PM Base Model Turning Movement Count Calibration Results

	PM Peak 1630 - 1730		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	Rigg Street to Main Street	39	5	1	1	0	46	37	4	1	1	0	43	-3	-6%	0.4	Pass	Pass
	A to C	Rigg Street to Vennel Street	191	26	3	3	1	224	182	25	2	3	0	212	-12	-5%	0.8	Pass	Pass
	A to D	Rigg Street to Lainshaw Street	108	15	2	2	0	126	106	12	2	1	0	121	-5	-4%	0.5	Pass	Pass
J1 Arm B	B to C	Main Street to Vennel Street	51	7	1	1	0	60	50	6	1	1	0	58	-2	-3%	0.2	Pass	Pass
	B to D	Main Street to Lainshaw Street	161	22	3	2	1	189	153	21	3	2	0	179	-10	-5%	0.7	Pass	Pass
	B to A	Main Street to Rigg Street	38	5	1	1	0	44	38	3	1	1	0	43	-1	-2%	0.1	Pass	Pass
J1 Arm C	C to D	Vennel Street to Lainshaw Street	150	20	2	2	1	176	139	18	1	1	0	159	-17	-10%	1.3	Pass	Pass
	C to A	Vennel Street to Rigg Street	178	24	3	3	1	209	170	22	2	2	0	196	-13	-6%	0.9	Pass	Pass
	C to B	Vennel Street to Main Street	59	8	1	1	0	69	56	7	1	0	0	64	-5	-8%	0.7	Pass	Pass
J1 Arm D	D to A	Lainshaw Street to Rigg Street	131	18	2	2	1	153	121	16	1	1	0	139	-14	-9%	1.2	Pass	Pass
	D to B	Lainshaw Street to Main Street	166	23	3	3	1	194	154	22	2	1	0	179	-15	-8%	1.1	Pass	Pass
	D to C	Lainshaw Street to Vennel Street	101	14	2	2	0	118	98	13	2	1	0	114	-4	-4%	0.4	Pass	Pass
J2 Arm A	A to B	Standalane to Lainshaw Street (E)	138	19	2	2	1	162	134	18	3	0	0	155	-7	-4%	0.6	Pass	Pass
	A to C	Standalane to Local Access	6	1	0	0	0	7	6	1	0	0	0	7	0	2%	0.1	Pass	Pass
	A to D	Standalane to Lainshaw Street (W)	85	12	1	1	0	100	80	9	1	0	0	90	-10	-10%	1.0	Pass	Pass
J2 Arm B	B to C	Lainshaw Street (E) to Local Access	4	1	0	0	0	5	3	1	0	0	0	4	-1	-18%	0.4	Pass	Pass
	B to D	Lainshaw Street (E) to Lainshaw Street (W)	238	32	4	4	1	278	231	28	3	2	0	264	-14	-5%	0.9	Pass	Pass
	B to A	Lainshaw Street (E) to Standalane	171	23	3	3	1	200	162	21	3	3	0	189	-11	-6%	0.8	Pass	Pass
J2 Arm C	C to D	Local Access to Lainshaw Street (W)	1	0	0	0	0	1	1	0	0	0	0	1	0	2%	0.0	Pass	Pass
	C to A	Local Access to Standalane	3	0	0	0	0	4	2	0	0	0	0	2	-2	-49%	1.1	Pass	Pass
	C to B	Local Access to Lainshaw Street (E)	3	0	0	0	0	3	1	0	0	0	0	1	-2	-66%	1.4	Pass	Pass
J2 Arm D	D to A	Lainshaw Street (W) to Standalane	79	11	1	1	0	93	76	9	1	2	0	88	-5	-5%	0.5	Pass	Pass
	D to B	Lainshaw Street (W) to Lainshaw Street (E)	250	34	4	4	1	293	239	32	2	2	0	275	-18	-6%	1.1	Pass	Pass
	D to C	Lainshaw Street (W) to Local Access	2	0	0	0	0	2	1	1	1	0	0	3	1	54%	0.7	Pass	Pass
			2352	320	39	36	9	2756	2240	289	33	24	0	2586	-170				
			2672		75		9		2529		57		0						

4.12.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the two junctions in the network have been compared against the base model link flows. Table 4.45 and Table 4.46 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 4.45 – Stewarton crossroads AM Base Model Link Flow Calibration Results

	AM Peak 0800 - 0900		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	Rigg Street	250	54	11	12	3	330	247	52	8	12	0	319	-11	-3%	0.6	Pass	Pass
	Arm B	Main Street	210	46	10	10	2	277	209	44	9	8	0	270	-7	-3%	0.4	Pass	Pass
	Arm C	Vennel Street	246	54	11	11	3	325	240	48	8	8	0	304	-21	-6%	1.2	Pass	Pass
	Arm D	Lainshaw Street	331	72	15	15	4	437	329	74	14	14	0	431	-6	-1%	0.3	Pass	Pass
J2	Arm A	Standalane	197	43	9	9	2	260	197	40	9	8	0	254	-6	-2%	0.4	Pass	Pass
	Arm B	Lainshaw Street (E)	320	70	15	15	4	423	309	63	12	12	0	396	-27	-6%	1.3	Pass	Pass
	Arm C	Local Access	1	0	0	0	0	2	0	0	0	0	0	0	-2	-100%	1.9	Pass	Pass
	Arm D	Lainshaw Street (W)	262	57	12	12	3	346	260	57	12	12	0	341	-5	-1%	0.3	Pass	Pass

Table 4.46 – Stewarton crossroads PM Base Model Link Flow Calibration Results

	PM Peak 1630 - 1730		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	Rigg Street	338	46	6	5	1	396	325	41	5	5	0	376	-20	-5%	1.0	Pass	Pass
	Arm B	Main Street	249	34	4	4	1	292	241	30	5	4	0	280	-12	-4%	0.7	Pass	Pass
	Arm C	Vennel Street	388	53	6	6	2	454	365	47	4	3	0	419	-35	-8%	1.7	Pass	Pass
	Arm D	Lainshaw Street	398	54	7	6	2	466	373	51	5	3	0	432	-34	-7%	1.6	Pass	Pass
J2	Arm A	Standalane	229	31	4	3	1	269	220	28	4	0	0	252	-17	-6%	1.0	Pass	Pass
	Arm B	Lainshaw Street (E)	413	56	7	6	2	484	396	50	6	5	0	457	-27	-6%	1.2	Pass	Pass
	Arm C	Local Access	7	1	0	0	0	8	4	0	0	0	0	4	-4	-49%	1.6	Pass	Pass
	Arm D	Lainshaw Street (W)	331	45	5	5	1	388	316	42	4	4	0	366	-22	-6%	1.1	Pass	Pass

4.12.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 2 journey time routes were acquired from TomTom which are illustrated in Figure 4.19 below. These routes cover the B778 and A735 northbound and southbound directions and travel through the Stewarton crossroads.

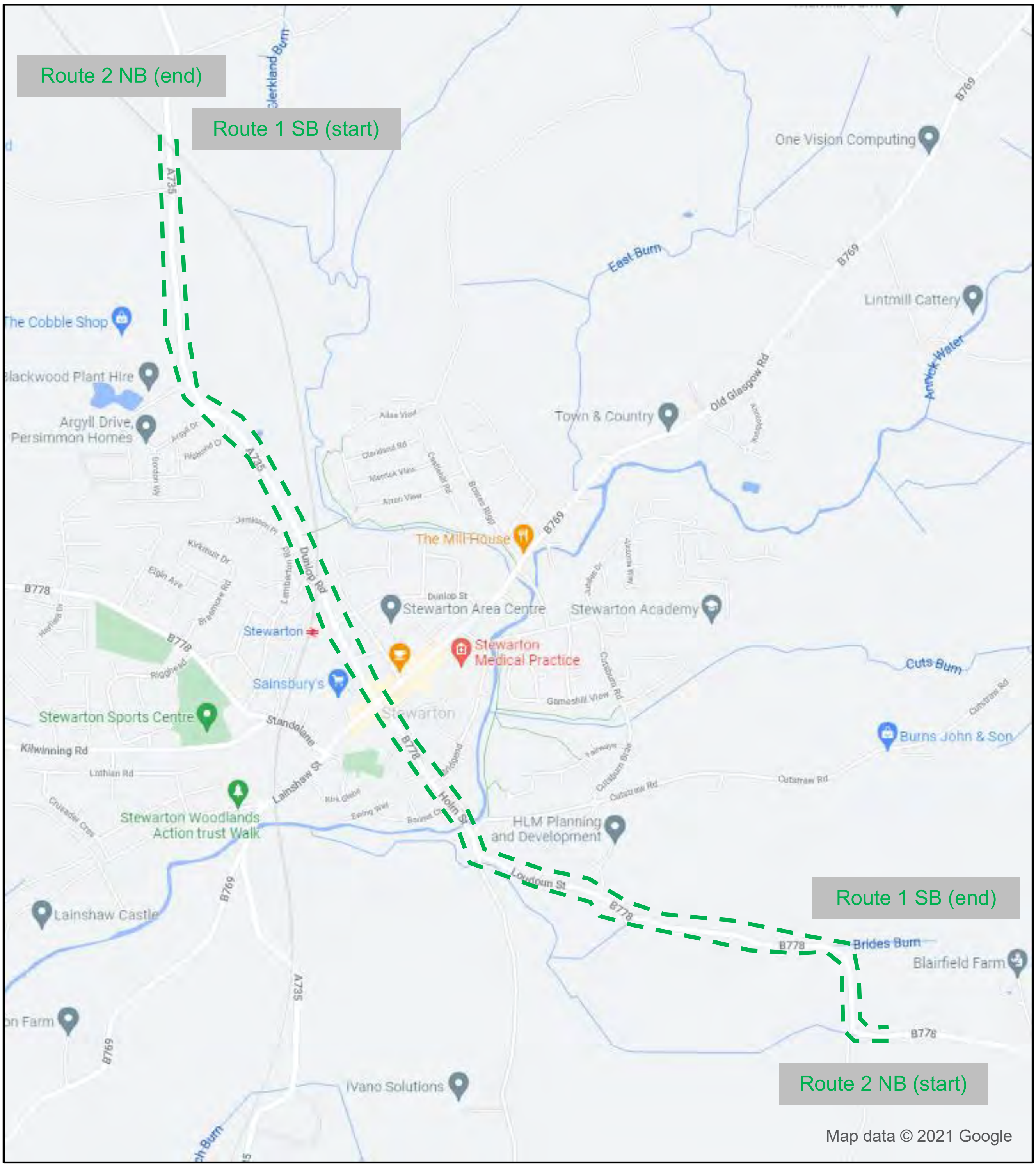


Figure 4.19 – Stewarton crossroads TomTom Journey Time Routes 1 & 2

Each route was split into two sub-sections to account for the approach to the Stewarton crossroads stopline and then the exit from the model.

As detailed in

Table 4.47 and Table 4.48 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% 'Pass' rate).

Table 4.47 – Stewarton crossroads AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0800 - 0900		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	**< 15%**
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - A735 SB to stopline	1715	02:47	03:18	31	18%	
		Route 1b - B778 SB exit	1888	03:20	02:54	-27	-13%	
		A735 (N) to B778 (S)	**3603**	**06:07**	**06:12**	**4**	**1%**	**Pass**
	2	Route 2a - B778 NB to stopline	1753	04:00	04:15	15	6%	
		Route 2b - A735 NB exit	1616	02:18	02:45	27	19%	
		B778 (S) to A735 (N)	**3369**	**06:18**	**07:00**	**42**	**11%**	**Pass**

Table 4.48 – Stewarton crossroads PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1630 - 1730		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	**< 15%**
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - A735 SB to stopline	1715	03:03	03:23	20	11%	
		Route 1b - B778 SB exit	1888	03:20	02:53	-27	-13%	
		A735 (N) to B778 (S)	**3603**	**06:23**	**06:16**	**-6**	**-2%**	**Pass**
	2	Route 2a - B778 NB to stopline	1753	04:55	04:23	-32	-11%	
		Route 2b - A735 NB exit	1616	02:25	02:51	26	18%	
		B778 (S) to A735 (N)	**3369**	**07:20**	**07:14**	**-6**	**-1%**	**Pass**

4.12.3. Stewarton Base Model Queuing

On site observations have indicated that the more notable queuing occurs on the B778 Vennel Street (S) and A735 Lainshaw Street (W) arms during the both the AM and PM peaks, while the A735 Rigg Street (N) and B769 Main Street (E) arms have a smaller level of queuing during these periods.

The AM and PM base model queue lengths reflect on the above junction operation of the Stewarton crossroads and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.13. A77 Meiklewood Junction

4.13.1. Model Extent

A full extent of the A77 Meiklewood junction VISSIM model is shown below in Figure 4.20.

Figure 4.20 – A77 Meiklewood Junction model extents

4.13.2. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for November 2021. The two base models simulate the following peak time periods:

- 07:30 – 08:30 AM weekday peak period (Thursday 25 November 2021); and
- 16:15 – 17:15 PM weekday peak period (Thursday 25 November 2021).

The periods were selected based on the busiest hour identified from turning movements counts undertaken for this study.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

4.13.2.1. Turning Movement Counts – (Calibration Results)

Turning movement flows from eight junctions have been utilised in the development of the A77 Meiklewood Junction VISSIM model. These junctions are:

- J1 – A77 NB Offslip / A77 NB Onslip / B7038 Glasgow Road;
- J2 – A77 SB Onslip / B7038;
- J3 – M77 J8 SB Offslip / B7061 / B7038;
- J4 – M77 J8 NB Offslip / A77 / B751 Kilmaurs Road;
- J5 – A77 / B778 Stewarton Road;
- J6 – M77 J7 SB Offslip / B778 Stewarton Road;
- J7 – M77 J7 NB Onslip / A77 / Ayr Road; and
- J8 – B7038 Glasgow Road / B751 Kilmaurs Road.

Observed turning movement counts at the eight junctions in the network have been compared against the base model turning movement counts. Table 4.49 and Table 4.50 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria (100% 'Pass' rate). This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced in the vicinity of the A77 Meiklewood Junction during the AM and PM peak periods.

Table 4.49 – A77 Meiklewood Junction AM Base Model Turning Movement Count Calibration Results

	AM Peak 0730 - 0830 (Thu 25 Nov 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm B	B to D	B7038 Glasgow Road (E) to B7038 Glasgow Road (W)	180	46	3	1	4	234	162	45	3	2	5	217	-17	-7%	1.1	Pass	Pass
J1 Arm C	C to D	A77 NB Offslip to B7038 Glasgow Road (W)	146	46	5	2	3	202	144	44	5	2	4	199	-3	-1%	0.2	Pass	Pass
	C to B	A77 NB Offslip to B7038 Glasgow Road (E)	12	2	3	0	0	17	12	2	3	0	0	17	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	B7038 Glasgow Road (W) to A77 NB Onslip	313	68	14	7	4	406	302	70	14	6	4	396	-10	-2%	0.5	Pass	Pass
	D to B	B7038 Glasgow Road (W) to B7038 Glasgow Road (E)	234	35	3	1	9	282	241	35	3	2	9	290	8	3%	0.5	Pass	Pass
J2 Arm A	A to B	B7038 (E) to B7038 (S)	180	45	2	1	4	232	165	44	1	2	5	217	-15	-6%	1.0	Pass	Pass
	A to C	B7038 (E) to A77 SB Onslip	16	5	3	1	0	25	15	5	3	1	0	24	-1	-4%	0.2	Pass	Pass
	A to A	B7038 (E) to B7038 (E)	1	0	0	0	0	1	2	0	0	0	0	2	1	100%	0.8	Pass	Pass
J2 Arm B	B to C	B7038 (S) to A77 SB Onslip	222	33	2	1	6	264	229	33	2	2	6	272	8	3%	0.5	Pass	Pass
	B to A	B7038 (S) to B7038 (E)	24	3	3	0	3	33	24	3	2	0	3	32	-1	-3%	0.2	Pass	Pass
	B to B	B7038 (S) to B7038 (S)	0	1	1	0	0	2	0	1	2	0	0	3	1	50%	0.6	Pass	Pass
J3 Arm A	A to B	A77 SB Offslip to B7061 Main Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	A to C	A77 SB Offslip to B7038 (S)	148	41	4	1	2	196	139	42	3	1	3	188	-8	-4%	0.6	Pass	Pass
J3 Arm B	B to C	B7061 Main Road to B7038 (S)	46	7	1	1	2	57	45	7	1	1	2	56	-1	-2%	0.1	Pass	Pass
	B to B	B7061 Main Road to B7061 Main Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm C	C to B	B7038 (S) to B7061 Main Road	22	2	3	0	3	30	25	3	2	0	3	33	3	10%	0.5	Pass	Pass
	C to C	B7038 (S) to B7038 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J4 Arm A	A to C	A77 (N) to B751 Kilmaurs Road	28	22	1	0	0	51	32	19	1	0	0	52	1	2%	0.1	Pass	Pass
	A to A	A77 (N) to A77 (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J4 Arm B	B to C	M77 NB Offslip to B751 Kilmaurs Road	4	0	0	0	0	4	4	0	0	0	0	4	0	0%	0.0	Pass	Pass
	B to A	M77 NB Offslip to A77 (N)	139	48	8	2	3	200	141	51	8	3	2	205	5	3%	0.4	Pass	Pass
J4 Arm C	C to A	B751 Kilmaurs Road to A77 (N)	72	31	0	0	0	103	74	32	0	0	0	106	3	3%	0.3	Pass	Pass
	C to C	B751 Kilmaurs Road to B751 Kilmaurs Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J5 Arm A	A to B	A77 (N) to B778 Stewarton Road	28	8	1	1	1	39	27	9	1	1	1	39	0	0%	0.0	Pass	Pass
	A to C	A77 (N) to A77 (S)	6	2	0	0	0	8	7	2	0	0	0	9	1	13%	0.3	Pass	Pass
	A to D	A77 (N) to B778	19	5	1	1	0	26	18	5	1	1	0	25	-1	-4%	0.2	Pass	Pass
	A to A	A77 (N) to A77 (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J5 Arm B	B to C	B778 Stewarton Road to A77 (S)	21	20	0	0	0	41	25	17	0	0	0	42	1	2%	0.2	Pass	Pass
	B to D	B778 Stewarton Road to B778	39	19	11	4	0	73	37	20	12	4	0	73	0	0%	0.0	Pass	Pass
	B to A	B778 Stewarton Road to A77 (N)	47	3	1	1	2	54	45	3	1	1	2	52	-2	-4%	0.3	Pass	Pass
	B to B	B778 Stewarton Road to B778 Stewarton Road	1	0	0	0	1	2	1	0	0	0	1	2	0	0%	0.0	Pass	Pass
J5 Arm C	C to D	A77 (S) to B778	56	26	3	0	0	85	61	27	3	0	0	91	6	7%	0.6	Pass	Pass
	C to A	A77 (S) to A77 (N)	126	45	4	2	2	179	133	53	4	2	1	193	14	8%	1.0	Pass	Pass
	C to B	A77 (S) to B778 Stewarton Road	21	2	0	0	1	24	22	2	0	0	1	25	1	4%	0.2	Pass	Pass
	C to C	A77 (S) to A77 (S)	0	0	1	0	0	1	0	0	1	0	0	1	0	0%	0.0	Pass	Pass
J5 Arm D	D to A	B778 to A77 (N)	107	17	3	4	0	131	106	17	3	5	0	131	0	0%	0.0	Pass	Pass
	D to B	B778 to B778 Stewarton Road	87	15	6	2	0	110	86	16	6	1	0	109	-1	-1%	0.1	Pass	Pass
	D to C	B778 to A77 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	D to D	B778 to B778	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J6 Arm A	A to B	M77 SB Offslip to B778 (E)	18	3	0	0	0	21	21	3	0	0	0	24	3	14%	0.6	Pass	Pass
	A to D	M77 SB Offslip to B778 (W)	48	36	11	4	1	100	48	34	12	3	1	98	-2	-2%	0.2	Pass	Pass
J6 Arm B	B to C	B778 (E) to M77 SB Onslip	27	4	0	0	0	31	28	4	0	0	0	32	1	3%	0.2	Pass	Pass
	B to D	B778 (E) to B778 (W)	60	6	1	1	2	70	60	6	1	1	2	70	0	0%	0.0	Pass	Pass
J6 Arm D	D to B	B778 (W) to B778 (E)	32	5	1	0	2	40	34	5	1	0	2	42	2	5%	0.3	Pass	Pass
	D to C	B778 (W) to M77 SB Onslip	105	20	6	3	1	135	102	22	6	2	1	133	-2	-1%	0.2	Pass	Pass
J7 Arm A	A to B	Ayr Road (N) to M77 NB Onslip	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
	A to C	Ayr Road (N) to A77 (S)	51	16	2	2	1	72	51	16	2	2	1	72	0	0%	0.0	Pass	Pass
	A to A	Ayr Road (N) to Ayr Road (N)	0	0	1	0	0	1	0	0	1	0	0	1	0	0%	0.0	Pass	Pass
J7 Arm C	C to A	A77 (S) to Ayr Road (N)	129	39	4	5	2	179	129	45	2	6	2	184	5	3%	0.4	Pass	Pass
	C to B	A77 (S) to M77 NB Onslip	151	25	4	2	2	184	154	28	5	2	1	190	6	3%	0.4	Pass	Pass
	C to C	A77 (S) to A77 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J8 Arm A	A to B	B7038 Glasgow Road (N) to B7038 Glasgow Road (S)	301	92	8	3	7	411	282	89	8	3	9	391	-20	-5%	1.0	Pass	Pass
	A to C	B7038 Glasgow Road (N) to B751 Kilmaurs Road	25	0	0	0	0	25	23	0	0	0	0	23	-2	-8%	0.4	Pass	Pass
J8 Arm B	B to C	B7038 Glasgow Road (S) to B751 Kilmaurs Road	37	0	0	0	0	37	34	0	0	0	0	34	-3	-8%	0.5	Pass	Pass
	B to A	B7038 Glasgow Road (S) to B7038 Glasgow Road (N)	484	103	17	8	13	625	480	104	17	8	13	622	-3	0%	0.1	Pass	Pass
J8 Arm C	C to A	B751 Kilmaurs Road to B7038 Glasgow Road (N)	63	0	0	0	0	63	63	0	0	0	0	63	0	0%	0.0	Pass	Pass
	C to B	B751 Kilmaurs Road to B7038 Glasgow Road (S)	29	0	0	0	0	29	33	0	0	0	0	33	4	14%	0.7	Pass	Pass
			3905	946	142	61	81	5135	3866	963	140	64	84	5117	-18				
			4851		203		81		4829		204		84						

Table 4.50 – A77 Meiklewood Junction PM Base Model Turning Movement Count Calibration Results

	PM Peak 1615 - 1715 (Thu 25 Nov 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm B	B to D	B7038 Glasgow Road (E) to B7038 Glasgow Road (W)	292	102	12	4	4	414	295	102	12	4	4	417	3	1%	0.1	Pass	Pass
J1 Arm C	C to D	A77 NB Offslip to B7038 Glasgow Road (W)	214	44	5	0	0	263	215	42	5	0	0	262	-1	0%	0.1	Pass	Pass
	C to B	A77 NB Offslip to B7038 Glasgow Road (E)	7	1	0	0	0	8	7	1	0	0	0	8	0	0%	0.0	Pass	Pass
J1 Arm D	D to A	B7038 Glasgow Road (W) to A77 NB Onslip	296	35	9	2	4	346	283	38	10	2	4	337	-9	-3%	0.5	Pass	Pass
	D to B	B7038 Glasgow Road (W) to B7038 Glasgow Road (E)	159	39	3	2	3	206	163	37	2	2	3	207	1	0%	0.1	Pass	Pass
J2 Arm A	A to B	B7038 (E) to B7038 (S)	291	102	12	4	4	413	293	101	12	4	4	414	1	0%	0.0	Pass	Pass
	A to C	B7038 (E) to A77 SB Onslip	13	5	0	0	0	18	14	5	0	0	0	19	1	6%	0.2	Pass	Pass
	A to A	B7038 (E) to B7038 (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm B	B to C	B7038 (S) to A77 SB Onslip	120	34	3	1	0	158	125	33	2	1	0	161	3	2%	0.2	Pass	Pass
	B to A	B7038 (S) to B7038 (E)	45	6	0	1	3	55	43	6	0	1	3	53	-2	-4%	0.3	Pass	Pass
	B to B	B7038 (S) to B7038 (S)	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
J3 Arm A	A to B	A77 SB Offslip to B7061 Main Road	1	1	0	0	0	2	1	1	0	0	0	2	0	0%	0.0	Pass	Pass
	A to C	A77 SB Offslip to B7038 (S)	254	97	10	4	1	366	260	98	10	4	1	373	7	2%	0.4	Pass	Pass
J3 Arm B	B to C	B7061 Main Road to B7038 (S)	48	8	2	0	3	61	47	8	2	0	3	60	-1	-2%	0.1	Pass	Pass
	B to B	B7061 Main Road to B7061 Main Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm C	C to B	B7038 (S) to B7061 Main Road	41	7	0	1	3	52	43	6	0	1	3	53	1	2%	0.1	Pass	Pass
	C to C	B7038 (S) to B7038 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J4 Arm A	A to C	A77 (N) to B751 Kilmaurs Road	104	43	4	0	0	151	106	41	5	0	0	152	1	1%	0.1	Pass	Pass
	A to A	A77 (N) to A77 (N)	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
J4 Arm B	B to C	M77 NB Offslip to B751 Kilmaurs Road	4	0	0	0	0	4	3	0	0	0	0	3	-1	-25%	0.5	Pass	Pass
	B to A	M77 NB Offslip to A77 (N)	144	22	7	3	2	178	142	25	7	3	2	179	1	1%	0.1	Pass	Pass
J4 Arm C	C to A	B751 Kilmaurs Road to A77 (N)	50	17	1	0	0	68	50	17	1	0	0	68	0	0%	0.0	Pass	Pass
	C to C	B751 Kilmaurs Road to B751 Kilmaurs Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J5 Arm A	A to B	A77 (N) to B778 Stewarton Road	71	27	1	0	2	101	72	28	1	0	2	103	2	2%	0.2	Pass	Pass
	A to C	A77 (N) to A77 (S)	24	10	1	0	0	35	24	11	1	0	0	36	1	3%	0.2	Pass	Pass
	A to D	A77 (N) to B778	32	4	1	0	0	37	31	3	1	0	0	35	-2	-5%	0.3	Pass	Pass
	A to A	A77 (N) to A77 (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J5 Arm B	B to C	B778 Stewarton Road to A77 (S)	76	32	4	0	0	112	78	30	4	0	0	112	0	0%	0.0	Pass	Pass
	B to D	B778 Stewarton Road to B778	97	28	2	0	0	127	92	29	2	0	0	123	-4	-3%	0.4	Pass	Pass
	B to A	B778 Stewarton Road to A77 (N)	24	3	1	0	3	31	23	3	1	0	3	30	-1	-3%	0.2	Pass	Pass
	B to B	B778 Stewarton Road to B778 Stewarton Road	1	0	0	0	3	4	1	0	0	0	3	4	0	0%	0.0	Pass	Pass
J5 Arm C	C to D	A77 (S) to B778	69	12	3	0	0	84	73	13	3	1	1	91	7	8%	0.7	Pass	Pass
	C to A	A77 (S) to A77 (N)	76	26	2	2	2	108	72	29	3	2	1	107	-1	-1%	0.1	Pass	Pass
	C to B	A77 (S) to B778 Stewarton Road	44	1	4	0	0	49	46	1	3	0	0	50	1	2%	0.1	Pass	Pass
	C to C	A77 (S) to A77 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J5 Arm D	D to A	B778 to A77 (N)	70	26	11	0	0	107	69	26	11	0	0	106	-1	-1%	0.1	Pass	Pass
	D to B	B778 to B778 Stewarton Road	87	25	3	1	0	116	87	25	3	1	0	116	0	0%	0.0	Pass	Pass
	D to C	B778 to A77 (S)	5	0	0	0	0	5	5	0	0	0	0	5	0	0%	0.0	Pass	Pass
	D to D	B778 to B778	0	1	0	0	0	1	0	1	0	0	0	1	0	0%	0.0	Pass	Pass
J6 Arm A	A to B	M77 SB Offslip to B778 (E)	32	7	0	0	0	39	33	7	0	0	0	40	1	3%	0.2	Pass	Pass
	A to D	M77 SB Offslip to B778 (W)	154	56	6	0	3	219	152	55	6	0	3	216	-3	-1%	0.2	Pass	Pass
J6 Arm B	B to C	B778 (E) to M77 SB Onslip	15	3	0	0	0	18	16	3	0	0	0	19	1	6%	0.2	Pass	Pass
	B to D	B778 (E) to B778 (W)	44	7	1	0	3	55	44	7	1	0	3	55	0	0%	0.0	Pass	Pass
J6 Arm D	D to B	B778 (W) to B778 (E)	67	5	4	0	2	78	70	7	3	0	2	82	4	5%	0.4	Pass	Pass
	D to C	B778 (W) to M77 SB Onslip	136	48	4	1	3	192	136	47	4	1	3	191	-1	-1%	0.1	Pass	Pass
J7 Arm A	A to B	Ayr Road (N) to M77 NB Onslip	3	0	1	0	0	4	4	0	1	0	0	5	1	25%	0.5	Pass	Pass
	A to C	Ayr Road (N) to A77 (S)	126	41	3	0	2	172	125	41	3	0	2	171	-1	-1%	0.1	Pass	Pass
	A to A	Ayr Road (N) to Ayr Road (N)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J7 Arm C	C to A	A77 (S) to Ayr Road (N)	71	18	4	2	3	98	71	20	4	2	2	99	1	1%	0.1	Pass	Pass
	C to B	A77 (S) to M77 NB Onslip	95	35	10	0	2	142	93	37	11	0	1	142	0	0%	0.0	Pass	Pass
	C to C	A77 (S) to A77 (S)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J8 Arm A	A to B	B7038 Glasgow Road (N) to B7038 Glasgow Road (S)	467	146	17	4	4	638	471	144	17	4	4	640	2	0%	0.1	Pass	Pass
	A to C	B7038 Glasgow Road (N) to B751 Kilmaurs Road	39	0	0	0	0	39	39	0	0	0	0	39	0	0%	0.0	Pass	Pass
J8 Arm B	B to C	B7038 Glasgow Road (S) to B751 Kilmaurs Road	31	0	0	0	0	31	31	0	0	0	0	31	0	0%	0.0	Pass	Pass
	B to A	B7038 Glasgow Road (S) to B7038 Glasgow Road (N)	429	74	12	4	7	526	421	74	12	4	7	518	-8	-2%	0.4	Pass	Pass
J8 Arm C	C to A	B751 Kilmaurs Road to B7038 Glasgow Road (N)	26	0	0	0	0	26	24	0	0	0	0	24	-2	-8%	0.4	Pass	Pass
	C to B	B751 Kilmaurs Road to B7038 Glasgow Road (S)	26	0	0	0	0	26	28	0	0	0	0	28	2	8%	0.4	Pass	Pass
			4522	1198	163	36	66	5985	4523	1202	163	37	64	5989	4				
			5720		199		66		5725		200		64						

4.13.2.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the eight junctions in the network have been compared against the base model link flows. Table 4.51 and

Table 4.52 and below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria (100% 'Pass' rate).

Table 4.51 – A77 Meiklewood AM Base Model Link Flow Calibration Results

	AM Peak 0730 - 0830 (Thu 25 Nov 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm B	B7038 Glasgow Road (E)	180	46	3	1	4	234	162	45	3	2	5	217	-17	-7%	1.1	Pass	Pass
	Arm C	A77 NB Offslip	158	48	8	2	3	219	156	46	8	2	4	216	-3	-1%	0.2	Pass	Pass
	Arm D	B7038 Glasgow Road (W)	547	103	17	8	13	688	543	105	17	8	13	686	-2	0%	0.1	Pass	Pass
J2	Arm A	B7038 (E)	197	50	5	2	4	258	182	49	4	3	5	243	-15	-6%	0.9	Pass	Pass
	Arm B	B7038 (S)	246	37	6	1	9	299	253	37	6	2	9	307	8	3%	0.5	Pass	Pass
J3	Arm A	A77 SB Offslip	148	41	4	1	2	196	139	42	3	1	3	188	-8	-4%	0.6	Pass	Pass
	Arm B	B7061 Main Road	46	7	1	1	2	57	45	7	1	1	2	56	-1	-2%	0.1	Pass	Pass
	Arm C	B7038 (S)	22	2	3	0	3	30	25	3	2	0	3	33	3	10%	0.5	Pass	Pass
J4	Arm A	A77 (N)	28	22	1	0	0	51	32	19	1	0	0	52	1	2%	0.1	Pass	Pass
	Arm B	M77 NB Offslip	143	48	8	2	3	204	145	51	8	3	2	209	5	2%	0.3	Pass	Pass
	Arm C	B751 Kilmaurs Road	72	31	0	0	0	103	74	32	0	0	0	106	3	3%	0.3	Pass	Pass
J5	Arm A	A77 (N)	53	15	2	2	1	73	52	16	2	2	1	73	0	0%	0.0	Pass	Pass
	Arm B	B778 Stewarton Road	108	42	12	5	3	170	108	40	13	5	3	169	-1	-1%	0.1	Pass	Pass
	Arm C	A77 (S)	203	73	8	2	3	289	216	82	8	2	2	310	21	7%	1.2	Pass	Pass
	Arm D	B778	194	32	9	6	0	241	192	33	9	6	0	240	-1	0%	0.1	Pass	Pass
J6	Arm A	M77 SB Offslip	66	39	11	4	1	121	69	37	12	3	1	122	1	1%	0.1	Pass	Pass
	Arm B	B778 (E)	87	10	1	1	2	101	88	10	1	1	2	102	1	1%	0.1	Pass	Pass
	Arm D	B778 (W)	137	25	7	3	3	175	136	27	7	2	3	175	0	0%	0.0	Pass	Pass
J7	Arm A	Ayr Road (N)	51	16	3	2	1	73	51	16	3	2	1	73	0	0%	0.0	Pass	Pass
	Arm C	A77 (S)	280	64	8	7	4	363	283	73	7	8	3	374	11	3%	0.6	Pass	Pass
J8	Arm A	B7038 Glasgow Road (N)	326	92	8	3	7	436	305	89	8	3	9	414	-22	-5%	1.1	Pass	Pass
	Arm B	B7038 Glasgow Road (S)	521	103	17	8	13	662	514	104	17	8	13	656	-6	-1%	0.2	Pass	Pass
	Arm C	B751 Kilmaurs Road	92	0	0	0	0	92	96	0	0	0	0	96	4	4%	0.4	Pass	Pass

Table 4.52 – A77 Meiklewood PM Base Model Link Flow Calibration Results

	PM Peak 1615 - 1715 (Thu 25 Nov 2021)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm B	B7038 Glasgow Road (E)	292	102	12	4	4	414	295	102	12	4	4	417	3	1%	0.1	Pass	Pass
J1	Arm C	A77 NB Offslip	221	45	5	0	0	271	222	43	5	0	0	270	-1	0%	0.1	Pass	Pass
J1	Arm D	B7038 Glasgow Road (W)	455	74	12	4	7	552	446	75	12	4	7	544	-8	-1%	0.3	Pass	Pass
J2	Arm A	B7038 (E)	304	107	12	4	4	431	307	106	12	4	4	433	2	0%	0.1	Pass	Pass
J2	Arm B	B7038 (S)	166	40	3	2	3	214	169	39	2	2	3	215	1	0%	0.1	Pass	Pass
J3	Arm A	A77 SB Offslip	255	98	10	4	1	368	261	99	10	4	1	375	7	2%	0.4	Pass	Pass
J3	Arm B	B7061 Main Road	48	8	2	0	3	61	47	8	2	0	3	60	-1	-2%	0.1	Pass	Pass
J3	Arm C	B7038 (S)	41	7	0	1	3	52	43	6	0	1	3	53	1	2%	0.1	Pass	Pass
J4	Arm A	A77 (N)	105	43	4	0	0	152	107	41	5	0	0	153	1	1%	0.1	Pass	Pass
J4	Arm B	M77 NB Offslip	148	22	7	3	2	182	145	25	7	3	2	182	0	0%	0.0	Pass	Pass
J4	Arm C	B751 Kilmaurs Road	50	17	1	0	0	68	50	17	1	0	0	68	0	0%	0.0	Pass	Pass
J5	Arm A	A77 (N)	127	41	3	0	2	173	127	42	3	0	2	174	1	1%	0.1	Pass	Pass
J5	Arm B	B778 Stewarton Road	198	63	7	0	6	274	194	62	7	0	6	269	-5	-2%	0.3	Pass	Pass
J5	Arm C	A77 (S)	189	39	9	2	2	241	191	43	9	3	2	248	7	3%	0.4	Pass	Pass
J5	Arm D	B778	162	52	14	1	0	229	161	52	14	1	0	228	-1	0%	0.1	Pass	Pass
J6	Arm A	M77 SB Offslip	186	63	6	0	3	258	185	62	6	0	3	256	-2	-1%	0.1	Pass	Pass
J6	Arm B	B778 (E)	59	10	1	0	3	73	60	10	1	0	3	74	1	1%	0.1	Pass	Pass
J6	Arm D	B778 (W)	203	53	8	1	5	270	206	54	7	1	5	273	3	1%	0.2	Pass	Pass
J7	Arm A	Ayr Road (N)	129	41	4	0	2	176	129	41	4	0	2	176	0	0%	0.0	Pass	Pass
J7	Arm C	A77 (S)	166	53	14	2	5	240	164	57	15	2	3	241	1	0%	0.1	Pass	Pass
J8	Arm A	B7038 Glasgow Road (N)	506	146	17	4	4	677	510	144	17	4	4	679	2	0%	0.1	Pass	Pass
J8	Arm B	B7038 Glasgow Road (S)	460	74	12	4	7	557	452	74	12	4	7	549	-8	-1%	0.3	Pass	Pass
J8	Arm C	B751 Kilmaurs Road	52	0	0	0	0	52	52	0	0	0	0	52	0	0%	0.0	Pass	Pass

4.13.2.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period September to November 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays.

In total, 4 journey time routes were acquired from TomTom which are illustrated in Figure 4.21 below. These routes cover the B7038, B7061, B778 and A77 northbound and southbound directions and travel through seven of the eight junctions within the model. The TomTom data was collected in continuous routes which included the sections through Fenwick village, but as this study does not include Fenwick only the southern and northern sections of the journey times as illustrated in Figure 4.21 have been used in the model validation.

