Department for Infrastructure (DfI)

A29 Cookstown Bypass

Stage 3 Scheme Assessment Report

718314-0000-R-022
October 2024

Public

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Stage 3 Scheme Assessment Report

Public

Project No. 718314

Our Ref. No. 718314-0000-R-022

Date: October 2024

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Quality control

Issue/revision	Revision 1	Revision 2	Revision 3
Remarks	SAR3 Report – October 2024		
Date	11/10/2024		
Prepared by	*Various design team*		
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Authorised by	Chris Barrett		
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Project number	718314		
Report number	718314-0000-R-022		
File reference	\\uk.wspgroup.com\central data\Projects\62241xxx\62241420 - A29 CIS\01 Manage\07 PM\09 Reports\718314-0000-R-0022 SAR3		

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About the Department for Infrastructure

The Department for Infrastructure (DfI) (formerly TransportNI and Roads Service) plays a significant role in facilitating the safe and convenient movement of people and goods throughout the province and the safety of road users, through the delivery of road maintenance services and the management and development of the transport network. It also informs the Department's policy development process to ensure that measures to encourage safe and sustainable travel are practical and can be delivered.

DfI's purpose statement is: 'Every day connecting people safely, supporting opportunities and creating sustainable living places.'

DfI is responsible for the maintenance of over 25,000km of public roads together with about 9,700km of footways, 5,800 bridges, 271,000 street lights and 51 Park & Ride/Park & Share (P&R/P&S) public car parks. It also has responsibility for the development of the transport network and a range of transport projects designed to improve network safety, sustainability and efficiency.

The key objectives of DfI 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 DfI.
- work constructively with DfI's key stakeholders to support the delivery of high-quality services.
- develop DfI's capacity and capability to meet objectives.
- ensure effective management of DfI's budget, assets, and corporate governance arrangements.

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Executive Summary

This report summarises the Design Manual for Roads and Bridges (DMRB) Stage 3 Scheme Assessment for the A29 Cookstown Bypass. This report presents the advantages and disadvantages of DfI Roads preferred scheme route option in environmental, engineering, economic, and traffic terms.

In accordance with the requirements of the DMRB, the Stage 3 assessment has been structured into two distinct parts, with this report representing **Part 2**:

- **Part 1** (the Environmental Impact Assessment Report); and
- **Part 2** (the Engineering, Traffic and Economic Assessment Report).

The A29 is a strategic route corridor extending from Coleraine to Armagh and travels directly through Cookstown town centre, carrying the regional traffic flow generated on the west side of Lough Neagh on a north-south route corridor. The town is a major thoroughfare for strategic traffic and local traffic journeys, resulting in significant congestion and delays.

To relieve this, a new 3.9km bypass has been proposed on the eastern corridor of Cookstown from the A29 Loughry Roundabout in the south to the A29 Moneymore Road in the north with new roundabouts situated at intersections with the Killymoon Road, Cloghog Road and Moneymore Road. Overbridges are also proposed at Coagh Road and Old Coagh Road with walking and cycling facilities incorporated along the full extent of the Bypass to enhance the sustainability of the project.

There are also carriageway improvement works proposed on the Sandholes Link Road to improve connectivity for strategic traffic from the A29 Loughry Roundabout to the A505 Drum Road. A new shared use footway/cycleway is also proposed on Sandholes Link Road which would provide improved access to nearby residential and industrial estates.

The A29 Cookstown Bypass project specific Scheme Objectives aim to:

- Relieve traffic congestion within Cookstown.
- Reduce journey travel times along the A29 corridor.
- Improve the road network between the north and south of the Province.
- Improve road safety.
- Improve the quality of life for the majority of residents.
- Improve the town centre environment.
- Minimise the impact on the natural and built environment.
- Enhance the economic growth of the area.
- Achieve value for money as demonstrated through a net positive return on investment.

Prior to the current stage of the scheme, the Stage 1 and Stage 2 assessments were completed and concluded the following:

Stage 1: The Stage 1 SAR concluded that alternative bypass route options within the eastern corridor including improvements to the Sandholes Link Road were to be developed and assessed at Stage 2.

Stage 2: The Stage 2 SAR (revised in 2020) was undertaken and considered four options: Red Route, Green Route, Purple A Route and Purple B Route. It recommended that the Purple A route option along with Sandholes Link Road improvements was taken forward as the Preferred Route and assessed further at Stage 3.

The Stage 3 scheme proposals were developed through a series of iterations to refine and optimise the design with further considerations given to road safety, climate change, active travel, alignment optimisation, statutory bodies (including statutory undertakers) and affected landowners. This has resulted in forming a 'specimen design' and evolution of the Preferred Route typical cross-section consisting of:

- WS2+1 type carriageway separated by four roundabouts with various overtaking opportunities in sections of the mainline;
- A 3.0m combined cycleway / footway along the mainline;
- 2.5m verges either side of the carriageway;
- 1.0m hard strips either side of the carriageway; and
- Where possible, a minimum 3.0m wide maintenance strip.

The Preferred Route has evolved from Stage 2 to Stage 3 with the following key changes:

- Upgrade of Active Travel provisions;
- Upgrade of Loughry Roundabout to include an additional arm and realignment on the Tullywiggan Road;
- Realignment of the Fairy Burn;
- Proposed Otter Lodge restaurant flood defence wall;
- Proposed retaining walls at Planning Development Boundary and Ballinderry River;
- Removal of retaining wall at Waste Water Treatment Works (WWTW);
- Proposed Killymoon Roundabout and the provision of link road to properties on Castle Road on the eastern side of the Bypass;
- Adjustment of Bypass further west between Cloghog Road and Old Coagh Road;
- Addition of segregated left turn lane at Moneymore Roundabout;
- Two roundabouts at Sandholes Link Road proposed with smaller Inscribed Circle Diameter (ICD);
- Addition of drainage attenuation ponds and swale features;
- Provision of two pedestrian overbridges at Killymoon Roundabout and Moneymore Roundabout.
- Provision of two underpasses to future proof potential greenway routes;
- Provision of toucan crossing point on Bypass adjacent to Loughry Roundabout

Separately to Sandholes Link Road, the Bypass proposes four side road adjustments:

- Clare Lane corner realignment;
- Coagh Road;
- Old Coagh Road; and
- Closure of Tamlaghtmore Road (north) junction with A29 Moneymore Road and adjacent central reservation gap.

The geometric design of the Bypass, its junctions with the existing road network, and the improvement scheme to the existing Sandholes Road have been undertaken in accordance with DMRB standards. However, due to the significantly constrained nature of the scheme study area, Departures and Relaxations from Standard have been identified to ensure a balanced design, reduce the extent of works, thereby minimising the impact on neighbouring properties.

Public utilities impacted by the Proposed Scheme include BT Apparatus, NIW Apparatus, NIE Apparatus and SGN Apparatus. These services are affected where the Bypass crosses the existing road network and will require minor diversionary works.

The Mainline requires a total of eighteen primary structures, which will incorporate footway/cycleway overbridges, underpasses to facilitate livestock and greenway purposes various culverts/ retaining structures and a flood protection wall. Sandholes Link Road will also require provision of several retaining structures and alterations to an existing culvert.

Extensive geotechnical investigations were undertaken to inform the design. The existing geotechnical ground conditions indicate that the cohesive glacial deposits on site will provide suitable founding strata for the Bypass embankments, with some ground improvements and slope strengthening measures also likely being required.

The drainage system has been designed to drain, attenuate, and treat the Bypass and side roads in accordance with DMRB guidance and sustainable drainage best practice. The design consists of Sustainable Drainage Systems (SuDs) in the form of retention ponds and swales, filter drains and grassed ditches, grassed surface water channels and combined kerb drainage systems. Additionally, the Stage 3 Flood Risk Assessment indicates that the impact of the Proposed Scheme is deemed overall neutral significance and low risk with appropriate mitigation measures in place.

The Traffic Assessment indicates that the Proposed Scheme will result in reduced journey times between Moneymore Road and Dungannon Road via the Bypass by more than 50%. Secondary and incidental routes in the surrounding areas would also benefit from reduced journey times upon completion of the Bypass.

Accident savings are predicted to range between £12-£14 million with approximately 400 fewer accidents and 500 fewer casualties predicted over 60 years.

Detailed cost estimates for the Proposed Scheme were developed at Stage 3 and indicated a total scheme cost of approximately £70 million.

The SAR3 economic assessment confirmed the SAR2 findings remain valid, and the Proposed Scheme continues to offer high value for money with a Benefit Cost Ratio of 3.98. The scheme is forecast to generate significant levels of users benefits with a Present Value Benefit ranging between £117-£151 million. The overall Net Present Value for the Core Scenario is approximately £102 million and between the demand scenarios, the Net Present Value ranges from £83-£117 million.

Following the Stage 3 assessment it is recommended that the Proposed Scheme be taken forward through to the next Statutory Orders publication stage.

Glossary

A5WTC	A5 Western Transport Corridor in the Regional Transportation Strategy for Northern Ireland
AAV	Aggregate Abrasion Value
AADT	Annual Average Daily Traffic
AC	Asphalt Concrete
AEP	Annual Exceedance Probability
AM	Before noon
AMCB	Analysis of Monetised Costs and Benefits
AOD	Above Ordnance Datum, height above the Ordnance Datum
Approx.	Approximately
ASSI	Area of Special Scientific Interest
AST	Appraisal Summary Table
ATC	Automatic Traffic Counter
BCIS	The Building Cost Information Service is an estimating expenditure tool which helps facility managers and surveyors find maintenance and operating costs
BCR	Benefit to Cost Ratio
bgl	below ground level
BT	British Telecommunications
Bypass	The proposed A29 Cookstown Bypass
C753	Manual published by CIRIA in December 2015 covers the planning, design, construction, and maintenance of Sustainable Drainage Systems (SuDS)
C786	Manual published by CIRIA in December 2019 covers the design and operation of culverts, screens and outfalls

CAP	Cookstown Area Plan 2010, a development plan for the Cookstown area prepared under the provisions of Part III of the Planning (Northern Ireland) Order 1991 by the Planning Service, an Agency within the Department of the Environment
CBGM	Cement Bound Granular Material
CBR	California Bearing Ratio
CC	Climate Change
CCTV	Closed Circuit Television
CD 109 Revision 1	DMRB CD 109 Revision 1 published by Highways England in March 2020 sets out the design requirements and advice to be used when developing the design of a highway / road link.
CD 224 Revision 0	DMRB CD 224 Revision 0 published by Highways England in March 2020 sets out the method for calculating traffic loading for the design of road pavements
CD 225 Revision 1	DMRB CD 225 Revision 1 published by Highways England in April 2020 sets out the design procedure for pavement foundations
CD 227 Revision 0	DMRB CD 227 Revision 0 published by Highways England in March 2020 describes the design requirements for pavement maintenance
CD 236 Revision 4.1.0	DMRB CD 234 Revision 4.1.0 published by National Highways in December 2022 sets out the design requirements for pavement surfacing for both flexible and rigid pavements
CD 239 Revision 1	DMRB CD 239 Revision 1 published by Highways England in March 2020 sets out the requirements for new footway and cycleway pavement construction
CD 356 Revision 1	DMRB CD 356 Revision 1 published by Highways England in March 2020 sets out the design requirements of highway structures for hydraulic action
CD 522 Revision 0	DMRB CD 522 Revision 0 published by Highways England in March 2020 sets out requirements for drainage of runoff from natural catchments
CD 529 Revision 1.0.1	DMRB CD 529 Revision 1.0.1 published by Highways England in December 2021 sets out design requirements for the design of outfall and culvert details

CG 501 Revision 2.1.0	DMRB CG 501 Revision 2.1.0 published by National Highways in August 2022 sets out the design requirements of highway drainage systems
Ch.	Chainage
CIRIA	Construction Industry Research and Information Association
CKD units	Combined Kerb Drain units
cm	centimetres
COBALT	Cost and Benefit to Accidents – Light Touch, version 2.3, a DfT cost benefit analysis program that assesses the monetary benefits from accident savings
Cookstown Area Plan 2010	The Cookstown Area Plan 2010 is a development plan prepared under the provisions of the Planning Order 1991 (Northern Ireland) by the Planning Service, within the Department of the Environment
CPI	Car Park Interview surveys
CS 228 Revision 2	DMRB CS 228 Revision 2 published by Highways England in January 2021 describes the requirements for provision and management of appropriate levels of skid resistance
CV/Day	Commercial Vehicles per Day
DEM	Director of Engineering Memorandum
DEM182/20	Director of Engineering Memorandum dated September 2020, which makes amendments to *TD37/93*
Department	Department for Infrastructure, Northern Ireland government department in the Northern Ireland Executive
Departure	As per DMRB GG 101 Version 0.1.0, “Variation or waiving of a requirement carried out in accordance with the Overseeing Organisation’s procedures”
DfI	Department for Infrastructure, Northern Ireland government department in the Northern Ireland Executive
DfT	Department for Transport, United Kingdom government department
DM	Do-Minimum

DMRB	Design Manual for Roads and Bridges, Standards for Highways on behalf of the Overseeing Organisations of England, Northern Ireland, Scotland and Wales
DNOC	Distribution Network Operator Connection
DS	Do-Something
e.g.	For example
EIAR	Environmental Impact Assessment Report
EME2	Enrobés à Module Elevé Class 2
FC	Foundation Class
FRA	Flood Risk Assessment (718314-0500-R-0005, Version 4.0, February 2024)
GEH statistic	The GEH statistic is a formula used to compare traffic volumes
GHG	Greenhouse Gas emissions
GPS	Global Positioning System
Green Route	A preferred bypass route option, as described within the Stage 2 Scheme Assessment Report
H&S	Health and Safety
Ha	Hectares
HBM	Hydraulically Bound Material
HDM	Heavy-Duty Materials
HGV	Heavy Goods Vehicle
hr	hours
HRA	Hot Rolled Asphalt
i.e.	That is
ICD	Inscribed Circle Diameter
JTC	Junction Turning Count

km	kilometres
km^2	kilometre squared
LA 104 Revision 1	DMRB document LA 104 Revision 1 published by Highways England in August 2020 sets out the design requirements for environmental assessment of projects, including reporting and monitoring of significant adverse environmental effects
LA 113 Revision 1	DMRB document LA 113 Revision 1 published by Highways England in March 2020 sets out the design requirements for assessment and management of the impacts of road projects on the water environment
LGV	Light Goods Vehicle
LiLo	Left-in/Left-out junction, as defined by CD123 Revision 2.1.0
LMVR	Local Model Validation Report defined in Section 6.1.1 of this report
LNRS	Low Noise Road Surfacing
LPP	Local Policies Plan detailed in the Mid Ulster Local Development Plan 2030
LV / HV	Low voltage / High voltage underground ducts
m	metres
m^3	cubic metres
MCHW	Manual of Contracts for Highway Works
ME	Matrix Estimation
Mid Ulster Local Development Plan 2030	A Draft Plan comprising the Plan Strategy and Local Policies Plan to inform the general public, statutory authorities, developers and other interested bodies of the policy framework and land use proposals that will implement the strategic objectives of the Regional Development Strategy and guide development decisions within Mid Ulster District Council up to 2030
Min.	minimum
ML	The A29 Cookstown Bypass Mainline
mm	millimetres

MPa	Mega Pascal
mph	miles per hour
msa	million standard axles
N/A	Not Applicable
N2W2	Roads Restraint System – safety barrier
NI	Northern Ireland
NIE	Northern Ireland Energy networks
NIMDO	Notice of Intention to Make a Direction Order
NIMVO	Notice of Intention to Make a Vesting Orders
NIW	Northern Ireland Water service
NO_2	Nitrogen Dioxide
NPV	Net Present Value
O/Ds	Origin / Destinations
OSNI	Ordnance Survey of Northern Ireland road network database
PA	Public Accounts
PCC	Pre-Coated Chips
PCU	Passenger Car Unit
PED	Pre-earthwork drainage
PIA	Personal Injury Accidents
PM	After noon
PM_{10}	Particulate Matter, 10 micrometers or less in diameter
PPS 15	Planning Policy Statement 15; 'Planning and Flood Risk'
Preferred Route	The bypass route described within this Stage 3 Scheme Assessment Report. This was the Preferred Route (Purple A Route) from Stage 2, with additional changes, as described within Sections 1.3 and 2.5 of this report

The Project	The A29 Cookstown Bypass and Sandholes Link Road project
Proposed Scheme	The proposed A29 Cookstown Bypass and Sandholes Link Road, as described within this Stage 3 Scheme Assessment Report, including associated construction elements and environmental mitigation
PSV	Polished Stone Value
Purple A Route	This was the preferred bypass route option, as described within the Stage 2 Scheme Assessment Report
PVB	Present Value Benefits
PVC	Present Value Costs
RSI	Roadside Interview Surveys
SA	Small Area
SAC	Special Area of Conservation
SAR	Scheme Assessment Report, Scheme Assessment Reporting
SAR1	*See Stage 1 Scheme Assessment Report*
SAR2	See *Stage 2 Scheme Assessment Report*
SAR3	See *Stage 3 Scheme Assessment Report*
SATURN suite of software	Simulation and Assignment of Traffic to Urban Road Networks software for the analysis of minor network changes
Scheme Objectives	The specific objectives for the A29 Cookstown Bypass project, as defined in Section 1.2 of this report
SGN	Scotia Gas Networks
SHL	Sandholes Link Road
SLNCI	Site of Local Nature Conservation Importance
SOA	Super Output Area
SPT	Standard Penetration Test
SR	The affected side roads by the A29 Cookstown Bypass
SRI	Strategic Road Improvement

SSM	Surface Subgrade Modulus
Stage 1 Scheme Assessment Report	The initial stage to this report dated November 2008
Stage 2 Scheme Assessment Report	The previous stage to this report dated September 2021
Stage 3 Scheme Assessment Report	This report
SU2	A single carriageway for an urban all-purpose road, as defined by CD 127 as a road with two lanes of travel in the opposite direction.
SuDS	Sustainable Drainage Systems
SUPA	Stopping-Up of Private Access
TAG	Transport Analysis Guidance, UK Department for Transport guidance that provides information on the role of transport modelling and appraisal
TBC	To be confirmed
TSCS	Thin Surface Course System
TD37/93	DMRB document *Scheme Assessment Reporting*, August 1993
TEE	Transport Economy Efficiency
TEMPRO	Trip End Model Presentation Program model developed by the Development for Transport to prepare future forecasts of traffic growth
TM	Traffic Model
TUBA	Transport Users Benefit Appraisal
UK	United Kingdom
VAT	Value Added Tax
VfM	Value for Money

VOC	Vehicle Operating Costs
WS2+1	Wide Single 2+1 carriageway, as defined by CD 127 as a road with two lanes of travel in one direction and a single lane in the opposite direction.
WWTW	Wastewater Treatment Works, site of the wastewater and sewage treatment company in southeast Cookstown
°	Angle degrees
°C	degrees Celsius
%	percentage
£	The Great British Pound

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Part 1: Environmental Impact Assessment Report

Part 1: Environmental Impact Assessment Report

The Stage 3 Scheme Assessment Report (SAR3) is divided into two parts: the Environmental Impact Assessment Report (EIAR); and a report covering all other aspects of the assessment not covered in the EIAR.

The EIAR forms a separate part of the assessment report at this stage. Please see document reference 718314-3000-R-0003 for further details.

Part 2: All Other Aspects of Assessment

Part 2: All Other Aspects of Assessment

This part forms the main body of this report.

1 Introduction

1.1 Purpose of the report

This Stage 3 Scheme Assessments Report (SAR3) provides a summary of the Stage 3 assessments for the A29 Cookstown Bypass project and makes recommendations on the Preferred Route to be taken forward to the next stage.

This report has been compiled in line with the Design Manual for Roads and Bridges (DMRB) document TD37/93 – Scheme Assessment Reporting and DfI Director of Engineering Memorandum (DEM) in September 2020 DEM182/20, which retains its use in lieu of other standards for Scheme Assessment Reporting.

The TD37/93 states that the overarching aims of assessment reporting are to "*permit consideration of the likely environmental, economic and traffic effects of alternative proposals, and to allow the public and statutory bodies to comment on proposals taking account of their environmental, economic and traffic implications*".

TD37/93 also states that Stage 3 reporting specifically aims to "*identify clearly the advantages and disadvantages, in environmental, engineering, economic and traffic terms, of the Overseeing Department's Preferred Route or Scheme option.*"

SAR3 has been prepared in conjunction with the EIAR, the Notice of Intention to Make a Direction Order (NIMDO), the Notice of Intention to Make a Vesting Orders (NIMVO) and the Stopping-Up of Private Access (SUPA) Order. The EIAR constitutes Part One of this report and Part Two provides the engineering, traffic and economics of the Preferred Route.

1.2 Scheme Objectives

The following four criteria, as set out in the Transport Analysis Guidance (TAG), are the overarching main objectives for transport:

1. Economy - to support sustainable economic activity and achieve good value for money.
2. Environment - to protect the built and natural environment.
3. Social - to improve safety, accessibility, and integration.
4. Public Accounts - to consider the cost to the broad transport budget.

The A29 Cookstown Bypass project specific Scheme Objectives aim to:

- Relieve traffic congestion within Cookstown.
- Reduce journey travel times along the A29 corridor.
- Improve the road network between the north and south of the province.
- Improve road safety.
- Improve the quality of life for the majority of residents.
- Improve the town centre environment.

- Minimise the impact on the natural and built environment.
- Enhance the economic growth of the area.
- Achieve value for money as demonstrated through a net positive return on investment.

1.3 Stage 2 Scheme Assessment Report

The Stage 2 Scheme Assessment Report (SAR2) presented four route options for the Bypass all to the east of Cookstown, with an improvement option also provided for Sandholes Road, as shown in below Figure 1-1.

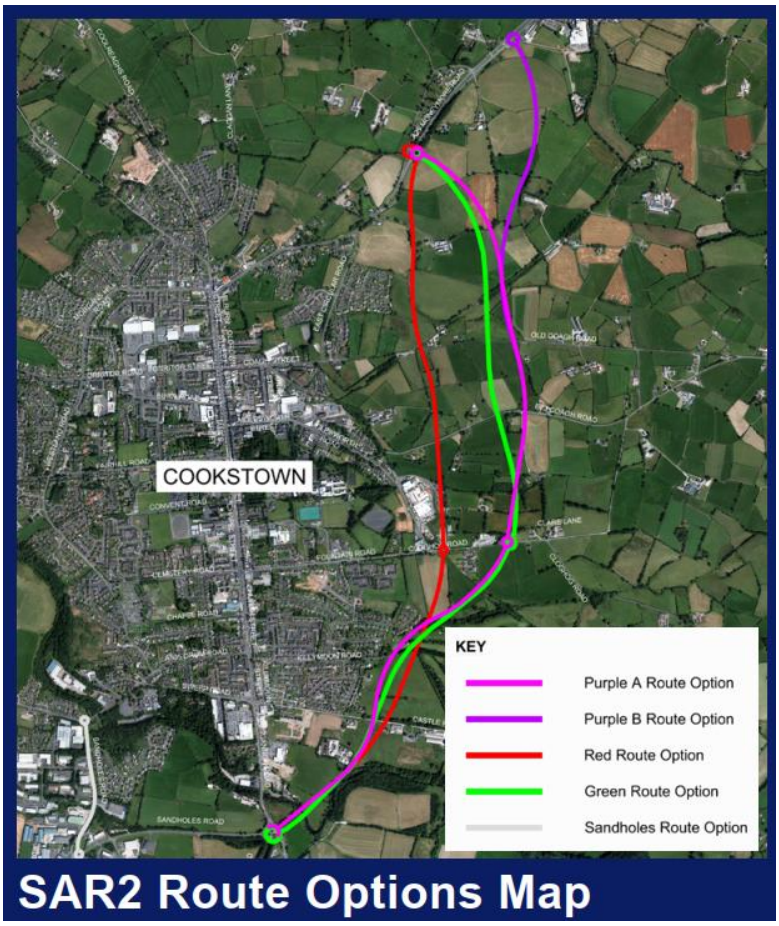


Figure 1-1 – Stage 2 Scheme Assessment Report Route Options Map, Public Exhibition Brochure December 2021

The Purple A Route option performed the best overall in terms of environment, social and public accounts, and ranked second in terms of economy, was deemed most favourable against the Scheme Objectives (Section 1.2) and therefore was taken forward as the Preferred Route.

