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Western Transport Corridor

Department for Infrastructure NI

A5 WESTERN TRANSPORT CORRIDOR OUTLINE BUSINESS CASE (2022)

OBC2022 *(Redacted)*

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INTRODUCTION

This document is the Outline Business Case (OBC) for the A5 Western Transport Corridor (A5WTC). It has been prepared on behalf of The Department for Infrastructure (the Department), the scheme promoters, for consideration by the Department of Finance.

The Proposed Scheme has been developed in line with the Design Manual for Roads and Bridges (DMRB) and Roads Service Policy and Procedures Guidance (RSPPG).

In February 2017 an OBC was prepared for the entire A5WTC Scheme between New Buildings and Aughnacloy. The Planning Appeals Commission (PAC) recommended that the Proposed Scheme should proceed and that the Vesting Order for Phase 1A, Phase 1B and Phase 2 should be made. In November 2017 the Department published its Notice of Intention to Proceed (NIP) with the Proposed Scheme.

A legal challenge to the Department's NIP was submitted in December 2017. Having given careful consideration to High Court decisions as well as the provisions of the NI (Executive Formation and Exercise of Functions) Act 2018, the Department decided that it was not in the public interest to continue defending the legal challenge. Consequently, at a Court hearing on the 15th November 2018, the Department invited the Court to quash the decision to proceed of November 2017.

The Department continued to develop and progress the Proposed Scheme and published an addendum to the Environmental Statement of 2016 in March 2019. The Department decided that a further public inquiry would be necessary and re-appointed the PAC to administer the inquiry process. This led to a new Public Inquiry between February and March 2020 and the PAC's Interim report on the Public Inquiry which was released to the Department in September 2020.

The Department reviewed the issues raised and recommendations made in the PAC's Interim report and announced publication of the PAC Interim report together with the Department's response to the recommendations made by the PAC in the form of an Interim Departmental Statement in March 2021.

The PAC Commissioner's key recommendations were accepted, regarding the preparation of and consultation on further documents on the topics of flood risk and the consideration of alternatives to the Proposed Scheme, requiring a new Environmental Statement Addendum (ESA) to be published.

ESA 2022 was published in March 2022 and a period of public consultation followed between March 2022 and May 2022. Subsequent consultation exercises on the supplementary information to ESA2022 were undertaken in November 2022 and January 2023. The reconvened Public Inquiry is scheduled for May / June 2023; this will enable the PAC to consider further public representations and prepare its final report.

The revised Proposed Scheme delivery programme now dictates that the OBC prepared in 2017 is no longer applicable and a new OBC should be prepared to capture the changes that have occurred since 2017 in the relevant transport appraisal guidance, economic and demographic forecasts as well as the programme affecting the Proposed Scheme opening year and construction assumptions.

INTRODUCTION TO OUTLINE BUSINESS CASE (OBC)

The OBC explains why the Proposed Scheme should receive support and provides a clear audit trail for the purposes of public accountability. The OBC also sets out how and why the decision has been made to put the proposal forward in its current form. It demonstrates that this is based on a robust analysis of current conditions and forecasts of future conditions including the effects of constructing the Proposed Scheme. It also includes an assessment of the social and economic benefits of the Proposed Scheme and the proposals for managing and financing its construction and delivery.

The OBC is structured so that it satisfies both the UK Treasury's advice on evidence-based decision making set out in the Green Book and the Better Business Cases Northern Ireland (NI) guidance. Better Business Cases NI came into operation in Northern Ireland from the 2nd of November 2020 and follows closely the UK Department for Transport (DfT), Five Case Model. This guidance supersedes the previous guidance known as NIGEAE (Northern Ireland Guide to Expenditure Appraisal and Evaluation). The Five Case Model, as set out by the DfT forms the structure of this document.

THE SCHEME

The Proposed Scheme is approximately 85km in length, between New Buildings and south of Aughnacloy where the existing A5 joins with the N2 at the border with the Republic of Ireland. It would provide approximately 82km of new dual carriageway, generally parallel with the existing A5 with a 2+1 carriageway bypass of New Buildings and a single carriageway section to the south-east of Aughnacloy.

A number of junctions will facilitate access to the towns and villages along the route corridor, currently served by the existing A5, as well as links to other strategic routes.

The Proposed Scheme is expected to be delivered in distinct Sections, comprised of phases, as follows:

- New Buildings to north of Strabane and south of Omagh to Ballygawley
  - Phase 1A (Section 1) construction period Q4 2023 to Q4 2026 and open for traffic in 2026
  - Phase 1B (Section 3) construction period Q1 2024 to Q1 2028 and open for traffic in 2028
- North of Strabane to South of Omagh
  - Phase 2A (Section 1) construction period Q3 2024 to Q4 2027
  - Phase 2B (Section 2) construction period Q1 2024 to Q4 2027
  - Combined Phase 2 (2A+2B) open for traffic in 2027
- Ballygawley to the Border at Aughnacloy
  - Phase 3 (Section 3) construction period Q3 2025 to Q3 2028 and open for traffic in 2028

Prior to the construction of each Section, a specific Full Business Case (FBC) will be prepared, which will review the continued accuracy of assumptions made within this OBC with a view to ensuring the robustness of the appraisal.

THE STRATEGIC CASE

The overarching theme of the Proposed Scheme is improved connectivity, safety, accessibility and enhanced economic growth. The Proposed Scheme is on a designated Key Transport Corridor and a component of the Regional Strategic Transport Network. It is strategically aligned with several central and local government plans and policies, which all demonstrate a strong ambition to improve the A5 as a key national and local link.

There are a number of specific problems that have been identified on the A5 corridor and the regions through which it runs, namely congestion at pinch points and poor journey time reliability; accessibility to key economic centres and international gateways; accident hotspots; and community severance. These problems have been considered within the context of strategic transport and economic policy and have informed the development of the Proposed Scheme objectives:

- To improve road safety
- To improve the road network in the west of the Province and North/South Links
- To reduce journey travel times along the A5 Western Transport Corridor
- To provide increased overtaking opportunities for motorists along the A5 Western Transport Corridor
- To develop the final proposals in light of safety, economic, environmental, integration and accessibility considerations.

Achieving these objectives would contribute to the higher-level objectives of balancing regional infrastructure, as well as improving competitiveness and economic prosperity through improving connectivity and accessibility across the region.

It is recognised that there are physical, environmental and other constraints in developing the Proposed Scheme, however, appropriate design techniques have been used and mitigation proposed which minimise both the impacts upon the Proposed Scheme and the impacts of the Proposed Scheme.

In order to identify and minimise these impacts, in accordance with the Department guidelines1, a three-stage assessment was used to develop and refine the Proposed Scheme which included: the selection of the preferred corridor, the development of route options and an assessment and re-assessment of the Proposed Scheme, demonstrating that the Proposed Scheme has been considered as part of a wider strategy for Northern Ireland.

The Proposed Scheme would facilitate the movement of people and goods along a modern, high-quality corridor and improve access to international gateways at Londonderry Port and City of Derry Airport in the north and the Republic of Ireland in the south and the north-west, and to market towns and tourist areas.

Consequently, the Proposed Scheme would assist with the delivery of economic and growth objectives for Northern Ireland, whilst potentially attracting inward investment to the districts of Derry City and Strabane, Fermanagh and Omagh and Mid Ulster, as well as other settlements along or near the route, making them better places in which to live, work and visit.

[1] RSPPG E030: Major Works Schemes: Inception to Construction (2013)

THE ECONOMIC CASE

The Economic Case presents results of the assessment of the Proposed Scheme's impacts to determine the overall Value for Money (VfM) of the Proposed Scheme. It takes account of the costs of developing, building and maintaining the scheme, and the benefits arising from the scheme. These include benefits that can be monetised, as well as quantitative and qualitative impacts that cannot be monetised.

A highway assignment traffic model of the A5 corridor has been used to inform the quantitative inputs into the scheme appraisal. To support the model's continuing use in informing the scheme appraisal for the OBC, a series of traffic model verification exercises have been carried out. These confirmed the model's ongoing validity for the assessment and appraisal of the Proposed Scheme.

Traffic forecasts were developed for the opening year of each phase of the scheme and for a design year of 2043 i.e.,15 years after the opening of Phase 3. Using these traffic forecasts, transport user benefits, accident benefits, construction and maintenance benefits and monetised environmental benefits (noise, local air quality and greenhouse gases) were derived by comparing the Do-Minimum and the Do-Something scenarios. These formed the Established monetised impacts.

Additional monetised benefits were determined for wider impacts and non-monetised benefits were determined for journey time reliability, landscape, historic environment, biodiversity, water environment and social impacts, as well as for non-monetised impacts of the Proposed Scheme on noise, local air quality and greenhouse gases. Distributional impacts of the Proposed Scheme, on groups regarded as vulnerable, were assessed for user benefits, accidents, severance, personal affordability, noise, and air quality.

The Present Value of Benefits (PVB) of the Proposed Scheme including the wider impact is **£1,168M** in 2010 values and prices.

The Present Value of Costs (PVC) for the Proposed Scheme including construction costs and whole life costs is **£866M** in 2010 values and prices.

Using the Value for Money Framework issued by the Department for Transport in July 2017, the Proposed Scheme offers **Low** value for money (VfM), with an adjusted Benefit-Cost Ratio (BCR) of **1.35**.

The monetary benefits are predominantly derived from the Established monetised impacts, namely accident savings and journey time savings to business users and consumers, with the wider impacts also providing a notable proportion of the scheme benefits.

The assessment of accident and casualty savings, as a result of the scheme, which have been included in the economic appraisal, indicate a reduction in the number of casualties by 3,793 over the 60 year appraisal period.

A number of sensitivity tests were undertaken to test the impacts of uncertainties around supply, demand, programme and cost assumptions on the Proposed Scheme's BCR. The sensitivity analysis has shown that the Proposed Scheme BRC falls in the range bounded by the Low and High growth assessments, from **1.13 to 1.65** respectively, representing a VfM category of **Low to Medium** respectively.

THE FINANCIAL CASE

The estimated capital costs (excluding sunk costs, client costs and non-recoverable VAT) at 2022:Q2 prices, is **£1,608.62M.**

[redacted]

[redacted]

The strategic importance of the Proposed Scheme is recognised at Northern Ireland Executive level, as such it is a priority for the allocation of capital funding. It is therefore assumed that the full capital allocation for the Proposed Scheme will be provided at the Executive level alongside contributions from the Irish Government, rather than being funded from within the Department's typical budget allocations.

THE COMMERCIAL CASE

The Proposed Scheme is commercially viable with a robust contracting and procurement strategy. This included the use of the OJEU 'restricted procedure' procurement tendering process using a traditional approach and based upon the NEC3 Engineering and Construction (ECC) form of contract.

A number of technical discussion papers were produced with regards to the most appropriate approach to delivery. These recommended the way forward in terms of promoting collaborative working through use of Early Contractor Involvement (ECI) and splitting the scheme into three contracts. The approach also includes pain/gain mechanisms within the NEC Option C form of contract.

The early appointment of contractors to the Proposed Scheme effectively manages risk and reduces cost uncertainty in line with the vision, aims and objectives of the procurement Strategy for 'a first-class and affordable A5 corridor upgrade delivered safely and sustainably through effective partnerships and project excellence'.

THE MANAGEMENT CASE

The Investment Decision Maker (IDM) for delivery of the project is the Permanent Secretary. Doctor Kaine Lynch, the Director of Major Projects and Procurement, is the Senior Responsible Owner (SRO) who leads the Project Delivery Team in the delivery of the Proposed Scheme. The Proposed Scheme will be delivered utilising appropriate project management and best practice. The Department has established a Project Delivery Team for the Proposed Scheme. The team is led by the SRO and includes representatives of the various disciplines and work streams involved in delivering the project to completion.

A thorough stakeholder communications strategy has been implemented throughout the development of the Proposed Scheme and consequently, there have been several public exhibitions and consultations with statutory bodies, landowners and stakeholders in order to explain the objectives of the scheme, outline the key criteria that has informed the planning, design and assessment process and describe the statutory process that would be followed.

Further to these, the Proposed Scheme has been through three Public Inquiries, with the third Inquiry due to reconvene in May 2023.

1 INTRODUCTION

1.1 THE OUTLINE BUSINESS CASE

1.1.1. This document is the Outline Business Case (OBC) for the A5 Western Transport Corridor (hereafter referred to also as the 'Proposed Scheme' or 'A5WTC'). It has been prepared on behalf of the Department for Infrastructure (the Department) for consideration by the Department of Finance (DoF).

1.1.2. The OBC satisfies both the UK Treasury's advice on evidence-based decision making set out in the Green Book[2] and the Better Business Cases Northern Ireland (NI) guidance. The Five Case Model[3], as set out by the UK Department for Transport (DfT), forms the structure of this document.

1.1.3. The OBC explains why the Proposed Scheme should receive support and provides a clear audit trail for the purposes of public accountability. The OBC also sets out how and why the decision has been made to put the proposal forward in its current form. It demonstrates that this is based on a robust analysis of current conditions, forecasts of future conditions including the effects of constructing the Proposed Scheme, an assessment of the social and economic benefits of the Proposed Scheme and finally the proposals for managing and financing its construction and delivery.

UPDATED BUSINESS CASE GUIDANCE

1.1.4. A review into the process for approving expenditure in Northern Ireland and the role of the business case was carried out in 2019 by the DoF. As a result of that review, it was decided that Northern Ireland Departments should use the HM Treasury model for developing business cases. This approach is known as the 'Five Case Model'. This model is also used by the administrations in England, Scotland and Wales[4].

1.1.5. Better Business Cases NI came into operation in Northern Ireland from the 2nd of November 2020 and closely follows the DfT Five Case Model, as illustrated in the correspondence matrix included as **Appendix A**. The Five Case Model does not mean producing five different business cases. It is a single business case, broken down into five different aspects, which are interconnected but distinct (the strategic, economic, financial, commercial and management aspects of the case).

1.1.6. The business case should enable departments and other stakeholders to ascertain that proposals:

- are supported by a robust case for change – the **strategic case**
- optimise value for money – the **economic case**
- are financially affordable – the **financial case**
- are commercially viable – the **commercial case**
- can be delivered successfully – the **management case**

1.1.7. The Better Business Cases NI and Supplementary Guidance[5] supersedes the previous guidance known as NIGEAE (Northern Ireland Guide to Expenditure Appraisal and Evaluation). The 10 steps previously outlined in NIGEAE will still be undertaken in some form. However, the Five Case Model

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[2] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent
[3] https://www.gov.uk/government/publications/transport-business-case
[4] https://www.finance-ni.gov.uk/articles/better-business-cases-ni
[5] https://www.finance-ni.gov.uk/publications/better-business-cases-ni-supplementary-guidance

structures the Business Case in a way that ensures specialists are providing advice to the cases most relevant to their area of expertise. Other notable differences include:

- a requirement to clearly outline critical success factors and categorise spending objectives to aid option shortlisting
- using the options framework to arrive at ideally four shortlisted options which should include business as usual and a do minimum
- a formal categorisation of benefits to identify cash releasing, non-cash releasing, quantifiable but not readily monetisable and qualitative benefits
- the use of workshops.

PURPOSE OF THE OUTLINE BUSINESS CASE

1.1.8. The main purpose of this OBC is to:

- set out a robust case for change that demonstrates how the proposal has a strong strategic fit with the organisation's priorities, government ambitions and the area(s) in scope – the '**strategic case'**
- present the full economic and financial appraisals in the **economic** and **financial cases**
- set out the preparations for the potential construction contracts through the development of the **commercial case**
- define the arrangements required to ensure successful delivery through the **management case.**

1.2 THE PROPOSED SCHEME

EXISTING A5

1.2.1. The existing A5 route runs from New Buildings to the border with the Republic of Ireland (RoI), just south of Aughnacloy, where it links to the N2 route travelling southwards towards Dublin. It passes through or adjacent to the settlements of New Buildings, Magheramason, Bready, Cloghcor, Ballymagorry, Strabane, Sion Mills, Victoria Bridge, Newtownstewart, Omagh, Garvaghy, Ballygawley and Aughnacloy.

1.2.2. The A5 was part of the Trans-European Transport Network (TEN-T) prior to the UK exiting the EU, reflecting its importance as a strategic link, joining Dublin with Londonderry, which is the principal city of the North West. Londonderry is a key cross-border and international gateway providing access by road, rail, sea and air to and from the northwest region. The UK government is planning a UK-wide strategic transport network (UKNET), which will deliver vital improvements that better connect all the nations of the UK[6].

SCHEME OUTLINE

1.2.3. The Proposed Scheme is an approximately 85km long corridor between New Buildings and south of Aughnacloy, where the existing A5 joins with the N2 at the border with the Republic of Ireland. The Proposed Scheme would provide approximately 82km of new dual carriageway parallel with the existing A5 with a 2+1 carriageway bypass of New Buildings and a single carriageway section to the southeast of Aughnacloy. The Proposed Scheme is on a designated Key Transport Corridor and a component of the Regional Strategic Transport Network. As a flagship project of the Northern

[6] https://www.gov.uk/government/news/uk-government-publishes-union-connectivity-review-proposed-transport-investments-for-stronger-and-better-connected-united-kingdom

Ireland Executive, a decision on the implementation of the Proposed Scheme remains a priority for the Department. The location of the Proposed Scheme is shown in Figure 1-1 (denoted in purple).

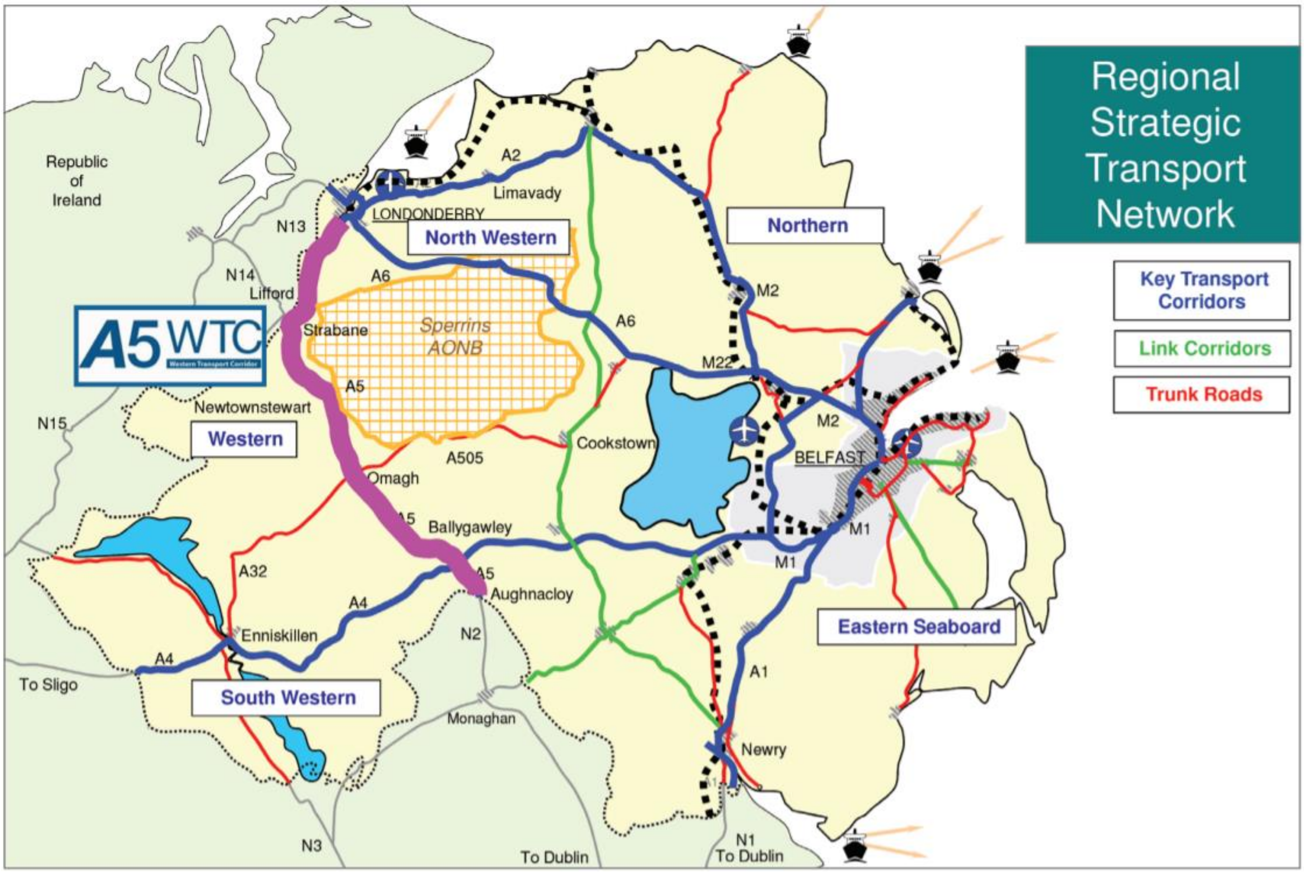

Figure 1-1: Key Transport Corridors in Northern Ireland

SCHEME DEVELOPMENT

1.2.4. Since its inception in 2008, the Proposed Scheme has been consulted on and considered at a number of public consultations and Public Inquiries.

Identification of the Preferred Corridor and Preliminary Options (2008 – 2009)

1.2.5. In 2008, a study area for the A5WTC dual carriageway scheme was defined that was the subject of a public consultation. Later in 2008 the study area was refined to a Preferred Corridor and a Stage 1 Scheme Assessment Report (Preliminary Options Report) was produced.

1.2.6. In early 2009, a further public consultation exercise was held in relation to the Preferred Corridor and a number of route options that had been developed within it. In July 2009, the Minister for Regional Development announced the Preferred Route for the A5WTC and the publication of a Preferred Options Report. The Preferred Options Report summarised the work carried out in the Stage 2 Scheme Assessment and detailed the Preferred Route and the rationale for its choice.

Consideration of the Preferred Route (2010)

1.2.7. Following receipt of additional information in relation to the Preferred Route, in particular in terms of ground investigation studies, flood modelling, cost information, and feedback from landowners, a number of alternatives to the Preferred Route were considered. These were published in 2010 in an 'Alternatives Discussion Paper'.

1.2.8. The combination of the Preferred Route and adopted alternatives became the 'Proposed Scheme' which was then the subject of draft Statutory Orders. An Environmental Statement was published in November 2010 with Public Exhibitions on the Proposed Scheme being held later in the month.

Public Inquiry (2011 – 2012)

1.2.9. A Public Inquiry was held in the summer of 2011 for the Proposed Scheme and the Inspector's report was published in February 2012. This recommended that the A5WTC scheme should proceed as proposed by the Department for Regional Development. In July 2012, the Orders were confirmed by the Minister to upgrade two sections of the A5: that from Londonderry to north of Strabane, and that from south of Omagh to Ballygally.

Legal Challenge (2012 - 2013)

1.2.10. During 2012 to 2013, a legal challenge was mounted against the Department and although the judge found for the Department on 11 of the 12 issues that were raised, he ruled against the Department under the Habitats Directive on the need for an Appropriate Assessment on Rivers Foyle and Finn Special Areas of Conservation.

1.2.11. Following the Court ruling, when the Minister's decision to make the Direction Order and Vesting Order was quashed, the Department initiated an assessment process not only for the River Foyle and River Finn Special Areas of Conservation (SACs), but also other SACs, Special Protection Areas (SPAs) and Ramsar Sites in the vicinity of the Proposed Scheme. These assessments were covered in the following reports:

- Report of Information to Inform an Appropriate Assessment: SAC Watercourses, covering:
  - River Foyle & Tributaries Special Area of Conservation
  - Owenkillew River Special Area of Conservation
  - River Finn Special Area of Conservation
- Report of Information to Inform Appropriate Assessment: Tully Bog SAC, covering:
  - Tully Bog Special Area of Conservation
- Report of Information to Inform Appropriate Assessment: SPAs, covering:
  - Lough Foyle Special Protection Area
  - Lough Swilly Special Protection Area
  - Lough Neagh & Lough Beg Special Protection Area
- Report of Information to Inform Appropriate Assessment: Ramsar Sites, covering:
  - Lough Foyle Ramsar Site
  - Lough Neagh & Lough Beg Ramsar Site

1.2.12. The Department also decided, at that time, that the Statutory Procedures would be revisited and that new draft Orders should be prepared to reflect any changes arising out of the original Public Inquiry process and to take account of any interim changes in legislation and design standards. The Preferred Route was, however, unaffected.

1.2.13. The draft Orders comprised:

- a draft Direction Order for a part of the Proposed Scheme between New Buildings and Ballygawley (junction with the A4)

- draft Vesting Orders to reflect the phased delivery programme and recognising that the section between Ballygawley and the border at Aughnacloy should not be included in line with the recommendations within the Inspectors Report from the 2011 Public Inquiry
  - Phase 1A – from New Buildings to north of Strabane
  - Phase 1B – from south of Omagh to Ballygawley
- a draft Stopping Up of Private Accesses Order relating to the length of the Proposed Scheme between New Buildings and Ballygawley (junction with the A4)

1.2.14. In addition, a new Environmental Statement (ES) for the whole scheme between New Buildings and the border south of Aughnacloy was prepared.

Environmental Statement and Public Consultation (2016 – 2017)

1.2.15. In February 2016, the Department published the draft Orders and Environmental Statement for the Proposed Scheme, and this was followed by a public consultation period extending to April 2016. A total of 1,001 representations were received in response to the consultation and in view of this, the Department appointed the Planning Appeals Commission (PAC) to administer a Public Inquiry which was held between October and December 2016.

1.2.16. The PAC submitted their report from the Public Inquiry to the Department on 25th May 2017. The PAC acknowledged that the benefits from the Proposed Scheme would be of major public significance and were not persuaded that alternatives to an off-line dual carriageway would be capable of achieving the same scale of benefits. Therefore, the PAC concluded that there was a compelling argument for the Proposed Scheme to be delivered in the wider public interest.

1.2.17. Following discussions with the DoF in February 2017 it was agreed to prepare an OBC for the entire A5WTC Scheme between New Buildings and Aughnacloy, which would supersede the earlier Major Scheme Business Case (MSBC 2012). The PAC recommended that the Proposed Scheme should proceed and that the Vesting Order for Phase 1A, Phase 1B and Phase 2 (from north of Strabane to south of Omagh) should be made.

1.2.18. In November 2017 the Department published its Notice of Intention to Proceed (NIP) with the Proposed Scheme. At the same time as the NIP the Department made the Direction Order (setting the line of the new road in legislation) for the section between New Buildings and Ballygawley and the Vesting Order purchasing the necessary lands for the construction of Phase 1A (New Buildings to north of Strabane).

Decision Quashed (2018)

1.2.19. A legal challenge to the Department's NIP was submitted in December 2017. Having given careful consideration to High Court decisions as well as the provisions of the NI (Executive Formation and Exercise of Functions) Act 2018, the Department decided that it was not in the public interest to continue defending the legal challenge. Consequently, at a Court hearing on the 15th November 2018, the Department invited the Court to quash the decision to proceed of November 2017.

1.2.20. Due to this quashed decision the Department moved back to a point in time just before its decision to proceed with the Proposed Scheme in November 2017 and, as a result, the made Direction and Vesting Orders for the Proposed Scheme were no longer in force. For landowners in Phase 1A, the lands that had been vested by the Department in January 2018 were therefore returned to their ownership with effect from 16th November 2018.

Public Inquiry (2020), Publication of the PAC Interim Report and the Interim Departmental Statement (March 2021)

1.2.21. The Department continued to develop and progress the Proposed Scheme and published an addendum to the Environmental Statement of 2016 in March 2019. With circa 250 objections received, the Department decided that a further public inquiry would be needed and therefore re-appointed the PAC. This led to a new public inquiry between February and March 2020 and the PAC's Interim report on the Public Inquiry released in September 2020.

1.2.22. The Department reviewed the issues raised and recommendations made in the PAC's Interim report on the proceedings of the public inquiry into the A5WTC and announced publication of the PAC Interim report together with the Department's response to the recommendations made by the PAC in the form of an Interim Departmental Statement in March 2021.

1.2.23. The PAC Commissioner's key recommendations were accepted, regarding the preparation of and consultation on further documents on the topics of flood risk and the consideration of alternatives to the Proposed Scheme, requiring a new Environmental Statement Addendum (ESA) to be published. ESA 2022 was published in March 2022 and a period of public consultation ran between March 2022 and May 2002. Further consultation was also undertaken to inform an Appropriate Assessment relating to the likely impacts of the A5WTC upon Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites.

1.2.24. In November 2022 the Department published and consulted on a number of new and updated reports as supplementary information to the ESA 2022. These reports relate to updates and additional information on scheme alternatives; scheme phasing; agricultural industry impacts and further background information on proposed mitigation measures at Tully Bog Special Area of Conservation as well as new information which became available as part of the development of this OBC - namely the Economic Appraisal Report (OBC2022) and Strategic Context and Policy Report (OBC2022) both of which are now superseded by this OBC.

1.2.25. The re-opening of the Public Inquiry, as recommended by the PAC, has been scheduled for May / June 2023 and will enable the PAC to consider further public representations and prepare its final report.

Updated OBC (2022)

1.2.26. The revised Proposed Scheme delivery programme now dictates that the OBC prepared in 2017 is no longer applicable and a new OBC needs to be prepared to capture the changes that have occurred since 2017 in the relevant transport appraisal guidance, economic and demographic forecasts as well as in programme affecting the Proposed Scheme opening year and phasing assumptions.

1.2.27. The Proposed Scheme is now expected to be delivered in distinct Sections, comprised of different phases as detailed in paragraph 1.2.47. As the scheme moves forward, a Full Business Case (FBC) will be prepared for each individual Section, which will review the continued accuracy of assumptions made within this OBC with a view to ensuring the robustness of the appraisal for the Section being assessed and for the whole scheme. Factors which will be considered include:

- scheme estimates
- delivery dates
- traffic growth rates
- lessons learned from previous Sections

1.2.28. The programme for the opening of the scheme phases reflected in this document is consistent with that assumed in the preparation of the 2022 Environmental Statement Addendum (ESA), and is as follows:

- Phase 1A opening 2026: New Buildings to north of Strabane (Junctions 1-3)
- Phase 2A and 2B opening 2027: North of Strabane to south of Omagh (Junctions 3-13)
- Phase 1B opening 2028: South of Omagh to Ballygawley (Junctions 13-15)
- Phase 3 opening 2028: Ballygawley to Aughnacloy (Junctions 15-17)

SCHEME DESCRIPTION

1.2.29. The Proposed Scheme begins at New Buildings and runs for 85km south to the border with the Republic of Ireland, south to the village of Aughnacloy. It would provide a new off-line dual carriageway running generally parallel to the existing A5 with a Wide Single (WS) 2+1 carriageway bypass of New Buildings and a single carriageway section to the southeast of Aughnacloy, connecting the Proposed Scheme to the existing A5 at the northern and southern ends respectively.

1.2.30. The Proposed Scheme would connect to the A4 dual carriageway at Ballygawley, linking to the M1 motorway to Belfast, and to the A505 and A32 at Omagh, reinforcing the east / west connections in the region. It would also connect to the N2 southwest of Aughnacloy and the N14 / N15 routes west of Strabane at Lifford, thereby providing improved southern and western strategic links to the Republic of Ireland, respectively. The N12 and N14 routes have also been identified for upgrades by the Irish Government.

1.2.31. There would be a roundabout on the existing A5 north of New Buildings (Junction 1) and a second roundabout with a link to the existing A5 at the end of the initial wide single 2+1 carriageway section southwest of the settlement (Junction 2). As the dual carriageway runs south towards Strabane there would be a grade-separated junction at Ballymagorry (Junction 3). Bridges either over or under the new road would enable established movements, along most of the existing local roads it crosses, to be maintained.

1.2.32. There would be a substantial cutting on the west facing slopes of Gortmonly Hill at Bready, open-span bridges carrying the dual carriageway over the Burn Dennet and Glenmornan River and long sections of embankment on the approaches to both bridges and from Junction 3 to Strabane where the dual carriageway would be located on the eastern margins of the River Foyle floodplain. The Proposed Scheme would include a number of flood connectivity structures where flood plains are crossed.

1.2.33. The alignment of the Proposed Scheme between the Burn Dennet and Glenmornan River would pass to the east of McKean's Moss Area of Special Scientific Interest (ASSI). At Strabane the Proposed Scheme would skirt the western edge of the urban area. There would be junctions west (Junctions 4 to 6), south-west (Junction 7) and south (Junction 8) of Strabane.

1.2.34. Junctions 4 to 6 comprise a composite grade-separated arrangement which would allow for all movements using land on both sides of the Mourne River at each end of a new open-span bridge over the Mourne River. At this location the Mourne River is part of the River Foyle and Tributaries Special Area of Conservation (SAC) and ASSI.

1.2.35. The alignment between Junctions 6 and 7 would run alongside the River Finn SAC and would require the demolition of Castletown House (a grade B1 listed building). Junction 7 would be a large roundabout and would include a spur to provide for a link crossing the River Finn to the N14 and N15 routes in the Republic of Ireland. The link crossing does not form part of the Proposed Scheme but is being developed by Donegal County Council and is scheduled to be constructed and opened to traffic at the same time as this part of the Proposed Scheme.

1.2.36. Junction 8 would be a compact grade-separated junction with a link to the existing A5, north of Sion Mills. South of Junction 8, the Proposed Scheme would pass between Sion Mills and Glebe following an alignment west of the existing road on the lower western slopes enclosing the Mourne Valley.

1.2.37. There would be compact grade-separated junctions west of Victoria Bridge on the B72 Fyfin Road (Junction 9) and north-west of Newtownstewart on the B84 Baronscourt Road (Junction 10) and an open-span bridge over the River Derg, part of the River Foyle and Tributaries SAC and ASSI.

1.2.38. The Proposed Scheme would follow an alignment to the west of Newtownstewart, passing close to Harry Avery's Castle, a State Care Monument, before descending into the Strule Valley and running above, and to the west of, the existing A5 towards Omagh.

1.2.39. Through the valley, it would pass west of Grange Wood ASSI and Beltany Tomb, a Scheduled Monument. Emerging from the enclosed Strule Valley the Proposed Scheme would enter the wide Fairy Water valley, passing west of Mountjoy and approaching a new grade-separated junction (Junction 11). The junction would be located north-west of Omagh close to Tully Bog SAC and ASSI.

1.2.40. The Proposed Scheme would cross over the Fairy Water via a new open-span bridge and the extensive river floodplain on embankment with connectivity structures incorporated. The Proposed Scheme would then curve west and south around Omagh, with access to Omagh being catered for via a grade-separated junction with the A32 Clanabogan Road west of Omagh (Junction 12) and a grade-separated junction at the B83 Seskinore Road, with a link to the existing A5 to the south (Junction 13).

1.2.41. There would be an open-span bridge over the Drumragh River. South of Omagh, the Proposed Scheme would continue west of the existing A5 passing east of Seskinore and onto a compact grade-separated junction on the B46 at Moylagh (Junction 14).

1.2.42. An open-span bridge would carry the dual carriageway over the Routing Burn. It would run east of, and close to, Newtownsaville and then curve to the east as it skirts the lower south facing slopes of Tycanny Hill requiring the establishment of a deep cutting in the locally prominent hill.

1.2.43. It would then descend the scarp slope of the Brougher Ridge and pass west of and below Errigal Keerogue Churchyard, a State Care Monument. Upon descending the ridge, it would enter the Clogher Valley and follow an easterly alignment to a new at-grade roundabout where the Proposed Scheme and existing A4 Annaghilla Road would cross some 1.5km west of Ballygawley (Junction 15).

1.2.44. An existing 1km single carriageway section of the A4 between Junction 15 and an existing roundabout located south-west of Ballygawley would be upgraded to a dual carriageway. Two open-span bridges would be introduced, one where the upgraded section of the A4 crosses Ballygawley Water and one south of Junction 15 where the A5WTC dual carriageway also crosses the watercourse. South of Ballygawley Water, the Proposed Scheme would enter a section of cutting below Lisdoart Rath and continue to a grade-separated junction on the existing A5 north of Aughnacloy (Junction 16).

1.2.45. Beyond the junction it would follow a broad sweep to the east and tie into a new roundabout where it crosses the A28 Caledon Road (Junction 17) southeast of Aughnacloy.

1.2.46. The final section of the Proposed Scheme would be a single carriageway road that would tie into the existing A5 at Moy Bridge, immediately north of the border with the Republic of Ireland. A location plan of the Proposed Scheme is presented in Figure 1-2.

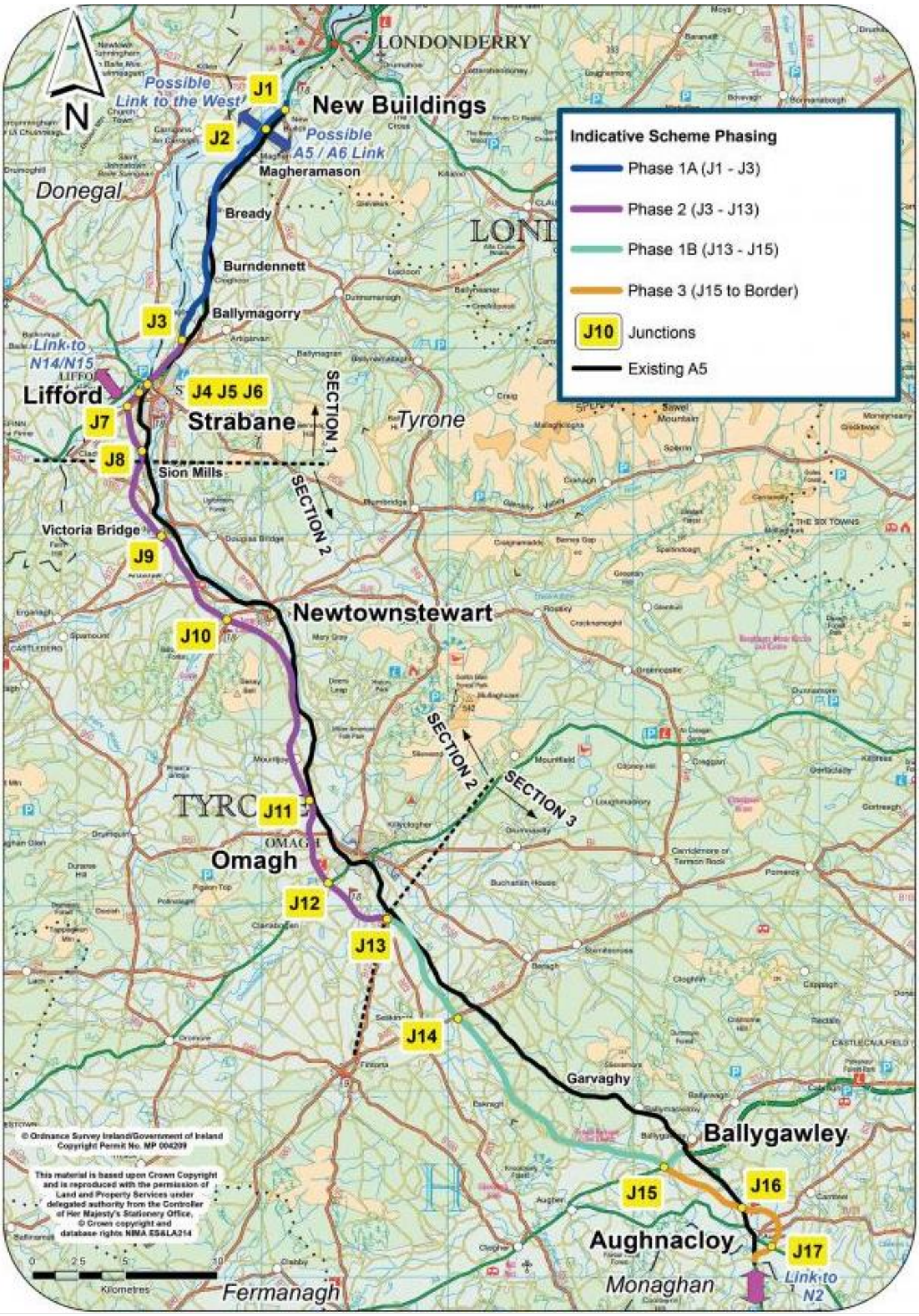

Figure 1-2: Location plan of the Proposed Scheme (Map Source: www.a5wtc.com)

1.2.47. Following the receipt of the Interim Report on the Public Inquiry in September 2020, the Department committed to producing a further addendum to the Environmental Statement which gives updated timeframes as follows:

- New Buildings to north of Strabane and south of Omagh to Ballygawley
  - Phase 1A (Section 1) construction period Q4 2023 to Q4 2026 and open for traffic in 2026
  - Phase 1B (Section 3) construction period Q1 2024 to Q1 2028 and open for traffic in 2028
- north of Strabane to south of Omagh
  - Phase 2A (Section 1) construction period Q3 2024 to Q4 2027
  - Phase 2B (Section 2) construction period Q1 2024 to Q4 2027
  - Combined Phase 2 (2A+2B) open for traffic in 2027
- Ballygawley to the Border at Aughnacloy
  - Phase 3 (Section 3) construction period Q3 2025 to Q3 2028 and open for traffic in 2028

1.2.48. Note, the construction start date could potentially be delayed should a legal challenge be made on the Proposed Scheme. It is anticipated the Proposed Scheme would now be constructed in three Sections aligned to the Phases, as set out above i.e. Section 1 comprises Phase 1A and Phase 2A; Section 2 comprises Phase 2B; and Section 3 comprises Phase 1B and Phase 3.

1.3 CASE FOR CHANGE

PROBLEMS

1.3.1. The overarching theme of the Proposed Scheme is improved connectivity, safety, accessibility and enhanced economic growth. There is a strategic need for good quality north-south connections in Northern Ireland between key centres of economic importance and between large populations, as well as cross border connectivity with the Republic of Ireland.

1.3.2. The inadequacy of the existing A5 is viewed by local people and the business community as a barrier to economic growth, as journey times are made unreliable by congestion caused at bottlenecks at junctions in key towns, a lack of overtaking opportunities and slow-moving agricultural traffic along the route, leading to increased safety risks.

1.3.3. The A5 is a designated Key Transport Corridor and a component of the Regional Strategic Transport Network. The Proposed Scheme has an overarching aim to improve links between the urban centres in the west of Northern Ireland and to provide a strategic link with international gateways. It is strategically aligned with several central and local government plans and policies, which all demonstrate a strong ambition to improve the A5 corridor as a key national and local link.

1.3.4. The Strategic Case identifies a number of key problems on the A5 corridor and the regions through which it runs:

- congestion pinch points and journey time unreliability
- accessibility to key economic centres and international gateways
- accident hotspots
- community severance

1.3.5. If the Proposed Scheme is not provided, the problems described above are expected to remain or worsen:

- congestion at pinch points is likely to worsen and journey times are expected to become more unreliable
- economic growth could be inhibited
- accidents could increase on key sections of the existing A5
- community severance will increase along the existing A5, particularly for non-motorised users

SCHEME OBJECTIVES

1.3.6. The objectives of the Proposed Scheme have been developed through considering the problems described above, within the study area and on the existing north-south route of the A5. These problems have been considered within the context of strategic transport and economic policy. The Proposed Scheme will improve links between the urban centres in the west of the province and provide a strategic link with international gateways.

1.3.7. The **objectives** of the Proposed Scheme are:

- To improve safety
- To improve the road network in the west of the Province and North / South links
- To reduce journey travel times along the A5 Western Transport Corridor
- To provide increased overtaking opportunities for motorists along the A5 Western Transport Corridor
- To develop the final proposals in light of safety, economic, environmental, integration and accessibility considerations.

1.3.8. Achieving these objectives would contribute to the higher-level objectives of balancing regional infrastructure, improving competitiveness and economic prosperity through improving connectivity and accessibility across the region, and contributing to the achievement of sustainable progress in relation to social, economic and development goals in Northern Ireland. These will be achieved by the following **outputs**:

- the Proposed Scheme - a new dual carriageway meeting the highest standards, which:
  - segregates traffic making strategic journeys from traffic making local journeys
  - provides increased, improved and safer overtaking opportunities for motorists along the A5WTC

1.3.9. The Proposed Scheme will deliver the following **outcomes**:

- reduced number of accidents
- reduced congestion & delay at pinch points
- improved journey time reliability
- improved connectivity between Londonderry and Aughnacloy, locally and strategically
- overtaking opportunities increased
- improved access to Londonderry port, City of Derry Airport & the RoI
- reduced community severance

1.3.10. Consequently, the Proposed Scheme would assist with the delivery of economic and growth objectives for Northern Ireland, whilst potentially attracting inward investment to the districts of Londonderry and Strabane, Fermanagh and Omagh and Mid Ulster, making them more attractive places in which to live, work and visit.

1.4 DOCUMENT STRUCTURE

1.4.1. Chapter 0 provides an overview of the OBC and covers the purpose, process and the relevant guidance that has been adopted, as well as a description of the Proposed Scheme which includes details of the proposed phasing.

1.4.2. Chapters 2 to 6 present the strategic, economic, financial, commercial and management cases.

2 THE STRATEGIC CASE

2.1 INTRODUCTION

PURPOSE

2.1.1. The strategic case is one of the five components of the Outline Business Case (OBC) and provides the strategic narrative for the scheme, setting out:

- what transport and economic problems exist which are related to the current infrastructure and urban form
- what the underlying policy objectives of the Department for Infrastructure and the Northern Ireland Executive are
- how the scheme has been developed to address these problems and how it aligns with strategic policy objectives.

2.1.2. The strategic case demonstrates that the proposed scheme has been considered as part of a wider strategy and that the overarching theme is accessibility and economic growth. There is a strategic need for good quality north-south connections in Northern Ireland between key centres of economic importance and population, as well as cross border connectivity with the Republic of Ireland.

STRUCTURE

2.1.3. The strategic case reflects both the Department for Transport (DfT) Business Case guidance[7] and the Department of Finance (DoF) Better Business Cases NI guidance[8] and covers:

- policy background against which the Proposed Scheme has been developed – **the strategic context**
- specific problems which the Proposed Scheme is designed to solve – **the case for change**
- what will happen if the Proposed Scheme is not delivered – **the impact of not changing**
- objectives of the Proposed Scheme and how success will be measured – **the investment proposal**
- what the Proposed Scheme will, and will not, include – **the scope**

2.1.4. The Strategic Case also considers strategic issues affecting the practical delivery of the scheme:

- what stakeholders require from the scheme, how they have been involved so far, and how they can support the delivery of the scheme - **key stakeholders views and requirements**
- the range of strategic options that were considered for the scheme – **the options**
- matters which could have an impact on the delivery of the scheme – **the constraints**
- the assumptions that underpin the assessment of the options – **the key assumptions**
- other factors that could affect the timely delivery of the scheme – **interdependencies**
- why the proposed scheme is recommended as the most appropriate solution – **summary and recommendations**

[7] https://www.gov.uk/guidance/transport-analysis-guidance-tag

[8] https://www.finance-ni.gov.uk/articles/better-business-cases-ni

BACKGROUND

2.1.5. The existing A5 is one of five Key Transport Corridors identified in the Regional Transportation Strategy for Northern Ireland which are components of the Regional Strategic Transport Network (RSTN). These corridors play a significant role in the movement of people and goods between cities, towns and communities internally within Northern Ireland, internally and externally to gateways such as ports and airports, and externally to international locations by connecting with onward routes via road and water.

2.1.6. Specifically, the A5 is the strategic route which links the northwest of Northern Ireland to Aughnacloy at the border and with the Republic of Ireland via Londonderry, Strabane, Omagh and Ballygawley. It connects with the A2 at Londonderry, part of the Northern Transport Corridor, and with the N2 at the border, with onward connections to Monaghan and Dublin. It also connects with the N14 / N15 routes west of Strabane at Lifford in the Republic of Ireland, and with the A505 / A32 east-west corridor at Omagh.

2.1.7. The existing A5 is a single carriageway road throughout its entire length with a number of wide single 2+1 links on rural inter-urban sections. The quality of the existing A5 is a barrier to economic growth, as journey times are made unreliable by congestion caused at bottlenecks at junctions in key towns, a lack of overtaking opportunities and slow-moving agricultural traffic along the route.

2.1.8. The overarching theme of the Proposed Scheme is connectivity, safety, accessibility and economic growth. As identified in the Regional Transportation Strategy (RTS), there is a strategic need for good quality north-south connections in Northern Ireland between key centres of economic importance and population, as well as cross border connectivity with the Republic of Ireland.

2.1.9. The objectives of the Proposed Scheme are specific, measurable, achievable, relevant and time-dependent (SMART) and, as set out in the previous chapter, are:

- To improve safety
- To improve the road network in the west of the Province and North / South links
- To reduce journey travel times along the A5 Western Transport Corridor
- To provide increased overtaking opportunities for motorists along the A5 Western Transport Corridor
- To develop the final proposals in light of safety, economic, environmental, integration and accessibility considerations.

2.1.10. Achieving these objectives would contribute to the higher-level objectives of balancing regional infrastructure, improving competitiveness and economic prosperity through improving connectivity and accessibility across the region.

2.2 STRATEGIC CONTEXT

2.2.1. This section provides an overview of how the Proposed Scheme contributes to achieving the Department's strategic priorities and wider government and national ambitions. Table 2-1 lists a series of strategy documents and plans and summarises the intrinsic links between the contents of each of these strategy and planning documents and the objectives of the Proposed Scheme.

Table 2-1: Alignment of Proposed Scheme objectives to strategy plans and policy documents

	Proposed Scheme Objectives				
Strategy Document	Improve Road Safety	Improve Road Network and North / South Links	Provide Increased Overtaking Opportunities	Reduce Journey Times	Develop proposals in light of safety, economic, environmental, integration & accessibility considerations
PLACE SPECIFIC STRATEGY					
Derry Area Plan, 2011		✓			✓
Derry City & Strabane District Council Local Development Plan (LDP) 2032	✓	✓		✓	✓
Fermanagh and Omagh District Council - Position Paper Six: Transportation, 2015	✓	✓	✓	✓	✓
Mid Ulster Preparatory Study - Transportation, 2015		✓			✓
Towards our LDP for Mid Ulster 2030 - Options Paper, 2016		✓			✓
Fermanagh and Omagh District Council Corporate Plan 2020-2024 & the Draft Local Development Plan 2030	✓	✓			✓
Fermanagh and Omagh District Council Climate Change and Sustainable Development Strategy 2020 - 2030					✓
Draft Mid Ulster Local Development Plan 2030	✓	✓	✓	✓	✓
Mid Ulster "Our Community Plan - 10-year Plan for Mid Ulster" (2017)		✓			✓
BUSINESS STRATEGY					
Northern Ireland Executive Budget 2016-17					✓

Strategy Document	Proposed Scheme Objectives: Improve Road Safety	Improve Road Network and North / South Links	Provide Increased Overtaking Opportunities	Reduce Journey Times	Develop proposals in light of safety, economic, environmental, integration & accessibility considerations
New Decade, New Approach (NDNA) 2020					✓
Planning for the Future of Transport: Time for Change 2021		✓			✓
WIDER STRATEGY					
Union Connectivity Review Final Report 2021		✓			✓
The North West Transport Plan: Transport Study 2021		✓			✓
A Fresh Start: The Stormont Agreement and Implementation Plan 2015	✓	✓	✓	✓	✓
Strategic Planning Policy Statement for Northern Ireland 2015	✓	✓		✓	✓
Ensuring a Sustainable Transport Future: A New Approach to Regional Transportation 2011	✓	✓	✓	✓	✓
Economic Strategy for Northern Ireland: Priorities for Sustainable Growth and Prosperity 2012	✓	✓	✓	✓	✓
Investment Delivery Plan for Roads 2015	✓	✓	✓	✓	✓
Investment Strategy for Northern Ireland, 2011-2021	✓	✓		✓	✓
Sub-regional Transport Plan 2015		✓	✓	✓	✓
Regional Development Strategy for Northern Ireland 2035		✓	✓	✓	✓
Regional Strategic Transport Network Transport Plan 2015		✓	✓	✓	✓
Regional Transportation Strategy 2002-2012	✓	✓	✓	✓	✓
Changing Gear - A Bicycle Strategy for Northern Ireland 2015	✓	✓		✓	✓
Levelling Up the United Kingdom, 2022		✓		✓	

Strategy Document	Proposed Scheme Objectives				
	Improve Road Safety	Improve Road Network and North / South Links	Provide Increased Overtaking Opportunities	Reduce Journey Times	Develop proposals in light of safety, economic, environmental, integration & accessibility considerations
United Nations Framework Convention on Climate Change					✓
The UK Climate Change Act 2008 (2050 Target Amendment)					✓
Environment Act 2021					✓
Glasgow Climate Pact (2021)					✓
Climate Change Act (Northern Ireland) 2022					✓

PLACE SPECIFIC STRATEGY

2.2.2. The A5 is designated one of Northern Ireland's five Key Transport Corridors and is a component of the Regional Strategic Transport Network (RSTN), as shown in Figure 2-1.

2.2.3. The existing A5 route connects with the A2 at Londonderry and continues south for approximately 85 kilometres through Strabane, Omagh and Aughnacloy. Its strategic importance is further emphasised by its direct cross border connectivity (south of Aughnacloy) with the N2 in the Republic of Ireland and its subsequent onward route to Monaghan and Dublin, and its indirect connectivity with the northwest region of the Republic of Ireland.

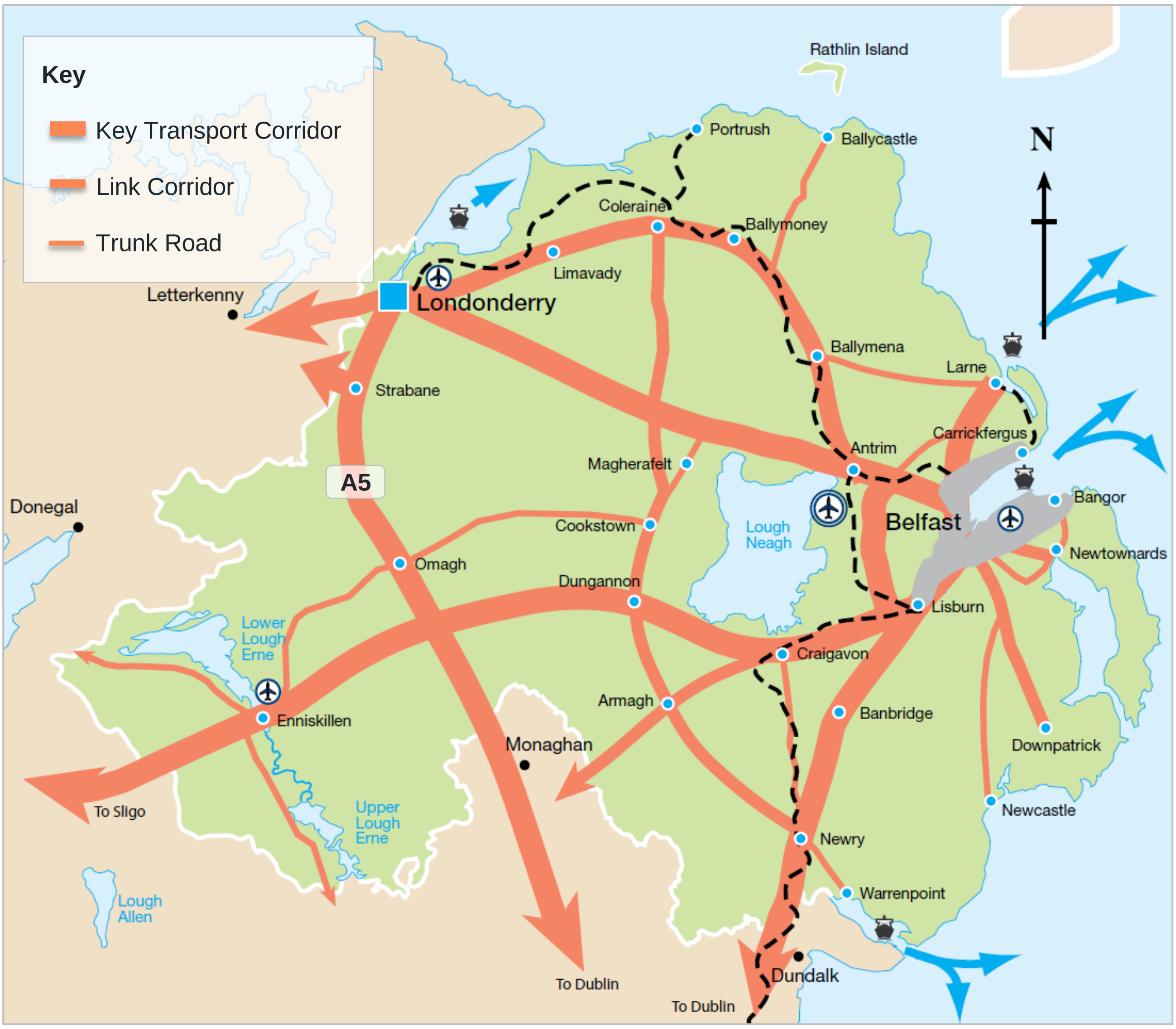

Figure 2-1: Key Transport Corridors in Northern Ireland (Source: Regional Development Strategy 2035)

2.2.4. With the reform of Local Government in Northern Ireland that took place in 2015, the newly formed Local Councils took responsibility for producing their own Local Development Plans (LDP). Whilst the Department continues to make decisions and take responsibility for the provision of transportation services across Northern Ireland, within their LDPs, Local Councils set out their own transport aims and objectives, in line with central Government policy. The Proposed Scheme will route through the territory of three Local Councils, who have all expressed strong support for the scheme. These are listed, from north to south:

- Derry City and Strabane
- Fermanagh and Omagh
- Mid Ulster

2.2.5. The nature of these areas is predominantly rural with a high dependence on private car usage. The planning documents include a number of policies that recognise high car dependency and promote the improvement of the road network alongside other policies aimed at redressing the balance. The policies relevant to the aims of the Proposed Scheme are set out below.

Derry City and Strabane

2.2.6. Derry City and Strabane District Council are in the process of producing a new Local Development Plan (LDP) to 2032. The draft LDP was previously consulted upon, and a Schedule of Proposed Changes was consulted upon during 2021 and 2022. The LDP Draft Plan Strategy[9] includes the Proposed Scheme as a "*key piece of infrastructure for the future of both Districts*"[10] and acknowledges its importance within a regional context (in chapter 2), its growth strategy (in chapter 5) as well as for the region's transport and movement (in chapter 11).

2.2.7. The draft LDP states that the A5WTC will improve linkages and increase the attractiveness of Strabane for economic development, as well as enabling enhancements to be made to the existing infrastructure by freeing up road space and reducing traffic on the existing road network.

2.2.8. The Council's Inclusive Strategic Growth Plan 2017-2032 (SGP 2017-2032)[11] envisages growth of approximately 15,000 jobs over the Plan period. Furthermore, the SGP 2017-2032 lists "*The A5 Western Transport Corridor from Derry to Aughnacloy and N2 improvements – enhancing critical and safe connectivity to Dublin*" as one of the priority actions.

2.2.9. With regard to active and sustainable travel to be delivered through other measures, the draft LDP notes that "*The A2 and A5 (proposed) schemes and the A6 road scheme (currently under construction) will reduce journeys times and improve journey time reliability for all users including public transport and freight in the wider North West region including Donegal.*"

2.2.10. Until the draft LDP is adopted, the relevant Area Plans currently applicable to the District, are the Derry Area Plan 2011, adopted in May 2000, and the Strabane Area Plan 2001.

2.2.11. The Strabane Area Plan was adopted in 1991 and notes (in para 16.3) that "the proposals in the Plan are geared primarily towards the improvement of the Omagh-Strabane-Londonderry road (T3), the reduction of traffic congestion and vehicular/pedestrian conflict in urban areas and the improvement of the existing road system to remove traffic hazards and to facilitate future development", all of which the Proposed Scheme would support. The Proposed Scheme is also well aligned to the following Derry Area Plan transport objectives[12]:

- implement a road works programme which will focus on the improvements and upgrading of key strategic routes (the Proposed Scheme will upgrade the current road network)
- a new dual carriageway will reduce journey travel times for users, increase road safety and relieve congestion (the proposed scheme also aims to improve connectivity between the urban settlement of Londonderry and its southwestern rural hinterland)

Fermanagh and Omagh

2.2.12. The Fermanagh and Omagh District Council - Position Paper Six: Transportation, 2015 is part of a series of preparatory studies aimed at gathering the evidence base for the new LDP. While the

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[9] https://www.derrystrabane.com/getmedia/f0dfee6f-7ba0-4422-8a29-6163562286e2/DC-SDC_Local-Development-Plan-final-online_1.pdf
[10] Local Development Plan (LDP) 2032 – Draft Plan Strategy, paragraph 2.45 page 29
[11] https://www.derrystrabane.com/getmedia/1eb99e2e-e657-45a1-8b27-e2b35a36d65c/SGP_22-November2017_lowres.pdf
[12] Derry Area Plan 2011, page 11, paragraph 1.30 (May 2000)

Council is currently in the process of producing the new LDP, the Position Paper has established broad aims and objectives for transport, to which the Proposed Scheme is aligned. These are to:

- promote / improve connectivity, particularly in rural areas
- protect road users and improve road safety for car users, public transport, cyclists and walkers

2.2.13. The Proposed Scheme is highlighted as one of the 'most significant highway transportation schemes [proposed] in the plan area[13] and will help to achieve the objectives described above within Fermanagh and Omagh, to which the Proposed Scheme objectives (Objectives 1 and 2 'to improve road safety' and 'to improve the road network in the west of the Province and North / South links') are well aligned.

2.2.14. Improving connectivity and road safety are also noted in the draft Local Development Plan 2030 - Draft Plan Strategy's approach to transportation (para 6.32) and reflected in the transport vision for the Council as "*a safe and resilient transport network that provides access for all people to key services and supports the long term sustainable economic growth of the Fermanagh and Omagh District Council area*".

Mid Ulster

2.2.15. The Local Development Plan 2030 – Draft Plan Strategy is supported by the Mid Ulster Preparatory Study – Transportation, 2015 and Towards our Local Development Plan for Mid Ulster 2030 – Preferred Options Paper, 2016. The aim of both these documents was to assist the Council in the preparation of the Local Development Plan.

2.2.16. Like the supporting documents which preceded it, the draft LDP sets out an objective around the need to improve connectivity between and within settlements and their rural hinterland through accommodating investment in transportation to:

- improve travel times
- alleviate congestion
- improve safety for both commercial and private vehicles as well as more sustainable modes of transport including buses, walking and cycling

2.2.17. A number of Strategic Planning Guidelines (SPG) for the Plan have been formulated to support the achievement of the Plan Objectives. The SPG that refers to transportation matters is SPG 8:

> *Encourage improvements to public and private transportation provision including railway lines and upgrading of the road network.*

2.2.18. The Proposed Scheme aligns to the objectives described above by upgrading the current road network. It will reduce journey times for users, increase road safety and relieve congestion.

2.2.19. All of the Proposed Scheme objectives are aligned to the objectives of the draft LDP and would contribute to the achievement the vision for the District Council.

[13] Fermanagh and Omagh District Council, Position Paper Six, Transportation, page 15, paragraph 4.1 (May 2015)

BUSINESS STRATEGY

2.2.20. The Business Strategy sets out the purpose and role of organisations promoting the Proposed Scheme, demonstrating the specific contributions the Proposed Scheme will make to help deliver the strategic goals of the Department.

The Northern Ireland Department for Infrastructure

2.2.21. The Northern Ireland Department for Infrastructure is responsible for the development of the transport network, including the A5WTC, and a range of other transport projects designed to improve network safety, sustainability and efficiency. The Department plays a significant role in facilitating the safe and convenient movement of people and goods throughout Northern Ireland.

2.2.22. The key objectives for the Department[14] are to:

- manage, maintain and improve the transport network to keep it safe, efficient, reliable and sustainable
- promote increased customer satisfaction with the services delivered by the Department
- work constructively with the Department's key stakeholders to support the delivery of high quality services
- develop the Department's capacity and capability to meet objectives
- ensure effective management of the Department's budget, assets and corporate governance arrangements
- improve the Department's resilience in responding to emergencies

2.2.23. These objectives have been developed for the social and economic benefit of all people and communities in Northern Ireland and are reflected in the strategic aims of the Proposed Scheme.

Planning for the Future of Transport: Time for Change 2021

2.2.24. Planning for the Future of Transport: Time for Change 2021 outlines how the Department's priorities for the future of transport can be supported by the improved planning, management and development of the transport networks in the next 15 years. It focuses on the economic, societal and environmental changes required, such as reducing travel and to effect a change in travel behaviour, away from polluting and carbon intensive modes to cleaner and more healthy modes.

2.2.25. The plan looks to reduce the carbon impact of transport through the substitution of trips, removal of trips and shortening of trips.

2.2.26. The relief along the existing A5 as a result of the Proposed Scheme has the potential to improve the public realm and in turn encourage a shift in local traffic towards more sustainable active modes. The multiple functions of the existing A5 result in a wide range of users and potential conflicts between them. The need for the route to accommodate strategic traffic inhibits the scope of the potential regeneration opportunities, including those that will improve the urban realm, reduce community severance and encourage the use of more sustainable modes. The provision of a new A5WTC will provide a reliable route for strategic traffic and enable the operation of the existing A5 to be changed in favour of local traffic and non-motorised users. This will also provide the basis for improving the public realm.

[14] https://www.infrastructure-ni.gov.uk/transportni-overview-0

2.2.27. The plan identifies the need to deliver transport schemes more quickly, with current approaches being overly complex and undervaluing the benefits of smaller items of infrastructure. A modal shift requires a new focus on the movement of people and goods rather than private vehicles.

2.2.28. The plan highlights that the COVID pandemic has shown that people can change behaviour and that there is a desire not to return to the "old normal", in particular, of peak period private vehicle commuting and the congestion and health and environmental problems that this creates. It is recognised that the pandemic will have long-lasting effects on society and behaviours, but although post COVID-19 journeys look to differ in type and time, recent monitoring data suggests that traffic volumes are predicted to recover[15]. Additional transport capacity would contribute towards fast and reliable journey times whilst improving air quality in towns.

2.2.29. The plan identifies a range of measures which focus on improving journey time reliability and safety, while reducing carbon, improving local air quality and communities. Measures such as bypasses of towns and small settlements and complementary local works can improve pedestrian and place-making conditions in the town centres and journey time reliability on the major road network whilst not encouraging increased private vehicle traffic. This fits with the Proposed Scheme Objectives of improving road network and providing reduced journey times.

2.2.30. The plan identifies measures in the open countryside and villages that focus on improving transport connectivity to local centres whilst providing a network of safe local roads which contributes to community uses. This fits with the Proposed Scheme Objective of improving safety.

2.2.31. Planning for the Future of Transport: Time for Change recognises that Northern Ireland must invest more to change the course of, and deliver the changes in, behaviour that are needed to improve people's health and happiness. It also recognises that this must be undertaken with regard to the need to manage, maintain and develop Northern Ireland's transport networks, which is deemed "essential", and that delivering on the promises of the Executive's flagship schemes – the projects in New Decade, New Approach[16] and those within the City and Growth Deals – is "a priority" for the Department and the Executive.

New Decade, New Approach 2020

2.2.32. Published in 2020, New Decade, New Approach (NDNA) under the heading Context and Responsibilities states that "*the deal will transform public services and restore public confidence in devolved government*" and explains that "*the participants throughout these talks were the UK and Irish Governments, each participating in accordance with their respective responsibilities, and the five main Northern Ireland parties.*"

2.2.33. Under the heading Turbocharging infrastructure on page 52 of the above noted report, the UK government states that: "*The Executive will benefit from increased funding for capital infrastructure investment as a result of the UK Government's infrastructure revolution*" which will enable the Executive to invest in a range of potential capital projects such as the A5WTC. Under the heading Connectivity and Infrastructure on page 59 of the above noted report, the Irish government states that: "*We believe this is an immediate opportunity to move forward quickly together to deliver on*

[15] https://www.transportxtra.com/publications/local-transport-today/news/69051/traffic-volumes-exceed-pre-lockdown-leve?etid=3344844&artid=69051

[16] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/856998/2020-01-08_a_new_decade__a_new_approach.pdf

plans to complete key infrastructure projects including the A5 and the Ulster Canal connection from Clones to Upper Lough Erne. The Government will deliver on its funding commitments to those projects, including a total of £75 million up to 2022 for the A5."

Ireland's National Development Plan 2021-2030 and Northern Ireland Executive Budget 2016-2017

2.2.34. The strategic importance of the Proposed Scheme is recognised by both the Northern Ireland Executive and the Irish Government, reflected in the substantial funding commitment from both sides.

2.2.35. In its Budget 2016-2017, the Northern Ireland Executive identified a number of flagship projects, including the A5WTC, where it recognised the importance of providing funding certainty beyond the immediate budget period. It therefore agreed an indicative funding allocation of £229 million for the scheme up to financial year 2020/21. At the same time, the Irish Government increased its contribution to £75 million (previously £50 million)[17].

2.2.36. Ireland's 2021 National Development Plan 2021-2030[18] recognises "*enhanced high-quality transport links for the region by road, rail, air and sea*" as one of the North West City Region Councils' regional priorities and it lists the Proposed Scheme as one of its strategic investment priorities, reconfirming the Irish Government's £75 million contribution to the A5WTC.

2.2.37. The recent update to Irish Government's Building a Shared Island, 2022[19] extends the budget to 2030 with a EUR1 billion commitment "*ring-fenced for investment in collaborative North/South projects to deliver key cross-border initiatives*" including "*working with the Executive to deliver key cross-border infrastructure initiatives, including the A5*".

WIDER STRATEGY

2.2.38. The Proposed Scheme contributes to a range of wider strategies such as those of other government departments, sub-national organisations, and regional and local authorities. The scheme is strategically aligned to a number of key strategies and policies that are important building blocks for economic growth and development in the province of Northern Ireland. These are described below and linked to the relevant scheme objectives to which it is strategically aligned.

Union Connectivity Review Final Report 2021

2.2.39. In 2020 the Government initiated a review into how the quality and availability of transport infrastructure across the UK can support economic growth and quality of life across the whole of the UK. As part of the review the independent Chair, Sir Peter Hendy CBE, was asked to consider:

- the quality and reliability of major connections across the UK
- likely current and future demand for transport links
- the environmental impact of policy options (including with regard to climate change)
- existing work completed by the government on cross-UK connectivity

[17] NDNA – see NDNA, Annex B: Irish Government Commitments
[18] https://www.gov.ie/en/publication/774e2-national-development-plan-2021-2030/#
[19] gov.ie - Building a Shared Island (www.gov.ie)

2.2.40. The Union Connectivity Review Final Report[20] highlights that, "Transport connectivity is vital to economic growth, job creation, building houses and social cohesion. Building back better and levelling up will be hugely assisted by better connectivity between the nations of the United Kingdom." It advocates a variety of measures to improve connectivity within the UK. It also recognises that:

> *"Northern Ireland is unique in that it shares a land border with a country in the European Union. As such, some elements of transport connectivity and provision ought to be considered on an 'all-island' basis."*

2.2.41. The Review states that:

> *"People in Northern Ireland are heavily reliant on cars to travel. The Belfast–Dublin and the Derry/Londonderry–Dublin corridors require improvements to enhance north-south connectivity and to support onward travel to Great Britain via Republic of Ireland seaports. The A5 is of particular importance for northwest-south connectivity and requires a significant upgrade."*

The North West Transport Plan: Transport Study 2021

2.2.42. The Transport Study generated the seven transport objectives for the development and assessment of transport options. These are shown in Table 2-2.

Table 2-2: **North West Transport Plan Objectives**

Objective 1	Improving external linkages: Enhance accessibility by road and public transport to the City of Derry from Letterkenny, Belfast, Dublin, Strabane and other gateways / hubs, to support greater levels of inward investment and tourism
Objective 2	Improving public transport accessibility: Ensure financially viable and sustainable public transport accessibility to essential services including health and education for people living in DCSDC
Objective 3	Improving active travel accessibility: Ensure there are attractive and safe active travel networks (walking and cycling) linking all residential, retail, leisure, culture, office and commercial uses within the urban areas of the DCSDC
Objective 4	Providing high quality public realm: Deliver high quality public realm in Derry City centre (especially the central riverfront area) and Strabane town centre with reduced vehicle dominance and permeability / walkability, to make them attractive, shared spaces to live and work and improve safety for active modes
Objective 5	Improving town centre accessibility: Enhance transport accessibility and manage traffic congestion in Derry City and Strabane town to strengthen Derry's role as the principal city of the cross border North West City Region
Objective 6	Improving public safety, including air quality: Enhance safety for all modes of travel, reduce the number and severity of casualties and improve air quality. Transportation should contribute to / not worsen the health and wellbeing of the people of the region

[20]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1036027/union-connectivity-review-final-report.pdf

Objective 7	Promoting sustainability and resilience: Protect and enhance the built and natural environment by ensuring transport systems operate sustainably and integrating climate change adaptation requirements

2.2.43. The study then proposed a range of indicative Transport Measures for delivery up to 2032 to guide the development Derry City and Strabane District Council LDPs. The measures were identified using a standard objectives-based approach and have been assessed against objectives in order to identify the most appropriate set of measures.

2.2.44. The study concluded that inter-urban road upgrades such as the A5 and A6 road schemes are important to the future of Derry as the economic hub of the North West. These schemes will reduce journeys times and improve journey time reliability for all users including public transport and freight.

A Fresh Start: The Stormont Agreement and Implementation Plan 2015

2.2.45. The Fresh Start Agreement 2015 signalised a resolve to defend core public services, to attract foreign direct investment, support indigenous businesses and to provide better jobs particularly for young people. Within the Agreement, the Irish Government reaffirmed its existing commitment to providing funding of £50 million for the Proposed Scheme and committed an additional £25m to ensure that Phase 1 of the project can commence as soon as the necessary planning issues have been resolved by the Northern Ireland authorities. In accordance with the revised project timeline, the Irish Government funding was to be provided in three tranches of £25m in the years 2017, 2018 and 2019 respectively.

2.2.46. On this basis, the Northern Ireland Executive and the Irish Government had agreed that construction of the first section of the Proposed Scheme would commence in 2017 with completion by 2019[21]. The first section of the route was to be between New Buildings and the north of Strabane.

Strategic Planning Policy Statement 2015

2.2.47. The Strategic Planning Policy Statement (SPPS) for Northern Ireland (September 2015) is based on the principle of sustainable development and describes three pillars that are intrinsically linked to one another when considering a development:

- needs and aspirations of the society
- economy
- environment

2.2.48. The SPPS recognises that the integration of transport is fundamental to its overall objective of furthering sustainable development. In view of this, the SPPS describes its regional strategic objectives for transport, which the Proposed Scheme aligns to. These are to[22]:

- promote sustainable patterns of development which reduce the need for motorised transport, encourage active travel, and facilitate travel by public transport in preference to the private car
- ensure accessibility for all, with the needs of people with disabilities and others whose mobility is impaired given particular consideration
- promote the provision of adequate facilities for cyclists in new developments

[21] A Fresh Start: The Stormont Agreement and Implementation Plan, page 31, paragraph 2.3 (2015)

[22] Strategic Planning Policy Statement for Northern Ireland, page 106, paragraph 6.297 (2015)

- protect routes required for new transport schemes including disused transport routes with potential for future reuse
- restrict the number of new accesses and control the level of use of existing accesses onto protected routes
- promote road safety, in particular for pedestrians, cyclists and other vulnerable road users

2.2.49. The Proposed Scheme Objectives 1 and 2 ('to improve road safety' and 'to improve the road network in the west of the Province and North / South links') align particularly well with the SPPS objectives.

Ensuring a Sustainable Transport Future: A New Approach to Regional Transportation 2011

2.2.50. The new approach to regional transportation complements the Regional Development Strategy and aims to achieve the transportation vision:

- support the growth of the economy
- enhance the quality of life for all
- reduce the environmental impact of transport

2.2.51. The document recognises that Northern Ireland's transport networks are important in achieving the Executive's goal of rebuilding and rebalancing the economy.

2.2.52. To achieve its vision and high level aims, the document outlines a number of strategic objectives for the province. Those objectives to which the Proposed Scheme is strategically aligned are summarised in Table 2-3 below. The Proposed Scheme aligns with all of the strategic objectives.

Table 2-3: Strategic Objectives to which the Proposed Scheme aligns

Strategic Objective	Aims
Improve connectivity within the region	To remain competitive and achieve economic growth by ensuring that connections to the Republic of Ireland and the rest of the United Kingdom are reliable and efficient
Better maintain transport infrastructure	To maintain roads in order to provide a reliable transport network that allows people and freight to move safely and have reliable journey times
Improve access in our towns and cities	To ensure that people have the opportunity to access education, training and employment by delivering good transport links
Improve connections to key tourism sites	To ensure that roads successfully connect visitors to tourist attractions and that the connecting transport system is reliable and represents value for money
Improve safety	To reduce the number of people killed or seriously injured on roads, for car users, pedestrians and cyclists
Enhance social inclusion	To bring communities together and enable access to services by ensuring good transport infrastructure is in place

Economic Strategy: Priorities for Sustainable Growth and Prosperity 2012

2.2.53. The overarching goal of the Economic Strategy for Northern Ireland 2012 is to improve the economic competitiveness of the Northern Ireland economy. In terms of transport, it concentrates on a policy of "moving people and goods rather than vehicles, with a complementary focus on better maintaining our existing infrastructure and using it in a smarter way"[23].

2.2.54. Transport networks are viewed as integral components of the economic infrastructure, in support of the Strategy's 2030 vision. It acknowledges that meeting the future needs of the economy, up to this time, and facilitating higher levels of economic growth, will necessitate increased capacity and improved connectivity on the transport network across Northern Ireland.

2.2.55. Improvements to the A5 are recognised as a 'Key Action' in the Strategy's aim to develop Northern Ireland's economic infrastructure. A key performance target of the Strategy is to improve average journey times on key transport corridors by 2030. The Proposed Scheme will help to achieve the Strategy's performance targets.

Investment Delivery Plan for Roads 2008

2.2.56. The Investment Delivery Plan for Roads identifies that "*transport is a key driver of economic development and provides the means for all citizens to access social and educational services as well as leisure activities. A modern economy needs an efficient and low cost transport system in order to compete in the global marketplace*"[24].

2.2.57. Hence, the Plan acknowledges that in order to deliver a strong, modern economy, an upgrade to all of the Key Transport Corridors, including the A5, to at least dual carriageway standard is required. It recognises that an improved A5 will provide significant benefits to the north west of Northern Ireland by improving linkages to and from Dublin and greatly improving journey times within the north.

2.2.58. The document includes the Proposed Scheme within its 'Preparation Pool' under the label 'A5 Derry to Aughnacloy Dual Carriageway'. The pool contains schemes that are expected to start within five years of the Plan being published, subject to the completion of necessary statutory procedures. The Proposed Scheme would help to achieve the targets of the Plan.

Investment Strategy for Northern Ireland 2011-2021

2.2.59. The Investment Strategy for Northern Ireland outlines how capital will be invested in modern infrastructure which is critical to the future success of the region. It states that "high quality transport networks are the vital arteries of today's most successful economies – powering competitive advantage in business, reducing social isolation, and linking people to an expanding world of information, services and opportunity"[25]. Enabling efficient, reliable and sustainable networks is critical to delivering the top priority of growing a dynamic and innovative economy.

2.2.60. The Investment Strategy highlights that a balanced programme of improvements is being delivered on the strategic road network to provide a dual carriageway on the A5. The planned improvement to

[23] Economic Strategy: Priorities for sustainable growth and prosperity, page 68, para 5.78 (2012)

[24] Investment Delivery Plan for Roads, page 3, paragraph 1.3 (2015)

[25] Investment Strategy for Northern Ireland 2011-2021, page 18 (2011)

the A5 will deliver a major upgrade to the strategic road network and the investment will improve safety and journey times in the North West.

2.2.61. The Proposed Scheme Objectives 1, 2 and 3 'to improve safety', 'to improve the road network in the west of the Province and North / South links' and 'to reduce journey travel times along the A5WTC' align to the Investment Strategy.

2.2.62. The Investment Strategy for Northern Ireland draft consultation document[26] published in January 2022 states, "there is much potential for further investment in cross-border strategic networks, for example the completion of the A5 Western Transport Corridor as a strategic corridor to the northwest; the Narrow Water Bridge, and the promotion of leisure routes and trails to support our tourism sector".

Regional Transportation Strategy, 2002-2012

2.2.63. The Regional Transportation Strategy (RTS) identified strategic transportation investment priorities up to 2012.

2.2.64. The RTS recognised that improvements to the road network will benefit a range of users, including freight, but this would only improve from the current situation with enhancements to the RSTN by implementing dual carriageways, bypasses and other main road improvements. These enhancements would provide improved journey times and reliability for all users, but particularly for freight. The RTS priorities accord with all of the Proposed Scheme Objectives.

Regional Development Strategy 2035

2.2.65. The Regional Development Strategy 2035 (RDS 2035) is the overarching spatial strategy of the Executive, which replaces the RDS 2025. Its principal transport aim is "to deliver transport arrangements which promote equitable access and meet wider economic and social needs, while limiting environmental impact and realising reductions in harmful emissions"[27].

2.2.66. The Strategy recognises that the transportation networks help to deliver balanced economic growth. The Key Transport Corridors, which include the A5, link people and freight to Northern Ireland's main cities, towns and air and sea ports. They provide a framework around which economic corridors can develop. Whilst the Key Transport Corridors comprise of 3% of all Northern Ireland's roads, they carry 26% of all traffic[28]. The Strategy has developed both Regional Guidance (RG) and Spatial Framework Guidance (SFG) in order to underpin sustainable economic growth. The Proposed Scheme is aligned to the guidance, as summarised below.

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[26] The Investment Strategy for Northern Ireland draft consultation document, page 45,(January 2022)

[27] Regional Development Strategy 2035, page 18, paragraph 2.9 (March 2012)

[28] Regional Development Strategy 2035, page 83, paragraph 4.9 (March 2012)

Table 2-4: RDS 2035 Guidance to which the Proposed Scheme aligns

Guidance	Summary of Aims
RG2: Deliver a balanced approach to transport infrastructure	For Northern Ireland to remain competitive in the global market it is important to promote transport which balances the needs of the environment, society and the economy. This Guidance aims to improve connectivity, maximise the potential of the RSTN, improve social inclusion, manage the movement of freight and improve access to cities and towns
SFG8: Manage the movement of people and goods within the North West	Transport has a key role to play in developing competitive cities and regions. This Guidance aims to support efficient transport infrastructure which is important for a successful economy. It will enhance transport linkages across regions, particularly between Londonderry, Strabane and Donegal, to and from air and sea ports and between transport corridors
SFG15: Strengthen the Gateways for Regional competitiveness	To compete globally, Northern Ireland must be well connected both internally and with the rest of the world. Gateways are strategically important transport interchanges which are important for economic development, freight distribution activities and additional employment generation. Londonderry Port is the North West City Gateway and handled 1.63 million tonnes of goods in 2014, worth approximately £474 billion[29]. This Guidance aims to provide high quality connections to and from air and sea ports

2.2.67. The Strategy outlines the objective to "*strengthen the role of Londonderry as the principal city for the North West*" and to "*Manage the movement of people and goods within the North West*" which includes to "*Enhance transport linkages across the Region particularly between Londonderry, Strabane and Donegal*". It also makes reference to improvements to the A5 linking Dublin and Omagh with Strabane and Londonderry, which will lead to stronger geographic links and shared services.

2.2.68. The Proposed Scheme will contribute to the Guidance summarised in Table 2-4 and will improve connectivity between cities, regions and international gateways and journey time reliability for commuters, customers and freight, as well as enhancing access to significant employment areas.

2.2.69. The RDS 2035 transport aims correspond to Proposed Scheme Objectives 2, 3 and 4 'to improve the road network in the west of the Province and North / South links', 'to reduce journey travel times and to provide increased overtaking opportunities for motorists along the A5 corridor' and 'to develop the final proposals in light of the safety, economic, environmental, integration and accessibility considerations'.

Regional Strategic Transport Network Transport Plan 2015[30]

2.2.70. The RSTN Transport Plan is founded in the Regional Transportation Strategy. The main objectives of the adopted Transport Plan, specifically for Strategic Road Improvements[31], under which the Proposed Scheme can be categorised, are to:

- remove bottlenecks on the strategic road network, where lack of capacity causes congestion

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[29] The Value of Goods Passing through UK Ports, pages 9-11, Tables 2 and 3 (July 2016)

[30] https://www.infrastructure-ni.gov.uk/publications/regional-strategic-transport-network-transport-plan-2015

[31] Strategic Road Improvements are major projects where the scheme cost is estimated to exceed £1.0m

- improve the environment by providing bypasses to towns situated on the RSTN, relieving the effects of heavy through traffic

2.2.71. The Transport Plan acknowledges that some sections of the strategic road network, particularly on Key Transport Corridors, are of a lower standard than others, having alignments that fall short of current design standards. In turn, this makes overtaking hazardous to vehicles on single carriageway roads.

2.2.72. Poor alignment in conjunction with high traffic volumes results in the reduction of safe overtaking opportunities for vehicles. This is particularly prevalent on the existing A5, which is also used by heavy freight transporters and agricultural traffic which reduce average speeds on sections of the route. Consequently, users experience increased journey times whilst there is an increasing risk of frustrated drivers attempting to overtake in unsafe circumstances.

2.2.73. The Plan also complements other policies by emphasising the importance of improving connections between regional gateways and cross border links and the RSTN, particularly the Key Transport Corridors.

2.2.74. The Proposed Scheme supports the objectives of the RSTN Transport Plan. A new dual carriageway will increase the capacity of the route, provide a safe, modern north-south corridor, remove congestion at key junctions and assist with environmental objectives by relieving the impacts of that congestion. Access to international and regional gateways will also be enhanced for users, including freight.

2.2.75. The Proposed Scheme Objectives 2, 3 and 4 ‘to improve the road network in the west of the Province and North / South links’, ‘to provide increased overtaking opportunities for motorists along the A5 corridor’ and ‘to reduce journey travel times’ all align with the objectives of the RSTN Transport Plan.

Sub-Regional Transport Plan 2015

2.2.76. The Sub-Regional Transport Plan (SRTP) is based upon the RDS 2025 and RTS. In turn, the SRTP has set targets which complement those adopted by the RTS, including proposals for improvements to highways which will contribute to an improvement in mobility for all, whilst seeking to minimise adverse environmental impacts.

2.2.77. The Proposed Scheme will contribute to the targets set by the SRTP. A new dual carriageway connecting cities, communities and gateways will improve mobility for users and improve journey time reliability, ensuring smoother and reliable flows of vehicles, minimising environmental impacts.

2.2.78. The Proposed Scheme objectives therefore align with the SRTP targets.

Changing Gear – A Bicycle Strategy for Northern Ireland 2015

2.2.79. Changing Gear – A Bicycle Strategy for Northern Ireland sets out the vision for Northern Ireland in the next 25 years to become:

> *“A community where people have the freedom and confidence to travel by bicycle for everyday journeys”.*

2.2.80. This vision for cycling aligns to the Executive’s Programme for Government priorities of growing a sustainable economy, improving health and well-being while building communities and protecting the environment.

2.2.81. In developing cycling infrastructure, the strategy adopts a three pillar approach:

- building a comprehensive network for the bicycle
- supporting people who choose to travel by bicycle
- promoting the bicycle as a mode of transport for everyday journeys

2.2.82. The Proposed Scheme will help to promote bicycle use on the existing route of the A5 by shifting strategic traffic onto the Proposed Scheme. This will help to lower accident risk, increase safety and make the existing route of the A5 a more attractive environment for cyclists. The A5 Active and Sustainable Travel Assessment[32] assesses the opportunities for active and sustainable transport infrastructure on and in the vicinity of the existing A5, following the reduction in traffic flows associated with the construction of the Proposed Scheme.

2.2.83. This Proposed Scheme Objectives 1 and 2 'to improve road safety' and 'to improve the road network in the west of the Province and North / South links' therefore align to this strategy.

2.2.84. As set out in the A5 Active and Sustainable Transport Assessment (ASTA), once the Proposed Scheme is built, the existing A5 could be downgraded, with a lower speed limit, increased public access and facilities for pedestrians and cyclists. This would provide an opportunity to re-purpose the A5 and facilitate a more 'liveable neighbourhood' [33].

Levelling Up the United Kingdom[34] - Department for Levelling Up, Housing and Communities, 2022

2.2.85. The government's publication of Levelling Up the United Kingdom sets out a new policy regime to address the unequal distribution of opportunity and socio-economic outcomes associated with where people live and work.

2.2.86. The paper sets out a broad and long-term programme to address geographical inequality, to transform underperforming places and boost local growth, so that people everywhere are living longer, healthier and more fulfilling lives.

2.2.87. Related to transport, people, places and the economy, Levelling Up will target the closing of the inequality gap between the highest and lowest performing areas of the UK by 2030 by:

- Boosting productivity, pay, jobs and living standards especially in those places where they are lagging
- Spread opportunities and improve public services, especially in those places where they are weakest
- Restore a sense of community, local pride and belonging, especially in those places where they have been lost

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[32] A5 Active and Sustainable Transport Assessment: A5 – New Buildings to Aughnacloy, Document Ref: 1058654/RP/002 (2017)

[33] https://www.a5wtc.com/A5ASTA-Master-Plan

[34] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1052708/Levelling_up_the_UK_white_paper.pdf

2.2.88. The paper notes the large geographic disparity in productivity, with Norther Ireland noted as the region with the lowest productivity:

> *"The differences between the best and worst performing areas are large. For productivity at the regional level, the gap between the highest (London) and lowest (Northern Ireland) is around 60%."*

2.2.89. Improving transport infrastructure and services is expected to drive economic growth and boost productivity through improved market access. This is fundamental to successfully achieving the Levelling Up ambitions. The Levelling Up Fund is already investing £49m in 11 projects across Northern Ireland, including provision of funding for upgrades to the electric vehicle charging network across Northern Ireland.

2.2.90. The Proposed Scheme, through achievement of its Objectives 2 and 3 'to improve the road network in the west of the Province and North / South links' and 'to reduce journey times and improve journey reliability along the A5 Western Transport Corridor', would contribute towards reducing the inequality gap between Northern Ireland and the rest of the UK.

THE CLIMATE CONTEXT

2.2.91. It is important to note the climate assessment, specifically the effect of the scheme on climate change (greenhouse gas emissions), has been completed in line with the appropriate methodologies available at the time of writing. The greenhouse gas emissions assessment was presented in the ESA 2022. The assessment was undertaken following the principles of PAS 2080:2016 Carbon Management in Infrastructure[35].

2.2.92. The estimated GHG emissions arising from the Scheme have been compared with UK carbon budgets and the associated reduction targets. Whilst the Scheme is estimated to result in a ~1.7% increase in road user emissions compared to the Do Nothing scenario due to an increase in total vehicle kilometres travelled, the overall CO2e emissions for both the Do Something and Do Nothing scenarios is estimated to reduce over the life of the Scheme as a result of changes to vehicle type mix due to ban on the sale of new petrol and diesel cars and vans from 2030, and HGVs from 2040 in the UK.

2.2.93. The following legislative and policy context has been considered when assessing the Greenhouse Gas (GHG) impacts of the Proposed Scheme:

- United Nations Framework Convention on Climate Change[36]
- The UK Climate Change Act 2008 (2050 Target Amendment)[37]
- Environment Act 2021[38]
- Glasgow Climate Pact (2021)[39]
- Climate Change Act (Northern Ireland) 2022[40]

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35 PAS2080:2016 Carbon Management in Infrastructure.

36 United Nations Framework Convention on Climate Change. Available at https://unfccc.int/

37 HM Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: https://www.legislation.gov.uk/ukdsi/2019/9780111187654

38 HM Government (2021) The Environment Act 2021. Available at: https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted

39 UNFCCC (2021) Glasgow Climate Pact. Available at: https://unfccc.int/sites/default/files/resource/cma2021_L16E.pdf

40 HM Government Climate Change Act (Northern Ireland) 2022. Available at: https://www.legislation.gov.uk/nia/2022/31/contents/enacted

- Northern Ireland Energy Strategy – Path to Net Zero Energy[41]
- Northern Ireland Climate Change Adaptation Programme 2019-2024[42]
- Sustainability for the Future – DAERA's Plan to 2050[43]
- United Nations / DAERA Sustainable Development Goals[44]
- 2030 Agenda for Sustainable Development (UK)[45]
- A 10X Economy[46]

SUMMARY OF STRATEGIC CONTEXT

2.2.94. The Proposed Scheme aligns well with both central and local Government plans and policies. There is a common theme throughout all of the relevant strategies discussed above. This is a strong ambition to improve the A5 corridor as a key national and local transport infrastructure link.

2.2.95. The Derry Area Plan looks to maximise its road network efficiency, reviewing various measures such as traffic management and upgrading its key strategic routes. The Fermanagh and Omagh District Council – Position Paper Six promotes increased connectivity, particularly in rural areas.

2.2.96. The Fresh Start Agreement confirmed that the Irish Government would provide funding for the Proposed Scheme to proceed and, under the heading Connectivity and Infrastructure in NDNA, the Irish Government noted the "*opportunity to move forward quickly together to deliver on plans to complete key infrastructure projects including the A5*" and reconfirmed the commitment to "*deliver on its funding commitments to those projects, including a total of £75 million up to 2022 for the A5*". The Proposed Scheme replicates the Government's general aims within the Strategic Planning Policy Statement as well as in the Ensuring a Sustainable Transport Future: A New Approach to Regional Transportation documents.

2.2.97. The Economic Strategy and Investment Strategy stress the need to increase the economic competitiveness of Northern Ireland, partially through improving the connectivity of its transport networks, terming them the "vital arteries" of the system. These strategies state that the improvements will decrease journey times, improve journey time reliability and enhance accessibility.

2.2.98. The Investment Delivery Plan for Roads recognises that upgrades to all Key Transport Corridors, including the existing A5 to dual carriageway as a minimum, are necessary for a strong and modern economy to succeed and flourish. The Regional Development Strategy 2035 goes further to say that

[41] Northern Ireland Energy Strategy – Path to Net Zero Energy. Available at: https://www.daera-ni.gov.uk/articles/green-growth-strategy-northern-ireland-balancing-our-climate-environment-and-economy

[42] Northern Ireland Climate Change Adaptation Programme 2019-2024. Available at: https://www.daera-ni.gov.uk/sites/default/files/publications/daera/Northern%20Ireland%20Climate%20Change%20Adaptation%20Programme%202019-2024%20Final-Laid.PDF

[43] Sustainability for the Future – DAERA's Plan to 2050. Available at: https://www.daera-ni.gov.uk/sites/default/files/publications/daera/SUSTAINABILITY%20FOR%20THE%20FUTURE%20DAERA%E2%80%99S%20-%20PLAN%20TO%202050.PDF

[44] United Nations / DAERA Sustainable Development Goals. Available at: https://www.daera-ni.gov.uk/articles/united-nations-sustainable-development-goals

[45] 2030 Agenda for Sustainable Development (UK). Available at: https://www.gov.uk/government/publications/implementing-the-sustainable-development-goals/implementing-the-sustainable-development-goals--2#:%7E:text=The%20UK%20is%20committed%20to,activity%20of%20each%20Government%20department.

[46] A 10X Economy. Available at: https://www.economy-ni.gov.uk/sites/default/files/publications/economy/10x-economy-ni-decade-innovation.pdf

the Key Transport Corridors allow for the continued growth of the adjacent economic corridors, as well as improving connectivity between various cities, regions and international gateways.

2.2.99. The Regional Transportation Strategy identified investment opportunities up to 2012 that would benefit the widest range of users. The RSTN Transport Plan and the Sub-Regional Transport Plan 2015 both drew from the Regional Transportation Strategy and make up two of the three plans which implement this Strategy. They reveal that the standards of the current A5 are below the required level, leading to increased safety risks. In addition, they also share the view that improving connectivity between various cities, regions and international gateways is highly important.

2.3 CASE FOR CHANGE

2.3.1. This section describes the current situation as well as the rationale for intervention. It demonstrates why an intervention is needed and details how the Proposed Scheme will directly address the problems identified and deliver on the investment objectives.

EXISTING ARRANGEMENTS

2.3.2. The A5 links the northwest of Northern Ireland to Aughnacloy at the border with the Republic of Ireland via Londonderry, Strabane, Omagh and Ballygawley. It connects with the A2 at Londonderry, part of the Northern Transport Corridor, and with the N2 at the border, with onward connections to Monaghan and Dublin. It also connects with the N14 / N15 routes west of Strabane at Lifford in the Republic of Ireland, and with the A505 / A32 east-west corridor at Omagh. The A4 intersects the A5 at Ballygawley, which connects to the M1 strategic corridor to Belfast in the east and Enniskillen in the west Figure 2-2 illustrates the route of the existing A5 and its connections with RSTN.

2.3.3. The recognition of the A5 as a Key Transport Corridor demonstrates its importance as a major infrastructure asset which supports both the national and regional economy of Northern Ireland.

2.3.4. As previously noted, the overarching theme of the Proposed Scheme is connectivity, safety, accessibility and economic growth. The existing A5 currently provides inadequate access to key economic centres of Northern Ireland and Co Donegal, including Londonderry, Strabane and Omagh.

2.3.5. Summaries of the existing situations through the urban settlements and economic hubs along the existing A5 are provided below.

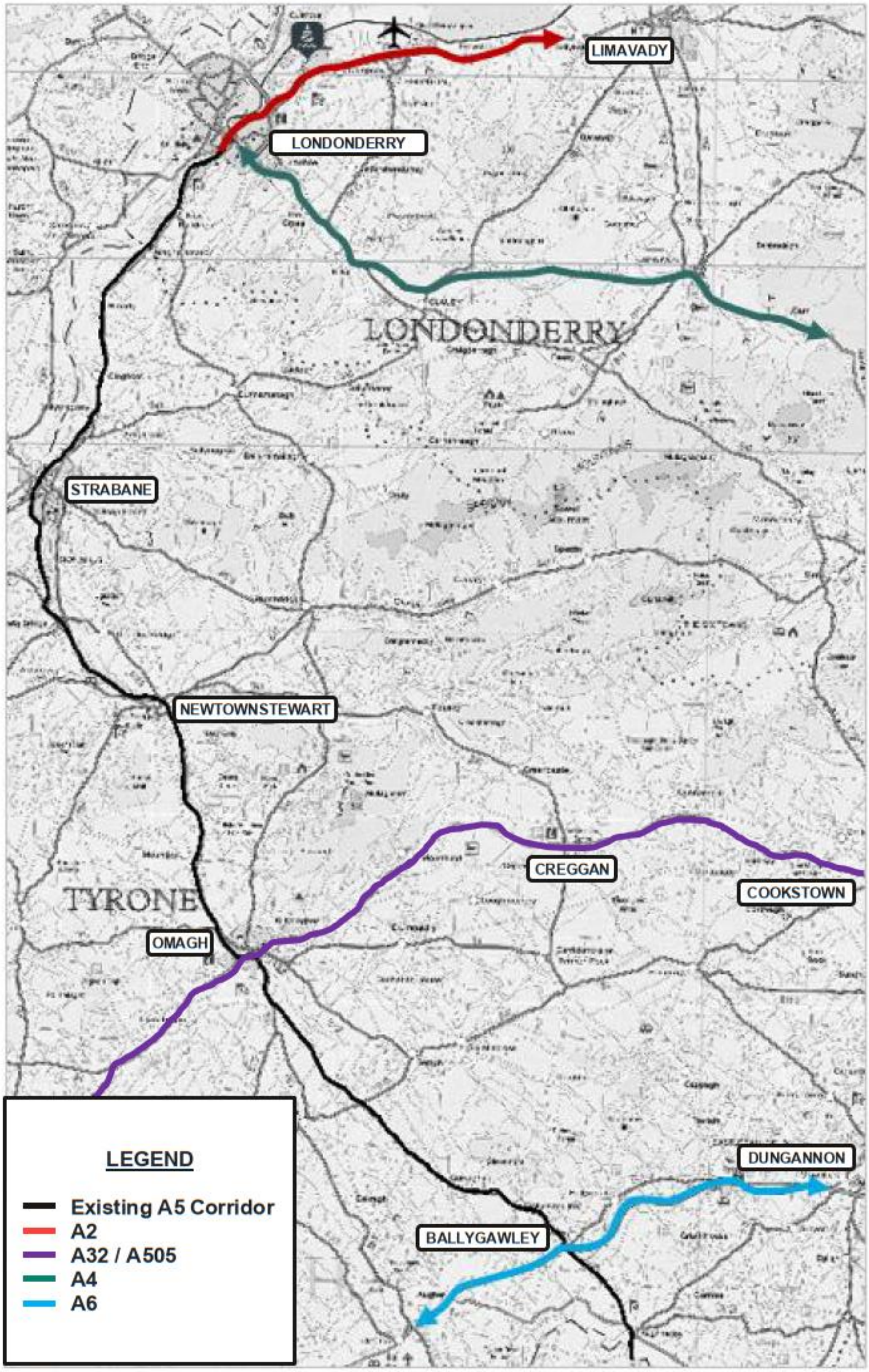

Figure 2-2: Existing A5 corridor and connections with the strategic road network

Londonderry

2.3.6. Londonderry is the second largest city in Northern Ireland with a population of approximately 111,000[47]. The existing A5 begins at Craigavon Bridge, which is one of three entry points into the city centre, crossing the River Foyle (two of these routes are for motorised vehicles).

2.3.7. One of the key centres of economic activity in Londonderry is located at Londonderry Port. Londonderry Port is a key marine gateway to the North West of Ireland, operated by the Londonderry Port and Harbour Commissioners (LPHC). Its importance to the local and regional economy of Londonderry and the North West is reflected in its position as a regional hub for international commercial and tourist activity.

2.3.8. At present, mainly conventional bulk cargo vessels utilise the Port for operational purposes, originating primarily from the USA, Colombia, South Africa and Europe. The port is also capable of accommodating visiting cruise ships throughout the year. There is also a marina – the Foyle Port Marina – which was installed in 2003.

2.3.9. The port is a major employment hub in Londonderry. LPHC supports approximately 1,000 jobs, both directly and indirectly. The port now handles 2 million tonnes of cargo annually. Its focus on major commodity imports for the North West, including animal feed and fertiliser, supports approximately 20,000 farms in the region, in addition to various other local business sectors including fuel and construction industries[48]. For the port to maintain its position as an international gateway, it requires high quality infrastructure, including the provision of excellent transport links so as to maintain movements of freight, passengers and commuters.

2.3.10. The primary access route from the south to Londonderry Port is via the existing A5, before its connection with the A2 at Craigavon Bridge. The quality of the existing A5 is inadequate in supporting the reliable movements of freight, passengers and commuters. This will hinder the port's ability to function and develop, as well as the Executive's aim to rebalance and rebuild the economy, and as such economic growth could potentially not materialise.

2.3.11. In addition to the port, Londonderry hosts a regional airport. The City of Derry Airport is located approximately 11km northeast of Londonderry and operates seven routes to the Algarve, Manchester, Edinburgh, Majorca, Liverpool, Stansted and Glasgow. The airport handled a total of 203,777 domestic and international passengers in 2019, however, this figure is 30% down from 2016. 2021 saw a 60% reduction in passenger numbers due to COVID-19.

2.3.12. Notwithstanding this recent decline, it is well acknowledged that airports play a prominent role in the economic development of a region. It is vital that the City of Derry Airport continues to operate for the benefit of the North West. Therefore, it must be ensured that the appropriate transport infrastructure is in place to provide access to and from the airport. The Proposed Scheme will contribute to a high-quality route connecting the airport with the main communities to the west of Northern Ireland.

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[47] 2020 mid-year population estimate (Source: NISRA, 2021)

[48] http://www.londonderryport.com/about-us (2017)

Connecting Towns

2.3.13. The existing A5 runs from Londonderry, through New Buildings, Strabane, Omagh and Aughnacloy, before terminating at the border with the Republic of Ireland. A number of A and B-Class routes join the existing A5 corridor during this journey and connect it to a significant number of villages and hamlets. The routes, from north to south, are identified in Table 2-5, along with the town / village with which they connect.

Table 2-5: A- and B-Class routes joining the existing A5 corridor between Londonderry and Aughnacloy

Route	Connecting Town
Between New Buildings and North of Strabane	
B48	New Buildings
B49	Ballymagorry / Strabane
B72	Strabane
Between North of Strabane and South of Omagh	
A38	Strabane / Lifford
B85	Strabane
B165	Clady
B72 / B165	Castlederg, Douglas Bridge
B164	Ardstraw
B84	Drumquin
B46	Fintona, Beragh, Newtownstewart, Plumbridge
B50	Drumquin, Omagh
A32	Dromore, Irvinestown, Enniskillen
Between South of Omagh and Ballygawley	
A505	Cookstown
B83	Tattyreagh, Fintona
B34	Cabragh
Between Ballygawley and Aughnacloy	
A4	Dungannon, Enniskillen
A28	Augher, Armagh, Enniskillen

2.3.14. In total, over 200 side roads connect with the existing A5, primarily by priority junctions, and there are approximately 1370 at-grade junctions/private accesses along the route. The private accesses include commercial, residential and agricultural use[49]. The number of accesses and adjoining junctions hinders the efficiency of the existing single carriageway A5 in moving people and goods. Invariably, congestion can occur as vehicle speed decreases so that vehicles can safely turn into these accesses and side roads. Vehicles turning on the existing A5 must wait until a suitable gap becomes available within the on-line traffic flows. Moreover, this can lead to driver frustration during periods of heavy traffic on the existing A5 and endanger both the oncoming vehicles and on-line vehicles due to unsafe turning movements.

2.3.15. An upgrade to the existing A5 is required in order to improve not only the efficiency of the route and accessibility between connecting towns, but also support the local economies which have built up along the corridor.

Economic Context

2.3.16. Northern Ireland has been recovering from an economic downturn since 2008. Figure 2-3 demonstrates the proportion claiming unemployment-related benefits[50] between 2005 and 2020 within the districts through which the existing A5 currently runs, compared to the Northern Ireland average.

2.3.17. The North West City Region remains the only region on the island that is not served by the motorway network. In addition, the standard of many sections of the legacy road network in the region remain significantly lower than other regions of the country. Londonderry and the wider North West Region has persistently underperformed economically relative to other cities on the Island due to legacy of underinvestment and in particular its peripherality and poor connectivity.

2.3.18. In terms of unemployment, Figure 2-3 shows that since 2005, Derry City and Strabane District Council had consistently demonstrated a higher overall claimant rate than for Northern Ireland as a whole, with Fermanagh and Omagh broadly tracking the Northern Ireland rate and Mid Ulster showing a slightly lower claimant count rate than Northern Ireland as a whole. The numbers claiming unemployment-related benefits for all areas increased post-economic downturn from 2008 up to 2013, when numbers plateaued and started to decline up to 2019 and then showed an increase in 2020.

2.3.19. Claimant count rates in 2020 were 6.4%, 3.6% and 3.6% for the Districts of Derry City and Strabane, Fermanagh and Omagh, and Mid Ulster, respectively. In line with historic trends, only Derry City and Strabane had a higher claimant count rate in 2020 than Northern Ireland as a whole. Whilst the method of reporting claimant count rates had changed following the release of 2020 data, the latest figures for March 2023[51] show an overall reduction in claimant count rates relative to 2020, but

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[49] A5WTC Proposed Scheme Theme Report, Ref: A5WTC-2019-TR-008

[50] Claimants' include the severely disabled claimants, but exclude students seeking vacation work and the temporarily stopped (Source: NISRA, https://www.ninis2.nisra.gov.uk/InteractiveMaps/Labour%20Market/Claimant%20Count%20Annual%20Averages%20LGD2014/atlas.html)

[51] Post August 2022, the new Claimant Count includes Jobseeker's Allowance Claimants and those Universal Credit claimants who were claiming principally for the reason of being unemployed (Source: NISRA, https://www.nisra.gov.uk/system/files/statistics/lmr-claimant-count-tables-march-2023.xlsx

nonetheless a similar trend with Derry City and Strabane (4.8%) exceeding the claimant count rate for Northern Ireland as a whole (3.0%) and the Districts of Fermanagh and Omagh (2.4%) and Mid Ulster (2.1%) both showing rates close to but lower than Northern Ireland claimant count rate.

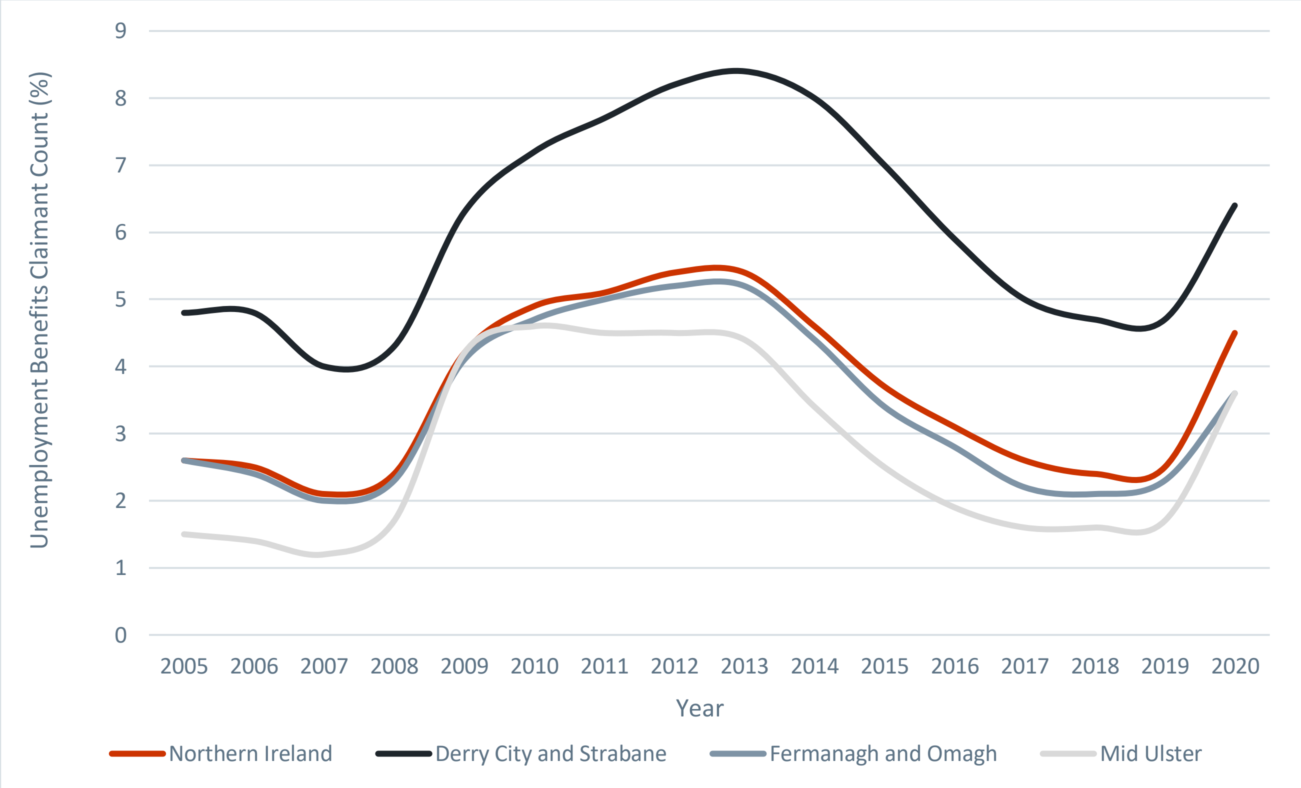

Figure 2-3: Unemployment benefits claimant count annual average (Source: NISRA)

2.3.20. The Northern Ireland Executive has entered an era of rebuilding and rebalancing the economy, to ensure there is long-term economic prosperity and employment opportunities are maximised.

2.3.21. The various policies and strategies examined in Section 2.2 have highlighted the positive correlation between good quality infrastructure, including an upgraded A5WTC, and a potential resurgence in economic growth.

2.3.22. Large scale projects will need good quality transport infrastructure in order to maximise their potential and benefits. They would be expected to lead to an increase in overall travel and trip making. The sites will need to be serviced, more people will be travelling to work and goods will have to be transported.

2.3.23. Whilst developers are encouraged to reduce the need to travel, this is not entirely practical in a province such as Northern Ireland. The rurality of the region means that it is a necessity for people to travel by private car or public transport in order to reach a destination further afield in a timely and efficient manner.

2.3.24. The Proposed Scheme will help to address this issue and greatly improve access to these and future developments along the north-south corridor. It will strengthen links between the connecting towns of the North West, opening up new opportunities for economic growth throughout a region which has suffered from a long-term lack of investment. In particular, the North West City Region is currently advancing and delivering ambitious sustainable growth proposals to reverse this underperformance in line with the Derry City and Strabane Strategic Growth Plan. The success of many of these proposals are dependent on significantly improved efficient and direct connectivity, particularly road connectivity for both people and freight to/from Derry and the wider North West to the other key cities, ports and airports on the Island.

2.3.25. A resilient and efficient highway corridor between the north and south of Northern Ireland will undoubtedly improve the attractiveness of the area for inward investment and new businesses from which the connecting towns will reap the benefits.

Cross Border Link

2.3.26. The existing A5 runs through Aughnacloy towards the border with the Republic of Ireland. At the border, it connects with the N2 which links with Monaghan and Dublin in the south. The opportunities for cross-border innovation and trade activity are strongly supported by the Executive and the Irish Government. Indeed, the Irish Government has reaffirmed its commitment to the Proposed Scheme by contributing to the construction costs (see Sections 2.2.34 to 2.2.37).

2.3.27. The UK left the EU on the 31 January 2020. A transition period was in place until 31 December 2020 and now a new relationship with the EU is beginning. This includes the Northern Ireland Protocol that there would be no new checks on goods crossing the border between NI and the Republic of Ireland. As a result of the protocol, NI has in effect remained in the EU's single market for goods (England, Scotland and Wales have left the EU's single market for goods). This allows goods to flow to and from NI to the RoI and the rest of the EU as they did while the UK was a member of the EU, without customs checks, tariffs or new paperwork. The EU's rules on customs and regulation of agri-food products will continue to apply to goods arriving in NI.

2.3.28. The Proposed Scheme is intended to strengthen the international gateway as one of the primary access routes between Northern Ireland and the Republic of Ireland. It will build upon this connectivity and help to unlock economic potential by attracting inward investment, boosting the local economies either side of the border, in addition to the economy of the North West.

2.3.29. To summarise, the Proposed Scheme will help to improve links between the urban centres in the west of the Province and provide a strategic link with international gateways.

2.3.30. The traffic modelling which underpins the Economic Case (Chapter 3) takes into account the improved accessibility between Londonderry, the connecting towns and the border with the Republic of Ireland which will result from the Proposed Scheme. This is demonstrated in the transport economic efficiency (TEE) and Benefit-Cost Ratio (BCR) calculations that are presented in Chapter 3 as part of the Economic Case.

2.4 BUSINESS NEED AND SERVICE GAPS

THE NEED FOR THE SCHEME

2.4.1. In September 2001, the Department for Regional Development (of which the Department for Infrastructure Roads was then a part when formerly known as Roads Service), formulated Shaping Our Future: the Regional Development Strategy for Northern Ireland 2025. That strategy was intended to guide the future development of the region up to 2025 and provided guidance on a range of social, economic and environmental matters which are implemented through the plans and strategies of Government Departments.

2.4.2. An integral feature of the Regional Development Strategy 2025 (RDS 2025) was the requirement to develop a Regional Transportation Strategy having a vision of “a modern, integrated and sustainable transportation system which benefits society, the economy and the environment and which actively contributes to social inclusion and everyone's quality of life". In July 2002, the Assembly approved the strategic direction and underlying principles of the Regional Transportation Strategy for Northern Ireland 2002-2012 (RTS). The RTS identified strategic transportation investment priorities and considered potential funding sources over a ten-year period as well as setting down guidance as to how funding would be split between areas and transport modes.

2.4.3. Delivery of the RTS was progressed through three multi modal transport plans including the Regional Strategic Transport Network - Transport Plan (RSTN-TP), published in March 2005.

2.4.4. The Regional Strategic Transport Network (RSTN) of Northern Ireland comprises the rail network, five Key Transport Corridors, four Link Corridors, the Belfast Metropolitan Transport Corridors and the remainder of the trunk road network. At that time it comprised 5% of the total road network but carried 35% of the traffic. A number of priority schemes to improve the RSTN were ongoing and appraisal work (based on the Government's five key criteria of environment, safety, economy, accessibility and integration) was undertaken to identify further Strategic Roads Infrastructure (SRI) schemes for inclusion in the RSTN-TP.

2.4.5. Delivery of the Regional Development Strategy received a boost in 2005 with the announcement of the Investment Strategy for Northern Ireland (ISNI). The £16bn strategy set out a high-level view of planned investment up to 2015 with proposals for up to £1.4 billion of strategic road improvement schemes. In July 2006, Roads Service published the consultation document Expanding the Strategic Road Improvement Programme 2015 which included schemes to the value of the ISNI programme as well as a list of schemes that performed well in assessment but were not affordable within anticipated ISNI funding for the period 2005 - 2015.

2.4.6. The RSTN-TP has 8 primary objectives including the need "to examine access to regional gateways and cross border links with an emphasis on improving connections from the 5 key transport and 4 link corridors".

2.4.7. With regard to Key Transport Corridors (KTC) the RTS 2012 states that "acting as the upper tier of regionally important routes (road and rail), the KTCs are those strategic long distance routes which connect a number of towns and provide links to the major regional gateways, including linkages to the transport corridors within the Belfast Metropolitan Area."

2.4.8. One such corridor identified in the RSTN-TP is the Western Transport Corridor (WTC) that comprises the existing A5 from Londonderry to Aughnacloy. This corridor is also an important all island route as it forms part of the main route from Dublin to the North West.

2.4.9. In contrast to the definition of a Key Transport Corridor, the existing A5 is a 'patch work' of differing width single carriageway roads with intermittent stretches of climbing lanes and overtaking opportunities. This lack of consistency in the road design parameters leads to the use of inappropriate high speeds through the good lengths of the road resulting in a lack of appreciation for the poorer conditions of the road ahead, as well as delays and inconsistency in journey times on the corridor. As identified in the Stage 3 Scheme Assessment Report[52] (SAR3), reference 718736-0000-R-010, produced by WSP in August 2016, in excess of 200 side road junctions connect with the A5 and over 420 domestic/commercial properties (excluding those in the various urban settlements) are accessed from the route.

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[52] https://www.a5wtc.com/Stage-3-Scheme-Assessment-Report Stage 3 Scheme Assessment Report Part 2, Ref: 718736-0000-R-010, page 1-4, paragraph 1.1.16 (August 2016)

2.4.10. At a meeting of the North South Ministerial Council in July 2007, the Irish Government indicated its intention to help fund major infrastructure programmes in Northern Ireland and in particular the upgrading of the A5 Western Transport Corridor and the A8 Eastern Seaboard Corridor (Belfast-Larne) to dual carriageway status, the latter of which has been constructed and is fully operational.

2.4.11. The Northern Ireland Executive agreed in principle to taking forward these two major roads projects which were included in the Investment Delivery Plan (IDP) for Roads which was published in April 2008. Also in 2008, the Northern Ireland Executive agreed its first Budget and endorsed a revised ten-year Investment Strategy, covering the period 2008-2018. That strategy indicated proposals to invest over £3bn in Northern Ireland's road infrastructure, which at that time included a contribution of £400m from the Irish Government.

Since 2008, despite the economic downturn of 2008 and delays to the scheme, support for the maintaining and enhancing the Regions' Key Transport Corridors and for the A5WTC has been maintained by the Northern Ireland Executive, as well as the British and Irish Governments and other bodies as evidenced by a variety of documents, which have been addressed above in Section 2.2.

PROBLEMS

2.4.12. There are a number of specific problems that have been identified on the A5 corridor and the regions through which it runs. These are summarised below and then described in greater detail in the text that follows.

- congestion pinch points and journey time reliability
- accessibility to key economic centres and international gateways
- accident hotspots
- community severance

Congestion Pinch Points and Journey Time Reliability

2.4.13. The existing A5 is a mixture of differing width single carriageway roads with intermittent stretches of climbing lanes and overtaking opportunities[53]. It passes through or is adjacent to two main urban areas (Strabane and Omagh) and various population settlements (New Buildings, Magheramason, Bready, Cloghcor, Ballymagorry, Sion Mills, Victoria Bridge, Newtownstewart, Garvaghy, Ballygawley and Aughnacloy).

2.4.14. The topography through which the A5 runs from north to south is generally undulating, ranging from the flat lands along the floodplains of river courses such as the Foyle, Mourne, Finn and Burn Dennet, to the moderately sloping foothills of the Sperrin Mountains and Bessy Bell.

2.4.15. The highest point of the existing A5 is 167 metres Above Ordnance Datum (AOD) at Garvaghy, approximately 8km northwest of Ballygawley. The lowest point of the road is 3.5m AOD between the A5 Barnhill Road and Park Road in Strabane. The topography of the North West means that users of the existing A5 experience steep climbs and sharp falls during their journeys. This has led to an inconsistency in road design through certain areas of the route.

[53] A5WTC On-line Assessment Report, page 3, paragraph 1.1.2 (July 2016)

2.4.16. The design inconsistencies, combined with relatively high volumes of traffic and routeing through settlements, means that the A5 experiences a number of congestion pinch points and some journey time reliability issues. This issue is exacerbated by the types of vehicles using the corridor.

2.4.17. There is a high proportion of Heavy Goods Vehicles (HGVs) using the existing A5 due to the movements of freight and the agricultural industry, which is one of the main providers of employment in the west. Overall, the proportion of heavy vehicles using the existing A5, combined with generally high volumes of traffic, can result in slow moving traffic, queuing and unreliable journey times.

2.4.18. There are notable congestion pinch points as the A5 passes through and around the urban settlements, along the corridor at Strabane and Omagh, as well as through Sion Mills. The traffic flows on the existing A5 lead to congestion during peak times, especially in urban areas.

2.4.19. Due to the nature and number of the vehicles, the prevailing traffic conditions during peak periods, lengths of urban areas and speed restrictions, and the geometric standard of the existing A5, speeds and journey times vary considerably and are unpredictable. HGVs and agricultural vehicles frequently force lighter vehicles to slow down, causing driver frustration which can lead to overtaking at unsuitable locations, increasing the possibility of collisions.

2.4.20. As previously outlined, suitable overtaking opportunities are intermittent along the existing road. In the 34 miles between Derry and Omagh there is just one 2+1 passing lane in each direction. The Stage 3 Scheme Assessment Report (SAR3), reference 718736-0000-R-010, produced by WSP in August 2016, highlighted those sections of the existing A5 which do not meet current design standards with regards to Stopping Sight Distances (SSD). The SSD is the minimum sight distance available on a highway at any spot having sufficient length to enable the driver to stop a vehicle travelling at design speed, safely without collision with any other obstruction. The existing A5 does not comply with SSD standards along the following sections:

- Doogary Road and Tullyrush Road, where 20% and 26% of the SSDs northbound and southbound, respectively, do not achieve current design standards
- Tullyheeran and Gortaclare, where 24% and 37% of the SSDs northbound and southbound, respectively, do not achieve current design standards
- Gortaclare and Garvaghy, where 7% and 17% of the SSDs northbound and southbound respectively do not achieve current design standards
- Garvaghy and Seskilgreen, where 27% and 20% of the SSDs northbound and southbound respectively do not achieve current design standards
- Seskilgreen and Ballygawley Roundabout, where 27% and 13% of the SSDs northbound and southbound respectively do not achieve current design standards
- Ballygawley Roundabout and Aughnacloy, where 29% and 41% of the SSDs northbound and southbound respectively do not achieve current design standards

2.4.21. On these particular sections of the existing A5, it is likely that vehicles will have extended stopping distances, or will start slowing sooner, on entry to a junction or a queue. This can potentially have a knock-on effect on following traffic, which leads to increased incidences of queuing, congestion and risk of accidents.

2.4.22. The SAR3 also documented the varying widths of the carriageway cross-section throughout the route of the existing A5. Between New Buildings and the north of Strabane, the cross-section of the carriageway ranges between 6.3m and 14.7m, and on occasion, does not meet the current standard requirement either in terms of road or verge widths, or by the absence of a hard strip along the edge of the carriageway. Between the south of Strabane and the south of Omagh, the carriageway is approximately 7.3m wide throughout and mostly meets current standards with regards to hard strips. Sections of the existing A5 between the south of Omagh and Aughnacloy are "considered to be high density access constraints, which has an impact on both traffic speed and safety"[54].

2.4.23. The narrowing of the existing carriageway, combined with the direct routeing through population settlements along the route in New Buildings, Magheramason, Bready, Cloghcor, Ballymagorry, Strabane, Sion Mills and Omagh, leads to slower speeds on these sections of the existing A5.

2.4.24. The rural character of the area means that conflicts can occur between the types of vehicles using the route i.e., agriculture, heavy vehicles, as well as conflicts between local and strategic traffic.

2.4.25. The combined effect of these conflicts, together with limited opportunities for overtaking and reduced speed limits through population settlements, is causing slower moving traffic, incidences of congestion and consequently, unreliable journey times and a higher risk of injury accidents.

ACCIDENT HOTSPOTS

2.4.26. Over the 12-month period October 2021-October 2022, there have been ten fatalities observed along the existing A5 corridor, this compares to 15 fatalities observed along the corridor in the five year period between 2015 to 2019 and points to a rising accident trend. This significant jump in fatal accidents leads to a general perception that accidents along the A5 are increasing. The relatively short timescale of post-Covid accident data is insufficient to draw robust conclusions for purposes of economic appraisal. However, if this trend continues, the economic assessment of accident savings reported within the Economic Case could be argued as an underestimate.

2.4.27. Accident analysis of the A5 corridor including the side roads accessing the A5 between New Buildings and Aughnacloy (illustrated on Figure 2-4) showed that there were 1,003 injury accidents, involving 1,589 casualties between 2015 and 2019. Of these:

- 2% of accidents were fatal, 9% were serious
- 11% of accidents involved elderly people and 9% involved children
- 5% of all pedestrian-related accidents were fatal and 20% were serious

[54] Stage 3 Scheme Assessment Report Part 2, Ref: 718736-0000-R-010, page 2-78, paragraph 2.4.11 (August 2016)

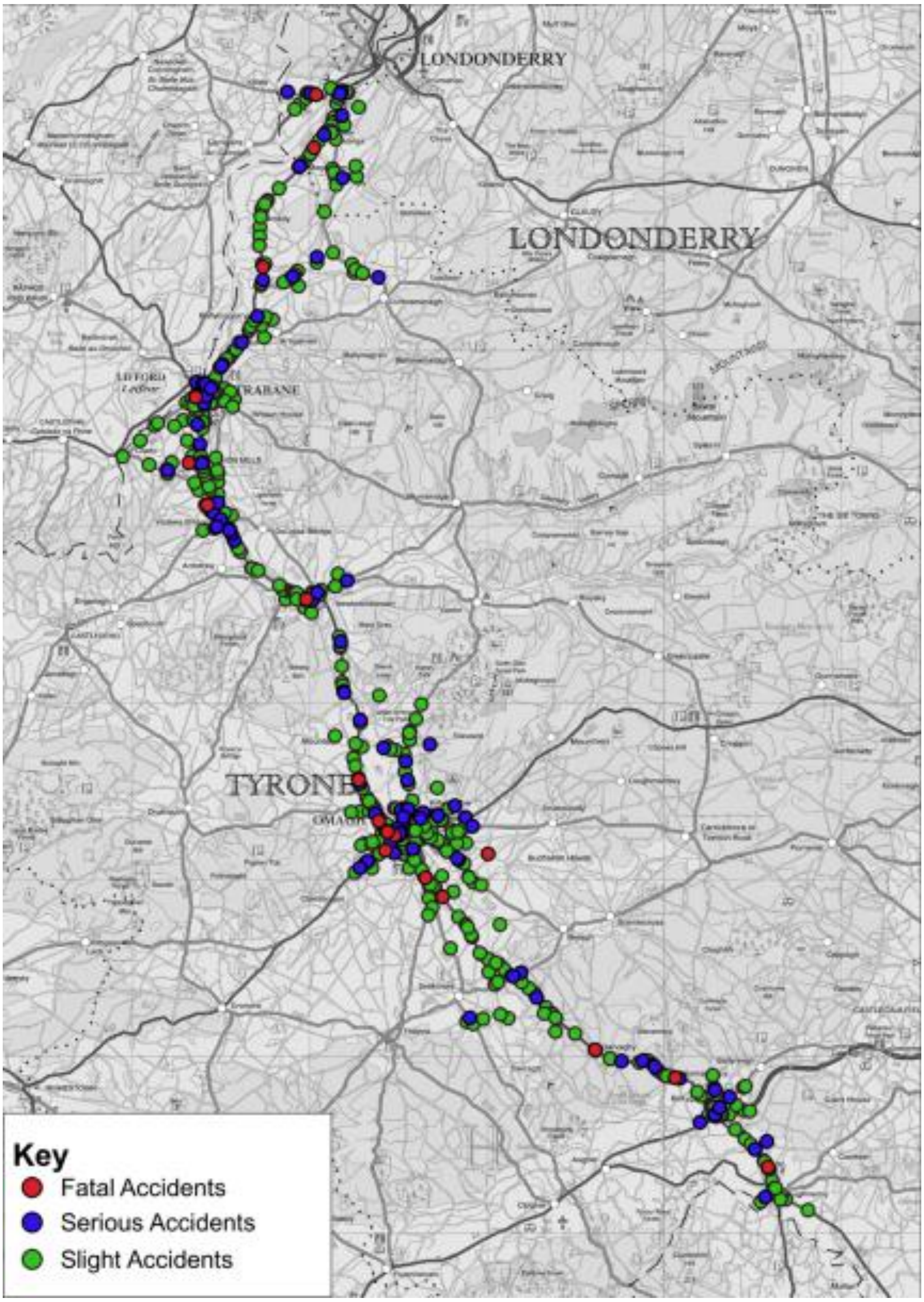

Figure 2-4: Injury accidents by severity on the A5 corridor

2.4.28. Considering the A5 corridor in isolation, accident data collected for the period 2015 to 2019 inclusive indicates that, there were a total of 408 Personal Injury Accident (PIA) on the existing A5 between New Buildings and Aughnacloy, involving 15 fatalities and 45 serious casualties, over the five-year period. These are presented in Table 2-6 broken down by section of the A5 corridor, together with a calculated observed accident rate (based on the five year period 2015-2019) and an equivalent national average rate for the type of road[55]. Although along most of the sections for the five-year period 2015-2019, the observed accident rate was lower than the equivalent national average rate, it is noteworthy that over the 12-month period October 2021-October 2022 there have been ten fatalities observed along the existing A5 corridor.

Table 2-6: Comparison of Observed and National Average accident rates for the existing A5

Section	Length	Total PIA	Observed Rate	National Average Rate
New Buildings to Strabane	17.10	63	0.15	0.17
Strabane Urban	2.90	29	0.23	0.62
Strabane to Sion Mills	3.00	44	0.52	0.62
Sion Mills to Newtownstewart	12.20	55	0.21	0.17
Newtonstewart to Omagh	12.80	40	0.13	0.17
Omagh Urban	1.80	48	0.70	0.37
Omagh to Ballygawley	26.10	92	0.15	0.17
Ballygawley to Aughnacloy	6.10	31	0.34	0.17
Aughnacloy Urban	2	6	0.23	0.37
Total		408		

2.4.29. The accident analysis highlighted noticeable clusters of accidents, or accident hotspots, at the following locations:

- New Buildings to Bready
- Ballymagorry to Strabane
- Sion Mills
- Omagh
- Ballygawley

2.4.30. These are shown in Figure 2-5 to Figure 2-9 respectively and discussed in turn below. It should also be noted that over the 12-month period October 2021-October 2022, new accident hotspots, in the areas like Garvaghy, are also emerging.

[55] National rates are documented in the COBALT manual, the DfT programme used to calculate accident savings and benefits

Figure 2-5: Accident hotspots – New Buildings to Bready

2.4.31. At the junction of A5 / Woodside Road in New Buildings there were a total of 16 slight accidents and 1 serious accident over the five year period. In Magheramason there were 14 accidents on the existing A5 including 1 fatal, 1 serious and 12 slight personal injury accidents.

2.4.32. The Proposed Scheme would provide a roundabout on the existing A5 north of New Buildings (Junction 1) and a second roundabout with a link to the existing A5 at the end of the initial wide single carriageway section south of the settlement. The proposed junctions and new carriageway would improve safety and alleviate existing accident hotspots currently occurring in New Buildings and Magheramason.

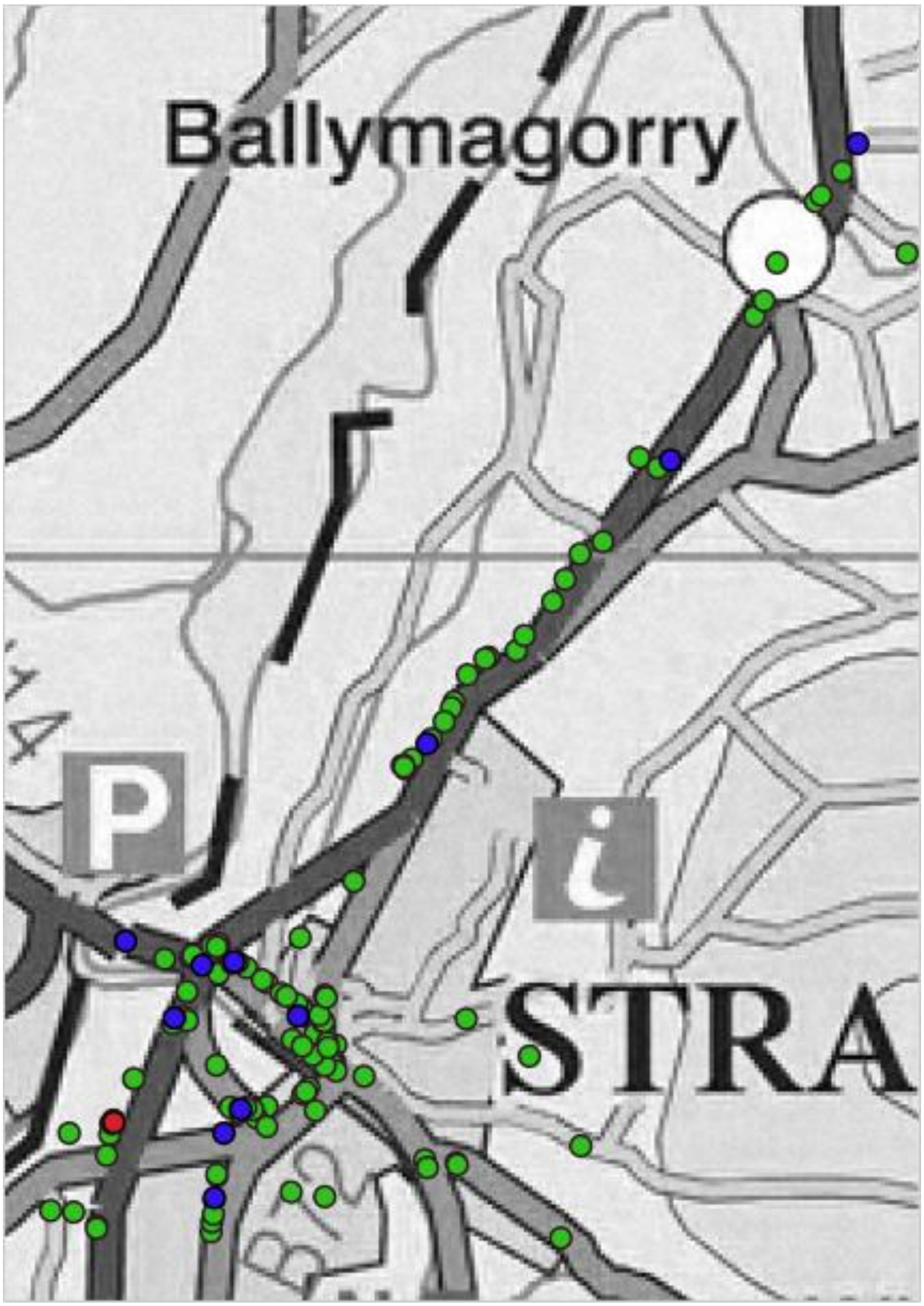

Figure 2-6: Accident hotspots – Strabane

2.4.33. There are a number of accident hotspots within Strabane. At the A5 / Railway Street junction the data shows there were 10 personal slight injury accidents. The data also shows a cluster of accidents within Strabane on Main Street and Railway Street.