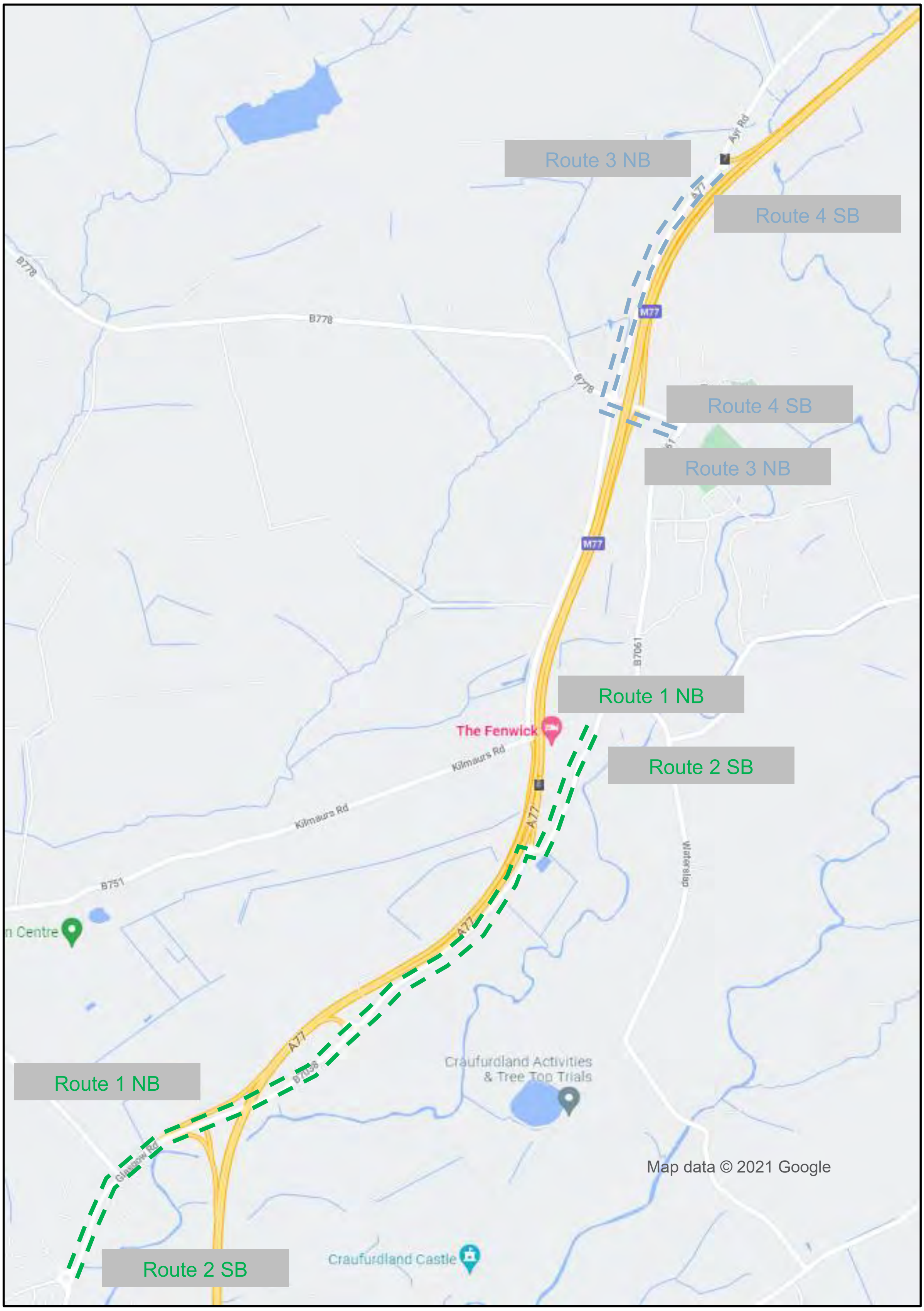


Figure 4.21 – A77 Meiklewood Junction TomTom Journey Time Routes 1 & 2

Each route was split into sub-sections to account for the approaches to different junctions through the model.

As detailed in Table 4.53 and Table 4.54 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated (100% ‘Pass’ rate).

Table 4.53 – A77 Meiklewood Junction AM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	AM Peak 0730 - 0830		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
AM Routes	1	Route 1a - Glasgow Rd rabt **to** B7038 / A77 SB Onslip rabt	1279	01:21	01:34	13	16%	
		Route 1b - B7038 / A77 SB Onslip rabt **to** B7038 / B7061 / A77 SB Offslip rabt	914	01:02	01:07	5	9%	
		Route 1c - B7038 / B7061 / A77 SB Offslip rabt **to** B7061 Main Rd	635	01:04	00:59	-5	-7%	
		Glasgow Rd rabt (S) to B7061 Main Rd (N)	**2828**	**03:26**	**03:40**	**14**	**7%**	Pass
	2	Route 2a - B7061 Main Rd **to** B7038 / B7061 / A77 SB Offslip rabt	639	01:13	01:08	-5	-7%	
		Route 2b - B7038 / B7061 / A77 SB Offslip rabt **to** B7038 / A77 SB Onslip rabt	892	00:51	00:53	2	4%	
		Route 2c - B7038 / A77 SB Onslip rabt **to** Glasgow Rd rabt	1279	01:23	01:29	6	7%	
		B7061 Main Rd (N) to Glasgow Rd rabt (S)	**2809**	**03:27**	**03:30**	**3**	**1%**	Pass
	3	Route 3a - Stewarton Rd / Skernieland Rd / Main Rd rabt **to** A77 / B778 rabt	242	00:30	00:29	-1	-4%	
		Route 3b - A77 / B778 rabt **to** Ayr Rd / M77 NB Onslip / A77 rabt	941	00:56	00:52	-4	-7%	
		Stewarton Rd / Skernieland Rd / Main Rd rabt (S) to Ayr Rd / M77 NB Onslip / A77 rabt (N)	**1183**	**01:26**	**01:21**	**-5**	**-6%**	Pass
	4	Route 4a - Ayr Rd / M77 NB Onslip / A77 rabt **to** A77 / B778 rabt	929	00:53	00:50	-3	-5%	
		Route 4b - A77 / B778 rabt **to** Stewarton Rd / Skernieland Rd / Main Rd rabt	206	00:31	00:26	-5	-16%	
		Ayr Rd / M77 NB Onslip / A77 rabt (N) to Stewarton Rd / Skernieland Rd / Main Rd rabt (S)	**1135**	**01:23**	**01:16**	**-8**	**-9%**	Pass

Table 4.54 – A77 Meiklewood Junction PM Base Model Journey Time Validation Results

	TomTom 03/09/2019 - 28/11/2019 (TUE to THU only)							
	PM Peak 1615 - 1715		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No.	Route Name	metres	mins	mins	secs	%	%
PM Routes	1	Route 1a - Glasgow Rd rabt **to** B7038 / A77 SB Onslip rabt	1279	01:20	01:32	12	15%	
		Route 1b - B7038 / A77 SB Onslip rabt **to** B7038 / B7061 / A77 SB Offslip rabt	914	00:59	01:08	8	14%	
		Route 1c - B7038 / B7061 / A77 SB Offslip rabt **to** B7061 Main Rd	635	01:03	01:00	-3	-5%	
		Glasgow Rd rabt (S) to B7061 Main Rd (N)	**2828**	**03:22**	**03:40**	**18**	**9%**	Pass
	2	Route 2a - B7061 Main Rd **to** B7038 / B7061 / A77 SB Offslip rabt	639	01:05	01:09	4	6%	
		Route 2b - B7038 / B7061 / A77 SB Offslip rabt **to** B7038 / A77 SB Onslip rabt	892	00:53	00:54	2	3%	
		Route 2c - B7038 / A77 SB Onslip rabt **to** Glasgow Rd rabt	1279	01:27	01:32	5	6%	
		B7061 Main Rd (N) to Glasgow Rd rabt (S)	**2809**	**03:25**	**03:35**	**11**	**5%**	Pass
	3	Route 3a - Stewarton Rd / Skernieland Rd / Main Rd rabt **to** A77 / B778 rabt	242	00:34	00:29	-4	-13%	
		Route 3b - A77 / B778 rabt **to** Ayr Rd / M77 NB Onslip / A77 rabt	941	00:56	00:52	-4	-7%	
		Stewarton Rd / Skernieland Rd / Main Rd rabt (S) to Ayr Rd / M77 NB Onslip / A77 rabt (N)	**1183**	**01:30**	**01:22**	**-8**	**-9%**	Pass
	4	Route 4a - Ayr Rd / M77 NB Onslip / A77 rabt **to** A77 / B778 rabt	929	00:54	00:50	-4	-8%	
		Route 4b - A77 / B778 rabt **to** Stewarton Rd / Skernieland Rd / Main Rd rabt	206	00:28	00:26	-2	-6%	
		Ayr Rd / M77 NB Onslip / A77 rabt (N) to Stewarton Rd / Skernieland Rd / Main Rd rabt (S)	**1135**	**01:21**	**01:16**	**-6**	**-7%**	Pass

4.13.2.4. A77 Meiklewood Base Model Queuing

On site observations have indicated that there is no notable queuing at any of the eight junctions within the extents of the A77 Meiklewood model during the AM and PM peaks.

The AM and PM base model queue lengths reflect on the above junction operation of the A77 Meiklewood model and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

4.14. Summary and Conclusions

4.14.1. Summary

Atkins has been commissioned by EAC to develop base models for a number of junctions on the A71, A76, A77 corridors and in Stewarton town centre to be used to model the proposed impacts of the LDP and test the proposed mitigations required at these junctions to offset the likely impacts. The base modelling has been developed using VISSIM microsimulation software for which the model development, calibration and validation have been outlined in this technical note.

4.14.2. Conclusions

The AM and PM base modelling for the nine junctions have been calibrated using turning movement counts and validated using TomTom data. All calibration and validation satisfy the required criteria with a 100% 'Pass' rate. It is therefore considered that the nine VISSIM models developed are an accurate reflection of the existing situations and appropriate tools to be taken forward for proposed testing.

5. Bellfield Interchange Base Model Development

5.1. Baseline Data

Traffic survey data for the Bellfield Interchange was acquired from EAC in the form of turning movements counts and TomTom journey times.

5.1.1. Turning Movements Counts

Turning movement counts for the Bellfield Interchange and the three adjacent junctions were undertaken in fifteen minute intervals over a 24hr period in 2019 (noon on Wednesday 19 June to noon on Thursday 20 June). The four surveyed junctions were:

- J1 – Bellfield Interchange (six arm priority roundabout);
- J2 – A735 Queen's Drive / B7072 (three arm priority roundabout);
- J3 – A71 Riccarton Road / Service Access North (three arm priority junction); and
- J4 – A76 / Service Access South (three arm priority junction).

The classified turning movement counts included five vehicle types (Car, LGV, OGV1, OGV2 and Bus). The junction locations are illustrated in Figure 5.1 below.

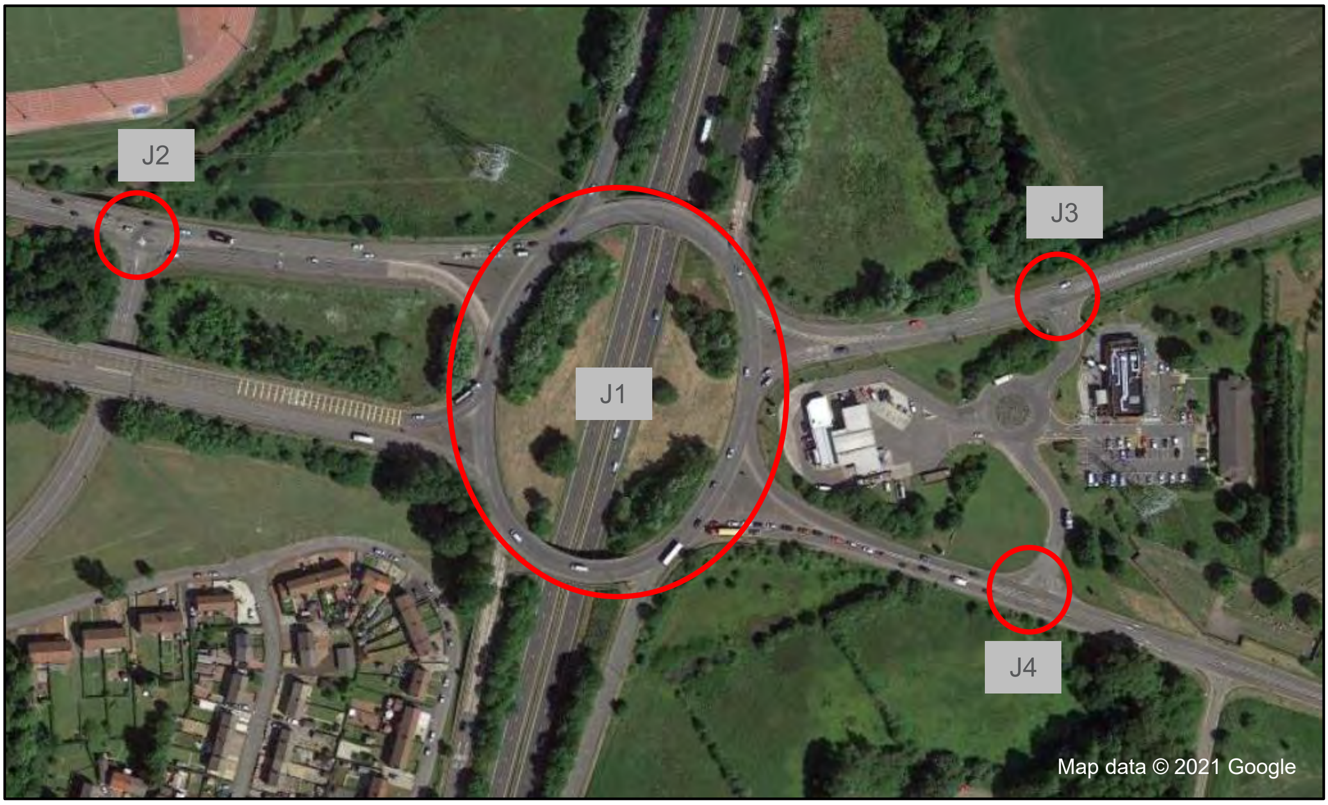


Figure 5.1 - Bellfield Interchange turning movement count locations

These turning movement counts indicated the following peak hour periods:

- 07:45 – 08:45 AM Peak; and

- 16:45 – 17:45 PM Peak.

The 07:45 – 08:45 AM peak hour survey data indicated 4,026 vehicle movements at the Bellfield Interchange while the hour prior to this and after this had 3,500 and 3,324 vehicle movements respectively.

The 16:45 – 17:45 PM peak hour survey data indicated 4,161 vehicle movements at the Bellfield Interchange while the hour prior to this and after this had 3,991 and 3,449 vehicle movements respectively.

5.1.2. TomTom Journey Time Data

Journey time data through the Bellfield Interchange in hourly intervals based on the three month period from March to June 2019 was acquired from TomTom. In total six journey time routes incorporating each approach arm of the junction, a U-turn of the roundabout and returning along the same arm were recorded (i.e. A77 North, U-turn at Bellfield then back to the A77 North).

5.2. Modelling Approach

Two base models were developed using PTV's VISSIM micro-simulation software for the weekday AM and PM peak periods. These models will be utilised to assess the impact of a number of proposed scenarios to better understand the likely traffic impacts to the Bellfield Interchange during each of the AM and PM peak periods.

VISSIM microsimulation software models each vehicle individually, including driver behaviour characteristics, and provides a visual representation of the interaction between vehicles, assisting in the assessment of the road network operation and model calibration. PTV's VISSIM Version 2021 (SP 09) has been used. It was considered that this modelling appraisal would enable a comprehensive assessment of the various transport issues to be considered at the Bellfield Interchange.

5.3. Base Modelling

The base year models are representative of traffic flow in the morning and evening peak periods for June 2019. The two base models simulate the following peak time periods:

- 07:45 – 08:45 AM weekday peak period (Thursday 20 June 2019); and
- 16:45 – 17:45 PM weekday peak period (Wednesday 19 June 2019).

The periods were selected based on the busiest hour identified from the classified junction counts provided by EAC.

A warm up and cool down period, fifteen minutes before and after each peak hour, has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the road before and after the evaluated single peak hour time periods.

5.4. Model Development

A transport model in VISSIM consists of transport supply and travel demand data. Transport supply data is represented in a network model, which includes the following network objects that can be modified interactively:

- **Links**: Links represent single or multi-lane carriageways with a specified direction of flow.
- **Connectors**: These are used to provide continuous routes between links. In order to join links together connectors are used to construct junctions and changes in road layout.
- **Vehicle Inputs**: Define the total number of vehicles which enter the network on a link (at the extremities of the model), for each defined time period. There are nine zones where vehicles enter and exit the Bellfield Interchange model.
- **Priority Rules**: Define rights of way at non-signalised junctions. Includes gap acceptance information which can be adjusted based on observed driver behaviour.
- **Desired Speed Decision**: Dictates the speed at which a vehicle wishes to travel at.
- **Reduced Speed Areas**: Dictates the speed at which the vehicle will travel at. These are used to model short areas of speed change for example on the approach to give-way junctions and at sharp bends.

- **Vehicle Classes**: Categorise the vehicle types used in the model. The vehicle classes used include light vehicles (Car and LGV) and heavy vehicles (OGV1, OGV2 and Bus). All vehicles were input to the models using vehicle volumes in 15-minute time intervals.
- **Matrix Development**: Each of the VISSIM models are static models that have used Vehicle Inputs and Static Routing Decisions which were used to calibrate the model based on the turning movements for the junction(s) contained in the model. The models are therefore not dynamic assignment, and so no matrices have been developed.
- **Parameters**: The following model parameters have been used:
  - Average standstill distance of 2.00m
  - Additive part of safety distance of 2.00
  - Multiplic. part of safety distance of 3.00

During the development stage of the network the VISSIM background mapping facility (i.e. Bing maps) was used to replicate a detailed account of the existing road layout in VISSIM. Junction layouts and markings were obtained from the in-built background mapping, on site observations and aerial photography.

Speed limits and road restrictions were gathered from site visits and online photography. Where appropriate, vehicle speeds have been restricted to ensure that the model replicates observed on site behaviour.

A full extent of the Bellfield Interchange VISSIM model is shown below in Figure 5.2.

Figure 5.2 - Bellfield Interchange model extents

5.5. Base Model Calibration and Validation Results

Model calibration is defined within DMRB as:

Adjusting the parameters used in the various mathematical relationships within the model to reflect the data as well as is necessary to satisfy the model objectives.

The calibration of the AM and PM Bellfield Interchange base models was focused on the comparison of the turning movement counts and a review of the model network and driver behaviour.

Model validation is an essential part of the development of a base year model. Validation acts as a confirmation of the ability of the model to represent the current traffic conditions and patterns in the modelled area. A successfully validated base model substantiates the model as a robust tool for future scheme assessments allowing for proposed transport scenarios to be tested.

Previously, modelling guidelines have indicated that 85% of modelled flows and turning movements should have a GEH of less than 5.0. The GEH value is in the form of a Chi-squared statistic and incorporates both relative and absolute errors, giving an overall measure of the accuracy of the model. The formula for the statistic is presented below:

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

M = Modelled Flow
C = Observed Flow

Guideline requirements in TAG Unit M3.1 state that the modelled flows should be within one of the three parameters below for more than 85% of cases;

- Individual flows within 100 vph of counts for flows less than 700 vph;
- Individual flows within 15% of counts for flows from 700 to 2,700 vph; or
- Individual flows within 400 vph of counts for flows more than 2,700 vph.

The following calibration and validation results are based on an average of ten runs, with different random seeds, ensuring that daily variation in vehicle arrival times were replicated.

TAG Unit M3.1 sets out the criteria and acceptability guidelines for the use of journey times to validate a base model. The preferred measure for journey time validation is the percentage difference between modelled and observed journey times. The modelled journey times should be within 15% of the observed journey times (or within one minute if higher than 15%) for more than 85% of all routes.

5.5.1. Turning Movement Counts – (Calibration Results)

Turning movement count surveys from four junctions have been utilised in the development of the Bellfield Interchange VISSIM model. These four junctions are:

- J1 – Bellfield Interchange (six arm priority roundabout);
- J2 – A735 Queen’s Drive / B7072 (three arm priority roundabout);
- J3 – A71 Riccarton Road / Service Access North (three arm priority junction); and
- J4 – A76 / Service Access South (three arm priority junction).

The four junctions were surveyed for a 24 hour period from noon on Wednesday 19 June to noon on Thursday 20 June 2019. This turning movement count data was provided by EAC.

Observed turning movement counts at the four junctions in the network have been compared against the base model turning movement counts.

Table 4.1 to

Table 4.2 below illustrate the full turning movement flow and GEH statistic results for the AM and PM base model simulations. In each case all the turning movements are within the modelling guidelines criteria **(100% *'Pass'* rate)**. This indicates that the base models have been well calibrated and reflect a good representation of the volume of throughput currently experienced at the Bellfield Interchange during the AM and PM peak periods.

Table 5.1 - AM Base Model Turning Movement Count Calibration Results

	AM Peak 0745 - 0845 (Thu 20 June 2019)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	**Obs**	CAR	LGV	OGV1	OGV2	Bus	**Mod**	**Total**	**Total**	**GEH**	**Flow**	**GEH < 5**
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A77 North to A71 Riccarton Road	62	32	4	3	1	102	58	33	4	3	1	99	**-3**	**-3%**	0.3	Pass	Pass
	A to C	A77 North to A76	175	38	3	10	2	228	174	42	4	10	2	232	**4**	**2%**	0.3	Pass	Pass
	A to D	A77 North to A77 South	4	1	2	0	0	7	4	1	2	0	0	7	**0**	**0%**	0.0	Pass	Pass
	A to E	A77 North to A71 Hurlford Road	476	72	17	25	1	591	432	64	17	24	1	538	**-53**	**-9%**	2.2	Pass	Pass
	A to F	A77 North to A735 Queen's Drive	187	50	4	2	1	244	174	47	4	3	0	228	**-16**	**-7%**	1.0	Pass	Pass
	A to A	A77 North to A77 North	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J1 Arm B	B to C	A71 Riccarton Road to A76	1	0	1	0	0	2	1	0	2	0	1	4	**2**	**100%**	1.2	Pass	Pass
	B to D	A71 Riccarton Road to A77 South	94	13	2	3	0	112	83	14	1	3	0	101	**-11**	**-10%**	1.1	Pass	Pass
	B to E	A71 Riccarton Road to A71 Hurlford Road	210	59	9	17	1	296	192	61	9	17	1	280	**-16**	**-5%**	0.9	Pass	Pass
	B to F	A71 Riccarton Road to A735 Queen's Drive	121	20	11	1	1	154	121	20	7	0	0	148	**-6**	**-4%**	0.5	Pass	Pass
	B to A	A71 Riccarton Road to A77 North	45	9	3	8	0	65	43	9	4	9	0	65	**0**	**0%**	0.0	Pass	Pass
	B to B	A71 Riccarton Road to A71 Riccarton Road	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J1 Arm C	C to D	A76 to A77 South	14	4	0	1	0	19	16	4	0	0	0	20	**1**	**5%**	0.2	Pass	Pass
	C to E	A76 to A71 Hurlford Road	221	42	8	10	0	281	211	45	9	14	0	279	**-2**	**-1%**	0.1	Pass	Pass
	C to F	A76 to A735 Queen's Drive	47	7	0	0	5	59	45	9	0	0	4	58	**-1**	**-2%**	0.1	Pass	Pass
	C to A	A76 to A77 North	69	19	6	10	0	104	73	19	4	6	0	102	**-2**	**-2%**	0.2	Pass	Pass
	C to B	A76 to A71 Riccarton Road	1	1	1	0	0	3	1	1	1	0	0	3	**0**	**0%**	0.0	Pass	Pass
	C to C	A76 to A76	0	0	0	1	0	1	0	0	0	0	0	0	**-1**	**0%**	1.4	Pass	Pass
J1 Arm D	D to E	A77 South to A71 Hurlford Road	23	2	0	0	0	25	22	1	0	0	0	23	**-2**	**-8%**	0.4	Pass	Pass
	D to F	A77 South to A735 Queen's Drive	99	1	2	1	2	105	97	0	2	1	2	102	**-3**	**-3%**	0.3	Pass	Pass
	D to A	A77 South to A77 North	1	0	0	0	0	1	1	0	0	0	0	1	**0**	**0%**	0.0	Pass	Pass
	D to B	A77 South to A71 Riccarton Road	64	10	5	6	1	86	61	13	4	7	1	86	**0**	**0%**	0.0	Pass	Pass
	D to C	A77 South to A76	12	2	0	1	0	15	12	2	0	1	0	15	**0**	**0%**	0.0	Pass	Pass
	D to D	A77 South to A77 South	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J1 Arm E	E to F	A71 Hurlford Road to A735 Queen's Drive	58	9	4	0	1	72	61	12	2	0	0	75	**3**	**4%**	0.3	Pass	Pass
	E to A	A71 Hurlford Road to A77 North	354	71	14	34	3	476	363	83	13	34	4	497	**21**	**4%**	1.0	Pass	Pass
	E to B	A71 Hurlford Road to A71 Riccarton Road	72	33	11	8	0	124	75	27	11	6	0	119	**-5**	**-4%**	0.5	Pass	Pass
	E to C	A71 Hurlford Road to A76	91	17	2	5	0	115	94	12	2	8	0	116	**1**	**1%**	0.1	Pass	Pass
	E to D	A71 Hurlford Road to A77 South	58	1	3	0	0	62	58	2	5	0	0	65	**3**	**5%**	0.4	Pass	Pass
	E to E	A71 Hurlford Road to A71 Hurlford Road	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J1 Arm F	F to A	A735 Queen's Drive to A77 North	228	63	4	8	4	307	233	65	7	7	3	315	**8**	**3%**	0.5	Pass	Pass
	F to B	A735 Queen's Drive to A71 Riccarton Road	145	44	8	1	1	199	141	44	8	2	0	195	**-4**	**-2%**	0.3	Pass	Pass
	F to C	A735 Queen's Drive to A76	64	11	8	1	2	86	66	11	8	1	3	89	**3**	**3%**	0.3	Pass	Pass
	F to D	A735 Queen's Drive to A77 South	44	9	3	0	1	57	43	8	1	0	0	52	**-5**	**-9%**	0.7	Pass	Pass
	F to E	A735 Queen's Drive to A71 Hurlford Road	22	4	1	1	0	28	21	4	2	1	0	28	**0**	**0%**	0.0	Pass	Pass
	F to F	A735 Queen's Drive to A735 Queen's Drive	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J2 Arm A	A to B	A735 Queen's Drive (E) to B7072	156	40	8	2	1	207	151	31	8	3	2	195	**-12**	**-6%**	0.8	Pass	Pass
	A to C	A735 Queen's Drive (E) to A735 Queen's Drive (W)	353	56	13	2	9	433	347	47	15	2	4	415	**-18**	**-4%**	0.9	Pass	Pass
	A to A	A735 Queen's Drive (E) to A735 Queen's Drive (E)	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J2 Arm B	B to C	B7072 to A735 Queen's Drive (W)	125	18	2	0	3	148	126	12	1	0	2	141	**-7**	**-5%**	0.6	Pass	Pass
	B to A	B7072 to A735 Queen's Drive (E)	269	64	10	5	4	352	264	71	13	5	4	357	**5**	**1%**	0.3	Pass	Pass
	B to B	B7072 to B7072	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J2 Arm C	C to A	A735 Queen's Drive (W) to A735 Queen's Drive (E)	242	63	14	6	4	329	239	62	14	5	2	322	**-7**	**-2%**	0.4	Pass	Pass
	C to B	A735 Queen's Drive (W) to B7072	79	9	0	0	4	92	76	8	0	0	7	91	**-1**	**-1%**	0.1	Pass	Pass
	C to C	A735 Queen's Drive (W) to A735 Queen's Drive (W)	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0%**	0.0	Pass	Pass
J3 Arm B	B to C	A71 Riccarton Road (E) to Service Access	18	4	0	1	1	24	16	10	0	1	2	29	**5**	**21%**	1.0	Pass	Pass
	B to D	A71 Riccarton Road (E) to A71 Riccarton Road (W)	374	74	21	20	1	490	346	66	20	20	0	452	**-38**	**-8%**	1.8	Pass	Pass
J3 Arm C	C to D	Service Access to A71 Riccarton Road (W)	94	29	4	11	1	139	93	31	5	10	1	140	**1**	**1%**	0.1	Pass	Pass
	C to B	Service Access to A71 Riccarton Road (E)	15	6	1	0	0	22	15	7	0	0	0	22	**0**	**0%**	0.0	Pass	Pass
J3 Arm D	D to B	A71 Riccarton Road (W) to A71 Riccarton Road (E)	268	77	14	15	4	378	266	82	15	14	2	379	**1**	**0%**	0.1	Pass	Pass
	D to C	A71 Riccarton Road (W) to Service Access	71	34	10	5	0	120	70	30	14	4	0	118	**-2**	**-2%**	0.2	Pass	Pass
J4 Arm A	A to B	Service Access to A76 (E)	27	9	4	0	0	40	28	9	4	0	0	41	**1**	**3%**	0.2	Pass	Pass
	A to C	Service Access to A76 (W)	14	7	1	0	0	22	13	6	1	0	0	20	**-2**	**-9%**	0.4	Pass	Pass
J4 Arm B	B to C	A76 (E) to A76 (W)	331	65	15	24	5	440	332	72	13	21	4	442	**2**	**0%**	0.1	Pass	Pass
	B to A	A76 (E) to Service Access	45	11	1	5	0	62	45	4	1	8	1	59	**-3**	**-5%**	0.4	Pass	Pass
J4 Arm C	C to A	A76 (W) to Service Access	13	4	1	0	0	18	15	3	0	0	0	18	**0**	**0%**	0.0	Pass	Pass
	C to B	A76 (W) to A76 (E)	332	67	14	20	4	437	332	70	14	15	4	435	**-2**	**0%**	0.1	Pass	Pass
			5888	1281	269	273	68	7779	5750	1274	271	265	58	7618	**-161**				
			7169		542		68		7024		536		58						

Table 5.2 - PM Base Model Turning Movement Count Calibration Results

	PM Peak 1645 – 1745 (Wed 19 June 2019)		Observed Flow						Modelled Flow							Difference (num)	Difference (%)		Pass / Fail	
	Movement	Road Names	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1 Arm A	A to B	A77 North to A71 Riccarton Road	81	19	3	0	0	103	75	21	3	0	0	99	-4	-4%	0.4	Pass	Pass
	A to C	A77 North to A76	151	64	2	4	0	221	151	66	2	5	0	224	3	1%	0.2	Pass	Pass
	A to D	A77 North to A77 South	12	0	0	0	0	12	10	0	0	0	0	10	-2	-17%	0.6	Pass	Pass
	A to E	A77 North to A71 Hurlford Road	323	49	11	14	0	397	302	45	10	14	0	371	-26	-7%	1.3	Pass	Pass
	A to F	A77 North to A735 Queen's Drive	222	33	3	1	0	259	207	30	3	1	0	241	-18	-7%	1.1	Pass	Pass
	A to A	A77 North to A77 North	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm B	B to C	A71 Riccarton Road to A76	1	0	0	0	0	1	2	0	0	1	1	4	3	300%	1.9	Pass	Pass
	B to D	A71 Riccarton Road to A77 South	74	6	1	4	0	85	72	7	1	2	0	82	-3	-4%	0.3	Pass	Pass
	B to E	A71 Riccarton Road to A71 Hurlford Road	146	28	1	1	0	176	132	32	0	1	0	165	-11	-6%	0.8	Pass	Pass
	B to F	A71 Riccarton Road to A735 Queen's Drive	217	24	5	0	0	246	223	26	4	0	0	253	7	3%	0.4	Pass	Pass
	B to A	A71 Riccarton Road to A77 North	23	9	1	1	0	34	23	9	1	1	0	34	0	0%	0.0	Pass	Pass
	B to B	A71 Riccarton Road to A71 Riccarton Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm C	C to D	A76 to A77 South	32	1	0	1	0	34	32	1	0	1	0	34	0	0%	0.0	Pass	Pass
	C to E	A76 to A71 Hurlford Road	134	18	2	4	0	158	131	19	2	4	0	156	-2	-1%	0.2	Pass	Pass
	C to F	A76 to A735 Queen's Drive	83	7	2	1	2	95	86	8	1	1	2	98	3	3%	0.3	Pass	Pass
	C to A	A76 to A77 North	186	31	5	10	0	232	189	35	5	12	0	241	9	4%	0.6	Pass	Pass
	C to B	A76 to A71 Riccarton Road	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
	C to C	A76 to A76	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm D	D to E	A77 South to A71 Hurlford Road	15	1	1	0	0	17	15	1	1	0	0	17	0	0%	0.0	Pass	Pass
	D to F	A77 South to A735 Queen's Drive	88	6	1	0	2	97	90	6	1	0	2	99	2	2%	0.2	Pass	Pass
	D to A	A77 South to A77 North	3	0	0	0	0	3	4	0	0	0	0	4	1	33%	0.5	Pass	Pass
	D to B	A77 South to A71 Riccarton Road	75	15	2	1	0	93	72	16	2	1	0	91	-2	-2%	0.2	Pass	Pass
	D to C	A77 South to A76	9	1	0	0	0	10	9	1	0	0	0	10	0	0%	0.0	Pass	Pass
	D to D	A77 South to A77 South	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm E	E to F	A71 Hurlford Road to A735 Queen's Drive	45	7	2	1	0	55	46	7	1	0	0	54	-1	-2%	0.1	Pass	Pass
	E to A	A71 Hurlford Road to A77 North	417	57	9	14	0	497	348	61	8	14	0	431	-66	-13%	3.1	Pass	Pass
	E to B	A71 Hurlford Road to A71 Riccarton Road	98	16	1	2	0	117	94	16	2	3	0	115	-2	-2%	0.2	Pass	Pass
	E to C	A71 Hurlford Road to A76	252	15	4	7	0	278	254	16	5	7	0	282	4	1%	0.2	Pass	Pass
	E to D	A71 Hurlford Road to A77 South	27	2	0	0	0	29	25	2	0	0	0	27	-2	-7%	0.4	Pass	Pass
	E to E	A71 Hurlford Road to A71 Hurlford Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J1 Arm F	F to A	A735 Queen's Drive to A77 North	246	32	9	1	0	288	225	31	8	1	0	265	-23	-8%	1.4	Pass	Pass
	F to B	A735 Queen's Drive to A71 Riccarton Road	350	26	3	0	1	380	315	26	3	0	1	345	-35	-9%	1.8	Pass	Pass
	F to C	A735 Queen's Drive to A76	104	17	0	1	1	123	93	17	0	1	0	111	-12	-10%	1.1	Pass	Pass
	F to D	A735 Queen's Drive to A77 South	71	3	0	0	3	77	65	2	0	0	3	70	-7	-9%	0.8	Pass	Pass
	F to E	A735 Queen's Drive to A71 Hurlford Road	40	3	0	0	0	43	34	2	0	0	0	36	-7	-16%	1.1	Pass	Pass
	F to F	A735 Queen's Drive to A735 Queen's Drive	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm A	A to B	A735 Queen's Drive (E) to B7072	235	47	5	1	0	288	232	46	7	1	0	286	-2	-1%	0.1	Pass	Pass
	A to C	A735 Queen's Drive (E) to A735 Queen's Drive (W)	426	32	6	2	5	471	420	31	4	1	4	460	-11	-2%	0.5	Pass	Pass
	A to A	A735 Queen's Drive (E) to A735 Queen's Drive (E)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J2 Arm B	B to C	B7072 to A735 Queen's Drive (W)	171	16	1	1	3	192	170	15	1	1	3	190	-2	-1%	0.1	Pass	Pass
	B to A	B7072 to A735 Queen's Drive (E)	275	44	6	2	0	327	273	45	6	2	0	326	-1	0%	0.1	Pass	Pass
	B to B	B7072 to B7072	1	0	0	0	0	1	1	0	0	0	0	1	0	0%	0.0	Pass	Pass
J2 Arm C	C to A	A735 Queen's Drive (W) to A735 Queen's Drive (E)	530	38	6	0	5	579	465	33	5	0	4	507	-72	-12%	3.1	Pass	Pass
	C to B	A735 Queen's Drive (W) to B7072	250	26	1	1	3	281	219	23	1	1	4	248	-33	-12%	2.0	Pass	Pass
	C to C	A735 Queen's Drive (W) to A735 Queen's Drive (W)	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0.0	Pass	Pass
J3 Arm B	B to C	A71 Riccarton Road (E) to Service Access	51	10	0	0	0	61	50	11	0	0	0	61	0	0%	0.0	Pass	Pass
	B to D	A71 Riccarton Road (E) to A71 Riccarton Road (W)	386	58	5	6	1	456	384	58	5	6	1	454	-2	0%	0.1	Pass	Pass
J3 Arm C	C to D	Service Access to A71 Riccarton Road (W)	72	14	1	0	0	87	71	14	1	0	0	86	-1	-1%	0.1	Pass	Pass
	C to B	Service Access to A71 Riccarton Road (E)	31	7	0	1	0	39	32	7	0	1	0	40	1	3%	0.2	Pass	Pass
J3 Arm D	D to B	A71 Riccarton Road (W) to A71 Riccarton Road (E)	513	70	10	3	1	597	470	72	9	4	1	556	-41	-7%	1.7	Pass	Pass
	D to C	A71 Riccarton Road (W) to Service Access	95	8	1	0	0	104	87	7	1	0	0	95	-9	-9%	0.9	Pass	Pass
J4 Arm A	A to B	Service Access to A76 (E)	55	12	0	0	0	67	55	12	0	0	0	67	0	0%	0.0	Pass	Pass
	A to C	Service Access to A76 (W)	29	3	0	2	0	34	29	3	0	2	0	34	0	0%	0.0	Pass	Pass
J4 Arm B	B to C	A76 (E) to A76 (W)	409	55	8	16	2	490	410	59	8	16	2	495	5	1%	0.2	Pass	Pass
	B to A	A76 (E) to Service Access	36	7	0	1	0	44	34	6	0	1	0	41	-3	-7%	0.5	Pass	Pass
J4 Arm C	C to A	A76 (W) to Service Access	20	4	0	1	0	25	18	4	0	2	1	25	0	0%	0.0	Pass	Pass
	C to B	A76 (W) to A76 (E)	497	95	8	11	1	612	491	95	7	11	0	604	-8	-1%	0.3	Pass	Pass
			7608	1036	126	116	30	8916	7236	1044	118	119	29	8546	-370				
			8644		242		30		8280		237		29						

5.5.2. Link Flows – (Calibration Results)

Observed link flows from each arm of the four junctions in the network have been compared against the base model link flows. Table 5.3 to Table 5.4 below illustrate the link flow and GEH statistic results for the AM and PM base model simulations. In each case all the link flows are within the modelling guidelines criteria **(100% *'Pass'* rate)**.