SAR2 also recommended the continued assessment of those options that were not carried forward to explore further optimisations for the Preferred Route. Since the SAR2 was completed, additional improvements to Sandholes Link Road have also been identified.

2 Existing Conditions

2.1 Description

This section of the report provides an overview of the road network, engineering, environmental and traffic conditions that related to the existing A29 road corridor and describes the evolution of the Preferred Route since the SAR2 in September 2021.

2.2 Existing Road Network

2.2.1 Overview

The A29 is a trunk road with one lane in each direction, which travels directly through Cookstown town centre and carries the major regional traffic flow generated on the west side of Lough Neagh on a north-south route corridor. The A29 trunk road extends from Coleraine to Armagh, serving both strategic and local traffic around Cookstown. There are several principal roads that join the A29 in Cookstown, these include:

- A505 to Omagh
- B520 to Stewartstown
- B73 to Coagh
- B162 to Dungiven

There are several strategic roads in the vicinity of Cookstown, namely the A505 and the A29 as shown in below Figure 2-1.

Figure 2-1 – Cookstown Area Road Network

2.2.2 A29 Trunk Road

To the south of Cookstown, the A29 Dungannon Road is linked to Sandholes Road, serving industry to the southwest of the town, and the B520 Tullywiggan Road by a roundabout known as the Loughry Roundabout. The traffic speed at the roundabout is 40 miles per hour (mph).

On the A29 north of the roundabout, a speed limit of 30 mph is applied directly south of Kings Bridge which carries the A29 over the Ballinderry River. Retail outlets, commercial and residential properties border the A29 between the roundabout and the junction with Sweep Road and Castle Road. This section of the A29 consists of single carriageway approximately 8m wide with 2m wide footways on both sides of the road and there are ghost island junctions at the accesses of several of the retail and commercial properties.

From the junction with Sweep Road and Castle Road to the junction with Fairhill Road, the A29 consists of 12m wide single carriageway, with provision for on-street parking parallel to the kerb and footways on both sides of the road. There are wide footways on both sides of the road and pedestrian refuges opposite footway buildouts. Most of the land use along this section of road is residential, with some retail premises scattered throughout.

North of the junction with Fairhill Road, the A29 widens into two 8.5m wide carriageways, each with two traffic lanes, separated by a 1.5m wide hard central reservation. There is an additional 5m width of parking bays orientated perpendicular to the flow of traffic and 3.5m wide footways on both sides of the road. This section of the A29 passes through the town centre; it has several official names but is known locally as Main Street. Retail and commercial properties are located along both sides of the road.

From the junction with Orritor Street and Coagh Street, the A29 continues north towards a double mini-roundabout junction with Morgans Hill Road and Lissan Road. The carriageway cross-section reduces to a 12m wide single carriageway with on-street parking generally permitted parallel to the kerb and 4m wide footways on both sides of the road.

Beyond the junction of Morgans Hill Road and Lissan Road, the A29 Moneymore Road continues northeast through a residential area. The speed limit increases to 40mph in advance of a T-junction with the East Circular Road. The A29 then continues in a north easterly direction with the speed derestricted to the northeast of a lay-by on the south side of the road. Northeast of this, the speed is limited to 60mph and the A29 becomes a 3.5km section of rural dual carriageway with hard shoulders towards Moneymore.

The horizontal alignment of the A29 is virtually straight through the town centre and the vertical alignment is undulating, with an overall rise of 30.8m from 46.5m Above Ordnance Datum (AOD) at the Loughry Roundabout to 77.3m AOD at the junction with Morgans Hill Road and Lissan Road.

Crests are located directly north of the junction with the A505 Drum Road, at the junctions with Convent Road and Fairhill Road and between the junctions with Orritor Street and Coagh Street and Morgans Hill Road and Lissan Road. Northeast of the junction with Morgans Hill Road and Lissan Road, the A29 falls to approximately 55.0m AOD at the start of the dual carriageway.

2.2.3 Sandholes Link Road

Sandholes Road extends west of the Loughry Roundabout as a single carriageway with a 2.5m shared use footway/cycleway on the northern side of the road. Traffic speed is derestricted, reducing to 40mph outside Cookstown Free Presbyterian Church to the proposed Sandholes Roundabout.

Sandholes Link Road connects the east-west Sandholes Road to the A505 Drum Road, in a north-south direction. This road has a concentration of industrial units on the west side and a mixture of industry and residential properties on the east side. On the approach to the A505 Drum Road a 30mph speed restriction is applied.

Sandholes Link Road has a level of 60.0m AOD at the junction with Sandholes Road. The level reduces to 53.5m AOD forming a sag curve where the road crosses the culverted Fairy Burn watercourse. The road then rises to a crest of 63.2m AOD before falling back to a level of 55.0m AOD at the junction with the A505 Drum Road.

The A505 Drum Road crosses the Ballinderry River via the Derryloran Bridge between the A29 and the Sandholes Link Road. This bridge has been widened in recent years to provide a 7.3m wide carriageway with 2.0m wide footways either side.

Westland Road, located to the west of the A29, joins the A505 Drum Road in the south and the A29 Moneymore Road, via Morgans Hill Road, in the north. This route is a single carriageway with a footway on both sides and forms an alternative route through Cookstown for traffic travelling north-west, to and from Omagh, and for north–south traffic wishing to avoid the town centre. There is no similar route to the east of the town.

2.3 Existing Environmental Conditions

The EIAR (718314-3000-R-0003) forms Part One of this assessment report and provides substantial detail on the scheme area's existing population and human health, biodiversity, land, soil, water, air and climate, material assets, cultural heritage and the landscape, and the interaction between these factors.

This Section 2.3 only provides a brief overview of the Cookstown area, its climate, local hydrology, topography and land use, and reference should be made for the EIAR for more detailed environmental reporting and assessment.

2.3.1 Cookstown Area Overview

Cookstown is located approximately 40km west of Belfast and is in County Tyrone. The existing A29 runs north-south through the centre of Cookstown, acting as the main local and through-traffic distributor road for the town.

Cookstown had an estimated population of 12,550 in 2021. It plays an important regional role as an economic and employment centre, with retail and commercial interests predominantly focused along the A29 corridor.

Settlement is concentrated around the A29 corridor in the town, with the spread of the built-up area greater to the west of the A29, with many farmsteads and individual dwellings scattered throughout the surrounding countryside.

The A29 directly connects the regional settlements including Coleraine on the north coast through to (from north to south), Garvagh; Swatragh; Maghera; Tobermore; Desertmartin; Moneymore; Cookstown; Dungannon; Moy; Charlemont and Armagh.

Important ecological and wildlife habitats associated with the Ballinderry River and Killymoon Castle are ascribed national and local protection through Special Area of Conservation (SAC), Area of Special Scientific Interest (ASSI) and Site of Local Nature Conservation Importance (SLNCI) designations.

Cultural heritage interests of national significance include the statutorily protected Court Tomb (Scheduled Monument), Killymoon Castle (Historic Park, Garden and Demesne), and Old Derryloran Church (under State Care). Several other local and regionally important unscheduled monuments are also recorded.

Refer to Section 2.3.4 for further topography and land use information.

2.3.2 Climate

Records of monthly rainfall at the nearest Lough Fea weather station indicate that the area is slightly wetter than the UK average. Annual average rainfall across Northern Ireland varies from approximately 2,000mm around Killeter Forest (west of Tyrone) to 800mm south and east of Lough Neagh. On average, extreme rainfall events (rainfall exceeding 10mm) for the area occur for three days in the winter, and just over two days in the summer.

Northern Ireland is slightly cooler than the UK average temperature in summer and slightly warmer in winter. Temperature data shows that the study area is slightly cooler than the average for the Northern Ireland climate region. In July 2022, the hottest day of the year was recorded with temperatures of up to 31.2°C. This was recorded as the hottest day in 135 years across the island of Ireland.

The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these winds is greatest during the winter

when mean speeds and gusts are strongest. The study area is less windy compared to the Northern Ireland annual average, but windier than average for the month of December.

2.3.3 Hydrology

The Proposed Scheme crosses several watercourses; some are designated watercourses under the jurisdiction of DfI, rivers and others are classed as non-designated (responsibility of the riparian landowners). The largest watercourse is the Ballinderry River (designated) which flows south of Cookstown, with its floodplain constrained between drumlins and ultimately flows into Lough Neagh. The Ballinderry River catchment upstream of where the A29 Cookstown Bypass crosses the river is approximately 135km^2.

The Fairy Burn (designated) flows west to east (south of Sandholes Road) discharging into the Ballinderry River to the northeast of Loughry Roundabout and is impacted by both the A29 Cookstown Bypass and Sandholes Link Road. The Fairy Burn catchment upstream of where the A29 Cookstown Bypass crosses the watercourse is approximately 8km^2.

Further designated watercourses within the Proposed Scheme area include Fountain Road Stormwater Drain flowing from west to east and Molesworth Road Stormwater Drain flowing from north to south. The catchment upstream of where the A29 Cookstown Bypass crosses Fountain Road Stormwater Drain and Molesworth Road Stormwater Drain is approximately 0.8km^2 inclusive of both watercourses.

There are also several undesignated watercourses in the vicinity of the Proposed Scheme area, many of which are unnamed. Claggan Lane watercourses and Old Coagh Road watercourses are tributaries of Lissan Water, located to the east of the Proposed Scheme. The Claggan Lane watercourses catchment upstream of where the A29 Cookstown Bypass crosses the watercourses is approximately 0.6km^2. The Proposed Scheme crosses three tributaries (collectively referred to as Old Coagh Road watercourses) at three locations with the total catchment upstream being approximately 2km^2.

Refer to Section 2 of the Flood Risk Assessment (FRA) (718314-0500-R-0005, Version 4.0, February 2024) that provides figures showing the Ballinderry River, Fairy Burn, Fountain Road Stormwater Drain and Molesworth Road Stormwater Drain. Further figures in Section 2 of the FRA also show the Claggan Lane watercourses and Old Coagh Road watercourses.

2.3.4 Topography and Land Use

The landscape character of the Cookstown area is dominated by drumlins. Ground levels vary between 55m to 85m Above Ordnance Datum (AOD) north of Castle Road and between 35m to 50m AOD south of Castle Road.

Steep slopes are found on the banks of the Ballinderry River to the east of Cookstown. Flat, boggy ground is associated with the inter-drumlin hollows and valleys of the Ballinderry River to the southwest of the Proposed Scheme, and Lissan Water to the northeast.

Several smaller tributary streams and drainage ditches associated with the Ballinderry River and Lissan Water catchments are in the immediate vicinity of the Proposed Scheme.

Along the existing A29, urban land uses include commercial interests, dense urban and suburban residential development, industrial estates, and occasional community open space. Footway facilities associated with urbanised areas typically terminate at the outermost housing developments.

To the east of the Cookstown settlement boundary, in proximity to the Proposed Scheme, agriculture forms the dominant land use, interspersed by farmsteads, hedgerows, ancient and community woodland and watercourses. Woodland areas are principally associated with the Killymoon Castle and Killymoon Golf Course.

Several areas of land are designated in the Cookstown Area Plan (CAP) 2010 for industry and mixed business use on the east and southwest periphery of the town and areas to the north, west, south and east have been designated for housing. The Mid Ulster Local Development Plan 2030 – Draft Plan Strategy promotes Cookstown as an economic hub with the aim to facilitate economic growth through land use zoning, as well as boosting housing development in the area. In the absence of the Proposed Scheme, the future land use is likely to align with the designations set out in the Cookstown Area Plan 2010, and when published the Mid Ulster Local Development Plan 2030 LPP (Local Policy Plan).

The Mid Ulster Local Development Plan 2030 – Draft Plan Strategy guides planning and development in the region until 2030, promoting Cookstown as an economic hub with the aim to facilitate economic growth through land use zoning as well as boosting housing development in the area.

2.4 Existing Traffic Conditions

As described within Section 2.2, the A29 runs through the core retail area within the town centre. The different uses of the network conflict in the town centre, where shopping, personal business and employment trips wishing to access the centre, demand the same road space required to service through traffic. This conflict is further confused by the needs of this section of the network to accommodate the demands of other road users, most noticeably pedestrians and public transport. It is unsurprising that these conflicts can lead to a large variation in travel times experienced by those using the A29 through Cookstown, contributing to driver stress and poor journey time reliability. The 2019 traffic surveys confirmed a large variation in journey times along the A29 through Cookstown, ranging from around 7 minutes in uncongested conditions to over 20 minutes in the most congested observations.

South of the town centre, between the junction of the A29 Killymoon Street / Sweep Road / Castle Road and the junction of the A29 William Street / A29 James Street / Molesworth Street, the A29 is a wide single carriageway. The central area has been utilised to provide localised sheltered island areas for pedestrians crossing the road and right turn lanes for

vehicular traffic. The road frontage for this section is predominantly residential. Parallel on-street parking is provided on both sides of the road. During the traffic survey period (September – October 2023) the average 24hr weekday flow recorded on Chapel Street was 15,580 vehicles.

The middle section is the town centre and is defined by the junction of the A29 William Street / A29 James Street / Molesworth Street and the junction of Orritor Street / Coagh Street / A29 William Street. The road standard for this section changes to a dual 2-lane carriageway. This section supports the core retail and business area of the town. On-street parking is provided on both sides of the dual carriageway, with parking being limited to short-stay, Monday to Saturday between 9:00am and 6:00pm. There are 128 parking bays at 90° angles to the kerbside, which requires the drivers to reverse into the nearside traffic lane when leaving the parking bay.

In the north, between the junction of Orritor Street / Coagh Street / A29 William Street and the junction of the A29 / Lissan Road / Morgans Hill Road, the A29 is a wide single carriageway with a mixture of parallel on-street parking provision and parking bays at 90º to the kerbside on both sides of the road. The frontage development is predominantly residential. The observed average weekday 24hr traffic flow on this section, during the survey period, was approximately equal to 15,960 vehicles.

In general, the local distributor road network servicing Cookstown runs east / west, providing direct connections with the A29. It is the connection of these local distributor roads with the A29 that forms the majority of the key junctions in the town. All east / west traffic movements need to cross the A29 at some point. The most disruptive of these movements are those using Fairhill Road and Molesworth Street which add to the already conflicting traffic demands within the town centre.

During the AM peak and during weekday afternoons, the effect of pupils arriving and leaving the schools affects even further the operation of the A29. The number of school buses servicing the schools is high and they are generally unable to pull out of the northbound and southbound traffic streams, therefore, delaying other vehicles. The pedestrian activity associated with pupils requires the assistance of local traffic wardens and school crossing patrols which also interrupt the flow of traffic. Added to this is a number of regular bus services that need to stop at the bus stops on the A29 to collect / drop off their passengers.

Westland Road provides a reasonably direct link between the north and the south of the town which attracts through traffic and, during the 2023 surveys, 2-way daily flows of 14,180 vehicles were recorded on Westland Road south of its junction with Fairhill Road. Heavy Goods Vehicles and other commercial traffic use Westland Road which connects to the A505 Drum Road (to Omagh). This route is also connected to the main industrial sites in Cookstown, to the south and west of the town at the Ballyreagh Business Park and the Derryloran Industrial Estate on the Sandholes Road.

2.5 Preferred Route Evolution

Since the SAR2, further consideration has been given to road safely, climate change, active travel, alignment optimisation, statutory bodies (including statutory undertakers) and affected landowners. This assessment has resulted in the development and evolution of the SAR3 Preferred Route, as shown in Figure 2-2.

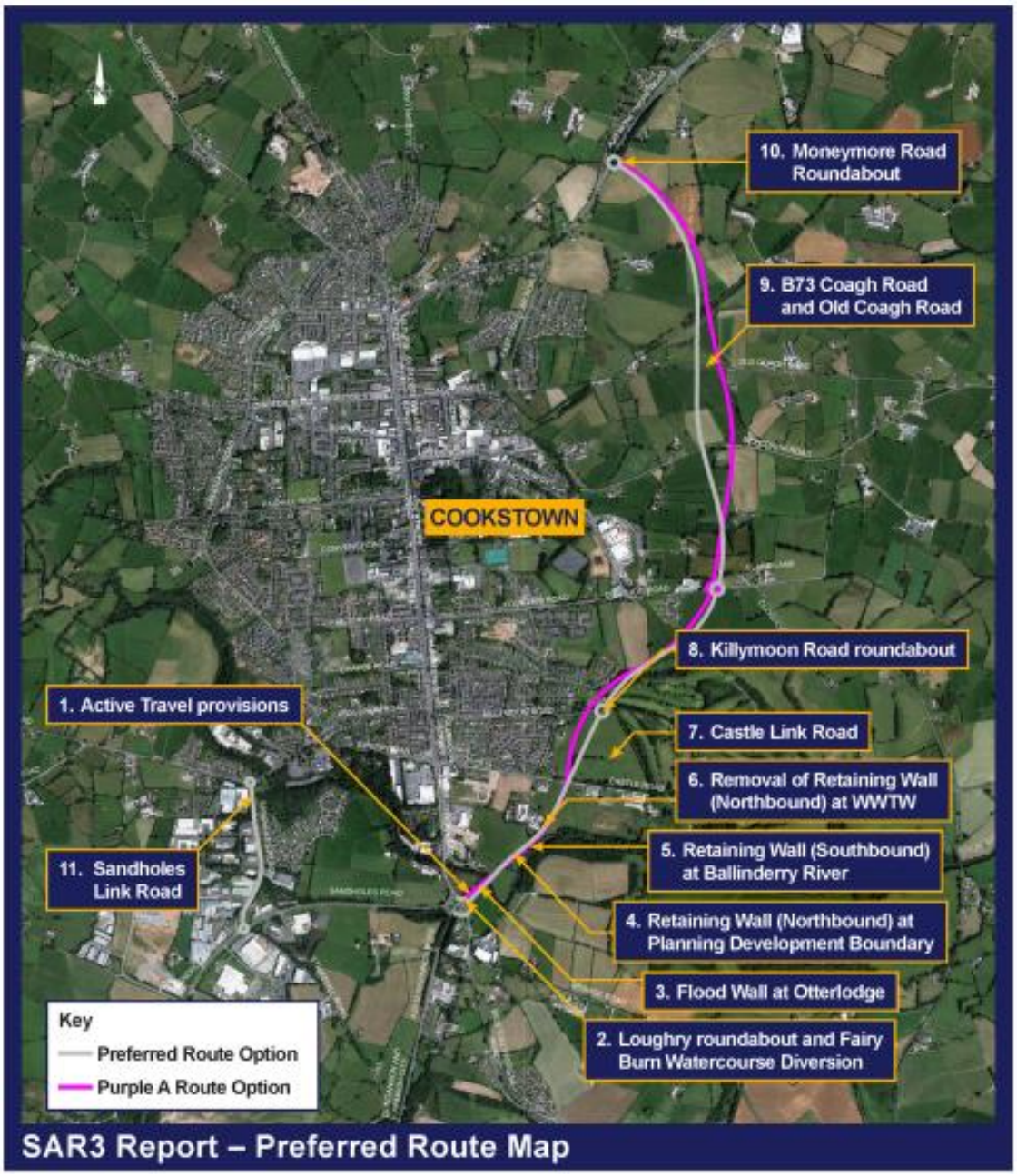


Figure 2-2 – Stage 3 Scheme Assessment Report Preferred Route Map

The Preferred Route contains the following ten key changes:

1. **Active Travel provisions**

The Active Travel provisions along the Bypass have been enhanced to provide greater accessibility for pedestrians, cyclists and other mobility users. A 3.0m wide shared use footway/cycleway, adjacent the Bypass northbound lane, is proposed the entire length of the A29 Cookstown Bypass and along Sandholes Link Road. On the northern side of the Loughry Roundabout, a toucan crossing is now provided (a signalised crossing which also allows for bicycles to be ridden across). Additionally, the overbridges accommodate the active travel paths at Killymoon Road and Moneymore Road.

2. **Loughry Roundabout and Fairy Burn Watercourse Diversion [Ch.00 to 170m]**

The Loughry Roundabout will be upgraded by extending one side of the roundabout to the east, adding a fifth arm and realigning Tullywiggan Road. The existing Fairy Burn culvert is proposed to be retained and the watercourse diverted to the north of the Bypass. A signalised pedestrian crossing is proposed at the Bypass arm utilising the island.

3. **Flood Wall at Otter Lodge [Ch.200m]**

A flood defence wall is proposed along the northern bank of the Ballinderry River upstream of the proposed Ballinderry bridge.

4. **Retaining Wall (Northbound) at Planning Development Boundary [Ch.285 to 430m]**

A retaining wall is proposed on the northbound carriageway to facilitate the construction of both the Bypass and planned housing developments. The wall will minimise the impact on the adjacent development boundary. Geotechnical measures (localised slope steepening) are also required in this area.

5. **Retaining Wall (Southbound) at Ballinderry River [Ch.320 to 510m]**

A retaining wall, which varies in height, is proposed on the southbound carriageway to facilitate the construction of the Bypass. The retaining wall will mitigate the impact of the Bypass on the Ballinderry River. Northern Ireland Water (NIW) access is required along the base of the proposed retaining structure to inspect and maintain the outfall infrastructure relating to the Cookstown Wastewater Treatment Works (WWTW) site. The proposal maximises the buffer zone between workers and the Ballinderry River as much as reasonably practicable, without impacting the WWTW.

6. **Removal of Retaining Wall (Northbound) at WWTW [Ch.480 to 550m]**

Construction of a retaining wall was planned in the Purple A Route option to ensure the WWTW remained unaffected by the construction of the Bypass. Upon further assessment, provision of a northbound retaining wall further south (see No. 3 above) is preferred from a

constructability perspective. An approximately 4m high embankment is required where the retaining wall in No. 4 on the southbound carriageway terminates.

7. Castle Link Road [Ch.775 to 1100m]

Construction of a Left-in Left-out (LiLo) junction at Castle Road was previously proposed in the Purple A Route option. However, Castle Road is to be stopped-up west of the Bypass with the provision of a turning head. Access to the severed Castle Road east of the Bypass will be accommodated by a new link road (Castle Link Road) connecting to the proposed Killymoon Roundabout.

Castle Road West will be provided as a direct connection onto the Bypass. Footpath connectivity from Castle Road west onto the Bypass will be provided via the overbridge at Killymoon Road.

8. Killymoon Road Roundabout [Ch.1050m to 1150m]

Construction of an overbridge at Killymoon Road (Killymoon Road over the Bypass) was previously proposed in the Purple A Route option. However, from a connectivity and road safety point of view, the overbridge was replaced by a roundabout on Killymoon Road.