2.4.34. At Strabane the Proposed Scheme would skirt the western edge of the urban area. There would be junctions west (Junctions 4-6), south-west (Junction 7) and south (Junction 8) of the town. Junctions

4-6 comprise a grade-separated arrangement. These upgraded junctions and carriageways would improve road safety.

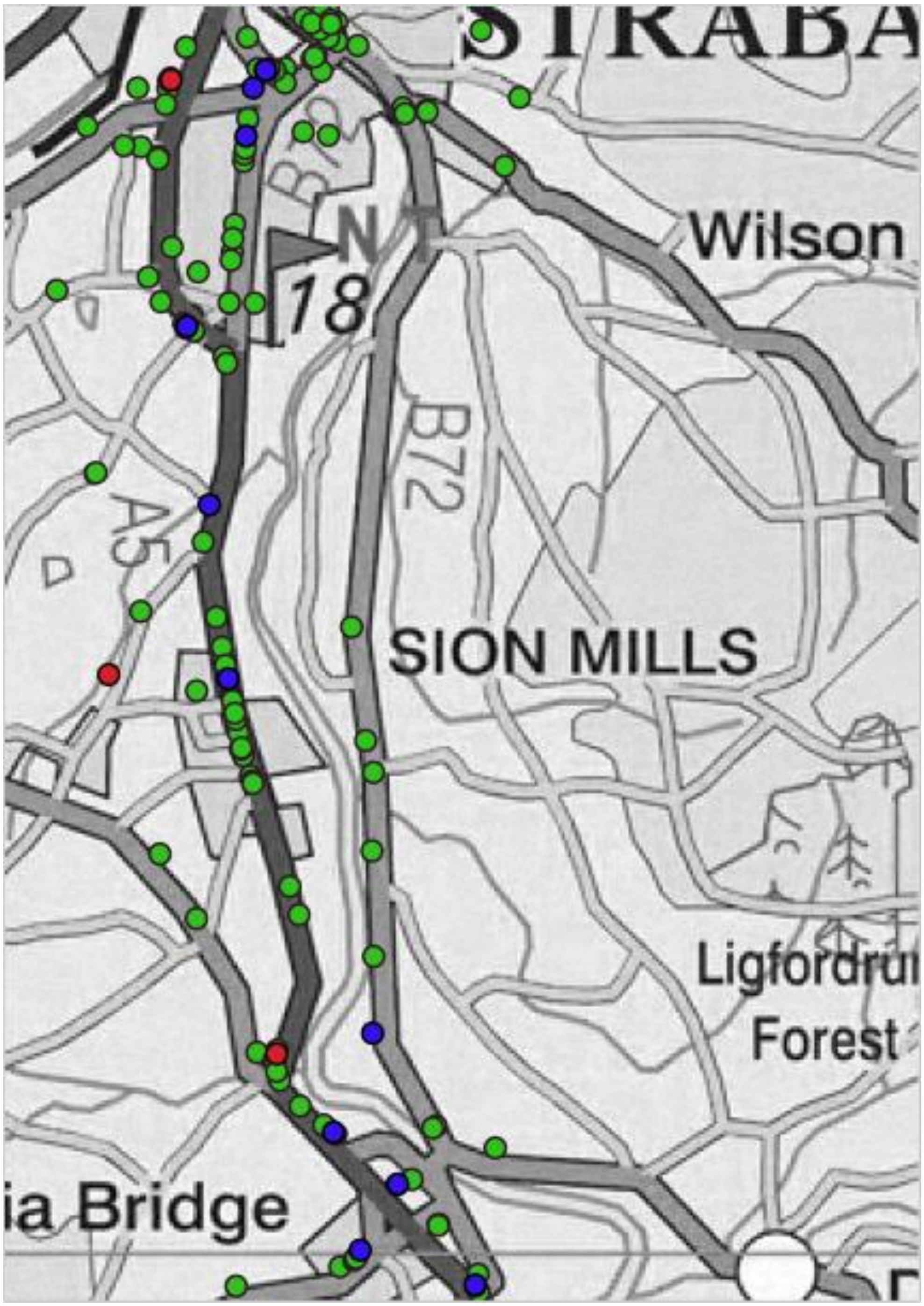

Figure 2-7: Accident hotspots – Sion Mills

2.4.35. Along the existing A5 in Sion Mills there has been a cluster of 25 accidents comprising 1 serious and 24 slight personal injury accidents.

2.4.36. The Proposed Scheme would pass between Sion Mills and Glebe with a new compact grade separated junction to the north of Sion Mills. The proposals would improve road safety along the existing A5.

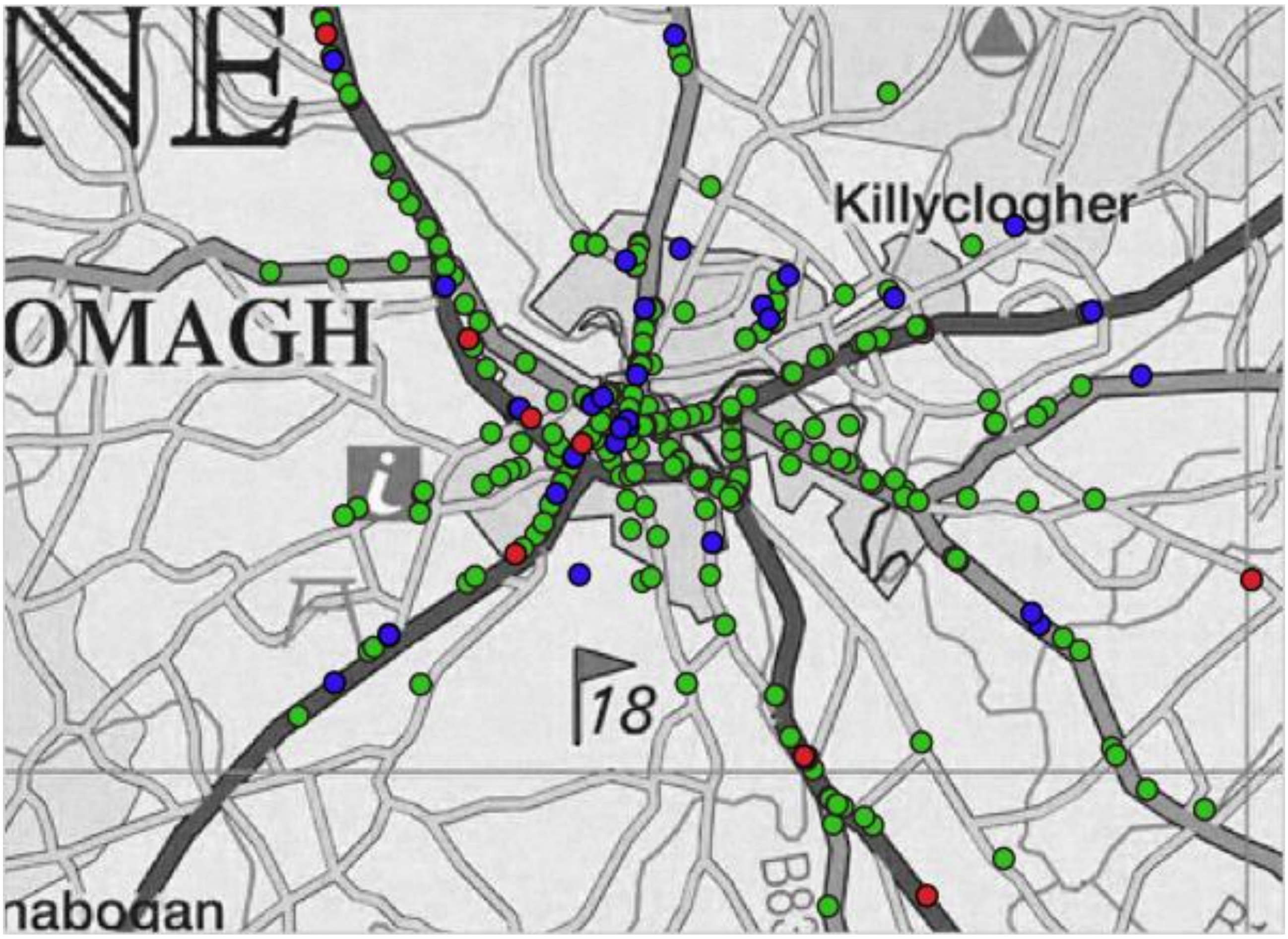

Figure 2-8: Accident hotspots – Omagh

2.4.37. There are a significant number of accident hotspots within Omagh. On the existing A5 travelling through Omagh (from the junction of A5 / Gillgooley to A5 / A505) there were 45 personal injury accidents. These accidents included 2 fatal, 2 serious and 41 slight personal injury accidents.

2.4.38. Access to Omagh would be catered for by the proposals via a grade-separated junction with the A32 west of the town (Junction 12) and a grade-separated junction at the B83 Seskinore Road, with a link to the existing A5 to the south (Junction 13). These improvements would improve safety and positively impact the accident hotspots currently occurring within Omagh.

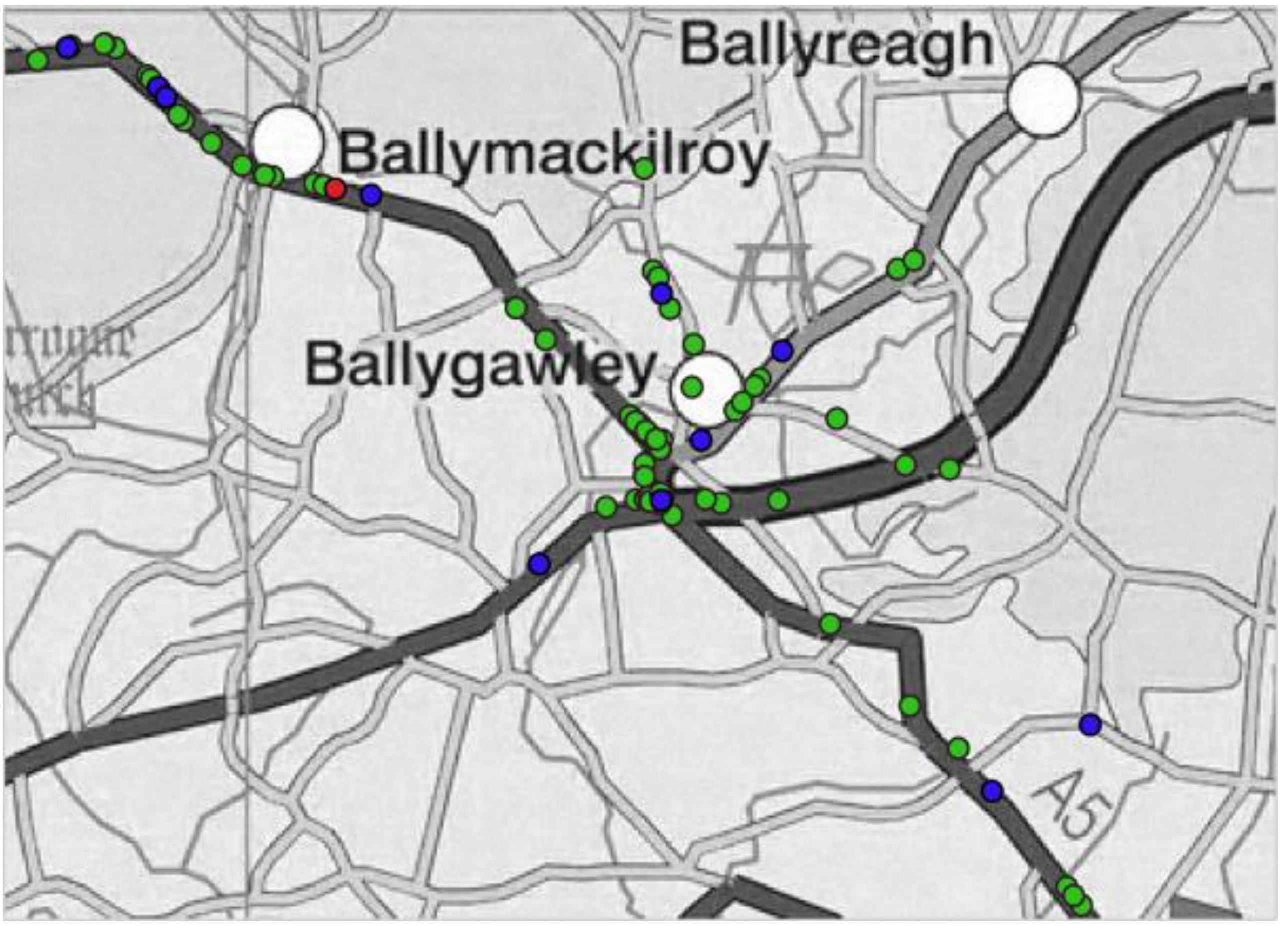

Figure 2-9: Accident hotspots – Ballygawley

2.4.39. Figure 2-9 shows a hotspot of accidents at the junctions of A5/ B34 and A5 / Annaghilla Road within Ballygawley. At the A5 / B34 there were 8 slight accidents reported and at the A5 / Annaghilla Road junction 16 slight accidents and 1 serious accident occurred.

2.4.40. The Proposed Scheme would improve the existing safety issues in Ballygawley as a new roundabout would be provided where the proposed carriageway and existing A4 Annaghilla Road would cross some 1.5km west of Ballygawley (Junction 15).

2.4.41. Accidents have a number of impacts, in addition to the direct impact on those directly involved in the incident. These impacts include financial costs associated with the police, medical assistance, insurance and court proceedings in addition to impacts on local businesses and commuters as a result of associated delays.

2.4.42. Resilience with respect to road traffic characteristics is the ability to absorb adverse or unforeseen events. Accidents at busy junctions, such as the junctions at A5 / Woodside Road in New Buildings, A5 / Railway Street in Strabane and the A5 / B34 and A5 / Annaghilla in Ballygawley, cause congestion and severe delays to road users and industries. Therefore, the Proposed Scheme would help to improve the resilience of the strategic road network such that the number and effect of accidents is reduced.

2.4.43. Accident savings are accounted for in the traffic modelling and economic appraisal within the Economic Case – forming part of the Present Value of Benefits (PVB) and benefit-cost ratio (BCR) calculations.

COMMUNITY SEVERANCE

2.4.44. Community severance can be defined as the separation of residents from the places they visit within their community, caused by a busy road or other transport link[56]. There are several towns and villages which experience severance as a consequence of traffic flows on the existing route of the A5. From north to south along the corridor, the main locations include New Buildings, Magheramason, Ballymagorry, Sion Mills, Strabane, Omagh and Aughnacloy, in addition to a number of small villages and hamlets. Severance is also exacerbated by the high proportions of heavy vehicles (up to one-fifth of total flows) which use the existing A5 to transport goods and freight.

2.4.45. The impacts of community severance can be profound in those towns and villages noted above. Given the prominence of the existing A5 as a route for strategic traffic between the northwest and southwest of the province, between Londonderry and Aughnacloy, there are limited opportunities for pedestrians and cyclists to cross the road at designated locations. For example, in Magheramason, shown in Figure 2-10, there is only one Pelican crossing on the 500m route between entry to and egress from the village. Two refuge islands exist to the southwest of the village and one to the northeast. Safe crossing points in the village are therefore restricted, including to Maghermason Presbyterian Church and other services, and are not comfortably accessible on foot by local residents.

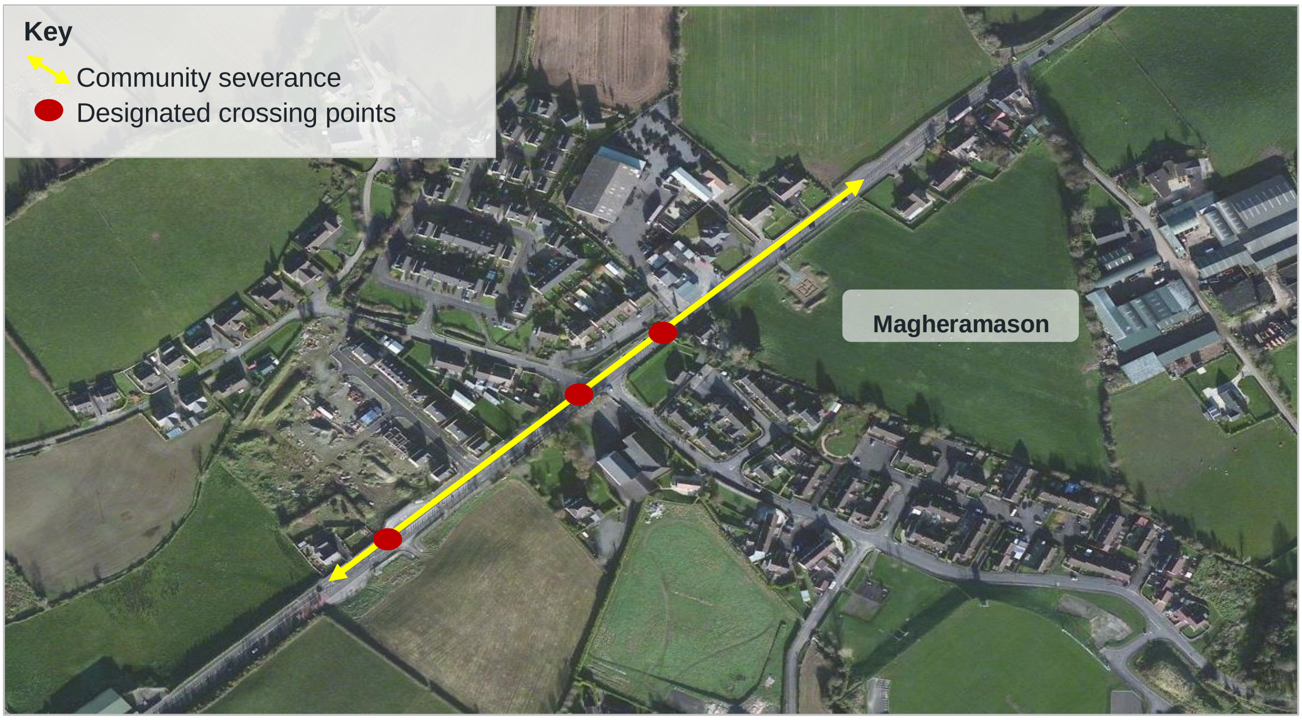

Figure 2-10: Overhead view of Magheramason, illustrating existing A5 route

[56] TAG Unit A4.1, page 18, paragraph 5.1.1 (November 2014)

2.4.46. Similarly, in Sion Mills shown in Figure 2-11, there are only three designated pedestrian crossing points, including one Pelican crossing, on the 1.5km route between entry to and egress from the village.

Figure 2-11: Overhead view of Sion Mills, illustrating existing A5 route

2.4.47. Community severance due to the existing A5 has several undesirable impacts:

- non-car modes of travel such as walking and cycling are less attractive
- reduces people's access to local services
- creates a physical separation between and within communities, and between communities and the surrounding countryside

2.4.48. A social and distributional impact analysis of severance along the entire route of the existing A5 was undertaken and is presented in Section 3.8 of the economic case. It demonstrates that the Proposed Scheme will reduce community severance primarily by reducing the volume of traffic flows on the existing A5 at both pedestrian crossings and within a 1km buffer zone of each of the 36 schools near the route. Traffic flows decrease at 46 of 50 crossings, with 32 of these crossings experiencing a flow reduction of 50% or greater. Similarly, average daily traffic flows in 2028 are forecast to decrease by an average of 42% in the vicinity of schools.

IMPACT OF NOT CHANGING

2.4.49. If the Proposed Scheme is not provided, the problems described above are expected to remain or worsen:

- congestion at pinch points is likely to worsen and journey times are expected to become more unreliable
- economic growth could be inhibited
- accidents could increase on key sections of the existing A5
- community severance will remain along the existing A5, particularly for non-motorised users

2.4.50. The reasons for this are set out in detail below.

Congestion At Pinch Points Is Likely To Worsen And Journey Times Are Expected To Become More Unreliable

2.4.51. Without the provision of a new dual carriageway that meets current design and safety standards, congestion at key sections and junctions is expected to worsen.

2.4.52. The existing A5 accommodates high proportions of HGVs which range from 11% to 22% across its overall length. If the existing A5 is not upgraded and the HGV proportions remain relatively similar, journey times would be expected to become even more unreliable due to fact that traffic is expected to increase and the opportunities for cars to overtake HGVs would remain limited.

2.4.53. Traffic forecasts predict an overall increase in traffic demand (trips) up to the scheme design year of 2043. For the AM peak period, traffic demand is predicted to increase by 14% between 2015 and 2028 and by 34% by 2043. As a result, traffic in the A5WTC study area is likely to experience deterioration in travel conditions during peak travel times.

2.4.54. For example, average end-to-end journey times along the existing A5 during the AM peak period is estimated to increase by some 4% from just under 71 minutes to nearly 74 minutes over the next thirteen years and by 9% over the next twenty-eight years from 2015. The start point of journey time is at the junction with A5 Victoria Road / Prehen Road and end point is the junction just beyond the border south of Aughnacloy.

2.4.55. The current road passes through two main urban areas (Strabane and Omagh) and various towns and settlements. As described in Section 2.3, there is a high number of side road junctions and accesses. This leads to conflicts between local and strategic traffic, a situation which is expected to get worse with traffic growth.

2.4.56. A further point of conflict is that between agricultural vehicles and HGVs, and other road users. This is likely to worsen with traffic growth in the absence of the provision of a new dual carriageway to separate different vehicle types and to provide an additional lane for overtaking.

Economic Growth Could Be Inhibited

2.4.57. Without the Proposed Scheme the economic prospects of the western part of Northern Ireland may fail to reach their maximum potential as access to the key urban centres (Londonderry, Strabane, Omagh) and international gateways (Londonderry Port, City of Derry Airport and the Republic of Ireland) becomes increasingly confined.

2.4.58. The region may experience stagnation in inward investment, a lack of regeneration and minimal economic growth. Potential development sites could become less attractive without high quality infrastructure. Local businesses could face increased transport costs and may choose to relocate to places with better transport connections.

2.4.59. The provision of resilient transport infrastructure, which minimises traffic problems, will be a key driver in achieving business growth and supporting economic growth across the region.

2.4.60. The proposed A5WTC is expected to have a significant influence on the region's future economic productivity and growth. A failure to improve this critical link is likely to worsen congestion and lead to reduced network resilience. This would increasingly become a hindrance to business and enterprise, inhibiting growth and regeneration, and making it harder for the region to realise its full economic potential.

2.4.61. The importance of the Londonderry Port and the City of Derry Airport as regional hubs for international trade and passenger activity could potentially come under jeopardy.

Accidents Could Increase on Key Sections of The Existing A5

2.4.62. A design check for the 85 km of existing A5 corridor indicated that approximately 32.3km (38%) does not meet the appropriate design standards for speeds currently in place. This is a safety hazard that could potentially lead to more accidents. If current speed limits had to be lowered, journey times would be further affected. Without the presence of a central reservation and a second lane for overtaking, cars currently attempt to overtake HGVs in less than ideal conditions entering the opposite lane, leading to increased accident risk.

2.4.63. The existing A5 has over 200 side road junctions. Without upgrading to a restricted access dual carriageway these points of conflict with other road users will remain and are likely to increase the potential for accidents to occur, as traffic volumes increase.

2.4.64. Any increase in accidents would also result in direct and indirect economic disbenefits associated with accident and injury damage, lost production potential, and increased congestion and delays (at the time of the accidents), significantly impacting the performance of the existing A5.

2.4.65. Accident data collected for the A5 corridor between 2015 to 2019 inclusive indicates that, over the five-year period there were a total of 408 Personal Injury Accident (PIA) on the existing A5 between New Buildings and Aughnacloy, involving 15 fatalities and 45 serious casualties. The most recent accident data collected over the 12-month period October 2021 to October 2022, although not necessarily representative of the typical journey conditions due to the ongoing COVID-19 disruptions, has recorded ten fatalities along the existing A5 corridor, indicating a rising trend.

2.4.66. Considering only the pre-2020 accident trends, it is forecast that the Proposed Scheme would save around 3793 casualties, including 36 fatalities, over the 60 year appraisal period.

Community Severance Will Remain Along the Existing A5, Particularly for Non-Motorised Users

2.4.67. If the Proposed Scheme is not constructed, the opportunity to improve provisions for non-motorised users (NMU) may not be realised, irrespective of any future budget available for implementing such NMU improvements. The A5 Active and Sustainable Transport Assessment considers potential opportunities for NMUs, as referred to in Section 2.7.

2.4.68. The existing A5 acts as a physical barrier through the settlements it passes, dividing the communities and disrupting local residents' movements and accessibility to services and social networks. It also causes separation between the settlements and the surrounding countryside.

2.4.69. Without the Proposed Scheme in place, increasing traffic and congestion would make conditions worse. Residents would continue to feel less connected to the services and community facilities that their town or village provides, and this would impact on their quality of life. The sense of separation between the two sides of the settlement would become more apparent, with adverse implications for economic growth and community coherence.

2.4.70. As traffic flows increase, the element of severance felt by active mode users along the existing A5 is expected to increase accordingly. Users would be increasingly forced to cross at the few existing designated locations as gaps between traffic become harder to find.

2.5 THE INVESTMENT PROPOSAL

2.5.1. The need and support for the Proposed Scheme is well documented and regularly features in Government transport strategies, programmes and budgets. There is a longstanding aim to provide dual carriageway standard on all the five Key Transport Corridors, which are a component of the Regional Strategic Transport Network (RSTN) in Northern Ireland.

OBJECTIVES

2.5.2. The objectives of the Proposed Scheme have been developed through considering the problems described above, within the study area and on the existing north-south route of the A5. These problems have been considered within the context of strategic transport and economic policy. The Proposed Scheme will improve links between the urban centres in the west of the province and provide a strategic link with international gateways

2.5.3. The **objectives** of the Proposed Scheme are:

- To improve road safety
- To improve the road network in the west of the Province and North/South Links
- To reduce journey travel times along the A5 Western Transport Corridor
- To provide increased overtaking opportunities for motorists along the A5 Western Transport Corridor
- To develop the final proposals in light of safety, economic, environmental, integration and accessibility considerations.

STRATEGIC BENEFITS

2.5.4. Achieving these objectives would contribute to the higher-level objectives of balancing regional infrastructure, improving competitiveness and economic prosperity through improving connectivity and accessibility across the region, and contributing to the achievement of sustainable progress in relation to social, economic and development goals in Northern Ireland. These will be achieved by the following **outputs**:

- the Proposed Scheme - a new dual carriageway meeting the highest standards, which:
  - segregates traffic making strategic journeys from traffic making local journeys
  - provides increased, improved and safer overtaking opportunities for motorists along the A5WTC.

2.5.5. The Proposed Scheme will deliver the following **outcomes**:

- reduced number of accidents
- reduced congestion & delay at pinch points
- improved journey time reliability
- improved connectivity between Londonderry and Aughnacloy
- overtaking opportunities increased
- improved access to Londonderry port, City of Derry Airport & the RoI
- reduced community severance

2.5.6. Proposed Scheme aims to significantly improve safety and journey times, to improve the links between the urban centres in the west of the province and to provide a strategic link with international gateways. At the border with the Republic of Ireland, it will connect with the N2 route.

2.5.7. It is important to consider what constitutes successful delivery of the above five objectives after each Phase and full scheme opening, as this informs the development and appraisal of the scheme and the monitoring and evaluation of the scheme's performance post-construction.

2.5.8. The specific objectives are specific, measurable, achievable, relevant and time-dependent (SMART). The Proposed Scheme success will be measured using the measures described in Table 2-7, as detailed in chapter 6. This shows the proposed success measures and respective SMART target that will be used to evaluate the success of the objectives.

2.5.9. The causal chain diagram in Figure 2-12 (further below) shows how the proposed scheme is expected to deliver the scheme objectives, and indicates how success can be measured, either directly or indirectly.

2.5.10. The measurement of delivery of the scheme and how it has achieved its objectives will be monitored as part of the post-scheme evaluation. A Monitoring and Evaluation Plan sets out how a programme of monitoring will be established from pre-construction, through scheme construction, and post-opening, to analyse and determine whether the scheme has been successfully delivered, as well as whether it has achieved its objectives.

Table 2-7: Scheme success indicators

Objective	Success Measure	Indicative Scheme Target
1. To improve road safety	▪ Measured accident rate comparisons before and after scheme opening	▪ A minimum of 5% reduction in accidents three years post-full scheme opening
2. To improve the road network in the west of the province and north / south Links	▪ Measured traffic flow volumes before and after scheme opening	▪ 85% traffic overall two-way reduction on existing A5 between J1-J2 equivalent ▪ 55% traffic overall two-way reduction on existing A5 between J6-J8 equivalent ▪ 80% traffic overall two-way reduction on A5 between J9-J10 equivalent ▪ 70% traffic overall two-way reduction on existing A5 between J13-J14 equivalent ▪ 40% traffic overall two-way reduction on existing A5 between J15-J16 equivalent
3. To reduce journey travel times along the A5WTC	▪ Measured journey time comparisons before and after scheme opening ▪ Physical provision of the dual carriageway standard road and provision of overtaking opportunities	▪ 30% reduction in peak hour journey times compared to the situation without the scheme
4. Provide increased overtaking opportunities for motorists along the A5 corridor		
5. To develop proposals in light of the safety, economic, environmental, integration and accessibility considerations	▪ Monitor the various environmental measures during and post construction ▪ The final constructed scheme meets current design and construction standards ▪ Achieve positive return on financial investment aligning to project programme	▪ Monitoring of the Contractors to check measures are implemented ▪ Carry out post construction surveys to assess effectiveness of the environmental measures – including occupancy of new badger setts, otter holts, bat boxes and records of any road kill ▪ All design approvals signed off and the Health and Safety File completed in full by the end of the Defects Period ▪ Control of construction budget and compensation events to avoid unnecessary additional costs

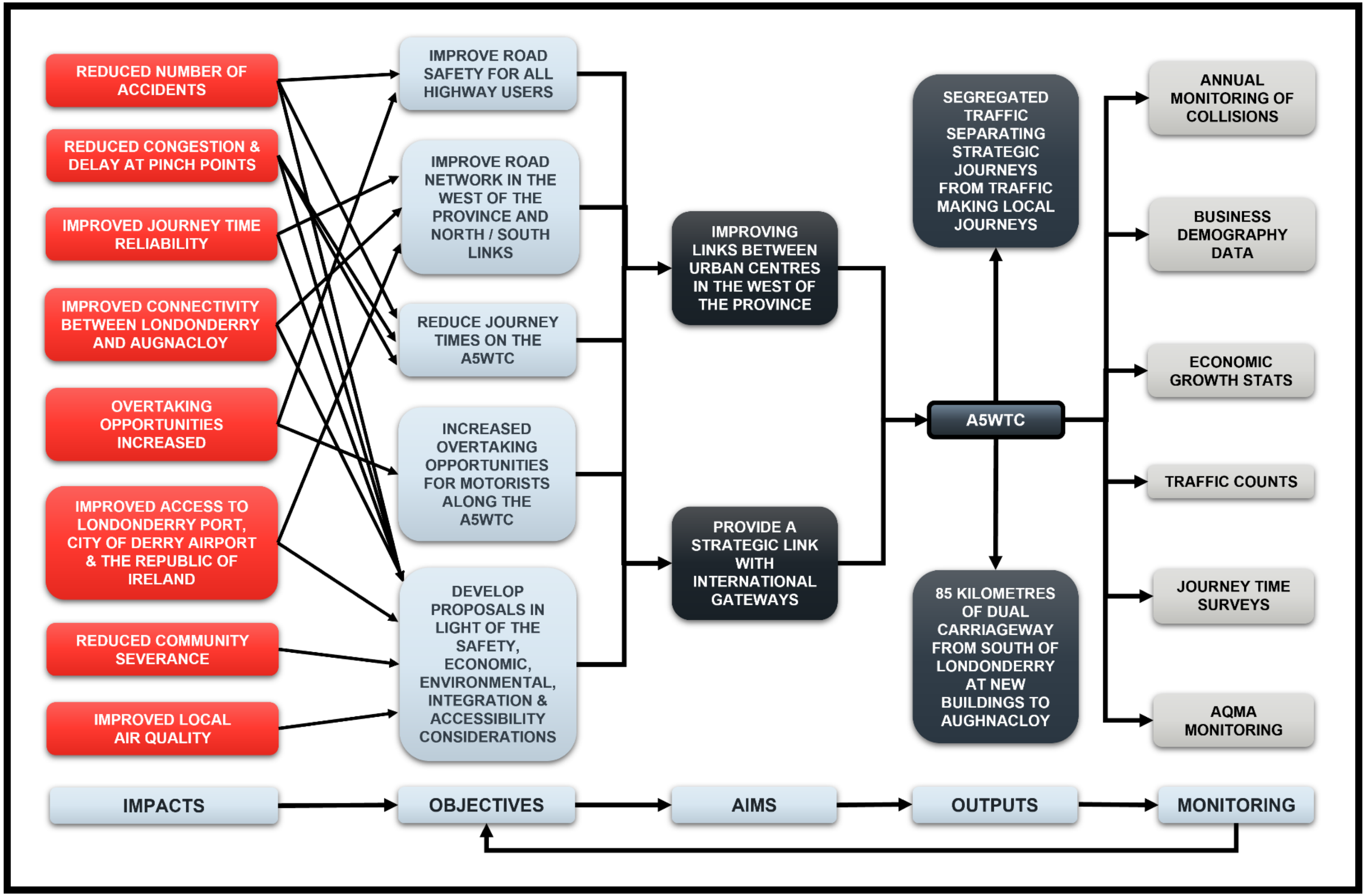

Figure 2-12: Causal chain diagram

2.6 KEY STAKEHOLDER VIEWS AND REQUIREMENTS

2.6.1. There has been an extensive process of consultation with all those affected by the Proposed Scheme since its inception in 2008. Consultation has taken a number of forms, including:

- Public Inquiries in 2011, 2016 and 2020
- public exhibitions at key design stages
- stakeholder meetings with statutory authorities and organisations
- updates to directly affected landowners through meetings and by letter at key stages in the development of the scheme

2.6.2. Formal consultation has been undertaken with over 30 statutory authorities and organisations as part of various studies and assessments. Consultation has been undertaken during the preparation of the orders and environmental statement for the Proposed Scheme.

2.6.3. In addition, the Proposed Scheme has a dedicated project website – www.a5wtc.com – and an 0845 telephone contact line. The website has supported the overall consultation strategy for the project, providing an additional means by which statutory, public and private stakeholders have been given access to scheme updates and announcements. Furthermore, the 2020 Public Inquiry is scheduled to be reconvened in May 2023.

2.6.4. The key stakeholders involved in the development and delivery of the Proposed Scheme are summarised in Table 2-8 below. Further details of stakeholder engagement, as well as stakeholder management, are described in the management case.

Table 2-8: List of stakeholders

Organisation, Business or Department	Division (if applicable)
Atlas Communications	
Council for Nature Conservation and the Countryside (CNCC)	
Department for Communities	Historic Environment Division, Heritage Development & Change Branch
	Historic Environment Division, State Care Heritage
	Historic Environment Division, Heritage Advice and Regulation Branch
	Housing & Urban Regeneration
	The Historic Buildings Council
	The Historic Monuments Council
	Historic Environment Division, Heritage Development & Change Branch
Department For Infrastructure	Strategic Planning Division
	Planning Division
	Rivers
Department for the Economy	Geological Survey of Northern Ireland
	Property Solutions Unit
	Environment, Marine and Fisheries

Department of Agriculture, Environment and Rural Affairs	Land and Resource Management Unit
	Countryside Management Unit
	Planning Response Team
	Marine and Fisheries - Inland Fisheries
	Loughs Agency Headquarters
	Marine and Fisheries Division
	Natural Environment Division - Countryside, Coast & Landscape
	Water Management Unit
	Natural Environment Division
Department of Culture, Heritage and the Gaeltacht	Development Applications Unit
Government of Ireland	Department of Housing, Local Government and Heritage
	EU & International Planning Regulation
Derry City & Strabane District Council	
Donegal County Council	
Education Authority	
Eircom UK	
Everything Everywhere Limited (EEL)	
Fermanagh & Omagh District Council	
Firmus Energy	
Freight Transport Association	
Invest NI	
Logistics UK	
Mid Ulster District Council	
Ministry of Defence (MoD)	Defence Infrastructure Organisation
Monaghan County Council Roads Office	
Mutual Energy	
NIE Networks Limited	
Northern Ireland Ambulance Service	Ambulance Headquarters
Northern Ireland Badger Group	
Northern Ireland Housing Executive	
Northern Ireland Water	
Openreach Northern Ireland	
Phoenix Natural Gas Limited	
Road Haulage Association Limited	Scotland and Northern Ireland
Royal Society for the Protection of Birds (RSPB)	
SGN NI	

Sustrans Limited	
The National Trust	
The Northern Ireland Bat Group	
The Northern Ireland Road Safety Partnership	Police Service of Northern Ireland (PSNI)
The Woodland Trust Northern Ireland	
Translink	Infrastructure and Property Division
Ulster Farmers Union	
Ulster Wildlife Trust	
Virgin Media	
Vodafone Limited	
Vodafone	

2.7 OPTIONS

2.7.1. A three-stage assessment has been used to identify the Proposed Scheme, in accordance with the Department guidelines[57]. The purpose of the three stage approach is to review the options at increasing levels of detail. At all three stages the scheme has been assessed against a set of predefined key criteria, with the three stages set out below:

STAGE 1 – SELECTION OF PREFERRED CORRIDOR (SPRING 2008 TO NOVEMBER 2008)[58]

2.7.2. The aim at Stage 1 was to identify a broadly defined improvement corridor and the major factors that may influence the later route selection process. Such factors included the existing geography across the study area, the presence of Planning Policy Areas, and areas of special ecological or historical significance.

2.7.3. The key criteria assessed at Stage 1 included Environment, Engineering, Economics and Traffic. In November 2008, at the end of Stage 1 a broad corridor was announced by the Minister and the Preferred Corridor was proposed for further examination at Stage 2. A total of eleven alternative alignments were then brought forward for consideration.

STAGE 2 – DEVELOPMENT OF ROUTE OPTIONS (NOVEMBER 2008 TO SUMMER 2009)[59]

2.7.4. Stage 2 took a more detailed look at the existing conditions within the Preferred Corridor. Routes were examined in detail to allow the anticipated effects of Route Options to be assessed against each other under the set of key criteria.

[57] RSPPG E030: Major Works Schemes: Inception to Construction (2013)

[58] Stage 1 Scheme Assessment Report – Preliminary Options Report, Document Reference: 796036/0000/R/006 (2008)

[59] Stage 2 Scheme Assessment Report – Preferred Options Report, Document Reference: 7960/0000/R/011 (2009)

2.7.5. Identification of the preferred route involved examination of the preferred corridor in more detail and comparison of route options within three sections of the corridor between New Buildings, Strabane, Omagh and Aughnacloy.

2.7.6. Evaluation of the options was based on engineering and environmental constraints. This led to the identification of four route options for each of the three sections. The preferred route was then selected having regard for the key criteria of safety, economics, environment, integration and accessibility.

2.7.7. Between New Buildings and Strabane the principal considerations leading to the preferred route in this section were the avoidance of potential impacts on settlements and areas of high ground to the east, sensitive areas to the west of Bready and McKean's Moss ASSI and providing better connectivity to Strabane and the Republic of Ireland.

2.7.8. Between Strabane and Omagh the principal considerations leading to the preferred route were the location of the Sperrins Area of Outstanding Natural Beauty (AONB), the presence of sites of cultural heritage value including a Franciscan Friary and Graveyard and Harry Avery's Castle, Grange Wood ASSI, the River Foyle and Tributaries Special Area of Conservation (SAC) and ASSI and Owenkillew River SAC and ASSI, Tully Bog SAC and ASSI and potential community severance at Mountjoy.

2.7.9. Between Omagh and Aughnacloy the principal considerations leading to the preferred route were connectivity to Omagh, the A4 and the A28, strategic connectivity to Fintona and Beragh, avoidance of large areas of peat and avoidance of The Thistle (a Registered Park, Garden and Demesne).

2.7.10. Refinement of the preferred route and identification of the alignment adopted for the Proposed Scheme involved consideration of a number of alternatives taking on board more detailed information. This included environmental survey data, ground investigation data, drainage surveys and flood modelling as well as feedback from landowners and the general public.

2.7.11. In July 2009, at the end of Stage 2, the Minister announced the Preferred Route.

2010 STAGE 3 – ASSESSMENT OF THE PROPOSED SCHEME (SUMMER 2009 TO AUTUMN 2010)

2.7.12. During the Stage 3 process, the Preferred Route was developed in more detail to allow the detailed assessment of the Proposed Scheme and its effects on the environment.

2.7.13. This included mitigation works to reduce the various impacts and determine the overall land take required for the project. This work led to the development of the Proposed Scheme 2010 and preparation of the draft Orders 2010 and Environmental Statement 2010.

2016 STAGE 3 – RE-ASSESSMENT OF THE PROPOSED SCHEME (SUMMER 2013 TO WINTER 2015)[60]

2.7.14. Further to the High Court judgement in 2013, the Stage 3 process for the Proposed Scheme was updated using new traffic and environmental survey data and accounted for current engineering and environmental standards and agreed commitments from the 2011 Public Inquiries.

[60] Stage 3 Scheme Assessment Report – Part 2, Document Reference: 718736-0000-R-010 REV 2

2.7.15. The scheme development also took account of the Inspector's recommendation from the 2011 Public Inquiry not to proceed with the statutory procedures for the section of the scheme south of the A4 at Ballygawley, though it has been necessary to prepare the Environmental Statement for the whole scheme as far as the border with the Republic at Moy Bridge.

2.7.16. This work has, therefore, led to the development of the Proposed Scheme 2016 and preparation of the following draft Orders 2016 and Environmental Statement 2016:

- Draft Trunk Road T3 (Western Transport Corridor) Order (Northern Ireland) 2016 – Junction 1 (New Buildings) to Junction 15 (Ballygawley)
- Draft Private Accesses on the A5 Western Transport Corridor (Stopping-Up) Order (Northern Ireland) 2016
- Notices of Intention to Make a Vesting Order Phase 1A – Junction 1 (New Buildings) to Junction 3 (north of Strabane)
- Notices of Intention to Make a Vesting Order Phase 1B – Junction 13 (south of Omagh) to Junction 15 (Ballygawley)
- Notices of Intention to Make a Vesting Order Phase 2 – Junction 3 (north of Strabane) to Junction 13 (south of Omagh)
- Environmental Statement 2016 – Junction 1 (New Buildings) to tie in to existing A5 south of Aughnacloy

2.7.17. These were published in February 2016. A Public Inquiry administered by the PAC was held between October and December 2016.

POST-PUBLIC INQUIRY 2020

2.7.18. At the Public Inquiry in 2020 further representations were made in relation to alternatives to the Proposed Scheme; this was referenced in the Interim PAC Report[61]. The report included a recommendation under paragraph 4.293 for the Department to: "*make an assessment of the suitability, environment effects and human rights implications of options comprising town bypasses and selected improvements to the existing A5 to WS2+1 standard*". In response to the PAC Report an alternative scheme review, as reported in the A5WTC Scheme Alternatives Study[62], has been undertaken which has considered the feasibility of two specific alternatives to the Proposed Scheme:

- Alternative 1 – Town Bypasses and Selected Improvements ('Alternative 1'); and
- Alternative 2 – Blended Hybrid ('Alternative 2').

2.7.19. The alternatives have been reviewed to understand where they meet or fail to meet the objectives of the proposed A5WTC. The review has taken cognisance of existing conditions, engineering considerations and assessment of associated impact, estimated cost and land take, and environmental constraints and opportunities. Whilst the alternative schemes could be feasible to construct and would bring some benefits and improvements to the strategic road network, they were found to only partly meet the scheme objectives previously outlined for the Proposed Scheme, which have been used as a benchmark for this study.

[61] https://www.a5wtc.com/Publication-of-the-PAC-Interim-Report-and-the-Interim-Departmental-Statement
[62] https://www.a5wtc.com/Documents/12201/Download

A5WTC MASTERPLAN FOR ACTIVE AND SUSTAINABLE TRANSPORT ASSESSMENT (ASTA)

2.7.20. Though not included within the scope of the Proposed Scheme, following the completion of the A5WTC, the existing A5 will be de-trunked and categorised as a B class road, meaning it will no longer be a KTC.

2.7.21. In response to the publishing of Draft Orders in February 2016, representations were made to the Department for Infrastructure Roads indicating that "*opportunities for the implementation of active and sustainable transport initiatives on and in the vicinity of the existing A5 had not been fully explored*". Subsequently the Department committed to the development of a strategic Masterplan that would seek to identify these opportunities between New Buildings and Aughnacloy and this was published in 2017[63]. The ASTA is currently in the process of being updated and is expected to be published later in 2023.

2.7.22. The 2017 ASTA Masterplan reviewed the existing A5, as well as adjacent roads and NMU networks in order to identify opportunities for active and sustainable transport infrastructure, such as:

- cycling routes that could be developed as a result of changes in traffic patterns along the existing A5
- potential new links between walking, cycling and public transport, considering park and ride sites in particular
- potential opportunities for urban cycling networks in populated areas
- improved facilities for equestrians
- an examination of potential opportunities deriving from the strategic plan for greenways
- potential for new links between communities, and safer routes to the schools initiatives

2.7.23. The 2017 ASTA Masterplan concluded that once traffic has been re-routed from the existing A5 to the A5WTC, the department will consider reviewing the speed limit along sections of the existing A5, to allow for increased public access and facilities for pedestrians and cyclists. The potential economic disbenefits of any speed reductions along the sections of the existing A5 is expected to be minimum, as the proposed A5WTC would segregate strategic and local traffic and would lead to a considerably lower level of traffic on the existing A5. Furthermore, any marginal travel time increase to the traffic using the existing A5 would be offset by the significant social and environmental benefits provided by the improvements to active mode and sustainable travel facilities. This proposal will also provide an opportunity to facilitate a more 'liveable neighbourhood', thus further contributing to the additional benefits brought to the corridor following the completion of the Proposed Scheme.

2.7.24. As the de-trunking of the existing A5 and subsequent active travel offering are not part of the Proposed Scheme, the benefits of these potential measures have not been taken into account and therefore have no impact on the assumptions made in the Economic Case. However, as these works are dependent on the A5WTC being completed, it does mean that the Proposed Scheme will enable these benefits to be realised in the future.

2.7.25. The existing A5 caters for local as well as strategic traffic. The high traffic volumes act as a deterrent for short-distance local traffic to move to more sustainable modes. A5WTC would remove the strategic traffic away from the existing A5, making the existing A5 route a safer and a more pleasant

[63] https://www.a5wtc.com/A5ASTA-Master-Plan

environment that may be more conducive to encourage modal shift in the local traffic away from motorised modes.

2.7.26. The Department is supportive of delivering the opportunities identified in the strategic Masterplan.

2.8 CONSTRAINTS

2.8.1. It is important to recognise the constraints which could affect the delivery of the Proposed Scheme. This section summarises these constraints, which in some circumstances could constrain the capacity to deliver the Proposed Scheme, or which could alter either the timescale or the range of route options available. Identification of the constraints and possible measures to address the constraints have been discussed in supporting documents[64] produced as part of the Proposed Scheme package. The following types of constraint were considered in this chapter:

- physical constraints
- environmental constraints
- other constraints

PHYSICAL CONSTRAINTS

2.8.2. There are physical constraints that could impact the Proposed Scheme. These are identified as follows:

Existing Watercourses and Flood Risk

2.8.3. There are a number of watercourses crossed by or flowing adjacent to the Proposed Scheme, and sections of the existing A5 have been disposed to historical flooding. A Flood Risk Assessment (FRA) has been prepared and provided as an appendix to the Environmental Statement Addendum 2022.

Ground Investigation

2.8.4. An extensive Ground Investigation was carried out along the Preferred Route to aid the geotechnical design of the Proposed Scheme.

2.8.5. As the information was fed into the design process the extents of certain geotechnical constraints were established. This led to the need to consider avoidance, where possible, of areas of poorer ground to alleviate the need for complex and expensive engineering solutions.

2.8.6. Geotechnical constraints requiring consideration include high mountains and steep sided river valleys, rock ridges, drumlins, potential contaminated land sites, raised peat bogs and floodplains with alluvial and peat deposits.

Land

2.8.7. Approximately 1,200 hectares of land will be required for the construction of the Proposed Scheme.

2.8.8. No work will be allowed outside of the Vesting Order (VO) boundary other than where the contractor has sought and received approval from the Department, the landowner and other relevant statutory bodies.

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[64] https://www.a5wtc.com/CoreDocuments

2.8.9. Construction of the Proposed Scheme will result in a number of buildings being demolished as the land on which they are situated will be required for construction of the scheme (Table 2-9).

Table 2-9: Buildings which require demolition

Type	Number
Residential	7
Flats (Castletown House)	1 (5 flats)
Grand Total	8

ENVIRONMENTAL CONSTRAINTS

2.8.10. Key environmental constraints within the vicinity of the Proposed Scheme have been identified as described below.

Ecology and Nature Conservation

2.8.11. A number of designated sites, including Areas of Special Scientific Interest (ASSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites, have been identified within the environmental study area incorporating the Proposed Scheme. These are noted in Table 2-10.

Table 2-10: Designated sites in the environmental study area

Type of Protected Area	Designated Sites
Area of Special Scientific Interest	▪ The River Foyle & Tributaries ASSI ▪ McKean's Moss ASSI ▪ McKean's Moss Part II ASSI ▪ Grange Wood ASSI ▪ Owenkillew River ASSI ▪ Tully Bog ASSI ▪ Strabane Glen ASSI ▪ Baronscourt ASSI ▪ Lough Neagh ASSI* ▪ Lough Beg ASSI*
Special Area of Conservation	▪ The River Foyle & Tributaries SAC ▪ The River Finn SAC ▪ Owenkillew SAC ▪ Tully Bog SAC
Special Protection Area	▪ Lough Foyle SPA ▪ Lough Swilly SPA ▪ Lough Neagh & Lough Beg SPA
Ramsar Site	▪ Lough Foyle Ramsar site ▪ Lough Neagh & Lough Beg Ramsar site

*Included as this ASSI is a component ASSI of Lough Neagh & Lough Beg SPA

2.8.12. The Department initiated an appropriate assessment process in order to identify and mitigate the potential impacts that the Proposed Scheme could have on the relevant designated sites and to ensure that the requirements of Conservation (Natural Habitats, etc.) Regulations (Northern Ireland)

1995 (as amended) are met. These assessments are covered in the following reports which were published in 2022[65]:

- Report of Information to Inform an Appropriate Assessment: SAC Watercourses, covering:
    - River Foyle & Tributaries Special Area of Conservation
    - Owenkillew River Special Area of Conservation
    - River Finn Special Area of Conservation
- Report of Information to Inform Appropriate Assessment: Tully Bog SAC, covering:
    - Tully Bog Special Area of Conservation
- Report of Information to Inform Appropriate Assessment: SPAs, covering:
    - Lough Foyle Special Protection Area (NI & ROI)
    - Lough Swilly Special Protection Area
    - Lough Neagh & Lough Beg Special Protection Area
- Report of Information to Inform Appropriate Assessment: Ramsar Sites, covering:
    - Lough Foyle Ramsar Site
    - Lough Neagh & Lough Beg Ramsar Site

Cultural Heritage

2.8.13. A number of sites, buildings and features of cultural heritage interest exist along the route of the Proposed Scheme including Harry Avery's Castle and Errigal Keerogue Graveyard.

2.8.14. 289 heritage assets have been identified in the study area surrounding the Proposed Scheme. These include former railway and industrial infrastructure, mills and bridges, historic and listed buildings.

Landscape and Visual

Landscape Character

2.8.15. Between New Buildings and Strabane the Proposed Scheme would be located within the wide valley of the River Foyle. The valley floor is framed by the prominent profile of the Sperrin Mountains to the east. The Burn Dennet and Glenmornan River flow east to west through foothills which form the transition from the mountains to the valley floor.

2.8.16. The Proposed Scheme between Strabane and Omagh would initially be located within the moderately incised valley of the Mourne River. It would then enter the more deeply incised valley of the Strule River south of Newtownstewart before emerging to cross the broad floodplain of the Fairy Water and an area of elevated drumlins west and south-west of Omagh. The main watercourses are the Mourne River, Strule River, River Derg, Owenkillew River and Fairy Water.

2.8.17. South of Omagh the Proposed Scheme continues through a drumlin-defined landscape. There is then a marked change in landscape character as the rolling dip slope of the Brougher ridgeline is encountered. The corridor rises onto and crosses the Brougher Ridge west of Tycanny Hill and then descends towards the Clogher Valley. The crossing of the A4 marks a transition as the influence of

[65] Habitats Regulations Assessments, Available at: https://www.a5wtc.com/Environmental-Consultation-2022

the Brougher Ridge is left behind and the rounded, wooded hills of Favour Royal Forest emerge. The main watercourses are the Drumragh River, Routing Burn, Ballygawley Water and River Blackwater.

Visual Effects

2.8.18. A number of visual receptors exist within the study area. The majority of these are residential receptors, either isolated properties or clusters of properties along the route of the Proposed Scheme.

2.8.19. There are also a number of recreational routes such as Public Rights of Way (PRoW) and National Cycle Network Routes (NCNR) within the study area including Greenbrae PRoW and the Mid Ulster Cycle Route; contiguous with NCNR 95.

Noise

2.8.20. Baseline noise surveys at specific locations along the route of the Proposed Scheme indicate that road traffic noise is the predominant noise source across the noise study area. Concentrations of noise sensitive receptors are located within the main settlements along the existing A5 and along the route of the Proposed Scheme. Outside of the main settlements, receptors are distributed throughout the countryside in smaller settlements or as isolated properties.

Greenhouse Gases

2.8.21. Greenhouse gases (GHG) occur constantly and widely as a result of human and natural activity including energy consumption (fuel, power), industrial processes, land use and land use change. For the Proposed Scheme GHG emissions are generated by vehicles and by operational energy use on the road network.

Air Quality

2.8.22. The Proposed Scheme traverses three district council areas; Fermanagh and Omagh District Council (FOC), Mid Ulster District Council (MUC) and Derry and Strabane District Council (DSC). There are no Air Quality Management Areas (AQMAs) located within the Proposed Scheme air quality study area.

2.8.23. Background pollutant concentrations are available from national maps provided on the Department of Environment, Food and Rural Affairs (Defra), and the data accounts for pollutant emissions from multiple sectors including the road sector, domestic heating, industrial sources, railways and rural emissions. For the area along the route of the Proposed Scheme, the Defra background concentrations are mapped to be demonstrably below the respective air quality objectives in each year, with a predicted decrease in levels of each pollutant between 2019 and 2028. These improvements would be predominantly related to the expected reduction in vehicle emissions as older, more polluting vehicles are replaced by cleaner vehicles.

Water Environment

2.8.24. The route of the Proposed Scheme is located within the catchments and subcatchments of the River Foyle and River Blackwater. The River Foyle catchment comprises several major tributaries including the Burn Dennet, Glenmoran, Finn, Mourne, Strule, Owenkillew, Derg, Fairy Water, Camowen and Drumragh rivers.

2.8.25. Many of the watercourse catchments crossed by the route of the Proposed Scheme have existing flood risk concerns, including the Mourne River, River Strule, Derg River, Camowen River, Eskragh

Water, Routing Burn and River Blackwater systems. However, the most extensive of the existing floodplains are those associated with sections of the River Foyle, Fairy Water and Ballygawley Water.

OTHER CONSTRAINTS

Existing Structures Conditions

2.8.26. There are 33 significant structures which could be affected by the proposed scheme, as shown in Table 2-11. The majority of the bridges carry the existing A5 over watercourses.

Table 2-11: Bridges by function

Function	Number
New Buildings to Strabane	
Footbridge Over Road	-
Road Over Accommodation	1
Road Over Pedestrian Subway	-
Road Over Road	1
Road Over Watercourse	6
Total	8
Strabane to Omagh	
Footbridge Over Road	-
Road Over Accommodation	-
Road Over Pedestrian Subway	1
Road Over Road	1
Road Over Watercourse	12
Total	14
Omagh to Aughnacloy	
Over Road	-
Road Over Accommodation	-
Road Over Pedestrian Subway	-
Road Over Road	-
Road Over Watercourse	11
Total	11
Grand Total	33

Raw Materials Supply from Natural Sources

2.8.27. The assessment conducted as part of the ESA 2022 focussed on likely significant effects from the consumption of material assets, and the generation and disposal of waste, as required by the delivery of the Proposed Scheme. To respond to potential for adverse impacts and significant effects, the Proposed Scheme has adopted a range of good practice measures and mitigations, including but not limited to:

- Deploying methods to recover / recycle more than 90% (by weight) of non-hazardous construction and demolition waste, to substitute the consumption of primary materials;
- Using 57% reused or recycled aggregates (2,895,500t reused of recycled aggregate from a total of 5,140,000t); and
- Plans to develop a detailed Peat Management Strategy.

2.8.28. Taking into account the good practice and mitigation measures set out, the assessment has concluded that the overall significance of effect for material assets, and for waste, is slight adverse in both cases. In accordance with the criteria and thresholds set out in the DMRB, the effects for both material assets, and waste, are therefore assessed to be not significant.

Outdoor Recreation

2.8.29. The assessment conducted as part of the ESA 2022 focussed on likely significant effects on journeys undertaken by pedestrians, cyclists and equestrians and users of local roads either for recreation or to access facilities used by communities relative to the existing A5 and the Proposed Scheme.

2.8.30. Access along the Ulster Way, Bessy Bell East and International Appalachian Trail at Beltany; existing long-distance cycle routes; and public rights of way (PRoW) would be maintained via bridges either beneath or over the proposed dual carriageway. There would also be no discernible impact on users of existing Scenic Driving Routes.

2.8.31. Whilst the design allows for continued access along local roads which would be crossed by the Proposed Scheme the assessment identified 10 locations where alternative routes would increase journey length and driving time. The increased journey length would range from 30m to 2.1km.

2.8.32. It was concluded that none of the impacts associated with the Ulster Way, Bessy Bell East, International Appalachian Trail, long-distance cycle routes, PRoW, Scenic Driving Routes and local roads would constitute a significant effect on the environment.

2.9 STRATEGIC CASE SUMMARY

2.9.1. The inadequacy of the existing A5 is widely recognised by the NI Executive and its associated policy documents as a barrier to economic growth. Local people and the business community view journey times as unreliable, due to congestion caused by bottlenecks at junctions in key towns. As well as a lack of overtaking opportunities, there is also slow-moving traffic along the route.

2.9.2. The specific problems identified are:

- congestion pinch points and poor journey time reliability
- accessibility to key economic centres and international gateways
- accident hotspots
- community severance

2.9.3. If the Proposed Scheme is not provided, these problems are expected to remain or worsen:

- congestion at pinch points is likely to worsen and journey times are expected to become more unreliable
- economic growth could be inhibited

- accidents could increase on key sections of the existing A5
- community severance will remain along the existing A5, particularly for non-motorised users

2.9.4. The provision of a new dual carriageway to replace the existing A5 would support the economic vitality of Northern Ireland, including the key centres and communities along the route: Londonderry, Strabane, Omagh, Ballygawley and Aughnacloy. It would also contribute towards balancing regional infrastructure, both within Northern Ireland and within the UK, and encourage competitiveness and economic prosperity through improving connectivity and accessibility across the region.

2.9.5. The Proposed Scheme would achieve this by facilitating the movement of people and goods along a modern, high-quality corridor and will improve access to:

- international gateways in the north (such as Londonderry Port) and the Republic of Ireland in the south and the north-west
- market towns and tourist areas

2.9.6. Consequently, the Proposed Scheme would assist with the delivery of economic and growth objectives for Northern Ireland. The Proposed Scheme is a key element of the Northern Ireland Executive's strategy to ensure a sustainable transport future. It would enable the A5 route to operate more efficiently by increasing capacity, reducing congestion and improving journey time reliability.

2.9.7. The Proposed Scheme would potentially also attract inward investment to the districts of Derry and Strabane, Fermanagh and Omagh and Mid Ulster, making them better places in which to live, work and visit.

2.9.8. On publishing the 2022 ESA, the then Minister, Nichola Mallon, stated[66] "The A5 is an absolute priority for me as a strategic road. It will critically improve road safety, tackle regional imbalance, contribute to economic growth and job opportunities for local communities, and improve connectivity on this island. I know this project has been long awaited and I have been determined as Minister to see it progress through the statutory processes as quickly as possible, ensuring the project is delivered."

2.9.9. Since his appointment in May 2022, Minister John O'Dowd has said[67] ""I am determined to do all that I can to progress this significant flagship project. This road must be upgraded, first and foremost to improve road safety but also as a strategically important route that will contribute to economic growth and improve connectivity across the island. It is vitally important that the A5 project moves forward without further delay."

[66] https://www.infrastructure-ni.gov.uk/news/publication-new-environmental-statement-addendum-a5-dual-carriageway-scheme
[67] https://www.infrastructure-ni.gov.uk/news/odowd-commits-progressing-a5

3 THE ECONOMIC CASE

3.1 INTRODUCTION

3.1.1. The Economic Case assesses the impacts of the Proposed Scheme to determine its overall Value for Money (VfM). It takes account of the costs of developing, building and maintaining the scheme, and the benefits arising from the scheme. These include benefits that can be monetised, as well as quantitative and qualitative impacts that cannot be monetised.

3.1.2. The economic case compares the assessed benefits against costs over the whole life of the scheme, 60 years after opening, to determine Value for Money (VfM) which is expressed as a **B**enefit to **C**ost **R**atio (BCR).

3.1.3. This Chapter details the economic assessment carried out for the Proposed Scheme and includes:

- the methodology and assumptions adopted to derive economic benefits to transport users
- details of the costs and economic benefits of the Scheme and its VfM including the BCR
- the economic impacts of the Proposed Scheme which affect the wider economy and additional to the economic benefits to transport users
- summary of the Social and Distributional Impacts of the Scheme
- the environmental impacts, both monetised and non-monetised
- sensitivity testing to assess the range of benefits around the 'core scenario'
- an Appraisal Summary Table (AST)

3.1.4. The Proposed Scheme is now expected to be delivered in distinct Sections, comprised of different phases as detailed in paragraph 1.2.47. As the scheme moves forward, a Full Business Case (FBC) will be prepared for each individual Section, which will review the continued accuracy of assumptions made within this OBC with a view to ensuring the robustness of the appraisal for the Section being assessed and for the whole scheme.

3.1.5. The assessment for the full scheme is detailed in Sections 3.3 to 3.12. The assessment of the individual phases of the scheme is detailed in Section 3.13.

3.2 GUIDELINES AND STANDARDS

3.2.1. The economic appraisal was prepared in accordance with the Green Book – Appraisal and Evaluation in Central Government ("the Green Book") (HM Treasury, 2003 – updated December 2020).

3.2.2. The detailed methodology for assessing the economic and environmental benefits and their social and Distributional Impacts followed good practice as set out in current Department for Transport TAG (Transport Analysis Guidance) as follows:

- TAG Unit A1 cost-benefit analysis
- TAG Unit A2 economic impacts
- TAG Unit A3 environmental impact appraisal
- TAG Unit A4 social and distributional Impacts

3.2.3. The process for assessing the VfM was based on the DfT 'VfM Framework' and 'VfM Supplementary Guidance on Categories' published in July 2017 and updated in July 2021.

3.3 SCOPE OF THE APPRAISAL

3.3.1. The appraisal of the proposed scheme included monetised benefits as well as impacts that cannot be quantified in monetary values.

3.3.2. The DfT VfM Framework identifies three categories of monetised impacts:

- established: where the method for estimating the impact and the monetary value is tried-and-tested
- evolving: where some evidence exists to support the estimation of a monetary value but is less widely accepted and researched
- indicative: where monetary valuation methods are not considered widely accepted or researched to be definitive, with a high degree of uncertainty in terms of the magnitude of the impact

3.3.3. The economic appraisal encompassed the following 'established' monetised impacts:

- economic benefits to road users, including time savings and vehicle operating costs
- economic benefits to road users resulting from a reduction in delays during periods of maintenance and dis-benefits due to delays during the scheme construction period
- accident savings and associated economic benefits
- monetised benefits/dis-benefits from changes to noise, local air quality and greenhouse gas emissions which could be monetised using established methods

3.3.4. In line with the DfT VfM Framework, these benefits were combined to derive the 'established' monetised impacts. These benefits were compared with costs to produce an initial BCR. The following assessment was carried out to assess the 'evolving' monetised impacts:

- wider economic benefits resulting from the scheme (termed wider benefits).

3.3.5. The inclusion of the 'evolving' impacts formed the basis for deriving the adjusted BCR. In accordance with the DfT VfM Framework this was used as a starting point to determine the VfM Category. No 'indicative' monetised impacts were assessed as part of the appraisal.

3.3.6. In addition, the appraisal included an assessment of the following non-monetised aspects of Proposed Scheme impacts:

- journey time reliability
- noise
- local air quality
- greenhouse gases
- landscape
- historic environment
- biodiversity
- water environment
- social and distributional impacts

3.3.7. An overview of the appraisal process is presented in Figure 3-1 below.

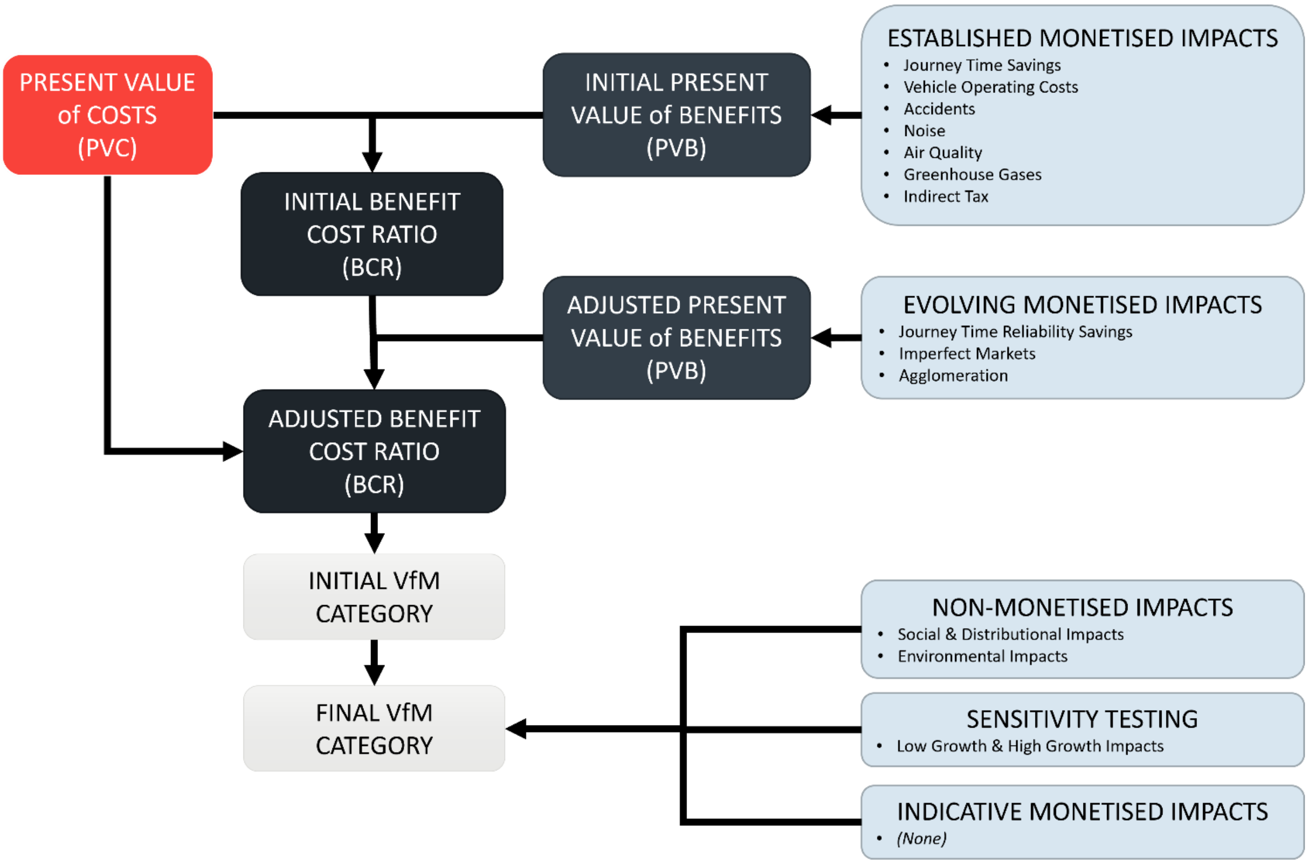

Figure 3-1: Process to derive BCR

3.4 METHODOLOGY AND ASSUMPTIONS

3.4.1. This section describes the processes and sets out the assumptions that underpin both the economic appraisal of the Whole Scheme between New Buildings and Aughnacloy and the appraisal of each of the constituent phases.

MONETISED BENEFITS

3.4.2. The calculation of economic benefits to road users (excluding accident benefits) was undertaken using the DfT's TUBA V.1.9.17 (Transport Users Benefit Appraisal) program, released in December 2021 and using economic inputs as issued in TAG Databook v1.17, (versions applicable at the time of the assessment)

3.4.3. TUBA compares the costs for the 'without scheme scenario' (Do-Minimum) against the cost for the 'with scheme scenario' (Do-Something) to establish the value of the savings in road user travel time and vehicle operating costs.

3.4.4. Benefits arising from changes in accidents with the Scheme were assessed using the DfT's COBALT V2.2 (Cost and Benefit to Accidents – Light Touch) software, released in March 2022.

3.4.5. The assessment of the road user benefits resulting from a reduction in delays during periods of maintenance was carried out using the National Highways program QUADRO version v4R18 released in July 2020. This included the dis-benefits associated with the delays during construction of the scheme.

3.4.6. Monetised benefits / disbenefits were also calculated for greenhouse gases, noise and local air quality. The benefits were calculated in accordance with TAG Unit A3 (Environmental Impact Appraisal) using the forecast flows from the traffic model, to derive the monetised environmental benefits of the scheme over a 60 year appraisal period (2028 – 2087). The Environmental Impacts are described in Section 3.7.

TRAFFIC FORECASTS

3.4.7. The traffic forecasts that underpin the economic assessment were derived from the Traffic Model. The development of the Traffic Model is described in the Local Model Validation Report ref. 718736-2700-R-026 (included in **Appendix B**). The development of future year forecasts is reported in the 'Traffic Forecast Report (OBC2022) ref 718736-2700-R-032 (included in **Appendix C**).

3.4.8. At the start of the OBC preparation, a model verification was undertaken using the 2019 traffic data. The 2019 model verification formed an analytical evidence base to support the model's continuing use to assess the likely impacts of the Proposed Scheme through EAS2022 and OBC2022 preparation. The methodology, outcomes and conclusions of this 2019 model verification work are reported in the Model Verification Note (Ref DM48_A5WTC_Model Verification Note v1.0), included as Appendix to the Traffic Forecast Report (OBC2022).

3.4.9. As part of the ongoing monitoring of model performance, a second model verification was undertaken using September 2022 traffic data. This 2022 model verification also confirmed the model's ongoing validity for the assessment and appraisal of the Proposed Scheme. The methodology, outcomes and conclusions of this 2022 model verification work are reported in the Model Verification Note (Ref DM54_A5WTC_Model Verification Note – September 2022 Traffic Data) (also included in **Appendix D**).

3.4.10. The scheme has a significant impact in terms of its effect on traffic and has been assessed using a highway assignment traffic model developed using SATURN software. The traffic forecasts for the economic appraisal were derived from the updated OBC2022 Traffic Model.

3.4.11. The traffic model consists of three separate sub-models covering three time periods, each of which were validated against a base year of 2015. The sub-models represent an average hour for an average weekday (Monday to Thursday) within the AM peak period (07:30-09:30), PM peak period (16:00-18:00) and inter peak period (09:30-16:00).

3.4.12. The outputs from the traffic model were expanded to cover the entire year in accordance with conventional modelling practice. This is described in paragraph 3.4.26.

3.4.13. The Traffic Model was set up to model highway assignment only, based on 'fixed demand matrix' approach and there is no associated public transport model nor variable demand modelling for the Proposed Scheme.

3.4.14. As part of the earlier stages of scheme assessment, the need for variable demand modelling was assessed and quantified using the guidance published in TAG Unit M2.1, adopting an elastic assignment procedure to assess the change in demand in terms of its sensitivity to a change in travel cost effected by the scheme. This demonstrated that, the likely impacts of the proposed scheme on public transport and wider demand responses would be limited and would fall well within the thresholds set out in TAG Unit M2.1, hence the Traffic Model was set up to model highway assignment only. These results also indicate that, the conditions favourable to induced demand are unlikely to feature on the A5 corridor.

3.4.15. The forecasts of future car traffic growth were based upon TEMPRO-NI, a software system developed to predict future travel (demand) growth in Northern Ireland for the Proposed Scheme.

3.4.16. TEMPRO-NI is consistent with the current version of National Trip End model (NTEM 7.2)/TEMPRO system developed by the DfT for Transport Planning in Great Britain. TEMPRO-NI uses the same software as the Great Britain version with the data tailored specifically to Northern Ireland.

3.4.17. TEMPRO-NI comprises a number of sub-models which build up the predictions of trip totals from a range of demographic data including forecasts of employment, household and population and car ownership.

3.4.18. TEMPRO-NI predicts the total number of trips that are made by each area (Ward / SOA / Zone) in its Base Year (2011) and future years at 5 yearly intervals (2016, 2021, 2026, 2031, 2036, 2041, 2046 & 2051). Hence growth factors can be calculated to represent the growth in traffic between certain years, which can be applied to the matrices of the traffic model.

3.4.19. Forecasts of future growth in LGVs and HGVs were based upon the Road Traffic Forecasts (RTF), published in 2018.

3.4.20. The traffic forecasts were developed for the opening year of each phase of the scheme (2026, 2027 and 2028) and also for a design year of 2043 i.e.,15 years after the opening of Phase 3. The road user benefits were derived from TUBA based on these traffic forecasts by comparing the Do-Minimum and the Do-Something scenarios.

3.4.21. The predicted growth for Cars, LGV's and HGV's from the 2015 base year to the scheme opening and design years is presented in Table 3-1 below.

Table 3-1: Forecast growth rates from 2015 Base Year

Years	Time Period	Cars			Goods Vehicles		Total
		Commute	Business	Other	LGV	HGV	
2015 to 2028	AM	11%	12%	16%	17%	0.4%	13%
	IP	11%	12%	18%	17%	0.7%	15%
	PM	11%	12%	16%	17%	0.4%	14%
2015 to 2043	AM	30%	31%	38%	37%	4.1%	32%
	IP	29%	31%	43%	37%	4.6%	37%
	PM	29%	31%	40%	37%	4.0%	34%

AREA OF ASSESSMENT

3.4.22. The traffic model and TUBA network illustrated in Figure 3-2 below includes the whole of Northern Ireland, the north and northwest of the Republic of Ireland and extends as far south as Dublin. It also shows the location of the existing A5 and the extent of the Proposed Scheme (shaded red) extending from New Buildings, south of Londonderry, to Aughnacloy.

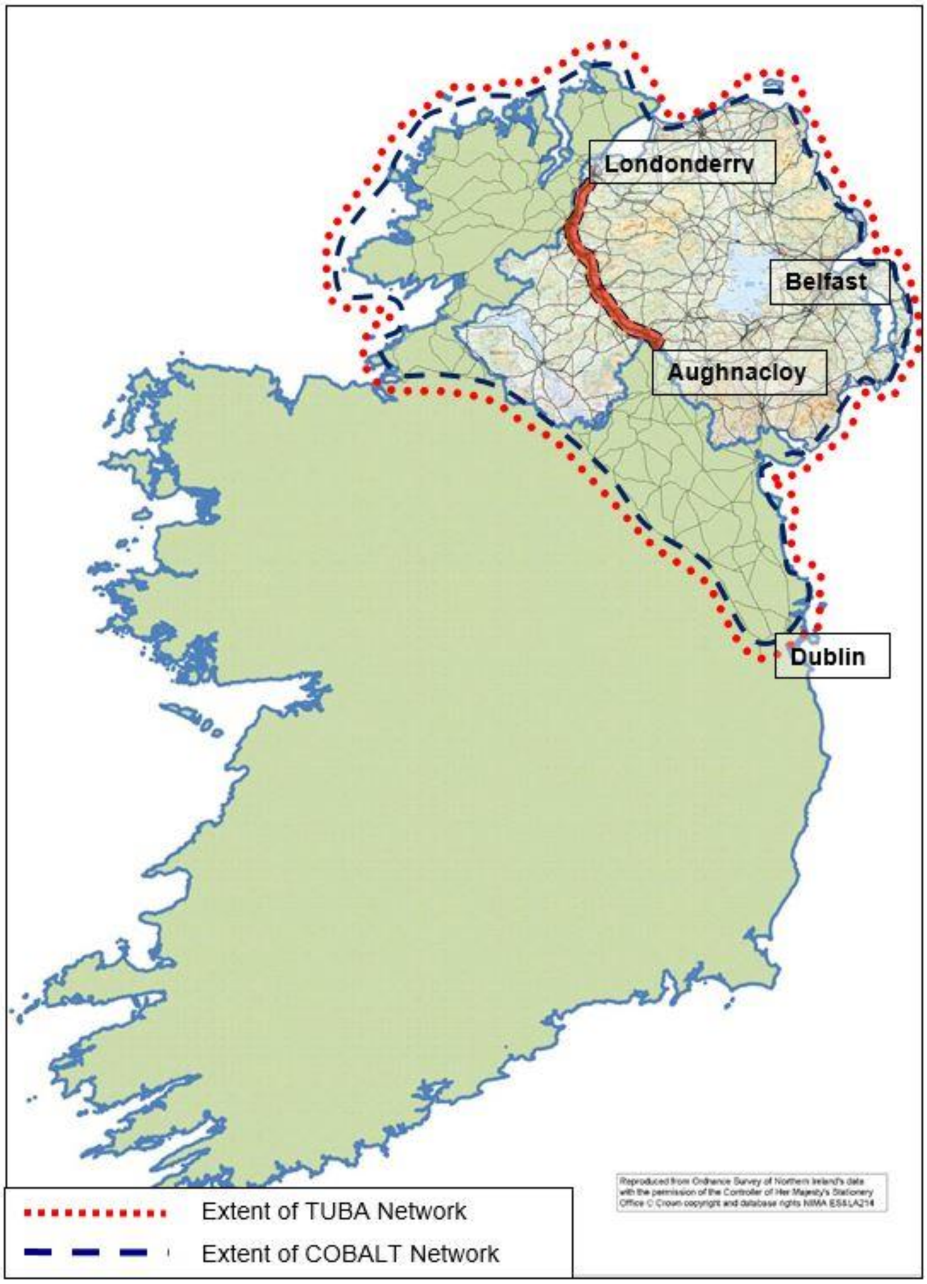

Figure 3-2: Extent of the Traffic Model and Economic Assessment Networks

3.4.23. The TUBA benefits, including the user time and operating costs, were assessed over the whole of the model area. The COBALT accident cost savings were also assessed over the whole model area, using the observed accident data for the existing A5 parallel to the Scheme and national average accident rates by road type for the remainder of the study area.

USER CLASSES

3.4.24. There were 5 user classes in the SATURN traffic model (Car Commute, Car Employers Business, Car Other, Light Goods Vehicle (LGV) and Heavy Goods Vehicle (HGV)). They were converted to 7 user classes as required in TUBA.

3.4.25. The LGV in the traffic model were split into work and non-work according to the proportions set out in TAG Unit A1.3 (User and Provider Impacts). The HGV were split into OGV1 and OGV2 based on the traffic counts. The disaggregation factors are shown in Table 3-2.

Table 3-2: Disaggregation of LGVs and HGVs

Time Period	LGVs		HGVs	
	Non-work	Work (Freight)	OGV1	OGV2
AM	12%	88%	43.64%	56.36%
IP	12%	88%	41.46%	58.54%
PM	12%	88%	43.19%	56.81%

ANNUALISATION FACTORS

3.4.26. Annualisation factors were used to expand the benefits identified for each model time period over a whole year. Annualisation factors for the three modelled time periods were based on values obtained from local traffic survey data.

3.4.27. These factors were derived through analysis of long-term Automatic Traffic Counters (ATC) and Manual Classified Counts (MCC) data. The process for determining the annualisation factors is set out in Table 3-3 below.

3.4.28. The calculation requires two steps:

1. expand and combine the AM, Inter, and PM peak periods to represent an average 12-hour weekday (5-days)
2. expand the Inter peak period to represent the remaining periods, comprising weekday night time, weekends, and Bank holidays

Table 3-3: Annualisation Factors

Calculation Stages		12 Hour Weekday			Weekday Night time / Weekends / Bank holidays			
1	Model Period	AM (0730 - 0930)	IP (1100 - 1500)	PM (1600 - 1800)	IP (1100 - 1500)			IP (1100 - 1500)
2	Expanded Period	AM (0700 - 1000)	IP (1000 - 1600)	PM (1600 - 1900)	Weekday night	Weekends	Bank Holidays	Combined Weekday Night time / Weekends / Bank holidays
3	Number of Days	253	253	253	253	104	8	-
4	Number of Hours per day	3	6	3	12	24	24	-
5	Total Number of Hours	759	1,518	759	3,036	2,496	192	5,724
5	Average Hour Factor	0.89	1.008	0.94	-	-	-	0.406
6	Annualisation Factor by period	**676**	**1,531**	**713**	-	-	-	**2,325**
7	Combined Annualisation Factors	**AM**	**676**					
		IP	**3,856** (1,531 + 2,325)					
		PM	**713**					

3.5 SCHEME COSTS

3.5.1. For the economic appraisal, scheme investment, operating and maintenance costs need to be presented as a 'Present Value of Cost' (PVC) for a standard base year of 2010. The derivation of PVC for the Proposed Scheme was undertaken following guidance in TAG Unit A1.2 (Scheme Costs) and includes the following components:

- Deriving base investment and operating cost estimates
- Account for real cost increase
- Identifying adjustment for risk and optimism bias
- Re-basing the price base to 2010 base year
- Discounting to 2010 base year
- Converting to market prices

BASE INVESTMENT COSTS

3.5.2. The base investment costs for the Proposed Scheme include construction, land, preparation, and supervision costs. The latest Scheme investment cost estimates are estimated at Q2 2022 prices and include all costs associated with scheme preparation and construction which will be incurred subsequent to the economic appraisal of the Proposed Scheme. In line with Guidance set out in TAG Unit A1.2, sunk costs, which represent expenditure incurred prior to the economic appraisal, are excluded. It should also be noted that for the Core estimates (which is provided in this document) the base investment costs include an approximate construction value for the Finn Crossing. This is further explained in paragraph 3.10.8.

3.5.3. Base cost estimates should use realistic assumptions of real cost changes, e.g. cost increase above or below inflation measured by the GDP deflator. For this, the BCIS and GDP deflator data have been used to derive the real cost growths that have been applied to the base costs.

3.5.4. The base investment costs are presented itemised by each cost element in Table 3-5 below.

OPTIMISM BIAS AND RISK

3.5.5. In line with TAG Unit A1.2 (Scheme Costs), for schemes like A5WTC, whose base costs exceed £5M in 2010 prices and values, it is necessary to include a risk allowance and optimism bias on top of the base cost estimates to allow for any uncertainties and risks associated with cost estimates.

3.5.6. Risk allowance is an estimate of potential cost changes that allows for an expected value (defined as the average of all possible outcomes, taking account of different probabilities of those outcomes occurring) of the cost of the scheme to be calculated, i.e. element of risks that can be quantified. The optimism bias, on the other hand, is to demonstrate that appraiser's systematic tendency to overly optimistic about key parameters. It is normally expected that the Optimism Bias uplift would be higher than the quantified risk assessment (QRA) risks as it does account "unknown unknowns" that might not have been captured or quantified in the risk assessments. TAG Unit A1.2 recommends that the Optimism Bias uplift at the FBC stage for a road scheme should be about 20% (Table 8 of the TAG A1.3 guidance) and advises that the Optimism Bias and Quantified Risks are reconciled in order to provide valuable insights and help build an overall picture of scheme costs.

3.5.7. In accordance with Roads Service Policy and Procedure Guide (RSPPG) E058 (Major Works Estimates) an Optimism Bias uplift has been derived in addition to the QRA estimates to allow for "unknown unknowns" elements that might not have been captured or quantified using the QRA approach, and therefore should be added to the scheme cost estimates to provide an overall cost of the scheme.

3.5.8. Optimism bias was calculated using a pre-determined set of criteria established in RSPPG E058. These criteria, and the calculated percentages, are included in **Appendix J** and a summary is presented in Table 3-4. For the Schedule (programme), optimism bias uplift was applied as percentage of time related costs i.e. client and contractor preliminaries.

Table 3-4: Optimism Bias Uplift by Cost Element

Item	Optimism Bias
General	5.3%
Schedule	6.0%
Land	5.3%

3.5.9. An allowance for risk has been determined in the form of a quantified risk assessment (QRA). This is detailed in Section 6.8 in the Management Case. The monetised adjustments for risk and optimism bias are set out as separate cost elements presented in Table 3-5 below.

DISCOUNTING AND ADJUSTMENTS

3.5.10. The PVC included the following adjustment and discount factors:

- an adjustment for inflation using the Retail Price Index from 2022 to 2010
- an adjustment to market prices (gross of indirect tax) in line with TAG Unit A1.1 (Cost and Benefit Analysis), using an indirect tax correction factor to uplift costs to those which are perceived by consumers, rather than the 'factor cost' unit of account (net of indirect tax) which is perceived by government or businesses
- a discount factor based on the HM Treasury "Green Book" to adjust costs occurring in different periods to a standard base year of 2010. An annual discount rate of 3.5% was applied for the first 30 years after opening and 3% for years 31 to 60. This reflects the lower weighting placed on costs (and benefits) incurred at a future date compared to those incurred in the present

3.5.11. The scheme capital investment costs for which approval is sought amounts to **£1,608.62M**. This is based on the outturn cost of the scheme at Q2 2022 prices. For the Economic Case, real cost inflation was added to the Base costs to provide estimates of real cost changes during construction period. The capital costs including real cost inflation, together with Quantified Risks and Optimism Bias, have subsequently been deflated and discounted to 2010 prices and values and finally adjusted for the average taxation to produce the PVC for the purpose of BCR calculation. The capital costs calculated at each step are summarised in Table 3-5 below.

3.5.12. It should be noted that the outturn cost for which approval is sought differs from the **£1,503.62M** used in the economic appraisal (Table 3-5 below). This is due to the fact that, real cost increase has been applied in the Economic Case as opposed to the inflation used in the Financial Case.

Table 3-5: Capital Costs Proposed Scheme (£M)

Cost Element	Scheme Capital Costs (£M)			
	Cost at Q2 2022 Prices	Deflated to 2010 Prices	Discounted to 2010 Values	Market Prices & Values
Construction Contracts and Statutory Undertaker Works	[redacted]	[redacted]	[redacted]	[redacted]
Land and Compensation	[redacted]	[redacted]	[redacted]	[redacted]
Preparation	[redacted]	[redacted]	[redacted]	[redacted]
Supervision	[redacted]	[redacted]	[redacted]	[redacted]
Quantified Risks	[redacted]	[redacted]	[redacted]	[redacted]
Optimism Bias	[redacted]	[redacted]	[redacted]	[redacted]
Total Capital Cost	**1,503.62**	**1,184.74**	**678.79**	**807.76**

3.5.13. The total costs of the Proposed Scheme include the costs for its maintenance and operation over the 60-year appraisal period. Estimates of Operations and Maintenance of the proposed scheme was provided in Q2 2022 prices, without accounting for real cost inflation. To reflect uncertainty in terms of costs during the appraisal period, assumption of real cost inflation (as derived from the figures that have been used in the Capital cost estimates) has been adopted. The Operations and Maintenance costs have been subsequently deflated, discounted and converted to 2010 market prices and values in a similar manner as the Capital costs. Details of overall investment costs are reported in Table 3-6 below.

Table 3-6: Total Cost of the Proposed Scheme (£M)

Cost Element	Total Scheme Cost (£M)			
	Cost at Q2 2022 Prices	Deflated to 2010 Prices	Discounted to 2010 Values	Market Prices & Values
Total Capital Cost	1,503.62	1,184.74	678.79	807.76
Total Maintenance and Operational Cost	359.60	283.34	48.87	58.16
Total Scheme Cost	**1,863.21**	**1,468.08**	**727.66**	**865.92**

3.5.14. Therefore, the PVC for the Proposed Scheme is comprised of £808M of capital costs and £58M of Maintenance and Operation costs, totalling £866M in 2010 market prices and values. As previously noted, the costs for the Finn Crossing have been included in the scheme costs.

3.6 ASSESSMENT OF THE MONETISED IMPACTS FOR THE COMPLETE SCHEME

3.6.1. This section describes the benefits of the full scheme between New Buildings and Aughnacloy. It describes and quantifies the Established monetised impacts and evolving monetised impacts as defined in the DfT VfM Framework. The non-monetised impacts for the full scheme are described in Section 3.7.

ASSESSMENT PERIOD

3.6.2. The programs TUBA, QUADRO and COBALT that were used to assess transport user benefits and accident savings, calculate benefits on a year-by-year basis for an appraisal period of 60 years from scheme opening as required by TAG Unit A1.1 (Cost-Benefit Analysis).

3.6.3. The phased construction required that benefits for the full scheme be calculated for each year of the appraisal taking account of the completion of each phase. As each phase of the scheme is opened at a particular time within that opening year, the part of the year before opening would have a different road network available to users from the part of the year after opening.

3.6.4. To reflect this would require Do-Minimum and Do-Something traffic forecasts for both scenarios. Since TUBA does not support more than one Do-Something scenario per year, as per the current construction programme Phase 1A of the Scheme opens for traffic towards end of Q4 2026 with scheme benefits accruing from 2027; Phases 1A+2 opens for traffic towards end of Q4 2027 with benefits accruing from 2028, Phases 1A+1B+2 operational from Q1 2028, and the full scheme operational within the same year when Phase 3 opens for traffic.

3.6.5. The appraisal period for the full scheme was based on a 60-year period from the opening of the first phase of the scheme with benefits accruing from 2027. The final year of the evaluation period was therefore 2086. The traffic forecasts beyond the last modelled year (i.e. from 2044 to 2086) were taken to remain constant with no further growth applied.

3.6.6. For the purpose of assessing the benefits for each of the four constituent phases, benefits were calculated over a 60 year period from the opening of each phase requiring four separate TUBAs. The method for assessing the benefits by phase is detailed in Section 3.13.

ESTABLISHED MONETISED IMPACTS

3.6.7. As noted in Section 3.3 above, the Established monetised impacts are used to determine an initial BCR and include;

1. benefits to road users from the scheme including time savings and savings in vehicle operating costs (VOC)
2. benefits to road users from a reduction in delays during periods of maintenance (and dis-benefits due to delays during the scheme construction period)
3. accident savings
4. benefits / dis-benefits from changes to noise and air quality and greenhouse gas emissions

3.6.8. Items 1 and 2 above are referred to as the Transport Economic Efficiency (TEE) benefits and are calculated by the programs TUBA and QUADRO respectively.

3.6.9. The Established monetised benefits together with the initial BCR is summarised in Table 3-40 in Section 3.9. This section describes how the Established monetised impacts are derived.

3.6.10. The TEE benefits arising from changes in journey times and vehicle operating costs are calculated separately for Business Users and Consumer Users.

3.6.11. Business Benefits are the benefits accrued by business travellers, including car (and van) occupants travelling on employers business. This group also includes HGV drivers. Consumer Users are non-business travellers, in cars and vans.

3.6.12. Commuters are classed as consumers as they are travelling in their own time, not that of their employers.

3.6.13. The TUBA and QUADRO programs include standard values of time, based on average earnings, with the values for time in the course of work (employers business) being much higher than personal time (including commuting).

3.6.14. The vehicle operating costs are both distance and speed related, and include fuel costs and non-fuel costs, e.g. tyres, maintenance and depreciation.

TRANSPORT USER BENEFIT APPRAISAL (TUBA)

3.6.15. TUBA takes, as its principal input, zone to zone matrices of trip numbers, times taken, and distances travelled. Values of time and operating cost are applied and a 60-year stream of benefits calculated that is discounted to the present value year (defined by the DfT as 2010) and expresses the benefits in 2010 market prices.

3.6.16. By subtracting the road user costs for the Do-Something case (i.e., with the scheme in place) from those for the Do-Minimum case (i.e. without the scheme in place) the net road user benefits are derived.

3.6.17. The benefits are calculated for all users of the network and include those who travel on the new road (A5WTC) and those travelling on all existing roads. For example, while users of the A5WTC would experience time savings, users of the old A5 may also experience benefits as average speeds for journeys increase on the old road as a result of traffic relief.

3.6.18. Whilst it is expected that most scheme benefits will accrue to the users of the A5 corridor (those transferring to the A5WTC as well as those using the existing A5), it is likely that some indirect benefits will be accrued to other users elsewhere on the network, including users travelling to, from and within RoI. Due to the size of the traffic model, it is not feasible to separately identify benefits accruing to direct users of the corridor and those benefiting from indirect impacts of the Proposed Scheme.

3.6.19. The TEE benefits of the Proposed Scheme calculated by TUBA are presented in Table 3-7 below.

Table 3-7: Transport User Benefits in £M

Road User	User Time	Fuel	Non-fuel	Indirect Tax Revenue	Total (Including Indirect Tax Revenue)
Consumer User Benefits					
Commuting	166.3	-1.8	-4.7	0.3	160.1
Other	233.5	-6.5	-12.0	2.0	217.0
Net Consumer Benefits	***399.9***	***-8.3***	***-16.6***	***2.2***	***377.1***
Business User Benefits					
Business Personal	209.5	-2.3	5.5	0.7	213.3
Business Freight	251.9	-7.8	6.7	4.0	254.9
Net Business Impact	***461.5***	***-10.1***	***12.2***	***4.7***	***468.2***
Present Value of Transport Economic Efficiency Benefits (PVB)	**861.3**	**-18.4**	**-4.4**	**6.9**	**845.4**

3.6.20. Figure 3-3 shows the road user benefits for each year of the economic appraisal period, also at 2010 prices discounted to 2010.

3.6.21. This demonstrates the impact of the introduction of Phase 2 in 2028 and shows a steady increase in annual benefit up to 2043. Beyond 2043 no further growth has been assumed and annual benefits begin to reduce after discounting, the later they occur in the future.

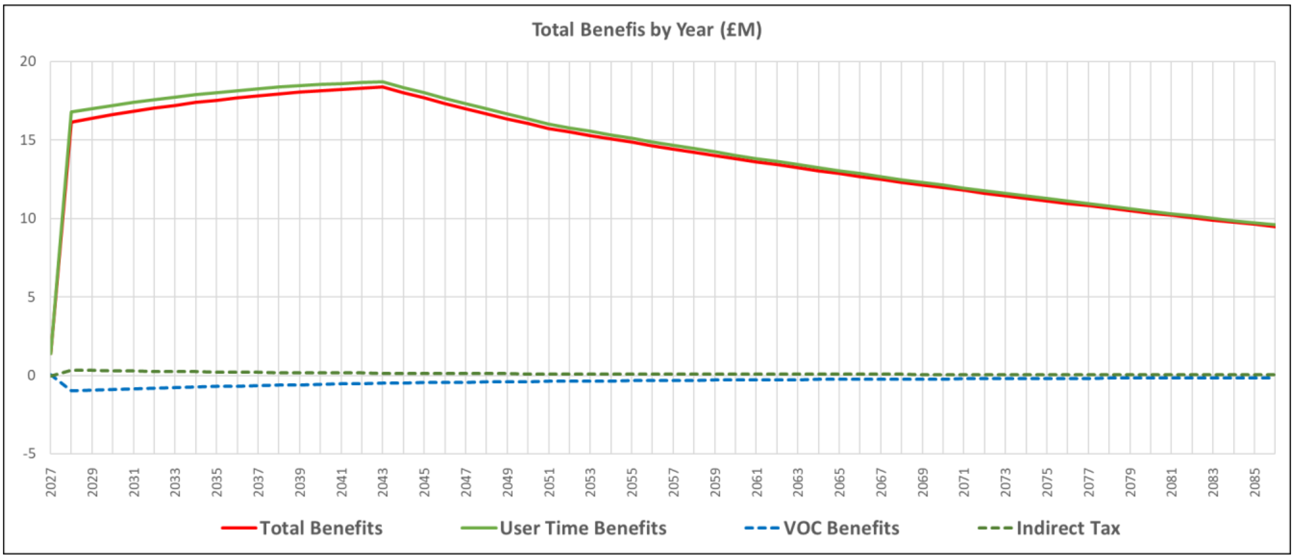

Figure 3-3: Road User Benefits by Year (discounted to 2010)

CONSTRUCTION AND MAINTENANCE IMPACT ASSESSMENT

3.6.22. The costs and benefits as a result of construction and maintenance activities were assessed using the National Highways program QUADRO (Queues and Delays at Roadworks). This represents a whole life cost over an evaluation period of 60 years.

3.6.23. This evaluation took account of the following:

- delays to vehicles on the existing A5 during the construction of the scheme
- delays to vehicles associated with maintenance activities on both the existing A5 and the Proposed Scheme

3.6.24. The Proposed Scheme is largely an offline scheme. Therefore, delays to traffic on the existing A5 carriageway are largely confined to the junction tie-ins.

3.6.25. Maintenance strategies were assessed for both the Proposed Scheme and for the existing A5 (the do-minimum). These strategies followed the principles set out in Table 4/1 of the latest version of the National Highways QUADRO Manual.

3.6.26. The maintenance impacts in the do-minimum are significant as the existing A5 is a single carriageway road. As a consequence maintenance activities will require partial and full closures of the existing A5 with heavy reliance on the existing local road network to operate diversions.

3.6.27. The maintenance impacts in the do-something are less severe as the Proposed Scheme is predominantly dual-carriageway and therefore maintenance can generally allow traffic to remain on the A5WTC due to its increased carriageway widths. In addition, any vehicles that are subject to diversion are able to utilise the existing A5, reducing the additional delays that would be experienced if the local road network were again required to be utilised.

CONSTRUCTION WORK ASSUMPTIONS

3.6.28. As noted above, the main construction impacts occur at locations where new junctions connect to the existing road network. During each construction phase, the works were assumed to take place during the year prior to opening.

3.6.29. QUADRO assessments were undertaken for each phase at all new junction locations, except those connecting to sections of the existing road network where the modelled two-way Average Annual Hourly Traffic (AAHT) flows were less than 200 vehicles.

3.6.30. The works at each junction were assumed to involve 2 weeks of 24/7 shuttle working and 52 weeks of 24/7 works with one narrow 3.0m wide lane in each direction. The only exceptions were as follows:

- junction 1 where 34 weeks of 24/7 narrow lanes were assumed
- junction 2 where 51 weeks of 24/7 narrow lanes were assumed
- junctions 3 and 16 where 4 weeks of 24/7 shuttle working were assumed as the length of the shuttle working section required exceeded the maximum permissible work site length of 500m and so the section was split into two parts with 2 weeks of 24/7 shuttle working assumed on each section
- junction 5 where no shuttle working was assumed.

3.6.31. Temporary speed limits were only assumed on sections of road with a posted speed limit in excess of 40mph and these sections were assumed to experience a reduction in the posted speed limit to 40mph. Diversion routes were derived for each section using other suitable routes.

MAINTENANCE WORK ASSUMPTIONS

3.6.32. The maintenance strategy adopted followed the principle set out in Table 4/1 of the latest version of the National Highways QUADRO manual. This provides indication for maintenance interventions every 10 to 11 years after the scheme opening. A detailed discussion was held with the Department maintenance team and they have confirmed a routine 12-year maintenance schedule for the Proposed Scheme which could comprise either a Thin Surface Course (TSC) overlay or resurfacing.

3.6.33. For the Do-Minimum, the maintenance works on the existing A5 were assumed to involve shuttle working. Temporary speed limits were only assumed on sections of road with a posted speed limit in excess of 40mph and these sections were assumed to experience a reduction in the posted speed limit to 40mph. Diversion routes were derived for each section using other suitable routes. The Department maintenance team has confirmed the existing A5 corridor is generally resurfaced with Hot Rolled Asphalt (HRA) every 20 years.

3.6.34. For the Do-Something, the maintenance schedule remains the same, but the works comprised of single lane contra-flow working with a reduction in the posted speed limit of 20mph assumed (i.e, 50mph as speed limit). Diversion routes were derived based on vehicles making use of the existing A5. The results of the QUADRO assessment are presented in Table 3-8. All monetised values are at 2010 prices and discounted to 2010.

Table 3-8: Road User Benefits during Construction and Maintenance in £M (discounted to 2010)

Impact on Road User	Benefit (£M)
During Construction	-1.44
During Maintenance	26.14
Total	24.70

3.6.35. The disbenefit to road user traffic due to construction is assessed as -£1.44M; the benefit as a consequence of reducing the impact of future maintenance activities is £26.14M. The resultant net benefit is assessed as £24.70M.

3.6.36. The total TEE benefits calculated by the TUBA and QUADRO assessments, as presented respectively in Table 3-7 and Table 3-8, is **£870.10M**.

ACCIDENT APPRAISAL

3.6.37. The assessment of the benefits associated with the reduction in accidents associated with the provision of the total scheme was undertaken using COBALT, the DfT's program for calculating the cost benefit analysis from savings in accidents. The appraisal used COBALT version 2.2 and the parameter file associated with version 1.17 of the TAG Databook (released in November 2021).

3.6.38. COBALT assesses the safety aspects of road schemes by calculating the number of accidents on each link in each year of the evaluation period with and without the Scheme. COBALT can either calculate accidents for road links and road junctions separately or combined. For the appraisal for the Proposed Scheme the combined link and junction accidents were assessed using assignment results from the traffic model as inputs.

3.6.39. The numbers of observed accidents on the existing A5 through the study area were collated from recorded accident data over a 5-year period from 2015 to 2019. For other roads, a set of standard rates was used. COBALT also calculates a severity split using standard factors which estimate the number of accidents classified by injury severity of fatal, serious or slight. COBALT applies the costs per accident severity to establish the economic cost of accidents over the appraisal period. It should be noted that over the 12-month period October 2021-October 2022, there have been ten fatalities observed along the existing A5 corridor, this compares to 15 fatalities observed along the corridor in the five year period between 2015 to 2019 and points to a rising accident trend. This significant jump in fatal accidents leads to a general perception that accidents along the A5 are increasing. The relatively short timescale of post-Covid accident data is insufficient to draw robust conclusions for purposes of economic appraisal. If this trend continues, the economic assessment of accident savings reported here could be seen as an underestimate.

3.6.40. Average Annual Daily Traffic (AADT) flows were taken from the SATURN model assignment for the forecast years used in each model stages to reflect the phased construction of the scheme.

3.6.41. The COBALT program was run for the four Phases separately, in line with the proposed opening dates for each Phase. The accident benefits for the Phase 1A, were calculated for the appraisal period between 2027 and 2086.

3.6.42. As mentioned in section 3.6.4, for all other Phases the benefits start to accrue from 2028 and they are assessed between 2028 and 2087 to complete the full 60-year appraisal. A fixed trip matrix approach was adopted in accordance with the TAG.

3.6.43. The projected changes in the numbers of accidents, over the appraisal period for the proposed scheme are presented in Table 3-9 below. The COBALT analysis estimates that 2,733 accidents would be saved as a result of the Proposed Scheme during the 60-year appraisal period (2027-2086).

Table 3-9: Accident savings over 60 years

Accident Summary		
'Without' Scheme Accidents	'With' Scheme Accidents	Reduction in accidents
38,017	35,284	2,733

3.6.44. COBALT also provides a summary of the predicted number of casualties saved as a result of the scheme. This is presented in Table 3-10 below.

Table 3-10: Casualty savings over 60 years

Casualty summary			
Severity	Total Casualties 'Without' Scheme	Total Casualties 'With' Scheme	Total Casualties Saved by Scheme
Fatal	456	421	36
Serious	4,948	4,507	442
Slight	46,596	43,281	3,315
Total	52,001	48,208	3,793

3.6.45. The economic benefit of the accident savings was calculated by comparing the cost of accidents over the 60-year appraisal period, with and without the scheme, at 2010 prices, discounted to 2010. The benefits arising from the accident savings are summarised in Table 3-11 below.

Table 3-11: Present value of accident savings over 60 years

Economic Summary (£M)		
'Without' Scheme Accident Costs	'With' Scheme Accident Costs	Total Accident Benefits Saved by Scheme
1,596.59	1,471.67	124.92

3.6.46. The total predicted accident benefits are **£124.92 million**.

ENVIRONMENTAL IMPACTS

3.6.47. Monetised impacts were calculated for noise, greenhouse gases and air quality.

3.6.48. The change in greenhouse gas emissions, local air quality and noise levels as a result of the scheme was assessed using the traffic forecasts from the model.

3.6.49. Monetary values were calculated in accordance with the methodology set out in TAG Unit A3 (Environmental Impact Appraisal) (November 2021).

3.6.50. In the context of the greenhouse gases assessment, the change in CO_2e emissions as a result of the Proposed Scheme is assessed. CO_2e is taken to be equivalent to the common greenhouse gases, as defined in the Kyoto Protocol (1997); Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6), and Nitrogen trifluoride (NF_3). Any increase in road traffic (and subsequent increase in fuel consumption) as a result of the scheme would result in a net increase in greenhouse gases emitted.

3.6.51. For the purposes of the OBC, the Department for Transport Greenhouse Gases workbook, as per *TAG Unit A3 (Environmental Impact Appraisal)* was used to assess the impacts of the Proposed Scheme over a 60 year appraisal period (2028 – 2087). The spreadsheet calculates and evaluates the discounted present value of changes in tCO_2e for non-traded (i.e. petrol, diesel, fuel oil).

3.6.52. The local air quality assessment appraisal takes account of the change in concentrations of $PM_{2.5}$ (particulate matter with a mean aerodynamic diameter of 2.5µm or less) and NO_2 (nitrogen dioxide) at identified sensitive receptors (e.g. residential properties, schools, hospitals) within 200m of the affected road network associated with the Proposed Scheme. In addition, the change in total mass emissions of NO_x (oxides of nitrogen) and $PM_{2.5}$ attributed to the Proposed Scheme operation is assessed to take account of impacts that do not directly affect properties, such as ecological receptors.

3.6.53. The monetised impacts of noise, greenhouse gasses and local air quality, are summarised in Table 3-12. A detailed breakdown of these impacts are shown in **Appendix E**.

Table 3-12: Monetised Environmental Benefits

Environmental Impacts	Quantified Benefits (£M)
Greenhouse Gases	-39.91
Local Air Quality	5.27
Noise	-0.64
Total Monetised Environmental Impacts	**-35.28**

3.6.54. The 2019 amendment to the Climate Change Act 2008 established a legal requirement for reaching Net Zero GHG emissions in the UK economy by 2050, which is reflected in the UK Net Zero Strategy. The UK Government's Transport Decarbonisation Plan details the decarbonisation of road traffic, including ending the sale of new petrol and diesel cars by 2030, and stating that 'All new cars and vans must be 100% zero emission at the tailpipe' by 2035. It should be noted that the Climate Change Act (Northern Ireland) 2022 has now been enshrined in law and commits net Northern Ireland emissions for the year 2050 to be at least 100% lower than the baseline. The baseline year varies by greenhouse gas, for Carbon Dioxide it is 1990.

3.6.55. The TAG workbook and methodology (TAG data v1.17) used for the GHG assessment takes into account decarbonisation over time based on the expected shift to electric vehicles.

3.6.56. For the air quality assessment, pollutant emissions from vehicles were derived using Defra's emissions factors toolkit version 11.0 (EFT v11.0), which provides emissions factors up to year 2030 for all pollutants for roads in Northern Ireland. Therefore, the EFT emissions factors applicable to year 2030 were used to calculate emissions of each pollutant for years later than 2030 (i.e. for 2043 design year). This is a conservative approach since it does not consider the likely reductions in vehicle emissions with the ongoing electrification of the fleet and uptake of cleaner vehicles, specifically in relation to UK Government commitments to phase out the sale of new petrol and diesel cars by 2030, with a subsequent commitment to ensure all new cars and vans will be fully zero emission from the exhaust pipe by 2035.

EVOLVING MONETISED IMPACTS

3.6.57. In accordance with the latest DfT Value for Money Framework, evolving monetised impacts capture those benefits where some evidence exists to support the estimation of a monetary value but is less widely accepted and researched. They are included, together with the Established monetised impacts, to derive an adjusted BCR. For the Proposed Scheme appraisal, the Evolving monetised impacts include wider impacts only.

3.6.58. The contribution of the Established and Evolving monetised benefits to the adjusted BCR is summarised in Section 3.9. This section described how the Evolving monetised impacts are derived.

WIDER IMPACTS

3.6.59. Wider Impacts is the current term for the quantities previously known as Wider Economic Benefits. Wider Impacts are defined in *TAG Unit A2.1 (Wider Impacts)*. They involve the following components:

1. **Agglomeration Benefits –** These arise from the positive link between density and productivity. When employment clusters together, the jobs in the cluster are likely to be more productive than they otherwise would be, due to better access to labour, increased competition between suppliers and greater interaction between businesses spreading knowledge

2. **Increase in Output in Markets with Imperfect Competition** – In markets which are dominated by a few suppliers, prices may be above the quantity which would occur in competitive markets. Transport investment may induce a price reduction and an increase in the quantity supplied, through its impact upon firms' cost base. This benefit is calculated as 10% of the benefits to business users, which are extracted from the TUBA appraisal
3. **Move to More or Less Productive Jobs** – If a transport scheme causes a relocation of jobs, this may lead to a change in productivity, for example, if jobs were to move from an area of low to high productivity. DfT TAG advises that this impact can only be valued if a Land Use-Transport Interaction (LUTI) model is used, and even then it can only be included as a sensitivity test

3.6.60. The assessment of the Wider Impacts that has been carried out for the Proposed Scheme, which takes account of items 1 and 2 only. Item 3 was not assessed as this would require a complex LUTI model (which has not been developed), this exclusion is likely to underestimate the Wider Impacts for the scheme and results in a conservative estimate of the adjusted BCR.

3.6.61. A stream of agglomeration benefits was calculated for a 60 year period from the opening of the final Phase of the scheme in 2028 and converted into a Present Value by discounting to a base year of 2010.

3.6.62. It should be noted that the 60 year period for the agglomeration benefits differs from the 60 year period adopted for TUBA that uses the opening year for Phase 1A (2027) in order to reflect the traffic changes due to the Phased opening of the scheme. This is not considered an important issue for the purpose of calculating the agglomeration benefits.

3.6.63. The benefit associated with the 'Increase in output in markets with imperfect competition' (item 2) was calculated by adding a value worth 10% of the time savings to business users from the TUBA appraisal, as advised by *TAG Unit A2.1*.

3.6.64. The Wider Impacts for the Proposed Scheme are presented in Table 3-13 below.

Table 3-13: Wider Impact Benefits

Wider Benefits	Value discounted to 2010 (£M)
Agglomeration	162.12
Increase in output in markets with imperfect competition	45.78
Tax revenues arising from labour market impacts	0.23
Total	**208.13**

3.6.65. The detailed methodology that includes an analysis of the benefits including the spatial distribution is described in a technical note on Wider Economic Benefits, presented in **Appendix F**.

3.7 NON-MONETISED IMPACTS – FULL SCHEME

3.7.1. This assessment of non-monetised impacts encompassed a quantitative and qualitative assessment of the following:

- journey time reliability
- noise
- air quality

- greenhouse gases
- landscape
- historic environment
- biodiversity
- water environment; and
- social and distributional impacts

3.7.2. It is noted that monetised values for Noise, Air Quality and Greenhouse gasses were calculated and reported in Section 3.6 above. The assessment detailed within this section describes the qualitative elements of the assessment of Noise, Air Quality and Greenhouse gas impacts, on the basis of a whole scheme. Social and distributional impacts of the full scheme are discussed in Section 3.8.

3.7.3. In addition to this, there are further non monetised benefits the Proposed Scheme could bring to the wider economy and society, these include Levelling Up, Social Value and Regeneration. The Proposed Scheme's potential around Levelling up of the regional imbalance has been outlined in Chapter 2. Similarly Chapter 5, Section 5.6 on Social Value summarises the scheme's wider financial and non-financial impacts on the wellbeing of individuals, communities and the environment. The Proposed Scheme could also bring a range of regeneration and wider impacts over and above the traditional transport benefits summarised in the sections above and these are detailed in the Regeneration Impacts note (included in **Appendix K**).

3.7.4. However, in accordance with the TAG Units A1.1 to A1.4 these are not considered in the Appraisal Summary Table and therefore not included in the derivation of the Proposed Scheme's Final Value for Money category.

JOURNEY TIME RELIABILITY BENEFITS

3.7.5. Benefits accruing through improved journey time reliability were assessed using *TAG Unit A1.3 (User and Provider Impacts)*.

3.7.6. For journeys on predominantly single carriageways outside urban areas TAG recommends a 'stress' based approach which reflects the situation where journey time reliability is believed to reduce as flows approach capacity. The predicted flows for a key link on the existing and new road are compared with the Congestion Reference Flow (CRF) and this ratio is quantified as the level of stress. The CRF represents an estimate of the total Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be 'congested' in the peak periods. The CRF is defined in TA 46/97 (DMRB Volume 5, Section 1, Part 3).

3.7.7. A worksheet is provided in *TAG Unit A1.3* (Worksheet B1, in Appendix C5) which sets out the method for determining the overall stress relief as a numerical value. This is calculated as the product of AADT and stress relief summed for both the existing and new carriageway. For the calculation, the stress levels are limited to the range 75-125% i.e. stress in excess of 125% is set to an upper bound of 125% and stress below 75% is set to a lower bound of 75%. The numerical value for stress relief is shown in Table 3-14.

3.7.8. *TAG Unit A1.3* indicates that the calculation should be carried out for the 'key' link on the existing A5 and the Proposed Scheme. The calculations have been undertaken for each section between junctions and then aggregated by weighting the assessed stress levels by vehicle-kilometres. The detailed methodology adopted for the journey time stress assessment is presented in **Appendix G**.

3.7.9. The assessed numerical stress value is presented in Table 3-15 below.

Table 3-14: Stress Relief Categories

Numerical Assessment of Stress Relief TAG Numerical Bands	Category
Stress < 200,000	Neutral
200,000 < Stress < 1,000,000	Slight
1,000,000 < Stress < 3,000,000	Moderate
3,000,000 < Stress	Large

Table 3-15: Assessment of Stress Relief weighted by Veh-km

Section	Stress Relief (TAG Numerical Calculation)	Category
New Buildings to Aughnacloy	301,903	Slight

3.7.10. For the whole scheme between New Buildings to Aughnacloy a value of 301,903 is assessed which falls within the Slight beneficial category.

NOISE

3.7.11. The noise assessment considered the impacts of the Proposed Scheme on the noise and vibration at nearby receptors during the construction phase and during operation of the Proposed Scheme. The main objective was to determine whether the Proposed Scheme would result in noise or vibration impacts at the receptors. The assessment took account of committed noise mitigation measures including noise barriers at targeted locations and the use of low noise surfacing along the full length of the scheme mainline.

3.7.12. The assessment identified that, whilst receptor noise level changes arising from the Proposed Scheme would range from major decreases to major increases, overall, there would be a significant adverse effect from road traffic noise.

3.7.13. The short-term change in noise level at residential dwellings has been derived based on the following comparisons, in line with the requirements of TAG Unit A3 Environmental Impact Appraisal Guidance and the ASR:

- Do Minimum Opening Year (DMOY) vs Do Something Opening Year (DSOY); and
- Do Minimum Design Year (DMDY) vs Do Something Design Year (DSDY).

3.7.14. The short-term noise level change results are presented in Table 3-16 and Table 3-17 for the two comparisons above.

3.7.15. These results are based on the latest updated noise modelling data analysis including for the benefit from the committed low noise surfacing and noise barriers at targeted locations, as well as the additional identified receptors including transboundary, planning consents and two further receptors identified in the study area (see paragraph 11.5.129 in Chapter 11 Noise and Vibration of the ESA 2022[68] for full details).

3.7.16. It should be noted that the results comparisons required for assessment in accordance with the TAG Unit A3 Environmental Impact Appraisal Guidance are different to those required for assessment in accordance with the DMRB HD 213/11 noise guidance (as reported in the ESA 2022). Differences

[68] https://www.a5wtc.com/Environmental-Consultation-2022

can therefore be expected between the results presented in Table 3-16 and Table 3-17 to those presented in the ESA 2022.

3.7.17. The Proposed Scheme will introduce a major new road traffic noise source through what is currently a comparatively quiet area in the most part. However, the route selection is such that there are generally reasonable to good separation distances between the Proposed Scheme and concentrations of local dwellings, affording a reasonable degree of noise attenuation due to distance, although isolated properties / small groups of properties do occur in close proximity to the scheme. Notwithstanding the above, there would remain significant noise level increases at numerous dwellings along the Proposed Scheme. It is not predicted that any receptors would be subject to noise levels over 80 dB $L_{Aeq,16h}$ as a result of the Proposed Scheme.

Table 3-16: Short term change in noise level – DMOY vs DSOY

Change in Short Term noise level		Dwellings
Increase in noise level, $L_{A10,\ 18h}$, dB	0.1-0.9 (Negligible)	3,721
	1.0-2.9 (Minor)	3,099
	3.0-4.9 (Moderate)	821
	5.0+ (Major)	851
No change	0 (No change)	604
Decrease in noise level, $L_{A10,\ 18h}$, dB	0.1-0.9 (Negligible)	3,729
	1.0-2.9 (Minor)	2,648
	3.0-4.9 (Moderate)	979
	5.0+ (Major)	496

Table 3-17: Short term change in noise level – DMDY vs DSDY

Change in Short Term noise level		Dwellings
Increase in noise level, $L_{A10,\ 18h}$, dB	0.1-0.9 (Negligible)	2,962
	1.0-2.9 (Minor)	3,913
	3.0-4.9 (Moderate)	1,042
	5.0+ (Major)	895
No change	0 (No change)	422
Decrease in noise level, $L_{A10,\ 18h}$, dB	0.1-0.9 (Negligible)	3,588
	1.0-2.9 (Minor)	2,617
	3.0-4.9 (Moderate)	919
	5.0+ (Major)	590

3.7.18. The Proposed Scheme would serve to reduce noise levels along the existing A5, which passes through the most urban local areas, including Omagh and Strabane. In general noise level decreases are predicted along that route, albeit small increases could arise on the facades of some receptors that face in the direction of the Proposed Scheme. The assessment methodology is such that for each dwelling the facade with the greatest increase / least beneficial decrease is brought forward into the change in noise levels presented in Table 3-16 and Table 3-17, as well as the calculated net Present Value (NPV) thereby not representing the lesser increases, or indeed benefits on other facades.

3.7.19. The assessments of construction vibration and construction traffic noise have established that, taking mitigation into account, impacts would be of relatively short duration in any one location and that the predicted impacts would not constitute a significant effect on the environment.

3.7.20. The assessment of construction noise has established that, taking mitigation into account, impacts would be of relatively short duration in any one location however some significant effects will remain, e.g., where works are necessary in close proximity to receptors.

AIR QUALITY

3.7.21. The air quality impacts depend upon changes in traffic flows, composition, speeds and distance travelled as a result of the Proposed Scheme. An assessment of both *local air quality impacts*, which focusses on the immediate impacts of changes in pollutant concentrations at sensitive receptors as a result of the Proposed Scheme operation, and *regional emissions impacts*, which focusses on the change in total mass emissions of air pollutants attributed to the Proposed Scheme operation, has been completed with reference to the Design Manual for Roads and Bridges (DMRB, Volume 11, Section 3, Part 1, HA 207/07).

Local Air Quality

3.7.22. Emissions of oxides of nitrogen (NO_x), including nitrogen dioxide (NO_2) and particulates with a mean aerodynamic diameter of 2.5µm or less ($PM_{2.5}$) from affected roads are of particular concern with respect to human health and ecosystems.

3.7.23. In accordance with guidance set out in *TAG Unit A3 (Environmental Impact Appraisal)*, the air quality assessment included a screening exercise to determine affected roads as defined by the DMRB, HA 207/07. Roads were flagged as affected if any of the following criteria were met:

- road alignment will change by 5 m or more
- daily traffic flows will change by 1,000 AADT or more
- heavy duty vehicle (HDV) flows will change by 200 AADT or more
- daily average speed will change by 10 km/hr or more
- peak hour speed will change by 20 km/hr or more

3.7.24. The screening included the identification of relevant sensitive receptors within 200m of affected roads, resulting in the selection of 11,929 receptors to be included in the atmospheric dispersion modelling exercise. These included receptors relating to:

- residential dwellings
- designated ecological sites
- nurseries and care homes
- hospitals
- schools.

3.7.25. A detailed review of potential air quality impacts of the Proposed Scheme has been undertaken, based on atmospheric dispersion modelling (ADMS-Roads) of vehicle emissions associated with traffic links affected by the Proposed Scheme for the opening year (2028) and design year (2043). The traffic data review and air quality modelling, completed with reference to HA207/07, were based on the provision of updated traffic datasets for both without (Do-Minimum) and with (Do-Something) the Proposed Scheme in 2028 and 2043, respectively. The Do-Something traffic data represents Phase 3 of the Proposed Scheme (i.e. the completed Proposed Scheme).

3.7.26. Modelled road links, with a forecast change in annual average daily traffic (AADT) flows of more than 1,000 and less than -1,000 were identified. The number of identified sensitive receptors included as part of the OBC local air quality assessment were then attributed to the nearest modelled road link and its corresponding change in AADT flow to provide a comparison, as summarised in Table 3-18 for the opening (2028) and design (2043) years.

Table 3-18: Local air quality assessment screening of sensitive receptors where predicted traffic flow changes are in excess of +/- 1,000 AADT

AADT flow change	Local Air Quality Impacts			
	No. modelled road links		No. receptors within 200 m	
	2028	2043	2028	2043
Increase ≥1,000	626	721	1,685	2,129
Decrease ≤-1,000	829	951	5,516	6,910
Between -1,000 and +1,000	3,260	3,043	4,728	2,890
Total	**4,715**	4,715	**11,929**	11,929

3.7.27. In the opening year (2028), 46.2% of the sensitive receptors are predicted to experience a reduction in vehicle flows of over 1,000 AADT as a result of the operational Proposed Scheme, compared to 14.1% expected to experience an increase of over 1,000 AADT, and 39.6% with a change in AADT between +1,000 and -1,000 AADT. In the design year (2043), 57.9% of receptors are predicted to experience a reduction in flows over 1,000 AADT, with 17.8% expected to experience an increase of over 1,000 AADT, and 24.2% with a change between +1,000 and -1,000 AADT.

3.7.28. Air quality modelling was utilised to predict the potential impact of changes to vehicle emissions on air pollutant concentrations (NO2 and PM2.5) at the identified sensitive receptors. A summary of the modelled impacts in the Proposed Scheme opening and design years is provided in Table 3-19 below.

Table 3-19: Summary of potential impacts on air pollutant (NO2 / PM2.5) concentrations at identified sensitive receptors (2028 opening year)

Pollutant	Number of Receptors						Total
	Improvement in Concentration		Worsening in Concentration		No Change in Concentration		
	2028	2043	2028	2043	2028	2043	
NO_2	8,492	8,620	2,657	2,785	780	524	11,929
$PM_{2.5}$	6,372	6,930	1,690	2,056	3,867	2,943	11,929

3.7.29. The local air quality modelling predicted that annual mean concentrations of NO_2 would improve (decrease) at 71% (2028) and 72% (2043) of the 11,929 identified receptors, worsen (increase) at 22% (2028) and 23% (2043), with no change at 7% (2028) and 4% (2043) of receptors. With respect to $PM_{2.5}$, annual mean concentrations are predicted to improve at 53% (2028) and 58% (2043) of receptors, worsen at 14% (2028) and 17% (2043), with no change at 32% (2028) and 25% (2043) of receptors, with the Proposed Scheme in operation.

3.7.30. The local air quality assessment has demonstrated that more sensitive receptors would benefit from reduced concentrations of key pollutants (NO_2 and $PM_{2.5}$) compared to those that would experience increases in concentrations, as a result of implementing the Proposed Scheme. This is predominantly attributed to the Proposed Scheme attracting traffic from the existing A5 road and associated link roads, thereby reducing vehicle emissions from the existing A5. Given that the existing A5 and associated links roads have a relatively higher number of receptors within 200 m of the road alignment compared to the Proposed Scheme alignment, more receptors will experience an air quality benefit than those that will experience a worsening.

Regional Emissions

3.7.31. The change in total mass emissions of vehicle pollutants resulting from the Proposed Scheme has been assessed, focussed on emissions of NO_x, PM_{10}, and $PM_{2.5}$, which can have air quality impacts on a regional, national, or international scale.

3.7.32. Regional emissions of each pollutant were predicted for all road links included in the traffic reliability area (TRA) in both the without Proposed Scheme (Do-Minimum) and with Proposed Scheme (Do-Something) scenarios for the opening year (2028) and Design Year (2043). Emissions were derived using Defra's EFT v11.0 based on the provision of updated traffic datasets for the Do-Minimum and the Do-Something scenarios (i.e. the completed Proposed Scheme).

3.7.33. Given that the EFT v11.0 provides emissions factors up to year 2030 for all pollutants for roads in Northern Ireland, emissions calculation for the 2043 design year were based on 2030 emissions factors. This is a conservative approach since it does not consider the likely reductions in vehicle emissions with the ongoing electrification of the fleet and uptake of cleaner vehicles, specifically in relation to UK Government commitments to phase out the sale of new petrol and diesel cars by 2030, with a subsequent commitment to ensure all new cars and vans will be fully zero emission from the exhaust pipe by 2035.

The results of the assessment are summarised in Table 3-20

Table 3-20: Regional air pollutant emissions impacts

Pollutant	Regional Emissions (Tonnes / Year)			Distance Travelled (Vehicle km)
	NO_x	PM_{10}	$PM_{2.5}$	
Do-Minimum (DM) (2028)	115	27	15	2,369,484
Do-Something (DS) (2028)	136	30	17	2,705,374
Change (2028)	21	3	2	335,889
% Change (DS-DM 2028)	18%	12%	13%	14%
Do-Minimum (DM) (2043)	114	31	18	2,806,552
Do-Something (DS) (2043)	136	36	21	3,278,773
Change (2043)	23	5	3	472,221
% Change (DS-DM 2043)	20%	16%	17%	17%

3.7.34. The regional emissions assessment has demonstrated that emissions of NO_x and particulate matter would increase as a result of implementing the Proposed Scheme relative to the Do-Minimum scenario. The predicted increase in total mass emissions is attributed to the increased number of vehicle kilometres travelled on the affected road network with the Proposed Scheme in operation.

Value of Change in Air Quality

3.7.35. The value of change in air quality is based on the total of the present value of change in NO_x and $PM_{2.5}$ emissions (regional emissions) and the present value of change in NO_2 and $PM_{2.5}$ concentrations (local air quality) over a 60-year appraisal period (2028 – 2087). A positive value reflects a net benefit (i.e. local air quality improvement).

3.7.36. The total value of change in local air quality for the Proposed Scheme is calculated to be £5.27M[69] as reported in Table 3-54 of Section 3.13, thus representing a **slight beneficial** improvement in air quality with the Proposed Scheme being implemented.

GREENHOUSE GASES

3.7.37. Greenhouse gas impacts depend upon changes in traffic flows, composition, speeds and distance travelled as a result of the scheme. As such, the Proposed Scheme is expected to have an impact on levels of greenhouse gas emissions.

3.7.38. As defined by the Intergovernmental Panel on Climate Change, GHG emissions are expressed as tonnes of carbon dioxide equivalent (tCO_2e) for the purposes of this appraisal.

3.7.39. The UK is legally bound by the Climate Change Act 2008 (2050 Target Amendment) Order 2019 to achieve Net Zero GHG emissions in the UK economy by 2050.

3.7.40. It should be noted that the Climate Change Act (Northern Ireland) 2022 has now been enshrined in law and commits net Northern Ireland emissions for the year 2050 to be at least 100% lower than the baseline. The baseline year varies by greenhouse gas, for Carbon Dioxide it is 1990. Targets must also be proposed for the years 2030 (at least 48% lower than the baseline) and 2040, which are in line with the 2050 target and laid before the assembly.

3.7.41. Under the Act carbon budgets must be set for 2023 to 2027, and for every five-year period following up to 2048 to 2052. The Act also requires sectoral plans to be produced for achieving the Northern Ireland Net Zero targets, including plans for infrastructure, transport, and active travel.

3.7.42. The Act requires all Northern Ireland Departments to “exercise its own functions, so far as is possible to do so, in a manner that is consistent with the achievement” of the objectives stated in the Act.

3.7.43. End-user vehicle emissions were calculated in accordance with DMRB LA 114. Emissions were quantified using TAG data[70] from the Department of Transport. For the purposes of the OBC, the Department for Transport Greenhouse Gases workbook, as per *TAG Unit A3 (Environmental Impact Appraisal)* was used to assess the impacts of the Proposed Scheme over a 60 year appraisal period (2028 – 2087). The spreadsheet calculates and evaluates the changes in tCO_2e for non-traded (i.e. petrol, diesel, fuel oil) and traded (e.g. electricity) fuel consumption. The results are reported in Table 3-21.

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[69] Based on output calculation provided by *TAG Unit A3* Air Quality Valuation Workbook (version Nov 2021) (‘*air-quality-valuation-workbook_full.xlsx*’)

[70] Department for Transport (2021) TAG data book. Available at: https://www.gov.uk/government/publications/tag-data-book

3.7.44. Table 3-21 shows that the Proposed Scheme is expected to increase non-traded greenhouse gas emissions by 544,713 tCO_2e and constitutes a Moderate Adverse impact.

3.7.45. As reported in Table 3-12, across the 60 year lifespan of the Proposed Scheme the change in tCO_2e in non-traded emissions (544,713 tCO_2e) would equate to a Net Present Value (NPV) loss of £39.91M. It should be noted that the central estimate NPV has been used.

Table 3-21: Change in greenhouse gas emissions (TAG Greenhouse Gases outputs)[71]

Emissions Class	Appraisal 60 Year Period GHG Emissions (tCO_2e)		Change (tCO_2e)
	Do Minimum	Do Something	
Non-traded	31,569,067	32,113,780	544,713
Traded	209,831	212,621	2,790

LANDSCAPE

3.7.46. The impacts of the Proposed Scheme on the landscape can be summarised across three sections of the A5 corridor: New Buildings to Strabane, Strabane to Omagh and Omagh to Aughnacloy. Further detail on the impact assessment of the Proposed Scheme can be found in the Environmental Statement Addendum 2022[72].

New Buildings to Strabane:

3.7.47. The Foyle Valley has an open, expansive character, its eastern margins linked by the A5 road corridor around which the majority of settlement is focused. The valley is framed by the Sperrin and Donegal hills, with locally prominent hills rising from the broad river floodplain. Pastoral farmland defines the hill slopes above the more developed local valleys.

3.7.48. The Proposed Scheme would run broadly in parallel with the existing A5, maintaining a similar relationship through the valley landscape between Londonderry and Strabane. Effects on landscape character would relate to the proximity of the route to the river setting south of New Buildings, which would impact locally upon the designated Area of High Scenic Value.

3.7.49. The proposed cutting through Sollus Hill at Bready would affect the profile of this locally prominent hill slope, resulting in large adverse effects within the immediate landscape and where the cutting is perceived in profile. Effects would also be evident where the route runs on embankment and would initially be exposed; maturation of planting would integrate the scheme within a landscape that is characterised by its linear form and features.

3.7.50. Within and on the approach to Strabane from the north, the alignment of the Proposed Scheme alongside the existing A5 corridor would not markedly change the nature of the towns setting and relationship with the River Foyle in the longer term. South of the Mourne River crossing, the diversion of the Proposed Scheme along the margins of the River Finn have a locally significant effect on the landscape quality of the river setting.

[71] Based on output calculation provided by *TAG Unit A3* Greenhouse Gases Workbook (‘*A5 WTC_tag-workbook-GREENHOUSE GASES-valuation-Jun17.xlsx*’)

[72] Chapter 8 – Landscape and Visual of the Environmental Statement Addendum (ESA) 2022 https://www.a5wtc.com/Environmental-Consultation-2022

3.7.51. Between New Buildings and Strabane the Proposed Scheme will have an overall Moderate Adverse impact on the landscape, with 2.5km (13%) experiencing a Large Adverse impact, 16.2km (83%) experiencing a Moderate Adverse impact and 0.8km (4%) experiencing a Slight Adverse impact.

Strabane to Omagh:

3.7.52. The Proposed Scheme would by-pass the historic town of Sion Mills, heading broadly south along the course of the Mourne and Strule River valleys towards Omagh. The Proposed Scheme would run across rising ground west of the existing A5 corridor, somewhat more exposed in aspect though remaining within the perceived confines of the river valleys. The cultural legacy of settlement, transportation and landscape utilisation within the river valleys has generated a character that would be further influenced by the Proposed Scheme.

3.7.53. At Newtownstewart the landscape setting of Harry Avery's Castle (State Care Monument) would be significantly affected locally where the Proposed Scheme passes to its immediate south, and within the wider Baronscourt Valley landscape.

3.7.54. The Strule Valley is encompassed by the western limits of the Sperrin AONB and the Proposed Scheme would pass within its designation. The existing A5 corridor is a feature of this locally attractive landscape setting, with the valley and its meandering river framed by the hill slopes of Bessy Bell and the Sperrin Hills.

3.7.55. Although the Proposed Scheme would be a more visible element of the valley landscape, particularly in early years as new planting establishes, the character impact would be mostly confined to the immediate valley and the context of the AONB setting would not dramatically change.

3.7.56. Approaching Omagh the Proposed Scheme would negotiate a landscape of drumlin farmland and scattered woodland, largely contained by landform and by-passing the town to its west. Character impacts would be very much localised due to the nature of the terrain, although the rural margins of the town would be physically eroded.

3.7.57. Between Strabane and Omagh the Proposed Scheme would have an overall Slight Adverse impact on the landscape, with 1.4km (5%) experiencing a Large Adverse impact, 6.4km (24%) experiencing a Moderate Adverse impact and 19.7km (71%) experiencing a Slight Adverse impact.

Omagh to Aughnacloy:

3.7.58. The Proposed Scheme would depart from the existing A5 corridor alignment, passing through a cohesive rural and tranquil landscape of drumlin topography that rises toward the Brougher Ridge. The nature of the drumlin terrain would accommodate the route alignment without widespread character impact; however, the transition of the ridge line between Tycanny and Errigal would place the Proposed Scheme in a sensitive and visually appealing landscape setting with a consequent large and adverse effect across the ridge setting.

3.7.59. The crossing of the existing A4 corridor and modified road links near Ballygawley would extend the influence of traffic movement to the west of the town. Towards Aughnacloy the Proposed Scheme would pass through a defined and visually appealing drumlin landscape, crossing the existing A5 corridor before bypassing the town to its east. The character of the town itself would not be significantly impacted upon, although the road corridor would present an erosion of the rural drumlin landscape surrounding the town.

3.7.60. Between Omagh and Aughnacloy the Proposed Scheme would have an overall Slight Adverse impact on the landscape, with 3.5km (9%) experiencing a Large Adverse impact, 4.7km (12%) experiencing a Moderate Adverse impact, 29.3km (74%) experiencing a Slight Adverse impact and 1.9km (5%) experiencing a Neutral impact.

3.7.61. Of the overall 4,468 visual receptors assessed across the Proposed Scheme, 446 would experience visual effects in the orders of moderate adverse or large adverse in Year 15.