Table 5.3 - AM Base Model Link Flow Calibration Results

	AM Peak 0745 – 0845 (Thu 20 June 2019)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A77 North	904	193	30	40	5	1172	842	187	31	40	4	1104	-68	-6%	2.0	Pass	Pass
	Arm B	A71 Riccarton Road	471	101	26	29	2	629	440	104	23	29	2	598	-31	-5%	1.3	Pass	Pass
	Arm C	A76	352	73	15	22	5	467	346	78	14	20	4	462	-5	-1%	0.2	Pass	Pass
	Arm D	A77 South	199	15	7	8	3	232	193	16	6	9	3	227	-5	-2%	0.3	Pass	Pass
	Arm E	A71 Hurlford Road	633	131	34	47	4	849	651	136	33	48	4	872	23	3%	0.8	Pass	Pass
	Arm F	A735 Queen's Drive	503	131	24	11	8	677	504	132	26	11	6	679	2	0%	0.1	Pass	Pass
J2	Arm A	A735 Queen's Drive (E)	509	96	21	4	10	640	498	78	23	5	6	610	-30	-5%	1.2	Pass	Pass
	Arm B	B7072	394	82	12	5	7	500	390	83	14	5	6	498	-2	0%	0.1	Pass	Pass
	Arm C	A735 Queen's Drive (W)	321	72	14	6	8	421	315	70	14	5	9	413	-8	-2%	0.4	Pass	Pass
J3	Arm B	A71 Riccarton Road (E)	392	78	21	21	2	514	362	76	20	21	2	481	-33	-6%	1.5	Pass	Pass
	Arm C	Service Access	109	35	5	11	1	161	108	38	5	10	1	162	1	1%	0.1	Pass	Pass
	Arm D	A71 Riccarton Road (W)	339	111	24	20	4	498	336	112	29	18	2	497	-1	0%	0.0	Pass	Pass
J4	Arm A	Service Access	41	16	5	0	0	62	41	15	5	0	0	61	-1	-2%	0.1	Pass	Pass
	Arm B	A76 (E)	376	76	16	29	5	502	377	76	14	29	5	501	-1	0%	0.0	Pass	Pass
	Arm C	A76 (W)	345	71	15	20	4	455	347	73	14	15	4	453	-2	0%	0.1	Pass	Pass

Table 5.4 - PM Base Model Link Flow Calibration Results

	PM Peak 1645 – 1745 (Wed 19 June 2019)		Observed Flow						Modelled Flow						Difference (num)	Difference (%)		Pass / Fail	
	Arm	Road Name	CAR	LGV	OGV1	OGV2	BUS	Obs	CAR	LGV	OGV1	OGV2	Bus	Mod	Total	Total	GEH	Flow	GEH < 5
			Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)		Vehs(10)	Vehs(15)	Vehs(16)	Vehs(17)	Vehs(30)						
J1	Arm A	A77 North	789	165	19	19	0	992	745	162	18	20	0	945	-47	-5%	1.5	Pass	Pass
	Arm B	A71 Riccarton Road	461	67	8	6	0	542	452	74	6	5	1	538	-4	-1%	0.2	Pass	Pass
	Arm C	A76	436	57	9	16	2	520	439	63	8	18	2	530	10	2%	0.4	Pass	Pass
	Arm D	A77 South	190	23	4	1	2	220	190	24	4	1	2	221	1	0%	0.1	Pass	Pass
	Arm E	A71 Hurlford Road	839	97	16	24	0	976	767	102	16	24	0	909	-67	-7%	2.2	Pass	Pass
	Arm F	A735 Queen's Drive	811	81	12	2	5	911	732	78	11	2	4	827	-84	-9%	2.8	Pass	Pass
J2	Arm A	A735 Queen's Drive (E)	661	79	11	3	5	759	652	77	11	2	4	746	-13	-2%	0.5	Pass	Pass
	Arm B	B7072	447	60	7	3	3	520	444	60	7	3	3	517	-3	-1%	0.1	Pass	Pass
	Arm C	A735 Queen's Drive (W)	780	64	7	1	8	860	684	56	6	1	8	755	-105	-12%	3.7	Pass	Pass
J3	Arm B	A71 Riccarton Road (E)	437	68	5	6	1	517	434	69	5	6	1	515	-2	0%	0.1	Pass	Pass
	Arm C	Service Access	103	21	1	1	0	126	103	21	1	1	0	126	0	0%	0.0	Pass	Pass
	Arm D	A71 Riccarton Road (W)	608	78	11	3	1	701	557	79	10	4	1	651	-50	-7%	1.9	Pass	Pass
J4	Arm A	Service Access	84	15	0	2	0	101	84	15	0	2	0	101	0	0%	0.0	Pass	Pass
	Arm B	A76 (E)	445	62	8	17	2	534	444	65	8	17	2	536	2	0%	0.1	Pass	Pass
	Arm C	A76 (W)	517	99	8	12	1	637	509	99	7	13	1	629	-8	-1%	0.3	Pass	Pass

5.5.3. Journey Times – (Validation Results)

Base model journey times have been compared to the observed journey times which were obtained from TomTom for the period March to June 2019. The TomTom data used for model validation was for Tuesdays, Wednesdays and Thursdays. This TomTom data was provided by EAC.

In total, 16 journey time routes were acquired from TomTom which are illustrated in Figure 5.3 below. Eight journey times routes (green) are associated with travel to and from the A77 North. Four of these routes begin at the A77 North and travel to the A71 East, A76, A71 West and A735 Queen's Drive. While four routes represent the inverse in which they begin at the A71 East, A76, A71 West and A735 Queen's Drive on route to the A77 North. The same methodology was applied to the eight journey time routes (red) that are associated with travel to and from the A77 South.

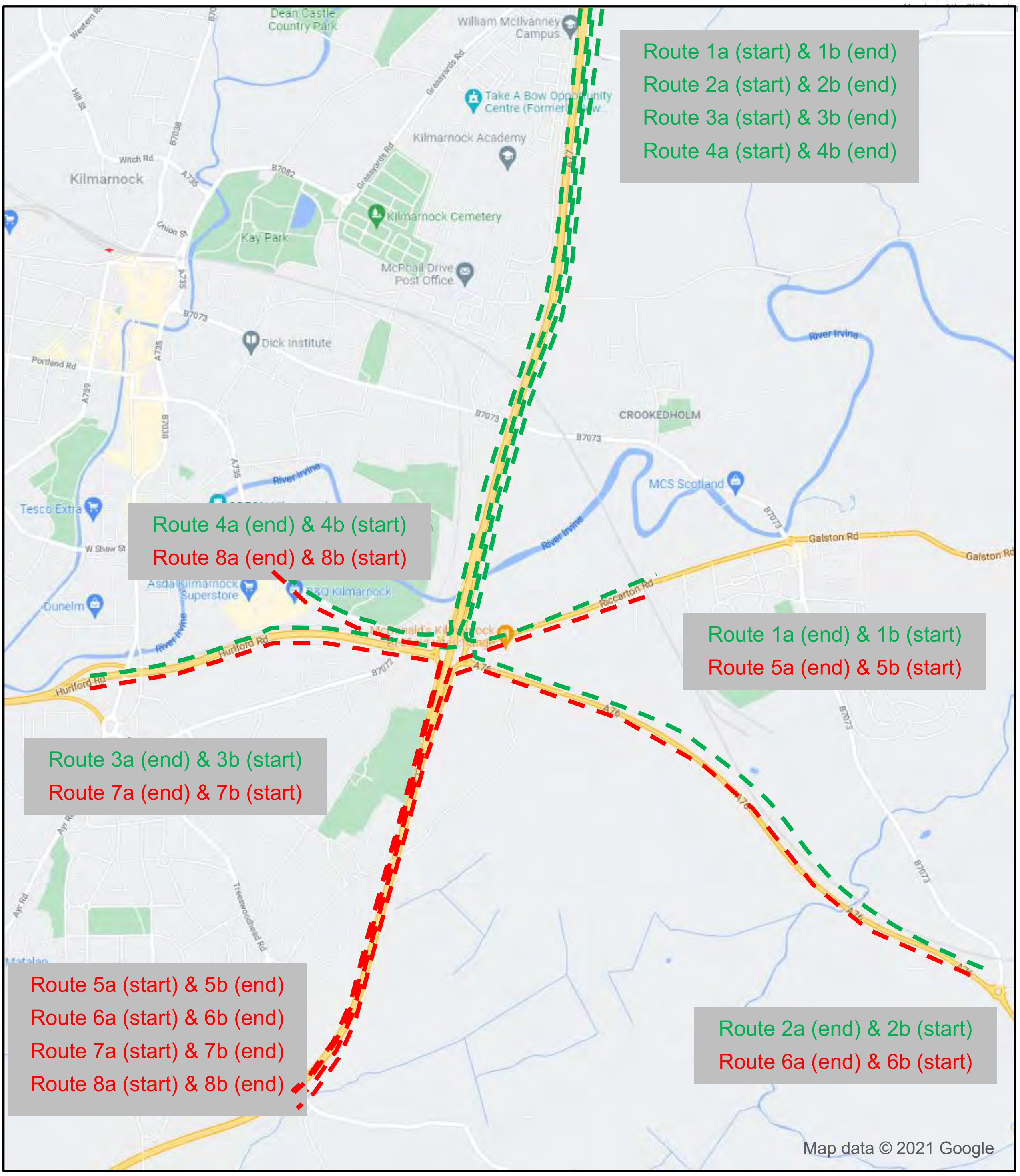


Figure 5.3 - TomTom Journey Time Routes 1a & 1b to 8a & 8b

The six recorded TomTom routes each accounted for the related approach to the Bellfield Interchange, a U-turn at the roundabout and then returning to the section of the same road adjacent to the starting point. These were deemed unusual journey times to record as U-turning movements at junctions are often the least representative, reflected by the fact that the observed turning movement counts indicated just one U-turning vehicle during the AM peak hour and none during the PM peak hour. Therefore, the journey time validation was undertaken by combined the junction entry route of one tourney time with the junction exit route of another. This created 8 two way journey time routes (four starting and ending at the A77 North and four at the A77 South). In affect 16 journey time routes were utilised in the validation of the Bellfield Interchange model as

illustrated in

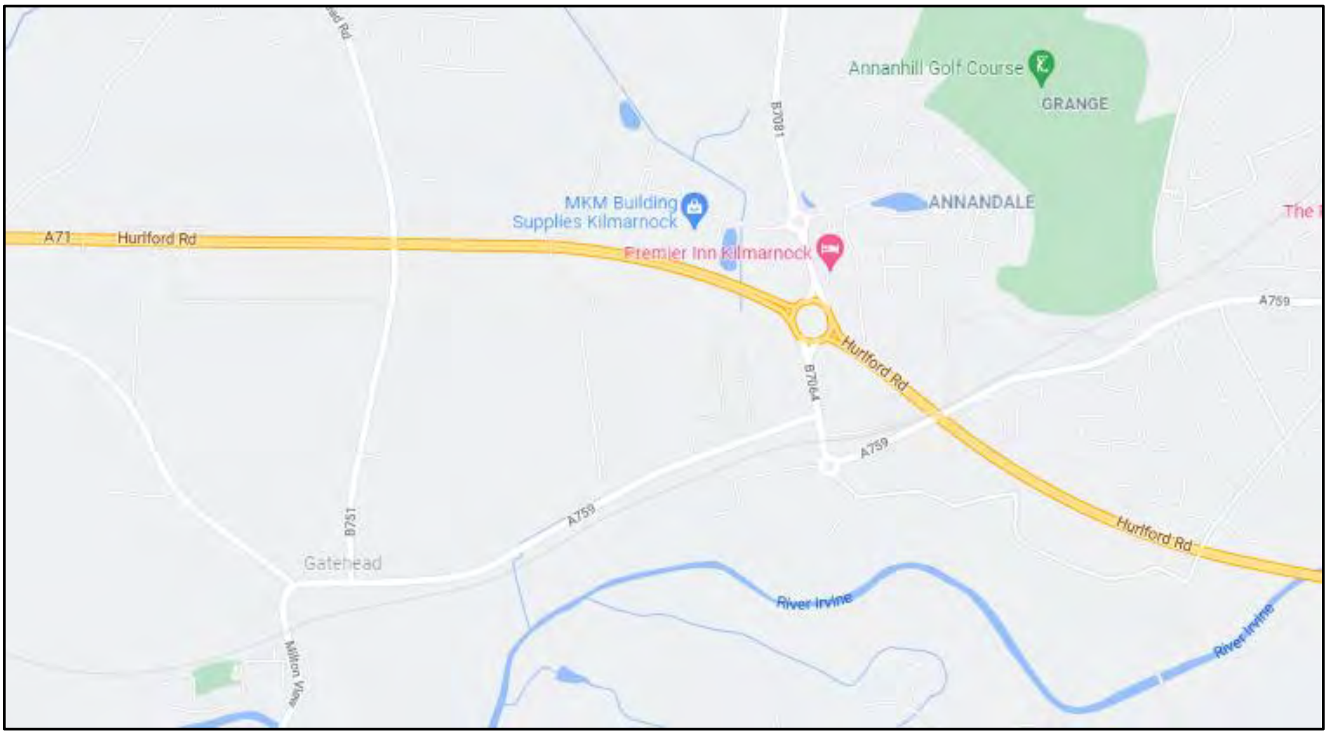


Figure 4.5Figure 5.3. Each route was split into three sub-sections to account for the approach to the Bellfield Interchange, the circulatory of the roundabout and the exit from the junction.

As detailed in Table 5.5 and Table 5.6 the observed TomTom routes have been compared against the modelled journey time outputs for the AM and PM peak hour periods.

In each case all the journey times are within 15% (or one minute if higher) demonstrating that the base models have been suitably validated **(100% *'Pass'* rate)**.

Table 5.5 - AM Base Model Journey Time Validation Results

	AM Peak 0800 - 0900		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No	Route Name	metres	mins	mins	secs	%	%
AM Routes	1a	A77 (N) to stopline	2515	02:43	02:14	-28	-17%	
		Bellfield roundabout	13	00:02	00:01	0	-27%	
		A71 (E) exit	771	00:53	00:56	3	5%	
		A77 (N) to A71 (E)	**3298**	**03:38**	**03:12**	**-26**	**-12%**	**Pass**
	1b	A71 (E) to stopline	795	02:55	03:15	19	11%	
		Bellfield roundabout	311	00:30	00:29	-1	-4%	
		A77 (N) exit	2458	01:35	01:29	-6	-6%	
		A71 (E) to A77 (N)	**3564**	**05:00**	**05:12**	**13**	**4%**	**Pass**
	2a	A77 (N) to stopline	2515	02:43	02:14	-28	-17%	
		Bellfield roundabout	80	00:09	00:06	-2	-27%	
		A76 exit	2387	01:51	01:49	-2	-2%	
		A77 (N) to A76	**4982**	**04:42**	**04:10**	**-32**	**-11%**	**Pass**
	2b	A76 to stopline	2430	03:31	04:08	37	17%	
		Bellfield roundabout	239	00:23	00:21	-2	-7%	
		A77 (N) exit	2458	01:35	01:29	-6	-6%	
		A76 to A77 (N)	**5128**	**05:29**	**05:58**	**30**	**9%**	**Pass**
	3a	A77 (N) to stopline	2515	02:43	02:14	-28	-17%	
		Bellfield roundabout	233	00:23	00:21	-2	-8%	
		A71 Hurlford Road exit	1457	01:09	01:14	6	8%	
		A77 (N) to A71 Hurlford R	**4205**	**04:14**	**03:50**	**-24**	**-10%**	**Pass**
	3b	A71 Hurlford Road to stopline	1463	01:33	02:02	28	30%	
		Bellfield roundabout	84	00:08	00:08	0	-1%	
		A77 (N) exit	2458	01:35	01:29	-6	-6%	
		A71 Hurlford Road to A77	**4006**	**03:16**	**03:39**	**23**	**12%**	**Pass**
	4a	A77 (N) to stopline	2515	02:43	02:14	-28	-17%	
		Bellfield roundabout	296	00:29	00:26	-4	-13%	
		A735 Queen's Drive exit	724	01:05	00:58	-7	-11%	
		A77 (N) to A735 Queen's D	**3535**	**04:17**	**03:38**	**-39**	**-15%**	**Pass**
	4b	Queen's Drive to stopline	719	01:23	01:16	-7	-8%	
		Bellfield roundabout	14	00:01	00:02	0	23%	
		A77 (N) exit	2458	01:35	01:29	-6	-6%	
		A735 Queen's Drive to A77	**3190**	**02:59**	**02:46**	**-12**	**-7%**	**Pass**
	5a	A77 (S) to stopline	1857	01:32	01:45	13	14%	
		Bellfield roundabout	234	00:22	00:17	-5	-22%	
		A71 (E) exit	771	00:53	00:56	3	5%	
		A77 (S) to A71 (E)	**2862**	**02:48**	**02:58**	**10**	**6%**	**Pass**
	5b	A71 (E) to stopline	795	02:55	03:15	19	11%	
		Bellfield roundabout	94	00:09	00:09	-1	-5%	
		A77 (S) exit	2015	00:55	01:06	10	19%	
		A71 (E) to A77 (S)	**2904**	**04:00**	**04:29**	**29**	**12%**	**Pass**
	6a	A77 (S) to stopline	1857	01:32	01:45	13	14%	
		Bellfield roundabout	302	00:29	00:31	1	5%	
		A76 exit	2387	01:51	01:49	-2	-2%	
		A77 (S) to A76	**4546**	**03:52**	**04:04**	**12**	**5%**	**Pass**
	6b	A76 to stopline	2430	03:31	04:08	37	17%	
		Bellfield roundabout	22	00:02	00:02	0	-7%	
		A77 (S) exit	2015	00:55	01:06	10	19%	
		A76 to A77 (S)	**4468**	**04:29**	**05:16**	**47**	**17%**	**Pass**
	7a	A77 (S) to stopline	1857	01:32	01:45	13	14%	
		Bellfield roundabout	15	00:02	00:02	0	2%	
		A71 Hurlford Road exit	1457	01:09	01:14	6	8%	
		A77 (S) to A71 Hurlford R	**3329**	**02:42**	**03:01**	**18**	**11%**	**Pass**
	7b	A71 Hurlford Road to stopline	1463	01:33	02:02	28	30%	
		Bellfield roundabout	307	00:30	00:23	-6	-22%	
		A77 (S) exit	2015	00:55	01:06	10	19%	
		A71 Hurlford Road to A77	**3786**	**02:58**	**03:30**	**32**	**18%**	**Pass**
	8a	A77 (S) to stopline	1857	01:32	01:45	13	14%	
		Bellfield roundabout	78	00:08	00:07	-1	-7%	
		A735 Queen's Drive exit	724	01:05	00:58	-7	-11%	
		A77 (S) to A735 Queen's D	**2658**	**02:45**	**02:50**	**5**	**3%**	**Pass**
	8b	Queen's Drive to stopline	719	01:23	01:16	-7	-8%	
		Bellfield roundabout	228	00:35	00:19	-16	-46%	
		A77 (S) exit	2015	00:55	01:06	10	19%	
		A735 Queen's Drive to A77	**2962**	**02:52**	**02:40**	**-13**	**-7%**	**Pass**

Table 5.6 - PM Base Model Journey Time Validation Results

	PM Peak 1700 - 1800		Distance	Observed TomTom	Modelled Journey Time	Difference	Difference (%)	< 15%
	Route No	Route Name	metres	mins	mins	secs	%	%
PM Routes	1a	A77 (N) to stopline	2515	04:08	03:32	-36	-15%	
		Bellfield roundabout	13	00:02	00:01	0	-22%	
		A71 (E) exit	771	00:54	00:57	3	5%	
		A77 (N) to A71 (E)	**3298**	**05:04**	**04:30**	**-34**	**-11%**	**Pass**
	1b	A71 (E) to stopline	795	01:31	01:42	11	12%	
		Bellfield roundabout	311	00:29	00:29	0	-1%	
		A77 (N) exit	2458	01:33	01:28	-5	-5%	
		A71 (E) to A77 (N)	**3564**	**03:33**	**03:39**	**6**	**3%**	**Pass**
	2a	A77 (N) to stopline	2515	04:08	03:32	-36	-15%	
		Bellfield roundabout	80	00:09	00:06	-3	-34%	
		A76 exit	2387	01:53	01:44	-9	-8%	
		A77 (N) to A76	**4982**	**06:09**	**05:21**	**-48**	**-13%**	**Pass**
	2b	A76 to stopline	2430	02:40	02:12	-27	-17%	
		Bellfield roundabout	239	00:23	00:21	-1	-5%	
		A77 (N) exit	2458	01:33	01:28	-5	-5%	
		A76 to A77 (N)	**5128**	**04:35**	**04:02**	**-33**	**-12%**	**Pass**
	3a	A77 (N) to stopline	2515	04:08	03:32	-36	-15%	
		Bellfield roundabout	233	00:23	00:20	-3	-12%	
		A71 Hurlford Road exit	1457	01:09	01:13	5	7%	
		A77 (N) to A71 Hurlford R	**4205**	**05:39**	**05:05**	**-34**	**-10%**	**Pass**
	3b	A71 Hurlford Road to stopline	1463	04:23	04:38	15	6%	
		Bellfield roundabout	84	00:08	00:08	0	-1%	
		A77 (N) exit	2458	01:33	01:28	-5	-5%	
		A71 Hurlford Road to A77	**4006**	**06:04**	**06:14**	**10**	**3%**	**Pass**
	4a	A77 (N) to stopline	2515	04:08	03:32	-36	-15%	
		Bellfield roundabout	296	00:29	00:26	-3	-11%	
		A735 Queen's Drive exit	724	01:09	01:01	-8	-12%	
		A77 (N) to A735 Queen's I	**3535**	**05:46**	**04:58**	**-47**	**-14%**	**Pass**
	4b	Queen's Drive to stopline	719	03:11	03:50	39	20%	
		Bellfield roundabout	14	00:01	00:02	0	17%	
		A77 (N) exit	2458	01:33	01:28	-5	-5%	
		A735 Queen's Drive to A7	**3190**	**04:45**	**05:19**	**34**	**12%**	**Pass**
	5a	A77 (S) to stopline	1857	01:25	01:25	1	1%	
		Bellfield roundabout	234	00:23	00:18	-4	-19%	
		A71 (E) exit	771	00:54	00:57	3	5%	
		A77 (S) to A71 (E)	**2862**	**02:42**	**02:41**	**-1**	**0%**	**Pass**
	5b	A71 (E) to stopline	795	01:31	01:42	11	12%	
		Bellfield roundabout	94	00:09	00:08	-1	-11%	
		A77 (S) exit	2015	00:54	01:05	11	21%	
		A71 (E) to A77 (S)	**2904**	**02:34**	**02:55**	**21**	**14%**	**Pass**
	6a	A77 (S) to stopline	1857	01:25	01:25	1	1%	
		Bellfield roundabout	302	00:30	00:21	-9	-29%	
		A76 exit	2387	01:53	01:44	-9	-8%	
		A77 (S) to A76	**4546**	**03:47**	**03:30**	**-17**	**-7%**	**Pass**
	6b	A76 to stopline	2430	02:40	02:12	-27	-17%	
		Bellfield roundabout	22	00:02	00:02	0	-8%	
		A77 (S) exit	2015	00:54	01:05	11	21%	
		A76 to A77 (S)	**4468**	**03:36**	**03:20**	**-16**	**-8%**	**Pass**
	7a	A77 (S) to stopline	1857	01:25	01:25	1	1%	
		Bellfield roundabout	15	00:02	00:02	0	-3%	
		A71 Hurlford Road exit	1457	01:09	01:13	5	7%	
		A77 (S) to A71 Hurlford R	**3329**	**02:35**	**02:40**	**5**	**3%**	**Pass**
	7b	A71 Hurlford Road to stopline	1463	04:23	04:38	15	6%	
		Bellfield roundabout	307	00:30	00:23	-7	-24%	
		A77 (S) exit	2015	00:54	01:05	11	21%	
		A71 Hurlford Road to A77	**3786**	**05:47**	**06:06**	**19**	**5%**	**Pass**
	8a	A77 (S) to stopline	1857	01:25	01:25	1	1%	
		Bellfield roundabout	78	00:08	00:08	0	6%	
		A735 Queen's Drive exit	724	01:09	01:01	-8	-12%	
		A77 (S) to A735 Queen's I	**2658**	**02:42**	**02:35**	**-7**	**-4%**	**Pass**
	8b	Queen's Drive to stopline	719	03:11	03:50	39	20%	
		Bellfield roundabout	228	00:51	00:19	-32	-63%	
		A77 (S) exit	2015	00:54	01:05	11	21%	
		A735 Queen's Drive to A7	**2962**	**04:55**	**05:14**	**18**	**6%**	**Pass**

5.6. Base Model Queuing

This section of the technical note provides a brief description of the performance and operation of the Bellfield Interchange in terms of vehicle queuing.

On site observations have indicated that the more notable queuing at the Bellfield Interchange occurs on the A77 North (offslip), A71 Riccarton Road and A76 during the AM peak. During the PM peak the arms where the most prominent queuing occurs are on the A77 North (offslip), A71 Riccarton Road, A71 Hurlford Road and A735 Queen's Drive. During the PM peak, queues on the A77 North (offslip) are known to reach the A77 southbound carriageway which in effect increases the likelihood of rear end shunts at this location.

The AM and PM base model queue lengths reflect on the above junction operation of the Bellfield Interchange and will be included as one of the baseline parameters when assessing the impacts of the proposed scenarios.

5.7. Summary and Conclusions

5.7.1. Summary

Atkins has been commissioned by EAC to develop a base model of the Bellfield Interchange to be used to model the proposed impacts of the LDP and test the proposed mitigations required at this junction to offset the likely impacts. The base model of the Bellfield Interchange has been developed using VISSIM microsimulation software for which the model development, calibration and validation have been outlined in this technical note.

5.7.2. Conclusions

The AM and PM base modelling for the Bellfield Interchange has been calibrated using turning movement counts and validated using TomTom data. All calibration and validation meet the required criteria with a 100% *'Pass'* rate. It is therefore considered that the Bellfield Interchange VISSIM model developed is an accurate reflection of the existing situation and an appropriate tool to be taken forward for proposed testing.

6. Modelling Appraisal – wider network

6.1. A71 Moorfield Roundabout

6.1.1. Model Extent

A full extent of the A71 Moorfield roundabout VISSIM model is shown below in Figure 6.1.

Figure 6.1 – A71 Moorfield model extents

The Moorfield model has been developed using the existing give-way junction operations for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to.

6.1.2. Moorfield Flows

As detailed in Table 6.1 the 'Base+LDP1' flows in the AM and PM are 2.5% and 6.6% higher than the 'Base' scenario demonstrating the modest impact anticipated at this location. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.1 – AM & PM Moorfield Flows Summary (vehicles)

Junction	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
J1 - B7081 Kilmarnock Rd / Irvine Rd roundabout	2121	2125	1776	1819	1848	1518
J2 - B7064 / Dumfries Drive roundabout	1888	1877	1515	1591	1619	1279
J3 - A71 Moorfield roundabout	3936	4119	3478	3600	4047	3304

J4 - A759 T junction	976	1083	966	986	1124	962
J5 - A759 Dundonald Rd roundabout	892	872	712	896	896	719
J6 - B7081 Kilmarnock Rd / Hospital roundabout	1496	1514	1283	1192	1220	1024
Total	**11309**	**11590**	**9730**	**10084**	**10754**	**8806**

6.1.3. Moorfield Queues

As detailed in Table 6.2 there is little impact on all arms of the three junctions apart from the A71 Hurlford Road (E) arm during the AM in the 'Base+LDP1' scenario which is highlighted red. It is noted that all queue lengths improve further in the 'Base+LDP1+LDP2' scenario when compared with the base scenario. But in the interim, two segregated left turn slips on the A71 Hurlford Road (E) and the B7064 (S) arms would alleviate any temporary queuing issues during the 'Base+LDP1' scenario. The A71 Hurlford Road (E) arm for which the 604m average queue in the AM 'Base+LDP1' would reduce to 87m average queue when the segregated left turn slips are implemented. Similarly, for the B7064 (S) arm the 203m average queue in the AM 'Base+LDP1' would reduce to 8m average queue with a segregated left turn slip.

Table 6.2 – AM & PM Moorfield Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
J1 - Irvine Road (E)	1	1	0	1	1	1
J1 - B7064 (S)	35	28	5	1	1	0
J1 - Kilmarnock Road (W)	0	0	0	1	2	1
J2 - B7064 (N)	1	1	0	4	5	1
J2 - Dumfries Drive (E)	0	1	0	0	0	0
J2 - B7064 (S)	7	6	1	0	0	0
J2 - Industrial Park	0	0	0	0	0	0
J3 - B7064 (N)	6	9	3	11	21	4
J3 - A71 Hurlford Road (E)	58	604	15	7	19	6
J3 - B7064 (S)	75	203	9	8	47	4
J3 - A71 Hurlford Road (W)	6	7	3	2	3	1

6.1.4. Moorfield Journey Times

As detailed in Table 6.3 the proposed journey times are in most cases similar to the base with one notably longer journey time highlighted red. This longer journey time occurs on A71 Hurlford Road (E) arm which makes up the first half of the *A71 (E) to A71 (W)* route in the AM. This occurs in the 'Base+LDP1' scenario before reducing to base like levels in the 'Base+LDP1+LDP2' scenario. However, when the segregated left turn slips are included in the 'Base+LDP1' model the 06:08 journey time for the *A71 (E) to A71 (W)* route in the AM reduces to 03:50.

Table 6.3 – AM & PM Moorfield Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2

A71 (E) to A71 (W)	03:22	06:08	03:04	02:58	03:04	02:56
A71 (W) to A71 (E)	02:52	02:53	02:49	02:48	02:49	02:47

6.1.5. Moorfield Network Performance

The Network Performance results for each scenario are summarised below in Table 6.4. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Moorfield model operates well in each of the scenarios.

Table 6.4 – AM & PM Moorfield Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	39	102	22	20	26	16
Stops *(average number of stops per vehicle)*	2	6	1	1	1	0
Speed *(average speed (mph))*	31	23	33	34	33	35
Delay Stopped *(average standstill time per vehicle)*	6	28	2	2	4	1
Distance *(total distance travelled by all vehicles)*	14438	15053	12572	13134	14564	11881
Travel Time *(total travel time of vehicles)*	1058599	1449379	842432	858191	973323	754043
Delay *(total delay of all vehicles)*	202378	561736	100711	92458	133520	68358
Stops *(total number of stops of all vehicles)*	7873	35888	2545	2698	5427	1692
Delay Stopped *(total standstill time of all vehicles)*	28326	154943	7424	7694	19689	4534
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	308	491	239	243	274	220
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	4821	5032	4272	4459	4932	4059
Delay (latent)	1889	2897	1240	1565	1879	1133

(total delay of vehicles that could not be used (immediately))						
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	1	3	1	0	0	0

6.1.6. Mitigation at Moorfield - Costs and Funding

6.1.6.1. Costs

The two proposed segregated left turn slips at the Moorfield roundabout of which the benefits are discussed in Sections 6.1.2 and 6.1.3 are likely to cost approximately **£550,000 each** (allowing for optimum bias and inflation across the LDP period). Therefore, the total cost would be in the region of **£1,100,000**.

6.1.6.2. Funding

It is recommended that funding for the two proposed segregated left turn slips at the Moorfield roundabout is generated from developer contributions associated with LDP2 developments located in the Moorfield Industrial Estates.

6.2. A76 Bowfield Roundabout

6.2.1. Model Extent

A full extent of the A76 Bowfield roundabout VISSIM model is shown below in Figure 6.2.

Figure 6.2 – A76 Bowfield roundabout model extents

The Bowfield model has been developed using the existing give-way junction operation for which the ‘Base’, ‘Base+LDP1’ and ‘Base+LDP1+LDP2’ results summarised in this section relate to.

6.2.2. Bowfield Flows

As detailed in Table 6.5 the ‘Base+LDP1’ flows in the AM and PM are approximately 20% and 16% higher than the ‘Base’ scenario. The total flows through the junction are lower in the ‘Base+LDP1+LDP2’ scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.5 – AM & PM Bowfield Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From Arm A - A76 (NW)	456	496	410	626	677	588
From Arm B - B7073	96	96	71	166	166	128
From Arm C - HMP Access	10	10	2	72	72	53
From Arm D - A76 (SE)	680	882	783	600	787	728
Total	**1242**	**1484**	**1266**	**1464**	**1702**	**1497**

6.2.3. Bowfield Queues

As detailed in Table 6.6 there is little impact in terms of queue lengths on all arms of the junction across all scenarios.

Table 6.6 – AM & PM Bowfield Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
Arm A - A76 (NW)	2	3	1	2	3	1
Arm B - B7073	0	0	0	0	1	0
Arm C - HMP Access	0	0	0	0	0	0
Arm D - A76 (SE)	1	1	0	1	2	1

6.2.4. Bowfield Journey Times

As detailed in Table 6.7 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.7 – AM & PM Bowfield Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A76 (N) to A76 (S)	02:57	03:03	02:56	02:47	02:52	02:47
A76 (S) to A76 (N)	03:06	03:10	03:07	03:04	03:08	03:05

6.2.5. Bowfield Network Performance

The Network Performance results for each scenario are summarised below in Table 6.8. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Bowfield model operates well in each of the scenarios.

Table 6.8 – AM & PM Bowfield Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	14	21	18	12	19	16
Stops *(average number of stops per vehicle)*	0	0	0	0	0	0
Speed *(average speed (mph))*	40	39	40	41	40	41
Delay Stopped *(average standstill time per vehicle)*	0	0	0	0	0	0
Distance *(total distance travelled by all vehicles)*	2885	4430	3828	3343	5022	4478
Travel Time *(total travel time of vehicles)*	161572	254234	214286	181615	280124	244136
Delay *(total delay of all vehicles)*	17552	33358	23556	17712	34097	24879
Stops *(total number of stops of all vehicles)*	115	162	68	210	316	140
Delay Stopped *(total standstill time of all vehicles)*	172	236	92	407	579	234
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	49	81	64	52	81	72
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	1242	1483	1266	1463	1701	1491
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	869	1609	1069	905	1467	1078
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	1	1	1	1	1	1

6.3. A76 Crossroads Roundabout

6.3.1. Model Extent

A full extent of the A76 Crossroads roundabout VISSIM model is shown below in Figure 6.3.

Figure 6.3 – A76 Crossroads roundabout model extents

The Crossroads model has been developed using the existing give-way junction operation for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to.

6.3.2. Crossroads Flows

As detailed in Table 6.9 the 'Base+LDP1' flows in the AM and PM are approximately 21% and 17% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.9 – AM & PM Crossroads Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From Arm A - A76 (NW)	504	544	451	797	848	723
From Arm B - A719 (NE)	189	209	159	115	130	99
From Arm C - A76 (SE)	637	873	774	535	742	690
From Arm D - A719 (SW)	99	99	73	150	151	118
Total	**1429**	**1725**	**1457**	1597	1871	1630

6.3.3. Crossroads Queues

As detailed in Table 6.10 and there is little impact in terms of queue lengths on all arms of the junction across all scenarios.

Table 6.10 – AM & PM Crossroads Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
Arm A - A76 (NW)	1	1	1	3	5	1
Arm B - A719 (NE)	0	0	0	0	0	0
Arm C - A76 (SE)	3	8	3	1	3	1
Arm D - A719 (SW)	0	0	0	0	0	0

6.3.4. Crossroads Journey Times

As detailed in Table 6.11 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.11 – AM & PM Crossroads Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A76 (N) to A76 (S)	02:31	02:32	02:27	02:24	02:25	02:21
A76 (S) to A76 (N)	02:42	02:49	02:37	02:36	02:40	02:33

6.3.5. Crossroads Network Performance

The Network Performance results for each scenario are summarised below in Table 6.12. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Crossroads model operates well in each of the scenarios.

Table 6.12 – AM & PM Crossroads Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	18	23	17	14	17	14
Stops *(average number of stops per vehicle)*	0	0	0	0	0	0
Speed *(average speed (mph))*	41	40	42	42	41	43
Delay Stopped *(average standstill time per vehicle)*	0	0	0	0	0	0
Distance *(total distance travelled by all vehicles)*	3460	4304	3703	3771	4545	4058
Travel Time *(total travel time of vehicles)*	190928	243765	198469	199978	245275	210442
Delay *(total delay of all vehicles)*	26272	41063	25657	23561	33904	23172
Stops *(total number of stops of all vehicles)*	184	368	159	207	353	164
Delay Stopped *(total standstill time of all vehicles)*	327	686	299	359	600	283
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	61	78	61	58	71	61
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	1428	1722	1450	1592	1867	1627
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	890	1614	1036	1371	1934	1371
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	1	0	0	1	1

6.4. A76 Mauchline Crossroads

6.4.1. Model Extent

A full extent of the A76 Mauchline crossroads VISSIM model is shown below in Figure 6.4.

Figure 6.4 – A76 Mauchline crossroads model extents

The Mauchline model has been developed using the existing signalised junction operation for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to. For the 'Base+LDP1' and Base+LDP1+LDP2' scenarios optimised signal timings from LinSig have been used which in affect portrays the junction as it would under the control of MOVA.

6.4.2. Mauchline Flows

As detailed in Table 6.13 the 'Base+LDP1' flows in the AM and PM are approximately 16% and 17% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.13 – AM & PM Mauchline Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From Arm A - A76 Kilmarnock Road	604	670	548	643	708	623
From Arm B - B743 High Street	140	128	154	107	115	109
From Arm C - A76 Cumnock Road	549	778	689	533	743	711
From Arm D - B743 Loudoun Street	229	188	224	278	264	237
Total	**1522**	**1764**	**1615**	**1561**	**1830**	**1680**

6.4.3. Mauchline Queues

As detailed in Table 6.14 there is some impact in terms of queue lengths on all arms of the junction but the 'Base+LDP1' model has demonstrated that it can accommodate the additional traffic. The 'Base+LDP1+LDP2' scenario then produces results more akin to the base model.

Table 6.14 – AM & PM Mauchline Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
Arm A - A76 Kilmarnock Road	110	174	50	220	319	59
Arm B - B743 High Street	40	171	93	16	41	25
Arm C - A76 Cumnock Road	44	147	80	36	114	71
Arm D - B743 Loudoun Street	111	334	37	37	148	24

6.4.4. Mauchline Journey Times

As detailed in Table 6.15 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.15 – AM Mauchline Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A76 (N) to A76 (S)	05:53	06:11	05:26	06:37	06:56	05:28
A76 (S) to A76 (N)	05:07	05:36	05:18	05:02	05:29	05:13

6.4.5. Mauchline Network Performance

The Network Performance results for each scenario are summarised below in Table 6.16. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Mauchline model operates well in each of the scenarios.

Table 6.16 – AM & PM Mauchline Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	99	189	89	89	135	67
Stops *(average number of stops per vehicle)*	2	3	1	2	3	1
Speed *(average speed (mph))*	20	16	21	21	18	22
Delay Stopped *(average standstill time per vehicle)*	68	146	59	60	97	38
Distance *(total distance travelled by all vehicles)*	4557	5768	5158	4719	5970	5401
Travel Time *(total travel time of vehicles)*	515616	830157	555783	511640	734289	537533
Delay *(total delay of all vehicles)*	165262	384451	157792	152798	276545	122781
Stops *(total number of stops of all vehicles)*	2938	6309	2450	3236	5269	2029
Delay Stopped *(total standstill time of all vehicles)*	113579	296481	104842	102485	200269	70594
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	150	275	165	153	227	158
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	1520	1761	1609	1559	1829	1677
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	836	1443	1001	888	1434	1153
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	0	0	0	0	0

6.4.6. Mitigation at Mauchline - Costs and Funding

6.4.6.1. Costs

The proposed upgrade of the Mauchline traffic signals to current MOVA is likely to cost approximately **£30,000 –** though it is noted this junction may already operate a version of the MOVA system.

6.4.6.2. Funding

It is recommended that funding for the proposed upgrade of the Mauchline traffic signals is generated from developer contributions associated with LDP2 developments located in Mauchline.

6.5. A76 Templeton Roundabout

6.5.1. Model Extent

A full extent of the A76 Templeton roundabout VISSIM model is shown below in Figure 6.5.

Figure 6.5 – A76 Templeton roundabout model extents

The Templeton model has been developed using the existing give-way junction operation for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to.

6.5.2. Templeton Flows

As detailed in Table 6.17 the 'Base+LDP1' flows in the AM and PM are approximately 30% and 34% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.17 – AM & PM Templeton Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From J1 Arm A - A76 (NW)	438	506	425	503	562	461
From J1 Arm B - A76 (S)	308	514	504	367	640	631
From J1 Arm C - Mauchline Road	251	328	292	195	255	247
From J2 Arm A - Mauchline Road (W)	255	316	305	358	481	417
From J2 Arm B - Darnlaw View	81	81	57	74	74	51
From J2 Arm C - Mauchline Road (E)	276	351	308	213	273	263
Total	**1609**	**2096**	**1891**	**1710**	**2285**	**2070**

6.5.3. Templeton Queues

As detailed in Table 6.18 and there is little impact in terms of queue lengths on all arms of the junction across all scenarios.

Table 6.18 – AM & PM Templeton Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
J1 Arm A - A76 (NW)	0	0	0	0	1	0
J1 Arm B - A76 (S)	0	1	0	0	0	0
J1 Arm C - Mauchline Road	0	0	0	0	0	0

6.5.4. Templeton Journey Times

As detailed in Table 6.19 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.19 – AM & PM Templeton Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A76 (N) to A76 (S)	02:53	02:53	02:48	02:43	02:43	02:41
A76 (S) to A76 (N)	02:52	02:53	02:48	02:35	02:38	02:36

6.5.5. Templeton Network Performance

The Network Performance results for each scenario are summarised below in Table 6.20. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Templeton model operates well in each of the scenarios.