The Bypass ties into the new three arm roundabout at Killymoon Road, from which vehicular access to Killymoon Golf Course and Killymoon Castle and the stopped-up eastern side of Castle Road is provided via Castle Link Road running adjacent to the Golf Course's boundary.

Pedestrian and cyclist movements will be facilitated by an overbridge structure, south of the roundabout.

9. B73 Coagh Road and Old Coagh Road [Ch.2525m and Ch.2885m]

The Purple A Route option proposed that the Bypass was located to the east of No. 17 Coagh Road. To achieve balanced overtaking opportunities and provision of a standard conflicting changeover in this vicinity, the Bypass has been adjusted so that it is located further west (the opposite side of No. 17 Coagh Road).

Provision of this conflicting changeover has also resulted in the Bypass being located further west on Old Coagh Road. To achieve required headroom, Old Coagh Road requires extensive vertical realignment works.

10. Moneymore Road Roundabout [Ch.3900m]

The Bypass connects with the A29 Moneymore Road and Tamlaghtmore Road via a four-arm roundabout as per the Purple A Route option. However, a segregated left turn lane onto the Bypass will also be provided from Moneymore Road.

Modifications have been made to accommodate private accesses to serve two properties: one domestic and one domestic/agricultural. The existing dual carriageway is proposed to be reduced by approximately 165m, with a new termination point located 165m to the

northeast of its current location. A section of the central reserve will be stopped-up to improve road safety by preventing vehicular crossing movements.

Tamlaghtmore Road's northern junction with Moneymore is proposed to be stopped-up and a turning head constructed.

Pedestrian and cyclist movements will be facilitated by an overbridge structure, south of the roundabout.

11. Sandholes Link Road

Roundabouts at each end of Sandholes Link Road are now proposed with smaller Inscribed Circle Diameter (ICD) to mitigate impact on surrounding domestic properties, commercial properties, a children's play park and the Derryloran Old Church and Cemetery.

The junction at Strifehill Road and Sandholes Link Road will be stopped-up to vehicular traffic. However, it is now proposed to provide pedestrian and cyclist access from Strifehill Road onto Sandholes Link Road.

The proposed carriageway will cross the Fairy Burn at a level of approximately 1.1m above the existing road level. It is proposed to retain the existing culvert, however construction of new headwalls and parapets will be required.

3 Description of Scheme

3.1 Description Overview

The overview of the Preferred Route is described per below Table 3-1, with additional details provided within this Section 3 as referenced.

Table 3-1 – Principal Design Components

(a) Length and cross-section	The mainline is 3900m in length, with the typical cross-section shown as Figure 3-1, drawing 718314-WSP-C-D-0800-0562. Sandholes Link Road is 660m in length, with the typical cross-section shown as Figure 3-10, drawing 718314-WSP-C-D-0800-0563. Refer to Section 3.2 for further road geometry and cross-section details.
(b) Line and level related to existing features	The drawing long-sections, 718314-WSP-C-D-0800-0215 to 718314-WSP-C-D-0800-0230 (refer Appendix A) provide the proposed surface levels relative to the existing surface. Refer to Section 3.2 for further road geometry and cross-section details.
(c) Amount and nature of landtake	Refer to Section 3.3 for details on land use requirements.
(d) Property demolished	A single disused cottage is proposed to be demolished on Coagh Road. Refer to Section 3.3 for further details.
(e) Volume of surplus excavated material for disposal off-site and/or volume of material required to be brought on site	Refer to Section 3.4 for high level volumes of earthworks materials expected for the scheme.
(f) Structures to be demolished and/or constructed	Refer to Section 3.5 for a summary of the structures required for the scheme.

3.2 Road Design

3.2.1 Engineering Standards

The A29 Cookstown Bypass, each of the affected side roads within the scheme and Sandholes Link Road have been designed in accordance with the DMRB and the Manual of Contract Documents for Highways Works (MCHW). The principal design guides are outlined below:

- DMRB CD 109 Highway Link Design
- DMRB CD 127 Cross Section and Headrooms
- DMRB CD 116 Geometric Design of Roundabouts
- DMRB CD 123 Geometric design of at-grade priority and signal-controlled junctions
- DMRB CD 143 Designing for walking, cycling and horse-riding

In addition to the DMRB design guides above, 'Creating Places' design guide published by the Department was used to inform the design of turning heads.

Given the rural nature and existing environmental and topographical constraints, in some instances it has been necessary to depart from these standards. Relaxations and Departures from Standards have therefore been proposed and incorporated into the design, as described in Section 5.7.

3.2.2 Design Speeds

A design speed assessment has been carried out in line with the requirements of the Director of Engineering Memorandum (DEM) 118/16 and as updated by DEM 118/21, to adhere to the 'Approval of Design Speeds' process for Strategic Road Improvement (SRI) schemes. The proposed design speeds were considered appropriate and approved by DfI-Roads HQ in December 2023.

The design speeds adopted for the Bypass are shown in Table 3-2.

Table 3-2 – Schedule of A29 Bypass Roads and Design Speeds

Road Ref	Road descriptions/Locations	Proposed Design Speed	Proposed Plate Speed Limits
A29/ML	A29 Bypass Mainline [Ch.55-210m]	100A	40mph
	A29 Bypass Mainline [Ch.210-3900m]		NSL

Road Ref	Road descriptions/Locations	Proposed Design Speed	Proposed Plate Speed Limits
A29/SR/SHL	Sandholes Link Road [Ch.000-480m]	70A	40mph
	Sandholes Link Road [Ch.480-670m]	60B	30mph
A29/SR/CAR	Castle Link Road	70A	40mph
A29/SR/CLR	Cloghog Road West	70A	40mph
	Cloghog Road East	85A	NSL
A29/SR/CL	Clare Lane	85A	NSL
A29/SR/CR	B73 Coagh Road	85B	NSL
A29/SR/OCR	Old Coagh Road	85A	NSL
A29/SR/MRW	Moneymore Road West Arm	70A	40mph
A29/SR/MRE	Moneymore Road East Arm	100A	NSL
A29/SR/TMR	Tamlaghtmore Road	70A	40mph

3.2.3 Mainline Road Alignment

3.2.3.1 Loughry Roundabout to Killymoon Roundabout

The existing A29 Dungannon Road / Loughry Roundabout will be extended east, creating a fifth arm to the existing roundabout and realigning Tullywiggan Road.

The Bypass cross-section is a Wide Single 2+1 carriageway (WS2+1 arrangement as defined by CD 109 Revision 1 as a road with two lanes of travel in one direction and a single lane in the opposite direction). The carriageway features two lanes northbound and one lane southbound between Loughry Roundabout and Killymoon Roundabout.

On the approach to Castle Road, the route passes between the Ballinderry River and the WWTW site.

Castle Road will be stopped-up where it is crossed by the Bypass, with pedestrian links provided to the Bypass. Castle Link Road on the eastern side of the Bypass will be provided to accommodate access to the proposed Killymoon Road Roundabout and onwards to The Bypass. Turning heads will be provided either side of the Bypass.

The Bypass ties into a new three arm roundabout (45m ICD) at Killymoon Road, from which vehicular access to Killymoon Golf Course, Killymoon Castle and the annexed Castle Road (east) is provided via Castle Link Road running adjacent to the Golf Course's boundary.

A 3.0m wide shared use footway/cycleway adjacent the Bypass northbound lane is proposed the entire length of the scheme.

Pedestrian movements will be facilitated by an overbridge structure, south of the Killymoon Roundabout. West of the new roundabout, Killymoon Road is to be stopped-up to vehicular traffic with turning head provided.

3.2.3.2 Killymoon Roundabout to Cloghog Roundabout

From Killymoon Roundabout, the route continues north-east to the east of Festival Park. The carriageway layout continues as a WS2+1 arrangement between the two roundabouts, however switches with one lane northbound from Killymoon Roundabout and two lanes southbound from Cloghog Roundabout.

A four-arm roundabout (45m ICD) is proposed for the connection to Cloghog Road east of Festival Park.

3.2.3.3 Cloghog Roundabout to Moneymore Roundabout

North from Cloghog Roundabout to Old Coagh Road, the carriageway layout continues as a WS2+1 arrangement with two lanes northbound and one lane southbound. The route passes Coagh Road and Old Coagh Road on embankments, allowing the respective side roads to remain open via an underbridge (mainline over side road).

A conflicting changeover is proposed on the Bypass in the vicinity of Old Coagh Road, where the WS2+1 arrangement switches to one lane northbound and two lanes southbound.

The route continues towards the A29 Moneymore Road, where it connects with the A29 Moneymore Road and Tamlaghtmore Road via a four-arm roundabout (60m ICD).

A segregated left turn lane onto the Bypass will be provided from Moneymore Road. The existing dual carriageway is proposed to be reduced, with a new termination point located 165m to the northeast of its current location, with a section of the central reserve to be stopped-up (preventing vehicular crossing movements). The junction at the northern end of Tamlaghtmore Road will be stopped-up.

3.2.4 Mainline Cross-Section

The Bypass consists of three sections of ‘wide single 2+1’ (WS2+1) type carriageway separated by three roundabouts.

The mainline also includes a 3.0m wide shared use footway/cycleway. Figure 3-1 shows the typical cross-section for the Bypass mainline, and Table 3-3 shows the typical cross-section dimensions.

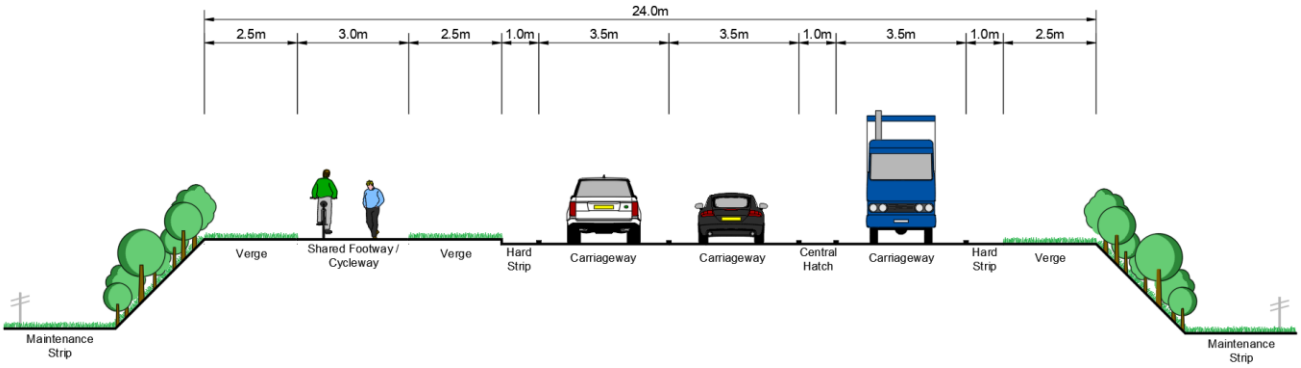


Figure 3-1 – A29 Cookstown Bypass Mainline Typical Cross-Section

For the southern section (approx. 1km), between Loughry Roundabout and the proposed Killymoon Road Roundabout, the Bypass is designed as a WS2+1, with two lanes providing overtaking opportunities northbound and one lane for travel southbound.

For the central section (approx. 1km), between the proposed roundabouts at Killymoon Road and Cloghog Road, the Bypass is designed as a WS2+1, with two lanes to provide overtaking opportunities southbound and one lane for travel northbound.

For the northern section (approx. 2km), the A29 Cookstown Bypass is designed as a WS2+1, initially consisting of two lanes providing overtaking opportunities northbound and one lane for travel southbound. Approximately mid-way along the northern section, from Old Coagh Road, the Bypass cross-section switches over and consists of two lanes providing overtaking opportunities southbound and one lane for travel northbound.

Table 3-3 – Bypass Mainline Typical Cross-section Dimensions (m)

Type	Verge	Footway / Cycleway	Verge	Hard Strip	Carriageway Lane(s)	Central Hatch	Carriageway Lane(s)	Hard Strip	Footway / Cycleway	Verge	Total Width
WS2+1	2.5	3.0	2.5	1.0	7.0 3.5	1.0	3.5 7.0	1.0	-	2.5	24.0 min.

Note 1: All measurements are in metres.
Note 2: The Bypass is a WS2+1 arrangement and northbound / southbound overtaking opportunities will change throughout. For example, when two lanes are provided northbound, the northbound carriageway width is 7.0m and the southbound is 3.5m wide; and vice versa.

Where possible, a minimum 3.0m wide maintenance strip has been made available throughout the scheme.

3.2.5 Mainline Junctions

The Bypass mainline proposes four new at-grade junctions:

- Loughry Roundabout;
- Killymoon Road roundabout;
- Cloghog Road roundabout; and
- A29 Moneymore Road roundabout.

3.2.5.1 Loughry Roundabout

An additional arm is proposed to the existing four-arm roundabout on the existing A29 Dungannon Road, resulting in a larger five-arm Loughry Roundabout. This will maintain access to the existing B520 Tullywiggan Road, the A29 Dungannon Road southbound and northbound for town centre traffic and Sandholes Road. The proposed roundabout is shown in Figure 3-2.

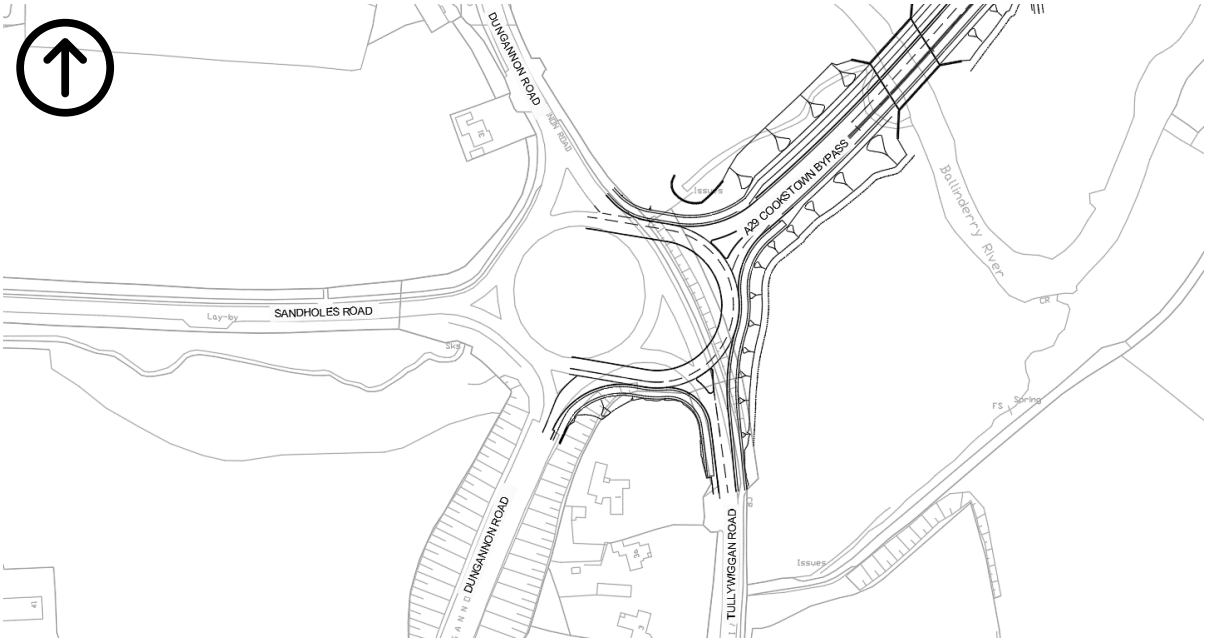


Figure 3-2 – Proposed Upgrades to Loughry Roundabout

The existing B520 Tullywiggan Road is approximately 8m wide on the approach to the existing roundabout, this will require minor realignment works to tie into the proposed plans, therefore widening the ICD of the current roundabout.

The new roundabout arm will tie into the existing road levels on the A29 Dungannon Road roundabout.

This arrangement has the added benefit of conserving an existing 120m long culvert under the existing Loughry Roundabout.

3.2.5.2 Killymoon Road Roundabout

A new at-grade, three-arm roundabout junction (45m ICD) is proposed on the Killymoon Road in the proximity of access lane to Killymoon Golf Course and Killymoon Castle. The proposed roundabout is shown in Figure 3-3.

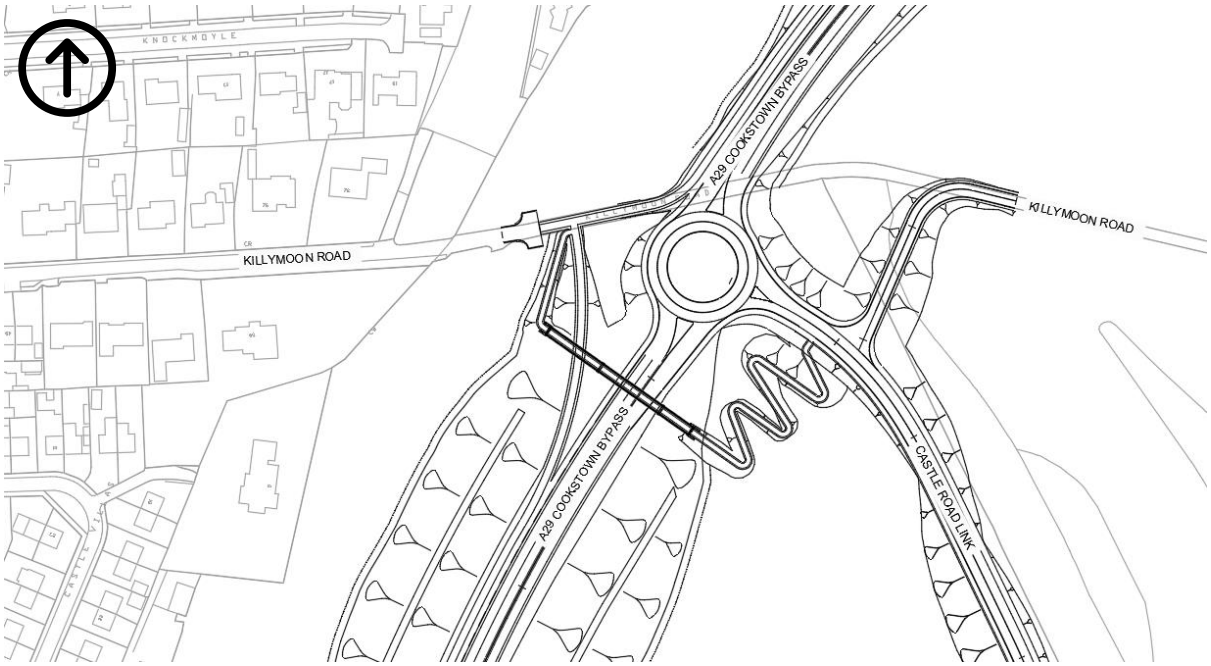


Figure 3-3 – Proposed Killymoon Road roundabout

Either side of the existing Killymoon Road is proposed to be stopped-up, with a turning head provided on the western side of the Bypass. Castle Road and a new access lane diverting patrons on to Castle Link Road (and onwards onto the Bypass). To facilitate access, Castle Link Road is being provided (refer to 3.2.6.1 for further details). A private access lane will be provided on Castle Link Road to offer and maintain access to and from Killymoon Golf Club and Killymoon Castle. Castle Link Road will provide access to 4No. domestic properties and 3No. commercial / agricultural premises.

3.2.5.3 Cloghog Road roundabout

A new at-grade, four-arm roundabout junction (45m ICD) is proposed on the Cloghog Road in the proximity of Festival Park and Clare Lane. The proposed roundabout is shown in Figure 3-4.

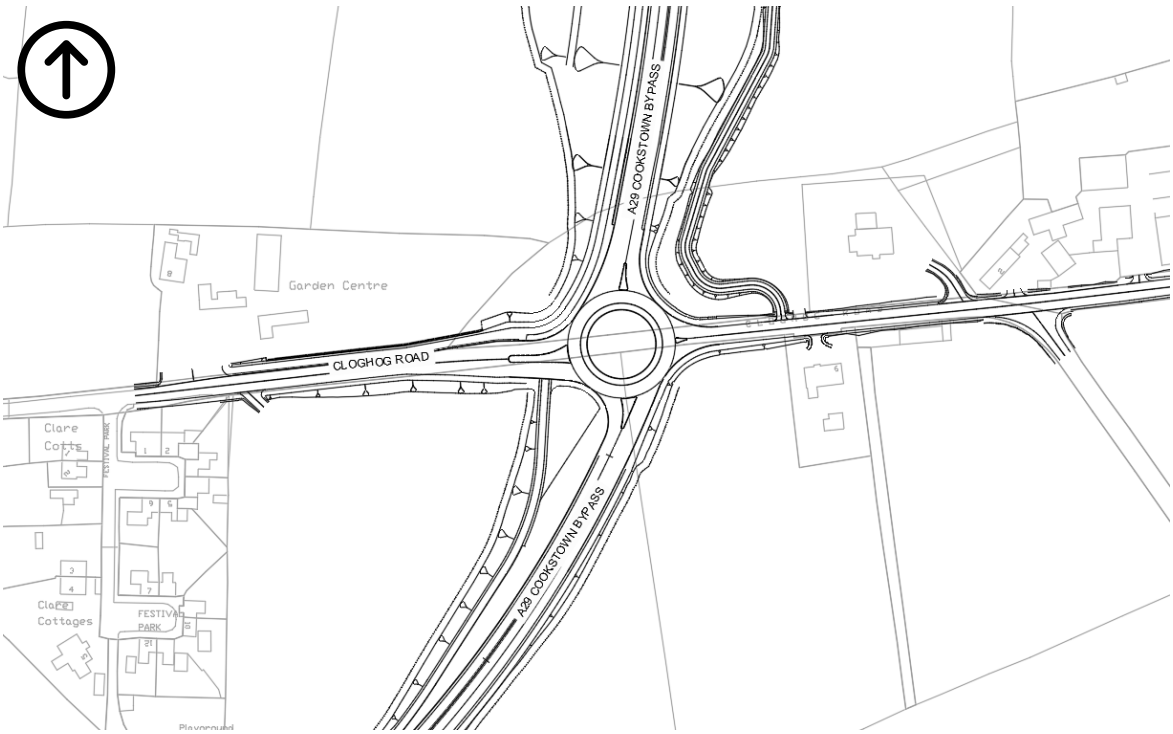


Figure 3-4 – Proposed Cloghog Road roundabout

The existing Cloghog Road east and west of the proposed roundabout will undergo horizontal, vertical and cross-sectional improvements, primarily to ensure an appropriate tie-in either side of the roundabout.

It is also proposed to relocate the existing 40mph/NSL speed limit interface further west (towards Cookstown), onto the western arm of the roundabout.

3.2.5.4 A29 Moneymore Road roundabout

The A29 Cookstown Bypass terminates at Moneymore Road, facilitated by a new at-grade four-arm roundabout (60m ICD). As part of the works, the existing Tamlaghtmore Road will connect into the Moneymore Road roundabout, allowing improved connectivity and traffic flow. The proposed roundabout is shown in Figure 3-5.