Agricultural Land

3.7.62. Updates to the Proposed Scheme have resulted in the total loss of Grade 2 and 3a agricultural land of 752ha. This is broken down as the loss of 10ha of Grade 2 and 3a in County Londonderry and 742ha in County Tyrone resulting in a total of 752ha in Northern Ireland overall.

3.7.63. Based on the criteria that loss of greater than 20ha of Grade 1, 2 or 3a agricultural land is a significant effect; resulting significant effects on agricultural land are likely to occur in County Tyrone and Northern Ireland overall.

HISTORIC ENVIRONMENT

3.7.64. The assessment focused on likely impacts and effects relative to archaeological remains, built heritage and historic landscapes.

3.7.65. The assessment of archaeological remains indicated that the Proposed Scheme would have an impact on 71 heritage assets identified within the baseline environment during the desk-based studies, a walkover survey and the site-based investigations undertaken to date. The significance of effect resulting from the impacts are as follows:

- 63 of the archaeological heritage assets would receive a neutral or slight adverse effect;
- Six of the archaeological heritage assets would receive a moderate adverse effect; and
- Two of the archaeological heritage assets would receive a large adverse effect.

3.7.66. The two archaeological heritage assets that would be subject to large adverse effects are the State Care Monuments of Harry Avery's Castle and Errigal Keerogue Graveyard. The impacts would be to the setting of both monuments. All six moderate effects relate to impacts on Scheduled Monuments, one of which, Strabane Canal Reach 3, would be directly impacted upon, with the remainder subject to impacts on their settings. The direct impact on the Scheduled Monument of the Strabane Canal Reach 3, the impacts on the setting of the two State Care Monuments, and the impacts on the setting of six other Scheduled Monuments would constitute significant effects on the environment.

3.7.67. The assessment of built heritage resources has indicated the Proposed Scheme would have an impact on 26 built heritage assets identified within the baseline environment during the desk-based studies and walkover survey undertaken to date. The significance of effect resulting from the impacts are as follows:

- 23 of the built heritage assets would receive a neutral or slight adverse effect;
- Two of the built heritage assets would receive a moderate adverse effect; and
- One of the built heritage assets would receive a large adverse effect.

3.7.68. The Grade B1 listed Castletown House would be subject to a large adverse effect as it would require demolition to accommodate the Proposed Scheme. The two moderate adverse effects would be the result of two former railway bridges being demolished as part of the Proposed Scheme. The demolition of Castletown House and the two former railway bridges would constitute significant effects on the environment.

3.7.69. The assessment of historic landscapes identified five historic landscape types along, and in the vicinity of, the Proposed Scheme: enclosed land; settlements; communications and industry; woodland; and parks and recreation. The first two were classified as being of medium cultural heritage value and the remaining three as being of low cultural heritage value. It was concluded that the introduction of the Proposed Scheme into the existing pattern of historic landscapes would have a neutral significance of effect on the historic environment.

BIODIVERSITY

3.7.70. The assessments focused on likely impacts and effects relative to designated sites of nature conservation interest, habitats and fauna associated with the Proposed Scheme boundary and surrounding areas.

3.7.71. With regards to designated sites, the assessments investigated impacts and likely effects on four Special Protection Areas (SPAs), four Special Areas of Conservation (SACs), two Wetlands of International Importance (Ramsar sites), seven ASSIs (three of which are affiliated with SACs), one Local Nature Reserve and one proposed Natural Heritage Area (pNHA). Through a combination of sensitive design and application of appropriate mitigation, the impacts and effects for all of the designated sites would not constitute a significant effect, individually or in combination with other plans or projects.

3.7.72. Regarding habitats, the assessments investigated impacts and likely effects on rivers, woodland and scrub, grassland and marsh, bog, ponds, hedgerows, veteran trees and bryophytes. Taking into account the nature and extent of habitat loss, potential for deterioration in habitat quality and mitigation measures focused on the protection of retained habitats and habitat creation, it was concluded that impacts and effects relative to all but one habitat type would not constitute a significant effect on the environment. The exception comprises the loss of long established or ancient woodland at Mulvin Park and Routing Burn which would constitute a significant effect on the environment.

3.7.73. With regards to species of conservation concern, the assessments investigated likely impacts and effects on fish (salmon and trout in particular), and on otter, bats, red squirrel, pine marten, badger, Irish hare, deer, breeding birds, wintering birds and smooth newt. Taking into account the nature and extent of potential impacts which may affect these species (loss and deterioration of habitat, severance of established ecological corridors, disturbance, accidental killing or injury) and the proposed mitigation measures, it has been concluded that impacts and effects relative to all but one species would not constitute a significant effect on the environment. The exception is the effect on established populations of barn owl for which it is predicted that impacts from the Proposed Scheme would constitute a significant effect on the environment.

3.7.74. There are a number of key constraints within the scheme footprint and in proximity to the Proposed Scheme, in particular the presence of the eight European designated sites (SPAs and SACs) and two Ramsar sites (and/or ecologically supporting habitat associated with them) that the Proposed Scheme would interact with. However, mitigation proposals within the scheme design have significantly reduced these impacts to protected and/or sensitive sites, habitats and species of conservation concern. As such the majority of the constraints identified are considered to have a neutral appraisal score.

3.7.75. In spite of the committed mitigation measures, some residual adverse impacts remain, including the loss of ponds, aquatic flora and bryophytes on a number of watercourses and loss of habitat or disturbance to species such as newts and breeding birds. However, the Proposed Scheme also provides beneficial impacts through an increase in habitat extent in some areas, including unimproved grassland, woodland and marshy grassland, with associated benefits for species including wintering and breeding birds. Mitigation provided through the Proposed Scheme also offsets the adverse effects of airborne emissions which are predicted to affect the sensitive bog habitat and associated flora at Tully Bog SAC and ASSI. The Proposed Scheme will also result in a reduction in airborne emissions affecting Grange Wood ASSI resulting in a beneficial impact on the habitats of this designated site.

3.7.76. The TAG environment assessment concludes an assessment score of **Neutral to Slight Adverse** for biodiversity.

WATER ENVIRONMENT

3.7.77. There are six Water Framework Directive (WFD) Groundwater Bodies along the length of the Proposed Scheme with a range of sizes. WFD bedrock overall status is Good for all groundwater bodies and has been used to determine the quality and importance values for the entire Proposed Scheme appraisal.

3.7.78. This area is underlain by bedrock geology of generally low groundwater productivity but localised aquifers within superficial deposits, typically glacial sands and gravels in the River Foyle corridor, enabling groundwater abstraction for private water supplies. The study area is considered of high groundwater vulnerability, but lower vulnerability occurs where deep deposits of glacial till act as a barrier.

3.7.79. There are circa 60 cuttings with the potential for slight / moderate local impact along the Proposed Scheme, with loss of permeable area due to Proposed Scheme construction no greater than 0.1% in any of the WFD groundwater bodies.

3.7.80. Based on available survey information there are 24 active well and spring supplies within the Proposed Scheme boundary, which will require decommissioning and alternative supply. In addition, there are 79 nearby groundwater supplies which will be potentially influenced by the Proposed Scheme.

3.7.81. Local water abstractions would be sensitive to localised effects, particularly in relation to groundwater supplies.

3.7.82. Peat deposits have been identified at a number of locations along the Proposed Scheme, with crossing of peatland minimised, whilst taking account of other constraints and design requirements. Tully Bog SAC & ASSI and McKean's Moss ASSI sites are raised bogs which are considered to be primarily rainwater-fed, however, the local groundwater regime may also have an influence. The Proposed Scheme has avoided crossing these designated sites.

3.7.83. There are 19 Water Framework Directive surface water bodies along the length of the Proposed Scheme, with latest (2018) overall status ranging from Moderate (including Moderate Ecological Potential) to Good. The River Foyle and Tributaries SAC and River Finn SAC are designated channels, with the majority (northern and central areas) of the Proposed Scheme draining indirectly or directly into these systems. The southern extent of the scheme drains to the River Blackwater system. The road drainage system has been designed to reduce potential for pollution to all receiving waters.

3.7.84. Receptors sensitive to flood risk include residential areas at various locations. The greatest concern is specific to the Strabane area, where the confluence of the River Finn and Mourne River form the River Foyle, with the related hydraulic model of the Foyle River System predicting a moderate adverse impact. The other 24 hydraulic models predict non-significant or beneficial effects.

3.7.85. The other main concern from a water environment perspective relates to potential adverse effects on the very high water quality features of the River Foyle and Tributaries SAC and River Finn SAC.

3.7.86. The construction phase is considered to be the stage with the highest risk of environmental effect in terms of surface water and groundwater quality, with flood risk and abstractions of greatest concern during operation.

3.7.87. The assessment assumes that the Proposed Scheme detailed design, construction and operational activities shall take account of the design features and mitigation measures identified in both the ESA 2022 (and preceding relevant documents) and the Flood Risk Assessment to protect surface water features, groundwater and floodplain.

3.7.88. Across surface water, flooding and groundwater appraisal categories, the overall scheme appraisal is evaluated as being of moderate adverse effect and therefore significant. This outcome is based on the localised flood risk outcome from the Foyle River System model. Detail on the mitigation can be found within the ESA 2022 Chapter 15, Section 16.5, and associated Appendix 16-1 – Flood Risk Assessment.

3.8 SOCIAL AND DISTRIBUTIONAL IMPACTS (SDIs) OF FULL SCHEME

3.8.1. An appraisal of the social impacts of the Proposed Scheme and the distribution of these impacts was carried out using the guidance set out in *TAG Units A4.1 (Social Impact Appraisal)* and *A4.2 (Distributional Impact Appraisal)*.

3.8.2. This assessment built upon the assessment of the impacts of the Proposed Scheme on the users of local roads, the results of which are reported in Chapter 14 of the Environmental Statement (ES) 2016 and further reported in Chapter 12 of the ESA 2022. Both assessments were undertaken with reference to the methodology set out in the Design Manual for Roads and Bridges (DMRB).

SCOPE OF SOCIAL IMPACTS

3.8.3. Guidance on the appraisal of social impacts is set out in *TAG Unit A4.1* released by the DfT in July 2021. This defines social impacts as the effects covering the human experience of the transport system and its impact on social factors (and have not been considered as part of economic or environmental impacts).

3.8.4. A total of eight social impacts are identified as follows:

- accidents
- physical activity (walking and cycling)
- security
- severance
- journey quality (perceived physical and social environment experienced while travelling)
- option and non-use values (changes to the availability of services e.g., closure / opening of bus and rail services)
- accessibility and
- personal affordability

3.8.5. Of the above, accidents, severance and personal affordability are of most relevance to highway schemes and therefore formed the basis for the Social Impact Appraisal undertaken for the Proposed Scheme[73]. A qualitative assessment of journey quality has also been undertaken as part of the social impact assessment.

SOCIAL IMPACTS – ACCIDENTS

3.8.6. The assessment of the Social Impact of accidents was undertaken in accordance with *TAG Unit A4.1* and comprised:

- the forecast numbers of accidents by severity between the 'with scheme' (Do-Something) and 'without scheme' (Do-Minimum) scenarios across the whole network;
- overall accident costs for the Do-Minimum and Do-Something scenarios; and
- monetised benefits as a result of the change in accident costs.

3.8.7. As described earlier, the DfT COBALT program was used to calculate the number and cost of accidents, between the 'without scheme' and 'with scheme' scenarios. The assessment of the reduction in accidents as a result of the Proposed Scheme using COBALT is fully documented in Section 3.6.

3.8.8. The value of the prevention of an accident varies by accident type (severity). The number of accidents on a given length of road is expressed as an accident rate, defined as 'Personal Injury Accidents per million vehicle-kilometres'.

3.8.9. Local accident data has been used for the existing A5. It is noted that the local data shows that accident rates are, in general terms, slightly lower than national average rates for single carriageway roads. Therefore, the predicted accidents from COBALT will reflect the lower than average rates for the existing A5.

3.8.10. An injury accident is classified according to the most severe casualty and may involve more than one casualty. The severity of the injuries sustained is defined by the following categories:

- fatality: any death that occurs within 30 days from causes arising out of the accident;
- serious injury: records casualties who require hospital treatment and have lasting injuries, but who do not die within the recording period for a fatality; and
- slight injury: where casualties have injuries that do not require hospital treatment, or if they do, the effects of the injuries quickly subside.

3.8.11. Table 3-22 shows the predicted numbers of casualties from COBALT by severity for both with and without scheme forecasts over the 60-year appraisal period, 2027 to 2086.

[73] In the context of TAG Unit A4.1, accessibility refers to public transport opportunity which has not been modelled nor scientifically assessed. However, the construction of the Proposed Scheme and the transfer of traffic off the existing road (and bus) network will provide opportunity for the bus operators to operate a more efficient service and as such provide benefits to the public transport user.

Table 3-22: Forecast number of casualties (over 60 years)

Severity	Number of Casualties		
	Without Scheme	With Scheme	Difference
Fatal	456	421	36
Serious	4,948	4,507	442
Slight	46,596	43,281	3,315
Total	52,001	48,208	3,793

3.8.12. Table 3-22 shows the reduction in the total number of casualties and by each type of individual severity category. The total reduction in the number of fatal, serious and slight casualties is predicted to be 3,793. The costs of accidents by category of severity, together with the net benefits of the Proposed Scheme are summarised in Table 3-23.

Table 3-23: Costs of accidents by severity (over 60 years)

	Costs (£M)		
Severity Category	Without Scheme	With Scheme	Difference
Fatal	357.87	330.03	27.84
Serious	426.09	388.50	37.59
Slight	306.85	285.27	21.57
Costs	Without Scheme	With Scheme	Difference
Insurance	13.93	12.83	1.10
Damage	472.91	437.54	35.37
Police	18.95	17.51	1.44
Total	1,596.59	1,471.67	124.92

3.8.13. Table 3-23 demonstrates that the total reduction in the accident costs as a result of the Proposed Scheme is predicted to be £124.92 million.

SOCIAL IMPACTS – SEVERANCE

3.8.14. *TAG Unit A4.1* defines community severance as the separation of residents from facilities and services they use within their community. It advises that severance should be assessed based on the impacts on pedestrians. For example, where infrastructure presents a physical barrier to movement or where vehicle flows are significant enough to impede pedestrian movement.

3.8.15. Guidance on the assessment of severance impacts is also provided in DMRB Volume 11. This focuses on community facilities and routes affected by severance in various locations.

3.8.16. An assessment of the impact of the Proposed Scheme on local routes used by pedestrians, cyclists and equestrians (through closure or re-alignment) is reported in Chapter 14 of the ES 2016 and further reported in Chapter 12 of the ESA 2022. Both assessments were undertaken in accordance with the guidelines set out in DMRB Volume 11, Section 3, Part 8 (Pedestrians, Cyclists, Equestrian and

Community Effects). This also includes an assessment of the reduction of severance along the existing A5 as a result of traffic transfer to the Proposed Scheme.

3.8.17. TAG advises that the impact of a transport scheme on severance should be based on an assessment of the level of severance with and without the scheme at a number of locations across the network.

3.8.18. Additional analysis was therefore undertaken that built on the work reported in the ES and ESA, to meet the requirements of TAG. This encompassed an analysis of the roads experiencing a change in traffic flow as a result of the scheme, and an analysis of the impact of changes in traffic flows in the vicinity of schools and pedestrian crossings where pedestrian movements are likely to be high. The additional analysis is described below.

Analysis Of Changes in Link Flows

3.8.19. An analysis of traffic flows was undertaken to identify links with flow changes of 10% or more as a result of the Proposed Scheme. The analysis was undertaken for the opening year, 2028 and was based on Annual Average Daily traffic flow totals (AADT). Figure 3-4 shows the links with flow increases and flow decreases of 10% or more. The number of roads with a decrease in flow exceeds the number experiencing an increase. This demonstrates that there will be a net reduction in the Severance Impact as a result of the Proposed Scheme, although the extent of the impact will depend upon the character of the individual road.

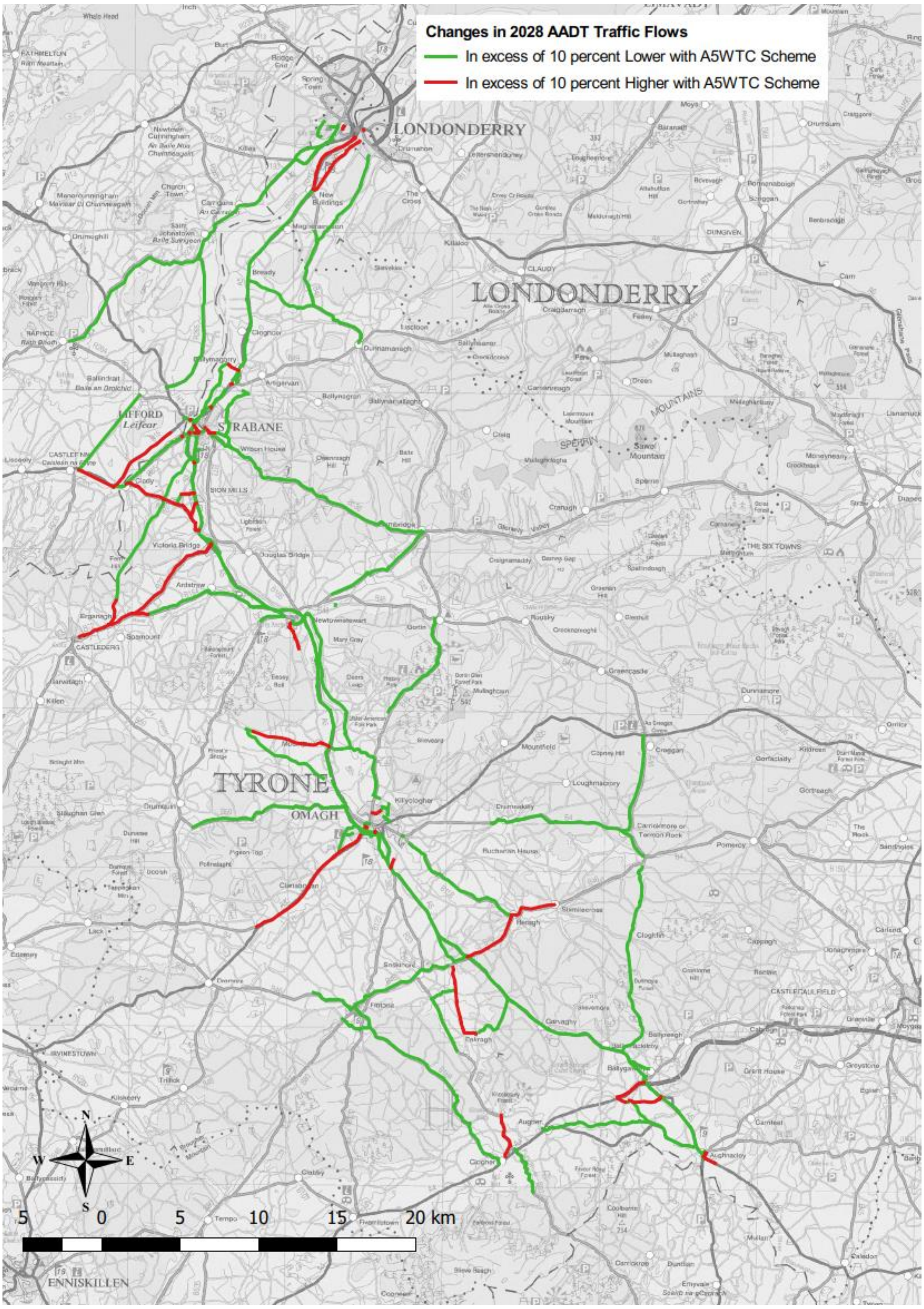

Figure 3-4: Links with flow changes greater than 10% lower and 10% higher as a result of the Proposed Scheme (2028 AADT)

Schools

3.8.20. TAG describes a number of local amenities where severance might be an issue in the context of a proposed transport facility. Given the size of the area affected by the Proposed Scheme, Primary Schools have been selected as a proxy for all community facilities and because they attract a high number of pedestrians. A total of 36 schools are located within the traffic model simulation area. These 36 schools are deemed to be affected by changes in traffic flow as a result of the Proposed Scheme. Figure 3-5 shows the location of the schools.

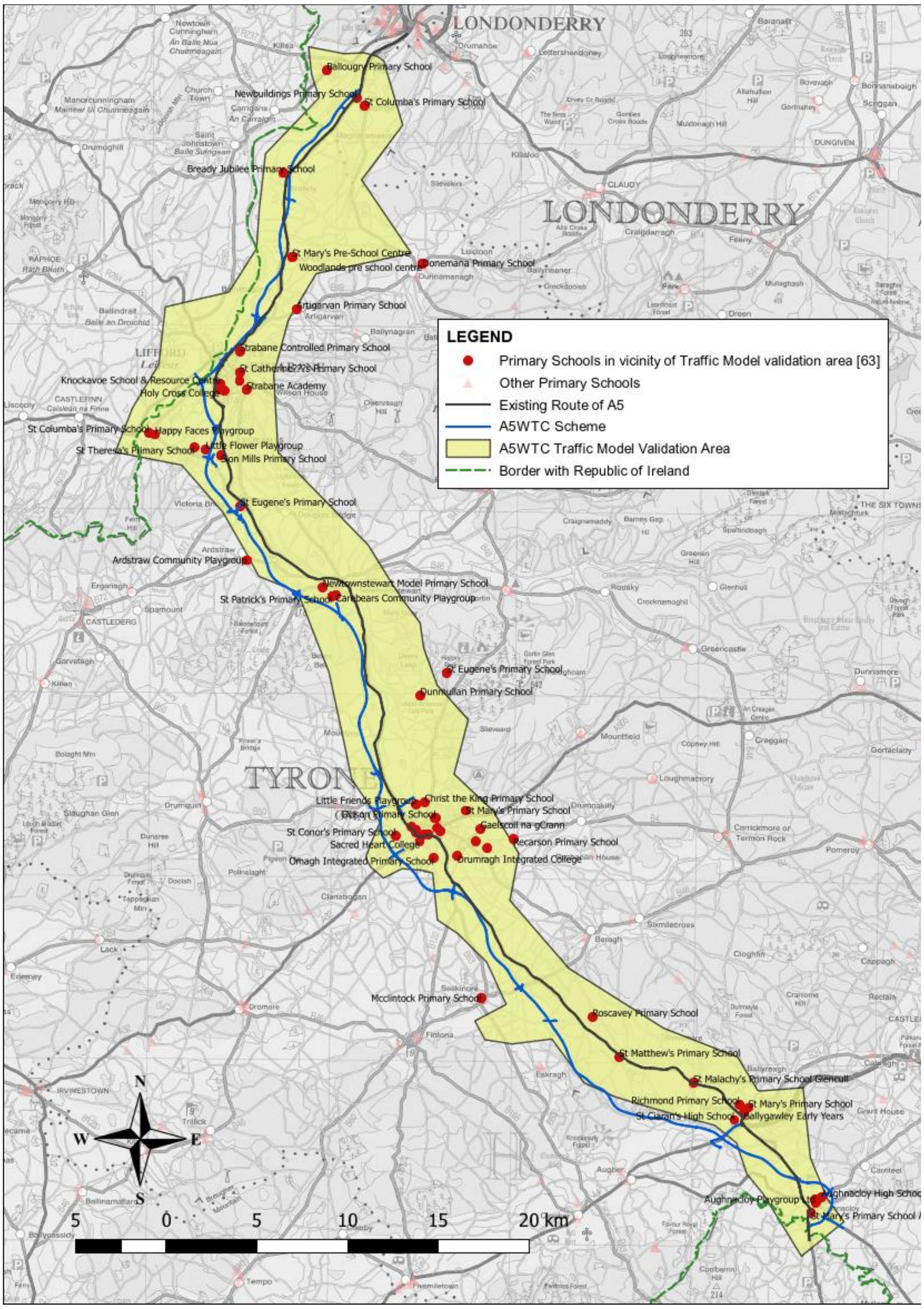

Figure 3-5: Location of primary schools affected by Proposed Scheme

3.8.21. Traffic flows were analysed by defining the closest roads near to each school (that could have an impact in order to capture changes in traffic movements).

3.8.22. The traffic flow analysis for each school is presented in Table 3-24, which shows the average change in flow within the roads defined near to each school.

Table 3-24: Traffic flow changes on roads nearby school affected by the Proposed Scheme

Primary School Name	Town	Average flow (AADT24 - 2028)		
		Without Scheme	With Scheme	Difference
Ardstraw Jubilee Primary School	Omagh	2,552	683	-73%
Artigarvan Primary School	Strabane	2,202	2,219	1%
Aughnacloy Primary School	Aughnacloy	2,448	1,683	-31%
Ballougry Primary School, Londonderry	Londonderry	2,526	1,875	-26%
Bready Jubilee Primary School	Strabane	7,240	457	-94%
Christ the King Primary School	Omagh	3,539	3,410	-4%
Donemana Primary School	Strabane	1,898	1,886	-1%
Gaelscoil na gCrann	Omagh	2,671	2,617	-2%
Gaelscoil U¡ Dhochartaigh	Strabane	2,844	2,673	-6%
Gibson Primary School	Omagh	4,141	3,960	-4%
Holy Family Primary School	Omagh	7,804	6,589	-16%
Mcclintock Primary School	Seskinore	1,155	960	-17%
Newbuildings Primary School	Newbuildings	4,866	1,437	-70%
Newtownstewart Model Primary School	Newtownstewart	882	645	-27%
Omagh County Primary School	Omagh	7,684	7,665	0%
Omagh Integrated Primary School	Omagh	2,440	1,863	-24%
Recarson Primary School	Omagh	2,115	1,911	-10%
Richmond Primary School	Ballygawley	2,674	1,394	-48%
Roscavey Primary School	Omagh	5,204	1,157	-78%
Sion Mills Primary School	Sion Mills	3,614	1,017	-72%
St Catherine's Primary School	Strabane	2,851	2,814	-1%
St Columba's Primary School, Clady	Clady	2,333	2,374	2%
St Columba's Primary School	Newbuildings	4,259	1,315	-69%
St Conor's Primary School	Omagh	3,255	2,749	-16%
St Eugene's Primary School	Strabane	2,800	1,314	-53%
St Eugene's Primary School, Omagh	Omagh	617	527	-14%
St Malachy's Primary School, Glencull	Glencull	7,235	1,240	-83%
St Mary's Primary School, Cloughcor	Cloughcor	7,409	532	-93%
St Mary's Primary School Aughnacloy	Aughnacloy	2,912	1,969	-32%
St Mary's Primary School, Ballygawley	Ballygawley	2,506	1,471	-41%
St Mary's Primary School, Omagh	Omagh	2,998	2,961	-1%
St Mary's Primary School, Strabane	Strabane	2,831	2,209	-22%
St Matthew's Primary School	Garvaghy	7,129	1,154	-84%
St Patrick's Primary School	Newtownstewart	459	468	2%
St Theresa's Primary School	Glebe	961	975	1%
Strabane Controlled Primary School	Strabane	5,905	2,891	-51%
All Affected Primary Schools		**126,959**	**73,064**	**-42%**

3.8.23. Of the 36 schools analysed, 32 would experience a net reduction in traffic flows in the catchment area, ranging from -94% to -0.2%. Four schools are predicted to experience a slight increase in traffic flows, ranging from 0.8% to 2%. In total, there is predicted to be a net reduction in traffic flows across all schools of around 42%. The reduction in traffic flows could lead to improved safety in the vicinity of schools and would be a significant benefit to the local areas around the schools.

Pedestrian Crossings

3.8.24. An important aspect of severance is the difficulty associated with crossing roads. To assess this element of severance, each pedestrian crossing location along the A5 within the study area was identified and the traffic flow with and without the scheme at each crossing was extracted from the traffic model.

3.8.25. The crossings included within the analysis includes crossings at road junctions, standalone signalised pedestrian crossings and non-signalised pedestrian crossings.

3.8.26. A total of 36 locations were identified that contained 50 crossing places. These 36 locations are shown in Figure 3-6.

3.8.27. For the purposes of the analysis and where pedestrian crossings are located at road junctions, the traffic flows on each arm of the junction were extracted. Overall, the analysis showed that traffic flows decrease at 46 of the 50 crossing places and increase at only 4 locations. It should be further noted that 32 of the 50 crossings (64%) experience a traffic flow reduction greater than 50%.

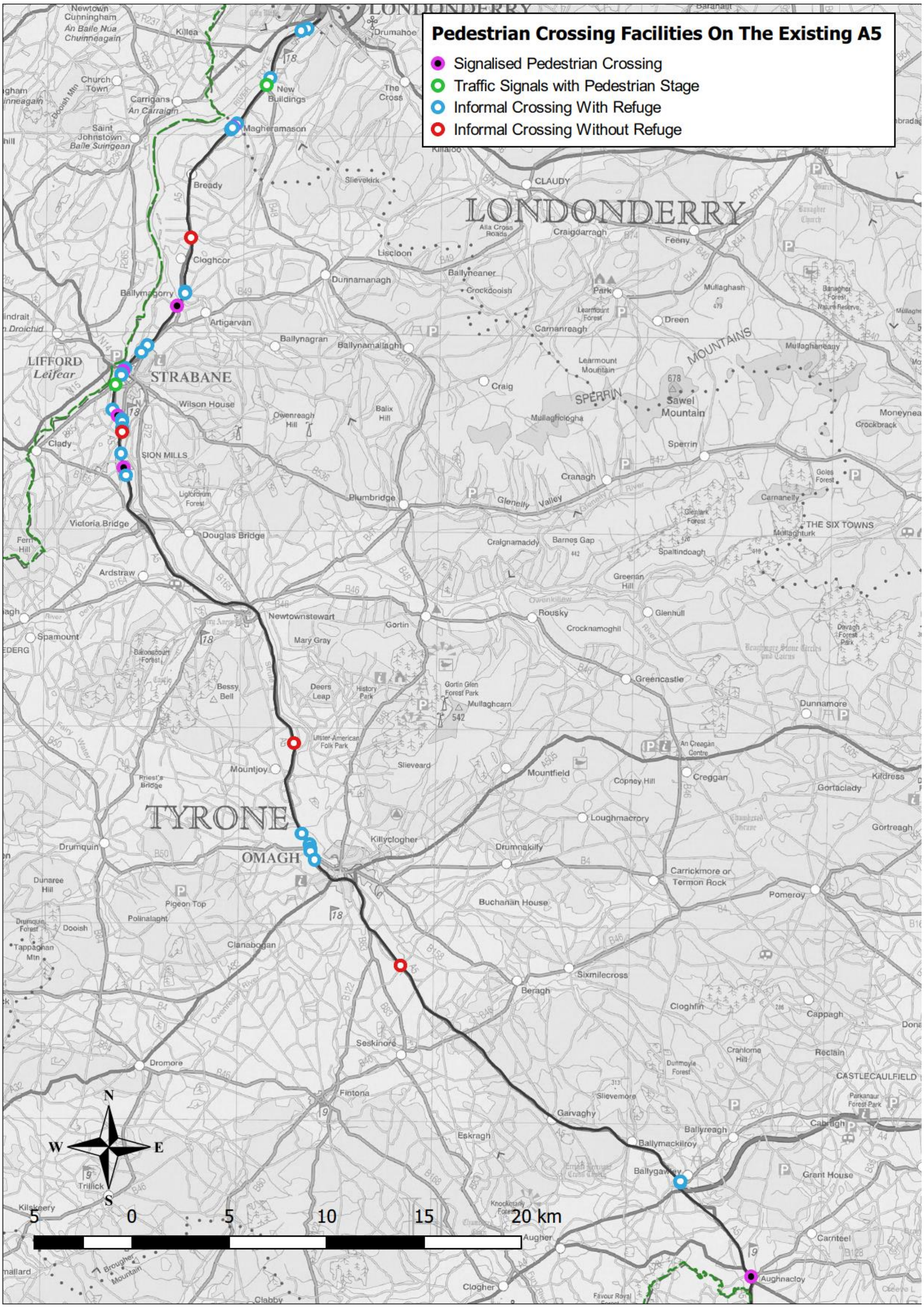

Figure 3-6: Location of pedestrian crossing facilities

SOCIAL IMPACTS – PERSONAL AFFORDABILITY

3.8.28. Personal affordability is a social impact that relates to the monetary cost of travel which can be a major barrier to mobility for certain groups of people.

3.8.29. The assessment of personal affordability was based on an analysis of the change in vehicle operating costs as a result of the Proposed Scheme. The change in vehicle operating costs was analysed for separate income groups and is therefore a Distributional Impact. This analysis is presented in the following section below alongside other Distributional Impacts.

SOCIAL IMPACTS – JOURNEY QUALITY

3.8.30. Journey quality is a measure of the real and perceived physical and social environment experienced while travelling, and includes such factors as public information provision, perception of safety and provisions for accessibility.

3.8.31. Journey quality impacts can be sub-divided into three groups: traveller care, travellers' views and traveller stress. For a qualitative approach, the difference between the with-scheme (Do-Something) and without-scheme (Do-Minimum) is looked at to understand if it would be better, worse or neutral, for each sub-factor and overall.

3.8.32. Traveller stress for the Do-Minimum scenario predicts that the majority of road sections along the existing A5 would be of Moderate or High levels of driver stress, except for road section J15-J16 (A4/A5 Junction to Lissenderry) with a Low level of driver stress.

3.8.33. Driver stress level would be reduced to Low for the majority of the road sections along the Proposed Scheme in Do-Something (future design year) scenario. Except for the northernmost section of the Proposed Scheme J1–J2 at New Buildings, where a reduced level of driver stress from High (Do-Minimum) to Moderate (Do-Something) is expected. The Proposed Scheme is also expected to accommodate an overall higher volume of traffic due to the additional lanes along the existing A5.

3.8.34. The analysis demonstrates that there would be a reduced level of driver stress under the Do-Something scenario for the Future Design Year. This would primarily be due to the decrease in frustration resulting from upgrade from single to dual carriageway. In addition, motorised users would also benefit from a reduction in the fear of potential accidents and route uncertainty. Overall for traveller stress there would be a Moderate Beneficial impact as a result of the Proposed Scheme.

3.8.35. Traveller Care is not a relevant factor in a new highway scheme and therefore not included as part of qualitative appraisal.

3.8.36. Traveller views are considered to be broadly similar in context to those of the current A5 corridor, in terms of the landscape types experienced and in their sequential experience. The Proposed Scheme in diverting away from existing A5 will, however, afford some degree of difference in traveller perspective.

3.8.37. The design profile of the dual carriageway, experienced at higher and less interrupted travelling speeds will subtly change the way in which the landscape is experienced from a traveller perspective. Design parameters to accommodate the route alignment often require a greater degree of intervention on the landscape by way of cutting and embankment, more so than for a single lane carriageway. The resulting sense of visual enclosure and exposure may serve as a stimulus for traveller views and overall journey experience; conversely there may also be a reduced sense of the road fitting with the landscape, contributing to a less satisfactory journey experience.

3.8.38. Areas of beneficial traveller experience are considered to include the bypass lengths of Omagh and south Strabane, where the distinct urban enclosure and restriction of traffic movement associated with the existing A5 corridor would contrast with the fewer junction interfaces and semi-rural context associated with the Proposed Scheme. The more elevated nature of open views along the Strule and Mourne Valleys will likely enhance the sense of journey for road travellers through this visually appealing and more remote landscape between Strabane and Omagh, as will the transition of the Brougher Ridge towards Ballygawley through a more remote landscape setting. Within the Foyle Valley and in particular towards Derry/Londonderry, the closer proximity of the Proposed Scheme to the river setting will intensify the traveller experience.

3.8.39. The potential for adverse traveller views will relate to those sections where the greatest perception of intervention on the landscape are experienced. This would include the deeper road cuttings such as the approach and transition of Sollus Hill within the Foyle Valley, the approach in cutting to the River Finn near Strabane and the negotiation of major cuttings across the Brougher Ridge at Tycanny Hill and Errigal.

3.8.40. Overall for journey quality there would be a Moderate Beneficial Impact.

DISTRIBUTIONAL ANALYSIS OF USER BENEFITS

3.8.41. User benefits in the form of journey time savings are experienced in certain areas / locations and by different groups of people. While it is not possible to attribute social impacts to user benefits, *TAG Unit 4.2* requires that an assessment of the distribution of benefits be undertaken to determine the impact amongst different income groups.

3.8.42. The Distributional Impacts of user benefits are based on the time benefits of the scheme, derived from TUBA output. The Distributional Impact analysis is undertaken for non-business journeys since these impacts are experienced by individuals on commuting and other trip purposes.

3.8.43. The Distributional Impact analysis for the Proposed Scheme is based on Northern Ireland Indices of Multiple Deprivation (NIIMD). NIIMDs were obtained for each area in Northern Ireland from NINIS[74] at Ward (and Super Output Area, SOA) level.

3.8.44. There are some 462 Wards in NI and 890 SOAs. These were matched against the traffic model zones as the analysis uses data from the TUBA appraisal. A system of 220 zones for the SDI analysis were defined to facilitate the comparison of NIIMD data and TUBA outputs.

3.8.45. The NIIMDs were ranked in quintiles ranging from the most deprived to the least deprived areas for each SDI zone together with population data from the 2011 Census [75].

3.8.46. The benefits comprising user time benefits for non-business journeys, i.e. commuting and other purposes, were extracted from the TUBA economic appraisal. The benefits were then aggregated for each SDI zone individually across Northern Ireland only and allocated to a category of deprivation. The benefits were then summed by category to provide a total value of benefits for each quintile of deprivation and expressed as a proportion or ‘share’ of the benefits.

3.8.47. The distribution of user benefits in presented in Table 3-25.

[74] NINIS is the Northern Ireland Neighbourhood Information service, https://www.ninis2.nisra.gov.uk/public/Home.aspx
[75] Full Census 2021 data is not available yet for Northern Ireland.

Table 3-25: Distribution of User Benefits

	NI Multiple Deprivation Measures 2017 – Income Domains Most deprived ← → Least deprived					Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Total Benefits (£M)	122.81	66.06	109.86	54.51	7.39	360.63
Total disbenefits (£M)	0.00	0.00	0.00	0.00	0.00	0
Share of User Benefits	34%	18%	30%	15%	2%	
Share of User Disbenefits	-	-	-	-	-	
Share of Population	20%	21%	20%	19%	20%	
Assessment	+++	++	+++	++	+	

3.8.48. Table 3-25 demonstrates that the total benefits, excluding indirect tax revenue, amount to some £360.63M at 2010 prices discounted to 2010 with the highest benefits accruing to the most deprived areas. The assessment score follows the example given in *TAG Unit A4.2*, where 3 pluses (ticks in TAG) are allocated where the benefits (for any quintile) exceed the % population by 5% or more. The two most deprived quintiles both have 3 and 2 pluses[76] respectively.

DISTRIBUTIONAL ANALYSIS OF ACCIDENT BENEFITS

3.8.49. *TAG Unit A4.2* advises that the Distributional Impact analysis should consider vulnerable groups of road users who may be particularly prone to accidents. These include:

- children
- older people
- young males (as drivers)
- motorcyclists; and
- cyclists

3.8.50. The social impact of the Proposed Scheme was described in Section 3.8.6 above. This showed that there would be a reduction in accidents resulting in an overall benefit. The purpose of the distributional assessment is to identify whether, within the overall benefit, there are specific vulnerable groups potentially disadvantaged by the Proposed Scheme. The screening process set out in TAG requires that if the intervention is likely to cause significant changes to traffic levels, then a distributional assessment of accidents should be undertaken.

3.8.51. In the '*Social Impacts – Severance'* section, Figure 3-4 identified links for which traffic flows change by more or less than 10%. This showed that the Proposed Scheme would provide relief to the majority of the existing road network but with a number of connecting roads to the Proposed Scheme showing increases in traffic flow. It was therefore determined that a distributional appraisal for accidents should be undertaken.

[76] According to the System for Grading of Transport user Benefits for social groups (TAG Unit A4.2):
3 pluses (+++) mean Beneficial and 5% or more greater than the proportion of the group in the population.
2 pluses (++) mean Beneficial and in line (+/- 5%) with the proportion of the group in the population.

3.8.52. An analysis of the observed accident data was undertaken to identify whether any of the specific vulnerable groups represented a significantly higher proportion compared with the national average for Northern Ireland. Where this was shown to be the case, further analysis was undertaken to assess the impact of the Proposed Scheme in relation to the specific vulnerable groups and whether there is a beneficial or adverse impact.

3.8.53. Observed (PIA) accident data was obtained from Police Service Northern Ireland (PSNI) records for the 5 years 2015-2019 inclusive. This data was analysed to identify the proportion of accidents that include casualties in each of the vulnerable groups. This was then compared with the overall NI proportion.

3.8.54. For the purpose of the analysis, a total of 7 areas were defined which include the areas most affected by the proposed scheme. The number of casualties within each area was summed to ensure that there were over 50 to be consistent with the TAG. Figure 3-7 defined the areas identified for the distributional assessment.

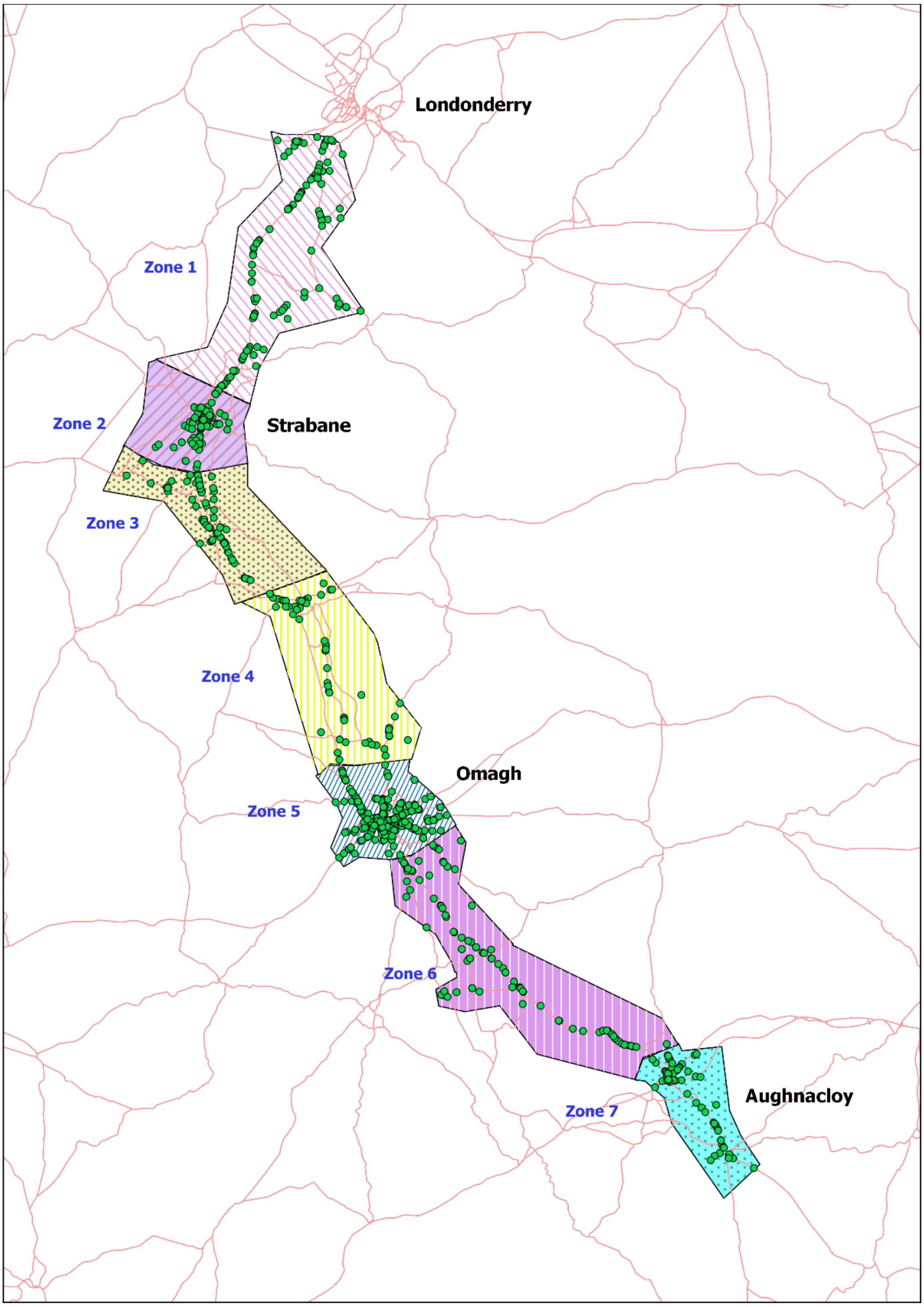

Figure 3-7: Areas defined for Distributional Impact Assessment of Accidents

3.8.55. Table 3-26 shows the number of casualties over the 5-year period within each zone among vulnerable users subdivided to show those occurring on the A5 separately from those on other roads.

Table 3-26: Number of casualties (vulnerable groups) for the period 2015-2019 by Zone

Zone	Description	Number of Casualties		
		A5	Other Roads	All Roads
1	Londonderry to Strabane	128	60	188
2	Strabane	72	132	204
3	Strabane to Newtownstewart	118	32	150
4	Newtownstewart to Omagh	49	37	86
5	Omagh	78	169	247
6	Omagh to Ballygawley	135	14	149
7	Ballygawley to Aughnacloy	56	10	66
Total All Zones		**636**	**454**	**1090**

3.8.56. Table 3-26 shows that the total number of casualties recorded within each zone (covering all roads) ranges between 66-247. For each zone, the proportion of casualties for each of the identified vulnerable groups was calculated. This was compared with national average statistics so as to identify any zones where there may be a 'hotspot' of casualties involving the vulnerable groups. A 'hotspot' is defined by TAG where the proportion of vulnerable group casualties is 30% higher or more than the national average.

3.8.57. Table 3-27 shows the national average for each vulnerable group and the proportion within each zone. When the casualties associated with a particular vulnerable group are 30% higher than the national average, they are highlighted as 'hotspots'.

Table 3-27: Distributional Analysis of Accidents involving Vulnerable Groups

		Pedestrian	Motorcyclist	Cyclist	Children	Aged 65+	Young Drivers
National Average		**7.18%**	**3.20%**	**3.26%**	**11.14%**	**9.99%**	**11.63%**
All	Zone 1	2.13%	1.60%	1.06%	5.32%	8.51%	18.09%
	Zone 2	10.29%	0.49%	2.94%	17.73%	5.42%	7.84%
	Zone 3	0.67%	2.00%	0.67%	5.33%	12.00%	9.33%
	Zone 4	2.33%	1.16%	2.33%	1.16%	18.60%	18.60%
	Zone 5	8.10%	2.02%	2.83%	12.96%	10.12%	9.31%
	Zone 6	1.34%	0.00%	0.00%	7.38%	16.78%	14.77%
	Zone 7	0.00%	1.52%	0.00%	4.55%	9.09%	10.61%
Total All		3.55%	1.26%	1.40%	7.78%	11.50%	12.65%

3.8.58. Table 3-27 shows that across all zones, the proportions of casualties within each vulnerable group is broadly consistent with the national average. This provides confidence in the data set used for the assessment. Vulnerable groups in zones which are identified as 30% (or more) higher than the national average, are highlighted as follows:

- Zone 1 – Young Drivers (Aged 17-24yrs);
- Zone 2 – Pedestrians and children (aged 16yrs and under);
- Zone 4 – Elderly (Aged 65yrs and greater) and Young Drivers (Aged 17-24yrs); and
- Zone 6 – Elderly (Aged 65yrs and greater).

3.8.59. A detailed analysis of the casualties in Zones 1, 2, 4 and 6 where flow changes of more than 10% are experienced is presented in Table 3-28 below.

Table 3-28: Casualties 2015-2019 by Vulnerable Group hotspots, Forecast Flow Change

<table>
<tr><th rowspan="3">Zone</th><th rowspan="3">Vulnerable Group</th><th colspan="4">Number of Casualties</th><th rowspan="3">Assessment</th></tr>
<tr><th colspan="2">Locations with Vulnerable Group Casualties are 'High'</th><th colspan="2">All Locations</th></tr>
<tr><th>With flow increase 10% or more</th><th>With flow decrease 10% or more</th><th>10% or more link flow increase</th><th>10% or more link flow decrease</th></tr>
<tr><td>2</td><td>Pedestrians</td><td>4</td><td>17</td><td>6</td><td>44</td><td>Large Beneficial</td></tr>
<tr><td>-</td><td>Motorcyclists</td><td>0</td><td>0</td><td>2</td><td>12</td><td>Moderate Beneficial</td></tr>
<tr><td>-</td><td>Cyclists</td><td>0</td><td>0</td><td>3</td><td>15</td><td>Moderate Beneficial</td></tr>
<tr><td>2</td><td>Children under 17</td><td>2</td><td>34</td><td>14</td><td>87</td><td>Large Beneficial</td></tr>
<tr><td>1</td><td rowspan="2">Young Drivers</td><td>4</td><td>30</td><td rowspan="2">28</td><td rowspan="2">104</td><td rowspan="2">Large Beneficial</td></tr>
<tr><td>4</td><td>0</td><td>16</td></tr>
<tr><td>4</td><td rowspan="2">Elderly 65+</td><td>2</td><td>14</td><td rowspan="2">17</td><td rowspan="2">100</td><td rowspan="2">Large Beneficial</td></tr>
<tr><td>6</td><td>2</td><td>23</td></tr>
</table>

3.8.60. Further analysis was undertaken for the zones for where the number of vulnerable groups was higher than the national average. This was undertaken by identifying (for these groups) whether the Proposed Scheme would result in an increase or decrease in the volume of traffic on specific links. The analysis was further split into links on the existing A5 and links on surrounding roads.

3.8.61. Table 3-29 shows the number of vulnerable group casualties in each zone and whether these occur on links where there is a flow increase or decrease by more than 10%. These are highlighted for the zones which include a 'hotspot'.

3.8.62. The observed casualties highlighted in red occur on links where flows are forecast to increase and green for links where flows are forecast to decrease. Yellow denotes where no accidents occurred.

3.8.63. Table 3-29 shows that there may be an adverse impact at some locations which are shown in red indicating flow increases. However, in overall terms, there are many more roads having a decrease in traffic flows which indicates a clear beneficial impact in those areas where vulnerable groups are identified as being higher than the national average.

3.8.64. In overall terms the assessment shows that the majority of existing 'hotspot' accidents involving vulnerable groups occur on roads where there is forecast to be a reduction in flows (and hence accidents) associated with the Proposed Scheme.

3.8.65. The Assessments follow the criteria given in *TAG Unit A4.2*, Table 11, and show the results to be mostly Large Beneficial. For Motorcyclists and cyclists, the assessment is given as Moderate Beneficial as there are no hotspots for this category in the impact area of the scheme.

Table 3-29: Number of casualties over 2015-2019 by Zone for each Vulnerable Group

Zone	Pedestrians				Motorcyclist				Cyclists				Children Under 17				Elderly (65+)				Young Drivers			
	Increase		Decrease		Increase		Decrease		Increase		Decrease		Increase		Decrease		Increase		Decrease		Increase		Decrease	
	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other	A5	Other
Zone 1	0	0	3	1	0	1	0	2	0	0	2	0	2	0	7	1	2	1	10	3	3	1	14	16
Zone 2	0	4	4	13	0	0	0	1	0	0	3	3	0	2	9	25	0	0	3	8	0	3	5	8
Zone 3	0	0	1	0	0	0	3	0	0	1	0	0	0	1	7	0	0	1	17	0	0	5	9	0
Zone 4	0	0	0	2	0	0	0	1	0	0	0	2	0	0	1	0	0	2	5	9	0	0	10	6
Zone 5	0	2	2	16	0	1	1	3	0	2	1	4	0	7	6	19	0	8	7	10	0	12	2	9
Zone 6	0	0	1	1	0	0	0	0	0	0	0	0	0	0	11	0	0	2	23	0	0	3	18	1
Zone 7	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	1	0	1	5	0	0	1	6	0

DISTRIBUTIONAL ANALYSIS OF SEVERANCE

3.8.66. *TAG Unit A4.2* identifies a number of groups who are potentially vulnerable to the effects of severance as a result of the transport network that form the basis of a Distributional Impact assessment. These are listed below:

- people without access to a car or van
- older people
- people with disabilities
- parents with pushchairs and children

3.8.67. Data was obtained for these groups from the 2011 Census at Output Area level for the area of impact of the Proposed Scheme. This data comprises:

- the percentage of no-car households
- the percentage of older residents (70+yrs)
- the percentage of households with disabled residents
- the percentage of children (aged 16yrs and under)

3.8.68. For each group, the mean percentage and a standard deviation were calculated and outliers identified where the percentage exceeded 1.96 Standard deviations above the mean.

3.8.69. This definition follows conventional statistical analysis of outliers, assuming a normal distribution. The analysis identified a group of 20 Output Areas (OAs) where the percentages were 'significantly' higher than the average.

3.8.70. These selected output areas were then overlaid on a map of the traffic model network in order to identify which model links occurred in the Output Areas and the corresponding Small Areas. This resulted in 125 individual links. Links that formed part of the Proposed Scheme were excluded on the basis that pedestrian access will not be provided for and will be discouraged.

3.8.71. Forecast traffic flows were extracted for each of the identified network links, with and without the scheme, using the AADT as an indicator of the traffic pattern.

3.8.72. The majority of the links showed a decrease in traffic flow, indicating that pedestrians in the vulnerable groups would benefit from the scheme in terms of reduced severance. A small minority of road links showed increases in traffic, although these increases were mainly where link flows were quite low.

3.8.73. Table 3-30 summarises the flows aggregated to the Small Areas, in terms of average flow across all links in each Small Area and shows that in 19 of the 22 Small Areas, there is a net reduction in traffic flow. This demonstrates a net benefit to vulnerable pedestrians, reducing severance.

Table 3-30: Severance Impacts

Households without Cars				
		Average Traffic Flow (2028 - AADT24 hr Flow)		
Small Area	Ward_2014	Without Scheme	With Scheme	Difference
N00004432	STRULE	6,838	6,242	-9%
N00004475	STRABANE NORTH	144	141	-2%
Children				
Small Area	Ward	Average Traffic Flow (2028 - AADT24 hr Flow)		Difference

		Without Scheme	With Scheme	
N00004403	GORTRUSH	3,544	4,560	29%
N00004534	FINN	5,447	2,204	-60%
Elderly				
		Average Traffic Flow (2028 - AM)		
Small Area	Ward	Without Scheme	With Scheme	Difference
N00004344	CAMOWEN	3,774	3,544	-6%
N00004345	CAMOWEN	6,615	6,551	-1%
N00004360	DERGMONEY	2,528	2,074	-18%
N00004413	STRULE	2,849	2,794	-2%
N00004432	STRULE	6,838	6,242	-9%
N00004536	STRABANE WEST	2,593	2,018	-22%
Disabled				
Small Area	Ward	Average Traffic Flow (2028 - AADT24 hr Flow)		Difference
		Without Scheme	With Scheme	
N00004344	CAMOWEN	3,774	3,544	-6%
N00004345	CAMOWEN	6,615	6,551	-1%
N00004348	CAMOWEN	5,029	4,966	-1%
N00004349	KILLYCLOGHER	1,952	1,660	-15%
N00004356	COOLNAGARD	6,631	7,176	8%
N00004361	DERGMONEY	4,029	4,049	1%
N00004382	CAMOWEN	1,136	1,090	-4%
N00004413	STRULE	2,849	2,794	-2%
N00004432	STRULE	6,838	6,242	-9%
N00004452	STRABANE WEST	2,676	2,470	-8%
N00004521	STRABANE WEST	2,137	1,714	-20%
N00004536	STRABANE WEST	2,593	2,018	-22%

DISTRIBUTIONAL ANALYSIS OF PERSONAL AFFORDABILITY

3.8.74. In accordance with *TAG Unit A4.2*, the assessment of the Distributional Impact of Personal Affordability was undertaken with reference to the distribution of costs among different income groups. This was based upon the Indices of Multiple Deprivation (IMD) ranked into quintiles as adopted for the analysis of user benefits.

3.8.75. Since personal affordability is concerned with changes in the monetary cost of travel, vehicle operating costs were used for the analysis. The car fuel and non-fuel costs, excluding vehicles in working time, were extracted from TUBA. These were then accumulated at the production end of each trip and mapped to the zones defined for the SDI analysis.

3.8.76. Table 3-31 presents the results of the Personal Affordability Impact, showing the distribution of user costs (VOC) by IMD quintiles.

Table 3-31: Distributional Analysis of User Costs

	NI Multiple Deprivation Measures 2010 – Income Domains Most deprived				Least deprived	Total
	0%-20%	20%-40%	40%-60%	60%-80%	80%-100%	
Total Increase in User Charges (£M)	6.98	4.62	2.85	1.95	1.64	18.04
Total Decrease in User Charges (£M)	0.00	0.00	0.00	0.00	0.00	0
Share of User Charge Increase	39%	26%	16%	11%	9%	
Share of User Charge Decrease	-	-	-	-	-	
Share of Population	20%	21%	20%	19%	20%	
Assessment	+++	++	++	+	+	

3.8.77. Table 3-31 shows that the user costs increase (these appear in the table as increases in user charges). It also shows that the highest charges (dis-benefits) accrue within the most deprived areas.

3.8.78. The two most deprived quintiles are both given an assessment of 3 and 2 pluses[77] respectively. A comparison with Table 3-25 shows that the two most deprived quintiles have a high proportion of user benefits and costs (where these exceed the proportion of the population).

DISTRIBUTIONAL IMPACT ANALYSIS OF NOISE

3.8.79. In total there are approximately 16,948 residential properties in the study area, with an estimated population of 38,980 as recorded in the 2011 census. The majority of dwellings are houses or bungalows. The Distributional Impacts of noise were assessed in accordance with *TAG Unit A4.2* and based on the following social groups:

- income distribution
- children: proportion of population aged <16
- older people: proportion of population aged 70+

3.8.80. The study area for SDI assessment is the same as that identified in the Environmental Statement Noise Assessment, defined by criteria within DMRB HD 213/11. The Super Output Areas (SOA) within the study area and their population and income profile are detail in Table 3-32 below.

[77] According to the System for Grading of Transport user Benefits for social groups (TAG Unit A4.2):
3 pluses (+++) mean Beneficial and 5% or more greater than the proportion of the group in the population.
2 pluses (++) mean Beneficial and in line (+/- 5%) with the proportion of the group in the population.

Table 3-32: SOAs in the SDI Noise Study Area

SOA Code	SOA	Population (in study area)	Quintile
95MM12S1	Crevagh_1	67	80 - 100 %
95MM18S1	Holly Mount_1	329	60 - 80 %
95MM21S1	New Buildings_1	1500	60 - 80 %
95MM21S2	New Buildings_2	713	80 - 100 %
95OO02W1	Augher	545	60 - 80 %
95OO03W1	Aughnacloy	1267	40 - 60 %
95OO04W1	Ballygawley	656	40 - 60 %
95OO09W1	Clogher	12	40 - 60 %
95YY01W1	Beragh	750	40 - 60 %
95YY02W1	Camowen	485	40 - 60 %
95YY03W1	Clanabogan	152	80 - 100 %
95YY04W1	Coolnagard	2201	40 - 60 %
95YY05W1	Dergmoney	1950	20 - 40 %
95YY07W1	Drumnakilly	81	60 - 80 %
95YY09W1	Drumragh	2174	20 - 40 %
95YY10W1	Fairy Water	520	80 - 100 %
95YY11W1	Fintona	166	20 - 40 %
95YY12W1	Gortin	150	60 - 80 %
95YY13S1	Gortrush_1	1263	60 - 80 %
95YY13S2	Gortrush_2	1339	0 - 20 %
95YY15S1	Lisanelly_1	23	40 - 60 %
95YY15S2	Lisanelly_2	9	0 - 20 %
95YY16W1	Newtownsaville	780	60 - 80 %
95YY18W1	Sixmilecross	51	40 - 60 %
95YY19W1	Strule	1389	0 - 20 %
95ZZ01W1	Artigarvan	932	60 - 80 %

SOA Code	SOA	Population (in study area)	Quintile
95ZZ02W1	Ballycolman	1626	0 - 20 %
95ZZ04W1	Clare	32	40 - 60 %
95ZZ06W1	East	1536	0 - 20 %
95ZZ07W1	Finn	987	40 - 60 %
95ZZ09W1	Newtownstewart	1686	20 - 40 %
95ZZ10W1	North	2468	40 - 60 %
95ZZ11W1	Plumbridge	106	40 - 60 %
95ZZ12W1	Sion Mills	2300	40 - 60 %
95ZZ13W1	Slievekirk	1067	40 - 60 %
95ZZ14S1	South_1	1481	60 - 80 %
95ZZ14S2	South_2	1164	80 - 100 %
95ZZ15W1	Victoria Bridge	1040	40 - 60 %
95ZZ16S1	West_1	1594	60 - 80 %
95ZZ16S2	West_2	1251	0 - 20 %
A057038001	Clonleigh South	253	80 - 100 %
A057038002	Clonleigh South	304	80 - 100 %
A057038005	Clonleigh South	5	80 - 100 %
A057038006	Clonleigh South	138	80 - 100 %
A057038007	Clonleigh South	170	80 - 100 %
A057038008	Clonleigh South	9	40 - 60 %
A057095002	Killea	53	80 - 100 %
A057095003	Killea	69	20 - 40 %
A057095007	Killea	16	20 - 40 %
A057135002	St. Johnstown	41	80 - 100 %
A057135005	St. Johnstown	48	80 - 100 %
A057135006	St. Johnstown	18	60 - 80 %
A177033001	Derrygorry	18	60 - 80 %

3.8.82. Using a Geographic Information System (GIS), the number of residential properties experiencing an increase, decrease or no change in noise level in each of the SOAs as a result of the Proposed Scheme in the project design year (15th year after opening) were identified (i.e. Do Minimum 2043 vs Do Something 2043).

3.8.83. The noise impact of the Proposed Scheme for each quintile in the income domain of Index of Multiple Deprivation (IMD) is presented in Table 3-33.

Table 3-33: SDI Analysis for Noise

	IMD Income Domain					TOTAL
	0-20%	20-40%	40-60%	60-80%	80-100%	
Properties with increased noise [A]	1,076	169	2,692	1,184	729	5,850
Properties with decreased noise [B]	211	815	1,333	1,490	277	4,126
Properties with no change in noise level [C]	1,822	1,651	1,824	1,104	571	6,972
Net number with positive change [D] = [B]-[A]	-865	646	-1,359	306	-452	
Total number of positive change across all groups						-1724
Net positive change as %	-50	37	-79	18	-26	
Share of total properties in study area	18	16	35	22	9	100%
Assessment of impact	Large Adverse	Large Beneficial	Large Adverse	Moderate Beneficial	Large Adverse	

3.8.84. Table 3-33 shows the adverse noise impacts that are experienced by the households in the lowest, middle and highest income groups. These income groups experience **Large Adverse** impacts in noise levels. In contrast, net beneficial noise impacts are experienced in the 2nd (20-40%) and 4th (60-80%) quintile income groups. These groups have a **Large Beneficial** and **Moderate Beneficial** noise impact respectively.

3.8.85. *TAG Unit A4.2* also requires the noise impact of the scheme on children and the elderly to be assessed. This was undertaken by appraising the change in noise level with and without the Scheme at all of the identified schools, nurseries, care homes and day centres in the noise study area (for the project design year).

3.8.86. The results of the appraisal are summarised in Table 3-34.

Table 3-34: Noise Impact on Facilities for the Young and Old in the Noise Study Area

Change in Short Term noise level		No of Schools and Nurseries	No of Care Homes/Day Centres
Increase in noise level, $L_{A10,\ 18h}$, dB	0.1-0.9 (Negligible)	14	6
	1.0-2.9 (Minor)	9	4
	3.0-4.9 (Moderate)	5	0
	5.0+ (Major)	3	1
No change	0 (No change)	3	0
Decrease in noise level, $L_{A10,\ 18h}$, dB	0.1-0.9 (Negligible)	9	2
	1.0-2.9 (Minor)	7	1
	3.0-4.9 (Moderate)	0	1
	5.0+ (Major)	2	0

3.8.87. Table 3-34 shows that there are a greater number of the identified receptors relevant to the young and the old that are predicted to experience noise increases than there are noise level decreases. The most significant of the noise changes shown in the table are the 5 moderate and 3 major noise level increases at schools/nurseries and a major increase predicted at a single care home. These are located as detailed in Table 3-35-.

Table 3-35: Facilities for Young and Old Subject to Significant Noise Level Increases

Type	Name	Address	Do Minimum $L_{A10,\ 18h}$, dB	Do Something $L_{A10,\ 18h}$, dB	Increase (dB)
High School	St Ciarans	15 Tullybryan Rd, Grange	47.9	53.4	5.5
Primary School	Consented Planning App LA11/2019/0521/F	North East of junction of Castletown Rd and Strahans Rd, Strabane	45.8	49.8	4.0
Primary School	St Eugenes	58 Fyfin Rd, Victoria Bridge	64.3	67.7	3.4
Primary School	St Columbas	86 Bells Park Rd, Clady	61.0	64.2	3.2
Primary School	St Patricks	59 Dublin St, Newtownstewart	35.9	42.3	6.4
Primary School	St Conors	109 Brookmount Rd, Lammy	42.6	47.7	5.1
Primary School	Sion Mills Primary	Westview Terrace, Liggartown	44.4	48.1	3.7
Playgroup	Happy Faces Play Group	83A Bells Park Road, Stephenstown, Clady	66.1	69.8	3.7
Nursing Home	Edgewater Private Nursing Home	70 Victoria Rd, Primity, New Buildings	52.2	61.6	9.4

DISTRIBUTIONAL IMPACT ASSESSMENT OF AIR QUALITY

3.8.88. The assessment of air quality impacts of the proposed scheme was undertaken in accordance with the *TAG Unit 4.2*. It focussed on two main user groups; income distribution and children under 16 years of age in schools.

3.8.89. The results of a detailed air quality assessment completed for the opening year (2028), with reference to the Design Manual for Roads and Bridges (DMRB, Volume 11, Section 3, Part 1, HA 207/07), have been used to provide inputs to the Distributional Impacts (DI) Appraisal.

3.8.90. *TAG Unit A4.2*, Chapter 4 outlines the requirement to assess the impact of changes in air quality that are experienced by lower income groups and children (nurseries and schools). Evidence is provided which suggests that these lower income groups and children are more at risk from air pollution.

3.8.91. A total of 24 schools and nurseries were identified in the air quality study area. The change in traffic-related air pollutant concentrations, NO_2 and particulate matter (PM_{10}), was reported for each of these schools, based on the local air quality assessment results for the Proposed Scheme opening year (2028). The results are presented in Table 3-38 (NO_2) and Table 3-39 (PM_{10}).

3.8.92. Income Domain data[78] from the Northern Ireland Multiple Deprivation Measure (NIMDM) were used to classify each lower layer super output area (LSOA) within the air quality study area into deprivation quintiles (0-20% being most deprived, 80-100% being least deprived).

3.8.93. All relevant receptors (residential, education, hospitals and care homes) within 200 metres of the affected road network were included in the DI analysis.

3.8.94. The DI Analysis requires identification of the number of receptors in each Income Domain quintile that experience an improvement, worsening or no change in air quality, specifically NO_2 and PM_{10}.

3.8.95. The respective air quality benefits / disbenefits are assessed for each Income Domain quintile, in relation to the share of the number of modelled properties within each domain. Each quintile is then given an overall Assessment Score.

3.8.96. Table 3-36 below for NO2 and Table 3-37 for PM10 for the opening year (2028).

3.8.97. Table 3-36 indicate that local air quality, with respect to concentrations of annual mean NO2, is predicted to improve in each of the income domains for the opening year of the Proposed Scheme (2028). This includes a large beneficial change in the most deprived areas and a moderate beneficial change in the second most deprived area and the least deprived area, with a minor beneficial change in all other areas.

3.8.98. The results of the assessment presented in Table 3-37 indicate that air quality, with respect to concentrations of annual mean PM10, is predicted to improve in each of the income domain quintiles for the opening year of the Proposed Scheme (2028). This includes a moderate beneficial change in the most and second most deprived areas and the least deprived area, with all other areas predicted to experience a minor beneficial change.

[78] http://www.nisra.gov.uk/deprivation/nimdm_2010.htm

Table 3-36: Air Quality (NO_2) DI Analysis (Opening Year 2028)

Air Quality DI Analysis	IMD Income Domain (0 Most Deprived Area - 100 Least Deprived Area)					
	0-20%	20-40%	40-60%	60-80%	80-100%	Total
No. of Properties with Improved Air Quality	1,830	3,038	2,404	690	530	8,492
No. of Properties with No Change in Air Quality	117	236	271	123	33	780
No. of Properties with Worsened Air Quality	319	792	1,048	317	181	2,657
No. of Net Benefits / Losses	1,511	2,246	1,356	373	349	-
Total Number of Benefits / Losses across all Groups	-	-	-	-	-	5,835
Net Benefits / Losses in each Area as % of Total	26%	38%	23%	6%	6%	-
Share of Total Population of Study Area	19%	34%	31%	9%	6%	-
Assessment Score	Large Beneficial	Moderate Beneficial	Minor Beneficial	Minor Beneficial	Moderate Beneficial	-

Table 3-37: Air Quality (PM10) DI Analysis (Opening Year 2028)

Air Quality DI Analysis	IMD Income Domain (0 Most Deprived Area - 100 Least Deprived Area)					
	0-20%	20-40%	40-60%	60-80%	80-100%	Total
No. of Properties with Improved Air Quality	1,528	2,709	2,142	661	483	7523
No. of Properties with No Change in Air Quality	460	780	796	230	127	2393
No. of Properties with Worsened Air Quality	278	577	785	239	134	2013
No. of Net Benefits / Losses	1,250	2,132	1,357	422	349	-
Total Number of Benefits / Losses across all Groups	-	-	-	-	-	5510
Net Benefits / Losses in each Area as %	23%	39%	25%	8%	6%	-
Share of Total Population	19%	34%	31%	9%	6%	-
Assessment	Moderate beneficial	Moderate beneficial	Minor beneficial	Minor beneficial	Moderate beneficial	-

3.8.100. Receptor classification data were used to determine the relative air quality benefits / disbenefits in relation to children (nurseries and schools). The predicted results with respect to NO_2 and PM_{10} are presented in Table 3-38 and Table 3-39 respectively.

3.8.101. Of the schools and nurseries identified within the air quality study area, Table 3-38 demonstrates that 20 are predicted to experience a negligible change in annual mean concentrations of NO_2 in the Proposed Scheme opening year (2028), with 4 experiencing a slight beneficial change. None of the identified nurseries/schools are expected to experience an adverse change in levels of NO_2 in the Do-Something scenario relative to the Do-Minimum scenario.

3.8.102. With respect to annual mean PM_{10} concentrations, Table 3-39 shows that all 24 schools are predicted to experience a negligible change in the opening year of the Proposed Scheme versus the Do-Minimum scenario.

Table 3-38: Schools and Nurseries (NO_2) – Opening Year (2028)

Receptor ID	Address	Opening Year (2028)			
		Do Nothing NO_2 ($\mu g/m^3$)	With Scheme NO_2 ($\mu g/m^3$)	NO_2 Change ($\mu g/m^3$)	Descriptor
186643352	Aughnacloy High School, 23 Carnteel Road, BT69 6DX	3.6	3.6	0	Negligible
186160094	Ballougry Primary School, 30A Mullenan Road, BT48 9XN	4	3.5	-0.5	Negligible
186451804	Christian Brothers' Grammar School, Kevlin Road, BT78 1LD	13.5	12.4	-1.1	Negligible
186160267	New Buildings Primary School, 83 Victoria Road, BT47 2RL	7.4	5.1	-2.3	Slight Beneficial
186285159	Newtownstewart Model Primary School, 6 Baronscourt Road, BT78 4EX	3.3	3.3	0	Negligible
186996561	Omagh Academy, Dublin Road, BT78 1HF	14.3	12.8	-1.5	Negligible
186247521	St. Eugene's Primary School, 58 Fyfin Road, BT82 9JH	5.7	6.4	0.7	Negligible
186603054	St. Matthews Primary School, 70 Rarogan Road, BT70 2DY	3.8	2.9	-0.9	Negligible
186450949	Holy Family Primary School, Brookmount Road, BT78 5HZ	12.3	11.4	-0.9	Negligible
186879816	St Conor's Primary School	6.2	5.9	-0.3	Negligible
186603278	St Malachy's Primary School Glencull, 107 Omagh road, BT70 2DB	6.2	3.4	-2.8	Slight Beneficial
186643205	St Mary's Primary School Aughnacloy, Caledon Road, BT69 6AJ	4.6	3.8	-0.8	Negligible
187546834	Loreto Grammar School, Jams street, BT781DL	10.6	10	-0.6	Negligible
186451112	Rainbow Community Playgroup	17.9	15.4	-2.5	Slight Beneficial
186232199	Knockavoe School & Resource Centre, Melmount Gardens, BT82 9EB	5.3	5.2	-0.1	Negligible
186232046	Sion Mills Primary School, Westview Terrace, BT82 9HP	3.5	3.4	-0.1	Negligible
186603464	St. Ciaran's High School, 15 Tullybryan Road, BT70 2LY	3.5	3.5	0	Negligible
186232718	St Mary's Primary School, 1 Whitebridge Road, BT70 2JH	6.2	5.7	-0.5	Negligible
186285732	St Patrick's Primary School, 59 Dublin Street, BT78 4AQ	2.7	3	0.3	Negligible
186235111	Strabane Controlled Primary School, 43 Derry Road, BT82 8DX	7	7	0	Negligible
186232718	St. Marys Boys Primary School, 48 Melmount Road, BT82 9EF	6.2	5.7	-0.5	Negligible
186232718	St. Marys Primary School, 43 Melmount Road, BT82 9EF	6.2	5.7	-0.5	Negligible
186235434	Strabane Academy, 61 Derry Road, BT82 8LD	7.1	6.8	-0.3	Negligible
186603278	Glencull Primary School, 107 Omagh Road, BT70 2DB	6.2	3.4	-2.8	Slight Beneficial

Table 3-39: Schools and Nurseries (PM_{10}) – Opening Year (2028)

Receptor ID	Address	Opening Year (2028)			
		Do Nothing PM_{10} ($\mu g/m^3$)	With Scheme PM_{10} ($\mu g/m^3$)	PM_{10} Change ($\mu g/m^3$)	Descriptor
186643352	Aughnacloy High School, 23 Carnteel Road, BT69 6DX	7.7	7.7	0.0	Negligible
186160094	Ballougry Primary School, 30A Mullenan Road, BT48 9XN	7.7	7.5	-0.2	Negligible
186451804	Christian Brothers' Grammar School, Kevlin Road, BT78 1LD	11.4	11.0	-0.4	Negligible
186160267	New Buildings Primary School, 83 Victoria Road, BT47 2RL	10.1	9.2	-0.9	Negligible
186285159	Newtownstewart Model Primary School, 6 Baronscourt Road, BT78 4EX	7.9	7.8	0.0	Negligible
186996561	Omagh Academy, Dublin Road, BT78 1HF	12.1	11.5	-0.6	Negligible
186247521	St. Eugene’s Primary School, 58 Fyfin Road, BT82 9JH	8.4	8.5	0.1	Negligible
186603054	St. Matthews Primary School, 70 Rarogan Road, BT70 2DY	7.8	7.4	-0.4	Negligible
186450949	Holy Family Primary School, Brookmount Road, BT78 5HZ	11.3	10.8	-0.4	Negligible
186879816	St Conor's Primary School	9.1	9.0	-0.1	Negligible
186603278	St Malachy's Primary School Glencull, 107 Omagh road, BT70 2DB	9.0	7.7	-1.3	Negligible
186643205	St Mary's Primary School Aughnacloy, Caledon Road, BT69 6AJ	8.4	8.2	-0.3	Negligible
187546834	Loreto Grammar School, Jams street, BT781DL	10.5	10.2	-0.2	Negligible
186451112	Rainbow Community Playgroup	13.1	12.3	-0.8	Negligible
186232199	Knockavoe School & Resource Centre, Melmount Gardens, BT82 9EB	10.0	9.8	-0.1	Negligible
186232046	Sion Mills Primary School, Westview Terrace, BT82 9HP	7.9	7.8	0.0	Negligible
186603464	St. Ciaran’s High School, 15 Tullybryan Road, BT70 2LY	8.1	8.1	0.0	Negligible
186232718	St Mary's Primary School, 1 Whitebridge Road, BT70 2JH	10.3	10.1	-0.2	Negligible
186285732	St Patrick's Primary School, 59 Dublin Street, BT78 4AQ	6.9	7.0	0.1	Negligible
186235111	Strabane Controlled Primary School, 43 Derry Road, BT82 8DX	8.7	8.6	0.0	Negligible
186232718	St. Marys Boys Primary School, 48 Melmount Road, BT82 9EF	10.3	10.1	-0.2	Negligible
186232718	St. Marys Primary School, 43 Melmount Road, BT82 9EF	10.3	10.1	-0.2	Negligible
186235434	Strabane Academy, 61 Derry Road, BT82 8LD	8.7	8.6	-0.1	Negligible
186603278	Glencull Primary School, 107 Omagh Road, BT70 2DB	9.0	7.7	-1.3	Negligible

3.9 INITIAL VALUE FOR MONEY ASSESSMENT – COMPLETE SCHEME

3.9.1. The Value for Money (VfM) assessment is intended to assist decision-makers judge whether the expected costs of a proposal are justified by its expected benefits to the public as a whole. This includes both positive and negative impacts of the proposal on the economy, society, environment and public accounts.

3.9.2. The VfM assessment for the Proposed Scheme was undertaken with reference to the VfM Framework published by the DfT in July 2017.

3.9.3. The VfM Framework sets out a process to assign a VfM Category that is intended to provide a succinct, overarching summary of the outcome of the scheme. The category is determined by considering costs and benefits and also takes account of all relevant risks, uncertainties and impacts.

INITIAL BENEFIT-COST RATIO

3.9.4. The first stage of the assessment is to calculate an initial Benefit to Cost Ratio (BCR) and the Net Present Value (NPV). The BCR is derived by dividing the Present Value of Benefits (PVB) by the Present Value of Costs (PVC). The Net Present Value (NPV) of the scheme is the difference between Present Value of Benefits (PVB) and Present Value of Cost (PVC).

3.9.5. The initial value of BCR includes the Established monetised benefits including transport user benefits, accident savings, greenhouse gas reductions and indirect taxation impacts, and the monetary benefits for noise and air quality. Evolving monetised benefits are not included at this stage. The calculation of the initial BCR is set out in Table 3-40 below.

Table 3-40: Initial BCR for Whole Scheme

	Costs & Benefits	In 2010 prices and values (£M)
Benefits	Consumer User Benefits: Commuting	159.88
	Consumer User Benefits: Other	215.03
	Business Benefits	463.53
	Total Economic Efficiency Benefits	838.44
	Accident Benefits	124.92
	Construction	-1.44
	Maintenance	26.14
	Carbon Benefits (Greenhouse Gas)	-39.91
	Monetised Noise Benefits	-0.64
	Monetised Air Quality Benefits	5.27
	Indirect Tax Revenue	6.92
	Present Value of Benefits (PVB)	**959.70**
Costs	Construction Cost	807.76
	Operating Cost	58.16
	Present Value of Cost (PVC)	**865.92**
Net Present Value	**Net Present Value (NPV)**	**93.78**
Benefit Cost Ratio	**Benefit to Cost Ratio (BCR)**	**1.11**

3.9.6. Table 3-40 shows that for the Proposed Scheme, total monetised benefits exceed the costs by £93.78M (i.e. the investment provides a positive return) giving an initial BCR of **1.11**.

ADJUSTED BENEFIT TO COST RATIO

3.9.7. The next stage of the assessment involves calculating an adjusted BCR by including the Wider Impact benefits (Evolving impacts). The adjusted BCR (Table 3-41) shows that with the addition of the Evolving monetised benefits the NPV increases to £301.91M giving an adjusted BCR of **1.35**.

Table 3-41: Adjusted BCR for Whole Scheme

Adjusted BCR	Reference	In 2010 prices and values (£M)
Established Benefits	Table 3-40 (Initial PVB)	959.70
Evolving Benefits	Table 3-13 (Wider Impacts)	208.13
Adjusted Present Value of Benefits (PVB)		**1,167.83**
Present Value of Costs (PVC)	Table 3-40 (Construction)	807.76
	Table 3-40 (Maintenance)	58.16
	TOTAL	**865.92**
Net Present Value (NPV)		**301.91**
Adjusted BCR		**1.35**

3.9.8. The adjusted BCR is used as a basis for determining an initial VfM Category. Six VfM categories are defined within the DfT framework and these are set out in Table 3-42 below.

Table 3-42: Value for Money Categories (Source: DfT Value for Money Framework)

Value for Money Category	Implied by
Very High	BCR greater than or equal to 4
High	BCR between 2 and 4
Medium	BCR between 1.5 and 2
Low	BCR between 1 and 1.5
Poor	BCR between 0 and 1
Very Poor	BCR less than or equal to 0

3.9.9. With reference to Table 3-42, using the adjusted BCR the initial VfM category for the Proposed Scheme between New Buildings and Aughnacloy indicates **Low** VfM.

3.9.10. The last stage of the process is to determine a final VfM Category. This is based upon a consideration of relevant indicative and / or non-monetised impacts together with risks and uncertainties. This could result in a final VfM category different to that which is implied solely by the adjusted BCR.

3.9.11. The sources of uncertainty are detailed in Section 3.10 below. The factors used to determine the final VfM category are considered in Section 3.12.

3.10 SENSITIVITY TESTING

SOURCES OF UNCERTAINTY

3.10.1. The forecasts and economic benefits reported in this document are based on the Core scenario. This represents the most unbiased and realistic set of assumptions that will form the central case that is presented in the Appraisal Summary Table (AST) in Section 3.11. The core scenario is based upon the following:

- the latest projections of demographic and economic data and using the TEMPRO-NI software as described in **Appendix C** - Traffic Forecast Report (2015 Rebased Model)
- Standard model parameters defined in TAG

3.10.2. It is recognised that forecasts are subject to uncertainty with the accuracy of forecasts decreasing in the later years in the forecast period. Uncertainty has a bearing on forecast traffic volumes, patterns of traffic flows with a consequential impact on the economic and environmental assessments.

3.10.3. Uncertainty can be at a national or local level. National uncertainty affects national projections such as population, households and employment, GDP growth and fuel price trends.

3.10.4. Local uncertainty depends on whether developments or other planned transport schemes go ahead in the vicinity of the scheme being built. To account for local uncertainty, an up-to-date Uncertainty Log was compiled based on the planning information supplied by the District Councils that the Proposed Scheme would pass through. This identified three major housing development proposals (of circa 300 dwellings or greater) and six major employment proposals (exceeding 1,000m^2 gross floor area (gfa) which were considered in the development of the traffic forecasts, as reported in more detail in the Traffic Forecasting Report (included as **Appendix C**). Any potential impacts of the local sources of uncertainty are therefore likely to be not significant. It should be noted that the Three Rivers development, a large multi-purpose site which if built would have had a significant effect on the Proposed Scheme impacts, has had its planning permission lapse and has consequently been removed from the scheme Uncertainty Log.

3.10.5. At the national level, the economic consequences of Brexit on the Northern Ireland economy present a potentially significant source of uncertainty. These are further compounded by the impacts of COVID and the technological and behavioural changes this has brought about. The COVID pandemic and the changes it has brought about to people's travel habits and behaviours are therefore noted as another significant source of uncertainty.

3.10.6. The traffic forecasting undertaken for the purposes of economic appraisal has made use of high and low growth sensitivity testing around demand forecasts, in line with the current guidance set out in TAG Unit M4 (May 2019).

3.10.7. Various uncertainty around this scheme has been assessed through a range of additional sensitivity tests. These have been undertaken to test the impacts of uncertainties around supply, demand, programme and cost assumptions and are reported in more detail in **Appendix I**. The sensitivity analysis reported in **Appendix I** has shown the Proposed Scheme BCR is likely to lie within the range of BCR bounded by the Low and High growth assessment.

3.10.8. To complete the new road network across the border into County Donegal from Junction 7 at Strabane to the existing N15 National Primary Route at Lifford, Transport Infrastructure Ireland and Donegal County Council have developed and will fund the construction of a new bridge over the River Finn. This scheme is programmed to be constructed and opened to traffic at the same time as

Phase 2 of the Proposed Scheme is completed and has been included in the traffic forecasting. The cost of the new Finn crossing and the associated benefits has been fully accounted within the core scheme assessment. An additional sensitivity test has also been undertaken to quantify the impact of the scheme without the Finn Crossing and reported in **Appendix I**.

LOW AND HIGH GROWTH ASSESSMENT

3.10.9. *TAG Unit M4 (Forecasting and Uncertainty)* advises that an effective way to test the uncertainty of national trends such as population and GDP growth and fuel price trends is by using high and low growth scenarios.

3.10.10. In accordance with advice in *TAG Unit M4*, low and high growth forecasts were prepared by increasing the forecast demand matrix by a proportion of the base year matrix which for highway demand is defined as:

$$\pm \mathbf{2.5} * \sqrt{\boldsymbol{N}}\,\%$$

where N represents the number of years into the future with respect to the base year.

3.10.11. For the Proposed Scheme, this amounts to a variation of 13% between the base year (2015) and Design Year (2043).

3.10.12. The transport user and accident benefits for the low and high growth scenarios were assessed using TUBA and COBALT, respectively.

3.10.13. A QUADRO analysis for low and high growth was not carried out since the benefits / dis-benefits as a result of construction and maintenance activities were very small. The benefits were therefore taken from the QUADRO for the core scenario.

3.10.14. The results of the sensitivity tests for the low and high growth scenario sensitivity are presented in Table 3-43 below.

Table 3-43: High Growth, Core and Low Growth scenario TUBA benefit sensitivity tests (£M)

Growth Scenario	User Time	Fuel	Non-fuel	Indirect Tax Revenue	Total (Including Indirect Tax Revenue)
Low Growth	700.36	-19.11	-6.35	7.69	682.59
High Growth	1,085.84	-16.35	-0.94	5.29	1,073.84
Core	861.31	-18.44	-4.43	6.92	845.37

3.10.15. The benefits arising from the accident savings are summarised in Table 3-44 below.

Table 3-44: Present value of accident savings over 60 years

Growth Scenario	Accident Benefits (£M)
Low Growth	112.66
High Growth	135.21
Core	124.92

3.10.16. Monetised values for greenhouse gas emissions, noise and local air quality were calculated for low and high growth based upon the low and high growth forecasts. These are given in Table 3-45 below.

3.10.17. Given the small proportion associated with the monetised noise and air quality benefits compared to the wider monetised benefits associated with the scheme, a proportionate approach has been adopted for the high and low growth scenarios. This approach derives a factor to apply to the monetised noise benefit associated with the core scenario, from the user time results presented in Table 3-43. Whilst this approach does not take account of the receptor-specific monetised benefits associated with the high and low growth scenarios, it is considered a reasonable and proportionate approach given the limited scale and share of the monetised noise benefits compared to other aspects.

3.10.18. For the GHG assessment of low and high growth scenarios traffic data sets for each scenario were assessed using the TAG methodology and workbook, as for the core scenario. This produced a NPV for each scenario, presented in Table 3-45

Table 3-45: High Growth, Core and Low Growth scenario Environmental benefits

Environmental Benefits	In 2010 prices and values (£M)		
	Low Growth	High Growth	Core
Carbon Benefits (Greenhouse Gas)	-35.4	-44.9	-39.9
Monetised Noise Benefits	-0.52	-0.81	-0.64
Monetised Air Quality Benefits	4.29	6.65	5.27

3.10.19. Finally, low and high growth values were calculated for the Evolving monetised impacts that included wider impacts. These are presented in Table 3-46 below.

Table 3-46: High Growth, Core and Low Growth scenario evolving benefits

Evolving Benefits	In 2010 prices and values (£M)		
	Low Growth	High Growth	Core
Wider Impacts – Agglomeration	151.51	180.41	162.12
Wider Impacts – Imperfect Markets	36.89	57.27	45.78
Wider Impacts – Tax	0.19	0.30	0.23

3.10.20. The Established benefits including QUADRO and those set out in Table 3-43, Table 3-44 and Table 3-45 and the evolving monetised impacts set out in Table 3-46 were combined to produce BCRs for the low and high growth scenarios. These are presented in Table 3-47, which provides a summary of benefits together with a comparison with the core scenario.

Table 3-47: BCR for Core, Low and High Growth scenarios

Costs and Benefits	In 2010 prices and values (£M)		
	Low Growth	High Growth	Core
Total Economic Efficiency Benefits	674.9	1,068.55	838.44
Accident Benefits	112.66	135.21	124.92
Construction and Maintenance	24.70	24.70	24.70
Carbon Benefits (Greenhouse Gas)	-35.37	-44.87	-39.91
Monetised Noise Benefits	-0.52	-0.81	-0.64
Monetised Air Quality Benefits	4.29	6.65	5.27
Indirect Tax Revenue	7.69	5.29	6.92
Present Value of Benefits (PVB)	**788.35**	**1194.72**	**959.70**
Wider Impacts	188.58	237.97	208.13
Adjusted Present Value of Benefits (PVB)	**976.94**	**1432.70**	**1167.83**
Present Value of Cost (PVC)	**865.92**	**865.92**	**865.92**
Net Present Value (NPV)	**111.01**	**566.77**	**301.91**
Adjusted Benefit to Cost Ratio (BCR)	**1.13**	**1.65**	**1.35**

3.10.21. Table 3-47 shows that the adjusted BCR ranges from 1.13 for low growth to 1.65 for high growth corresponding to **Low** and **Medium** VfM, respectively.

3.10.22. The Net Present Value (NPV) of the scheme is the difference between Present Value of Benefits (PVB) and Present Value of Cost (PVC). The NPV is above £100M for all the growth tests, which confirms the investment continues to provide a positive return.

3.11 APPRAISAL SUMMARY TABLE

3.11.1. The Appraisal Summary Table (AST) presents in a single table all the evidence from the economic appraisal. It records all the impacts which have been assessed and described above including economic, fiscal, social distributional and environmental impacts, assessed using monetised, quantitative or qualitative information as appropriate. The AST is presented in **Appendix H**.

3.12 FINAL VALUE FOR MONEY CATEGORY – COMPLETE SCHEME

FACTORS INFLUENCING THE FINAL VFM CATEGORY

3.12.1. As noted in Section 3.9, the adjusted BCR is used to define an initial VfM category. Consideration is then taken of other non-monetised impacts together with risks and uncertainties in order to determine the final VfM category.

3.12.2. In determining the final VfM category for the Proposed Scheme, consideration has been given to:

1. The extent to which the adjusted BCR captures all the impacts of the proposal (either monetised or non-monetised);
2. Whether the magnitude of any non-monetised impacts are sufficient to enhance or diminish the initial VfM category;

3. The extent to which the impacts vary across different social groups (Distributional Impacts); and
4. Sensitivity analysis and the extent to which the risks and uncertainty widens the range of benefits.

3.12.3. With respect to item **1** the assessment has captured all the main monetised impacts with one exception. This is the productivity benefits that could result from a relocation of jobs as a result of the scheme.

3.12.4. As noted in Section 3.6 , this can only be valued with a LUTI model which was not developed for the Proposed Scheme. This impact would, if assessed, fall into the 'Indicative' category using the DfT VfM framework. While this could be relevant to the Proposed Scheme this cannot be quantified and therefore cannot be considered in determining the final VfM category.

3.12.5. In respect to item **2** it is acknowledged that the non-monetised impacts of the Proposed Scheme, are generally adverse. These are detailed in Sections 3.7 and 3.8 and demonstrate that the impacts on landscape vary between moderate adverse between New Buildings and Strabane to slight adverse south of Strabane. The impacts of the Proposed Scheme on the historic environment is either moderate or large adverse for 12 of the 89 heritage assets identified. The impacts on ecology / biodiversity is neutral to moderate adverse and the impact on the water environment is slight adverse.

3.12.6. There are positive non-monetised impacts on journey time reliability and journey quality. The Social and Distributional Impact analysis presented in Section 3.8 demonstrated that the Proposed Scheme had positive social impacts including a reduction in severance. This largely results from a reduction in traffic flows on the existing A5.

3.12.7. The distributional analysis of user benefits demonstrated that the highest benefits accrued to the most deprived income groups. The accident analysis also demonstrated that vulnerable road users generally benefitted from the Proposed Scheme.

3.12.8. In terms of air quality, all income groups are predicted to experience a net air quality benefit, with the most deprives areas experiencing the largest beneficial change. For noise, benefits and disbenefits were distributed across the income groups with adverse effects in the least, middle and most deprived income groups.

3.12.9. While the Social and Distributional Impacts of the scheme were shown to largely benefit lower income groups and vulnerable road users, this is offset against the generally adverse environmental impacts described in paragraph 3.12.5 above. On balance, the magnitude of the non-monetised impacts were not considered to weigh substantially to warrant any adjustment of the initial VfM category.

3.12.10. The final consideration is the sensitivity testing as reported in Section 3.10. The sensitivity testing presented in Table 3-47 showed that under the low growth scenario the BCR for the Proposed Scheme would reduce to 1.13 but the VfM category would remain Low. Under the high growth scenario, the BCR would be 1.65, changing the VfM category to Medium.

3.12.11. The adjusted BCR for the core scenario is 1.35 which is comfortably within the Low VfM threshold. This means that the scheme benefits would need to be increase by about £131M to £1,299M to result in a BCR of 1.5 and a change in the VfM category from Low to Medium. This equates to an increase in benefits of 11%. Conversely, the benefits would need to reduce by £302M , a drop of 26%, for the VfM category to diminish from Low to Poor.

3.12.12. A further test to determine whether these sensitivity tests may change the VfM category of the Proposed Scheme was undertaken following guidance set out in the DfT 'VfM Supplementary Guidance on Categories', published in July 2017.

3.12.13. This approach is based upon the assumption that each of the three estimates for user benefits i.e. Low, High and Core is equally likely. The average estimate for user benefits for the three scenarios is calculated and if this is less than the 'switching' value required to change the VfM Category, it can be judged that the sensitivity tests do not provide sufficient evidence to change the VfM category.

3.12.14. Applying this to the Proposed Scheme, the average estimate for user benefits is calculated at £1,192.5M, which is an increase of £24.7M above the core scenario. With reference to paragraph 3.12.11 above, it is noted that the 'switching value' required to change the VfM category to Medium is about £131M. It is therefore judged that these sensitivity tests do not provide sufficient evidence to change the VfM category.

Conclusions

3.12.15. From the analysis presented above, it is concluded that the non-monetised environmental impacts would be adverse.

3.12.16. By contrast, the non-monetised social impacts and the distributional impacts are both shown to be largely positive and to an extent offset some of the non-monetised environmental impacts. The net outcome of the scheme non-monetised impact assessments were, however, not considered sufficient to warrant any adjustment of the initial VfM.

3.12.17. The sensitivity analysis showed that under the high growth scenario, the VfM category would increase to Medium. However, based upon an average of the three scenarios tested, the VfM category would remain Low.

3.12.18. It is acknowledged that the adjusted BCR of 1.35 is comfortably within the Low VfM category. This means that benefits would need to be increased by about £131M, for the VfM category to be changed from Low to Medium; or reduced by about £302M for the VfM category to be changed from Low to Poor.

3.12.19. Based on this analysis, the final VfM category for the Scheme between New Buildings and Aughnacloy has been determined as **Low**.

3.13 ECONOMIC APPRAISAL OF PHASES OF SCHEME

METHODOLOGY

3.13.1. In 2012 the Department identified the most appropriate split of the scheme into phases that best met the buildability and affordability requirements, as detailed in Phasing Report[79].

3.13.2. The economic appraisal of each individual phase of the Proposed Scheme required the calculation of benefits over a 60-year period from the start of each of the four phases. Phase 1A was assessed against the Do-Minimum as adopted for the full scheme assessment, whereas Phase 2 was assessed against a Do-Minimum that contained Phase 1A, since this will be operational upon

[79] Phasing Report V1.0, March 2022 - https://www.a5wtc.com/Documents/12247/Download

opening of Phase 1A. The assessment periods and forecast scenarios adopted for each of the four phases is summarised in Table 3-48 below.

Table 3-48: Methodology for Evaluation of Benefits by Phase

Phase	Do Minimum Network	Do Something Network	Evaluation Period
1A	Do Minimum	Phase 1A	2027 to 2086
2	Phase 1A	Phase 1A+2	2028 to 2087
1B	Phase 1A+2	Phase 1A+2+1B	2028 to 2087
3	Phase 1A+2+1B	Full scheme	2028 to 2087

3.13.3. It should be noted that the assessment of benefits by phase was based upon the core scenario and no sensitivity testing, for example for low and high growth, was carried out.

ESTABLISHED MONETISED IMPACTS

Transport Economic Efficiency

3.13.4. The transport economic efficiency benefits of each Phase of the scheme were derived from TUBA for the time savings and vehicle operating costs as a result of the scheme and QUADRO for maintenance savings and delays during construction.

3.13.5. The TEE benefits for each Phase from TUBA and QUADRO are presented in Table 3-49 and Table 3-50 respectively.

Table 3-49: TUBA Benefits by Phase (£M)

Road User Benefits	Phase 1A	Phase 1B	Phase 2	Phase 3	Total (all Phases)
Consumer User Benefits					
Commuting	13.76	35.26	102.88	8.07	159.97
Other	17.27	42.43	148.67	4.64	213.01
Net Consumer Benefits	**31.03**	**77.69**	**251.55**	**12.71**	**372.98**
Business User Benefits					
Business Personal	14.63	54.03	133.81	9.92	212.39
Business Freight	11.49	72.34	162.53	7.87	254.22
Net Business Impact	**26.12**	**126.37**	**296.34**	**17.79**	**466.62**
Present Value of Transport Economic Efficiency Benefits	**57.15**	**204.05**	**547.89**	**30.49**	**839.59**

Table 3-50: QUADRO Benefits by Phase (£M)

Road User Benefits	Phase 1A	Phase 1B	Phase 2	Phase 3	Total (all Phases)
Construction	-0.62	-0.28	-0.42	-0.13	-1.44
Maintenance	2.12	13.65	10.27	0.10	26.14
Total for Construction and maintenance	1.50	13.38	9.84	-0.03	**24.7**

3.13.6. The total TEE benefits from TUBA and QUADRO by Phase are presented in Table 3-51.

Table 3-51: Total TEE Benefits by Phase (£M)

	Phase 1A	Phase 1B	Phase 2	Phase 3
Total TEE Benefits	58.66	217.43	557.74	30.46

3.13.7. It should be noted that the sum of the TEE benefits for each phase differs from the TEE benefits for the whole scheme presented in Section 3.6 while costs remain the same. The difference in benefits is due to the evaluation periods, with the benefits from the full scheme (opened successively from 2027 to 2028) being evaluated over a 60 year period from opening of Phase 1A in 2027, whereas the benefits for each Phase were based on four evaluation periods from the respective years of opening.

3.13.8. Tables 5-49 to 5-51 demonstrate that Phase 2 generates the majority of benefits within the complete scheme. It is also the longest section of the scheme stretching from north of Strabane to South of Omagh. Phases 1A and 3 are the shortest sections of the scheme and cover the northernmost and the southernmost parts of the corridor. As such, they are shown to generate the lowest TEE benefits, but they maximise the benefits of Phase 2 and Phase 1B in the central section of the corridor.

Accident Reduction Benefits

3.13.9. The number of casualties saved attributed to each phase of the scheme is presented in Table 3-52.

Table 3-52: Casualty savings by phase over 60 years

Number of Casualty Savings by Phase					
	Phase 1A	Phase 1B	Phase 2	Phase 3	Total (all Phases)
Fatal	3	16	15	2	36
Serious	43	148	229	31	449
Slight	254	981	1,897	245	3,378
TOTAL	**300**	**1,145**	**2,141**	**277**	**3,863**

3.13.10. The economic benefits of the accident savings is calculated by comparing the cost of accidents over the 60 year appraisal period, with and without the scheme, at 2010 prices, discounted to 2010. The benefits per phase arising from the accident savings are summarised in Table 3-53 below.

3.13.11. Table 3-53 demonstrates that the highest proportion of total monetary accident benefits is derived from Phase 2 of the Proposed Scheme. The cumulative total from each of the phases amounts to £126.45M.

Table 3-53: Present value of accident savings over 60 years

Phase	Accident Benefits (£M)
Phase 1A	10.75
Phase 1B	41.27
Phase 2	66.04
Phase 3	8.39
Total	**126.45**

Environmental Benefits

3.13.12. The monetised environmental benefits/dis-benefits include noise, greenhouse gasses and local air quality. The benefits by phase, at 2010 prices and discounted to 2010 values, are summarised in Table **3-54**.

3.13.13. Given the small proportion associated with the monetised noise and air quality benefits compared to the wider monetised benefits associated with the scheme, a proportionate approach has been adopted for the phased assessment. This approach uses the receptor specific results for each phased area but based on the traffic data for the full scheme. The scheme has been divided at each phase boundary by a straight horizontal line to avoid double counting. Whilst this approach does not take account of the receptor-specific monetised benefits associated with each phase in isolation (i.e. by using traffic data for each phase in isolation), it is considered a reasonable and proportionate approach given the limited scale and share of the monetised noise and air quality benefits compared to other aspects.

3.13.14. For the GHG assessment a proportionality approach was taken to produce a high-level estimate of the disbenefits of each phase and summarised in Table 3-54. TUBA outputs for each phase were used to determine the proportion of total scheme each phase represents. These proportions were then applied to the NPV of the full scheme, to produce an estimate of the NPV of each phase.

3.13.15. The Environmental Benefits will be refined further at FBC stage for each of the Sections as they are taken forward for approval for funding.

Table 3-54: Monetised Environmental Benefits by Phase (£M)

Environmental Benefit (£M)	Phase 1A	Phase 1B	Phase 2	Phase 3
Greenhouse Gases	-2.72	-9.70	-26.05	-1.45
Local Air Quality	0.83	-0.03	4.00	0.48
Noise	0.62	-0.15	-1.41	0.30
Total	**-1.27**	**-9.88**	**-23.46**	**-0.97**

Evolving Monetised Impacts

3.13.16. The evolving monetised impacts include wider impacts only. Table 3-55 provides a breakdown for each phase of the scheme.

Table 3-55: Evolving Monetised Benefits by Phase (£M)

Benefits	Phase 1A	Phase 1B	Phase 2	Phase 3
Wider Impacts	19.25	38.55	141.79	8.75
Total	**19.25**	**38.55**	**141.79**	**8.75**

Present Value of Costs

3.13.17. The Present Value of Cost (PVC) for each Phase was determined using the same methodology as for the Full Scheme, described in the '*Present Value of Costs*' section from Section 3.5. The PVC for each Phase are presented in Table 3-56.

Table 3-56: Adjusted BCR by Phase

Costs and Benefits	In 2010 prices and values (£M)			
	Phase 1A	Phase 1B	Phase 2	Phase 3
Total Economic Efficiency Benefits	57.74	197.61	547.99	29.15
Accident Benefits	10.75	41.27	66.04	8.39
Construction and Maintenance	1.50	13.38	9.84	-0.03
Carbon Benefits (Greenhouse Gas)	-2.72	-9.70	-26.05	-1.45
Monetised Noise Benefits	0.62	-0.15	-1.41	0.30
Monetised Air Quality Benefits	0.83	-0.03	4.00	0.48
Indirect Tax Revenue	-0.59	6.44	-0.10	1.35
Present Value of Benefits (PVB)	**67.30**	**249.81**	**599.49**	**38.00**
Wider Impacts	19.25	38.55	141.79	8.75
Adjusted Present Value of Benefits (PVB)	**86.55**	**288.37**	**741.28**	**46.75**
Present Value of Cost (PVC)	**144.64**	**187.94**	**436.76**	**96.58**
Net Present Value (NPV)	**-58.09**	**100.42**	**304.52**	**-49.83**
Benefit to Cost Ratio (BCR)	**0.60**	**1.53**	**1.70**	**0.48**

Adjusted BCR and Value for Money Assessment by Phase

3.13.18. The adjusted BCRs for each phase of the scheme are presented in Table 3-56.

3.13.19. Table 3-56 shows that the adjusted BCR ranges from 1.70 for Phase 2 to 0.48 for Phase 3. The initial VfM category is therefore 'Poor' for Phases 1A and 3 and 'Medium' for Phase 1B and 2.

3.13.20. It should be noted that a final VfM category for each Phase has yet to be determined. This will be assessed and included in the Full Business Cases that will be prepared for each Phase of the Proposed Scheme.

3.14 SUMMARY (COMPLETE SCHEME AND PHASES)

3.14.1. The initial VfM assessment for the complete scheme produced an adjusted BCR of 1.35 which demonstrated that the Proposed Scheme offered **Low** VfM.

3.14.2. Sensitivity testing demonstrated, given equal probability of a low, core and high growth scenario, that the Proposed Scheme would remain in the **Low** VfM category.

3.14.3. In determining a final VfM category, non-monetised environmental and social impacts and Distributional Impacts were considered in addition to the sensitivity tests.

3.14.4. Analysis of Social and Distributional Impacts showed that areas within the study area with lower average incomes will benefit the most. Impacts on the environment have been assessed and range from neutral to moderate adverse. However, none of these impacts were considered to weigh substantially against the overall scheme benefits.

3.14.5. A significant factor in determining the final VfM category was that benefits would need to be increased by about £131M (equivalent to 11% of total benefits) or decreased by £302M for the BCR to be changed sufficiently to affect the determined VfM category.

3.14.6. This is regarded as significant with respect to determining the final VfM category, since this provides a relatively large margin as the analyses presented above together with the sensitivity analyses reported in **Appendix I** do not offer sufficient evidence that the scheme VfM category is likely to fall outside of that. The final VfM category for the Proposed Scheme between New Buildings and Aughnacloy was therefore determined as **Low**.

3.14.7. Initial VfM categories have been produced for each Phase of the Proposed Scheme based upon the adjusted BCRs.

4 THE FINANCIAL CASE

4.1 INTRODUCTION

4.1.1. This chapter sets out the financial case for the proposed scheme to demonstrate its affordability. This chapter describes:

- how much the proposed scheme is expected to cost, and how this has been calculated
- how the scheme will be paid for and by whom
- the anticipated profile of expenditure over time (whole life costs)

4.1.2. This chapter deals with costs and accounting issues. The question of value for money is dealt with separately in the economic case.

4.2 SCHEME COSTS

4.2.1. The estimated capital cost of the scheme, at 2022: Q2 prices, is shown in Table 4-1. It is noted that the capital cost estimates include quantified risks, optimism bias and inflation, however, excludes client costs and non-recoverable VAT. The costs are presented with and without 'Sunk' costs, Sunk costs are those costs which represent expenditure incurred prior to the scheme appraisal and which cannot be retrieved.

Table 4-1: Estimated capital costs of the Proposed Scheme at Q2:2022

Scheme	Cost (£)
A5 Western Transport Corridor *(including Phase 1A, 1B, 2, 3) – Excluding sunk costs*	£1,608,624,276
A5 Western Transport Corridor *(including Phase 1A, 1B, 2, 3) – Including sunk costs*	£1,697,776,585

4.2.2. The build-up of the cost estimate and spend profile over time is demonstrated in Table 4-2.

Table 4-2: Breakdown of the scheme costs by financial year for the Proposed Scheme at Q2:2022

Scheme Element	Financial Year (Cost in £)											
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	Total
Base Costs in 2022: Q2													
Construction Contracts including Statutory Undertakers Works	[redacted]												
Land and Compensation													
Design Investigations, Surveys, Procurement, IDT Costs													
Supervision													
Total Cost (excluding quantified risk and optimum bias)													
Costs in 2022: Q2 (including Quantified Risks, Inflation but excluding Optimism Bias)													
Quantified Risk	[redacted]												
Inflation													
Risk-adjusted Total Cost (excluding Optimism Bias)													
Account for Optimism Bias													
Optimism Bias	[redacted]												
Scheme Cost (out-turn prices)	**0**	**5,327,475**	**27,521,640**	**83,492,455**	**396,072,623**	**628,051,409**	**380,806,902**	**58,176,254**	**13,905,726**	**10,030,085**	**4,875,449**	**364,260**	**1,608,624,276**

SUNK COSTS

4.2.3. 'Sunk' costs are those costs which represent expenditure incurred prior to the scheme appraisal and which cannot be retrieved. In line with *TAG Unit A1.2 (Scheme Costs),* these 'sunk' costs were not included in the economic appraisal. The costs incurred prior to the scheme appraisal, at 2022: Q2 prices, are presented in Table 4-3. These values are taken from Table 3 of the "Whole Scheme Cost Estimate 2022" (Ref: 718736-0000-R-084, November 2022)

Table 4-3: A5WTC Spend to Date ('Sunk' Costs) at Q2:2022

Scheme Element	Spend to Date
Construction Contracts	£0
Statutory Undertakers Works	£1,049,607
Land and Compensation	£2,925,660
Preparation (inc. Design Investigations, Surveys, Procurement & IDT Costs)	£85,177,042
Supervision	£0
Total	**£89,152,309**

SCHEME PREPARATION AND CONSTRUCTION

4.2.4. The cost of the Proposed Scheme's preparation and construction has been estimated by the cost consultant, ChandlerKBS.

RISK BUDGET

4.2.5. The cost of delivering the Proposed Scheme will not be fully known until the detailed design has been completed, land purchases and the target costs agreed by all contractors have been received. These costs will be quantified in the production of the Full Business Case for the respective phases of the Proposed Scheme. To reflect the uncertainty associated with known risks at this stage, a Quantified Risk Assessment (QRA) has been undertaken[80]. Details of the QRA is presented in Section 6.8

OUT-TURN PRICE ADJUSTMENT

4.2.6. The cost estimate is prepared based on 2022: Q2 prices. An allowance is therefore made for expected inflation between the date of the estimate and the date when the expenditure is expected to occur. The uplift factors to reflect price inflation have been estimated based on the GDP deflator methodology recommended by TAG. A further allowance has been made for construction inflation that is based on the Building Cost Information Services (BCIS) five-year forecast for increases in tender prices.

[80] Risk allowance is a factor applied to project costs to act as a contingency for unforeseen circumstances. At the concept stage, the risks of being able to accurately assess cost is deemed high, and this reduces throughout the scheme's lifecycle

SUMMARY OF SCHEME COSTS

4.2.7. The Proposed Scheme is now expected to be delivered in distinct Sections, comprised of different phases as detailed in paragraph 1.2.47. As the scheme moves forward, a Full Business Case (FBC) will be prepared for each individual Section, which will review the continued accuracy of assumptions made within this OBC with a view to ensuring the robustness of the appraisal for the Section being assessed and for the whole scheme. A summary of the scheme costs that will form the basis for approval is presented in Table 4-4.

Table 4-4: Summary of Scheme Costs at Q2:2022

Scheme Element	Phase 1A (Section 1)	Phase 1B (Section 3)	Phase 2A (Section 1)	Phase 2B (Section 2)	Phase 3 (Section 3)	Total
Construction & Statutory Undertakers Works	[redacted]					
Land and Compensation						
Design Investigations, Surveys, Procurement, IDT Costs						
Supervision						
Quantified Risk						
Inflation						
Optimism Bias						
Total	**256,486,961**	**348,071,289**	**318,842,681**	**497,385,963**	**187,837,382**	**1,608,624,276**

4.2.8. As detailed above, Proposed Scheme would now be constructed in three Sections aligned to the phases. Section 1 comprises of Phase 1A and Phase 2A, for which approval is sought amounts to **£575.32M.** Section 2 comprises just Phase 2B for which approval is sought amounts to **£497.39M** and Section 3 comprises of Phase 1B and Phase 3 for which approval is sought amounts to **£535.91M**.

4.2.9. Table 4-4 confirms that the total capital investment costs for which approval is sought amounts to **£1,608.62M**. This is based on the outturn cost of the scheme that includes an allowance for future inflation 2022 to 2028, quantified risks and Optimism bias (i.e. other risks associated with the scheme that is not yet quantified). Optimism bias is calculated using the Department's E058 templates, further details are presented in **Appendix J.**

4.2.10. It should be noted that the outturn cost for which approval is sought differs from the **£1,503.62M** used in the economic appraisal (Table 3-5 – Economic Case document). This is due to the fact that, real cost increase has been applied in the Economic Case as opposed to the inflation used in the Financial Case.

WHOLE LIFE COSTS

4.2.11. The Proposed Scheme will give rise to additional revenue liabilities for capital renewals and maintenance, when compared to the situation in which the Proposed Scheme does not exist.

Highway- Maintenance Costs

4.2.12. It is estimated that approximately **£222.93M** (at Q2 2022 price base) is required for resurfacing / renewing the new highway infrastructure asset relating to the whole scheme. This is based on a 60-year appraisal period commencing on the opening of all the Phases of the Proposed Scheme. The costs are based on the assumption that, the surface and binder courses being replaced approximately every 12 years after the opening of each Phase.

4.2.13. The major maintenance cost, over 60 years, for each of the Phases and the linked Sections are shown in Table 4-5 below.

Table 4-5: Highway maintenance cost over 60 years, by phase, at Q2 2022 prices

Phase / Section	Highway Maintenance Cost
Phase 1A (Section 1)	£38,342,373
Phase 1B (Section 3)	£57,173,416
Phase 2A (Section 1)	£21,451,059
Phase 2B (Section2)	£82,808,857
Phase 3 (Section 3)	£23,149,652
Total	**£222,925,357**

Annual Routine Maintenance Costs

4.2.14. It is estimated that approximately **£13.14M** (at Q2 2022 price base) will be required to meet routine & cyclical highways maintenance requirements including but not limited to Sustainable Urban Drainage System (SuDS) clearance, communications equipment, road and street lighting operation, winter maintenance (i.e. application of salt and snow clearance) and infrastructural and safety inspections. This is based on a 60-year appraisal period commencing on the opening of all Phases of the Proposed Scheme.

4.2.15. The routine (annual) maintenance cost, over 60 years, for each of the Phases and the linked Sections are shown in Table 4-6 below.

Table 4-6: Traffic-related maintenance cost over 60 years, by phase, at Q2 2022 prices

Phase	Routine (Annual) Maintenance Cost
Phase 1A (Section 1)	£2,241,098
Phase 1B (Section 3)	£3,142,344
Phase 2A (Section 1)	£1,109,193
Phase 2B (Section2)	£5,225,003
Phase 3 (Section 3)	£1,424,333
Total	**£13,141,971**

4.2.16. The whole life costs identified above have been factored into the economic appraisal, contained within the Economic Case, and have therefore been included within the BCR and NPV calculations.

4.2.17. It should be noted that the O&M figures provided in Table 4-5 and 4-6 do not account for inflation during the scheme maintenance cycle. For the purpose of the Economic Appraisal, the O&M costs have been adjusted to account for real cost inflation as per TAG A1.2 guidance.

4.3 BUDGET, FUNDING AND KEY FINANCIAL RISKS

4.3.1. Since July 2007 both the NI Executive and the Irish Government have been committed to the delivery of the A5WTC. As such, it is designated as a Flagship Project of the NI Executive. This means that it is prioritised ahead of other capital projects for funding. The continuing commitment to funding over the years is evidenced through the Fresh Start agreement in 2015 and New Decade New approach in 2020. Furthermore, following the release of the Draft Budget 2022-2025 in December 2021, the then Finance Minister, Conor Murphy, reconfirmed the Proposed Scheme's Flagship status and the NI Executive's commitment to the scheme.

4.3.2. Ireland's 2021 National Development Plan 2021-20301 lists the Proposed Scheme as one of its strategic investment priorities and the recent update to the Irish Government's Building a Shared Island2, extends the budget to 2030 with a EUR1 billion commitment ring-fenced for investment in collaborative North/South projects to deliver key cross-border initiatives including working with the Executive to deliver key cross-border infrastructure initiatives, including the A5WTC.

4.3.3. It is therefore assumed that the full capital allocation for the Proposed Scheme will be provided at the Executive level alongside contributions from the Irish Government, rather than being funded from within the Department's typical budget allocations.

4.3.4. Final value for money and affordability factors will be considered again in detail as part of any decision to authorise the scheme; however, at this stage, the Department does not foresee any difficulties with either given the rationale set out above.

4.3.5. An indicative programme is presented in Section 6.3, while Section 6.8 details the risk management strategy for the Proposed Scheme. A risk register has been developed for the construction of the Proposed Scheme accounting for all risks and their management relating to the development of its entire length. The risk register is presented in **Appendix L**.

5 THE COMMERCIAL CASE

5.1 INTRODUCTION

PURPOSE

5.1.1. The purpose of the commercial case is to demonstrate that the preferred option will result in a viable procurement and a well-structured Deal between the public sector and its service providers.

5.1.2. The Commercial Case outlines the commercial viability of the Proposed Scheme and describes the procurement strategy that was developed and implemented in 2008. It explains the planned method for risk allocation and transfer during the construction stage, contract and implementation timescales, in addition to how the capability and technical expertise of the team delivering the project will be secured.

5.1.3. This Outline Business Case (OBC) satisfies both the UK Treasury's advice on evidence-based decision making set out in the Green Book[81] and the Better Business Cases Northern Ireland (NI) guidance[82] and Supplementary Guidance 2021[83]. The Five Case Model[84], as set out by the UK Department for Transport (DfT), forms the structure of this document.

5.1.4. This Chapter includes reference to *Contract Phases* and *Geographical Phases*. A reference to a *Contract Phase* relates to two discrete Phases of the Early Contractor Involvement (ECI) contracts whereby Phase 1 relates to the Contractors providing design support and construction planning; and Phase 2 relates to Design and Build (D&B) construction.

5.1.5. The Proposed Scheme is now expected to be delivered in three distinct contract Sections, which are expected to comprise geographical phases as detailed in paragraph 1.2.47. A reference to a *Geographical Phase* relates to the sub-division of a Section: Section 1 was split into Phases 1A and 2A; Section 2 became Phase 2B and Section 3 was split into Phases 1B and 3.

5.1.6. As the scheme moves forward, a Full Business Case (FBC) will be prepared for each individual Section, which will review the continued accuracy of assumptions made within this OBC with a view to ensuring the robustness of the appraisal for the Section being assessed and for the whole scheme.

5.1.7. The procurement was completed in 2009, with three ECI contracts awarded, one for each Section. All three contracts remain in Contract Phase 1. As the procurement is now complete and the contracts are live, this Chapter will set out the following details:

1. **Background** – Covering the background to the Procurement and Commercial Strategy.
2. **Procurement Strategy (2008)** – Providing details of the 2008 procurement strategy, which has been partially implemented following the award of ECI contracts in 2009.

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[81] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

[82] https://www.financeni.gov.uk/sites/default/files/publications/dfp/Final%20Best%20practice%20in%20business%20cases%20August%2021%20update_0.pdf

[83] https://www.finance-ni.gov.uk/publications/better-business-cases-ni-supplementary-guidance

[84] https://www.gov.uk/government/publications/transport-business-case

3. **Procurement and Commercial Strategy Review** – Covering the work undertaken since 2020 to review the validity of the original commercial and procurement strategy and consider how best to move forward, including whether the strategy continues to provide a good basis for delivery of value for money.
4. **Strategy Planning and Progress** – This part explains the plan to implement the Procurement Strategy and deliver value for money, including progress to date and the next steps.
5. **Contingency Planning** – This section explains the contingency planning to help mitigate key risks to successful delivery to the programme.
6. **Social Value** - This sections explains the wider financial and non-financial impacts on the wellbeing of individuals, communities and the environment.
7. **Summary and Recommendation**

BACKGROUND

5.1.8. The initial Business Case Assessment task completed in early 2008 considered how the project objectives could be achieved, including achieving accelerated delivery. The outcome of this initial Business Case Assessment determined the approach adopted by the Project Team in achieving the delivery programme between 2008 and 2012. The overarching aims and objectives of that assessment have been maintained as the project has been taken through the statutory process between 2013 and 2022.

5.1.9. In June 2008, a Discussion Paper entitled 'An Integrated Approach to Major Project Delivery' was prepared which advocated using an integrated approach to delivery and ECI as the most appropriate way of achieving value for money and accelerated delivery.

5.1.10. This early work continued with a market sounding questionnaire of the construction sector to gather the industry's views on how a scheme of approximately 85km in length could be delivered to achieve this in the accelerated delivery programme.

5.1.11. The 'Procurement Strategy Summary for Outline Business Case Discussions' recommended the way forward in terms of promoting collaborative working through an integrated delivery team; sharing the workload and risk throughout the industry by splitting the scheme into three contracts; and adopting an ECI approach using the New Engineering Contract (NEC3) Option C form of contract for the construction stage.

5.1.12. Whilst accepting the use of the ECI approach, the Department recognised that transferring the responsibility for scheme design to three Contractors would introduce unacceptable consistency and co-ordination risks. Therefore, it was decided that the consultant (WSP) would lead the design development through the statutory process. The ECI contractors (and their designers) are responsible for supporting the design process by providing input on value engineering and construction impacts (buildability).

5.1.13. A new OBC was prepared in 2017 confirming that the Proposed Scheme was commercially viable with an appropriate contracting and procurement strategy.

5.2 PROCUREMENT STRATEGY (2008)

OVERVIEW

5.2.1. This part provides historical information that justified the procurement strategy developed in 2008. The procurement strategy is already partly implemented with ECI contracts successfully awarded to three Contractors in 2009.

5.2.2. The 2008 procurement strategy was developed in line with government policy and best practice. The resulting integrated approach to delivery using ECI remains accepted good practice, as confirmed in the Cabinet Office's Construction Playbook. The early appointment of Contractors in 2009, to form part of the IDT prior to the Public Inquiry in 2011, generated the following benefits:

- the design was informed by the knowledge and experience of contractors and key supply chain partners prior to being constrained by the draft Orders and Environmental Statement.
- there was an opportunity for the contractors to plan, recruit, motivate and retain the best team and to plan and source the necessary labour, plant and materials.
- there was an opportunity for the contractors to plan and to address buildability requirements, which promotes safe delivery and a 'right first time' approach during construction.
- there was an opportunity for the contractors to assess construction risks, mitigate the consequences and agree the optimal allocation of risks for the construction phase.
- the Department had time to consider and assess the merits of value engineering proposals by the contractors, and to secure all necessary approvals.
- there were enhanced opportunities for the team to develop strong working relationships.
- the contractors could develop relationships with local communities and stakeholders helping consider construction and buildability issues early in the planning stage helping minimise scheme objections and programme risk.

5.2.3. Having the Contractors integrated within the delivery team allowed improved construction planning and the effective management of risks, helping to drive value for money.

5.2.4. Details of the strategy and its development are provided in **Appendix M**.

5.2.5. A comparison of the original and current delivery dates is shown in Table 5-1.

Table 5-1: Key programme dates (in 2008 and 2022)

Element	Indicative Date (2008)[1]	Indicative Date (2022)[2]
Preferred Corridor	Late 2008	Late 2008
Preferred Route Announcement	Mid 2009	Mid 2009
Statutory Orders Publication	Late 2010	Mid-2023[3]
Start on Site (main works)	2012	2024
Open to Traffic	2015	2028

Notes: 1 Dates are Calendar years and relevant at the time that the Procurement Strategy with prepared in 2008.
2 Dates are Calendar years and are current.
3 For all Phases excluding Section 3; Phase 3.

5.3 PROCUREMENT AND COMMERCIAL STRATEGY REVIEW

SCENARIO PLANNING IN 2020

5.3.1. In 2020 the Department carried out scenario planning (known as '2028 Scenario Planning') to develop strategies for completion of the entire A5WTC route by 2028 taking into account the outcomes from the 2020 Public Inquiry.

5.3.2. The 2028 Scenario Planning concluded that the Department should continue to deliver the scheme using the ECI Contractors appointed in 2009. This would facilitate value for money by strongly supporting the delivery of the minimal overall cost and maximising the ability to complete the entire Scheme by 2028. Key advantages and benefits of the proposed approach are:

- Avoiding the need for a time-consuming new procurement that would introduce significant new risks to delivery. The outcome of procurement processes in NI are routinely challenged by contractors, which would be a significant risk to timely progress.

- Making best use of the time needed to address the Planning Appeals Commission (PAC) issues[85] by taking full advantage of the planning and design phase (Phase 1 of the existing contracts). The three delivery contracts include a valuable planning and design phase where the work can be planned and optimised along the entire route to maximise efficiency in parallel to dealing with the PAC issues.

- Allowing delivery risks to be avoided or mitigated and efficient plans and prices to be developed as originally envisaged when the contracts were awarded.

- Supporting largely concurrent delivery on the Proposed Scheme, which helps to reduce the overall cost by reducing the amount paid for inflation, allowing the optimisation of earthworks along the route and building resilience into programming.

PROCUREMENT STRATEGY - VALUE FOR MONEY REVIEW

5.3.3. Following the 2028 Scenario Planning a review of the original Procurement and Commercial Strategy further confirmed that it remains valid and continues to offer value for money. This review involved representation from Roads and Rivers, Centre of Procurement Expertise (CoPE), and Rowsell Wright Ltd as expert procurement advisers.

5.3.4. The original procurement strategy intended that value for money would be maximised through early appointment of the delivery teams and incentivising all three Contractors, the Department's designers (WSP) and their Partners to work together as an Integrated Delivery Team (IDT) to optimise delivery plans and effectively manage risk. Integrated working was incentivised using an overarching Project Target Cost, which was to be set in Phase 1 of the contracts.

5.3.5. In the time since the original procurement strategy was developed and implemented, the published procurement and commercial guidance has consolidated ECI as good practice. ECI is at the heart of the A5WTC procurement strategy and clearly remains a valid basis for obtaining value for money.

[85] https://www.a5wtc.com/Publication-of-the-PAC-Interim-Report-and-the-Interim-Departmental-Statement

5.3.6. The original procurement strategy sought to establish a delivery and commercial environment where the likelihood of delivering value for money is maximised. A well-planned and effective construction methodology will be critical to scheme success, and the ECI contract provides the A5WTC contractors with the time needed to plan the works so they can be delivered as efficiently as possible.

5.3.7. Under the A5WTC contracts, the Department pays the actual costs for construction plus the contractor's fee, which is incentivised based on the target price agreed at the end of Phase 1. The fees secured under competition in 2009 are competitive and supplier feedback indicates that lower fees are unlikely to be obtained from a new procurement exercise. The contractors are further incentivised via the Project Target Cost, which promotes collaboration to minimise the overall outturn cost and maximise value for money

5.3.8. The ECI benefits envisaged by the original contract strategy are either being delivered or remain part of the delivery plan, which include:

- More time and scope for the Contractors to support the development of innovative and better value solutions.
- Improved and safer buildability of the project.
- Improved understanding and estimating of costs and spend forecasts.
- Better understanding and mitigation of risk.
- Development of improved relationships with stakeholders.

As part of the Construction Planning currently underway a baseline carbon assessment will be agreed with the Contractors. During Phase 1 carbon reduction targets will be discussed and agreed with all Contractors and construction methods developed to reduce embedded carbon. This will be set out in more detail in the Full Business Case.

ACTION PLANNING

5.3.9. The 2028 Scenario Planning exercise developed an action plan for completion of the entire A5WTC route by 2028. An initial action for re-mobilising the IDT was to contact the Contractors to explain how the project was developing, set out the next stages of development, and to re-establish communication. This included a discussion regarding timescales, anticipated project development, and key decisions to be taken.

5.3.10. Actions were needed to determine whether the existing ECI two-stage contracts, which remained live but with reduced activity, could be re-mobilised. The actions included:

- checking each Contractor's on-going fitness to supply the services and works, including their financial standing to deliver works that have increased in value due to inflation.
- determining whether the Contractors were willing to deliver the Phase 1 ECI Professional Services Contract (PSC) based on their original offers.
- reviewing the original contract terms and making any necessary modifications (as permitted by the Public Contracts Regulations 2015) to implement changes to the Department's policies and procedures since 2009 and to support value for money.
- confirming the phasing and packaging of the works to deliver best value and alignment with the Environmental Statement Addendum prepared in 2022.

5.3.11. Prior to Phase 2 award, the focus will be on checking that the contractors possess the necessary economic and financial capacity and stability to perform the contract. This will protect the Department from entering a Phase 2 contract with a contractor with a risk of insolvency.

5.4 STRATEGY PLANNING AND PROGRESS

PROGRESS FROM 2020 TO DATE

5.4.1. In the autumn of 2021, the Contractors confirmed that they were willing to deliver the scheme on the basis of the original contracts and for their tendered rates.

5.4.2. In September 2022 the Department completed their 'fitness to supply' review of the three Contractors. It was confirmed that whilst there had been some changes to the original Contracts the current arrangements, as set out below, were permitted by the Public Contracts Regulations 2015 and the organisations are fit to supply the A5WTC contracts.

- Section 1 BAM | McCann
- Section 2 Sisk Holdings
- Section 3 Graham | Farrans

5.4.3. When appropriate, and prior to contract award, a more comprehensive appraisal of the proposed delivery team, tender obligations, including financial standing and insurances will be undertaken.

5.4.4. The Contractors have been remobilised and construction planning is now underway after a period of reduced activity. As part of the construction planning an indicative Target Cost is being developed by all three Contractors to determine whether the original contract terms are likely to produce an affordable solution.

5.4.5. Activities are underway to finalise the Phase 2 Terms and Conditions, including the phasing of the works. The contractual Target Cost for each section will be agreed based on the finalised terms and conditions and in line with the agreed pricing process. It is intended to move all three contracts into Phase 2 subject to the Contractors satisfying all the requirements for Phase 1. If the requirements are not fully met, then contingency plans would be implemented.

COMMERCIAL STRATEGY

5.4.6. A procedure for progressively developing, presenting, and agreeing the Phase 2 Target Cost before the end of Phase 1 has been agreed with all Contractors and is being implemented in two Stages as follows.

Stage 1

5.4.7. All Contractors develop Target Costs at the same time to demonstrate that the scheme is affordable, deliverable and the procurement route still delivers value for money for the Department.

5.4.8. At Stage 1, it is intended to resolve key project considerations such as the Commercial Assessment Model and the Project Share. By prioritising these considerations, it will provide the Department an early indication of both the viability and validity of progressing with the current Contractors. This will allow the fundamental aspects of developing a Target Cost to be finalised.

5.4.9. The Target Cost Process sets out a best practice approach to progressively developing a Target Cost for each Section of the Proposed Scheme in accordance with the originally intended approach. It provides a process that will allow the Department to monitor the progressive build-up of the Target

Cost and reduces the risk of surprises as the programme moves closer to the construction phase. The process provides for concurrent agreement of relevant sections of the Target Cost across each of the Sections, thereby putting the Department in a stronger commercial position as they can use information to benchmark prices across the Proposed Scheme programme.

5.4.10. Stage 1 is currently underway as part of the current Task Order being delivered under Contract Phase 1 and due for completion later in 2023.

Stage 2

5.4.11. Stage 2 will predominantly consist of obtaining quotation for various packages of work and potential optimisation of earthworks, drainage and structures which should be enhanced through engagement with the Contractors. It is envisaged that other elements of the Target Cost previously agreed in Stage 1 will not be revisited other than to ensure that the rates are representative of the market at that time. Resource requirements (from a Client, Consultant and Contractor perspective) are significantly less onerous than what is required in Stage 1.

5.4.12. The NEC3 Engineering Construction Contract (ECC) through Main Option C is being used. The contract includes two share mechanisms:

- one related to performance against the contract Target Cost (the Section Share)
- the other related to performance against a pre-set Project Target Cost (the Project Share).

5.4.13. The Project Target Cost (PTC) is set by the Department during Phase 1. It will comprise all elements of the scheme budget (all Sections) that it is considered that the Contractors can influence.

5.4.14. The pain/gain mechanism for Phase 2 is given in the Contract in the Contract Data Part one – Data provided by the Employer. The A5WTC share ranges and percentages are shown in Table 5-2.

Table 5-2: The Contractor's share percentages and the share ranges are

Share range	Contractor's share percentage
less than …… 80..…..%	…………..0…………….%
from 80…% to 95.…%	…………25…………….%
from 95…% to 100…%	…………50…………….%
from 100..% to 105…%	…………25…………….%
from 105..% to 120…%	…………50…………….%
greater than …120… ..%	…………100...…...……%

5.4.15. If the final Price for Work Done to Date (Defined Cost-plus fee) is greater than the total of the Prices (Target Cost) the Contractor and the Employer (Department) share the cost over-run. If the final Price for Work Done to Date (Defined Cost-plus fee) is greater than 120% of the total of the Prices (Target Cost) the Contractor pays all additional costs.

5.4.16. The Employer's financial liability (defined cost) is therefore capped at 120% of the total of the Prices (Target Cost), unless the Target Cost increases, via Compensation Events in accordance with the contract including changes in scope, restriction of access and other work on site etc.

5.4.17. The purpose of the two level incentivisation is to encourage the Contractors on each of the Sections to work collaboratively to successfully deliver the entire A5WTC project on time, to the required specification and within the budget set by the Department.

5.4.18. The project incentive is subject to an overarching cap, which will limit the maximum incentive payment to each Contractor to £3 million. This incentive payment would be an attractive increase to the profit that might otherwise be expected by contractors on infrastructure projects of this type. It is considered sufficient to provide the required degree of motivation without providing the potential for excessive profits.

5.4.19. As the share of any savings is divided equally between the three Contractors and Department, for the maximum incentive payments to be obtained the actual project cost would need to be at least £12 million below the PTC. Payment of this level of bonus (a maximum of £9 million in total to Contractors) would represent good value for money when compared with typical outcomes on conventionally procured contracts.

5.4.20. Unlike the NEC3 target price mechanism in the Phase 2 contracts, there is no pain-share for the IDT contractors if the actual A5WTC project cost exceeds the PTC. Therefore, the Contractors do not take any risk if Department determines the PTC at a level that proves to be too low. However, in such circumstances, an unachievable PTC would not provide an additional incentive above the contract specific incentive mechanism.

PAYMENT MECHANISMS

5.4.21. The contract includes incentives to motivate the Contractors to work closely together with the Department to achieve the scheme aims for minimum out-turn cost within the available budget.

5.4.22. The contract is divided into two broad phases:

- **Contract Phase 1** – preliminary design process and promotion of the project through the statutory process up to the Orders being confirmed and operative
- **Contract Phase 2** – completion of the detailed design and construction

5.4.23. Payment during Phase 1 will be calculated by multiplying the Contractors' time spent delivering the services by tendered staff rates. This is subject to a monthly cap to help control costs, which is established by multiplying a tendered resource profile for Phase 1 by the tendered staff rates for Phase 1. As the Phase 1 payments are made on a cost reimbursable basis, and the Contractors have a supporting rather than leading role, the Department has a high degree of control over Phase 1 costs. The Project Manager will process payment applications in accordance with the PSC Contract and Department's accounting procedures.

5.4.24. Payment during Phase 2 will be Defined Cost plus fee and then adding 'gain-share' or subtracting 'pain-share' depending on how the final price compares to the total of the Prices (Target Cost) which will be updated if Compensation Events occur. The Project Manager will process payment applications in accordance with the ECC Contract and Department's accounting procedures.

5.4.25. It was intended that both phases would be progressed using Target Cost mechanisms with actual costs reimbursed. Phase 1 utilised the NEC Professional Services Contract with costs being budgeted and paid for using tendered daily rates for resources. The task orders for Phase 1 were estimated using tendered rates and agreed post award using procedures given in the contract.

5.4.26. During Phase 1 the Target Cost for Phase 2 is being progressively developed and agreed including construction risks prior to awarding Phase 2. Construction risks are assessed and allocated by the Client in consideration of cost premiums proposed by the contractor.

5.4.27. Controls are incorporated to give the Client comfort that the Target Cost represents good value and that the accounting of actual costs is robust. These include a tendered quality plan for building up the Target Cost (which would be a contractual commitment), the development of resourced programmes of work based on benchmarked productivity rates, processes to agree quantities of work and appropriate market rates for labour, plant and materials.

5.4.28. In addition, the contract includes open book accounting arrangements and provision is included for independent third-party reviews of the Target Cost. The financial and performance incentives are structured in a way to reward an accurate Target Cost.