Table 6.20 – AM & PM Templeton Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	16	18	15	10	12	10
Stops *(average number of stops per vehicle)*	0	0	0	0	0	0
Speed *(average speed (mph))*	43	42	43	45	45	46
Delay Stopped *(average standstill time per vehicle)*	0	0	0	0	0	0
Distance *(total distance travelled by all vehicles)*	3129	4264	3823	3301	4529	4172
Travel Time *(total travel time of vehicles)*	164119	225209	197060	162469	226228	204758
Delay *(total delay of all vehicles)*	18106	27855	20547	12599	19985	15196
Stops *(total number of stops of all vehicles)*	67	158	102	59	135	95
Delay Stopped *(total standstill time of all vehicles)*	130	305	193	112	230	152
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	43	62	53	40	60	54
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	1100	1451	1292	1160	1553	1408
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	61	269	269	63	359	392
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	0	0	0	0	0

6.6. A76 Dettingen Roundabout

6.6.1. Model Extent

A full extent of the A76 Dettingen roundabout VISSIM model is shown below in Figure 6.6.

Figure 6.6 – A76 Dettingen roundabout model extents

The Dettingen model has been developed using the existing give-way junction operation for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to.

6.6.2. Dettingen Flows

As detailed in

Table 6.21 the 'Base+LDP1' flows in the AM and PM are approximately 34% and 36% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.21 – AM & PM Dettingen Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From Arm A - A76 (NW)	472	568	492	336	417	371
From Arm B - Ayr Road	336	409	334	432	524	421
From Arm C - A76 (SE)	269	513	502	252	532	547
From Arm D - A70	176	192	162	245	253	207
Total	**1253**	**1682**	**1490**	**1265**	**1726**	**1546**

6.6.3. Dettingen Queues

As detailed in Table 6.22 there is little impact in terms of queue lengths on all arms of the junction across all scenarios

Table 6.22 – AM & PM Dettingen Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
Arm A - A76 (NW)	0	1	0	0	0	0
Arm B - Ayr Road	0	0	0	0	1	0
Arm C - A76 (SE)	0	1	1	0	2	2
Arm D - A70	0	1	1	1	2	1

6.6.4. Dettingen Journey Times

As detailed in Table 6.23 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.23 – AM & PM Dettingen Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A76 (N) to A76 (S)	02:43	02:44	02:42	02:39	02:40	02:39
A76 (S) to A76 (N)	02:30	02:31	02:29	02:24	02:26	02:25

6.6.5. Dettingen Network Performance

The Network Performance results for each scenario are summarised below in Table 6.24. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Dettingen model operates well in each of the scenarios.

Table 6.24 – AM & PM Dettingen Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	9	12	10	8	10	9
Stops *(average number of stops per vehicle)*	0	0	0	0	0	0
Speed *(average speed (mph))*	40	41	42	42	42	43
Delay Stopped *(average standstill time per vehicle)*	0	0	0	0	1	0
Distance *(total distance travelled by all vehicles)*	3162	4472	4071	3188	4625	4284
Travel Time *(total travel time of vehicles)*	175661	245610	217603	170561	244695	221817
Delay *(total delay of all vehicles)*	11979	20840	16127	9979	18108	14925
Stops *(total number of stops of all vehicles)*	74	221	137	108	350	257
Delay Stopped *(total standstill time of all vehicles)*	128	485	282	225	957	647
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	50	71	63	46	69	65
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	1251	1678	1482	1265	1722	1542
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	478	835	647	440	844	620
Demand (latent)	0	0	0	0	0	0

(number of vehicles from vehicle inputs that could not be used until the end of the simulation)						

6.7. A76 Skerrington Roundabout

6.7.1. Model Extent

A full extent of the A76 Skerrington roundabout VISSIM model is shown below in Figure 6.7.

Figure 6.7 – A76 Skerrington roundabout model extents

The Skerrington model has been developed using the existing give-way junction operation for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to.

6.7.2. Skerrington Flows

As detailed in Table 6.25 the 'Base+LDP1' flows in the AM and PM are approximately 66% and 51% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.25 – AM & PM Skerrington Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From Arm A - A76 (NW)	279	375	328	335	418	359
From Arm B - B7073	182	251	192	265	373	291
From Arm C - A76 (SE)	198	485	476	241	493	502
From Arm D - Glaisnock Road	57	80	62	44	56	38
Total	**716**	**1191**	**1058**	**885**	**1340**	**1190**

6.7.3. Skerrington Queues

As detailed in Table 6.26 there is little impact in terms of queue lengths on all arms of the junction across all scenarios

Table 6.26 – AM & PM Skerrington Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
Arm A - A76 (NW)	0	1	0	0	1	0
Arm B - B7073	0	0	0	0	0	0
Arm C - A76 (SE)	0	1	0	0	1	0
Arm D - Glaisnock Road	0	0	0	0	0	0

6.7.4. Skerrington Journey Times

As detailed in Table 6.27 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.27 – AM & PM Skerrington Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A76 (N) to A76 (S)	02:29	02:29	02:24	02:25	02:26	02:22
A76 (S) to A76 (N)	02:25	02:25	02:22	02:21	02:23	02:20

6.7.5. Skerrington Network Performance

The Network Performance results for each scenario are summarised below in Table 6.28. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Skerrington model operates well in each of the scenarios.

Table 6.28 – AM & PM Skerrington Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	11	14	11	10	13	10
Stops *(average number of stops per vehicle)*	0	0	0	0	0	0
Speed *(average speed (mph))*	42	42	44	43	43	45
Delay Stopped *(average standstill time per vehicle)*	0	0	0	0	0	0
Distance *(total distance travelled by all vehicles)*	2103	3602	3294	2680	4108	3744
Travel Time *(total travel time of vehicles)*	112235	190653	167467	139303	213392	186988
Delay *(total delay of all vehicles)*	7963	17066	12334	9523	17421	12330
Stops *(total number of stops of all vehicles)*	22	122	78	42	195	89
Delay Stopped *(total standstill time of all vehicles)*	29	225	118	74	370	133
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	25	48	45	32	55	51
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	715	1188	1055	884	1338	1185
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	160	448	344	268	574	467
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	0	0	0	0	0

6.8. Stewarton Crossroads

6.8.1. Model Extent

A full extent of the Stewarton crossroads VISSIM model is shown below in Figure 6.8.

Figure 6.8 – Stewarton crossroads model extents

The Stewarton model has been developed using the existing signalised junction operation for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to. For the 'Base+LDP1' and Base+LDP1+LDP2' scenarios optimised signal timings from LinSig have been used which in affect portrays the junction as it would under the control of MOVA.

6.8.2. Stewarton Flows

As detailed in Table 6.29 the 'Base+LDP1' flows in the AM and PM are approximately 2% and 5% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.29 – AM & PM Stewarton Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
From J1 Arm A - Rigg Street	319	326	269	376	406	334
From J1 Arm B - Main Street	270	309	254	280	305	231
From J1 Arm C - Vennel Street	304	305	263	419	417	380
From J1 Arm D - Lainshaw Street	431	435	342	432	457	369
From J2 Arm A – Standalane	254	253	197	252	261	207
From J2 Arm B - Lainshaw Street (E)	396	396	318	457	467	376
From J2 Arm C - Local Access	0	0	0	4	5	5
From J2 Arm D - Lainshaw Street (W)	341	345	269	366	389	317
Total	**2315**	**2369**	**1912**	**2586**	**2707**	**2219**

6.8.3. Stewarton Queues

As detailed in Table 6.30 there is some impact in terms of queue lengths on all arms of the junction but the 'Base+LDP1' model has demonstrated that it can accommodate the additional traffic. The 'Base+LDP1+LDP2' scenario then produces results more akin to the base model.

Table 6.30 – AM & PM Stewarton Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
J1 - A735 Rigg Street (N)	26	33	16	37	42	22
J1 - B769 Main Street (E)	30	35	20	46	39	18
J1 - B778 Vennel Street (S)	74	121	22	128	226	45
J1 - A735 Lainshaw Street (W)	90	99	27	76	67	33
J2 - Standalane	5	7	0	9	2	0
J2 - Lainshaw Street (E)	3	3	1	13	5	2
J2 - Local Access	0	0	0	0	0	0
J2 - Lainshaw Street (W)	2	2	0	8	1	0

6.8.4. Stewarton Journey Times

As detailed in Table 6.31 there is little impact in terms of journey times through the junction across all scenarios.

Table 6.31 – AM & PM Stewarton Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
A735 (N) to B778 (S)	06:12	06:21	06:01	06:16	06:29	06:04
B778 (S) to A735 (N)	07:00	08:01	05:50	07:14	08:48	06:11

6.8.5. Stewarton Network Performance

The Network Performance results for each scenario are summarised below in Table 6.32. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Stewarton model operates well in each of the scenarios.

Table 6.32 – AM & PM Stewarton Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	88	105	56	112	116	65
Stops *(average number of stops per vehicle)*	2	2	1	2	2	1
Speed *(average speed (mph))*	18	17	21	17	17	20
Delay Stopped *(average standstill time per vehicle)*	60	75	34	84	84	41
Distance *(total distance travelled by all vehicles)*	3190	3341	2777	3818	3994	3327
Travel Time *(total travel time of vehicles)*	393839	439192	293861	506407	540482	363123
Delay *(total delay of all vehicles)*	139994	173847	74412	206348	226337	102017
Stops *(total number of stops of all vehicles)*	3034	3681	1638	3453	4556	2074
Delay Stopped *(total standstill time of all vehicles)*	96395	124656	45071	152229	163377	64282
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	116	136	85	173	169	100
Vehicles (arrived)	1481	1527	1249	1694	1775	1465

(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)						
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	408	438	243	10762	566	366
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	0	0	20	0	0

6.8.6. Mitigation at Stewarton - Costs and Funding

6.8.6.1. Costs

The proposed upgrade of the Stewarton traffic signals to MOVA is likely to cost approximately **£30,000**.

6.8.6.2. Funding

It is recommended that funding for the proposed upgrade of the Stewarton traffic signals to MOVA is generated from developer contributions associated with LDP2 developments located in Stewarton.

6.9. A77 Meiklewood Junction

6.9.1. Model Extent

A full extent of the A77 Meiklewood junction VISSIM model is shown below in Figure 6.9.

Figure 6.9 – A77 Meiklewood Junction model extents

The Meiklewood model has been developed using the existing give-way junction operations for which the 'Base', 'Base+LDP1' and 'Base+LDP1+LDP2' results summarised in this section relate to.

6.9.2. Meiklewood Flows

As detailed in Table 6.33 the 'Base+LDP1' flows in the AM and PM are approximately 48% and 39% higher than the 'Base' scenario. The total flows through the junction are lower in the 'Base+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 6.33 – AM & PM Meiklewood Flows Summary (vehicles)

Junction	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
J1 - A77 NB Offslip / A77 NB Onslip / B7038 Glasgow Road	1119	2021	1737	1231	2089	1794
J2 - A77 SB Onslip / B7038	550	1033	860	648	1045	908
J3 - M77 J8 SB Offslip / B7061 / B7038	277	439	370	488	683	614
J4 - M77 J8 NB Offslip / A77 / B751 Kilmaurs Road	367	366	283	403	403	310
J5 - A77 / B778 Stewarton Road	792	792	603	919	918	700
J6 - M77 J7 SB Offslip / B778 Stewarton Road	399	398	294	603	603	462
J7 - M77 J7 NB Onslip / A77 / Ayr Road	447	446	343	417	417	317
J8 - B7038 Glasgow Road / B751 Kilmaurs Road	1166	2068	1775	1280	2140	1831
Total	**5117**	**7563**	**6265**	**5989**	**8298**	**6936**

6.9.3. Meiklewood Queues

As detailed in Table 6.34 there is little impact in terms of queue lengths on all arms of the junctions across all scenarios.

Table 6.34 – AM & PM Meiklewood Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
	Average Queue					
J6 - M77 J7 SB Offslip (N)	0	0	0	0	0	0
J3 - M77 J8 SB Offslip (N)	0	0	0	0	0	0
J3 - B7061 Main Road (E)	0	0	0	0	0	0
J3 - B7038 (S)	0	0	0	0	0	0
J2 - B7038 (N)	0	0	0	0	0	0
J2 - B7038 (S)	0	2	1	0	0	0
J1 - A77 NB Offslip (right turn)	0	0	0	0	0	0
J4 - A77 (N)	0	0	0	0	0	0
J4 - M77 J8 NB Offslip (S)	0	0	0	0	0	0
J4 - B751 Kilmaurs Road (W)	0	0	0	0	0	0
J5 - A77 (N)	0	0	0	0	0	0
J5 - Stewarton Road (E)	0	0	0	0	0	0
J5 - A77 (S)	0	0	0	0	0	0
J5 - B778 (W)	0	0	0	0	0	0
J7 - Ayr Road (N)	0	0	0	0	0	0

J7 - A77 (S)	0	0	0	0	0	0
J8 - B751 Kilmaurs Road	0	0	0	0	0	0
J8 - B7038 Glasgow Road (right turn)	0	0	0	0	0	0

6.9.4. Meiklewood Journey Times

As detailed in Table 6.35 there is little impact in terms of journey times through the junctions across all scenarios.

Table 6.35 – AM & PM Meiklewood Journey Times Summary (minutes)

Journey Time Route	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Glasgow Rd rbt (S) to B7061 Main Rd (N)	03:40	03:45	03:42	03:40	03:44	03:39
B7061 Main Rd (N) to Glasgow Rd rbt (S)	03:30	03:34	03:33	03:35	03:40	03:37
Stewarton Rd / Skernieland Rd / Main Rd rbt (S) to Ayr Rd / M77 NB Onslip / A77 rbt (N)	01:21	01:21	01:19	01:22	01:22	01:19
Ayr Rd / M77 NB Onslip / A77 rbt (N) to Stewarton Rd / Skernieland Rd / Main Rd rbt (S)	01:16	01:16	01:14	01:16	01:16	01:15

6.9.5. Meiklewood Network Performance

The Network Performance results for each scenario are summarised below in Table 6.36. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Base+LDP1' scenario which has the highest level of demand before improving again in the 'Base+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Meiklewood model operates well in each of the scenarios.

Table 6.36 – AM & PM Meiklewood Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Base +LDP1	Base +LDP1 +LDP2	Base	Base +LDP1	Base +LDP1 +LDP2
Delay *(average delay per vehicle)*	8	9	7	9	9	8
Stops *(average number of stops per vehicle)*	0	0	0	0	0	0
Speed *(average speed (mph))*	46	48	49	45	48	50
Delay Stopped *(average standstill time per vehicle)*	0	0	0	0	0	0
Distance *(total distance travelled by all vehicles)*	8386	14173	13046	9424	15727	14671

Travel Time *(total travel time of vehicles)*	411618	666048	591052	465767	734675	659572
Delay *(total delay of all vehicles)*	16394	30400	22426	21572	35778	26909
Stops *(total number of stops of all vehicles)*	77	196	97	109	213	106
Delay Stopped *(total standstill time of all vehicles)*	129	494	218	171	442	207
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	122	198	177	140	219	198
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	2062	3258	2864	2286	3569	3172
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	123	453	333	143	451	328
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	0	0	0	0	0

6.10. Summary and Conclusions

6.10.1. Summary

Atkins has been commissioned by EAC to undertake a transport appraisal in order to consider the cumulative impacts of potential development opportunity sites for inclusion in the Proposed East Ayrshire Local Development Plan 2 (LDP2) and legacy sites contained in the adopted (2017) East Ayrshire Local Development Plan (LDP1) on the trunk and main road network within East Ayrshire (primarily the A71, A76 and A77 corridors and in Stewarton town centre).

As part of this study Atkins has developed microsimulation models for ten junctions on the A71, A76, A77 corridors and in Stewarton town centre to be used to assess the proposed impacts of the LDP and test the proposed mitigations (when required) at these junctions to offset the likely impacts. The modelling has been undertaken using VISSIM microsimulation software and the results from the following three scenarios are contained within this technical note for each of the ten junctions appraised:

- Base
- Base + LDP1
- Base + LDP1 + LDP2

6.10.2. Conclusions

The results from the AM and PM modelling across the three scenarios for each of the ten junctions is detailed in chapter 6 of this report. This modelling assessment has determined the following:

- The LDP1 assessment undertaken at Moorfield indicates an increase to congestion on the east and south arms of the A71 Moorfield roundabout in the AM peak. This can be alleviated with the introduction of two segregated left turn slips on the A71 west arm and the B7064 south arm of the roundabout.

- It is recommended that the traffic signals at Mauchline and Stewarton are upgraded to the latest MOVA to allow for the best operation of these signalised crossroad junctions.
- All the remaining junction models assessed on the strategic network indicate that they will not be notably impacted with the inclusion of LDP1 and LDP2.

7. Modelling Appraisal – Bellfield Interchange

7.1.1. Model Extent

A full extent of the Bellfield Interchange VISSIM model is shown below in Figure 7.1.

Figure 7.1 – Bellfield Interchange model extents

The Bellfield Interchange base model has been developed using the existing give-way roundabout operation for which the 'Base' results summarised in this section relate to.

In order to accommodate the anticipated traffic growth associated with LDP1 and LDP2 a proposed signalised option has been modelled. The indicative design of this proposed signalisation is illustrated in Figure 7.2 and is also known as the Amey design from circa 2010 (Drawing Title: A77 Bellfield roundabout traffic simulation 3 lane spirals with signals and segregated left turn lane). Therefore, the 'Proposed+LDP1' and 'Proposed+LDP1+LDP2' scenario results summarised in this section include this proposed signalisation of the Bellfield Interchange.

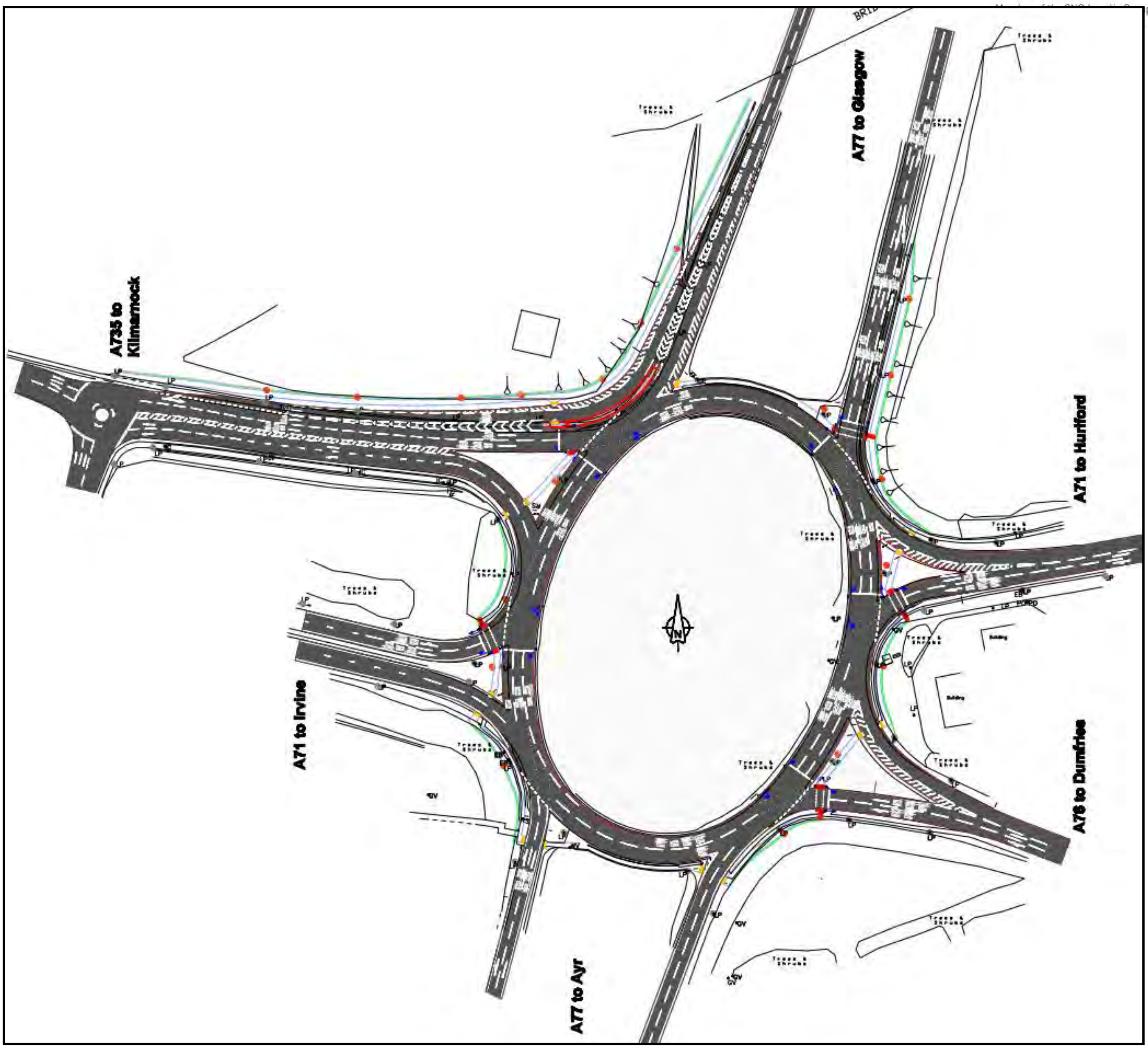


Figure 7.2 – Indicative design of proposed Bellfield Interchange signalisation (Amey 2010)

7.1.2. Bellfield Flows

As detailed in

Table 7.1 the 'Proposed+LDP1' flows in the AM and PM are approximately 20% higher than the 'Base' scenario demonstrating the increased capacity that can be accommodated at Bellfield when the junction is signalised. The total flows through the junction are lower in the 'Proposed+LDP1+LDP2' scenario, but this is due to the reduced demand owing to the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP).

Table 7.1 – AM & PM Bellfield Flows Summary (vehicles)

Junction Arm	AM			PM		
	Base	Proposed +LDP1	Proposed +LDP1 +LDP2	Base	Proposed +LDP1	Proposed +LDP1 +LDP2
From Arm A - A77 North	1104	1186	992	945	1016	940
From Arm B - A71 Riccarton Road	598	813	675	538	954	824
From Arm C - A76	462	663	609	530	696	625
From Arm D - A77 South	227	331	309	221	377	437
From Arm E - A71 Hurlford Road	872	956	794	909	1068	888
From Arm F - A735 Queen's Drive	679	791	914	827	763	889
Total	**3942**	**4740**	**4293**	**3970**	**4874**	**4603**

7.1.3. Bellfield Queues

As detailed in Table 7.2 the proposed queue lengths are shorter on most of the junction arms apart from the A71 Hurlford Road in the AM and the A77 North in the PM. These longer queue lengths are highlighted red in the 'Proposed+LDP1' scenario and it is noted that all queue lengths reduce further in the 'Proposed+LDP1+LDP2' scenario.

Table 7.2 – AM & PM Bellfield Queues Summary (metres)

Junction Arm	AM			PM		
	Base	Proposed +LDP1	Proposed +LDP1 +LDP2	Base	Proposed +LDP1	Proposed +LDP1 +LDP2
	Average Queue					
Arm A - A77 North	120	32	19	261	458	28
Arm B - A71 Riccarton Road	207	37	26	40	30	42
Arm C - A76	80	19	13	19	20	14
Arm D - A77 South	10	7	2	3	14	12
Arm E - A71 Hurlford Road	89	418	36	401	340	100
Arm F - A735 Queen's Drive	16	60	39	124	154	85

As the proposed Bellfield improvements outlined by Amey include an extended A77 southbound slip (Parallel Diverge – Option B of 780m slip road length) the modelled PM average queue of 458m and maximum queue of 774m can be accommodated during the 'Proposed+LDP1' scenario. A proposed drawing of the Parallel Diverge slip is presented in drawing no. CO25000313/04 in Appendix C of this report.

7.1.4. Bellfield Journey Times

As detailed in Table 7.3 the proposed journey times are in most cases similar to the base with the routes experiencing longer journey times highlighted red. These longer journey times are those travelling from the A71 Hurlford Road in the AM and from the A77 North and A735 Queen's Drive in the PM. These all occur in the 'Proposed+LDP1' scenario before reducing to base like levels in the 'Proposed+LDP1+LDP2' scenario.

Table 7.3 – AM & PM Bellfield Journey Times Summary (minutes)

	Journey Time Route	AM			PM		
		Base	Proposed +LDP1	Proposed +LDP1 +LDP2	Base	Proposed +LDP1	Proposed +LDP1 +LDP2
1a	A77 (N) to A71 (E)	03:12	03:01	02:53	04:30	07:22	03:07
1b	A71 (E) to A77 (N)	05:12	04:04	04:16	03:39	04:18	04:16
2a	A77 (N) to A76	04:10	04:07	03:55	05:21	08:24	04:05
2b	A76 to A77 (N)	05:58	04:40	04:29	04:02	04:43	04:16
3a	A77 (N) to A71 Hurlford Road	03:50	04:02	03:40	05:05	08:17	04:02
3b	A71 Hurlford Road to A77 (N)	03:39	05:36	03:30	06:14	05:37	04:11
4a	A77 (N) to A735 Queen's Drive	03:38	04:13	03:41	04:58	08:19	04:16
4b	A735 Queen's Drive to A77 (N)	02:46	02:45	02:40	05:19	06:00	03:08
5a	A77 (S) to A71 (E)	02:58	03:27	03:20	02:41	04:02	03:36
5b	A71 (E) to A77 (S)	04:29	03:03	02:49	02:55	03:06	03:15
6a	A77 (S) to A76	04:04	04:29	04:30	03:30	04:55	04:14
6b	A76 to A77 (S)	05:16	03:38	03:23	03:20	03:35	03:19
7a	A77 (S) to A71 Hurlford Road	03:01	02:48	02:37	02:40	02:58	02:49
7b	A71 Hurlford Road to A77 (S)	03:30	06:04	03:48	06:06	06:18	04:34
8a	A77 (S) to A735 Queen's Drive	02:50	02:51	02:38	02:35	03:07	02:52
8b	A735 Queen's Drive to A77 (S)	02:40	04:31	03:32	05:14	08:59	04:56

7.1.5. Bellfield Network Performance

The Network Performance results for each scenario are summarised below in Table 7.4. As can be seen the changes to the levels of delay, travel time and speed are most notable in the 'Proposed+LDP1' scenario which has the highest level of demand before improving again in the 'Proposed+LDP1+LDP2' back to levels more in line with the base scenario results. Overall, the Network Performance results indicate that the Bellfield Interchange model operates well in each of the scenarios in terms of:

1. Delay (between 47-81 and 76-201 seconds per vehicle in the AM and PM respectively);
2. Stops (between 2-4 and 3-10 stops per vehicle in the AM and PM respectively); and
3. Speed (between 26-31 and 17-25 mph in the AM and PM respectively).

Table 7.4 – AM & PM Bellfield Network Performance Summary

Network Performance KPI	AM			PM		
	Base	Proposed +LDP1	Proposed +LDP1 +LDP2	Base	Proposed +LDP1	Proposed +LDP1 +LDP2
Delay *(average delay per vehicle)*	69	81	47	123	201	76
Stops *(average number of stops per vehicle)*	4	3	2	9	10	3
Speed *(average speed (mph))*	31	26	29	24	17	25
Delay Stopped *(average standstill time per vehicle)*	16	40	19	29	110	36
Distance *(total distance travelled by all vehicles)*	16940	17175	15177	17832	18352	16993
Travel Time *(total travel time of vehicles)*	1211603	1459930	1156787	1660040	2387126	1501556
Delay *(total delay of all vehicles)*	327266	455119	232375	641289	1263777	428124
Stops *(total number of stops of all vehicles)*	18446	16366	7488	48442	62120	15641
Delay Stopped *(total standstill time of all vehicles)*	76279	220971	92237	153175	690678	204361
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	425	460	348	584	805	470
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	4317	5133	4584	4613	5486	5160
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	1574	2739	2179	4195	84881	3628
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	1	1	5	145	1

7.1.6. Bellfield Interchange Mitigation - Costs and Funding

7.1.6.1. Costs

7.1.6.1.1. Signalisation Of Bellfield Interchange

The proposed signalisation of the Bellfield Interchange as illustrated in Figure 7.2 was first mooted in 2010 as part of a study undertaken by Amey. The proposed design option can be summarised as:

- Signalising five of the six entry arms (A77 (S) entry arm will remain as a give-way);
- A segregated left turn from the A735 Queen's Drive to the A77 (N);
- Widening of the east and west sides of the circulating carriageway to three lanes;
- Adding a third lane at the top of the A77 (N) entry arm; and
- Two lanes to be retained on the north and south sides of the circulating carriageway to avoid having to alter the bridges over the A77 dual carriageway.

At the time, an outline preliminary estimate of the cost of constructing the proposal was approximately £2.2 million. Within the figure an uplift of 5% was applied to the market rates for pavement construction to reflect current inflationary effects. A 40% optimism bias was also added to the total estimated cost to take account of uncertainty in the approximate figure. It was also noted that this estimate excluded the cost of any land purchase. The fee did not consider any abnormal ground conditions or the possible presence of public utilities or any issues that may arise with Temporary Traffic Management.

The overall cost breakdown, was as follows:

- Preliminary works including site accommodation **£400,000**;
- Traffic signals and associated carriageway surfacing and lining work **£500,000**;
- Widening the circulatory carriageway and the A77 (N) entry arm **£550,000**; and
- Segregated left turn lane from the A735 Queen's Drive to the A77 (N) **£750,000**.

Total estimated cost (from 2010): **£2,200,000**.

7.1.6.2. A77 (N) Parallel Diverge Slip Road

The proposed A77 (N) parallel diverge slip road as detailed in Section 5 of the *Option Appraisal, Bellfield Interchange Stage 1* Amey report dated 21/12/2018 notes the following aspects and construction cost:

Design aspects:

- Further investigations are required to fully understand what public utilities currently within the verge will require to be protected or diverted. It is noted that power is likely to be located within the verge given the presence of the vehicle activated signs;
- The length of the slip road is dictated by the B7303 overbridge which reduces the forward visibility on the A77 southbound mainline;
- Assessment of what departures from standards is needed prior to approval being sought from Transport Scotland;
- The acquisition of third party land has not been included within the estimated construction costs;
- It has been assumed that the extended slip road can be supported by standard embankments and that there will be no requirement to use soil nails or retaining walls;
- There is mature foliage present between the existing slip road and adjacent property.

Construction costs (from 2018):

- Construction costs (using SPONS rates) is estimated to be **£500,000**.

In general terms applying an allowance for inflation the construction cost is likely to have increased (based on relevant construction indices) from the 2010 values by around 35% which would raise the main Bellfield works to around **£2,975,000**. Similarly the slip roads works, applying the cost increase developed from construction price indices would have increased by around 10% to **£550,000**.

7.1.6.2.1. Bellfield Footbridge

In terms of the likely cost of a non-motorised user overbridge, there is significant variation in relation to costs for other bridges depending on the style, standard and design solution. Two current examples are the new bridge over the M8 in Glasgow linking Sighthill to the city centre which has a cost of £19m associated with it, while the Edinburgh LDP identified that for a new pedestrian / cycle bridge over the A9000 at Queensferry there would be a cost of £3.65m (updated in 2021). It is therefore thought that the best way to account for a Bellfield footbridge would be to include a reference in the build out of Bellfield East to a package of Active Travel measures and set aside an amount of £5m for it which could cover a new bridge (in part or match funded by LUF or Sustrans) and improvements to the routes that exist to the north as well as ensuring connections to Hurlford. Construction of the footbridge would enable the existing footpaths on the north and south bridges of the interchange to be removed. This offers the opportunity to install a third traffic lane on both bridges.

7.1.6.3. Funding

It is recommended that funding for the proposed signalisation of the Bellfield Interchange and A77 (N) parallel diverge slip road is also generated from developer contributions associated with LDP2 and AMIC Phases 1 + 2 on the basis of the trips arriving at the Bellfield Interchange. A significant proportion of traffic at the junction is existing however and a proportionate, fair and equitable approach to account for this will also need to be identified to comply with the requirements of Planning Circular 3/2012. This may mean that some funding would be sought from Transport Scotland towards the delivery of the improvement and alongside developer contributions and other sources e.g. LUF with contributions collected by East Ayrshire Council on TS behalf.

7.2. Ayrshire Growth Deal Development at Bellfield East (Kirklandside / Kaimshill) - Testing

7.2.1. Introduction

This section of the report focuses on the impact of proposed further development to the lands east of the Bellfield Interchange associated with the Ayrshire Growth Deal. Two phases of development are proposed under the Advanced Manufacturing Investment Corridor (AMIC) scheme. These phases are:

- Phase 1 – Land between A71 and A76; and
- Phase 2 – Land south of A76.

An outline illustration of the proposed AMIC scheme with its access points to the existing road network is illustrated overleaf in Figure 7.3. This is for indicative purposes only and is subject to any changes which may occur during the course of the planning process.

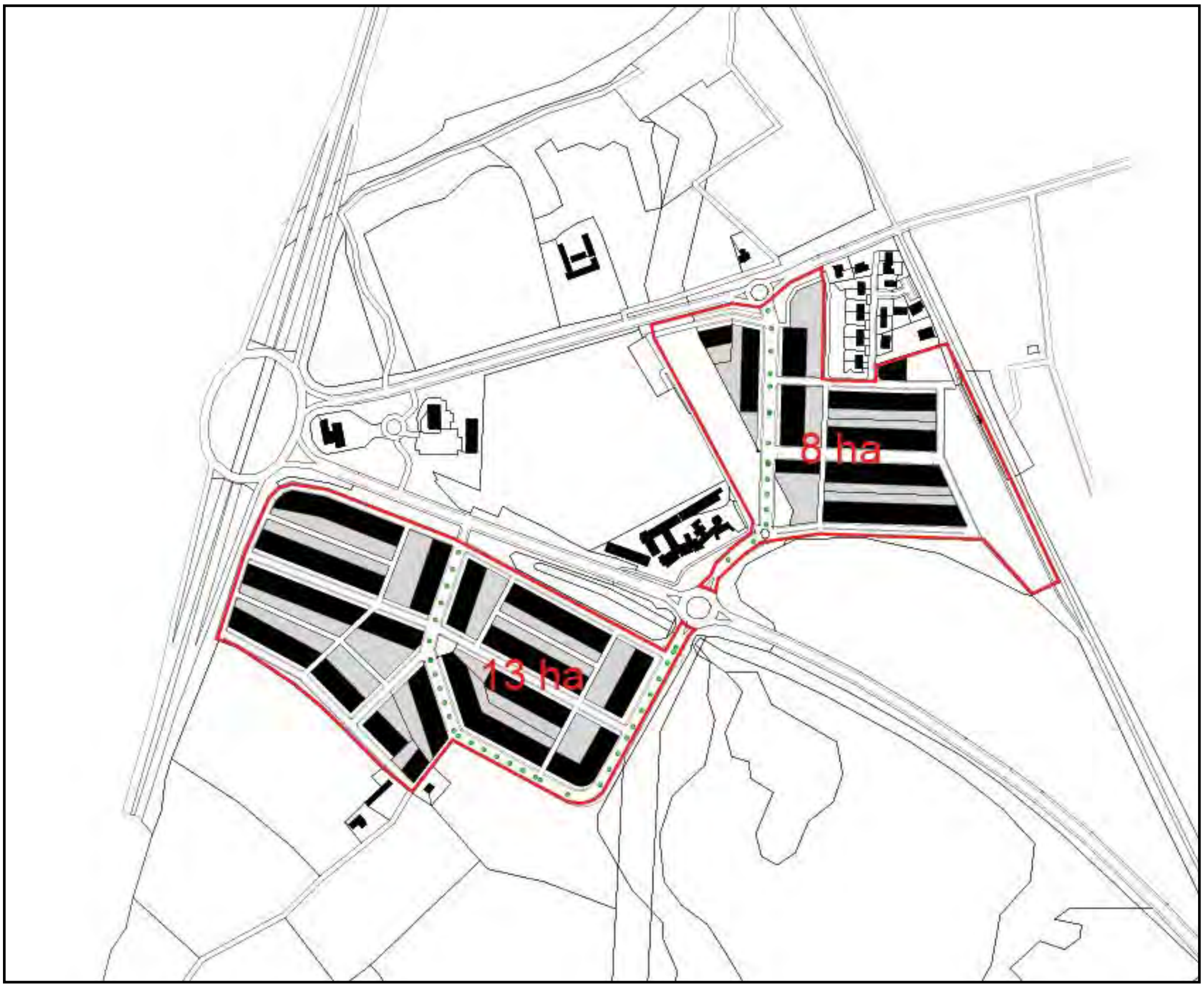


Figure 7.3 – Indicative layout of AMIC development

This additional development has been added to the 'Proposed+LDP1+LDP2' scenario and the model outputs of which have been compared to the 'Base' scenario in Section 4.3 to 4.6.

7.2.2. Bellfield East (Kirklandside / Kaimshill) Trip Generation and Distribution

7.2.2.1. Trip Rates

The proposed uses and gross floor areas for AMIC are summarised in Table 7.5 below.

Table 7.5 – AMIC Proposed Land Uses

Location	Use	TRICS land use	GFA (m²)
Land between A71 and A76 **(Phase 1)**	Class 4, 5, 6	Science Park (Cambridge)	18,000
	Class 1, 2, 3	Local Shops	1,000
	Class 7	Hotels	1,000
Land south of A76 **(Phase 2)**	Class 4, 5, 6	75% Science Park (Cambridge)	33,750
		20% Warehousing (Commercial)	9,000
		5% Industrial Estate	2,250

Referring to the proposed use of Phase 1 and Phase 2 of the AMIC development, trip rates have been extracted from the TRICS database (TRICS 7.8.4) in a bid to apply the most appropriate TRICS land use to each site. Table 7.6 below details the trip rates that have been extracted from TRICS to be applied to the proposed sites within Phase 1 and Phase 2 of AMIC.

Table 7.6 – AMIC Proposed Trip Rates (TRICS)

	AM Peak		PM Peak	
	Arr	Dep	Arr	Dep
TRICS - 02_B - Science Park (Cambridge) *(per 100 m²)*	0.837	0.104	0.034	0.547
TRICS - 01_1 - Shopping Centre - Local Shops *(per 100 m²)*	2.609	2.338	4.332	4.695
TRICS - 06_A - Hotels *(per 100 m²)*	0.256	0.344	0.212	0.196
TRICS - 02_F - Warehousing (Commercial) *(per 100 m²)*	0.168	0.092	0.076	0.159
TRICS - 02_D - Industrial Estate *(per 100 m²)*	0.172	0.066	0.054	0.156

7.2.3. Trip Generation

The proposed trip generation for AMIC phases 1 and 2 is detailed in Table 7.7 below, in which the gross floor area has been applied to the TRICS rates to determine the individual trip generations for each of the two phases.

Table 7.7 – AMIC Proposed Trip Generation

Location	Use	TRICS land use	GFA (m²)	AM Peak		PM Peak	
				Arr	Dep	Arr	Dep

Land between A71 and A76 (Phase 1)	Class 4, 5, 6	Science Park (Cambridge)	18,000	151	19	6	98
	Class 1, 2, 3	Local Shops	1,000	26	23	43	47
	Class 7	Hotels	1,000	3	3	2	2
			Phase 1 - Total	**179**	**46**	**52**	**147**
Land south of A76 (Phase 2)	Class 4, 5, 6	75% Science Park (Cambridge)	33,750	282	35	11	185
		20% Warehousing (Commercial)	9,000	15	8	7	14
		5% Industrial Estate	2,250	4	1	1	4
			Phase 2 - Total	**301**	**45**	**20**	**202**

7.2.4. Trip Distribution

The AMIC trip distribution has been applied using the same methodology as set out in Section 3.4. In the case of AMIC the distribution is based on the arrival and departure data of the *Earlston and Hurlford Rural* ward (datashine dot) which is the closest to the proposed development location. This trip distribution is summarised in Table 7.8 below and has been applied to the AMIC generated trips prior to input to the microsimulation model.