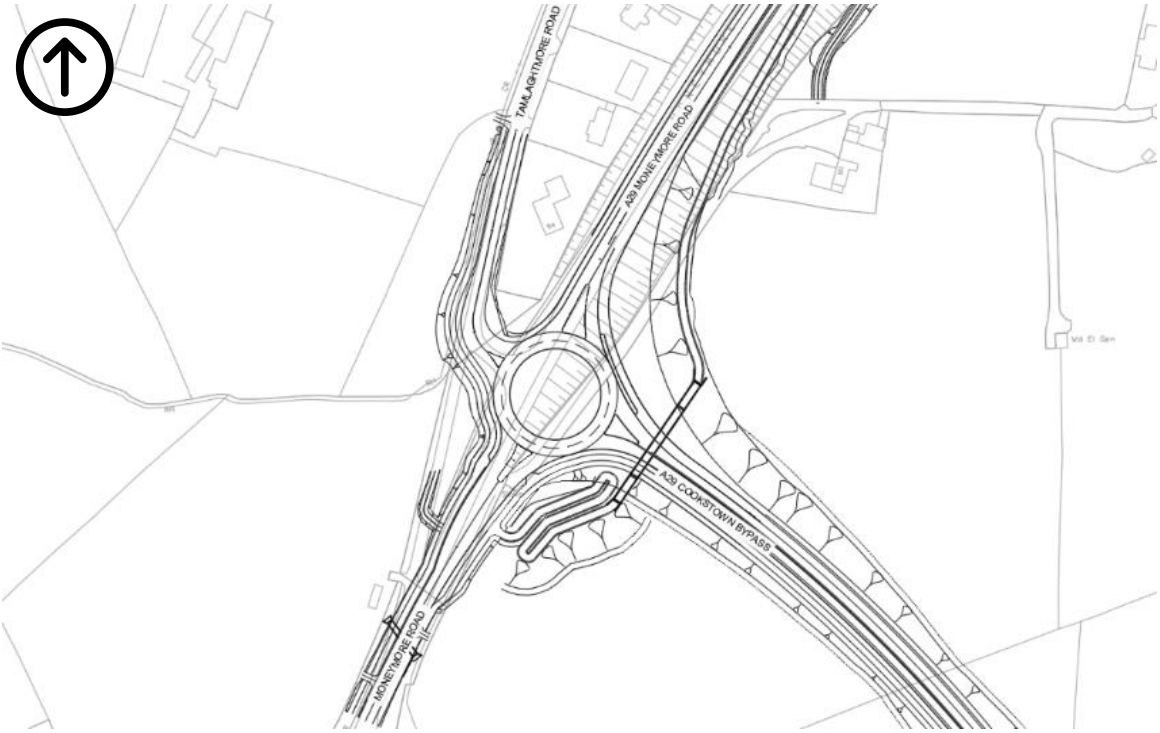


Figure 3-5 – Proposed Moneymore Road roundabout

The existing Tamlaghtmore Road and Moneymore Road east and west of the proposed roundabout will undergo horizontal, vertical and cross-sectional improvements, primarily to ensure an appropriate tie-in either side of the roundabout.

A segregated left turn lane onto the Bypass will be provided from Moneymore Road. The existing dual carriageway is proposed to be reduced, with a new termination point located approximately 165m to the northeast of its current location, with a section of the central reserve to be stopped-up (preventing vehicular crossing movements) allowing safe access to two private properties.

The existing Tamlaghtmore Road / Moneymore Road junction located further northeast is proposed to be stopped-up and a turning head provided; combined with the closure of the break in the central reserve on the dual carriageway. This will eliminate dangerous U-turns and force drivers to use the proposed roundabout, resulting in improved road safety.

3.2.6 Mainline Side Roads

The mainline crosses several side roads, which as part of the works will undergo a series of improvements to existing road safety, such as realigned horizontal and vertical geometry, improved cross-section (larger verges) as well as greater forward sight distance.

The A29 Cookstown Bypass includes four side road adjustments:

- Castle Link Road;
- Clare Lane Improvement Works;
- Coagh Road; and
- Old Coagh Road.

Note: Sandholes Link Road side roads are described separately to those for the A29 Cookstown Bypass in 3.2.7.

Table 3-4 shows the proposed typical cross-sections dimensions of these side roads.

Table 3-4 – Mainline Side Roads Typical Cross-section Dimensions (m)

Side Road	Verge	Footway	Hard Strip	Carriageway	Hard Strip	Footway	Verge	Total Width
Castle Link Road	0.5	2.0	-	7.3	-	-	2.5	12.3
Clare Lane	0.5	-	-	6.0	-	-	0.5	7.0
Coagh Road	2.5	-	-	6.0	-	-	2.5	11.0
Old Coagh Road	0.5	-	-	6.0	-	-	0.5	7.0

Note: All measurements are in metres

3.2.6.1 Castle Link Road

As part of the scheme, the A29 mainline crosses the existing Castle Road and Killymoon Road. Castle Road is to be stopped-up either side of the mainline with turning heads provided and Killymoon Road will be stopped-up on the west of the Bypass. The proposed Castle Link Road improvement works are shown in Figure 3-6.

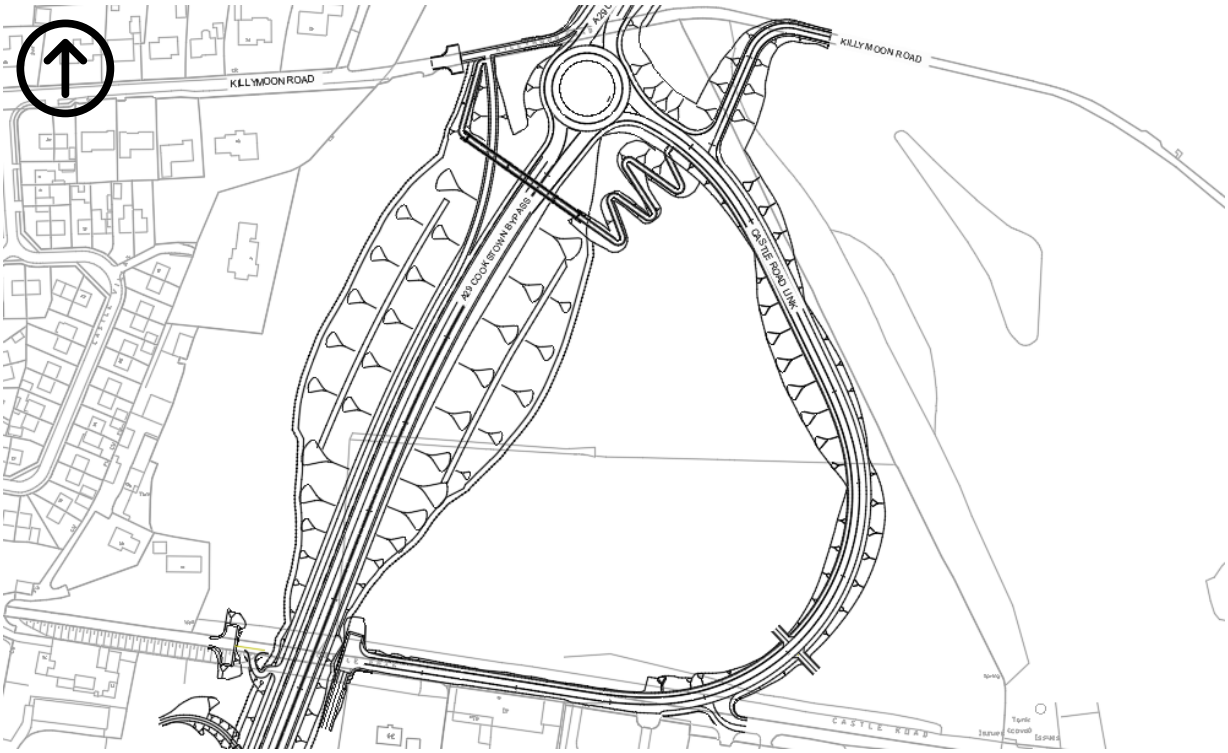


Figure 3-6 – Proposed Castle Link Road

To facilitate access, Castle Link Road is being provided between the eastern extent of Castle Road and the proposed Killymoon Roundabout. A private access lane will be provided on Castle Link Road to maintain access to and from Killymoon Golf Club and Killymoon Castle. Castle Link Road will also provide access to 4No. domestic properties and 3No. commercial / agricultural premises.

3.2.6.2 Clare Lane Improvement Works

Road improvement works are proposed to increase the radius of an existing bend (horizontal radius = 24m) on Clare Lane to provide an increased horizontal radius of 180m. The proposed road would be located approximately 70m in a north-west direction from its current position. The proposed Clare Lane improvement works are shown in Figure 3-7.

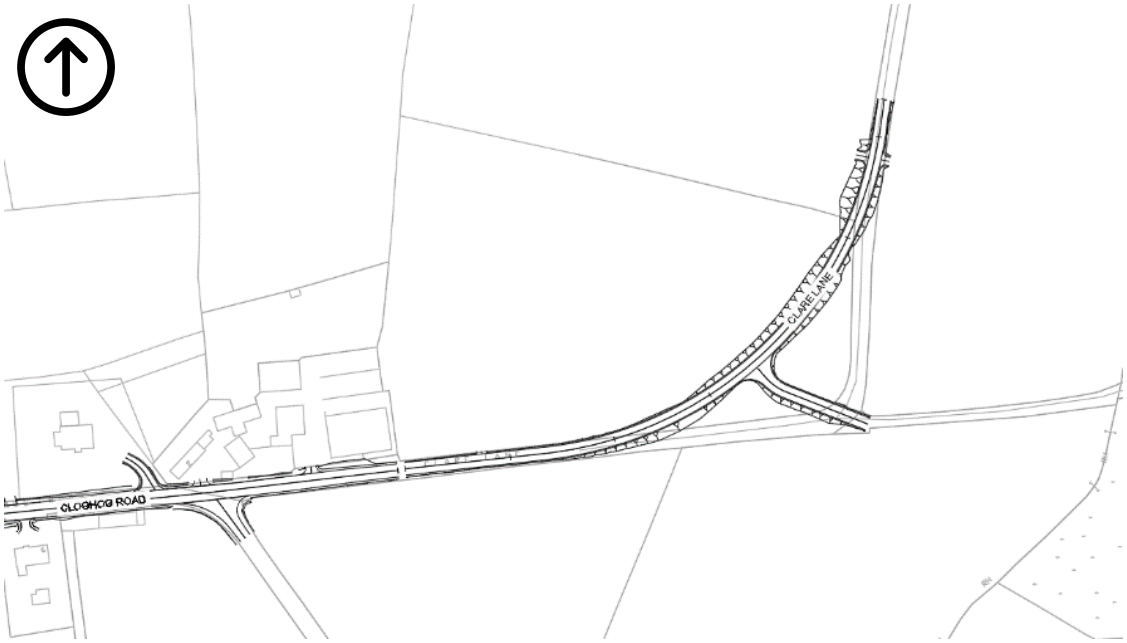


Figure 3-7 – Proposed Clare Lane Improvement Works

The cross-section will be widened to include 0.5m wide verges (currently no verges in sections) to both sides of the carriageway. These improvements allow for a smoother transition approaching the roundabout, whilst increasing forward visibility and driver comfort.

3.2.6.3 Coagh Road

Realignment works are proposed on B73 Coagh Road so that the existing road will travel under the Bypass (with a new overbridge structure being provided for the Bypass). The Bypass mainline crosses Coagh Road on an embankment, therefore sufficient headroom underneath is available without significant changes to the existing Coagh Road vertical geometry. The proposed Coagh Road works are shown in Figure 3-8.

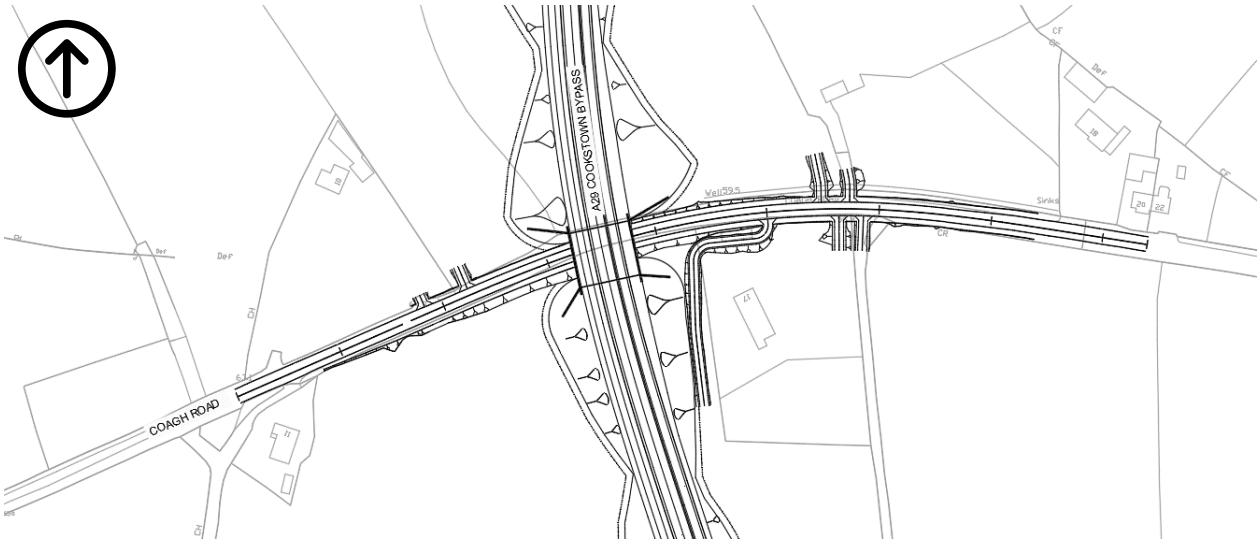


Figure 3-8 – Proposed Coagh Road

The cross-section will be widened to include 2.5m wide verges (currently no verges) to both sides of the carriageway. These improvements allow for increased forward visibility and driver comfort.

3.2.6.4 Old Coagh Road

Vertical realignment works are proposed on Old Coagh Road to facilitate the headroom required for the bridge under the Bypass mainline, as shown in Figure 3-9. To achieve clearance, it is proposed to lower the existing Old Coagh Road levels up to approximately 9m along a length of 300m.

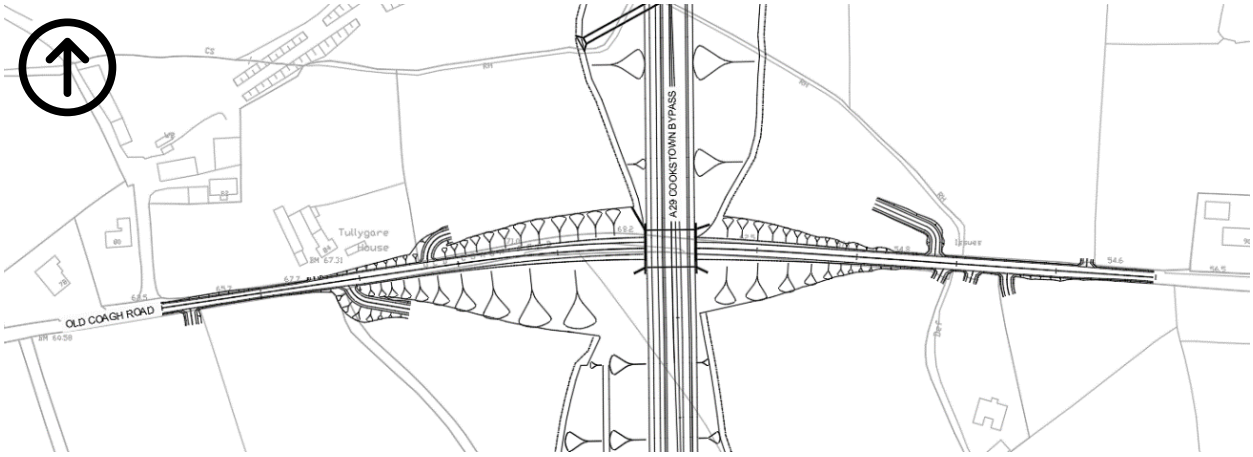


Figure 3-9 – Proposed Old Coagh Road

The cross-section will be widened to include 2.5m wide verges (currently no verges) to both sides of the carriageway. These improvements allow for increased forward visibility and driver comfort.

3.2.7 Sandholes Link Road

Sandholes Link Road commences at Sandholes Road, opposite the Ballyreagh Industrial Estate, creating a new three-arm roundabout (32m ICD). A 3.0m wide (typical) shared use footway/cycleway is proposed adjacent the Sandholes Link Road's northbound lane.

Figure 3-10 shows the typical cross-section for the Bypass mainline, and Table 3-5 shows the typical cross-section dimensions.

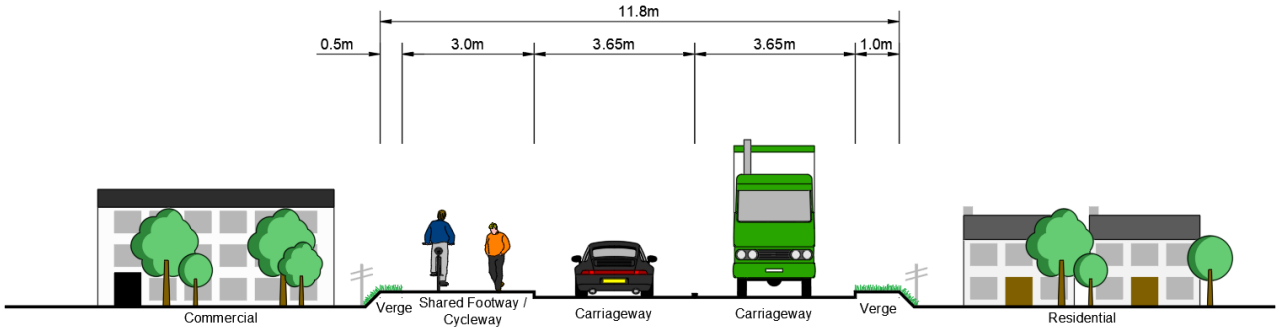


Figure 3-10 – A29 Cookstown Bypass Sandholes Link Road Typical Cross-section

Table 3-5 – Sandholes Link Road Typical Cross-section Dimensions (m)

Carriageway Type	Verge	Footway / Cycleway	Hard Strip	Carriageway	Hard Strip	Footway / Cycleway	Verge	Total Width
Wide Single	0.5	3.0	-	7.3	-	-	1.0	11.8 min.

Note: All measurements are in metres

From the Ballyreagh industrial estate to the Derryloran Old Church Cemetery junction over a length of approximately 600m, the link road is designed to filter traffic effectively on the outskirts of Cookstown, avoiding the town centre and therefore minimising the chance of traffic becoming blocked up.

In the new proposed plan, Strifehill Road - currently a small road connected to Sandholes Road - would be stopped-up with a turning head provided. A 2m wide footway is proposed along the northbound carriageway on Strifehill Road with provision for an uncontrolled pedestrian crossing in the vicinity of the existing junction with Sandholes Road.

The carriageway widens in the proximity of the junctions with Derryloran Industrial Estate and Old Rectory Park for the provision of ghost island right turn pockets.

The link road currently approaches the A505 Drum Road, where there is a give-way junction (with a 2-way slip road connecting Omagh traffic).

This existing junction is proposed to be replaced by a new at-grade, three-armed roundabout (32m ICD), to allow for a smoother flow of traffic, avoiding any back log of traffic on Sandholes Road.

As noted above, there are two junction proposals in the Sandholes Road area. These include two new junctions at grade three junctions:

- Sandholes Road roundabout; and
- Drum Road roundabout.

3.2.7.1 Sandholes Road Roundabout

At the existing main Sandholes Road, there is a junction onto the slip road heading northbound. This is proposed to be a three-armed roundabout of 32 ICD that will maintain access onto the main Sandholes Road, the road off the roundabout would be approx. 7.3m in width, widening to approximately 14m on the approach to the roundabout. The proposed layout is shown in Figure 3-11 below.

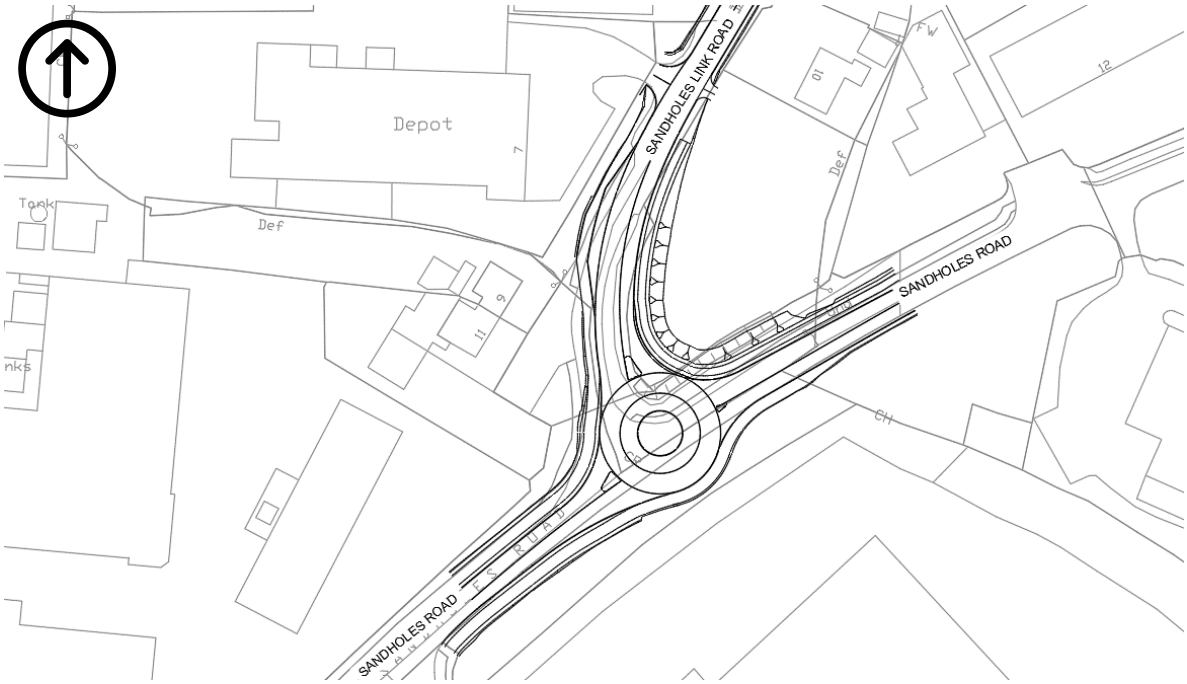


Figure 3-11 – Proposed Sandholes Road Roundabout

3.2.7.2 Drum Road Roundabout

Where Sandholes Link Road meets A505 Drum Road, there is a junction, the proposal is for a three-armed roundabout of 32m ICD, as shown in Figure 3-12 below. This will maintain access onto Drum Road, while enabling the smoother flow of traffic. The road off the roundabout would be approximately 7.3m in width, widening to approximately 14m on the approach to the roundabout.