RISK ALLOCATION AND TRANSFER

5.4.29. The three Contractors were appointed in 2009 and under Phase 1 of their contracts were actively engaged in the development of the specimen design of the scheme, providing value engineering and buildability input into the design and the land take requirements for the draft Vesting Order. As such, the level of risk reduced through this process. This was captured and quantified within the Qualitative and Quantitative Risk Assessment process. The description of this process is outlined in the Management Case.

5.4.30. During the development of the Target Cost process, some of the risk (such as scheme cost increases associated with the design and construction) can be transferred to the contractor. Other risks, such as the identification of statutory undertaker equipment, and mitigation costs associated with these, can be removed from the 'risk pot' completely if they do not materialise, or transferred to 'actual' scheme costs if they do materialise, rather than remaining as risks.

5.4.31. The construction contract amends some of the core clauses of the NEC Conditions of Contract to facilitate the transferring of specific risks from the Department to the Contractor – some examples of these are specified below. These risks could increase the scheme costs above those forecast in the financial case however transferring them to the Contractor affords the employer (The Department) an element of cost certainty.

5.4.32. The delivery and programme risks will substantially lie with the Contractor as they are best placed to manage them. In addition, the following examples of risks have been considered by the Department and have been transferred to the contractor. Nevertheless, some of the effects of these risks will impact the Department through the pain / gain mechanism.

- unforeseen ground conditions / contaminated land
- weather and flooding
- cost inflation
- vandalism / theft
- protestors (delay)
- environmental (delay)
- archaeology
- surveys (adequacy / suitability)

CONTRACT DURATION

5.4.33. The Proposed Scheme is currently mid-way through the preconstruction stage. The Contractors construction and buildability advice has informed the production of the Draft Orders. The Contractors are currently undertaking construction planning to develop a whole scheme Target Cost alongside supporting preparation for the upcoming reconvened Public Inquiry.

5.4.34. This stage takes the scheme from feasibility to possession of the land required to construct the scheme. It is envisaged that the Delivery agreements for each Contractor will be signed as funding becomes available for each of the construction Sections; commencing with Section 1; Phase 1A main works in early 2024 with completion of the whole of the A5WTC scheme (open to traffic) in 2028. An indicative timeline for each Section and Phase is provided in below Table 5-3.

5.4.35. The Department has a Central Procurement Branch (Transport and Roads Asset Management Centre of Procurement Excellence - CoPE) which oversees Roads and Rivers procurements and contracts. Relevant templates and contract clauses applicable for use in Northern Ireland have been provided and incorporated within the Engineering Construction Contract (ECC) conditions of contract and appendices.

5.4.36. The programme for implementation of the Proposed Scheme is summarised in Section 6.3. Further details will be provided in the Full Business Cases (FBC).

Table 5-3: Indicative timeline for each contract (Main Works)

Geographical		Extent	Contract Phase 1 Professional Services Contract (PSC)	Contract Phase 2 Engineering Construction Contract (ECC) - Main Works	
Section	Phase			Start	End
1	1A	New Buildings to North of Strabane	Ongoing	Q1 2024	Q4 2026
	2A	North of Strabane to South of Strabane	Ongoing	Q1 2025	Q4 2027
2	2B	South of Strabane to South of Omagh	Ongoing	Q1 2025	Q4 2027
3	1B	South of Omagh to Ballygawley	Ongoing	Q1 2025	Q1 2028
	3	Ballygawley to the Border	Ongoing	Q2 2026	Q3 2028

Notes:
ECC Phase 2 contracts will proceed for each Section as a whole and the geographical phases/subsections are indicated to show the delivery details.
Where possible archaeological investigation and geotechnical investigation and other advanced works could commence as set out in ESA2022.
The construction start date could potentially be delayed should a legal challenge be made on the Proposed Scheme

CONTRACT MANAGEMENT

5.4.37. The ECC Option C form of contract provides the contracting authority (Department) with an appropriate means of managing risk. Both the PSC and the ECC Contract are linked with conditions that set out how the Consultant will transition to Phase 2. This will allow the Department to commence the detailed design process when funding permits.

5.4.38. On behalf of the Department, WSP with expert cost consultants ChandlerKBS will oversee the process to develop the Target Cost, review the contractors detailed design proposals, audit and inspect the works and administer payments in accordance with the contract as works progress. Further details on contract management will be provided in the FBC for each Section.

5.5 CONTINGENCY PLANNING

[redacted]

[redacted]

5.6 SOCIAL VALUE

INTRODUCTION

5.6.1. Social Value refers to wider financial and non-financial impacts on the wellbeing of individuals, communities and the environment. Social Value has been incorporated within the three contracts in accordance with Procurement Policy Note (PPN) 01/21 (Scoring Social Value Policy). The following text provides an overview to the Social Value themes identified within PPN 01/21 and how it will be incorporated within the Proposed Scheme. These themes are linked to the Programme for Government (PfG) outcomes. The four Social Value themes are described in greater detail below.

- **Theme 1** Increasing secure employment and skills
- **Theme 2** Building ethical and resilient supply chains
- **Theme 3** Delivering zero carbon
- **Theme 4** Promoting wellbeing

Increasing secure employment and skills

5.6.2. This theme aims to create employment and training opportunities, contribute to in work progression and skills development, create opportunities for entrepreneurs and support economic growth.

Table 5-4: Increasing secure employment and skills

SOCIAL VALUE INDICATOR	SOCIAL VALUE INITIATIVES
1.1 Create employment, retraining and other return to work opportunities for those furthest from the labour market.	Paid employment Paid employment – priority group
1.2 Create employment opportunities particularly for those who face barriers to employment and/ or who are located in deprived areas.	Paid employment: Apprentice Paid employment: Student Placement/ Professional trainee
1.3 Create employment and training opportunities in industries with known skills shortages or in high growth sectors	Continued employment for a person who has completed their 52-week period Work placements Work placement – priority group Skills development and educational attainment Skills development and educational attainment – priority group
1.4 Support in-work progression and educational attainment in the workforce, including training schemes that address skill gaps and result in recognised qualifications, to help people to move into higher paid work by developing new skills	In-work progression and skills development

1.5 Increase the representation of disabled people in the contract workforce	Paid employment
1.6 Support disabled people to develop new skills and recognised qualifications	Skills development and educational attainment
1.7 Create opportunities for entrepreneurship and help new, small organisations to grow, supporting economic growth and business creation.	Inclusion of Social and Micro Enterprises in the contract's supply chain Business development and knowledge sharing

Building ethical and resilient supply chains

5.6.3. This theme aims to tackle employment inequality, reduce the risk of modern slavery and human rights abuses within the supply chain, and promote diverse and secure supply chains.

Table 5-5: Building ethical and resilient supply chains

SOCIAL VALUE INDICATOR	SOCIAL VALUE INITIATIVES
2.1 Demonstrate action to promote collaboration and a fair and responsible approach to working throughout the supply chain	Fair Work strategy for the contract
2.2 Demonstrate action to promote ethical supply chains and practices; and, identify and manage risks of modern slavery and human rights abuses in the delivery of the contract, including in the supply chain.	Human Rights strategy for the contract including Ethical Supply chain
2.3 Maximise security of supply, for example by minimising proximity of supply chains to point of delivery	Supply Chain Resilience and Capacity strategy for the contract
2.4 Create a diverse supply chain to deliver the contract including new businesses and entrepreneurs, start-ups, SMEs and VCSEs.	Inclusion of MEs, which are in their first 48 months of trading, in the contract's supply chain Inclusion of VCSE sector organisations in the contract's supply chain Business development and knowledge sharing

Delivering Zero Carbon

5.6.4. This theme aims to promote environmental benefits, influence environmental protection and improvement and work towards Net Zero greenhouse gas emissions. A BREEAM (the Building Research Establishment Environmental Assessment Method) infrastructure assessment will be undertaken for the design of the Proposed Scheme. Furthermore, during construction the Contractor(s) will further develop the Outline CEMP (Appendix 5-1 – Outline Construction Environmental Management Plan of the ESA 2022) which includes carbon mitigation measures. The Contractor(s) will implement these measures throughout the construction stage. In addition to the Outline CEMP the Contractor(s) will also implement design optimisation to reflect the carbon reduction hierarchy (detailed Chapter 15: Climate of the ESA 2022 and found in clause 6.1.4 of PAS:2080:2016).

Table 5-6: Delivering Zero Carbon

SOCIAL VALUE INDICATOR	SOCIAL VALUE INITIATIVES
3.1 Deliver additional environmental benefits in the performance of the contract including working towards Net Zero greenhouse gas emissions. 3.2 Supply chains that minimise carbon footprint and emissions.	Environmental Strategy for the contract including Carbon Reduction.
3.3 Companies employ low or zero-carbon practices and/or materials.	Waste and Resource Efficiencies in the delivery of the contract
3.4 Assessing and minimising embodied carbon	Environmental Awareness Initiatives

Promoting Wellbeing

5.6.5. This theme aims to improve the health and wellbeing of the contract workforce, tackle employment inequality, contribute to in-work progression and skills development, and improve community integration.

Table 5-7: Promoting Wellbeing

SOCIAL VALUE INDICATOR	SOCIAL VALUE INITIATIVES
4.1 Support the health and wellbeing, including physical and mental health, in the contract workforce 4.2 Promote equality, diversity and inclusion in the contract's workforce	Health and Wellbeing strategy for the staff employed on the contract, including Equality, Diversity and Inclusion
4.3 Influence staff, suppliers, customers and communities through the delivery of the contract to support health and wellbeing, including physical and mental health	Health and Wellbeing initiative
4.4 Allocate a percentage of the budget to artwork or cultural activities	Activities to promote supply chain opportunities related to the artwork or cultural activities to micro businesses, social enterprises or organisations within the arts, cultural and heritage sectors

Monitoring Social Value

5.6.6. There is a robust Social Value monitoring system in place. The Contractors are required to report on their Social Value contribution, e.g., details of the number of weeks work experience opportunities delivered or the number of hours of health and wellbeing initiatives delivered on the proposed scheme.

5.6.7. The monitoring reports generated by the system will allow the Department to understand who the beneficiaries of each Social Value outcome have been, including a breakdown to include priority groups. In this way, the Social Value monitoring system reports can be used to report delivery against the Department's strategic priorities and Programme for Government responsibilities.

5.7 SUMMARY AND RECOMMENDATION

5.7.1. An **OJEU 'restricted procedure'** procurement tendering process was used which was appropriate for large scale infrastructure projects which involved "pre-qualification" of suppliers based on their financial standing and technical or professional capability. It also had clear and distinct timescales for each of its stages which permitted the contracting authority (Department) to ensure that the tenders were received by the dates required.

5.7.2. In 2020 the Department carried out scenario planning to develop strategies for project delivery by 2028, considering a range of outcomes from the 2020 Public Inquiry and establishing measures to allow the Department to 'hit the ground running' to achieve this. The 2028 Scenario Planning was developed to achieve best value for money in the delivery of this 'Executive Flagship' project, which is defined as:

- successful delivery of all the Proposed Scheme objectives.
- completion and opening of the Proposed Scheme to traffic by the end of 2028.
- delivery for minimum overall cost within the agreed budget and funding profile.

5.7.3. Despite the passage of time all three Contractors remain appointed and the Department's preferred approach is to proceed with the existing contracts.

5.7.4. In 2022, a 'Fitness to Supply' assessment was developed to test whether the Contractors remained eligible to deliver public contracts of this scale and have retained the necessary technical ability and financial standing to deliver their contract. The process was developed based on the Department's standard pre-qualification evaluation and was approved by the Department. The process commenced with the issue of documents to the Contractors in October 2021 and was completed following a consensus exercise. All Contractors passed the assessment.

5.7.5. The information provided demonstrates that the contracting, procurement and commercial arrangements are appropriate and robust. Key features include:

- the contract includes risk management as a core principle, using strategies of risk allocation and transfer to the contractor where they are best placed to mitigate and manage risk effectively thereby providing increased cost certainty to the Department
- the contract includes disincentives and penalties for programme overruns, to achieve delivery on time
- at the time of the procurement there was a significant level of interest and a high level of competition amongst contractors for the design and construction

5.7.6. The Commercial Case demonstrates that the contracting and procurement strategy is robust and contains appropriate and workable contractual and commercial arrangements so that the Department achieves value for money.

6 THE MANAGEMENT CASE

6.1 INTRODUCTION

6.1.1. The purpose of the management section of the business case is to demonstrate that robust arrangements are in place for the delivery, monitoring and evaluation of the scheme, including feedback into the organisation's strategic planning cycle.

6.1.2. This chapter forms the management case for the Proposed Scheme. The management case will aim to demonstrate that the Preferred Scheme can be successfully delivered in accordance with best practice, subjected to independent assurance and that the necessary arrangements are in place for contract and change management, benefits realisation and risk management.

6.1.3. This chapter describes how the scheme will be delivered through project management best practice, confirming that the timescales are realistic, and demonstrating that an appropriate governance structure is in place to oversee project delivery. Specifically, the section provides and sets out:

- Project management governance arrangements (roles, responsibilities, plans etc.)
- Use of specialist advisers
- Change and contract management arrangements
- Risk management arrangements
- Benefits realisation arrangements
- Post-completion and evaluation arrangements
- Contingency arrangements and plans

6.1.4. This Outline Business Case (OBC) satisfies both the UK Treasury's advice on evidence-based decision making set out in the Green Book[86] and the Better Business Cases Northern Ireland (NI) guidance[87] and Supplementary Guidance 2021[88]. The Five Case Model[89], as set out by the UK Department for Transport (DfT), forms the structure of this document.

6.2 PROJECT GOVERNANCE

6.2.1. A well-functioning governance structure will be crucial to the successful delivery of the scheme. The governance structure for the Proposed Scheme is shown in Figure 6-1.

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[86] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

[87] https://www.financeni.gov.uk/sites/default/files/publications/dfp/Final%20Best%20practice%20in%20business%20cases%20August%2021%20update_0.pdf

[88] https://www.finance-ni.gov.uk/publications/better-business-cases-ni-supplementary-guidance

[89] https://www.gov.uk/government/publications/transport-business-case

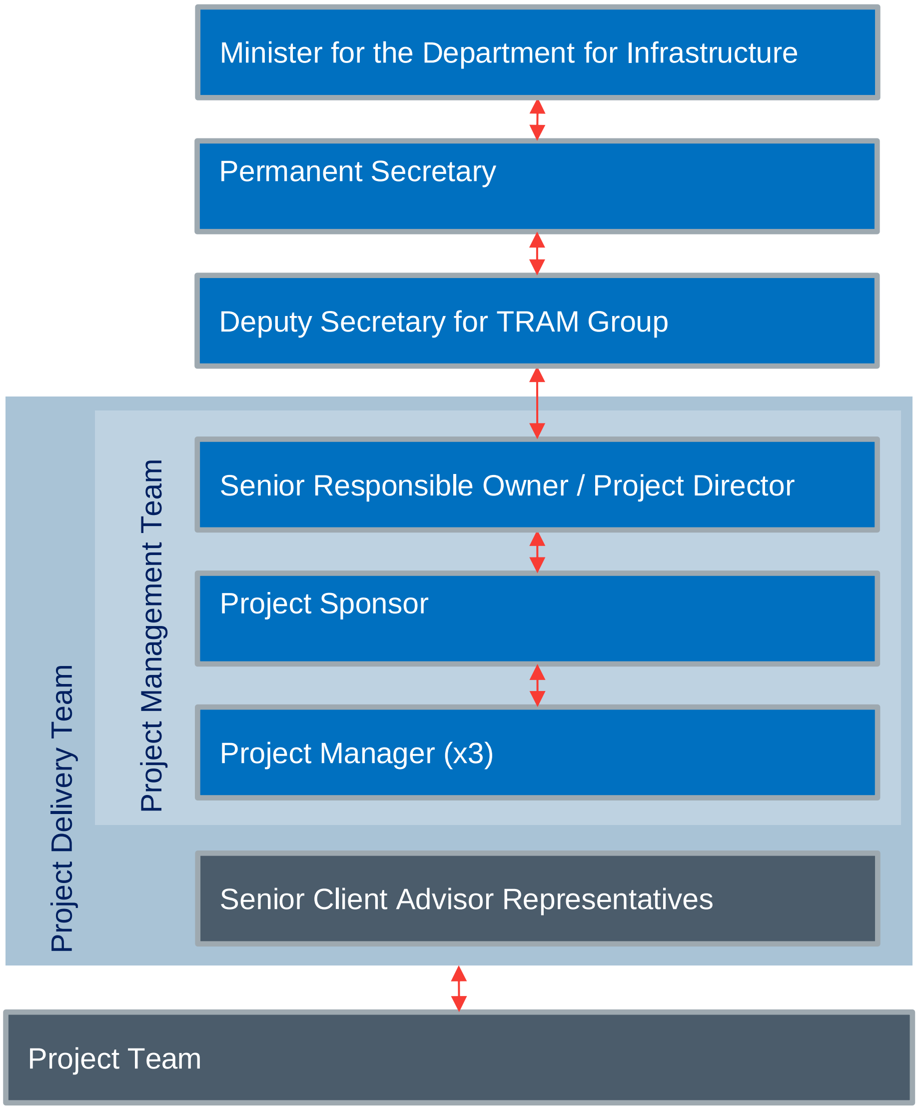


Figure 6-1: Governance structure for the Proposed Scheme

INVESTMENT DECISION MAKER

6.2.2. The Investment Decision Maker (IDM) for delivery of the project is Colin Woods, Deputy Secretary for Transport and Road Asset Management Group (TRAM).

SENIOR RESPONSIBLE OWNER

6.2.3. Dr Kaine Lynch, the Director of Major Projects and Procurement, is the Senior Responsible Owner (SRO) appointed by the Permanent Secretary, who leads the Project Delivery Team in the delivery of the Proposed Scheme.

6.2.4. The SRO confirms that the Proposed Scheme is progressing in line with the project programme and that key deliverables and milestones are achieved.

6.2.5. The SRO has operational responsibility for the development of a proposal, including the production of a proportionate, cohesive business case which supports the expenditure decision. It is the SRO's responsibility to seek the relevant advice and input into the development of the business case and to present it for approval. Formal chapter by chapter sign-off is obtained within the Department but ultimate responsibility lies with the SRO.

6.2.6. The SRO is responsible for ensuring that their project is governed and managed in line with current policies and guidance, making sure that all options are investigated to deliver Value for Money (VfM) to the organisation and that the benefits anticipated in the Outline Business Case (OBC) are fully realised. This includes an analysis of the benefits to the citizen as part of the business case.

6.2.7. Successful projects require clear, active and visible leadership. Overall responsibility for delivering the business objectives and benefits of any project must be vested in a single, responsible and visible individual, the SRO. The SRO is the owner of the overall business case that is being delivered by the project.

PROJECT MANAGEMENT TEAM

6.2.8. The project management team, and ultimately the SRO, have ownership of the OBC from its inception to final approval. They are also responsible for developing the management case. Expert advice may also be sought from project management specialists to inform the development of the management case.

6.2.9. The project management team comprises the following project roles:

- SRO
- Project Sponsor
- Project Manager

PROJECT DELIVERY TEAM

6.2.10. The Department has established a Project Delivery Team for the Proposed Scheme. The team is led by the SRO and includes representatives of the various disciplines and work streams involved in delivering the project to completion. The Project Delivery Team meets regularly, at formal monthly meetings with the SRO responsible for determining which disciplines or work streams need to be represented at any particular meeting, which may include additional specialist expertise.

6.2.11. The main responsibilities of the Project Delivery Team are to:

- co-ordinate the different activities which make up the project
- provide direction to the technical delivery of the project
- undertake reviews of progress against targets and programme
- undertake review of the risk register, and initiate corrective action where appropriate
- provide necessary updates to the IDM, as a minimum quarterly progress reports.

6.2.12. The current Project Delivery Team is set out in Table 6-1. It should be noted that this is relevant to the current stage and will evolve to align with future project stages, as described in section 6.7.

Table 6-1: Project Delivery Team

Individual	Role	Role in Own Organisation
Kaine Lynch	Senior Responsible Owner (Department)	Director of Major Projects and Procurement
Seamus Keenan	Project Sponsor (Department)	Principal Engineer – Western Division
Willie Kerr	PDT Member (Department)	Major Projects Head Quarters
Liam McEvoy	PDT Member (Department)	Deputy Director of Major Projects and Procurement
[redacted]	Project Manager (Department)	Senior Engineer – Western Division
[redacted]	Project Director (WSP)	Technical Director
[redacted]	Project Manager (WSP)	Associate Director
[redacted]	Project Inquiry Workstream Lead (WSP)	Technical Director
[redacted]	Finance and Governance Lead (WSP)	Principal Engineer
[redacted]	Pre-Construction Lead (WSP)	Associate Director
[redacted]	Design Lead (WSP)	Associate

6.2.13. The Department appointed a Client Advisor (Mouchel, subsequently acquired by WSP) to assist in the development of the project. Several members of the Client Advisors staff have a role within the Project Delivery Team. The Client Advisor comprises a wide range of project management and technical specialists. The Client Advisor and the Department staff required to deliver the project are herein referred to as the Project Team.

6.3 PROGRAMME / PROJECT PLAN

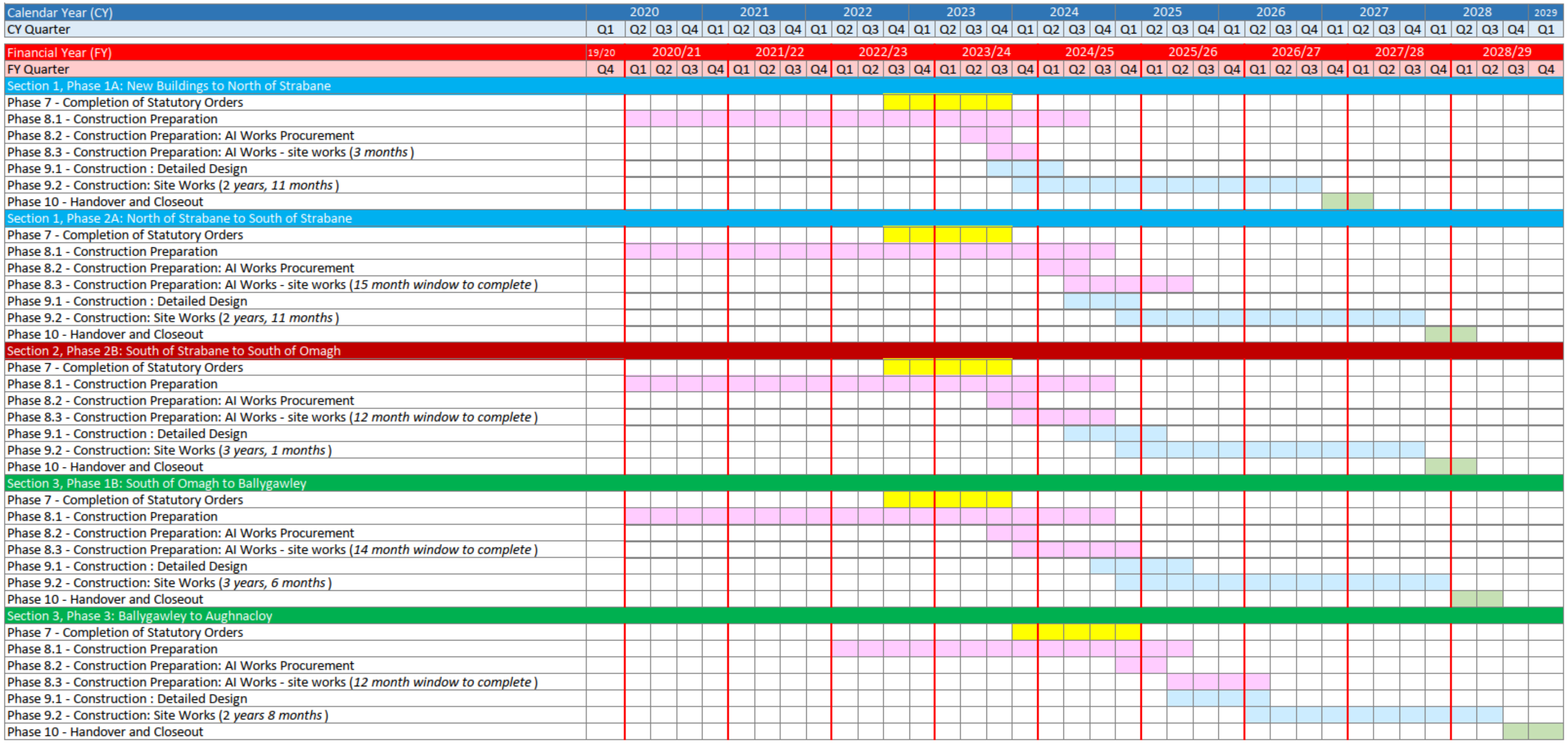
PROGRAMME

6.3.1. An indicative project programme has been developed for the Outline Business Case, setting out the key project tasks, durations and the interdependencies between each task. The programme has been developed to capture the key major project lifecycle phases and associated activities in accordance with 'RSPPG E030 v5 Major Works Schemes: Inception to Construction[90]. The programme key stages, at high-level, are illustrated in Figure 6-2. Note, the Construction start date could potentially be delayed should a legal challenge be made on the Proposed Scheme.

6.3.2. The project programme is a live document, with progress on planned task completion being monitored against actual progress by the SRO. The SRO will report progress against programme to the IDM.

[90] https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/major-works-schemes-inception-to-construction-rsppg-e030v5.pdf

Figure 6-2: Project Programme



GATEWAYS

6.3.3. The following RSPPG E030 Gateway Approvals have been granted:

- Gateway 0 – September 2008 for the entire A5WTC scheme
- Gateway 2 – June 2009 for the entire A5WTC scheme. With the introduction of the Phased delivery programme a Full Business Case will be required for each Section.
- Gateway 3 – Early Contractor Involvement (ECI) is utilised in the delivery of the scheme through the statutory procedures and therefore this Gateway is not applicable

6.3.4. The following Office of Government Commerce Gateways have been reached.

- Gateway 3 – February 2010 for the entire A5WTC scheme
- Gateway 3A – June 2012 for Phase 1
- Gateway 3B – October 2017 for Scheme 1; Phase 1A.

PROJECT PLAN

6.3.5. Certain elements of the programme have built in tolerance / contingency to account for risks identified within the risk register included at Section 6.8 Risk Management Strategy.

6.3.6. Three Contractor organisations currently form part of an Integrated Delivery Team (IDT) with the Project Delivery Team via Early Contractor Involvement (ECI). ECI Phase 1 of their contracts involves supporting the Department to progress the Proposed Scheme thorough the statutory orders process and prepare for construction.

6.3.7. ECI Phase 1 of their Contracts includes for:

- Construction planning, development and agreement of a Target Cost,
- Agreement of the conditions of contract for ECI Phase 2 and the execution of a Form of Agreement,
- Acceptance of the specimen design to be taken forward by the Contractor to detailed design,
- Acceptance and ownership by the Contractor of all information supplied by the Employer including documents, drawings, data and reports,
- Acceptance and ownership by the Contractor of the Geotechnical Interpretative Report.

6.3.8. The Target Costs produced by the Contractors will inform the investment costs for the Full Business Case (FBC). Approval of the FBC will ultimately lead to approval of the necessary funding and trigger commencement of ECI Phase 2 (i.e. construction).

6.4 ASSURANCES AND APPROVALS PLAN

APPROVALS

6.4.1. The responsibility for assurance and approval of the Outline Business Case (OBC) rests with the SRO. The Department of Finance (DoF) approves the expenditure rather than approving the business case; the implication of this is that DoF does not bear primary responsibility or accountability for the quality of that case, including the accuracy and robustness of information required to make a decision on approval, which ultimately rests with the Departmental Accounting Officer (DAO) in the source Department.

6.4.2. DoF Supply's[91] review concerns value for money, affordability, regularity and propriety. All of these matters are for the submitting approver to secure on behalf of their DAO. DoF Supply's approval confirms from an independent point of view whether the decision as documented is value for money against the business case guidance. The other points, if identified by DoF Supply as significant, might equally affect whether approval can be given, or whether it will be conditional.

6.4.3. The technical content of the OBC will be assessed against appropriate financial and transport appraisal guidance, which in this case, is the DoF Better Business Case NI Best Practice in Business Cases August 2021 Version 2[92]; The Five Case model approach.

6.4.4. The OBC covers the structure of the DoF Better Business Case NI model. It delivers a proportionate and balanced appraisal of the Proposed Scheme which includes an economic appraisal for a combination of all Sections and Phases of the project, and an incremental phased approach, therefore providing an assessment of value for money across the entirety of the Proposed Scheme. This will be presented to the DoF for conditional approval.

6.4.5. The OBC is the gateway to proceed to the development of the Full Business Case (FBC) for each Section but does not guarantee full funding or commitment to the project.

6.4.6. The Proposed Scheme is now expected to be delivered in distinct Sections, comprised of different phases as detailed in paragraph 1.2.47. This OBC will be supplemented by a specific FBC for each Section. The FBC will review the continued accuracy of assumptions made within this OBC, with a view to ensuring the robustness of the appraisal for the Section being assessed and for the whole scheme. Each FBC will incorporate the agreed Target Cost. Once approved, the Department will draw down funding and begin construction.

ASSURANCE

6.4.7. It is essential that large, complex infrastructure projects are monitored effectively. All major transport schemes must demonstrate that a system for monitoring progress is part of the management structure and plan. The Department of Finance, Northern Ireland Gateway Review process is a formal assessment of the progress of a project at key stages in its development which is endorsed by the Department. Gateway reviews are managed in Northern Ireland by the Centre of Expertise

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[91] DoF Supply – Approval of the expenditure where the Authority to do so is not delegated to Departments
[92] https://www.finance-ni.gov.uk/sites/default/files/publications/dfp/Final%20Best%20practice%20in%20business%20cases%20August%2021%20update_0.pdf

for Programme and Project Management (CoE) within Construction and Procurement Delivery (CPD), the local authorised hub.

6.4.8. A Gateway review is a 'peer review' in which independent project managers from outside the project use their experience and expertise to examine the progress and likelihood of successful delivery of the project. A Gateway review provides assurance and support to the SRO that:

- suitable skills and experience are deployed on the project
- all stakeholders understand the project status and issues
- there is assurance that the project can progress to the next phase
- time and cost targets have a realistic basis
- lessons are learned
- the Project Team are gaining the appropriate input from appropriate stakeholders

6.4.9. NI Gateway 3B reviews will be undertaken prior to committing to the construction of each phase. The previous gateway reviews which have been undertaken are as follows:

- February 2010 – NI Gateway 3 Review: This review covered all aspects of the delivery of the whole scheme
- June 2012 – NI Gateway 3A Review: This review focussed on the delivery of Phase 1 of the scheme which aligned with the phased delivery programme that was set in 2012
- October 2017 – NI Gateway 3B Review (Phase 1A): This review focussed on the delivery of Phase 1A of the scheme

6.4.10. Following completion of the Gateway Reviews an action and implementation plan was developed by the Project Delivery Team. The most recent review of 2017 included recommendations relating to how overall project costs are reported in the FBC, agreeing a Target Cost process, risk and opportunity reporting, developing a more detailed delivery programme to construction commencement, agreeing a methodology for undertaking the remaining archaeological investigation and enhancing project dash boards. All items have since been addressed.

6.4.11. The Department will liaise with the DoF to develop and agree the Assurance and Approvals plan during the development of the FBC for each individual Section of the Proposed Scheme.

6.5 COMMUNICATIONS STRATEGY AND STAKEHOLDER MANAGEMENT

6.5.1. When developing the Project Brief in 2007, the Department recognised the importance of a clear and informative communications strategy in enabling the Project Team to deliver the scheme to the agreed milestones. As such, public consultation, which forms a key part of the overall communications strategy, has been a key aspect of scheme delivery.

DEPARTMENT STAKEHOLDER ENGAGEMENT

6.5.2. The Department has a committed approach to communication and has embarked on an extensive consultation process to develop and maintain the active support and commitment of stakeholders and the community to facilitate the timely and successful implementation of the project. The various forms of this process are described below:

PUBLIC EXHIBITIONS

April / May 2008

6.5.3. A series of Public Awareness days were held during April and May 2008. These involved individual one day events in Londonderry, Strabane, Omagh and Ballygawley and were attended by 388 persons or groups of people as follows; on 28th April in Ballygawley 84 attended; on 29th in Omagh 118 attended; on 8th May in Strabane 102 attended and on 9th May in Londonderry 84 attended. The purpose was to:

- advise the public that the Department was promoting the scheme
- explain the objectives of the scheme
- introduce the key transport, engineering, economic and environmental criteria that would inform the planning, design and assessment process
- outline the statutory process that would be followed
- introduce the public to the extent of the initial study areas being considered
- seek initial information and responses from attendees

6.5.4. Feedback was received by making a written record of conversations at the Public Information days, completion of event questionnaires, subsequent correspondence and via the project website.

February 2009

6.5.5. A series of Public Consultation days were held in February 2009 for the exhibition of the Preferred Corridor and potential route options. These events adopted the same format and used the same locations as the 2008 Public Information days. There were 2,546 attendees recorded.

6.5.6. The Preferred Corridor and the route options had emerged following preliminary consideration of key constraints. Comments were sought relating to the preliminary route options and the public were encouraged to provide information relating to the corridors. This information assisted with the refinement and, where relevant, modification of the route options prior to their subsequent evaluation and selection of a Preferred Route.

6.5.7. The feedback from this second public consultation included concerns relating to local ecology, the severance of farms, potential impacts on floodplains and on designated ecological and heritage sites, impacts on the landscape, interactions with proposed development sites, loss of traffic from the existing A5 and the consequential impacts that would result on local businesses, community severance and loss of community facilities (e.g. sports fields) and impacts on property and homes.

July 2009

6.5.8. A series of Public Exhibitions were held in July 2009 over four consecutive days in Omagh, Strabane, Londonderry and Ballygawley. This was to present the Department's Preferred Route to the public. Over 2,500 attendees at the exhibitions were invited to comment on the Preferred Route and individual landowners, who would be potentially affected, were offered the opportunity for individual discussions with members of the Project Team.

6.5.9. The feedback from these events included issues similar to those raised previously including the severance of dairy farms and the locations of junctions as well as more local issues with regard to moving the alignment to avoid natural features (away from rivers and floodplains), public amenities (e.g. footpaths) and community severance.

November 2010

6.5.10. Pre-Orders Public Exhibitions for the scheme were held in November 2010 over four consecutive days in Omagh, Strabane, Londonderry and Ballygawley. This involved presentation of the Department's proposals to the public and was attended by 1,219 people. The aims and objectives of this event were to:

- demonstrate the assessments carried out so far and explain how the proposals had been developed including the approach to alternatives
- highlight the key factors which had influenced the choice and development of the proposals
- present the junction layouts
- explain the direct or indirect effects that the proposals would have on property, the community and the environment
- detail the next steps in the process
- inform the public of the statutory procedures and anticipated programme to the opening of the road
- increase public awareness of the project
- engage with a range of stakeholders

6.5.11. Following the Pre-Orders Public Exhibitions the draft Orders were published in November 2010. There was an eight-week formal consultation period associated with the Environmental Statement 2010 and Statutory Orders 2010 which ended on 21 January 2011.

2016 Statutory Orders

6.5.12. The Department published new draft Orders in February 2016 as follows:

- Environmental Statement 2016
- Notice of Intention to Make a Vesting Order Phase 1A
- Notice of Intention to Make a Vesting Order Phase 1B
- Notice of Intention to Make a Vesting Order Phase 2
- The Draft Trunk Road T3 (Western Transport Corridor) Order (Northern Ireland) 2016 (referred to as the Notice of Intention to Make a Direction Order)
- The Draft Private Accesses on the A5 Western Transport Corridor (Stopping-Up) Order (Northern Ireland) 2016 (referred to as the Notice of Intention to Make a Stopping Up Order)

6.5.13. The publication was followed by a seven-week consultation period between February 2016 and April 2016. Associated with the publication of these Orders, as in 2010, was a series of Public Exhibitions.

March 2016

6.5.14. In early March 2016 the Department held a series of Public Exhibitions over four consecutive days in Londonderry, Strabane, Omagh and Ballygawley attended by over 1,000 people. The aims and objectives were to:

- present the Proposed Scheme 2016 and draft Orders
- demonstrate the assessments carried out so far and to explain the changes that had taken place since 2010 to comply with current engineering and environmental standards and agreed commitments from the 2011 Public Inquiry

- explain the assessment and consultation process under the Environmental Impact Assessment and Habitats Directive associated with Special Areas of Conservation and internationally designated sites
- highlight the key factors which have influenced the development of the Proposed Scheme to date
- explain the anticipated phased approach to the draft Orders, assessment and construction programme
- explain the direct and / or indirect effects that the Proposed Scheme would be likely to have on property, the community and the environment
- inform the public of the statutory procedures and the next steps in the scheme development process
- engage with a range of stakeholders, and
- increase public awareness of the scheme

MARCH 2019

6.5.15. The Department published an Addendum and revised Non-Technical Summary (NTS) (Revision B) to the existing Environmental Statement (ES 2016) for the Proposed Scheme in March 2019, referred to as the Environmental Statement Addendum 2019 (ESA 2019). There was a seven-week formal consultation period following this publication. This was followed by the publication of base data used for the new traffic model (supplementary information to the ESA 2019) in November 2019, also subject to a seven-week formal consultation period from November 2019 to January 2020.

MARCH 2022

6.5.16. The Department published a further Addendum and Non-Technical Summary (NTS) (Revision C) to the existing Environmental Statement (ES 2016 and ESA 2019) in March 2022, and associated documentation as follows:

- Environmental Statement Addendum 2022
- Non-Technical Statement (Revision C)
- Habitats Regulations Assessments
- Notice of Intention to Make a Vesting Order, Supplementary Vesting along scheme corridor
- Agricultural Industry Impact Assessment
- Local Business Impact Assessment
- Phasing Report
- Human Rights Impact Assessment

6.5.17. A seven-week consultation period followed the publication, which ran from March 2022 to May 2022.

NOVEMBER 2022

6.5.18. The Department published supplementary information to the Environmental Statement Addendum (2022) in November 2022, as detailed below:

- Traffic Forecast Report (OBC2022)
- Economic Appraisal Report (OBC2022)
- Strategic Context and Policy Report (OBC 2022)
- Alternative Scheme Options: Environmental Review Summary Report (including Greenhouse Gas Emissions)
- Development of Mitigation Options at Tully Bog Special Area of Conservation

- Phasing Report - Addendum
- A5WTC Agricultural Industry Impact Assessment - Addendum Report

6.5.19. A seven-week consultation period followed the publication, which ran from November 2022 to December 2022.

JANUARY 2023

6.5.20. The Department published a minor revision to the Non-Technical Summary (NTS) (Revision D) and a report comprising the scheme layout drawings. These drawings detailed the plan, profile and selected cross sections covering the length of the full scheme. A seven week consultation period followed the publication, which ran from January 2023 to March 2023.

STATUTORY CONSULTEES AND OTHER STAKEHOLDERS

6.5.21. A wide range of statutory authorities and organisations have been consulted in accordance with DEM 175/18 - Environmental Communication & Quality Management as part of the studies and assessments which have been undertaken during the preparation of the draft Orders and Environmental Statement Addendum (ESA) 2022 for the Proposed Scheme.

6.5.22. Meetings have been held with many stakeholders across Northern Ireland and the Republic of Ireland including those set out in Table 6-2 below.

Table 6-2: Summary of statutory consultees and stakeholder

Organisation, Business or Department	Division (if applicable)
Atlas Communications	
Council for Nature Conservation and the Countryside (CNCC)	
Department for Communities	Historic Environment Division, Heritage Development & Change Branch
	Historic Environment Division, State Care Heritage
	Historic Environment Division, Heritage Advice and Regulation Branch
	Housing & Urban Regeneration
	The Historic Buildings Council
	The Historic Monuments Council
	Historic Environment Division, Heritage Development & Change Branch
Department For Infrastructure	Strategic Planning Division
	Planning Division
	Rivers
Department for the Economy	Geological Survey of Northern Ireland
	Property Solutions Unit
Department of Agriculture, Environment and Rural Affairs	Environment, Marine and Fisheries
	Land and Resource Management Unit

Organisation, Business or Department	Division (if applicable)
	Countryside Management Unit
	Planning Response Team
	Marine and Fisheries - Inland Fisheries
	Loughs Agency Headquarters
	Marine and Fisheries Division
	Natural Environment Division - Countryside, Coast & Landscape
	Water Management Unit
	Natural Environment Division
Department of Culture, Heritage and the Gaeltacht	Development Applications Unit
Government of Ireland	Department of Housing, Local Government and Heritage
	EU & International Planning Regulation
Derry City & Strabane District Council	
Donegal County Council	
Education Authority	
Eircom UK	
Everything Everywhere Limited (EEL)	
Fermanagh & Omagh District Council	
Firmus Energy	
Freight Transport Association	
Invest NI	
Logistics UK	
Mid Ulster District Council	
Ministry of Defence (MoD)	Defence Infrastructure Organisation
Monaghan County Council Roads Office	
Mutual Energy	
NIE Networks Limited	
Northern Ireland Ambulance Service	Ambulance Headquarters
Northern Ireland Badger Group	
Northern Ireland Housing Executive	
Northern Ireland Water	
Openreach Northern Ireland	
Phoenix Natural Gas Limited	
Road Haulage Association Limited	Scotland and Northern Ireland
Royal Society for the Protection of Birds (RSPB)	
SGN NI	

Organisation, Business or Department	Division (if applicable)
Sustrans Limited	
The National Trust	
The Northern Ireland Bat Group	
The Northern Ireland Road Safety Partnership	Police Service of Northern Ireland (PSNI)
The Woodland Trust Northern Ireland	
Translink	Infrastructure and Property Division
Ulster Farmers Union	
Ulster Wildlife Trust	
Virgin Media	
Vodafone Limited	

6.5.23. The objective of the consultations with the above authorities, agencies and bodies has been to:

- collect and verify known environmental data relevant to the wider study area and specific to the Proposed Scheme
- seek comment relating to the assessment process, the scope of the ESA 2022 and the methods of assessment adopted
- discuss mitigation requirements and measures where appropriate

LANDOWNERS AND OTHER AFFECTED PARTIES

6.5.24. The Project Team has maintained an accurate record of all communications with stakeholders since the commencement of the scheme using the proprietary database system, Pinpoint (a wholly owned process developed by the project consultants, WSP).

6.5.25. Pinpoint contains records of over 5,500 land interests and over 60,000 unique communications. The 2016 Public Inquiry process resulted in over 3,500 items of communication with 1,090 objections received. Pinpoint has been used to generate mail merges of standard letters and enclosures to recipients as well as the development of the Statutory Orders schedules and plans. It has also been used for the logging of representations to the draft Statutory Orders and formatting of the written responses by Department following the Consultation Periods in 2016, 2019, 2022 and 2023.

6.5.26. Pinpoint has also been used to carry out gap analysis, thus ensuring all recipient lists are complete. In addition, monthly statistics are generated to demonstrate compliance with the requirement for the Department to respond to third parties within a set period.

6.5.27. In addition to any written communications, specific consultation with landowners and other parties, who would be directly affected by the Proposed Scheme, has generally involved a series of landowner / stakeholder meetings, held during key stages of the design development. The issues discussed at these meetings have been considered throughout the process of appraising alternatives and when developing the Proposed Scheme. The objectives for each of the meeting types are outlined in Table 6-3 below.

Table 6-3: Summary of landowner meetings

Meeting Type	Date	Key Objectives
Introductory	August 2009 – October 2009	▪ introduce specific landowners to the reasoning behind the selection of the Preferred Route ▪ confirm the lines of communication between each landowner and the Project Team ▪ gather data from landowners to further inform local design development and identify potential mitigation needs ▪ explain the process through to the preparation of Orders ▪ outline the expected programme of subsequent meetings
Mitigation	April 2010 – October 2010	▪ update landowners on progress and any emerging information such as development of side roads, junctions and alignments ▪ review impacts specific to each landowner including potential land take in light of the further development of the design proposals ▪ discuss and seek agreement to proposed mitigation measures and outline accommodation works
Pre-vesting	October 2010 – November 2010	▪ confirm the extent of land take proposed and other impacts specific to each landowner / stakeholder ▪ confirm the proposed design and mitigation measures specific to each landowner / stakeholder ▪ reprise the statutory context and rights relative to landowners and potential sources of advice
Additional	September 2011 – April 2015	▪ confirmation of the land ownership and interests and particular recording changes that may have taken place since the previous orders ▪ inform landowners of progress with the scheme ▪ discuss and agree accommodation works (Phase 1 of the scheme only), which aligned with the phased delivery programme that was set in 2012 ▪ explain the Permit to Enter agreement process to be used to reduce the area of vested lands and request signing of the PTE prior to finalising the vesting boundary (Phase 1 of the scheme only), which aligned with the phased delivery programme that was set in 2012 ▪ to note any recent planning applications or change in use, conacre etc
Pre-vesting	March 2017	▪ explain the Permit to Enter agreement process to be used to reduce the area of vested lands and request signing of the PTE prior to finalising the vesting boundary (Phase 1A and 1B only) ▪ discuss and agree accommodation works (Phase 1A only) ▪ confirmation of the land ownership and interests and particular recording changes that may have taken place since the previous orders ▪ to note any recent planning applications or change in use, conacre etc.
Mitigation	March 2017 – April 2018	▪ provide a scheme update to the landowners on Phase 1A and 1B of the scheme in 2017 ▪ agree PTE's with the affected landowners ▪ discuss the planned temporary lands works and accommodation works and agreed on the discussed works for the owners on Phase 1A in 2018
Mitigation	June 2021	▪ letter issued to landowners with a farm holding directly impacted, asking them to confirm any changes to their agricultural practices.

Meeting Type	Date	Key Objectives
Pre-Vesting	January 2022	▪ provide a scheme update to landowners on the Department's intentions for the upcoming draft Vesting Order and ESA 2022. ▪ confirm the extent of land take proposed to each landowner affected by supplementary vesting
Scheme Update & Accommodation Works	July 2022 – March 2023	▪ provide a scheme update to landowners in Sections 1, 2 and 3 (Phase 1b only) on the Department's intentions for the upcoming draft Vesting Order and ESA 2022. ▪ confirm the extent of land take proposed to each landowner affected by supplementary vesting ▪ discuss and agree accommodation works

PUBLIC INQUIRIES

May-July 2011

6.5.28. Between May and July 2011, a composite Public Inquiry was held, overseen by a number of Inspectors appointed by the (then) Department for Regional Development (DRD) Department. A total of 2,579 letters / signatories were received during the statutory objection / comment period associated with the publication of the draft Orders and the ES 2010.

6.5.29. Comments and recommendations following the Public Inquiries were published in the Inspector's Report in February 2012. The recommendations and comments were reviewed and, where accepted, recorded in the Departmental Statement (July 2012) and incorporated into the Proposed Scheme design. The then Department for Regional Development (DRD) Minister made the decision to proceed with the A5WTC project on 31 July 2012. However, following a challenge in the High Court, Justice Stephens ruled that the Habitats Regulations Assessment had not been completed and as such the Orders were rescinded and the statutory process was revisited.

October-December 2016

6.5.30. Following the publication of the draft Orders and the ES in February 2016, a Public Inquiry, administered by the Planning Appeals Commission (PAC), commenced on 04 October 2016 and concluded on 14 December 2016. The PAC report into the inquiry was submitted to the Department on 25 May 2017 and its recommendations had been considered in detail, as reported in the Departmental Statement (November 2017), and taken into consideration before a decision made on whether to proceed with the Proposed Scheme and make the necessary Statutory Orders.

March-June 2017

6.5.31. Following the conclusion of the Public Inquiry in 2016, the affected landowners in Phases 1A and 1B of the Proposed Scheme were met to discuss the planned temporary land and accommodation works for their land and agree the necessary Permission to Enter (PTE) forms for the works.

November 2017-January 2018

6.5.32. On Tuesday 28 November 2017 the Department published the Statutory Procedures for Phase 1A of the scheme. This included the Notice of Making a Vesting Order (NMVO), the Notice of Making a Direction Order (NMDO), and the Environmental Statement: Notice of Intention to Proceed and the Notice of Making of Vesting Order - Phase 1A. Affected landowners received written notification and plans showing the areas of land that the Department proposed to vest to construct the Proposed Scheme – Phase 1A.

6.5.33. On Friday 05 January 2018 the Statutory Procedures for Phase 1A of the Proposed Scheme became operative, with the lands vested passing to the ownership of the Department. All affected landowners, stakeholders and statutory consultees were informed via written representation.

6.5.34. Following the receipt of a legal challenge on Friday 22 December 2017, the Department wrote to all landowners on the whole scheme informing them of the legal challenge. The recipients were informed that the matter was unlikely to be resolved for a number of months.

March-June 2018

6.5.35. Meetings were held with the affected landowners in Phase 1A to agree accommodation works for their land.

November-December 2018

6.5.36. Having given careful consideration to High Court decisions as well as the provisions of the recently enacted NI (Executive Formation and Exercise of Functions) Act 2018, the Department decided that it was not in the public interest to continue defending the legal challenge. Consequently, at a Court hearing on the 15 November 2018, the Department invited the Court to quash decision to proceed and this took effect from Friday 16 November 2018. In terms of process, the Department moved back to a point in time just before its decision to proceed with the Proposed Scheme in November 2017 and, as a result, the Direction and Vesting Orders for the Proposed Scheme would no longer be in force. For landowners in Phase 1A, the lands that had been vested by the Department in January 2018 would be back in their ownership with effect from 16 November 2018.

March 2019

6.5.37. The Department updated the Environmental Statement (ES 2016) with an Environmental Statement Addendum (ESA 2019) and accompanying Non-Technical Summary (NTS Revision B) together with the Extraction Impact Report on Quarrying in the Townland of Urbalreagh. These environmental reports were published for consultation during the period 26 March 2019 to 17 May 2019. These documents are to be read in conjunction with the ES 2016 as they provide additional information to the ES 2016.

November 2019

6.5.38. The Department, having considered all the representations made on the environmental consultation carried out earlier in 2019, decided that a further Public Inquiry will be necessary. The PAC were appointed to hold a Public Inquiry into the Proposed Scheme, and the scope included for the ES 2016, ESA 2019, along with the four updated draft reports to inform an Appropriate Assessment under the Habitats Regulations prepared by the Department, together with opinions expressed in relation thereto. A Public Inquiry was subsequently held in February and March 2020.

March 2021

6.5.39. Following receipt of the Interim PAC Report in September 2020, the Project Team reviewed the issues raised and recommendations made by the PAC on the proceedings of the public inquiry into the A5 Western Transport Corridor scheme and sought legal advice. Having considered all of the advice given, the Minister, Nichola Mallon MLA, announced publication of the Interim PAC Report together with the Department's response to the recommendations made by the PAC in the form of an Interim Departmental Statement (March 2021). The PAC's key recommendations were accepted, regarding the preparation of and consultation on further documents on the topics of flood risk and the consideration of alternatives to the Proposed Scheme.

6.5.40. The Minister accordingly directed the Project Team to prepare a further addendum to the Environmental Statement for consultation prior to the anticipated reconvening of the Public Inquiry.

January 2022

6.5.41. On completion of the assessment and modelling undertaken as part of the ESA 2022, a letter was issued to landowners directly affected by proposed additional land-take as a consequence of this assessment work in January 2022. The letter offered a meeting with the affected landowners in order to:

- provide a scheme update
- confirm the extent of land-take proposed and other impacts specific to each landowner; and discuss specific details in relation to the farm business.

March 2022

6.5.42. The Department published an ESA 2022. This includes information on the topics of flood risk and the consideration of alternatives to the Proposed Scheme, as recommended by the PAC.

6.5.43. Reports of Information to Inform an Appropriate Assessment (RIAAs) relating to the likely impacts of the Proposed Scheme on Special SPAs, SACs and Ramsar sites were also published and supersede the previous versions.

6.5.44. A further Notice of Intention to Make a Vesting Order has also been published on the proposal to vest additional lands required for environmental mitigation purposes.

November 2022

6.5.45. Mid-inquiry meeting was held on 15th November 2022. Following a request from the PAC, a subsequent consultation exercise was undertaken in January 2023 to provide requested plan and profile drawings.

May 2023

6.5.46. The reconvened Public Inquiry is currently scheduled to commence on 15 May 2023 over two sessions. The first session will take place from 15 May 2023 to 19 May 2023 and cover the environmental statement, the habitats reports and the proposed supplementary vesting order The second session will take place from 30 May 2023 to 2 June 2023 where strategic issues (including the justification for the scheme, alternatives, funding and phasing) will be discussed.

6.6 PROJECT REPORTING ARRANGEMENTS

6.6.1. The Consultant Project Brief, procured under the Major Works Framework in October 2007, and corresponding Project Inception Document in November 2007 and any associated standards or guidance define the reporting arrangements required to deliver the commission including:

- Monthly reports to the Project Delivery Team (PDT) including:
    - Progress Report
    - Director's Report
    - Risk Dashboard

- Minutes of Previous Meeting

- Major Works Framework governance requirements and associated project plans:
  - Project Initiation Document (PID) for each stage of the delivery programme
  - Inception Reports for the work to be completed within each year
  - Integrated Service Delivery Plans for the ECI Phase 1 delivery
- Major milestone reports in accordance with the DMRB and RSPPG E030
  - Stage 1 Scheme Assessment Report – Preliminary Options Report
  - Stage 2 Scheme Assessment Report – Preferred Options Report
  - Stage 3 Scheme Assessment Report – the Proposed Scheme
  - Environmental Statement
  - Habitats Regulations Assessment Reports
- Supplementary reporting as required

6.6.2. Reports are prepared in accordance with WSP's Quality Management System - Business Management System and finalised following approval from the Project Sponsor and his team.

6.7 CHANGE AND CONTRACT MANAGEMENT ARRANGEMENTS

6.7.1. Letters of appointment were issued to WSP by the previous SRO Mr Pat Doherty to deliver the various stages of the scheme. The current NEC3 Professional Services Contract Work Package is being delivered pursuant in accordance with the Department Major Works Consultancy Services Framework 2017. The Project Team prepared a PID for each stage which defined the scope baseline, the programme for delivery and the budget fees and costs. The PID is refined by the provision of an annual Inception Report. The Inception Report defines the individual packages of work to be delivered within the forthcoming financial year aligned to the planned programme and supplemented by an organisation chart that establishes the required resource.

6.7.2. The Inception Report therefore establishes the cost and schedule baseline. Both baselines are closely monitored and reported monthly at Finance and Governance meetings with a summary provided at wider monthly progress meetings. Where change in scope is identified, Change Controls are raised to describe the nature of the change and provide any revision to either the cost or schedule baseline.

6.7.3. The Department's Project Sponsor and support team are responsible for the day-to-day management of the delivery programme by WSP as defined in the annual Inception Report. To achieve the delivery programme, the WSP Project Director is supported by the Project Manager and five workstream leads who are in turn supported by teams of engineers, consultants and technicians for the various disciplines together with peer reviewers to check and validate the deliverables.

6.7.4. The Project Sponsor also provides oversight to the Integrated Delivery Team in aspects of the project relating to the construction planning, buildability advice, detailed design and construction. The Project Team manages the project in a collaborative, open and trusting manner with all members of the team working closely to achieve the Department's objectives.

6.7.5. The Project Team meet monthly to review progress and agree the forward workload and deliverables including managing and minimising risks as well as reviewing the liaison with stakeholders. The Commission requires WSP to provide timely information to the Project Sponsor to monitor the delivery of the services and Key Performance Indicators including:

- MS Project Programmes and agreed milestones
- Actual hours v anticipated hours and associated approved change controls
- Outturn and forecast costs against project estimate
- Quality of output
- Client satisfaction

6.7.6. As the scheme moves through the statutory processes and towards construction the Project Team structure evolves in order to cover emerging roles within site supervision and design team site support functions. These roles will be a combination of the Department and Client Advisor staff as delegated appropriately by the Department. This integrated approach is designed to deliver full collaboration. The agreed structure will be presented in the Full Business Case, however for a scheme of this size it would be anticipated that twenty-six Department roles would be required as detailed in Figure 6-3.

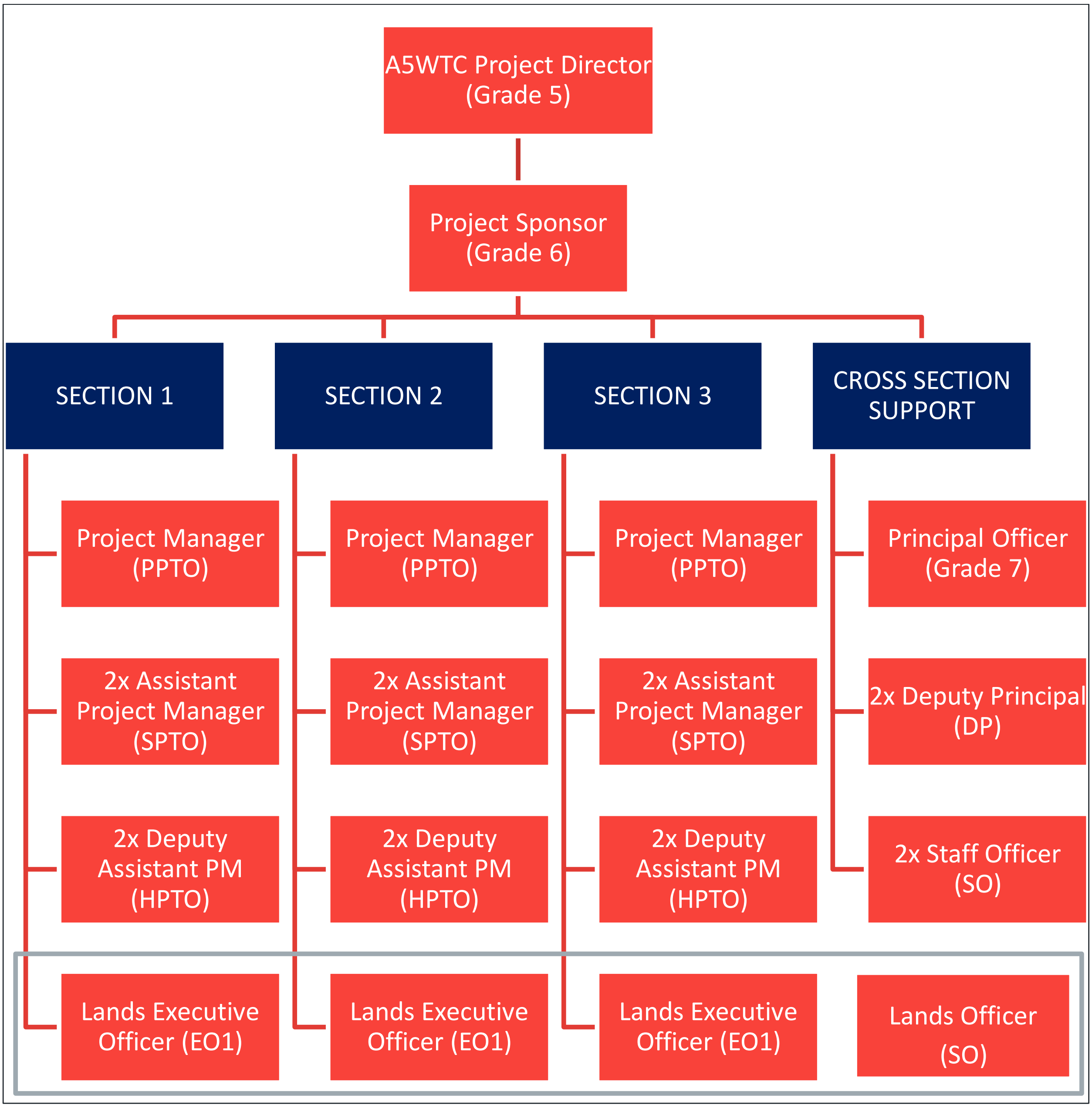

Figure 6-3: Potential Department resource requirement at Construction stage

6.7.7. The grades (shown in brackets) in Figure 6-3 relate to internal Department grading structure, where:

- PPTO = Principal Professional and Technical Officer (Grade 7)
- SPTO = Senior Professional and Technical Officer
- HPTO = Higher Professional and Technical Officer
- DP = Deputy Principal
- SO = Staff Officer
- EO1 = Executive Officer

6.7.8. Delegated functions to the client advisor role would typically include

- Overall Project Management Office
- NEC Project and Deputy Project Managers (per Section)
- Commercial Manager
- Delivery and Interface Manager
- Supervision Team and Inspectors (per Section)
- Buildability Support
- Technical Specialists as and when appropriate

6.7.9. Project reporting involves a monthly cascade of meetings reporting upwards to the PDT including:

- **Week 2** – WSP team co-ordination meeting:
  - co-ordinate delivery
  - report on progress by each discipline
  - review potential delays to the programme and develop remedial action plans
  - identify risks and mitigation measures
  - identify opportunities and methods of exploiting them so that the team can deliver in accordance with the scheme programme
- **Week 3** – Department / WSP Progress Meeting:
  - review progress against the programme
  - report on finances
  - agree changes in the scope baseline
  - manage risks and exploit opportunities
  - agree programme changes to achieve key milestone dates
  - review IDT progress
  - review stakeholder liaison
- **Week 4** – PDT Meeting:
  - provide an update to the SRO and other PDT members, summarising the key matters that were discussed at the Progress Meeting
  - discuss and agree strategic matters that could impact on scheme delivery

6.7.10. This cascade of meetings is augmented by ad-hoc meetings with the team and stakeholders to maintain the delivery programme and achieve scheme delivery milestones.

6.7.11. All meetings are recorded by agreed minutes with actions and their owners clearly identified. The WSP Project Director monitors the delivery of actions and presents a progress report at PDT meetings using a RAG system to enable the key delivery issues to be highlighted, allowing focussed attention on resolving issues and maintaining the delivery programme.

6.8 RISK MANAGEMENT STRATEGY

6.8.1. Risk management is the methodical approach to identifying, quantifying and managing risks that occur during the lifecycle of a project. The key to effectively mitigating risks is to develop a series of well-defined steps to support better decision-making through an understanding of the potential risks inherent to a scheme and their likely impact.

6.8.2. The Treasury Orange Book recommends a four-stage process which is broadly cyclical (plan-do-review) requiring on-going review and update of risks to provide effective controls during scheme development and delivery. The risk management strategy is illustrated in Figure 6-4[93].

Figure 6-4: Risk Management Strategy

RISK MANAGEMENT PROCESS

6.8.3. Risk management is seen as a key process underpinning good scheme governance and achievement of scheme objectives in a cost-effective manner. *TAG Unit A1.2 (Scheme Costs)* requires all project related risks, which may impact on the scheme costs, to be identified and quantified in a Quantified Risk Assessment (QRA) to produce a risk-adjusted cost estimate.

6.8.4. The outcome of the QRA process is the prediction of an 'expected' risk value which is the average of all risk outcomes, factoring in the various probabilities of these risks materialising. This 'expected' value effectively becomes the 'risk adjusted cost estimate'. The risk assessment has been undertaken using the following four-stage process:

- risk identification and assessment
- risk treatment
- risk monitoring
- risk reporting

6.8.5. This process is described below.

[93] Extract from HM Government The Orange Book Management of Risk – Principles and Concepts Page 6

RISK IDENTIFICATION AND ASSESSMENT

6.8.6. Risks for this scheme have been identified during multi-disciplinary discussions, including inputs from technical experts in highway engineering, stakeholder engagement, geotechnical, structures, drainage, flood risk, lands, transport planning, economics, cost management and environmental disciplines. These risks have been catalogued within the project specific risk and opportunity register.

6.8.7. The risk identification and assessment process is carried out in accordance with the ISO31000 and the Departments Roads Service Policy & procedures Guide: RSPPG_E058 Major Works Estimates.

RISK IDENTIFICATION

6.8.8. Risk and opportunities are identified through a series of risk workshops with key project stakeholders.

6.8.9. The outputs of this are the identification of a range of discreet risk and opportunity events, and their associated causes and consequences, across the range of project Phases and disciplines.

6.8.10. The scheme risks can largely be grouped into the following categories:

- project programme
- scheme cost
- scheme funding
- operation of the transport network
- design development and scope change
- age of data and interpretation of information
- resources and resourcing
- approvals by third parties and stakeholder
- construction and buildability
- reputation
- health and safety

RISK ASSESSMENT

6.8.11. Each risk is evaluated in terms of the cost impact of the risk. Whilst the DfT recommends[94] the use of empirical evidence to estimate a range of cost outcomes, wherever possible, it is noted that 'common sense approximations' should be used when such empirical data is not available, rather than aiming for unrealistic levels of accuracy.

6.8.12. The risks/opportunities identified are then assessed based on the likelihood of the event occurring and the impact in terms of cost and time to the project in the event of occurrence.

6.8.13. These assessments are made qualitatively, using a pre-defined risk matrix that defines the probability of occurrence and impact to cost/time over a 5-point scale.

6.8.14. These qualitative assessments are used as the basis for quantitative 3-point cost estimates (most likely, minimum, and maximum cost impact) for each risk/opportunity, based on Phase and total project cost.

[94] TAG Unit A1.2, page 9, Section 3.2 (November 2021)

RISK TREATMENT

6.8.15. Once risks and opportunities are identified and assessed actions are identified to help mitigate (in the event of a risk) or enhance (in the event of an opportunity).

6.8.16. For risk actions this is achieved by reducing the likelihood (by targeting risk causes) or the impact (by targeting risk consequences) of the risk event, and conversely opportunity actions seek to increase the likelihood or consequence of the opportunity event.

RISK RE-ASSESSMENT

6.8.17. Risks and opportunities are then re-assessed in terms of likelihood and impact rating, with the identified risk and opportunity actions in place, providing a residual risk/opportunity rating.

RISK MONITORING (REVIEW AND MANAGEMENT)

6.8.18. The outputs of this work are collected in the project risk register (see **Appendix L**) to enable future identification, assessment, and management of project risks.

6.8.19. Following the initial assessment of scheme risks, a systematic approach is adopted to respond to risks and allocate responsibility to the most appropriate party in line with governance arrangements set out in Section 6.2. One of the following four strategies has been adopted for each risk when developing a suitable response plan:

- accept or tolerate consequences in the event that the risk occurs – in the event that:
  - the cost of taking any action exceeds the potential benefit gained
  - there are no alternative courses of action available
- treating the risk – continuing with the activity that caused the risk by employing four different types of control including preventative, corrective, directive and detective controls
- transferring the risk – risks could be transferred to a third party e.g. insurer or contractor
- terminating the activity that gives rise to the risk

Development of response plans to manage risks are undertaken only where the likelihood of occurrence and impact can be cost effectively managed.

6.8.20. The key risks identified during multi-disciplinary discussions are catalogued within a risk register. A snapshot of the template used for recording risk is included in Figure 6-5.

6.8.21. The risk register is reviewed, updated, and amended, if required, by the risk owners monthly. Changes are considered prior to implementation by a change manager prior to being embedded into the risk register. The top risks in terms of residual risks, highest estimated costed residual risks and time realisation risks are presented at the monthly Progress Meeting.

6.8.22. Independently facilitated risk and opportunity workshops are ran bi-annually as a minimum but also at key stages to gain a team consensus of all existing and new risks.

A5 WTC	A5 Western Transport Corridor	Risk Dashboard 15th December 2022

PART ONE : MONTHLY SHORT-TERM PROJECT RISKS WITH A MEDIUM TO HIGH RESIDUAL RISK EXPOSURE RATING REPORTING

RISK ID	RISK OWNER	RISK DESCRIPTION	INITIAL RISK EXPOSURE			RESPONSE (Mitigation (M) and/ or Contingency (C))	RESIDUAL RISK EXPOSURE			QUALITATIVE RISK ASSESSMENT (Most Likely Cost)	POTENTIAL RISK REALISATION
			Probability	Impact	Risk Rating		Probability	Impact	Risk Rating		
			4	4	16		3	4	12		
			3	5	15		3	4	12		
			4	3	12		3	4	12		
			3	4	12		2	4	8		
			4	5	20		3	5	15		
			4	4	16		3	3	9		
			3	3	9		2	3	6		
			2	4	8		2	3	6		
			3	5	15		3	4	12		
			4	3	12		4	3	12		
			4	3	12		3	3	9		

Figure 6-5: Example of the Project Risk and Opportunity Register template

QUANTITATIVE RISK ASSESSMENT

6.8.23. A quantitative risk assessment is carried out considering the cost impact for risks and opportunities.

Step 1 – Cost Assessment

6.8.24. Qualitative likelihood, and impact values (both pre and post mitigation), for risks and opportunities, are converted into quantitative cost values for the quantitative modelling.

6.8.25. The likelihood scores are converted into a percentage probability of occurrence and the impact scores are converted into a three-point cost estimate (most likely, minimum, and maximum cost impact) in GBP.

Step 2 – Quantitative Risk Modelling

6.8.26. Quantitative risk modelling is carried out for all the project risks and opportunities, both pre and post mitigation, using Monte Carlo analysis in @RISK modelling software.

6.8.27. Using the likelihood and range of potential cost impacts for each risk/opportunity, @RISK is used to model 10,000 scenarios to assess the probability of the risk/opportunity events occurring and their potential cost impact in the event of occurrence.

6.8.28. The output of this Monte Carlo simulation is a probability distribution for pre and post mitigated risk/opportunity exposure that shows the range of potential risk and opportunity cost to the project.

Step 3 – Quantitative Risk Assessment Results

6.8.29. When probabilistic Monte Carlo type evaluations are adopted, this provides a statistical confidence level for determining the QRA value. In accordance with the Department's RSPPG E058 a risk contingency based on the P50 post mitigated risk exposure plus the P50 inherent opportunity exposure was determined. The P50 value indicates that 50% of the modelled scenarios had a risk/ opportunity exposure of this value or lower. These figures are presented from the assessment undertaken in July 2022.

- Figure 6-6 shows the mean and the distribution of the residual risk value post mitigation
- Figure 6-7 shows risks that have the biggest impact on the mean risk value post mitigation
- Figure 6-8 shows the mean and the distribution of the residual opportunity value post exploitation
- Figure 6-9 shows the opportunities that have the biggest impact on the mean opportunity value post exploitation.

6.8.30. The risk cost (negative value) is added to the opportunity cost (positive value) to determine the risk exposure.

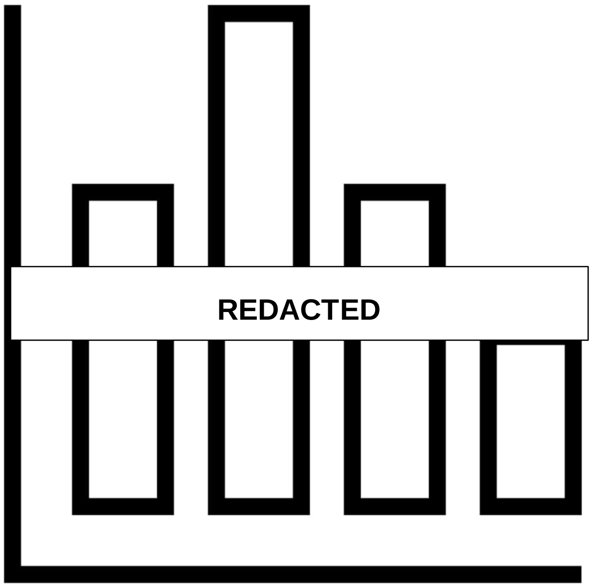

Figure 6-6: Chart showing mean and the distribution of the residual risk value post mitigation

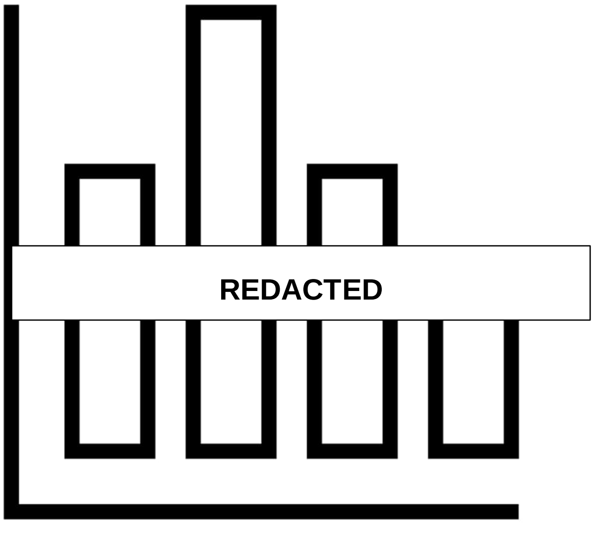

Figure 6-7: Chart showing risks that have the biggest impact on the mean risk value post mitigation

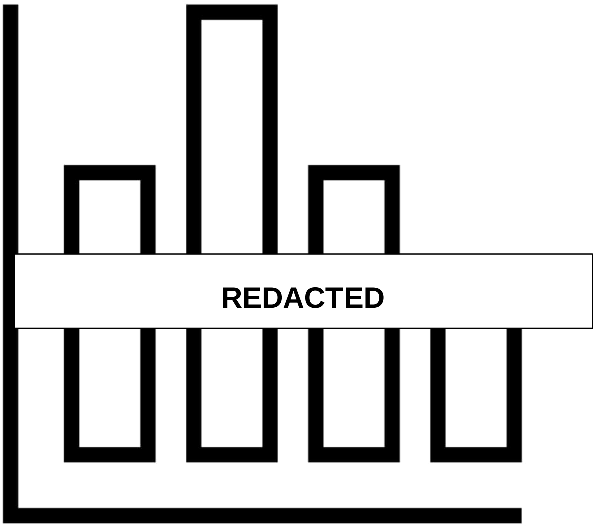

Figure 6-8: Chart showing the mean and the distribution of the residual opportunity value post exploitation

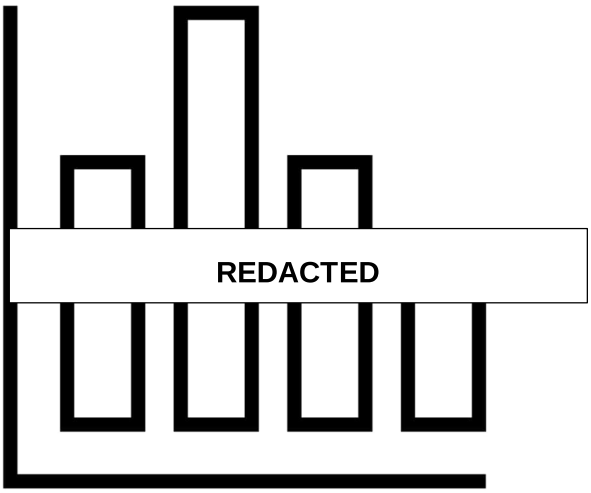

Figure 6-9: Chart showing the opportunities that have the biggest impact on the mean opportunity value post exploitation.

IMPLEMENTATION AND REVIEW OF THE RESIDUAL RISK

6.8.31. Effectiveness of the response plan to manage the risk is dependent on the proper implementation and review of the residual risk (including any secondary risk associated with implementation). Reviews of the status of scheme risk assessments and their related response plans (as part of project reporting) will be an integral part of progress meetings during progression of detailed design and the construction period. All key risks will be formally reviewed at key decision points in the scheme lifecycle.

6.8.32. Risk workshops have been held at the commencement of and prior to completion of each key stage. The attendees at each risk workshop would depend on the stage being considered and the technical and procedural complexity required. The risk register is a live document with ongoing reviews held monthly. In addition, further risk workshops are held every 6 months or as agreed at significant project milestones.

6.9 BENEFITS REALISATION PLAN

6.9.1. A full Benefits Realisation Plan (BRP) will form part of the Full Business Case. This section outlines the approach that will be taken for the preparation of a BRP for the Proposed Scheme. It will enable the benefits and disbenefits that are expected to be derived from the project to be planned, tracked, managed, and realised. It will help demonstrate whether the scheme objectives identified in the strategic case are being achieved in terms of the desired measures for success.

6.9.2. The planned approach in respect to social value is described in Chapter 5.

6.9.3. Carbon targets are set at an international and national level, the following section sets out the context of carbon targets and legislation.

NATIONAL CARBON TARGETS, BUDGETS & LEGISLATION

United Nations Framework Convention on Climate Change

6.9.4. The UK is a member of the United Nations Framework Convention on Climate Change (UNFCCC) which drives international action on climate change. As a result of the UNFCCC negotiation process, the Paris Agreement was adopted by 196 Parties (countries) at the Paris Conference of the Parties (COP) in 2015. Under the Paris agreement the UK has, as a part of a joint pledge by members of the European Union (EU), committed to limit global warming to 2°C and to pursue efforts to limit it to 1.5°C. This provides an overarching commitment by the UK.

6.9.5. Details of commitments include, but are not limited to:

- Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;
- take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases; and
- reach global peaking of greenhouse gas emissions as soon as possible.

6.9.6. More recently (2018) the Intergovernmental Panel on Climate Change (IPCC) released a special report which compared the likely climate impacts between a 1.5°C and 2°C warming scenario. They found that, “Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C”.

The UK Climate Change Act 2008 (2050 Target Amendment)

6.9.7. The 2019 amendment to the Climate Change Act 2008 established a legal requirement for reaching Net Zero GHG emissions in the UK economy by 2050, which is reflected in the UK Net Zero Strategy. The 2008 Act also created the Committee on Climate Change, which has responsibility for setting the five-year UK carbon budgets. The 6th Carbon Budget has recently been enshrined in law and commits the UK to 78% reduction in GHG emissions by 2035.

Climate Change Act (Northern Ireland) 2022

6.9.8. The Climate Change Act (Northern Ireland) 2022 has now been enshrined in law and commits Northern Ireland's net emissions for the year 2050 to be at least 100% lower than the baseline. The baseline year varies by greenhouse gas, for carbon dioxide it is 1990. Interim targets must be proposed for the years 2030 and 2040, which are in line with the 2050 target and laid before the assembly.

6.9.9. Under the Act carbon budgets must be set for 2023 to 2027, and for every five-year period following up to 2048 to 2052. The Act also requires sectoral plans to be produced for achieving the Northern Ireland Net Zero targets, including plans for infrastructure, transport, and active travel.

6.9.10. The Act requires all Northern Ireland Departments to "exercise its own functions, so far as is possible to do so, in a manner that is consistent with the achievement" of the objectives stated in the Act.

The A5WTC contextualised against the UK carbon budgets

6.9.11. Chapter 15 of the ESA 2022 contextualises the total predicted emissions for the A5WTC against the UK carbon budgets. The UK Government's commitment to new Net Zero carbon targets for 2050 is not a moratorium on the development of new roads or the improvement of existing roads. The Net Zero target includes the provision for emissions to increase if there is a commensurate decrease at a national scale.

Roads in a Net Zero Northern Ireland

6.9.12. The strategic and economic case will justify the importance of the A5WTC to the economy, however, it is important to consider the role of roads in a Net Zero future.

6.9.13. In 2019, "84% of passenger kilometres [were] made by cars, vans and taxis" and "79% of domestic freight was moved by road" (DfT, 2020). National Highways, who operate England's Motorways and major A roads believe that "a Net Zero Britain will still travel by road in 2050" (National Highways, 2021). For Northern Ireland, almost all freight is moved by road, given there are "no rail freight operations in Northern Ireland", as stated in the All-Island Strategic Rail Review Consultation Paper[95].

6.9.14. Whilst road travel is currently carbon intensive the projected transition to electric vehicles, decarbonisation of the electricity grid, and other shifts to more sustainable travel modes and patterns will help to decarbonise UK roads, as set out in DfT's Transport Decarbonisation Plan.

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[95] All Island Strategic Rail Review – Consultation Paper, November 2021 https://www.infrastructure-ni.gov.uk/sites/default/files/consultations/infrastructure/consultation-all-island-strategic-rail-review.PDF

TRACKING IMPACTS ON THE WHOLE SCHEME VALUE FOR MONEY

6.9.15. The Proposed Scheme is now expected to be delivered in distinct Sections, comprised of different phases.. Prior to the construction of each Section, a specific Full Business Case (FBC) will be prepared, which will review the continued accuracy of assumptions made within this OBC with a view to ensuring the robustness of the appraisal for the Section being assessed and for the whole scheme. Factors which will be considered include:

- scheme estimates
- delivery dates
- traffic growth rates
- lessons learned from previous Phases or Sections

6.9.16. Any subsequent impacts on the whole scheme Value for Money (VfM) will be noted. If something changes significantly to a Section, the VfM calculation will be retested and published in the FBC reports rather than updating the OBC.

6.9.17. The programme for the opening of the scheme phases reflected in this document is consistent with that assumed in the preparation of the 2022 Environmental Statement Addendum (ESA2022), and is as follows:

- Section 1
    - Phase 1A opening 2026: New Buildings to north of Strabane (Junctions 1-3)
    - Phase 2A opening 2027: North of Strabane to Sion Mills (Junction 3 – 8)
- Section 2
    - Phase 2B opening 2027: Sion Mills to south of Omagh (Junctions 8-13)
- Section 3
    - Phase 1B opening 2028: South of Omagh to Ballygawley (Junctions 13-15)
    - Phase 3 opening 2028: Ballygawley to Aughnacloy (Junctions 15-17)

6.9.18. The desired outputs are those tangible effects that are funded and produced directly as a result of the scheme. The desired outcomes are the final impacts brought about by the scheme in the short, medium and long term. The five scheme objectives, together with the desired outputs and outcomes are summarised in Table 6-4 below, as well as indicative scheme targets and review period. The Department's Project Sponsor is accountable and is the owner of all items listed.

6.9.19. The SRO will develop the BRP further for inclusion in the FBC, linking it to the Monitoring and Evaluation Plan (MEP) as set out in Section 6.10. This will include further development of the indicative scheme targets and detail of how these will be measured and reported.

Table 6-4: Scheme objectives, outputs, outcomes, indicative targets and review periods

Outputs	Outcomes	Indicative Scheme Target	Review Period
1. IMPROVE ROAD SAFETY FOR ALL HIGHWAY USERS			
▪ Reduced road accidents at hotspots with high accident rates ▪ Minimised risk of accidents	▪ Reduced fatalities and severe or slight injuries due to road accidents on the A5 corridor ▪ Reduced accidents on the A5 corridor and within towns and villages along the corridor	▪ A minimum of 5% reduction in accidents three years post-full scheme opening	3 years post-scheme opening
2. IMPROVE THE ROAD NETWORK IN THE WEST OF THE PROVINCE AND NORTH / SOUTH LINKS			
▪ Direct road link between the North at Londonderry and the South at Aughnacloy ▪ Improved journey time reliability for movements of people and goods ▪ Segregated strategic traffic from local traffic	▪ Reduced journey times on the A5 corridor between the North at Londonderry and the South at Aughnacloy ▪ Improved access between the North and the South, and connecting towns in between, for employment, education, social and recreational trips ▪ Better potential and more attractive for increased inward investment and commercial opportunities	▪ 85% traffic overall two-way reduction on existing A5 between J1-J2 equivalent ▪ 55% traffic overall two-way reduction on existing A5 between J6-J8 equivalent ▪ 80% traffic overall two-way reduction on A5 between J9-J10 equivalent ▪ 70% traffic overall two-way reduction on existing A5 between J13-J14 equivalent ▪ 40% traffic overall two-way reduction on existing A5 between J15-J16 equivalent	3 years post-scheme opening
3. REDUCE JOURNEY TRAVEL TIME			
▪ Improved traffic flow at congestion hotspots on the A5 corridor where journey times can currently be unpredictable due to congestion ▪ Increased provision for overtaking opportunities for users of the A5 corridor	▪ More efficient road network, reducing fuel consumption and emissions, and therefore, running costs, for private, commercial, and public service operators. ▪ Reduced incidences of congestion on the A5 corridor ▪ Time savings which benefit users of the A5 corridor and the economy ▪ Improved perceptions of accessibility between the North at Londonderry and the South at Aughnacloy for business	▪ 30% reduction in peak hour journey times compared to the situation without the scheme	3 years post-scheme opening

Outputs	Outcomes	Indicative Scheme Target	Review Period
4. PROVIDE INCREASED OVERTAKING OPPORTUNITIES FOR MOTORISTS ALONG THE A5 WESTERN TRANSPORT CORRIDOR			
▪ Improved traffic flow at congestion hotspots on the A5 corridor where journey times can currently be unpredictable due to congestion ▪ Increased provision for overtaking opportunities for users of the A5 corridor	▪ More efficient road network, reducing fuel consumption and emissions, and therefore, running costs, for private, commercial, and public service operators. ▪ Reduced incidences of congestion on the existing A5 ▪ Time savings which benefit users of the A5WTC and the economy ▪ Improved perceptions of accessibility between the North at Londonderry and the South at Aughnacloy for business	▪ 30% reduction in peak hour journey times compared to the situation without the scheme	3 years post-scheme opening
5. DEVELOP THE FINAL PROPOSALS IN LIGHT OF THE SAFETY, ECONOMIC, ENVIRONMENTAL, INTEGRATION AND ACCESSIBILITY CONSIDERATIONS			
▪ Improved safety for all road users, contributes to economic growth, minimises impacts on the environment, and enhances integration and accessibility to key economic centres and international gateways	▪ Reduced number of fatalities and severe or slight injuries due to road accidents on the A5 corridor ▪ Minimises the scheme cost and impact on the built and natural environment and provides good value for money. ▪ Environmental assets protected and adverse impacts minimised or mitigated ▪ Contributes towards improved health and wellbeing and carbon impacts ▪ A more efficient road network, with greater connectivity between the North at Londonderry and the south at Aughnacloy, enhancing access to jobs and services and increasing the attractiveness for inward investment.	▪ Monitoring of the Contractors to check measures are implemented ▪ Carry out post construction surveys to assess effectiveness of the environmental measures – including occupancy of new badger setts, otter holts, bat boxes and records of any roadkill ▪ All design approvals signed off and the Health and Safety File completed in full by the end of the Defects Period ▪ Control of construction budget and compensation events to avoid unnecessary additional costs	3 years post-scheme opening

6.10 MONITORING AND EVALUATION OF IMPACTS

6.10.1. Monitoring and evaluation of impacts is required to establish the extent to which the scheme meets the objectives and the forecast benefits described in the Economic Case section of the OBC as set out below:

- **monitoring** – seeks to check progress against planned targets and can be defined as the formal reporting and evidencing that spend and outputs are successfully delivered, and milestones met; and
- **evaluation** – is the assessment of the initiative's effectiveness and efficiency during and after implementation. It seeks to measure the causal effect of the scheme on planned outcomes and impacts and to assess whether the anticipated benefits have been realised, how this was achieved, or if not, why not.

6.10.2. To be fully effective, plans for monitoring and evaluation should form part of the early development of the scheme's business case and be a continuous process within the project. The full Plan for each individual Section of the Proposed Scheme will form part of the respective Full Business Case.

MONITORING AND EVALUATION OF THE PROPOSED SCHEME

6.10.3. The Proposed Scheme is unique in that it will be completed in individual phases over different timescales, in accordance with the availability of funding. The following sections summarise this proposed monitoring and evaluation methodology.

6.10.4. Monitoring and evaluation will be carried out after the completion of each phase and via the approach outlined below. At the completion of any project, the Department's Post Benefit Evaluation procedure requires that a two-stage review is carried out at different times:

- Project Management Evaluation (PME)
- Post Benefit Evaluation (PBE)

6.10.5. These two stages are described in the below two paragraphs. The PME records and comments on:

- Project management
- Budget compliance
- Project schedule compliance

6.10.6. The PME is to be completed no more than 12 months after the scheme opens to traffic or is completed (whichever is later). The PME involves a description of the project, a capital cost analysis, commentary on capital expenditure, a review of actual construction programme duration versus planned and an overall assessment of project management.

6.10.7. The PBE records and comments on the achievement of:

- Project objectives
- Project benefits
- Project outcomes
- Lessons learned

6.10.8. The PBE is completed three years after the scheme opens to traffic or is completed (whichever is later). This allows time to evaluate how the scheme is performing and gather traffic data, journey time information and accident data.

6.10.9. The PBE includes an assessment of the degree to which the Project's Objectives and Targets have been met. It also comprises a review of the Project's Monetary and Qualitative Benefits quantified during the scheme appraisal. It contains a description of how the project is currently operating and whether the scheme has provided value for money. Finally, the PBE conducts a review of lessons to be learned and recommendations for the appraisal and management of future projects.

6.10.10. Interim PBEs will be completed as far as practically possible for the individual Phases completed. However, due to the condensed construction programme and the difficulties this would present in obtaining unbiased data for monitoring, ultimately the full scheme PBE will be of greatest relevance.

6.10.11. The programmes for the construction and implementation phase of the scheme will be closely monitored by the Department. Monitoring of the construction process during implementation will be undertaken to check compliance with the Contract and Employers Requirements including planning and environmental conditions set out in the Environmental Statement.

6.10.12. The main construction works are programmed to start in late 2023 with the entire A5WTC scheme open to traffic by 2028.

6.10.13. It is important that pre-scheme data be collected in the months leading up to and during the pre-construction phase of the scheme; as there needs to be a robust and accurate comparison available for the Post Project Evaluation (PPE).

6.10.14. The Department's monitoring will also focus on the wider set of impacts as a result of the scheme:

- **benefits** – a summary of the formal benefits review, twelve months and three years post-scheme completion
- **unexpected (dis)benefits –** identifying any additional impacts that were not planned for as part of the Proposed Scheme

LOGIC MODEL

6.10.15. The logic map in Figure 6-10 shows how the impacts will be achieved and monitored:

- **problems** - the existing problems the Proposed Scheme will address
- **aims** - the aims of the Proposed Scheme
- **objectives** – the objectives of the Proposed Scheme
- **outputs** – what has been produced
- **outcomes –** the longer-term impacts
- **monitoring** – the proposed methods of evaluating the scheme impacts

DATA COLLECTION REQUIREMENTS

6.10.16. In line with the Department's requirements for the standard monitoring process Table 6-5 sets out data collection requirements to allow performance against metrics to be evaluated.

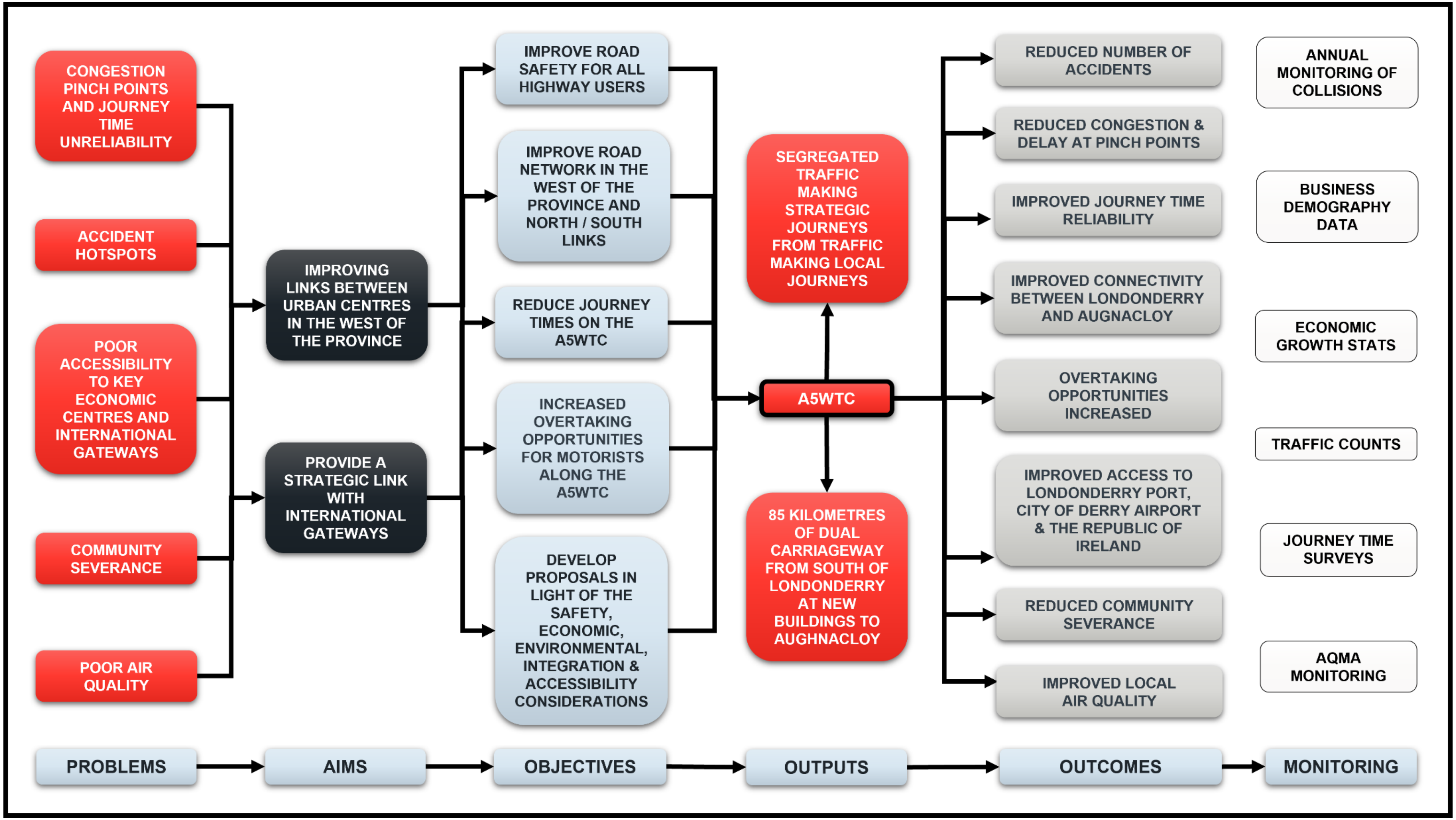

Figure 6-10: Monitoring & Evaluation Logic Map

A5WTC Western Transport Corridor

Table 6-5: Data requirements and metrics

Measure	Stage	Data to be used	Data collection methods	Data collection Frequency & Report Timing	Rationale for inclusion
Scheme	Output Outcome	Description (and quantities) of the delivered scheme to be provided. Progress against key milestones Financial monitoring/reporting, scheme cost plans, outturn costs, overall expenditure of each funding stream	Description of scheme outputs & design. Observation of scheme outputs & identification of changes Monitoring of construction works project plan assessment Financial monitoring system	Post opening (up to 1 year)	Accountability Determine if output is delivered
Objective 1	Output Outcome	Road accident data	Police Service of Northern Ireland Road Traffic Collision Statistics	Pre scheme / 1 year / 3 years	Accountability
Objective 2	Output Outcome	Traffic flows data, Journey time data	ATC and manual counts/surveys, Journey time surveys or GPS data collection	Pre scheme / 1 year / 3 years	Accountability
Objective 3	Output Outcome	Journey time data	Journey time surveys or GPS data collection	Pre scheme / 1 year / 3 years	Accountability / Knowledge
Objective 4	Output Outcome			Pre scheme / 1 year / 3 years	Accountability / Knowledge
Objective 5	Output Outcome	AQMA Particulate Matter PM_{10} Data, ONS health data, noise level monitoring	Existing AQMA monitoring reporting, ONS data collection, noise monitoring surveys	Pre scheme / 1 year / 3 years	Accountability / Knowledge
Monitor & Evaluation	Monitoring	Progress against key milestones	Monitoring of construction works project plan assessment	Continuous collection during construction / monthly reporting	Knowledge / Accountability / Timing

DATA SOURCES

6.10.17. Data will be collated by the Department in order to adequately monitor and evaluate the achievements of the benefits. These are shown in Table 6-6 below.

Table 6-6: Data sources

Data and geographic location	Provider	When Needed	"Before" Surveys Available
Road traffic surveys ATC and Manual Counts	The Department	Prior to construction Post opening 1 to 3 years.	Available via the Department
Road traffic accidents within the COBA-LT area specified within the FBC	PSNI	Prior to construction Post opening after 3 years.	Available via PSNI
Journey time data / GPS data	The Department	Prior to construction Post opening 1 to 3 years.	Available via the Department
Stopping Sight Distances (SSD), Full Overtaking Sight Distances (FOSD)	The Department	Prior to construction Post opening 1 to 3 years.	Available via the Department
Nitrogen Dioxide (NO_2) Data for the Proposed Scheme	The Department	Prior to construction Post opening 1 to 3 years.	Available via the Department
Noise Level Data (Baseline noise monitoring)	The Department	Prior to construction Post opening 1 to 3 years.	Available via the Department
ONS Health Data	Office for National Statistics	Prior to construction Post opening 1 to 3 years.	Available via ONS

MEASURES FOR SUCCESS

6.10.18. Fully achieving all the scheme objectives is the measure for success and is essential in contributing to the high-level objectives of balancing regional infrastructure, improving competitiveness and economic prosperity through improving connectivity and accessibility across the region.

TIMESCALE FOR EVALUATION

6.10.19. It is proposed the evaluation process consists of three key stages:

- **Stage 1:** Pre-construction Baseline
- **Stage 2:** 1 year after Section opening
- **Stage 3:** 3 years after Section opening

6.10.20. Before (prior to construction start) and after scheme monitoring will be undertaken to evaluate the schemes effectiveness against the stated objectives. Monitoring (data collection) will also take place at regular intervals before and after the scheme has opened at 1 and 3 years after opening. This will allow a full before and after comparison to be made and allow judgment of whether the scheme has met its objectives. It should be noted that the collection of accident data is not proposed after 1 year since to be statistically significant, data is required over a period of at least 3 years.

6.10.21. The monitoring programme will be aligned to the phased construction programmes changes. Lessons that have been learnt from one phase will be considered and incorporated in subsequent phases for continual improvement.

COUNTERFACTUALS

6.10.22. A counterfactual analysis has been carried out to assist in assigning the outcomes of the Proposed Scheme directly to the existing A5. Figure 6-11 shows a counterfactual position for the area immediately surrounding the existing A5 corridor if the Proposed Scheme is not implemented.

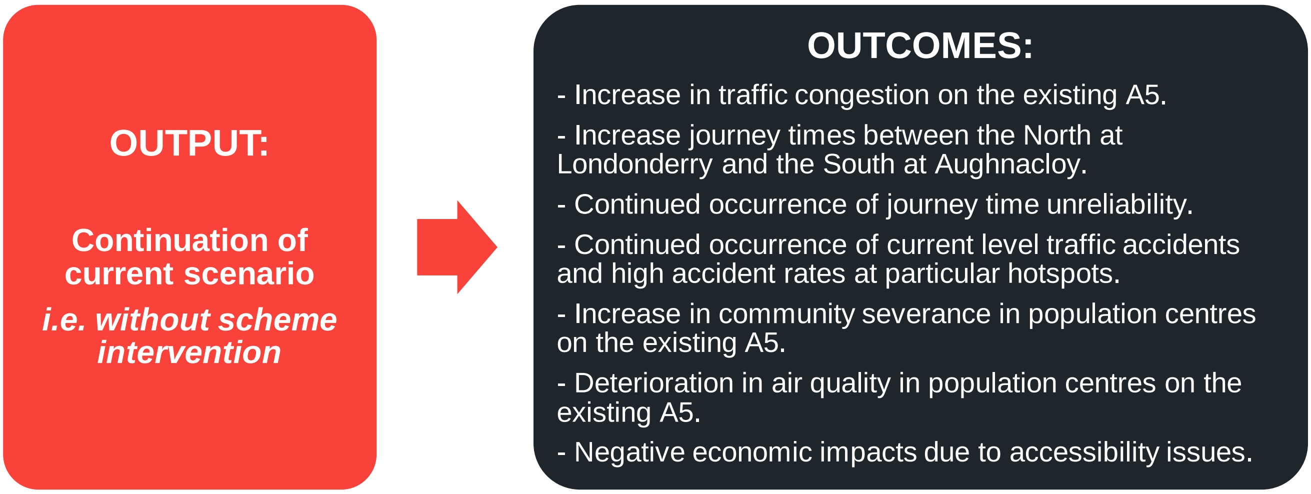

Figure 6-11: Counterfactual position

SETTING TARGETS

6.10.23. The Department recognises the importance of setting specific indicators and targets. These will be set out at the FBC stage. It may be possible to involve stakeholders to take ownership of some parts of the monitoring and evaluation.

LINKING INDICATORS TO OUTCOMES

6.10.24. It is important to demonstrate how the proposed indicators relate to the desired outcomes. The logic map presented in Figure 6-10 shows how interventions link to the achievement of objectives and how these will be monitored either directly or indirectly.

SUMMARY OF ANALYSIS – MONITORING AND EVALUATION OF IMPACTS

6.10.25. The monitoring and evaluation process will be used to answer the following key questions:

- have the anticipated outcomes and impacts been achieved?
- to what extent are the observed changes additional to what would have happened in the absence of the intervention?
- were there any unanticipated impacts / displacement effects?
- which elements of the scheme were particularly influential in achieving the overall goals?
- what lessons can be learnt for future scheme / policy development?
- what is the contribution of the policy to the Department's strategic goals and polices? including:
  - North-South connectivity
  - wider regional development goals
  - accidents
  - air quality
  - noise reduction
- to what extent did the anticipated costs and benefits match the actual outcome?
- has the scheme been successful? if not, why not?

6.10.26. The evaluation of the scheme will:

- measure the level of traffic congestion on the existing network
- measure the level of traffic congestion on the improved network
- measure journey times on the existing A5 and the improved network i.e. the A5WTC
- measure the levels of accidents on the existing and improved network

6.10.27. The initial 1-year impact assessment will be used to understand the impact mainly on journey times and travel patterns. There may be some evidence at this stage of the scheme impact in terms of developments and jobs. The 3-year assessment will look at longer term benefits including accidents, travel patterns and jobs / additional investment.

6.11 SUMMARY

6.11.1. In summary, the Proposed Scheme will be governed by the SRO, who will be responsible for its delivery.

6.11.2. The TRAM G3 (Colin Woods) is the Investment Decision Maker.

6.11.3. The SRO, Dr Kaine Lynch, leads the Project Delivery Team as set out by the Department.

6.11.4. The main responsibilities of the Project Delivery Team are to:

- co-ordinate the different activities which make up the project
- provide direction on the technical delivery of the project
- undertake monthly reviews of progress against targets and programme
- review the risk register on a monthly basis, and initiate corrective action where appropriate; and
- provide, as a minimum, quarterly progress reports for the Permanent Secretary.

6.11.5. Subject to the availability of funding, the Proposed Scheme will be constructed in accordance with the indicative construction programme provided in 6.3.

6.11.6. The Department's Project Sponsor and support team are responsible for the day-to-day management of the delivery programme.

6.11.7. To achieve the delivery programme, the WSP Project Director is supported by a Project Manager and five workstream leads who are in turn supported by teams of engineers, consultants and technicians for the various disciplines together with peer reviewers to check and validate the deliverables.

6.11.8. The Project Sponsor also leads the Integrated Delivery Teams in aspects of the project relating to the construction planning, buildability advice, detailed design and construction.

6.11.9. A full Benefits Realisation Plan will form part of the Full Business Case which will outline the desired Specific, Measurable, Achievable, Relevant, and Time-Bound (SMART) targets, outputs, desired outcomes against each of the five key scheme objectives defined in the strategic case.

6.11.10. The monitoring and evaluation processes provide a means whereby the Department can compare the achieved benefits to the forecast benefits and demonstrate that the scheme objectives have been achieved.

Appendix A

DFT/BETTER BUSINESS CASE NI MATRIX

DfT WebTAG and Better Business Cases NI Matrix			Better Business Cases NI																			
DfT WebTAG			Ascertain Strategic Fit	Agree Strategic Context	Determine spending objectives, existing arrangements & business needs	Determine potential business scope and service requirements	Determine benefits, risks, constraints and dependencies	Prepare the economic appraisals for shortlisted options	Undertake benefits appraisal	Undertake risk assessment / appraisal	Select preferred option and undertake sensitivity analysis	Determine procurement strategy	Determine service streams and required outputs	Outline potential risk apportionment	Outline potential payment mechanisms	Ascertain contractual issues and accountancy treatment	Prepare financial model and financial appraisals	Plan project management	Plan change management	Plan benefits realisation	Plan risk management	Plan Post-Project Evaluation
Strategic Case	Strategic Context	Place Specific Strategy	■	■																		
		Business Strategy	■	■																		
		Wider Strategy	■	■																		
	Case for Change	Spending Objectives			■																	
		Existing Arrangements			■																	
		Business Need			■																	
		Scope & Options				■																
		Benefits & Risks					■															
		Constraints & Dependancies					■															
Economic Case	Economic Analysis	Longlist Appraisal						■														
		Methodologies						■														
		Short List Appraisal						■														
		Uncertainty Analysis								■	■											
		Distributional Analysis							■													
		Place-Based Analysis							■													
		Wider Analysis							■													
		ASTs							■													
		Value for Money									■											
	Findings & Reccomendations										■											
Commercial Case		Procurement Strategy										■										
		Sourcing Options											■									
		Pricing Framework													■							
		Risk Allocation												■								
		Human Resources														■						
		Contract Management														■						
		Best Value														■						
Financial Case		Budget Profile															■					
		Budget Arrangements															■					
		Funding Arrangements															■					
		Balance Sheets															■					
Management Case		Objectives																■				
		Programme																■	■			
		Contract Management																■	■			
		Risk Management																			■	■
		Benefits Management																		■		
		Contingency Plans																		■		
		Reccomendations																				■

Appendix B

LOCAL MODEL VALIDATION REPORT

A5 WTC: 2015 Rebased Model - Local Model Validation Report

March 2017

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1 Introduction

1.1 Scope of Report

This report describes the stages, procedures and data used in the rebasing (incorporating data analysis and model calibration and validation) of the strategic traffic model for the A5 Western Transport Corridor (A5WTC) to a 2015 Base Year. This model will form the basis for the production of traffic forecasts and an economic appraisal to support the submission of a Business Case for the A5WTC scheme.

The scope of this report covers the data sources, network development and zoning structure, development of the trip demand matrices and the validation of the modelled link flows and journey times. The validation describes the extent to which the model conforms to the Department of Transport (DfT) criteria for validation as set out in WebTAG.

The report contains a number of appendices, identified in the contents list, providing technical information relating to the processes of the model development as well as a detailed breakdown of the results of the model validation tests.

1.2 Background to the Commission

The 'Regional Transportation Strategy for Northern Ireland 2002-2012' defines the A5 Western Transport Corridor as one of five key strategic corridors in Northern Ireland. The corridor starts in the North West of the Province at Londonderry and extends 88km south to the border with the Republic of Ireland (ROI), close to the village of Aughnacloy. At this point, the A5WTC links into the N2 at the border with Co Monaghan.

Together, the A5 and N2 provide the strategic link between Dublin and the North West of ROI. The A5 also provides a strategic link between the urban centres of Londonderry, Strabane and Omagh.

The A5 is currently a single carriageway road throughout its entire length with some wide single links on rural inter-urban sections. The objectives of the scheme are to

- Improve Road Safety
- Improve the road network in the west of the Province and North/South Links
- Reduce journey travel times along the A5 Western transport Corridor
- Provide increased overtaking opportunities for motorists along the A5 Western Transport Corridor
- Develop the final proposals in light of safety, economic, environmental, integration and accessibility considerations.

The scheme will incorporate new junctions and enhanced links to local towns and villages as part of a wider encouragement for economic and social growth and integration.

In October of 2007 Mouchel was appointed by the former Roads Service to assist in the development of the scheme through to Preferred Route Announcement. The first major deliverable of this process, the Preliminary Options Report, was published in October 2008.

In July of 2009 the Minister for Regional Development announced the Preferred Route for the A5 WTC and the publication of the Preferred Options Report. The Preferred Options Report summarised the work carried out in the Stage 2 Scheme Assessment and detailed the Preferred Route and the rationale for its choice.

A Public Inquiry was held in the summer of 2011 for the proposed scheme. Following the Inquiry there was a successful legal challenge under the Habitats Directive that resulted in a decision to update a previously published (2010) Environmental Statement (ES) for the A5WTC. This required the traffic modelling and forecasting that informed parts of the ES to be brought up to date and to conform to the latest DfT WebTAG Guidance.

1.3 Traffic Model

The original traffic model had been developed from Roadside Interview (RSI) data collected in 2008, together with RSI data from other studies collected in 2006 and 2010. The RSI data-sets were merged to form a matrix of observed movements with the un-observed movements synthesised. This model was used as a basis for the production of traffic forecasts to inform the 2010 ES and to provide the basis for an economic appraisal.

The development of the original base year model for the A5WTC is described in the report 'A5 Western Transport Corridor, Local Model Validation Report' Ref: 718736-2700-R-003, dated 1st April 2011.

Following the decision to update the ES in 2013, it was recognised that updated traffic forecasts would be required. Furthermore WebTAG guidance (TAG Unit M3.1 – Highway Modelling Assignment) advises that trip matrices should be based on survey data which are less than six years old. Since the model was substantially based on data which were over six years old it was considered that new trip data should be obtained, particularly for trips using the existing A5.

In August 2013 Mouchel was instructed to update the traffic model and forecasts to support a revised Environmental Statement for the proposed scheme. A programme of surveys was undertaken in autumn 2013 and spring 2014, comprising RSI's, ANPR's, volumetric counts and journey time surveys. This data was used to update the model to a 2013 base year in accordance with WebTAG guidance.

The development and validation of the model to a 2013 base year, which was completed in August 2014, is documented in ‘A5WTC Local Model Validation Report’ (Ref 718736-2700-R-010) dated January 2015.

This model provided the traffic forecasts for the environmental appraisal required for the production of the revised ES. The ES was ‘print ready’ in January 2015, although publication was delayed until February 2016.

The 2013 based model also provided forecast flows for an operational assessment and economic appraisal of the A5WTC. These were presented to the A5WTC Public Inquiry, held between October and December 2016, in the following documents:

1. TNI Theme Report – Traffic Forecasts;
   Ref A5WTC-TR-009; 29 July 2016

2. TNI Theme Report – Economic Assessment;
   Ref A5WTC-TR-023, 20 October 2016

3. Economic Appraisal Report – A5WTC Updated Traffic Model;
   Ref 718736-2700-R-013, 2 November 2016

1.4 2015 Model Rebasing

At the time of completion of the ES in January 2015, it was expected that a Public Inquiry would be held during 2015. However, in the light of the subsequent delay to the programme, it was decided in December 2015 that preparations should be made for a further update of the traffic model. This decision was taken as an insurance against further delays to the programme and the associated risk that, as time progressed, the age of some of the data within the model, notably the pre 2013 RSI data, could become an issue.

The 2013 model update had focused on updating trip movements on the A5 and therefore those trips most relevant to, and affected by, the proposed scheme. The model rebase to 2015 was focused on updating the modelling of trips on the main East West routes linking to the A5 which had previously been based upon data from RSI sites surveyed in 2008.

It was determined that a programme of traffic surveys, including 7 RSI’s, would be carried out in Autumn 2015 and Spring 2016, focusing on those locations that had been surveyed in 2008. This programme then provided the basis for a major update and re-basing of the model to a 2015 base year.

It was recognised that availability of the rebased model to provide traffic data and forecasts for a Public Inquiry would be dependent upon the timing for publishing draft scheme orders, but that it would not be available in time for a Public Inquiry in 2016.

It was anticipated that, in the event of a 2016 Public Inquiry, the model would be completed in time to provide updated forecasts to support the economic appraisal and business case submission that would be required following the Public Inquiry.

The update of the A5WTC traffic model to a 2015 base year, utilising the programme of traffic data collected in autumn 2015 and spring 2016, as described within this report, was completed in January 2017.

This report confirms that this 2015 rebased model is ‘fit for purpose’ as the basis for the development of forecasts and an economic appraisal to support the Business Case for the A5WTC.

2 Model Specification

2.1 Background

As noted in Chapter 1, the traffic model was originally developed for the A5WTC in 2009 from Roadside Interview (RSI) data collected in 2008, together with data from other studies collected prior to 2008.

The model was subsequently updated to a 2013 base year from RSI data collected in spring 2014 on the existing A5, which would be most affected by the proposed scheme. The model, which had originally been developed using the CUBE Voyager suite of transport modelling software, was also converted to SATURN as part of the 2013 update.

SATURN is a widely used industry standard modelling software package. It enables a detailed representation of the highway network, both links and junctions to be specified and provides a comprehensive range of analytical tools.

The 2015 model rebasing has incorporated data from the 7 RSI's carried out in April 2016, which focused on traffic movements that had been surveyed in 2008 but not amended within the 2013 update. The surveys are described in detail in Section 3.1.

The specification for the 2015 rebased model is unchanged from earlier versions, but details are provided in Sections 2.2 to 2.6 below for completeness.

2.2 Study Area

The A5WTC model study area covers a large area from south of Londonderry at Newbuildings to the border at Aughnacloy. It therefore takes account of all strategic trips that could potentially re-route as a result of the proposed scheme.

A plan of the study area is shown as Figure 2-1

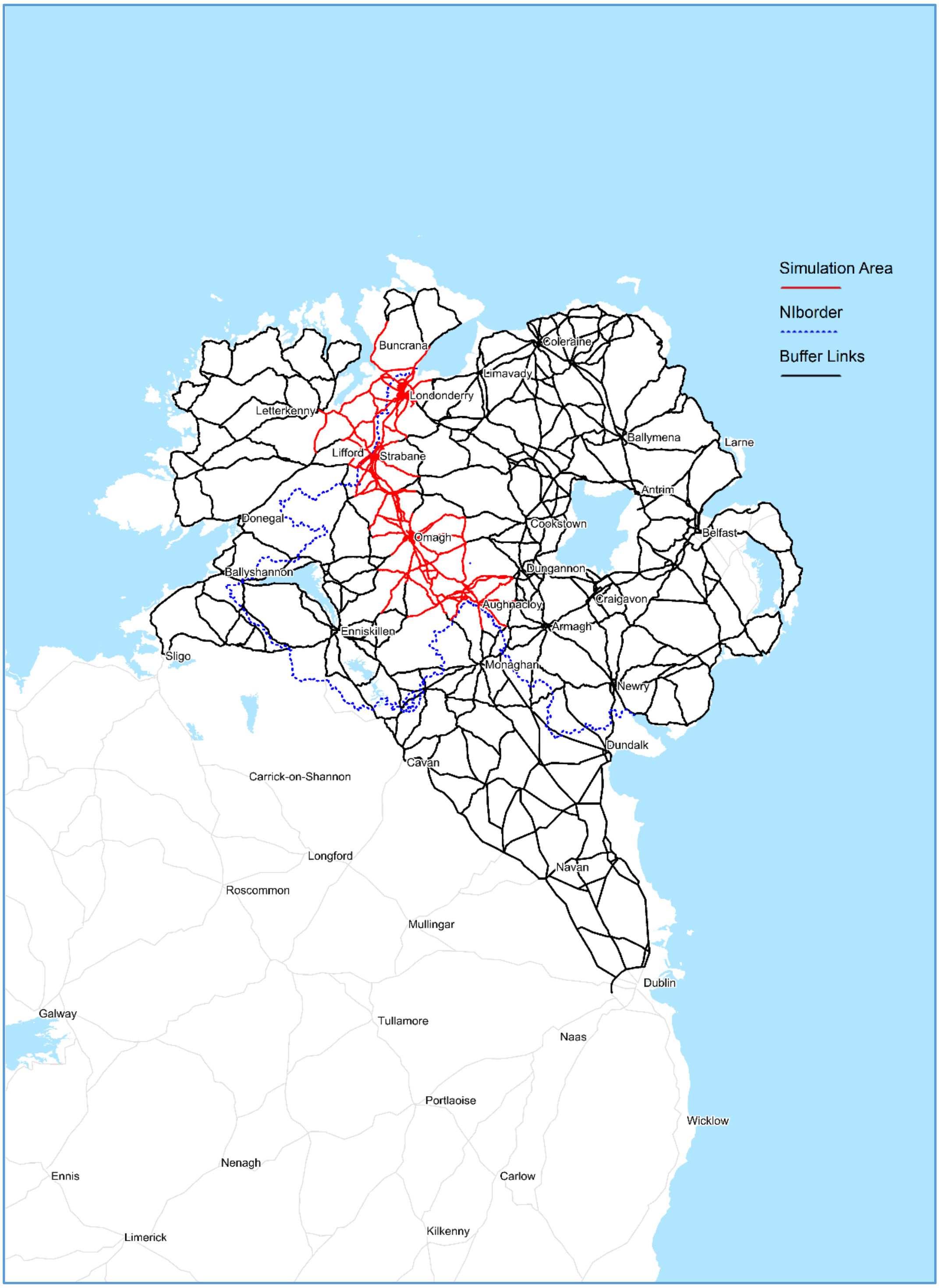

Figure 2-1: Plan of Study Area

The area has a number of key cross border links with the ROI, and includes 3 major urban areas (Londonderry, Strabane and Omagh) along the route of the existing A5.

Within the study area, the network includes all major A and B roads, together with minor roads which have been observed to be of importance to the local area. In addition, alternative routes running parallel to the A5 are modelled since it is possible that trips from these may reassign to the proposed A5WTC.

2.3 Zoning System

A detailed zone system was developed within the main population centres along the route of the existing A5, particularly Londonderry, Strabane and Omagh.

For the inter-urban sections of the A5, the zone system was also relatively detailed in order to represent the smaller urban areas. Zones were then drawn progressively larger away from the route of the A5.

The zone system within Northern Ireland was designed to be consistent with the local government (District) boundaries and the Parliamentary Constituency boundaries. Within areas near to the A5 (defined by the Districts of Londonderry, Omagh, Strabane and Dungannon) zones were consistent with the Ward boundaries. Northern Ireland has been covered by 481 zones.

In the Republic of Ireland the zone system was relatively detailed in County Monaghan and County Donegal that border Northern Ireland at either end of the A5 scheme. Within these counties, zones typically contain two or three medium sized towns. Within the remainder of the Republic of Ireland, the zone system generally follows the county boundaries.

The Republic of Ireland was covered by 44 zones, giving an overall total of 525 zones for the entire study area.

The zone system for the whole of Ireland is illustrated in Figure 2-2. Figure 2-3 shows the zone system in Northern Ireland, County Donegal and County Monaghan. Figure 2-4 shows the zones along the existing A5.

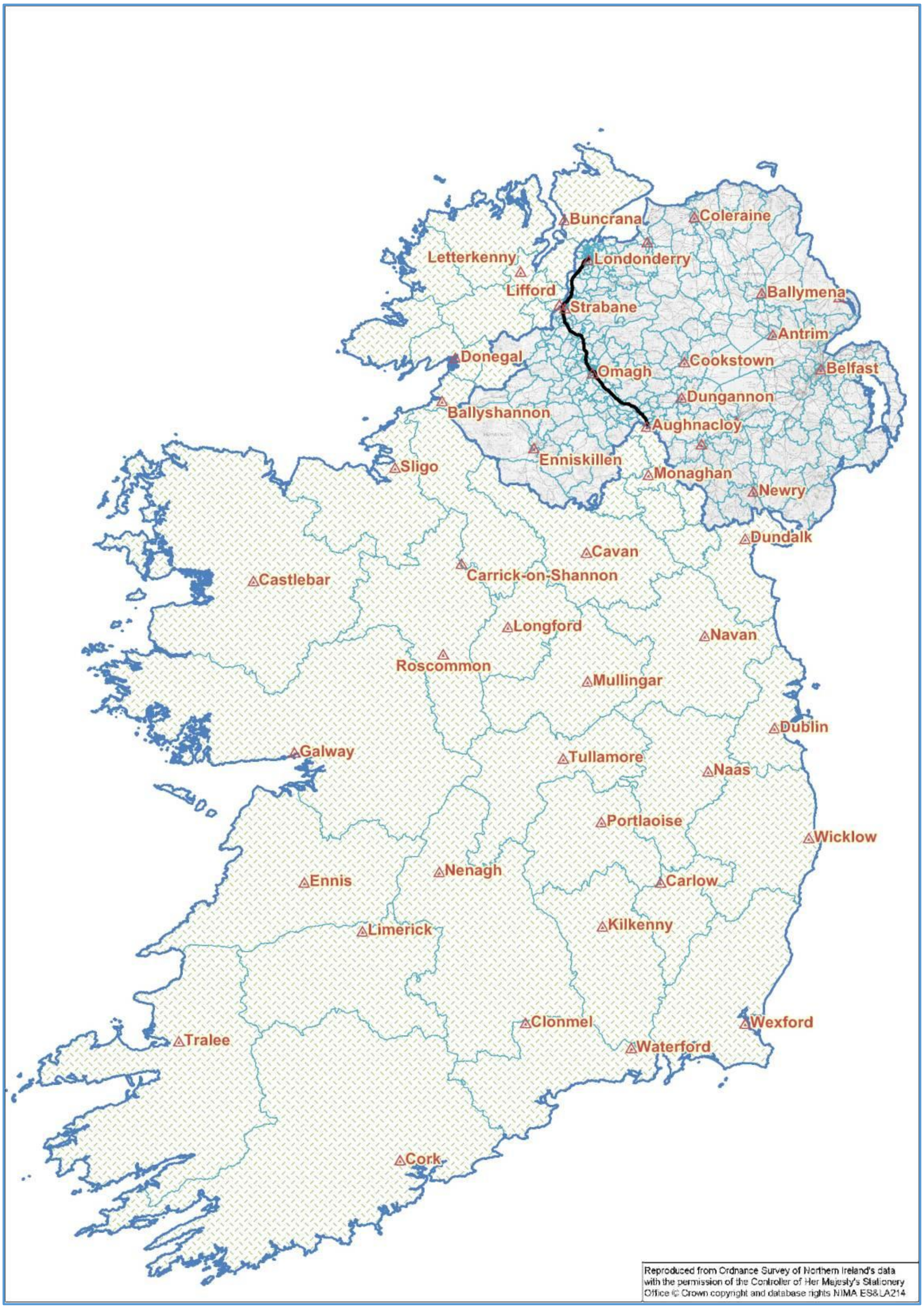

Figure 2-2 Plan showing the distribution of A5WTC zone system across Northern Ireland and the Republic of Ireland

Figure 2-3 Plan showing the distribution of A5WTC zone system across Northern Ireland

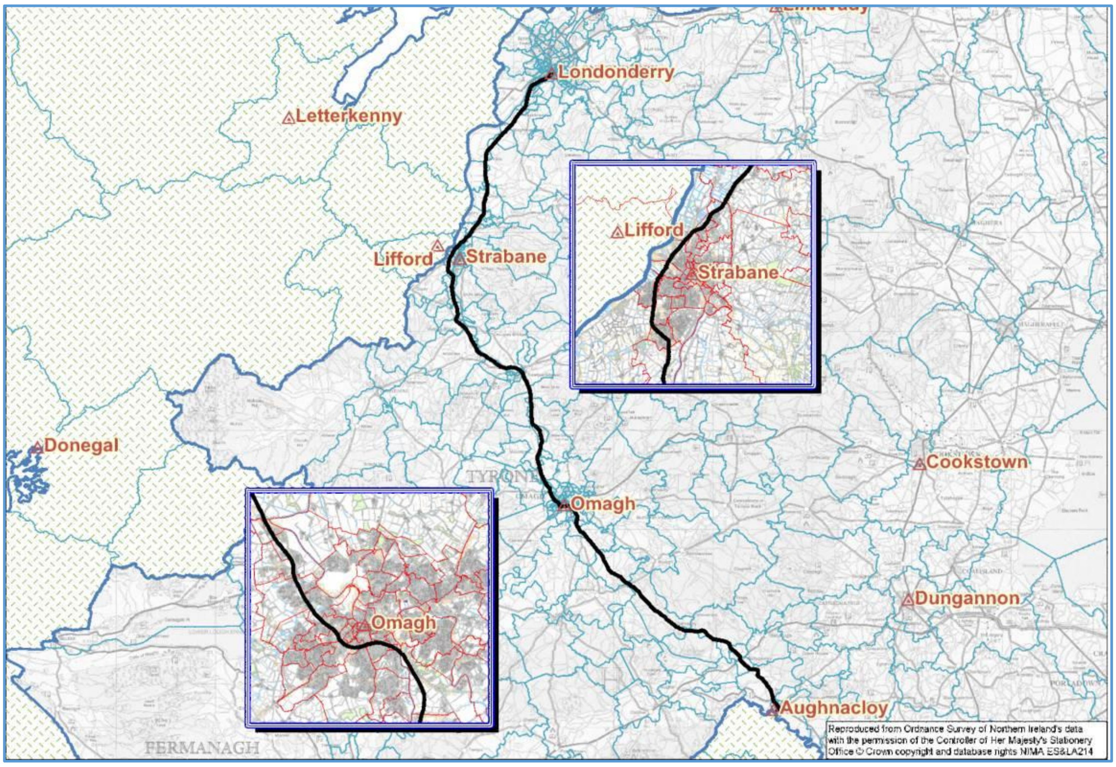

Figure 2-4 Plan showing the distribution of A5WTC zone system along A5

2.4 Model Time Periods

Model time periods were established with reference to traffic flow profiles relating to the 3 main sections of the A5.

i. Section 1 – Newbuildings to Strabane

ii. Section 2 – Strabane to Omagh

iii. Section 3 – Omagh to Ballygawley

Typical flow profiles are shown in Figure 2-5 (taken from 2013 traffic data) for each of the 3 main sections of the A5. The flow profiles indicate that the 2 peak periods cover approximately 2 hour periods in each case. The time periods selected for the model were defined as:

i. AM period from 7:30am to 9:30am;

ii. Inter-peak (IP) period from 09:30am to 4:00pm;

iii. PM period from 4:00pm to 6:00pm.

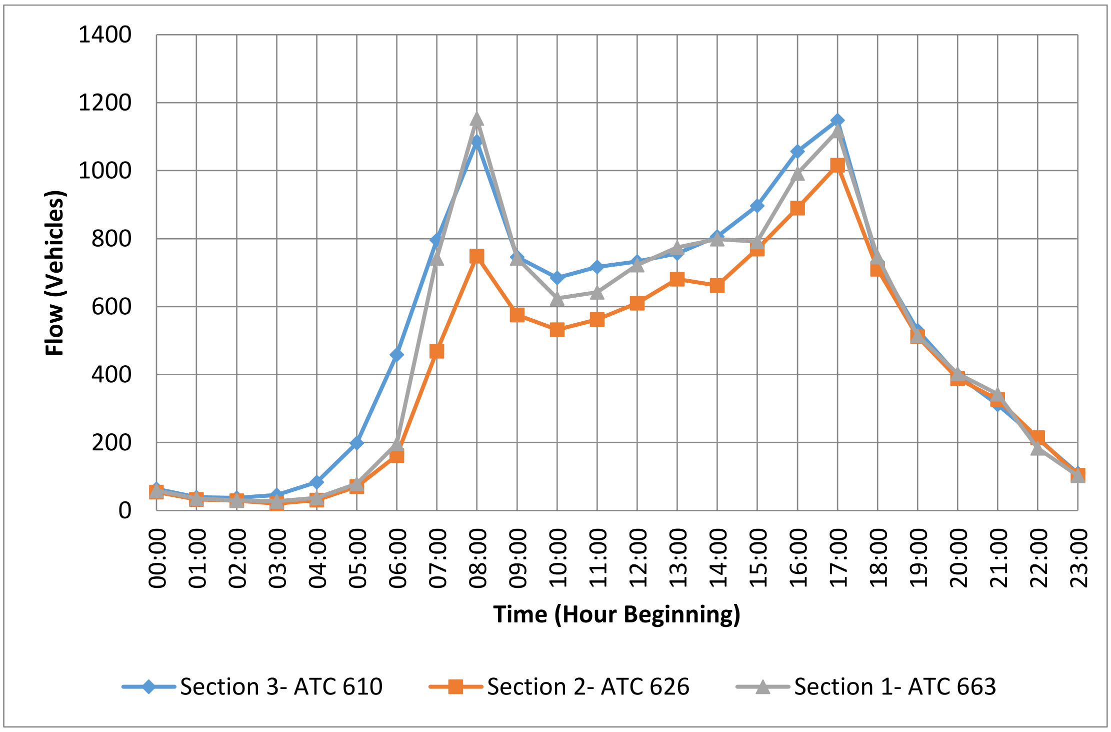

Figure 2-5 Daily flow profile on the existing A5 from Long Term ATC sites (Avg. Mon-Thurs in Oct 2013)

2.5 Vehicle Classes & Trip Purposes

Separate matrices were developed for the following combinations of vehicle type and trip purpose, referred to as user classes.

i. Car – Journey from home to work, and vice versa ("Commute")

ii. Car – Employers Business

iii. Car – Other trip purposes

iv. Light Goods Vehicle – All Purpose

v. Heavy Goods Vehicle (including Medium Goods Vehicles) – All Purpose

Further details of this process are reported in the A5 Western Transport Corridor Data Collection Report (No. 718736-2700-R-024).

2.6 Modelled Network

The traffic model network is divided into simulation and buffer areas. The simulation area incorporates detailed coding of junctions to facilitate the modelling of queues and delays and their effects on traffic routeing.

Outside the simulation area a buffer area comprises a coarser network of links so that routes used by long distance traffic to and from the study area can be accurately represented.

The model network is essentially unchanged from the previous model. Details of the network specification and coding are provided in Appendix A.

3 Traffic Surveys

3.1 Data for Original Model

The original A5WTC model was developed primarily from a programme of surveys collected in 2008, augmented by data from other sources.

The 2008 surveys comprised:

- A series of 12 Roadside Interviews
- 31 Automatic Number Plate Recognition (ANPR) sites
- 51 Automatic Traffic Counts
- 30 Manual Classified Counts

The RSI data was used to populate the base year trip matrices, by time period and vehicle type / trip purpose. The ANPR data was used to observe traffic routeing patterns. The traffic count data was used to expand the sampled interview data and provide control totals for traffic flows.

Further details of the data used for the original A5WTC Traffic model is presented in A5 WTC Data Collection Report, April 2011 (Ref 718736-2700-R-001).

3.2 Data for 2013 Model Update

The main objective of the 2013 model refresh was to update the modelling of trips on the A5. The primary source of data came from surveys carried out in spring 2014 that comprised:

- 7 Roadside Interview sites (RSIs) - 6 on the existing A5 between Londonderry and Aughnacloy and one on the A32 west of Omagh. The locations of the sites are shown in Figure 3-1.

- Automatic Number Plate Recognition (ANPR) surveys at the 7 RSI sites to derive the return times of trips in the non-interviewed directions.

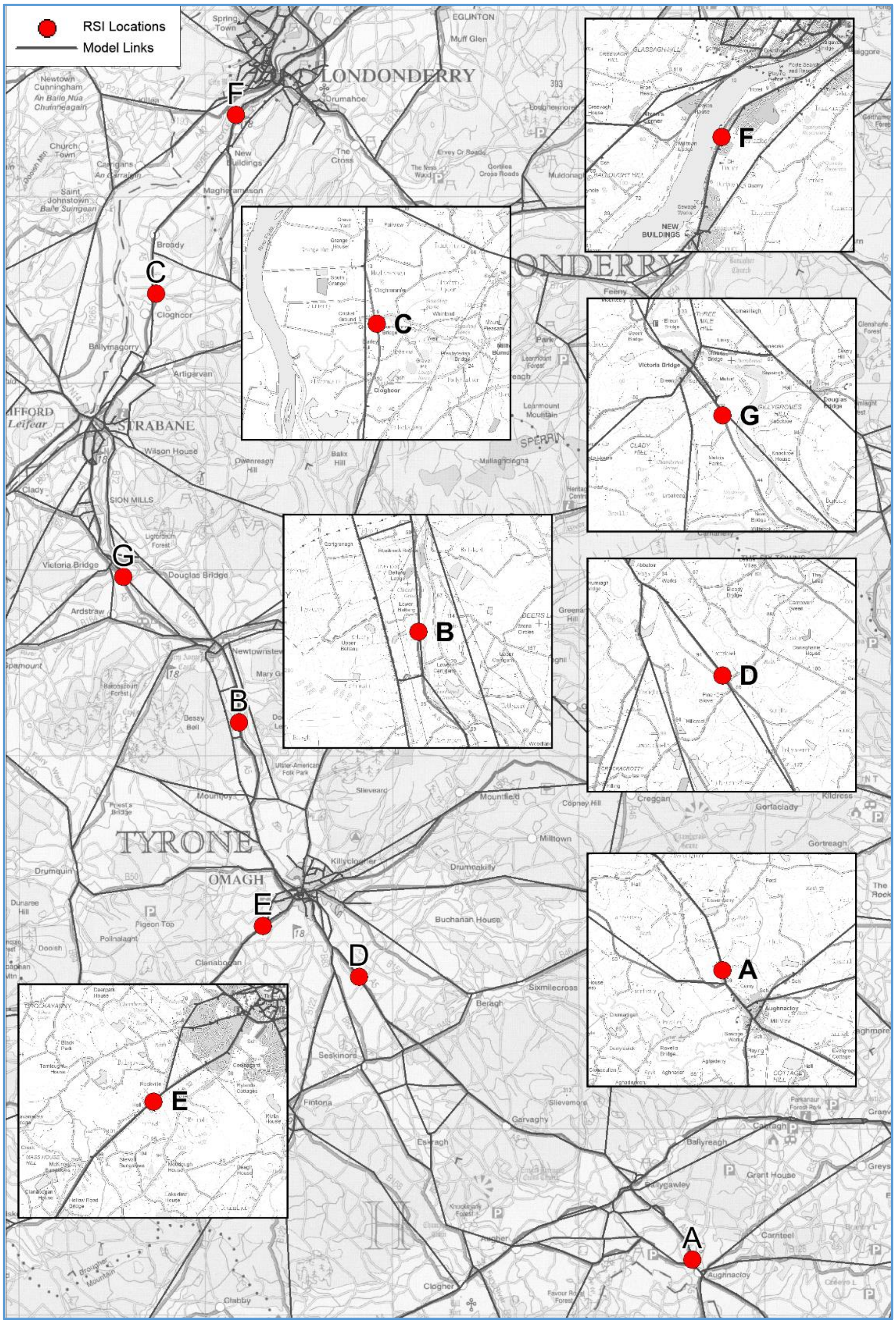

Figure 3-1 Location of RSIs carried out in April/June 2014

In addition, ANPR surveys were carried out in April 2014 at 24 sites forming 2-way cordons around the urban areas of Londonderry, Strabane, Omagh and Aughnacloy. These ANPRs provided information on trips passing through those urban areas.

Journey time surveys were also carried out on the A5 in April 2014 to provide data for journey time validation, and volumetric count data from a series of MCC's and ATC's undertaken in autumn 2013 were used for model validation.

Further details of the data used for the 2013 model update are presented in A5 WTC Traffic Data Collection Report 2013 – 2014, January 2015 (Ref 718736-2700-R-007).

3.3 Surveys for 2015 Model Rebase

The principal purpose of the 2015 model rebasing was to update the modelling of trips which had previously been derived from surveys carried out prior to 2013.

The 2013 model update had focussed on trips using the A5, i.e. travelling in the north/south directions. The 2016 surveys were primarily designed to capture data on trips on roads linking to the A5 but travelling in the east/west directions.

Data for the 2015 model rebase were obtained from the following surveys:

- October / November 2015 — ATCs at 22 sites across W-E screenlines as validation / calibration data
- April 2016 — 7 RSI with supporting MCC, ATC and two-way ANPR to detect return trips

  43 ATCs including N-S screenlines and on A5 as validation / calibration data

  Journey time surveys on A5 between New Buildings and Aughnacloy.

The RSI and supporting MCC survey programme were carried out between 12th and 20th April. Details of the 7 sites are set out in Table 3-1 and the locations are shown in Figure 3-2.