Table 7.8 – AMIC Proposed Trip Distribution

Ward (Data Shine dot)	% Direction Arrivals			
	% N	% S	% E	% W
Earlston and Hurlford Rural	32%	26%	16%	26%
	% Direction Departures			
	% N	% S	% E	% W
	30%	16%	3%	51%

7.2.5. Bellfield East (Kirklandside / Kaimshill) Flows

As detailed in Table 7.9 the 'Proposed+LDP1+LDP2+AMIC1+2' flows in the AM and PM are approximately 14% and 19% higher than the 'Base' scenario. Owing to the signalisation of Bellfield this proposed scenario (with AMIC phases 1+2) can be accommodated in addition to the LDP1 and LDP2 scenarios.

Table 7.9 – AM & PM Kirklandside / Kaimshill Flows Summary (vehicles)

Junction Arm	AM		PM	
	Base	Proposed +LDP1 +LDP2 +AMIC1+2	Base	Proposed +LDP1 +LDP2 +AMIC1+2
From Arm A - A77 North	1104	1097	945	959
From Arm B - A71 Riccarton Road	598	640	538	832
From Arm C - A76	462	634	530	786
From Arm D - A77 South	227	363	221	441

From Arm E - A71 Hurlford Road	872	792	909	888
From Arm F - A735 Queen's Drive	679	958	827	852
Total	**3942**	**4484**	**3970**	**4712**

7.2.6. Bellfield East (Kirklandside / Kaimshill) Queues

As detailed in Table 7.10 the 'Proposed+LDP1+LDP2+AMIC1+2' queue lengths are similar to the 'Base' scenario in most instances apart from the A71 Hurlford Road arm during the AM peak (increase of approximately 200m), and the A71 Riccarton Road and A76 arms during the PM peak (increase of approximately 400m).

Table 7.10 – AM & PM Kirklandside / Kaimshill Queues Summary (metres)

Junction Arm	AM		PM	
	Base	Proposed +LDP1 +LDP2 +AMIC1+2	Base	Proposed +LDP1 +LDP2 +AMIC1+2
	Average Queue			
Arm A - A77 North	120	79	261	26
Arm B - A71 Riccarton Road	207	286	40	419
Arm C - A76	80	142	19	485
Arm D - A77 South	10	3	3	5
Arm E - A71 Hurlford Road	89	307	401	321
Arm F - A735 Queen's Drive	16	51	124	123

7.2.7. Bellfield East (Kirklandside / Kaimshill) Journey Times

As detailed in Table 7.11 the proposed journey times are in most cases similar to the base. Journey time increases greater than two minutes have been highlighted red. These longer journey times are those travelling from the A71 Hurlford Road in the AM and from the A71 Riccarton Road and A76 in the PM. These journey time increases correlate with the longer queue lengths presented in Table 7.10 for these three arms of the Bellfield Interchange.

Table 7.11 – AM & PM Kirklandside / Kaimshill Journey Times Summary (minutes)

	Journey Time Route	AM		PM	
		Base	Proposed +LDP1 +LDP2 +AMIC1+2	Base	Proposed +LDP1 +LDP2 +AMIC1+2
1a	A77 (N) to A71 (E)	03:12	03:45	04:30	03:11
1b	A71 (E) to A77 (N)	05:12	07:42	03:39	08:08
2a	A77 (N) to A76	04:10	04:57	05:21	04:19
2b	A76 to A77 (N)	05:58	06:32	04:02	08:33
3a	A77 (N) to A71 Hurlford Road	03:50	05:07	05:05	04:26
3b	A71 Hurlford Road to A77 (N)	03:39	06:22	06:14	06:53

4a	A77 (N) to A735 Queen's Drive	03:38	05:13	04:58	04:28
4b	A735 Queen's Drive to A77 (N)	02:46	02:41	05:19	03:48
5a	A77 (S) to A71 (E)	02:58	04:04	02:41	03:26
5b	A71 (E) to A77 (S)	04:29	06:02	02:55	06:47
6a	A77 (S) to A76	04:04	04:52	03:30	04:24
6b	A76 to A77 (S)	05:16	05:00	03:20	07:14
7a	A77 (S) to A71 Hurlford Road	03:01	02:38	02:40	02:40
7b	A71 Hurlford Road to A77 (S)	03:30	06:53	06:06	07:14
8a	A77 (S) to A735 Queen's Drive	02:50	02:49	02:35	02:42
8b	A735 Queen's Drive to A77 (S)	02:40	04:10	05:14	06:25

While some of the proposed journey times are twice as long as currently experienced in the base model, they are not deemed a significant impact as each of the routes are 3km in length and the proposed signalisation of a junction inherently causes benefits to some movements and disbenefits to others as the traffic demand and delay is balanced across the whole junction.

7.2.8. Bellfield East (Kirklandside / Kaimshill) Network Performance

The Network Performance results for the base and proposed scenarios are summarised below in Table 7.12. As can be seen the changes to the Network Performance statistics are not deemed problematic and the proposed scenario results are reflective of the higher demand and vehicular throughput over that of the base. Overall, the Network Performance results indicate that the proposed signalised Bellfield Interchange model operates well in the 'Proposed+LDP1+LDP2+AMIC1+2' AM and PM scenarios in terms of:

1. Delay (141 and 189 seconds per vehicle in the AM and PM respectively);
2. Stops (6 and 10 stops per vehicle in the AM and PM respectively); and
3. Speed (21 and 17 mph in the AM and PM respectively).

Table 7.12 – AM & PM Kirklandside / Kaimshill Network Performance Summary

Network Performance KPI	AM		PM	
	Base	Proposed +LDP1 +LDP2 +AMIC1+2	Base	Proposed +LDP1 +LDP2 +AMIC1+2
Delay *(average delay per vehicle)*	69	141	123	189
Stops *(average number of stops per vehicle)*	4	6	9	10
Speed *(average speed (mph))*	31	21	24	17
Delay Stopped *(average standstill time per vehicle)*	16	75	29	90
Distance *(total distance travelled by all vehicles)*	16940	16376	17832	17346
Travel Time *(total travel time of vehicles)*	1211603	1792688	1660040	2250554
Delay	327266	782237	641289	1144530

(total delay of all vehicles)				
Stops *(total number of stops of all vehicles)*	18446	34018	48442	59612
Delay Stopped *(total standstill time of all vehicles)*	76279	413638	153175	544364
Vehicles (active) *(total number of vehicles in the network at the end of the simulation)*	425	634	584	804
Vehicles (arrived) *(total number of vehicles which have already reached their destination and have been removed from the network before the end of the simulation)*	4317	4920	4613	5252
Delay (latent) *(total delay of vehicles that could not be used (immediately))*	1574	8511	4195	34828
Demand (latent) *(number of vehicles from vehicle inputs that could not be used until the end of the simulation)*	0	14	5	37

7.2.9. Bellfield Queuing information

Queue lengths for the six arms of the Bellfield Interchange are summarised below in Table 7.13 and

Table 7.14. Each of the scenarios include indicative queue lengths without any reductions to flows applied associated with the targeted reduction in vehicle kms from both Local Authority and Scottish Government. The 'Base' scenario is the junction as it currently operates, while the 'Proposed' scenarios are with the proposed signalisation mitigation.

In the AM the proposed scenarios with LDP1 and LDP2 operate with little queuing apart from the A71 Hurlford Road arm which indicates queuing of over 400m on approach to the roundabout. When the AMIC1+2 development is added this Hurlford Road queuing extends further to approximately 700m, while the queuing on the remaining arms is 300m or less.

In the PM proposed scenarios the heaviest queuing occurs in the 'AMIC1+2' scenario on the A77 North, A71 Riccarton Road, A76 and A71 Hurlford Road arms for which queues occur of approximately 400m to 600m in length.

The Bellfield mitigation also includes the lengthening of the A77 southbound slip (Arm A – A77 North) to a Parallel Diverge of 780m slip road length, therefore the modelled PM average queue of around 500m can be accommodated during the 'Proposed+LDP1+LDP2+AMIC1+2' scenario, and certainly managed by the inclusion of queue monitoring on this key approach to the Bellfield Interchange.

Table 7.13 – AM Bellfield Queues Summary (metres)

Scenario	AM					
	Arm A - A77 North	Arm B - A71 Riccarton Road	Arm C - A76	Arm D - A77 South	Arm E - A71 Hurlford Rd	Arm F - A735 Queen's Dr
Base	120	207	80	10	89	16
Proposed+LDP1	32	37	19	7	418	60

Proposed+LDP1+LDP2 third phase	33	40	22	8	439	84
Proposed+LDP1+LDP2 third phase+AMIC1+2	93	300	151	9	710	96

Table 7.14 – PM Bellfield Queues Summary (metres)

Scenario	PM					
	Arm A - A77 North	Arm B - A71 Riccarton Road	Arm C - A76	Arm D - A77 South	Arm E - A71 Hurlford Rd	Arm F - A735 Queen's Dr
Base	261	40	19	3	401	124
Proposed+LDP1	458	30	20	14	340	154
Proposed+LDP1+LDP2 third phase	495	33	24	21	350	177
Proposed+LDP1+LDP2 third phase+AMIC1+2	493	410	495	14	571	215

7.2.10. Partial dualling the A71 and A76

In order to accommodate the further development of the lands south of the A76 (i.e. development beyond the 45,000m² accounted for in Phase 2) consideration should be given to the partial dualling of the A71 and A76 on the approach to the Bellfield Interchange from the two access roundabouts. These would likely best operate as a lane gain from the Phase 1 and Phase 2 development sites using a segregated left turn slip (from the site accesses to the A71 (W) and A76 (W) arms) at the proposed roundabouts. This would facilitate vehicular movements exiting from the sites travelling in the direction of the Bellfield Interchange. This would in effect dual the A71 and A76 approaches to the Bellfield Interchange for approximately 600m and 750m respectively. This mitigation could be considered to enhance the road capacity in the local area immediately adjacent to the development sites when seeking to unlock the remaining development lands south of the A76 (i.e. development beyond the 45,000m² accounted for in Phase 2).

7.2.11. Additional Benefits of the Mitigation

In terms of what the improvement to the junction delivers there are benefits beyond the increased throughput of the junction which would also align with the hierarchical approach to considering transport modes and the wider drive towards traffic safety which emerges from the STPR trunk road investment.

Specifically upgrading the junction to signal control alongside the provision of new segregated NMU connection is able to:

- Remove of walking, wheeling and cycling movements from the junction, thus removing vehicle conflicts with these users;
- Facilitate the introduction of detectors on the A77 off slips as part of the signalisation which would allow queue management measures to be implemented – these would allow a green signal to be given to these movements in the event queues extend back close to the main road carriageway;
- Allow the road authority to manage all traffic through the junction prioritising what are considered key routes and not simply the highest demand by managing the signal timings – this could include bus priority measures if desirable in future;
- Help to reduce vehicle speeds through the junction and hence the risk of high speed collisions; and
- Encourage more trips by sustainable modes by providing a safe, attractive NMU routes across the A77.

7.3. Summary

A detailed analysis of the performance of the Bellfield Interchange has been undertaken to test performance with the additional traffic associated with the proposed Local Development Plan allocation.

The proposed mitigation, in the form of signalisation of the Bellfield Interchange and extension of the A77 southbound offslip to a parallel diverge is appropriate to accommodate the traffic growth associated with LDP1, LDP2 and AMIC Phase 1 + 2 as well as providing additional benefits in terms of safety, pedestrian and cyclist safety and management of traffic through the junction.

8. Summary and Conclusion

8.1. Summary

Atkins was commissioned by EAC to undertake a transport appraisal in order to consider the cumulative impacts of potential development opportunity sites for inclusion in the Proposed East Ayrshire Local Development Plan 2 (LDP2) and legacy sites contained in the adopted (2017) East Ayrshire Local Development Plan (LDP1) on the trunk and main road network within East Ayrshire (primarily the A71, A76 and A77 corridors and in Stewarton town centre).

As part of this study Atkins has developed microsimulation models for ten junctions on the A71, A76, A77 corridors and in Stewarton town centre to be used to assess the proposed impacts of the LDP and test the proposed mitigations (when required) at these junctions to offset the likely impacts. One of these microsimulation models was for the Bellfield Interchange which was the biggest junction within the study and the subject of the points raised by TS.

In consultation with EAC and TS to discuss the results and findings of the transport appraisal this document has been prepared to assess the impacts of the traffic demand contained within the '*Proposed+LDP1+LDP2*' scenario.

This report sets out the rationale to managing demand within the future LDP scenarios, commitments to support and develop active travel and public transport facilities within the LDP and robust approach of the transport appraisal, to support the Scottish Government commitment to reduce car kilometres travelled by 20% by 2030 as included in the update to the Climate Change Plan (CCP). Applying such a reduction to the traffic through the Bellfield *'Proposed+LDP1+LDP2*' scenario inputs is considered not only appropriate but also a realistic and proportionate assessment of the likely effects on the LDP on the transport network.

The transport modelling has identified that the majority of the network is able to accommodate the predicted levels of traffic expected to occur in the future scenarios with mitigation identified at 4 locations including the Bellfield interchange.

In the development of the mitigation options it was considered that the proposed measures have not simply been identified as a case of providing for the anticipated demand whereby the provision of greater road capacity would result in the attraction of more traffic and risk undermining the traffic reduction strategy with the local and national policy but has sought to manage delays, congestion, resilience and road safety through appropriate mitigation whilst not adversely impacting other road users.

8.2. Conclusion

The detailed modelling of the transport network has been undertaken at the locations identified below.

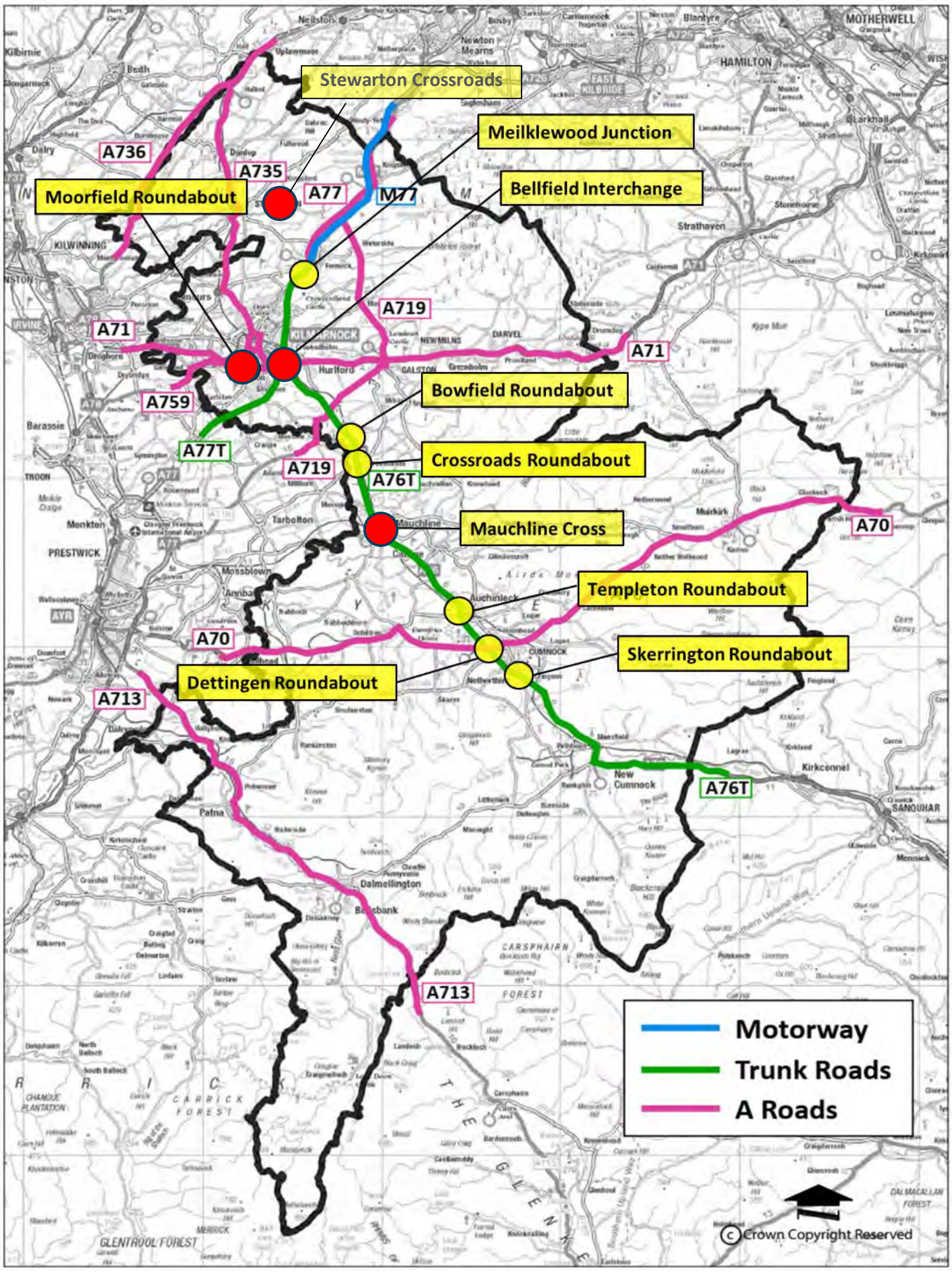


Figure 8.1 – Junctions requiring mitigation within the LDP

The assessment has shown that mitigation works are only required at the following locations:

- Moorfield Roundabout – introduction of 2 left turn slip lanes;
- Mauchline Cross – upgrade of signals to latest MOVA and equipment;
- Stewarton Crossroads – upgrade of signals to latest MOVA and equipment; and
- Bellfield Interchange – signalisation, widening, queue detection and pedestrian/cycle overbridge.

The modelling of the Bellfield Interchange modelling indicates that signalisation should be implemented prior to traffic levels being at the levels which could occur with LDP1 development. Based on the information presented in this note this should be delivered in advance of completion of Phase 1 of LDP2 anticipated to be within 1-3years of the LDP being adopted.

Appendix A. Proposed Trip Rates and Modelling Methodology

Technical Note

Project:	East Ayrshire Local Development Plan		
Subject:	Proposed Trip Rates and Modelling Methodology		
Author:	Kenny Fearnside		
Date:	06/09/2021	Project No.:	5208398.020
Atkins No.:	TN002		
Distribution:	Karl Doroszenko Kerr Chalmers Deborah Livingstone Amy Phillips	Representing:	East Ayrshire Council Ayrshire Roads Alliance Transport Scotland Transport Scotland

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Draft for comment	LB	KF		KF	03/09/2021

Client signoff

Client	East Ayrshire Council
Project	East Ayrshire Local Development Plan
Project No.	5208398.020
Client signature / date	

1. Background

Atkins has been commissioned by East Ayrshire Council (EAC) to provide consultancy services in relation to the transport appraisal of the East Ayrshire Proposed Local Development Plan (LDP). The study requires the undertaking of a transport appraisal in order to consider the cumulative impacts of potential development opportunity sites for inclusion in the Proposed East Ayrshire Local Development Plan 2 (LDP2) and legacy sites contained in the adopted (2017) East Ayrshire Local Development Plan (LDP1) on the trunk and primary road network within East Ayrshire, as shown in Figure 1 below.

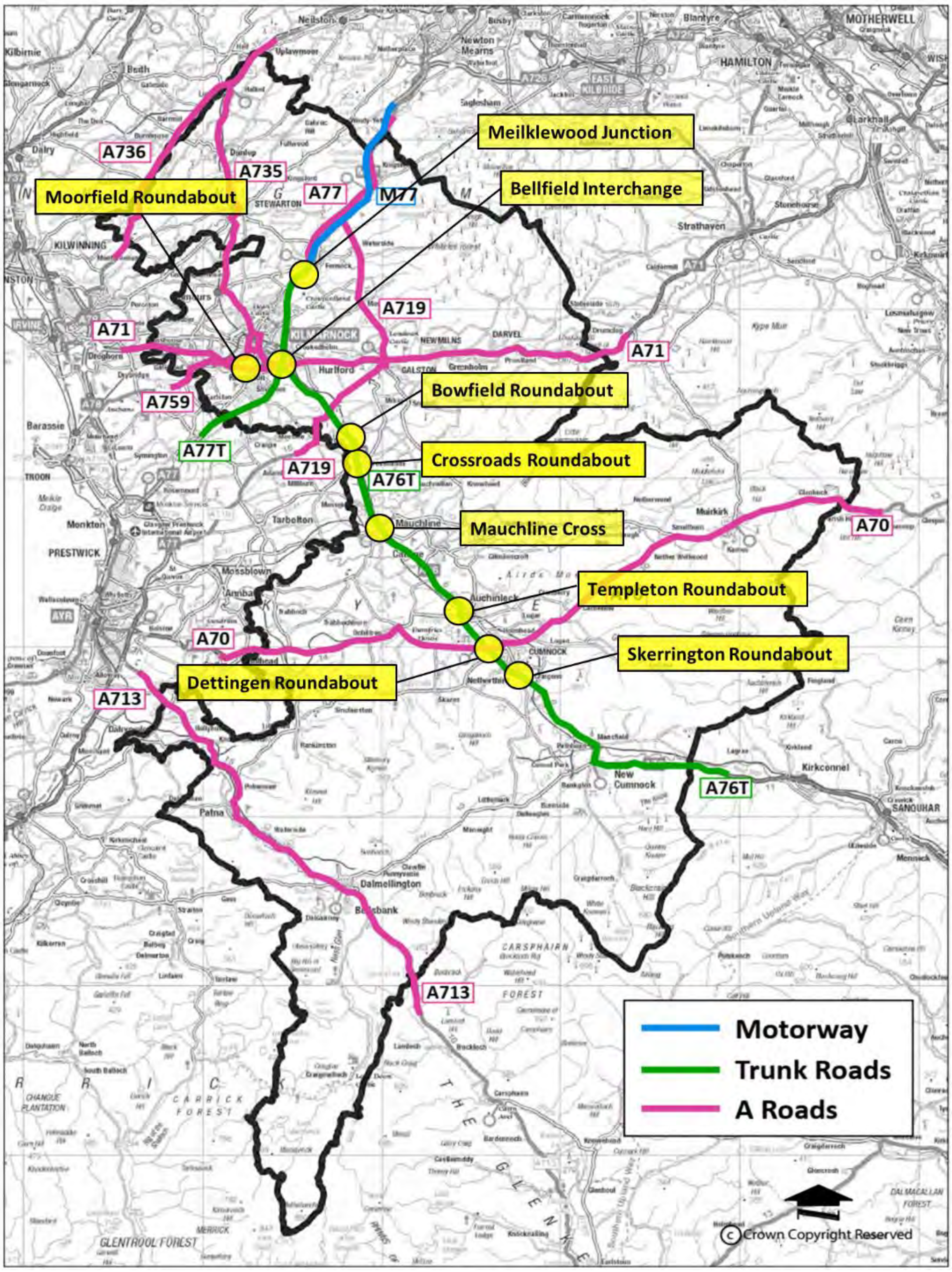


Figure 1 - East Ayrshire Road Network & Junctions

2. Modelling Approach and Methodology

2.1. Our Approach

There are a number of stages to the completion of the transport modelling and we set out below our proposed approach to each key stage of the model process. Our approach has bene developed in response to the requirements of this LDP modelling to facilitate adaptability and flexibility so that key assumptions can be updated easily where required. It is also intended that as much as possible results from data analysis and assessments will be presented graphically / visually which will make the outputs easy to interpret.

2.2. Base Traffic Flow Diagrams

Key Output –Development of base traffic flows diagrams for the study area.

In order to undertake the assessment it is necessary to develop a baseline traffic network for the main study area. This will draw on a mix of sources to identify appropriate (pre pandemic) traffic patterns across the East Ayrshire area. We are aware that there are a number of locations where traffic count data is accessible from a mix of data held by EAC, including JTC and ATC data along with a range of counts on the Department for Transport (DfT) Road Traffic Statistics website. We would also likely seek data from TS for the trunk road counters on the roads within the study area.

It is recognised that the traffic data obtained from the various sources would not be consistent in terms of the survey month and year. It is therefore proposed to agree a baseline month and year (e.g. November 2019) with appropriate growth and seasonality factors applied to data sources to achieve a consistent baseline for the base year traffic flows.

As part of this baseline review any committed development i.e. that built out since the data was gathered will be added to the network using data from relevant planning consents known to East Ayrshire Council.

In accordance with EAC's requirements the base year flows will be grown to 2023 (when the LDP2 is to be adopted) and to 2033 (i.e. 2023 + 10 years). These assessment years will be the basis for a number of different scenarios to cover different levels of build-out of the LDP2 sites.. The weekday AM and PM network peaks will be assessed with respect to cumulative impact on the trunk road network.

Network flow diagrams for agreed base and future years will be provided.

2.3. Modelling Approach

Key Output – Development of calibrated and validated base year models for key junctions included within the study area.

Base Models – in order to provide a consistency of approach across the study area it is proposed that all junctions within the modelled network are modelled using the VISSIM microsimulation software. The reasoning for this is that prior experience has indicated that ARCADY can underestimate (or overestimate) levels of delay and queues and the use of microsimulation modelling provides a more accurate representation of the performance of junctions (compared to ARCADY) as well as allowing the user to visualise the build-up of queuing on the different arms of the junction. As the Bellfield Interchange requires to be modelled using microsimulation techniques the application of a consistent model approach across the study area also allows for consistent junction performance to be provided across the study network.

All models will be provided with calibration and validation reports, which will outline the calibration and validation data used to assess the junction. This will be a mix of East Ayrshire Council and the project team's knowledge of the junction performance alongside any quantitive information which is available e.g. queue data and journey times.

It is understood from feedback received from Transport Scotland's consultant Amey that there is a concern about the relevance of the existing Paramics model of the Bellfield interchange which was originally prepared some 12 years ago and may therefore not be considered 'fit for purpose' in assessing the current LDP. As a result it is proposed to develop a new VISSIM model of the junction which will be based on 2019 traffic count data collected by EAC which included journey time and queue information. Given the critical nature of this junction within the study there will be a standalone calibration and validation report specifically for the Bellfield Interchange.

All modelling assessments will be undertaken with queue length analysis and comparisons between the different scenarios. If necessary where models show congestion occurring, further analysis in the form of journey times will also be undertaken. With the current list of stand-alone junctions, it does not appear that any blocking back to upstream junctions would occur and as such not connection between the models is currently proposed.

Scenario Testing and Modelling Outputs

Key Output – Assessment and reporting of the impact of development sites on key junctions included within the study area.

Scenario Testing – The base modelling will be used to develop and assess the impact of the six proposed scenarios as set out in the brief for the proposed assessment years and network peak periods. The proposed scenarios are summarised in Table 2.1.

Table 2.1 - Scenario Testing

Scenario No.	Base Flows	Committed Development	LDP1	LDP2	AGD (Committed and Optional Sites)	Area East of Bellfield Interchange
1	✓	✓				
2	✓	✓	✓	✓		
3	✓	✓			✓	
4	✓	✓				✓
5	✓	✓	✓	✓	✓	
6	✓	✓	✓	✓	✓	✓

All scenario results will be compared with each other and the baseline, with comparison analysis provided. Key modelling results will include:

- Network performance;
- Delays; and
- Queue lengths.

The results of this assessment will provide an indication of the predicted performance of the junctions and where mitigation may be required at a junction to improve performance.

3. Trip Rates and Distribution

3.1. Introduction

EAC has provided a spreadsheet with the proposed sites to be included in this assessment which is to cover four main plans:

1. LDP 1;
2. LDP 2;
3. AGD (Committed and Optional Sites); and
4. Area East of Bellfield Interchange.

The following sections of this technical note detail the proposed trip rates to be used, and how they are to be applied to the appropriate sites within each of the plans (thus determining the proposed trip generations). The proposed trip generations have been calculated for arrivals and departures during the AM and PM peak hours (0800-0900hrs and 1700-1800hrs).

3.2. Trip Rates

Referring to the proposed use of the sites which will be included across the LDP legacy sites and the LDP sites, trip rates have been extracted from the TRICS database (TRICS 7.8.2) in a bid to apply the most appropriate TRICS land use to each site. Table 2 below details the trip rates that have been extracted from TRICS to be applied to the sites.

Table 2 - LDP Proposed Trip Rates (TRICS)

	AM Peak		PM Peak	
	Arrivals	Departures	Arrivals	Departures
02_D - Industrial Estate *(per hectare)*	11.999	4.558	3.721	11.059
03_A - Houses privately owned *(per house)*	0.129	0.382	0.353	0.178
03_C - Flats privately owned *(per flat)*	0.06	0.209	0.188	0.087
12_A - Civic Amenity Site *(per hectare)*	91.411	82.618	56.701	67.01
12_C - Landfill *(per hectare)*	0.347	0.252	0.168	0.399
07_Q - Community Centre *(per hectare)*	23.973	2.74	20.588	14.706
07_M - Country Parks *(per hectare)*	0.89	0.623	1.423	0.89

The sites included in the LDP are made up of the following four use types:

1. Business / Industry;
2. Miscellaneous;
3. Residential; and
4. Waste.

The TRICS land use applied to *Business / Industry*, *Residential* and *Waste* was straightforward and is set out as follows:

- **Business / Industry**
  - TRICS 02_D - Industrial Estate *(per hectare)*
- **Residential**
  - TRICS 03_A - Houses privately owned *(per house)*
  - TRICS 03_C - Flats privately owned *(per flat)*
- **Waste**

- TRICS 12_A - Civic Amenity Site *(per hectare)*
- TRICS 12_C - Landfill *(per hectare)*

The TRICS land use applied to the any *Miscellaneous* sites will be more bespoke and relate specifically to the site under consideration.

3.3. Trip Distribution

Trip Distribution – Distribution patterns for each site will be established using Travel to Work Census Data and illustrated in QGIS. Consideration will be given to the travel to work patterns in the Middle-Layer Super Output Area (MSOA) each site is located within. The online platform “Datashine” will be used to interrogate the areas travelled to, and as such the road network used to facilitate these movements. These distribution patterns will then be incorporated into the network flow diagrams at the entry and exit points of the trunk road or main road network so that the proposed traffic from the various development sites are included in the transport appraisal.

4. Summary

4.1. Summary

This technical note has summarised the proposed approach to the LDP modelling and the suggested trip rates for all the main land uses included in the East Ayrshire LDP.

There remains a requirement to assess the Ayrshire Growth Deal sites and while data exists for the Cumnock site there will be a need to develop trip generation for others on a first principles basis. Once information on the locations and content to be assessed this can be developed and provided for review

Appendix B. Trip Distribution

Technical Note

Project:	East Ayrshire LDP Transport Appraisal		
Subject:	Trip Distributions and Direction of Travel for LDP Sites		
Author:	Eoan McTernan		
Date:	16/11/2021	Project No.:	5208398
Distribution:	Karl Doroszenko Kerr Chalmers Deborah Livingstone	Representing:	East Ayrshire Council Ayrshire Roads Alliance Transport Scotland

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
v1.0	EAC, ARA and TS comments	EM	LB			25/10/2021
v2.0	Revised after TS comments	EM	LB			16/11/2021

Client signoff

Client	East Ayrshire Council
Project	East Ayrshire LDP Transport Appraisal
Project No.	5208398
Client signature / date	

1. Background

East Ayrshire Council (EAC) has agreed with Transport Scotland to undertake a transport appraisal to assess the cumulative impacts of potential development sites on the trunk and main road network within East Ayrshire. One of the key aims of this study is to provide an indication of the level of developments and where these developments can be accommodated (i.e. spatial strategy) on the road network. However, in order to provide a steer on where potential developments site can be allocated, it is necessary to identify the potential impact of these developments on the road network and to investigate the cost of mitigating the impacts of the developments sites.

The purpose of the study is therefore to provide this supporting evidence which will provide EAC and key stakeholders an understanding of how the proposed development sites would impact on the road network and whether suitable mitigation can be provided with support from the development sites.

The study will take the form of a transport appraisal using a variety of data sources to develop traffic models for key junctions on trunk roads within East Ayrshire. The models will form the basis of assessing the impact of traffic generated by the proposed development sites including the identification of suitable improvements at these junctions to mitigate the impact of the developments.

Atkins has been commissioned by EAC to undertake the transport appraisal of the proposed Local Development Plan (LDP). As part of this study Atkins has developed a methodology to calculate trip generations for the sites proposed across LDP1 and LDP2. Specifically, this technical note demonstrates the trip distribution methodology for the sites listed within the two LDPs.

2. Trip Distribution Spreadsheet Development

2.1. Introduction

This section outlines the methodology used to determine and assess the likely directions of travel demand during the AM and PM peaks for each site.

2.2. Mapping to QGIS

Using the shapefile provided by East Ayrshire Council, each of the proposed sites within the Local Development Plan were mapped on QGIS. Figure 2-1 shows the sites distributed across the county of East Ayrshire.

There were four use types that the sites had been categorised into. These were:

- Busines / Industry;
- Miscellaneous;
- Residential; and
- Waste.

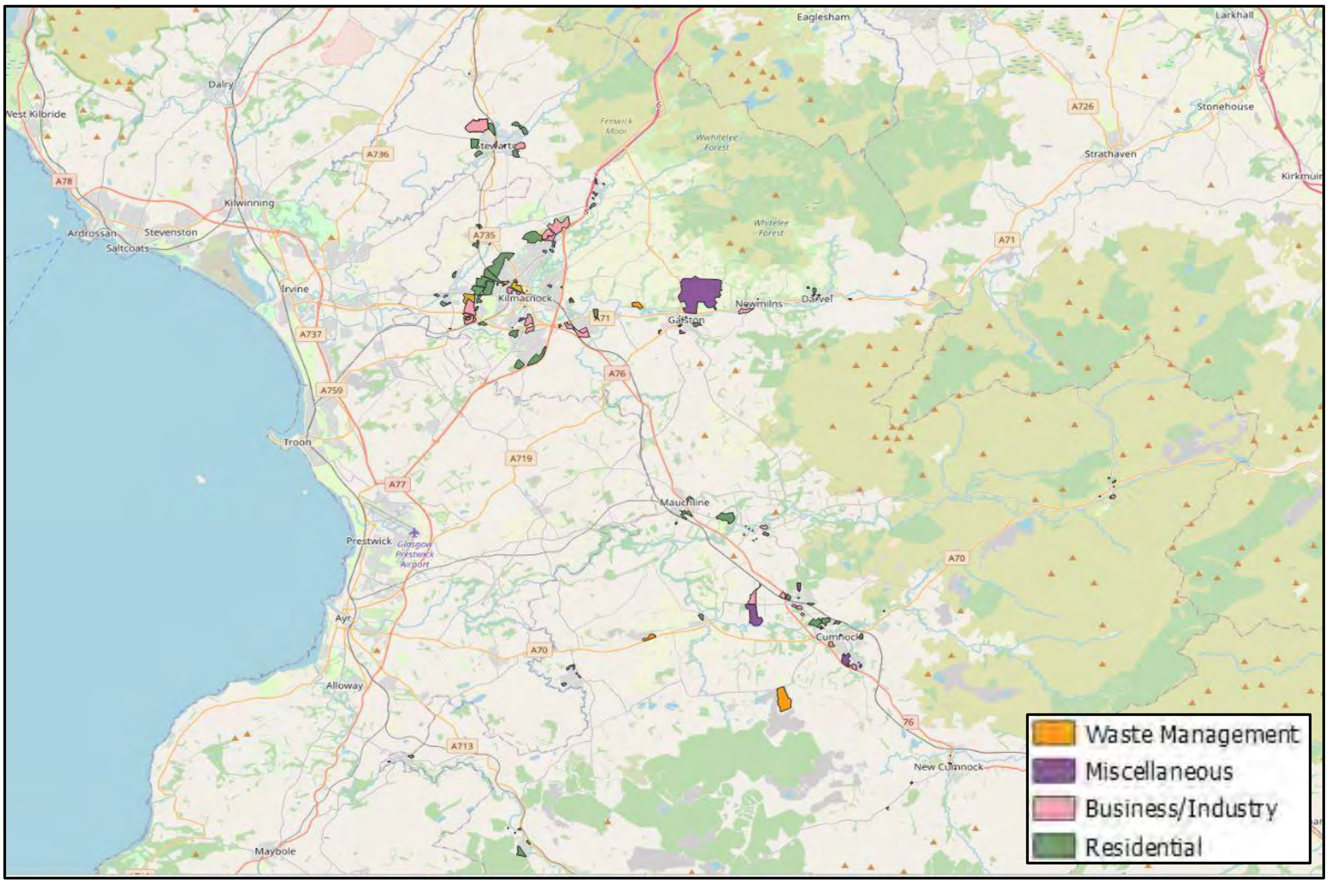


Figure 2-1 - GIS Map Showing LDP Sites

Using this data an initial Excel spreadsheet was created to list each site with its:

- Land use;
- Settlement location;
- Address;

- Number of units;
- Size in hectares; and
- Proposed number of houses and apartments (for Residential sites).

Using the above information, trip distributions / directions of travel for each of the proposed developments were determined using Datashine. In order to understand the AM / PM peaks, the TRICS database was interrogated using each site's land use and hectare size (or number of units) which identified the AM / PM peaks for arrivals and departures.

2.3. Data Shine Scotland

In order to distribute the flows for each proposed development the Datashine Scotland Commute website was used which enabled each site to be allocated to a specific electoral ward or 'Datashine Dot' to which they were closest to.

Each 'Dot' contained travel to work data from Scotland's Census, including arrivals and departures to and from other wards or 'Dots'. Each site (based on its location) within the proposed LDP was then assigned a 'Datashine Dot' and this information was used to distribute the proposed development flows onto the trunk road network. Figure 2-2 displays the 'Datashine Dots' distributed around the Kilmarnock area.

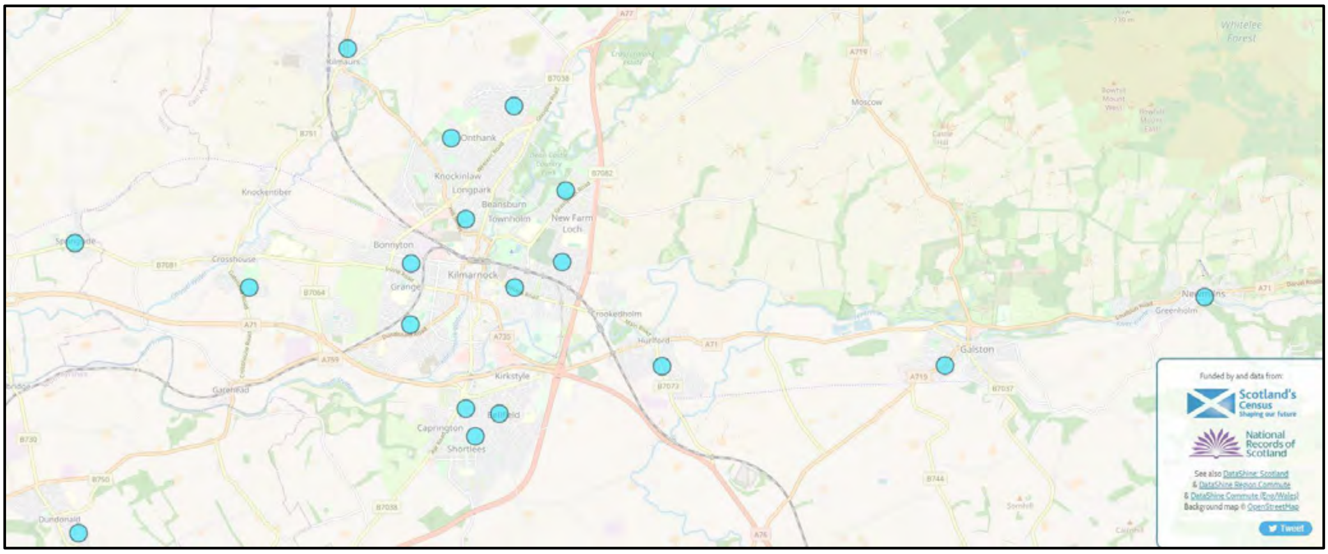


Figure 2-2 - Datashine Dots - Kilmarnock

2.4. Determining Overall Direction of Travel Percentages (by Ward)

There was a total of 31 wards / Datashine dots associated with the arrivals and departures of the sites. These wards are listed below in Table 2-1.