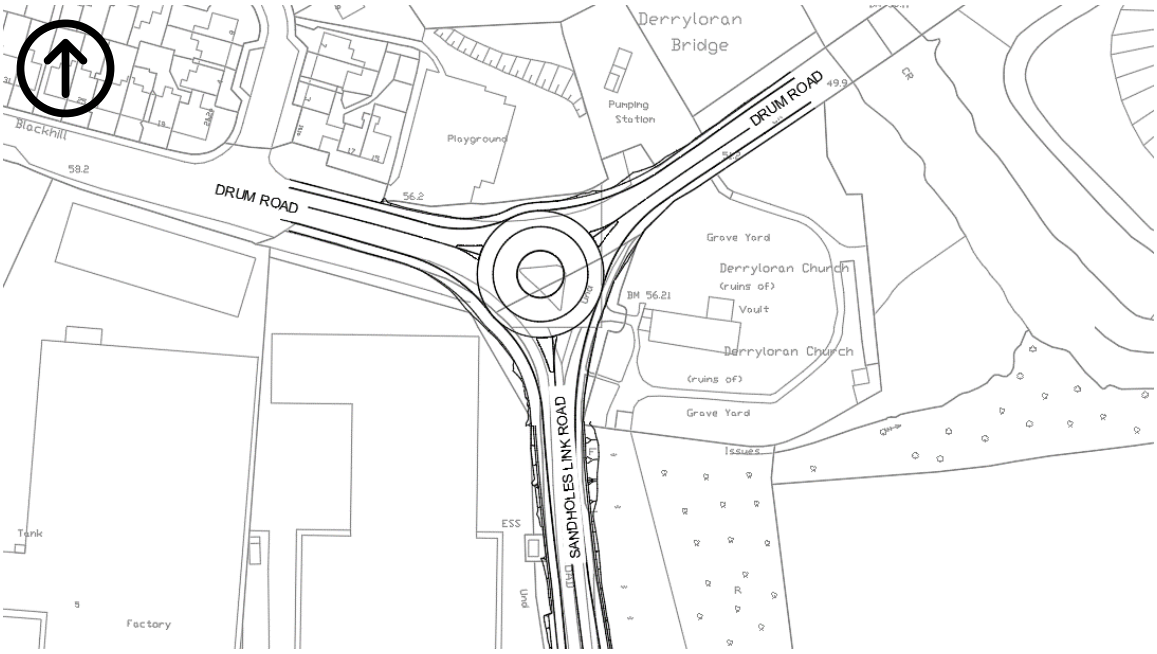


Figure 3-12 – Proposed Drum Road Roundabout

3.2.8 Road Closures

There are several road closures and diversions proposed. These include:

- *Castle Road* would be stopped-up where it is crossed by the Bypass to avoid traffic from entering the town. Castle Link Road will be provided to accommodate access to the proposed Killymoon Road Roundabout and onwards to the Bypass. Turning heads will be provided either side of the Bypass.
- *Killymoon Road* will also be stopped-up where it crosses the Bypass to stop vehicles accessing the town. A turning head will be provided on the western side of the Bypass. A private access lane will be provided onto Castle Link Road to offer and maintain access to and from Killymoon Golf Club and Killymoon Castle.
- The existing *Tamlaghtmore Road / Moneymore Road junction* located further northeast from the new Moneymore Roundabout is proposed to be stopped-up and a turning head provided; combined with the closure of the break in the central reserve on the dual carriageway. This will eliminate dangerous U-turns and force drivers to use the proposed roundabout, resulting in improved road safety.

- *Tamlaghtmore Road sliproad* is proposed to be stopped-up where the SuDS retention pond is proposed to discharge the realigned Claggan Lane watercourse.
- The existing junction of *Strifehill Road* / *Sandholes Road* would be stopped-up to avoid any traffic using this road to bypass the proposed roundabout. A turning head will be provided and there will be a 2.0m wide footway put in place with the provision of an uncontrolled pedestrian crossing in the vicinity of the existing junction (which currently links Strifehill Road and Sandholes Link Road).

3.3 Land Use Requirements

The Proposed Scheme will require approximately 42.5 hectares (Ha) of land to be acquired in total. This is predominantly made up of agricultural land (approx. 32Ha). Approximately 5.3Ha in land zoned for residential development, approximately 0.5Ha of land zoned in existing industry, approximately 0.4Ha in garden ground, approximately 2.3Ha in special amenity land (golf course) and approximately 2.0Ha in other uses.

Some 21.8Ha of land would be required for the construction of the Bypass. A further 25.9Ha would be required for mitigation purposes to include for minor carriageway improvement works, drainage outfall locations, flood storage areas, environmental mitigation areas and accommodation works. Some of these works will be carried out on lands already within the Department's maintenance remit and will not be required to be vested, such as existing carriageway works within the curtilage of the road.

All works (including the identification of site compounds and storage areas during construction) will be carried out within the Vesting Order boundaries, other than where the contractor has sought and received approval from the Department, landowner(s) and other relevant statutory bodies.

Provision has been made within the vested land for working space adjacent to proposed structures and along the length of the route.

Deposition areas do not form part of the land to be vested by the Department, rather the Principal Contractor would be responsible for seeking arrangement with those with an interest in the landholdings to use identified land parcels and to ensure compliance with waste regulations.

Several potential deposition areas have been identified along the Proposed Scheme for the purpose of depositing surplus material arising from excavated areas. Following construction, land within the deposition areas would be reinstated to an agreed standard for future use.

Construction of the Proposed Scheme would result in a single disused cottage being demolished on the B73 at 17 Coagh Road. This is shown below as Figure 3-13.

Figure 3-13 – 17 Coagh Road, location of disused cottage for demolition

3.4 Volumes of Earthworks Material

Earthwork material volumes for the Preferred Route have been extracted from the current design model, with the assumptions and exclusions, material re-use assessment and calculations documented within WSP Ltd *Technical Note Earthworks and Imported Fill Requirements* dated 01/02/24.

Note that proposed ponds, watercourse diversions, flood compensation areas, structures (bridges, culverts and similar) and Sandholes Link Road are excluded from the volume assessment at this stage, and as such the volumes quoted are to be considered high level and are approximate only for the purpose of understanding the overall mass haul strategy.

Considering the cut and fill volumes required for the works, special measures and imported fill requirements the overall estimated earthworks balance is as follows:

- Total excavated materials 766,000m^3
- Total imported materials 119,000m^3
- Total deposited volume 602,000m^3
- Resulting surplus 283,000m^3

3.5 Structures Required

3.5.1 Overview

The primary structures required on the mainline are categorised as follows:

- 3No. underbridges (carrying the A29 Bypass Mainline over obstacles);
- 2No. foot/cycle overbridges (crossing over the A29 Bypass Mainline);
- 4No. underpasses (1No. cattle, 2No. greenway, 1No. accommodation);
- 5No. culverts (4No. proposed, 1No. existing culvert to be retained);
- 3No. retaining structures; and
- 1No. flood protection wall (adjacent to A29).

The structures required on Sandholes Link Road are categorised as follows:

- 1No. existing culvert (to be retained); and
- 3No. retaining structures.

3.5.2 Proposed Structures

Table 3-6 and Table 3-7 below provide a summary of the existing and proposed structures on the mainline and Sandholes Link Road respectively. The locations of the structures are shown on drawing 718314-WSP-C-D-1700-1001, refer to Appendix A. Further engineering detail on the proposed structures is given in Section 5.3 of this report.

Table 3-6 – Mainline Structures

Ref	Chainage	Name / Category
SE-PR-01	0m	Loughry Roundabout Culvert
SP-PR-01a	N/A (B'derry River)	Otter Lodge Flood Wall
SP-PR-02	185m	Ballinderry River Underbridge
SP-PR-03	280m to 440m	Ballinderry Retaining Wall - LH
SP-PR-04	320m to 565m	Ballinderry Retaining Wall - RH
SP-PR-06	700m	Cattle Underpass
SP-PR-06a	1075m	Killymoon Roundabout Foot / Cycle Overbridge
SP-PR-07	1370m	Watercourse Culvert
SP-PR-08	1610m	Greenway Underpass South
SP-PR-09	N/A (C'hog Rd)	Cloghog Road West Retaining Wall

Ref	Chainage	Name / Category
SP-PR-11	2525m	Coagh Road Underbridge
SP-PR-12	2880m	Old Coagh Road Underbridge
SP-PR-13	2975m	Watercourse Culvert
SP-PR-14	3100m	Greenway Underpass North
SP-PR-15	3150m	Watercourse Culvert
SP-PR-16	3175m	Accommodation Underpass
SP-PR-17	N/A (Exist. A29)	Moneymore Road Culvert
SP-PR-19	3875m	Moneymore Roundabout Foot / Cycle Overbridge

Table 3-7 – Sandholes Link Road Structures

Ref	Chainage	Name
SE-SHL-02	250m	Fairy Burn Culvert
SP-SHL-03a	240m to 295m	Fairy Burn Parapet Wall - LH
SP-SHL-03b	230m to 255m	Fairy Burn Parapet Wall - RH
SP-SHL-01	N/A (Strifehill Rd)	Strifehill Road Retaining Wall

3.6 Construction Programme

A construction timeframe has been assumed of twenty months, commencing on site in spring 2026 (subject to statutory procedures and funding availability). The construction completion, handover and road opening is expected by the end of 2027.

The scheme will be tendered as a single contract with construction of the Bypass and Sandholes Link Road improvement works running in parallel. Once appointed, the Design and Build (D&B) Contractor shall undertake detailed design prior to the construction activities commencing. These activities are typical for a major roads scheme and include:

- advance / preparatory works such as Archaeological Investigation, site clearance, compound establishment, fencing and demolition works.
- main construction works including earthworks, structures, drainage and roadworks.
- final finishes to include landscaping.

4 Cost Estimates

4.1 Overview

Throughout the development of the scheme, cost estimates have been prepared to a level appropriate to the assessment stage being undertaken. During the earlier stages, they were broad estimates prepared to allow for meaningful comparison of options. During Stage 3, the Preferred Route has now been sufficiently detailed so that a more accurate estimate of the scheme cost can be calculated.

The scheme cost estimates have been prepared within the *Updated A29 Cookstown Bypass - SAR 3 Cost Report* (dated 11 September 2023) prepared by Chandler KBS. This report provided the methodology and assumptions used as the basis. These costs are summarised within Section 4.3 of this report.

4.2 Risk Cost

Construction schemes inherently contain uncertainties that have the potential to impact the final construction cost. Ongoing risk analysis and management provides a process to identify, reduce and where possible remove those uncertainties as far as practicable.

The key risks, and their associated financial impact have been reviewed at regular intervals as the scheme has been developed, with the most recent review held in December 2022.

Following this workshop, the risk cost was derived using @RISK software, which undertakes a Monte-Carlo simulation. This provides a ‘percentage confidence of attainment (CoA)’ – which is the likelihood that the overall estimate of time or cost for The Project, including risk allowances, will not be exceeded. In line with the Department’s Policy and Procedure Guide E058, the 50th percentile CoA has been used.

4.3 Scheme Cost Summary

At Stage 3 Chandler KBS prepared a detailed cost estimate for this scheme. A summary of the scheme cost estimates is provided in Table 4-1 with historical expenditure figure added.

Table 4-1 – Scheme Costs

Item Description	Estimated Amount (£)
S200 – Site Clearance	£ 100,232.50
S300 – Fencing and Environmental Barriers	£ 1,497,650.89
S400 – Road Restraint Systems	£ 274,087.50
S500 – Drainage	£ 1,228,186.98
S600 – Earthworks	£ 7,019,816.00
S700 – Pavements	£ 6,196,239.70
S1100 – Kerbs, Footways and Paved Areas	£ 1,115,474.34
S1200 – Traffic Signs and Road Markings	£ 162,729.00
S1300 – Road Lighting Columns and Brackets	£ 262,321.28
S1400 – Electrical Work for Road Lighting and Traffic Signs	£ 180,845.09
S2500 – Special Structures	£ 9,200,319.00
S3000 – Landscaping and Ecology	£ 335,132.74
Total Construction Cost	**£ 27,573,035.02**
Design	£ 1,528,651.75
Preliminaries	£ 4,411,685.60
Overheads and Profit	£ 2,067,977.63
Archaeological Investigation Works	£ 300,000.00
Traffic Management	£ 413,595.53
Sub Total	**£ 36,294,945.53**
Statutory Undertakers	£ 856,494.69
Risk	£ 2,610,890.31
Inflation from the Building Cost Information Service (BCIS)	£ 3,144,836.26
Optimum Basis @ 11%	£ 4,449,658.36
Land Optimum Basis @ 5%	£ 340,053.00
Land Cost Estimate (LPS Values)	£ 11,111,284.51
Preparation	£ 1,850,000.00
Supervision	£ 1,450,000.00
Sub Total	**£ 62,108,162.66**
Historical Expenditure (provided by DfI)	*£7,714,511.00*
Total	**£ 69,822,673.66**

5 Engineering Assessment

5.1 Geotechnical

5.1.1 Background

The existing geotechnical conditions have been established using desk study and ground investigation data. The desk study involved the examination of published data such as geological maps, hydrogeological maps, and previous ground investigation records. The desk study informed the scope of ground investigation required for the Preferred Route.

Previous ground investigations were carried out in 2008 (Factual Report Ref, Y8907) and 2010 / 2011 (Factual Report Ref, 1901), to inform ground conditions for the route selection process, as detailed in Section 5.4 of the SAR2.

Supplementary ground investigation has been carried out in two phases in 2020 (Factual Report Ref, A112794-73) and 2021 (Factual Report Ref, 787-B027259), to understand the depths and extents of soft ground and investigate the impact of proposed cut slopes for the Preferred Route.

The results of the preliminary, detailed, and supplementary phases of ground investigation are presented in the respective Ground Investigation Reports produced by WSP identified in Table 5-1 below in conjunction with other relevant Geotechnical reports produced for the scheme.

Table 5-1 - Geotechnical Reporting and Ground Investigations

Date	Title	Reference	Comments
March 2008	A29 Cookstown, Geotechnical Statement of Intent	718314/A/R/5001	-
June 2008	A29 Cookstown Bypass, Preliminary Sources Study Report	718314/B/R/5003	A Preliminary Ground Investigation scoped and supervised by Mouchel and undertaken by Soil Mechanics Ltd was undertaken in November and December 2008 with the aim of providing provisional information on the ground conditions for the five
April 2009	Soil Mechanics Cookstown By-Pass – Factual Report on Ground Investigation, April 2009	Y8907	

Date	Title	Reference	Comments
April 2009	A29 Cookstown Bypass, Preliminary Ground Investigation Report	718314/B/R/5006	route options, which were developed as part of the Stage 1 Scheme Assessment Report (SAR1), to aid in selection of the Preferred Route.
August 2011	Soil Mechanics A29 Cookstown By-Pass – Factual Report on Ground Investigation, August 2011	Y1901	Following the selection of an emerging Preferred Route in the 2010 SAR2, a targeted Main Ground Investigation scoped and supervised by Mouchel and undertaken by Soil Mechanics Ltd in 2011 was undertaken from January to March 2011, with the aim of providing sufficient information to assess the ground and groundwater conditions.
September 2011	A29 Cookstown Bypass, Ground Investigation Report	718314/C/R/5011	
July 2021	A29 Cookstown Bypass, Preliminary Sources Report To consider geotechnical constraints and risks associated with changes to the eastern route options	718314-0600-R-0003-P04-PSSR	Further ground investigation was identified to assist the development of the preferred options. The ground investigation scoped by WSP Ltd was split into two phases and carried out by Tetra Tech Environmental Planning Transport Limited. Site works for Phase 1 were carried out between 26th October 2020 and 22nd January 2021, and site works for Phase 2 took place between 2nd February and 13th April 2021
July 2021	A29 Cookstown Bypass, Ground Investigation Scoping Report	718314-0600-R-0001-P01-GISR	
October 2021	A29 Cookstown By-pass Phase One Ground Investigation Factual Report	A112794-73	
February 2022	A29 Cookstown By-pass Phase Two	787-B027259	

Date	Title	Reference	Comments
	Ground Investigation Factual Report		
July 2022	A29 Cookstown Bypass, Ground Investigation Report	718314-0600-001-GIR	

5.1.2 Existing Ground Conditions

A summary of anticipated ground conditions associated with the Preferred Route is summarised in Table 5-2, and is based on information from each ground investigation considered collectively.

Superficial deposits in the study area predominantly comprise Glacial Till, with other deposits present locally such as made ground, peat, and alluvium. The bedrock encountered on the site has been divided into four units: Metasediments, Sandstone, Limestone and Mudstone. Several historical mineral workings and quarries identified along the scheme have been investigated and the findings reported in the factual report ref, A112794-73, 787-B027259 and 787-B027259. The location and layout of earthworks, structures and generalised ground conditions along the Preferred Route are indicated on Geological Plan and Profile Drawings Ref: 718314-WSP-B-D-0600-0078 to 0084 (refer to Appendix A).

Table 5-2 - Summary of Anticipated Superficial and Bedrock Geological Units associated with the Preferred Route

Geological Unit	Typical Description	Depth Encountered from (m bgl)	Typical Thickness (m)	Anticipated Location
Topsoil	Soft to firm dark brown slightly sandy slightly gravelly CLAY or SILT with rootlets.	0.0	0.1 – 0.9	Encountered frequently, except for the Sandholes Road realignment
Made Ground	Soft to Firm/Stiff, brown, slightly sandy, gravelly CLAY, with high cobble content.	0.0 – 2.1	0.1 – 4.8	Generally associated with existing roads and abandoned railway lines. The thickest

Geological Unit	Typical Description	Depth Encountered from (m bgl)	Typical Thickness (m)	Anticipated Location
	Predominantly reworked natural deposits used as embankment fill, with a few instances of anthropogenic material including concrete, rubble debris, tile, brick, macadam, plastic, and wood			deposit of 4.8m bgl associated with the abandoned railway line which crosses the proposed route at mainline Ch.3100m, north of Old Coagh Road
Peat	Soft, dark brown or black, clayey and/or sandy pseudo-fibrous Peat	0.3 – 0.9	0.35 – 1.1	Localised deposits encountered at/near the abandoned railway line (Ch.3100m and Ch.3150m), Moneymore Road proposed roundabout connection and Mainline Ch.2525m, at realigned Coagh Road
Alluvium (Cohesive)	Soft reddish brown slightly sandy slightly gravelly CLAY.	0.1 – 5.0	0.25 – 6.9	Generally localised around Ballinderry River and within the vicinity of smaller watercourses. Generally interbedded with Granular Alluvium.

Geological Unit	Typical Description	Depth Encountered from (m bgl)	Typical Thickness (m)	Anticipated Location
Alluvium (Granular)	Loose to medium dense brown slightly gravelly very silty fine to medium SAND.	0.15 – 6.0	0.5 – 5.4	Generally localised around Ballinderry River and within the vicinity of smaller watercourses. Generally interbedded with Cohesive Alluvium.
Glacial Till (Cohesive)	Firm to very stiff reddish brown slightly sandy slightly gravelly CLAY.	0.0 – 12.5	0.1 – 22.9+	Cohesive Glacial Deposits are generally interbedded with Granular Glacial Deposits, and both were prevalent throughout the site, generally from ground level, underlying topsoil or underlying Alluvium deposits
Glacial Till (Granular)	Loose to dense reddish brown slightly gravelly, silty, fine to coarse predominantly fine SAND. Gravel is angular to subrounded fine to coarse. Where the gravel was the main constituent, the	0.0 – 17.9	0.1 – 14.8+	Granular Glacial Deposits were found often interbedded with Cohesive Glacial Deposits but were encountered less frequently than cohesive deposits

Geological Unit	Typical Description	Depth Encountered from (m bgl)	Typical Thickness (m)	Anticipated Location
	particles were generally described subrounded to subangular, fine to medium of MUDSTONE and SANDSTONE.			
Metasediments	Medium strong to very strong, grey or greyish pink, medium grained unfoliated METASEDIMENT	2.5 – 4.9	7.1 – 13.3	Wastewater Treatment works along the Ballinderry River
Limestone	Medium strong to strong, grey or reddish grey, thinly to thickly laminated, fine grained fossiliferous LIMESTONE	2.5 – 7.5	0.5 – 4.3	Ballinderry River Crossing
Mudstone	Extremely weak to weak, brown or reddish thinly laminated, fine to medium grained MUDSTONE	2.6 – 16.5	0.4 – 9.9	Ballinderry River Crossing
Sandstone	Extremely weak to medium strong, reddish brown, thinly laminated, poorly to moderately cemented, fine to medium grained SANDSTONE	0.4 – 18.2	0 – 12.5	Bedrock underlying much of the Bypass

5.1.3 Supplementary Ground Investigations

Previous geotechnical investigations undertaken for the scheme had predominantly focused on the Purple A Route and Purple B Route option alignments, with very limited Ground Investigation information for the Green Route alignment. As a result, supplementary ground investigation (2020 and 2021) was carried out for the preferred scheme alignment option including the Purple A Route and Green Route, where alignments were similar, and the Sandholes Link Road.

The supplementary ground investigation, scoped by WSP Ltd, was split in to two phases and carried out by Tetra Tech Environmental Planning Transport Limited. Site works for Phase 1 were carried out between October 2020 and January 2021, and site works for Phase 2 took place between February and April 2021. The investigation consisted of 88No. exploratory holes incorporating, 51No. boreholes, 33No. trial pits, 4No. window samples and road cores.

In-situ tests were carried out and included Standard Penetration Test (SPT), variable head permeability testing and hand-held shear vane tests. Groundwater monitoring installations were constructed in specified locations. Laboratory testing was also carried out on selected samples to provide design parameters for the various material types encountered.

From the two ground investigations undertaken in 2008 and 2011, 148No. exploratory holes (59No. boreholes, 46No. trial pits, 21No. window samples and 22No. dynamic probes) are relevant to the current proposed route and have been used in conjunction with the 2020/2021 ground investigation records to develop the ground model.

The July 2022 Ground Investigation Report for The Project (718314-0600-001-GIR) summarises findings from the recent ground investigations and relevant historical exploratory holes. It provides interpretation of the ground conditions and geotechnical parameters, to enable the assessment of earthwork slope angles, enabling the estimation of cut / fill volumes provided in Section 3.4 and the assessment of likely subgrade conditions.

A small ground investigation comprising 3No. boreholes and 3No. trial pits, targeting a proposed flood defence wall extending parallel to the Ballinderry River adjacent to Otters Lodge, downstream of Kings bridge on the existing A29, was undertaken by Tetra Tech, in August 2023, with the findings reported in a factual report reference: 787-B049204.

Since the completion of the supplementary ground investigation, the preferred scheme alignment has evolved, therefore further ground investigation may be required.

5.1.4 Geotechnical Constraints

In general, the cohesive glacial deposits that make up most superficial deposits on site are deemed to be suitable founding strata for embankments. Soft and loose deposits of alluvium and soft weathered cohesive glacial deposits have been encountered sporadically throughout the site, which may cause adverse settlement and issues with bearing capacity.

Where these materials are encountered at formation level for embankments, it is recommended that some form of ground improvement is employed such as excavation and replacement, basal reinforcement, staged construction, or a combination of solutions.

For cuttings, it is anticipated that the cohesive glacial deposits will generally remain stable at a slope of 1(v):3(h) depending on the depth of the cutting, the depth of the water table and the implementation of drainage. Where cutting slopes steeper than 1(v):3(h) are proposed, or there is a shallow water table, it is anticipated that special measures may be required to ensure long term stability.

The locations of the anticipated problematic ground conditions, associated geotechnical risks and proposed treatments are listed in Table 5-3.