Site Ref	Road	Location	Dir
RSI H	B72 Fyfin Rd	Junction with Brocklis Rd	EB
RSI I	B50 Gillygooley Rd	Adjacent to Terex Finlay	EB
RSI J	B83 Seskinore Rd	Between A5 & B122 junctions	NB
RSI K	A4 Annaghilla Rd (w)	Junction with Tullybryan Rd	EB
RSI L	B48 Gortin Rd	Adjacent to Coronation Cottages	SB
RSI M	A505 Killyclogher Rd	Opposite Glendale Service Station	WB
RSI N	A4 Annaghilla Rd *(Dual Carriageway)*	Located at WB layby	WB
RSI O	B34 Dungannon Rd	at Knockconny Baptist Church	WB

Table 3-1: Details of RSI Surveys undertaken during 2016

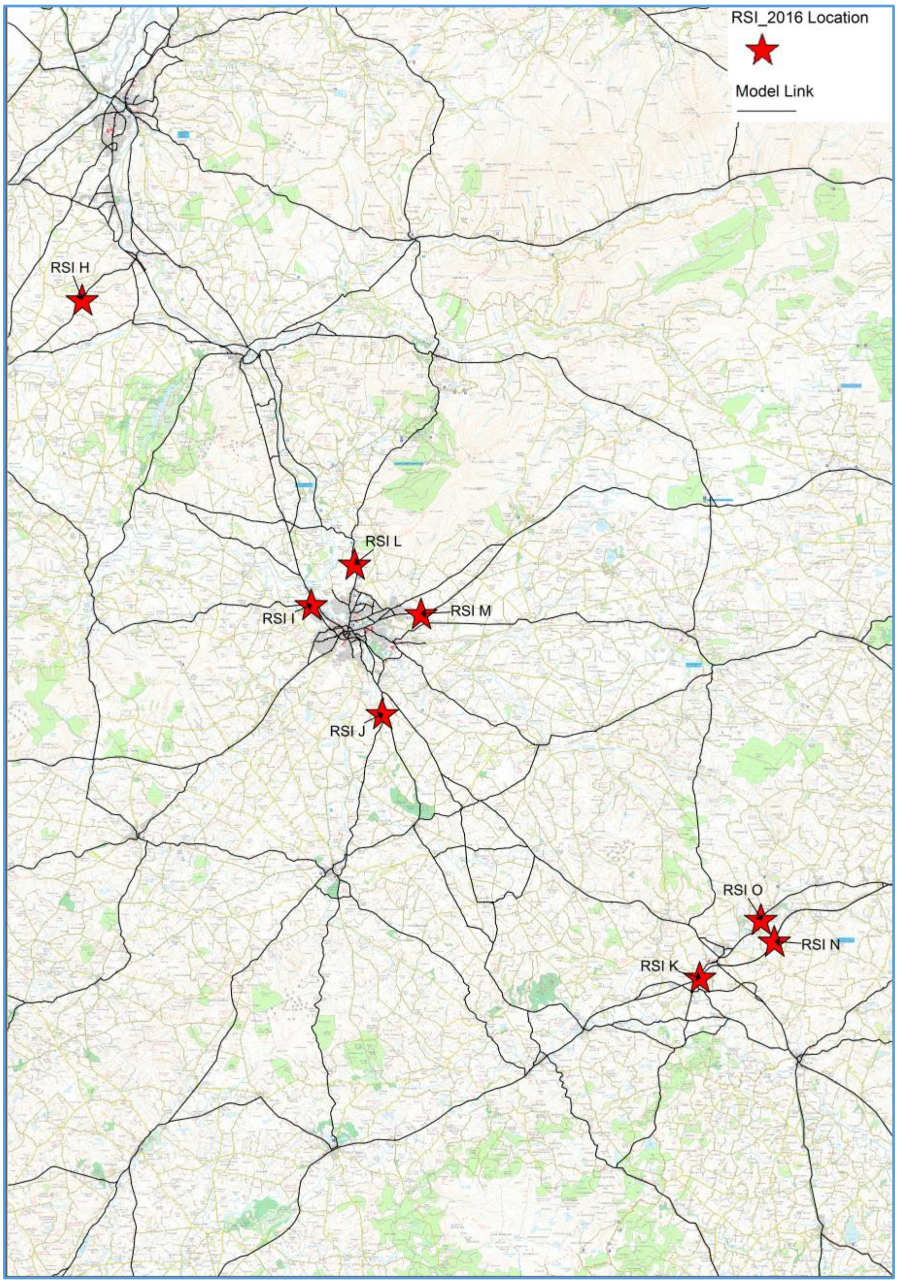

Figure 3-2: Location of RSI Surveys undertaken during 2016

ANPR data was obtained at each survey site, and in each direction, on the RSI day to record vehicles passing from 06:00 to 20:00. The data obtained was subsequently analysed to identify return trips opposite to the interview direction.

ATC's were carried out at the RSI sites and at an additional 43 sites for a continuous period of three weeks, commencing Monday 11th April 2016.

Figure 3-3 shows the locations of the 22 ATC sites undertaken during October/November 2015.

Figure 3-4 shows the locations of the 43 ATC sites undertaken during April 2016.

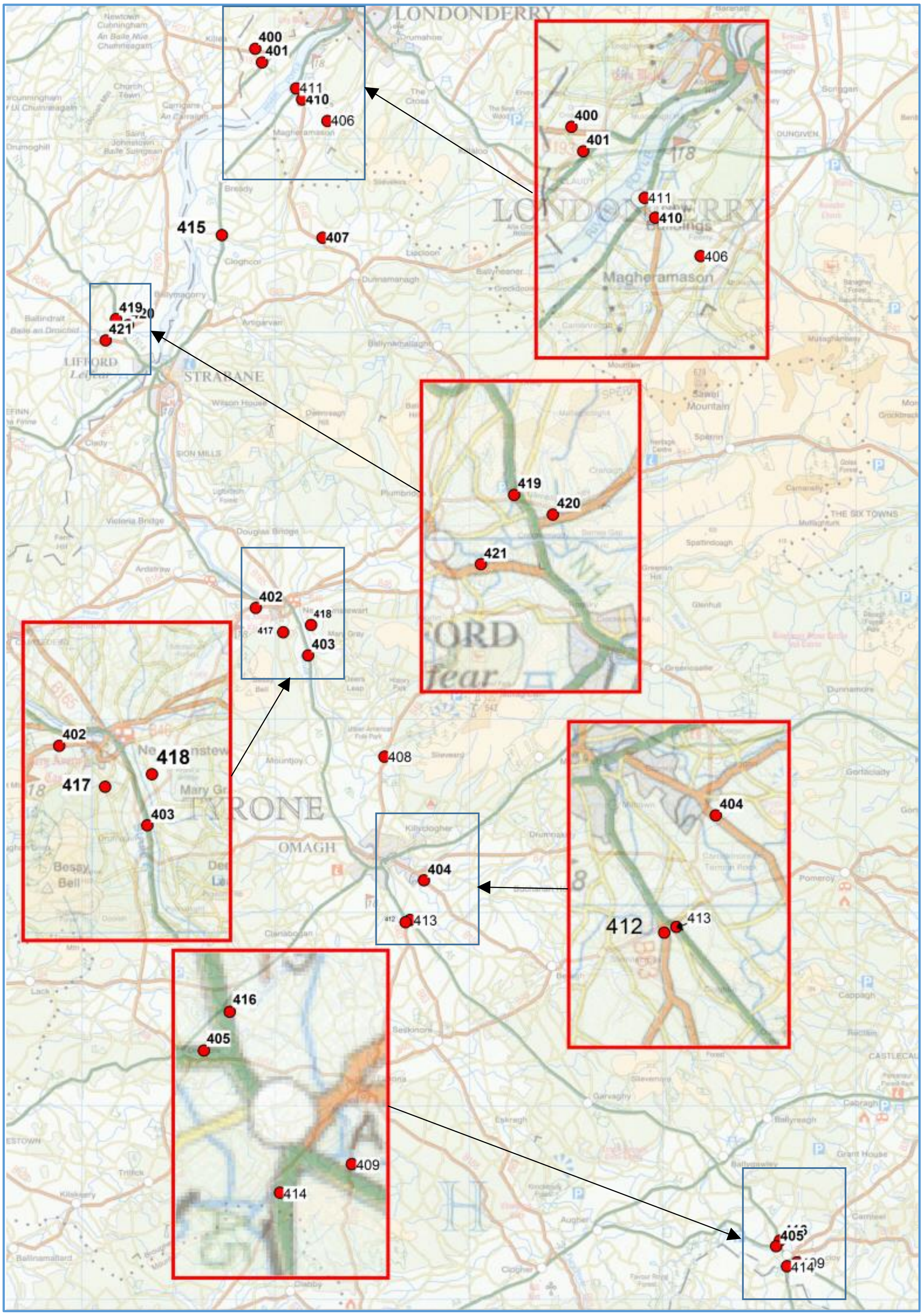

Figure 3-3: Locations of ATC Sites Surveyed during Autumn 2015 (22 Sites)

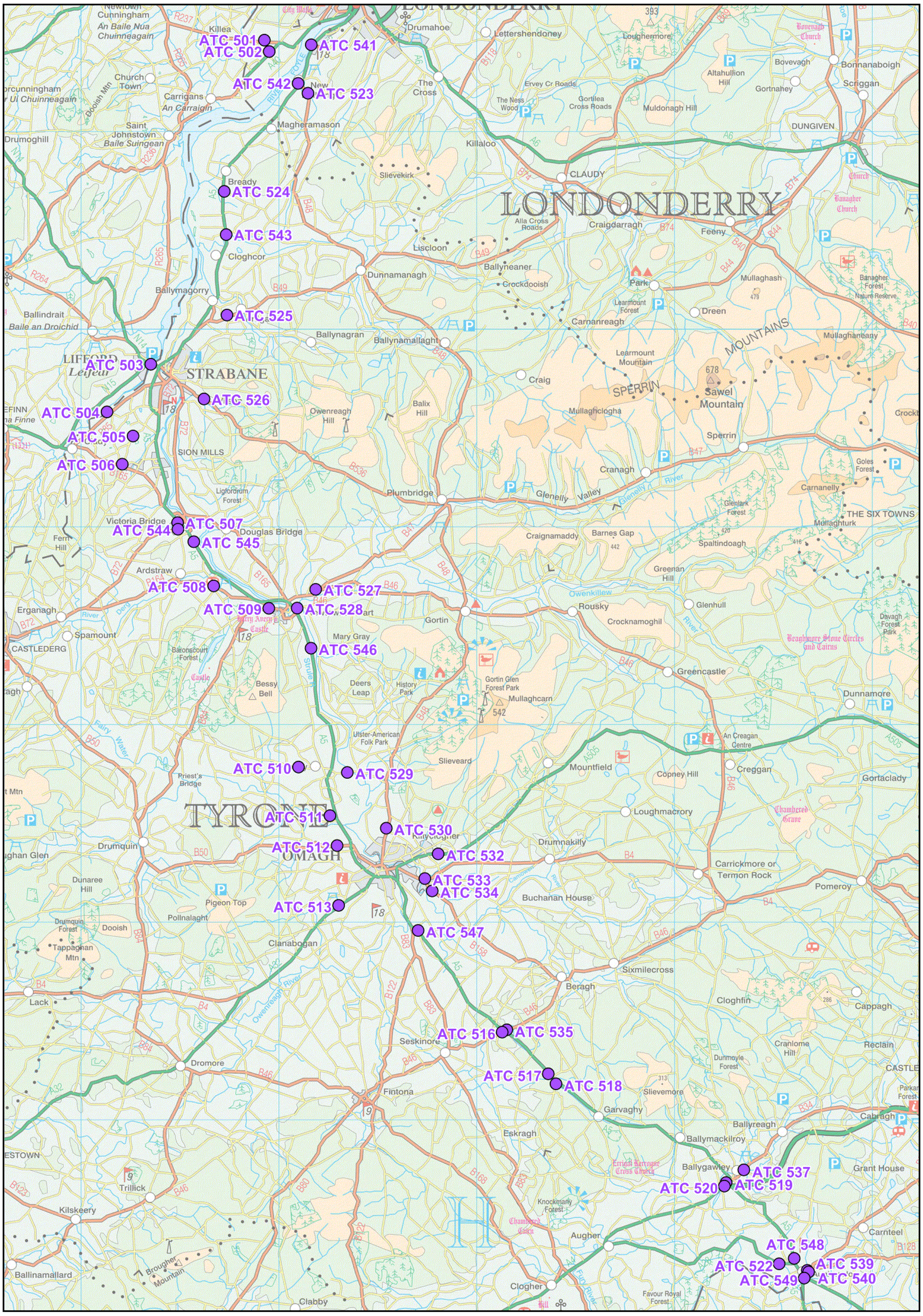

Figure 3-4: Locations of ATC Sites Surveyed during April 2016 (43 Sites)

The surveys are described in more detail in the Data Collection Report April 2017 (Ref 718736-2700-R-024).

This survey programme provided a combination of Origin/Destination and traffic flow data for both model calibration and validation processes, as summarised below:

i. RSI data - the observed trips from the RSI surveys, primarily East-West movements connecting with the A5, were used to replace corresponding movements obtained from earlier (pre 2013) RSI surveys

ii. ANPR data – the ANPR data collected at the RSI sites were used to provide times for return trips in the unobserved direction.

iii. Volumetric count data – were used either as part of the calibration process to further refine the matrices through the application of matrix estimation, or for link flow validation.

iv. Journey time data – used for model validation.

3.4 Data checks

The survey data was checked to ensure that it met appropriate quality thresholds.

The checks carried out on the RSI data comprised:

- Range checks – to ensure that the responses in the various data fields were within expected ranges.

- Logic Checks – to determine that the responses for various combinations of data fields were logical. For example a car could have a maximum of 6 passengers and an HGV could only have a maximum of 2 passengers.

- Trip End Checks – The origin and destination addresses given by interviewed drivers needed to have a postcode specified, either supplied by the driver or allocated during data processing. The postcodes were subsequently converted to Ordinance Survey Grid References (OSGRs) which in turn enabled model zones to be identified. The survey contractor was responsible for allocating the postcodes and a number of checks were undertaken to ensure that the origins and destinations observed at the RSI locations were feasible.

- A check that all records had postcodes allocated for both ends of each trip.

- A sample check of interview records to confirm that the allocated postcodes were correct.
- Plotting of individual trip records (using OSGRs and Geographic Information System (GIS)) to ensure that each trip would logically pass through the survey location, in the right direction.

From the ANPR data collected at the RSI sites, matched records were used to determine a return time distribution. Match rates were checked to ensure that capture of return trips was consistent.

Traffic volumetric count data, both MCC’s and ATC’s, were checked for completeness and consistency.

3.5 RSI Data Processing

The interview records from the RSI surveys were expanded to provide total trips and adjusted to represent an October 2015 base.

Expansion factors were derived for each interview based on the total count of traffic (for each vehicle type) through the site compared with the number interviewed.

Limited patching of data was required for LGVs and OGV1/OGV2 in instances where there were too few or no survey records of a vehicle type in a certain time interval relative to the MCC.

A summary of the sample rates for each RSI station for light and heavy vehicles by time period is included in the Traffic Data Collection Report 2015 – 2016 (Ref 718736-2700-R-024).

3.6 Processing of ANPR data

The ANPR data collected at the RSI survey stations were used to derive the return trip in the unobserved direction. At each site ANPR software was used to match vehicles passing in the interview direction with their return journey in the non-interview direction. This provided a typical return time distribution in order to synthesis trips in the non-interview direction

4 Matrix Rebasing

4.1 Introduction

This chapter describes the methods adopted to rebase the 2013 highway trip matrices to a 2015 base year.

A description of the updating of the original base year model matrices to a 2013 Base Year is contained in Chapter 5 of the report 'Local Model Validation Report: A5 WTC Updated Traffic Model' Ref: 718736-2700-R-010, dated January 2015.

4.2 Matrix Rebasing

The starting point for the model rebase was the 2013 prior set of base matrices. This is in accordance with WebTAG guidance which seeks to minimise the overall effect of matrix estimation by not using post-calibration matrices.

The matrix rebasing involved 3 main stages;

i. Factoring all trips in the 2013 prior matrices from October 2013 to October 2015 based on factors derived through comparison of E-W screenline data.

ii. Replacement of relevant trips within the 2013 prior matrices with trips observed at the RSI sites undertaken in 2016.

iii. Refining the matrices through the application of matrix estimation

Since the RSI surveys were undertaken during 2016, the volumetric totals were adjusted to an October 2015 base before incorporation into the new base year matrices.

These stages are described below:

Stage 1 – Factor Trips from 2013 to 2015

- The 2013 prior matrix was factored to 2015, using factors derived from ATC data collected on the A5 and other key roads within the A5 corridor in October 2015.

Stage 2 – Inclusion of observed data for trips observed at 2016 RSI sites

- Build Observed Trip Matrices from 2016 RSI data

  A set of individual trip matrices was developed for each of the 7 RSI survey stations. This process is described in Section 3.4 above and described in detail in the A5WTC Data Collection Report (Ref 718736-2700-R-024 dated April 2017).

Trip matrices for the non-interview direction were derived through transposing the observed trips. Analysis of ANPR surveys undertaken at each of the RSI sites in each direction provided a return time probability distribution for this purpose.

- Check Routeings for each RSI.

  Each individual station matrix was assigned onto the model network to check that trips would be correctly assigned to the link representing the location of the respective RSI.

  It was noted that a small proportion of trips were assigned onto adjacent links. However all routeings were deemed logical and no trips were removed from the observed station matrices.

- Incorporate new RSI data into the 2013 prior matrices.

  Select link analyses were undertaken to identify which trips to remove from the prior matrix. Each new RSI data set was then sequentially substituted into the 2013 prior matrix. This was done starting with the highest trip matrix total. After each substitution, assignments were undertaken to check that the process was logical.

  Sample rates were reasonably constant across all RSI sites and therefore no differential weights were applied between sites.

Stage 3 – Matrix refinement

- Refine ‘Prior’ matrices

  A matrix estimation procedure was applied to refine the prior matrices as part of the model calibration process.

  The matrix estimation procedure utilised traffic count data on selected links within the A5 corridor, as described in detail in Section 5.2 below.

  The output matrices were then subject to model validation, in accordance with WebTAG criteria, as described in detail in Chapter 6 below.

5 Model Calibration

5.1 Calibration Process

Model calibration is the iterative process of reviewing and adjusting the model's network and/or trip matrices so that modelled traffic flows, speeds, junction delays and routeings through the network provide a reliable match to observed data.

The calibration procedure for the rebased model involved the following processes:

- Verification of link speeds
- Checks to ensure no spurious blocking back at junctions
- Verification that vehicle routeings were realistic
- Refinement of network parameters (e.g. capacities) to match modelled data (e.g. traffic flows and journey times) to observed data.
- Use of matrix estimation to adjust the prior trip matrices to match observed traffic flows from link and turning counts.

The matrix estimation procedure is described in detail below.

5.2 Matrix Estimation

Matrix estimation is a process that adjusts the travel pattern for compatibility with the observed traffic counts to produce a matrix which 'best fits' the observed counts.

The matrix estimation procedure was undertaken within SATURN, in order to improve the prior matrix using observed traffic counts.

The matrix estimation procedure within SATURN uses an objective function, which it seeks to minimise in order to find an optimal solution that improves the goodness of fit between the modelled flows and counts.

The matrix of trips input to matrix estimation is known as the 'prior' matrix and the matrix of trips output from matrix estimation is termed the 'post' matrix. The post matrix will therefore contain a better representation of the individual trip movements on counted links, compared to the prior matrix.

For the purposes of matrix estimation, and subsequent validation, traffic counts were grouped together to form screenlines.

6 east-west screenlines EW (1) to EW (6) and 2 north-south screenlines NS (W) and NS (E) were defined, as illustrated in Figure 5-1 and Figure 5-2 below.

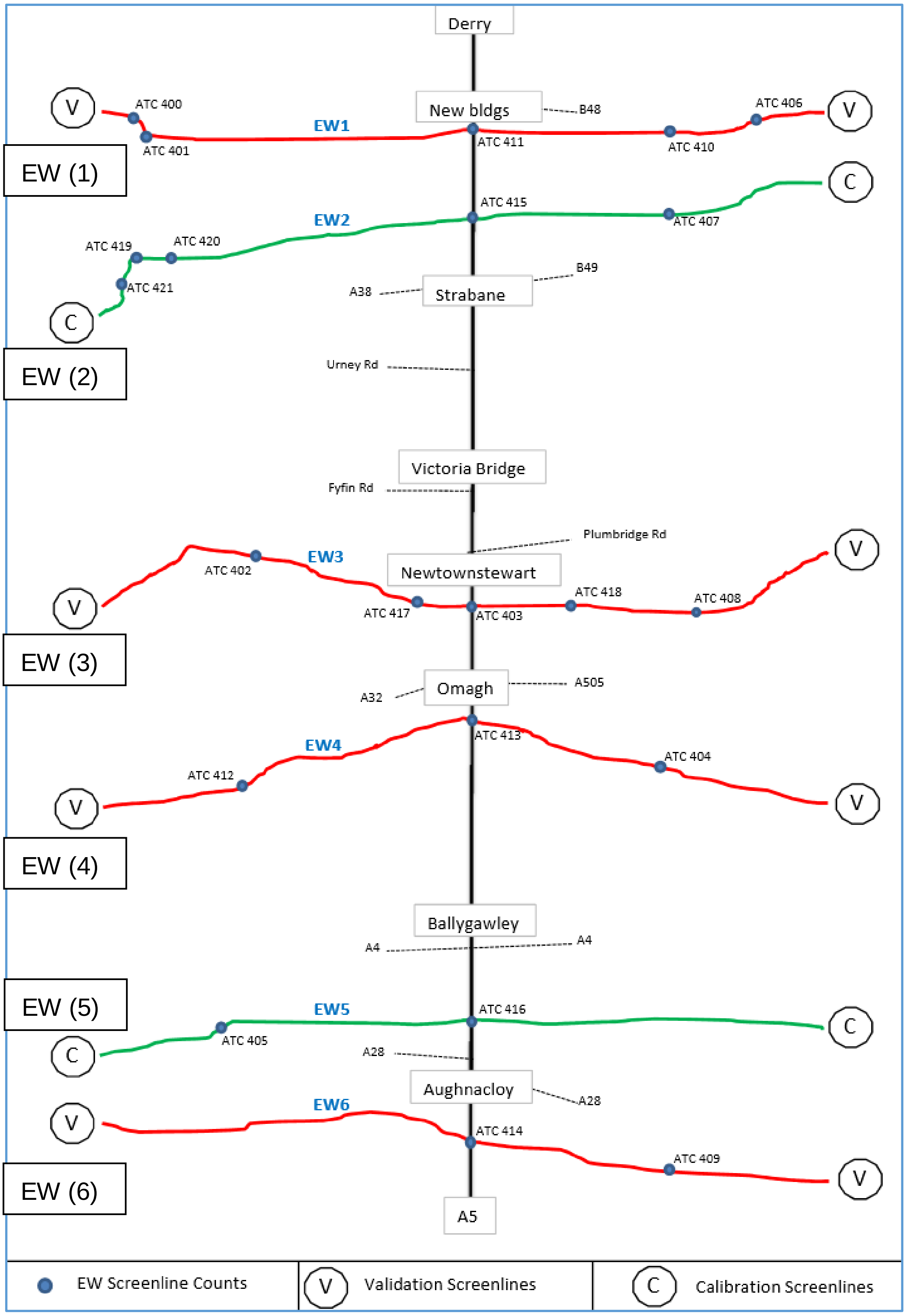

Figure 5-1: East-West Screenlines

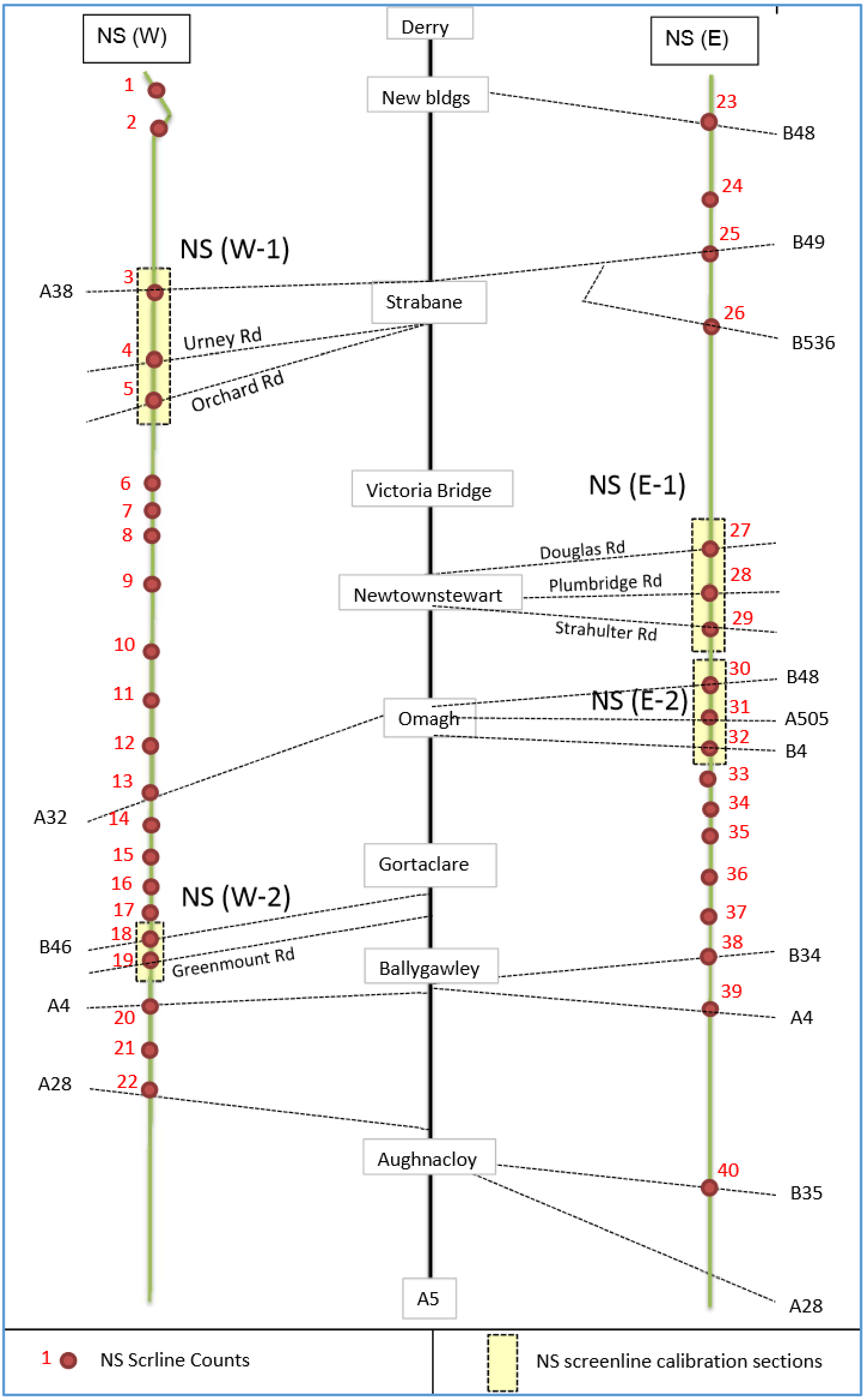

Figure 5-2: North-South Screenlines

The matrix was calibrated to individual traffic count data on the following selected screenlines:

- EW (2) (n/b and s/b)
- EW (5) (n/b and s/b)
- NS (W-1) (e/b and w/b) west of Strabane
- NS (E-1) (e/b and w/b) east of Newtownstewart
- NS (E-2) (e/b and w/b) east of Omagh
- NS (W-2) (e/b and w/b) south of Gortaclare (west of A5)

The traffic count data on the remaining screenlines i.e. east-west 1, 3, 4 and 6 and sections of the north-south screenlines 1 and 2 were used for model validation as described in Chapter 6.

The selection of the screenlines for model calibration was based upon comparisons between observed and modelled flows following initial assignments of the prior matrix. The screenlines showing the highest variance were selected for calibration, with the remainder being utilised for subsequent model validation.

5.3 Assigned Prior and Post Calibrated Trips across Screenlines

Table 5-1, Table 5-2 and Table 5-3 show the total assigned screenline flows for both the prior and post calibrated matrices for the AM, Inter-peak and PM peak respectively. This shows that the matrix estimation procedure has improved the comparison of modelled flows against observed flow for the majority of screenlines selected for calibration. The one exception is NS (W-2) for which flows are relatively low. Further information on screenline validation is provided in Chapter 6.

			Prior to ME				Post ME	Post ME			
Screenlines	Dir	Observed	Modelled	Mod-Obs	% Diff	GEH	Obs	Modelled	Mod-Obs	% Diff	GEH
EW-2	N/b	1179	1204	25	2%	0.7	1179	1179	0	0%	0.0
EW-2	S/b	848	864	17	2%	0.6	848	847	0	0%	0.0
EW-5	S/b	318	328	11	3%	0.6	318	315	-3	-1%	0.2
EW-5	S/b	346	400	55	16%	2.8	346	361	16	4%	0.8
NS (W-1)	E/b	561	624	62	11%	2.6	561	559	-2	0%	0.1
NS (W-1)	W/b	716	578	-138	-19%	5.4	716	715	-1	0%	0.0
NS (E-1)	E/b	94	112	18	19%	1.8	94	94	0	0%	0.0
NS (E-1)	W/b	157	167	10	6%	0.8	157	161	3	2%	0.3
NS (E-2)	E/b	461	367	-93	-20%	4.6	461	460	-1	0%	0.0
NS (E-2)	W/b	944	758	-186	-20%	6.4	944	934	-11	-1%	0.3
NS (W-2)	E/b	166	271	105	63%	7.1	166	273	107	65%	7.3
NS (W-2)	W/b	98	157	59	60%	5.2	98	194	96	98%	8.0

Table 5-1: Comparison of Prior and Post Calibration Screenline Total Flows - AM

			Prior to ME				Post ME	Post ME			
Screenlines	Dir	Observed	Modelled	Mod-Obs	% Diff	GEH	Obs	Modelled	Mod-Obs	% Diff	GEH
EW-2	N/b	777	784	7	1%	0.3	777	773	-4	-1%	0.2
EW-2	S/b	783	804	21	3%	0.7	783	784	0	0%	0.0
EW-5	S/b	283	299	15	5%	0.9	283	301	18	6%	1.0
EW-5	S/b	302	273	-29	-10%	1.7	302	306	4	1%	0.2
NS (W-1)	E/b	657	562	-95	-14%	3.9	657	652	-5	-1%	0.2
NS (W-1)	W/b	675	597	-78	-12%	3.1	675	675	0	0%	0.0
NS (E-1)	E/b	92	85	-6	-7%	0.7	92	94	2	2%	0.2
NS (E-1)	W/b	92	96	4	4%	0.4	92	92	0	0%	0.0
NS (E-2)	E/b	493	352	-141	-29%	6.8	493	492	-1	0%	0.1
NS (E-2)	W/b	484	401	-84	-17%	4.0	484	484	0	0%	0.0
NS (W-2)	E/b	88	157	69	78%	6.2	88	150	62	70%	5.7
NS (W-2)	W/b	85	144	59	69%	5.5	85	145	60	70%	5.6

Table 5-2: Comparison of Prior and Post Calibration Screenline Total Flows - IP

			Prior to ME				Post ME	Post ME			
Screenlines	Dir	Observed	Modelled	Mod-Obs	% Diff	GEH	Obs	Modelled	Mod-Obs	% Diff	GEH
EW-2	N/b	959	994	35	4%	1.1	959	951	-8	-1%	0.3
EW-2	S/b	1238	1296	58	5%	1.6	1238	1235	-3	0%	0.1
EW-5	S/b	409	455	46	11%	2.2	409	407	-2	0%	0.1
EW-5	S/b	401	421	20	5%	1.0	401	406	6	1%	0.3
NS (W-1)	E/b	881	779	-103	-12%	3.6	881	877	-4	0%	0.1
NS (W-1)	W/b	788	740	-47	-6%	1.7	788	787	-1	0%	0.0
NS (E-1)	E/b	167	154	-13	-8%	1.0	167	166	-1	-1%	0.1
NS (E-1)	W/b	118	137	20	17%	1.7	118	118	0	0%	0.0
NS (E-2)	E/b	944	752	-193	-20%	6.6	944	942	-2	0%	0.1
NS (E-2)	W/b	558	532	-26	-5%	1.1	558	552	-6	-1%	0.3
NS (W-2)	E/b	114	190	77	67%	6.2	114	201	87	77%	6.9
NS (W-2)	W/b	188	250	62	33%	4.2	188	290	102	54%	6.6

Table 5-3: Comparison of Prior and Post Calibration Screenline Total Flows - PM

5.4 Tests of Validity of Matrix Estimation

WebTAG guidance on the application of matrix estimation, as set out in Section 8.3 of TAG Unit M3.1, advises that two tests of validity should be undertaken.

i. An analysis of the changes to the prior matrix resulting from the matrix estimation process

ii. An analysis of the prior and post matrix estimated (ME) trip totals across the screenlines and cordons along which roadside interviews were undertaken and the screenlines and cordons used in applying count constraints in the matrix estimation process.

These tests are described in this Chapter and full validation results are presented in Chapter 6.

The changes between the prior and post ME trip matrices were assessed using the criteria set out in Section 8.3.13 of TAG Unit M3.1. These comprise:

- Matrix zonal cell values, prior to and post matrix estimation, with regression statistics (slopes, intercepts and R^2 values);
- Zonal trip ends, prior to and post matrix estimation, with regression statistics (slopes, intercepts and R^2 values);

- Trip length distributions, prior to and post matrix estimation, with means and standard deviations; and
- Sector to sector level matrices, prior to and post matrix estimation, with absolute and percentage changes.

The criteria by which the significance of the changes brought about by matrix estimation may be judged are given in Table 5-4.

Measure	Significance Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

Table 5-4 WebTAG criteria for pre and post matrix estimation

5.4.1 Changes in zonal and trip end values between Pre and Post Calibration

Appendix B shows the relevant changes brought about by matrix estimation. These are presented as a set of scatter plots for each respective model time period showing the changes in i) matrix zonal cell values ii) matrix trip end totals for origins and, iii) matrix trip end totals for destinations. The results of the analysis of these changes against the WebTAG stability criteria are presented in Table 5-5.

	Zonal Cell Values		Zonal Origins		Zonal Destinations	
	Target	Achieved	*Target*	Achieved	Target	Achieved
AM Peak						
Intercept	*Near zero*	0.01	*Near zero*	1.82	*Near zero*	1.62
Slope	*0.98 to 1.02*	0.99	*0.99 to 1.01*	1.01	*0.99 to 1.01*	1.01
R squared	*> 0.95*	0.96	*> 0.98*	0.99	*> 0.98*	0.99
Inter-Peak						
Intercept	*Near zero*	0.01	*Near zero*	1.85	*Near zero*	1.84
Slope	*0.98 to 1.02*	0.96	*0.99 to 1.01*	1.00	*0.99 to 1.01*	1.00
R squared	*> 0.95*	0.96	*> 0.98*	0.99	*> 0.98*	0.99
PM Peak						
Intercept	*Near zero*	0.01	*Near zero*	1.45	*Near zero*	2.40
Slope	*0.98 to 1.02*	1.00	*0.99 to 1.01*	1.01	*0.99 to 1.01*	1.00
R squared	*> 0.95*	0.97	*> 0.98*	0.99	*> 0.98*	0.99

Table 5-5 WebTAG Tests for changes in Matrix Cell and Tripend Totals

Table 5-5 shows that:

- the WebTAG criteria for the zonal cell values have either been met or are very close to being achieved for all 3 time periods.
- the WebTAG criteria for zonal origins and destinations have either been met or are very close to being achieved for all 3 time periods. It is noted that the intercepts are marginally greater than zero. However these are still very small in relation to trip-end totals, as can be seen from Figure B 1 to Figure B 9 in Appendix B.

5.4.2 Changes in Trip Length between Pre and Post Calibration

Trip length distribution comparisons between the prior and post matrices were undertaken and are shown in figures in Appendix C. These show small trip length changes for trip lengths up to about 40km across all time periods between the prior and post calibrated matrices.

Table 5-6 below shows the changes in the average trip lengths and standard deviations within the three modelled time period matrices.

Time Period	Average Trip Length Km			Standard Deviation of Trip length		
	Prior	Post	Difference	Prior	Post	Difference
AM	27.641	27.646	0.02%	38.538	37.576	-2.50%
IP	26.106	25.748	-1.37%	39.233	38.258	-2.49%
PM	26.609	25.783	-3.10%	40.407	38.719	-4.18%

Table 5-6: Average Trip Length and Standard Deviation for Prior and Post Calibrated Matrices

This table shows that all the trip length changes are relatively small and less than the relevant WebTAG guidance criterion of 5%.

5.4.3 Changes in Sector to Sector Trips between Pre and Post Calibration

Across the whole matrix the prior and post calibrated matrix totals for the AM, Inter-Peak and PM Peak are shown in Table 5-7.

All vehicle totals (PCUs)	Prior	Post	% change
AM peak	29769	30933	+3.9%
Inter-Peak	29011	29906	+3.1%
PM Peak	37232	38437	+3.2%

Table 5-7 Pre and post ME matrix totals

This shows total increases in trips of less than 5%.

A more detailed analysis of the changes in trip patterns was carried out through a sector to sector analysis. This was based upon comparing the prior and post ME trip totals between a total of 12 sectors which are illustrated in Figure 5-3. Table 5-8 identifies each sector with respect to key conurbations / areas.

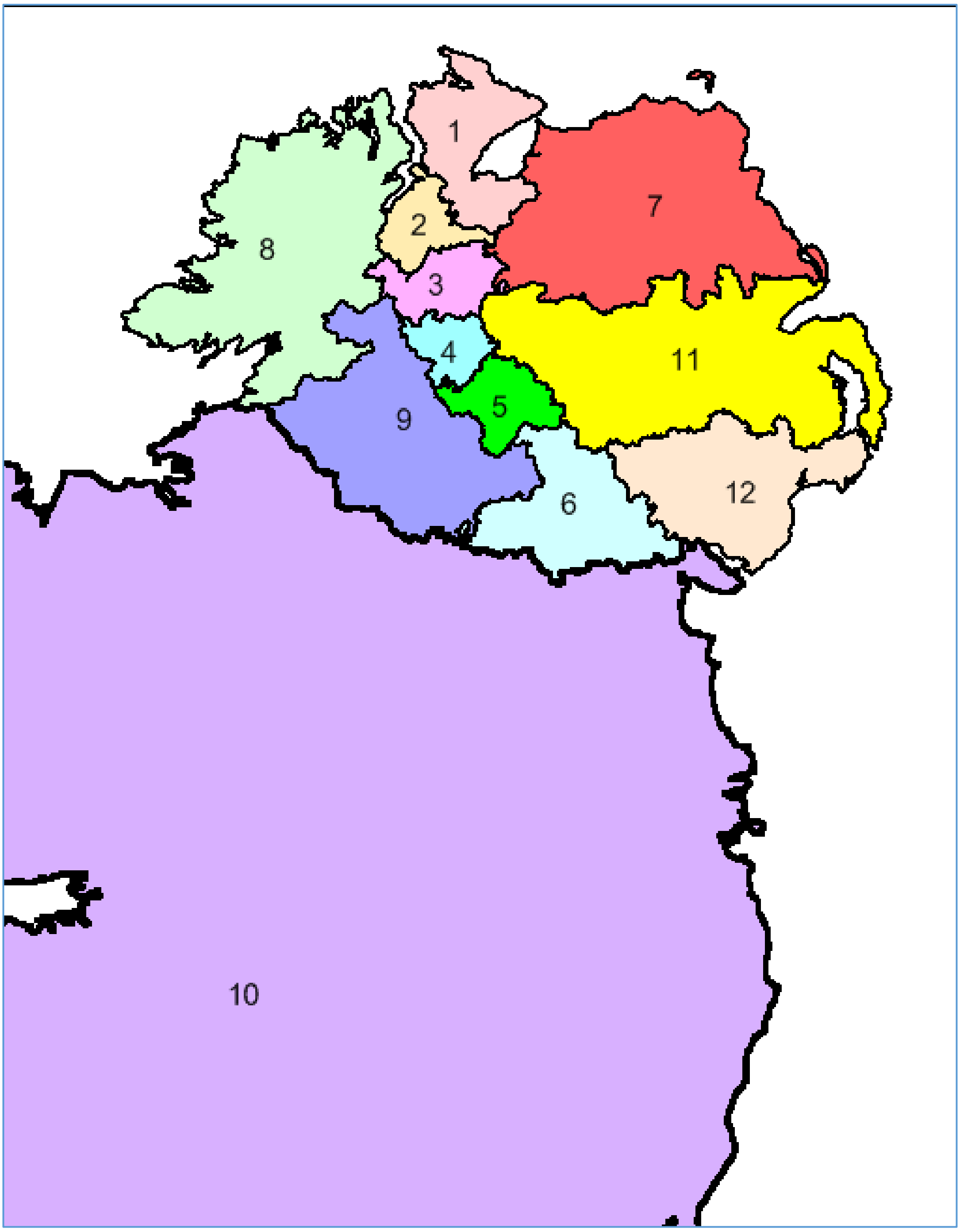

Figure 5-3: Sector System

Sector Number	Location	Sector Name
1	Core area	Londonderry
2	Core area	Letterkenny / Magheramason
3	Core area	Strabane / Plumb Bridge
4	Core area	Gillygooley / Mountfield
5	Core area	Seskinore / Beragh / Aughnacloy / Carnteel
6	Core area	Clontibret
7	External	Maghera
8	External	Fintown
9	External	Enniskillen
10	External	Ireland
11	External	West NI Inc. Belfast
12	External	Newcastle

Table 5-8: Sector Locations

The results of the sector to sector comparison are summarised in Appendix D. For each time period, the prior and post calibrated matrices are shown together with the resultant changes and percentage changes in trips. Key sector to sector pairs within the core model area and particularly adjacent sectors are shaded. These sector pairs are of primary concern with regard to the effects of the matrix estimation process.

The WebTAG criterion for assessing the significance of sector to sector trip changes is that differences should be within 5%. In many cases, sector to sector trip totals are relatively low, which commonly gives rise to large percentage differences. For this reason the approach adopted was to review the absolute changes together with the percentage changes in order to assess significance.

Focussing on the sectors within the core model area, key points are noted as follows:

- For the AM period, changes are relatively small. The largest change in trips being 256 (from 5102 to 5358), i.e. an increase of 5%, within Sector 4.

  Other changes within the core area for the AM, although in excess of 5%, relate to low numbers of trips, i.e. less than 90.

- For the IP period the changes are also small. The largest trip change being an increase within Sector 4 of 218 trips from 6134 to 6351, i.e. of 4%.

  Other changes within the core area for the IP, although in excess of 5%, again relate to low numbers of trips, i.e. less than 70.

- For the PM period the changes are slightly higher than for the AM and IP periods.

  - The largest change in trips is an increase of 6% within Sector 4 of 366 from 5842 to 6208.

  - An increase of 6% within Sector 3 by 185 from 2961 to 3146.

- An increase of 29% in trips within Sector 5 by 111 from 384 to 495

  Other changes within the core area for the PM, although in excess of 5%, are low numbers of trips, i.e. less than 80.

In summary, the largest changes in trips within the Core Area are intra-sector within Sector 4, although only marginally exceeding 5% in the PM. The highest percentage change in trips is in the PM for trips within Sector 5 although this is also a relatively low number at 111 trips. In particular, there is no evidence of any geographically consistent large, i.e. greater than 5%, changes across time periods between the prior and post calibration matrices.

Trip changes between core area and external area sectors show generally only small absolute changes. The one exception to this is between the external Sector 11 (Western NI) and core Sector 4. In the AM there is an increase of 180 trips from 629 to 809 representing 29% inbound to the core area. In the PM this is reversed with an increase of 180 trips from 610 to 790 representing 30% outbound from the core area. A more detailed investigation was undertaken and established that matrix estimation had resulted in an increase of west-east trip movements to/from the eastern side of Omagh. In the AM an increase westbound into Omagh and in the PM an increase eastbound from Omagh. However, it was established that these trips would not reassign to an improved A5 and would not impact on the overall appraisal of the scheme.

Changes in numbers of trips within and between external sectors were not considered to be of concern.

5.4.4 Summary of Matrix Changes through Calibration

Section 5.4.1 considered the changes to the matrix zonal and trip end values against statistical criteria given in WebTAG for the slope, intercept and R^2. This demonstrated a high level of compliance with only the slope for zonal cell values for the interpeak being marginally outside the WebTAG criteria.

Section 5.4.2 considered trip length changes between prior and post calibrated matrices. This demonstrated full compliance with the WebTAG criteria for average trip length and standard deviation.

Section 5.4.3 considered sector to sector trip changes using a 12 sector system. Although the comparisons between the prior and post calibration matrices were not fully WebTAG compliant, more detailed analysis, including identification of the relatively small numbers of trips involved, showed that the matrix estimation process had produced acceptable outcomes.

6 Model Validation

6.1 Introduction

The test of a model's 'fitness for purpose' is carried out by examining the extent to which the model reproduces observed conditions. Validation of the rebased model was based upon a comparison of observed against modelled traffic flow and journey time data.

The wealth of traffic count data covering the study area provided a stringent test of the model's performance.

The validation of traffic flows was a 2-stage process. The first stage involved a comparison of observed and modelled flows across a number of screenlines. These were designed to capture traffic movements considered to be of particular importance to the A5 and the proposed scheme and therefore represent a robust test of the trip matrices.

As noted in Section 6.2 below, not all screenline data was used in the validation since some of the counts had been used in the Matrix Estimation process and were not independent of the model calibration.

The second stage involved validation on individual links within the model network. This included a comparison between observed and modelled flows on the existing A5 and other main routes within the A5 corridor.

6.2 Screenline Validation

For validation of the trip matrix WebTAG advises that comparisons of modelled flows and counts should be undertaken at screenline level. Screenlines are typically comprised of 5 or more links capturing traffic along a particular axis or between sectors.

The validation criterion and acceptability guideline for screenline flows are defined in Section 3.2.5 of TAG Unit M3.1 which is reproduced in Table 6-1 below.

Criteria	Acceptability Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines

Table 6-1 WebTAG Screenline Flow Validation Criteria

For this process, two sets of screenlines were developed:

i) East-West Screenlines – these encompassed a number of roads on an east to west axis and were intended to capture traffic travelling between north and south

ii) North-South Screenlines – encompassing roads on a north-south axis capturing traffic travelling between east and west.

The screenlines are shown within Chapter 5 as Figure 5-1 for the East West Screenlines and Figure 5-2 for the North South Screenlines.

Traffic flow data across the following east-west screenlines are independent of the Matrix Estimation process and were therefore included in the validation;

- East West Screenline 1 (northbound and southbound)
- East West Screenline 3 (northbound and southbound)
- East West Screenline 4 (northbound and southbound)
- East West Screenline 6 (northbound and southbound)

The results of the East West Screenline comparisons are presented in Table 6-2, Table 6-3 and Table 6-4 for the AM, Inter-Peak and PM peak respectively.

Screenline	Direction	Observed	Modelled	Mod - Obs	% Diff	GEH
EW-1	Northbound	1473	1445	-28	-2%	0.7
EW-1	Southbound	711	708	-3	0%	0.1
EW-3	Northbound	543	526	-17	-3%	0.7
EW-3	Southbound	860	872	12	1%	0.4
EW-4	Northbound	1037	1062	25	2%	0.8
EW-4	Southbound	627	619	-9	-1%	0.3
EW-6	Northbound	370	354	-16	-4%	0.9
EW-6	Southbound	380	380	0	0%	0.0

Table 6-2: East West Screenline Flow Validation AM Peak

Screenline	Direction	Observed	Modelled	Mod - Obs	% Diff	GEH
EW-1	Northbound	777	804	27	4%	1.0
EW-1	Southbound	784	756	-28	-4%	1.0
EW-3	Northbound	466	475	9	2%	0.4
EW-3	Southbound	486	484	-2	0%	0.1
EW-4	Northbound	579	589	11	2%	0.4
EW-4	Southbound	629	598	-31	-5%	1.3
EW-6	Northbound	319	341	22	7%	1.2
EW-6	Southbound	338	332	-6	-2%	0.3

Table 6-3: East West Screenline Validation Inter-Peak

Screenline	Direction	Observed	Modelled	Mod - Obs	% Diff	GEH
EW-1	Northbound	841	809	-31	-4%	1.1
EW-1	Southbound	1438	1468	30	2%	0.8
EW-3	Northbound	866	894	28	3%	0.9
EW-3	Southbound	596	612	16	3%	0.6
EW-4	Northbound	787	751	-36	-5%	1.3
EW-4	Southbound	1049	1045	-4	0%	0.1
EW-6	Northbound	452	447	-6	-1%	0.3
EW-6	Southbound	463	461	-2	0%	0.1

Table 6-4: East West Screenline Validation PM Peak

Table 6-2 to Table 6-4 show that total flows across the east-west screenlines are relatively low, in relation to typical WebTAG considerations. This means that the WebTAG guidelines, of a less than 5% difference between modelled and observed totals, is a very stringent test. This is because small absolute differences can result in relatively high percentage differences.

The GEH statistic is designed to provide a weighting in accordance to scale of traffic flow and is calculated as follows;

$$GEH = \sqrt{(VO - VA)^2 / (0.5 * (VO + VA))}$$

Where VO = observed traffic flow and VA = assigned traffic flow.

The GEH statistics were calculated for each screenline total and are also shown in Table 6-2 to Table 6-4.

While the GEH statistic is no longer used as a test for screenline totals within WebTAG, it is considered a valid test for the A5 WTC model in view of the low screenline flows. It should be noted that earlier guidance contained within the Design Manual for Roads and Bridges (DMRB) Volume 12, Table 4.1 Traffic Appraisal in Urban Areas (since withdrawn) indicates a GEH of 4 or less would be an acceptable criterion for validation of screenline flows.

The results of the screenline comparisons for each of the modelled time periods are summarised below.

i. AM Peak:

- The WebTAG validation criterion was achieved on all 8 independent east-west screenline directions, with all modelled totals within 5% of the observed totals

- The related GEH values were all no greater than 0.9.

ii. Inter Peak:

- The WebTAG validation criterion was achieved on 6 out of the 8 independent east-west screenline directions, with only E-W 4 southbound (-5%) and E-W 6 northbound (+7%) modelled totals greater than, or equal to, +/-5% of the observed totals.

- The GEH values on all 8 independent east-west screenlines were less than 1.3.

iii. PM Peak:

- The WebTAG validation criterion was achieved on 7 out of the 8 independent east-west screenline directions, with the 8th being equal to the 5% criterion.

- The related GEH values were all no greater than 1.1.

Sections of the North South Screenlines were used in the calibration process as noted at Section 5.2 above. However comparisons of modelled flows with observed flows for screenlines NS-1 and NS-2 are presented as totals rather than splitting into discrete sections.

The results for the North South Screenline are presented in Table 6-5, Table 6-6, and Table 6-7 for the AM, Inter-Peak and PM peak respectively.

Screenline	Direction	Observed	Modelled	Mod - Obs	% Diff	GEH
NS-W	Eastbound	3460	3501	41	1%	0.7
NS-W	Westbound	2037	2163	126	6%	2.7
NS-E	Westbound	2494	2633	139	6%	2.7
NS-E	Eastbound	1856	2041	185	10%	4.2

Table 6-5: North South Screenline Flow Validation AM Peak

Screenline	Direction	Observed	Modelled	Mod - Obs	% Diff	GEH
NS-W	Eastbound	2197	2273	77	3%	1.6
NS-W	Westbound	2287	2305	18	1%	0.4
NS-E	Westbound	1627	1629	2	0%	0.1
NS-E	Eastbound	1652	1733	80	5%	2.0

Table 6-6: North South Screenline Flow Validation Inter- Peak

Screenline	Direction	Observed	Modelled	Mod - Obs	% Diff	GEH
NS-W	Eastbound	2485	2684	199	8%	3.9
NS-W	Westbound	3749	3911	161	4%	2.6
NS-E	Westbound	2332	2381	49	2%	1.0
NS-E	Eastbound	2548	2766	218	9%	4.2

Table 6-7: North South Screenline Flow Validation PM Peak

The above tabulations for the N-S screenlines, while not strictly in accordance with validation criteria, in relation to both independency and values, indicate that the modelling of East West movements is fit for purpose, bearing in mind that the primary objective of the A5WTC scheme is to serve north-south movements currently using the A5.

6.3 Link Flow Validation

The validation criteria and acceptability guidelines for link flows and turning movements are defined in Section 3.2.8 of TAG Unit M3.1 and are reproduced in Table 6-8 below:

Criteria (Hourly Modelled Flows)	Acceptability Guideline
Individual flows within 100vph (flows<700vph)	85% of all cases
Individual flows within 15% (flows 700-2700vph)	85% of all cases
Individual flows within 400vph (flows>2700vph)	85% of all cases
GEH statistic: individual flows GEH<5	85% of all cases

Table 6-8 TAG Unit M3.1 Link and Turning Flow Validation Criteria

The traffic database available for model validation included ATC link counts from surveys undertaken during autumn 2015 and spring 2016.

The majority of these traffic counts were recorded in 2015 (the date of the base year model) and were separate and independent of traffic data used for matrix estimation.

The assigned base year traffic flows from the 2015 Rebased model were compared with observed traffic counts to assess the accuracy of the model and the extent to which WebTAG criteria were achieved.

The link flow validation was undertaken based upon comparing observed and modelled flows:

i. at sites on the A5
ii. at sites on E-W screenlines not included in the calibration
iii. at sites on N-S screenlines not included in the calibration

It is noted that datasets i) and ii) include links that will be directly affected by the proposed scheme and are therefore considered of particular importance with regard to the link flow validation. Figure 6-1 shows the broad geographical spread of all the counts used for the link flow validation.

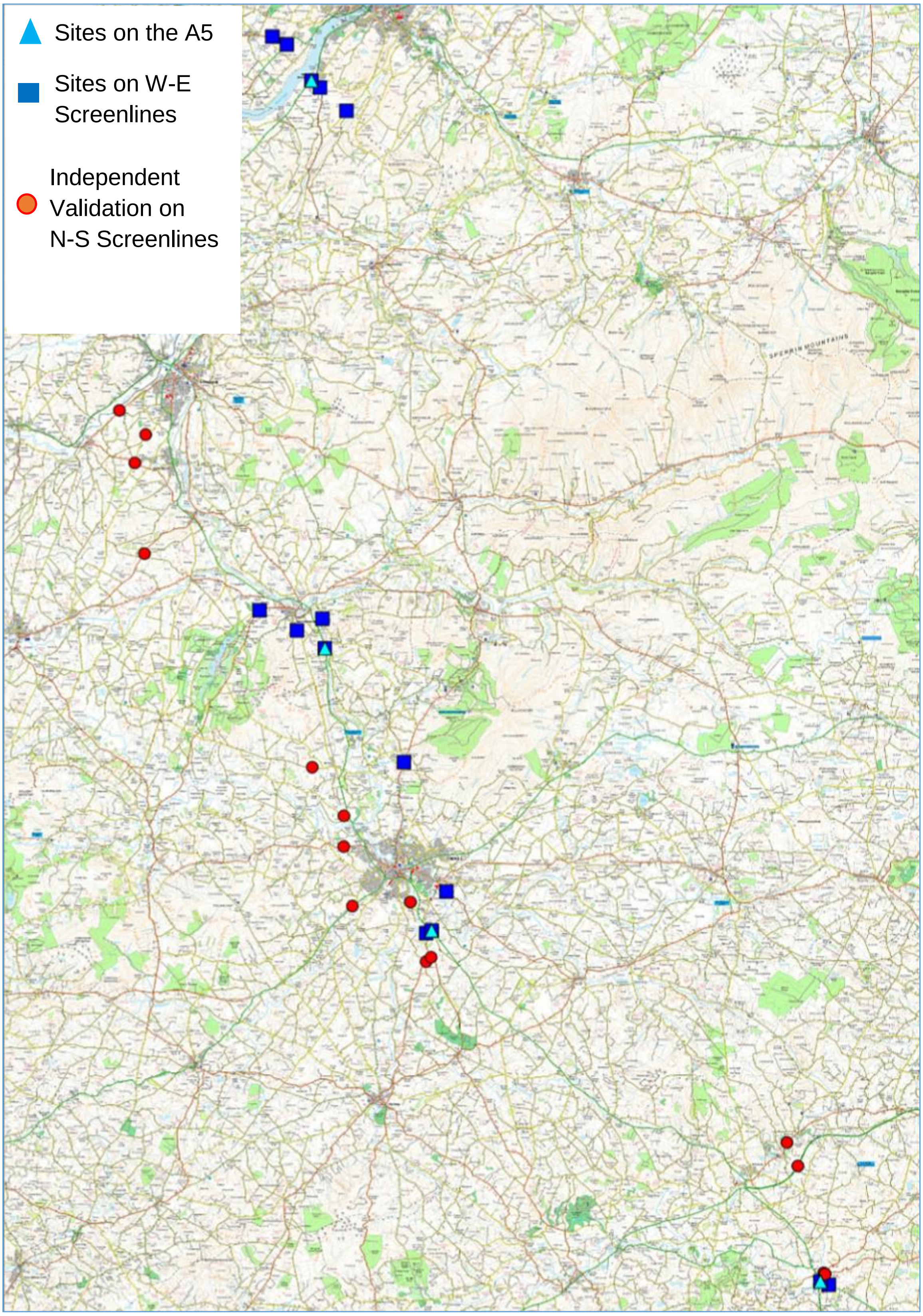

Figure 6-1: Locations of Counts used for Link Flow Validation

6.3.1 A5 Link Flows

The link flow validation for sites on the A5 is presented in Table 6-9. This comprised 4 sites (8 counts).

Measure	Time Period		
	AM Peak	Inter-peak	PM Peak
Link Flow Criteria (Cars)	100%	100%	100%
Link Flow Criteria (All Vehicles)	100%	100%	100%
GEH < 5 (Cars)	100%	100%	100%
GEH < 5 (All Vehicles)	100%	100%	100%

Table 6-9: Link Flow Validation – A5

The results presented in Table 6-9 shows that over all time periods, 100% of the links on the A5 links achieved both the link flow and GEH criteria. This is well in excess of the 85% target set out in WebTAG.

A breakdown of the validation for each individual site on the A5 is presented in Appendix E.

6.3.2 Sites on E-W Screenlines used for Validation

The results of the link flow validation for the individual sites on the East-West screenlines not included in the validation, a total of 11 locations (22 counts), are presented in Table 6-10.

Measure	Time Period		
	AM Peak	Inter-peak	PM Peak
Link Flow Criteria (Cars)	100%	100%	100%
Link Flow Criteria (All Vehicles)	100%	100%	100%
GEH < 5 (Cars)	90%	100%	93%
GEH < 5 (All Vehicles)	93%	100%	97%

Table 6-10: Link flow Validation – East West Screenlines

Table 6-10 shows that the link flow criteria was achieved across 100% of all links in all time periods.

The GEH criterion of less than 5 was achieved across 90% or more of links in the AM and PM periods - significantly above the 85% target set out in WebTAG guidance. For the IP 100% of links achieved the WebTAG target.

A detailed breakdown for all sites on each of the east-west screenlines is presented in Appendix F.

6.3.3 Sites on N-S Screenline used for Validation

Independent data was available for a total of 30 locations (60 counts) within the study area. A summary of the validation of these sites that were not included in the calibration process is summarised in Table 6-11.

Measure	Time Period		
	AM Peak	Inter-peak	PM Peak
Link Flow Criteria (Cars)	98%	100%	100%
Link Flow Criteria (All Vehicles)	98%	100%	100%
GEH < 5 (Cars)	93%	97%	88%
GEH < 5 (All Vehicles)	93%	97%	88%

Table 6-11 Link Flow Validation Summary – Other links

Table 6-11 demonstrates that, in all time periods, over 85% of all links achieved the criteria for link flow validation and the criteria for the GEH statistic - thereby meeting the WebTAG guidelines.

A detailed breakdown for all sites on each of the north-south screenlines is presented in Appendix G.

6.3.4 Link Flow Validation Summary

The results of the link flow validation presented in this section demonstrate that the model achieves the WebTAG guidelines for both the GEH and link flow validation criteria on all links for which independent data is available.

More important, the validation of link flows on the links on the A5 and east-west screenlines, shows that the percentage of links achieving the link flow and GEH criteria is very high. This demonstrates that the model validates exceptionally well on the links within the network that are most likely to be relevant to the scheme.

6.4 Journey Time Validation

Validation of journey time is carried out to determine how well model journey times match observed times.

The observed data was collected from journey time surveys undertaken during April 2016 using the moving observer method. A number of survey vehicles were utilised to undertake a series of journeys along the A5 in both directions during all model time periods.

The surveys were conducted in accordance with the advice given in DMRB to ensure adequate sampling. GPS (Global Positioning System) loggers were used to provide a facility to interrogate the data.

The A5 within the model area was split into 14 sections and surveyed in both directions, providing 28 separate but consecutive journey time routes. The journey time routes are shown in Figure 6-2. They are similar to those routes surveyed in 2008 and 2013 apart from sections around Strabane which have been split.

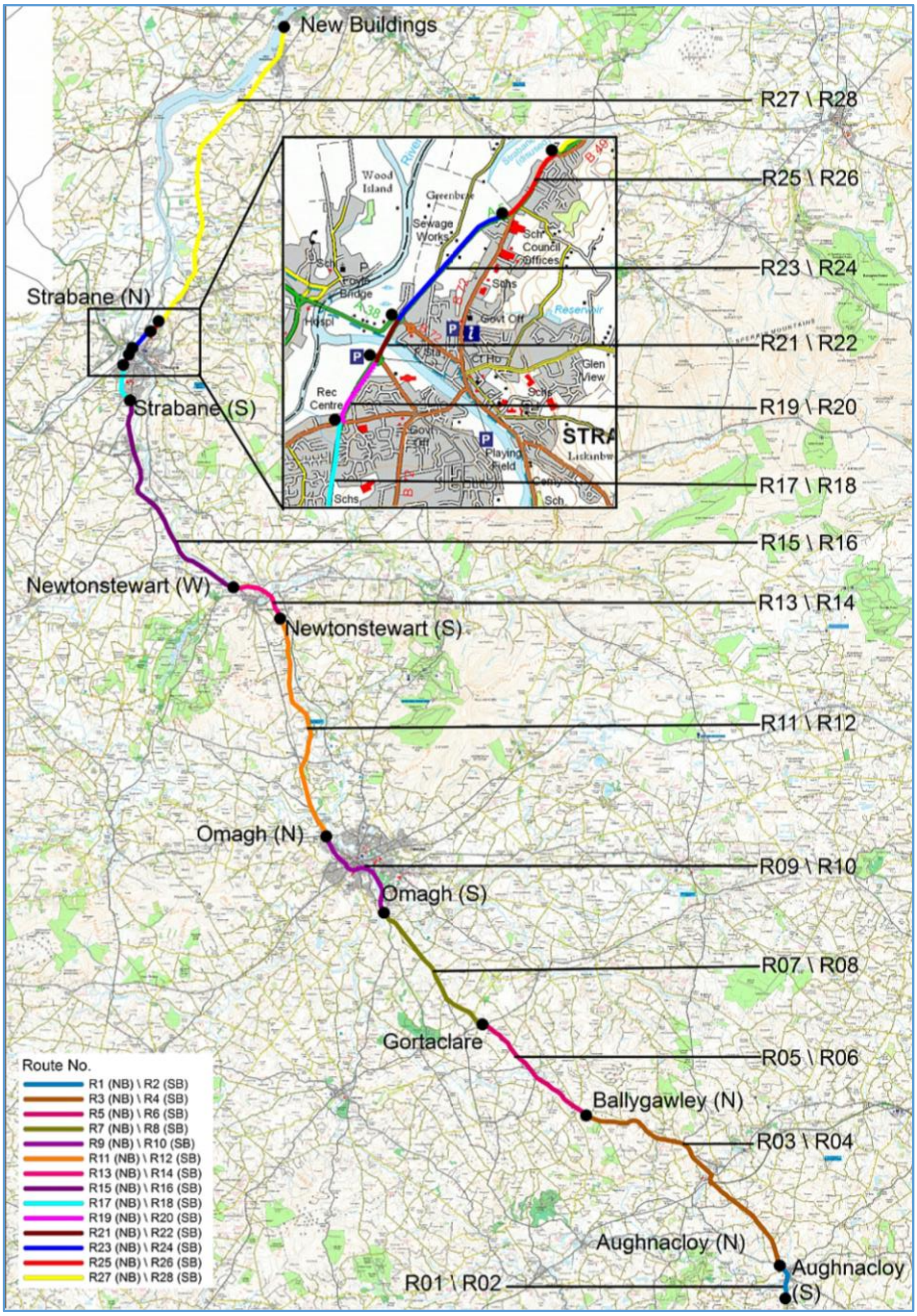

Figure 6-2: Journey Time Routes

The validation was assessed using the WebTAG validation guidelines as set out in section 3.2.10 of TAG Unit M3.1. The guidelines are set out in Table 6-12 below.

Criteria	Acceptability Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	> 85% of routes

Table 6-12 WebTAG Journey Time Validation Guidelines

The results of the validation of the modelled journey times for the morning peak hour, inter-peak and evening peak hours are presented in Table 6-13 below.

Time Period	Routes within 15% or 1 min	
	Number	Percentage
AM	28	96%
IP	28	100%
PM	28	96%

Table 6-13: Journey Time Validation Summary

Table 6-13 shows the number and percentage of routes (out of 28) that achieve the WebTAG criteria of modelled times within 1 minute or 15% of observed journey times.

This demonstrates that in the AM and PM peak 96% of the modelled routes are within the criteria and this increases to 100% for the inter-peak. The journey time validation therefore is well above the 85% guidelines set out in WebTAG.

A detailed analysis and breakdown of the journey time validation on each section of route is presented in Appendix H.

7 Summary and Conclusions

This report has described the rebasing and validation of the traffic model for appraisal of the A5WTC scheme from a 2013 base year to a 2015 present year. The purpose of the validation was to assess the accuracy of the traffic model against independent data and to demonstrate its suitability as a forecasting and appraisal tool.

The model rebasing encompassed the collection of new trip data, focusing on the A5 corridor, to update the trip movements derived from earlier surveys, including those undertaken before 2013. A number of measurement and recording checks were carried out on the inputs and parameters relating to the highway network model and visual checks on the routeing of trips across the model network.

The validation process involved comparisons between observed and modelled flows over a number of screenlines and on major road links, together with a comparison between modelled and observed journey times. The comparisons were assessed using the DfT WebTAG criteria that provide acceptability guidelines for the validation of link flows, screenline totals and journey times.

The validation of the east west screenlines showed that of the 8 screenlines in the AM period all screenlines were within 5% of observed totals, in the interpeak 6 were within 5% of observed totals and in the PM peak 7 were within 5% of observed totals.

The GEH statistic, although no longer officially recognised within WebTAG for screenline validation, was nevertheless considered a relevant indicator since it incorporates weighting in accordance with the scale of traffic flow. A value of less than 4 had previously been considered acceptable for screenline validation. The GEH values for the defined East West screenlines were all well below 4 for all time periods and demonstrated the excellent match between modelled and observed totals.

The results of the link flow validation presented in this report demonstrate that the model achieves the WebTAG link flow and GEH criteria on individual sites on east-west screenlines and the A5 over all time periods. These links are considered the most important links within the network as they will be directly affected by the scheme.

The link flow validation over a wider area, at a total of 30 locations, shows that for all time periods, well over 85% of links achieve the WebTAG link flow criteria with almost 100% of links achieving the link flow criteria. This demonstrates an excellent match with observed flows.

Journey time comparisons demonstrate that at least 96% of routes comply with the WebTAG criteria in all three time periods. This, together with the earlier checks on network routeing, demonstrates that the model provides an accurate and realistic representation of travel times during the three modelled time periods.

The results of the model validation have demonstrated that the model performs exceptionally well, particularly on the A5 and other roads within the corridor that are likely to be most affected by the proposed scheme.

Overall, the model validation results demonstrate that the base year traffic model provides an excellent representation of the current traffic demands and conditions in the A5 WTC Study area. It therefore provides a reliable basis from which to prepare forecasts of future traffic growth and economic appraisal in support of the Business Case.

Appendix A – Network Development

Network Development

A-1 Introduction

The network is a representation of the highway system within the study area. The network comprises a system of nodes connected by links. The nodes mostly represent junctions and the links represent homogenous stretches of road between junctions.

A-2 Highway Network Definition

The modelled network provides an accurate representation of the existing highway network in the western area of Northern Ireland, including the towns of New Buildings, Strabane, Omagh, Ballygawley and Aughnacloy. The network also includes links into the ROI from both the north and south of NI.

The network is modelled at two levels of detail: a simulation network in the vicinity of the A5 within which the junctions are coded in detail in order to model associated delays and a network outside the simulation area where only the links are modelled.

Within the simulation area, the modelled network includes the entire length of the A5 from Londonderry to the Border with ROI at Aughnacloy, all ‘A’ and ‘B’ class roads and most minor roads with traffic volumes more than one hundred vehicles per hour. In urban areas, residential roads which act as distributor routes or rat-runs are also modelled.

The extent of the simulation network within the study area is shown in Appendix A as Figure A 1.

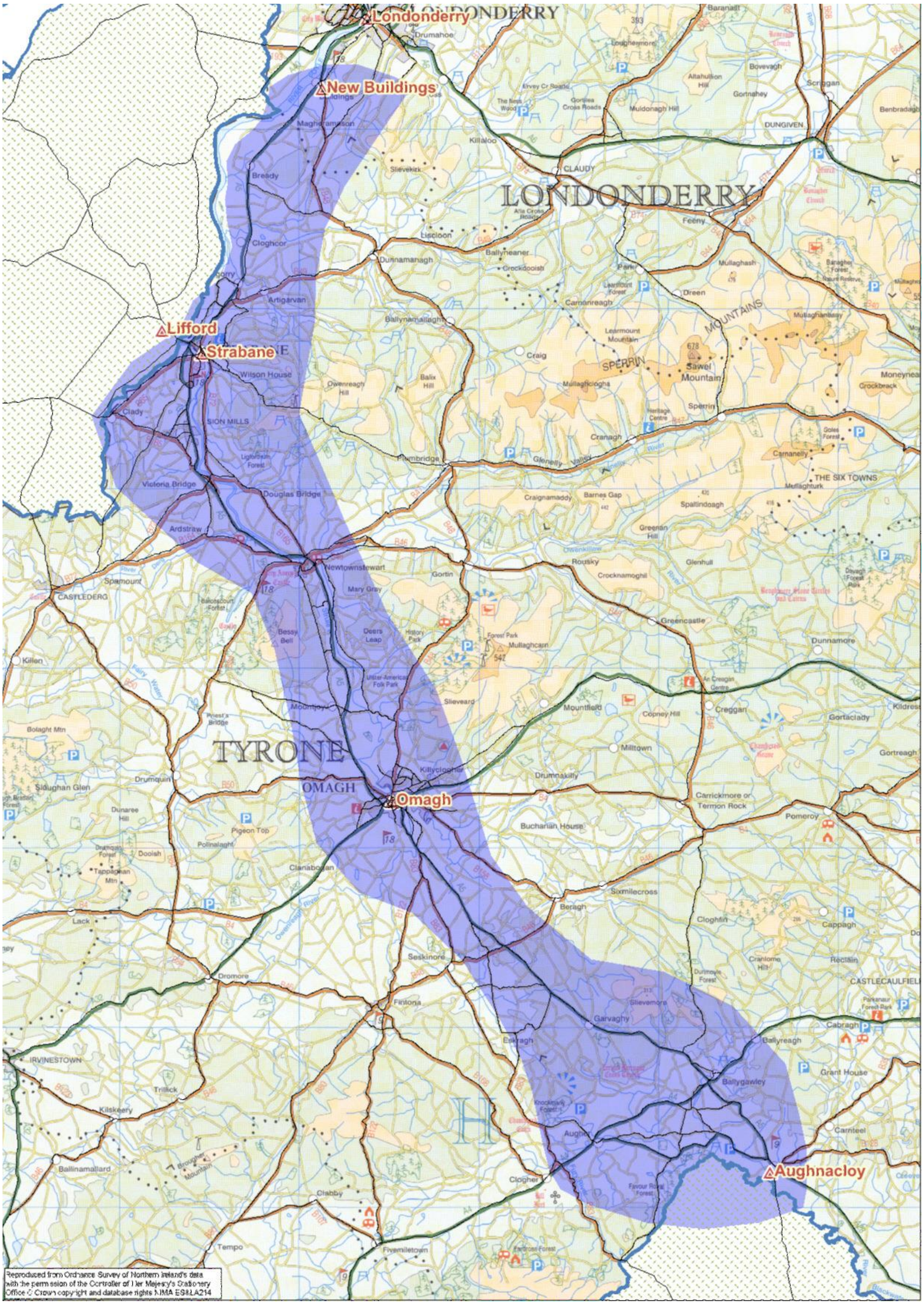

Figure A 1: Extent of simulation area of traffic model

Outside the simulation area, the network has been defined to reflect the routeing of longer distance traffic. The external model network is shown in Figure A 2.

Figure A 2: Extent of area covered by traffic model

A-3 Network Inventory

The structure of the 2015 base year model network was the same as the 2013 base year model network except for inclusion of the Omagh Hospital Link Road completed in 2013. Checks together with some adjustments were also undertaken, as follows:

- Loading of zone centroids to network.
- Link lengths
- Routeing through the network
- Capacity and speed flow definition

A-4 Link and Speed Flow Curves

The roads were modelled as links in SATURN. All of the links were assigned distances together with a link category to define its characteristics.

Speed flow curves were applied to all links in the network in order to define the relationship between traffic volume and link speed.

Link types and speed flow curves were allocated with reference to TAG Unit M3.1 Appendix D which specifies the speed/flow relationships used in COBA (the DfT's link-based Cost Benefit Analysis software)

Speed-flow curves were allocated to all links in the network based on:

- their location and function (urban, suburban, rural, village);
- type of the road, (dual or single carriageway);
- number of lanes on the road;
- road classification (motorway, A, B, C);
- quality of the road (good, average, poor);
- speed limit; and
- extent of frontage development.

This information was gathered from a combination of maps and plans, inventories and site visits.

The speed-flow curves developed for the A5WTC model are set out in Table A 1.

Index	Speed in free-flow conditions (km/h)	Speed at capacity (km/h)	Capacity	Power	Description
1	88	58	1393	2.2	Rural 7.3m single A roads
2	87	57	1393	2.2	Rural 7.3m single B roads
3	64	43	1010	1.8	Rural 7.3m single C roads
4	76	56	937	2.0	Rural 5m single road
5	24	16	600	1.8	Village road
6	78	55	1091	2.1	Rural single carriageway 6m
7	64	33	1415	2.2	Rural single carriageway 7.3m
8	92	49	1750	2.2	Rural single carriageway 10m
9	105	72	4457	2.9	Rural dual carriageway 2 lanes
10	109	45	6300	3.7	Rural dual carriageway 3 lanes
11	104	42	4660	3.8	Rural motorway 2 lanes 70mph
12	97	39	4200	3.8	On/Off-ramps 70 mph
13	109	42	6990	3.8	Rural motorway 3 lanes 70mph
14	109	42	9320	3.8	Rural motorway 4 lanes 70mph
15	109	42	11650	3.8	Rural motorway 5 lanes 70mph
16	46	30	1200	1.5	Small Town good
17	57	30	1300	2.3	Small Town general
18	46	30	1200	1.5	Small Town bad
19	48	25	1000	1.6	Residential access
20	48	25	1065	1.6	Suburban 6m one-way 30mph
21	48	25	1200	1.6	Suburban 7.3m one-way 30mph
22	48	25	1725	1.6	Suburban 10m one-way 30mph
23	48	26	1680	6.3	Suburban 30mph S2
24	64	36	1680	4.5	Suburban 40mph S2
25	75	28	1700	3.7	Suburban 50mph S2
26	91	33	1700	3.8	Suburban 60mph S2
27	48	26	1680	6.3	Suburban 6m single 30mph
28	59	24	1065	2.4	Suburban 6m single 40mph
29	64	26	1680	3.1	Suburban 7.3m single 40mph
30	75	28	1200	3.7	Suburban 7.3m single 50mph
31	64	26	1725	2.4	Suburban 10m single 40mph
32	80	29	1725	3.8	Suburban 10m single 50mph
33	48	35	3360	2.0	Suburban 30mph D2
34	68	34	3500	2.0	Suburban 40mph D2
35	80	36	3600	3.3	Suburban 50mph D2
36	64	32	3450	2.0	Suburban dual 2-lanes 40mph
37	80	36	3450	3.3	Suburban dual 2-lanes 50mph
38	64	32	5175	2.0	Suburban dual 3-lanes 40mph
39	80	36	5175	3.3	Suburban dual 3-lanes 50mph
40	64	32	6900	2.0	Suburban dual 4-lanes 40mph
41	80	36	6900	3.3	Suburban dual 4-lanes 50mph
42	80	32	4660	3.8	Urban motorway 2 lanes 50mph
43	64	26	1725	3.8	On/Off-ramps 50 mph

44	80	31	6990	3.9	Urban motorway 3 lanes 50mph
45	80	31	9320	3.9	Urban motorway 4 lanes 50mph
46	80	31	11650	3.9	Urban motorway 5 lanes 50mph
47	35	18	1800	1.7	Urban central 30mph D2
48	55	24	3600	1.8	Urban central 40mph D3
49	55	24	2400	1.8	Urban central 40mph D2
50	70	28	2700	1.8	Urban central 50mph D2
51	35	18	2700	1.7	Urban central 30mph D3
52	15	8	450	1.3	Urban central narrow road 20mph
53	28	15	840	0.5	Urban central 30mph S2
54	37	15	740	1.8	Urban central 40mph S2
55	45	21	1800	1.7	Urban non central Dual 2-lanes 30mph
56	45	21	2700	1.7	Urban non central Dual 3-lanes 30mph
57	45	21	3600	1.7	Urban non central dual 4-lanes 30mph
58	40	22	800	1.5	Urban non central 6m one-way 30mph
59	40	22	800	1.5	Urban non central 7.3m one-way 30mph
60	42	24	863	1.5	Urban non central 10m one-way 30mph
61	32	18	650	1.5	Urban non central 6m single 30mph
62	47	25	840	1.2	Urban non central 7.3m single 30mph
63	42	22	875	1.5	Urban non central 10m single 30mph
64	68	68	-	-	Primary route single carriageway
65	64	64	-	-	Primary route single carriageway tunnel
66	68	68	-	-	A road single carriageway u/c
67	64	64	-	-	A road single carriageway in tunnel
68	48	48	-	-	B road single carriageway
69	97	97	-	-	Primary route dual carriageway
70	64	64	-	-	Primary route dual carriageway tunnel
71	97	97	-	-	A road dual carriageway
72	68	68	-	-	A road dual carriageway
73	97	97	-	-	B road dual carriageway
74	113	113	-	-	Motorway
75	40	40	-	-	Urban central road single carriageway
76	40	40	1700	0.0	Junction modelling only
77	30	15	400	1.3	Diversionary roads
79	25	25	-	-	Centroid connectors
80	80	80	-	-	Centroid connectors motorways
81	5	5	-	-	Centroid connectors Walk
82	48	31	880	2.1	Urban Non-central good condition 1-lane
83	48	25	784	1.6	Urban Non-central typical condition 1-lane
84	48	31	1760	2.1	Urban Non-central good condition 2-lane
85	48	25	1568	1.6	Urban Non-central typical condition 2-lane
86	48	31	2640	2.1	Urban Non-central good condition 3-lane
87	48	25	2352	1.6	Urban Non-central typical condition 3-lane
88	57	25	1184	1.7	Suburban S2 poor condition
89	61	25	1520	1.9	Suburban S2 typical condition
90	62	49	1353	7.1	S2 rural unclassified 7.3m 40mph

91	63	35	1320	2.5	Small town light dev
92	63	25	1878	2.8	Suburban S2 good condition
93	64	35	1878	2.9	Suburban D1AP good condition
94	64	35	1520	1.7	Suburban D1AP Typical condition
95	86	64	1060	1.9	S2 Rural TD9/81 6m
96	89	60	1353	2.1	S2 Rural TD9/81 7.3m
97	102	73	2009	2.8	D1AP Slip
98	101	72	4017	2.8	D2AP Rural 70mph
99	88	46	1380	2.1	Rural 7.3m single A roads
101	105	79	2009	2.8	D1M Slip
102	105	72	3540	2.8	Slip D2M
103	105	72	4457	2.8	D2M Rural 70mph
104	111	79	6886	2.8	D3M Rural 70mph
131	104	104	-	-	Buffer link 70mph
132	70	70	-	-	Buffer link 50&60 mph
133	55	55	-	-	Buffer link 40mph
134	40	40	-	-	Buffer link 30mph
135	30	30	-	-	Buffer link <30mph
209	105	72	4457	2.9	Rural dual carriageway 2 lanes
301	46	33	600	2.0	Rural 5m single road
631	103	103	-	-	Buffer link 70mph for 2019
632	69	69	-	-	Buffer link 50&60 mph for 2019
633	54	54	-	-	Buffer link 40mph for 2019
634	40	40	-	-	Buffer link 30mph for 2019
731	102	102	-	-	Buffer link 70mph for 2023
732	69	69	-	-	Buffer link 50&60 mph for 2023
733	53	53	-	-	Buffer link 40mph for 2023
734	39	39	-	-	Buffer link 30mph for 2023
831	100	100	-	-	Buffer link 70mph for 2028
832	68	68	-	-	Buffer link 50&60 mph for 2028
833	52	52	-	-	Buffer link 40mph for 2028
834	39	39	-	-	Buffer link 30mph for 2028
931	96	96	-	-	Buffer link 70mph for 2041
932	66	66	-	-	Buffer link 50&60 mph for 2041
933	50	50	-	-	Buffer link 40mph for 2041
934	38	38	-	-	Buffer link 30mph for 2041

Table A 1: Speed Flow Curves

A-5 Junction Modelling

Within the simulation area, the junctions were modelled in detail to represent the effect of traffic delays and queues.

SATURN enables junction capacities to be determined taking account of the traffic flows through the junction. Saturation flows are specified for each turn which represents the maximum traffic throughput. The actual capacity is then determined taking account of conflicting traffic movements, signal times (for signalised junctions) and gap acceptance.

Each junction was coded by using detailed information which included:

- junction type (signalised, priority, roundabout)
- number of arms
- allowed turns
- turning capacities based on geometric parameters
- traffic signal details (stage/ phase arrangements and timings)
- vehicle circulating capacity and travel time (for roundabouts)

Data for junction layouts was obtained from Google Earth and verified through site visits.

The saturation flows and capacities were specified in accordance with industry standard practice based on Transport Road Research (TRL) formulae and software.

A-6 Priority Junction Modelling

A total of 363 priority junctions were modelled in the simulation network. Saturation flows were determined taking account of radius of turn (for turning movements) and visibility where movements conflict. Typical values are as follows:

- Major Road Straight Ahead = 1950 pcu/hr;
- Major Road Left Turn = 1800 pcu/hr;
- Major Road Right Turn = 675 pcu/hr;
- Minor Road Left Turn = 700 pcu/hr;
- Minor Road Right Turn = 675 pcu/hr.

A-7 Roundabout Modelling

For roundabouts the maximum entry flow on each arm of the roundabout and the maximum circulating flow were based on various geometric measurements. These included the approach width, the entry width at the give way line and the length of the flare on the approach and the inscribed circle diameter of the roundabout.

Typical values are as follows:

Roundabout Size	Saturation Flow pcu/hr	
	Entry	Circulatory c/w
Single 3.65m lane without flare (20m dia rbt)	1000	2094
Single 3.65m lane without flare (40m dia rbt)	1050	2170

Single 3.65m lane flaring to 2-lanes (40m dia rbt)	1650	2620
Single 3.65m lane flaring to 2-lanes (60m dia rbt)	1675	3010
Dual c/w 7.3m width flaring to 3-lanes (60m dia rbt)	2850	3760

A total number of 47 roundabouts were modelled, including 7 large roundabouts. The large roundabouts were modelled as a series of priority junctions.

A-8 Signalised Junctions

All of the signalised junctions within the study area were modelled in detail. The signal data was provided by the Department for Infrastructure and included details of minimum green time, maximum green time, inter-green time and junction layouts with turning allocations, phases and stages. This information was input into SATURN for the three time periods (AM, IP and PM).

There are a total of 35 signalised junctions within the study area,
Saturation flows at signalised junctions were allocated according to the type of the turning movement as below:

- Straight ahead movement = 1950 pcu/hr;
- Left turning movement = 1800 pcu/hr;
- Right turning movement = 1800 pcu/hr.

A-9 Centroid/ Zone Connectors

The loading of traffic onto the network from zones was achieved through the use of 'Centroid Connectors' at appropriate locations.

For the A5WTC model, the loading points were determined specifically for each zone. The length of the connector in each case was measured from plans/maps. The speed was then assigned based on the network characteristics of the zone.

For the external zones (outside the study area), the loading points were attached to the appropriate locations at the edge of the network. The distance and speed for these connectors were estimated using GIS information.

A-10 Network Checks

In order to verify that the modelled network provided an accurate representation of the current highway conditions, the following checks were undertaken:

- The routes taken through the network; produced by a standard path building algorithm by assigning a unity matrix;
- Physical characteristics of the coded network (junction type, number of arms and lanes, lane usage);
- Parameters assigned to the network (distances, saturation flow for each turning movement, speed flow curves);
- Loading points of every zone;
- Zone-to-zone distances;

An examination of the network and zone boundaries confirmed that each zone centroid had been loaded within its geographical zone boundary. The link lengths were calculated directly from the GIS network.

The calculated traffic routeing pattern through the road network was also checked. The routes were analysed using the path analysis facility available in SATURN. This confirmed that routeings through the network were logical.

Appendix B – Scatter Plots of Matrix Changes

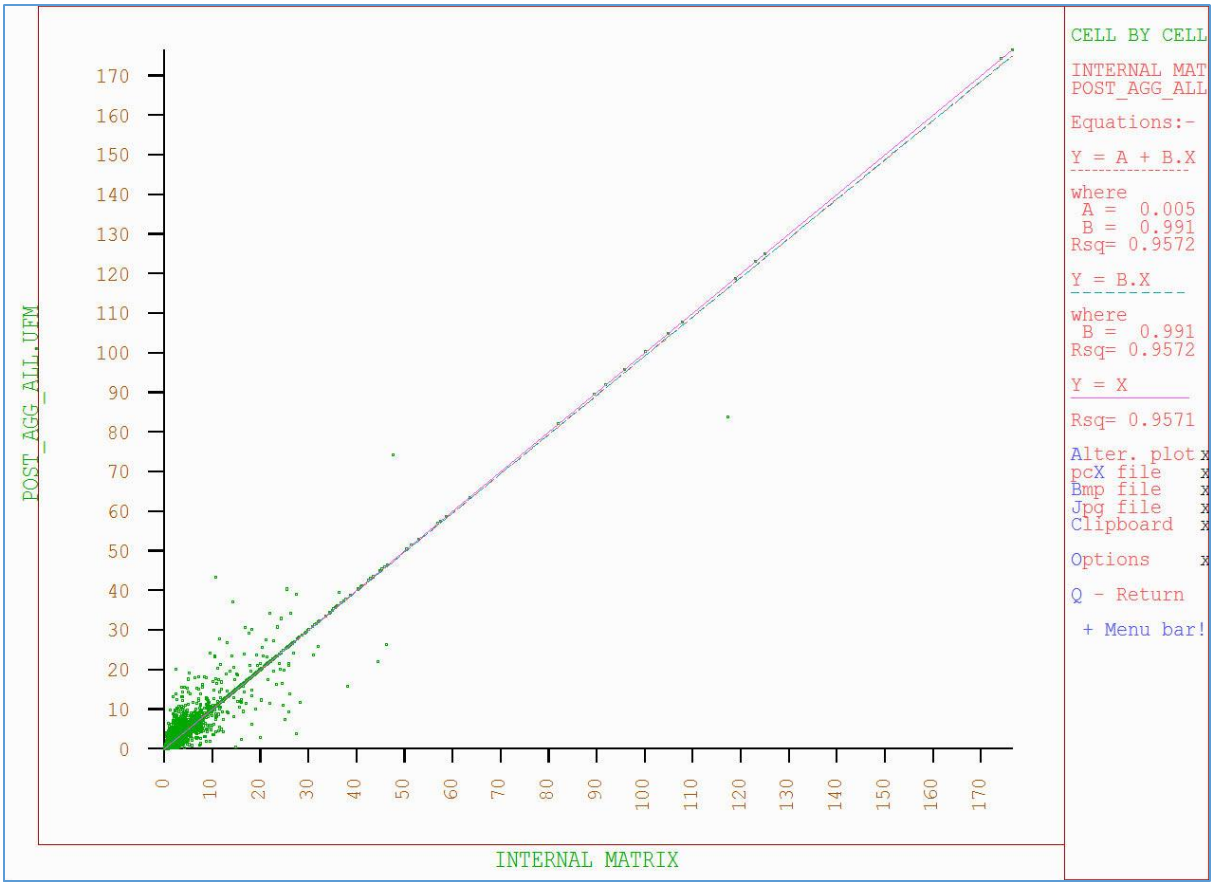

Figure B 1: Changes Resulting from Matrix Estimation AM Period - Cells

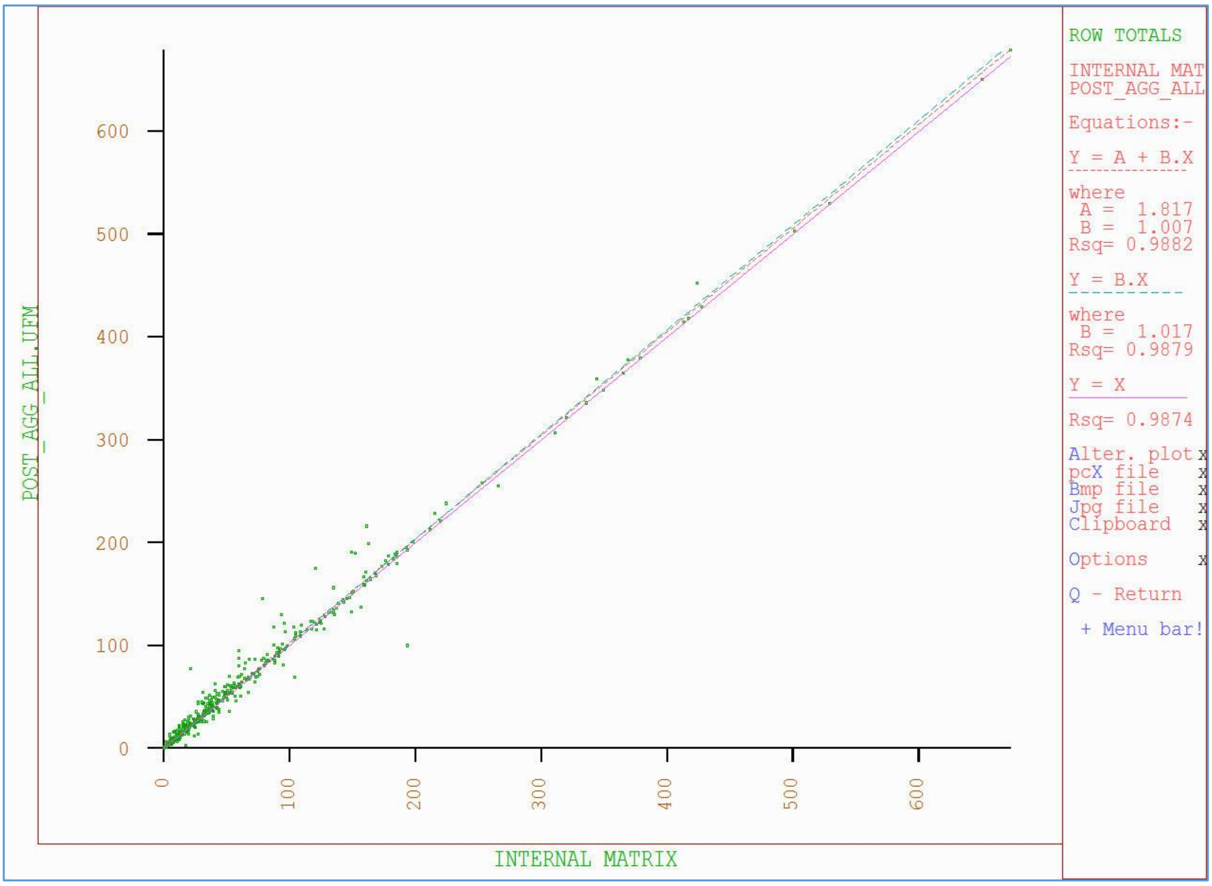

Figure B 2: Changes Resulting from Matrix Estimation AM Period - Row Totals

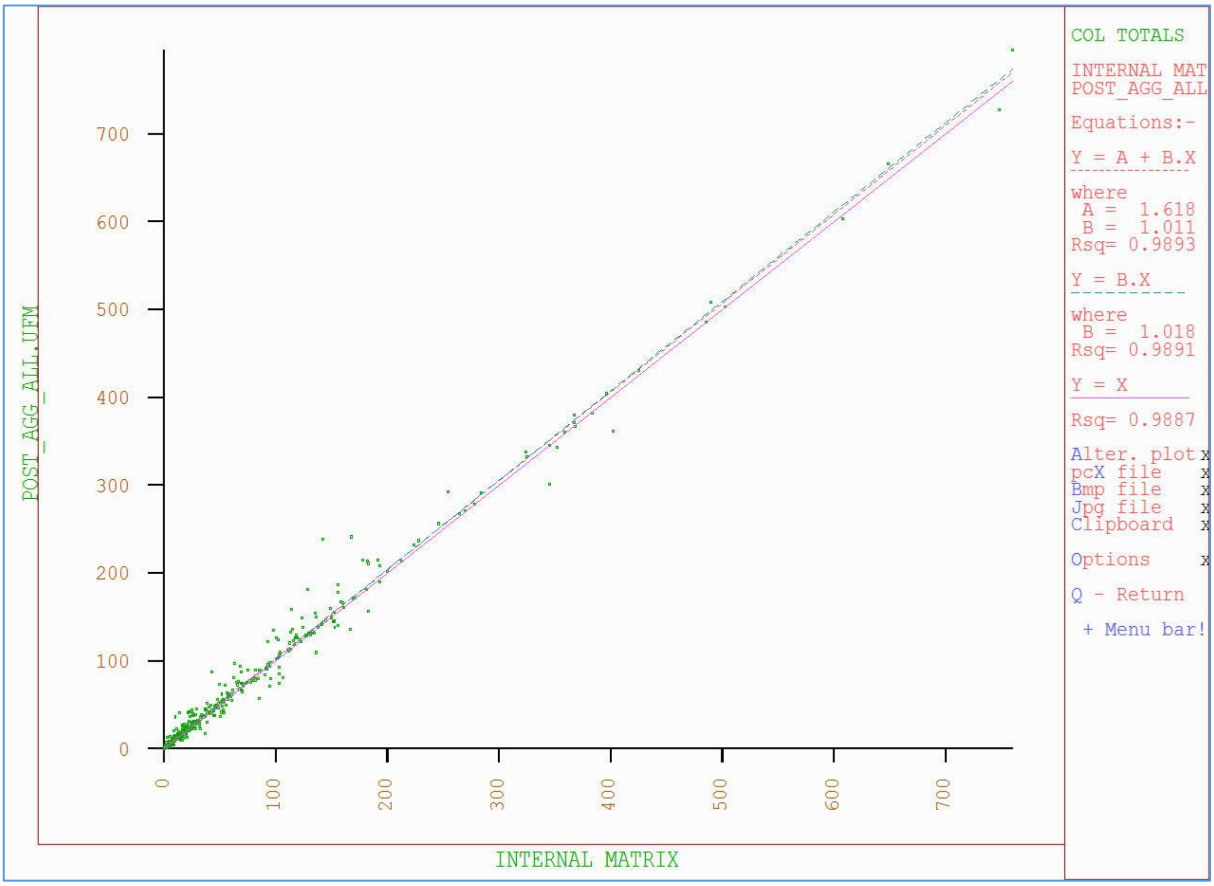

Figure B 3: Changes Resulting from Matrix Estimation AM Period - Column Totals

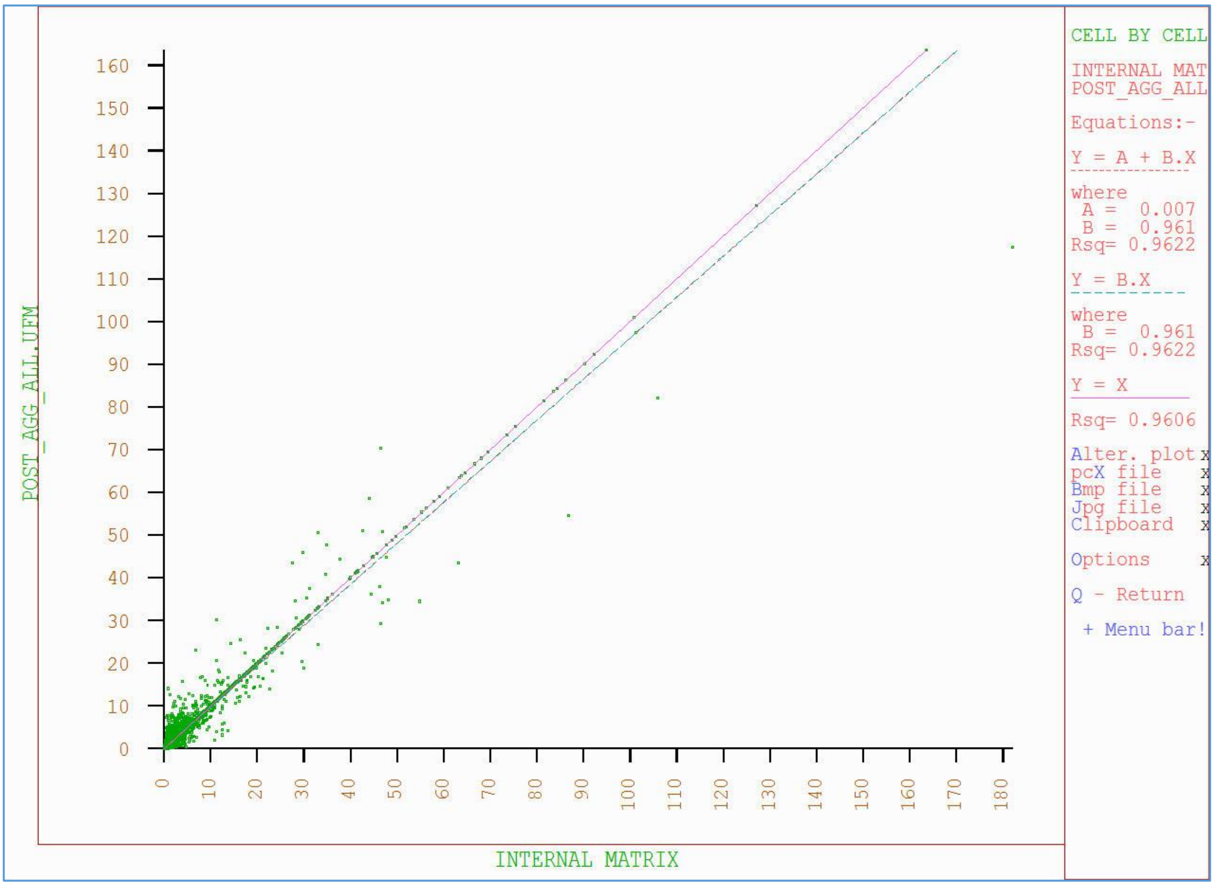

Figure B 4: Changes Resulting from Matrix Estimation IP Period - Cells

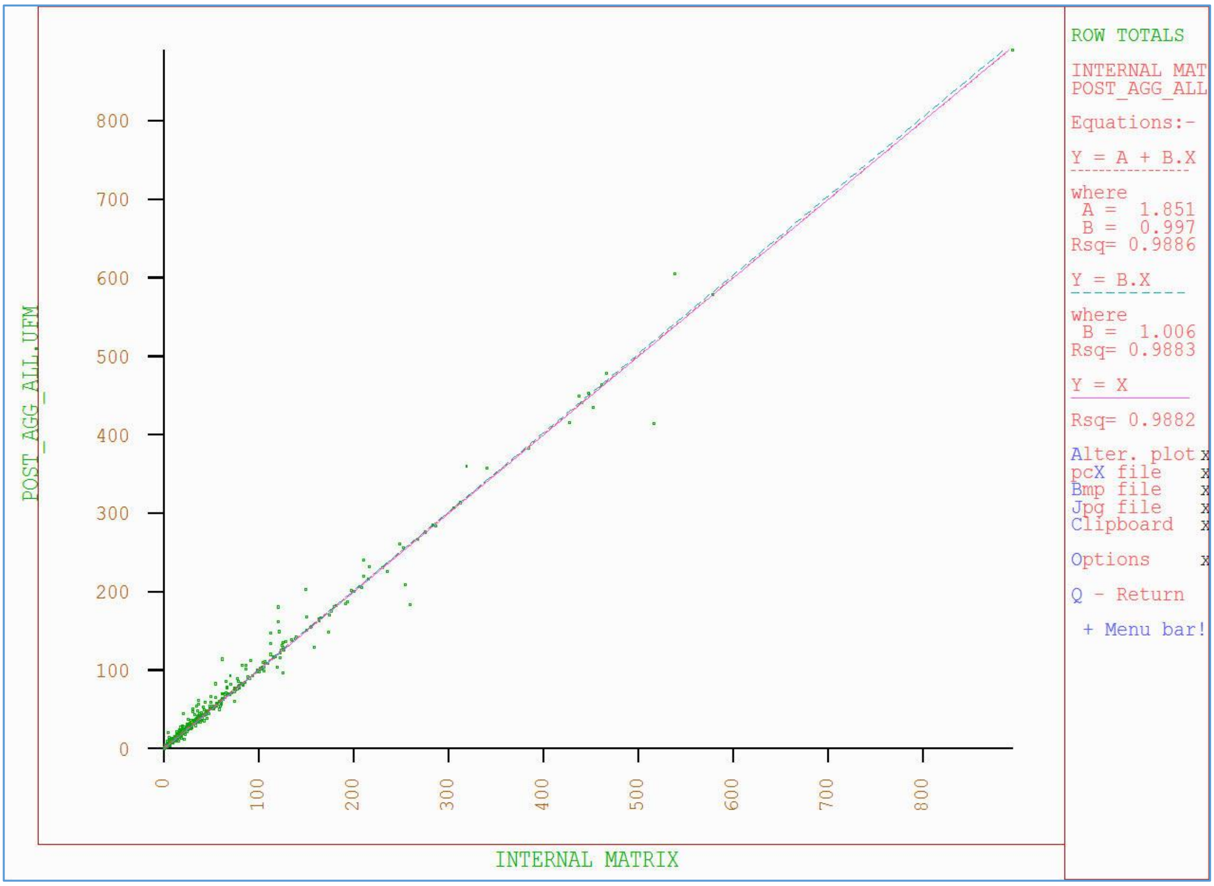

Figure B 5: Changes Resulting from Matrix Estimation IP Period - Row Totals

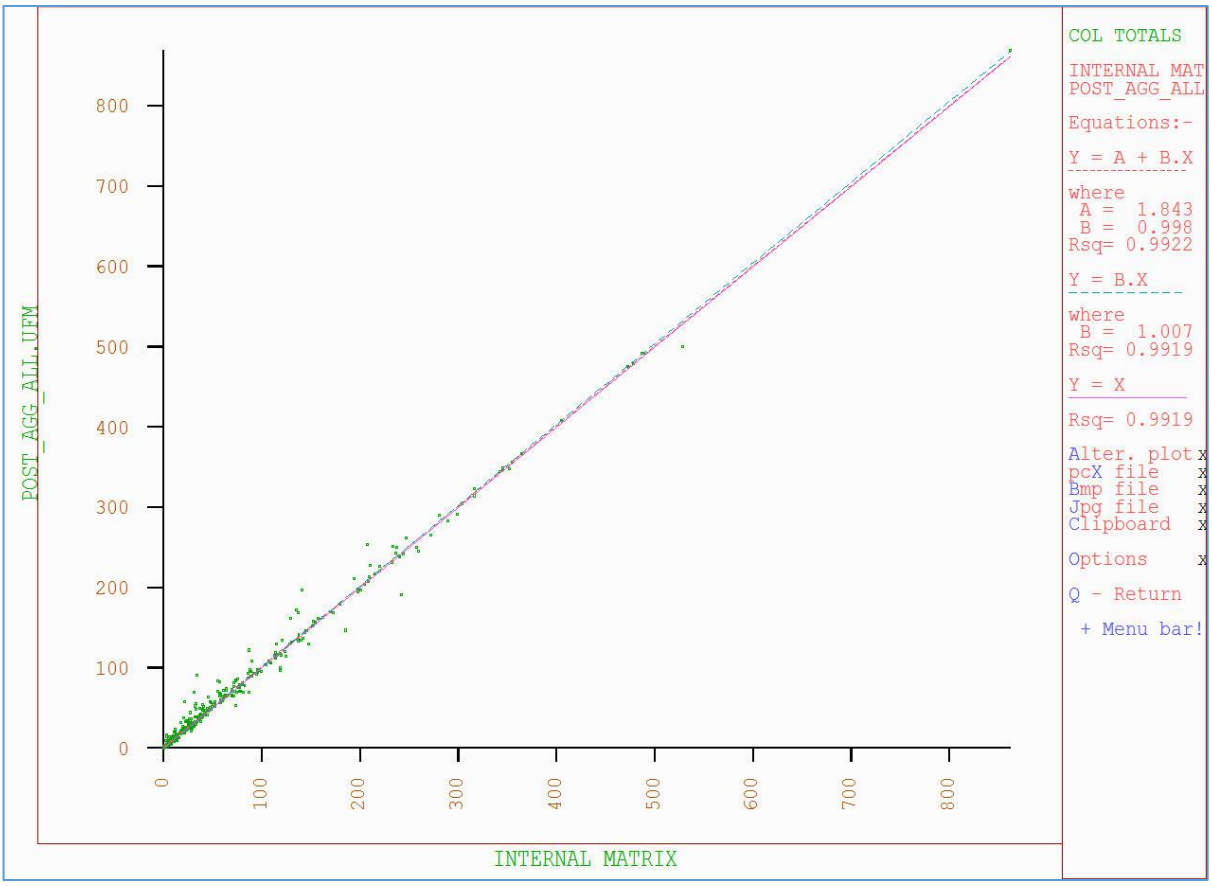

Figure B 6: Changes Resulting from Matrix Estimation IP Period - Column Totals

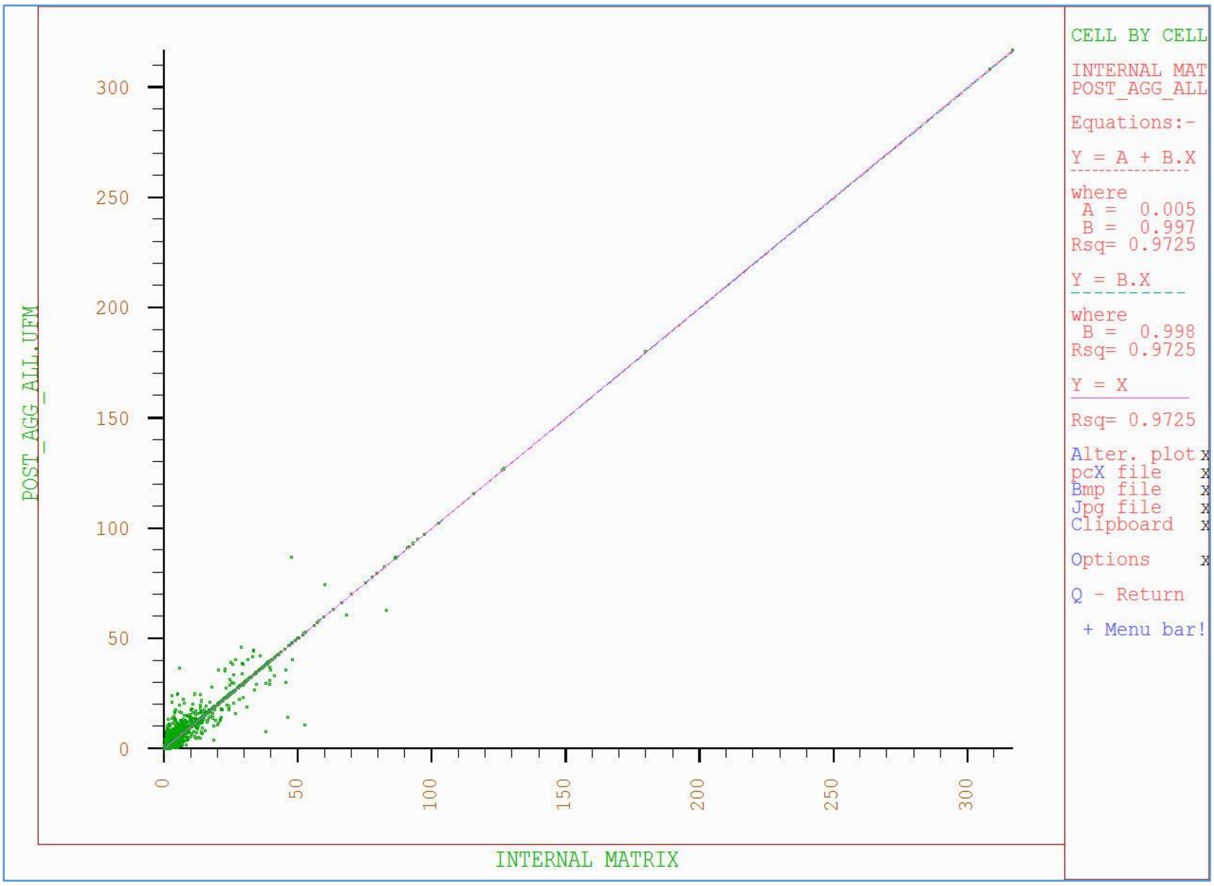

Figure B 7: Changes Resulting from Matrix Estimation PM Period - Cells

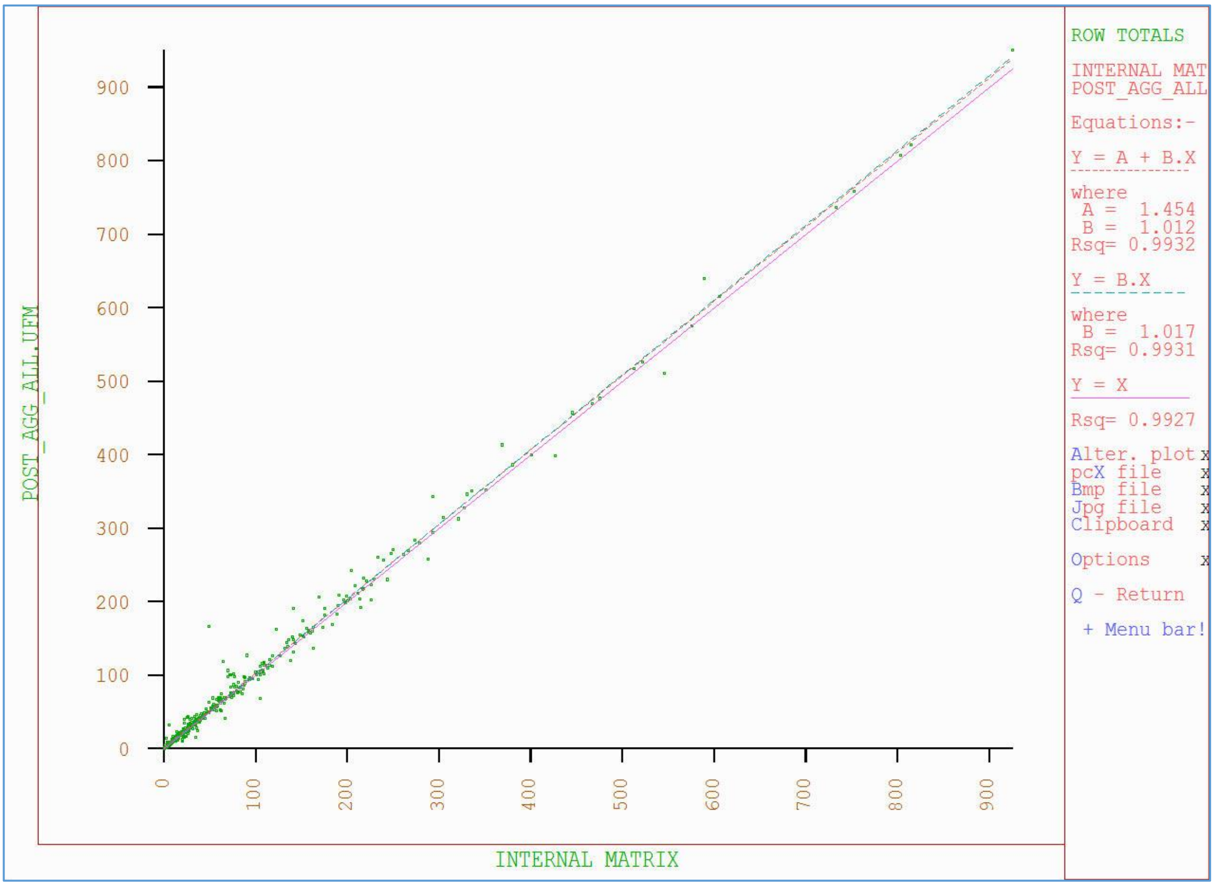

Figure B 8: Changes Resulting from Matrix Estimation PM Period - Row Totals

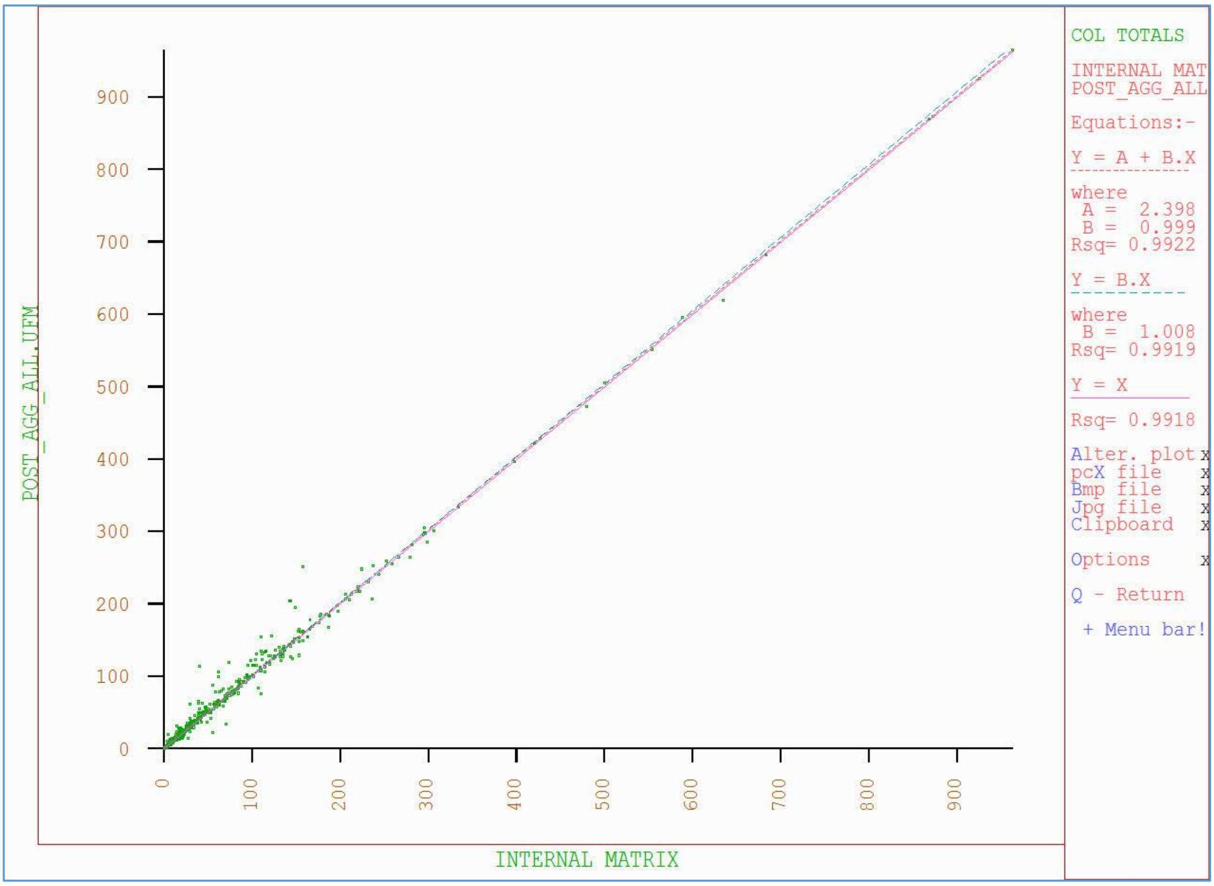

Figure B 9: Changes Resulting from Matrix Estimation PM Period - Column Totals

Appendix C – Trip Length Distribution Histograms

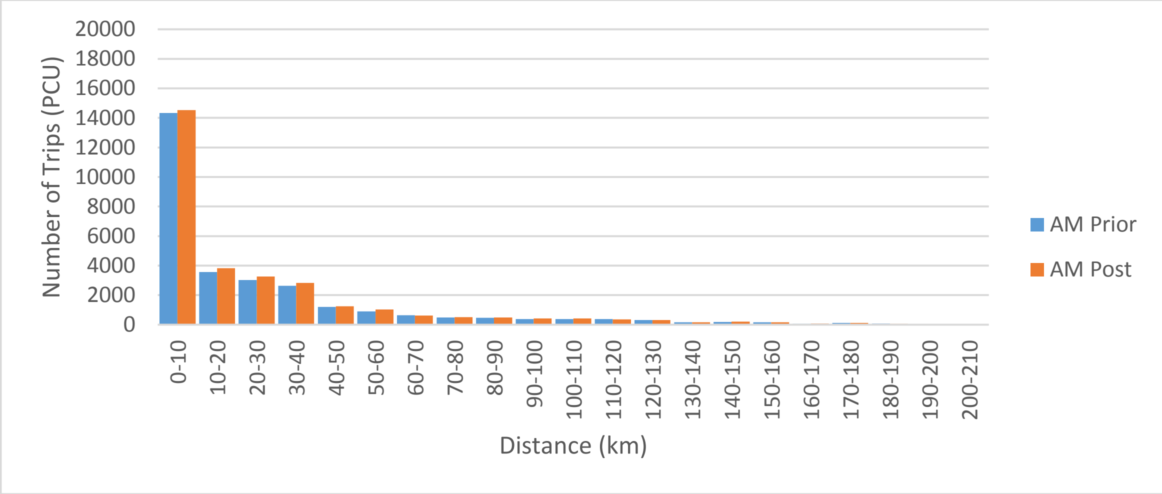

Figure C 1: AM Trip Length Distribution Comparison

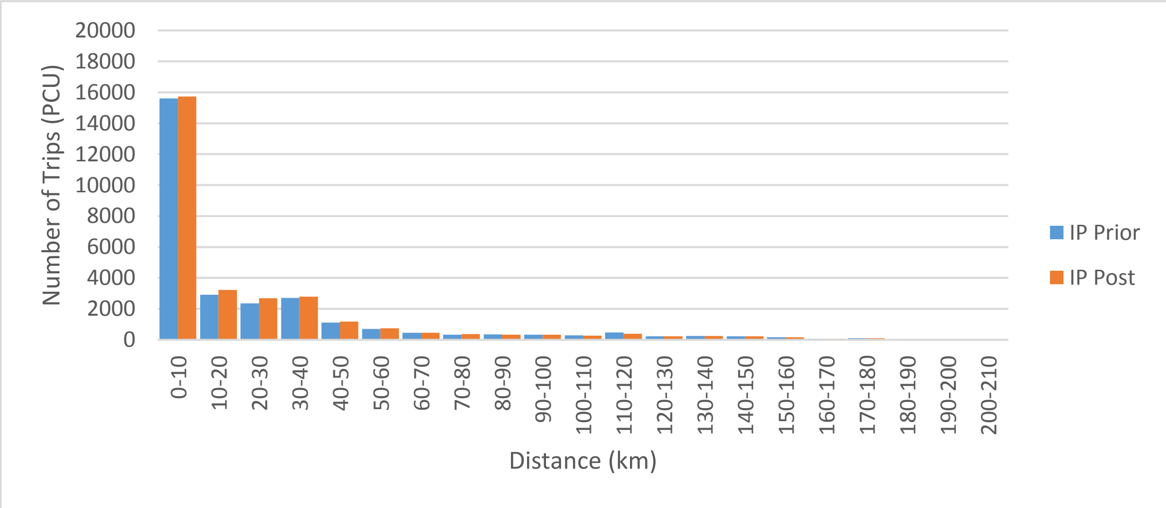

Figure C 2: IP Trip Length Distribution Comparison

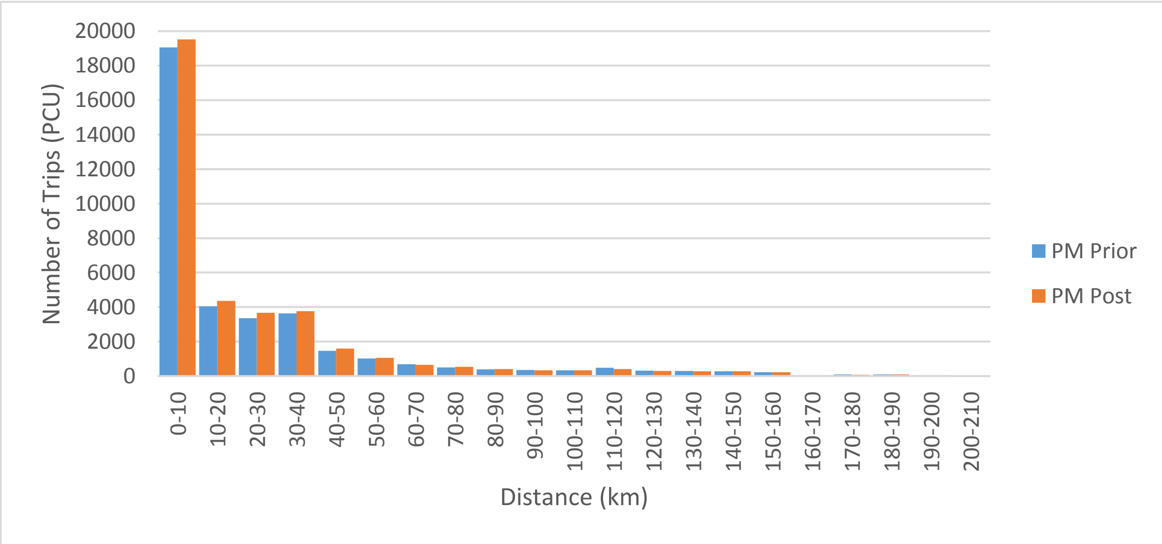

Figure C 3: PM Trip Length Distribution Comparison

Appendix D – Sector to Sector Summary

AM Prior	1	2	3	4	5	6	7	8	9	10	11	12	
1	9649	195	242	114	10	7	395	130	36	60	144	26	11009
2	425	111	267	6	5	1	22	109	8	7	15	0	976
3	555	264	1837	358	29	5	59	148	106	24	120	8	3513
4	62	7	171	5102	204	35	47	11	194	14	358	23	6228
5	27	4	10	462	330	104	17	7	96	52	315	34	1458
6	10	0	3	26	98	8	14	9	8	5	56	0	238
7	765	23	18	145	13	7	0	65	45	15	25	0	1121
8	336	78	179	20	6	10	21	8	9	58	77	3	806
9	114	2	87	478	83	40	32	18	758	9	306	56	1983
10	40	10	11	15	59	4	34	67	9	0	38	3	290
11	169	44	97	629	243	40	25	66	233	123	298	8	1975
12	19	0	2	27	56	1	2	3	55	4	3	0	173
	12171	739	2923	7383	1134	262	669	641	1558	371	1757	162	29769

Figure D 1: AM Prior Matrix at Sector Level

AM Post	1	2	3	4	5	6	7	8	9	10	11	12	
1	9691	172	270	116	6	4	396	130	35	44	139	22	11025
2	414	124	236	7	8	0	25	155	9	8	15	0	1001
3	607	229	1856	421	27	5	90	153	121	29	101	7	3646
4	69	5	191	5358	224	29	59	6	199	12	447	26	6626
5	25	4	11	474	414	111	23	20	133	51	406	37	1709
6	9	0	5	27	90	8	14	11	7	5	56	0	232
7	764	30	37	172	16	7	0	78	39	7	25	0	1174
8	335	101	178	22	6	10	19	8	9	49	67	3	807
9	108	1	97	492	94	40	33	17	758	9	360	62	2072
10	44	8	13	17	61	4	21	59	9	0	40	3	280
11	171	22	93	809	286	38	25	57	266	114	299	8	2187
12	21	0	2	30	53	1	2	4	55	3	3	0	175
	12259	696	2989	7946	1284	258	709	698	1639	331	1959	167	30933

Figure D 2: AM Post Matrix at Sector Level

AM Diff	1	2	3	4	5	6	7	8	9	10	11	12	
1	42	**-23**	29	2	-4	-4	1	0	-1	-16	-5	-4	17
2	-11	**13**	**-31**	1	3	-1	3	46	1	1	0	0	25
3	52	**-35**	19	**63**	-2	0	31	5	15	5	-19	-2	133
4	7	-2	**20**	256	**20**	-5	12	-5	5	-2	89	3	397
5	-2	0	1	12	**84**	**8**	5	13	36	-1	90	3	251
6	-1	0	2	0	**-9**	0	0	2	-1	0	0	0	-6
7	0	7	19	27	2	0	0	12	-6	-8	0	0	53
8	-1	22	0	2	0	-1	-1	0	0	-9	-10	0	1
9	-6	-1	10	15	11	0	2	-1	0	0	53	6	89
10	4	-2	2	3	2	0	-13	-7	0	0	3	-1	-10
11	2	-23	-5	180	43	-1	0	-8	33	-9	1	0	213
12	2	0	0	3	-2	0	0	0	0	0	0	0	2
	88	-44	66	563	149	-4	41	57	81	-40	202	5	1165

Figure D 3: AM Change between Prior and Post Matrix at Sector Level

AM %Diff	1	2	3	4	5	6	7	8	9	10	11	12	
1	0%	**-12%**	12%	2%	-43%	-50%	0%	0%	-3%	-27%	-3%	-15%	0%
2	-3%	**12%**	**-12%**	16%	65%	-63%	15%	42%	8%	18%	1%	-	3%
3	9%	**-13%**	1%	**18%**	-6%	-3%	53%	4%	14%	19%	-16%	-23%	4%
4	12%	-28%	**12%**	5%	**10%**	-16%	25%	-42%	2%	-16%	25%	14%	6%
5	-7%	-5%	11%	3%	**26%**	**7%**	32%	195%	37%	-1%	29%	9%	17%
6	-7%	-43%	72%	2%	**-9%**	0%	0%	19%	-14%	0%	0%	-	-3%
7	0%	31%	104%	18%	18%	0%	-	19%	-13%	-55%	0%	-	5%
8	0%	28%	0%	8%	-4%	-5%	-7%	0%	0%	-15%	-13%	-14%	0%
9	-5%	-42%	11%	3%	13%	1%	6%	-6%	0%	0%	17%	11%	4%
10	10%	-23%	19%	17%	3%	0%	-38%	-11%	0%	-	7%	-17%	-3%
11	1%	-51%	-5%	29%	18%	-4%	0%	-13%	14%	-7%	0%	0%	11%
12	11%	-43%	-4%	11%	-4%	0%	0%	11%	0%	-13%	5%	-	1%
	1%	-6%	2%	8%	13%	-1%	6%	9%	5%	-11%	11%	3%	4%

Figure D 4: AM Percentage Change between Prior and Post Matrix at Sector Level

IP Prior	1	2	3	4	5	6	7	8	9	10	11	12	
1	9515	179	251	64	8	18	490	217	57	50	171	37	11058
2	191	154	339	6	0	1	11	107	2	14	25	0	851
3	293	375	2115	167	18	5	62	125	66	13	107	4	3349
4	59	15	175	6134	228	14	38	19	211	18	382	14	7307
5	16	1	15	195	281	85	11	8	56	65	196	19	947
6	13	1	3	12	73	7	1	13	9	8	36	0	177
7	503	20	45	46	10	13	0	40	48	16	28	1	768
8	280	57	229	19	6	13	47	6	7	54	65	7	788
9	59	5	67	224	56	8	30	12	781	10	261	31	1544
10	32	10	16	19	88	9	14	62	13	0	80	3	345
11	185	30	119	404	190	45	21	77	231	47	370	13	1732
12	26	0	6	14	44	0	0	8	33	6	6	0	143
	11172	846	3379	7304	1003	219	726	692	1513	302	1727	128	29011

Figure D 5: IP Prior Matrix at Sector Level

IP Post	1	2	3	4	5	6	7	8	9	10	11	12	
1	9575	183	284	56	7	14	494	221	43	38	166	31	11112
2	205	168	363	6	0	1	15	144	2	17	11	0	932
3	315	352	2126	203	17	6	70	146	105	15	76	4	3436
4	55	5	222	6351	251	13	44	19	213	25	452	12	7664
5	11	1	18	214	351	88	10	7	62	66	247	21	1097
6	10	0	3	15	75	7	1	13	9	8	36	0	179
7	513	28	67	49	9	13	0	42	35	16	28	1	801
8	282	76	242	20	7	12	51	6	6	49	55	8	814
9	41	4	82	230	65	9	30	11	781	10	307	39	1608
10	26	10	19	26	89	9	13	59	13	0	85	3	351
11	177	14	104	434	230	46	21	62	251	51	370	13	1773
12	24	0	6	15	42	0	0	7	33	5	5	0	138
	11235	844	3537	7619	1143	218	751	737	1553	299	1838	131	29906

Figure D 6: IP Post Matrix at Sector Level

IP Diff	1	2	3	4	5	6	7	8	9	10	11	12	
1	60	5	33	-8	-2	-5	4	4	-14	-12	-5	-6	54
2	**14**	**14**	**24**	0	0	0	4	37	0	2	-14	0	80
3	23	**-23**	11	**36**	-1	1	8	22	39	2	-31	0	88
4	-4	-10	**47**	218	**23**	-1	6	0	2	7	70	-2	357
5	-5	0	4	**19**	**70**	3	-1	0	6	0	52	2	150
6	-3	0	1	3	2	0	0	0	0	0	0	0	2
7	10	8	22	3	-1	0	0	2	-12	0	0	0	33
8	3	20	13	2	1	-1	4	0	-1	-6	-10	0	26
9	-18	-1	15	6	9	1	0	-1	0	0	45	7	63
10	-6	1	3	7	1	0	-1	-3	0	0	5	1	7
11	-7	-16	-16	30	40	1	0	-15	20	4	0	0	41
12	-2	0	0	1	-2	0	0	0	0	-1	-1	0	-5
	63	-2	158	315	140	0	25	45	40	-2	112	2	895

Figure D 7: IP Change between Prior and Post Matrix at Sector Level

IP %Diff	1	2	3	4	5	6	7	8	9	10	11	12	
1	1%	3%	13%	-12%	-19%	-26%	1%	2%	-24%	-24%	-3%	-17%	0%
2	**7%**	**9%**	**7%**	0%	-24%	2%	36%	34%	-13%	17%	-57%	-68%	9%
3	8%	**-6%**	1%	**21%**	-3%	29%	13%	18%	59%	17%	-29%	3%	3%
4	-7%	-64%	**27%**	4%	**10%**	-5%	15%	2%	1%	42%	18%	-12%	5%
5	-31%	50%	24%	**10%**	**25%**	3%	-9%	-4%	11%	1%	27%	10%	16%
6	-26%	-47%	32%	24%	3%	0%	0%	2%	0%	0%	0%	0%	1%
7	2%	41%	50%	7%	-8%	0%	-	5%	-26%	0%	0%	0%	4%
8	1%	35%	6%	8%	15%	-6%	9%	0%	-11%	-11%	-16%	6%	3%
9	-31%	-21%	23%	3%	16%	10%	1%	-8%	0%	0%	17%	23%	4%
10	-19%	6%	19%	34%	1%	0%	-6%	-5%	0%	-	6%	23%	2%
11	-4%	-52%	-13%	7%	21%	2%	0%	-20%	9%	9%	0%	2%	2%
12	-9%	125%	5%	6%	-5%	0%	0%	-1%	1%	-14%	-19%	-	-4%
	1%	0%	5%	4%	14%	0%	3%	6%	3%	-1%	6%	2%	3%

Figure D 8: IP Percentage Change between Prior and Post Matrix at Sector Level

PM Prior	1	2	3	4	5	6	7	8	9	10	11	12	
1	12843	359	540	99	15	4	825	443	96	49	199	26	15498
2	192	194	361	5	1	3	8	148	1	6	12	0	932
3	268	482	2961	216	24	6	33	145	78	14	107	4	4339
4	68	43	386	5842	435	30	58	38	399	13	610	16	7936
5	15	5	36	238	384	102	12	10	103	78	205	20	1208
6	6	1	1	18	70	9	6	8	25	9	51	1	205
7	592	29	40	98	18	15	0	19	32	46	25	1	915
8	308	81	295	30	2	10	47	6	31	88	72	2	974
9	37	11	137	258	107	22	26	2	1041	24	336	54	2055
10	71	1	71	35	229	14	70	96	6	0	61	11	666
11	178	42	170	503	395	73	38	74	354	49	445	7	2328
12	42	3	8	14	39	1	0	6	58	1	5	0	178
	14619	1251	5007	7355	1718	291	1123	994	2222	380	2129	142	37232

Figure D 9: PM Prior Matrix at Sector Level

PM Post	1	2	3	4	5	6	7	8	9	10	11	12	
1	12942	382	580	85	10	6	824	445	83	33	203	23	15615
2	202	218	285	5	0	4	9	216	1	5	5	0	950
3	282	439	3146	271	27	6	46	186	85	21	88	4	4600
4	51	26	449	6208	463	28	88	34	415	12	790	14	8577
5	15	3	37	251	495	116	13	12	108	77	263	20	1409
6	4	0	1	20	69	9	6	5	23	9	53	1	201
7	592	39	35	99	20	15	0	19	28	40	25	1	914
8	310	114	290	32	1	9	50	6	30	74	66	3	985
9	24	10	153	267	128	25	20	2	1041	24	348	54	2097
10	60	1	69	36	185	14	78	79	6	0	63	15	605
11	179	31	126	511	427	71	38	68	364	51	446	7	2320
12	30	1	5	14	46	1	0	7	53	1	5	0	164
	14691	1265	5176	7799	1872	303	1172	1079	2237	349	2354	140	38437

Figure D 10: PM Post Matrix at Sector Level

PM Diff	1	2	3	4	5	6	7	8	9	10	11	12	
1	98	**23**	40	-14	-5	1	-1	2	-13	-16	4	-3	117
2	10	**25**	**-77**	0	0	1	1	68	0	-1	-7	0	19
3	14	**-43**	**185**	**56**	3	-1	13	41	7	7	-19	-1	262
4	-17	-17	**63**	**366**	**28**	-3	31	-4	17	-1	180	-2	640
5	1	-2	1	**13**	**111**	**14**	1	2	5	-1	58	0	202
6	-3	-1	0	3	0	0	0	-2	-2	0	1	0	-3
7	0	10	-5	2	2	0	0	1	-3	-6	0	0	-1
8	2	33	-5	2	-1	-1	3	0	-1	-14	-6	0	12
9	-12	-1	16	9	22	2	-6	0	0	0	12	0	42
10	-11	-1	-3	0	-43	0	8	-16	0	0	2	3	-61
11	2	-11	-44	8	32	-2	0	-7	10	2	1	0	-8
12	-11	-2	-3	-1	7	0	0	1	-4	0	0	0	-14
	71	13	169	443	154	12	49	85	15	-31	225	-2	1205