Table 2-1 - Wards / Datashine dots

No.	Ward Name
1	Altonhill North and Onthank
2	Altonhill South, Longpark and Hillhead
3	Auchinleck
4	Beith East and Rural
5	Bonnyton and Town Centre
6	Carrick North
7	Crosshouse, Gatehead and Kilmaurs Rural

8	Cumnock North
9	Cumnock Rural
10	Cumnock South and Craigens
11	Darvel
12	Dean and New Farm Loch North
13	Doon Valley North
14	Doon Valley South
15	Drongan
16	Earlston and Hurlford Rural
17	Galston
18	Grange, Howard and Gargieston
19	Kilmarnock South Central and Caprington
20	Kilmaurs
21	Mauchline
22	Mauchline Rural
23	New Cumnock
24	New Farm Loch South
25	Newmilns
26	Northern and Irvine Valley Rural
27	Piersland
28	Shortlees
29	Southcraig and Beansburn
30	Stewarton East
31	Stewarton West

Subsequently, the arrival and departure percentages (by direction) for each ward was extracted. Figure 2-3 shows the 'Shortlees' dot/ward as an example, which displays departure data in red and arrival data in blue. The data from the list below was used to determine a descending list of the most popular wards/dots that are travelled to and from the Shortlees area. Lines that indicated trips 'working from home', 'no fixed place', or within the selected ward, were removed to show only trips coming in or out of the area. This process was repeated for all 31 Dots / Wards.

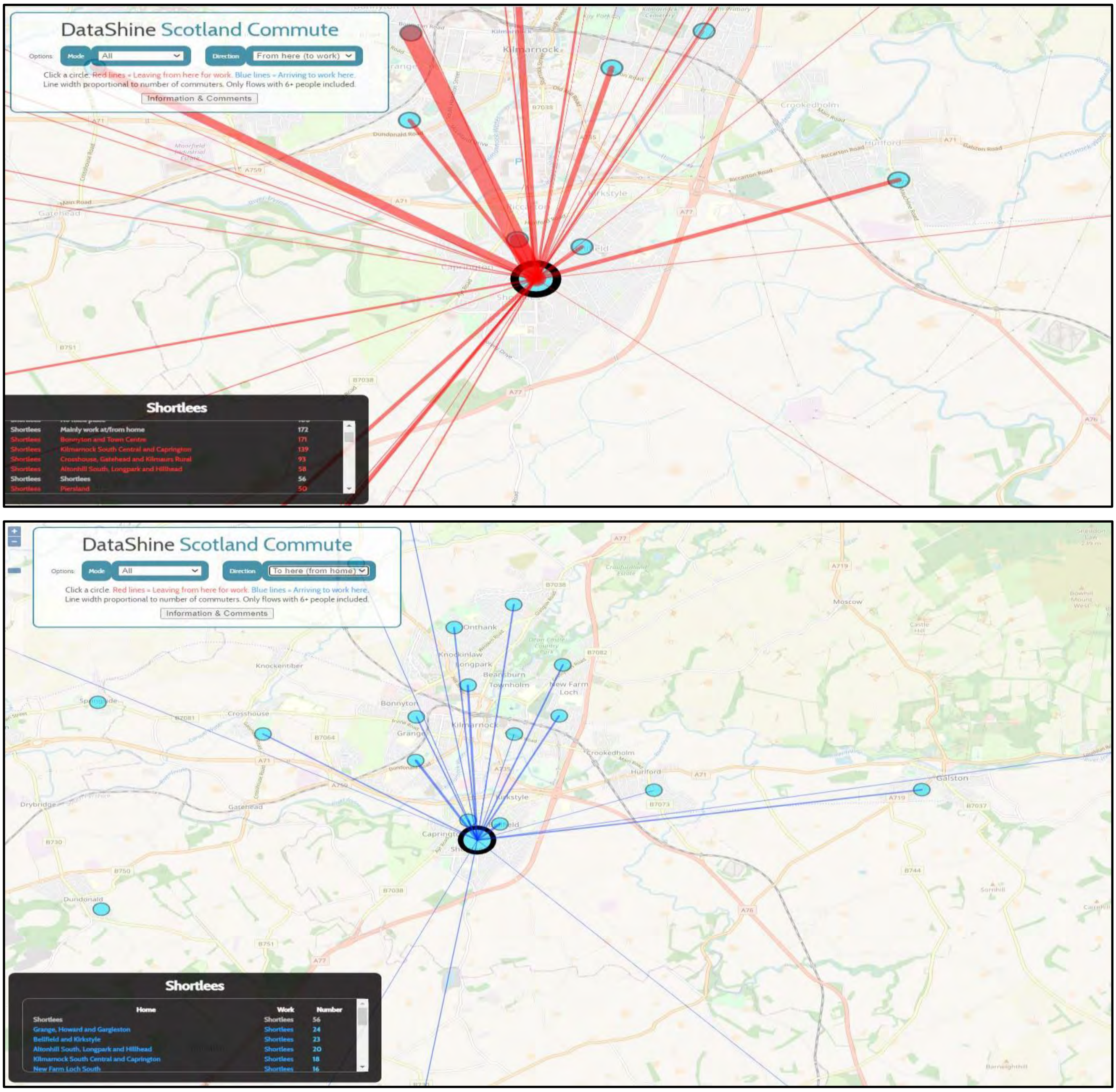


Figure 2-3 - Shortlees Departure Data (Red) and Arrival Data (Blue)

2.5. Finding the Direction of Travel

All 31 wards / dots have had their arrivals / departure data itemised to determine where the departing / arriving trips were travelling to and from in terms of direction on the trunk road network. For example, the first ward in alphabetical order, was *Altonhill North and Onthank* (North Kilmarnock). Figure 2-4 is an extract from the first three entries of the departures table for this ward / dot and it shows that the most travelled to ward for work was *Bonnyton and Town Centre* (also in Kilmarnock), which is located south of *Altonhill North and Onthank*. Departures were colour coded based on their direction of travel i.e. North (blue), East (green), South (red) and West (yellow).

Therefore, this was determined as 209 trips travelling south from this ward / dot toward *Bonnyton and Town Centre*. The total number of trips in each direction is then totalled at the bottom, so for *Altonhill North and Onthank*, this was 1174 departure trips, which was subsequently categorised into directions. The second table in Figure 2-4 shows the total departure trips for *Altonhill North and Onthank* categorised into directions. Finally, the percentage direction of travel was derived as:

- North - 193 trips (16%)
- East - 87 trips (7%)
- South - 724 trips (62%)
- West - 170 trips (14%)

This process was repeated for all of the 31 wards (and for arrivals) with the overall output as the percentage direction of travel for each ward, both for departures and arrivals. Once the percentages for the dots / wards were calculated they were assigned to the appropriate sites (based on the proposed sites proximity to the Datashine dots) as the assumed direction of travel.

Altonhill North and Onthank			Direction
Altonhill North and Onthank	Bonnyton and Town Centre	209	S
Altonhill North and Onthank	Kilmarnock South Central and Caprington	115	S
Altonhill North and Onthank	Crosshouse, Gatehead and Kilmaurs Rural	98	W

N	193	16%
E	87	7%
S	724	62%
W	170	14%
	1174	100%

Figure 2-4 - Extracts from Departures Spreadsheet

2.6. Calculating the Trip Distributions

The calculation of trip distributions was undertaken by using the assumed direction of travel percentages for each dot / ward and using each individual site's TRICS data to calculate the AM and PM peak arrivals / departures for each site. This was done by multiplying the sites TRICS peak with the percentage of trips from each direction. For example, in Figure 2-5, to find the first value – AM peak arrivals, 'Flow from North' (green) for the first site, the AM peak arrivals (127, far left) were multiplied by the percentage direction of arrivals from 'North' associated with the site's assigned Datashine Dot (16%).

This process can be summarised as – *AM / PM peak arrivals directional flow = Sites TRICS peak arrivals / departures x Datashine Dot Direction %*

This resulted in a calculation of 20 trips for that site, heading north, during the AM peak. This process was applied to AM / PM peak arrivals / departures for every site within the LDP.

AM Peak		PM Peak			Data Shine dot	Entry/Exit on TFD	% Direction Arrivals				% Direction Departures				AM Peak Arrivals				AM Peak Departures			
Arr	Dep	Arr	Dep				% N	% S	% E	% W	% N	% S	% E	% W	Flow from N	Flow from S	Flow from E	Flow from W	Flow to N	Flow to S	Flow to E	Flow to W
127	376	347	175		Altonhill North and Onthank		18%	52%	0%	32%	18%	82%	7%	14%	20	88	0	41	82	232	28	54
21	2	18	13	*100% 07_Q Com	Altonhill South, Longpark and Hillhead		26%	33%	17%	24%	25%	55%	6%	15%	5	7	4	5	1	1	0	0
41	29	66	41	*100% 07_M Cour	Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	2	37	1	2	14	10	0	6
7	21	20	10		Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	0	6	0	0	10	7	0	4
14	41	38	19		Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	1	12	0	1	20	14	0	8
2	6	6	3		Auchinleck		5%	88%	2%	5%	48%	33%	0%	19%	0	2	0	0	3	2	0	1
1	1	0	1		Beith East and Rural		42%	0%	31%	27%	57%	21%	5%	16%	0	0	0	0	0	0	0	0
1	3	3	2		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	0	0	0	0	1	1	0	1
9	27	25	13		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	2	3	2	2	9	10	1	6
19	55	51	26		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	5	6	4	4	19	21	3	12
77	70	48	57	*0.85ha Civic Ame	Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	19	24	17	17	24	28	4	15
0	0	0	0		Bonnyton and Town Centre		25%	31%	23%	22%	35%	38%	5%	22%	0	0	0	0	0	0	0	0
7	22	20	10		Carrick North		9%	72%	0%	19%	84%	14%	2%	0%	1	5	0	1	19	3	0	0
347	132	108	320		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	65	83	127	73	33	20	58	20
247	94	76	227		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	46	59	90	52	24	14	41	14
4	11	11	5		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	1	1	1	1	3	2	5	2
7	21	19	10		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	1	2	3	1	5	3	9	3
1	2	2	1		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	0	0	0	0	1	0	1	0
1	1	0	1		Crosshouse, Gatehead and Kilmaurs Rural		19%	24%	37%	21%	25%	15%	44%	15%	0	0	0	0	0	0	0	0
85	34	28	82		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	12	69	1	7	16	6	4	8
5	15	14	7		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	1	4	0	0	7	3	2	3
3	10	10	5		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	0	3	0	0	5	2	1	2
1	4	4	2		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	0	1	0	0	2	1	0	1
2	7	6	3		Cumnock North		13%	77%	1%	8%	47%	17%	13%	23%	0	2	0	0	3	1	1	2
1	4	4	2		Cumnock Rural		11%	78%	2%	9%	38%	9%	5%	48%	0	1	0	0	2	0	0	2
4	11	10	5		Cumnock Rural		11%	78%	2%	9%	38%	9%	5%	48%	0	3	0	0	4	1	1	5
267	101	83	246	*100% 02_D Indus	Cumnock South and Craigens		11%	84%	0%	5%	63%	4%	12%	21%	31	224	0	13	64	4	12	22

Figure 2-5 – Extract from Trip Distributions

3. Summary

Atkins has been commissioned by EAC to undertake a transport appraisal to assess the cumulative impacts of potential development sites on the trunk and main road network within East Ayrshire. The purpose of this study has been to provide supporting evidence which will provide EAC and key stakeholders with an understanding of how the proposed development sites would likely impact on the road network and whether suitable mitigation can be provided with support from the development sites.

This technical note has discussed the methodology of the trip distribution aspect of the appraisal. This involved mapping every proposed site onto QGIS and using the Datashine Scotland Commute website to understand the likely trip distributions for each site, based on the Wards that they are located in. Finally, the trip distribution data extracted from each Ward was combined with the TRICS data for each site to estimate the amount of proposed traffic flow on the road network and its direction of travel.

Traffic Flow Diagrams

Cov Vers Base AM

Key:
Manual Completion
Automatic Completion

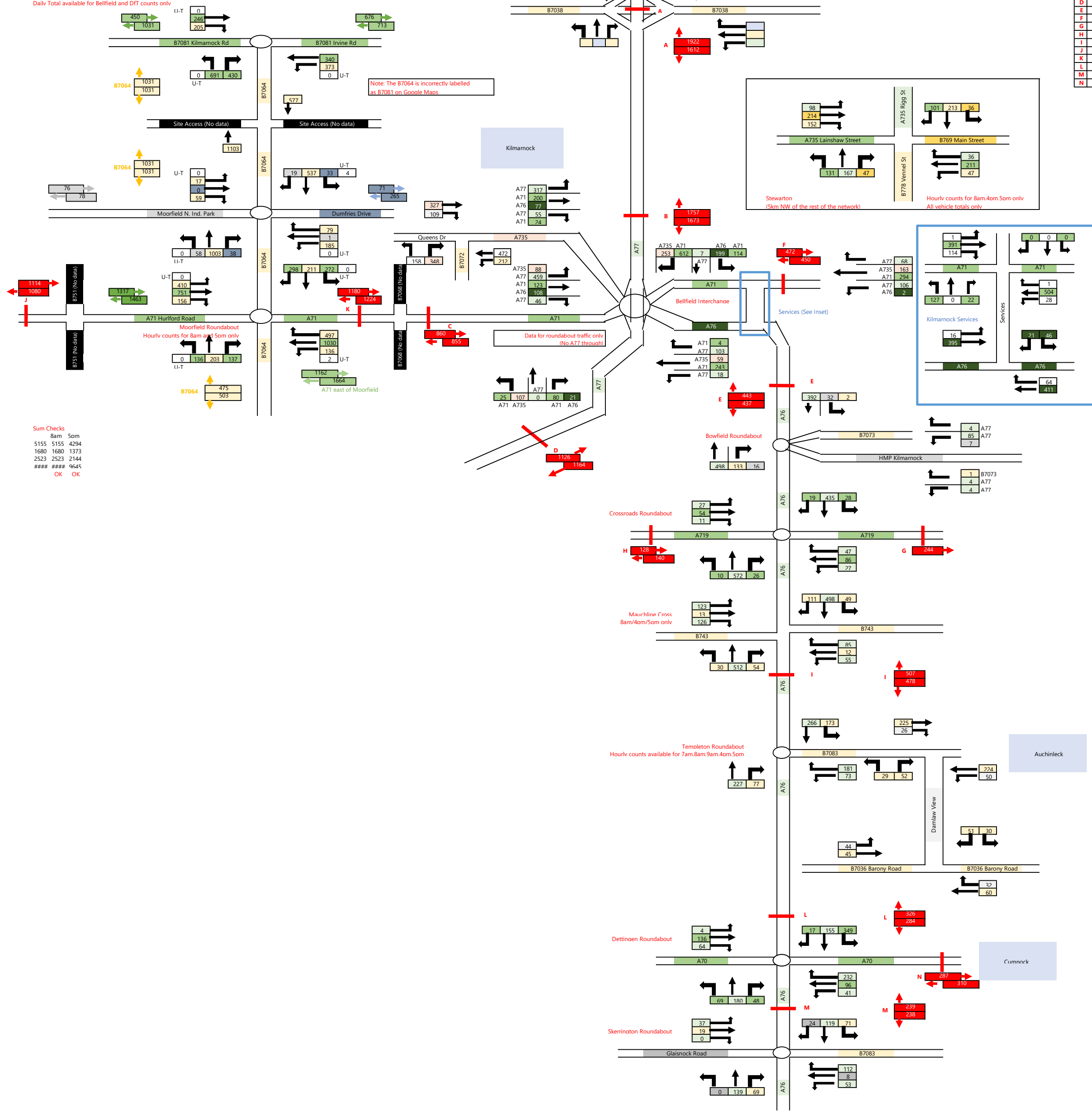
She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

Year	**2020 Pre-Covid (Uses 2019 DfT counts)**
Mode	**All Motor Vehicles**
Time	**Hour: 08:00 - 09:00**

2019 (2018 Hour Conv
2019B 1.00 1.00 0.1
13
10

DfT Counts available for Daily Total only (Red cells)
Daily Total available for Bellfield and DfT counts only

	DfT Site Results	
	NB or EB	SB or WB
A	1922	1612
B	1757	1673
C	860	855
D	1126	1164
E	443	437
F	472	450
G	244	
H	128	140
I	507	478
J	1114	1080
K	1180	1224
L	326	284
M	239	238
N	287	310



Cov Vers Base PM

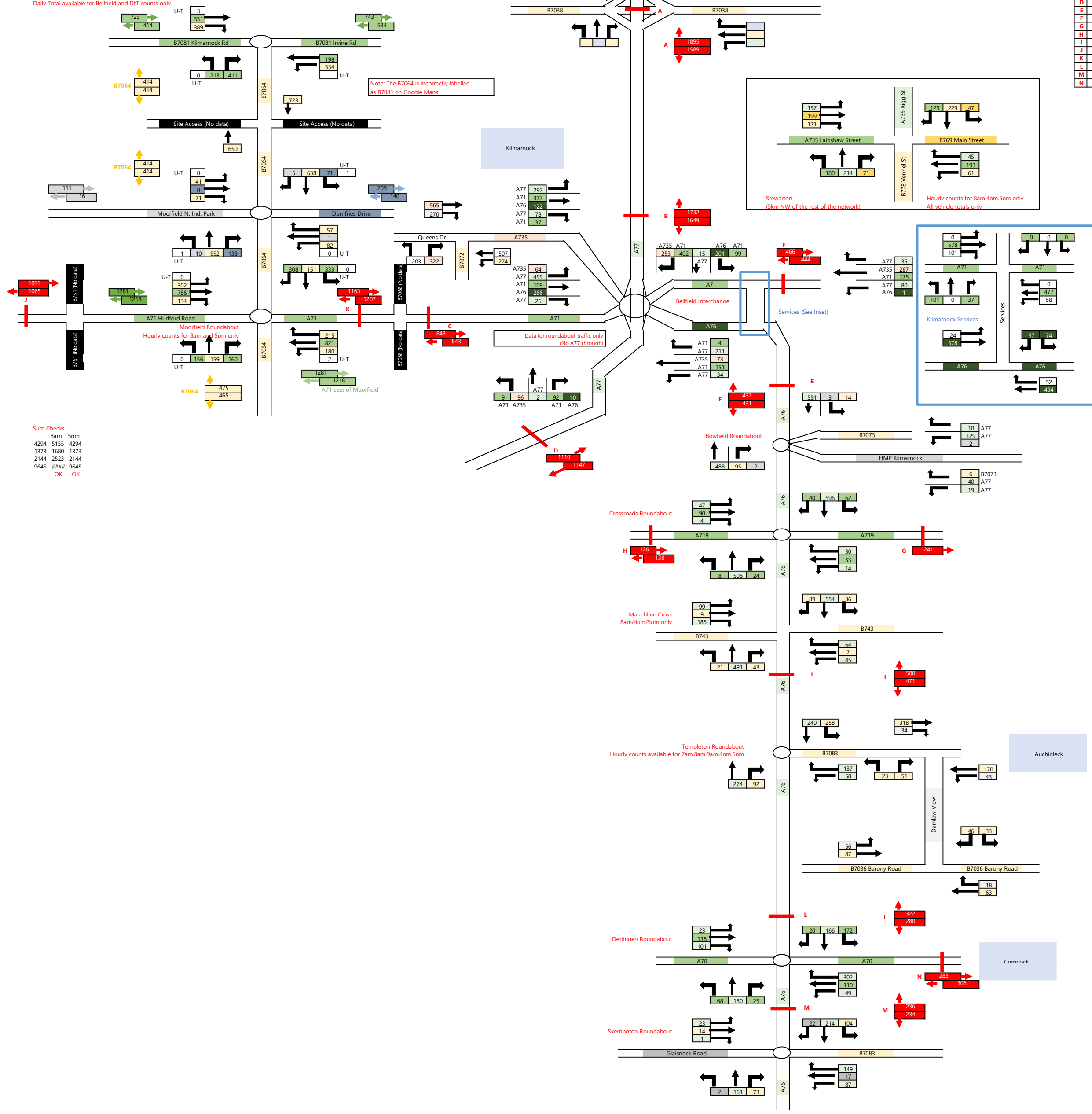
Key:
Manual Completion
Automatic Completion

She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

		2019 (	2018	Hour Conv
Year	**2020 Pre-Covid (Uses 2019 DfT counts)** 2019B	1.00	1.00	0.1
Mode	**All Motor Vehicles** 13			
Time	**Hour: 17:00 - 18:00** 19			

DfT Counts available for Daily Total only (Red cells)
Daily Total available for Bellfield and DfT counts only

	DfT Site Results	
	NB or EB	SB or WB
A	1895	1589
B	1732	1649
C	848	843
D	1110	1147
E	437	431
F	466	444
G	241	
H	126	138
I	500	471
J	1099	1065
K	1163	1207
L	322	280
M	236	234
N	283	306



Sum Checks

	8am	5pm
4294	5155	4294
1373	1680	1373
2144	2523	2144
9645	####	9645
	OK	OK

Cov Vers 2023 Base AM

Key:
Manual Completion
Automatic Completion

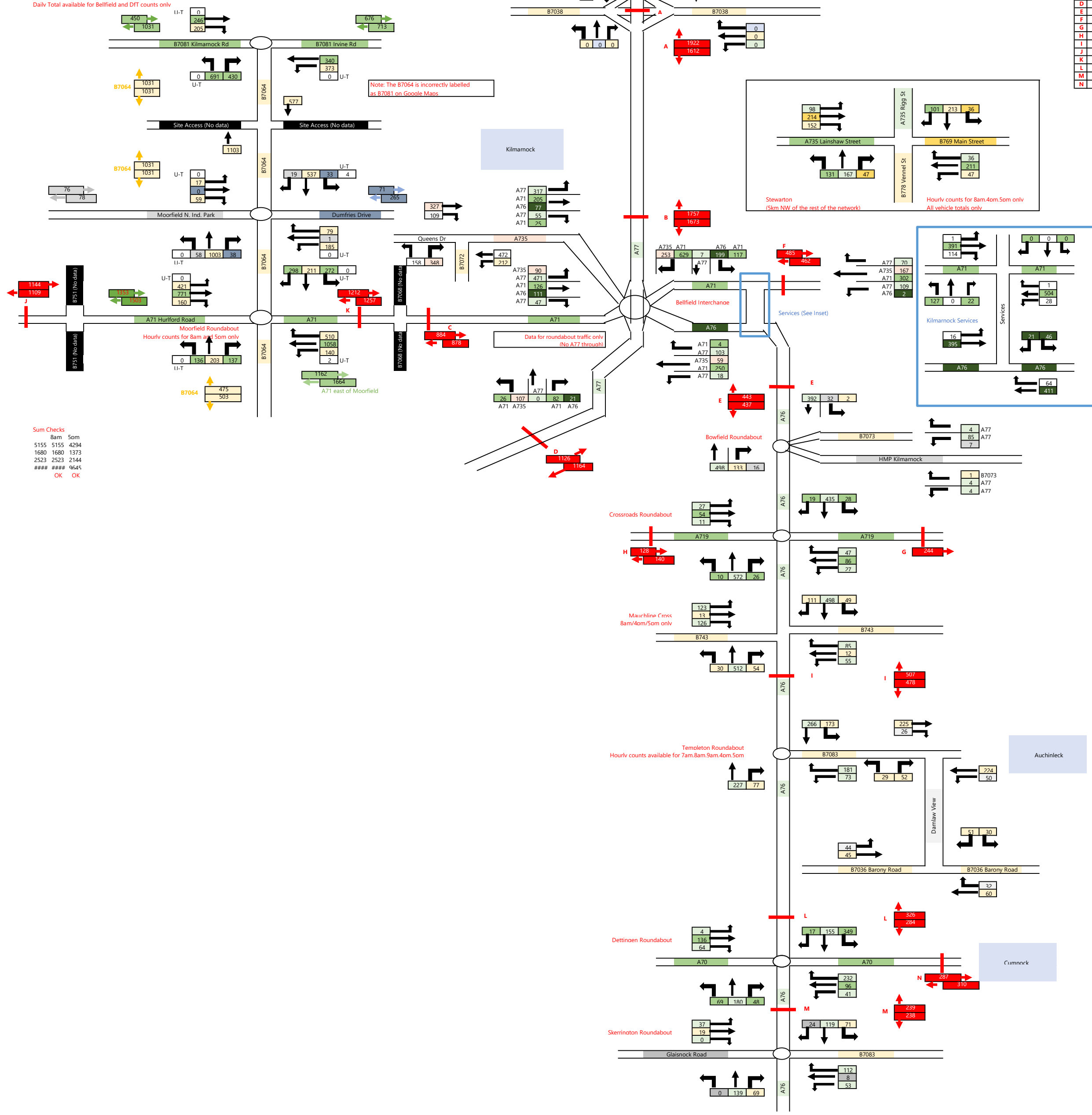
She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

Year	**2020 Pre-Covid (Uses 2019 DfT counts)**
Mode	**All Motor Vehicles**
Time	**Hour: 08:00 - 09:00**

	2019 (	2018	Hour Conv
2019B	1.00	1.00	0.1
13			
10			

DfT Counts available for Daily Total only (Red cells)
Daily Total available for Bellfield and DfT counts only

	DfT Site Results	
	NB or EB	SB or WB
A	1922	1612
B	1757	1673
C	884	878
D	1126	1164
E	443	437
F	485	462
G	244	
H	128	140
I	507	478
J	1144	1109
K	1212	1257
L	326	284
M	239	238
N	287	310



Cov Vers 2023 Base PM

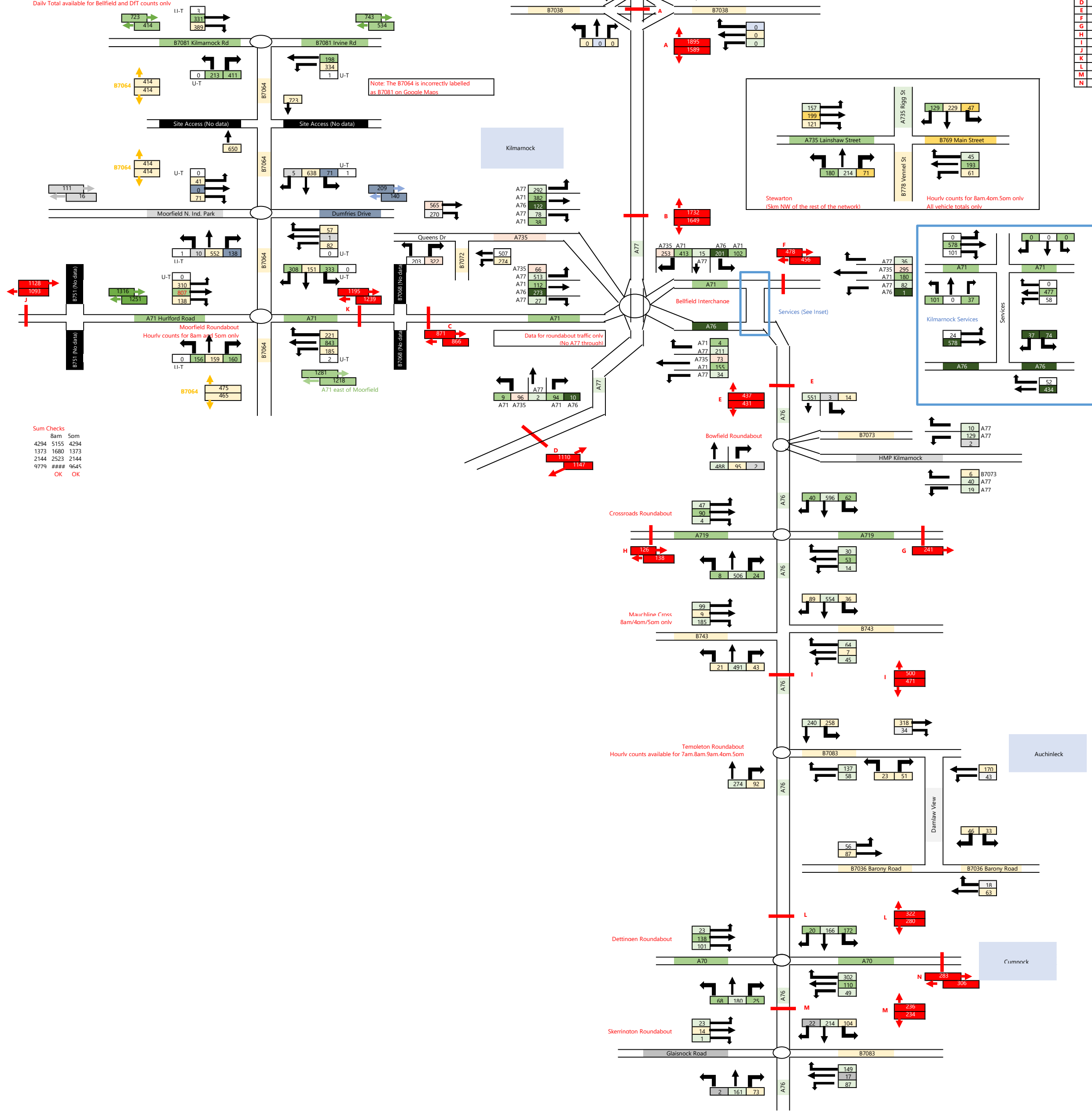
Key:
Manual Completion
Automatic Completion

She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

			2019 (	2018	Hour Conv
Year	**2020 Pre-Covid (Uses 2019 DfT counts)**	2019B	1.00	1.00	0.1
Mode	**All Motor Vehicles**	13			
Time	**Hour: 17:00 - 18:00**	19			

DfT Counts available for Daily Total only (Red cells)
Daily Total available for Bellfield and DfT counts only

	DfT Site Results	
	NB or EB	SB or WB
A	1895	1589
B	1732	1649
C	871	866
D	1110	1147
E	437	431
F	478	456
G	241	
H	126	138
I	500	471
J	1128	1093
K	1195	1239
L	322	280
M	236	234
N	283	306



Sum Checks

	8am	5pm
4294	5155	4294
1373	1680	1373
2144	2523	2144
9779	####	9645
	OK	OK

Cov Ver LDP1 AM

Key:
Manual Completion
Automatic Completion

She Reference
Des Codes used to generate output models
Source:
Updated:
Self-checking:
Check and Review:
Sta In Progress

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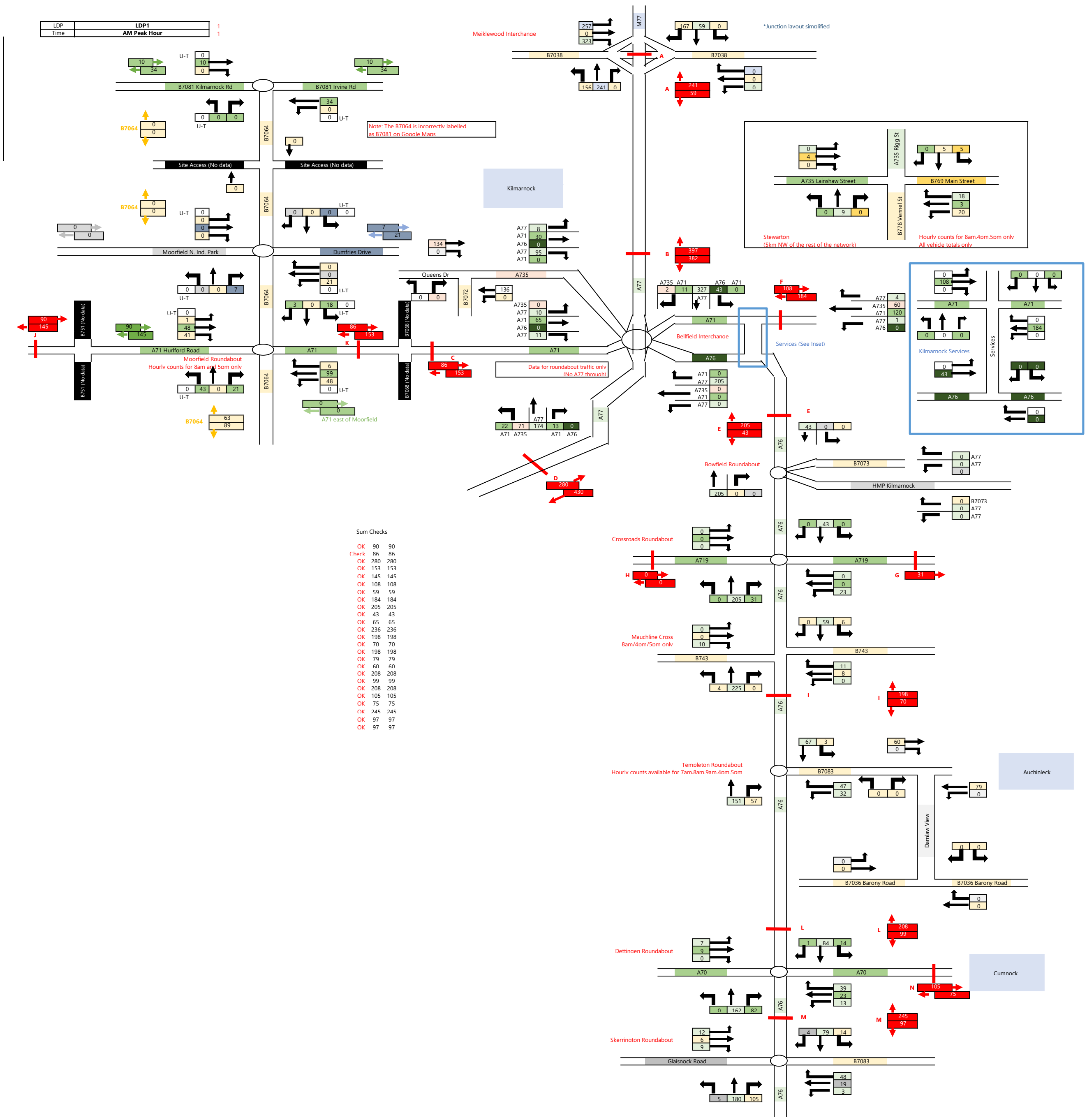
Time	**AM Peak Hour**	1



Sum Checks

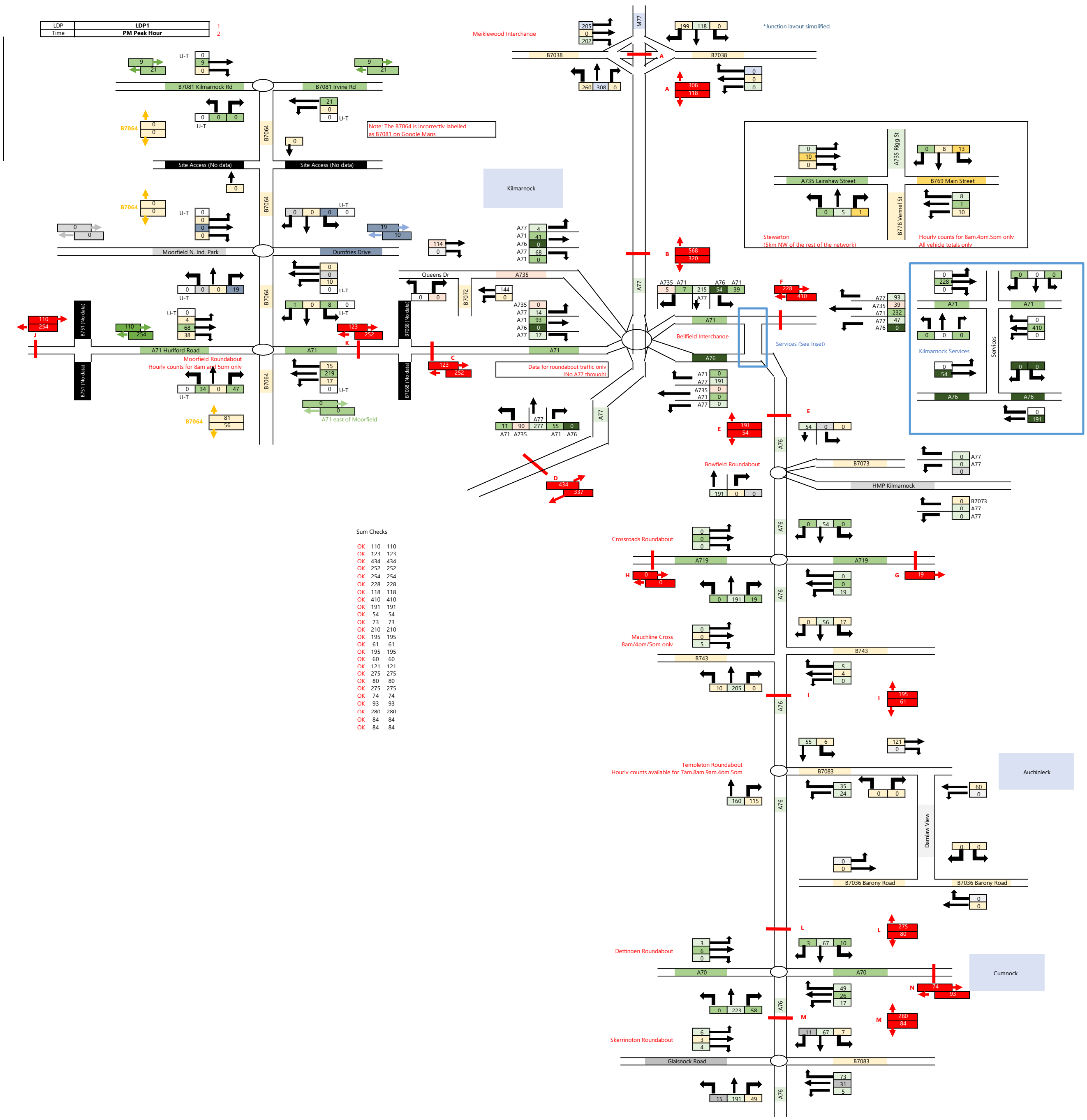
OK	90	90
Check	86	86
OK	280	280
OK	153	153
OK	145	145
OK	108	108
OK	59	59
OK	184	184
OK	205	205
OK	43	43
OK	65	65
OK	236	236
OK	198	198
OK	70	70
OK	198	198
OK	79	79
OK	60	60
OK	208	208
OK	99	99
OK	208	208
OK	105	105
OK	75	75
OK	245	245
OK	97	97
OK	97	97