Table 5-3 – Earthwork Constraints

Chainage From (m)	Chainage to (m)	Problematic Ground Conditions	Geotechnical Risk	Possible Treatment
35	170	Soft deposits associated with the existing Fairy Burn watercourse	Bearing capacity failure, excessive/adverse settlement	Treatment of abandoned watercourse
150	170	Area prone to flooding	Excess pore pressure, embankment instability	Granular starter layer for embankment
60	240	Soft cohesive alluvium up to 4.5m depth	Bearing capacity failure, excessive/adverse settlement	Excavation and replacement / staged construction
1310	1400	Potential Treatment of Fountain Road drainage ditch – possible alluvium.	Bearing capacity failure, excessive/adverse settlement	Excavation and replacement / staged construction
1950	2150	Deep cutting with high groundwater table and potential for	Instability / localised erosion of cut slopes	Slope drainage measures

Chainage From (m)	Chainage to (m)	Problematic Ground Conditions	Geotechnical Risk	Possible Treatment
		groundwater issues		
2160	2290	Deep cutting in cohesive glacial deposits with high groundwater table	Instability of cut slopes	Slope strengthening measures (e.g. rock blanket) where slopes steeper than 1v:3h
2500	2560	High embankment	Internal stability of embankment fill material	Strengthen embankment shoulders / base. Appropriate minimum strength requirement for embankment fill
2930	3180	High embankment	Internal stability of embankment fill material	Strengthen embankment shoulders / base. Appropriate minimum strength requirement for embankment fill
2930	3200	Low strength cohesive founding stratum and localised peat deposits	Global instability of slope, excessive settlement, bearing failure	Excavation and replacement of soft deposits
3050	3150	Localised peat deposits up to 1.35m thick	Bearing capacity failure, excessive/adverse settlement	Excavation and replacement of peat
Old Coagh Road Ch.50	Old Coagh Road Ch.350	Deep cutting in cohesive glacial deposits with high groundwater table	Instability of cut slopes	Slope strengthening measures (e.g. rock blanket) required for stability of 1v:2.5h slopes

5.2 Pavement

The proposed design for the Bypass includes the use of flexible pavement along the entire mainline and roundabouts. The mainline is intended to be constructed as a low-noise road surfacing. Separate pavement shall be used where the mainline crosses a proposed structure.

The pavement designs have been undertaken in accordance with the current Design Manual for Roads and Bridges (DMRB) as follows:

- DMRB CD 224 Traffic assessment
- DMRB CD 225 Design for new pavement foundations
- DMRB CD 226 Design for new pavement construction
- DMRB CS 228 Skidding resistance
- DMRB CD 236 Surface course materials for construction
- DMRB CD 239 Footway and cycleway pavement design

The specimen designs were completed with preliminary foundation Surface Subgrade Modulus (SSM) values and traffic flow values as provided in September 2022. The design includes four construction options per area, utilising the following standard pavement types and materials all in accordance with CD226:

Flexible with an asphalt base -

A. Asphalt Concrete (AC) Heavy-Duty Materials (HDM)

B. Enrobés à Module Elevé Class 2 (EME2) High Modulus Asphalt Concrete

Flexible with a Hydraulically Bound Base (HBM) -

C. Flexible with an HBM base Type B (C8/10)

D. Flexible with an HBM base Type C (C12/16)

The pavement designs presented in this report are specimen designs intended to be utilised for information only and are not to be taken forward as final designs.

5.2.1 Traffic

The traffic data in the form of Annual Average Daily Flow per direction (AADF) and the percentage of commercial vehicles are taken from data provided in September 2022.The design traffic in terms of million standard axles (msa), for commercial vehicles per day (CV/Day), was calculated in accordance with CD 224 for an opening year of 2027 plus the subsequent 15-year period for Polished Stone Value (PSV) surface course design and the cumulative 40-year period for new road schemes.

Table 5-4 – Traffic summary

Road Name	AADF 2027 (vpd)	CV/day 2027 (vpd)
Loughry Roundabout	7715	1570
Loughry - Killymoon (NB)	7655	892
Killymoon - Loughry (SB)	7715	1046
Killymoon Roundabout	7715	1570
Killymoon - Clare Lane (NB)	7678	892
Clare Lane - Killymoon (SB)	7701	1047
Clare Lane Roundabout	7715	1570
Old Coagh Road o/b – Clare Lane (NB)	6342	763
Clare Lane - Old Coagh Road o/b (SB)	6342	763
Old Coagh Road o/b (SB) - Clare Lane (SB)	6317	888
Old Coagh Road o/b - Moneymore (NB)	6342	763
Moneymore - Old Coagh Road o/b (SB)	6317	888
Moneymore Roundabout	6317	1331

An assumed a nominal design value of 2msa was used for Coagh Road, Old Coagh Road or Castle Link Road as there was no traffic data available.

5.2.2 Foundation

The foundation designs have been developed based on the SSM and California Bearing Ratio (CBR) values as supplied in November 2022. Any sections not included in this assessment have been assumed to have a SSM of 30MPa equivalent to a 2.5% CBR, which is the minimum allowable design value. Any value lower than 30MPa is considered

unsuitable for pavement construction and must be improved, with stabilisation or other ground improvements.

EME2 has been proposed as a material option, which requires a minimum Class 3 foundation. Additionally, any sections with design traffic more than 80msa also require a Class 3 foundation. Therefore, foundation designs were developed for Restricted Class 2 Unbound, (e.g. Type 1) and Class 3 (Bound, with Cement Bound Granular Material (CBGM). These foundation designs are summarised in Table 5-5 below.

Table 5-5 – Foundation design summary

CBR (%)	Subgrade Modulus (MPa)	Class 2 Foundation			Class 3 Foundation		
		Subbase only (mm)	Unbound Subbase + Capping		Bound Subbase only (mm)	Bound Subbase + Capping	
			Subbase (mm)	Capping (mm)		Bound Subbase (mm)	Capping (mm)
2.50	30		250	430		230	430
3.00	35		230	380		220	380
10.00	75	220			200		
15.00	100	200			200		

The foundation design for all new sections of the A29 Cookstown Bypass, Old Coagh Road, Castle Link Road and Clare Lane are based on a design SSM of 35MPa. However as identified in the SSM and CBR values as supplied in November 2022, a section of Loughry – Killymoon between the chainages of 360 – 500m, has been indicated to have a SSM of 100MPa. A thinner foundation design at this location has not been proposed as it could lead to continuity issues with the subsurface drainage in the foundation in this very short section.

Coagh Road has a SSM design value of 75Mpa, all other sections are based on 30MPa SSM.

Where necessary, the proposed specimen designs have been amended to accommodate the requirements from the Manual of Contracts for Highway Works (MCHW) for the upper 450mm of the pavement structure to be constructed of non-frost susceptible material.

5.2.3 Pavement Bound Layers

Four standard pavement types and materials were developed. There is no preference which of these options are taken forward to detailed design, the provided (A/B/C/D) options are to provide opportunity to develop the best solution with respect to cost and constructability.

- Option A is based AC20/32 HDM binder/base materials.
- Option B is based on the EME2 which is a high modulus asphalt. This material allows the bound layer thickness to be reduced significantly in comparison to HDM but comes with cost premium and it also requires a bound Class 3 foundation.
- Option C and D are what used to be referred to as flexible composite design where the surface/binder layers are constructed from asphalt and the base is Hydraulically Bound Material (HBM) or 'Lean Mix' concrete.

The design traffic was used to determine the total bound thickness of each section. The new A29 Cookstown Bypass will be of completely new construction and linked or tied into several existing connection roads, with proposed treatments for each detailed in Table 5-6 below and in 70054376-HPV-SP-700 Specification for Highway Works Appendix 700 Revision 1.

It should be noted that for any section of inlay or tie-in, the existing road pavement condition is unknown and any design life for these sections would be indeterminate. To achieve a design for maintenance in accordance with CD 227, a full investigation would need to be undertaken.

Please note the that the minimum thickness for a new pavement is 200mm.

Table 5-6 - Pavement Thickness as per CD226

Option	Road Name	Traffic (msa) 40yrs new construction	Thickness (mm) Flexible with an asphalt base HDM 40/60	Thickness (mm) Flexible with an asphalt base EME2	Thickness Flexible with and HBM Base) B – C8/10	Thickness Flexible with and HBM Base) C – C12/16	Foundation Class CD225
1	Loughry - Killymoon	92	320	270	380	350	FC3
	Killymoon - Clare Lane	92					
	Clare Lane – Old Coagh Road o/b	78					
2	Loughry Roundabout	137	320	270	380	350	FC3

Option	Road Name	Traffic (msa) 40yrs new construction	Thickness (mm) Flexible with an asphalt base HDM 40/60	Thickness (mm) Flexible with an asphalt base EME2	Thickness Flexible with and HBM Base) B – C8/10	Thickness Flexible with and HBM Base) C – C12/16	Foundation Class CD225
	Killymoon Roundabout	137					
	Clare Lane Roundabout	137					
	Old Coagh Road o/b - Moneymore	78					
	Moneymore Roundabout	117					
3	A29 Moneymore Road North	68	360	270	400	360	FC2 (FC3 for EME2)
	Sandholes Roundabout	81					
4	Sandholes Road	54	340	255	390	360	FC2 (FC3 for EME2)
	Sandholes Road East	54					
	Drum Road Roundabout	55					
5	Dungannon Road South	46	330	250	370	350	FC2 (FC3 for EME2)
6	SHL_South - Ballyreagh Business Park	34	320	240	370	340	FC2 (FC3 for EME2)
	Ballyreagh Business Park- Derryloran Ind. Estate (	33					
	Derryloran Ind. Estate - Old Rectory Park	32					

Option	Road Name	Traffic (msa) 40yrs new construction	Thickness (mm) Flexible with an asphalt base HDM 40/60	Thickness (mm) Flexible with an asphalt base EME2	Thickness Flexible with and HBM Base) B – C8/10	Thickness Flexible with and HBM Base) C – C12/16	Foundation Class CD225
	Old Rectory Park - Drum Road	33					
	Drum Road West	37					
7	Tullywiggan Road	28	310	235	370	340	FC2 (FC3 for EME2)
	Sandholes Road West	28					
	Drum Road East	23					
8	Clare Lane East	15	285	220	330	300	FC2 (FC3 for EME2)
	Tamlaghtmore Road	12					
	A29 Moneymore Road South	10					
	Dungannon Road North	15					
9	Clare Lane West	5	240	200	270	260	FC2 (FC3 for EME2)
10	SR2 – Coagh Road	2	210	200	250	250	FC2 (FC3 for EME2)
	Killymoon Road	0					
	SR1 – Old Coagh Road	2					
	Castle Link Road	2					
11	Bridge Deck Only	-	130	-	-	-	-

Option	Road Name	Traffic (msa) 40yrs new construction	Thickness (mm) Flexible with an asphalt base HDM 40/60	Thickness (mm) Flexible with an asphalt base EME2	Thickness Flexible with and HBM Base) B – C8/10	Thickness Flexible with and HBM Base) C – C12/16	Foundation Class CD225
12	Tie In only	-	110	-	-	-	-

Proposed pavement details for the 12 options shown in Table 5-6 can be found in drawings 718314-WSP-C-D-0700-0001 to 0003, refer to Appendix A.

5.2.3.1 Side Roads and Sandholes Link Road

Sandholes Link Road will undergo planing and resurfacing and widening where required. The existing junctions at north and south connections will be reconstructed as roundabouts to new levels and tied into the arms of Sandholes Road and Drum Road.

Castle Road will be reconstructed to accommodate the proposed realignment and tied into the existing road with planing and resurfacing at the west end. A new link road from Castle Road (East) will connect to the new Killymoon Road Roundabout.

Similarly, the existing Cloghog Road will be reconstructed to new levels and alignment to form the connection with the proposed Cloghog Roundabout. The new section will be tied into the existing with milling and resurfacing. A section of Clare Lane will be constructed to the new road alignment.

Coagh Road and Old Coagh Road will also be reconstructed to new levels and tied into the existing with milling and resurfacing.

A new roundabout at Moneymore Road will be constructed. New arms will be constructed to suit the realignment and tie into the existing A29 Moneymore Road and Tamlaghtmore Road.

5.2.3.2 Surfacing

There are two surface courses selected for use within The Project, consisting of Hot Rolled Asphalt (HRA) and Low Noise Road Surfacing (LNRS) designed in accordance with CD 236 Northern Ireland National Annex.) and summarised below. Surface courses typically require replacement after 10-20 years depending on the choice of material and traffic levels.

- HRA is a dense material containing 20mm pre-coated chips (PCC). It is also considered as a durable surface course with a proven long design life of 15+ years.
- LNRS is a Thin Surface Course System (TSCS) with a maximum 10mm aggregate size. The negative surface texture promotes good ride quality with noise reducing characteristics (when compared to HRA) and has a proven design life of 10-15 years.

Drawings displaying all sections that are required to be low noise zones (supplied in January 2023), show that the LNRS section begins at Loughry Roundabout and ends at the Old Coagh Road overbridge. Low noise surfacing has been specified for these sections, except for the roundabouts which do not require low noise surfacing.

5.2.3.3 Polished Stone Value

PSV and Aggregate Abrasion Value (AAV) have been assigned in accordance with CD 236, CS 228 and informed by Director of Engineering Memorandum (DEM) 168/19 for the minor roads. The guidance states that a PSV value not lower than 60PSV is required on the minor roads network for HRA in Northern Ireland.

5.2.4 Bridges

The asphalt for the new bridges consists of binder and surface course and allows for a continuation of the TSCS low noise surfacing within the new sections of the A29. A performance HRA that is compatible with concrete bridge deck water proofing systems has been specified as the binder course.

5.2.5 Footways

Two options have been provided for the footways/cycleways for pedestrian-only and light vehicle footways/cycleways. HRA has been specified as the surface course as it should provide good durability. See summary below and Table 5-7.

- Option 1: Areas adjacent to the carriageway where some overrun is likely – e.g. light vehicle footways/cycleways where occasional access by delivery vehicles is likely or footways/cycleways that are not physically separated from the carriageway by verge or bollards etc.
- Option 2: Pedestrian-only footways and cycle-only cycleways - for areas separated from the carriageway.

Table 5-7 – Footway design summary

Pavement Layer	Material ref.	Heavy Vehicle Overrun Option 1 Depth (mm)	Pedestrian/cycle-only Option 2 Depth (mm)
Surface Course	HRA 15/10f	25	25
Binder	AC 20 dense bin 40/60 rec	90	50
Subbase	Type 1 unbound	320	100
Total Construction Depth (mm)	**-**	**435***	**170***

**All materials within 450mm of the finished footway level must be non-frost susceptible.*

5.3 Structures

Requirement for structures along the Bypass is largely dictated by the proposed horizontal and vertical alignment of the Preferred Route and how this interacts with the existing topography and surrounding features such as watercourses, public roads / access routes, private access and land boundaries.

As a general approach, the requirement for structures may be reduced by constructing the Preferred Route using earthworks as much as possible. This has the dual environmental benefit of reducing the visual impact and embodied carbon of the design. Structures are relatively costly to construct and bring long-term maintenance obligations; therefore, optimising the structural provision has immediate and future cost benefits for the scheme.

Where structures remain necessary, the following considerations have been made in terms of the design proposals:

- Adherence to DMRB and DFI design standards / guidance for structures in a highway setting, particularly in relation to geometry, safety provision, materials, structural form and durability
- Adherence to structural Eurocodes in terms of design life requirements and material strengths
- Ease of future inspection
- Minimising future maintenance obligations
- Method / feasibility of construction

The structures outlined in Section 3.5 are proposed for the Preferred Route, the associated benefits and reasons for selection of each type of structure and specifics of each location are discussed in the following paragraphs and tables. All new structures have been specified with a 120-year design life.

The location of structures on are shown on drawing 718314-WSP-C-D-1700-1001. Example general arrangements of the structural forms are shown in drawings 718314-WSP-C-D-1700-1002 to 718314-WSP-C-D-1700-1004. Refer to Appendix A for the drawings.

5.3.1 Concrete Beam / Slab Bridge

Pre-casting components off-site enhances quality, reduces safety risks, and accelerates construction. Making structures integral (i.e. casting bridge decks monolithically with the supports) eliminates the requirement for bearings, which are an intensive inspection and maintenance item. Concrete structures do not require painting or other surface treatment and so reduce future maintenance. Designed and detailed properly, concrete structures should require minimal future maintenance. Precast concrete is a locally produced resource, reducing risks and costs relating to supply and transport.

Table 5-8 – Concrete Beam / Slab Bridges

Ref	Name	Clear Width	Clear Span	Additional Features / Considerations
SP-PR-02	Ballinderry River Underbridge	25m	27m	Opening sized for future flood events Mammal passage provided above flood level Maintenance / Inspection steps provided to river banks Bat boxes / tubes provided due to proximity to water
SP-PR-11	Coagh Road Underbridge	28m	19m	Hard surfacing on verge beneath structure footprint
SP-PR-12	Old Coagh Road Underbridge	26m	19m	Hard surfacing on verge beneath structure footprint

5.3.2 Concrete Box

A benefit a concrete box structure has over a concrete beam/slab arrangement is that it removes sour risk along the structure length. All concrete box watercourse structures will include:

- Opening sized for future flood events
- Mammal passage above flood level
- Bat boxes / tubes due to proximity to water

Table 5-9 – Concrete Box Structures

Ref	Name	Clear Width	Clear Height	Additional Features / Considerations
SP-PR-06	Cattle Underpass	3m	1.85m	Concrete track & additional cover through structure to resist animal waste
SP-PR-07	Watercourse Culvert	3m	1.8m	
SP-PR-08	Greenway Underpass South	3m	2.85m	Structure provided for futureproofing of greenway Security gates to prevent unauthorised access.
SP-PR-13	Watercourse Culvert	3m	1.8m	
SP-PR-14	Greenway Underpass North	3m	2.85m	Structure provided for futureproofing of greenway Security gates to prevent unauthorised access (allows for bat passage)
SP-PR-15	Watercourse Culvert	2.4m	1.2m	
SP-PR-17	Moneymore Road Culvert	2.4m	1.2m	Cascade feature required upstream of culvert Concrete cantilever wall required on approach at upstream end

5.3.3 Concrete Portal / Split Box

A benefit of a split concrete box structure over a beam/slab arrangement is that pre-cast sections reduce installation time and are typically more suitable for transportation.

Table 5-10 – Concrete Portal / Split Box Structures

Ref	Name	Clear Width	Clear Height	Additional Features / Considerations
SP-PR-16	Accommodation Underpass	4.5m	4.35m	Concrete track & additional cover through structure to resist animal waste

5.3.4 Steel Truss Footbridges

Trusses are a very efficient structural form and therefore reduce material usage by limiting the section sizes required. Using a through-truss means there are opportunities to use the structural elements to form or support the parapet, which further saves on material and cost. Using three-span structures allows the structural depth and steel member section sizes to be kept to a minimum and limits the visual impact as far as possible. Visually this makes a steel truss preferable to a concrete beam and slab bridge which would be the likely alternative. More costly steel structural forms (e.g. cable stayed) were not considered to be appropriate within the context of the overall scheme budget.

Table 5-11 – Steel Truss Bridges

Ref	Name	Clear Width	Clear Span	Additional Features / Considerations
SP-PR-06a	Killymoon Roundabout Foot/Cycle Overbridge	3.5m	71m	3.5m clear width provided for unsegregated foot/cycle use
SP-PR-19	Moneymore Roundabout Foot/Cycle Overbridge	3.5m	69m	3.5m clear width provided for unsegregated foot/cycle use. Reinforced earth wall required to form approach ramp on west side

5.3.5 Block Gravity Walls

Block gravity walls are proposed to be used for retaining elements below 5m height where space permits. The key benefits are as above, plus as concrete blocks do not contain

reinforcement, there is limited scope for them to degrade and should remain maintenance-free throughout their design life.

Table 5-12 – Block Gravity Walls

Ref	Name	Length	Max. Height	Additional Features / Considerations
SP-PR-03	Ballinderry Retaining Wall - LH	160m	2.5m	Land boundary constraint to rear
SP-PR-09	Cloghog Road West Retaining Wall	85m	2m	Land boundary constraint to rear
SP-SHL-01	Strifehill Road Retaining Wall	25m	1.75m	Land boundary constraint to rear

5.3.6 Reinforced Earth Walls

For retaining elements between 5m and 10m, reinforced earth walls' key benefits include reduction in costs associated with future maintenance as they do not require painting or other surface treatments and can be finished in a variety of facings or (up to a certain angle) be grassed to soften visual impact. They have lesser requirement for temporary works on the front face, when compared with other forms of retaining wall, advantageous where obstacles are close and propping of large formwork or formation of piling platforms is not possible or would be excessively costly, e.g. at Ballinderry River Wall.

Table 5-13 – Reinforced Earth Walls

Ref	Name	Length	Max. Height	Additional Features / Considerations
SP-PR-04	Ballinderry Retaining Wall - RH	245m	9m	Close proximity to Ballinderry River Block facing to improve aesthetic Bat boxes / tubes provided due to proximity to water Additional ground beam provided for fixing of mainline parapet

5.3.7 Concrete Cantilever Wall

The stem of the wall can be used to fix whatever cladding is required and can also be used as a foundation for construction above or for fixing of parapets. The backfill to the wall remains free of obstructions (e.g. straps associated with reinforced earth) which can impede services.

Table 5-14 – Concrete Cantilever Walls

Ref	Name	Length	Max. Height	Additional Features / Considerations
SP-SHL-03a	Fairy Burn Culvert Parapet Wall - LH	60m	1.5m	Close proximity to existing structures & services – firm structure required for mounting of parapet Masonry cladding on wall stem to soften aesthetic
SP-SHL-03b	Fairy Burn Culvert Parapet Wall - RH	35m	1.5m	Close proximity to existing structures & services – firm structure required for mounting of parapet Masonry cladding on wall stem to soften aesthetic

5.3.8 Bored Secant Pile Wall

Piling requires less disruptive excavation during construction than a cantilever wall with bored concrete piles better suited to unknown ground conditions than other forms of pile (e.g. sheet piles). A secant arrangement (i.e. interlocking) creates an impervious barrier and thus prevents below-ground seepage of flood water, particularly relevant and applicable for construction of floodwall.

Table 5-15 – Bored Secant Piled Wall

Ref	Name	Length	Max. Height	Additional Features / Considerations
SP-PR-01a	Otter Lodge Flood Wall	174m	2m	Close proximity to property and car park Masonry cladding on wall stem to soften aesthetic

5.3.9 Existing Structures

Use of existing structures reduces cost and disruption associated with construction of the scheme. While 120-year design life will not be achieved, as for new structures, measures can be undertaken by DfI Roads to extend the service life of existing structures, including regular inspection and maintenance activities.

Table 5-16 – Existing Structures

Ref	Name	Primary reasons for retaining existing structure
SE-PR-01	Loughry Roundabout Culvert	Existing structure in good condition Significant junction – potential for severe disruption and temporary works Large number of existing services over structure Environmental
SE-SHL-02	Fairy Burn Culvert	Existing structure in good condition Potential for severe disruption to nearby business owners Temporary works Close proximity of third-party property Gas main present within carriageway

5.4 Flooding and Hydrology

5.4.1 Policies, Guidance, Standards and Consultation

The FRA for the Proposed Scheme has been carried out with reference to:

- Strategic Planning Policy Statement for Northern Ireland
- Planning Policy Statement 15
- DMRB; specifically, LA 113 Road drainage and the water environment (formerly HD 45/09), Revision 1, March 2020[1] and LA 104[2] Environmental assessment and monitoring (formerly HA 205/08, HD 48/08, IAN 125/15 and IAN 133/10) Revision 1, August 2020.

[1] LA 113 includes definitions of the importance of water environment attributes with respect to flood risk (Low, Medium, High, Very High) and a classification system for the magnitude of the impact of a scheme (No Change, Major Beneficial, Moderate Beneficial, Minor Beneficial, Negligible, Minor Adverse, Moderate Adverse, Major Adverse).
[2] Importance and magnitude are then used to determine the significance of the potential impact in accordance with LA 104.

- Information from the Client, Northern Ireland Water (NIW) and Department of Agriculture, Environment and Rural Affairs provided through site-specific consultation. Mid Ulster District Council was consulted however no information was received.