Figure D 11: PM Change between Prior and Post Matrix at Sector Level

PM %Diff	1	2	3	4	5	6	7	8	9	10	11	12	
1	1%	**6%**	7%	-14%	-34%	33%	0%	1%	-14%	-33%	2%	-11%	1%
2	5%	**13%**	**-21%**	-4%	-53%	39%	10%	46%	-19%	-18%	-59%	439%	2%
3	5%	**-9%**	**6%**	**26%**	13%	-14%	39%	28%	9%	47%	-18%	-16%	6%
4	-25%	-40%	**16%**	**6%**	**6%**	-8%	53%	-11%	4%	-7%	30%	-13%	8%
5	4%	-41%	3%	**6%**	**29%**	**13%**	7%	18%	5%	-1%	28%	0%	17%
6	-44%	-52%	50%	15%	0%	0%	0%	-31%	-8%	0%	2%	0%	-2%
7	0%	33%	-14%	2%	10%	0%	-	3%	-10%	-13%	0%	0%	0%
8	1%	40%	-2%	6%	-37%	-10%	6%	0%	-4%	-16%	-8%	10%	1%
9	-34%	-8%	12%	3%	20%	11%	-22%	-1%	0%	0%	4%	1%	2%
10	-16%	-44%	-4%	1%	-19%	0%	11%	-17%	0%	-	4%	30%	-9%
11	1%	-26%	-26%	2%	8%	-2%	0%	-9%	3%	4%	0%	0%	0%
12	-27%	-77%	-38%	-6%	18%	0%	-	18%	-8%	-19%	0%	-	-8%
	0%	1%	3%	6%	9%	4%	4%	9%	1%	-8%	11%	-1%	3%

Figure D 12: PM Percentage Change between Prior and Post Matrix at Sector Level

Appendix E – Validation along A5 Links

Site Description	Reference	Direction	Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
			Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT
A5 Victoria Road	ATC-411	NB	594	83	57	733	671	80	52	803	77	-3	-4	70	13%	-4%	-7%	10%	3.1	0.3	0.6	2.5	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	NB	296	54	57	407	299	55	52	406	3	1	-5	-1	1%	1%	-9%	0%	0.2	0.1	0.7	0.1	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	NB	483	73	53	609	503	89	47	639	20	16	-6	30	4%	22%	-12%	5%	0.9	1.8	0.9	1.2	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	NB	148	30	40	218	126	31	47	205	-21	1	7	-13	-14%	4%	17%	-6%	1.8	0.2	1.1	0.9	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	SB	376	55	30	461	356	29	26	411	-20	-26	-4	-50	-5%	-47%	-14%	-11%	1.0	4.0	0.8	2.4	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	SB	508	63	48	620	507	63	50	620	-2	0	2	0	0%	-1%	4%	0%	0.1	0.0	0.3	0.0	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	SB	334	77	56	467	311	74	55	440	-23	-2	-1	-27	-7%	-3%	-3%	-6%	1.3	0.3	0.2	1.3	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	SB	175	27	36	237	151	19	62	232	-24	-8	27	-5	-14%	-29%	74%	-2%	1.9	1.6	3.8	0.3	Yes	Yes	Yes	Yes

Table E 1: Validation of Flows along the A5 by Vehicle Category - AM

Site Description	Reference	Direction	Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
			Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT
A5 Victoria Road	ATC-411	NB	357	49	47	453	365	40	34	440	8	-9	-13	-13	2%	-19%	-27%	-3%	0.4	1.4	2.0	0.6	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	NB	245	40	55	340	249	41	56	346	4	1	2	6	2%	2%	3%	2%	0.2	0.1	0.2	0.3	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	NB	252	48	52	352	246	59	65	370	-6	11	13	18	-2%	22%	25%	5%	0.4	1.5	1.7	1.0	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	NB	148	24	45	217	120	26	63	209	-28	3	17	-8	-19%	12%	39%	-4%	2.4	0.6	2.4	0.5	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	SB	358	51	49	458	373	42	34	449	15	-9	-15	-9	4%	-17%	-31%	-2%	0.8	1.3	2.3	0.4	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	SB	256	43	57	356	252	43	57	352	-3	0	0	-4	-1%	-1%	0%	-1%	0.2	0.1	0.0	0.2	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	SB	291	59	60	411	270	53	60	382	-21	-6	-1	-28	-7%	-11%	-1%	-7%	1.3	0.8	0.1	1.4	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	SB	161	24	46	231	132	41	51	224	-29	17	5	-7	-18%	71%	10%	-3%	2.4	3.0	0.7	0.5	Yes	Yes	Yes	Yes

Table E 2: Validation of Flows along the A5 by Vehicle Category - IP

Site Description	Reference	Direction	Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
			Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT
A5 Victoria Road	ATC-411	NB	399	57	25	481	333	33	21	386	-67	-24	-5	-95	-17%	-41%	-18%	-20%	3.5	3.5	1.0	4.6	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	NB	513	70	39	622	552	71	43	666	39	1	4	44	8%	2%	10%	7%	1.7	0.2	0.6	1.8	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	NB	417	90	52	558	419	87	53	560	3	-3	1	1	1%	-3%	2%	0%	0.1	0.3	0.1	0.1	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	NB	221	32	39	292	193	51	65	309	-27	18	27	18	-12%	57%	69%	6%	1.9	2.9	3.7	1.0	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	SB	601	83	53	738	623	68	43	734	22	-16	-10	-4	4%	-19%	-20%	-1%	0.9	1.8	1.5	0.1	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	SB	331	48	56	435	352	52	57	461	21	4	1	26	6%	9%	2%	6%	1.1	0.6	0.1	1.2	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	SB	491	68	45	604	484	68	29	581	-7	0	-17	-23	-1%	0%	-37%	-4%	0.3	0.0	2.7	0.9	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	SB	213	44	44	301	224	48	41	314	12	5	-3	14	5%	11%	-6%	5%	0.8	0.7	0.4	0.8	Yes	Yes	Yes	Yes

Table E 3: Validation of Flows along the A5 by Vehicle Category – PM

Appendix F – East-West Screenlines by Vehicle Category

EW 1 - NB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Trench Road	ATC-406	83	9	6	98	54	11	0	66	-29	2	-5	-32	-35%	24%	-95%	-33%	3.5	0.7	3.1	3.5	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-410	95	10	7	112	51	16	5	72	-44	5	-2	-40	-46%	52%	-23%	-36%	5.2	1.5	0.6	4.2	Yes	Yes	Yes	Yes
A40 Mullenan Road	ATC-401	217	19	9	245	241	22	28	291	24	4	19	46	11%	19%	210%	19%	1.6	0.8	4.4	2.8	Yes	Yes	Yes	Yes
B193 Letterkenny Road	ATC-400	262	15	9	286	182	11	21	214	-81	-3	12	-72	-31%	-24%	142%	-25%	5.4	1.0	3.2	4.6	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	594	83	57	733	671	80	52	803	77	-3	-4	70	13%	-4%	-7%	10%	3.1	0.3	0.6	2.5	Yes	Yes	Yes	Yes
Total screenline		1251	136	86	1473	1199	140	106	1445	-52	4	20	-28	-4%	3%	23%	-2%	1.5	0.4	2.0	0.7	Yes	Yes	Yes	Yes

EW 1 - SB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Trench Road	ATC-406	27	3	3	33	13	20	4	37	-14	17	1	4	-53%	552%	45%	12%	3.2	5.0	0.7	0.6	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-410	35	4	4	42	18	0	4	22	-17	-4	1	-20	-48%	-100%	18%	-48%	3.3	2.8	0.3	3.5	Yes	Yes	Yes	Yes
A40 Mullenan Road	ATC-401	61	5	4	70	90	25	20	135	29	20	16	65	48%	370%	405%	93%	3.4	5.1	4.6	6.4	Yes	Yes	Yes	Yes
B193 Letterkenny Road	ATC-400	93	9	4	105	68	17	18	104	-24	8	14	-2	-26%	92%	410%	-2%	2.7	2.3	4.4	0.2	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	376	55	30	461	356	29	26	411	-20	-26	-4	-50	-5%	-47%	-14%	-11%	1.0	4.0	0.8	2.4	Yes	Yes	Yes	Yes
Total screenline		591	77	44	711	545	92	72	708	-46	15	28	-3	-8%	20%	64%	0%	1.9	1.7	3.7	0.1	Yes	Yes	Yes	Yes

EW 2 - NB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
R264 Orchard Park	ATC-421	61	10	7	77	45	5	8	58	-15	-5	2	-19	-26%	-51%	25%	-24%	2.1	1.9	0.6	2.3	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-407	87	11	8	105	55	25	8	87	-32	14	0	-18	-37%	127%	0%	-17%	3.8	3.3	0.0	1.9	Yes	Yes	Yes	Yes
R265 Rossgier Close	ATC-420	127	21	14	162	150	19	6	175	23	-2	-8	13	18%	-9%	-59%	8%	1.9	0.4	2.6	1.0	Yes	Yes	Yes	Yes
N14	ATC-419	141	23	16	180	75	23	22	120	-66	0	6	-60	-47%	-1%	40%	-33%	6.3	0.1	1.5	4.9	Yes	Yes	Yes	Yes
A5 Victoria Road at Burndennett Bridge	ATC-415	530	74	51	654	620	67	51	739	91	-7	1	85	17%	-10%	2%	13%	3.8	0.8	0.1	3.2	Yes	Yes	Yes	Yes
Total screenline		945	139	95	1179	945	139	95	1179	0	0	1	0	0%	0%	1%	0%	0.0	0.0	0.1	0.0	Yes	Yes	Yes	Yes

EW 2 - SB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Road	ATC-407	29	4	3	35	14	15	2	31	-15	11	-1	-4	-51%	299%	-23%	-13%	3.2	3.6	0.4	0.8	Yes	Yes	Yes	Yes
R264 Orchard Park	ATC-421	94	14	8	116	77	18	3	97	-17	4	-5	-19	-19%	29%	-65%	-16%	1.9	1.0	2.2	1.8	Yes	Yes	Yes	Yes
R265 Rossgier Close	ATC-420	109	16	9	134	89	27	13	130	-19	11	4	-4	-18%	67%	48%	-3%	1.9	2.3	1.3	0.4	Yes	Yes	Yes	Yes
N14	ATC-419	142	21	12	175	160	15	16	191	18	-7	4	15	12%	-31%	37%	9%	1.4	1.6	1.2	1.1	Yes	Yes	Yes	Yes
A5 Victoria Road at Burndennett Bridge	ATC-415	316	46	25	388	348	27	24	399	32	-20	-1	11	10%	-43%	-4%	3%	1.8	3.3	0.2	0.6	Yes	Yes	Yes	Yes
Total screenline		690	102	56	848	688	101	58	847	-2	-1	2	0	0%	-1%	4%	0%	0.1	0.1	0.3	0.0	Yes	Yes	Yes	Yes

EW 3 - NB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Castletown Road	ATC-417	4	1	1	6	5	0	0	5	0	-1	-1	-1	6%	-100%	-100%	-18%	0.1	1.2	1.1	0.5	Yes	Yes	Yes	Yes
Carrigans Road	ATC-418	13	2	2	16	0	0	0	0	-13	-2	-2	-16	-100%	-100%	-100%	-100%	5.0	2.0	1.9	5.7	Yes	Yes	Yes	Yes
B84 Baronscourt Road	ATC-402	30	3	7	40	29	4	10	43	-1	1	3	3	-2%	37%	43%	9%	0.1	0.6	1.0	0.5	Yes	Yes	Yes	Yes
B48 Glenpark Road	ATC-408	53	13	8	74	66	2	4	72	14	-12	-4	-2	26%	-87%	-50%	-2%	1.8	4.2	1.6	0.2	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	296	54	57	407	299	55	52	406	3	1	-5	-1	1%	1%	-9%	0%	0.2	0.1	0.7	0.1	Yes	Yes	Yes	Yes
Total screenline		396	73	74	543	400	61	66	526	4	-12	-8	-17	1%	-17%	-11%	-3%	0.2	1.5	1.0	0.7	Yes	Yes	Yes	Yes

EW 3 - SB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Castletown Road	ATC-417	6	1	1	8	0	0	0	0	-6	-1	-1	-8	-100%	-100%	-100%	-100%	3.4	1.3	1.3	3.9	Yes	Yes	Yes	Yes
Carrigans Road	ATC-418	6	1	1	8	8	0	0	8	2	-1	-1	0	26%	-100%	-100%	-3%	0.6	1.3	1.3	0.1	Yes	Yes	Yes	Yes
B84 Baronscourt Road	ATC-402	26	4	4	34	44	7	7	58	17	3	3	23	66%	79%	71%	68%	2.9	1.3	1.2	3.4	Yes	Yes	Yes	Yes
B48 Glenpark Road	ATC-408	135	34	20	190	155	25	7	187	20	-9	-13	-3	15%	-27%	-67%	-2%	1.6	1.7	3.7	0.2	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	508	63	48	620	507	63	50	620	-2	0	2	0	0%	-1%	4%	0%	0.1	0.0	0.3	0.0	Yes	Yes	Yes	Yes
Total screenline		682	103	74	860	713	95	64	872	31	-8	-11	12	5%	-8%	-14%	1%	1.2	0.8	1.3	0.4	Yes	Yes	Yes	Yes

Table F 1: East-West Screenlines 1 to 3 Modelled and Observed Flows by Vehicle Category AM

EW 4 - NB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B158 Donaghanie Road	ATC-404	97	14	10	122	109	16	1	126	12	1	-10	4	12%	9%	-92%	3%	1.2	0.3	4.0	0.3	Yes	Yes	Yes	Yes
B83 Seskinore Road	ATC-412	237	48	20	306	239	24	35	297	1	-25	15	-8	1%	-51%	77%	-3%	0.1	4.1	2.9	0.5	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	483	73	53	609	503	89	47	639	20	16	-6	30	4%	22%	-12%	5%	0.9	1.8	0.9	1.2	Yes	Yes	Yes	Yes
Total screenline		818	135	83	1037	851	128	82	1062	33	-7	-1	25	4%	-5%	-1%	2%	1.2	0.6	0.1	0.8	Yes	Yes	Yes	Yes

EW 4 - SB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B158 Donaghanie Road	ATC-404	31	5	3	39	35	8	4	46	4	3	0	7	12%	67%	10%	18%	0.6	1.2	0.2	1.1	Yes	Yes	Yes	Yes
B83 Seskinore Road	ATC-412	95	19	8	122	98	21	14	133	3	2	7	12	3%	10%	84%	10%	0.3	0.4	2.0	1.0	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	334	77	56	467	311	74	55	440	-23	-2	-1	-27	-7%	-3%	-3%	-6%	1.3	0.3	0.2	1.3	Yes	Yes	Yes	Yes
Total screenline		460	100	67	627	443	103	73	619	-17	3	5	-9	-4%	3%	8%	-1%	0.8	0.3	0.6	0.3	Yes	Yes	Yes	Yes

EW 5 - NB		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Favour Royal Road	ATC-405	30	8	7	45	18	12	23	53	-12	4	16	8	-41%	49%	247%	18%	2.5	1.3	4.3	1.1	Yes	Yes	Yes	Yes
A5 at Tullyvar Road	ATC-416	185	37	50	273	196	30	35	262	11	-7	-15	-11	6%	-19%	-30%	-4%	0.8	1.2	2.3	0.7	Yes	Yes	Yes	Yes
Total screenline		215	46	57	318	213	43	58	315	-1	-3	1	-3	-1%	-6%	2%	-1%	0.1	0.4	0.2	0.2	Yes	Yes	Yes	Yes

EW 5 - SB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Favour Royal Road	ATC-405	39	4	4	46	47	4	13	64	8	1	10	18	21%	16%	264%	40%	1.2	0.3	3.3	2.5	Yes	Yes	Yes	Yes
A5 at Tullyvar Road	ATC-416	221	34	45	300	222	40	35	297	1	6	-10	-3	0%	18%	-22%	-1%	0.1	1.0	1.6	0.2	Yes	Yes	Yes	Yes
Total screenline		259	37	49	346	268	44	49	361	9	7	0	16	3%	18%	-1%	4%	0.6	1.1	0.0	0.8	Yes	Yes	Yes	Yes

EW 6 - NB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Caledon Road	ATC-409	106	24	22	152	100	22	27	149	-6	-2	4	-3	-5%	-9%	19%	-2%	0.5	0.5	0.9	0.3	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	148	30	40	218	126	31	47	205	-21	1	7	-13	-14%	4%	17%	-6%	1.8	0.2	1.1	0.9	Yes	Yes	Yes	Yes
Total screenline		253	54	63	370	227	53	74	354	-27	-1	11	-16	-11%	-2%	18%	-4%	1.7	0.1	1.4	0.9	Yes	Yes	Yes	Yes

EW 6 - NB (AM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Caledon Road	ATC-409	107	19	17	143	104	32	12	148	-3	13	-5	5	-2%	69%	-31%	3%	0.3	2.6	1.4	0.4	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	175	27	36	237	151	19	62	232	-24	-8	27	-5	-14%	-29%	74%	-2%	1.9	1.6	3.8	0.3	Yes	Yes	Yes	Yes
Total screenline		281	45	53	380	255	51	74	380	-26	5	21	0	-9%	12%	40%	0%	1.6	0.8	2.7	0.0	Yes	Yes	Yes	Yes

Table F 2: East-West Screenlines 4 to 6 Modelled and Observed Flows by Vehicle Category AM

EW 1 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Trench Road	ATC-406	38	3	2	44	21	3	7	30	-17	-1	4	-14	-46%	-24%	197%	-32%	3.2	0.5	2.1	2.3	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-410	47	4	3	54	25	3	3	31	-22	-1	0	-23	-46%	-23%	-7%	-43%	3.6	0.5	0.1	3.5	Yes	Yes	Yes	Yes
A40 Mullenan Road	ATC-401	63	9	7	79	100	14	8	122	37	5	1	43	59%	52%	17%	55%	4.1	1.4	0.4	4.3	Yes	Yes	Yes	Yes
B193 Letterkenny Road	ATC-400	127	14	6	148	151	14	17	182	24	-1	11	34	19%	-5%	177%	23%	2.0	0.2	3.2	2.7	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	357	49	47	453	365	40	34	440	8	-9	-13	-13	2%	-19%	-27%	-3%	0.4	1.4	2.0	0.6	Yes	Yes	Yes	Yes
Total screenline		632	80	65	777	662	74	68	804	30	-7	4	27	5%	-8%	6%	4%	1.2	0.8	0.5	1.0	Yes	Yes	Yes	Yes

EW 1 - SB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Trench Road	ATC-406	35	4	2	41	25	3	4	31	-10	-1	2	-9	-28%	-27%	82%	-23%	1.8	0.6	1.0	1.5	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-410	48	5	3	55	26	2	1	28	-22	-3	-2	-27	-46%	-61%	-81%	-49%	3.6	1.6	1.8	4.2	Yes	Yes	Yes	Yes
A40 Mullenan Road	ATC-401	68	10	7	85	75	19	9	103	8	9	2	18	11%	91%	25%	22%	0.9	2.4	0.6	1.9	Yes	Yes	Yes	Yes
B193 Letterkenny Road	ATC-400	123	16	8	146	111	23	12	146	-12	7	5	-1	-10%	44%	61%	-1%	1.1	1.6	1.5	0.1	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	358	51	49	458	373	42	34	449	15	-9	-15	-9	4%	-17%	-31%	-2%	0.8	1.3	2.3	0.4	Yes	Yes	Yes	Yes
Total screenline		631	85	68	784	609	88	59	756	-22	3	-9	-28	-4%	4%	-14%	-4%	0.9	0.3	1.2	1.0	Yes	Yes	Yes	Yes

EW 2 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
R264 Orchard Park	ATC-421	81	11	7	98	64	13	6	84	-17	2	0	-15	-21%	21%	-2%	-15%	2.0	0.7	0.1	1.5	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-407	32	4	3	39	21	3	7	32	-11	0	4	-7	-34%	-8%	141%	-18%	2.1	0.2	1.9	1.2	Yes	Yes	Yes	Yes
R265 Rossgier Close	ATC-420	83	11	7	101	79	10	14	104	-4	-1	8	3	-4%	-7%	116%	3%	0.4	0.2	2.4	0.3	Yes	Yes	Yes	Yes
N14	ATC-419	132	18	11	160	108	18	11	137	-23	0	0	-23	-18%	1%	3%	-14%	2.1	0.0	0.1	1.9	Yes	Yes	Yes	Yes
A5 Victoria Road at Burndennett Bridge	ATC-415	299	41	39	379	349	40	27	416	50	-1	-12	37	17%	-2%	-31%	10%	2.8	0.2	2.1	1.9	Yes	Yes	Yes	Yes
Total screenline		627	85	66	777	622	85	66	773	-5	0	0	-4	-1%	0%	0%	-1%	0.2	0.0	0.0	0.2	Yes	Yes	Yes	Yes

EW 2 - SB		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Road	ATC-407	35	4	3	43	22	2	3	27	-13	-2	0	-16	-37%	-53%	-14%	-37%	2.4	1.2	0.3	2.7	Yes	Yes	Yes	Yes
R264 Orchard Park	ATC-421	77	11	6	94	60	11	1	73	-17	1	-5	-21	-22%	9%	-87%	-23%	2.0	0.3	2.8	2.3	Yes	Yes	Yes	Yes
R265 Rossgier Close	ATC-420	89	12	7	108	62	15	13	90	-27	3	6	-18	-30%	27%	87%	-17%	3.1	0.9	1.9	1.8	Yes	Yes	Yes	Yes
N14	ATC-419	140	19	11	169	135	16	17	168	-5	-2	6	-1	-3%	-13%	57%	-1%	0.4	0.6	1.6	0.1	Yes	Yes	Yes	Yes
A5 Victoria Road at Burndennett Bridge	ATC-415	289	41	40	370	351	42	34	426	61	1	-6	56	21%	2%	-14%	15%	3.4	0.1	0.9	2.8	Yes	Yes	Yes	Yes
Total screenline		630	87	66	783	630	87	67	784	-1	0	1	0	0%	0%	1%	0%	0.0	0.0	0.1	0.0	Yes	Yes	Yes	Yes

EW 3 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Castletown Road	ATC-417	4	1	1	6	1	1	0	2	-4	1	-1	-4	-82%	101%	-100%	-63%	2.2	0.7	1.4	1.9	Yes	Yes	Yes	Yes
Carrigans Road	ATC-418	7	1	2	9	4	0	0	4	-3	-1	-2	-6	-46%	-100%	-100%	-61%	1.4	1.5	1.7	2.3	Yes	Yes	Yes	Yes
B84 Baronscourt Road	ATC-402	22	4	5	31	28	6	8	41	6	2	3	11	28%	46%	54%	34%	1.2	0.8	1.1	1.8	Yes	Yes	Yes	Yes
B48 Glenpark Road	ATC-408	60	11	9	80	68	9	4	81	8	-2	-5	1	14%	-16%	-58%	2%	1.0	0.6	2.0	0.2	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	245	40	55	340	249	41	56	346	4	1	2	6	2%	2%	3%	2%	0.2	0.1	0.2	0.3	Yes	Yes	Yes	Yes
Total screenline		338	57	71	466	349	58	68	475	11	0	-3	9	3%	1%	-5%	2%	0.6	0.1	0.4	0.4	Yes	Yes	Yes	Yes

EW 3 - SB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Castletown Road	ATC-417	5	1	1	6	1	0	0	1	-4	0	-1	-5	-83%	-62%	-100%	-83%	2.3	0.6	1.4	2.7	Yes	Yes	Yes	Yes
Carrigans Road	ATC-418	7	1	2	10	1	1	0	3	-5	0	-2	-7	-79%	-2%	-100%	-73%	2.7	0.0	1.8	2.8	Yes	Yes	Yes	Yes
B84 Baronscourt Road	ATC-402	23	5	5	33	29	9	7	45	6	4	2	12	28%	70%	47%	37%	1.2	1.3	0.9	1.9	Yes	Yes	Yes	Yes
B48 Glenpark Road	ATC-408	61	11	9	81	71	9	3	84	10	-2	-5	3	16%	-18%	-60%	3%	1.2	0.6	2.1	0.3	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	256	43	57	356	252	43	57	352	-3	0	0	-4	-1%	-1%	0%	-1%	0.2	0.1	0.0	0.2	Yes	Yes	Yes	Yes
Total screenline		351	62	73	486	355	62	67	484	4	1	-6	-2	1%	1%	-8%	0%	0.2	0.1	0.7	0.1	Yes	Yes	Yes	Yes

Table F 3: East-West Screenlines 1 to 3 Modelled and Observed Flows by Vehicle Category IP

EW 4 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B158 Donaghanie Road	ATC-404	50	8	8	67	59	5	1	65	9	-4	-7	-2	17%	-44%	-89%	-4%	1.2	1.4	3.4	0.3	Yes	Yes	Yes	Yes
B83 Seskinore Road	ATC-412	123	23	14	159	124	13	18	154	1	-10	4	-5	1%	-44%	29%	-3%	0.1	2.4	1.0	0.4	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	252	48	52	352	246	59	65	370	-6	11	13	18	-2%	22%	25%	5%	0.4	1.5	1.7	1.0	Yes	Yes	Yes	Yes
Total screenline		425	79	74	579	429	76	84	589	4	-3	10	11	1%	-4%	13%	2%	0.2	0.3	1.1	0.4	Yes	Yes	Yes	Yes

EW 4 - SB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B158 Donaghanie Road	ATC-404	46	8	8	62	32	3	13	48	-14	-5	5	-13	-31%	-61%	72%	-22%	2.3	2.0	1.7	1.8	Yes	Yes	Yes	Yes
B83 Seskinore Road	ATC-412	121	22	13	157	114	27	26	167	-7	5	13	11	-6%	21%	97%	7%	0.6	0.9	2.9	0.8	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	291	59	60	411	270	53	60	382	-21	-6	-1	-28	-7%	-11%	-1%	-7%	1.3	0.8	0.1	1.4	Yes	Yes	Yes	Yes
Total screenline		458	89	82	629	416	83	99	598	-42	-6	18	-31	-9%	-7%	22%	-5%	2.0	0.7	1.9	1.3	Yes	Yes	Yes	Yes

EW 5 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Favour Royal Road	ATC-405	36	5	6	47	29	2	16	47	-8	-3	10	-1	-21%	-65%	174%	-2%	1.3	1.8	3.1	0.1	Yes	Yes	Yes	Yes
A5 at Tullyvar Road	ATC-416	161	26	49	236	183	31	41	254	21	6	-8	18	13%	22%	-17%	8%	1.6	1.0	1.3	1.2	Yes	Yes	Yes	Yes
Total screenline		197	31	55	283	211	33	57	301	14	2	2	18	7%	7%	3%	6%	1.0	0.4	0.2	1.0	Yes	Yes	Yes	Yes

EW 5 - SB		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Favour Royal Road	ATC-405	38	5	6	50	35	2	15	52	-3	-3	9	2	-9%	-54%	144%	5%	0.6	1.4	2.7	0.3	Yes	Yes	Yes	Yes
A5 at Tullyvar Road	ATC-416	176	26	50	252	179	33	42	254	4	6	-8	2	2%	24%	-16%	1%	0.3	1.2	1.2	0.1	Yes	Yes	Yes	Yes
Total screenline		214	32	56	302	214	35	56	306	0	4	0	4	0%	11%	1%	1%	0.0	0.6	0.0	0.2	Yes	Yes	Yes	Yes

EW 6 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Caledon Road	ATC-409	75	12	15	102	95	17	20	132	20	5	5	30	26%	37%	35%	29%	2.2	1.2	1.2	2.7	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	148	24	45	217	120	26	63	209	-28	3	17	-8	-19%	12%	39%	-4%	2.4	0.6	2.4	0.5	Yes	Yes	Yes	Yes
Total screenline		224	36	60	319	215	43	82	341	-8	7	23	22	-4%	21%	38%	7%	0.6	1.2	2.7	1.2	Yes	Yes	Yes	Yes

EW 6 - NB (IP)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Caledon Road	ATC-409	77	13	17	107	75	14	20	108	-3	0	3	1	-3%	3%	18%	1%	0.3	0.1	0.7	0.1	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	161	24	46	231	132	41	51	224	-29	17	5	-7	-18%	71%	10%	-3%	2.4	3.0	0.7	0.5	Yes	Yes	Yes	Yes
Total screenline		238	37	63	338	206	55	71	332	-32	18	8	-6	-13%	47%	13%	-2%	2.1	2.6	1.0	0.3	Yes	Yes	Yes	Yes

Table F 4: East-West Screenlines 4 to 6 Modelled and Observed Flows by Vehicle Category IP

EW 1 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Trench Road	ATC-406	43	4	2	49	14	4	7	25	-29	1	5	-23	-68%	15%	247%	-48%	5.4	0.3	2.3	3.8	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-410	57	5	3	65	33	0	0	33	-24	-5	-3	-32	-42%	-100%	-100%	-49%	3.6	3.2	2.3	4.6	Yes	Yes	Yes	Yes
A40 Mullenan Road	ATC-401	74	10	4	88	136	21	10	167	63	11	6	79	85%	107%	146%	90%	6.1	2.7	2.2	7.0	Yes	Yes	Yes	Yes
B193 Letterkenny Road	ATC-400	140	12	6	158	145	27	26	198	5	15	20	39	3%	128%	308%	25%	0.4	3.4	4.9	2.9	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	399	57	25	481	333	33	21	387	-67	-24	-4	-95	-17%	-41%	-18%	-20%	3.5	3.5	0.9	4.5	Yes	Yes	Yes	Yes
Total screenline		713	88	40	841	661	85	64	809	-52	-3	23	-31	-7%	-3%	58%	-4%	2.0	0.3	3.3	1.1	Yes	Yes	Yes	Yes

EW 1 - SB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Trench Road	ATC-406	92	8	3	104	65	5	16	85	-27	-4	12	-19	-30%	-42%	359%	-18%	3.1	1.4	3.9	1.9	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-410	90	8	3	101	71	14	3	87	-19	5	0	-14	-21%	64%	-14%	-14%	2.1	1.6	0.3	1.4	Yes	Yes	Yes	Yes
A40 Mullenan Road	ATC-401	188	18	8	213	168	30	11	208	-20	12	3	-5	-10%	67%	35%	-2%	1.5	2.5	0.9	0.3	Yes	Yes	Yes	Yes
B193 Letterkenny Road	ATC-400	251	24	6	282	315	26	9	351	64	2	3	68	25%	6%	48%	24%	3.8	0.3	1.1	3.8	Yes	Yes	Yes	Yes
A5 Victoria Road	ATC-411	601	83	53	738	625	68	43	737	24	-15	-10	-1	4%	-18%	-19%	0%	1.0	1.7	1.5	0.0	Yes	Yes	Yes	Yes
Total screenline		1222	142	74	1438	1244	142	81	1468	22	1	7	30	2%	0%	10%	2%	0.6	0.0	0.8	0.8	Yes	Yes	Yes	Yes

EW 2 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
R264 Orchard Park	ATC-421	106	13	6	125	141	17	2	161	35	4	-4	35	33%	33%	-71%	28%	3.2	1.1	2.2	3.0	Yes	Yes	Yes	Yes
B48 Duncastle Road	ATC-407	39	5	2	46	25	1	2	28	-15	-3	-1	-18	-37%	-76%	-22%	-40%	2.6	2.0	0.4	3.0	Yes	Yes	Yes	Yes
R265 Rossgier Close	ATC-420	132	16	8	156	113	17	10	139	-19	1	2	-16	-15%	6%	26%	-10%	1.7	0.2	0.7	1.3	Yes	Yes	Yes	Yes
N14	ATC-419	175	22	10	207	188	33	11	231	12	11	1	24	7%	50%	6%	12%	0.9	2.1	0.2	1.6	Yes	Yes	Yes	Yes
A5 Victoria Road at Burndennett Bridge	ATC-415	352	50	22	425	330	38	24	392	-22	-13	2	-33	-6%	-25%	10%	-8%	1.2	1.9	0.5	1.6	Yes	Yes	Yes	Yes
Total screenline		804	106	48	959	796	106	48	951	-8	0	0	-8	-1%	0%	0%	-1%	0.3	0.0	0.0	0.3	Yes	Yes	Yes	Yes

EW 2 - SB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Road	ATC-407	86	10	5	101	73	17	12	103	-13	7	7	2	-15%	75%	142%	2%	1.4	2.0	2.4	0.2	Yes	Yes	Yes	Yes
R264 Orchard Park	ATC-421	81	10	4	96	80	14	0	94	-1	3	-4	-2	-1%	34%	-100%	-2%	0.1	1.0	3.0	0.2	Yes	Yes	Yes	Yes
R265 Rossgier Close	ATC-420	163	21	9	193	126	27	7	160	-37	6	-2	-33	-23%	31%	-21%	-17%	3.1	1.3	0.7	2.5	Yes	Yes	Yes	Yes
N14	ATC-419	182	23	10	215	180	23	13	216	-2	0	3	1	-1%	-2%	35%	1%	0.1	0.1	1.0	0.1	Yes	Yes	Yes	Yes
A5 Victoria Road at Burndennett Bridge	ATC-415	517	71	46	634	565	55	41	662	48	-16	-4	28	9%	-23%	-10%	4%	2.1	2.1	0.7	1.1	Yes	Yes	Yes	Yes
Total screenline		1029	135	74	1238	1025	136	74	1235	-4	0	0	-3	0%	0%	0%	0%	0.1	0.0	0.0	0.1	Yes	Yes	Yes	Yes

EW 3 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Castletown Road	ATC-417	6	1	1	8	0	0	0	0	-6	0	-1	-7	-100%	-42%	-100%	-94%	3.5	0.4	1.2	3.5	Yes	Yes	Yes	Yes
Carrigans Road	ATC-418	10	1	1	12	11	0	0	11	1	-1	-1	-1	13%	-99%	-100%	-11%	0.4	1.6	1.5	0.4	Yes	Yes	Yes	Yes
B84 Baronscourt Road	ATC-402	35	4	3	42	50	7	4	61	15	3	2	20	44%	56%	60%	47%	2.4	1.1	0.8	2.7	Yes	Yes	Yes	Yes
B48 Glenpark Road	ATC-408	136	26	21	182	123	24	9	157	-13	-1	-12	-26	-9%	-5%	-58%	-14%	1.1	0.2	3.1	2.0	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	513	70	39	622	551	71	42	664	38	1	4	43	7%	2%	9%	7%	1.6	0.2	0.6	1.7	Yes	Yes	Yes	Yes
Total screenline		700	102	64	866	736	103	55	894	36	1	-9	28	5%	1%	-13%	3%	1.3	0.1	1.1	0.9	Yes	Yes	Yes	Yes

EW 3 - SB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
Castletown Road	ATC-417	7	1	1	8	2	2	0	4	-5	1	-1	-4	-75%	153%	-100%	-52%	2.5	1.1	1.3	1.8	Yes	Yes	Yes	Yes
Carrigans Road	ATC-418	13	2	2	16	1	1	2	4	-11	-1	0	-12	-89%	-70%	32%	-76%	4.3	1.2	0.4	3.9	Yes	Yes	Yes	Yes
B84 Baronscourt Road	ATC-402	35	6	4	46	52	8	9	68	17	1	4	23	48%	22%	96%	49%	2.6	0.5	1.6	3.0	Yes	Yes	Yes	Yes
B48 Glenpark Road	ATC-408	68	13	10	91	70	3	4	77	2	-10	-6	-14	3%	-77%	-63%	-16%	0.3	3.5	2.4	1.5	Yes	Yes	Yes	Yes
A5 Beltany Road	ATC-403	331	48	56	435	351	52	56	459	20	4	0	24	6%	9%	0%	5%	1.1	0.6	0.0	1.1	Yes	Yes	Yes	Yes
Total screenline		454	70	73	596	476	66	70	612	22	-4	-2	16	5%	-6%	-3%	3%	1.0	0.5	0.3	0.6	Yes	Yes	Yes	Yes

Table F 5: East-West Screenlines 1 to 3 Modelled and Observed Flows by Vehicle Category PM

EW 4 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B158 Donaghanie Road	ATC-404	52	8	5	64	41	5	2	47	-11	-3	-3	-17	-21%	-42%	-54%	-26%	1.6	1.3	1.4	2.3	Yes	Yes	Yes	Yes
B83 Seskinore Road	ATC-412	135	23	7	165	107	26	13	147	-28	4	6	-18	-20%	15%	91%	-11%	2.5	0.7	2.0	1.4	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	417	90	52	558	417	87	53	557	1	-2	1	-1	0%	-3%	1%	0%	0.0	0.3	0.1	0.0	Yes	Yes	Yes	Yes
Total screenline		603	120	64	787	565	118	68	751	-38	-2	4	-36	-6%	-2%	7%	-5%	1.6	0.2	0.5	1.3	Yes	Yes	Yes	Yes

EW 4 - SB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B158 Donaghanie Road	ATC-404	95	14	9	118	94	0	0	94	-1	-14	-9	-24	-1%	-98%	-99%	-20%	0.1	5.2	4.2	2.3	Yes	Yes	Yes	Yes
B83 Seskinore Road	ATC-412	268	45	14	327	285	41	44	369	17	-5	30	42	6%	-11%	220%	13%	1.0	0.7	5.6	2.3	Yes	Yes	Yes	Yes
A5 Doogary Road	ATC-413	491	68	45	604	485	68	29	582	-6	0	-17	-22	-1%	0%	-37%	-4%	0.3	0.0	2.8	0.9	Yes	Yes	Yes	Yes
Total screenline		853	128	68	1049	864	109	72	1045	10	-19	4	-4	1%	-15%	6%	0%	0.4	1.7	0.5	0.1	Yes	Yes	Yes	Yes

EW 5 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Favour Royal Road	ATC-405	52	5	3	61	44	3	21	68	-8	-2	18	7	-15%	-48%	515%	12%	1.1	1.3	5.0	0.9	Yes	Yes	Yes	Yes
A5 at Tullyvar Road	ATC-416	264	39	46	349	264	42	33	339	0	4	-13	-9	0%	10%	-28%	-3%	0.0	0.6	2.1	0.5	Yes	Yes	Yes	Yes
Total screenline		316	44	50	409	308	45	54	407	-8	1	5	-2	-2%	3%	9%	0%	0.4	0.2	0.6	0.1	Yes	Yes	Yes	Yes

EW 5 - SB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Favour Royal Road	ATC-405	41	11	4	56	60	25	23	108	19	14	19	52	46%	125%	480%	92%	2.7	3.2	5.2	5.7	Yes	Yes	Yes	Yes
A5 at Tullyvar Road	ATC-416	244	50	50	345	227	40	32	299	-18	-10	-19	-46	-7%	-20%	-37%	-13%	1.1	1.5	2.9	2.6	Yes	Yes	Yes	Yes
Total screenline		285	61	54	401	286	65	55	406	1	4	0	6	0%	6%	1%	1%	0.1	0.5	0.0	0.3	Yes	Yes	Yes	Yes

EW 6 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Caledon Road	ATC-409	132	17	12	161	93	25	20	138	-40	8	8	-23	-30%	48%	72%	-14%	3.7	1.8	2.1	1.9	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	221	32	39	292	192	51	66	309	-28	18	27	17	-13%	56%	70%	6%	2.0	2.8	3.7	1.0	Yes	Yes	Yes	Yes
Total screenline		353	49	50	452	285	76	86	447	-68	26	35	-6	-19%	54%	70%	-1%	3.8	3.3	4.3	0.3	Yes	Yes	Yes	Yes

EW 6 - NB (PM)		Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Site Description	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
A28 Caledon Road	ATC-409	117	24	21	162	100	26	22	148	-17	2	1	-14	-14%	7%	4%	-9%	1.6	0.3	0.2	1.1	Yes	Yes	Yes	Yes
A5 Mill Street	ATC-414	213	44	44	301	224	48	41	313	11	5	-3	13	5%	11%	-6%	4%	0.7	0.7	0.4	0.7	Yes	Yes	Yes	Yes
Total screenline		330	68	65	463	324	74	64	461	-6	6	-2	-2	-2%	9%	-3%	0%	0.3	0.7	0.2	0.1	Yes	Yes	Yes	Yes

Table F 6: East-West Screenlines 4 to 6 Modelled and Observed Flows by Vehicle Category PM

Appendix G – North-South Screenlines by Vehicle Category

NS 1 screenline - EB (AM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B193 Letterkenny Rd	Val	ATC 400	262	15	9	286	182	11	21	214	-81	-3	12	-72	-31%	-24%	142%	-25%	5.4	1.0	3.2	4.6	Yes	Yes	Yes	Yes
A40 Mullenan Rd	Val	ATC 401	217	19	9	245	241	22	28	291	24	4	19	46	11%	19%	210%	19%	1.6	0.8	4.4	2.8	Yes	Yes	Yes	Yes
A38 Lifford Rd	Cal	ATC 52	355	53	30	438	299	57	32	388	-56	4	2	-50	-16%	7%	8%	-11%	3.1	0.5	0.4	2.4	Yes	Yes	Yes	Yes
B86 Umey Rd	Val	ATC 504	78	8	3	89	77	12	12	100	-1	3	9	11	-2%	39%	328%	12%	0.1	1.0	3.3	1.1	Yes	Yes	Yes	Yes
Orchard Rd	Val	ATC 505	53	9	6	67	41	11	1	53	-12	3	-5	-14	-23%	30%	-82%	-21%	1.7	0.8	2.6	1.8	Yes	Yes	Yes	Yes
B165 Bells Park Road	Val	ATC 506	61	10	8	80	47	7	9	63	-14	-3	0	-17	-23%	-29%	3%	-21%	1.9	1.0	0.1	2.0	Yes	Yes	Yes	Yes
B72 Fyfin Rd	Val	ATC 507	175	31	37	243	174	31	17	222	-1	-1	-20	-21	0%	-2%	-53%	-9%	0.0	0.1	3.8	1.4	Yes	Yes	Yes	Yes
B164 Deerparl Rd	Val	ATC 508	32	5	4	41	32	5	4	40	0	0	0	0	1%	-5%	-4%	0%	0.0	0.1	0.1	0.0	Yes	Yes	Yes	Yes
Baroncourt Road	Val	ATC 509	43	4	10	58	43	4	10	57	-1	0	0	-1	-2%	-6%	-2%	-2%	0.1	0.1	0.0	0.1	Yes	Yes	Yes	Yes
From Cube 2008 base model	Val	ATC 510	14	4	2	20	15	1	0	16	1	-3	-2	-4	8%	-76%	-100%	-19%	0.3	1.8	2.1	0.9	Yes	Yes	Yes	Yes
Drumlegah Rd S	Val	ATC 511	48	10	9	66	60	2	2	64	13	-8	-7	-2	26%	-81%	-77%	-3%	1.7	3.3	2.9	0.3	Yes	Yes	Yes	Yes
B50 Gillygooley Rd	Val	ATC 512	246	34	8	288	251	35	26	311	5	1	18	24	2%	3%	224%	8%	0.3	0.2	4.3	1.4	Yes	Yes	Yes	Yes
A32 Clanabogan Road, SW of Omagh	Val	ATC 513	521	60	32	614	503	62	18	583	-18	2	-14	-30	-3%	3%	-44%	-5%	0.8	0.2	2.9	1.2	Yes	Yes	Yes	Yes
B83 Seskinore Rd	Val	ATC 412	237	48	20	306	239	24	35	297	1	-25	15	-8	1%	-51%	77%	-3%	0.1	4.1	2.9	0.5	Yes	Yes	Yes	Yes
Augher Point Road	Val	Observation count	16	2	1	19	30	4	0	34	14	2	-1	15	88%	84%	-100%	78%	2.9	1.0	1.4	2.9	Yes	Yes	Yes	Yes
Moylagh Rd	Val	ATC 516	40	8	7	54	124	31	23	178	84	23	17	123	209%	302%	252%	227%	9.2	5.3	4.3	11.5	Yes	Yes	Yes	No
Greenmount Road	Val	Observation count	37	4	2	43	0	0	0	0	-37	-4	-2	-43	-100%	-100%	-100%	-100%	8.6	2.8	2.0	9.3	Yes	Yes	Yes	Yes
Springhill Road	Cal	ATC 518	36	7	6	49	82	14	0	96	46	7	-6	47	128%	103%	-100%	97%	6.0	2.2	3.4	5.5	Yes	Yes	Yes	Yes
Tulybryan Road	Val	2008model flows in vph	0	0	0	0	8	0	0	8	8	0	0	8	0%	0%	0%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 Annaghilla Road W	Val	ATC 520	312	40	49	402	323	40	52	414	10	0	3	13	3%	-1%	6%	3%	0.6	0.1	0.4	0.6	Yes	Yes	Yes	Yes
Tullywinny Rd	Val	Observation count	7	1	0	8	3	2	1	6	-4	1	1	-2	-51%	113%	0%	-23%	1.6	0.9	0.0	0.7	Yes	Yes	Yes	Yes
A28 Favour Royal Rd	Val	ATC 405	39	4	4	46	47	4	13	64	8	1	10	18	21%	16%	264%	40%	1.2	0.3	3.3	2.5	Yes	Yes	Yes	Yes
Total scrrenline			2830	376	254	3460	2821	378	302	3501	-9	2	48	41	0%	1%	19%	1%	0.2	0.1	2.9	0.7				

Table G 1: NS (West) Screenline EB - Modelled and Observed Flows by Vehicle Category AM

NS 1 screenline - WB (AM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	Type	Reference	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT	Car	LGV	HGV	TOT
B193 Letterkenny Rd	Val	ATC 400	93	9	4	105	68	17	18	104	-24	8	14	-2	-26%	92%	410%	-2%	2.7	2.3	4.4	0.2	Yes	Yes	Yes	Yes
A40 Mullenan Rd	Val	ATC 401	61	5	4	70	90	25	20	135	29	20	16	65	48%	370%	405%	93%	3.4	5.1	4.6	6.4	Yes	Yes	Yes	Yes
A38 Lifford Rd	Val	ATC 503	348	55	34	436	346	55	34	435	-2	0	0	-1	-1%	1%	1%	0%	0.1	0.1	0.1	0.1	Yes	Yes	Yes	Yes
B86 Umey Rd	Val	ATC 504	38	7	2	48	52	6	9	66	13	-2	7	18	35%	-22%	308%	39%	2.0	0.6	2.8	2.5	Yes	Yes	Yes	Yes
Orchard Rd	Val	ATC 505	33	5	4	42	24	0	7	32	-9	-5	3	-11	-28%	-95%	93%	-26%	1.7	3.0	1.5	1.8	Yes	Yes	Yes	Yes
B165 Bells Park Road	Val	ATC 506	36	13	10	58	27	7	6	39	-9	-6	-3	-19	-26%	-49%	-35%	-33%	1.7	2.0	1.2	2.7	Yes	Yes	Yes	Yes
B72 Fyfin Rd	Val	ATC 507	125	22	27	174	125	22	27	173	0	-1	0	0	0%	-2%	0%	0%	0.0	0.1	0.0	0.0	Yes	Yes	Yes	Yes
B164 Deerparl Rd	Val	ATC 508	27	5	5	37	27	6	5	38	0	1	0	0	-1%	15%	0%	1%	0.1	0.3	0.0	0.1	Yes	Yes	Yes	Yes
Baroncourt Road	Val	ATC 509	44	7	7	57	44	7	7	58	0	0	0	0	-1%	7%	3%	1%	0.0	0.2	0.1	0.0	Yes	Yes	Yes	Yes
From Cube 2008 base model	Val	ATC 510	4	1	1	6	3	3	0	6	-2	2	-1	0	-38%	163%	-100%	-8%	0.9	1.3	1.1	0.2	Yes	Yes	Yes	Yes
Drumlegah Rd S	Val	ATC 511	19	3	2	24	7	1	1	10	-12	-1	-1	-14	-62%	-46%	-42%	-59%	3.3	0.8	0.6	3.4	Yes	Yes	Yes	Yes
B50 Gillygooley Rd	Val	ATC 512	72	14	8	94	64	26	16	106	-8	12	7	12	-11%	91%	88%	13%	0.9	2.8	2.1	1.2	Yes	Yes	Yes	Yes
A32 Clanabogan Road, SW of Omagh	Val	ATC 513	211	47	27	285	191	45	17	253	-20	-3	-10	-33	-10%	-6%	-36%	-11%	1.4	0.4	2.1	2.0	Yes	Yes	Yes	Yes
B83 Seskinore Rd	Val	ATC 412	95	19	8	122	98	21	14	133	3	2	7	12	3%	10%	84%	10%	0.3	0.4	2.0	1.0	Yes	Yes	Yes	Yes
Augher Point Road	Val	Observation count	3	0	0	3	0	13	0	13	-3	13	0	10	-100%	0%	0%	333%	2.4	0.0	0.0	3.5	Yes	Yes	Yes	Yes
Moylagh Rd	Val	ATC 516	33	6	5	44	82	40	33	155	50	34	28	111	153%	540%	511%	251%	6.6	7.0	6.3	11.1	Yes	Yes	Yes	No
Greenmount Road	Val	Observation count	41	4	3	48	0	0	0	0	-41	-4	-3	-48	-100%	-100%	-100%	-100%	9.1	2.8	2.4	9.8	Yes	Yes	Yes	Yes
Springhill Road	Cal	ATC 518	22	4	4	30	39	0	0	39	17	-4	-4	9	75%	-100%	-100%	29%	3.0	2.9	2.7	1.5	Yes	Yes	Yes	Yes
Tulybryan Road	Val	2008model flows in vph	0	0	0	0	5	0	0	5	5	0	0	5	0%	0%	0%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 Annaghilla Road W	Val	ATC 520	190	51	63	304	194	51	66	311	5	0	3	7	2%	-1%	5%	2%	0.3	0.1	0.4	0.4	Yes	Yes	Yes	Yes
Tullywinny Rd	Val	Observation count	3	0	0	3	0	0	0	0	-3	0	0	-3	-100%	0%	0%	-100%	2.4	0.0	0.0	2.4	Yes	Yes	Yes	Yes
A28 Favour Royal Rd	Val	ATC 405	30	8	7	45	18	12	23	53	-12	4	16	8	-41%	49%	247%	18%	2.5	1.3	4.3	1.1	Yes	Yes	Yes	Yes
Total scrrenline			1528	286	222	2037	1503	357	303	2163	-26	71	81	126	-2%	25%	36%	6%	0.7	3.9	5.0	2.7				

Table G 2: NS (West) Screenline WB - Modelled and Observed Flows by Vehicle Category AM

NS 2 screenline - WB (AM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Rd	Val	ATC 410	95	10	7	112	51	16	5	72	-44	5	-2	-40	-46%	52%	-23%	-36%	5.2	1.5	0.6	4.2	Yes	Yes	Yes	Yes
Donagheady Rd	Val	Observation count	9	1	1	11	10	1	1	12	1	0	0	1	11%	0%	3%	9%	0.3	0.0	0.0	0.3	Yes	Yes	Yes	Yes
B49 Beryhill Rd	Val	ATC 525	179	24	17	219	180	17	15	212	1	-6	-2	-7	1%	-27%	-10%	-3%	0.1	1.4	0.4	0.5	Yes	Yes	Yes	Yes
B536 Spout Rd	Val	ATC 526	44	7	6	56	44	7	6	56	0	0	0	1	0%	5%	2%	1%	0.0	0.1	0.1	0.1	Yes	Yes	Yes	Yes
B46 Plumbridge Rd	Cal	ATC 527	70	16	11	97	82	8	19	109	12	-8	8	12	18%	-52%	72%	12%	1.4	2.4	2.1	1.2	Yes	Yes	Yes	Yes
Strahutter Rd	Cal	ATC 528	18	4	3	25	20	12	0	32	3	8	-3	7	14%	177%	-100%	27%	0.6	2.7	2.6	1.3	Yes	Yes	Yes	Yes
Gortnagarn Rd	Val	ATC 529	65	17	10	92	67	17	0	84	2	0	-10	-7	3%	3%	-99%	-8%	0.2	0.1	4.3	0.8	Yes	Yes	Yes	Yes
B48 Gortin Rd, North of Omagh	Val	ATC 530	222	19	6	246	214	19	7	240	-8	0	2	-6	-3%	2%	27%	-2%	0.5	0.1	0.6	0.4	Yes	Yes	Yes	Yes
Tirquin Rd	Val	Observation count	21	2	2	25	22	8	7	38	1	6	5	13	7%	321%	249%	52%	0.3	2.8	2.4	2.3	Yes	Yes	Yes	Yes
A505 Killyclogher Rd	Cal	ATC 532	314	46	33	394	319	48	51	417	5	1	17	24	2%	3%	52%	6%	0.3	0.2	2.7	1.2	Yes	Yes	Yes	Yes
B4 Drumnakilly Rd	Cal	ATC 533	187	28	20	234	248	31	2	281	61	4	-18	46	33%	13%	-91%	20%	4.1	0.7	5.5	2.9	Yes	Yes	Yes	Yes
B158 Donaghanie Rd	Val	ATC 404	97	14	10	122	109	16	1	126	12	1	-10	4	12%	9%	-92%	3%	1.2	0.3	4.0	0.3	Yes	Yes	Yes	Yes
B46 Moylagh Rd	Val	ATC 535	56	11	9	77	56	11	9	76	0	0	0	0	-1%	2%	-1%	0%	0.1	0.1	0.0	0.0	Yes	Yes	Yes	Yes
Cavey Rd	Val	Observation count	9	1	1	11	31	8	5	43	22	7	4	32	242%	660%	352%	290%	4.9	3.2	2.1	6.1	Yes	Yes	Yes	Yes
B34 Dungannon Rd	Val	ATC 537	91	33	22	146	91	33	22	146	0	0	0	0	0%	0%	1%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 New Annaghilla Rd E of A5	Val	ATC N	308	79	90	478	317	84	80	482	9	4	-10	3	3%	6%	-11%	1%	0.5	0.5	1.1	0.1	Yes	Yes	Yes	Yes
B128 Sydney St	Val	ATC 539	16	3	4	22	42	31	12	85	26	28	8	63	167%	955%	240%	284%	4.9	6.8	3.0	8.6	Yes	Yes	Yes	Yes
B35 Dungannon Rd	Val	ATC 540	91	17	20	129	74	19	29	123	-17	2	9	-6	-18%	13%	43%	-5%	1.8	0.5	1.8	0.5	Yes	Yes	Yes	Yes
Total scrrenline			1891	332	272	2494	1977	385	271	2633	86	54	-1	139	5%	16%	-1%	6%	2.0	2.8	0.1	2.7				

Table G 3: NS (East) Screenline WB - Modelled and Observed Flows by Vehicle Category AM

NS 2 screenline - EB (AM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Rd	Val	ATC 410	35	4	4	42	18	0	4	22	-17	-4	1	-20	-48%	-100%	18%	-48%	3.3	2.8	0.3	3.5	Yes	Yes	Yes	Yes
Donagheady Rd	Val	Observation count	8	1	1	10	9	0	1	10	1	-1	0	0	13%	-100%	3%	0%	0.3	1.4	0.0	0.0	Yes	Yes	Yes	Yes
B49 Beryhill Rd	Val	ATC 525	86	17	16	119	86	17	16	119	0	0	0	-1	0%	-2%	-3%	0%	0.0	0.1	0.1	0.0	Yes	Yes	Yes	Yes
B536 Spout Rd	Val	ATC 526	17	3	2	21	17	3	4	24	0	0	2	3	2%	19%	87%	13%	0.1	0.3	1.1	0.6	Yes	Yes	Yes	Yes
B46 Plumbridge Rd	Cal	ATC 527	36	8	6	50	34	8	10	52	-2	0	4	2	-6%	-5%	78%	3%	0.4	0.2	1.6	0.2	Yes	Yes	Yes	Yes
Strahutter Rd	Val	Supporting ATC 13CB	15	2	1	18	14	0	1	15	-1	-2	0	-3	-10%	-84%	13%	-17%	0.4	1.5	0.1	0.7	Yes	Yes	Yes	Yes
Gortnagarn Rd	Val	ATC 529	79	20	12	110	78	20	0	98	-1	0	-12	-12	-1%	0%	-100%	-11%	0.1	0.0	4.8	1.2	Yes	Yes	Yes	Yes
B48 Gortin Rd, North of Omagh	Val	ATC 530	93	10	3	106	93	10	5	108	0	0	2	1	0%	-3%	46%	1%	0.0	0.1	0.8	0.1	Yes	Yes	Yes	Yes
Tirquin Rd	Val	Observation count	4	0	0	4	32	9	11	53	28	9	11	49	703%	0%	0%	1216%	6.6	0.0	0.0	9.1	Yes	Yes	Yes	Yes
A505 Killyclogher Rd	Cal	ATC 532	176	26	19	221	215	29	22	267	40	4	3	46	23%	14%	16%	21%	2.8	0.7	0.7	3.0	Yes	Yes	Yes	Yes
B4 Drumnakilly Rd	Cal	ATC 533	79	12	8	99	71	13	5	90	-8	2	-3	-9	-10%	13%	-35%	-9%	0.9	0.4	1.1	0.9	Yes	Yes	Yes	Yes
B158 Donaghanie Rd	Val	ATC 404	31	5	3	39	35	8	4	46	4	3	0	7	12%	67%	10%	18%	0.6	1.2	0.2	1.1	Yes	Yes	Yes	Yes
B46 Moylagh Rd	Val	ATC 535	42	8	7	57	42	8	7	57	0	0	0	0	1%	0%	-3%	0%	0.0	0.0	0.1	0.0	Yes	Yes	Yes	Yes
Cavey Rd	Val	Observation count	9	1	1	11	24	3	7	34	15	2	6	23	169%	167%	588%	207%	3.7	1.2	3.0	4.8	Yes	Yes	Yes	Yes
B34 Dungannon Rd	Val	ATC 537	109	32	23	164	109	20	23	152	0	-13	0	-12	0%	-39%	1%	-8%	0.0	2.5	0.0	1.0	Yes	Yes	Yes	Yes
A4 New Annaghilla Rd E of A5	Val	ATC N	508	61	58	626	532	87	84	702	24	26	26	76	5%	43%	45%	12%	1.0	3.0	3.1	2.9	Yes	Yes	Yes	Yes
B128 Sydney St	Val	ATC 539	29	5	7	41	53	8	10	70	24	2	3	29	81%	37%	46%	70%	3.7	0.8	1.1	3.8	Yes	Yes	Yes	Yes
B35 Dungannon Rd	Val	ATC 540	82	15	18	116	76	24	24	124	-6	8	5	8	-7%	55%	30%	7%	0.6	1.9	1.2	0.8	Yes	Yes	Yes	Yes
Total scrrenline			1436	231	189	1856	1538	266	237	2041	101	35	48	185	7%	15%	26%	10%	2.6	2.2	3.3	4.2				

Table G 4: NS (East) Screenline EB - Modelled and Observed Flows by Vehicle Category AM

NS 1 screenline - EB (IP)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B193 Letterkenny Rd	Val	ATC 400	127	14	6	148	151	14	17	182	24	-1	11	34	19%	-5%	177%	23%	2.0	0.2	3.2	2.7	Yes	Yes	Yes	Yes
A40 Mullenan Rd	Val	ATC 401	63	9	7	79	100	14	8	122	37	5	1	43	59%	52%	17%	55%	4.1	1.4	0.4	4.3	Yes	Yes	Yes	Yes
A38 Lifford Rd	Cal	ATC 52	329	45	25	398	250	41	30	320	-79	-4	5	-78	-24%	-9%	19%	-20%	4.6	0.6	0.9	4.1	Yes	Yes	Yes	Yes
B86 Umey Rd	Val	ATC 504	59	8	3	70	145	8	4	156	85	0	1	87	144%	0%	36%	124%	8.5	0.0	0.6	8.1	Yes	Yes	Yes	Yes
Orchard Rd	Val	ATC 505	36	5	5	46	31	2	2	34	-5	-4	-3	-11	-13%	-69%	-64%	-25%	0.8	2.0	1.7	1.8	Yes	Yes	Yes	Yes
B165 Bells Park Road	Val	ATC 506	44	11	11	66	37	9	9	55	-8	-2	-2	-11	-17%	-20%	-14%	-17%	1.2	0.7	0.5	1.5	Yes	Yes	Yes	Yes
B72 Fyfin Rd	Val	ATC 507	108	21	30	159	108	21	24	153	0	1	-7	-7	0%	3%	-22%	-4%	0.0	0.1	1.3	0.5	Yes	Yes	Yes	Yes
B164 Deerparl Rd	Val	ATC 508	22	4	5	31	22	4	5	31	0	0	0	0	-1%	-4%	1%	-1%	0.0	0.1	0.0	0.1	Yes	Yes	Yes	Yes
Baroncourt Road	Val	ATC 509	33	6	8	47	33	6	8	46	-1	0	0	-1	-2%	-5%	1%	-2%	0.1	0.1	0.0	0.1	Yes	Yes	Yes	Yes
From Cube 2008 base model	Val	ATC 510	5	1	1	7	1	0	0	2	-4	-1	0	-5	-73%	-100%	-55%	-75%	2.1	1.4	0.6	2.5	Yes	Yes	Yes	Yes
Drumlegah Rd S	Val	ATC 511	23	4	4	31	19	10	16	45	-4	6	12	14	-17%	131%	291%	44%	0.9	2.1	3.8	2.2	Yes	Yes	Yes	Yes
B50 Gillygooley Rd	Val	ATC 512	102	22	9	132	117	18	8	143	16	-3	-1	11	15%	-16%	-12%	8%	1.5	0.8	0.4	0.9	Yes	Yes	Yes	Yes
A32 Clanabogan Road, SW of Omagh	Val	ATC 513	276	36	29	341	255	37	17	309	-21	1	-12	-32	-7%	3%	-41%	-9%	1.3	0.2	2.5	1.8	Yes	Yes	Yes	Yes
B83 Seskinore Rd	Val	ATC 412	123	23	14	159	124	13	18	154	1	-10	4	-5	1%	-44%	29%	-3%	0.1	2.4	1.0	0.4	Yes	Yes	Yes	Yes
Augher Point Road	Val	Observation count	16	2	1	19	1	2	2	6	-15	0	1	-13	-91%	1%	111%	-71%	4.9	0.0	0.9	3.8	Yes	Yes	Yes	Yes
Moylagh Rd	Val	ATC 516	26	5	6	37	73	15	27	115	48	10	20	78	185%	191%	313%	208%	6.8	3.1	5.0	8.9	Yes	Yes	Yes	Yes
Greenmount Road	Val	Observation count	36	4	2	42	0	0	0	0	-36	-4	-2	-42	-100%	-100%	-100%	-100%	8.5	2.8	2.0	9.2	Yes	Yes	Yes	Yes
Springhill Road	Cal	ATC 518	19	4	5	27	35	0	0	35	16	-4	-5	8	88%	-100%	-100%	29%	3.2	2.8	3.0	1.4	Yes	Yes	Yes	Yes
Tulybryan Road	Val	2008model flows in vph	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 Annaghilla Road W	Val	ATC 520	206	33	60	299	213	35	62	310	8	2	2	11	4%	4%	3%	4%	0.5	0.3	0.3	0.6	Yes	Yes	Yes	Yes
Tullywinny Rd	Val	Observation count	7	1	0	8	3	0	0	3	-4	-1	0	-5	-58%	-100%	0%	-63%	1.8	1.4	0.0	2.2	Yes	Yes	Yes	Yes
A28 Favour Royal Rd	Val	ATC 405	38	5	6	50	35	2	15	52	-3	-3	9	2	-9%	-54%	144%	5%	0.6	1.4	2.7	0.3	Yes	Yes	Yes	Yes
Total scrrenline			1696	264	236	2197	1752	251	271	2273	56	-13	34	77	3%	-5%	15%	3%	1.3	0.8	2.2	1.6				

Table G 5: NS (West) Screenline EB - Modelled and Observed Flows by Vehicle Category IP

NS 1 screenline - WB (IP)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B193 Letterkenny Rd	Val	ATC 400	123	16	8	146	111	23	12	146	-12	7	5	-1	-10%	44%	61%	-1%	1.1	1.6	1.5	0.1	Yes	Yes	Yes	Yes
A40 Mullenan Rd	Val	ATC 401	68	10	7	85	75	19	9	103	8	9	2	18	11%	91%	25%	22%	0.9	2.4	0.6	1.9	Yes	Yes	Yes	Yes
A38 Lifford Rd	Val	ATC 503	449	61	35	545	445	61	35	541	-4	0	0	-3	-1%	0%	0%	-1%	0.2	0.0	0.0	0.1	Yes	Yes	Yes	Yes
B86 Umey Rd	Val	ATC 504	60	7	4	71	82	13	4	100	23	6	1	29	38%	80%	15%	41%	2.7	1.8	0.3	3.1	Yes	Yes	Yes	Yes
Orchard Rd	Val	ATC 505	37	6	5	47	14	1	13	28	-23	-5	9	-19	-62%	-91%	179%	-41%	4.5	2.9	2.8	3.1	Yes	Yes	Yes	Yes
B165 Bells Park Road	Val	ATC 506	44	11	10	65	44	9	6	59	0	-2	-4	-6	0%	-18%	-38%	-9%	0.0	0.6	1.3	0.8	Yes	Yes	Yes	Yes
B72 Fyfin Rd	Val	ATC 507	97	19	27	143	97	19	27	143	0	0	0	0	0%	2%	0%	0%	0.0	0.1	0.0	0.0	Yes	Yes	Yes	Yes
B164 Deerparl Rd	Val	ATC 508	23	4	5	32	23	4	5	32	1	0	0	0	2%	-10%	-2%	0%	0.1	0.2	0.1	0.0	Yes	Yes	Yes	Yes
Baroncourt Road	Val	ATC 509	35	8	7	50	35	9	7	51	0	1	0	1	-1%	11%	2%	1%	0.1	0.3	0.1	0.1	Yes	Yes	Yes	Yes
From Cube 2008 base model	Val	ATC 510	6	1	1	8	3	0	1	3	-3	-1	0	-5	-55%	-96%	-36%	-59%	1.6	1.4	0.4	2.0	Yes	Yes	Yes	Yes
Drumlegah Rd S	Val	ATC 511	24	5	4	34	36	3	1	39	12	-2	-4	6	48%	-44%	-87%	17%	2.1	1.1	2.5	0.9	Yes	Yes	Yes	Yes
B50 Gillygooley Rd	Val	ATC 512	101	20	13	134	110	18	12	140	10	-2	-1	6	9%	-12%	-8%	4%	0.9	0.6	0.3	0.5	Yes	Yes	Yes	Yes
A32 Clanabogan Road, SW of Omagh	Val	ATC 513	265	38	34	337	244	26	16	285	-22	-12	-17	-52	-8%	-33%	-52%	-15%	1.4	2.2	3.5	2.9	Yes	Yes	Yes	Yes
B83 Seskinore Rd	Val	ATC 412	121	22	13	157	114	27	26	167	-7	5	13	11	-6%	21%	97%	7%	0.6	0.9	2.9	0.8	Yes	Yes	Yes	Yes
Augher Point Road	Val	Observation count	3	0	0	3	2	2	1	5	-1	2	1	2	-17%	0%	0%	73%	0.3	0.0	0.0	1.1	Yes	Yes	Yes	Yes
Moylagh Rd	Val	ATC 516	23	5	6	33	65	18	20	103	42	13	15	70	185%	280%	255%	211%	6.4	3.9	4.0	8.5	Yes	Yes	Yes	Yes
Greenmount Road	Val	Observation count	41	5	3	49	0	0	0	0	-41	-5	-3	-49	-100%	-100%	-100%	-100%	9.1	3.2	2.4	9.9	Yes	Yes	Yes	Yes
Springhill Road	Cal	ATC 518	19	4	5	28	36	6	0	42	17	2	-5	14	89%	51%	-100%	51%	3.2	0.9	3.1	2.4	Yes	Yes	Yes	Yes
Tulybryan Road	Val	2008model flows in vph	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 Annaghilla Road W	Val	ATC 520	182	34	56	272	181	34	56	271	0	0	0	-1	0%	-1%	0%	0%	0.0	0.1	0.0	0.1	Yes	Yes	Yes	Yes
Tullywinny Rd	Val	Observation count	3	0	0	3	0	0	0	0	-3	0	0	-3	-100%	0%	0%	-100%	2.4	0.0	0.0	2.4	Yes	Yes	Yes	Yes
A28 Favour Royal Rd	Val	ATC 405	36	5	6	47	29	2	16	47	-8	-3	10	-1	-21%	-65%	174%	-2%	1.3	1.8	3.1	0.1	Yes	Yes	Yes	Yes
Total scrrenline			1759	280	248	2287	1746	291	268	2305	-13	11	20	18	-1%	4%	8%	1%	0.3	0.6	1.2	0.4				

Table G 6: NS (West) Screenline WB - Modelled and Observed Flows by Vehicle Category IP

NS 2 screenline - WB (IP)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Rd	Val	ATC 410	47	4	3	54	25	3	3	31	-22	-1	0	-23	-46%	-23%	-7%	-43%	3.6	0.5	0.1	3.5	Yes	Yes	Yes	Yes
Donagheady Rd	Val	Observation count	9	1	1	11	7	1	1	9	-2	0	0	-2	-22%	0%	-49%	-23%	0.7	0.0	0.6	0.8	Yes	Yes	Yes	Yes
B49 Beryhill Rd	Val	ATC 525	102	20	19	141	102	20	18	139	-1	0	-1	-2	-1%	0%	-6%	-1%	0.1	0.0	0.3	0.1	Yes	Yes	Yes	Yes
B536 Spout Rd	Val	ATC 526	24	4	4	32	24	4	4	32	0	0	0	0	-2%	5%	12%	0%	0.1	0.1	0.2	0.0	Yes	Yes	Yes	Yes
B46 Plumbridge Rd	Cal	ATC 527	40	8	7	54	41	9	7	57	1	1	0	3	3%	15%	3%	5%	0.2	0.4	0.1	0.3	Yes	Yes	Yes	Yes
Strahutter Rd	Cal	ATC 528	15	3	3	20	11	0	3	14	-5	-3	1	-7	-30%	-100%	28%	-32%	1.3	2.3	0.4	1.6	Yes	Yes	Yes	Yes
Gortnagarn Rd	Val	ATC 529	42	8	6	56	42	8	1	51	0	0	-5	-5	-1%	1%	-79%	-9%	0.0	0.0	2.5	0.7	Yes	Yes	Yes	Yes
B48 Gortin Rd, North of Omagh	Val	ATC 530	108	13	5	125	107	13	5	126	0	0	1	1	0%	3%	18%	1%	0.0	0.1	0.4	0.1	Yes	Yes	Yes	Yes
Tirquin Rd	Val	Observation count	21	2	1	24	0	6	1	7	-21	4	0	-17	-100%	196%	25%	-70%	6.5	2.0	0.2	4.3	Yes	Yes	Yes	Yes
A505 Killyclogher Rd	Cal	ATC 532	193	32	32	257	220	30	40	291	27	-2	9	34	14%	-6%	27%	13%	1.9	0.4	1.4	2.0	Yes	Yes	Yes	Yes
B4 Drumnakilly Rd	Cal	ATC 533	69	11	11	91	59	15	3	77	-10	4	-8	-14	-14%	33%	-73%	-16%	1.2	1.0	3.1	1.6	Yes	Yes	Yes	Yes
B158 Donaghanie Rd	Val	ATC 404	50	8	8	67	59	5	1	65	9	-4	-7	-2	17%	-44%	-89%	-4%	1.2	1.4	3.4	0.3	Yes	Yes	Yes	Yes
B46 Moylagh Rd	Val	ATC 535	33	7	8	48	33	7	8	48	0	0	0	0	0%	3%	-2%	0%	0.0	0.1	0.0	0.0	Yes	Yes	Yes	Yes
Cavey Rd	Val	Observation count	9	1	1	11	16	3	3	22	7	2	2	11	73%	201%	221%	98%	1.9	1.4	1.5	2.7	Yes	Yes	Yes	Yes
B34 Dungannon Rd	Val	ATC 537	69	19	26	114	69	19	26	114	-1	0	0	-1	-1%	0%	0%	-1%	0.1	0.0	0.0	0.1	Yes	Yes	Yes	Yes
A4 New Annaghilla Rd E of A5	Val	ATC N	263	55	75	394	254	52	89	395	-9	-3	13	1	-4%	-6%	18%	0%	0.6	0.4	1.5	0.1	Yes	Yes	Yes	Yes
B128 Sydney St	Val	ATC 539	11	2	3	16	40	9	6	55	28	7	3	39	247%	401%	105%	238%	5.6	3.1	1.5	6.5	Yes	Yes	Yes	Yes
B35 Dungannon Rd	Val	ATC 540	78	13	20	111	50	21	27	98	-28	9	6	-13	-36%	71%	31%	-12%	3.5	2.2	1.3	1.3	Yes	Yes	Yes	Yes
Total scrrenline			1185	209	233	1627	1158	225	246	1629	-27	16	14	2	-2%	7%	6%	0%	0.8	1.1	0.9	0.1				

Table G 7: NS (East) Screenline WB - Modelled and Observed Flows by Vehicle Category IP

NS 2 screenline - EB (IP)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Rd	Val	ATC 410	48	5	3	55	26	2	1	28	-22	-3	-2	-27	-46%	-61%	-81%	-49%	3.6	1.6	1.8	4.2	Yes	Yes	Yes	Yes
Donagheady Rd	Val	Observation count	9	1	1	11	8	1	1	10	-1	0	0	-1	-11%	0%	-50%	-14%	0.3	0.0	0.6	0.5	Yes	Yes	Yes	Yes
B49 Beryhill Rd	Val	ATC 525	105	20	19	144	105	20	19	144	0	0	0	0	0%	0%	-1%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
B536 Spout Rd	Val	ATC 526	25	4	4	32	25	4	4	33	0	0	0	1	2%	5%	-2%	2%	0.1	0.1	0.0	0.1	Yes	Yes	Yes	Yes
B46 Plumbridge Rd	Cal	ATC 527	40	8	7	54	44	7	10	61	4	0	3	7	11%	-5%	39%	13%	0.7	0.1	1.0	0.9	Yes	Yes	Yes	Yes
Strahutter Rd	Val	Supporting ATC 13CB	19	2	1	22	12	1	1	14	-7	-1	0	-8	-39%	-37%	19%	-36%	1.9	0.6	0.2	1.9	Yes	Yes	Yes	Yes
Gortnagarn Rd	Val	ATC 529	44	8	6	58	44	8	1	53	0	0	-5	-5	1%	-1%	-79%	-8%	0.0	0.0	2.5	0.6	Yes	Yes	Yes	Yes
B48 Gortin Rd, North of Omagh	Val	ATC 530	114	13	6	133	113	13	6	132	-1	0	0	-1	-1%	-3%	-3%	-1%	0.1	0.1	0.1	0.1	Yes	Yes	Yes	Yes
Tirquin Rd	Val	Observation count	3	0	0	3	14	7	6	27	11	7	6	24	361%	0%	0%	796%	3.7	0.0	0.0	6.2	Yes	Yes	Yes	Yes
A505 Killyclogher Rd	Cal	ATC 532	195	32	32	260	198	37	42	278	3	5	10	18	2%	15%	32%	7%	0.2	0.8	1.7	1.1	Yes	Yes	Yes	Yes
B4 Drumnakilly Rd	Cal	ATC 533	67	11	11	89	79	8	2	89	12	-3	-9	1	18%	-25%	-82%	1%	1.4	0.9	3.5	0.1	Yes	Yes	Yes	Yes
B158 Donaghanie Rd	Val	ATC 404	46	8	8	62	32	3	13	48	-14	-5	5	-13	-31%	-61%	72%	-22%	2.3	2.0	1.7	1.8	Yes	Yes	Yes	Yes
B46 Moylagh Rd	Val	ATC 535	34	7	8	49	34	7	9	50	0	0	0	0	1%	1%	2%	1%	0.0	0.0	0.1	0.1	Yes	Yes	Yes	Yes
Cavey Rd	Val	Observation count	9	1	1	11	16	1	3	19	7	0	2	8	73%	-39%	156%	71%	1.9	0.4	1.2	2.0	Yes	Yes	Yes	Yes
B34 Dungannon Rd	Val	ATC 537	85	18	29	131	85	18	16	119	0	0	-13	-13	0%	0%	-45%	-10%	0.0	0.0	2.8	1.1	Yes	Yes	Yes	Yes
A4 New Annaghilla Rd E of A5	Val	ATC N	282	55	78	416	320	58	101	478	37	3	23	63	13%	5%	29%	15%	2.2	0.4	2.4	3.0	Yes	Yes	Yes	Yes
B128 Sydney St	Val	ATC 539	25	4	6	35	39	7	16	63	15	3	10	27	60%	76%	150%	78%	2.6	1.3	2.9	3.9	Yes	Yes	Yes	Yes
B35 Dungannon Rd	Val	ATC 540	61	10	16	87	43	12	33	88	-18	2	17	1	-29%	21%	107%	1%	2.5	0.6	3.5	0.1	Yes	Yes	Yes	Yes
Total scrrenline			1209	207	236	1652	1236	214	282	1733	27	8	46	80	2%	4%	19%	5%	0.8	0.5	2.8	2.0				

Table G 8: NS (East) Screenline EB - Modelled and Observed Flows by Vehicle Category IP

NS 1 screenline - EB (PM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B193 Letterkenny Rd	Val	ATC 400	140	12	6	158	145	27	26	198	5	15	20	39	3%	128%	308%	25%	0.4	3.4	4.9	2.9	Yes	Yes	Yes	Yes
A40 Mullenan Rd	Val	ATC 401	74	10	4	88	136	21	10	167	63	11	6	79	85%	107%	146%	90%	6.1	2.7	2.2	7.0	Yes	Yes	Yes	Yes
A38 Lifford Rd	Cal	ATC 52	418	53	22	493	366	55	20	441	-52	3	-3	-52	-12%	5%	-12%	-11%	2.6	0.4	0.6	2.4	Yes	Yes	Yes	Yes
B86 Umey Rd	Val	ATC 504	71	10	2	83	105	10	8	122	34	0	6	40	47%	1%	316%	48%	3.6	0.0	2.7	3.9	Yes	Yes	Yes	Yes
Orchard Rd	Val	ATC 505	47	7	3	56	4	0	0	4	-43	-7	-3	-52	-91%	-100%	-100%	-93%	8.5	3.7	2.3	9.5	Yes	Yes	Yes	Yes
B165 Bells Park Road	Val	ATC 506	66	12	10	89	52	6	10	68	-15	-6	0	-21	-22%	-50%	2%	-23%	1.9	2.0	0.1	2.3	Yes	Yes	Yes	Yes
B72 Fyfin Rd	Val	ATC 507	128	28	24	179	127	28	20	176	-1	0	-3	-4	0%	1%	-14%	-2%	0.0	0.1	0.7	0.3	Yes	Yes	Yes	Yes
B164 Deerparl Rd	Val	ATC 508	27	5	5	37	27	5	5	36	0	0	0	0	-2%	4%	2%	-1%	0.1	0.1	0.0	0.0	Yes	Yes	Yes	Yes
Baroncourt Road	Val	ATC 509	53	7	4	63	53	7	4	64	0	0	0	0	0%	3%	6%	1%	0.0	0.1	0.1	0.0	Yes	Yes	Yes	Yes
From Cube 2008 base model	Val	ATC 510	6	1	1	8	7	0	0	7	1	-1	-1	-1	14%	-100%	-100%	-15%	0.3	1.5	1.4	0.4	Yes	Yes	Yes	Yes
Drumlegah Rd S	Val	ATC 511	25	4	2	30	12	0	0	13	-12	-3	-2	-17	-50%	-90%	-100%	-57%	2.8	2.4	1.8	3.7	Yes	Yes	Yes	Yes
B50 Gillygooley Rd	Val	ATC 512	101	11	4	116	106	35	5	146	5	24	1	31	5%	213%	37%	26%	0.5	5.0	0.7	2.7	Yes	Yes	Yes	Yes
A32 Clanabogan Road, SW of Omagh	Val	ATC 513	286	52	24	361	313	54	33	400	27	3	9	39	9%	5%	38%	11%	1.6	0.4	1.7	2.0	Yes	Yes	Yes	Yes
B83 Seskinore Rd	Val	ATC 412	135	23	7	165	107	26	13	147	-28	4	6	-18	-20%	15%	91%	-11%	2.5	0.7	2.0	1.4	Yes	Yes	Yes	Yes
Augher Point Road	Val	Observation count	16	2	1	19	18	3	4	25	2	1	3	6	10%	26%	336%	29%	0.4	0.3	2.1	1.2	Yes	Yes	Yes	Yes
Moylagh Rd	Val	ATC 516	38	7	5	50	114	17	22	153	76	10	17	103	199%	142%	337%	205%	8.7	2.9	4.6	10.2	Yes	Yes	Yes	No
Greenmount Road	Val	Observation count	36	4	2	42	0	0	0	0	-36	-4	-2	-42	-100%	-100%	-100%	-100%	8.5	2.8	2.0	9.2	Yes	Yes	Yes	Yes
Springhill Road	Cal	ATC 518	25	5	3	33	43	5	0	48	17	1	-3	15	69%	15%	-100%	44%	3.0	0.3	2.6	2.3	Yes	Yes	Yes	Yes
Tulybryan Road	Val	2008model flows in vph	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 Annaghilla Road W	Val	ATC 520	242	59	49	351	249	61	51	361	7	2	1	10	3%	3%	3%	3%	0.4	0.2	0.2	0.5	Yes	Yes	Yes	Yes
Tullywinny Rd	Val	Observation count	7	1	0	8	2	0	0	2	-5	-1	0	-6	-70%	-100%	0%	-74%	2.3	1.4	0.0	2.6	Yes	Yes	Yes	Yes
A28 Favour Royal Rd	Val	ATC 405	41	11	4	56	60	25	23	108	19	14	19	52	46%	125%	480%	92%	2.7	3.2	5.2	5.7	Yes	Yes	Yes	Yes
Total scrrenline			1981	323	181	2485	2045	385	254	2684	64	63	73	199	3%	19%	40%	8%	1.4	3.3	5.0	3.9				

Table G 9: NS (West) Screenline EB - Modelled and Observed Flows by Vehicle Category PM

NS 1 screenline - WB (PM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B193 Letterkenny Rd	Val	ATC 400	251	24	6	282	315	26	9	351	64	2	3	68	25%	6%	48%	24%	3.8	0.3	1.1	3.8	Yes	Yes	Yes	Yes
A40 Mullenan Rd	Val	ATC 401	188	18	8	213	168	30	11	208	-20	12	3	-5	-10%	67%	35%	-2%	1.5	2.5	0.9	0.3	Yes	Yes	Yes	Yes
A38 Lifford Rd	Val	ATC 503	553	69	31	653	547	69	31	647	-6	0	0	-6	-1%	-1%	0%	-1%	0.3	0.0	0.0	0.3	Yes	Yes	Yes	Yes
B86 Umey Rd	Val	ATC 504	87	11	2	100	108	16	6	131	21	5	4	30	24%	49%	193%	30%	2.1	1.5	2.0	2.8	Yes	Yes	Yes	Yes
Orchard Rd	Val	ATC 505	70	10	4	84	93	0	10	103	23	-10	6	18	33%	-100%	146%	22%	2.5	4.5	2.2	1.9	Yes	Yes	Yes	Yes
B165 Bells Park Road	Val	ATC 506	76	16	5	97	68	14	4	86	-9	-3	-1	-12	-11%	-16%	-10%	-12%	1.0	0.7	0.2	1.2	Yes	Yes	Yes	Yes
B72 Fyfin Rd	Val	ATC 507	156	34	29	219	156	34	23	213	0	0	-6	-6	0%	0%	-21%	-3%	0.0	0.0	1.2	0.4	Yes	Yes	Yes	Yes
B164 Deerparl Rd	Val	ATC 508	33	6	3	42	33	6	3	42	0	0	0	1	1%	3%	4%	1%	0.1	0.1	0.1	0.1	Yes	Yes	Yes	Yes
Baroncourt Road	Val	ATC 509	52	10	7	69	52	8	9	68	0	-2	2	0	-1%	-19%	31%	0%	0.1	0.6	0.7	0.0	Yes	Yes	Yes	Yes
From Cube 2008 base model	Val	ATC 510	15	3	2	21	8	0	0	9	-7	-2	-2	-12	-47%	-84%	-100%	-58%	2.1	1.9	2.1	3.1	Yes	Yes	Yes	Yes
Drumlegah Rd S	Val	ATC 511	55	10	8	73	20	8	2	31	-35	-2	-6	-43	-63%	-18%	-73%	-58%	5.7	0.6	2.6	5.9	Yes	Yes	Yes	Yes
B50 Gillygooley Rd	Val	ATC 512	240	35	8	283	223	46	14	283	-17	11	6	0	-7%	32%	73%	0%	1.1	1.7	1.8	0.0	Yes	Yes	Yes	Yes
A32 Clanabogan Road, SW of Omagh	Val	ATC 513	518	56	24	598	433	58	25	516	-86	3	2	-81	-17%	5%	7%	-14%	3.9	0.3	0.3	3.4	Yes	Yes	Yes	Yes
B83 Seskinore Rd	Val	ATC 412	268	45	14	327	285	41	44	369	17	-5	30	42	6%	-11%	220%	13%	1.0	0.7	5.6	2.3	Yes	Yes	Yes	Yes
Augher Point Road	Val	Observation count	3	0	0	3	6	1	2	10	3	1	2	7	105%	0%	0%	225%	1.5	0.0	0.0	2.7	Yes	Yes	Yes	Yes
Moylagh Rd	Val	ATC 516	46	8	6	60	134	21	20	175	88	13	14	115	193%	152%	232%	191%	9.3	3.3	3.9	10.6	Yes	Yes	Yes	No
Greenmount Road	Val	Observation count	41	5	3	49	0	0	0	0	-41	-5	-3	-49	-100%	-100%	-100%	-100%	9.1	3.2	2.4	9.9	Yes	Yes	Yes	Yes
Springhill Road	Cal	ATC 518	39	7	5	52	97	15	2	115	58	8	-3	63	147%	115%	-54%	122%	7.0	2.5	1.4	6.9	Yes	Yes	Yes	Yes
Tulybryan Road	Val	2008model flows in vph	0	0	0	0	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0.0	0.0	0.0	0.0	Yes	Yes	Yes	Yes
A4 Annaghilla Road W	Val	ATC 520	369	52	41	461	388	55	43	486	19	3	2	24	5%	6%	5%	5%	1.0	0.4	0.3	1.1	Yes	Yes	Yes	Yes
Tullywinny Rd	Val	Observation count	3	0	0	3	2	0	0	2	-1	0	0	-1	-33%	0%	0%	-33%	0.6	0.0	0.0	0.6	Yes	Yes	Yes	Yes
A28 Favour Royal Rd	Val	ATC 405	52	5	3	61	44	3	21	68	-8	-2	18	7	-15%	-48%	515%	12%	1.1	1.3	5.0	0.9	Yes	Yes	Yes	Yes
Total scrrenline			3116	425	209	3749	3180	451	280	3911	64	26	71	161	2%	6%	34%	4%	1.1	1.3	4.5	2.6				

Table G 10: NS (West) Screenline WB - Modelled and Observed Flows by Vehicle Category PM

NS 2 screenline - WB (PM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Rd	Val	ATC 410	57	5	3	65	33	0	0	33	-24	-5	-3	-32	-42%	-100%	-100%	-49%	3.6	3.2	2.3	4.6	Yes	Yes	Yes	Yes
Donagheady Rd	Val	Observation count	9	1	1	11	5	0	0	5	-4	-1	-1	-6	-47%	-100%	-95%	-56%	1.6	1.4	1.3	2.2	Yes	Yes	Yes	Yes
B49 Beryhill Rd	Val	ATC 525	124	22	18	165	124	22	12	158	0	0	-6	-7	0%	-2%	-32%	-4%	0.0	0.1	1.5	0.5	Yes	Yes	Yes	Yes
B536 Spout Rd	Val	ATC 526	26	4	2	32	26	4	3	33	0	0	2	1	-1%	3%	90%	4%	0.1	0.1	1.0	0.2	Yes	Yes	Yes	Yes
B46 Plumbridge Rd	Cal	ATC 527	50	9	7	66	36	9	12	56	-14	-1	5	-10	-28%	-9%	68%	-15%	2.1	0.3	1.6	1.3	Yes	Yes	Yes	Yes
Strahutter Rd	Cal	ATC 528	26	4	3	32	36	6	0	42	10	2	-3	9	39%	50%	-93%	28%	1.8	0.9	2.2	1.5	Yes	Yes	Yes	Yes
Gortnagarn Rd	Val	ATC 529	91	17	14	122	91	6	3	99	0	-12	-11	-23	0%	-67%	-79%	-19%	0.0	3.4	3.8	2.2	Yes	Yes	Yes	Yes
B48 Gortin Rd, North of Omagh	Val	ATC 530	124	10	4	138	122	10	4	136	-2	0	0	-2	-2%	3%	0%	-1%	0.2	0.1	0.0	0.2	Yes	Yes	Yes	Yes
Tirquin Rd	Val	Observation count	21	2	1	24	3	18	0	21	-18	16	-1	-3	-86%	821%	-100%	-11%	5.3	5.1	1.4	0.6	Yes	Yes	Yes	Yes
A505 Killyclogher Rd	Cal	ATC 532	238	36	22	296	262	41	29	331	24	5	7	35	10%	13%	30%	12%	1.5	0.7	1.3	2.0	Yes	Yes	Yes	Yes
B4 Drumnakilly Rd	Cal	ATC 533	74	11	7	92	81	9	1	91	7	-2	-6	-1	10%	-22%	-87%	-1%	0.8	0.8	3.0	0.1	Yes	Yes	Yes	Yes
B158 Donaghanie Rd	Val	ATC 404	52	8	5	64	41	5	2	47	-11	-3	-3	-17	-21%	-42%	-54%	-26%	1.6	1.3	1.4	2.3	Yes	Yes	Yes	Yes
B46 Moylagh Rd	Val	ATC 535	48	9	6	63	48	9	6	63	0	0	0	0	0%	5%	-4%	1%	0.0	0.1	0.1	0.0	Yes	Yes	Yes	Yes
Cavey Rd	Val	Observation count	9	1	1	11	20	3	7	29	11	2	6	18	117%	161%	613%	166%	2.8	1.2	3.0	4.1	Yes	Yes	Yes	Yes
B34 Dungannon Rd	Val	ATC 537	163	35	14	212	163	35	13	211	0	0	-2	-1	0%	0%	-12%	-1%	0.0	0.0	0.5	0.1	Yes	Yes	Yes	Yes
A4 New Annaghilla Rd E of A5	Val	ATC N	592	102	56	751	605	87	68	760	13	-16	11	9	2%	-15%	20%	1%	0.5	1.6	1.4	0.3	Yes	Yes	Yes	Yes
B128 Sydney St	Val	ATC 539	17	3	3	23	49	14	29	91	31	11	26	67	181%	343%	858%	289%	5.4	3.7	6.5	8.9	Yes	Yes	Yes	Yes
B35 Dungannon Rd	Val	ATC 540	123	22	21	166	123	25	27	175	0	4	6	9	0%	16%	27%	6%	0.0	0.7	1.2	0.7	Yes	Yes	Yes	Yes
Total scrrenline			1842	302	188	2332	1864	301	215	2381	22	-1	27	49	1%	0%	14%	2%	0.5	0.0	1.9	1.0				

Table G 11: NS (East) Screenline WB - Modelled and Observed Flows by Vehicle Category PM

NS 2 screenline - EB (PM)			Observed flows (veh)				Modelled flows (veh)				Abs Difference				% Difference				GEH				DMRB			
Road Name	**Type**	**Reference**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**	**Car**	**LGV**	**HGV**	**TOT**
B48 Duncastle Rd	Val	ATC 410	90	8	3	101	71	14	3	87	-19	5	0	-14	-21%	64%	-14%	-14%	2.1	1.6	0.3	1.4	Yes	Yes	Yes	Yes
Donagheady Rd	Val	Observation count	9	1	1	11	10	0	0	10	1	-1	-1	-1	11%	-100%	-100%	-9%	0.3	1.4	1.4	0.3	Yes	Yes	Yes	Yes
B49 Beryhill Rd	Val	ATC 525	179	28	11	218	179	26	0	205	0	-2	-11	-13	0%	-8%	-100%	-6%	0.0	0.4	4.7	0.9	Yes	Yes	Yes	Yes
B536 Spout Rd	Val	ATC 526	41	6	3	49	41	6	3	49	0	0	0	0	0%	0%	-7%	0%	0.0	0.0	0.1	0.0	Yes	Yes	Yes	Yes
B46 Plumbridge Rd	Cal	ATC 527	78	15	11	104	72	16	10	98	-6	1	-1	-6	-8%	9%	-8%	-6%	0.7	0.3	0.3	0.6	Yes	Yes	Yes	Yes
Strahutter Rd	Val	Supporting ATC 13CB	29	3	2	34	19	1	4	24	-10	-2	2	-10	-35%	-56%	105%	-28%	2.1	1.1	1.2	1.8	Yes	Yes	Yes	Yes
Gortnagarn Rd	Val	ATC 529	74	14	11	100	73	13	0	86	-2	-1	-11	-14	-2%	-7%	-100%	-14%	0.2	0.3	4.7	1.4	Yes	Yes	Yes	Yes
B48 Gortin Rd, North of Omagh	Val	ATC 530	220	25	5	250	219	24	10	253	-1	-1	5	3	-1%	-3%	87%	1%	0.1	0.2	1.7	0.2	Yes	Yes	Yes	Yes
Tirquin Rd	Val	Observation count	3	0	0	3	70	47	17	134	67	47	17	131	2230%	0%	0%	4367%	11.1	0.0	0.0	15.8	Yes	Yes	Yes	No
A505 Killyclogher Rd	Cal	ATC 532	338	51	31	420	314	41	33	388	-24	-10	1	-33	-7%	-20%	4%	-8%	1.3	1.5	0.2	1.6	Yes	Yes	Yes	Yes
B4 Drumnakilly Rd	Cal	ATC 533	167	25	15	208	268	40	9	316	101	14	-6	108	60%	56%	-42%	52%	6.8	2.5	1.8	6.7	No	Yes	Yes	No
B158 Donaghanie Rd	Val	ATC 404	95	14	9	118	94	0	0	94	-1	-14	-9	-24	-1%	-98%	-99%	-20%	0.1	5.2	4.2	2.3	Yes	Yes	Yes	Yes
B46 Moylagh Rd	Val	ATC 535	65	12	9	85	65	12	11	88	0	0	2	3	1%	3%	27%	4%	0.1	0.1	0.7	0.3	Yes	Yes	Yes	Yes
Cavey Rd	Val	Observation count	9	1	1	11	27	9	2	38	18	8	1	27	202%	817%	80%	247%	4.3	3.6	0.7	5.5	Yes	Yes	Yes	Yes
B34 Dungannon Rd	Val	ATC 537	120	24	23	168	120	24	1	144	0	0	-23	-23	0%	0%	-97%	-14%	0.0	0.0	6.5	1.8	Yes	Yes	Yes	Yes
A4 New Annaghilla Rd E of A5	Val	ATC N	356	87	67	511	397	80	67	543	41	-7	-1	33	11%	-8%	-1%	6%	2.1	0.8	0.1	1.4	Yes	Yes	Yes	Yes
B128 Sydney St	Val	ATC 539	37	7	6	51	58	22	12	92	21	15	5	41	56%	223%	83%	81%	3.0	4.0	1.8	4.9	Yes	Yes	Yes	Yes
B35 Dungannon Rd	Val	ATC 540	78	14	14	106	46	25	44	115	-32	11	30	9	-41%	79%	225%	9%	4.1	2.5	5.7	0.9	Yes	Yes	Yes	Yes
Total scrrenline			1988	336	224	2548	2141	401	224	2766	153	65	0	218	8%	19%	0%	9%	3.4	3.4	0.0	4.2				

Table G 12: NS (East) Screenline EB - Modelled and Observed Flows by Vehicle Category PM

Appendix H – Journey Time Validation along the A5

Run41c_ME Loop 6								
Route	Model Distance (Km)	New Observed Average (hh:mm:ss)	Observed average (mins)	Model Time (secs)	Model Time (mins)	Diff (min)	%diff	Pass/Fail
R1	1.796	00:02:14	2.2	127	2.1	-0.12	-5%	Y
R2	1.796	00:02:13	2.2	127	2.1	-0.10	-5%	Y
R3	13.379	00:10:28	10.5	604	10.1	-0.40	-4%	Y
R4	13.467	00:10:09	10.2	610	10.2	0.02	0%	Y
R5	6.938	00:05:35	5.6	340	5.7	0.08	1%	Y
R6	6.938	00:05:45	5.8	324	5.4	-0.35	-6%	Y
R7	7.633	00:06:16	6.3	355	5.9	-0.35	-6%	Y
R8	7.633	00:06:08	6.1	336	5.6	-0.53	-9%	Y
R9	5.436	00:05:27	5.5	373	6.2	0.77	14%	Y
R10	5.436	00:06:05	6.1	463	7.7	1.63	27%	N
R11	11.639	00:08:42	8.7	526	8.8	0.07	1%	Y
R12	11.639	00:09:29	9.5	578	9.6	0.15	2%	Y
R13	3.197	00:02:16	2.3	144	2.4	0.13	6%	Y
R14	3.197	00:02:10	2.2	148	2.5	0.30	14%	Y
R15	11.699	00:09:34	9.6	588	9.8	0.23	2%	Y
R16	11.699	00:09:59	10.0	583	9.7	-0.27	-3%	Y
R17	1.974	00:02:08	2.1	148	2.5	0.33	16%	Y
R18	1.974	00:01:59	2.0	130	2.2	0.18	9%	Y
R19	0.645	00:00:46	0.8	46	0.8	0.00	0%	Y
R20	0.644	00:01:05	1.1	71	1.2	0.10	9%	Y
R21	0.384	00:00:37	0.6	29	0.5	-0.13	-22%	Y
R22	0.384	00:00:27	0.5	27	0.5	0.00	0%	Y
R23	1.217	00:01:12	1.2	74	1.2	0.03	3%	Y
R24	1.217	00:01:19	1.3	75	1.3	-0.07	-5%	Y
R25	0.659	00:00:48	0.8	53	0.9	0.08	10%	Y
R26	0.659	00:00:48	0.8	54	0.9	0.10	13%	Y
R27	16.817	00:14:45	14.8	920	15.3	0.58	4%	Y
R28	16.817	00:14:35	14.6	814	13.6	-1.02	-7%	Y
								96%

Table H 1: Journey Time Validation along the A5 - AM Period

Run41c_ME Loop 6								
Route	Model Distance (Km)	New Observed Average (hh:mm:ss)	Observed average (mins)	Model Time (secs)	Model Time (mins)	Diff (min)	%diff	Pass/Fail
R1	1.796	00:02:33	2.6	126	2.1	-0.45	-18%	Y
R2	1.796	00:02:11	2.2	125	2.1	-0.10	-5%	Y
R3	13.379	00:10:18	10.3	591	9.9	-0.45	-4%	Y
R4	13.467	00:10:10	10.2	596	9.9	-0.23	-2%	Y
R5	6.938	00:05:51	5.9	315	5.3	-0.60	-10%	Y
R6	6.938	00:05:51	5.9	312	5.2	-0.65	-11%	Y
R7	7.633	00:06:31	6.5	332	5.5	-0.98	-15%	Y
R8	7.633	00:06:16	6.3	332	5.5	-0.73	-12%	Y
R9	5.436	00:05:47	5.8	360	6.0	0.22	4%	Y
R10	5.436	00:06:16	6.3	393	6.6	0.28	5%	Y
R11	11.639	00:09:03	9.1	522	8.7	-0.35	-4%	Y
R12	11.639	00:09:34	9.6	534	8.9	-0.67	-7%	Y
R13	3.197	00:02:19	2.3	142	2.4	0.05	2%	Y
R14	3.197	00:02:15	2.3	139	2.3	0.07	3%	Y
R15	11.699	00:09:57	10.0	573	9.6	-0.40	-4%	Y
R16	11.699	00:10:12	10.2	567	9.5	-0.75	-7%	Y
R17	1.974	00:02:10	2.2	142	2.4	0.20	9%	Y
R18	1.974	00:02:03	2.1	129	2.2	0.10	5%	Y
R19	0.645	00:00:46	0.8	43	0.7	-0.05	-7%	Y
R20	0.644	00:00:59	1.0	77	1.3	0.30	31%	Y
R21	0.384	00:00:43	0.7	28	0.5	-0.25	-35%	Y
R22	0.384	00:00:28	0.5	28	0.5	0.00	0%	Y
R23	1.217	00:01:10	1.2	71	1.2	0.02	1%	Y
R24	1.217	00:01:23	1.4	74	1.2	-0.15	-11%	Y
R25	0.659	00:00:45	0.8	52	0.9	0.12	16%	Y
R26	0.659	00:00:46	0.8	53	0.9	0.12	15%	Y
R27	16.817	00:14:53	14.9	818	13.6	-1.25	-8%	Y
R28	16.817	00:14:45	14.8	822	13.7	-1.05	-7%	Y
								100%

Table H 2: Journey Time Validation along the A5 - AM Period

Run41c_ME Loop 6								
Route	Model Distance (Km)	New Observed Average (hh:mm:ss)	Observed average (mins)	Model Time (secs)	Model Time (mins)	Diff (min)	%diff	Pass/Fail
R1	1.796	00:02:28	2.5	131	2.2	-0.28	-11%	Y
R2	1.796	00:02:20	2.3	128	2.1	-0.20	-9%	Y
R3	13.379	00:10:45	10.8	626	10.4	-0.32	-3%	Y
R4	13.467	00:10:15	10.3	602	10.0	-0.22	-2%	Y
R5	6.938	00:05:45	5.8	353	5.9	0.13	2%	Y
R6	6.938	00:05:43	5.7	319	5.3	-0.40	-7%	Y
R7	7.633	00:05:57	6.0	348	5.8	-0.15	-3%	Y
R8	7.633	00:06:01	6.0	343	5.7	-0.30	-5%	Y
R9	5.436	00:08:10	8.2	378	6.3	-1.87	-23%	N
R10	5.436	00:07:34	7.6	494	8.2	0.67	9%	Y
R11	11.639	00:09:30	9.5	569	9.5	-0.02	0%	Y
R12	11.639	00:09:26	9.4	547	9.1	-0.32	-3%	Y
R13	3.197	00:02:21	2.4	153	2.6	0.20	9%	Y
R14	3.197	00:02:13	2.2	142	2.4	0.15	7%	Y
R15	11.699	00:10:09	10.2	595	9.9	-0.23	-2%	Y
R16	11.699	00:10:03	10.1	584	9.7	-0.32	-3%	Y
R17	1.974	00:02:33	2.6	140	2.3	-0.22	-8%	Y
R18	1.974	00:02:02	2.0	131	2.2	0.15	7%	Y
R19	0.645	00:00:47	0.8	44	0.7	-0.05	-6%	Y
R20	0.644	00:01:24	1.4	83	1.4	-0.02	-1%	Y
R21	0.384	00:00:52	0.9	28	0.5	-0.40	-46%	Y
R22	0.384	00:00:39	0.7	30	0.5	-0.15	-23%	Y
R23	1.217	00:01:11	1.2	72	1.2	0.02	1%	Y
R24	1.217	00:01:30	1.5	77	1.3	-0.22	-14%	Y
R25	0.659	00:00:49	0.8	54	0.9	0.08	10%	Y
R26	0.659	00:00:48	0.8	54	0.9	0.10	13%	Y
R27	16.817	00:14:45	14.8	812	13.5	-1.22	-8%	Y
R28	16.817	00:15:10	15.2	881	14.7	-0.48	-3%	Y
								96%

Table H 3: Journey Time Validation along the A5 - AM Period

Appendix C

TRAFFIC FORECAST REPORT (OBC2022)

Refer to November 2022 “Traffic Forecast Report (OBC2022)” available on A5WTC Website:

https://www.a5wtc.com/Documents/12258/Download

Appendix D

2022 TRAFFIC MODEL VERIFICATION NOTE

Refer to April 2023 "Traffic Model Verification Note 2022" available on A5WTC Website:

https://www.a5wtc.com/Traffic-Model-Verification-Note2022

Appendix E

ENVIRONMENTAL IMPACT CALCULATIONS

Greenhouse Gases Workbook - Inputs

Scheme details

Scheme name	A5WTC core scenario	*Scheme_name*
Opening year	2028	*Opening_year_in*
Scheme type (select from list)	road	*Scheme_type*
Current year	2022	*Current_year_in*

Emissions (tCO2e per year)

Non-traded sector

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	*year_in*
Road without scheme		655215.9	645287.8	635359.8	625431.7	615503.7	605575.6	595647.5	585719.5	575791.4	565863.4	555935.3	546007.2	536079.2	526151.1	516223.1	506295	*Non_traded_emissions_road_without_scheme_in*
Road with scheme		665239.5	655238.7	645238	635237.2	625236.5	615235.7	605235	595234.2	585233.4	575232.7	565231.9	555231.2	545230.4	535229.7	525228.9	515228.2	*Non_traded_emissions_road_with_scheme_in*
Rail without scheme																		*Non_traded_emissions_rail_without_scheme_in*
Rail with scheme																		*Non_traded_emissions_rail_with_scheme_in*

Traded sector

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Road without scheme		9489.297	9028.365	8567.433	8106.501	7645.568	7184.636	6723.704	6262.772	5801.84	5340.908	4879.976	4419.044	3958.112	3497.18	3036.248	2575.316	*Traded_emissions_road_without_scheme_in*
Road with scheme		9603.721	9137.564	8671.407	8205.25	7739.093	7272.936	6806.779	6340.622	5874.465	5408.308	4942.151	4475.994	4009.837	3543.68	3077.524	2611.367	*Traded_emissions_road_with_scheme_in*
Rail without scheme																		*Traded_emissions_rail_without_scheme_in*
Rail with scheme																		*Traded_emissions_rail_with_scheme_in*

Emission values

Non-traded values (£/tCO2e)

price base year 2010 *CO2e_value_price_base_in*
price base year

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Low	83.0	109.3	111.0	112.6	114.4	116.1	117.9	119.7	121.5	123.3	125.2	127.1	129.1	131.0	133.0	135.0	137.0	*CO2e_values_low_in*
Central	165.9	218.6	221.9	225.3	228.7	232.2	235.7	239.3	243.0	246.7	250.4	254.2	258.1	262.0	266.0	270.0	274.0	*CO2e_values_central_in*
High	248.9	327.9	332.9	337.9	343.1	348.3	353.6	359.0	364.5	370.0	375.6	381.4	387.2	393.1	399.0	404.9	411.0	*CO2e_values_high_in*

source: TAG data book v1.16 (September 2021), Table A3.4

Traded values (£/tCO2e) [same as non-traded - see note]

price base year 2010 *CO2e_value_price_base_in*
price base year

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Low	83.0	109.3	111.0	112.6	114.4	116.1	117.9	119.7	121.5	123.3	125.2	127.1	129.1	131.0	133.0	135.0	137.0	*CO2e_values_low_in*
Central	165.9	218.6	221.9	225.3	228.7	232.2	235.7	239.3	243.0	246.7	250.4	254.2	258.1	262.0	266.0	270.0	274.0	*CO2e_values_central_in*
High	248.9	327.9	332.9	337.9	343.1	348.3	353.6	359.0	364.5	370.0	375.6	381.4	387.2	393.1	399.0	404.9	411.0	*CO2e_values_high_in*

source: TAG data book v1.16 (September 2021), Table A3.4.
Note: the latest BEIS carbon values (Sep 2021) are no longer split into separate "traded" and "non-traded" series.

Appraisal period and discounting

Appraisal period (years)	60	*Appraisal_period_length_in*
PV base year	2010	*PV_base_year_in*
Outputs price year	2010	*Price_base_outputs_in*

Discount period 1	30	*Discount_period_1_in*
Discount period 2	75	*Discount_period_2_in*
Discount period 3	125	*Discount_period_3_in*
Discount rate 1	3.5%	*Discount_rate_1_in*
Discount rate 2	3.0%	*Discount_rate_2_in*
Discount rate 3	2.5%	*Discount_rate_3_in*

source: TAG data book v1.16 (September 2021), Table A1.1.1

Carbon budget 1 start	2008	*Carbon_budget_1_start_in*
Carbon budget 1 end	2012	*Carbon_budget_1_end_in*
Carbon budget 2 start	2013	*Carbon_budget_2_start_in*
Carbon budget 2 end	2017	*Carbon_budget_2_end_in*
Carbon budget 3 start	2018	*Carbon_budget_3_start_in*
Carbon budget 3 end	2022	*Carbon_budget_3_end_in*
Carbon budget 4 start	2023	*Carbon_budget_4_start_in*
Carbon budget 4 end	2027	*Carbon_budget_4_end_in*

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
GDP deflator	100.0	144.9	148.2	151.6	155.1	158.7	162.3	166.1	169.9	173.8	177.8	181.9	186.1	190.3	194.7	199.2	203.8	*GDP_deflator_in*

source: TAG Data Book v1.17 (November 2021), Annual Parameters

Greenhouse Gases Workbook - Calculations

		2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	*year*
Appraisal period																			
Opening year	2028	*Opening_year*																	
Opening year		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_year_mask*
Appraisal period length (years)	60	*Appraisal_period_length*																	
Appraisal period		0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*Appraisal_period*
Check	FALSE																		
Emissions (tCO2e)																			
Non-traded sector																			
Road without scheme		0	655215.899	645287.8384	635359.7782	625431.718	615503.6579	605575.5977	595647.5375	585719.4774	575791.4172	565863.357	555935.2968	546007.2367	536079.1765	526151.1163	516223.0561	506294.996	*Non_traded_emissions_road_without_scheme*
Road with scheme		0	665239.492	655238.7362	645237.9802	635237.224	625236.4682	615235.7123	605234.9563	595234.2003	585233.4443	575232.6883	565231.9323	555231.1764	545230.4204	535229.6644	525228.9084	515228.1524	*Non_traded_emissions_road_with_scheme*
Road - change in emissions		0	10023.5936	9950.897776	9878.201968	9805.50616	9732.810353	9660.114545	9587.418737	9514.72293	9442.027122	9369.331314	9296.635507	9223.939699	9151.243891	9078.548083	9005.852276	8933.156468	*Non_traded_emissions_road_change*
Rail without scheme		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Non_traded_emissions_rail_without_scheme*
Rail with scheme		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Non_traded_emissions_rail_with_scheme*
Rail - change in emissions		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Non_traded_emissions_rail_change*
Total change in non-traded emissions		0	10023.5936	9950.897776	9878.201968	9805.50616	9732.810353	9660.114545	9587.418737	9514.72293	9442.027122	9369.331314	9296.635507	9223.939699	9151.243891	9078.548083	9005.852276	8933.156468	*Non_traded_emissions_TOTAL_change*
Change over 60 years (tCO2e)	151654.0004	*Non_traded_emissions_change_60years*																	
Traded sector																			
Road without scheme		0	9489.29668	9028.364631	8567.432585	8106.50054	7645.568492	7184.636446	6723.704399	6262.772353	5801.840307	5340.908261	4879.976214	4419.044168	3958.112122	3497.180075	3036.248029	2575.315983	*Traded_emissions_road_without_scheme*
Road with scheme		0	9603.72054	9137.563615	8671.406686	8205.24976	7739.09283	7272.935901	6806.778973	6340.622045	5874.465116	5408.308188	4942.15126	4475.994331	4009.837403	3543.680475	3077.523546	2611.366618	*Traded_emissions_road_with_scheme*
Road - change in emissions		0	114.423866	109.1989836	103.9741016	98.7492196	93.52433753	88.2994555	83.07457346	77.84969143	72.62480939	67.39992736	62.17504533	56.95016329	51.72528126	46.50039922	41.27551719	36.05063515	*Traded_emissions_road_change*
Rail without scheme		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Traded_emissions_rail_without_scheme*
Rail with scheme		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Traded_emissions_rail_with_scheme*
Rail - change in emissions		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Traded_emissions_rail_change*
Total change in traded emissions		0	114.423866	109.1989836	103.9741016	98.7492196	93.52433753	88.2994555	83.07457346	77.84969143	72.62480939	67.39992736	62.17504533	56.95016329	51.72528126	46.50039922	41.27551719	36.05063515	*Traded_emissions_TOTAL_change*
Change over 60 years (tCO2e)	1203.796007	*Traded_emissions_change_60years*																	
Total change in CO2e emissions		**0**	**10138.017**	**10060.09676**	**9982.17607**	**9904.2554**	**9826.33469**	**9748.414**	**9670.493311**	**9592.572621**	**9514.65193**	**9436.73124**	**9358.81055**	**9280.88986**	**9202.96917**	**9125.04848**	**9047.12779**	**8969.2071**	*CO2e_emissions_TOTAL_change*
Change over 60 years (tCO2e)	152857.7964	*TOTAL_emissions_change_60years*																	
Change in opening year (tCO2e)	10138.01745	*TOTAL_emissions_change_opening_year*																	
Carbon budget periods																			
Carbon budget 1 start	2008	*Carbon_budget_1_start*																	
Carbon budget 1 end	2012	*Carbon_budget_1_end*																	
Carbon budget 2 start	2013	*Carbon_budget_2_start*																	
Carbon budget 2 end	2017	*Carbon_budget_2_end*																	
Carbon budget 3 start	2018	*Carbon_budget_3_start*																	
Carbon budget 3 end	2022	*Carbon_budget_3_end*																	
Carbon budget 4 start	2023	*Carbon_budget_4_start*																	
Carbon budget 4 end	2027	*Carbon_budget_4_end*																	
Masks																			
Carbon Budget 1		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Carbon_budget_1_mask*
Carbon Budget 2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Carbon_budget_2_mask*
Carbon Budget 3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Carbon_budget_3_mask*
Carbon Budget 4		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Carbon_budget_4_mask*
Change in traded emissions (tCO2e)																			
Carbon Budget 1	0	*Traded_emissions_change_Budget_1*																	
Carbon Budget 2	0	*Traded_emissions_change_Budget_2*																	
Carbon Budget 3	0	*Traded_emissions_change_Budget_3*																	
Carbon Budget 4	0	*Traded_emissions_change_Budget_4*																	
Change in non-traded emissions (tCO2e)																			
Carbon Budget 1	0	*Non_traded_emissions_change_Budget_1*																	
Carbon Budget 2	0	*Non_traded_emissions_change_Budget_2*																	
Carbon Budget 3	0	*Non_traded_emissions_change_Budget_3*																	
Carbon Budget 4	0	*Non_traded_emissions_change_Budget_4*																	

Emission valuations

Price adjustment

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
GDP deflator	100.0	144.9	148.2	151.6	155.1	158.7	162.3	166.1	169.9	173.8	177.8	181.9	186.1	190.3	194.7	199.2	203.8

CO2e values price base	2010	*CO2e_value_price_base*
GDP deflator index - base	100	*GDP_deflator_base*
Price base for outputs	2010	*Price_base_outputs*
GDP deflator index - for outputs	100	*GDP_deflator_outputs*
Price base adjustment	1.00	*Price_adjustment*

Carbon values in 2010 prices

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
low (£/tCO2e)	83.0	109.3	111.0	112.6	114.4	116.1	117.9	119.7	121.5	123.3	125.2	127.1	129.1	131.0	133.0	135.0	137.0	*CO2e_values_low*
central (£/tCO2e)	165.9	218.6	221.9	225.3	228.7	232.2	235.7	239.3	243.0	246.7	250.4	254.2	258.1	262.0	266.0	270.0	274.0	*CO2e_values_central*
high (£/tCO2e)	248.9	327.9	332.9	337.9	343.1	348.3	353.6	359.0	364.5	370.0	375.6	381.4	387.2	393.1	399.0	404.9	411.0	*CO2e_values_high*

Valuing changes in emissions (non-traded) (£)

positive values represent a benefit - a reduction in GHG emissions

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Low (£)	0.0	-1095484.5	-1104101.1	-1112726.0	-1121357.6	-1129994.0	-1138633.4	-1147273.9	-1155913.5	-1164550.2	-1173181.8	-1181806.3	-1190421.4	-1199024.8	-1207342.5	-1215639.9	-1223914.6	*CO2e_benefits_undiscounted_low*
Central (£)	0.0	-2190969.1	-2208202.2	-2225452.0	-2242715.2	-2259988.0	-2277266.8	-2294547.8	-2311827.0	-2329100.3	-2346363.6	-2363612.6	-2380842.8	-2398049.6	-2414684.9	-2431279.7	-2447829.1	*CO2e_benefits_undiscounted_central*
High (£)	0.0	-3286453.6	-3312303.2	-3338178.0	-3364072.7	-3389982.0	-3415900.2	-3441821.7	-3467740.5	-3493650.5	-3519545.4	-3545418.9	-3571264.1	-3597074.4	-3622027.4	-3646919.6	-3671743.7	*CO2e_benefits_undiscounted_high*

Discounting and present values

Discount period

Current year	2022	*Current_year*
PV base year	2010	*PV_base_year*
discount period 1	30	*Discount_period_1*
discount period 2	75	*Discount_period_2*
discount period 3	125	*Discount_period_3*

Masks

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Discount period 1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*Discount_period_1_mask*
Discount period 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Discount_period_2_mask*
Discount period 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Discount_period_3_mask*

Discount rates and factors

discount rate 1	3.5%	*Discount_rate_1*
discount rate 2	3.0%	*Discount_rate_2*
discount rate 3	2.5%	*Discount_rate_3*

		2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Discount rate profile		0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	*Discount_rate_profile*
Discount factor	1	1.00	1.04	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.41	1.46	1.51	1.56	1.62	1.68	1.73	*Discount_factor*

Discounted GHG benefits

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Low (£)	0	-1058439.2	-1030690.2	-1003615.1	-977198.4	-951424.6	-926279.0	-901746.9	-877814.1	-854466.5	-831690.7	-809473.2	-787801.0	-766661.4	-745874.2	-725604.0	-705838.8	*CO2e_benefits_discounted_low*
Central (£)	0	-2116878.3	-2061380.3	-2007230.2	-1954396.7	-1902849.3	-1852558.0	-1803493.8	-1755628.1	-1708933.0	-1663381.3	-1618946.3	-1575602.0	-1533322.9	-1491748.4	-1451208.1	-1411677.5	*CO2e_benefits_discounted_central*
High (£)	0	-3175317.5	-3092070.5	-3010845.3	-2931595.1	-2854273.9	-2778837.0	-2705240.7	-2633442.2	-2563399.6	-2495072.0	-2428419.5	-2363403.0	-2299984.3	-2237622.6	-2176812.1	-2117516.3	*CO2e_benefits_discounted_high*

Present values

Low (£)	-13,954,617	*NPV_low*
Central (£)	-27,909,234	*NPV_central*
High (£)	-41,863,851	*NPV_high*

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: A5WTC core scenario

Present Value Base Year 2010

Current Year 2022

Proposal Opening year: 2028

Project (Road/Rail or Road and Rail): road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): -£39,912,348

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): 547,503
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded 2790.023953

Change in carbon dioxide equivalent emissions in opening year (tonnes): 10,138
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): -£224,868
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	0	0
Non-traded sector	0	0	0	0

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£59,868,522

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£19,956,174

Data Sources:

Air Quality Valuation Workbook - Inputs

Scheme details

Scheme name	A5WTC	*Scheme_name*
Opening year	2028	*Opening_year_in*
Forecast year	2043	*Forecast_year_in*
Current year	2022	*Current_year_in*
Scheme type (select from list)	National	Scheme_type_damage_cost_category
Impact pathways or Damage costs	Impact pathways	Choice_of_concentrations_damage_costs
Measured up to PM2.5 or PM10?	PM2.5	Choice_of_PM

Promoters should use this workbook to appraise schemes due to open in the future (opening year should be after current year).

NOx emissions or NO2 concentrations

NO2 assessment scores (using local air quality workbook)

	Opening year	
Without scheme	78104.1	*Opening_year_without_scheme_NO2_concentrations_in*
With scheme	73254	*Opening_year_with_scheme_NO2_concentrations_in*

	Forecast year	
Without scheme	76467.3	*Forecast_year_without_scheme_NO2_concenz*
With scheme	71269	*Forecast_year_with_scheme_NO2_concentrations_in*

Other impacts (emissions in tonnes)

In order to calculate effects of impacts that do not directly affect households such as ecosystem damages, change in emissions in tonnes is needed.

	Opening year	
Without scheme	115.1716898	*Opening_year_without_scheme_NO2_other_emissions_in*
With scheme	135.9531371	*Opening_year_with_scheme_NO2_other_emissions_in*

	Forecast year	
Without scheme	113.7663635	*Forecast_year_without_scheme_NO2_other_emissions_in*
With scheme	136.3476692	*Forecast_year_with_scheme_NO2_other_emissions_in*

PM2.5 emissions/concentrations or PM10 emissions

PM2.5 assessment scores (using local air quality workbook)

	Opening year	
Without scheme	67131.1	*Opening_year_without_scheme_PM2.5_concentrations_in*
With scheme	65896.1	*Opening_year_with_scheme_PM2.5_concentrations_in*

	Forecast year	
Without scheme	68025.0	*Forecast_year_without_scheme_PM2.5_concentrations_in*
With scheme	66612.0	*Forecast_year_with_scheme_PM2.5_concentrations_in*

Other impacts (emissions in tonnes)

In order to calculate effects of impacts that do not directly affect households such as ecosystem damages, change in emissions in tonnes is needed.

	Opening year	
Without scheme	15.30389316	*Opening_year_without_scheme_PM2.5_other_emissions_in*
With scheme	17.25137642	*Opening_year_with_scheme_PM2.5_other_emissions_in*

	Forecast year	
Without scheme	17.61674923	*Forecast_year_without_scheme_PM2.5_other_emissions_in*
With scheme	20.55228058	*Forecast_year_with_scheme_PM2.5_other_emissions_in*

Exceedances

Select the method used to calculate emissions on links exceeding limit values (i.e. default for the scheme category or if custom analysis has been undertaken) from the drop-down in cell C100.

These profiles should be used only when it is not proportionate to carry out modelling identifying % of emissions in exceedance. Local or scheme specific modelling is always prefered.

If using the 'custom' method, enter the appropriate percentages in row 105.

Exceedance method Custom *Exceedance_method_in*

Percentage of emissions on links exceeding limit values (all vehicles) - an approximation of the true split between emissions above legal limits and those below.