Cov Ver   LDP1 PM

Key:
Manual Completion
Automatic Completion

She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Sta In Progress

LDP	**LDP1**	1
Time	**PM Peak Hour**	2



Sum Checks

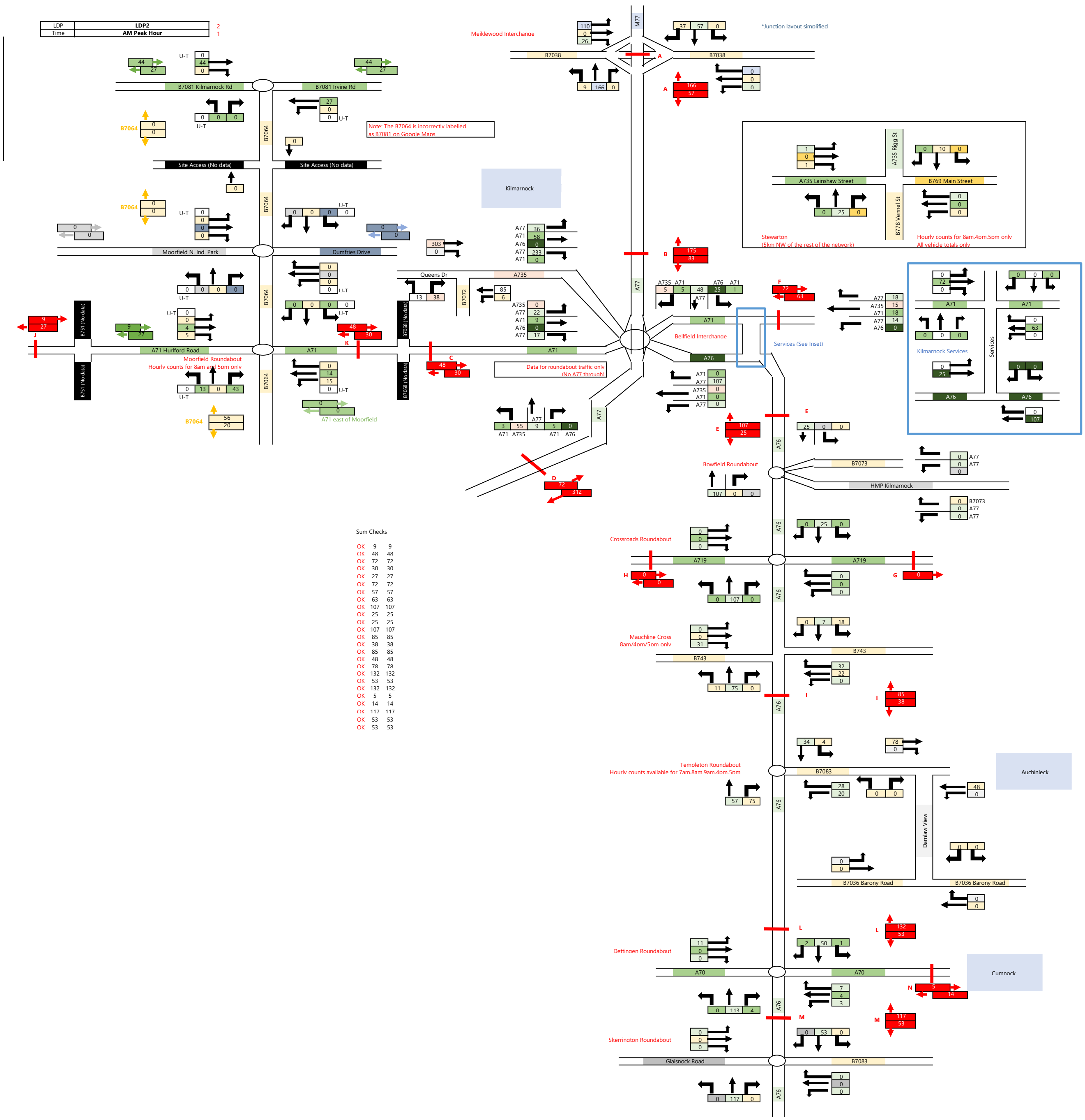
OK	110	110
OK	123	123
OK	434	434
OK	252	252
OK	254	254
OK	228	228
OK	118	118
OK	410	410
OK	191	191
OK	54	54
OK	73	73
OK	210	210
OK	195	195
OK	61	61
OK	195	195
OK	60	60
OK	121	121
OK	275	275
OK	80	80
OK	275	275
OK	74	74
OK	93	93
OK	280	280
OK	84	84
OK	84	84

Cov Ver: LDP2 AM

Key:
Manual Completion
Automatic Completion

She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Sta In Progress

LDP	**LDP2**	2
Time	**AM Peak Hour**	1



Sum Checks

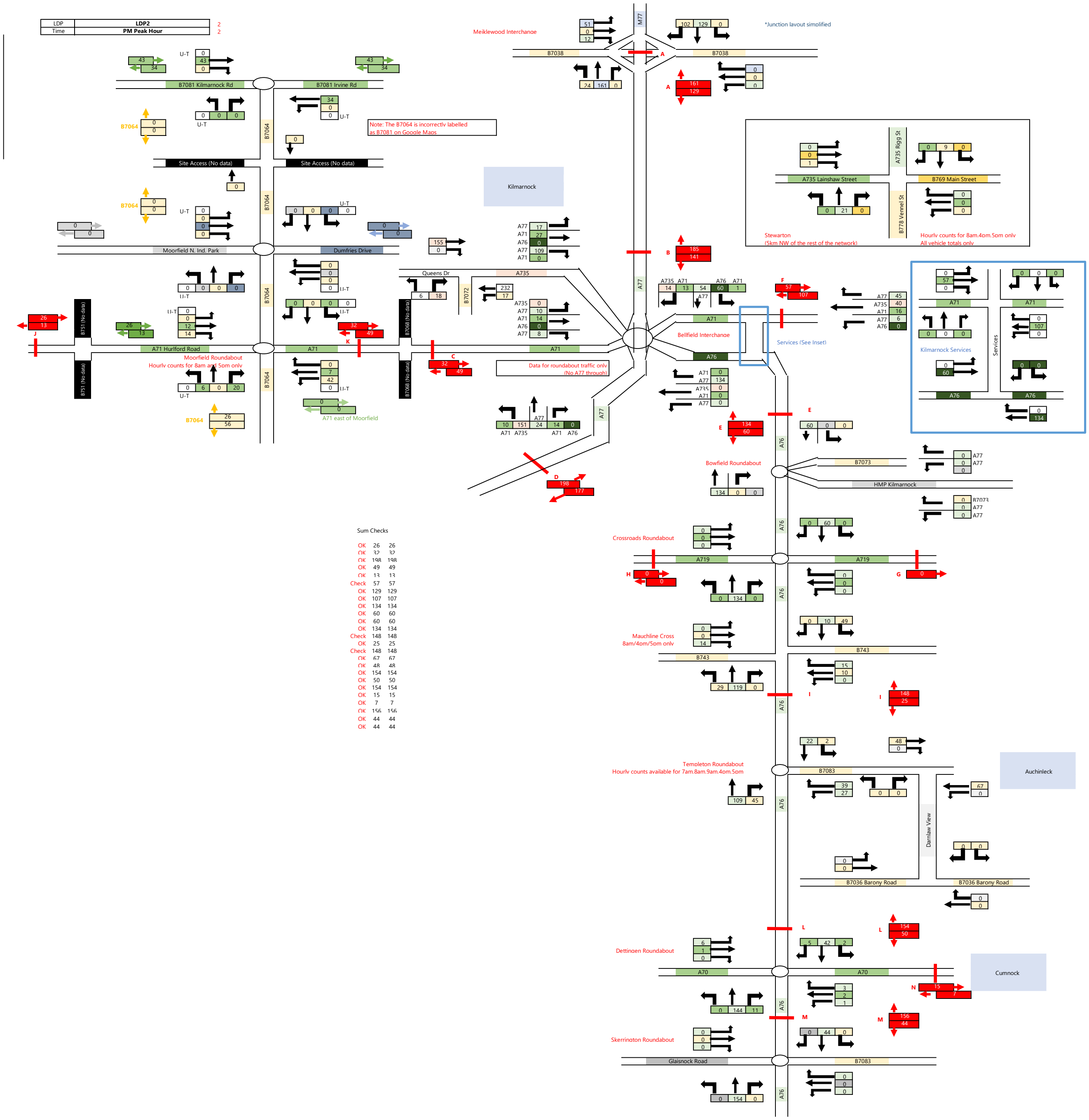
OK	9	9
OK	48	48
OK	72	72
OK	30	30
OK	27	27
OK	72	72
OK	57	57
OK	63	63
OK	107	107
OK	25	25
OK	25	25
OK	107	107
OK	85	85
OK	38	38
OK	85	85
OK	48	48
OK	78	78
OK	132	132
OK	53	53
OK	132	132
OK	5	5
OK	14	14
OK	117	117
OK	53	53
OK	53	53

Cov Ver LDP2 PM

Key:
Manual Completion
Automatic Completion

She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

LDP	**LDP2**	2
Time	**PM Peak Hour**	2



Sum Checks

OK	26	26
OK	32	32
OK	198	198
OK	49	49
OK	13	13
Check	57	57
OK	129	129
OK	107	107
OK	134	134
OK	60	60
OK	60	60
OK	134	134
Check	148	148
OK	25	25
Check	148	148
OK	67	67
OK	48	48
OK	154	154
OK	50	50
OK	154	154
OK	15	15
OK	7	7
OK	156	156
OK	44	44
OK	44	44

Cov Vers 2023 Base + LDP1+2 AM

Key:
Manual Completion
Automatic Completion

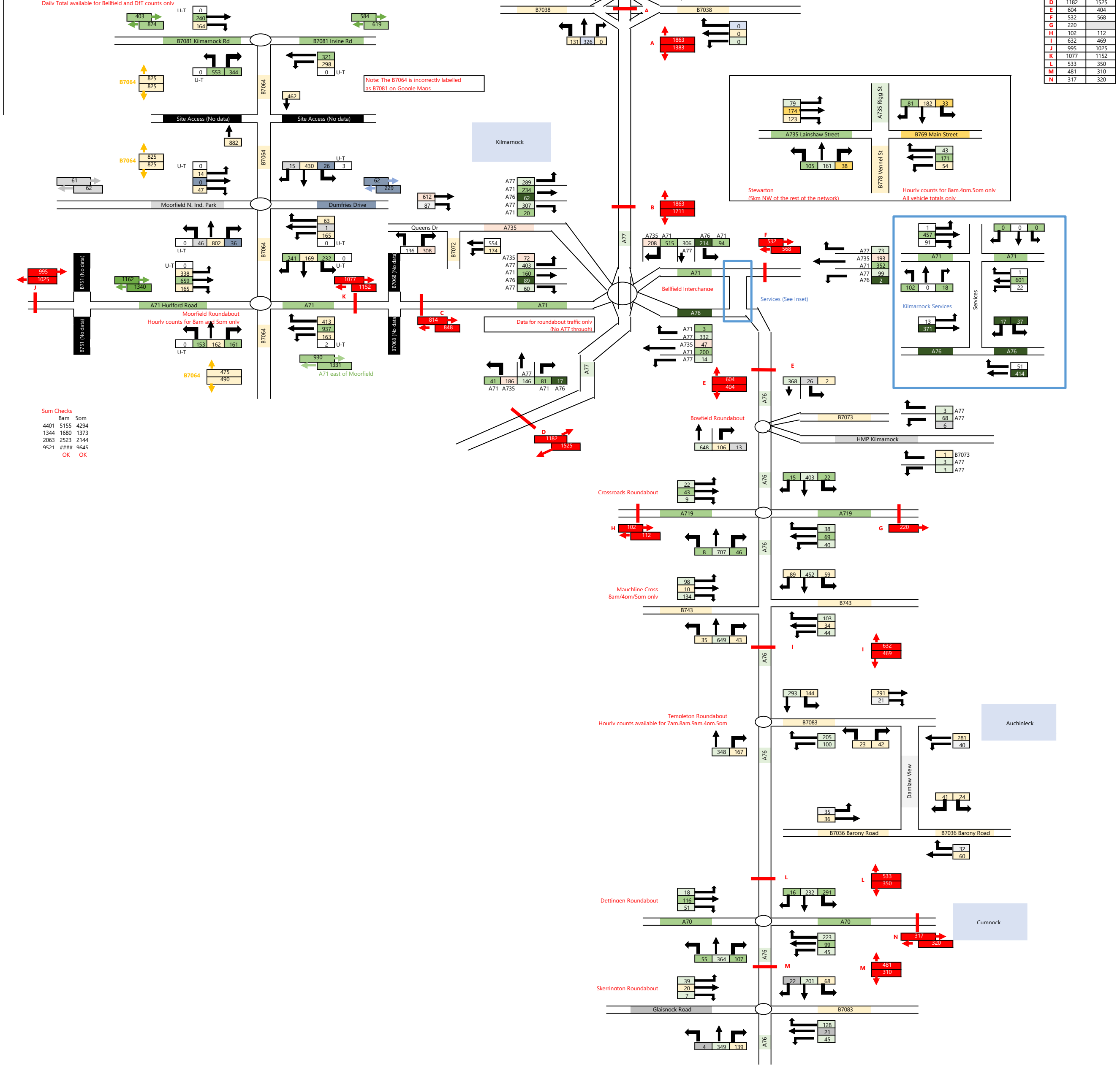
She Output
Des Model output
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

Year	2020 Pre-Covid (Uses 2019 DfT counts)
Mode	All Motor Vehicles
Time	Hour: 08:00 - 09:00

	2019 (	2018	Hour Conv
2019B	1.00	1.00	0.1
13			
10			

DfT Counts available for Daily Total only (Red cells)
Daily Total available for Bellfield and DfT counts only

	DfT Site Results	
	NB or EB	SB or WB
A	1863	1383
B	1863	1711
C	814	848
D	1182	1525
E	604	404
F	532	568
G	220	
H	102	112
I	632	469
J	995	1025
K	1077	1152
L	533	350
M	481	310
N	317	320



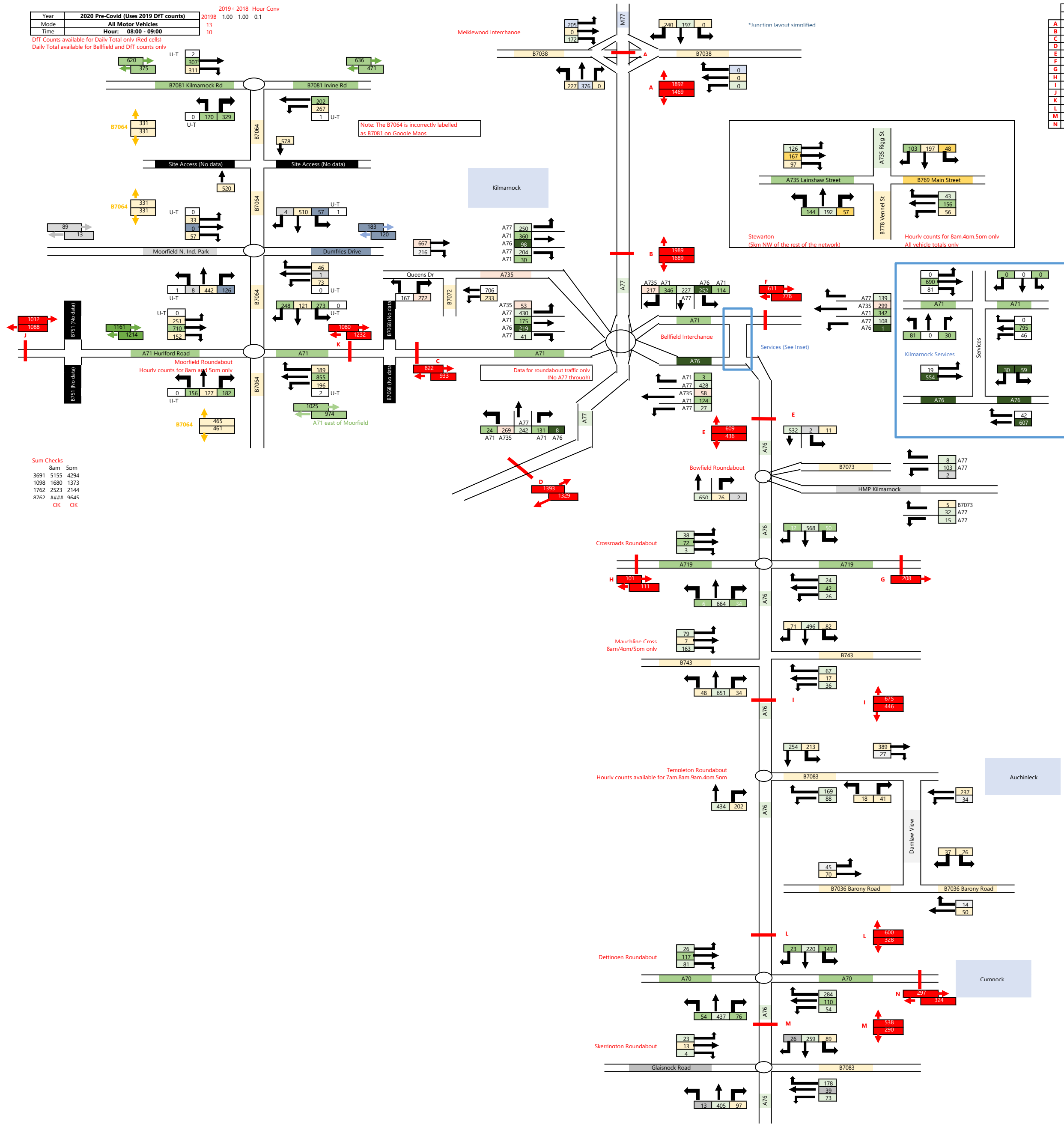
Cov Vers 2023 Base + LDP1+2 PM

Key:
Manual Completion
Automatic Completion

She **Not Set!**
Des **Not Set!**
Source:
Updated:
Self-checking:
Check and Review:
Stat In Progress

			2019 (	2018	Hour Conv
Year	**2020 Pre-Covid (Uses 2019 DfT counts)**	2019B	1.00	1.00	0.1
Mode	**All Motor Vehicles**	13			
Time	**Hour: 08:00 - 09:00**	10			

DfT Counts available for Daily Total only (Red cells)
Daily Total available for Bellfield and DfT counts only

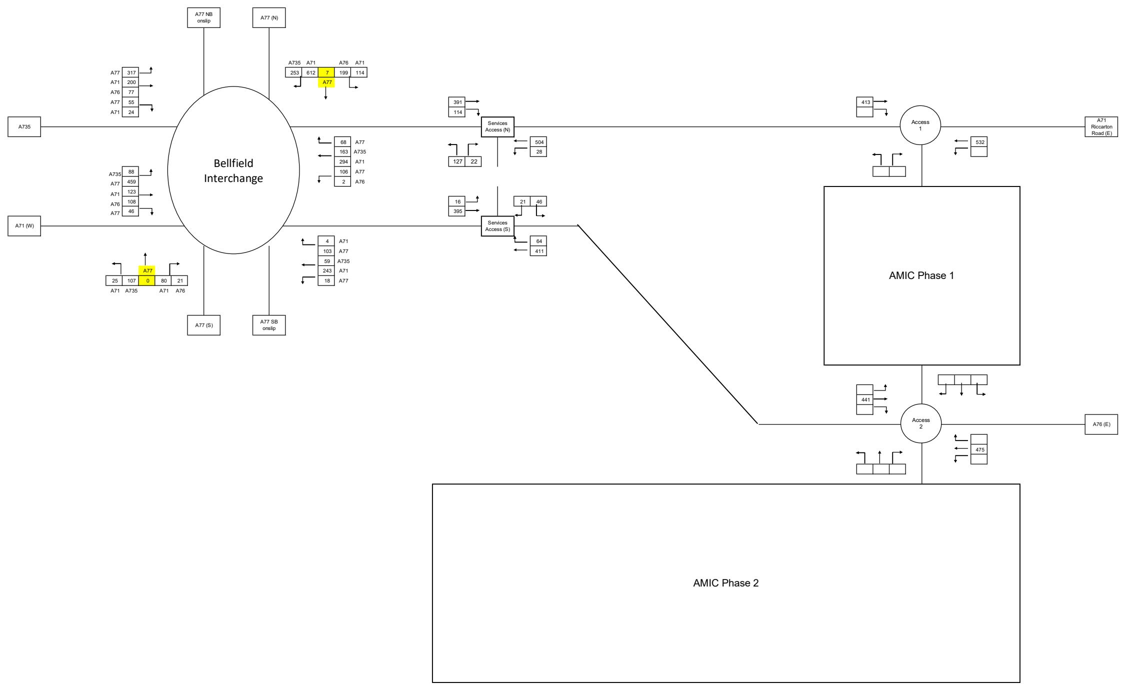


	DfT Site Results	
	NB or EB	SB or WB
A	1892	1469
B	1989	1689
C	822	933
D	1393	1329
E	609	436
F	611	778
G	208	
H	101	111
I	675	446
J	1012	1088
K	1080	1232
L	600	328
M	538	290
N	297	324

Sum Checks

	8am	5pm
3691	5155	4294
1098	1680	1373
1762	2523	2144
8762	####	9645
	OK	OK

Bellfield East (Kirklandside / Kaimshill) AMIC Phase 1+2 TFDs



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

2019 AM Peak Hour Base Flows (PCUs)

07:45-08:45

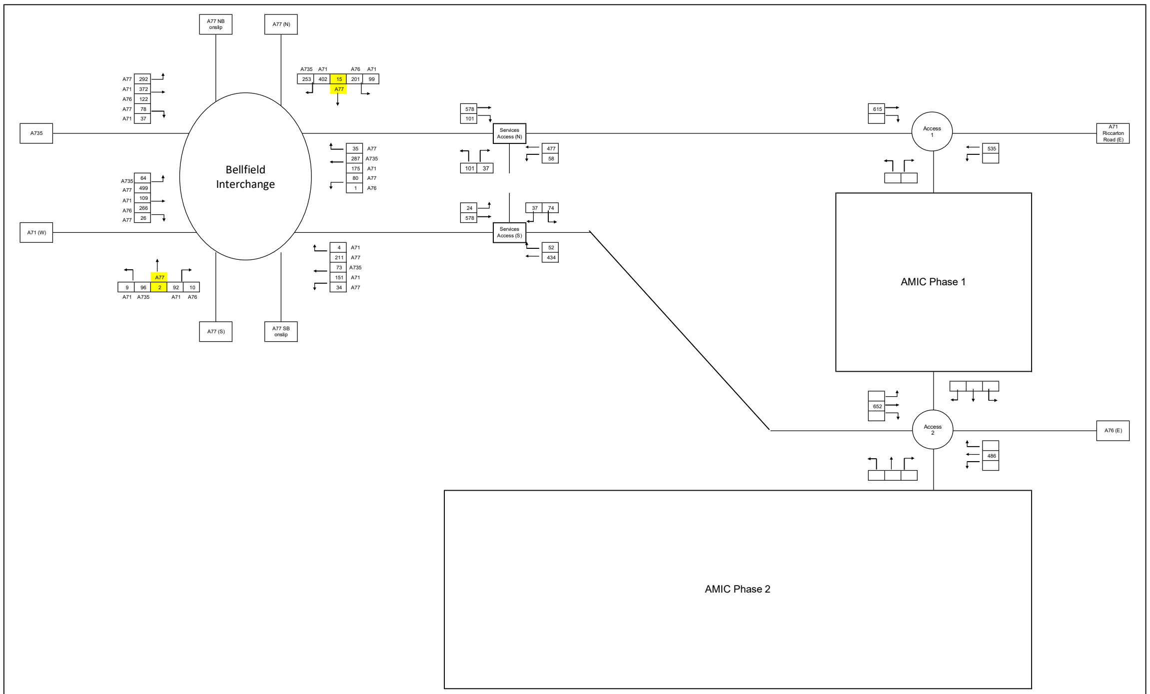
MA	A	B	C	D	E	F	Tot
A		114	199	7	612	253	1185
B	68		2	106	294	163	633
C	103	4		18	243	59	427
D	0	80	21		25	107	233
E	459	123	108	46		88	824
F	317	200	77	55	24		673
Tot	947	521	407	232	1198	670	3975

MA	A	B	C	Tot
A		28	504	532
B	22		127	149
C	391	114		505
Tot	413	142	631	1186

MA	A	B	C	Tot
A		46	21	67
B	64		411	475
C	16	395		411
Tot	80	441	432	953

MA	A	B	C	Tot
A		0	532	532
B	0		0	0
C	413	0		413
Tot	413	0	532	945

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	475	475
C	0	0		0	0
D	0	441	0		441
Tot	0	441	0	475	916



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

2019 PM Peak Hour Base Flows (PCUs)

16:45-17:45

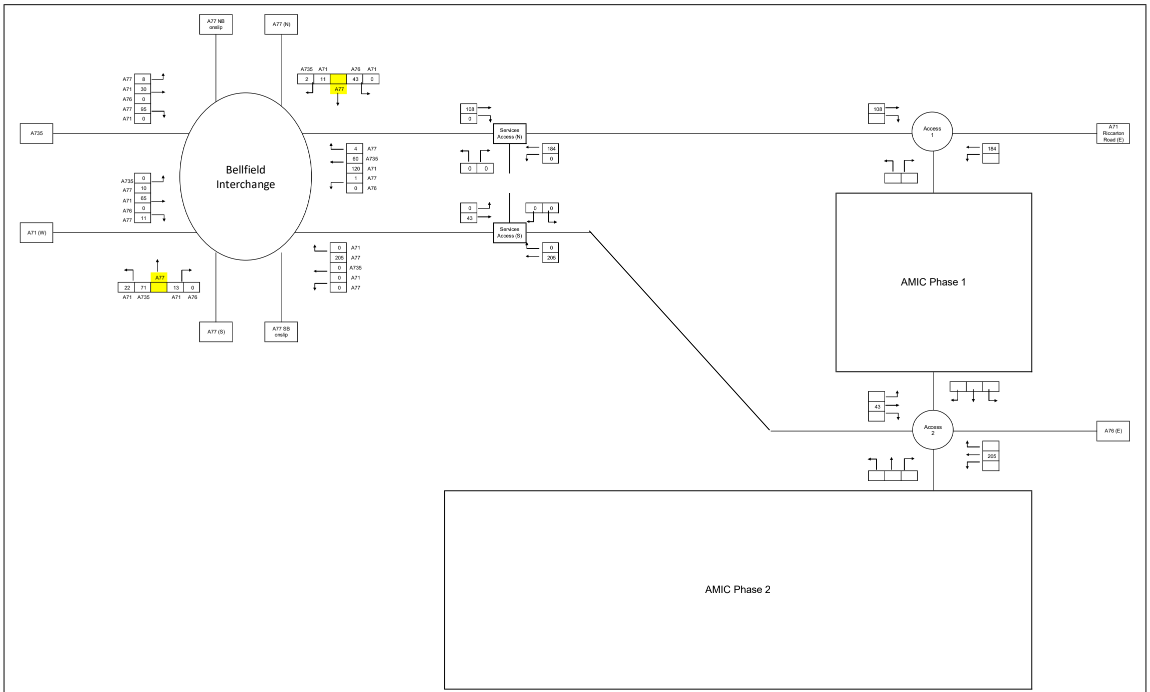
MA	A	B	C	D	E	F	Tot
A		99	201	15	402	253	970
B	35		1	80	175	287	578
C	211	4		34	151	73	473
D	2	92	10		9	96	209
E	499	109	266	26		64	964
F	292	372	122	78	37		901
Tot	1039	676	600	233	774	773	4095

MA	A	B	C	Tot
A		58	477	535
B	37		101	138
C	578	101		679
Tot	615	159	578	1352

MA	A	B	C	Tot
A		74	37	111
B	52		434	486
C	24	578		602
Tot	76	652	471	1199

MA	A	B	C	Tot
A		0	535	535
B	0		0	0
C	615	0		615
Tot	615	0	535	1150

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	486	486
C	0	0		0	0
D	0	652	0		652
Tot	0	652	0	486	1138



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AM LDP1 Peak Hour Base Flows (PCUs)

07:45-08:45

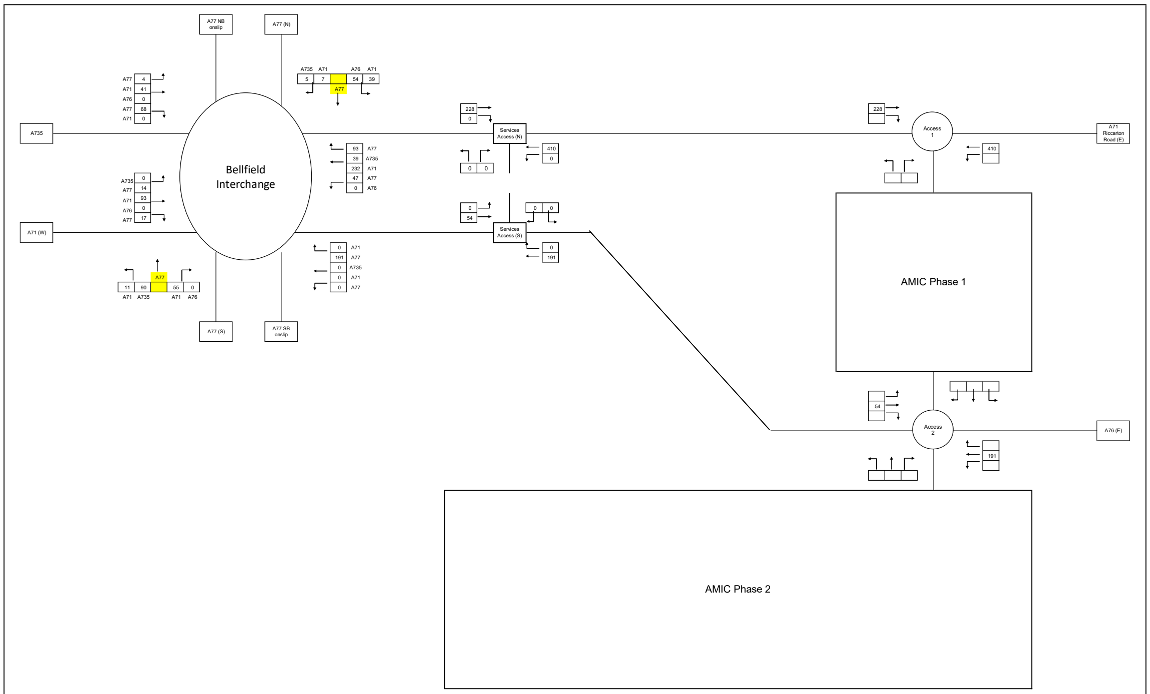
MA	A	B	C	D	E	F	Tot
A		0	43	0	11	2	55
B	4		0	1	120	60	184
C	205	0		0	0	0	205
D	0	13	0		22	71	106
E	10	65	0	11		0	86
F	8	30	0	95	0		133
Tot	227	108	43	107	152	132	769

MA	A	B	C	Tot
A		0	184	184
B	0		0	0
C	108	0		108
Tot	108	0	184	292

MA	A	B	C	Tot
A		0	0	0
B	0		205	205
C	0	43		43
Tot	0	43	205	248

MA	A	B	C	Tot
A		0	184	184
B	0		0	0
C	108	0		108
Tot	108	0	184	292

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	205	205
C	0	0		0	0
D	0	43	0		43
Tot	0	43	0	205	248



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

PM LDP1 Peak Hour Base Flows (PCUs)

16:45-17:45

Member of the SNC-Lavalin Group

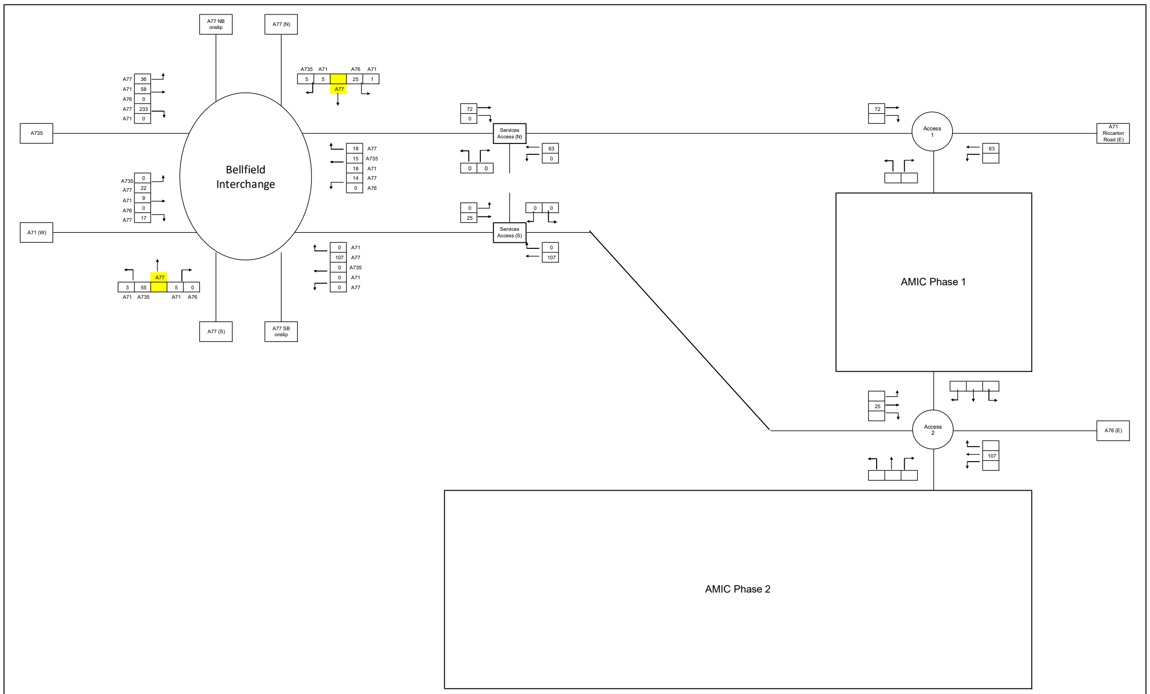
MA	A	B	C	D	E	F	Tot
A		39	54	0	7	5	105
B	93		0	47	232	39	410
C	191	0		0	0	0	191
D	0	55	0		11	90	156
E	14	93	0	17		0	123
F	4	41	0	68	0		113
Tot	301	228	54	132	249	133	1098

MA	A	B	C	Tot
A		0	410	410
B	0		0	0
C	228	0		228
Tot	228	0	410	638

MA	A	B	C	Tot
A		0	0	0
B	0		191	191
C	0	54		54
Tot	0	54	191	245

MA	A	B	C	Tot
A		0	410	410
B	0		0	0
C	228	0		228
Tot	228	0	410	638

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	191	191
C	0	0		0	0
D	0	54	0		54
Tot	0	54	0	191	245



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AM LDP2 Peak Hour Base Flows (PCUs)

07:45-08:45

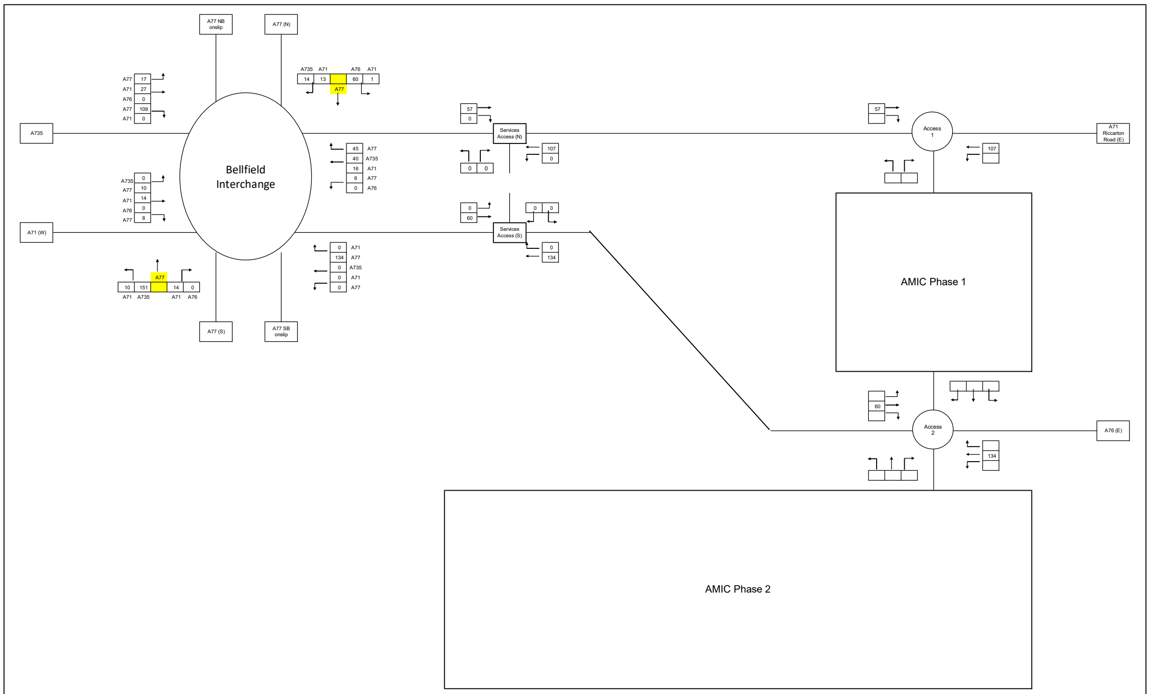
MA	A	B	C	D	E	F	Tot
A		1	25	0	5	5	35
B	18		0	14	18	15	63
C	107	0		0	0	0	107
D	0	5	0		3	55	64
E	22	9	0	17		0	48
F	36	58	0	233	0		327
Tot	182	72	25	264	26	75	644

MA	A	B	C	Tot
A		0	63	63
B	0		0	0
C	72	0		72
Tot	72	0	63	136

MA	A	B	C	Tot
A		0	0	0
B	0		107	107
C	0	25		25
Tot	0	25	107	132

MA	A	B	C	Tot
A		0	63	63
B	0		0	0
C	72	0		72
Tot	72	0	63	136

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	107	107
C	0	0		0	0
D	0	25	0		25
Tot	0	25	0	107	132



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

PM LDP2 Peak Hour Base Flows (PCUs)

16:45-17:45

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

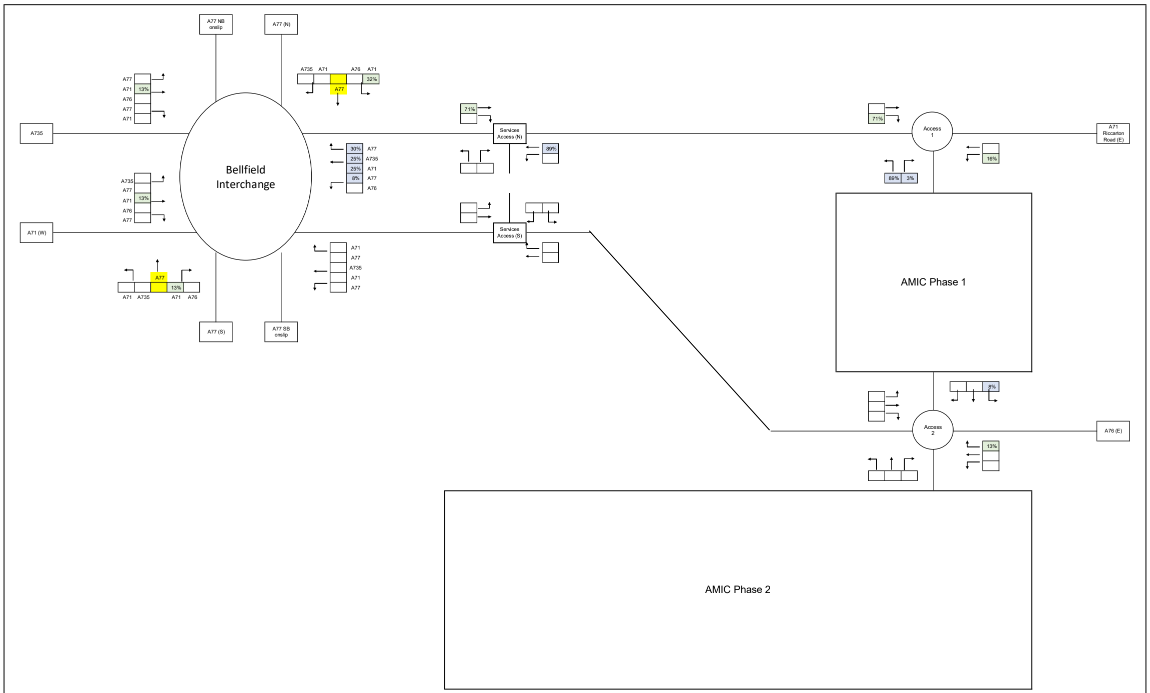
MA	A	B	C	D	E	F	Tot
A		1	60	0	13	14	87
B	45		0	6	16	40	107
C	134	0		0	0	0	134
D	0	14	0		10	151	175
E	10	14	0	8		0	32
F	17	27	0	109	0		152
Tot	205	57	60	123	38	205	687

MA	A	B	C	Tot
A		0	107	107
B	0		0	0
C	57	0		57
Tot	57	0	107	164

MA	A	B	C	Tot
A		0	0	0
B	0		134	134
C	0	60		60
Tot	0	60	134	193

MA	A	B	C	Tot
A		0	107	107
B	0		0	0
C	57	0		57
Tot	57	0	107	164

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	134	134
C	0	0		0	0
D	0	60	0		60
Tot	0	60	0	134	193