The flood risk has been assessed from rivers, sea/tidal sources, surface water, groundwater, sewers and artificial sources.

The following guidance documents have been used in the design of the Proposed Scheme:

- CD 529: Design of Outfall and Culvert (Version 1.0.1, December 2021, replaces HA 107/04) and supplements the guidance given in the Construction Industry Research and Information Association (CIRIA) document C786 and explains how the guidance in that document applies to motorways and all-purpose trunk roads.
- CIRIA C786 (December 2019) guidance for changes to existing or design of new culverts, screens and outfalls.
- CD 356: Design of Highways Structures for hydraulic action (Revision 1, March 2020, formerly BA 59/94).
- DfI Rivers Technical Guidance Note 29: Design of Culverts, Screens and Outfalls (January 2021).
- Technical Flood Risk Guidance in relation to Allowances for Climate Change in Northern Ireland (DfI Water and Drainage Policy Division, February 2019).

The FRA should be read in conjunction with the EIAR, including Chapter 9 Geology and Soils and Chapter 15 Road Drainage and Water Environment. It should also be noted that further information regarding stakeholder consultation, including liaison with the Client, can be found in Chapter 5 Approach to EIAR, of the EIAR.

5.4.2 Existing and Future Flood Risk

DfI flood maps show fluvial flood risk in the vicinity of the Proposed Scheme for both the 'Present Day - Floodplain Rivers' (1% AEP fluvial flood event) and 'Climate Change – Floodplain Rivers' (1% AEP fluvial flood event plus 20% climate change (CC) allowance). The Proposed Scheme does not lie within either present day or climate change tidal flood event extent.

It has been established through discussion with DfI Roads and DfI Rivers that the Proposed Scheme should be considered as a strategically important development. The NI guidance on climate change allowances states that *"where a strategically important development is being designed or assessed for climate impacts or, where risk to life or major economic losses could occur should design levels be overtopped, it may be more precautionary to use allowances based on the 90% and 95% percentiles for fluvial and coastal design respectively"*. DfI Water and Drainage Policy Division confirmed (during a meeting regarding the A5WTC) that the 90% probability level for fluvial design should be taken as +35%. It was agreed with DfI Roads that the 1% AEP event plus 35% climate change allowance should be the design event for the Proposed Scheme to be precautionary as it is

strategically important infrastructure and to ensure the Proposed Scheme design is robust throughout its design life.

Refer to Section 6 of the FRA (718314-0500-R-0005, Version 4.0, February 2024) for figures showing present day (1% AEP) and climate change (1% AEP plus 20% climate change allowance) fluvial flood event scenarios taken from DfI web-based mapping, for Ballinderry River and tributaries, Old Coagh Road watercourses and Claggan Lane watercourses.

5.4.3 Modelling Methodology

The main risk of flooding to the Proposed Scheme and surrounding areas is fluvial flood risk from watercourses. Hydraulic modelling has been undertaken to understand the existing (baseline) flood risk and the impact of the Proposed Scheme on flood risk. Where the Proposed Scheme was shown to have an adverse impact on flood risk, appropriate mitigation has been determined using the hydraulic models and through discussions with the various stakeholders within the design team and DfI.

Three hydraulic models were developed to inform the FRA to include all the watercourses crossed by the Proposed Scheme. The largest of the models represents the Ballinderry River, Fairy Burn, Molesworth Road Stormwater Drain, Fountain Road Stormwater Drain plus some smaller tributaries.

Two other models were developed, representing smaller watercourses that cross the Proposed Scheme further north of the Ballinderry River; named as Old Coagh Road watercourses and Claggan Lane watercourses.

5.4.4 Bridges, Culverts and Diversions

The proposed structures and diversions associated with each watercourse crossing of the Proposed Scheme are provided in Table 5-17.

Table 5-17 - Structures and Diversions for each watercourse crossing

Approximate Chainage on Mainline (m)	River / Location	Feature Reference	Feature Details
3897 (Moneymore Roundabout)	Claggan Lane watercourses	SP-PR-17	Proposed box culvert 2.4m (w) x 1.5m (h) x 22m long (includes 300mm embedment and 900mm mammal ledge). Includes a cascade structure approx. 10m upstream of the culvert inlet. Cascade includes 3 equal steps, total length is 4m, total drop is 1.1m.

Approximate Chainage on Mainline (m)	River / Location	Feature Reference	Feature Details
			Cascade required to achieve sufficient cover and freeboard for culvert.
3897 (Moneymore Roundabout)	Claggan Lane watercourses	WD-PR-04	Approx. 310m long diversion channel.
3150	Old Coagh Road watercourses	SP-PR-15	Proposed box culvert 2.4m (w) x 1.5m (h) x 105m long (includes 300mm embedment and 900mm mammal ledge).
3000	Old Coagh Road watercourses	SP-PR-13	Proposed box culvert 3.4m (w) x 2.1m (h) x 101m long (includes 300mm embedment and 900mm mammal ledge).
2950 to 3050	Old Coagh Road watercourses	WD-PR-03	Approx. 128m long diversion channel.
1350	Fountain Road Drain Crossing	SP-PR-07	Proposed box culvert 3.0m (w) x 2.1m (h) x 74m long (includes 300mm embedment and 900mm mammal ledge). 30m long diversion at the confluence of Molesworth Road Drain and Fountain Road Drain at upstream end of proposed culvert. 44m long diversion at downstream end of proposed culvert and removal of small existing field crossing arch culvert.
200	Ballinderry Bridge Crossing	SP-PR-02	Proposed clear span bridge with an opening width of 27m and opening height of 6.2m above channel invert.
50 - 150	Fairy Burn Diversion	SP-PR-01	Approx. 120m long diversion channel on the Fairy Burn which joins the Ballinderry River upstream of the proposed bridge.

Approximate Chainage on Mainline (m)	River / Location	Feature Reference	Feature Details
Sandholes Link Road	Sandholes Road Bridge Parapet	SP-SHL-02	Edits to the parapet of the existing Sandholes Road bridge (no change to bridge opening).

The hydraulic models have been used to determine the size of culverts and bridge openings required to convey the 1% AEP event plus 35% climate change allowance plus 600mm freeboard. The culvert sizes allow for a minimum 300mm embedment depth and 1500mm cover to culvert, as well as a 900mm wide mammal ledge. The hydraulic models have been used to inform the design of the watercourse diversion (and cascade) required to contain the 1% AEP event plus 35% CC allowance flows.

5.4.5 Impacts and Mitigation Measures

Once the components of the Proposed Scheme had been sized appropriately, the baseline and Proposed Scheme hydraulic model results for the 1% AEP event plus 35% climate change allowance were compared at specific points along the watercourses to ascertain the impact of the Proposed Scheme to determine if further mitigation is required.

5.4.5.1 Old Coagh Road watercourses

At Old Coagh Road watercourses, hydraulic modelling results for the Proposed Scheme does not indicate any properties at risk, due to the Proposed Scheme. As there is a small localised floodplain (at TRIB02_656) on the right bank in agricultural land, immediately downstream of the proposed culvert (SP-PR-13) and the proposed diversion the importance as per LA 113 is ‘Medium’. There is an increase of 10mm in peak water level, therefore the magnitude as per DMRB LA 113 is ‘Negligible’. The overall significance of impact on the floodplain for Old Coagh Road watercourses as per DMRB LA 104 is classified as ‘Neutral or slight’. As the floodplain (at TRIB02_656) is localised at the periphery of the agricultural field immediately adjacent to the channel, professional judgement has been made and the overall significance is deemed ‘Neutral’. The increase in water levels is localised and there are no properties adjacent to the channel at this location therefore does not pose any additional flood risk. No additional floodwater has been displaced as a result of the Proposed Scheme; therefore, no mitigation is required.

5.4.5.2 Claggan Lane watercourses

At Claggan Lane watercourses, the hydraulic modelling results do not indicate any additional properties at risk due to the Proposed Scheme. It should be noted that the water levels do not alter with the Proposed Scheme at the location where the WWTW and Tamlaghtmore Road is at risk of flooding in baseline scenario. The WWTW sits adjacent to Claggan Lane watercourses and is over 600m downstream of any proposed works at the

northern extent of the Proposed Scheme. As there is some floodplain in agricultural land downstream of the Proposed Diversion the importance as per DMRB LA 113 is 'Medium'. There is either no impact on water levels or some reduction on water levels in the watercourses as a result of the Proposed Scheme. Consequently, the magnitude as per DMRB LA 113 is 'No Change'. The overall significance of impact on the floodplain for Claggan Lane watercourses as per DMRB LA 104 is 'Neutral'. The Claggan Lane watercourses results have shown that there is no detrimental impact of the Proposed Scheme. No additional floodwater has been displaced as a result of the Proposed Scheme; therefore, no mitigation is required.

5.4.5.3 Fountain Road Stormwater Drain

The results at the diverted Fountain Road Drain indicate there is a decrease in water level immediately upstream of the proposed structure, associated with the introduction of a diversion channel, a culvert crossing the proposed A29 alignment and the removal of the arch culvert downstream of the crossing. The Proposed Scheme does not interact with the existing floodplain at Fountain Road Drain so there is no loss of floodplain and no compensatory storage needed. There is an area of existing floodplain that is adversely impacted further downstream on Fountain Road Drain (within adjacent fields by a former railway embankment). The results show up to 44mm increase in water level, this is classified as "Minor Adverse" impact for magnitude of flood risk (within the vesting line, please see Figure 6-7 and Table 6-7 within the FRA for further detail). There are no properties at flood risk but the land use on the floodplain is agricultural land, so is classified as "Less Vulnerable", and sits in the "Medium" category for importance/environmental value. The overall significance is classified as "Slight Adverse." As the overall significance of the impact of the Proposed Scheme is "Slight Adverse" with areas of beneficial impact, no further mitigation is proposed in this area.

5.4.5.4 Fairy Burn watercourse

The impact of the Proposed Scheme on the diverted Fairy Burn has no change in peak water levels upstream of the existing Loughry Roundabout culvert. Any increase is within the proposed diversion only and there are no properties impacted and no increase in flood extent. The overall significance is therefore "Neutral" for the Fairy Burn.

5.4.5.5 Ballinderry River

There is one property at risk in this location (Otter Lodge, it is classified as "Less Vulnerable" and sits in the "Medium" category, as per DMRB LA 113 for importance) . The water level increase predicted as a result of the Proposed Scheme is 50mm above the threshold for "Major Adverse" magnitude of impact, the overall significance has been determined as "Moderate Adverse".

Following the impact assessments on fluvial flood risk for the Proposed Scheme works, further testing of alternative designs and mitigation measures was undertaken, with further detail within the FRA.

The proposed mitigation for Ballinderry River and Fairy Burn area is detailed below in Table 5-18. It consists of a flood wall to protect the property on the left bank of the Ballinderry River upstream of the proposed bridge crossing. A compensatory storage area is also planned to offset the loss of floodplain due to the Proposed Scheme. The total volume of floodplain displaced is 2,323m^3 and the total proposed to compensate is 3,166m^3, which allows for some minor changes at detailed design if required.

There is no mitigation proposed for a residential property that is adjacent to the Ballinderry River, as this is above the 1% AEP + 35% CC design event water level and hence is not at existing flood risk. The residential property is also not at flood risk due to the Proposed Scheme. Access and egress during a flood event would be possible on the northern side of the residential property, which is not at risk of flooding.

Table 5-18 – Proposed Flood Mitigation

Approximate Chainage on Mainline (m)	Mitigation	Mitigation Details
200	Flood Defence Wall (SP-PR-01a)	Approx. 174m long flood wall on left bank of Ballinderry River downstream of existing Dungannon Road Bridge. Proposed top wall level at approx. 41.5mAOD to protect against 1% AEP plus 35% CC water level with 600mm freeboard.
300	Compensatory Storage Area on left bank of Ballinderry River	Area lowered to approx. 38.0mAOD and 1:20 gradient towards Ballinderry River to allow flow in and out during times of flood. Excavation cut at 1:3 slope on West side and tie-in with an extension to the proposed retaining wall of the main route. Maintenance access is via proposed Sustainable Drainage System (SuDS) Pond ML2 with access slopes at approx.1:4.

The Otter Lodge property shown to be at risk of flooding is being protected by the flood wall as part of mitigation within the Proposed Scheme. The increase in water levels in channel and in front of the flood wall is greater than 100mm and is therefore classed as “Major Adverse”. In terms of overall significance, this translates to “Slight or Moderate Adverse” in

DMRB LA104. However, the water level increases above 100mm are only in channel and immediately in front of the flood wall with mostly beneficial impacts seen further downstream, the residual flood risk significance has been deemed as “Slight Adverse”.

5.5 Drainage

The proposed road drainage system has been designed in accordance with the requirements set out in the DMRB, guidance set out in the Construction Industry Research, and Information Association (CIRIA) C753 The Sustainable Drainage System (SuDS) Manual, and best practice.

Drainage Plan drawings 718314-WSP-C-D-0500-0301 to -0306 (refer to Appendix A) provide an overview of the proposed design, including drainage networks and flow directions, open channel ditches, swales and SuDS ponds. The drawings also show the proposed outfall locations.

To ensure the drainage design is fit for purpose and in accordance with design standards and best practice, design objectives were established as follows:

- Prevention of flooding of the proposed carriageway and ponding on the surface;
- Provision of subsurface drainage for protection of the integrity of the road pavement and subgrade;
- Provision of top/toe of slope drainage for protection of earthworks;
- Interception of overland flows separate from the road drainage;
- Control of waterborne pollutants associated with carriageway runoff and accidental spillage to protect receiving water bodies and groundwater from risk of contamination;
- Control the water quantity to mitigate the impact on watercourses and flood risk within the Ballinderry catchment.

The scheme will introduce new areas of hard standing. Drainage of these surfaces would be managed to ensure that surface water passing from them to the ground or watercourses is controlled and treated. The Bypass and side roads will be drained, attenuated, and treated in accordance with DMRB guidance and sustainable drainage best practice.

5.5.1 Mainline Drainage

5.5.1.1 Surface and Sub-Surface Drainage

The primary method of surface and sub-surface drainage on the mainline is proposed to be through filter drains.

For kerbed sections of the Bypass, surface runoff would be collected along the kerb line and conveyed via kerb grips to shallow roadside dry swales with underlying filter drains. The dry swale is located within the verge adjacent to the edge of carriageway and will follow the same longitudinal gradient. Water would infiltrate through the swale topsoil and underlying filter media to the filter pipe, where it is conveyed along the network to the attenuation pond

feature. Chamber covers for the dry swale sections are proposed to sit slightly proud of the swale invert level and have a grated cover to allow direct access during extreme rainfall events to minimise risk of ponding on the road.

For non-kerbed sections of the Bypass, surface runoff water is proposed to drain over the edge and be collected by filter drains where the water would infiltrate through the topsoil and underlying filter media to the filter pipe, where it is conveyed along the network to the attenuation feature.

Additionally, for sections where it not possible to provide filter drains, combined kerb drainage systems have been proposed. Example of such locations include sections of bridges, retaining walls, roundabout central islands, and traffic islands.

5.5.1.2 Attenuation

The Bypass is proposed to be attenuated via SuDS in the form of four retention ponds and two swales, designed in accordance with The SuDS Manual (CIRIA C753).

In accordance with CG501 of the DMRB, retention ponds have been designed to attenuate the 100-year design storm event, including a 20% uplift in peak rainfall for climate change, and discharge at the greenfield runoff rate. Additional capacity has been built-in with a 300mm typical freeboard above the stated storm.

5.5.1.3 Treatment

The proposed treatment regime for non-kerbed sections of the mainline is filter drain discharging to a SuDS pond or swale, followed by a set-back outfall via a grassed ditch.

The proposed treatment for kerbed sections of the mainline is a roadside shallow swale to a filter drain, followed by a SuDS pond / swale, then a set-back outfall via a grassed ditch.

5.5.2 Side Road Drainage

5.5.2.1 Surface and Sub-Surface Drainage

Surface and subsurface drainage for side roads would be via filter drains where possible, with the proposed drainage more closely matching the existing system near tie-in locations.

5.5.2.2 Attenuation and Treatment

Side roads have been checked against existing pre-development discharge rates and attenuation needs have been estimated. Attenuation for this is typically provided via grassed surface water channels with check-dams, oversized pipes, or other flow-slowing features.

5.5.3 Sandholes Link Road Drainage

5.5.3.1 Surface Drainage

Along Sandholes Link Road, topographical survey information and utilities information have been used to identify existing drainage and any outfalls to be maintained. The existing

drainage consists of kerb and gully systems, and it is proposed to maintain the existing regime as much as possible as there is limited available space to introduce new SuDS.

5.5.3.2 Attenuation

The attenuation for Sandholes Road is proposed by use of oversized pipes.

5.5.4 Pre-Earthworks Drainage

Pre-earthworks drainage (PED) is proposed by means of grassed ditches or filter drains at the top of cutting slopes and toe of embankment slopes to intercept overland flows from adjacent natural catchments.

The proposed pre-earthworks drainage would also intercept existing field drainage where the proposed works severs or otherwise interrupts these networks.

Pre-earthworks drainage have been sized to accommodate flows and proposed at a longitudinal gradient suitable to discharge to a receiving watercourse via a channel connection. Where it is not possible to discharge to a receiving watercourse, the PED is proposed to tie-in with mainline drainage.

Due to topographical constraints, it is necessary for some PED networks to transfer flows from one side of the carriageway to the other, which is facilitated by pipe crossings.

5.5.5 Outfalls

Outfalls are proposed to watercourses via set-back outfalls to grassed ditches, with a direct open-channel to open channel connection. Some sections of road will connect to existing drainage systems where appropriate. For more details on outfalls refer to Section 5.5.6.

5.5.6 Summary of Drainage Networks

The drainage networks for the mainline, Sandholes Link Road, and side roads have been summarised in Table 5-19 below. The drainage networks have been identified by providing an outfall reference number as shown on drainage plan drawing numbers 718314-WSP-C-D-0500-0301 to -0306 (refer to Appendix A).

Table 5-19 – Summary of Proposed Drainage Networks

Network Outfall Reference	Drawing Reference	Catchment	Chainage Reference (m)	Outfall Details
O-ML1	0301	Mainline	Ch.0 to 170	Discharging to Ballinderry river via proposed swale with check dams

Network Outfall Reference	Drawing Reference	Catchment	Chainage Reference (m)	Outfall Details
O-ML2	0301	Mainline	Ch.170 to 1090	Discharging to Ballinderry river via proposed SuDS retention pond followed by a grassed ditch
O-ML3	0303	Mainline	Ch.1590 to 2500	Discharging to Fountain Road drain via proposed SuDS retention pond followed by a grassed ditch
O-ML4	0303	Mainline	Ch.1590 to 2500	Discharging to Fountain Road drain via proposed SuDS swale followed by a grassed ditch
O-ML5	0305	Mainline	Ch.2500 to 3380	Discharging to Old Coagh Road watercourse via proposed SuDS retention pond followed by a short length of grassed ditch. The drainage network includes the drainage network for Old Coagh Road Ch. 80 to 380
O-ML6	0306	Mainline	Ch.3380 to 3390	Discharging to realigned Claggan Lane watercourse via proposed SuDS retention pond

Network Outfall Reference	Drawing Reference	Catchment	Chainage Reference (m)	Outfall Details
O-SR1	0302	Side Road-Killymoon Road	Ch.0 to 100	Discharging to existing ditch via proposed grassed ditch with check dams for attenuation
O-SR2	0302	Side Road-Castle Road	Ch.0 to 596	Discharging to existing ditch via proposed SuDS swale with check dams for attenuation
O-SR4	0303	Side Road-Cloghog Road (East) & Clare Lane	Cloghog Road (East) Ch.0 to 200 & Clare Lane Ch.0 to 190	Discharging to existing ditch via proposed ditch with check dams for attenuation
O-SR5	0303	Side Road-Clare Lane	Ch.190 to 455	Discharging to existing ditch. As the network is very similar to existing drainage system, no additional attenuation is required
O-SR6	0304	Side Road-Coagh Road	Ch.20 to 380	Discharging to existing ditch via proposed grassed ditch with check dams for attenuation
O-SR8	0305	Side Road-Old Coagh Road	Ch.0 to 80	Discharging to existing ditch via proposed grassed ditch with check

Network Outfall Reference	Drawing Reference	Catchment	Chainage Reference (m)	Outfall Details
				dams for attenuation
O-SR10	0306	Side Road-Moneymore Road (S-W)	Ch.0 to 50	Discharging into realigned Claggan Lane watercourse via grassed ditch with check dams for attenuation
O-SR11	0306	Side Road-Tamlaghtmore Road	Ch.0 to 110	Discharging into realigned Claggan Lane watercourse. As the catchment is very similar to existing, no additional attenuation is required
O-SR12	0306	Side Road-Moneymore Road (S-W)	Ch.50 to 400	Discharging to existing ditch. As the network is very similar to existing drainage system, no additional attenuation is required
O-SHL1	0301	Sandholes Road	Sandholes Road Roundabout East and West Arm	Discharging to existing drainage network at Sandholes Road. Attenuation provided by oversized pipes
O-SHL2	0301	Sandholes Road	Ch.0 to 200	Discharging to existing drainage network at Sandholes Road. Attenuation

Network Outfall Reference	Drawing Reference	Catchment	Chainage Reference (m)	Outfall Details
				provided by oversized pipes
O-SHL3	0301	Sandholes Road	Ch.550 to 700	Discharging to existing drainage network at Drum Road. Attenuation provided by oversized pipes

Notes:

1. *The drawing reference numbers represent the last 4 numbers of the drawing series 718314-WSP-C-D-0500-0301 to -0306 (refer to Appendix A).*
2. *The outfall details indicate the drainage arrangements immediately prior to the outfall and do not include the surface water and sub-surface water collection arrangement.*

5.5.7 Assumptions and Key Considerations

The following section outlines the assumptions and other key considerations related to the drainage networks.

- Where drainage networks are shown to cross over other infrastructure such as structures or utilities, adequate cover has been achieved where the depth information is available. Where utility depth information has been absent (e.g. due to a lack of survey), utilities are assumed to pass based on typical depths. All structure and utility depths will need to be confirmed during future design development, which may result in updates to the drainage network levels being required.
- Where existing drainage networks are shown to be retained within The Project vested boundaries, the existing drainage infrastructure is assumed to be of suitable condition to be retained.
- The condition of existing drainage shall be confirmed by a detailed CCTV survey at a future design stage. The CCTV survey shall also assist in confirming exact tie-in locations and levels of proposed drainage with existing. If it is deemed that the existing pipework within The Project vesting boundary is unsatisfactory, replacement with like for like infrastructure may be required.
- Assumes that the outfalls (or diversions) of assets from the WWTW (Ch.480-580m) is subject to ongoing coordination and assumes for the gravity connections to be maintained.
- Areas with significant areas of cut may require pre-earthworks drainage to tie into mainline drainage for the purpose of crossing the works.

- Due to difficult existing terrain and in order to minimise land-take, there is a location adjacent Cloghog Roundabout where the runoff from natural catchment is proposed to enter road drainage. This has been documented as a Departure from Standards, refer to Appendix D.

5.6 Public Utilities

To determine the presence of existing services within the Bypass' study area and the extent of diversionary works (and costs) required, C3 requests were issued in mid-2022 to the following Statutory Authorities, Public Utilities and Service Providers:

- British Telecommunications (BT)
- Northern Ireland Water (NIW)
- Northern Ireland Electricity (NIE)
- Department for Infrastructure – Roads (street lighting, traffic signals, etc.)
- Scotia Gas Networks (SGN)
- Clear Channel NI.