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Custom													
Road Transport (RT)	22.1%	12.3%	10.0%	7.7%	5.3%	3.0%	0.7%	0.6%	0.4%	0.3%	0.1%	0.0%	0.0%
RT Central London	88.6%	48.6%	40.0%	31.4%	22.7%	14.1%	5.5%	4.4%	3.3%	2.2%	1.1%	0.0%	0.0%
RT Inner London	56.4%	30.3%	25.4%	20.6%	15.7%	10.9%	6.0%	4.8%	3.6%	2.4%	1.2%	0.0%	0.0%
RT Outer London	56.6%	31.8%	25.6%	19.3%	13.1%	6.8%	0.6%	0.5%	0.4%	0.2%	0.1%	0.0%	0.0%
RT Inner Conurbation	18.4%	10.4%	8.3%	6.2%	4.2%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Outer Conurbation	10.8%	6.1%	4.9%	3.7%	2.4%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Big	17.0%	9.6%	7.7%	5.8%	3.8%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Large	4.4%	2.5%	2.0%	1.5%	1.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Medium	3.5%	2.0%	1.6%	1.2%	0.8%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Small	3.5%	2.0%	1.6%	1.2%	0.8%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Rural	12.1%	6.8%	5.5%	4.2%	2.8%	1.5%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
Rail	1.8%	1.0%	0.8%	0.7%	0.5%	0.4%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Custom												
Road Transport (RT)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Central London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Inner London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Outer London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Inner Conurbation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Outer Conurbation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Big	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Large	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Medium	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Urban Small	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RT Rural	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rail	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: Defra analysis (2019)

Emissions and concentrations values

Income base year	2010	*Income_base_values_in*
Price base year	2010	*Price_base_values_in*

NOx damage base values (2010£ per/tonne)

	National	Aircraft	Rail	Ships	Road Transport (RT)	RT Central London	RT Inner London	RT Outer London	RT Inner Conurbation	RT Outer Conurbation	RT Urban Big	RT Urban Large	RT Urban Medium	RT Urban Small	RT Rural
Central	£5,754	£8,628	£6,728	£2,209	£8,170	£46,118	£47,388	£24,998	£17,043	£10,066	£10,389	£8,554	£6,861	£5,633	£2,853
Low	£551	£771	£625	£278	£736	£3,652	£3,750	£2,029	£1,418	£882	£907	£766	£636	£542	£328
High	£21,784	£33,118	£25,625	£7,807	£31,307	£180,917	£185,924	£97,653	£66,292	£38,782	£40,060	£32,825	£26,152	£21,308	£10,348

Source: TAG data book v1.15 (July 2021). Table A3.2.1

OR

NO2 concentration damage base values (2010£ per/household/1ug/m3)

			Other impacts (£ per tonne):	
Central	£13.65	*No2_concentration_central_value_in*	£1,282.64	*No2_concentration_other impacts_central_value_in*
Low	£1.05	*No2_concentration_low_value_in*	£239.00	*No2_concentration_other_impacts_low_value_in*
High	£53.60	*No2_concentration_high_value_in*	£3,910.41	*No2_concentration_other_impacts_high_value_in*

Source: TAG data book v1.15 (July 2021). Table A3.2.3

NOx abatement base values 2010£

	National	
Central	£29,000	NOx_abatement_base_value_central_in
Low	£27,000	NOx_abatement_base_value_low_in
High	£73,000	NOx_abatement_base_value_high_in

Source: TAG data book v1.15 (July 2021). Table A3.2.2

PM2.5 concentrations damage base values (2010£/household/1ug/m3)

			Other impacts (£ per tonne):	
Central	£108.40	*PM2.5_damage_base_value_central_in*	£785.11	*PM2.5_concentration_other_impacts_central_value_in*
Low	£22.42	*PM2.5_damage_base_value_low_in*	£785.11	*PM2.5_concentration_other_impacts_low_value_in*
High	£337.78	*PM2.5_damage_base_value_high_in*	£785.11	*PM2.5_concentration_other_impacts_high_value_in*

Source: TAG data book v1.15 (July 2021). Table A3.2.3

PM2.5 emissions damage base values (2010£/tonne)

	National	Aircraft	Rail	Ships	Road Transport (RT)	RT Central London	RT Inner London	RT Outer London	RT Inner Conurbation	RT Outer Conurbation	RT Urban Big	RT Urban Large	RT Urban Medium	RT Urban Small	RT Rural
Central	£66,146	£65,846	£51,860	£21,857	£73,458	£361,840	£369,727	£200,236	£139,380	£85,705	£88,730	£74,121	£60,193	£50,262	£27,662
Low	£14,317	£14,101	£11,150	£4,942	£15,830	£75,415	£77,086	£42,043	£29,461	£18,360	£18,984	£15,961	£13,077	£11,022	£6,351
High	£204,848	£194,968	£150,487	£62,626	£227,711	£1,112,888	£1,147,228	£622,253	£433,096	£265,664	£275,030	£229,366	£185,785	£154,792	£84,521

Source: TAG data book v1.15 (July 2021). Table A3.2.1

PM10 emissions damage base values (2010£/tonne)

	National	Aircraft	Rail	Ships	Road Transport (RT)	RT Central London	RT Inner London	RT Outer London	RT Inner Conurbation	RT Outer Conurbation	RT Urban Big	RT Urban Large	RT Urban Medium	RT Urban Small	RT Rural
Central	£42,002	£53,928	£48,178	£20,698	£46,646	£246,413	£240,692	£128,551	£89,064	£54,765	£56,698	£47,511	£38,764	£32,419	£17,759
Low	£9,091	£11,549	£10,358	£4,680	£10,052	£51,357	£50,183	£26,992	£18,825	£11,732	£12,131	£10,231	£8,422	£7,109	£4,077
High	£130,078	£159,678	£139,802	£59,307	£144,597	£757,877	£746,845	£399,486	£276,748	£169,759	£175,744	£147,023	£119,646	£99,841	£54,263
PM2.5/10 factor	0.635	0.819	0.929	0.947	0.635	0.681	0.651	0.642	0.639	0.639	0.639	0.641	0.644	0.645	0.642

Source: TAG data book v1.15 (July 2021). Table A3.2.1

Appraisal period and discounting

Appraisal period (years)	60	*Appraisal_period_length_in*
PV base year	2010	*PV_base_year_in*
Outputs price year	2010	*Price_base_outputs_in*
Discount period 1	12	*Discount_period_1_in*
Discount period 2	30	*Discount_period_2_in*
Discount period 3	75	*Discount_period_3_in*
Discount rate 1	3.5%	*Discount_rate_1_in*
Discount rate 2	1.5%	*Discount_rate_2_in*
Discount rate 3	1.3%	*Discount_rate_3_in*

Source: TAG Data Book v1.15, July 2021, Table A1.1.1

	2010	2011	2012	2013	2014	2015	2016	2017	2018
GDP deflator for health-related impacts	100.00	102.07	103.76	105.60	107.43	108.15	110.47	112.61	115.14
Real GDP per household	123.39	124.16	124.94	127.47	130.77	132.31	134.28	136.03	135.99
Real GDP per capita	138.15	138.75	139.80	141.97	144.92	147.18	148.48	150.17	151.15

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
GDP deflator for health-related impacts	117.58	124.41	124.87	127.57	130.53	133.06	135.65	138.44	141.62	144.88	148.21	151.62	155.11
Real GDP per household	136.71	123.39	129.30	136.17	138.07	139.04	140.51	142.12	143.83	145.56	147.30	149.04	150.75
Real GDP per capita	152.49	136.89	145.58	153.71	156.26	157.78	159.85	162.10	164.50	166.94	169.38	171.82	174.25

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
GDP deflator for health-related impacts	158.68	162.33	166.06	169.88	173.79	177.78	181.87	186.06	190.33	194.71	199.19	203.77	*GDP_deflator_in*
Real GDP per household	152.43	154.14	155.86	157.58	159.52	161.50	163.51	165.55	167.90	170.24	172.59	174.92	*GDP_household_in*
Real GDP per capita	176.67	179.12	181.58	184.02	186.74	189.49	192.27	195.04	197.81	200.57	203.33	206.07	*GDP_capita_in*

Income elasticity (for uprating)	1.3

Source: TAG Data Book v1.17, November 2021, Annual Parameters. (For use of income elasticity for uprating purposes, see TAG Units A3 and A4.1)

Air Quality Valuation Workbook - Calculations

			2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
		2010	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	*year*

Appraisal period

			2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year	**2028**	*Opening_year*																	
Opening year			1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_year_mask*
Forecast year	**2043**	*Forecast_year_in*																	
Forecast year			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*Forecast_year_mask*
Difference (years)	15	*Interpolation_period_length_in*																	
Appraisal period length (years)	60	*Appraisal_period_length_in*																	
Interpolation			0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	*Interpolation_mask*
Extrapolation			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Extrapolation_mask*
Appraisal period			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*Appraisal_period*
Check	TRUE																		

NOx concentrations

Without scheme (1ug/m3 change)

	2028	
Opening year NOx concentrations	78104.1	*Opening_year_without_scheme_NOx_concentrations*
	2043	
Forecast year NOx concentrations	76467.3	*Forecast_year_without_scheme_NOx_concentrations*
Difference	-1636.80	*Difference_without_scheme_NOx_concentrations*

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year	78104.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_NOx_concentrations_in_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76467.30	*Forecast_year_without_scheme_NOx_concentrations_in_mask*
Interpolation	0.00	77994.98	77885.86	77776.74	77667.62	77558.50	77449.38	77340.26	77231.14	77122.02	77012.90	76903.78	76794.66	76685.54	76576.42	0.00	*Interpolation_without_scheme_NOx_concentrations_in_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_NOx_concentrations_in_mask*
Total	78104.10	77994.98	77885.86	77776.74	77667.62	77558.50	77449.38	77340.26	77231.14	77122.02	77012.90	76903.78	76794.66	76685.54	76576.42	76467.30	*Total_without_scheme_NOx_concentrations_in*

With scheme (1ug/m3 change)

	2028	
Opening year NO2 concentrations	73254	*Opening_year_with_scheme_NO2_concentrations*
	2043	
Forecast year NO2 concentrations	71269	*Forecast_year_with_scheme_NO2_concentrations*
Difference	-1985	*Difference_with_scheme_NO2_concentrations*

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year	73254.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_NOx_concentrations_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	71269.00	*Forecast_year_with_scheme_NOx_concentrations_mask*
Interpolation	0.00	73121.67	72989.33	72857.00	72724.67	72592.33	72460.00	72327.67	72195.33	72063.00	71930.67	71798.33	71666.00	71533.67	71401.33	0.00	*Interpolation_with_scheme_NOx_concentrations_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_NOx_concentrations_mask*
Total	73254.00	73121.67	72989.33	72857.00	72724.67	72592.33	72460.00	72327.67	72195.33	72063.00	71930.67	71798.33	71666.00	71533.67	71401.33	71269.00	*Total_with_scheme_NOx_concentrations*

Total change in NO2 assessment scores			**-4850.10**	**-4873.31**	**-4896.53**	**-4919.74**	**-4942.95**	**-4966.17**	**-4989.38**	**-5012.59**	**-5035.81**	**-5059.02**	**-5082.23**	**-5105.45**	**-5128.66**	**-5151.87**	**-5175.09**	**-5198.30**	*NO2_concentrations_total_change*
Change over 60 years		*-309112.40*																	
NO2 CONCENTRATION OTHER IMPACTS																			
Without scheme (tonnes)																			
	2028																		
Opening year NOx emissions (other	115.1716898	*Opening_year_without_scheme_NO2_other_emissions*																	
	2043																		
Forecast year NOx emissions (other	113.7663635	*Forecast_year_without_scheme_NO2_other_emissions*																	
Difference (emissions other impacts)	-1.405326295	*Difference_without_scheme_NO2_other_emissions*																	
Opening year			115.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_NO2_emissions_other_mask*
Forecast year			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	113.77	*Forecast_year_without_scheme_NO2_emissions_other_mask*
Interpolation			0.00	115.08	114.98	114.89	114.80	114.70	114.61	114.52	114.42	114.33	114.23	114.14	114.05	113.95	113.86	0.00	*Interpolation_without_scheme_NO2_emissions_other_mask*
Extrapolation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_NO2_emissions_other_mask*
Total			115.17	115.08	114.98	114.89	114.80	114.70	114.61	114.52	114.42	114.33	114.23	114.14	114.05	113.95	113.86	113.77	*Total_without_scheme_NO2_other_emissions*
With scheme (tonnes)																			
	2028																		
Opening year NOx emissions	135.9531371	*Opening_year_with_scheme_NO2_other_emissions*																	
	2043																		
Forecast year NOx emissions	136.3476692	*Forecast_year_with_scheme_NO2_other_emissions*																	
Difference	0.394532104	*Difference_with_scheme_NO2_other_emissions*																	
Opening year			135.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_NO2_emissions_other_mask*
Forecast year			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	136.35	*Forecast_year_with_scheme_NO2_emissions_other_mask*
Interpolation			0.00	135.98	136.01	136.03	136.06	136.08	136.11	136.14	136.16	136.19	136.22	136.24	136.27	136.30	136.32	0.00	*Interpolation_with_scheme_NO2_emissions_other_mask*
Extrapolation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_NO2_emissions_other_mask*
Total			135.95	135.98	136.01	136.03	136.06	136.08	136.11	136.14	136.16	136.19	136.22	136.24	136.27	136.30	136.32	136.35	*Total_with_scheme_NO2_emissions_other*
Total change in NOx emissions (tonnes)			**20.78**	**20.90**	**21.02**	**21.14**	**21.26**	**21.38**	**21.50**	**21.62**	**21.74**	**21.86**	**21.98**	**22.10**	**22.22**	**22.34**	**22.46**	**22.58**	*NO2_emissions_other_TOTAL_change*
Change over 60 years	1340.479474																		
NOx emissions																			
Without scheme (tonnes)																			
	2028																		
Opening year NOx emissions	0	*Opening_year_without_scheme_NOx_emissions*																	
	2043																		
Forecast year NOx emissions	0	*Forecast_year_without_scheme_NOx_emissions*																	
Difference	0	*Difference_without_scheme_NOx_emissions*																	
Opening year			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_NOx_emissions_mask*
Forecast year			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_year_without_scheme_NOx_emissions_mask*
Interpolation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Interpolation_without_scheme_NOx_emissions_mask*
Extrapolation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_NOx_emissions_mask*
Total			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Total_without_scheme_NOx_emissions*
With scheme (tonnes)																			
	2028																		
Opening year NOx emissions	0	*Opening_year_with_scheme_NOx_emissions*																	
	2043																		
Forecast year NOx emissions	0	*Forecast_year_with_scheme_NOx_emissions*																	
Difference	0	*Difference_with_scheme_NOx_emissions*																	
Opening year			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_NOx_emissions_mask*
Forecast year			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_year_with_scheme_NOx_emissions_mask*
Interpolation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Interpolation_with_scheme_NOx_emissions_mask*
Extrapolation			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_NOx_emissions_mask*
Total			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Total_with_scheme_NOx_emissions*
Total change in NOx emissions (tonnes)			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	*NOx_emissions_TOTAL_change*
Change over 60 years	0	*TOTAL_emissions_change_60years*																	
EU emission exceedance values																			
Exceedance method	**Custom**	*Exceedance_method*																	
Exceedance %			**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	*Exceedance_percentages*
Exceedance without			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Exceedance_without*
Exceedance with			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Exceedance_with*
Exceedance difference			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Exceedance_difference*
NOx emissions in areas of exceedance																			
			2028	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	
Without scheme			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Without_scheme_NOx_emissions_in_exceedance*
With scheme			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*With_scheme_NOx_emissions_in_exceedance*
Change in emissions			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Change_NOx_emissions_in_exceedance*
Without scheme opening year	0.00	*Without_scheme_opening_year_exceedance*																	
With scheme opening year	0.00	*With_scheme_opening_year_exceedance*																	
Change	0.00	*Change_opening_year_exceedance*																	
Without scheme forecast year	0.00	*Without_scheme_forecast_year_exceedance*																	
With scheme forecast year	0.00	*With_scheme_forecast_year_exceedance*																	
Change	0.00	*Change_forecast_year_exceedance*																	

NOx emissions not in areas of exceedance

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Without scheme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Without_scheme_NOx_emissions_not_in_exceedance*
With scheme	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*With_scheme_NOx_emissions_not in_exceedance*
Change in emissions	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Change_NOx_emissions_not_in_exceedance*

Without scheme opening year	0.00	*Without_scheme_opening_year_not_in_exceedance*
With scheme opening year	0.00	*With_scheme_opening_year_not_in_exceedance*
Change	0.00	*Change_opening_year_not_in_exceedance*
Without scheme forecast year	0.00	*Without_scheme_forecast_year_not_in_exceedance*
With scheme forecast year	0.00	*With_scheme_forecast_year_not_in_exceedance*
Change	0.00	*Change_forecast_year_not_in_exceedance*

PM2.5 concentrations

Without scheme

		2028	
Opening year PM2.5 concentrations	67131.1		*Opening_year_without_scheme_PM2.5_concentrations*
		2043	
Forecast year PM2.5 concentrations	68025		*Forecast_year_without_scheme_PM2.5_concentrations*
Difference		893.9	*Difference_without_scheme_PM2.5_concentrations*

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year	67131.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_PM2.5_concentrations_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68025.00	*Forecast_year_without_scheme_PM2.5_concentrations_mask*
Interpolation	0.00	67190.69	67250.29	67309.88	67369.47	67429.07	67488.66	67548.25	67607.85	67667.44	67727.03	67786.63	67846.22	67905.81	67965.41	0.00	*Interpolation_without_scheme_PM2.5_concentrations_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_PM2.5_concentrations_mask*
Total	67131.10	67190.69	67250.29	67309.88	67369.47	67429.07	67488.66	67548.25	67607.85	67667.44	67727.03	67786.63	67846.22	67905.81	67965.41	68025.00	*Total_without_scheme_PM2.5_concentrations*

With scheme

		2028	
Opening year PM2.5 concentrations	65896.1		*Opening_year_with_scheme_PM2.5_concentrations*
		2043	
Forecast year PM2.5 concentrations	66612		*Forecast_year_with_scheme_PM2.5_concentrations*
Difference		715.9	*Difference_with_scheme_PM2.5_concentrations*

		2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year		65896.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_PM2.5_concentrations_mask*
Forecast year		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66612.00	*Forecast_year_with_scheme_PM2.5_concentrations_mask*
Interpolation		0.00	65943.83	65991.55	66039.28	66087.01	66134.73	66182.46	66230.19	66277.91	66325.64	66373.37	66421.09	66468.82	66516.55	66564.27	0.00	*Interpolation_with_scheme_PM2.5_concentrations_mask*
Extrapolation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_PM2.5_concentrations_mask*
Total		65896.10	65943.83	65991.55	66039.28	66087.01	66134.73	66182.46	66230.19	66277.91	66325.64	66373.37	66421.09	66468.82	66516.55	66564.27	66612.00	*Total_with_scheme_PM2.5_concentrations*
Change in PM2.5 concentrations net total assessmen	**0.00**	**-1235.00**	**-1246.87**	**-1258.73**	**-1270.60**	**-1282.47**	**-1294.33**	**-1306.20**	**-1318.07**	**-1329.93**	**-1341.80**	**-1353.67**	**-1365.53**	**-1377.40**	**-1389.27**	**-1401.13**	**-1413.00**	***Change_in_PM2.5_concentrations_net_total_assessm***

Opening year net route assessment	-83356.00	*Change_in_PM2.5_concentrations_net_total_assessment*

PM2.5 CONCENTRATION OTHER IMPACTS

Without scheme

		2028	
Opening year PM2.5 emissions	15		*Opening_year_without_scheme_PM2.5_concentration_other_impacts*
		2043	
Forecast year PM2.5 emissions	17.61674923		*Forecast_year_without_scheme_PM2.5_concentration_other_impacts*
Difference		2.312856071	*Difference_without_scheme_PM2.5_concentration_other_impacts*

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year	15.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_PM2.5_concentration_other_ir*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.62	*Forecast_year_without_scheme_PM2.5_concentration_other_ir*
Interpolation	0.00	15.46	15.61	15.77	15.92	16.07	16.23	16.38	16.54	16.69	16.85	17.00	17.15	17.31	17.46	0.00	*Interpolation_without_scheme_PM2.5_concentration_other_imp*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_PM2.5_concentration_other_im*
Total	15.30	15.46	15.61	15.77	15.92	16.07	16.23	16.38	16.54	16.69	16.85	17.00	17.15	17.31	17.46	17.62	*Total_without_scheme_PM2.5_concentration_other_impacts*

With scheme

		2028	
Opening year PM2.5 emissions	17.25137642		*Opening_year_with_scheme_PM2.5_concentration_other_impacts*
		2043	
Forecast year PM2.5 emissions	20.55228058		*Forecast_year_with_scheme_PM2.5_concentration_other_impacts*
Difference		3.300904164	*Difference_with_scheme_PM2.5_concentration_other_impacts*

	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
Opening year	17.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_PM2.5_concentration_other_impa*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.55	*Forecast_year_with_scheme_PM2.5_concentration_other_impa*
Interpolation	0.00	17.47	17.69	17.91	18.13	18.35	18.57	18.79	19.01	19.23	19.45	19.67	19.89	20.11	20.33	0.00	*Interpolation_with_scheme_PM2.5_concentration_other_impac*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_PM2.5_concentration_other_impac*
Total	17.25	17.47	17.69	17.91	18.13	18.35	18.57	18.79	19.01	19.23	19.45	19.67	19.89	20.11	20.33	20.55	*Total_with_scheme_PM2.5_concentration_other_impacts*
Change in PM2.5 emissions	**1.95**	**2.01**	**2.08**	**2.15**	**2.21**	**2.28**	**2.34**	**2.41**	**2.47**	**2.54**	**2.61**	**2.67**	**2.74**	**2.80**	**2.87**	**2.94**	***Change_in_PM2.5_concentrations_other_impacts_to***

Total 60-year change in emissions	168.23	*TOTAL_PM2.5_concentrations_other_impacts_change*

PM2.5 emissions

Without scheme

		2028	
Opening year PM2.5 emissions	0		*Opening_year_without_scheme_PM2.5_emissions*
		2043	
Forecast year PM2.5 emissions	0		*Forecast_year_without_scheme_PM2.5_emissions*
Difference		0	*Difference_without_scheme_PM2.5_emissions*

Opening year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_PM2.5_emissions_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_year_without_scheme_PM2.5_emissions_mask*
Interpolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Interpolation_without_scheme_PM2.5_emissions_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_PM2.5_emissions_mask*
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Total_without_scheme_PM2.5_emissions*

With scheme

		2028	
Opening year PM2.5 emissions	0		*Opening_year_with_scheme_PM2.5_emissions*
		2043	
Forecast year PM2.5 emissions	0		*Forecast_year_with_scheme_PM2.5_emissions*
Difference		0	*Difference_with_scheme_PM2.5_emissions*

Opening year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_PM2.5_emissions_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_year_with_scheme_PM2.5_emissions_mask*
Interpolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Interpolation_with_scheme_PM2.5_emissions_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_PM2.5_emissions_mask*
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Total_with_scheme_PM2.5_emissions*
Change in PM2.5 emissions	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	***Change_in_PM2.5_emissions_net_total***

Total 60-year change in emissions	0.00	*TOTAL_PM2.5_emissions_change*

PM10 emissions

Without scheme

		2028	
Opening year PM10 emissions	0		*Opening_year_without_scheme_PM10_emissions*
		2043	
Forecast year PM10 emissions	0		*Forecast_year_without_scheme_PM10_emissions*
Difference		0	*Difference_without_scheme_PM10_emissions*

Opening year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_without_scheme_PM10_emissions_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_year_without_scheme_PM10_emissions_mask*
Interpolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Interpolation_without_scheme_PM10_emissions_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_without_scheme_PM10_emissions_mask*
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Total_without_scheme_PM10_emissions*

With scheme

		2028	
Opening year PM10 emissions	0		*Opening_year_with_scheme_PM10_emissions*
		2043	
Forecast year PM10 emissions	0		*Forecast_year_with_scheme_PM10_emissions*
Difference		0	*Difference_with_scheme_PM10_emissions*

Opening year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_year_with_scheme_PM10_emissions_mask*
Forecast year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_year_with_scheme_PM10_emissions_mask*
Interpolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Interpolation_with_scheme_PM10_emissions_mask*
Extrapolation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Extrapolation_with_scheme_PM10_emissions_mask*
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Total_with_scheme_PM10_emissions*
Change in PM10 emissions net total assessment	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	***Change_in_PM10_emissions_net_total***

Total 60-year change in emissions	0.00	*TOTAL_PM10_emissions_change*

Damage Costs

Income and price adjustment

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
GDP deflator index	100.00	144.88	148.21	151.62	155.11	158.68	162.33	166.06	169.88	173.79	177.78	181.87	186.06	190.33	194.71	199.19	203.77	*GDP_deflator*
Real GDP per household index	123.39	145.56	147.30	149.04	150.75	152.43	154.14	155.86	157.58	159.52	161.50	163.51	165.55	167.90	170.24	172.59	174.92	*GDP_household*
Real GDP per capita index	138.15	166.94	169.38	171.82	174.25	176.67	179.12	181.58	184.02	186.74	189.49	192.27	195.04	197.81	200.57	203.33	206.07	*GDP_capita*

emission/concentration values	2010	*Income_base_values*
GDP per capita index - values	138.15	*GDP_capita_base_values*
GDP per household index - values	123.39	*GDP_household_base_values*
emission/concentration values	2010	*Price_base_values*
GDP deflator index - values	100.00	*GDP_deflator_base_values*
Price base for outputs	2010	*Price_base_outputs*
GDP deflator index - for outputs	100.00	*GDP_deflator_outputs*
Price base adjustment	1.00	*Price_adjustment*
Income elasticity	1.30	*Income_elasticity*

	2010	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Uprating mask	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NO2 concentration costs (£/HH/1µgm-3)																			
Low base value	1.05	*No2_concentration_cost_low*																	
Central base value	13.65	*No2_concentration_cost_central*																	
High base value	53.60	*No2_concentration_cost_high*																	
Low		0.00	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	*NO2_total_concentration_costs_low*
Central		0.00	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52	*NO2_total_concentration_costs_central*
High		0.00	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	60.93	*NO2_total_concentration_costs_high*
Other impacts (£/tonne)																			
Low base value	239.00	*No2_concentration_other_impacts_low*																	
Central base value	1,282.64	No2_concentration_other_impacts_central																	
High base value	3910.41	No2_concentration_other_impacts_high																	
Low		0.00	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	274.58	*NO2_total_other_impacts_low*
Central		0.00	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	1473.65	*NO2_total_other_impacts_central*
High		0.00	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	4492.73	*NO2_total_other_impacts_high*
NOx damage costs (£/tonne)																			
Low base value	551	*Nox_damage_base_value_low*																	
Central base value	5754	*Nox_damage_base_value_central*																	
High base value	21784	*Nox_damage_base_value_high*																	
Low		0	633	633	633	633	633	633	633	633	633	633	633	633	633	633	633	633	*NOx_damage_costs_low*
Central		0	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	6611	*NOx_damage_costs_central*
High		0	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	25028	*NOx_damage_costs_high*
NOx abatement costs (£/tonne)																			
Low base value	27000	*NOx_abatement_base_value_low*																	
Central base value	29000	*NOx_abatement_base_value_central*																	
High base value	73000	*NOx_abatement_base_value_high*																	
Low		0	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	31021	*NOx_abatement_costs_low*
Central		0	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	33319	*NOx_abatement_costs_central*
High		0	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	83871	*NOx_abatement_costs_high*
PM2.5 concentration costs (£/HH/1µgm-3)																			
Low base value	22.42	*PM2.5_concentrations_base_value_low*																	
Central base value	108.40	*PM2.5_concentrations_base_value_central*																	
High base value	337.78	*PM2.5_concentrations_base_value_high*																	
Low		0.00	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	25.49	*PM2.5_concentration_costs_low*
Central		0.00	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	123.22	*PM2.5_concentration_costs_central*
High		0.00	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	383.96	*PM2.5_concentration_costs_high*
Other impacts (£/tonne)																			
Low base value	785.11	*PM2.5_concentration_other_impacts_low*																	
Central base value	785.11	PM2.5_concentration_other_impacts_central																	
High base value	785.11	PM2.5_concentration_other_impacts_high																	
Low		0.00	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	*PM2.5_total_other_impacts_low*
Central		0.00	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	*PM2.5_total_other_impacts_central*
High		0.00	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	892.44	*PM2.5_total_other_impacts_high*
PM2.5 (£/tonne)																			
Low base value	14317	*PM2.5_damage_base_value_low*																	
Central base value	66146	*PM2.5_damage_base_value_central*																	
High base value	204848	*PM2.5_damage_base_value_high*																	
Low		0	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	16275	*PM2.5_damage_costs_low*
Central		0	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	75189	*PM2.5_damage_costs_central*
High		0	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	232854	*PM2.5_damage_costs_high*
PM10 (£/tonne)																			
Low base value	9091	*PM10_emissions_base_value_low*																	
Central base value	42002	*PM10_emissions_ damage_base_value_central*																	
High base value	130078	*PM10_emissions_base_value_high*																	
Low		0	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	10334	*PM10_damage_costs_low*
Central		0	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	47745	*PM10_damage_costs_central*
High		0	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	147862	*PM10_damage_costs_high*

Valuations

NO2 IPA VALUATIONS																			
NO2 concentration benefits																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	5788.848625	5816.554955	5844.261286	5871.967616	5899.673946	5927.380277	5955.086607	5982.792937	6010.499268	6038.205598	6065.911928	6093.618259	6121.324589	6149.030919	6176.73725	6204.44358	*NO2_concentrations_benefits_low*
Central (£)		0	75255.03212	75615.21442	75975.39671	76335.57901	76695.7613	77055.9436	77416.12589	77776.30819	78136.49048	78496.67277	78856.85507	79217.03736	79577.21966	79937.40195	80297.58425	80657.76654	*NO2_concentrations_benefits_central*
High (£)		0	295506.9393	296921.2815	298335.6237	299749.9659	301164.3081	302578.6503	303992.9925	305407.3347	306821.6769	308236.0191	309650.3613	311064.7035	312479.0457	313893.3879	315307.7301	316722.0723	*NO2_concentrations_benefits_high*
Other impacts - NO2																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	-11442.06588	-11508.13154	-11574.19719	-11640.26284	-11706.3285	-11772.39415	-11838.4598	-11904.52546	-11970.59111	-12036.65676	-12102.72242	-12168.78807	-12234.85372	-12300.91938	-12366.98503	-12433.05068	*NO2_concentrations_other_impacts_low*
Central (£)		0	-30624.48206	-30801.30558	-30978.12911	-31154.95263	-31331.77616	-31508.59968	-31685.4232	-31862.24673	-32039.07025	-32215.89378	-32392.7173	-32569.54083	-32746.36435	-32923.18787	-33100.0114	-33276.83492	*NO2_concentrations_other_impacts_central*
High (£)		0	-93365.39563	-93904.48061	-94443.56559	-94982.65057	-95521.73555	-96060.82053	-96599.90551	-97138.99049	-97678.07547	-98217.16045	-98756.24543	-99295.33041	-99834.41539	-100373.5004	-100912.5854	-101451.6703	*NO2_concentrations_other_impacts_high*
TOTAL IPA NO2 concentration																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	-5653.217258	-5691.576581	-5729.935904	-5768.295227	-5806.65455	-5845.013873	-5883.373196	-5921.732519	-5960.091842	-5998.451165	-6036.810488	-6075.169811	-6113.529134	-6151.888457	-6190.24778	-6228.607103	*NO2_concentrations_TOTAL_benefits_low*
Central (£)		0	44630.55007	44813.90884	44997.26761	45180.62638	45363.98515	45547.34392	45730.70269	45914.06146	46097.42023	46280.779	46464.13777	46647.49654	46830.85531	47014.21408	47197.57285	47380.93162	*NO2_concentrations_TOTAL_benefits_central*
High (£)		0	202141.5437	203016.8009	203892.0581	204767.3154	205642.5726	206517.8298	207393.087	208268.3442	209143.6014	210018.8586	210894.1159	211769.3731	212644.6303	213519.8875	214395.1447	215270.4019	*NO2_concentrations_TOTAL_benefits_high*
NOx Damage Costs Calculation																			
NOx emissions benefits not in areas of exceedance																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_not_in_exceedance_low*
Central (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_not_in_exceedance_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_not_in_exceedance_high*
NOx emissions benefits in areas of exceedance																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_in_exceedance_low*
Central (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_in_exceedance_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_in_exceedance_high*
PM2.5 IPA Calculation																			
PM2.5 concentrations benefits																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	31474	31777	32079	32381	32684	32986	33289	33591	33894	34196	34498	34801	35103	35406	35708	36011	*PM2.5_concentrations_low*
Central (£)		0	152177	153639	155101	156563	158026	159488	160950	162412	163874	165337	166799	168261	169723	171186	172648	174110	*PM2.5_concentrations_central*
High (£)		0	474191	478747	483303	487860	492416	496972	501529	506085	510641	515198	519754	524310	528867	533423	537979	542536	*PM2.5_concentrations_high*
PM2.5 Other Impact benefits																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	-1738.017166	-1796.802252	-1855.587337	-1914.372423	-1973.157508	-2031.942593	-2090.727679	-2149.512764	-2208.29785	-2267.082935	-2325.86802	-2384.653106	-2443.438191	-2502.223277	-2561.008362	-2619.793448	*PM2.5_concentrations_other_impacts_low*
Central (£)		0	-1738.017166	-1796.802252	-1855.587337	-1914.372423	-1973.157508	-2031.942593	-2090.727679	-2149.512764	-2208.29785	-2267.082935	-2325.86802	-2384.653106	-2443.438191	-2502.223277	-2561.008362	-2619.793448	*PM2.5_concentrations_other_impacts_central*
High (£)		0	-1738.017166	-1796.802252	-1855.587337	-1914.372423	-1973.157508	-2031.942593	-2090.727679	-2149.512764	-2208.29785	-2267.082935	-2325.86802	-2384.653106	-2443.438191	-2502.223277	-2561.008362	-2619.793448	*PM2.5_concentrations_other_impacts_high*
PM2.5 IPA Total Benefits																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	29736.18767	29979.82679	30223.46592	30467.10504	30710.74416	30954.38329	31198.02241	31441.66153	31685.30065	31928.93978	32172.5789	32416.21802	32659.85715	32903.49627	33147.13539	33390.77452	*PM2.5_concentrations_TOTAL_benefits_low*
Central (£)		0	150438.7805	151842.207	153245.6336	154649.0601	156052.4866	157455.9131	158859.3396	160262.7662	161666.1927	163069.6192	164473.0457	165876.4722	167279.8988	168683.3253	170086.7518	171490.1783	*PM2.5_concentrations_TOTAL_benefits_central*
High (£)		0	472452.746	476950.2878	481447.8296	485945.3714	490442.9132	494940.4551	499437.9969	503935.5387	508433.0805	512930.6223	517428.1641	521925.706	526423.2478	530920.7896	535418.3314	539915.8732	*PM2.5_concentrations_TOTAL_benefits_high*
PM2.5 Damage Costs Calculation																			
PM2.5 emissions benefits																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM2.5_emissions_low*
Central (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM2.5_emissions_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM2.5_emissions_high*
PM10 Damage Costs Calculation																			
PM10 emissions benefits																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM10_emissions_low*
Central (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM10_emissions_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM10_emissions_high*

Discounting and present values

Discount period																			
Current year	2022	*Current_year*																	
PV base year	2010	*PV_base_year*																	
discount period 1	12	*Discount_period_1*																	
discount period 2	30	*Discount_period_2*																	
discount period 3	75	*Discount_period_3*																	
Masks																			
Discount period 1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Discount_period_1_mask*
Discount period 2		0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*Discount_period_2_mask*
Discount period 3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Discount_period_3_mask*
Discount rates and factors																			
discount rate 1	3.5%	*Discount_rate_1*																	
discount rate 2	1.5%	*Discount_rate_2*																	
discount rate 3	1.3%	*Discount_rate_3*																	
Discount rate profile		0.0%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	*Discount_rate_profile*
Discount factor	1	1.00	1.65	1.68	1.70	1.73	1.75	1.78	1.81	1.83	1.86	1.89	1.92	1.95	1.98	2.01	2.04	2.07	*Discount_factor*

Discounted benefits for NO2 concentrations																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0.00	-3,421.49	-3,393.80	-3,366.18	-3,338.63	-3,311.17	-3,283.79	-3,256.49	-3,229.28	-3,202.17	-3,175.15	-3,148.23	-3,121.41	-3,094.70	-3,068.10	-3,041.61	-3,015.23	No2_concentrations_discounted_low
Central (£)		0.00	27,011.69	26,721.84	26,434.65	26,150.12	25,868.22	25,588.95	25,312.27	25,038.19	24,766.68	24,497.73	24,231.32	23,967.43	23,706.05	23,447.16	23,190.74	22,936.78	No2_concentrations_discounted_central
High (£)		0.00	122,341.87	121,055.77	119,780.96	118,517.38	117,265.00	116,023.75	114,793.57	113,574.42	112,366.23	111,168.94	109,982.50	108,806.85	107,641.93	106,487.67	105,344.02	104,210.92	No2_concentrations_discounted_high
Of which:																			
Concentration costs (HHs):																			
Low (£)		0	3503.577609	3468.321455	3433.342177	3398.639292	3364.21227	3330.060536	3296.183473	3262.58042	3229.250679	3196.193509	3163.408134	3130.893739	3098.649476	3066.674462	3034.96778	3003.528484	NO2_concentration_hh_discounted_low
Central (£)		0	45546.50892	45088.17891	44633.4483	44182.31079	43734.75951	43290.78697	42850.38514	42413.54547	41980.25883	41550.51562	41124.30574	40701.61861	40282.44319	39866.76801	39454.58115	39045.87029	NO2_concentration_hh_discounted_central
High (£)		0	178849.2951	177049.5524	175263.9435	173492.4439	171735.0263	169991.6616	168262.3182	166546.9624	164845.5585	163158.0687	161484.4533	159824.6709	158178.678	156546.4297	154927.8791	153322.9778	NO2_concentration_hh_discounted_high
Other impacts:																			
Low (£)		0	-6925.067216	-6862.120245	-6799.521348	-6737.273986	-6675.38144	-6613.846816	-6552.673054	-6491.862927	-6431.419047	-6371.343869	-6311.639698	-6252.308688	-6193.352849	-6134.774049	-6076.574021	-6018.754363	NO2_concentration_other_impacts_discounted_low
Central (£)		0	-18534.81695	-18366.34052	-18198.79571	-18032.19178	-17866.5375	-17701.84119	-17538.11072	-17375.35352	-17213.57657	-17052.78645	-16892.98931	-16734.19094	-16576.3967	-16419.61161	-16263.84029	-16109.08702	NO2_concentration_other_impacts_discounted_central
High (£)		0	-56507.42156	-55993.78452	-55482.98771	-54975.05936	-54470.02626	-53967.91374	-53468.7458	-52972.54506	-52479.33283	-51989.12916	-51501.95284	-51017.82145	-50536.75139	-50058.75792	-49583.85517	-49112.05617	NO2_concentration_other_impacts_discounted_high
Discounted benefits for NOx emissions not in areas of exceedance																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_not_in_exceedance_discounted_low*
Central (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_not_in_exceedance_discounted_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_not_in_exceedance_discounted_high*
Discounted benefits for NOx emissions in areas of exceedance																			
(positive values represent a benefit - an improvement in air quality)																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_in_exceedance_discounted_low*
Central (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_in_exceedance_discounted_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*NOx_benefits_in_exceedance_discounted_high*
Discounted benefits for PM2.5 concentrations																			
Low (£)		0.00	17,997.20	17,876.51	17,755.45	17,634.07	17,512.40	17,390.48	17,268.33	17,146.00	17,023.51	16,900.89	16,778.19	16,655.41	16,532.61	16,409.79	16,286.99	16,164.24	*PM2.5_benefits_discounted_low*
Central (£)		0.00	91,049.87	90,541.15	90,027.58	89,509.41	88,986.90	88,460.28	87,929.79	87,395.66	86,858.12	86,317.38	85,773.64	85,227.13	84,678.04	84,126.56	83,572.89	83,017.22	*PM2.5_benefits_discounted_central*
High (£)		0.00	285,941.98	284,398.05	282,837.31	281,260.58	279,668.69	278,062.42	276,442.54	274,809.82	273,164.97	271,508.73	269,841.78	268,164.80	266,478.46	264,783.39	263,080.22	261,369.56	*PM2.5_benefits_discounted_high*
Of which:																			
Concentration costs (HHs):																			
Low (£)		0.00	19,049.09	18,947.91	18,845.56	18,742.09	18,637.57	18,532.04	18,425.56	18,318.18	18,209.96	18,100.92	17,991.14	17,880.65	17,769.49	17,657.71	17,545.36	17,432.47	PM2.5_concentration_hh_discounted_low
Central (£)		0.00	92,101.77	91,612.56	91,117.69	90,617.43	90,112.07	89,601.85	89,087.03	88,567.85	88,044.57	87,517.41	86,986.60	86,452.36	85,914.92	85,374.49	84,831.26	84,285.44	PM2.5_concentration_hh_discounted_central
High (£)		0.00	286,993.88	285,469.46	283,927.42	282,368.60	280,793.85	279,203.98	277,599.77	275,982.00	274,351.42	272,708.76	271,054.73	269,390.03	267,715.34	266,031.31	264,338.58	262,637.79	PM2.5_concentration_hh_discounted_high
Other impacts:																			
Low (£)		0.00	-1,051.90	-1,071.41	-1,090.11	-1,108.02	-1,125.17	-1,141.57	-1,157.23	-1,172.19	-1,186.45	-1,200.03	-1,212.95	-1,225.23	-1,236.88	-1,247.92	-1,258.36	-1,268.22	PM2.5_concentration_other_impacts_discounted_low
Central (£)		0.00	-1,051.90	-1,071.41	-1,090.11	-1,108.02	-1,125.17	-1,141.57	-1,157.23	-1,172.19	-1,186.45	-1,200.03	-1,212.95	-1,225.23	-1,236.88	-1,247.92	-1,258.36	-1,268.22	PM2.5_concentration_other_impacts_discounted_central
High (£)		0.00	-1,051.90	-1,071.41	-1,090.11	-1,108.02	-1,125.17	-1,141.57	-1,157.23	-1,172.19	-1,186.45	-1,200.03	-1,212.95	-1,225.23	-1,236.88	-1,247.92	-1,258.36	-1,268.22	PM2.5_concentration_other_impacts_discounted_high
Discounted benefits for PM2.5 emissions																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM2.5_emissions_discounted_low*
Central(£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM2.5_emissions_discounted_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM2.5_emissions_discounted_high*
Discounted benefits for PM10 emissions																			
Low (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM10_emissions_discounted_low*
Central(£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM10_emissions_discounted_central*
High (£)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*PM10_emissions_discounted_high*

NPV	
NO2 concentration costs NPV estimates	
(positive values represent a benefit - an improvement in air quality)	
Low (£)	-150,573
Central (£)	1,152,768
High (£)	5,234,622
Of which:	
Concentration costs (HHs):	
Low (£)	150702.054
Central (£)	1959126.702
High (£)	7692981.041
Other impacts:	
Low (£)	-301275.5308
Central (£)	-806358.5004
High (£)	-2458359.304
NOx damage costs NPV estimates	
(positive values represent a benefit - an improvement in air quality)	
Low (£)	0
Central (£)	0
High (£)	0
NOx abatement costs NPV estimates	
Low (£)	0
Central (£)	0
High (£)	0
Total present value of change in NOx emissions	
Low (£)	0
Central (£)	0
High (£)	0
PM2.5 concentration costs NPV estimates	
Low (£)	804,627
Central (£)	4,122,126
High (£)	12,972,647
Of which:	
Concentration costs (HHs):	
Low (£)	865065.3443
Central (£)	4182563.931
High (£)	13033085.28
Other impacts:	
Low (£)	-60438.29979
Central (£)	-60438.29979
High (£)	-60438.29979
PM2.5 damage costs NPV estimates	
Low (£)	0
Central (£)	0
High (£)	0
PM10 damage costs NPV estimates	
Low (£)	0
Central (£)	0
High (£)	0
Total present value of change in air quality: £NPV	
Low (£)	**654,054**
Central (£)	**5,274,894**
High (£)	**18,207,269**

Air Quality Valuation Workbook - Worksheet 3

Scheme Name:	A5WTC
Present Value Base Year	2010
Current Year	2022
Proposal Opening year:	2028
Project (Road/Rail or Road and Rail):	National

Overall Assessment Score:

Damage Costs Approach (Emissions)

Present value of change in NOx emissions (£):	£0
Present value of change in PM2.5 emissions (£):	£0
OR	
Present value of change in PM10 emissions (£):	£0

Impact Pathways Approach (Concentrations)

Present value of change in NO2 concentrations (£):	£1,152,768
Of which:	
Concentration costs:	£1,959,127
Other impacts:	-£806,359
Present value of change in PM2.5 concentrations (£):	£4,122,126
Of which:	
Concentration costs:	£4,182,564
Other impacts:	-£60,438

Total Change

Total value of change in air quality (£):	£5,274,894

*positive value reflects a **net benefit** (i.e. air quality improvement)

Quantitative Assessment:

Impact Pathways Approach (Concentrations)

Change in NO2 assessment scores over 60 year appraisal period: (between 'with scheme' and 'without scheme' scenarios)	-309,112.40
Change in PM2.5 assessment scores over 60 year appraisal period: (between 'with scheme' and 'without scheme' scenarios)	-83,356.00

Damage Costs Approach (Emissions)

Change in NOX emissions over 60 year appraisal period (tonnes): (between 'with scheme' and 'without scheme' scenarios)	0
Change in PM2.5 emissions over 60 year appraisal period (tonnes): (between 'with scheme' and 'without scheme' scenarios)	0
OR	
Change in PM10 emissions over 60 year appraisal period (tonnes): (between 'with scheme' and 'without scheme' scenarios)	0

Qualitative Comments:

Sensitivity Analysis:

Upper estimate net present value of change in air quality (£):	£18,207,269
Lower estimate net present value of change in air quality (£):	£654,054

Data Sources:

Noise Workbook - Inputs

Scheme details

Scheme name	A5 WTC OBC	*Scheme_name_in*
Opening year	2028	*Opening_year_in*
Forecast year	2043	*Forecast_year_in*
Scheme type (select from list)	road	*Scheme_type_in*
Current year	2022	*Current_year_in*

Noise modelling inputs

Night noise impact	yes	*Night_noise_impact_in*

If night time noise (and sleep disturbance impacts) are to be included, select 'yes'. If night time impacts are to be excluded, select 'no'.

Night noise (dB Lnight) modelling	yes	*Night_noise_modelling_in*

If night time (sleep disturbance) impacts are to be calculated from modelling of the Lnight period, select 'yes'. If night time impacts are to be translated from daytime noise metrics (for roads only), select 'no'.

Opening year: no. of households experiencing 'without scheme' and 'with scheme' noise levels

(dB Leq, 16h)	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		3002	1205	260	150	79	26	8	0	0	0	0	0	0	0	*Opening_without_45_with_xx_in*
45-48		637	2309	960	92	41	19	20	1	0	0	0	0	0	0	*Opening_without_45_48_with_xx_in*
48-51		113	733	1927	401	50	17	6	5	1	0	0	0	0	0	*Opening_without_48_51_with_xx_in*
51-54		18	165	473	858	149	18	9	1	1	0	0	0	0	0	*Opening_without_51_54_with_xx_in*
54-57		0	13	111	222	505	63	12	0	1	0	0	0	0	0	*Opening_without_54_57_with_xx_in*
57-60		0	5	19	68	149	362	39	6	0	0	0	0	0	0	*Opening_without_57_60_with_xx_in*
60-63		1	0	2	9	49	91	372	46	0	0	0	0	0	0	*Opening_without_60_63_with_xx_in*
63-66		0	0	0	2	6	28	57	300	63	3	0	0	0	0	*Opening_without_63_66_with_xx_in*
66-69		0	0	0	0	0	2	14	66	271	24	1	0	0	0	*Opening_without_66_69_with_xx_in*
69-72		0	0	0	0	0	1	1	8	50	117	5	0	0	0	*Opening_without_69_72_with_xx_in*
72-75		0	0	0	0	0	0	0	2	3	17	6	0	0	0	*Opening_without_72_75_with_xx_in*
75-78		0	0	0	0	0	0	0	0	0	0	2	0	0	0	*Opening_without_75_78_with_xx_in*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_78_81_with_xx_in*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_81_with_xx_in*

(dB Lnight)	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		13729	274	61	33	5	0	0	0	0	0	0	0	0	0	*Opening_without_45_with_xx_night_in*
45-48		291	522	68	8	1	0	0	0	0	0	0	0	0	0	*Opening_without_45_48_with_xx_night_in*
48-51		63	137	389	43	0	0	0	0	0	0	0	0	0	0	*Opening_without_48_51_with_xx_night_in*
51-54		9	32	116	363	49	2	0	0	0	0	0	0	0	0	*Opening_without_51_54_with_xx_night_in*
54-57		1	1	9	52	368	48	0	0	0	0	0	0	0	0	*Opening_without_54_57_with_xx_night_in*
57-60		0	1	0	9	54	160	6	0	0	0	0	0	0	0	*Opening_without_57_60_with_xx_night_in*
60-63		0	0	0	2	4	20	16	0	0	0	0	0	0	0	*Opening_without_60_63_with_xx_night_in*
63-66		0	0	0	0	0	0	2	0	0	0	0	0	0	0	*Opening_without_63_66_with_xx_night_in*
66-69		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_66_69_with_xx_night_in*
69-72		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_69_72_with_xx_night_in*
72-75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_72_75_with_xx_night_in*
75-78		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_75_78_with_xx_night_in*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_78_81_with_xx_night_in*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_81_with_xx_night_in*

Forecast year: no. of households experiencing 'without scheme' and 'with scheme' noise levels

(dB Leq, 16h)	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		2472	1079	309	144	84	41	9	4	0	0	0	0	0	0	*Forecast_without_45_with_xx_in*
45-48		610	2250	1083	121	49	22	8	12	1	0	0	0	0	0	*Forecast_without_45_48_with_xx_in*
48-51		115	701	1939	654	41	31	7	6	4	0	0	0	0	0	*Forecast_without_48_51_with_xx_in*
51-54		30	192	546	885	213	22	9	2	0	0	0	0	0	0	*Forecast_without_51_54_with_xx_in*
54-57		2	32	95	266	443	110	16	3	2	0	0	0	0	0	*Forecast_without_54_57_with_xx_in*
57-60		0	5	29	50	175	319	61	9	0	0	0	0	0	0	*Forecast_without_57_60_with_xx_in*
60-63		2	0	2	15	35	101	304	37	7	0	0	0	0	0	*Forecast_without_60_63_with_xx_in*
63-66		0	0	0	4	11	26	71	289	78	5	1	0	0	0	*Forecast_without_63_66_with_xx_in*
66-69		0	0	0	0	0	4	10	51	263	45	2	0	0	0	*Forecast_without_66_69_with_xx_in*
69-72		0	0	1	0	0	1	5	12	52	148	7	0	0	0	*Forecast_without_69_72_with_xx_in*
72-75		0	0	0	0	0	1	0	3	4	23	10	1	0	0	*Forecast_without_72_75_with_xx_in*
75-78		0	0	0	0	0	0	0	0	1	1	3	0	0	0	*Forecast_without_75_78_with_xx_in*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_78_81_with_xx_in*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_81_with_xx_in*

(dB Lnight)	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		13584	349	83	35	11	0	0	0	0	0	0	0	0	0	*Forecast_without_45_with_xx_night_in*
45-48		319	472	83	5	2	0	0	0	0	0	0	0	0	0	*Forecast_without_45_48_with_xx_night_in*
48-51		74	151	320	62	1	0	0	0	0	0	0	0	0	0	*Forecast_without_48_51_with_xx_night_in*
51-54		12	30	102	358	75	3	0	0	0	0	0	0	0	0	*Forecast_without_51_54_with_xx_night_in*
54-57		1	2	15	54	338	65	4	0	0	0	0	0	0	0	*Forecast_without_54_57_with_xx_night_in*
57-60		1	0	2	13	53	177	17	0	0	0	0	0	0	0	*Forecast_without_57_60_with_xx_night_in*
60-63		0	0	1	4	7	36	20	1	0	0	0	0	0	0	*Forecast_without_60_63_with_xx_night_in*
63-66		0	0	0	0	1	2	3	0	0	0	0	0	0	0	*Forecast_without_63_66_with_xx_night_in*
66-69		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_66_69_with_xx_night_in*
69-72		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_69_72_with_xx_night_in*
72-75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_72_75_with_xx_night_in*
75-78		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_75_78_with_xx_night_in*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_78_81_with_xx_night_in*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_81_with_xx_night_in*

Value of a 1dB change in noise, £/HH/annum

Income base year	2010	*Income_base_values_in*
Price base year	2010	*Price_base_values_in*
Assumed average household size	2.3	*Default_HH_size_in*

Road

Noise change in the interval,	**<**	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**
(dB Leq, 16hr)	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**	**64.00**
Sleep disturbance		0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.77	24.83	26.89	28.94	31.00	33.06	35.12	37.18	39.24	41.30	43.36	45.42
Amenity		10.02	10.20	10.50	10.91	11.44	12.07	12.82	13.68	14.65	15.74	16.94	18.25	19.68	21.21	22.86	24.62	26.50	28.49	30.59
AMI		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	2.72	3.85	5.02	6.22	7.46	8.73	10.04
Stroke		0.00	0.00	2.31	2.31	2.32	2.32	2.33	2.33	2.34	2.35	2.35	2.36	2.36	2.37	2.38	2.38	2.39	2.39	2.40
Dementia		0.00	0.00	3.49	3.50	3.51	3.52	3.52	3.53	3.54	3.55	3.55	3.56	3.57	3.58	3.58	3.59	3.60	3.61	3.62

Noise change in the interval,	**64.00**	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	
(dB Leq, 16hr)	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	**84.00**	
Sleep disturbance	47.48	49.54	51.60	53.66	55.72	57.77	59.83	61.89	63.95	66.01	68.07	68.07	68.07	68.07	68.07	68.07	68.07	68.07	68.07	68.07	*Sleep_disturbance_values_road_1dB_16hr_in*
Amenity	32.80	35.13	37.57	40.12	42.78	45.56	48.45	51.45	54.56	57.79	61.13	64.58	64.58	64.58	64.58	64.58	64.58	64.58	64.58	64.58	*Amenity_values_road_1dB_in*
AMI	11.38	12.76	14.18	15.62	17.11	18.62	20.18	21.77	23.39	25.05	26.74	28.47	30.23	32.03	33.87	33.87	33.87	33.87	33.87	33.87	*AMI_values_road_1dB_in*
Stroke	2.41	2.41	2.42	2.42	2.43	2.44	2.44	2.45	2.46	2.46	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	*Stroke_values_road_1dB_in*
Dementia	3.62	3.63	3.64	3.65	3.65	3.66	3.67	3.68	3.69	3.69	3.70	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	*Dementia_values_road_1db_in*

Noise change in the interval,	**<**	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**
(Lnight)	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**	**64.00**
Sleep disturbance		25.86	28.40	30.94	33.48	36.03	38.57	41.11	43.65	46.19	48.74	51.28	53.82	56.36	58.91	61.45	63.99	66.53	69.08	71.62

Noise change in the interval,	**64.00**	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	
(Lnight)	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	**84.00**	
Sleep disturbance	74.16	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	*Sleep_disturbance_values_road_1dB_night_in*

Rail

Noise change in the interval,	**<**	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**
(dB Leq, 16hr)	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**	**64.00**
Amenity		3.45	3.49	3.64	3.90	4.25	4.72	5.29	5.97	6.75	7.64	8.64	9.74	10.95	12.27	13.69	15.21	16.85	18.59	20.43
AMI		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	2.72	3.85	5.02	6.22	7.46
Stroke		0.00	0.00	0.00	0.00	0.00	2.51	2.52	2.53	2.53	2.54	2.55	2.55	2.56	2.57	2.57	2.58	2.59	2.60	2.60
Dementia		0.00	0.00	0.00	0.00	0.00	3.81	3.81	3.82	3.83	3.84	3.85	3.86	3.87	3.88	3.89	3.89	3.90	3.91	3.92

Noise change in the interval,	**64.00**	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	
(dB Leq, 16hr)	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	**84.00**	
Amenity	22.38	24.44	26.60	28.87	31.25	33.73	36.32	39.02	41.82	44.72	47.74	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	*Amenity_values_rail_1dB_in*
AMI	8.73	10.04	11.38	12.76	14.18	15.62	17.11	18.62	20.18	21.77	23.39	25.05	26.74	28.47	30.23	32.03	33.87	33.87	33.87	33.87	*AMI_values_rail_1dB_in*
Stroke	2.61	2.62	2.62	2.63	2.64	2.65	2.65	2.66	2.67	2.67	2.68	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	*Stroke_values_rail_1dB_in*
Dementia	3.93	3.94	3.95	3.96	3.97	3.98	3.99	4.00	4.00	4.01	4.02	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	*Dementia_values_rail_1db_in*

Noise change in the interval,	**<**	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**
(Lnight)	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**	**64.00**
Sleep disturbance		12.03	13.33	14.63	15.93	17.23	18.53	19.83	21.12	22.42	23.72	25.02	26.32	27.62	28.92	30.21	31.51	32.81	34.11	35.41

Noise change in the interval,	**64.00**	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	
(Lnight)	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	**84.00**	
Sleep disturbance	36.71	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	38.01	*Sleep_disturbance_values_rail_1dB_night_in*

Aviation

Noise change in the interval,	**<**	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**
(dB Leq, 16hr)	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**	**64.00**
Amenity		13.83	15.69	17.55	19.39	21.22	23.03	24.83	26.62	28.39	30.15	31.90	33.63	35.35	37.06	38.75	40.43	42.10	43.75	45.39
AMI		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	2.72	3.85	5.02	6.22	7.46
Stroke		0.00	0.00	0.00	0.00	0.00	4.48	4.50	4.52	4.54	4.57	4.59	4.61	4.63	4.66	4.68	4.70	4.72	4.75	4.77
Dementia		0.00	0.00	0.00	0.00	0.00	6.77	6.80	6.83	6.85	6.88	6.91	6.94	6.97	7.00	7.03	7.05	7.08	7.11	7.14

Noise change in the interval,	**64.00**	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	
(dB Leq, 16hr)	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	**84.00**	
Amenity	47.01	48.62	50.22	51.81	53.38	54.94	56.48	58.01	59.53	61.03	62.52	64.00	64.00	64.00	64.00	64.00	64.00	64.00	64.00	64.00	*Amenity_values_aviation_1dB_in*
AMI	8.73	10.04	11.38	12.76	14.18	15.62	17.11	18.62	20.18	21.77	23.39	25.05	26.74	28.47	30.23	32.03	33.87	33.87	33.87	33.87	*AMI_values_aviation_1dB_in*
Stroke	4.79	4.82	4.84	4.87	4.89	4.91	4.94	4.96	4.99	5.01	5.04	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	5.06	*Stroke_values_aviation_1dB_in*
Dementia	7.17	7.20	7.23	7.26	7.29	7.32	7.35	7.38	7.41	7.44	7.47	7.51	7.51	7.51	7.51	7.51	7.51	7.51	7.51	7.51	*Dementia_values_aviation_1db_in*

Noise change in the interval,	**<**	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**
(Lnight)	**45.00**	**46.00**	**47.00**	**48.00**	**49.00**	**50.00**	**51.00**	**52.00**	**53.00**	**54.00**	**55.00**	**56.00**	**57.00**	**58.00**	**59.00**	**60.00**	**61.00**	**62.00**	**63.00**	**64.00**
Sleep disturbance		33.59	36.12	38.66	41.19	43.73	46.26	48.80	51.33	53.87	56.40	58.94	61.48	64.01	66.55	69.08	71.62	74.15	76.69	79.22

Noise change in the interval,	**64.00**	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	
(Lnight)	**65.00**	**66.00**	**67.00**	**68.00**	**69.00**	**70.00**	**71.00**	**72.00**	**73.00**	**74.00**	**75.00**	**76.00**	**77.00**	**78.00**	**79.00**	**80.00**	**81.00**	**82.00**	**83.00**	**84.00**	
Sleep disturbance	81.76	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	84.29	*Sleep_disturbance_values_aviation_1dB_night_in*

source: TAG data book v1.15 (July 2021). Table A3.1.

Appraisal period and discounting

Appraisal period (years)	60	*Appraisal_period_length_in*
PV base year	2010	*PV_base_year_in*
Outputs price year	2010	*Price_base_outputs_in*

discount period 1	12	*Discount_period_1_in*
discount period 2	30	*Discount_period_2_in*
discount period 3	75	*Discount_period_3_in*
discount rate 1	3.5%	*Discount_rate_1_in*
discount rate 2	1.5%	*Discount_rate_2_in*
discount rate 3	1.3%	*Discount_rate_3_in*

source: TAG Data Book v1.15, July 2021, Table A1.1.1

	2010	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	
GDP deflator	100.00	144.88	148.21	151.62	155.11	158.68	162.33	166.06	169.88	173.79	177.78	181.87	186.06	190.33	194.71	199.19	203.77	*GDP_deflator_in*
Real GDP per capita	138.15	166.94	169.38	171.82	174.25	176.67	179.12	181.58	184.02	186.74	189.49	192.27	195.04	197.81	200.57	203.33	206.07	*GDP_capita_in*

source: TAG Data Book v1.17, November 2021, Annual Parameters

Income elasticity (for uprating)	1.3	*income_elasticity_in*

Household size - user input	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	*Household_size_user_input_in*

Noise Workbook - Calculations

Noise modelling inputs

Opening year: no. of households experiencing 'without scheme' and 'with scheme' noise levels

(dB Leq, 16h)	**With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		3002	1205	260	150	79	26	8	0	0	0	0	0	0	0	*Opening_without_45_with_xx*
45-48		637	2309	960	92	41	19	20	1	0	0	0	0	0	0	*Opening_without_45_48_with_xx*
48-51		113	733	1927	401	50	17	6	5	1	0	0	0	0	0	*Opening_without_48_51_with_xx*
51-54		18	165	473	858	149	18	9	1	1	0	0	0	0	0	*Opening_without_51_54_with_xx*
54-57		0	13	111	222	505	63	12	0	1	0	0	0	0	0	*Opening_without_54_57_with_xx*
57-60		0	5	19	68	149	362	39	6	0	0	0	0	0	0	*Opening_without_57_60_with_xx*
60-63		1	0	2	9	49	91	372	46	0	0	0	0	0	0	*Opening_without_60_63_with_xx*
63-66		0	0	0	2	6	28	57	300	63	3	0	0	0	0	*Opening_without_63_66_with_xx*
66-69		0	0	0	0	0	2	14	66	271	24	1	0	0	0	*Opening_without_66_69_with_xx*
69-72		0	0	0	0	0	1	1	8	50	117	5	0	0	0	*Opening_without_69_72_with_xx*
72-75		0	0	0	0	0	0	0	2	3	17	6	0	0	0	*Opening_without_72_75_with_xx*
75-78		0	0	0	0	0	0	0	0	0	0	2	0	0	0	*Opening_without_75_78_with_xx*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_78_81_with_xx*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_81_with_xx*

(dB Lnight)	**With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		13729	274	61	33	5	0	0	0	0	0	0	0	0	0	*Opening_without_45_with_xx_night*
45-48		291	522	68	8	1	0	0	0	0	0	0	0	0	0	*Opening_without_45_48_with_xx_night*
48-51		63	137	389	43	0	0	0	0	0	0	0	0	0	0	*Opening_without_48_51_with_xx_night*
51-54		9	32	116	363	49	2	0	0	0	0	0	0	0	0	*Opening_without_51_54_with_xx_night*
54-57		1	1	9	52	368	48	0	0	0	0	0	0	0	0	*Opening_without_54_57_with_xx_night*
57-60		0	1	0	9	54	160	6	0	0	0	0	0	0	0	*Opening_without_57_60_with_xx_night*
60-63		0	0	0	2	4	20	16	0	0	0	0	0	0	0	*Opening_without_60_63_with_xx_night*
63-66		0	0	0	0	0	0	2	0	0	0	0	0	0	0	*Opening_without_63_66_with_xx_night*
66-69		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_66_69_with_xx_night*
69-72		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_69_72_with_xx_night*
72-75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_72_75_with_xx_night*
75-78		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_75_78_with_xx_night*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_78_81_with_xx_night*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_81_with_xx_night*

Forecast year: no. of households experiencing 'without scheme' and 'with scheme' noise levels

(dB Leq, 16h)	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+		HH with increased noise
Without scheme																	*Forecast_HH_increased_noise_day*
<45		2472	1079	309	144	84	41	9	4	0	0	0	0	0	0	*Forecast_without_45_with_xx*	1670
45-48		610	2250	1083	121	49	22	8	12	1	0	0	0	0	0	*Forecast_without_45_48_with_xx*	1296
48-51		115	701	1939	654	41	31	7	6	4	0	0	0	0	0	*Forecast_without_48_51_with_xx*	743
51-54		30	192	546	885	213	22	9	2	0	0	0	0	0	0	*Forecast_without_51_54_with_xx*	246
54-57		2	32	95	266	443	110	16	3	2	0	0	0	0	0	*Forecast_without_54_57_with_xx*	131
57-60		0	5	29	50	175	319	61	9	0	0	0	0	0	0	*Forecast_without_57_60_with_xx*	70
60-63		2	0	2	15	35	101	304	37	7	0	0	0	0	0	*Forecast_without_60_63_with_xx*	44
63-66		0	0	0	4	11	26	71	289	78	5	1	0	0	0	*Forecast_without_63_66_with_xx*	84
66-69		0	0	0	0	0	4	10	51	263	45	2	0	0	0	*Forecast_without_66_69_with_xx*	47
69-72		0	0	1	0	0	1	5	12	52	148	7	0	0	0	*Forecast_without_69_72_with_xx*	7
72-75		0	0	0	0	0	1	0	3	4	23	10	1	0	0	*Forecast_without_72_75_with_xx*	1
75-78		0	0	0	0	0	0	0	0	1	1	3	0	0	0	*Forecast_without_75_78_with_xx*	0
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_78_81_with_xx*	0
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_81_with_xx*	
HH with decrease in noise		759	930	673	335	221	133	86	66	57	24	3	0	0		*Forecast_HH_decreased_noise_day*	

Forecast year: no. of households experiencing 'without scheme' and 'with scheme' noise levels

(dB Lnight)	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+		HH with increased noise
Without scheme																	*Forecast_HH_increased_noise_night*
<45		13584	349	83	35	11	0	0	0	0	0	0	0	0	0	*Forecast_without_45_with_xx_night*	478
45-48		319	472	83	5	2	0	0	0	0	0	0	0	0	0	*Forecast_without_45_48_with_xx_night*	90
48-51		74	151	320	62	1	0	0	0	0	0	0	0	0	0	*Forecast_without_48_51_with_xx_night*	63
51-54		12	30	102	358	75	3	0	0	0	0	0	0	0	0	*Forecast_without_51_54_with_xx_night*	78
54-57		1	2	15	54	338	65	4	0	0	0	0	0	0	0	*Forecast_without_54_57_with_xx_night*	69
57-60		1	0	2	13	53	177	17	0	0	0	0	0	0	0	*Forecast_without_57_60_with_xx_night*	17
60-63		0	0	1	4	7	36	20	1	0	0	0	0	0	0	*Forecast_without_60_63_with_xx_night*	1
63-66		0	0	0	0	1	2	3	0	0	0	0	0	0	0	*Forecast_without_63_66_with_xx_night*	0
66-69		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_66_69_with_xx_night*	0
69-72		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_69_72_with_xx_night*	0
72-75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_72_75_with_xx_night*	0
75-78		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_75_78_with_xx_night*	0
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_78_81_with_xx_night*	0
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_81_with_xx_night*	
HH with decrease in noise		407	183	120	71	61	38	3	0	0	0	0	0	0	0	*Forecast_HH_decreased_noise_night*	

Households experiencing increase (day)	4339	*Total_HH_increase_day*
Households experiencing decrease (day)	3287	*Total_HH_reduction_day*
Households experiencing increase (night)	796	*Total_HH_increase_night*
Households experiencing decrease (night)	883	*Total_HH_reduction_night*

Noise valuations, £/household/annum

Mode	**road**	*Scheme_type*
Road	**1**	*Road_mask*
Rail	**0**	*Rail_mask*
Aviation	**0**	*Aviation_mask*
Night noise impact	**yes**	*Night_noise_impact*
Impact on night noise	**1**	*Night_impact_mask*
No impact on night noise	**0**	*Non_night_impact_mask*
Night-noise modelling	**yes**	*Night_noise_modelling*
Leq night modelled	**1**	*Night_modelling_mask*
Leq night not modelled	**0**	*Non_night_modelling_mask*

Sleep disturbance

Noise change in the interval, (dB Lnight)	**<45 45-48**	**45-48 48-51**	**48-51 51-54**	**51-54 54-57**	**54-57 57-60**	**57-60 60-63**	**60-63 63-66**	**63-66 66-69**	**66-69 69-72**	**69-72 72-75**	**72-75 75-78**	**75-78 78-81**	**78-81 81+**	
Value of the change	40.06	96.64	119.52	142.40	165.28	188.16	211.04	228.84	230.11	230.11	230.11	230.11	230.11	*Sleep_disturbance_values_3dB_table*

Without scheme \ **With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	*Noise_3dB_bands*
<45	0.00	-40.06	-136.69	-256.21	-398.60	-563.88	-752.04	-963.08	-1191.91	-1422.02	-1652.13	-1882.23	-2112.34	-2342.45	*Without_45_with_xx_sleep_disturbance_value*
45-48	40.06	0.00	-96.64	-216.15	-358.55	-523.83	-711.98	-923.02	-1151.86	-1381.97	-1612.07	-1842.18	-2072.29	-2302.39	*Without_45_48_with_xx_sleep_disturbance_value*
48-51	136.69	96.64	0.00	-119.52	-261.91	-427.19	-615.35	-826.39	-1055.22	-1285.33	-1515.44	-1745.54	-1975.65	-2205.76	*Without_48_51_with_xx_sleep_disturbance_value*
51-54	256.21	216.15	119.52	0.00	-142.40	-307.67	-495.83	-706.87	-935.71	-1165.81	-1395.92	-1626.03	-1856.13	-2086.24	*Without_51_54_with_xx_sleep_disturbance_value*
54-57	398.60	358.55	261.91	142.40	0.00	-165.28	-353.44	-564.48	-793.31	-1023.42	-1253.52	-1483.63	-1713.74	-1943.84	*Without_54_57_with_xx_sleep_disturbance_value*
57-60	563.88	523.83	427.19	307.67	165.28	0.00	-188.16	-399.20	-628.03	-858.14	-1088.25	-1318.35	-1548.46	-1778.57	*Without_57_60_with_xx_sleep_disturbance_value*
60-63	752.04	711.98	615.35	495.83	353.44	188.16	0.00	-211.04	-439.87	-669.98	-900.09	-1130.19	-1360.30	-1590.41	*Without_60_63_with_xx_sleep_disturbance_value*
63-66	963.08	923.02	826.39	706.87	564.48	399.20	211.04	0.00	-228.84	-458.94	-689.05	-919.16	-1149.26	-1379.37	*Without_63_66_with_xx_sleep_disturbance_value*
66-69	1191.91	1151.86	1055.22	935.71	793.31	628.03	439.87	228.84	0.00	-230.11	-460.21	-690.32	-920.43	-1150.53	*Without_66_69_with_xx_sleep_disturbance_value*
69-72	1422.02	1381.97	1285.33	1165.81	1023.42	858.14	669.98	458.94	230.11	0.00	-230.11	-460.21	-690.32	-920.43	*Without_69_72_with_xx_sleep_disturbance_value*
72-75	1652.13	1612.07	1515.44	1395.92	1253.52	1088.25	900.09	689.05	460.21	230.11	0.00	-230.11	-460.21	-690.32	*Without_72_75_with_xx_sleep_disturbance_value*
75-78	1882.23	1842.18	1745.54	1626.03	1483.63	1318.35	1130.19	919.16	690.32	460.21	230.11	0.00	-230.11	-460.21	*Without_75_78_with_xx_sleep_disturbance_value*
78-81	2112.34	2072.29	1975.65	1856.13	1713.74	1548.46	1360.30	1149.26	920.43	690.32	460.21	230.11	0.00	-230.11	*Without_78_81_with_xx_sleep_disturbance_value*
81+	2342.45	2302.39	2205.76	2086.24	1943.84	1778.57	1590.41	1379.37	1150.53	920.43	690.32	460.21	230.11	0.00	*Without_81_with_xx_sleep_disturbance_value*

Amenity

Noise change in the interval, (dB Leq, 16hr)	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	
	45-48	**48-51**	**51-54**	**54-57**	**57-60**	**60-63**	**63-66**	**66-69**	**69-72**	**72-75**	**75-78**	**78-81**	**81+**	
Value of the change	15.12	32.23	37.45	45.70	57.00	71.34	88.72	109.15	132.62	159.13	186.90	193.75	193.75	*Amenity_values_3db_table*

Without scheme \ **With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	*Noise_3dB_bands*
<45	0.00	-15.12	-47.36	-84.80	-130.51	-187.51	-258.85	-347.58	-456.73	-589.34	-748.47	-935.37	-1129.12	-1322.87	*Without_45_with_xx_amenity_value*
45-48	15.12	0.00	-32.23	-69.68	-115.39	-172.39	-243.73	-332.45	-441.60	-574.22	-733.35	-920.25	-1114.00	-1307.74	*Without_45_48_with_xx_amenity_value*
48-51	47.36	32.23	0.00	-37.45	-83.15	-140.15	-211.49	-300.22	-409.37	-541.99	-701.12	-888.01	-1081.76	-1275.51	*Without_48_51_with_xx_amenity_value*
51-54	84.80	69.68	37.45	0.00	-45.70	-102.70	-174.05	-262.77	-371.92	-504.54	-663.67	-850.57	-1044.31	-1238.06	*Without_51_54_with_xx_amenity_value*
54-57	130.51	115.39	83.15	45.70	0.00	-57.00	-128.34	-217.07	-326.22	-458.84	-617.97	-804.86	-998.61	-1192.36	*Without_54_57_with_xx_amenity_value*
57-60	187.51	172.39	140.15	102.70	57.00	0.00	-71.34	-160.07	-269.22	-401.84	-560.96	-747.86	-941.61	-1135.36	*Without_57_60_with_xx_amenity_value*
60-63	258.85	243.73	211.49	174.05	128.34	71.34	0.00	-88.72	-197.88	-330.49	-489.62	-676.52	-870.27	-1064.01	*Without_60_63_with_xx_amenity_value*
63-66	347.58	332.45	300.22	262.77	217.07	160.07	88.72	0.00	-109.15	-241.77	-400.90	-587.79	-781.54	-975.29	*Without_63_66_with_xx_amenity_value*
66-69	456.73	441.60	409.37	371.92	326.22	269.22	197.88	109.15	0.00	-132.62	-291.75	-478.64	-672.39	-866.14	*Without_66_69_with_xx_amenity_value*
69-72	589.34	574.22	541.99	504.54	458.84	401.84	330.49	241.77	132.62	0.00	-159.13	-346.03	-539.77	-733.52	*Without_69_72_with_xx_amenity_value*
72-75	748.47	733.35	701.12	663.67	617.97	560.96	489.62	400.90	291.75	159.13	0.00	-186.90	-380.65	-574.39	*Without_72_75_with_xx_amenity_value*
75-78	935.37	920.25	888.01	850.57	804.86	747.86	676.52	587.79	478.64	346.03	186.90	0.00	-193.75	-387.49	*Without_75_78_with_xx_amenity_value*
78-81	1129.12	1114.00	1081.76	1044.31	998.61	941.61	870.27	781.54	672.39	539.77	380.65	193.75	0.00	-193.75	*Without_78_81_with_xx_amenity_value*
81+	1322.87	1307.74	1275.51	1238.06	1192.36	1135.36	1064.01	975.29	866.14	733.52	574.39	387.49	193.75	0.00	*Without_81_with_xx_amenity_value*

AMI

Noise change in the interval, (dB Leq, 16hr)	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	
	45-48	**48-51**	**51-54**	**54-57**	**57-60**	**60-63**	**63-66**	**66-69**	**69-72**	**72-75**	**75-78**	**78-81**	**81+**	
Value of the change	0.00	0.00	0.00	0.00	6.03	16.90	28.20	40.44	53.63	67.77	82.85	97.95	101.60	*AMI_values_3db_table*

Without scheme \ **With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	*Noise_3dB_bands*
<45	0.00	0.00	0.00	0.00	0.00	-6.03	-22.93	-51.13	-91.57	-145.20	-212.97	-295.82	-393.77	-495.37	*Without_45_with_xx_AMI_value*
45-48	0.00	0.00	0.00	0.00	0.00	-6.03	-22.93	-51.13	-91.57	-145.20	-212.97	-295.82	-393.77	-495.37	*Without_45_48_with_xx_AMI_value*
48-51	0.00	0.00	0.00	0.00	0.00	-6.03	-22.93	-51.13	-91.57	-145.20	-212.97	-295.82	-393.77	-495.37	*Without_48_51_with_xx_AMI_value*
51-54	0.00	0.00	0.00	0.00	0.00	-6.03	-22.93	-51.13	-91.57	-145.20	-212.97	-295.82	-393.77	-495.37	*Without_51_54_with_xx_AMI_value*
54-57	0.00	0.00	0.00	0.00	0.00	-6.03	-22.93	-51.13	-91.57	-145.20	-212.97	-295.82	-393.77	-495.37	*Without_54_57_with_xx_AMI_value*
57-60	6.03	6.03	6.03	6.03	6.03	0.00	-16.90	-45.10	-85.54	-139.18	-206.94	-289.80	-387.74	-489.34	*Without_57_60_with_xx_AMI_value*
60-63	22.93	22.93	22.93	22.93	22.93	16.90	0.00	-28.20	-68.64	-122.27	-190.04	-272.89	-370.84	-472.44	*Without_60_63_with_xx_AMI_value*
63-66	51.13	51.13	51.13	51.13	51.13	45.10	28.20	0.00	-40.44	-94.07	-161.84	-244.69	-342.64	-444.24	*Without_63_66_with_xx_AMI_value*
66-69	91.57	91.57	91.57	91.57	91.57	85.54	68.64	40.44	0.00	-53.63	-121.40	-204.25	-302.20	-403.80	*Without_66_69_with_xx_AMI_value*
69-72	145.20	145.20	145.20	145.20	145.20	139.18	122.27	94.07	53.63	0.00	-67.77	-150.62	-248.57	-350.17	*Without_69_72_with_xx_AMI_value*
72-75	212.97	212.97	212.97	212.97	212.97	206.94	190.04	161.84	121.40	67.77	0.00	-82.85	-180.80	-282.40	*Without_72_75_with_xx_AMI_value*
75-78	295.82	295.82	295.82	295.82	295.82	289.80	272.89	244.69	204.25	150.62	82.85	0.00	-97.95	-199.55	*Without_75_78_with_xx_AMI_value*
78-81	393.77	393.77	393.77	393.77	393.77	387.74	370.84	342.64	302.20	248.57	180.80	97.95	0.00	-101.60	*Without_78_81_with_xx_AMI_value*
81+	495.37	495.37	495.37	495.37	495.37	489.34	472.44	444.24	403.80	350.17	282.40	199.55	101.60	0.00	*Without_81_with_xx_AMI_value*

Stroke

Noise change in the interval, (dB Leq, 16hr)	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	
	45-48	**48-51**	**51-54**	**54-57**	**57-60**	**60-63**	**63-66**	**66-69**	**69-72**	**72-75**	**75-78**	**78-81**	**81+**	
Value of the change	0.00	5.78	6.98	7.03	7.08	7.14	7.19	7.25	7.30	7.36	7.41	7.42	7.42	*Stroke_values_3db_table*

Without scheme	**With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	*Noise_3dB_bands*
<45		0.00	0.00	-5.78	-12.75	-19.78	-26.87	-34.00	-41.20	-48.44	-55.74	-63.10	-70.51	-77.93	-85.35	*Without_45_with_xx_stroke_value*
45-48		0.00	0.00	-5.78	-12.75	-19.78	-26.87	-34.00	-41.20	-48.44	-55.74	-63.10	-70.51	-77.93	-85.35	*Without_45_48_with_xx_stroke_value*
48-51		5.78	5.78	0.00	-6.98	-14.01	-21.09	-28.23	-35.42	-42.67	-49.97	-57.32	-64.73	-72.15	-79.58	*Without_48_51_with_xx_stroke_value*
51-54		12.75	12.75	6.98	0.00	-7.03	-14.11	-21.25	-28.44	-35.69	-42.99	-50.35	-57.75	-65.18	-72.60	*Without_51_54_with_xx_stroke_value*
54-57		19.78	19.78	14.01	7.03	0.00	-7.08	-14.22	-21.41	-28.66	-35.96	-43.31	-50.72	-58.15	-65.57	*Without_54_57_with_xx_stroke_value*
57-60		26.87	26.87	21.09	14.11	7.08	0.00	-7.14	-14.33	-21.57	-28.88	-36.23	-43.64	-51.06	-58.48	*Without_57_60_with_xx_stroke_value*
60-63		34.00	34.00	28.23	21.25	14.22	7.14	0.00	-7.19	-14.44	-21.74	-29.09	-36.50	-43.93	-51.35	*Without_60_63_with_xx_stroke_value*
63-66		41.20	41.20	35.42	28.44	21.41	14.33	7.19	0.00	-7.25	-14.55	-21.90	-29.31	-36.73	-44.16	*Without_63_66_with_xx_stroke_value*
66-69		48.44	48.44	42.67	35.69	28.66	21.57	14.44	7.25	0.00	-7.30	-14.66	-22.07	-29.49	-36.91	*Without_66_69_with_xx_stroke_value*
69-72		55.74	55.74	49.97	42.99	35.96	28.88	21.74	14.55	7.30	0.00	-7.36	-14.77	-22.19	-29.61	*Without_69_72_with_xx_stroke_value*
72-75		63.10	63.10	57.32	50.35	43.31	36.23	29.09	21.90	14.66	7.36	0.00	-7.41	-14.83	-22.25	*Without_72_75_with_xx_stroke_value*
75-78		70.51	70.51	64.73	57.75	50.72	43.64	36.50	29.31	22.07	14.77	7.41	0.00	-7.42	-14.84	*Without_75_78_with_xx_stroke_value*
78-81		77.93	77.93	72.15	65.18	58.15	51.06	43.93	36.73	29.49	22.19	14.83	7.42	0.00	-7.42	*Without_78_81_with_xx_stroke_value*
81+		85.35	85.35	79.58	72.60	65.57	58.48	51.35	44.16	36.91	29.61	22.25	14.84	7.42	0.00	*Without_81_with_xx_stroke_value*

Dementia

Noise change in the interval, (dB Leq, 16hr)	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	
	45-48	**48-51**	**51-54**	**54-57**	**57-60**	**60-63**	**63-66**	**66-69**	**69-72**	**72-75**	**75-78**	**78-81**	**81+**	
Value of the change	0.00	8.75	10.56	10.63	10.70	10.77	10.83	10.90	10.97	11.04	11.11	11.13	11.13	*dementia_values_3db_table*

Without scheme	**With scheme**	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	*Noise_3dB_bands*
<45		0.00	0.00	-8.75	-19.31	-29.94	-40.64	-51.40	-62.24	-73.14	-84.12	-95.16	-106.27	-117.40	-128.53	*Without_45_with_xx_dementia_value*
45-48		0.00	0.00	-8.75	-19.31	-29.94	-40.64	-51.40	-62.24	-73.14	-84.12	-95.16	-106.27	-117.40	-128.53	*Without_45_48_with_xx_dementia_value*
48-51		8.75	8.75	0.00	-10.56	-21.19	-31.89	-42.65	-53.49	-64.39	-75.37	-86.41	-97.52	-108.65	-119.78	*Without_48_51_with_xx_dementia_value*
51-54		19.31	19.31	10.56	0.00	-10.63	-21.33	-32.09	-42.93	-53.83	-64.80	-75.85	-86.96	-98.09	-109.22	*Without_51_54_with_xx_dementia_value*
54-57		29.94	29.94	21.19	10.63	0.00	-10.70	-21.46	-32.30	-43.20	-54.18	-65.22	-76.33	-87.46	-98.59	*Without_54_57_with_xx_dementia_value*
57-60		40.64	40.64	31.89	21.33	10.70	0.00	-10.77	-21.60	-32.50	-43.48	-54.52	-65.64	-76.76	-87.89	*Without_57_60_with_xx_dementia_value*
60-63		51.40	51.40	42.65	32.09	21.46	10.77	0.00	-10.83	-21.74	-32.71	-43.76	-54.87	-66.00	-77.13	*Without_60_63_with_xx_dementia_value*
63-66		62.24	62.24	53.49	42.93	32.30	21.60	10.83	0.00	-10.90	-21.88	-32.92	-44.04	-55.16	-66.29	*Without_63_66_with_xx_dementia_value*
66-69		73.14	73.14	64.39	53.83	43.20	32.50	21.74	10.90	0.00	-10.97	-22.02	-33.13	-44.26	-55.39	*Without_66_69_with_xx_dementia_value*
69-72		84.12	84.12	75.37	64.80	54.18	43.48	32.71	21.88	10.97	0.00	-11.04	-22.16	-33.28	-44.41	*Without_69_72_with_xx_dementia_value*
72-75		95.16	95.16	86.41	75.85	65.22	54.52	43.76	32.92	22.02	11.04	0.00	-11.11	-22.24	-33.37	*Without_72_75_with_xx_dementia_value*
75-78		106.27	106.27	97.52	86.96	76.33	65.64	54.87	44.04	33.13	22.16	11.11	0.00	-11.13	-22.26	*Without_75_78_with_xx_dementia_value*
78-81		117.40	117.40	108.65	98.09	87.46	76.76	66.00	55.16	44.26	33.28	22.24	11.13	0.00	-11.13	*Without_78_81_with_xx_dementia_value*
81+		128.53	128.53	119.78	109.22	98.59	87.89	77.13	66.29	55.39	44.41	33.37	22.26	11.13	0.00	*Without_81_with_xx_dementia_value*

Noise cost

Opening year: sleep disturbance

Without scheme	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45		0	-10975.09771	-8338.110222	-8454.810213	-1993.02	0	0	0	0	0	0	0	0	0	*Opening_without_45_with_xx_sleep_disturbance_cost*
45-48		11656.0344	0	-6571.195666	-1729.210152	-358.548	0	0	0	0	0	0	0	0	0	*Opening_without_45_48_with_xx_sleep_disturbance_cost*
48-51		8611.49088	13239.02656	0	-5139.18966	0	0	0	0	0	0	0	0	0	0	*Opening_without_48_51_with_xx_sleep_disturbance_cost*
51-54		2305.85733	6916.840608	13863.86048	0	-6977.45	-615.349	0	0	0	0	0	0	0	0	*Opening_without_51_54_with_xx_sleep_disturbance_cost*
54-57		398.603217	358.5481158	2357.215969	7404.636034	0	-7933.33	0	0	0	0	0	0	0	0	*Opening_without_54_57_with_xx_sleep_disturbance_cost*
57-60		0	523.8257708	0	2769.070517	8924.993	0	-1128.95	0	0	0	0	0	0	0	*Opening_without_57_60_with_xx_sleep_disturbance_cost*
60-63		0	0	0	991.6659302	1413.744	3763.169	0	0	0	0	0	0	0	0	*Opening_without_60_63_with_xx_sleep_disturbance_cost*
63-66		0	0	0	0	0	0	422.0785	0	0	0	0	0	0	0	*Opening_without_63_66_with_xx_sleep_disturbance_cost*
66-69		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_66_69_with_xx_sleep_disturbance_cost*
69-72		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_69_72_with_xx_sleep_disturbance_cost*
72-75		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_72_75_with_xx_sleep_disturbance_cost*
75-78		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_75_78_with_xx_sleep_disturbance_cost*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_78_81_with_xx_sleep_disturbance_cost*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_81_with_xx_sleep_disturbance_cost*

Opening year sleep disturbance cost	£25,706	*Opening_year_sleep_disturbance_cost*

Forecast year: sleep disturbance

Without scheme	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45		0.00	-13979.23	-11345.30	-8967.22	-4384.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_45_with_xx_sleep_disturbance_cost*
45-48		12777.58	0.00	-8020.72	-1080.76	-717.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_45_48_with_xx_sleep_disturbance_cost*
48-51		10115.08	14591.92	0.00	-7409.99	-261.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_48_51_with_xx_sleep_disturbance_cost*
51-54		3074.48	6484.54	12190.64	0.00	-10679.76	-923.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_51_54_with_xx_sleep_disturbance_cost*
54-57		398.60	717.10	3928.69	7689.43	0.00	-10743.05	-1413.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_54_57_with_xx_sleep_disturbance_cost*
57-60		563.88	0.00	854.38	3999.77	8759.72	0.00	-3198.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_57_60_with_xx_sleep_disturbance_cost*
60-63		0.00	0.00	615.35	1983.33	2474.05	6773.70	0.00	-211.04	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_60_63_with_xx_sleep_disturbance_cost*
63-66		0.00	0.00	0.00	0.00	564.48	798.40	633.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_63_66_with_xx_sleep_disturbance_cost*
66-69		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_66_69_with_xx_sleep_disturbance_cost*
69-72		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_69_72_with_xx_sleep_disturbance_cost*
72-75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_72_75_with_xx_sleep_disturbance_cost*
75-78		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_75_78_with_xx_sleep_disturbance_cost*
78-81		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_78_81_with_xx_sleep_disturbance_cost*
81+		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_81_with_xx_sleep_disturbance_cost*

Forecast year sleep disturbance cost	£16,652	*Forecast_year_sleep_disturbance_cost*
Difference in sleep disturbance (	-£9,054	*Difference_sleep_disturbance_cost*

Opening year: amenity

Without scheme	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45		0.00	-18222.08	-12312.70	-12720.64	-10310.11	-4875.24	-2070.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_45_with_xx_amenity_cost*
45-48		9632.75	0.00	-30945.11	-6410.76	-4730.81	-3275.36	-4874.58	-332.45	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_45_48_with_xx_amenity_cost*
48-51		5351.29	23627.88	0.00	-15016.54	-4157.56	-2382.59	-1268.97	-1501.10	-409.37	0.00	0.00	0.00	0.00	0.00	*Opening_without_48_51_with_xx_amenity_cost*
51-54		1526.48	11497.57	17712.78	0.00	-6809.81	-1848.69	-1566.42	-262.77	-371.92	0.00	0.00	0.00	0.00	0.00	*Opening_without_51_54_with_xx_amenity_cost*
54-57		0.00	1500.01	9229.78	10146.15	0.00	-3591.09	-1540.12	0.00	-326.22	0.00	0.00	0.00	0.00	0.00	*Opening_without_54_57_with_xx_amenity_cost*
57-60		0.00	861.94	2662.90	6983.93	8493.22	0.00	-2782.34	-960.40	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_57_60_with_xx_amenity_cost*
60-63		258.85	0.00	422.99	1566.42	6288.83	6492.12	0.00	-4081.35	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_60_63_with_xx_amenity_cost*
63-66		0.00	0.00	0.00	525.54	1302.41	4481.87	5057.32	0.00	-6876.47	-725.31	0.00	0.00	0.00	0.00	*Opening_without_63_66_with_xx_amenity_cost*
66-69		0.00	0.00	0.00	0.00	0.00	538.43	2770.25	7203.92	0.00	-3182.83	-291.75	0.00	0.00	0.00	*Opening_without_66_69_with_xx_amenity_cost*
69-72		0.00	0.00	0.00	0.00	0.00	401.84	330.49	1934.15	6630.90	0.00	-795.64	0.00	0.00	0.00	*Opening_without_69_72_with_xx_amenity_cost*
72-75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	801.79	875.24	2705.18	0.00	0.00	0.00	0.00	*Opening_without_72_75_with_xx_amenity_cost*
75-78		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	373.80	0.00	0.00	0.00	*Opening_without_75_78_with_xx_amenity_cost*
78-81		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_78_81_with_xx_amenity_cost*
81+		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_81_with_xx_amenity_cost*

Opening year amenity cost	-£11,641	*Opening_year_amenity_cost*

Forecast year: amenity

Without scheme	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45		0.00	-16316.70	-14633.17	-12211.82	-10962.65	-7687.88	-2329.66	-1390.30	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_45_with_xx_amenity_cost*
45-48		9224.46	0.00	-34909.96	-8431.55	-5653.90	-3792.52	-1949.83	-3989.45	-441.60	0.00	0.00	0.00	0.00	0.00	*Forecast_without_45_48_with_xx_amenity_cost*
48-51		5446.00	22596.38	0.00	-24490.82	-3409.20	-4344.73	-1480.46	-1801.32	-1637.48	0.00	0.00	0.00	0.00	0.00	*Forecast_without_48_51_with_xx_amenity_cost*
51-54		2544.13	13378.99	20446.46	0.00	-9734.82	-2259.51	-1566.42	-525.54	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_51_54_with_xx_amenity_cost*
54-57		261.02	3692.34	7899.36	12157.10	0.00	-6270.16	-2053.50	-651.21	-652.44	0.00	0.00	0.00	0.00	0.00	*Forecast_without_54_57_with_xx_amenity_cost*
57-60		0.00	861.94	4064.43	5135.24	9975.26	0.00	-4351.86	-1440.60	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_57_60_with_xx_amenity_cost*
60-63		517.70	0.00	422.99	2610.70	4492.02	7205.54	0.00	-3282.82	-1385.13	0.00	0.00	0.00	0.00	0.00	*Forecast_without_60_63_with_xx_amenity_cost*
63-66		0.00	0.00	0.00	1051.09	2387.75	4161.74	6299.47	0.00	-8513.72	-1208.84	-400.90	0.00	0.00	0.00	*Forecast_without_63_66_with_xx_amenity_cost*
66-69		0.00	0.00	0.00	0.00	0.00	1076.87	1978.75	5566.66	0.00	-5967.81	-583.49	0.00	0.00	0.00	*Forecast_without_66_69_with_xx_amenity_cost*
69-72		0.00	0.00	541.99	0.00	0.00	401.84	1652.47	2901.22	6896.14	0.00	-1113.90	0.00	0.00	0.00	*Forecast_without_69_72_with_xx_amenity_cost*
72-75		0.00	0.00	0.00	0.00	0.00	560.96	0.00	1202.69	1166.99	3659.95	0.00	-186.90	0.00	0.00	*Forecast_without_72_75_with_xx_amenity_cost*
75-78		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	478.64	346.03	560.69	0.00	0.00	0.00	*Forecast_without_75_78_with_xx_amenity_cost*
78-81		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_78_81_with_xx_amenity_cost*
81+		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_81_with_xx_amenity_cost*

Forecast year amenity cost	-£38,191	*Forecast_year_amenity_cost*
Difference in amenity cost	-£26,550	*Difference_amenity_cost*

Opening year: AMI

Without scheme	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45		0.00	0.00	0.00	0.00	0.00	-156.67	-183.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_45_with_xx_AMI_cost*
45-48		0.00	0.00	0.00	0.00	0.00	-114.49	-458.58	-51.13	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_45_48_with_xx_AMI_cost*
48-51		0.00	0.00	0.00	0.00	0.00	-102.44	-137.57	-255.64	-91.57	0.00	0.00	0.00	0.00	0.00	*Opening_without_48_51_with_xx_AMI_cost*
51-54		0.00	0.00	0.00	0.00	0.00	-108.46	-206.36	-51.13	-91.57	0.00	0.00	0.00	0.00	0.00	*Opening_without_51_54_with_xx_AMI_cost*
54-57		0.00	0.00	0.00	0.00	0.00	-379.62	-275.15	0.00	-91.57	0.00	0.00	0.00	0.00	0.00	*Opening_without_54_57_with_xx_AMI_cost*
57-60		0.00	30.13	114.49	409.75	897.83	0.00	-659.23	-270.61	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_57_60_with_xx_AMI_cost*
60-63		22.93	0.00	45.86	206.36	1123.53	1538.21	0.00	-1297.15	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_60_63_with_xx_AMI_cost*
63-66		0.00	0.00	0.00	102.26	306.77	1262.87	1607.34	0.00	-2547.82	-282.22	0.00	0.00	0.00	0.00	*Opening_without_63_66_with_xx_AMI_cost*
66-69		0.00	0.00	0.00	0.00	0.00	171.09	960.97	2669.15	0.00	-1287.15	-121.40	0.00	0.00	0.00	*Opening_without_66_69_with_xx_AMI_cost*
69-72		0.00	0.00	0.00	0.00	0.00	139.18	122.27	752.58	2681.57	0.00	-338.84	0.00	0.00	0.00	*Opening_without_69_72_with_xx_AMI_cost*
72-75		0.00	0.00	0.00	0.00	0.00	0.00	0.00	323.68	364.20	1152.06	0.00	0.00	0.00	0.00	*Opening_without_72_75_with_xx_AMI_cost*
75-78		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	165.70	0.00	0.00	0.00	*Opening_without_75_78_with_xx_AMI_cost*
78-81		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_78_81_with_xx_AMI_cost*
81+		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_81_with_xx_AMI_cost*

Opening year AMI cost	£7,611	*Opening_year_AMI_cost*

Forecast year: AMI

Without scheme	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45		0.00	0.00	0.00	0.00	0.00	-247.05	-206.36	-204.51	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_45_with_xx_AMI_cost*
45-48		0.00	0.00	0.00	0.00	0.00	-132.57	-183.43	-613.54	-91.57	0.00	0.00	0.00	0.00	0.00	*Forecast_without_45_48_with_xx_AMI_cost*
48-51		0.00	0.00	0.00	0.00	0.00	-186.80	-160.50	-306.77	-366.28	0.00	0.00	0.00	0.00	0.00	*Forecast_without_48_51_with_xx_AMI_cost*
51-54		0.00	0.00	0.00	0.00	0.00	-132.57	-206.36	-102.26	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_51_54_with_xx_AMI_cost*
54-57		0.00	0.00	0.00	0.00	0.00	-662.83	-366.87	-153.38	-183.14	0.00	0.00	0.00	0.00	0.00	*Forecast_without_54_57_with_xx_AMI_cost*
57-60		0.00	30.13	174.75	301.29	1054.50	0.00	-1031.11	-405.92	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_57_60_with_xx_AMI_cost*
60-63		45.86	0.00	45.86	343.94	802.52	1707.25	0.00	-1043.36	-480.48	0.00	0.00	0.00	0.00	0.00	*Forecast_without_60_63_with_xx_AMI_cost*
63-66		0.00	0.00	0.00	204.51	562.41	1172.66	2002.13	0.00	-3154.45	-470.37	-161.84	0.00	0.00	0.00	*Forecast_without_63_66_with_xx_AMI_cost*
66-69		0.00	0.00	0.00	0.00	0.00	342.18	686.41	2062.52	0.00	-2413.41	-242.80	0.00	0.00	0.00	*Forecast_without_66_69_with_xx_AMI_cost*
69-72		0.00	0.00	145.20	0.00	0.00	139.18	611.36	1128.88	2788.83	0.00	-474.38	0.00	0.00	0.00	*Forecast_without_69_72_with_xx_AMI_cost*
72-75		0.00	0.00	0.00	0.00	0.00	206.94	0.00	485.52	485.60	1558.67	0.00	-82.85	0.00	0.00	*Forecast_without_72_75_with_xx_AMI_cost*
75-78		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	204.25	150.62	248.56	0.00	0.00	0.00	*Forecast_without_75_78_with_xx_AMI_cost*
78-81		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_78_81_with_xx_AMI_cost*
81+		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Forecast_without_81_with_xx_AMI_cost*

Forecast year AMI cost	£5,225	*Forecast_year_AMI_cost*
Difference in AMI cost	-£2,386	*Difference_AMI_cost*

Opening year: stroke

Without scheme \ With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45	0.00	0.00	-1501.60	-1912.95	-1562.88	-698.54	-272.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_45_with_xx_stroke_cost*
45-48	0.00	0.00	-5544.39	-1173.27	-811.11	-510.47	-680.08	-41.20	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_45_48_with_xx_stroke_cost*
48-51	652.62	4233.37	0.00	-2798.01	-700.39	-358.55	-169.37	-177.10	-42.67	0.00	0.00	0.00	0.00	0.00	*Opening_without_48_51_with_xx_stroke_cost*
51-54	229.55	2104.24	3300.39	0.00	-1047.52	-254.05	-191.26	-28.44	-35.69	0.00	0.00	0.00	0.00	0.00	*Opening_without_51_54_with_xx_stroke_cost*
54-57	0.00	257.18	1554.87	1560.73	0.00	-446.26	-170.65	0.00	-28.66	0.00	0.00	0.00	0.00	0.00	*Opening_without_54_57_with_xx_stroke_cost*
57-60	0.00	134.33	400.74	959.74	1055.44	0.00	-278.35	-85.97	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_57_60_with_xx_stroke_cost*
60-63	34.00	0.00	56.46	191.26	696.81	649.48	0.00	-330.80	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_60_63_with_xx_stroke_cost*
63-66	0.00	0.00	0.00	56.88	128.47	401.19	409.90	0.00	-456.49	-43.64	0.00	0.00	0.00	0.00	*Opening_without_63_66_with_xx_stroke_cost*
66-69	0.00	0.00	0.00	0.00	0.00	43.15	202.12	478.22	0.00	-175.22	-14.66	0.00	0.00	0.00	*Opening_without_66_69_with_xx_stroke_cost*
69-72	0.00	0.00	0.00	0.00	0.00	28.88	21.74	116.37	365.04	0.00	-36.78	0.00	0.00	0.00	*Opening_without_69_72_with_xx_stroke_cost*
72-75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.81	43.97	125.06	0.00	0.00	0.00	0.00	*Opening_without_72_75_with_xx_stroke_cost*
75-78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.82	0.00	0.00	0.00	*Opening_without_75_78_with_xx_stroke_cost*
78-81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_78_81_with_xx_stroke_cost*
81+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*Opening_without_81_with_xx_stroke_cost*

Opening year stroke cost	-£2,028	*Opening_year_stroke_cost*

Forecast year: stroke

Without scheme \ With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
<45	0	0	-1784.59893	-1836.428036	-1661.8	-1101.54	-306.035	-164.781	0	0	0	0	0	0	*Forecast_without_45_with_xx_stroke_cost*
45-48	0	0	-6254.759357	-1543.109669	-969.381	-591.069	-272.031	-494.342	-48.441	0	0	0	0	0	*Forecast_without_45_48_with_xx_stroke_cost*
48-51	664.171123	4048.556149	0	-4563.331697	-574.323	-653.833	-197.6	-212.519	-170.662	0	0	0	0	0	*Forecast_without_48_51_with_xx_stroke_cost*
51-54	382.589174	2448.570714	3809.753985	0	-1497.46	-310.504	-191.259	-56.8844	0	0	0	0	0	0	*Forecast_without_51_54_with_xx_stroke_cost*
54-57	39.5665621	633.0649932	1330.748597	1870.062079	0	-779.185	-227.53	-64.2356	-57.3154	0	0	0	0	0	*Forecast_without_54_57_with_xx_stroke_cost*
57-60	0	134.3338893	611.6499272	705.6902699	1239.612	0	-435.366	-128.955	0	0	0	0	0	0	*Forecast_without_57_60_with_xx_stroke_cost*
60-63	68.0078369	0	56.45703474	318.7641895	497.7223	720.8512	0	-266.076	-101.059	0	0	0	0	0	*Forecast_without_60_63_with_xx_stroke_cost*
63-66	0	0	0	113.7687607	235.5307	372.538	510.5783	0	-565.173	-72.7333	-21.903	0	0	0	*Forecast_without_63_66_with_xx_stroke_cost*
66-69	0	0	0	0	0	86.29679	144.3706	369.5364	0	-328.538	-29.3144	0	0	0	*Forecast_without_66_69_with_xx_stroke_cost*
69-72	0	0	49.96642302	0	0	28.87505	108.6895	174.5599	379.6442	0	-51.4945	0	0	0	*Forecast_without_69_72_with_xx_stroke_cost*
72-75	0	0	0	0	0	36.23141	0	65.70906	58.62884	169.1963	0	-7.40922	0	0	*Forecast_without_72_75_with_xx_stroke_cost*
75-78	0	0	0	0	0	0	0	0	22.06642	14.76558	22.22765	0	0	0	*Forecast_without_75_78_with_xx_stroke_cost*
78-81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_78_81_with_xx_stroke_cost*
81+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_81_with_xx_stroke_cost*

Forecast year stroke cost	-£6,050	*Forecast_year_stroke_cost*
Difference in stroke cost	-£4,021	*Difference_stroke_cost*

Opening year: dementia

	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		0	0	-2275.084032	-2896.698224	-2365.27	-1056.56	-411.222	0	0	0	0	0	0	0	*Opening_without_45_with_xx_dementia_cost*
45-48		0	0	-8400.31027	-1776.641577	-1227.54	-772.104	-1028.05	-62.2375	0	0	0	0	0	0	*Opening_without_45_48_with_xx_dementia_cost*
48-51		988.786521	6413.986904	0	-4234.960317	-1059.49	-542.075	-255.914	-267.436	-64.3915	0	0	0	0	0	*Opening_without_48_51_with_xx_dementia_cost*
51-54		347.603787	3186.368047	4995.352194	0	-1583.69	-383.863	-288.823	-42.9262	-53.8306	0	0	0	0	0	*Opening_without_51_54_with_xx_dementia_cost*
54-57		0	389.2210758	2352.063311	2359.584999	0	-673.91	-257.552	0	-43.2018	0	0	0	0	0	*Opening_without_54_57_with_xx_dementia_cost*
57-60		0	203.1853019	605.8480064	1450.150244	1593.85	0	-419.86	-129.603	0	0	0	0	0	0	*Opening_without_57_60_with_xx_dementia_cost*
60-63		51.4027109	0	85.30477548	288.822505	1051.669	979.6742	0	-498.4	0	0	0	0	0	0	*Opening_without_60_63_with_xx_dementia_cost*
63-66		0	0	0	85.85234536	193.7845	604.8121	617.5826	0	-686.976	-65.6365	0	0	0	0	*Opening_without_63_66_with_xx_dementia_cost*
66-69		0	0	0	0	0	65.00963	304.3483	719.689	0	-263.387	-22.0194	0	0	0	*Opening_without_66_69_with_xx_dementia_cost*
69-72		0	0	0	0	0	43.47925	32.7136	175.0306	548.722	0	-55.2249	0	0	0	*Opening_without_69_72_with_xx_dementia_cost*
72-75		0	0	0	0	0	0	0	65.84758	66.05824	187.7645	0	0	0	0	*Opening_without_72_75_with_xx_dementia_cost*
75-78		0	0	0	0	0	0	0	0	0	0	22.22402	0	0	0	*Opening_without_75_78_with_xx_dementia_cost*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_78_81_with_xx_dementia_cost*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Opening_without_81_with_xx_dementia_cost*

Opening year dementia cost	-£3,089	*Opening_year_dementia_cost*

Forecast year: dementia

	With scheme	<45	45-48	48-51	51-54	54-57	57-60	60-63	63-66	66-69	69-72	72-75	75-78	78-81	81+	
Without scheme																
<45		0	0	-2703.849868	-2780.830295	-2514.97	-1666.12	-462.624	-248.95	0	0	0	0	0	0	*Forecast_without_45_with_xx_dementia_cost*
45-48		0	0	-9476.600024	-2336.669901	-1467.06	-894.015	-411.222	-746.85	-73.1419	0	0	0	0	0	*Forecast_without_45_48_with_xx_dementia_cost*
48-51		1006.28717	6133.976562	0	-6906.892886	-868.78	-988.489	-298.567	-320.923	-257.566	0	0	0	0	0	*Forecast_without_48_51_with_xx_dementia_cost*
51-54		579.339645	3707.773727	5766.30507	0	-2263.93	-469.166	-288.823	-85.8523	0	0	0	0	0	0	*Forecast_without_51_54_with_xx_dementia_cost*
54-57		59.8801655	958.0826481	2013.027158	2827.250495	0	-1176.67	-343.402	-96.8922	-86.4036	0	0	0	0	0	*Forecast_without_54_57_with_xx_dementia_cost*
57-60		0	203.1853019	924.7153783	1066.286944	1871.971	0	-656.705	-194.404	0	0	0	0	0	0	*Forecast_without_57_60_with_xx_dementia_cost*
60-63		102.805422	0	85.30477548	481.3708417	751.192	1087.331	0	-400.887	-152.174	0	0	0	0	0	*Forecast_without_60_63_with_xx_dementia_cost*
63-66		0	0	0	171.7046907	355.2715	561.6113	769.2696	0	-850.542	-109.394	-32.9238	0	0	0	*Forecast_without_63_66_with_xx_dementia_cost*
66-69		0	0	0	0	0	130.0193	217.3916	556.1233	0	-493.85	-44.0388	0	0	0	*Forecast_without_66_69_with_xx_dementia_cost*
69-72		0	0	75.36599047	0	0	43.47925	163.568	262.5458	570.6709	0	-77.3148	0	0	0	*Forecast_without_69_72_with_xx_dementia_cost*
72-75		0	0	0	0	0	54.52423	0	98.77137	88.07765	254.0344	0	-11.112	0	0	*Forecast_without_72_75_with_xx_dementia_cost*
75-78		0	0	0	0	0	0	0	0	33.13142	22.15698	33.33603	0	0	0	*Forecast_without_75_78_with_xx_dementia_cost*
78-81		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_78_81_with_xx_dementia_cost*
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0	*Forecast_without_81_with_xx_dementia_cost*

Forecast year dementia cost	-£9,171	*Forecast_year_dementia_cost*
Difference in dementia cost	-£6,082	*Difference_dementia_cost*

Appraisal period

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Opening year	**2028**	*Opening_year*																									
Opening year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Forecast year	**2043**	*Forecast_year*																									
Forecast year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Difference (years)	15	*Forecast_and_opening_year_difference*																									
Appraisal period length (years)	60	*Appraisal_period_length*																									
Interpolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
Extrapolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Appraisal period		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Check	TRUE																										

Annual sleep disturbance cost

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Opening year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25706	0	0	0	0	0	0	0
Forecast year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interpolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25103	24499	23896	23292	22688	22085	21481
Extrapolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25706	25103	24499	23896	23292	22688	22085	21481

Annual amenity cost

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Opening year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-11641	0	0	0	0	0	0	0
Forecast year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interpolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-13411	-15181	-16951	-18721	-20491	-22261	-24031
Extrapolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-11641	-13411	-15181	-16951	-18721	-20491	-22261	-24031

Annual AMI cost

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Opening year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7611	0	0	0	0	0	0	0
Forecast year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interpolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7452	7293	7134	6975	6816	6656	6497
Extrapolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7611	7452	7293	7134	6975	6816	6656	6497

Annual stroke cost

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Opening year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2028	0	0	0	0	0	0	0
Forecast year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interpolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2296	-2564	-2832	-3101	-3369	-3637	-3905
Extrapolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2028	-2296	-2564	-2832	-3101	-3369	-3637	-3905

Annual dementia cost

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Opening year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3089	0	0	0	0	0	0	0
Forecast year		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interpolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3495	-3900	-4306	-4711	-5117	-5522	-5928
Extrapolation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3089	-3495	-3900	-4306	-4711	-5117	-5522	-5928

Income and price adjustment

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
GDP deflator index		100.00	102.07	103.76	105.60	107.43	108.15	110.47	112.61	115.14	117.58	124.41	124.87	127.57	130.53	133.06	135.65	138.44	141.62	144.88	148.21	151.62	155.11	158.68	162.33	166.06	169.88
Real GDP per capita		138.15	138.75	139.80	141.97	144.92	147.18	148.48	150.17	151.15	152.49	136.89	145.58	153.71	156.26	157.78	159.85	162.10	164.50	166.94	169.38	171.82	174.25	176.67	179.12	181.58	184.02
Uprating mask		0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise values price base	2010	*Noise_values_price_base*																									
GDP deflator index - base	100.00	*GDP_deflator_base*																									
Outputs price base	2010	*Outputs_price_base*																									
GDP deflator index - for out	100	*GDP_deflator_outputs*																									
Price base adjustment	1.00	*Price_adjustment*																									
Income elasticity	1.3	*income_elasticity_in*																									
Noise values income base	2010	*Noise_values_income_base*																									
GDP per capita index - base	138.15	*GDP_capita_base*																									

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	16652	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20877	20274	19670	19067	18463	17859	17256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652
20877	20274	19670	19067	18463	17859	17256	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652	16652

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
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0	0	0	0	0	0	0	-38191	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-25801	-27571	-29341	-31111	-32881	-34651	-36421	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191
-25801	-27571	-29341	-31111	-32881	-34651	-36421	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191	-38191

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
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6338	6179	6020	5861	5702	5543	5384	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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6338	6179	6020	5861	5702	5543	5384	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225	5225

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	-6050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-4173	-4441	-4709	-4977	-5245	-5513	-5782	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050
-4173	-4441	-4709	-4977	-5245	-5513	-5782	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050	-6050

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	-9171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-6333	-6739	-7144	-7549	-7955	-8360	-8766	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171
-6333	-6739	-7144	-7549	-7955	-8360	-8766	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171	-9171

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
173.79	177.78	181.87	186.06	190.33	194.71	199.19	203.77	208.46	213.25	218.16	223.18	228.31	233.56	238.93	244.43	250.05	255.80	261.68	267.70	273.86	280.16	286.60	293.19	299.94	306.84	313.89	321.11	328.50	336.05	343.78	351.69	359.78	368.05	376.52	385.18	394.04	403.10	412.37	421.86	431.56	441.49	451.64	462.03	472.65	483.52
186.74	189.49	192.27	195.04	197.81	200.57	203.33	206.07	208.82	211.58	214.35	217.12	219.90	222.72	225.59	228.54	231.56	234.64	237.78	241.01	244.31	247.70	251.16	254.69	258.30	262.01	265.80	269.67	273.62	277.68	281.95	286.48	290.87	295.29	299.70	304.25	308.70	313.11	317.35	321.53	325.57	329.70	333.83	337.90	341.93	346.21
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Valuing changes in noise (£)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Sleep disturbance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29534	28841	28147	27454	26760	26067	25373	24680
Amenity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-13374	-15408	-17441	-19475	-21509	-23542	-25576	-27609
AMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8744	8562	8379	8196	8013	7830	7648	7465
Stroke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2330	-2638	-2946	-3254	-3562	-3870	-4178	-4486
Dementia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3549	-4015	-4481	-4947	-5413	-5878	-6344	-6810

Valuing changes in noise - household size adjusted (£):

Household size **2.3** *Default_HH_size*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Household size - user input	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Household size multiplier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Sleep disturbance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29534	28841	28147	27454	26760	26067	25373	24680
Amenity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-13374	-15408	-17441	-19475	-21509	-23542	-25576	-27609
AMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8744	8562	8379	8196	8013	7830	7648	7465
Stroke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2330	-2638	-2946	-3254	-3562	-3870	-4178	-4486
Dementia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3549	-4015	-4481	-4947	-5413	-5878	-6344	-6810

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058
23986	23293	22599	21906	21212	20519	19825	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132
-29643	-31676	-33710	-35743	-37777	-39811	-41844	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878
7282	7099	6917	6734	6551	6368	6186	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003
-4794	-5102	-5410	-5718	-6026	-6334	-6642	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950
-7276	-7742	-8208	-8674	-9140	-9605	-10071	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537

2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132
-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878
6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003
-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950
-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537	-10537

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058
2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058
23986	23293	22599	21906	21212	20519	19825	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132
-29643	-31676	-33710	-35743	-37777	-39811	-41844	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878
7282	7099	6917	6734	6551	6368	6186	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003
-4794	-5102	-5410	-5718	-6026	-6334	-6642	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950

2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132	19132
-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878	-43878
6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003	6003
-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950	-6950

Discounting and present values

Discount period

Current year	2022	*Current_year*
PV base year	2010	*PV_base_year*
discount period 1	12	*Discount_period_1*
discount period 2	30	*Discount_period_2*
discount period 3	75	*Discount_period_3*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Masks																										
Discount period 1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Discount period 2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
Discount period 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Discount rates and factors

discount rate 1	3.5%	*Discount_rate_1*
discount rate 2	1.5%	*Discount_rate_2*
discount rate 3	1.3%	*Discount_rate_3*

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Discount rate profile		0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Discount factor	1	1.00	1.04	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.41	1.46	1.51	1.53	1.56	1.58	1.60	1.63	1.65	1.68	1.70	1.73	1.75	1.78	1.81	1.83

Discounted noise benefits

(positive values represent a benefit - a reduction in noise)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Sleep disturbance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17875	17197	16536	15890	15260	14645	14044	13459
Amenity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8095	-9188	-10246	-11272	-12265	-13226	-14156	-15056
AMI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5292	5105	4922	4744	4569	4399	4233	4071
Stroke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1410	-1573	-1731	-1884	-2031	-2174	-2313	-2447
Dementia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2148	-2394	-2632	-2863	-3086	-3303	-3512	-3714

Total present value of noise impact pathway

Sleep disturbance	£517,551	*Total_discounted_sleep_disturbance_valuation*
Amenity	-£941,078	*Total_discounted_amenity_valuation*
AMI	£160,024	*Total_discounted_AMI_valuation*
Stroke	-£150,030	*Total_discounted_stroke_valuation*
Dementia	-£227,525	*Total_discounted_dementia_valuation*

Total present value of change in noise: £NPV

Noise NPV	-£641,058	*Total_noise_net_present_value*

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
1.86	1.89	1.92	1.95	1.98	2.01	2.04	2.07	2.10	2.13	2.16	2.19	2.23	2.26	2.29	2.33	2.36	2.39	2.42	2.45	2.49	2.52	2.55	2.58	2.62	2.65	2.68	2.72	2.75	2.79	2.83	2.86	2.90	2.94	2.97	3.01	3.05	3.09	3.13	3.17	3.21	3.25	3.30	3.34	3.38	3.43

2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081
12887	12330	11786	11255	10738	10233	9741	9262	9125	8990	8857	8726	8597	8470	8345	8222	8100	7997	7895	7795	7695	7597	7501	7405	7311	7218	7126	7035	6945	6857	6770	6683	6598	6514	6431	6349	6268	6189	6110	6032	5955	5879	5804	5730	5658	5585
-15926	-16767	-17580	-18365	-19123	-19855	-20560	-21241	-20927	-20618	-20313	-20013	-19717	-19426	-19139	-18856	-18577	-18341	-18107	-17876	-17649	-17424	-17202	-16983	-16767	-16553	-16342	-16134	-15929	-15726	-15526	-15328	-15133	-14940	-14750	-14562	-14376	-14193	-14012	-13834	-13658	-13484	-13312	-13143	-12975	-12810
3912	3758	3607	3460	3316	3176	3039	2906	2863	2821	2779	2738	2697	2658	2618	2580	2541	2509	2477	2446	2414	2384	2353	2323	2294	2265	2236	2207	2179	2151	2124	2097	2070	2044	2018	1992	1967	1942	1917	1893	1868	1845	1821	1798	1775	1752
-2576	-2701	-2822	-2938	-3051	-3159	-3264	-3365	-3315	-3266	-3218	-3170	-3123	-3077	-3032	-2987	-2943	-2905	-2868	-2832	-2796	-2760	-2725	-2690	-2656	-2622	-2589	-2556	-2523	-2491	-2459	-2428	-2397	-2367	-2336	-2307	-2277	-2248	-2220	-2191	-2163	-2136	-2109	-2082	-2055	-2029
-3909	-4098	-4280	-4457	-4627	-4790	-4949	-5101	-5026	-4951	-4878	-4806	-4735	-4665	-4596	-4528	-4461	-4404	-4348	-4293	-4238	-4184	-4131	-4078	-4027	-3975	-3925	-3875	-3825	-3777	-3728	-3681	-3634	-3588	-3542	-3497	-3452	-3408	-3365	-3322	-3280	-3238	-3197	-3156	-3116	-3076

Noise Workbook - Worksheet 1

Proposal Name: A5 WTC OBC

Present Value Base Year	2010
Current Year	2022
Proposal Opening year:	2028
Project (Road, Rail or Aviation):	road

Net present value of change in noise (£):	-£641,058

*positive value reflects a **net benefit** (i.e. a reduction in noise)

Net present value of impact on sleep disturbance (£):	£517,551
Net present value of impact on amenity (£):	-£941,078
Net present value of impact on AMI (£):	£160,024
Net present value of impact on stroke (£):	-£150,030
Net present value of impact on dementia (£):	-£227,525

Quantitative results

Households experiencing increased daytime noise in forecast year:	4339
Households experiencing reduced daytime noise in forecast year:	3287
Households experiencing increased night time noise in forecast year:	796
Households experiencing reduced night time noise in forecast year:	883

Qualitative Comments:

Data Sources:

Appendix F

WIDER ECONOMIC BENEFIT ASSESSMENT

Internal

F1 INTRODUCTION

F1.1. The A5WTC scheme will provide 85 kilometres of dual carriageway from south of Londonderry at New Buildings to the border at Aughnacloy, improving accessibility between urban centres in the west of the province and opening up regional gateways and cross border links.

F1.2. Improvements to accessibility can increase productivity and this is measured by ‘effective density’, or Access to Economic Mass. As part of the economic appraisal, WSP has undertaken a Wider Impacts assessment. The assessment has estimated the economic benefits due to Wider Impacts of the scheme, which will contribute to the overall economic benefit estimated for the scheme.

F1.3. The wider impacts due to a scheme include ‘static’ benefits to the economy where existing land uses generate wider economic benefits due to the scheme. In addition, there will also be dynamic changes, where the land use changes due to the scheme. These dynamic changes will also provide additional economic benefits. This assessment only considers the wider benefits due to static changes. Benefits due to dynamic changes are beyond the scope of this assessment.

F1.4. It is intended to accompany the analysis of the transport benefits of the scheme and the Outline Business Case which summarises the scheme and its objectives in greater detail. The rest of this appendix is structured as follows:

- Chapter F2 provides some background on the wider impact benefits
- Chapter F3 describes briefly the input data used in the assessment
- Chapter F4 summarises the approach that has been used for A5WTC
- Chapter F5 presents the results
- Chapter F6 presents the results of the sensitivity tests
- Chapter F7 provides some conclusions.

F2 WIDER IMPACT BENEFITS

F2.1. The Wider Impact benefits were appraised using a WSP bespoke WITA emulation tool, a spreadsheet-based program that calculates the wider benefits from economic data in terms of GDP and employment, as well as from the demand data and generalised cost data obtained from the transport model. The macro program has been used to estimate Wider Impacts for number of highway improvement schemes located in England.

F2.2. The DfT TAG Units A2.1, A2.2, A2.3 and A2.4 describe the Wider Impact appraisal process. Of the Wider Impacts described in TAG Unit A2.1, the following are applicable to the A5 WTC.

PRODUCTIVITY: AGGLOMERATION IMPACTS

F2.3. The productivity of an economy is related to the transport connections, as better connections reduce production costs. As TAG Unit A2.4 shows, the productivity is related to the calculable value known as access to economic mass, or in other word “effective density”, which for a particular location measures the accessibility at that location to jobs in other locations. The Wider Impacts assessment uses elasticity values that relate changes in effective density to changes in productivity to calculate the benefit due to the changes in effective density due to the scheme. Chapter F4 outlines the methodology and assumptions that has been used to estimate these benefits.

INDUCED INVESTMENT: OUTPUT CHANGE IN IMPERFECTLY COMPETITIVE MARKETS

F2.4. Transport improvements can increase outputs in the economy. Some of this is due to reductions in road user costs which are captured in the direct user benefits assessment. In addition, in imperfect markets where output values are higher than inputs, some of the output change is not captured in the direct user benefits. Therefore, the Wider Impacts assessment includes the estimation of these benefits. As described in TAG Unit A2.2, these effects are estimated as being at 10% of the direct business user benefits. Therefore, the output change in imperfectly competitive market has been derived from the business user benefits that was calculated from the transport user benefit assessment (TUBA).

EMPLOYMENT EFFECTS: LABOUR SUPPLY IMPACTS

F2.5. Transport improvements can improve access to jobs. Under the static land-use assessment (i.e., no change in number of employments as a result of interventions), employment effects refer to relocation of employment to places with better job accessibility as a result of transport investment, thus increase effective return to labour and capital and therefore generate additional tax revenue. In accordance with TAG Unit A2.3, the Wider Impacts assessment first estimates the potential reallocation of jobs due to the transport improvement by using labour elasticity values that relate the changes in employment to the changes in generalised costs. The GDP per employee is then used to calculate the impact on the economy. The tax impact is then estimated at 40% of the total GDP impact for the static benefits.

OTHER WIDER IMPACTS

F2.6. Scheme interventions would normally result in potential change in land-use such as new developments within vicinity of the interventions or re-allocation of jobs to benefit from better accessibility as a result of the scheme.

F2.7. There are however no dependent developments due to the A5 scheme, they are therefore not included in the Wider Impacts assessment. In addition, wider impact benefits with respect to dynamic land use changes due to the scheme such as reallocation of employments to benefits from scheme interventions have also not been modelled. As a result, benefits due to moving to more/less productive jobs are not included within the wider impact appraisal.

F3 INPUT DATA

ECONOMIC DATA

F3.1. The Wider Impact benefits assessment uses the following data:

- Employment numbers for local government district, by economic sector (manufacturing, construction, producer services and consumer services, and others) for current and future years
- GDP per worker data for local government districts by economic sector for current and future years

F3.2. For previous Wider Impact assessments located in Britain, the spreadsheet tool used the Wider Impacts Datasets provided by the Department for Transport.

F3.3. The DfT WITA Datasets do not include data for Northern Ireland or the Republic of Ireland. Therefore this data has been collated and derived from the following sources:

- Northern Ireland Statistics and Research Agency (NISTRA)
- Central Statistics Office Ireland (CSO)
- Office of National Statistics UK (ONS)

F3.4. In addition, the WITA dataset provides labour market impact parameters and distance decay and agglomeration elasticity values. These values are considered to be applicable to Ireland and therefore used in the Wider Impacts assessment.

F3.5. The data for Northern Ireland and Republic of Ireland is described in Section F4.

TRAFFIC MODEL DATA

F3.6. Data from the traffic model informs the Wider Impacts assessment. The traffic model includes a Do Minimum Scenario (without the scheme) and Do Something Scenario (with the Scheme). For each Phase, there is a Do Minimum model (with the current highway network as well as any phases already built) and Do Something model (with the Do Minimum network as well as the Phase being assessed).

F3.7. For the purpose of Wider Impacts calculations, only business and commuting trips are required.

F3.8. From the models, the following data was obtained for business and commuting users for the AM Peak, Interpeak and PM Peak:

- Trip numbers
- Travel distances
- Travel Times

F3.9. Generalised costs are then calculated between each origin and destination pair in the matrix using values of time and values of distance, in keeping with the DfT TAG Databook from the trip, travel distance and time data as recommended in TAG A2.1.

F4 AGGLOMERATION IMPACT: METHODOLOGY

EFFECTIVE DENSITY

F4.1. The first step to estimate agglomeration benefits is to estimate the change to effective density (or Access to Economic Mass) resulting from the scheme.

F4.2. Effective density is determined by the level of accessibility and employment. For accessibility, updated matrices of generalised costs were extracted from the Do Minimum and Do Something scenarios. The generalised cost (GC) matrices for the morning peak, inter peak and evening peak periods in 2028 (the first year in the appraisal period) and 2043 (model horizon year) were used in the analysis.

F4.3. The generalised costs that were provided were weighted across business and commuter user classes. These were then weighted across the three time periods to obtain a single weighted GC matrix for each scenario and year.

F4.4. A key dataset required for the Wider Impacts assessment is the number of employments in each aggregate industrial sector. NISTRA provided the data on employee numbers for the year 2020 divided by Local Government District and economic sector as shown in

F4.5. Table F4-1. The employee numbers are assumed to be the same as the number of employments, as required for the assessment.

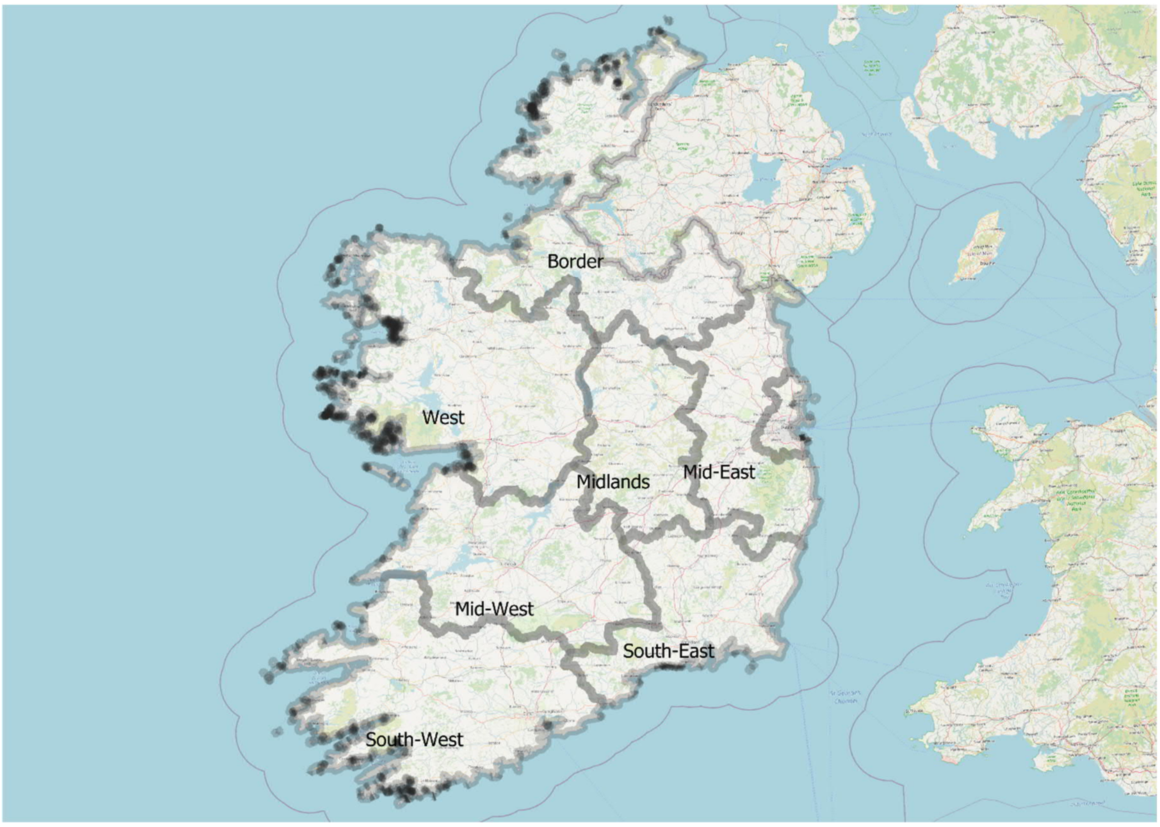
Figure F-1 - Northern Ireland Local Government Districts

Table F4-1 - Employees in Northern Ireland - 2021

District	Construction	Manufacturing	Other	Consumer Services	Producer Services	Total
Antrim and Newtownabbey	2,783	9,215	16,493	22,768	9,094	60,354
Ards and North Down	1,247	3,774	11,893	16,604	6,632	40,150
Armagh City, Banbridge and Craigavon	3,524	17,511	20,222	28,110	11,228	80,595
Belfast	4,349	12,178	70,570	98,871	39,492	225,460
Causeway Coast and Glens	2,173	5,786	11,511	15,996	6,389	41,855
Derry City and Strabane	2,879	7,978	16,562	23,083	9,220	59,720
Fermanagh and Omagh	3,006	8,212	11,126	15,254	6,093	43,690
Lisburn and Castlereagh	2,996	7,480	16,478	22,995	9,185	59,133
Mid and East Antrim	1,933	8,981	11,505	15,942	6,368	44,728
Mid Ulster	5,126	21,433	11,979	16,405	6,552	61,496
Newry, Mourne and Down	3,815	9,843	15,730	21,573	8,617	59,579
Northern Ireland	**33,830**	**112,390**	**214,070**	**297,600**	**118,870**	**776,760**
Northern Ireland (%)	4%	14%	28%	38%	15%	100%

F4.6. Data for the Republic of Ireland is divided according to the NUTS3 regions which are shown in Figure F4-2.

Figure F4-2 - Republic of Ireland NUTS3 Regions



F4.7. The employee data for the Republic of Ireland was obtained based on the NUTS3 region division. The number of employees in 2021 in the Republic of Ireland, divided by region and economic sector was obtained from the CSO. The services were divided into consumer and producer services assuming the same proportions as the DfT WITA dataset for Britain. They are shown in Table F4-2 below.

Table F4-2 - Employees in the Republic of Ireland - 2021

NUTS3 Region	Manufacturing	Construction	Consumer Services	Producer Services	Other
Border	49,565	12,016	40,790	23,934	59,979
West	55,273	12,116	60,480	25,934	69,291
Mid-West	52,469	12,216	56,074	33,845	71,594
South-East	39,052	11,115	48,029	31,312	61,916
South-West	77,903	20,627	94,525	42,256	96,327
Dublin	64,185	24,633	234,209	166,219	226,699
Mid-East	49,565	25,834	98,330	49,465	110,946
Midland	31,942	8,912	33,342	16,849	49,331
ROI	**419,954**	**127,468**	**665,779**	**389,814**	**746,085**

F4.8. Effective densities for 2028 and 2043 were then calculated using the standard formula

$$EDi = \sum_j \left(\frac{Ej}{(gij^{\propto}}\right)$$

F4.9. Where:

- EDi = effective density of zone i;
- Ej = Employment in area j;
- (gi,j) = average generalised cost of travel between zones i and j; and
- α = a distance decay parameter, which reflects the fact that agglomeration benefits diminish with distance – so places that are close together influence each other's effective density more than places that are far away from each other.

F4.10. The TAG guidance is that effective densities should be estimated by aggregate sectors for four types of employment:

- Construction
- Manufacturing
- Consumer services; and
- Producer services.

F4.11. TAG indicates that agglomeration benefits should only be calculated for the four sectors quoted. As shown by 'Other sectors' in Table 1, 28% of Northern Ireland's employment does not fall within the four broad industrial sectors defined by TAG hence this employment is excluded from the agglomeration calculations. Based on TAG's sectoral aggregation, 'Other sectors' captures the following sectors:

- Public administration and defence; compulsory social security.
- Human health and social work activities.
- Arts, entertainment, and recreation; and
- Other service activities.

F4.12. The TAG guidance provides a value of α, the distance decay parameter, for each sector. Table F4-3 shows the distance decay parameter used in the assessment.

Table F4-3 – Distance decay parameters (TAG A2.4)

Sector	Distance decay parameter
Manufacturing	1.097
Construction	1.562
Consumer services	1.818
Producer services	1.746
Other sectors	N/A
Weighted average	1.655

PRODUCTIVITY

F4.13. The other key component of the agglomeration calculation is the base level of productivity. Changes in effective density translate into changes in productivity, so the base level of output per worker is required.

F4.14. The GDP values were necessary to assess the economic impacts. For Northern Ireland, NISTRA provided the GDP values shown in Table F4-4

Table F4-4 - GDP in Northern Ireland - 2019

Local Government District	GDP (£ million)
Belfast	14,353
Armagh City, Banbridge and Craigavon	4,730
Newry, Mourne and Down	3,808
Ards and North Down	2,595
Derry City and Strabane	3,466
Mid Ulster	3,977
Causeway Coast and Glens	2,694
Antrim and Newtownabbey	3,771
Lisburn and Castlereagh	3,665
Mid and East Antrim	2,833
Fermanagh and Omagh	2,693
Northern Ireland	**48,584**

F4.15. The Northern Ireland GDP data provided was not divided into sectors. Therefore, sector proportions were obtained from GVA data, that was also obtained from NISRA. The GDP data divided into economic sectors is given in Table F4-5 below.

F4.16. The services were divided into consumer and producer services assuming the same proportions as the DfT WITA dataset for Britain.

Table F4-5 - GDP in Northern Ireland by Sectors – 2019 (£ million)

District	Manufacturing	Construction	Producer Services	Consumer Services	Other	Total
Antrim and Newtownabbey	600	332	647	1,297	895	3,771
Ards and North Down	293	116	831	588	768	2,595
Armagh City, Banbridge and Craigavon	1,061	395	876	1,249	1,150	4,730
Belfast	662	681	4327	4,182	4,501	14,353
Causeway Coast and Glens	441	254	517	707	775	2,694
Derry City and Strabane	531	250	670	838	1,178	3,466
Fermanagh and Omagh	565	234	428	756	711	2,693
Lisburn and Castlereagh	417	485	700	839	1,225	3,665
Mid and East Antrim	562	186	477	966	642	2,833
Mid Ulster	1,369	613	518	908	570	3,977
Newry, Mourne and Down	729	368	631	1,139	942	3,808
Northern Ireland	**7,230**	**3,912**	**10,620**	**13,468**	**13,355**	**48,585**

F4.17. The GDP was deflated to the base year of 2010, projected to 2021 by using total GDP for Northern Ireland numbers for 2019 and 2021. Then the GDP values for 2021 were divided by those for employment in 2021 to obtain the GDP per worker numbers shown in Table F4-6 below.

Table F4-6 - GDP per worker in Northern Ireland for 2021 – 2010 prices (£)

District	Manufacturing	Construction	Consumer Services	Producer Services	Other
Antrim and Newtownabbey	57,061	104,349	62,300	49,903	47,512
Ards and North Down	68,039	81,134	109,743	30,992	56,532
Armagh City, Banbridge and Craigavon	53,051	98,092	68,317	38,919	49,788
Belfast	47,576	137,143	95,969	37,042	55,861
Causeway Coast and Glens	66,786	102,258	70,899	38,721	58,935
Derry City and Strabane	58,273	75,956	63,609	31,781	62,309
Fermanagh and Omagh	60,245	68,314	61,453	43,381	55,932
Lisburn and Castlereagh	48,790	141,722	66,702	31,963	65,096
Mid and East Antrim	54,837	84,225	65,542	53,079	48,881
Mid Ulster	55,932	104,692	69,227	48,451	41,670
Newry, Mourne and Down	64,880	84,375	64,098	46,231	52,435

F4.18. The employment and GDP data was obtained for past years, usually 2021 or 2020 or 2019. The Wider Impacts appraisal is for a period of 60 years. Therefore, the employment and GDP per worker data is needed for future years as well.

F4.19. Population projections for Northern Ireland and the Republic of Ireland were obtained from NISRA. The number of workers in employment in Northern Ireland was assumed to grow at the same rate as the working age population, until 2068. After this, it was assumed that the working population will be fixed at the 2068 level.

F4.20. The GDP and GVA data for the Republic of Ireland was also obtained from the CSO. The GVA data was provided divided into regions and economic sectors. The same proportions were assumed to apply to GDP, enabling allocation of the GDP by region and sector. The GDP values are given in Table F4-7 below.

Table F4-7 - GDP in the Republic of Ireland – 2021 (Euro, million)

NUTS3 Region	Industry	Construction	Consumer Services	Producer Services	Other	Total
Border	3,461	193	3,280	2,551	1,416	10,902
West	5,332	297	4,488	3,490	1,938	15,546
Mid-West	20,917	1,166	7,408	5,760	3,198	38,450
South-East	10,169	567	5,593	4,349	2,415	23,093
South-West	63,089	3,518	13,629	10,598	5,885	96,719
Dublin	27,765	1,548	53,443	41,559	23,075	147,391
Mid-East	13,444	750	8,602	6,689	3,714	33,199
Midland	2,428	135	2,266	1,762	978	7,570
Sum	**146,607**	**8,175**	**98,709**	**76,759**	**42,619**	**372,869**

Table F4-8 - GDP per worker in the Republic of Ireland – 2021 (Euro)

NUTS3 Region	Industry	Construction	Consumer Services	Producer Services	Other
Border	62,847	10,957	43,822	79,021	24,857
West	86,811	16,738	43,200	99,777	29,411
Mid-West	358,765	65,125	71,841	126,184	50,032
South-East	234,341	34,798	62,716	102,977	44,171
South-West	728,812	116,331	86,760	185,954	63,540
Dublin	389,298	42,872	138,181	185,367	106,694
Mid-East	244,104	19,794	50,660	100,258	35,709
Midland	68,415	10,364	34,868	77,531	22,654

F4.21. The values in Euro have been converted to GBP based on an exchange rate of 0.89. Subsequently, the values were deflated to a base year of 2010, for compatibility with the economic assessment, using the GDP deflator values from the DfT TAG Databook.

REGIONAL TRIP PROPORTIONALITY FACTORS

F4.22. The user benefits calculated by TUBA are estimated by calculating time/fuel savings directly from the number of trips that are affected by the scheme. By contrast, the Wider Impacts assessment calculates effective density changes between regions for the whole of Ireland and calculates wider benefits regardless of the number of trips between those regions. Therefore, adjustments were made for regions based on the number of trips from them using the scheme. Accordingly, proportionality factors were introduced, based on the regional trip numbers in the traffic model. These factors are given in Table F4-9 below.

Table F4-9 - Proportionality Factors

Sector	Sector Number	Factor
Belfast	TLN06	0.0046
Armagh City	TLN07	0.0121
Newry	TLN08	0.0055
Ards and North Down	TLN09	0.0029
Derry City and Strabane	TLN0A	1.0000
Mid Ulster	TLN0B	0.1284
Causeway Coast and Glens	TLN0C	0.0663
Antrim and Newtownabbey	TLN0D	0.0121
Lisburn and Castlereagh	TLN0E	0.0057
Mid and East Antrim	TLN0F	0.0066
Fermanagh and Omagh	TLN0G	1.0000
Border	IE041	0.0405
Midland	IE063	0.0000
West	IE042	0.0005
Dublin	IE061	0.0004
Mid-East	IE062	0.0004
Mid-West	IE051	0.0002
South-East	IE052	0.0000
South-West	IE053	0.0000

F5 RESULTS

F5.1. The process was applied for 2028 and 2043. The benefit for years in between 2028 and 2043 was obtained by interpolating the results for those two years. Beyond 2043, the only change to the annual benefit comes from the assumed real productivity growth rate. A stream of benefits over 60 years (2028-2087) was estimated and converted into a Present Value by using discount rates from TAG, discounting back to a base year of 2010.

F5.2. Table F5-1 shows the overall benefit for the 60-year appraisal period for the full scheme assessment and Table F5-2 shows the results by Phase.

Table F5-1 - Wider Impacts of Full A5 Scheme (£000) – 60 years

Wider Impact	Full Scheme
Agglomeration	
Manufacturing	16,376
Construction	14,647
Consumer Services	39,804
Producer Services	91,293
Total Agglomeration	162,119
Output in Imperfectly Competitive Markets	**45,777**
Labour Supply Impact	**234**
Total	**208,130**

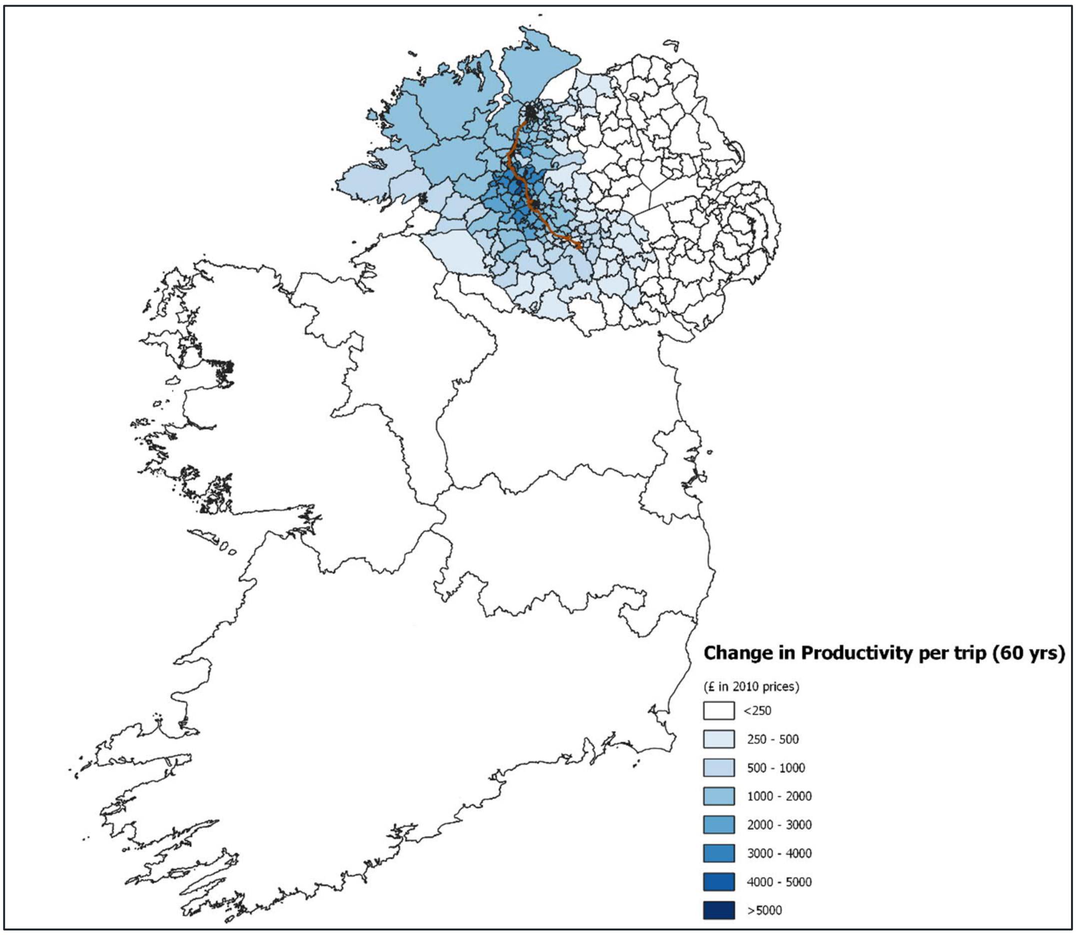
Table F5-2 - Wider Impacts by Phase (£000) – 60 years

Wider Impact	Ph1A	Ph1B	Ph2	Ph3	Sum
Agglomeration					
Manufacturing	1,123	3,322	11,040	774	16,259
Construction	1,331	2,587	10,007	627	14,552
Consumer Services	3,947	6,327	27,448	1,843	39,564
Producer Services	10,130	14,072	62,900	3,819	90,921
Total Agglomeration	**16,531**	**26,308**	**111,396**	**7,062**	**161,296**
Output in Imperfectly Competitive Markets	**2,704**	**12,195**	**30,248**	**1,677**	**46,824**
Labour Supply Impact	**20**	**51**	**148**	**12**	**230**
Total	**19,255**	**38,553**	**141,791**	**8,751**	**208,351**

F5.3. The Wider Impact benefit due to the scheme is £208m, the bulk of which is due to Phase 2. This is in keeping with the user benefits appraisal which shows that the largest proportion of user benefits are due to Phase 2.

F5.4. Of the wider benefits, the agglomeration benefits make up most of the benefits. Figure F5-1 maps the average benefit per trip for each zone. This shows that the largest benefits accrue along the area served by the corridor, this is because locations with closer proximity to the scheme benefit from larger increase in effective density.

Figure F5-1 – Change in productivity per trip (60 years)



F6 LOW AND HIGH GROWTH ASSESSMENT

F6.1. The TAG Unit M4 (Forecasting and Uncertainty) advises that an effective way to test the uncertainty in national trends such as population and GDP growth and fuel price trends is by using high and low growth scenarios.

F6.2. In accordance with advice in TAG Unit M4, low and high growth forecasts were prepared by increasing the forecast demand matrix by a proportion of the base year matrix which for highway demand is defined as

$\pm 2.5 * \sqrt{N}\%$

F6.3. where N represents the number of years into the future with respect to the base year.

F6.4. For the A5WTC, this amounts to a variation of 13% between the base year (2015) and Design Year (2043).

F6.5. The wider impacts assessment was carried out for the low and high growth scenarios. The results of the sensitivity tests for the low and high growth scenarios are presented in Table F6-1 below.

Table F6-1 - Wider Impacts of Full A5WTC Scheme – 60 yrs (£000)

Wider Impact	Low Growth Scenario	High Growth Scenario
Agglomeration		
Manufacturing	14,972	18,142
Construction	13,537	310
Consumer Services	36,857	842
Producer Services	86,141	1,927
Total Agglomeration	**151,506**	**180,408**
Output in Imperfectly Competitive Markets	**36,887**	**57,266**
Labour Supply Impact	**191**	**299**
Total	**188,584**	**237,973**

F7 CONCLUSIONS

F7.1. This note summarises the calculation of the benefits produced by the Wider Impacts of the A5 Western Transport Corridor (A5WTC) scheme in Northern Ireland. These benefits are additional to the conventional transport benefits of a scheme and reflect the increase in productivity that is brought about by improvements to accessibility.

F7.2. An approach consistent with the DfT's TAG guidance has been applied, supplemented by a set of assumptions in areas where TAG does not cover Northern Ireland.

F7.3. This suggests that the total wider impact benefit of the scheme, as a Present Value over a 60 year appraisal period, is £208.1m for the core scenario.

F7.4. The sensitivity tests show that the low growth scenario would generate £188.6m and the high growth scenario £237.9m over the 60-year appraisal period.

Appendix G

JOURNEY TIME RELIABILITY ASSESSMENT

G1 INTRODUCTION

G1.1. This report describes the procedures and data used for the production of the economic appraisal of journey time reliability benefits to support the Outline Business Case for the proposed A5 Western Transport Corridor (A5WTC) scheme.

G1.2. TAG Unit A1.3 (July 2021) includes methods for the assessment of reliability benefits accruing to highway schemes. Section 6.2 discusses inter urban and dual carriageways and refers to a National Highways (previously Highways Agency) bespoke tool to estimate monetary benefits. Section 6.3 discusses urban roads and provides a mathematical approach to estimate monetary benefits. Section 6.4 discusses journeys on other roads predominantly single carriageways outside urban areas. The A5 falls substantially within this ‘other roads’ category. For ‘other roads’ TAG states that it is not currently possible to estimate monetised reliability benefits.

G1.3. This report describes the procedures and data used for the production of the economic appraisal of journey time reliability benefits to support the Outline Business Case for the proposed A5 Western Transport Corridor (A5WTC) scheme.

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G1.5. For ‘other roads’, TAG recommends a ‘stress’ based approach which reflects the situation where journey time reliability is thought to reduce as flows approach capacity. The predicted flows for a key link on the existing and new road are compared with the Congestion Reference Flow (CRF) and this ratio is quantified as the level of stress. The CRF represents an estimate of the total Annual Average Daily Traffic (AADT) flow at which the carriageway is likely to be ‘congested’ in the peak periods. The CRF is defined in TA 46/97 (DMRB Volume 5, Section 1, Part 3).