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AMIC Phase 1 % Distribution

SNC·LAVALIN

ATKINS

Member of the SNC-Lavalin Group

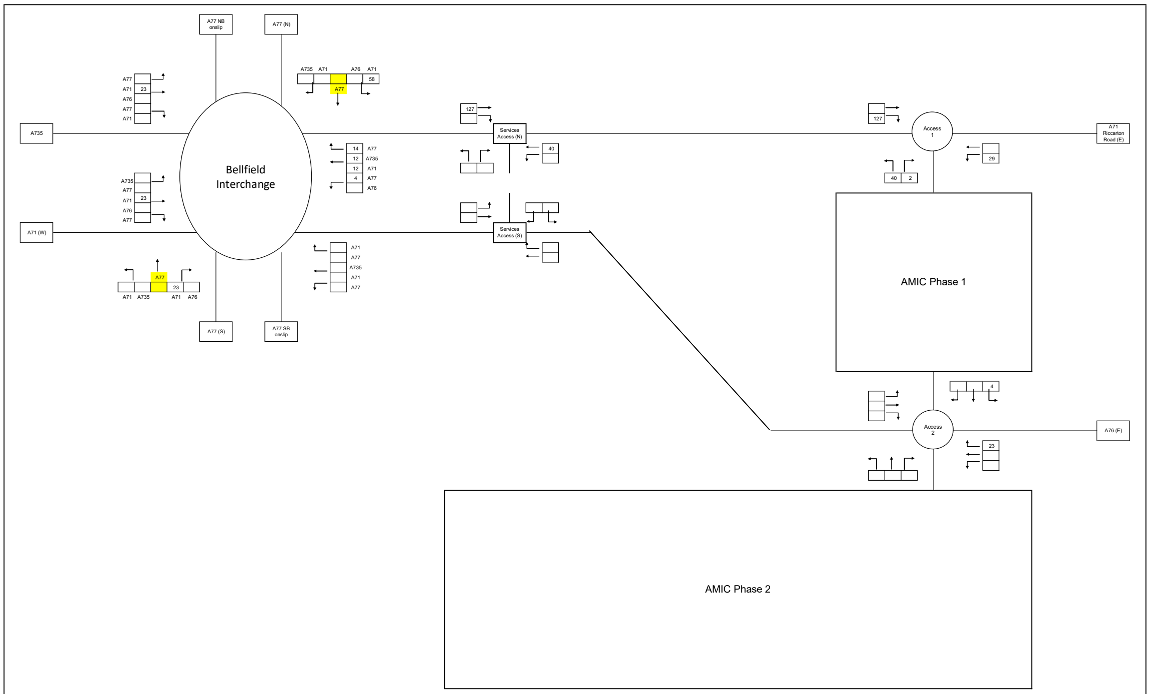
MA	A	B	C	D	E	F	Tot
A		0	0	0	0	0	0
B	0		0	0	0	0	1
C	0	0		0	0	0	0
D	0	0	0		0	0	0
E	0	0	0	0		0	0
F	0	0	0	0	0		0
Tot	0	1	0	0	0	0	2

MA	A	B	C	Tot
A		0	1	1
B	0		0	0
C	1	0		1
Tot	1	0	1	2

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	Tot
A		0	0	0
B	0		1	1
C	0	1		1
Tot	0	1	1	2

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	0	0
C	0	0		0	0
D	0	0	0		0
Tot	0	0	0	0	0



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AM AMIC Phase 1 Peak Hour Flows (PCUs)

07:45-08:45

SNC·LAVALIN

ATKINS

Member of the SNC-Lavalin Group

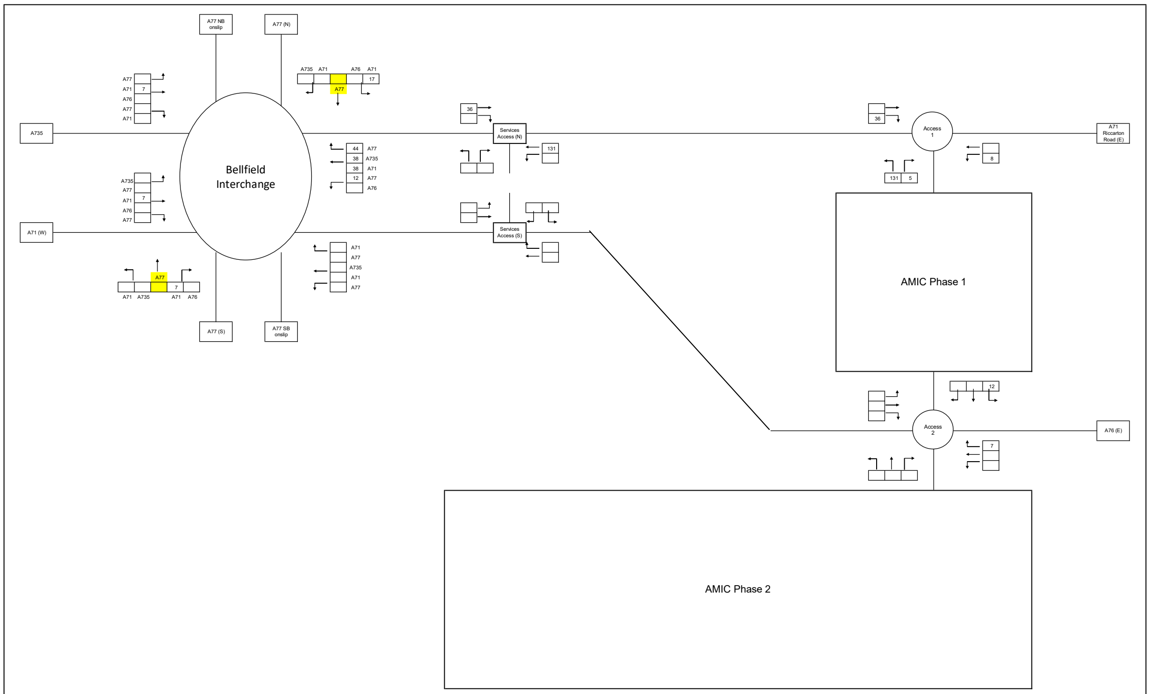
MA	A	B	C	D	E	F	Tot
A		58	0	0	0	0	58
B	14		0	4	12	12	40
C	0	0		0	0	0	0
D	0	23	0		0	0	23
E	0	23	0	0		0	23
F	0	23	0	0	0		23
Tot	14	127	0	4	12	12	167

MA	A	B	C	Tot
A		0	40	40
B	0		0	0
C	127	0		127
Tot	127	0	40	167

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	Tot
A		29	0	29
B	2		40	42
C	0	127		127
Tot	2	156	40	198

MA	A	B	C	D	Tot
A		4	0	0	4
B	23		0	0	23
C	0	0		0	0
D	0	0	0		0
Tot	23	4	0	0	27



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

PM AMIC Phase 1 Peak Hour Flows (PCUs)

16:45-17:45

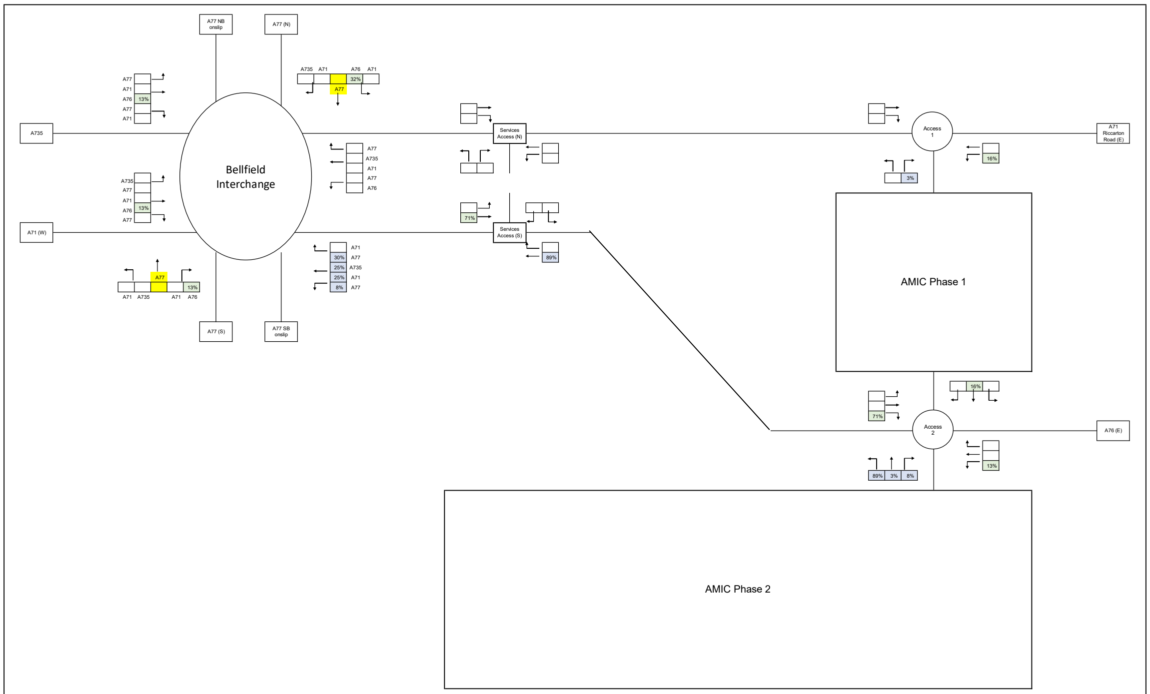
MA	A	B	C	D	E	F	Tot
A		17	0	0	0	0	17
B	44		0	12	38	38	131
C	0	0		0	0	0	0
D	0	7	0		0	0	7
E	0	7	0	0		0	7
F	0	7	0	0	0		7
Tot	44	36	0	12	38	38	167

MA	A	B	C	Tot
A		0	131	131
B	0		0	0
C	36	0		36
Tot	36	0	131	167

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	Tot
A		8	0	8
B	5		131	136
C	0	36		36
Tot	5	45	131	181

MA	A	B	C	D	Tot
A		12	0	0	12
B	7		0	0	7
C	0	0		0	0
D	0	0	0		0
Tot	7	12	0	0	18



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AMIC Phase 2 % Distribution

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

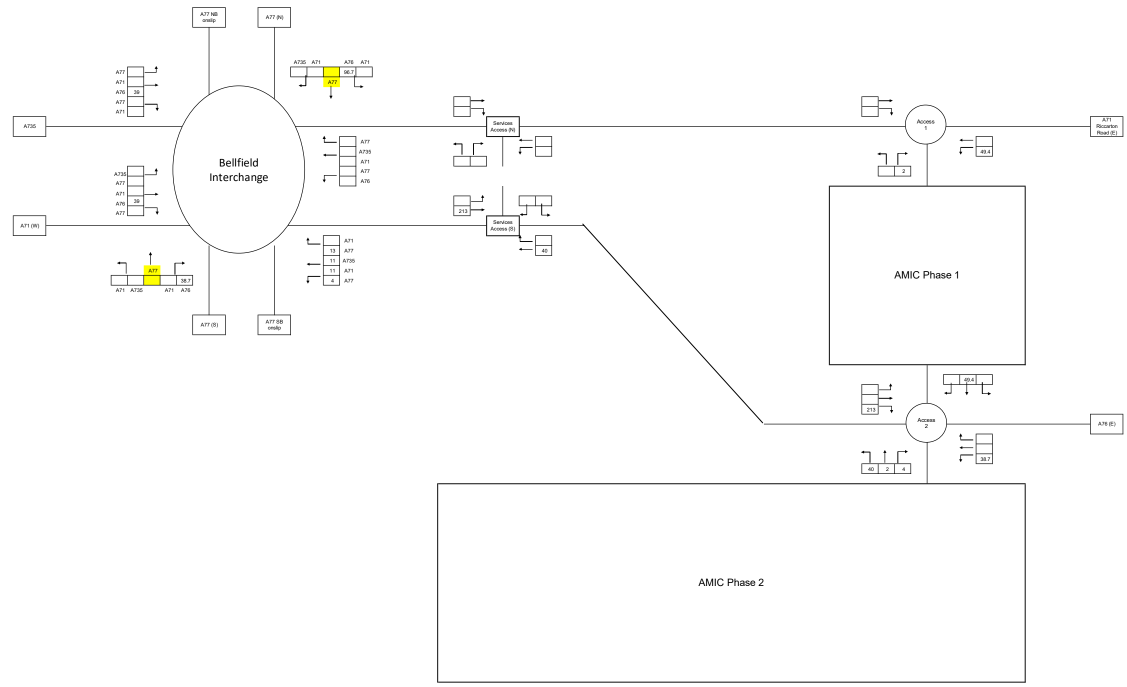
MA	A	B	C	D	E	F	Tot
A		0	0	0	0	0	0
B	0		0	0	0	0	0
C	0	0		0	0	0	1
D	0	0	0		0	0	0
E	0	0	0	0		0	0
F	0	0	0	0	0		0
Tot	0	0	1	0	0	0	2

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	Tot
A		0	0	0
B	0		1	1
C	0	1		1
Tot	0	1	1	2

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	D	Tot
A		0	0	0	0
B	0		0	0	0
C	0	0		1	1
D	0	0	1		1
Tot	0	0	1	1	2



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AM AMIC Phase 2 Peak Hour Flows (PCUs)

07:45-08:45

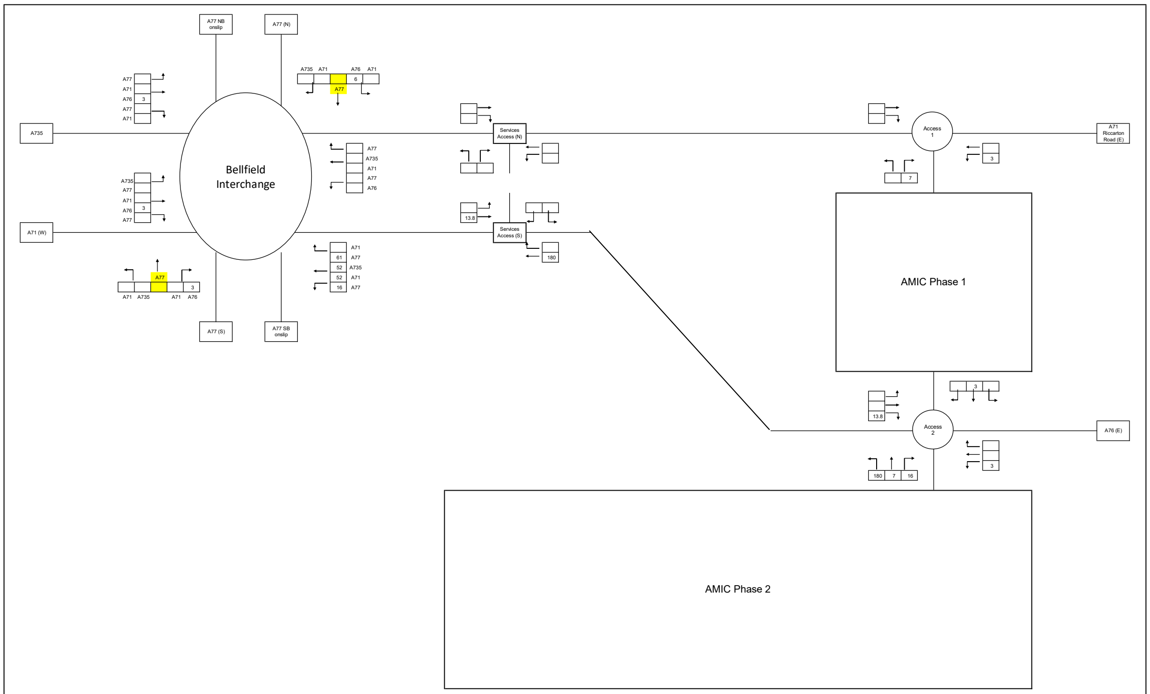
MA	A	B	C	D	E	F	Tot
A		0	97	0	0	0	97
B	0		0	0	0	0	0
C	13	0		4	11	11	40
D	0	0	39		0	0	39
E	0	0	39	0		0	39
F	0	0	39	0	0		39
Tot	13	0	213	4	11	11	253

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	Tot
A		0	0	0
B	0		40	40
C	0	213		213
Tot	0	213	40	253

MA	A	B	C	Tot
A		49	0	49
B	2		0	2
C	0	0		0
Tot	2	49	0	51

MA	A	B	C	D	Tot
A		0	49	0	49
B	0		39	0	39
C	2	4		40	45
D	0	0	213		213
Tot	2	4	301	40	346



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

PM AMIC Phase 2 Peak Hour Flows (PCUs)

16:45-17:45

SNC·LAVALIN

ATKINS

Member of the SNC-Lavalin Group

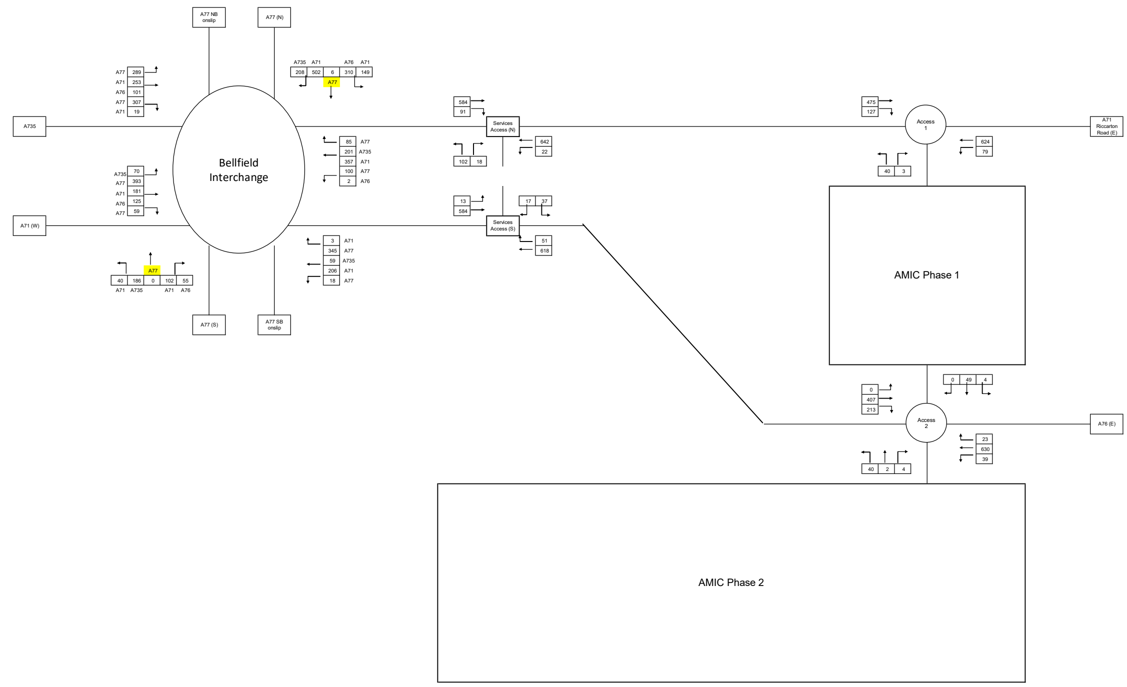
MA	A	B	C	D	E	F	Tot
A		0	6	0	0	0	6
B	0		0	0	0	0	0
C	61	0		16	52	52	180
D	0	0	3		0	0	3
E	0	0	3	0		0	3
F	0	0	3	0	0		3
Tot	61	0	14	16	52	52	194

MA	A	B	C	Tot
A		0	0	0
B	0		0	0
C	0	0		0
Tot	0	0	0	0

MA	A	B	C	Tot
A		0	0	0
B	0		180	180
C	0	14		14
Tot	0	14	180	194

MA	A	B	C	Tot
A		3	0	3
B	7		0	7
C	0	0		0
Tot	7	3	0	10

MA	A	B	C	D	Tot
A		0	3	0	3
B	0		3	0	3
C	7	16		180	202
D	0	0	14		14
Tot	7	16	20	180	222



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

AM Proposed (AMIC Phase 1+2) Peak Hour Flows (PCUs)

07:45-08:45

*20% reduction factor applied to the Base, LDP1 and LDP2 flows

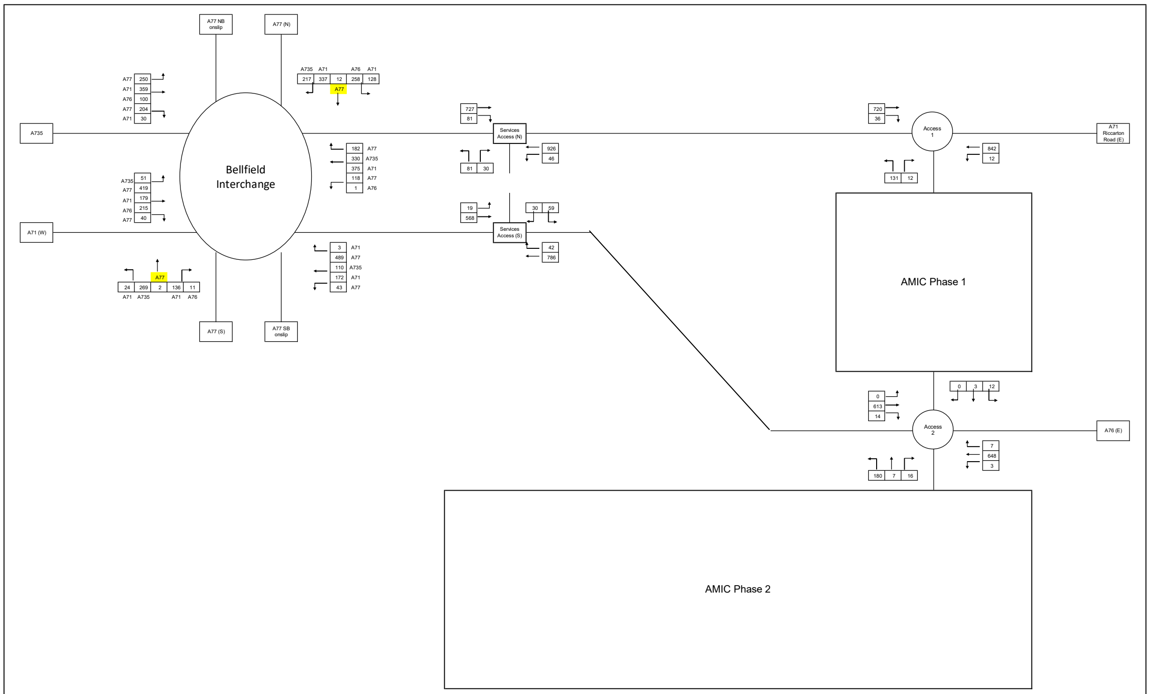
MA	A	B	C	D	E	F	Tot
A		149	310	6	502	208	1175
B	85		2	100	357	201	745
C	345	3		18	206	59	631
D	0	102	55		40	186	384
E	393	181	125	59		70	829
F	289	253	101	307	19		968
Tot	1112	688	594	490	1124	724	4731

MA	A	B	C	Tot
A		22	642	664
B	18		102	119
C	584	91		675
Tot	601	114	743	1458

MA	A	B	C	Tot
A		37	17	54
B	51		618	669
C	13	584		597
Tot	64	621	635	1320

MA	A	B	C	Tot
A		79	624	702
B	3		40	43
C	475	127		601
Tot	478	205	664	1347

MA	A	B	C	D	Tot
A		4	49	0	53
B	23		39	630	691
C	2	4		40	45
D	0	407	213		621
Tot	25	414	301	669	1410



Bellfield East (Advanced Manufacturing Investment Corridor) Phase 1 + 2

PM Proposed (AMIC Phase 1+2) Peak Hour Flows (PCUs)

16:45-17:45

*20% reduction factor applied to the Base, LDP1 and LDP2 flows

MA	A	B	C	D	E	F	Tot
A		128	258	12	337	217	953
B	182		1	118	375	330	1007
C	489	3		43	172	110	818
D	2	136	11		24	269	441
E	419	179	215	40		51	905
F	250	359	100	204	30		942
Tot	1341	805	585	418	938	978	5065

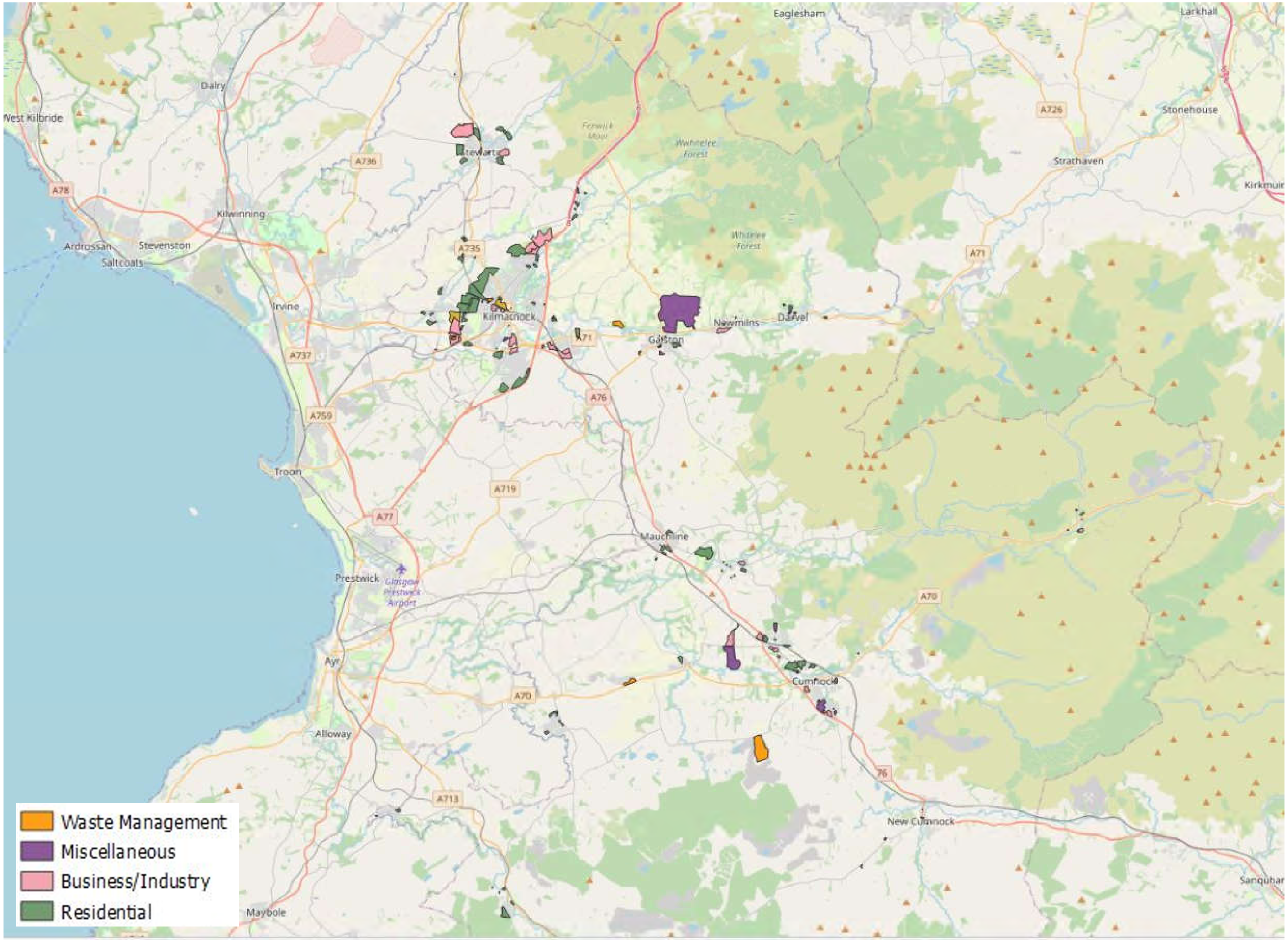
MA	A	B	C	Tot
A		46	926	972
B	30		81	110
C	727	81		808
Tot	756	127	1007	1891

MA	A	B	C	Tot
A		59	30	89
B	42		786	828
C	19	568		587
Tot	61	627	816	1503

MA	A	B	C	Tot
A		12	842	853
B	12		131	143
C	720	36		756
Tot	732	48	972	1752

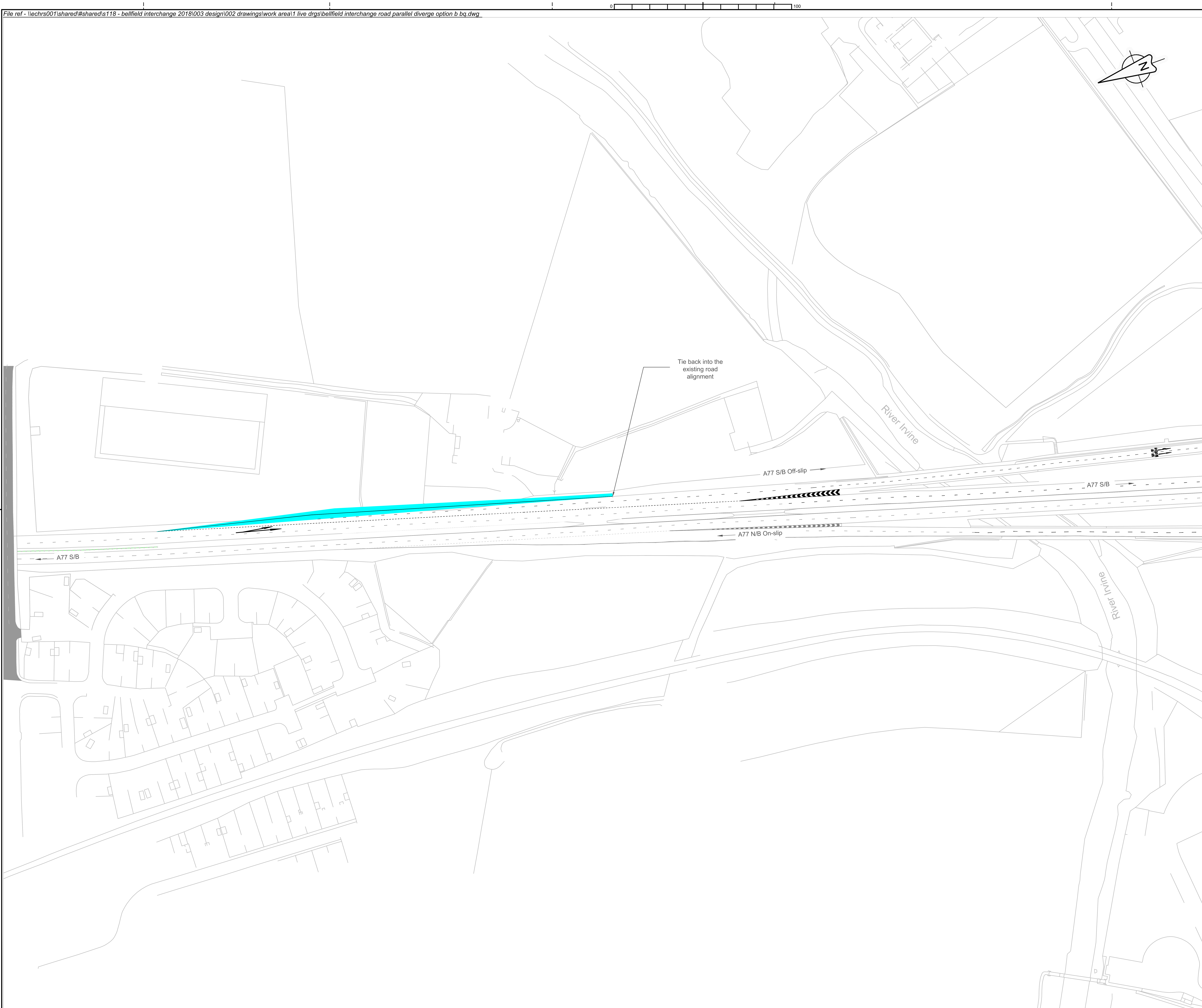
MA	A	B	C	D	Tot
A		12	3	0	15
B	7		3	648	657
C	7	16		180	202
D	0	613	14		627
Tot	13	640	20	828	1501

Appendix B. LDP Sites Mapping


Waste Management
Miscellaneous
Business/Industry
Residential
Eaglesham
Larkhall
Dalry
West Kilbride
Stonehouse
Strathaven
Kilwinning
Ardrossan
Stevenston
Saltcoats
Irvine
Kilmarnock
Newmilns
Darvel
Galston
Troon
Mauchline
Prestwick
Glasgow Prestwick Airport
Ayr
Cumnock
Alloway
New Cumnock
Maybole
Whitelee Forest
Fenwick Moor
A78
A736
A735
A737
A759
A77
A719
A71
A76
A70
A713
A726

Appendix C. Indicative Mitigation Plans

File ref - \\echrs001\shared\#shared\s118 - bellfield interchange 2018\003 design\002 drawings\work area\1 live drgs\bellfield interchange road parallel diverge option b bq.dwg



RESIDUAL DESIGN HAZARDS

(The following information has been collected from Preconstruction Information and the Amey CDM Hazard Management Process.)

1. N/A

NOTES

1. This is only indicative drawing showing a proposed parallel diverge (Option B) for the A77 Southbound Off-slip
2. Topographical survey required to identify existing boundaries and what can be achieved within the existing trunk road boundary;
3. Road signs required to be relocated and re-designed;
4. Public Utilities are unknown at this stage and further information would be required;
5. Several constraints have been identified
   - 5.1. The overbridge for the B7303 reduces the parallel diverge
   - 5.2. The River Irvine reduces the overall lane widths
   - 5.3. Mature trees that are adjacent to the current A77 will need to be removed;
   - 5.4. Embankments that will need to be regraded. Further assessment required if it can be built within the existing trunk road boundary

A77 Bellfield Interchange (Parallel Diverge - Option B)			
Taper across two lanes	Auxiliary Lane	Nose	Total Length of slip road
110m	Approx 670m	70	Approx 780m

KEY

Proposed road surface area require. Full depth reconstruction required

Rev	Revision details	Drwn	Chkd	Appd	Date

Designed: . Date: .
Drawn: . Date: .
Checked: . Date: .
Approved: . Date: .

DRAFT

ameyconsulting

www.amey.co.uk

Client

East Ayrshire Council

Project Name

A77 Bellfield Interchange

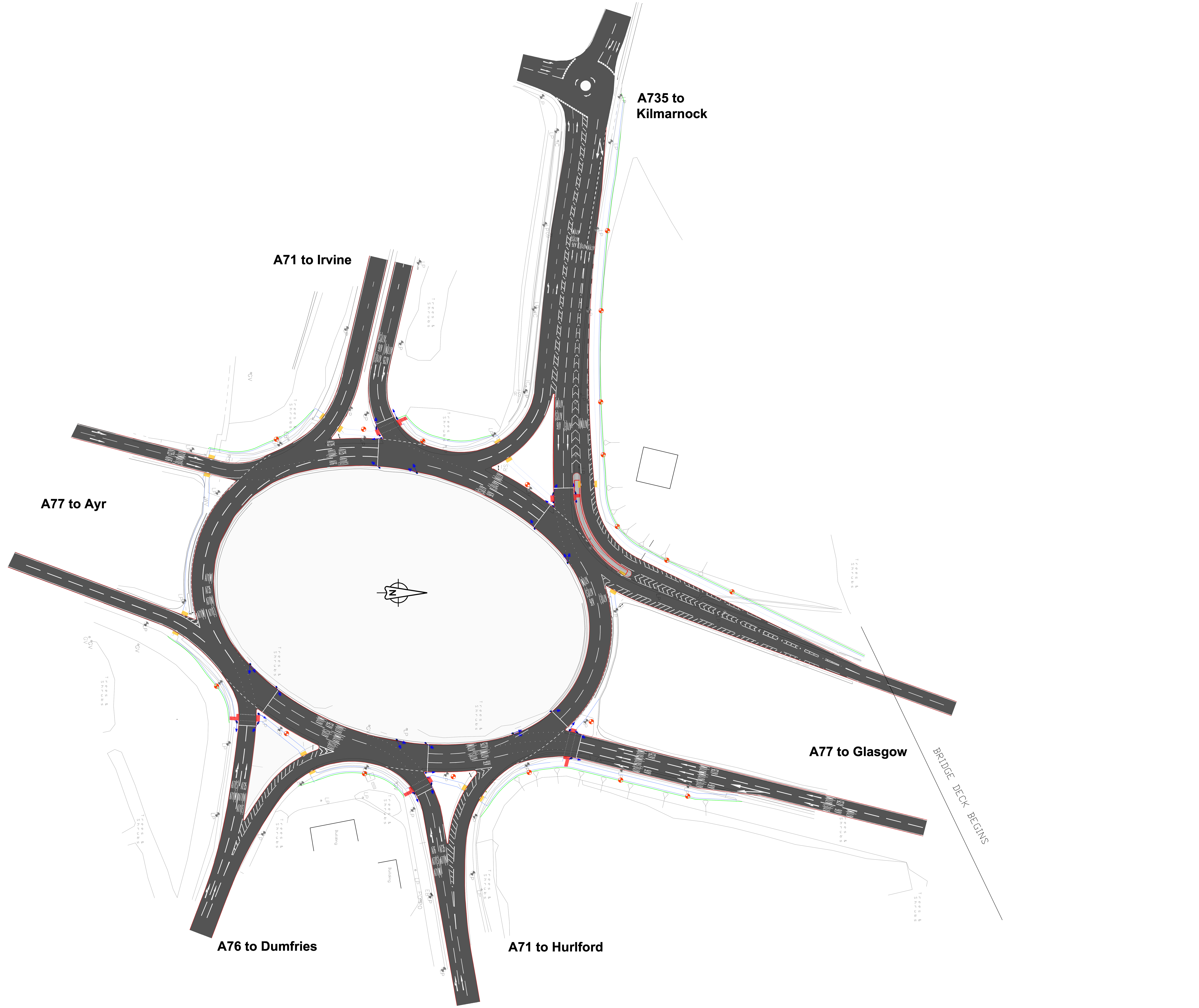
Drawing Title

A77 S/B Off-Slip
Proposed Parallel Diverge
Road Markings

Original Drawing Size : A1 Scale : As Shown
Dimensions : -

Drawing Status: FOR INFORMATION
Suitability: S0

Drawing No: CO25000313/04
Rev: P01.1



Legend

- Proposed kerb line
- Existing kerb line
- Proposed pathway
- Proposed boundary
- Existing boundary
- Pedestrian railing
- Proposed street lighting
- Existing street lighting
- Steep slope indication
- Buff tactile paving
- Tactile paving
- Area of land required for the proposed layout
- Traffic signal head
- Secondary traffic signal head
- Pedestrian traffic signal unit
- Traffic signal pole
- Direction sign

Rev	Date	Drawn	Description	Chkd	Appvd

Amey
Langmuir Way
Bargeddie
Glasgow
G69 7RW

Tel: 0141 781 6900
Fax: 0141 771 0893

Project Title

TERM CONTRACT FOR THE MANAGEMENT AND MAINTENANCE OF THE SCOTTISH TRUNK ROAD NETWORK SOUTH WEST UNIT

Drawing Title

A77 - BELLFIELD ROUNDABOUT TRAFFIC SIMULATION 3 LANE SPIRALS WITH SIGNALS AND SEGREGATED LEFT TURN LANE

Drawn	Date	Status	Scale
RC	Dec 2010	DRAFT	1:500 @ A0
Designed: DL	Date: Dec 2010		
Checked: YS	Date: Dec 2010	CAD Reference: q:\gilmerton\share\design section\paramics models\a77 bellfield (additional option)\6. drawings\option9 superimposed on existing layout rc.dwg	
Approved: JR	Date: Dec 2010		

Drawing No.	Revision
09/SW/0401/009/011	P0

Atkins
10 Canning Street
Edinburgh
EH3 8At

<contact info>