G1.6. A worksheet is provided in TAG Unit A1.3 (Worksheet B1, in Appendix C5) which sets out the method for determining the overall stress relief as a numerical value. This is calculated as the product of AADT and stress relief summed for both the existing and new carriageway. For the calculation, the stress levels are limited to the range 75-125% i.e. stress in excess of 125% is set to an upper bound of 125% and stress below 75% is set to a lower bound of 75%.

G1.7. The numerical value for stress relief is then categorised as follows:

Table G1-1 Stress categories

Level of Stress (‘000)	Category
Stress < 200	Neutral
200< Stress < 1000	Slight
1000 < Stress < 3000	Moderate
Stress > 3000	Large

G1.8. Reliability benefits have previously been estimated by the DfT by applying uplifts of 5%, 10% and 20% of the total road user time savings (determined for example using TUBA). These provide an indicative measure of reliability benefits to reflect Slight, Moderate or Large impacts respectively.

G1.9. This Appendix applies a similar approach to the Proposed Scheme for the A5WTC.

G2 RELIABILITY BENEFITS ASSESSED AS AN AVERAGE

G2.1. Table G2-1 shows the predicted flows on key sections of the existing A5 for the opening year 2028, with and without the Proposed Scheme, together with the assessed levels for the CRF in each case.

Table G2-1 Flows and Capacities of key road Sections (Full Scheme – Core scenario)

		Existing/Old A5					
Section	Phase	AADT (2028)		Standard	CRF	Stress	
		DoMin	DoSom			DoMin	DoSom
New Buildings to Bready (J1-J2)	PH1A	15,300	1,800	S2	16,939	90.32%	10.63%
Bready to Ballmagorry (J2-J3)		14,500	800	S2	16,939	85.60%	4.72%
Ballymagorry to Strabane (J3-J4/5)	PH2	22,700	10,500	S2	17,212	131.88%	61.00%
Strabane (J4/5-J8)		18,100	6,800	S2	17,212	105.16%	39.51%
South of Strabane (J8-J9)		14,200	2,000	S2	19,762	71.85%	10.12%
North of Newtownstewart (J9-J10)		13,000	2,400	WS2	28,902	44.98%	8.30%
South of Newtownstewart (J10-J11)		14,200	5,000	WS2	26,012	54.59%	19.22%
Omagh North (J11-J12)		27,800	20,500	WS2	26,012	106.87%	78.81%
Omagh South (J12-J13)		20,600	12,500	S2	18,400	111.96%	67.94%
South of Omagh (J13-J14)	PH1B	14,300	4,300	S2	18,400	77.72%	23.37%
North of Ballygawley (J14-J15)		14,300	2,300	S2	18,400	77.72%	12.50%
South of Ballygawley (J15-J16)	PH3	8,700	5,200	S2	18,400	47.28%	28.26%
Aughnacloy (J16-ROI)		7,100	200	S2	18,400	38.59%	1.09%
Average New Buildings to Ballygawley		**17182**	**6264**			**92.07%**	**53.16%**
Average New Buildings to Auchnacloy		**15754**	**5715**			**88.31%**	**51.27%**

G2.2. It can be seen that the level of stress varies along the route in accordance with changes in flow and standard of road. Urban and peri-urban sections tend to have higher flows and higher stress levels. It is noticeable that flows and stress levels also reduce significantly south of the A4 and this affects the average values. Table G2-1 therefore provides for two averages a) Newbuildings to Ballygawley (Phases 1A, 1B and 2) and b) the whole scheme Newbuildings to south of Aughnacloy near the border with the ROI (Phases 1A, 1B, 2 and 3).

G2.3. Table G2-2 shows the equivalent data for the Proposed Scheme, again with two averages.

Table G2-2 - Flows and Stress on Proposed Scheme (Full Scheme – Core scenario)

		New A5 Route			
Section	Phase	AADT (2028)	CRF	Stress	
				DoMin	DoSom
New Buildings to Bready (J1-J2)	PH1A	17,000	55,532	90.32%	30.61%
Bready to Ballmagorry (J2-J3)		17,100	55,532	85.60%	30.79%
Ballymagorry to Strabane (J3-J4/5)	PH2	17,300	55,532	131.88%	31.15%
Strabane (J4/5-J8)		17,450	55,532	105.16%	31.42%
South of Strabane (J8-J9)		14,400	55,532	71.85%	25.93%
North of Newtownstewart (J9-J10)		15,700	55,532	44.98%	28.27%
South of Newtownstewart (J10-J11)		14,500	55,532	54.59%	26.11%
Omagh North (J11-J12)		12,100	55,532	106.87%	21.79%
Omagh South (J12-J13)		12,900	55,532	111.96%	23.23%
South of Omagh (J13-J14)	PH1B	13,800	55,532	77.72%	24.85%
North of Ballygawley (J14-J15)		14,500	55,532	77.72%	26.11%
South of Ballygawley (J15-J16)	PH3	6,700	55,532	47.28%	12.07%
Aughnacloy (J16-ROI)		6,350	55,532	38.59%	11.43%
Average New Buildings to Ballygawley		**15159**		**92.07%**	**27.68%**
Average New Buildings to Auchnacloy		**13831**		**88.31%**	**26.52%**

G2.4. The Worksheet B1 in TAG Unit A1.3 is reproduced in Table G2-3 below with values extracted from the above tables. The stress levels are limited to the range 75-125%, so the values for the Scheme and the A5 (in the Do Something) are increased from the actual values to 75%.

Table G2-3 – Stress Calculation as per Worksheet B1 (TAG Unit A1.3)

	Newbuildings to Ballygawley		Newbuildings to ROI	
	Old Route	New Route	Old Route	New Route
Without scheme stress (a)	92.07	92.07	88.31	88.31
With scheme stress (b)	75.00	75.00	75.00	75.00
Difference in stress (c=a-b)	17.07	17.07	13.31	13.31
With scheme AADT (d)	6264	15159	5715	13831
Overall Impact (e=c*d)	106,899	258,713	76,073	184,090
Overall Assessment	**365,612**		**260,162**	

G2.5. The logic behind the table is that the residual flows on the Old Road will enjoy a reduction in Stress amounting to (c = a-b) and the new flows on the New Road (assumed to have diverted from the old road) also enjoy a similar reduction in stress. Thus the total 'benefit' is the addition of these two quantities.

G2.6. The overall assessment gives a figure of 365,612 for Newbuildings to Ballygawley and for the whole scheme Newbuildings to the ROI a lesser value of 260,162. The southern section between Ballygawley and ROI has lower flows and therefore reduces the average. In both cases this would be classified as 'Slight'.

G3 RELIABILITY BENEFITS ASSESSED BY SECTION

G3.1. In addition to the above, it is pertinent that the A5 is a large scheme. As noted above, conditions vary significantly over the length of the road. For this reason, it is considered simplistic to present the Stress Calculation for the A5 as a single value, based on average flows and stress levels.

G3.2. Table G3-1 below shows the equivalent stress calculations for individual sections of the road. The parameters relate to the TAG Unit A1.3 (Worksheet B1, in Appendix C5).

Table G3-1 - Stress Calculations for individual road sections

Section	Phase	Distance	Old Route [ai]	Old Route [bi]	Old Route 75%<>125% [ai]'	Old Route 75%<>125% [bi]'	Old Route [ci] = [a] -[b]	Old Route [di]	Old Route [ei] = [ci] * [di]	New Route [aii]	New Route [bii]	New Route 75%<>125% [aii]'	New Route 75%<>125% [bii]'	New Route [cii] = [a] -[b]	New Route [dii]	New Route [eii] = [cii] * [dii]	Impact [ei] + [eii]	Category N/S/M/L
New Buildings to Bready (J1-J2)	PH1A	1.336	90%	11%	90%	75%	15%	1,800	27,581	90%	31%	90%	75%	15%	17,000	260,484	**288,065**	Slight
Bready to Ballmagorry (J2-J3)	PH1A	12.994	86%	5%	86%	75%	11%	800	8,480	86%	31%	86%	75%	11%	17,100	181,257	**189,737**	Slight
Ballyagorry to Strabane (J3-J4/5)	PH2	3.504	132%	61%	125%	75%	50%	10500	525,000	132%	31%	125%	75%	50%	17,300	865,000	**1,390,000**	Moderate
Strabane (JJ4/5-J8)	PH2	3.833	105%	40%	105%	75%	30%	6800	205,062	105%	31%	105%	75%	30%	17,450	526,225	**731,286**	Slight
South of Strabane (J8-J9)	PH2	5.298	72%	10%	75%	75%	0%	2000	0	72%	26%	75%	75%	0%	14,400	0	**0**	Neutral
North of Newtownstewart (J9-J10)	PH2	5.793	45%	8%	75%	75%	0%	2400	0	45%	28%	75%	75%	0%	15,700	0	**0**	Neutral
South of Newtownstewart (J10-J11)	PH2	13.824	55%	19%	75%	75%	0%	5000	0	55%	26%	75%	75%	0%	14,500	0	**0**	Neutral
Omagh North (J11-J12)	PH2	4.39	107%	79%	107%	79%	28%	20500	575,308	107%	22%	107%	75%	32%	12,100	385,665	**960,973**	Slight
Omagh South (J12-J13)	PH2	2.309	112%	68%	112%	75%	37%	12500	461,989	112%	23%	112%	75%	37%	12,900	476,773	**938,762**	Slight
South of Omagh (J13-J14)	PH1B	6.841	78%	23%	78%	75%	3%	4300	11,693	78%	25%	78%	75%	3%	13,800	37,525	**49,218**	Neutral
North of Ballygawley (J14-J15)	PH1B	14.561	78%	13%	78%	75%	3%	2300	6,254	78%	26%	78%	75%	3%	14,500	39,429	**45,683**	Neutral
South of Ballygawley (J15-J16)	PH3	4.337	47%	28%	75%	75%	0%	5200	0	47%	12%	75%	75%	0%	6,700	0	**0**	Neutral
Aughnacloy (J16-ROI)	PH3	5.353	39%	1%	75%	75%	0%	200	0	39%	11%	75%	75%	0%	6,350	0	**0**	Neutral
Average New Buildings to Ballygawley		74.683	92%	53%	92%	75%	17%	6263.6	106,899	92%	28%	92%	75%	17%	15,159	258,713	**365,612**	Slight
Average New Buildings to Aughnacloy		84.373	88%	51%	88%	75%	13%	5715.4	76,073	88%	27%	88%	75%	13%	13,831	184,090	**260,162**	Slight

G3.3. Table G3-1 shows that the stress impact varies along the road, as flows and standards vary. The impact ranges from Neutral (0) for sections bypassing Newtownstewart and sections south of Ballygawley, to Moderate (1.4M) for the section between Ballymagorry and Strabane. Where a zero stress reduction is assessed e.g. for Newtownstewart this is because both Do Nothing and Do Something 'stress' percentages are reset to the minimum 75%.

G3.4. The two sections within Phase 1A both have a stress relief level in the Slight Category. Within Phase 1B both sections are classified as Neutral. Within Phase 2, a section falls within the Moderate category, three within Slight and three within the Neutral range. Phase 3, as would be expected with much lower flows is assessed as Neutral stress relief.

G3.5. WebTAG Unit A3.1 indicates that the calculation should be carried out for the 'key' link on the Old Road and the Proposed Scheme. It does not specifically explain how this should be undertaken for a large scheme, such as the A5 where there are many 'key' links. The calculation below has been carried out by weighting the assessed stress levels by vehicle-kilometres.

Table G3-2 - Assessment of Stress Relief by Section weighted by veh-km

Section	Stress Relief	Category
Phase 1A	199,361	Neutral
Phase 2	485,789	Slight
Phase 1B	46,813	Neutral
Phase 3	0	Neutral
New Buildings to Ballygawley	**321,276**	**Slight**
New Buildings to Aughnacloy	**301,903**	**Slight**

G3.6. Although sections with high stress relief have higher flows they occur over shorter distances generally within proximity to urban areas. This is considered to be the best approach to assess stress over multiple sections as it takes account of both distance travelled and volume of traffic.

G3.7. On this basis, Table G3-2 shows that the assessment gives a figure of 321,276 for Newbuildings to Ballygawley and for the whole scheme Newbuildings to Aughnacloy a value of 301,903. In both cases the assessment would be classified as 'Slight'. Although the results are different than the 'averaged' assessment given in Section G2 above, the outcome of 'Slight' relief is consistent.

G4 LOW AND HIGH GROWTH ASSESSMENT

G4.1. TAG Unit M4 (Forecasting and Uncertainty) advises that an effective way to test the uncertainty around national trends such as population and GDP growth and fuel price trends is by using high and low growth scenarios.

G4.2. In accordance with advice in TAG Unit M4, low and high growth forecasts were prepared by increasing the forecast demand matrix by a proportion of the base year matrix which for highway demand is defined as

$\pm 2.5 * \sqrt{N}\%$

where N represents the number of years into the future with respect to the base year.

G4.3. For the A5WTC, this amounts to a variation of 13% between the base year (2015) and Design Year (2043).

G4.4. The journey time reliability assessment was carried out for the low and high growth scenarios. The results of the sensitivity tests for the low and high growth scenario sensitivity are presented in Table G4-1 and Table G4-2 below.

Table G4-1 – Stress Relief by Section weighted by veh-km – Low Growth scenario

Section	Stress Relief	Category
Phase 1A	96,243	Neutral
Phase 2	378,820	Slight
Phase 1B	0	Neutral
Phase 3	0	Neutral
New Buildings to Ballygawley	**230,886**	**Slight**
New Buildings to Aughnacloy	**216,980**	**Slight**

Table G4-2 - Stress Relief by Section weighted by veh-km – High Growth scenario

Section	Stress Relief	Category
Phase 1A	303,066	Slight
Phase 2	593,539	Slight
Phase 1B	142,163	Neutral
Phase 3	0	Neutral
New Buildings to Ballygawley	**425,519**	**Slight**
New Buildings to Aughnacloy	**399,426**	**Slight**

G4.5. In both cases the assessment would be classified as ‘Slight’.

G5 CONCLUSION

G5.1. The above has applied the TAG method for assessing journey time reliability benefits for the A5WTC Proposed Scheme.

G5.2. Given the length of the scheme and varying nature of the existing carriageway standard the assessment was undertaken a) based on pure averages and b) by section weighted by vehicle kilometres. Over the whole length of the scheme both methods resulted in an overall stress relief which TAG would classify as 'Slight'.

G5.3. By section, the assessed stress relief ranged from Neutral to Moderate The section between Ballymagorry to Strabane was assessed to benefit from the highest stress relief.

G5.4. Adopting a pragmatic approach, it is considered reasonable to apply an overall category of "Slight" for the whole scheme. This would translate to an uplift on journey time benefits of 5%. It is also considered that a similar uplift could be applied to each Phase in order to be consistent with the overall assessment for the full scheme.

Appendix H

APPRAISAL SUMMARY TABLE

A5 Western Transport Corridor

- Appraisal Summary Table -

Impacts		Summary of Key Impacts	Assessment: Quantitative	Assessment: Qualitative	Assessment: Monetary £(NPV)	Assessment: Distributional 7-pt scale / vulnerable grp
Economy	Business users & transport providers	There is forecast to be significant benefits to business users and transport providers of the A5WTC and the existing A5, due to the transfer of strategic traffic to the A5WTC. The provision of a high-quality dual carriageway standard highway will reduce incidences of congestion, reduce journey times and enhance journey time reliability. Benefits will be realised by businesses due to improved accessibility between key economic centres (including Londonderry, Strabane and Omagh) and international gateways (including Londonderry Port, City of Derry Airport and the Republic of Ireland) in the Northwest. It is forecast that there will be slightly higher vehicle operating costs including fuel due to the increased number of vehicle kilometres travelled on the A5WTC. However, there are also forecast to be very significant benefits to user through time savings. The economic benefit to business users and transport providers is demonstrated by the highly positive TUBA economic assessment.	**Value of journey time changes (£)**: N/A **Net journey time changes (£)** 0 to 2min: N/A 2 to 5min: N/A > 5min: N/A	Large beneficial	£463.53M	N/A
Economy	Reliability impact on Business users	Business users will experience a particular improvement to journey time reliability due to less incidences of congestion and the ability to maintain higher average speeds on the A5WTC. This will improve reliability and reduce journey times, saving time for business users. This can be assessed as a benefit do to a reduction in instances of stress due to a reduction in instances of congestion. Using the methodology set out in TAG Unit A1.3 (Worksheet B1, Appendix C5) a stress relief assessment weighted by Veh-km was calculated at 301,903. This equates to a slight decrease in the instances of stress due to the introduction of the A5WTC scheme.	N/A	Slight beneficial	N/A	
Economy	Regeneration	A number of developments have been proposed within the A5 study area, including to the west of Strabane and in Omagh, which aim to act as a catalyst for urban regeneration and economic growth. The A5WTC will provide the transport infrastructure, through improved journey times and reliability, which will stimulate further growth and help maximise the benefits of regenerative opportunities. Improved network resilience will help attract inward investment and new businesses to the North West.	N/A	Moderate beneficial	N/A	
Economy	Wider Impacts	The impacts that the Proposed Scheme will have on the wider economy include: a) Agglomeration benefits that represent the increase in productivity due to improved accessibility (£162.12M); b) Increase in Output in Markets with Imperfect Competition whereby reduced transport costs may induce increased output of goods or services that require use of transport in their production (£45.78M) and c)Tax revenue arising from labour market impacts generates £0.23M additional benefits.	N/A	Large beneficial	£208.13M	
Environmental	Noise	The scheme will introduce a major new road traffic noise source through what is currently a comparatively quiet area in the most part. Consequently, significant adverse noise impacts are predicted for receptors close to the A5WTC. The scheme will also serve to reduce noise levels along the existing A5, which passes through the most urban local areas, including Omagh and Strabane. Consequently, significant beneficial noise impacts are predicted for receptors close to the existing A5. The assessment incudes for the benefit of the committed low noise surfacing and noise barriers at targeted locations.	N/A	Moderate adverse	-£0.641M	0-20%: Large Adverse 20-40%: Large Beneficial 40-60%: Large Adverse 60-80%: Moderate Beneficial 80-100%: Large Adverse
Environmental	Air Quality	Regionally, total mass emissions of all pollutants (NO_X, PM_{10}, $PM_{2.5}$) are predicted to increase. This is predominantly a function of the increased number of vehicle kilometres travelled. Locally, concentrations of annual mean NO_2 are predicted to decrease at 8,492 (71%) of the 11,929 identified sensitive receptors and increase at 2,657 (22%) in the opening year (2028). Similarly, concentrations of $PM_{2.5}$ are predicted to decrease at 6,372 receptors (53%) and increase at 1,690 (14%). The results of the design year (2043) local air quality assessment scenario demonstrate a very similar magnitude of change with respect to both NO_2 and $PM_{2.5}$. This represents a net improvement in local air quality over the appraisal period.	N/A	Slight beneficial	£5.27M	0-20%: Large (NO_2) – Moderate (PM_{10}) Beneficial 20-40%: Moderate Beneficial (NO_2 & PM_{10}) 40-60%: Minor Beneficial (NO_2 & PM_{10}) 60-80%: Moderate Beneficial (NO_2 & PM_{10}) 80-100%: Large Beneficial (NO_2 & PM_{10})
Environmental	Greenhouse gasses	There is expected to be an increase in non-traded and traded greenhouse gas emissions as a result of the Proposed Scheme which is attributable to the increased number of vehicle kilometres travelled on the road network.	Change in non-traded carbon over 60y (CO_2e): 544,713 t Change in traded carbon over 60y (CO_2e): 2,790 t	Moderate adverse	-£39.9M	
Environmental	Landscape	There will be adverse impacts to landscape surrounding the A5WTC. The overall impact to landscape between Newbuildings and Strabane is predicted to be *moderate adverse*, with 16.2km (83%) of the route experiencing an impact to this extent. Between Strabane and Omagh, the overall impact is predicted to be *slight adverse* (19.7km / 71%). Between Omagh and Aughnacloy, the overall impact is predicted to be *slight adverse* (29.3km / 74%). An indicative monetary assessment for the scheme has been undertaken based on changes in natural capital value. The assessment indicates a net-loss in natural capital value (landscape, natural air quality regulation and natural carbon storage) of between -£12.3M and -£78.9M (central estimate: -£24.3M). Not accounted for are changes in carbon stocks (release of carbon stored in existing trees) and impacts on peat soils which are likely to further worsen the results if accounted for.	N/A	Moderate adverse	-£24.3M (-£12.3M to -£78.9M)	
Environmental	Townscape	There will be no significant changes to the nature of the main towns' setting and relationships with the environment along the route of the A5WTC, including Strabane with the Foyle Valley, Omagh's rural margins and Aughnacloy's character.	N/A	Neutral	N/A	
Environmental	Historic Environment	Archaeological resources: there will be adverse impacts to 71 heritage assets resulting in 63 neutral / slight adverse effects; six moderate adverse effects; and two large adverse effects on the archaeological resource. Built heritage resources: there will be adverse impacts to 26 heritage assets resulting in 23 neutral / slight adverse effects; two moderate adverse effects; and one large adverse effect on the built heritage resource. Historic landscapes: no significant effect predicted on five historic landscape types including enclosed land, settlements, communications and industry, woodland and parks and recreation.	N/A	Moderate to Large Adverse	N/A	
Environmental	Biodiversity	There are a number of designated sites, habitats and fauna associated with the Proposed Scheme corridor whereby impacts are predicted to range from *neutral* to *slight adverse*. Whilst adverse impacts are predicted, there are also expected to be beneficial impacts through improved buffering of sensitive habitats from airborne emissions and an increase in habitat extent in some areas, including unimproved grassland and woodland, with associated benefits for species including wintering and breeding birds.	N/A	Neutral to Slight Adverse	N/A	
Environmental	Water Environment	It is assessed that there will be a moderate adverse impact to flood risk based on the Foyle River System model, predicting flooding effects in the vicinity of the confluence of the River Finn and Mourne River, forming the River Foyle, at Strabane. At the other 24 locations where the Proposed Scheme crosses a floodplain, flood models assess flood risk as a non-significant or beneficial impact. No other significant impacts are identified for the water environment. Flood risk impact is most likely to occur during the operational	N/A	Moderate adverse	N/A	

		phase alongside effects on water abstractions, with the construction phase having the highest risk of impact on water quality and groundwater effects. The assessment assumes that mitigation measures identified in the Environmental Statement Addendum 2022 (and preceding relevant documents) and within the Flood Risk Assessment will be incorporated during detailed design, construction and operational activities. The summary of the Water Environment assessment is conservatively based on the localised flood risk impact for the Foyle River System model.				
Social	Commuting and Other users	There is forecast to be significant benefits to commuters and other users of the A5WTC and the existing A5, due to the rerouting of strategic traffic onto the A5WTC. The provision of a high-quality dual carriageway standard highway with associated grade-separated junctions will ensure large benefits to users through time savings and higher average speeds, reduced congestion and journey time reliability. Fuel and non-fuel impacts are expected to be slightly negative due to the increased number of vehicle kilometres travelled. Local traffic on the existing A5 will experience less congestion and improved journey time reliability. The economic benefits to commuters and other users is highlighted by the highly positive TUBA economic assessment.	**Value of journey time changes(£)**: N/A **Net journey time changes (£)** 0 to 2min: N/A 2 to 5min: N/A > 5min: N/A	Large beneficial	£374.92M	N/A
	Reliability impact on Commuting and Other users	Strategic traffic using the A5WTC will experience significant journey time reliability benefits due to less incidences of congestion with the ability to maintain higher average speeds on a high-quality dual carriageway standard highway with grade-separated junctions. This can be assessed as a benefit do to a reduction in instances of stress due to a reduction in instances of congestion. Using the methodology set out in TAG Unit A1.3 (Worksheet B1, Appendix C5) a stress relief assessment weighted by Veh-km was calculated at 301,903. This equates to a slight decrease in the instances of stress due to the introduction of the A5WTC scheme.	N/A	Slight beneficial	N/A	
	Physical activity	There will be improvements to physical activity as the rerouting of strategic traffic from the existing A5 onto the A5WTC will create a safer environment for sustainable travel users and will encourage greater use of walking and cycling. These improvements have not been quantified; therefore a neutral impact has been assigned to the scheme.	N/A	Neutral	N/A	
	Journey quality	The construction of a high-quality dual carriageway standard highway will improve journey quality for transport users. There would be a reduced level of driver stress under the Do-Something scenario for the Future Design Year. This would primarily be due to the decrease in frustration resulting from upgrade from single to dual carriageway. In addition, motorised users would also benefit from a reduction in the fear of potential accidents and route uncertainty. Overall for traveller stress there would be a Moderate Beneficial impact as a result of the Proposed Scheme. Traveller views are considered to be broadly similar in context to those of the current A5 corridor, in terms of the landscape types experienced and in their sequential experience. The Proposed Scheme in diverting away from existing A5 will, however, afford some degree of difference in traveller perspective. Beneficially this would relate to the bypassing of urban corridors at Omagh and south Strabane, along with an enhanced sense of journey for road users through more remote sections of visually appealing landscapes. Adverse experience would relate to areas of higher intervention on the landscape, such as through deep and extended cuttings and other large modifications of landform.	N/A	Moderate beneficial	N/A	
	Accidents	There will be a reduction in the number and severity of accidents, as forecast by COBALT, occurring as a result of the construction of a high-quality dual carriageway standard highway, with associated grade-separated junctions. This is a result of a transfer of traffic from the existing A5 onto the A5WTC. The benefits of reducing the number of accidents has been quantified and monetised using COBALT.	3,793 casualty savings (36 fatal, 442 serious, 3,315 slight)	Large beneficial	£124.92M	N/A
	Security	Transport users will be less vulnerable to crime associated with road users as a result of higher average speeds due to less congested conditions, less incidences of 'stopping' at junctions and clearly marked perimeters surrounding the A5WTC.	N/A	Slight beneficial	N/A	N/A
	Access to services	There will be improved access to services as a result of the Proposed Scheme. Accessibility between key economic centres, including Londonderry (and its international Port and airport), Strabane and Omagh, as well as to international gateways with the Republic of Ireland (and Dublin), will be strengthened, helping to unlock economic potential and attracting inward investment. Local communities will also benefit with greater access to services on the existing A5, whilst strategic users of the A5WTC will experience improved access through reduced incidences of congestion and enhanced journey time reliability.	N/A	Moderate beneficial	N/A	N/A
	Affordability	It is predicted that vehicle operating costs will slightly increase as a result of the increased number of vehicle kilometres travelled on the A5WTC. However, consumers will also benefit from decreased journey times and reduced congestion contributing to large savings in user time.	N/A	Slight adverse	N/A	N/A
	Severance	There will be reductions in severance, particularly for vulnerable groups, as a result of the Proposed Scheme. It is predicted that there will be an average 42% reduction in flows on roads nearby the 36 schools located on the existing area of analysis around the A5 corridor. 92% of pedestrian crossings on the existing A5 will experience a reduction in traffic flows and vulnerable users (including children aged 16 and under, elderly aged 70 and over and disabled residents) in Output Areas impacted by the existing A5 will experience reduced traffic flows. Communities within these settlements will greatly benefit from the redistribution of existing A5 traffic onto the A5WTC.	N/A	Moderate beneficial	N/A	N/A
	Option and non-use values	The improved reliability of journey times for public transport services using both the existing A5 and A5WTC will enhance the values placed upon these services as a consequence of the Proposed Scheme.	N/A	Slight beneficial	N/A	
Public Accounts	Cost to Broad Transport Budget	These consist of the scheme investment costs and operating costs (i.e. annual maintenance costs and capital renewal costs).	N/A	N/A	£865.92M	
	Indirect Tax Revenues	Indirect tax revenues due to a slightly higher vehicle operating cost.	N/A	N/A	£6.92M	

Appendix I

SENSITIVITY ASSESSMENTS

I 1 INTRODUCTION

I 1.1. This note presents the results of sensitivity testing around a number of variables to support the economic case for the A5WTC scheme.

I 1.2. Whilst the Core scheme appraisal, presented in the OBC 2022 document, takes account of the 60-year appraisal period based on the phased opening of the scheme from 2027, the sensitivity testing has been undertaken for a simplified 60-year period from whole scheme opening in 2028 to 2087 inclusive. The two exceptions to this are the 100-year appraisal test which takes account of the phased scheme opening in 2027 and extends the scheme appraisal period for 100 years to 2126; and the delayed scheme opening test which assumes a whole scheme opening in 2030 and extends the appraisal period for 60 years until 2089.

I 1.3. The assessment of sensitivities has been limited to the appraisal of transport economic efficiency benefits, accident benefits and indirect tax revenues – which form in excess of 95% of initial scheme benefits. For the purposes of the sensitivity analysis, the scheme construction and maintenance impacts, greenhouse gas impacts, monetised noise benefits and monetised air quality benefits have been assumed unchanged from those reported for the scheme core scenario appraisal.

I 1.4. This note describes each of the sensitivity scenarios tested, presents the economic benefits in terms of Net Present Value (NPV) and the Benefit to Cost Ratio (BCR) and provides a comparison against the Core, Low and High scenarios reported in the OBC 2022 document.

I 2 SENSITIVITY TEST SCENARIOS

I 2.1. The sensitivity tests discussed in this technical note are all variations on the Core scenario economic appraisal.

I 2.2. All the sensitivity scenarios are benchmarked against a baseline Sensitivity Test (ST) 00, which is a variation of the Core scenario with the assumption that the appraisal of the entire scheme over a 60-year period from when the whole scheme will be in place (from 2028) as opposed to the phased opening of the scheme from 2027. ST00 has the same demand levels and network as the Core scenario reported in OBC2022, but the appraisal was undertaken for a simplified 60-year period from whole scheme opening in 2028 to 2087 inclusive to provide a like for like comparison with other sensitivity tests. The sensitivity tests are described in more detail below and the key assumptions underpinning each of the sensitivity tests are summarised in Table 1 at the end of this section.

I 2.3. ST01 and ST02 examine the sensitivities of A5WTC to changes in network supply assumptions, mainly around the proposed new Finn Crossing and the completion of the TEN-T network in Republic of Ireland. The cost of the new Finn Crossing and the associated benefits have been fully accounted within the Core scheme assessment reported in Chapter 3 of this OBC. Sensitivity Test 1 (ST01) was essentially developed to quantify the impact of the A5WTC scheme without the new Finn Crossing, hence the new Finn Crossing link was excluded from the DS network coding in ST01. The cost of the proposed Finn Crossing is also removed from the PVC calculation for this test.

I 2.4. At the time of the Core scenario assessment, the proposals for the TEN-T schemes were not sufficiently advanced, hence these schemes were excluded from the Core scenario assumptions. ST02 assesses the likely impact of the TEN-T schemes (schemes 2 and 3 in Figure 1 below) on A5WTC scheme economics. This test assumes that TEN-T schemes are in place in both DM and DS scenarios. It should be noted, there is also a proposal to improve the N2 network at the border at Aughnacloy, but there is no clear commitment yet on this scheme therefore N2 proposals have been excluded from ST02 assumptions. Figure 1 below outlines the extent of the proposed TEN-T schemes.

I 2.5. ST03 and ST04 test the sensitivity of A5WTC to changes in demand assumptions, notably around observed reductions in traffic in recent years and the potential impacts of the updated DfT TEMPro v8 forecasts on NI demand forecasts. ST03 assumes that 10% of traffic present in the 2019 demand is removed from all forecast years. The level of reduction (10%) is thought to be an appropriate test, based on traffic monitoring data published by DfI for the period between January-May 2022 which showed a reduction of around 8-10% when compared to spring 2019 data at a 24hr level (please refer to Appendix D of the OBC). Although the recent observations suggest the traffic levels are constantly improving, the 10% threshold was chosen to demonstrate a worst-case scenario.

I 2.6. TEMPro-NI v7.2 demand assumptions remained current throughout the time of the forecast model development and therefore continued to inform the Core scenario assessment. In August 2022, the DfT released TEMPro v8 demand forecasts for GB, as a forthcoming change, which consider the recent social, behavioural, technological, and economic changes. Whilst TEMPro does not provide demand forecasts for NI and given that the development of the equivalent TEMPro-NI V8 forecast is a considerable undertaking and not feasible within the current timescales, under ST04, an approximation to TEMPro-NI v8 demand forecasts was developed. This was based on the existing TEMPro-NI v7.2 and the proportional difference between TEMPro v7.2 and TEMPro v8 demand forecasts for Wales, since earlier comparisons undertaken during development of TEMPro-NI v7.2

showed NI to have the closest alignment to Wales, out of the three GB countries. It should be noted that this is a proportionality test developed to assess the impact of changes in demand assumptions on A5WTC scheme economics in the absence of an equivalent TEMPro-NI V8.

I 2.7. ST05 assesses the sensitivity of the scheme economics on programme delays and ST06 tests the sensitivity of the scheme economics by changing the Present Value Cost (PVC) calculation in line with TAG A1.2 (compared to E058). ST05 assumes that the scheme opening is delayed by 2 years to 2030 and consequently considers the 60-year appraisal period 2030 to 2089. The scheme cost for test ST05 is adjusted to reflect the 2-year delay to the scheme spend profile. It should be noted, in test ST05 the outturn cost goes up in line with the inflation for the extended two years, but when discounting is applied and this is deflated back to 2010 prices and values, the PVC reduces to be slightly below the Core scheme PVC.

I 2.8. ST06 assumes no changes to scheme demand, supply, or programme assumptions, but tests the sensitivity of scheme costs by adopting an optimism bias of 23% based on TAG Unit A1.2 Table 8.

I 2.9. TAG A1.1 acknowledges that, while an appraisal period of 60 years is suitable for most schemes, some projects will be constructed to have a design life far exceeding this, often having design lives of 100 years or more before a major renewal is needed. To test this, ST07 was developed and this assumes a 100-year appraisal period for the phased scheme opening from 2027 to 2126. The cost (PVC) for ST07 reflects the greater maintenance costs due to the longer appraisal period.

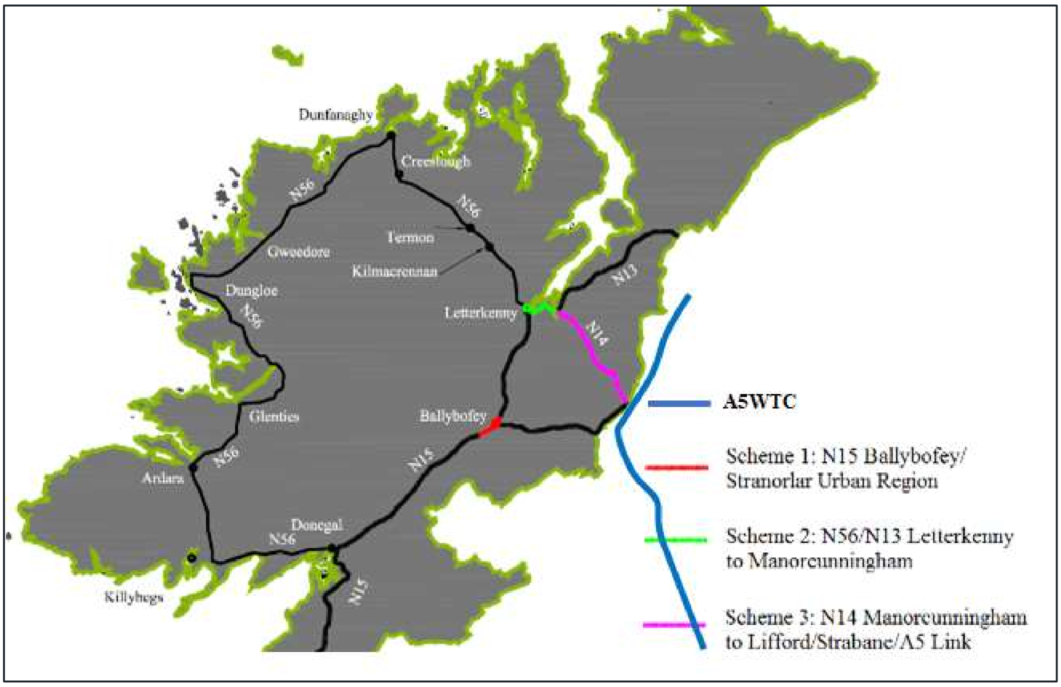
I 2.10. Finally, ST08 was developed to test the combined sensitivity of the scheme with respect to TEMPro v8 demand and adopting a 23% optimism bias based on TAG Unit A1.2. This test was built by combining the scheme benefits from the ST04 test (TEMPro v8) and the scheme costs from test ST06 (TAG based optimism bias).

Table 1. Sensitivity Test Demand and Network Assumptions Definition

Sensitivity Test ID	Appraisal Period	Test Description	Network Scenario	Demand Scenario
ST00	2028-87	60-year appraisal starting from 2028	Core	Core
ST01	2028-87	Removal of Finn Crossing	Exclusion of Finn Crossing from the Core DS Scenario	Core
ST02	2028-87	Addition of TEN-T scheme in DM and DS	Inclusion of TEN-T scheme in both DM and DS	Core
ST03	2028-87	10% reduction demands	Core	10% reduction to 2019 Core demand
ST04	2028-87	Forecast demands adjusted to TEMPro V8 (Proportionality test)	Core	TEMPro v8 adjustments
ST05	2030-89	Two-year delay to the current construction programme	Core	Core

Sensitivity Test ID	Appraisal Period	Test Description	Network Scenario	Demand Scenario
ST06	2028-87	Adopting TAG based PVC estimation	Core	Core
ST07	2027-2126	Extending the scheme appraisal period from 60 to 100 years	Core	Core
ST08	2028-87	Combined ST04 (benefits) and ST06 (cost)	Core	Core

Figure 1. Proposed TEN-T Route



I 3 SCHEME BENEFITS

I 3.1. Scheme benefits over a 60-year appraisal period have been estimated for each of the sensitivity test scenarios and for the following elements only:

I 3.2. Transport User benefits appraisal provides the transport economic efficiency benefits and indirect tax revenues. It was undertaken using the latest version of TUBA software (V.1.9.17) allowing for a 60-year appraisal period, calculated from the scheme opening year 2028 and extrapolated from the design year 2043 to the end of the appraisal period, except for ST05 and ST07 which were appraised for 2030-2089 and 2027-2126 respectively. The TUBA assessment was undertaken based on the scheme impacts derived from the transport model forecasts for DM and DS for the scheme opening year and design years and extrapolated linearly to the end of the appraisal period. After the design year 2043, the impacts were assumed to remain constant and to decline in line with the relevant discount rates.

I 3.3. Road Accident impact appraisal was undertaken using the latest version of COBALT software (V2.2) allowing for 60- or 100-year appraisal periods, as above. The same assumptions as for TUBA were also applied in the calculation of Accident benefits.

I 3.4. The environmental elements were shown to contribute only around 3% of the overall benefits (Present Value Benefits - PVB) of the Core scenario. So, the Air Quality, Noise and Greenhouse gas (GHG) impact appraisals calculated for the Core scenario were assumed to remain unchanged, with the exception for the ST07 (100-year appraisal test) where they were extrapolated to cover the longer appraisal period.

I 3.5. Construction and Maintenance benefits have been shown to contribute only around 3% of the overall scheme benefits of the Core scenario. For the sensitivity testing it was assumed that construction and maintenance benefits would remain unchanged from those calculated for the Core scenario.

I 3.6. Wider Benefits contribution for each of the sensitivity test was determined by adopting a pragmatic trendline approach using the estimated wider benefits values from Core, Low and High growth scenarios.

I 4 TUBA BENEFITS

I 4.1. Table 2 is a summary of the transport user's benefits generated for each of the sensitivity test scenarios from the TUBA assessments.

Table 2. TUBA Assessment Economic Efficiency User Benefits and Indirect Tax Benefit. (£M in 2010 prices and values)

Test ID	ST00	ST01	ST02	ST03	ST04	ST05	ST06	ST07	ST08
Test Description	60-year appraisal starting from 2028	Removal of Finn Crossing	Addition of TEN-T scheme in DM and DS	10% reduction demands	Forecast demands adjusted to TEMPro V8	Two-year delay to the current construction programme	Adopting TAG based PVC estimation	100-year scheme appraisal	Combined ST04 (benefits) and ST06 (cost)
Business Benefits	468.0	456.0	479.9	384.7	450.6	459.4	468.0	625.4	450.6
User Benefits - Commuting	161.3	158.8	163.0	130.0	155.4	158.8	161.3	217.4	155.4
User Benefits - Other	217.1	207.4	223.9	170.2	193.5	214.5	217.1	294.7	193.5
Total Economic Efficiency Benefits	846.3	822.2	866.8	684.9	799.6	832.7	846.3	1,137.5	799.6
Indirect Tax Revenue	7.0	7.3	6.4	8.0	7.5	6.4	7.0	8.1	7.5
Total TUBA Benefit (£M)	**853.3**	**829.5**	**873.2**	**692.8**	**807.0**	**839.1**	**853.3**	**1,145.6**	**807.0**

I 5 COBALT BENEFITS

I 5.1. Table 3 is a summary of the benefits generated by the different sensitivity scenarios derived from accident analysis using COBALT. Where monetary values are shown these have been presented in 2010 values and prices.

Table 3. COBALT Accident Forecasting and Accident Saving Benefit

Test ID	ST00	ST01	ST02	ST03	ST04	ST05	ST06	ST07	ST08
Test Description	60-year appraisal starting from 2028	Removal of Finn Crossing	Addition of TEN-T scheme in DM and DS	10% reduction demands	Forecast demands adjusted to TEMPro V8	Two-year delay to the current construction programme	Adopting TAG based PVC estimation	100-year scheme appraisal	Combined ST04 (benefits) and ST06 (cost)
Economic Summary (£M in 2010 values and prices)									
Without Scheme Accident Cost (£M)	1,572.4	1,572.4	1,567.5	1,445.5	1,534.8	1,527.2	1,572.4	2,141.4	1,534.8
With Scheme Accident Cost (£M)	1,446.3	1,453.9	1,437.6	1,328.7	1,411.1	1,404.5	1,446.3	1,972.3	1,411.1
Accident Benefit (£M)	126.1	118.5	129.9	116.8	123.7	122.8	126.1	169.2	123.7
Accident Summary									
Without Scheme Accidents	38,021	38,021	37,942	34,883	36,998	38,057	38,021	63,578	36,998
With Scheme Accidents	35,244	35,441	35,095	32,351	34,289	35,271	35,244	58,960	34,289
Accidents Saved	2,777	2,580	2,847	2,532	2,709	2,786	2,777	4,619	2,709
Fatal Casualties Saved	36	35	38	35	36	36	36	60	36
Serious Casualties Saved	448	425	462	418	439	450	448	746	439
Slight Casualties Saved	3,369	3,141	3,457	3,077	3,289	3,380	3,369	5,602	3,289

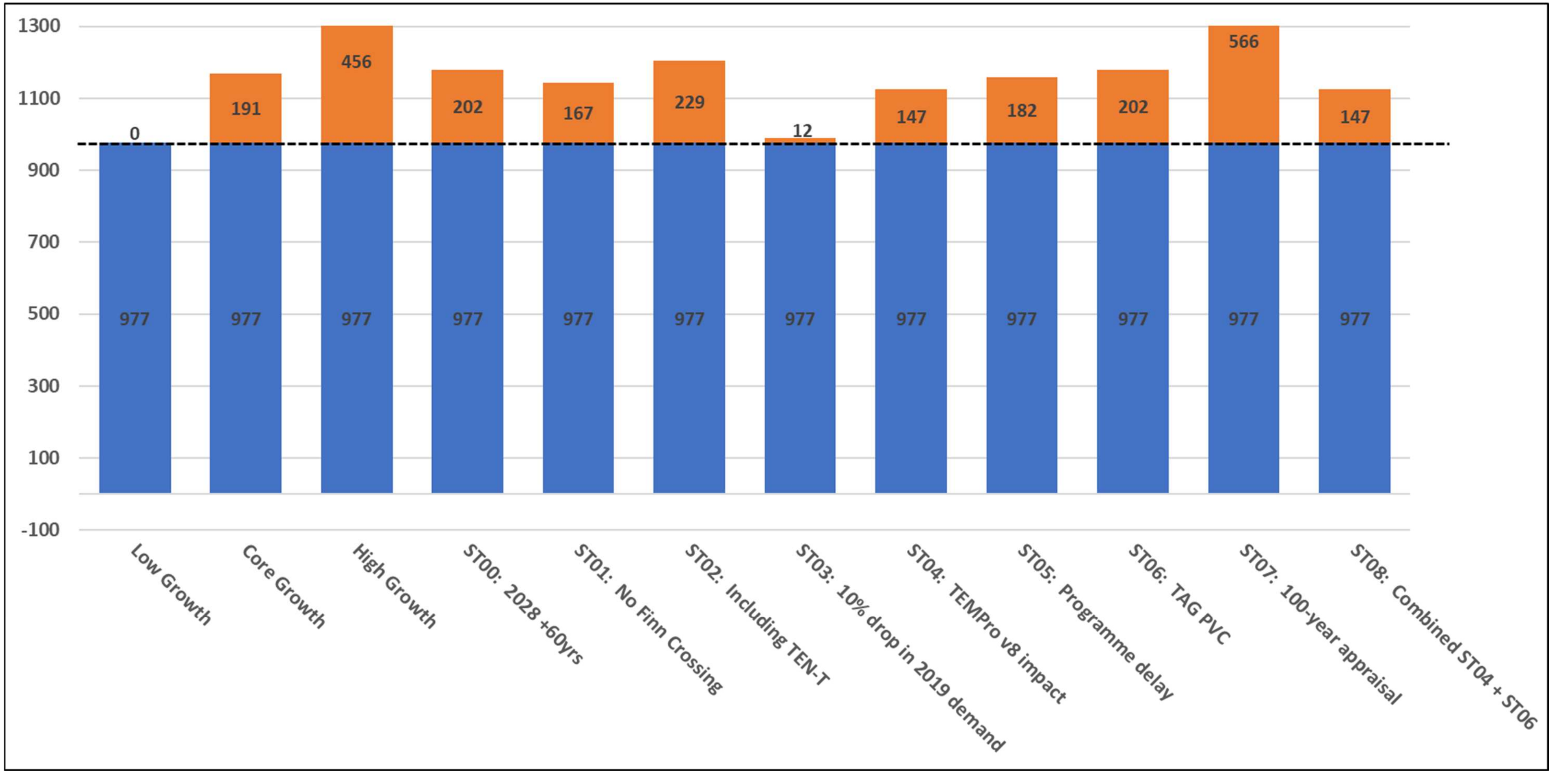
I 6 SENSITIVITY TEST RESULTS

I 6.1. The sensitivity test results are presented below in Table 4, for comparison, the Core, Low and High Growth scenario results are also displayed.

Table 4. Present Value of Benefits, Present Value of Costs, Benefit to Cost Ratio - All scenarios (£M in 2010 values and prices)

	Low growth	Core growth	High growth	ST00	ST01	ST02	ST03	ST04	ST05	ST06	ST07	ST08
				60-year appraisal starting from 2028	Removal of Finn Crossing	Addition of TEN-T scheme in DM and DS	10% reduction demands	Forecast demands adjusted to TEMPro V8	Two-year delay to the current construction programme	Adopting TAG based PVC estimation	100-year scheme appraisal	Combined ST04 (benefits) and ST06 (cost)
Total Economic Efficiency Benefits	674.9	838.4	1068.6	846.3	822.2	866.8	684.9	799.6	832.7	846.3	1137.5	799.6
Accident Benefits	112.7	124.9	135.2	126.1	118.5	129.9	116.8	123.7	122.8	126.1	169.2	123.7
Construction and Maintenance	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
Carbon Benefits	-35.4	-39.9	-44.9	-39.9	-39.9	-39.9	-39.9	-39.9	-39.9	-39.9	-52.4	-39.9
Monetised Noise	-0.5	-0.6	-0.8	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-1.0	-0.6
Monetised Air Quality	4.3	5.3	6.7	5.3	5.3	5.3	5.3	5.3	5.3	5.3	7.1	5.3
Indirect Tax Revenue (TUBA)	7.7	6.9	5.3	7.0	7.3	6.4	8.0	7.5	6.4	7.0	8.1	7.5
Present Value of Benefits (PVB)	788.4	959.7	1194.7	968.8	937.4	992.5	799.1	920.1	951.3	968.8	1293.2	920.1
Wider Impacts	188.6	208.1	238.0	210.1	206.3	213.0	189.4	204.2	208.0	210.1	249.7	204.2
Adjusted PVB	976.9	1167.8	1432.7	1178.9	1143.7	1205.5	988.5	1124.3	1159.3	1178.9	1542.9	1124.3
Present Value of Cost (PVC)	865.9	865.9	865.9	865.9	856.0	865.9	865.9	865.9	831.8	917.0	883.4	917.0
Net Present Value (NPV)	111.0	301.9	566.8	313.0	287.7	339.6	122.6	258.4	327.5	261.9	659.5	207.3
Adjusted Benefit to Cost Ratio (BCR)	**1.13**	**1.35**	**1.65**	**1.36**	**1.34**	**1.39**	**1.14**	**1.30**	**1.39**	**1.29**	**1.75**	**1.23**

Figure 2 PVB compared to Low growth scenario (£M in 2010 prices and values)



I 6.2. The comparisons in Figure 2 show that the PVB for all sensitivity tests falls within the range of Low to High growth scenario PVBs, with the exception of the ST07 100-year appraisal period. As expected, due to the significantly longer appraisal period, ST07 returns the highest level of PVB exceeding that of the High growth scenario.

I 6.3. The Net Present Value (NPV) of the scheme is the difference between Present Value of Benefits (PVB) and Present Value of Cost (PVC). The NPV continues to be above £100M across all the sensitivity tests carried out, which confirms the investment would continue to provide a positive return.

I 6.4. The resulting scheme BCRs for all the sensitivity tests remain in the range of BCRs bounded by the Low and High growth scenarios, with the exception of ST07, which exceeds the high growth BCR. It should be also noted that all the sensitivity tests return an adjusted BCR value greater than 1.0. Most of the sensitivity test BCR values remain within around 5% of the Core BCR. The only exceptions to this are test ST07 which returns a significantly higher BCR than all other tests at 1.75; ST03 (10% drop in 2019 demand), which returns a BCR value of 1.14 but remains higher than the Low growth scenario BCR; and ST08 which is a combined impact of ST04 and ST07 and returns a BCR value of 1.23, some 9% below the Core scenario BCR.

I 6.5. The above sensitivity test scenarios report scheme benefits accrued from when the whole scheme opens (from 2028), as opposed to the phased opening of the scheme from 2027 which is presented for the Core, Low and High growth scenarios. The impact on PVB between test ST00 (which assumes whole scheme opening in 2028) and the core scenario (which assumes a phased opening from 2027 to 2028) is marginal (£1,179M v's £1,168M i.e.<1%). This provides confidence that the potential impact on scheme PVB and BCR, of different phasing sequence or a section-based delivery of the whole scheme within the period 2027-2028, would also be marginal.

Appendix J

OPTIMISM BIAS CALCULATOR - E058 ESTIMATES

OPTIMISM BIAS SECTION

Please select appropriate Level of Complexity: Standard Scheme / Non-Controversial

Please select appropriate Stage of Preparation: Economic Appraisal

Please detail the level of QRA analysis completed and taken into account in the Works Cost Estimate: Detailed QRA analysis undertaken on risk and opportunity register that considers the cost and programme impact (inflation) as part of simulation

Basic Optimism Bias Addition Factors :

Scheme Type	Stage of Preparation	Basic Optimism Factor (%)	
		Lower bound	Upper bound
Standard Scheme / Non-Controversial	Preliminary & Preferred Options	15	45
	Economic Appraisal	5	25
Non-Standard / Controversial / Tunnels / Complicated Structures	Preliminary & Preferred Options	32	65
	Economic Appraisal	15	40

Optimism Bias Mitigation Factors

Control	Cause	Evidence Required	Select	%
Value Management	Poor planning Delivery fails to meet objectives Lack of innovation Stakeholder involvement Critical item programme Scope change / late changes in design	Workshop undertaken with facilitator independent of project	☑	13.33
		Stated objectives expressed to team/stakeholders	☑	13.33
		Optioneering undertaken differentiating using performance criteria	☑	13.33
Site Surveys / investigations	Buildability issues unknown until construction Unforeseen service diversions Unforeseen archaeological find	Desktop study identifies likely risks (comply with HD22 process)	☑	5.00
		Environmental stage two surveys completed and reported	☑	5.00
Risk Management	Fail to sufficiently scope project Contractual disputes Delivery fails to meet objectives Optimistic benefits	Workshop carried out with facilitator independent of project	☑	5.00
		Uncertainties in scope and risk contingency defined	☑	5.00
		Evidence risk register is continually updated / risks managed	☑	5.00
Identify internal and external approvals and prepare timeline	Third party approvals not granted Fail to secure permits, consents approvals	Communication plan in place	☑	3.75
		Potential changes in ministerial/local strategy identified in risks	☑	3.75
		Approvals built into project programme	☑	3.75
		Written communications with key third party stakeholders	☑	3.75
Effective governance	HA corporate governance/political/standards influences Lack of adequate change control Funding availability Duration to construction start Construction duration	Scope of works, objectives and scheme outputs documented	☑	1.67
		Deliverables at key gateways defined	☑	1.67
		Change control system implemented/experienced Project Leader	☑	1.67
		Adequate funds allocated within specific spend years	☐	-
		Detailed programme for development reflecting most likely option	☑	1.67
		Detailed programme available from ECI contractor	☑	1.67
Clear roles and responsibilities	Contractual disputes Poor communication Duplication	Organogram exists	☑	1.67
		Procurement route selected	☑	1.67
		Role of client/consultant expressed in terms of reference	☑	1.67
Estimates cost/benefits independently verified	Estimates unsound	Cost build-up independently checked & signed	☑	1.67
		Comparison made on cost build-up and use of benchmarked prices	☑	1.67
		Independent check of this checklist	☑	1.67
			TOTAL	98.3%

Gross, Mitigated Optimism Bias calculation :

Upper Bound =	Lower Bound =	Difference =	x	Mitigation proportion	=	Mitigation OB	Gross OB = Lower Bound
25.0%	5.0%	20.0%	x	1.7%	=	0.3%	5.3%

Total Optimism Bias which will be applied to this Cost Estimate = 5.3%

ROADS Service

Roads Service Policy & Procedure Guide: RSPPG_E058

Title:	**Major Works Estimates**

Author :	J. Saulters & S. Wells RSHQ
Version :	1
Implementation Date:	To be effective from the Date Issued.
Date issued to users:	21 June 2011

Classification

Level 1 (Title / Key Words) **:**	Estimate Range, Optimism Bias, Quantified Risk Assessment, HARM, Programme Estimate, Upper Bound Estimate
Level 2 : (Directorate/Owner)**:**	Strategic Programmes
Level 3: (RSHQ or HoBU Managed Function):	Strategic Road Improvements
Level 4 : (Work Areas)	Contracts, Design, Forward Planning

Notes

Certification

This document complies with Roads Service Policy. For Implementation and Issue Dates, see above.

Signed RJM Cairns Director of Engineering

Certification Date: 21 June 2011

CONTENTS

1 Introduction

1.1 Purpose

This Roads Service Policy & Procedure Guide (RSPPG):-

a) Is aimed at all Roads Service staff involved with compiling estimates for Major Works schemes at all stages of the scheme development.

b) Defines the procedures involved in obtaining RSHQ approvals for scheme estimates.

c) Provides guidance on how allowance should be made for risks/ uncertainty.

d) Provide guidance on the preparation of estimates in a consistent format enabling project costs and performance to be reliably compared and benchmarked.

1.2 Definitions

1.2.1 SP is Strategic Programmes.

1.2.2 SRIHQ is the Strategic Road Improvements Team in HQ

1.2.3 TEPU is the Transportation and Engineering Policy Unit in HQ

1.2.4 Investment Decision Maker (IDM) is the Roads Service Board.

1.2.5 The Director of Strategic Programmes is responsible for monitoring and approving the changes in the scheme estimate on behalf of the Roads Service Board acting as IDM.

1.2.6 Project Owner[1] (PO) is normally the Divisional Roads Manager (DRM). The DRM has primary ownership of the relevant scheme estimate.

1.2.7 Project Sponsor (PS) will normally be a PPTO in the Divisional Strategic Road Improvement Team or Network Services.

1.2.8 Estimate is a calculated prediction of the amount of money required to undertake a specified scope of work for the base year in which it was prepared.

1.2.9 Risk is defined as uncertainty of outcome, whether opportunity or threat, of actions and events which could affect the objectives of an organisation, schedule or project.

[1] Also known as the Senior Responsible Owner (SRO)

1.2.10 Risk Register is a document that collates risks and outlines mitigation measures throughout the life of the project.

1.3 Background

1.3.1 As a scheme progresses through the early inception stages to the pre-tender estimate the elements of uncertainty and risk reduce as the scheme is developed and information is confirmed. The optimism bias relating to the estimate has to be carefully assessed and applied appropriately at the relevant level (Appendix 3).

1.3.2 It may also be appropriate to apply higher levels of optimism bias than that indicated in this guidance where there is a high level of uncertainty to a scheme.

1.3.3 Scheme Estimates must be reasonably accurate. It is important that the Investment Decision Maker and other approving bodies (such as DFP) are given robust information on the total cost of the scheme (including land and consultants fees). This will help ensure Roads Service retains its credibility as a competent custodian of financial resources and a professional programme manager. There is also an expectation from those controlling government finances that Roads Service will live within a finite funding envelope for SRI schemes which form the basis of the current programme.

1.3.4 In all cases the following must be avoided:

- instances where the scheme estimate increases significantly, either in one jump or over a series of moves;
- systematic estimate creep, where scheme estimates consistently increase over and above the rate of inflation;
- estimating low to get a scheme on the programme and once secure increasing the estimate to more realistic levels; and
- the practice of new consultants coming to a scheme and seeking a significant increase in the estimate, often to give themselves a higher tolerance level.

1.3.5 Scheme estimates may need to be increased from time to time, sometimes for good reason. For example:

- a change in the price base – until a scheme enters the Construction Programme (i.e. contract award) the price base is usually at current prices which need to be updated from time to time in line with construction price inflation.
- unforeseen cost increases outside Roads Service’s control: e.g. significant increases/decreases in the estimated cost of land acquisition notified to us by the LPS;

- changes in the scope of the scheme: e.g. providing a high standard off-line dual carriageway with grade separation instead of the on-line option that was originally envisaged – where this occurs it is important to report the estimate for the original scheme and the additional cost for the improved standard, thus giving the Investment Decision Maker the opportunity to decide whether or not to endorse the improved standard at increased cost.

1.3.6 There are also other less acceptable reasons for increases in scheme estimates which lead to poor estimating such as failure to:

- include the appropriate compensating adjustment for optimism bias;
- include the cost of key elements of the scheme;
- allow for, or undertake timely investigations into, high-risk items such as ground conditions, archaeology or underground services;
- have regard for the scheme estimate during scheme development, resulting in over-ambitious schemes;
- check the scheme estimate against a high-level estimating model using the cost of previous recent schemes (e.g. cost of normal standard dualling per kilometre, cost per compact grade separated junction etc.)

1.4 Costs and Benefits

1.4.1 This RSPPG is the formalisation of existing practice, the costs and benefits are not relevant at this time

2 Roads Service Policy & Procedure

2.1 Major Works Estimating

2.1.1 Estimates are prepared and reviewed throughout the life of a major works scheme at the following milestones:

(i) Feasibility Report;

(ii) Preliminary Options Report;

(iii) Preferred Options Appraisal Report;

(iv) Economic Appraisal Report;

(v) Pre-Tender Estimate;

(vi) Tender Cost; and

(vii) Any stage a major change, amendment or review occurs in the life of a project.

2.1.2 Responsibility for the scheme estimate passes to the Project Owner when appointed.

2.1.3 The guidance on Optimism Bias and Quantified Risk Assessment in Appendix 3 should be applied when compiling estimates.

2.2 Level of Cost-Estimation Required through Scheme Development

A Programme Scheme Estimate should be produced at each stage of development, contained initially within an Options Range and then within an Estimate Range, when the Preferred Option has been identified.

		Feasibility Report	Preliminary Options	Preferred Options	Economic Appraisal & Stage 3	Pre-tender Estimate	Tender Cost
Estimate Management	Programme Scheme Estimate	Produced	Updated	Updated	Refined	Refined	Refined
	Options Range	Produced	Refined				
	Estimate Range			Produced	Refined[2]	Refined	Refined

2.3 Programme Scheme Estimate

2.3.1 The Programme Scheme Estimate is a single point estimate identifying the "most likely" cost of the scheme. Accordingly the Programme Scheme Estimate uses a "most likely" assessment of optimism bias and risk. The Programme Scheme Estimate is commonly referred to as the Scheme Estimate.

2.3.2 This estimate will be used for programming and profiling purposes by SRIHQ.

2.3.3 At feasibility and preliminary options stage, before a preferred option has been identified, the Programme Scheme Estimate will be agreed between SRIHQ and the Project Team.

2.4 Options Range

2.4.1 In the conception stages there will be various options identified to meet the scheme objectives and to ameliorate the problems. The range in cost between the various options is known as the Options Range.

[2] The Upper Bound limit of the Estimate Range is to be used as the estimate for the DFP Economic Appraisal. Refer to section 2.4.

2.4.2 Not every scheme will undertake a feasibility study prior to the preliminary options stage. However for those schemes that do, depending on the specific purpose of the feasibility study, an attempt should be made to estimate the cost of each feasible option being brought forward. The Options Range will be developed from the most expensive and the least expensive options. It is recognised that this level of detail may not always be available.

2.4.3 At preliminary options stage there may be 1 preferred option, (generally identified as a preferred corridor), or there may still be 2 or 3 leading options. The construction costs for all recommended options are to be developed with an appropriate level of detail. If there is only a single preferred option, the Options Range will be developed from the uncertainties within the option.

2.4.4 An assessment of potential Blight (particularly in urban areas) will also need to be undertaken at preliminary options stage. This risk allowance will be included in the estimate.

2.4.5 If it is necessary to state scheme costs publically in the early stages of development the Options Range should be used. This should be accompanied by a caveat stressing that this is an indicative assessment to give perspective to the likely scale of the works involved, until sufficient detail is developed to identify a preferred solution. Project Owners should nonetheless endeavour to ensure the Options Range is as realistic as possible.

2.5 Estimate Range

2.5.1 Once the Preferred Option has been identified an Estimate Range should be established. This will be contained by an Upper Bound and a Lower Bound Estimate and identifies the range within which it is expected the scheme cost will fall. The Estimate Range demonstrates that there is uncertainty over the estimated scheme cost before detailed design has taken place. It is however expected that the Programme Scheme Estimate will remain within the Estimate Range and that this range will narrow as the scheme progresses.

2.5.2 The Upper Bound Estimate should be based on maximum plausible levels of optimism bias with the Lower Bound Estimate based on minimum plausible levels of optimism bias. The “most likely” assessment of risk allowance (consistent with the Programme Scheme Estimate) will be included in the Upper and Lower Bound Estimates. The suggested range will be submitted by the Project Owner and agreed by SRIHQ.

2.5.3 At the preferred options stage there will still be some uncertainty over the detail of various construction elements, for example the earthworks strategy. Whilst every effort should be made to find the optimal solution these uncertainties should be dealt with in the Quantified Risk Assessment.

2.5.4 The Estimate Range rather than a single point estimate will be quoted publically in all press releases, publications, web site etc.

2.6 Economic Appraisal

2.6.1 The Economic Appraisal submitted to DFP will seek approval for the Upper Bound limit of the Estimate Range (as explained in section 2.5) that is identified at this stage of scheme development.

2.6.2 This Upper Bound Estimate identifies the plausible worst case scenario. It is this estimate that is used when identifying the Benefit to Cost Ratio (BCR) for the DFP economic appraisal. In the event that the full contingencies are required, then the scheme should remain within the DFP approved figure, thus ensuring acceptable value for money despite the contingencies being expended.

2.7 Inflation

2.7.1 With the exception of the tender estimates, all estimates will be expressed in terms of a baseline date. No allowance is to be added for inflation beyond the base date selected on the major works estimate pro-forma. The allowances for inflation are reported separately by SRIHQ.

2.8 Property Compensation

2.8.1 Blight costs if applicable normally occur after the announcement of the preferred route but may also occur prior to this. The cost of acquisitions through Blight form part of the scheme cost to Roads Service and therefore should be included as part of the scheme estimate.

2.8.2 As the costs of these acquisitions are realised during the scheme development phase they must be clearly identified as soon as the issue arises to enable SRIHQ to manage budgets accordingly.

2.8.3 The treatment of these costs in economic appraisal is set out in Annex A of WebTAG Unit 3.5.9.

2.8.4 Scheme estimates must also make allowances for The Land Acquisition and Compensation (NI) Order 1973 Part II compensation claims for depreciation caused by public works. These claims are normally served during a 2 year period starting 1 year after the date of opening to public traffic. Allowance should also be made for providing insulation/compensation under the Noise Insulation Regulations (NI) 1995.

2.9 Procedures for obtaining Director of Strategic Programmes approval

2.9.1 All major works estimates are required to be approved by the Director of Strategic Programmes.

2.9.2 All (Programme) Scheme Estimates from Gateway 0 to Gateway 2 should be itemised on the proforma in **Appendix 1** and signed off by the Project Sponsor and DRM prior to submission to SRIHQ. The upper and lower Range Estimates should also be entered on the proforma.

2.9.3 All estimates from Gateway 3 (Pre-Tender) to Gateway 4 (Tender) should be itemised on the proforma in **Appendix 2** and be signed off by the DRM prior to submission to SRIHQ.

2.9.4 SRIHQ will consider the (Programme) Scheme Estimate and associated Estimate Range and will seek clarification, if required, before seeking approval from the Director.

2.9.5 Gateway approvals can not be advanced until the respective proforma is received and agreed by SRIHQ.

2.10 Major Works Database / Roads Service Website

2.10.1 SRIHQ retains a database on all major projects in Roads Service. Part of this database records the approved estimates for each scheme, as well as the history of previous estimates.

2.10.2 Where necessary the estimates contained therein, and on the Roads Service website, will be adjusted once the estimate proforma has been approved by the Director of Strategic Programmes. The purpose is to provide a system of control which:

- ensures estimates are realistic and up to date; and
- avoids ad hoc changes without proper authorisation.

3 Equality Impact Assessment (EQIA)

3.1 Equality Impact Assessment Section 75 of the Northern Ireland Act 1998

3.1.1 The amendments to this RSPPG are being made to an existing internal document covering internal Roads Service procedures. As the amendments will not have any impact on any Section 75 group it is deemed that an EQIA Screening Analysis / full EQIA is not necessary.

4 References

4.1 General References

4.1.1 None used.

4.2 Endnote References

4.2.1 None used.

5 Appendices

5.1 Appendix 1: Proforma for Major Works Estimate

ROADS Service

Scheme Estimate Approval

Project: | Division:

Approval Required: | Form:

Construction Costs

(i)	Preliminary Works			#DIV/0!
(ii)	Road Works			#DIV/0!
(iii)	Structures			#DIV/0!
(iv)	Utilities			#DIV/0!
(v)	Other Costs			#DIV/0!
	Total Works Costs		(a)	#DIV/0!

Previous Estimate

Estimate:

Approved Date:

Price Base for this Estimate

Quarter:

Base Year:

Land Costs (No LPS Estimate)

(vi)	Land Estimate		(b)	#DIV/0!

Land Costs (Current LPS Estimate)

(vii)	Land Purchase Cost			#DIV/0!
(viii)	Disturbance / Severance / Injurious Affection / Part 2			#DIV/0!
	Total Land Costs		(c)	#DIV/0!

Date of Land Estimate:

Sub-total Construction and Land Costs (a+b+c) (d) #DIV/0!

Consultant Costs

(ix)	Preparation Costs		(e)	#DIV/0!
	% of d			#DIV/0!
(x)	Supervision Costs		(f)	#DIV/0!
	% of d			#DIV/0!
	Total Consultant Costs (e+f)		(g)	#DIV/0!

Total Construction, Land & Consultant Costs (d+g) (h) #DIV/0!

Risk

(xi)	Risk Allowance (HARM)		(i)	#DIV/0!
(xii)	Optimism Bias			
	%		(j)	#DIV/0!
(xiii)	Land Optimism Bias (if different)			
	%		(k)	#DIV/0!
	Total Risk Element (i+j+k)		(l)	#DIV/0!

Date of Risk Assessment:

☐ Tick if OB should **NOT** be applied to the current LPS Land Estimate

☐ Tick if OB should be applied to Risk Allowance

Total Estimate (h+l)

Scheme Estimate £ 0m

Estimate Range m to m

DIVISIONAL APPROVAL:

Estimate prepared by: Signed: Date:

Approved by (DRM): Signed: Date:

SRI HQ APPROVAL:

Estimate checked by: Signed: Date:

DIRECTOR / RS BOARD APPROVAL:

Approved by: Signed: Date:

Director of Strategic Programmes / Roads Service Board

Comments:

5.2 Appendix 2: Proforma for Pre-Tender & Post-Tender Costs

(Also available in RSPPG_P003)

Division

Scheme

Details of Works

Comments

Current Project Estimate £k Date Approved

Contract Period Weeks

PROCUREMENT TIMETABLE (Forecast use Month and Year Only, Actual use Day, Month and Year)

Advertise for restricted list | Issue of tender documents | Award Contract

Selection of restricted list | Return of tenders | Start work

Estimated Costs Pre-tender (£k)

a) Consultant Fees

Design

Site Supervision

Sub-total

b) Land

c) Advance Works

d) Risk / OB element (for a,b,c)

Pre-tender Contract Costs

e) Preliminary Works

f) Main Contract Works

Design

Build

Sub-total

g) Other costs or contributions

Sub-total

h) Contract Risk Contingency %

Pre-tender Contract Total

Pre-tender Project Estimate

ESTIMATE RANGE (£m) to

Scheme Costs Post-tender (£k)

a) Consultant Fees

Design

Site Supervision

b) Land

c) Advance Works

d) Risk / OB element (for a,b,c)

Post-tender Contract Costs

e) Preliminary Works

f) Main Contract Works

Design

Build

Sub-total

g) Other costs or contributions

Sub-total

h) Contract Risk Contingency %

Post-tender Contract Total

Post-tender Project Cost

ESTIMATE RANGE (£m) to

Expenditure Profile (£k)

	Paid to Date	2011/12	2012/13	2013/14	Future	Total
Pre-tender Project Estimate						
Post tender Project Cost						

Signed: DRM / on behalf of DRM*
(*Delete as appropriate)

Date:

Signed: DRM / on behalf of DRM*
(*Delete as appropriate)

Date:

5.3 Appendix 3: Risk Assessment & Optimism Bias

5.3.1 Introduction

5.3.1.1 Organisations of all types and sizes face a range of risks affecting the achievement of their objectives and Roads Service is no different. While "risk" is commonly regarded as negative, risk management is as much about helping to realise potential opportunities as well as preventing potential problems. It is important to bear this in mind whenever managing risk. Risk management is an essential part of good management.

5.3.1.2 This Appendix does not set out to establish a certifiable process or to produce a totally prescriptive framework rather this document is intended to provide guidance on best practice.

5.3.2 Adjusting for Risk and Optimism Bias

5.3.2.1 Roads Service requires that the base cost estimate should be adjusted to account for risk and optimism bias in order to obtain more accurate cost estimates. (A quantified risk assessment is not required until the preferred options report).

5.3.2.2 The risk adjustment should be calculated first and then the optimism bias applied to the full risk adjusted cost. Generally the land costs should be reported separately and an appropriate rate (if any) of optimism bias applied.

5.3.3 Risk Assessment

5.3.3.1 Risk assessment is required to determine the current level of and exposure to risk, and provide input to decisions on where responses to reduce or exploit risk are required.

5.3.3.2 A risk might have a number of consequences which could be negative or positive. Risk assessment can be undertaken with varying levels of detail depending upon the risk, the purpose of the assessment, and the information, data and resources available. Risk assessment can be qualitative or quantitative, or a combination of these.

5.3.3.3 A qualitative risk assessment is an initial evaluation of risk and determines the type, probability, impact and relative importance of the risk events using 'expert' opinion and engineering judgement.

5.3.3.4 A quantitative risk assessment defines the evaluation further by ascribing values to likelihood and impact and determines the range of uncertainty in cost and time, (which translates into cost) to the project out-turn.

5.3.3.5 The qualitative and quantitative assessments are used to develop an understanding of a project's risk in terms of its risk profile, and where and when the risk events might occur, in order to assist with evolving a risk management approach.

5.3.3.6 Each risk should be analysed to an appropriate extent, considering its consequences, and summarised in terms of the consequences arising and their likelihood. The process should be iterative being repeated as more data become available.

5.3.3.7 In most situations, it will be appropriate to carry out a qualitative assessment initially, followed by a quantitative assessment once the key risks from the qualitative assessment have been examined in detail.

5.3.4 Risk Register

5.3.4.1 A risk register should be produced at feasibility stage and updated as the scheme progresses.

5.3.5 Qualitative Risk Assessment

5.3.5.1 For qualitative risk assessment a 5x5 probability and impact scale aligned to a matrix should be used to ascertain priority.

5.3.5.2 *Probability*

Putting a number to the five categories often helps to give people a common understanding of risk exposure. The table below shows an approach to stating the probabilities of risks occurring.

Rating Level	Likelihood	Description	%
1	Very Low	Virtually impossible	0 to 5%
2	Low	Low but not impossible	6 to 20%
3	Medium	Fairly likely to occur	21 to 50%
4	High	More likely to occur than not	51 to 80%
5	Very High	Probably will occur	> 80%

A risk that has 'no' impact is unlikely to be assessed for probability; no matter how likely it is to occur. Similarly, a risk with zero probability will never happen and therefore presents no risk. Something which has happened or will definitely happen is not a risk, it is certain and should be included in the project cost estimate and programme.

5.3.5.3 *Impact*

Similarly for impact, putting a number to the five categories often helps to give people a common understanding of risk exposure.

For *individual* risks, consider impact separately in terms of the effects on:

- Costs;
- Time (programme and resources); and
- Quality (ability to meet objectives/reputation/information).

Individual risks will have a separate rating for each of the impact areas. Each needs to be defined in terms of appropriateness to the activity against the defined objective for the activity. The ranges should be selected to suit the activity, situation or size of project. The tables below provide examples of impact for individual risks on a project.

5.3.5.4 **Cost** (Budget) Impact

Rating Level	Degree of impact	Description	%	Example for a £50m project
1	Very Low	Minimal impact on project cost	< 0.5%	<£250k
2	Low	Minor impact on project cost	0.5 to 1%	£250k-£500k
3	Medium	Moderate impact on project cost	1 to 3%	£500k-£1.5m
4	High	Large impact on project cost	3 to 5%	£1.5m-£2.5m
5	Very High	Major impact on project cost	> 5%	>£2.5m

Note that whilst a percentage has been given for cost impact this should be converted to a value and then adjusted accordingly for appropriateness to size of scheme. For large projects e.g. over approx £200million then the degree of risk impact should be adjusted relative to the activities undertaken rather than a % based on overall project value. The above impact parameters can further be refined when a project moves into Construction stage.

5.3.5.5 **Time** (Project programme) Impact

Rating Level	Degree of impact	Description	%	Example 2yr programme
1	Very Low	Minimal impact on project programme	< 1%	< 1week

2	Low	Minor impact on project programme	1 to 5%	1 – 4 weeks
3	Medium	Moderate impact on project programme	5 to 10%	1 – 3 mths
4	High	Large impact on project programme	10 to 20%	3 – 5 mths
5	Very High	Major impact on project programme	> 20%	>5 mths

The above impact parameters can be refined when a project moves into Construction stage.

5.3.5.6 **Quality** Impact

Rating Level	Degree of impact	Generic Description
1	Very Low	Minimal - meets or exceeds mandatory requirements, minimal adverse impact on reputation, service delivery, and information to customers. E.G Some planting failures in new landscaping works not completed. Matrix sign temporarily unavailable during TM.
2	Low	Minor - a few minor shortfalls, some small changes required to rectify. Minor adverse impact on reputation, service delivery, information to customers. E.g. lighting failure
3	Medium	Moderate – some shortfalls requiring moderate changes to rectify but not impacting on delivery of an objective. Moderate adverse impact on reputation, service delivery, information to customers. E.g. temporary drainage failure/flooding during works affects road users.
4	High	Large - a large shortfall with an objective not being met, significant change required to rectify. Large adverse impact on reputation, service delivery, information to customers e.g. speed limit imposed due to poor pavement condition.
5	Very High	Major - a major shortfall with more than one objective not being met and requiring significant changes to rectify. Major adverse impact on reputation, service delivery, information to customers e.g. failure of asset following works.

Note – Appropriate values for quality impact should be defined on the basis of individual project's requirements. It is recognised that many of the quality impacts will be difficult to assess until later in the scheme development and that the contract specification will prevent many items from dropping below a minimum standard.

5.3.5.7 Project Qualitative Risk Assessment Matrix

5x5 level probability/impact risk assessment matrix to be used to rank risks:

	PROBABILITY >80%	Very High 5	5	10	15	20	25
	51-80%	High 4	4	8	12	16	20
	21-50%	Medium 3	3	6	9	12	15
	6-20%	Low 2	2	4	6	8	10
	<5%	Very Low 1	1	2	3	4	5
	CRITICAL RISK	IMPACT	Very Low 1	Low 2	Medium 3	High 4	Very High 5
	HIGH RISK	Cost	< 0.5%	0.5 to 1%	1 to 3%	3 to 5%	> 5%
	MEDIUM RISK	Time	< 1%	1 to 5%	5 to 10%	10 to 20%	> 20%
	LOW RISK	Quality	Minimal	Minor	Moderate	Large	Major

The above matrix is for use on assessing risks to projects. The parameters of Very Low to Very High impact ratings are indicative and need to be tailored to suit the circumstances on the project. The combination of probability and impact assessment gives a risk rating – number and colour. The following table explains the approach in terms of risk exposure and management response.

Risk Exposure	Management Response
Low	Acceptable – monitor risk Ensure adequate allowance included in cost estimates/risk allowances and programme plans
Medium	Manage/mitigate the risk as part of day-day project team activities and re-assess as risk register is updated. Ensure adequate allowance included in cost estimates/risk allowances and programme plans.
High	Focused project management attention is required to address the risk and seek to mitigate. Ensure adequate allowance included in cost estimates/risk allowances and programme plans. Report to Senior Project Management.
Critical	Risk with high likelihood and having significant detrimental impact on the achievement of project objectives which may/may not be effectively controlled by project team. Report to Senior Project Management. May require further upward reporting to Roads Service Board.

5.3.6 Quantitative Risk Assessment

5.3.6.1 Quantitative risk assessments (QRA's) are used later in the process when there is a more detailed understanding of the risks including consequences, probabilities and mitigation and management methods.

5.3.6.2 A QRA is a key process in developing a detailed quantified understanding of the overall cost and time effects of the portfolio of risk, whether at strategic, programme, or project level. A member from SRIHQ should be invited to Risk Management Workshops.

5.3.6.3 They are to be carried out using estimates of the actual costs, delays or other effects of a risk and the percentage probability of the risk occurring. This will usually be done taking into consideration any management of the risk to reduce the chance of it occurring and any mitigation of its effect if it does occur.

5.3.6.4 A considerable amount of work needs to be carried out in preparation for a quantitative risk assessment to ensure that the potential cost and time effects of a risk are fully understood. This underlines the importance of the qualitative risk assessment in focusing this activity on the key risks. Preparation work also needs to focus on understanding the likelihood of the risk occurring, potential mitigation measures and the cost and effectiveness of such measures. The quantification of risk provides a probability of occurrence in % terms. The product of probability times consequence provides the expected risk value.

5.3.6.5 There are a number of risk analysis software programs available on the market which use Monte Carlo simulation. Schemes with capital cost estimates of greater than £10M should use such a programme. In using these programmes, it is important to ensure that detailed preparatory work on the key issues is carried out to avoid 'garbage in, garbage out' and the number of iterations carried out is sufficient.

5.3.6.6 The overall cost and time effect is quoted at the percentage confidence levels (i.e. the likelihood that the overall estimate of time or cost for the project including risk allowances will not be exceeded). If used then it is recommended that the 50 percentile level is applied in the estimates. A check should be made on the 80 percentile level and reported to SRIHQ if there is a marked difference.

5.3.7 Minimum Level of Risk Assessment at Each Estimating Milestone

A key part of risk management is reviewing implementation of the process to ensure that risks are being proactively and effectively managed on the project and that the exposure to risk is being kept within acceptable/ tolerance levels. Any risk assessment should be commensurate to the size and the stage of development of the project. In addition, the amount of time and resources that are devoted to quantifying risks should relate to how many risks have to be analysed, how difficult that is to do and the materiality of these risks. The table below indicates the minimum level of risk assessment required at each estimating milestone.

		Feasibility Report	Preliminary Options	Preferred Options	Economic Appraisal	Pre-tender Estimate	Tender Cost
Risk and Uncertainty Management	Risk Register	Produced	Updated	Updated	Updated	Updated	Updated
	Qualitative Risk Assessment		Produced	Reviewed			
	Quantitative Risk Assessment (including Monte Carlo Analysis)			Produced	Refined	Refined	Refined

The Risk Register and Quantitative Risk Assessment at the Economic Appraisal and Tender Cost milestones should be forwarded to SRIHQ. SRIHQ will have opportunity to consider the itemised levels of risk before tender documents are issued. The risks detailed at the Tender Cost milestone will be considered in the Post Project Evaluation. This will assess if the appropriate risks were detailed and if the cost allowances were appropriate.

5.3.8 **Optimism Bias**

5.3.8.1 As there is a tendency for all projects to be overly optimistic, project sponsors / mangers should make adjustments (i.e. increasing estimates of the capital/operating costs, works duration and decreasing/delaying the receipt of benefits) to reduce this bias. The following paragraphs detail the generic adjustment factors to be included in estimates to make the optimism bias adjustments.

5.3.8.2 *Capital Cost Adjustments*

The spreadsheet in the web link below should be completed. This spreadsheet calculates the level of optimism bias to be used in the Programme Scheme Estimate, based on the project complexity (most road schemes will be *Standard Scheme / Non Controversial)*; the stage of preparation and the selected response to each of the 24 statements contained therein.

http://roadsnet/rshq/sri/OB.xls

The spreadsheet has default upper bound and lower bound optimism levels for the purposes of the spreadsheet calculations. These figures may be used for the Preliminary Options and the Economic Appraisal cost estimate range. Alternatively if there are valid reasons for using a different scheme specific figure, this may be used. For the Preferred Option cost estimate range the upper bound level of optimism bias will generally be less, at around 35%. Divisions should consult SRIHQ where it is proposed to depart from default levels.

5.3.8.3 *Works Duration Adjustments*

An adjustment process can then be carried out in relation to estimated works duration. The steps below show how to calculate the optimism bias.

Step 1 Determine project type (see following table. Most road schemes will be *Standard Civil Engineering.*)

Project Type	Optimism Bias (%)	
	Works Duration	
	Upper	Lower
Standard Buildings	4	1
Non-standard buildings	39	2
Standard Civil Engineering	**20**	**1**
Non-standard Civil Engineering	25	3
Equipment / Development	54	10
Outsourcing	NA	NA

(source: Mott MacDonald)

Step 2 Using your own knowledge, or that given from the Mott Macdonald Study, take the Upper Bound limit for optimism bias (i.e. 20% for standard civil engineering).

Step 3 Adjust the works duration estimate by the optimism bias adjustment (thus, a project initially expected to take 20 months it will now take 24 months).

Step 4 Assess the risk factors, which cause works duration to overrun. HMT (through Mott MacDonald) has provided information on the factors which contribute to time overruns. Those for a standard civil engineering project are set out in the table below.

Contributory Factor to Upper Bound Optimism Bias	% Contribution to Works Duration Optimism Bias	Mitigation Factor (0.0 to 1.0)	Reduction in OB Adjustment %
Poor Contractor Capabilities	16		
Environmental Impact	46		
Inadequacy of the Business Case	8		
Funding Availability	6		
Poor Project Intelligence	14		
Site Characteristics	10		
TOTAL	**100**		

The next step, therefore, is to examine these factors and to determine if there are actions, which can be taken which would allow these risks to be mitigated. If so, that risk is allocated a risk mitigation factor of 1.0 and the optimism bias adjustment is thus reduced. Ideally, the adjustment will be reduced to the lower bound for the type of project being considered.

Step 5 Following this risk mitigation process, a final risk adjusted works duration estimate is determined. This will be the sum of the column entitled “Reduction in OB adjustment” subtracted from 100% and then multiplied by the Upper Bound works duration optimism bias factor. For example, if the sum of the column entitled “Reduction in OB adjustment” was 70% then the OB would be (100-70)% x 20% = 6%. Therefore if the project was initially expected to take 20 months it will now take 20 x 1.06 = 21.2 months.

6 Control Sheet - Roads Service Policy & Procedure Guide: E058

Title: Major Works Estimates

6.1 Document History

Version	Date	Author	Authorised by Document Control Panel Members Name : Signature
1		J. Saulters / S. Wells	P. Hamilton R. Spiers C. Hutchinson

6.2 Overall Reasons for this Version

Version	Reasons
1	First Issue of RSPPG

6.3 Revision Details

Version	Amendments

Appendix K

REGENERATION REPORT

TECHNICAL NOTE

DATE:	20 January 2023	**CONFIDENTIALITY:**	Public
SUBJECT:	A5WTC - Regeneration Impacts		
PROJECT:	A5 Western Transport Corridor	**AUTHOR:**	[redacted]
CHECKED:	[redacted]	**APPROVED:**	[redacted]

INTRODUCTION

The purpose of this Technical Note is to set out wider economic and regeneration impacts that the A5 Western Transport Corridor ("A5WTC") scheme will have.

The note accompanies the Outline Business Case (OBC) that has been developed in support of the A5WTC scheme. The benefits quantified in the Economic Case in the OBC cover 'traditional' transport economics impacts such as monetised journey time savings, accident reductions and agglomeration improvement impacts. The latter are based on outputs from the traffic modelling work and calculate the increase in Gross Domestic Product (GDP) per worker in the local authority areas relevant to the A5WTC scheme.

In recent years, there has been an acknowledgment that major transport schemes generate a range of wider economic and regeneration impacts that are not captured within traditional modelling analyses (the latter includes the traffic modelling output-based agglomeration improvement impacts that have already been captured in the Economic Case section of the OBC).

Those impacts relevant to the A5WTC scheme include the following:

- Construction phase impacts, covering the additional employment and Gross Value Added (GVA) generated by A5WTC construction;
- Regeneration impacts, including new businesses and housing developments supported by the scheme;
- Socio-economic impacts, including reduced levels of deprivation in certain areas as well as the ability of the scheme to reduce net out-migration, especially of younger, highly qualified people who will seek economic opportunities in better connected regions (if not overseas);
- Other impacts, such as active travel (walking and cycling) scheme benefits in more urbanised areas along the existing A5. By building the new scheme away from these areas, traffic conditions will be such that active travel schemes can be developed, thus enabling people to travel in more sustainable, healthy ways; and,
- Tourism impacts from increased number of visitors as a result of improved connectivity, generating additional spending activity for the local economy.

These are described in more detail below.

CONSTRUCTION PHASE IMPACTS

In addition to the impacts that will be realised when the scheme has been built and is operational, the construction phase will also generate economic benefits in the form of construction sector employment

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benefits. Based on the scale and timing of the construction works (and costs), these will take the form of direct employment at the various construction sites as well as indirect employment in the local supply chain.

Construction impacts are calculated by taking the estimated cost of all works associated with the scheme and dividing this by the amount needed to support one direct position (Full Time Equivalent, FTE) in the construction sector. A standard employment multiplier parameter (from additionality guidance[1]) is then applied to the direct employment total to represent indirect employment in the supply chain. Other additionality factors such as displacement and deadweight are also taken into account before Gross Value Added (GVA) per worker in the construction sector is applied to the employment total. GVA is the metric used to quantify the monetary value of economic activity in a particular area and represents the value of all goods and services produced. The GVA per worker data is obtained from the Office of National Statistics (ONS) and Northern Ireland (NI) Business Register and Employment Survey sources for the respective local authority areas.

Although construction phase impacts are not included in more traditional transport scheme Benefit Cost Ratios (BCRs), they are nevertheless an important type of economic benefit and can be considered as part of the overall Value for Money (VfM) category of the A5WTC project.

The latest cost estimates associated with the scheme are calculated in 2022 Q2 prices and total £1.6 million.

Based on the above methodology (and with conservative values for leakage, displacement, substitution and multiplier effects), the number of additional FTEs and their associated GVA impacts are 1) 244 construction jobs and 2) additional GVA of £16.1 million (2010 prices – the same price base as the OBC traffic modelling benefits).

ENABLING EMPLOYMENT AND HOUSING DEVELOPMENTS

The A5WTC will help to enable – and accelerate – much-needed new commercial development in the three local authority areas through which the new scheme will pass. These are:

- Derry and Strabane;
- Fermanagh and Omagh; and
- Mid Ulster.

Within each of these areas, there are forecasts covering both new employment and new residential developments. By constructing the A5WTC, north-south connectivity through the three regions will be greatly enhanced and this will accelerate the delivery of the sites generating new employment opportunities as well as the new residential developments.

[1] Additionality Guide, Fourth Edition, HCA (now Homes England), 2014

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Although the A5WTC will not be solely responsible for these proposed sites going ahead, the scheme will nevertheless play an important role with respect to their delivery. These impacts are typical of similar transformational transport schemes where the much-enhanced connectivity boosts the attractiveness of both commercial developments and new housing.

By adopting accepted 'additionality' economic impact principles, it is possible to attribute the proportion of the new developments to the impact of the A5WTC. This process is covered by the following steps:

- The respective development proposals have been obtained from the Local Development Plans (LDPs) for each of the three local authority areas;
- Based on additionality principles, the extent to which the new developments can be attributed to the A5WTC is calculated in proportionate terms; and
- The degree of additionality (i.e. the proportion of development attributed to the A5WTC) is based on 1) "deadweight" (the extent and pace that the developments will come forward in the absence of the scheme), 2) "displacement" (the extent to which the impacts may be displaced from activity elsewhere), 3) "leakage" (the extent to which the impacts 'leak' to other areas) and 4) economic multipliers effects.

The analysis generates additionality impacts covering both additional employment and the corresponding GVA generated by the new workers.

The economic benefits derived from the additionality analysis are based on the housing and employment projections up to 2030. These projections are contained in the latest LDPs for each of the local authority areas and are identified in Table 1.

As expected, the majority of new housing (and new employment opportunities) are concentrated in the relatively densely populated area in Derry and Strabane. By contrast, Fermanagh and Omagh is a largely rural / agricultural area. Of the three local authority areas, the A5WTC primarily serves Derry and Strabane as well as Fermanagh and Omagh with only the south western part of Mid Ulster being served by the road.

These spatial characteristics are incorporated in the additionality analysis.

Table 1 – Housing and Jobs Projections

Local Authority	Housing Projections	Jobs Projections
Derry and Strabane	15,000 (average)	10,000 (average)
Fermanagh and Omagh	4,590	4,875 (average)
Mid Ulster	11,000	8,500
Total	**30,590**	**23,375**

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The impacts of the A5WTC and the enhanced connectivity it will generate are summarised in Table 2. These cover the additional value gain from the new housing developments, the additional employment and the corresponding GVA from creating these new jobs.

To support the robustness of these estimates, 'low' additionality parameters have been adopted. These are based on the guidance for this economic impact approach. These are 75% for leakage, 50% for displacement, 75% for substitution and a multiplier of 1.05 respectively.

In addition, as the A5WTC passes through only a relatively small area in Mid Ulster, the highest leakage, displacement and substitution assumptions are applied to the housing and employment impacts this area (respectively 75% leakage, 75% displacement and 75% substitution).

Table 2 – Housing and Jobs Impacts (2010 prices)

Local Authority	Housing Impacts	Jobs Impacts	Number of Jobs
Derry and Strabane	£49,416,597	£11,204,761	325
Fermanagh and Omagh	£20,252,575	£3,342,013	122
Mid Ulster	£25,798,095	£9,278,305	154
Total	**£95,467,267**	**£23,825,079**	**601**

SOCIO-ECONOMIC IMPACTS

As well as the quantifiable / monetizable wider economic impacts of the A5WTC, the new scheme will also generate a range of positive socio-economic outcomes.

These include helping to reduce the levels of deprivation in certain areas affected by the A5WTC. The extent of deprivation in the north-south corridor covered by the A5 is shown in Figure 1.

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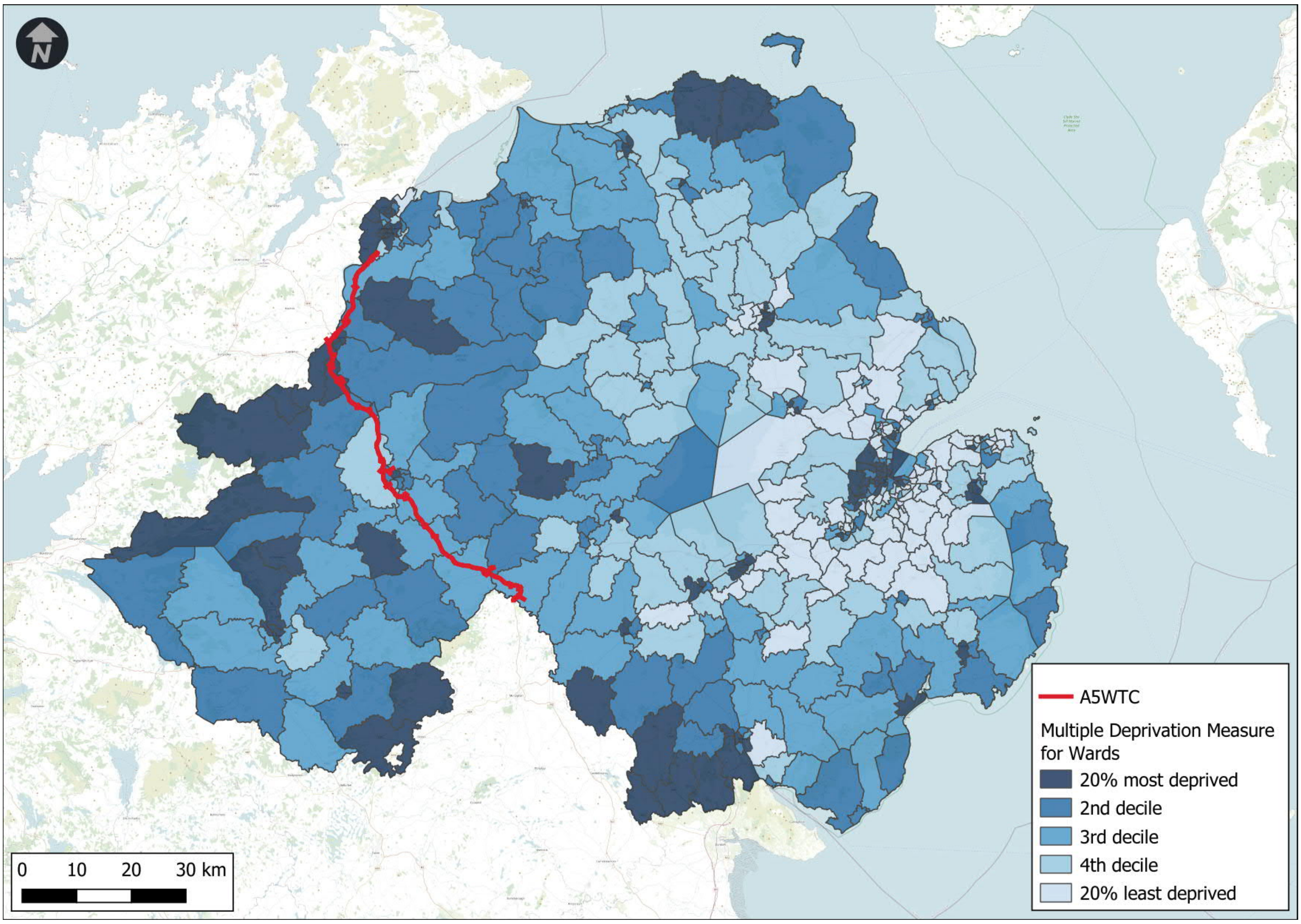
Figure 1 - Multiple Deprivation Measure for Electoral Wards



The figure clearly shows how the north-south corridor between New Buildings and Aughnacloy features some of Northern Ireland's most deprived wards. The majority of wards are in the second most deprived decile, for example, with deprivation measured across several indicators, including income levels, (un)employment and health deprivation.

Those wards with high levels of deprivation along the A5 corridor are:

- Dunnamanagh;
- Glenelly Valley;
- Owenkillew;
- Drumnakilly;

- Termon;
- Sixmilecross; and
- Ballygawley.

By greatly enhancing transport connectivity throughout this part of Northern Ireland, those who live in these relatively deprived areas will have much better access to employment opportunities, places of learning and other areas of economic activity.

This improved access will help these areas significantly as they look to opportunities to reduce current levels of deprivation across a number of indicators.

Figure 1 also indicates the strategic role the A5WTC will play with respect to helping reducing deprivation in the west of Northern Ireland relative to less deprived areas to the east. Given that the A5 connects the important urban centre of Londonderry with other major towns such as Strabane, Omagh and the Border at Aughnacloy, there is great potential for the new scheme and the resulting journey time improvements to be a real driver of transformative regeneration in the region.

Although not directly situated on the A5 corridor, several areas with high levels of deprivation are located to the west of the corridor (as shown in Figure 1) and these will also benefit from the much enhanced transport connectivity. The A5WTC will enable those who live in these areas to access the new alignment and travel to locations throughout the north (including Londonderry) and south, including locations across the Border.

The A5WTC will thus be a facilitator of economic regeneration in areas both directly on the corridor and areas situated away from the corridor but will nevertheless have good access on to the new alignment once it is opened and operational.

OTHER IMPACTS

Active Modes Impacts

Alongside the provision of a dual carriageway from south of Londonderry at New Buildings to the Border at Aughnacloy, opportunities for active travel provision (covering walking, cycling, and horse riding infrastructure) have been reviewed, building on work completed as part of the Masterplan for Active and Sustainable Transport Assessment (which is currently being reviewed and updated), and the Walking Cycling and Horse Riding Assessment Report (WHCAR). Opportunities identified for the proposed scheme include, but are not limited to, the following examples:

- Provision of connectivity from the N14/N15 Link to Urney Road, promoting use of the existing network in and around Strabane;

- Provision of connectivity to the Riverine Development, promoting use of the existing network in and around Strabane; and
- Provision of connectivity to and from other population centres along the A5WTC corridor.

Improving connectivity for pedestrians, cyclists, and horse riders is designed to encourage active travel and promote health and wellbeing across the region, particularly for shorter distance journeys.

The A5WTC scheme will also indirectly encourage an uptake in active mode journeys due to the reduction in traffic flows on the local network, as a consequence of re-routing traffic from the existing A5 to the new alignment of the A5WTC. This will allow active mode users to travel safely on the local road network, where traffic flows might have caused severance to active mode users prior to the implementation of the scheme. Three key categories of benefits are associated with increased levels of active modes:

- Reduced levels of poor health and absenteeism;
- Mode shift; and
- Improved journey ambience.

Typically, the health and absenteeism impacts represent the largest proportion of benefits for active mode users, and refer to how increased physical activity through walking, cycling, and horse riding can have a significant positive impact on health, on an individual and wider society basis. Two key health impacts of increased cycling and walking activity are typically monetised – number of deaths avoided and number of Years of Life Lost (YLL) avoided (i.e. benefits from gaining life years from increased physical activity). These are based on decades of research (including World Health Organisation (WHO) studies and its Health Economic Assessment Tool) which have estimated that the mortality burden of inactivity is similar to that of smoking and obesity. To calculate the health impact, these mortality impacts are converted to Metabolically Equivalent Task (MET) hours. Cyclists, for example, are thus estimated to be 10% less likely to die from any health-related cause than non-cyclists.

Absenteeism benefits rest on research by the National Institute for Health and Care Excellence (NICE) and others which shows that physical activity reduces short-term sick leave by 27%, compared with similar studies elsewhere in developed economies, which show reductions of between 13% and 40%. UK Department for Transport (DfT) Transport Appraisal Guidance (TAG) unit A4.1 recommends assuming a reduction of 25% in short-term sick leave from regular physical activity, which consequently increases productivity and output. As such, absenteeism benefits are only applicable to commuters and the benefits derived are based on average gross salary costs (based on data in the TAG Databook, Table A1.3.1)

Mode shift impacts refer to the economic benefits realised from the uptake in active mode trips, due to the improved connectivity for pedestrians, cyclists and horse-riders and the reduced severance issues from the re-directed motorised traffic from implementation of the A5WTC. These comprise estimates related to decongestion, accidents, greenhouse gas, air quality, noise, infrastructure, and indirect tax benefits.

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Whilst the ‘traditional’ transport economic impacts indicate adverse greenhouse gas emissions impacts from the Proposed scheme, the uptake of active modes on the local network will have a slight counter-effect of reduction in greenhouse gas emissions. This is due to the fact that users, particularly for shorter journeys on the local network, will shift away from vehicles (predominantly cars), and hence emit less greenhouse gases. The calculations include assumptions of ongoing changes in the chemical composition of petrol (as biofuels are blended in), the changing blend of fuels in the energy generation sector, how people typically travel shorter distances to derive an appropriate balance of vehicle types being used less (e.g. no change in HGV (Heavy Goods Vehicle) km as people tend not to make short commuting trips in HGVs). The latest carbon values for appraisal, published by the Department for Business, Energy and Industrial Strategy (BEIS) in September 2021, are based on updated evidence on the valuation of greenhouse gas (GHG) emissions for transport interventions.

Journey quality is a measure of the real and perceived physical and social environment experienced while travelling, which is predominantly related to the fear of potential accidents with regard to active mode users. Whilst the Proposed scheme does not include specific infrastructure provision for active mode users, the improved safety on the local network from re-routing motorised traffic to the A5WTC could be considered as a journey quality benefit to active mode users. The journey quality benefits will be experienced by both current active mode users and any additional users, who will walk and cycle following the implementation of the Proposed scheme.

Tourism Impacts

Based on official tourism statistics for Northern Ireland, there has been an increase in the number of tourist trips and estimated expenditure associated with these trips between 2013 and 2019. In 2019, for example, there were an estimated 5.3 million overnight trips in Northern Ireland and these generated tourism expenditure of £1 billion. Based on 2018 tourism GVA data, the annual expenditure from overnight trips equated to approximately 2.5% of the local economy.

The A5WTC will improve connectivity to tourist attractions and this will increase visitor numbers in the region, generating additional expenditure within the regional economy.

The tourism benefit of the A5WTC will primarily consist of increased tourism sector GVA and employment. This will be a direct result of the new alignment helping to attract and facilitate additional visits and expenditure.

The additional visitor expenditure will support employment in the tourism sector and the wider economy (due to tourism businesses’ expenditure across their supply chains). The number of jobs supported is typically determined by a ‘spend per job’ benchmark, which is measured by the GVA per head in the tourism sector.

To calculate the net additional impacts, the following effects are taken into account:

- Leakage – any spending outside of the regional economy affected by the A5WTC;

- Displacement – any spending which has been offset by a reduction in spend elsewhere in Northern Ireland. Depending on the type of visitors, i.e. day visitors or overnight visitors, the displacement effect is expected to be different. The displacement effect of overnight visitor spending is anticipated to be smaller, as these will include international visitors and people who would have otherwise not spent in the Northern Ireland economy; and
- Deadweight – spending that would occur in the Northern Ireland economy anyway (even if the Proposed Scheme is not implemented).

As an indicator of the potential tourism impacts of the A5WTC, the respective tourism development strategies for both Derry and Strabane as well as Fermanagh and Omagh have been taken account. These strategies set out both the current level of visitor numbers, tourism expenditure and jobs supported in the sector. The strategies also contain forecasts as to how these could increase over time as the visitor sector and 'offer' develops further (and after certain activities and interventions are put in place to boost tourism in these areas in the future).

The respective targets for each local authority area are as follows:

- Derry and Strabane: doubling tourism expenditure per annum from £50 million to £100 million and increasing jobs in the sector by 1,000 (from a base of 4,685); and;
- Fermanagh and Omagh: boosting tourism expenditure by 5% per annum from a base of £64 million (supporting 3,800 jobs) to £86 million within six years.

Based on additionality principles, the impact of the A5WTC will be to support these objectives as the much enhanced connectivity will help visitors to both reach and travel around the region (and thus gain access to the various visitor attractions in this part of Northern Ireland, as well as those in County Donegal).

As there will be other factors influencing the achievement of these tourism objectives, the level of additionality applied to the impact of the A5WTC (i.e. what level of attribution is assigned to the Proposed Scheme) is as follows: Leakage = 50%, Displacement = 50% and Economic Multiplier = 1.05.

These indicate that in Derry and Strabane, employment in the tourism sector will be boosted by an additional 263 jobs and additional visitor expenditure of over £2.8 million. For Fermanagh and Omagh, the respective impacts are 476 additional jobs and over £8 million in additional expenditure.

The A5WTC will therefore play an important role with respect to the region achieving its visitor and tourism targets (a key sector in the regional economy and one that needs to grow as the region recovers from the impact of the pandemic).

SUMMARY AND CONCLUSIONS

The A5WTC will generate a range of regeneration and wider economic impacts over and above the traditional transport benefits summarised in the Outline Business Case (OBC).

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These comprise a mixture of impacts that can be quantified / monetised and those that are best represented in qualitative terms.

The different types of wider impacts are summarised below:

- **Construction phase benefits**: the scale of the A5WTC construction programme and associated capital expenditure will support many direct and indirect employment opportunities in the sector (as well as the additional GVA generated by these employees). Note that as well as direct on-site construction employment, the A5WTC will also support employment in various supply chain businesses;
- **Enabling additional employment**: the A5WTC will also help to facilitate (and accelerate) the various employment sites and job opportunities that form part of the local authorities' LDPs. Based on additionality economic impact guidance, it is possible to adopt relatively conservative assumptions yet still obtain significant additional economic impacts. These impacts will also help to regenerate the region and provide its workforce with much-needed new employment opportunities;
- **Enabling additional housing development**: the enhanced connectivity generated by the A5WTC will also support the unlocking of land for new housing development. This economic is captured by land value gain and is a recognised impact of transformative transport corridor improvements (as the enhanced connectivity will help to unlock land for new residential development. By helping to bring forward housing, the A5WTC will further support regeneration in the region and will also help to rebalance or level up economic activity across Northern Ireland;
- **Helping to reduce relative deprivation**: as the most recent deprivation statistics for Northern Ireland demonstrate, there are areas (or wards) of relative deprivation either on the A5 corridor or relatively close to it. The statistics also show that the areas to the south and west of Londonderry have some of the highest levels of deprivation across Northern Ireland. Without the improved access to a range of activities that the A5WTC will generate, deprivation levels in these areas are likely to remain relatively high. This means that without the Proposed Scheme, the population in these areas will not be able to access employment and education opportunities amongst other opportunities;
- **Active modes (enhanced walking and cycling) impacts**: the Proposed Scheme will also help to develop several walking and cycling proposals at key locations on the A5 corridor. Examples include plans to use the existing A5 through some of the more built-up areas on the corridor for enhanced walking and cycling provision. This will help to achieve several national, regional and local objectives with respect to sustainable transport provision and the need to develop cleaner, greener and more healthy means of transportation; and
- **Tourism impacts:** the A5WTC scheme will also support tourism and visitor expenditure in the region by enabling visitors to have much better access to a wide range of attractions across the

region. As well as visits to Londonderry and the coastal region, there will also be much better access to attractions throughout the region. Additional visits and expenditure will support further employment in the tourism sector (both direct jobs and indirect jobs in the supply chain).

The A5WTC is thus a major facilitator of regeneration and economic growth in the region. This has been proved by other transformative road schemes such as the A55 upgrade in North Wales. The region served by the A5WTC will benefit from the new alignment in several different ways, including better access across the border as well as a wide range of benefits 'internal' to this part of Northern Ireland.

Appendix L

RISK REGISTER

Appendix L - Redacted in full.

Appendix M

PROCUREMENT STRATEGY SUMMARY

M1 APPENDIX M

M1.1 VISIONS, AIMS AND OBJECTIVES TO THE PROCUREMENT STRATEGY 2008

M1.1.1. This section presents the visions, aims and objectives as outlined in *'Procurement Strategy Summary for Outline Business Case Discussions'* report from 2008, which is included below in Section M2 of this Appendix M.

M1.1.2. The programme and the cost estimates of the 2008 report were current at the time of the procurement strategy preparation.

M1.1.3. The OBC 2022 programme and costs estimates are provided in the main body of the report.

M1.1.4. The remaining recommendations of this '*Procurement Strategy Summary for Outline Business Case Discussions - 2008'* remain valid today.

M2 PROCUREMENT STRATEGY SUMMARY FOR OUTLINE BUSINESS CASE DISCUSSIONS – DECEMBER 2008

A5 Western Transport Corridor

Procurement Strategy Summary for Outline Business Case Discussions

Document History:

Version:	**Date:**	**Authorised by:**
Draft	3 December 2008	Gary Wright

Contents

1.0 Purpose

This report summarises the Procurement Strategy proposed by the Northern Ireland Roads Service (NIRS) to deliver the A5 Western Transport Corridor (A5 WTC) project.

The report has been prepared to support discussions with the Northern Ireland Department of Finance and Personnel (DFP) prior to the publication of the OJEU Contract Notice and has been structured as follows:

- Summary of the procurement proposal
- Background to the project
- Aims and constraints
- Current progress
- Option development and appraisal
- Description of preferred option including key milestones

2.0 Proposed Procurement Strategy

The procurement strategy has been developed in line with government policy and best practice advice. It addresses the specific A5 WTC project aims and constraints and aims to deliver value for money.

During its development the strategy has been discussed with the Strategic Investment Board (SIB), who support the proposed way forward, the National Roads Authority and the Highways Agency. A key benefit of the approach is its ability to deliver quickly with work able to start on site in early 2012 (see Appendix B).

The proposed approach is to establish an integrated delivery team comprising a consultant that will be responsible for progressing the project through the statutory procedures (currently being undertaken by Mouchel) supported by contractor-led teams that will be responsible for detailed design and construction following a successful Public Inquiry.

The proposal includes dividing the A5 WTC into three similar sized contract packages (see Appendix D) to establish a good balance between level of competition, use of available resources and complexity of the contractual and physical interfaces.

The main contract would be taken forward in two phases with a clear break point at the end of the statutory procedures when an economic appraisal report would be submitted to DFP before progressing to the construction phase. It will be based on the NEC3 Option C - a target cost approach that will involve open-book accounting procedures. Additional project-wide incentives will be developed to encourage the contractors to co-operate with one another over the full duration of the A5 WTC project (see Appendix C).

3.0 Background

3.1 Project Background

In recent years several plans have been published detailing a growing level of investment in Northern Ireland's roads infrastructure, including:

- In March 2005, the Regional Strategic Transport Network Transport Plan, which led to the £1bn Strategic Road Improvement (SRI) programme; and

- In December 2005, the Investment Strategy for Northern Ireland (ISNI), which resulted in a proposed £400m expansion of the SRI plan.

Both of these strategic documents have identified proposed improvements to the A5 between Aughnacloy and Londonderry, as part of the development programme for the Western Key Transport Corridor.

On 23rd January 2007 the Irish Government announced the new National Development Plan (NDP) 2007-2013 which contained proposals for considerable Irish Government investment in North/South projects and initiatives for mutual benefit. This includes joint investment in new strategic projects and one of these is:

- the completion by 2013 of a high quality road network on the inter-urban route linking the major population centres of Dublin and the North West (especially the Letterkenny-Derry Gateway).

At the North/South Ministerial Council meeting held in Armagh in July 2007 the Council noted the Irish Government's Intention to make available £400 million to help fund major roads programmes providing dual carriageway standard on routes within Northern Ireland on the A5 Western Corridor and the A8 Eastern Seaboard Corridor (Belfast to Larne). The Northern Ireland Executive has confirmed its acceptance, in principle, to progressing these two major road projects.

The Programme for Government and Investment Strategy for Northern Ireland 2008-2018 were agreed by the Executive on 21 January 2008 and endorsed by the Assembly on 28 January 2008. The Department for Regional Development published its Investment Delivery Plan for Roads in April 2008 outlining a £3.1 billion programme of works envisaged under the Investment Strategy. At the core of this programme is the upgrade of the A5 Western Transport Corridor. At over 80 km in length the dualling of the A5 is the largest road project ever to be undertaken on the Island of Ireland.

3.2 Funding

Funding for this project is derived from two sources. Both the UK and Irish governments have committed investment through separate plans. The Strategic Road Improvement (SRI) programme derived from the Regional Strategic Transport Network Transport Plan and supplemented by the Investment Strategy for Northern Ireland (ISNI) forms the vehicle for committed funds from the UK government.

The NDP 2007-2013 commits funding from the Irish government for this scheme. This was reflected in the *2007 Pre-Budget Report and Comprehensive Spending Review* of October 2007, which referred to the announcement of the peace dividend package, a key feature of which is the development of the all island economy, including an additional £400 million provided by the Irish Government to promote better road links between Northern Ireland and the Republic of Ireland (ROI). A number of key project milestones (see 4.2) have been established and the ROI funding will be aligned with the achievement of these milestones.

4.0 Aims and Constraints

4.1 Vision, Aims and Objectives

The A5 WTC study area is given in Figure 1. The A5 shown in the figure represents the extent of the scheme, which is from Londonderry to Aughnacloy. Border crossings are not part of the A5 WTC project brief.

The A5 WTC vision is: *'A first-class and affordable A5 corridor upgrade delivered safely and sustainably through effective partnerships and project excellence'.* Linked to this vision, the core aims and objectives for the A5 WTC are listed below:

1. NIRS Satisfaction with the Product - the product is a dual carriageway upgrade along the length of the current A5 route that maximises performance against highway investment criteria (environment, economy, safety, accessibility, and integration).

2. NIRS Satisfaction with the Service - the service is the service received from the delivery team during the design and construction of the project (including risk management, supply chain management and communications).

3. Delivery to Budget - the project is currently valued within the range of £650 million to £850 million.

4. Delivery to programme - the current key programme dates are:

- Preferred Corridor — Late 2008
- Preferred Route Announcement — Mid 2009
- Draft Orders — Late 2010
- Start on Site — 2012
- Open to Traffic — 2015

5. Excellent Health and Safety - including safety of the workforce and public during construction and workforce welfare.

6. Sustainable Delivery - excellent standards of sustainable planning and environmental management during construction.

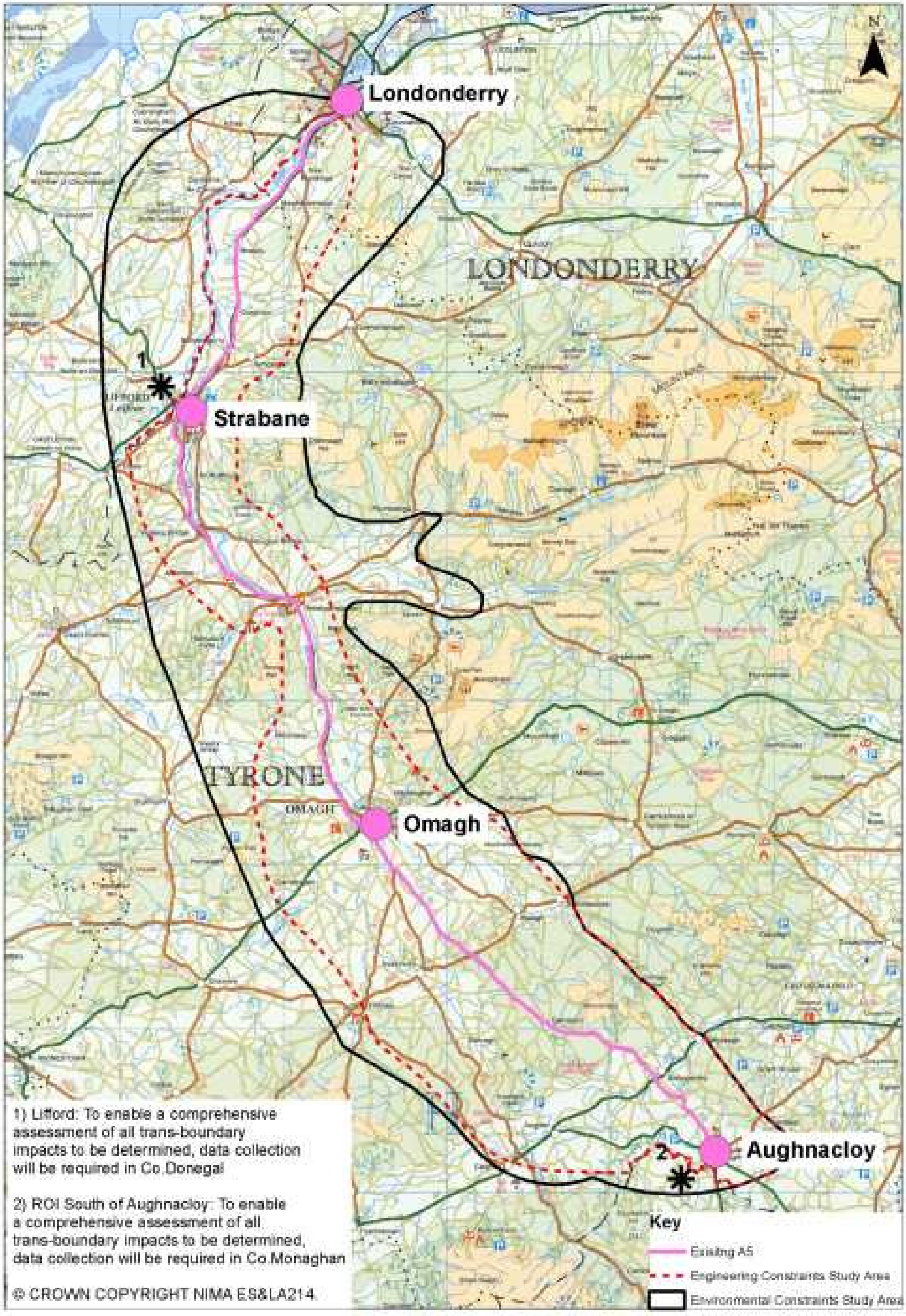

Figure 1 - A5 WTC Study Area

4.2 Priorities and Constraints

The following priorities and constraints have been taken into account in strategy development:

1. Rapid delivery is a high priority requirement to align delivery to the timetable outlined in the Republic of Ireland's NDP. Failure to meet the NDP timetable may result in the loss of the £400m contribution from the Republic of Ireland.

2. The development timetable (4.1) is particularly challenging and will require a significant reduction on the time typically taken (six years) to bring a major road scheme to the point of construction.

3. The procurement strategy options must build upon central and local government best practice in the delivery of major highway improvements.

4.3 Statutory Process

A major risk to delivery and influence on the procurement strategy is the Public Inquiry process.

The programme does not provide time for separate and consecutive Public Inquiries for sections of the A5 WTC. Separate and concurrent Public Inquiries for different sections of the A5 route would be very difficult to co-ordinate and control and could lead to consistency issues and an argument could be made that the inquires should be heard together as the route is being developed and justified as a whole. Whereas a large single inquiry would carries the risk of the whole project being delayed if problems were to arise.

On balance, NIRS has been decided that the best approach to satisfy the key priorities and constraints (see 4.2) will be to undertake one Public Inquiry for the full A5 WTC. This will involve the same team (and inspector) moving to hear evidence at different venues along the route. This decision must be taken into account in the selection of the procurement strategy.

5.0 Current Progress

5.1 Milestone Delivery

The Preliminary Options Report for the A5 project was completed on schedule and was formally announced by the Minister for Regional Development on 7 November 2008.

The next key milestone is the Preferred Route Announcement in mid-2009 followed by draft Order publication in late 2010 leading to a start on site in early 2012.

5.2 A5 WTC Spend Profile

The latest spend profile is given in Table 1 below, it shows that less than 4% of the overall project value will be spent before the project passes through to detailed design and construction. Most of the fees up to the end of milestone 4 will be for Mouchel's services (direct and sub-consulted). A small proportion will be for contractor support of the statutory process in line with the recommended procurement strategy.

Table 1
A5 WTC Spend Profile (October 2008 Update)*

Milestone	Date	Total Spend, £	% Total
1. Preferred Corridor SAR1	Oct 2008	**£6,239,617**	0.8
2. Preferred Route Announcement SAR 2	Jul 2009	**£10,192,430**	1.4
Phase 1 of the IDT contracts commences between these milestones			
3. Publish Draft Orders SAR 3	Aug 2010	**£19,600,577**	2.6
4. Vesting of Land	Oct 2011	**£29,577,393**	3.9
Phase 2 of the IDT contracts commences between these milestones			
5. Commence Construction	Feb 2012	**£50,501,450**	6.7
6. Mid-construction	Oct 2013	**£455,457,113**	60.7
7. Complete construction	Mar 2015	**£743,525,073**	99.0
8. Realisation of outstanding lands costs	Jun 2016	**£750,663,134**	100.0

* Funding from the ROI will be aligned to key milestones, i.e., by October 2011 four payments will have been received from the ROI.

6.0 Procurement Strategy Development

6.1 Option Development and Initial Appraisal

Based on current industry practices, best practice advice and government policy, four main procurement options were identified for delivery of the A5 WTC:

- Option 1 - Integrated Delivery Teams leading the design and statutory processes (IDT-A);
- Option 2 - Integrated Delivery Teams supporting the design and statutory processes (IDT-B);
- Option 3 - Fast-track Design and Build (FD&B);
- Option 4 - Design, Build, Finance and Operate (DBFO)

These options are described in more detail in Appendix A. An initial review identified the key milestones and potential delivery timescales for each option, which is presented in the Appendix B flow-chart. Following this initial appraisal work it was clear that the DBFO option would not be suitable for the delivery of the A5 WTC for two primary key reasons:

- It did not meet with the clear priority for rapid delivery. The earliest possible start on site is October 2013, which is beyond the current ROI NDP period. However, the DBFO option requires substantial time for consultation with the industry, preparation of specialist reports, and negotiations which could easily lead to significant slippage to this timescale.
- The accounting treatment and financial profile for DBFO would be different to that required under a conventional procurement. This is incompatible with, and may affect, the ROI Government funding.

The options being considered and the results of the initial review work were discussed with the SIB and, as a result, the DBFO option was discounted on the above grounds.

6.2 Preferred Option Selection

Following the initial review, which ruled out the DBFO option, the remaining options were appraised to determine which approach is most likely to delivery value for money, i.e., ’the full achievement of the A5 WTC aims for a minimal affordable cost’.

The likelihood of the procurement options delivering the aims and priorities outlined in section 4.0 was considered. From this appraisal it was found that the Integrated Delivery Team options were most likely to deliver the full range of A5 WTC project aims compared to the FD&B option. Key advantages of the proposed integrated approach over design and build include:

- The design can be informed by the knowledge and experience of contractors and key supply chain partners prior to being constrained by the draft Orders and Environmental Statement;

- There is more time for the contractor to plan, recruit, motivate and retain the best team and to plan and source the necessary labour, plant and materials;

- There is more time to plan ahead and to address buildability requirements, which promotes safe delivery and a 'right first time' approach during construction;

- There is more time to assess construction risks, mitigate the consequences and agree the optimal allocation of risks in the construction phase;

- NIRS has more time to assess proposed value engineering, and to approve any necessary departures from standards;

- Over the course of the project there are greater opportunities for strong relationships and understanding to be built within the team;

- As part of the integrated team, the contractors can become involved earlier in developing relationships with the local communities that can help to minimise scheme objections and programme risk; and

- The Contractor has substantial time to develop the Health and Safety Plan for the construction stage.

Of the integrated delivery team approaches IDT-B was selected as the preferred option for two main reasons:

- It is more compatible with a single route Public Inquiry. IDT-A is not as well suited to a single route Public Inquiry because a number of different suppliers would take lead responsibility for developing and progressing their section of the project. Applying the IDT-A strategy in conjunction with a single contract would resolve this problem but it would also eliminate the opportunity to benchmark costs between suppliers and maintain a degree of competitive tension post-award.

- It is a faster procurement route, which satisfies with the top priority of rapid delivery.

A market soundings exercise was held over the summer of 2008 during the finalisation of the preferred option. The market feedback suggests that the construction industry will find the A5 WTC project very attractive and would support the integrated delivery team approach that has been developed.

6.3 Contract Packages

The market soundings exercise suggested that the work should be packaged to provide a number of opportunities to the industry. The potentially increased competition pre-award and competitive tension post-award from a greater number of contract packages needs to be set against the greater complexity arising from a higher number of contractual and physical interfaces. This balance has been considered and, in overall terms, NIRS consider that three works contracts will provide the best balance between competition and interface complexity.

The characteristics of the three sections that have been selected to develop a good balance between engineering characteristics, interface issues and contract value are given in Appendix D.

Appendix A Main Procurement Options

A.1 Option 1 – Integrated Delivery Teams Leading the Design and Statutory Processes (IDT-A)

For each A5 contract package Integrated Delivery Teams (IDT) would be appointed to undertake design development, the statutory procedures (including the Public Inquiry) detailed design and construction. Ideally, these contracts would be awarded around the time of the Preferred Route Announcement to allow a reasonable period for handover and mobilisation before draft Order publication.

Each package would be awarded to a different IDT organisation, which would comprise a contractor (single firm or JV), designers and key supply chain partners. The IDT would be required to have all of the skills and competence needed to deliver a successful outcome for their contract package. One of the IDT's would be appointed to co-ordinate the overall approach to the statutory process and Public Inquiry.

Following IDT appointment NIRS would be supported by Mouchel in a Client Advisor role, which would include overall programme management, project controls, contract management and ensuring consistency of engineering standards along the A5 route. The IDT organisation would be expected to deliver in partnership with NIRS. Incentives would be developed to encourage collaboration between the separate IDTs.

A.2 Option 2 – Integrated Delivery Teams Supporting the Design and Statutory Processes (IDT- B)

Under this option Mouchel would undertake design development and the statutory procedures up to and including the Public Inquiry. For each A5 contract package Integrated Delivery Teams (IDT) would be appointed to support Mouchel during this process and to begin to plan delivery. Following a favourable decision the IDT organisations would take responsibility for detailed design and construction.

The IDT contracts would be awarded around the time of the Preferred Route Announcement, the supporting role requiring much less input than IDT Option A up to the publication of the inspector's decision. Each package would be awarded to a different IDT organisation, which would comprise a contractor (single firm or JV), designers and key supply chain partners. The IDT would be required to have all of the skills and competence needed to deliver a successful outcome for their contract package.

Following transfer of design responsibility to the IDT organisations NIRS would be supported by Mouchel in a Client Advisor role, which would include contract management. The IDT organisation would be expected to deliver partnership with NIRS. Incentives would be developed to encourage collaboration between the separate IDTs.

A.3 Option 3 – Fast-track Design and Build (FD&B)

Under this option Mouchel would undertake design development and the statutory procedures up to an including the Public Inquiry and confirmation of Orders. The fast-track design and build (FD&B) team would comprise a contractor (single firm or JV) and designer that would have all of the skills and competence finalise design and construct the project. The FD&B team would be appointed after the statutory processes were completed but, to save time, the OJEU procedures would be started before the inspector's decision. NIRS would be supported by Mouchel as Employer's Agent, undertaking a contract management and administration function.

This option has no early contractor involvement element, but it may be possible to involve a contractor during the early scheme preparation stage to provide advice on construction methods that can be taken into account in the design. However, this contractor would normally be excluded from the subsequent D&B competition, so interest in this role is likely to be limited. In addition, the contractor's incentive to use the best people to find the most effective solution would be limited.

A.4 Option 4 – Design, Build, Finance and Operate (DBFO)

The Design, Build, Finance and Operate (DBFO) option is based on established practices for major highways PFIs. The following assumptions have been made for the purposes of considering the potential timescales for this option:

- Mouchel would undertake design development and the statutory procedures up to and including the Public Inquiry and confirmation of Orders;
- The DBFO competition would start after a positive inspector's decision is received and a (short) industry consultation exercise has been completed;
- Payments to the DBFO contractor would be funded by Government on an availability charge basis and not through real tolls which would require different statutory procedures;
- DBFO tenders would be progressed largely on the basis of an output specification with tender documents prepared by Mouchel;
- Competitive Dialogue would be used to confirm NIRS's requirements and the DBFO bidders would be invited to submit tenders based on these requirements;
- Appointment of a preferred bidder would be followed by a Funding Competition.
- Following the outcome of the funding competition the DBFO contract could be awarded, the design completed and the scheme constructed.

Appendix B Comparison of Procurement Routes (Including Key Dates)

A5 WTC - Comparison of Procurement Routes

Team Roles and Programme for Procurement Options

Process & Key Target Dates	Identify Preferred Route Mid-2009	→	Publish Draft Orders and ES Late-2010	→ Public Inquiry and Confirm Orders	→	Detailed Design	→	Construction Period 2012 to 2015
IDT – A	Consultant (Mouchel) responsible Jul 2009	IDT Appointed Aug 2009	IDT responsible, Consultant is Employer's Agent Oct 2010	IDT responsible, Consultant is Employer's Agent Jan 2012		IDT responsible, Consultant is Employer's Agent	Start on Site May 2012	IDT responsible, Consultant is Employer's Agent 2012 to 2015
IDT – B	Consultant (Mouchel) responsible Jul 2009	IDT Appointed Oct 2009	Consultant responsible, IDT supports process Aug 2010	Consultant responsible, IDT supports PI Oct 2011		IDT responsible, Consultant is Employer's Agent	Start on Site Feb 2012	IDT responsible, Consultant is Employer's Agent 2012 to 2015
FD&B	Consultant (Mouchel) responsible Jul 2009		Consultant responsible, contractor input minimal Aug 2010	Consultant responsible, minimal contractor input at PI Oct 2011	FD&B Appointed Apr 2012	FD&B responsible, Consultant is Employer's Agent	Start on Site Nov 2012	FD&B responsible, Consultant is Employer's Agent 2012 to 2015
DBFO	Consultant (Mouchel) responsible Jul 2009		Consultant responsible, contractor input minimal Aug 2010	Consultant responsible, minimal contractor input at PI Oct 2011	FD&B Appointed Jul 2013	DBFO responsible	Start on Site Oct 2013	DBFO responsible and for 25+years maintenance 2013 to 2016

Appendix C IDT B Summary of Approach

IDT B – Summary

Delivery process, key dates, team roles and the proposed approach to delivering value for money with budget

Process & Target Dates	Identify Preferred Route Mid-2009 → Publish Draft Orders and ES Late-2010 → Public Inquiry and Confirm Orders → Detailed Design → Construction Period 2012 to 2015
Team Roles & Planned Dates	Consultant (Mouchel) responsible Jul 2009; IDT Appointed Oct 2009; IDT responsible, Consultant is Employer's Agent Aug 2010; Consultant responsible, IDT supports PI Oct 2011; Proceed to Construction; IDT responsible, Consultant is Employer's Agent; Start on Site Feb 2012; IDT responsible, Consultant is Employer's Agent 2012 to 2015
Contract Award	**Contract Award** Three different contractors will be selected to take forward three similar sized schemes that make up the A5 WTC. This may be achieved with a single competition. Pre-award 'competitive tension' will be achieved against Award Criteria that will drive a successful project outcome. Early selection (see timing above) will be on the basis of the most economically advantageous offer. Award Criteria will be based on supplier quality (people, processes and partnering) and commercial information that will be used to assess the tender price. This will include staff rates (used up to 'Proceed to Construction'); direct fee percentage and sub-contract fee percentage and other pricing information. Post-Contract award the tendered commercial information will be used as the basis for developing a target price (using an activity schedule). The target price mechanism will encourage individual contractors to develop efficient solutions. Co-operation between the contractors will be encouraged by introducing a group incentive to deliver the A5 WTC within budget
Phase 1	**Contract Award to Proceed to Construction** Payment during this phase will be made on the basis of tendered staff rates on an NEC3 Option E profession services type arrangement (contract incentives and resource approvals control costs) The contractor works as part of the team to optimise the scheme that is taken through the statutory processes and commences planning and establishing the necessary supply chain. The contractor's role is to assist Mouchel in the development of a scheme design that will be most easily and efficiently constructed - they will not lead the scheme development process. The contractor develops a construction target cost during this phase, which is based information and methodologies contained within his tender submission and will be closely examined and challenged by the Roads Service's cost advisors. Following a positive outcome to the Public Inquiry, and agreement of the target price, the Roads Service issues a notification allowing the contractor to proceed to construction (a break point will exist in the Contract that can be exercised at will and the Contract will not proceed unless these conditions are met). The early appointments facilitate rapid delivery by enabling work to start on site soon after a positive Public Inquiry.
Phase 2	**Construction** The target cost mechanism maintains downward pressure on costs and the NEC3 contract requires competitive market procedures to be used for sub-contracting and materials purchases. Ongoing cost challenge and monitoring by the Roads Service's cost advisers will provide auditable assurance that value for money is being achieved. The use of three contracts will allow the Roads Service's cost advisers to 'internally benchmark' the contractor's prices against each other, which helps to maintain commercial tension. A final incentive payment will be made to each contractor based on a comparison of the total project cost (three construction out-turns plus all other costs covered by the budget) with the Roads Service's budget figure. This incentivises the contractors to form a co-operative alliance and to share ideas, resources and suppliers.

Appendix D Contract Package Characteristics

Characteristic	Contract Package		
	Section 1 **New Buildings to South of Strabane**	**Section 2** **South of Strabane to South of Omagh**	**Section 3** **South of Omagh to Aughnacloy**
Length	21 - 25km (depending on option)	33 - 34km (depending on option)	31 - 36km (depending on option)
Cross Section	2 x 7.3m + central reserve and hardstrips, 1 in 3 earthworks slopes		
Approx. Contract Value	£226M	£239M	£222M
Main Watercourse Crossings	1 x 70m span, 3 x 30m span approx All crossings relatively square	110m span (heavy skew); 70m, 50m, 30m and 20m spans (all generally square)	3 major (30-70m); 6 minor (<30m)
Junctions	Approx 4 Grade Separated Junctions	Approx 5 Grade Separated Junctions	Approx 4 grade separated junctions
Road Crossings	2 no. B roads Approximately 20 minor roads Initial assumption that 90% of side roads will be kept online requiring an under/overbridge structure	1 No A class road, 5 no. B class roads Approximately 30 minor roads Initial assumption that 90% of side roads will be kept online requiring an under/overbridge structure	2 No A class roads, 5 No B class roads, 28 No minor roads. Initial assumption that 90% of side roads will be kept online requiring an under/overbridge structure
Other Structures	West – elevated road due to floodplain, up to 10km in length East – significant cut, potential tunnel 1km in length	Possible 500m long viaduct north side of Clady Hill (western route) otherwise typical earthworks.	
Ground Conditions	West – Glacial Fluvial, Peat, Bog East – Likely to be rock	Glacial/ fluvial between Ardstraw and Newtownstewart. Widespread gravel north of Ardstraw. Drumlins common around of Omagh – poor ground in between.	North and south – drumlin topography with peat/bog infill; Knockmany Ridge – likely to be rock
Topography	West – predominantly floodplain East – Undulating, foothills of Sperrins	Rising steeply from river valleys to the west, undulating	
Stats	Fibre Optic – diversion required 110kv crossed up to 5 times	Fibre optic cable along existing A5 corridor.	Fibre optic cable along existing A5 corridor.
Properties	Up to 20 requiring acquisition	Approx 20 requiring acquisition	Minimum of 13 to be acquired
Tie-ins to ROI	Southwest of Strabane. Links to proposed upgrades of N14 and N15. Border crossing of River Finn may require major structure to facilitate u-turn for emergency services (PSNI and Gardai)	n/a	South of Aughnacloy. Will link with existing/proposed N2 to Dublin. Border crossing of River Blackwater will require major structure to facilitate u-turn for emergency services (PSNI and Gardai)

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