The majority of the services affected are located where the Bypass crosses the existing road network and will require minor diversionary works as summarised in the following sections.

5.6.1 Loughry Roundabout

With the existing Loughry Roundabout now proposed to be a five-arm oval roundabout, several existing utilities will need to be diverted.

NIW has an existing Foul Water Service around the eastern perimeter of Loughry Roundabout, which is proposed to be replaced with 225mm concrete pipes. The pipes will tie into the existing network at the Stewartstown Road arm, and a new run is proposed to tie into the existing Fairy Burn wastewater pumping station (WwPS) on the A29 Dungannon Road arm.

BT has an existing underground duct around the eastern perimeter of Loughry Roundabout, which is proposed to be replaced with underground ducts and joint boxes running along the southern perimeter of Loughry Roundabout. This new duct will connect into the existing services on the Cookstown and Stewartstown Road arms.

NIE has existing low voltage (LV) and high voltage (HV) underground ducts around the eastern perimeter of Loughry Roundabout. It is proposed to abandon and replace with underground ducts running underneath the new Bypass arm, connecting into the existing services on the Cookstown and Stewartstown Road arms.

5.6.2 Mainline south [Ch.0 - 1100m]

NIW has existing utilities at the WWTW. At approximate Ch.500m, an existing Final Effluent Water service will be removed and replaced with a proposed 525mm concrete Final Effluent service with two proposed Final Effluent manholes either side of the Bypass.

At Ch.520m, an existing Combined Water service will be removed and replaced with a proposed Combined service (pipe diameter TBC).

At Ch.570m, an existing Combined Water service will be removed and replaced with a 600mm concrete Combined service pipe with two Combined manholes either side of the Bypass. Access to the outlets on the eastern side of the Bypass will be provided via the pedestrian access alongside the nearby Ballinderry River retaining wall.

NIE has existing overhead services at Ch.250m and Ch.700m. NIE has proposed to replace these services and raise the poles to provide the correct clearance over proposed road levels.

5.6.3 Castle Link Road

The Bypass will intersect an existing NIW water main on Castle Road. NIW has proposed to replace this water main at a new depth to cross under the Bypass with new hydrants, sluice and air valves.

BT has existing overhead services on the Castle Road. BT has proposed to divert this underground beneath the Bypass and connect into the existing services on the Castle Road.

5.6.4 Killymoon Roundabout

BT has existing underground services on the Killymoon Road. With the introduction of Killymoon Roundabout, BT has proposed new underground services to the northern extents of the proposed roundabout and along the new access lane (off Castle Link Road) to the golf club and castle.

5.6.5 Mainline middle [Ch.1100 - 1900m]

NIW has an existing Final Effluent Water service at approximate Ch.1600m that requires new discharge and consent. A final location will be confirmed prior to works commencing.

The Bypass will intersect existing NIE overhead services at approximate Ch.1600m to Ch.1800m. NIE has clarified the existing posts are sound and already provide the correct clearance requirements over the Bypass.

5.6.6 Cloghog Roundabout

NIW has an existing Foul Water Service on Cloghog West Arm at approximate Ch30. NIW has proposed a 225mm concrete pipe with foul manholes to replace the existing services.

NIW has an existing water main on the Cloghog Road. NIW has proposed to abandon and replace this with a diversion running south of the roundabout, south of the arms, and south of the new Clare Lane alignment with several proposed hydrants, air valves and sluice valves.

BT has existing overhead services on the Cloghog Road. With the introduction of Cloghog Roundabout, BT has proposed new underground services to the northern extents of the proposed roundabout.

NIE has existing overhead services on the Cloghog Road. With the introduction of Cloghog Roundabout NIE has proposed replacement underground ducts to the west of the roundabout. These works will also include erecting new poles and connections to the existing apparatus north and south of the roundabout.

5.6.7 Mainline north [Ch.1900 - 3900m]

NIE has existing overhead services at approximate Ch2320m. NIE propose to erect a new 12m stout inter pole to the west of the Bypass. The existing pole to the east of the Bypass is to be removed, repositioned, and replaced with a new 12m stout inter pole. Another pole located further east is to be replaced with a 14m stout section.

NIE has existing overhead services between Ch.2780 to Ch2860m. NIE propose to remove, reposition and replace two existing poles east and west of the Bypass. A 13m and 14m med inter poles will be erected to the west and east on the vesting boundary, respectively.

The Bypass will intersect existing NIE overhead services at approximate Ch.3700m. NIE has clarified the existing posts are sound and already provide the correct clearance requirements over the Bypass.

5.6.8 Coagh Road

NIW has an existing water main on Coagh Road. NIW has proposed to replace this existing water main with a main with hydrants, sluice and air valves in the vicinity of the proposed realignment works.

BT has existing underground services on Coagh Road, which will be replaced by new underground services to the north of the realignment works.

5.6.9 Old Coagh Road

NIW has an existing water main on Old Coagh Road. NIW has proposed to replace this existing water main with a main with hydrants, sluice and air valves in the southern verge in the vicinity of the proposed realignment works.

BT currently has a gap between existing services on Old Coagh Road. BT has proposed new underground services to connect these existing networks together.

5.6.10 Moneymore Roundabout

NIW has an existing Foul Water service along the eastern side of Moneymore Road. NIW has proposed to divert this service with 225mm concrete pipes (with new foul manholes) to the western extents of the new Moneymore Roundabout.

NIW has an existing water main on the Moneymore Road. NIW has proposed to replace this existing water main with a main with hydrants, sluice and air valves in the southern verge in the vicinity of the proposed roundabout. A minor water main diversion on the Tamlaghtmore Road is also proposed.

BT has existing underground services to the north of the Moneymore Road. BT has proposed similar lines running along the northwest of the Moneymore Roundabout. It is proposed that overhead lines in the Tamlaghtmore Road area are diverted underground.

SGN has existing intermediate pressure mains underneath the existing Moneymore Road. SGN will provide information regarding protection works prior to construction.

5.6.11 Sandholes Link Road

5.6.11.1 Sandholes Road Roundabout

NIW has existing Foul and Surface Water services on the Sandholes Road. NIW has proposed a 225mm concrete foul line to run south of the roundabout (with 6No. new manholes). A proposed 900mm concrete surface water line will run south of the roundabout (with 7No. new manholes).

There is an existing water main in this vicinity which NIW has proposed to abandon. A new main is proposed crossing the western and northern roundabout arms and continues along Sandholes Link Road (with a proposed sluice and air valves). A minor section on the eastern arm will also be abandoned and a replacement main (with proposed sluice valves, a hydrant, and air valve) is proposed.

Existing BT underground ducts on the northern extent of Sandholes Road are proposed to be diverted to the south of the roundabout.

SGN has proposed gas mains to the north of the proposed roundabout. If this work is complete prior to construction commencing, SGN will provide as-built information and protection works.

5.6.11.2 Sandholes Link Road

NIW has an existing Foul Water service on the Sandholes Link Road. NIW propose a 225mm concrete foul line (with 5No. manholes) along the proposed footway between Ch.00m and Ch.130m. A second 900mm concrete foul line (with 5No. manholes) is proposed crossing the Sandholes Link Road at approximate Ch.500m and runs to the Drum Road Roundabout, replacing the existing line.

NIW has an existing water main on Sandholes Link Road and Strifehill Road. NIW has proposed a new main (with hydrants, air valves and sluice valves) along the proposed footway.

An existing NIE service between Ch.70 to 150m will not be impacted by proposed road levels.

A length of existing underground NIE ducting in the western footway on the approach to Drum Road Roundabout (and around the roundabout) is proposed to be replaced. These new services will connect to the existing network.

SGN has an existing intermediate pressure main along the Strifehill Road and the eastern extent of Sandholes Link Road. Information regarding protection works will be provided by SGN prior to construction.

SGN has proposed gas mains to the eastern extent of Sandholes Link Road, crossing to the west at approximate Ch.210m. If this work is complete prior to construction commencing, SGN will provide as-built information and protection works.

5.6.11.3 Drum Road Roundabout

NIW has an existing Foul Water service (with manholes) on the Drum Road. NIW propose to be replace this line with a 225mm concrete run (5No. manholes).

NIW will replace all existing water mains along the footways with several proposed hydrants, air valves and sluice valves.

BT has existing underground ducts in Drum Road. With the introduction of the Drum Road Roundabout, it is proposed that the replacement underground ducts will run southeast of the roundabout, crossing the west arm and along the north of the roundabout.

NIE has existing underground services in Drum Road. With the introduction of the Drum Road Roundabout, it is proposed that the replacement underground ducts will run in the of the roundabout, crossing the west arm and along the north of the roundabout.

NIE has proposed new underground ducting under the northern footway of the roundabout, replacing the existing section. Proposed works will tie into the existing services.

SGN has an existing intermediate pressure mains along the east and west of the Sandholes Link Road and to the east and west of Drum Road. SGN will provide information regarding protection works prior to construction.

5.7 Road Lighting

The new Bypass is aligned through existing fields and side roads where there is no existing road lighting. It is proposed to install new road lighting at each of the roundabouts and arms. The Killymoon, Cloghog and Moneymore roundabouts will have a mixture of aluminium road lighting columns of 12m nominal height with a planted base and post top mounted, and

aluminium road lighting columns of 12m nominal height with a planted base and single bracket arms. There will also be a need to install road lighting feeder pillars, earth electrodes and road lighting chambers.

Where there are proposed works on Sandholes Link Road, the existing road lighting columns are to be removed. These are to be replaced with aluminium road lighting columns of 10m nominal height with a planted base and post top mounted. With these proposed works there will also be road lighting feeder pillars, earth electrodes and road lighting chambers installed. These works affect the Sandholes Roundabout, Sandholes Link Road, Drum Road Roundabout and Strifehill Road.

Loughry Roundabout has existing road lighting columns that are to be removed. With Loughry Roundabout converting into a five-arm roundabout, the road lighting will change too. The existing lighting is to be replaced with a mixture of aluminium road lighting columns of 12m nominal height with a planted base and post top mounted, and aluminium road lighting columns of 12m nominal height with a planted base and single bracket arms. There will also be a need to install road lighting feeder pillars, earth electrodes and road lighting chambers.

5.8 Proposed Departures from Standards

A tabulated summary of the Relaxations and Departures from Standards is included in Appendix D, with high level details also summarised below.

5.8.1 Mainline Geometry

The scheme mainline geometry consists of eight (8No.) Departures from Standards and ten (10No.) Relaxations from Standards. These are recommended to achieve appropriate headroom through structures, improve visibility and road safety, whilst ensuring a balanced design by minimising the extent of realignment works and associated impact on neighbouring properties.

- Horizontal geometry and superelevation – four (4No.) Departures from Standards for provision of a sub-standard 5% superelevation applied to a horizontal curve of radius 510m. DMRB CD 109 stipulates that a desirable minimum superelevation of 7% would be required for a 510m horizontal curve.
- Cross Section – one (1No.) Departure from Standard required for a reduced verge width of 0.6m across a retaining wall structure. DMRB CD 127 stipulates that a verge width of 2.5m should be provided.
- Provision of access and junction visibility – two (2No.) Departures from Standards required for the provision of ‘maintenance only’ simple priority junctions on the mainline in line with DMRB CD 123. Due to various constraints and severance, these junctions will provide safe access to SuDS ponds for maintenance. A reduced ‘Y-distance’ visibility

from the southern junction is required due to a proposed parapet restraint system associated with the retaining structure adjacent the Ballinderry River.

- Overtaking Opportunity – one (1No.) Departure required for sub-standard overtaking lane length of 740m. DMRB CD 109 stipulates the desirable minimum overtaking lane length should be 800m.
- Horizontal curve radius Relaxations – four (4No.) Relaxations from Standards for provision of sub-standard horizontal curve radii of 510m. DMRB CD 109 stipulates that a desirable minimum horizontal curve radius should be 720m.
- Transition length Relaxations – six (6No.) Relaxations from Standards proposed for reduced transition lengths in line with DMRB CD 109.

5.8.2 Side Roads and Sandholes Link Road Geometry

The mainline crosses various side roads and includes other localised improvement works. Departures and Relaxations from Standards are also recommended for side roads and Sandholes Link Road to ensure a balanced design, minimise the extent of works, thereby reducing the impact on neighbouring properties. These are primarily as a result of existing non-conforming geometry and constraints.

5.8.3 Drainage

Due to difficult existing terrain and in order to minimise land-take, there is a location adjacent Cloghog Roundabout where the runoff from natural catchment is proposed to enter road drainage.

6 Traffic and Economic Assessment

6.1 Cookstown Traffic Model

6.1.1 Methodology

To facilitate a robust assessment and appraisal of the options identified for the A29 Cookstown Bypass Scheme at SAR2 stage, a traffic model for A29 Cookstown Bypass was developed representing a Base Year of 2019. Survey data collected between March 2019 and April 2019 was used to calibrate and validate the traffic model, which was built using the SATURN suite of software (version 11.4.07H).

The model study area was defined to capture the likely impacts of the proposed A29 Cookstown Bypass as well as the impacts of any other proposed local interventions within Cookstown and its immediate surroundings. The model study area centres on Cookstown, with the model network extending across a wider area to include relevant local and strategic alternative routes.

The traffic model is set up to model highway assignment only. Due to the nature and the objectives of the Proposed Scheme, the traffic model is not set up to model public transport demand nor to assess the variable demand impacts of the Proposed Scheme (i.e. the number of vehicles forecast, otherwise known as the demand, is fixed).

The performance of the traffic model against observed data is reported in 'A29 Cookstown Bypass, Local Model Validation Report – Ref 718314-2700-R-0004' (LMVR) dated November 2019, which describes in detail the work carried out in the development and validation of the traffic model. It presents the various data sources used for the model development and explains the methods used for the development of the trip matrices and highway network. The LMVR presents the results of the model calibration and validation with reference to the UK Department for Transport's (DfT) Transport Analysis Guidance (TAG)[3] and demonstrates that the model produces an accurate representation of observed traffic conditions in Cookstown, including the routes most likely to be impacted by the Proposed Scheme in future scenarios.

The model was used to produce traffic forecasts and assessments reported in SAR2. Following the identification of the Preferred Route and the consequent refinements to scheme design, an updated set of traffic forecasts reflecting the progression of the scheme design and updated guidance, methodology and modelling parameters have been developed to inform the assessments presented within this SAR3 document. The traffic model and economic assessments reported within this SAR3 document therefore

[3] https://www.gov.uk/guidance/transport-analysis-guidance-webtag

supersede all previously reported traffic forecasts and economic appraisal of the Proposed Scheme.

Following the unexpected event of Covid-19 pandemic, and subsequent to the development of the updated traffic forecasts, in April 2023 the DfT issued guidance on accounting for the Covid pandemic in traffic models. Where model rebasing was impractical or required disproportionate effort, the guidance provided three alternative methodologies for assessing the extent of the divergence of travel patterns and traffic volumes from the equivalent pre-pandemic projections, using local data where available, and outlined various possible measures that can be applied to address the divergence if required.

In line with this guidance, DfI commissioned volumetric traffic data to be collected in autumn 2023 to inform the performance of the traffic model against the observed post-Covid traffic data. This model verification exercise followed the most robust of the three suggested methodologies and found only relatively minor divergence between the pre-pandemic projections and local volumetric traffic data from 2023. This confirmed the model's suitability as a tool to be used for the assessment and appraisal of the A29 Cookstown Bypass scheme at SAR3 stage. The results of the model verification exercise are reported in Appendix B.

The forecasting assumptions used in the traffic forecasts which have informed the SAR3 assessment are entirely consistent with those used in the 2023 model verification work. The traffic forecasts were prepared in accordance with the advice set out in TAG Unit M4 dated May 2019, which was applicable until December 2022 and covered the period of SAR3 model forecast development. Traffic forecast scenarios were developed for the scheme opening year of 2027 and a future year of 2042 representing a scenario 15 years after the scheme opens.

For each forecast year, traffic models were prepared for the Do-Minimum (without the Proposed Scheme) and the Do-Something (with the Proposed Scheme) scenarios. These were developed from the 2019 Base Year model, reflecting the changes to highway supply and demand between the Base Year and the forecast years. The forecast demand assumptions are the same between the Do-Minimum and Do-Something scenarios; the only difference between the Do-Minimum and the Do-Something being the inclusion of the Bypass and Sandholes Link Road improvements within the Do-Something scenario. The Do-Minimum scenario therefore provides a baseline against which the scheme has been assessed.

The traffic model represents the following time periods and vehicle classes as listed below; further details are provided in the LMVR.

6.1.2 Model Time Periods

The model reflects the typical traffic conditions during the morning (AM), average inter-peak and evening (PM) peak hours, for an average Monday to Thursday weekday, as follows:

- AM Peak hour: 08:00 – 09:00.
- PM Peak hour: 17:00 – 18:00.
- Average Inter-peak hour: 10:00 - 16:00.

6.1.3 Vehicle Classes and Trip Purposes

Separate demand segments were developed for various combinations of vehicle type and trip purpose. This recognises the different characteristics of trips and facilitates distinction in some of the modelling processes.

The combination of vehicle types and trip purposes are known as user classes and within the traffic model these are represented, as follows:

- Cars – Commute (representing the journey from home to work and vice versa)
- Cars – Employers Business
- Cars – Other trip purposes
- Light Goods Vehicles (LGV)
- Heavy Goods Vehicles (including Medium Goods Vehicles) (HGV)

The separation of trip demands to different user classes was undertaken based on journey purpose data collected in Roadside Interview Surveys (RSI) and Car Park Interview (CPI) surveys. This disaggregation of trips provides insights on the demand matrices in varying spatial, temporal and purpose/segment resolution.

Standard values of Passenger Car Unit (PCU) were obtained from TAG Unit M3.1 D.7.2 (January 2014) and used within the model (presented in Table 6-1).

Table 6-1 – PCU Value by Vehicle Type

Vehicle Type	PCU Value
Car	1.00
LGV	1.00
HGV	2.00
Bus	2.25

6.1.4 Model Zoning System

A detailed zone system was developed for Cookstown town centre and the road network within the detailed study area. Zones were then drawn progressively larger and less detailed further away from the study area and represent the remainder of Northern Ireland.

The model zone system is based on the Northern Ireland Small Area (SA) and Super Output Area (SOA) boundaries. The zoning system follows the classifications with the

smallest zones within the fully modelled area becoming coarser further away from the area of interest.

The zone system was designed to be consistent with the NI District boundaries and the census zoning system at SOA level. Within Cookstown, the finer SA boundaries were adopted where practical. Where necessary these were broken down further, based on the local land use and suitable loading points from the zone onto the highway network. Immediately outside of the study area, SOA boundaries were adopted. Model zones are illustrated in Figure 6-1.

A subset of ‘empty’ model zones were also developed and included within the base model. In the base model, these ‘empty’ zones have no assigned trips or defined geographical coverage, but were reserved for representing any significant proposed developments in the forecast scenarios. Their inclusion in the base model serves to ensure consistency between the base and forecast future year networks.

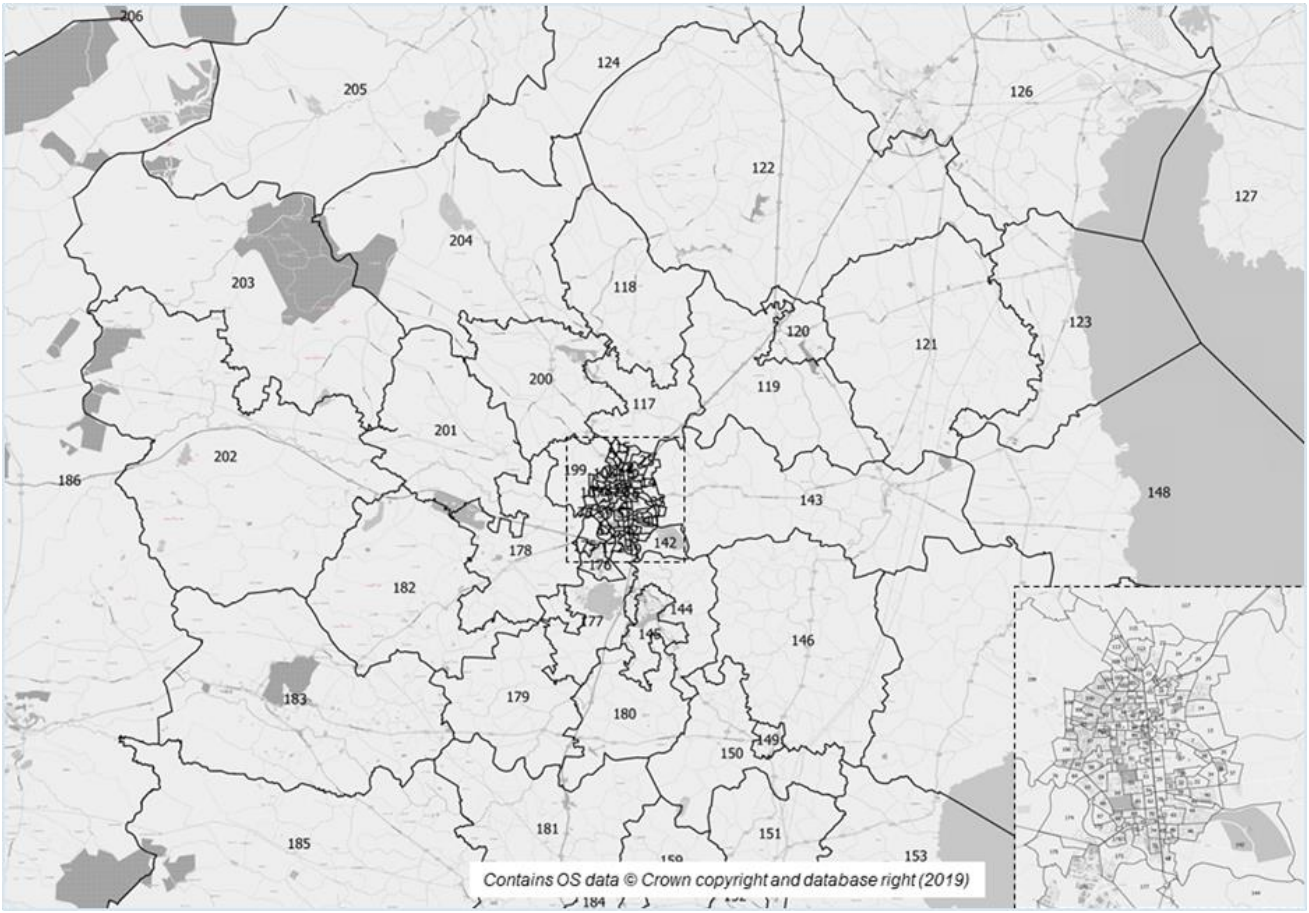


Figure 6-1 – Model Zones

6.2 Traffic Forecasting

6.2.1 Methodology

The 2019 Base Year traffic model formed the basis for the development of the future year traffic models to support the design and appraisal of the Bypass and Sandholes Link Road Scheme. The future year models were developed for a scheme Opening Year of 2027 and a Design Year of 2042.

The forecast model comprises a process of predicting the future flows on the highway network across the study area and includes the following main components:

- Estimate of future highway supply
- Estimate of future travel demand
- A mechanism of assigning demand to the highway network

To address uncertainty, a range of demand scenarios were developed for the purpose of the Stage 3 testing. This includes a Core Scenario as well as High Growth and Low Growth scenarios. These varying growth scenarios were applied to the forecast networks to produce a range of forecasts reflecting the potential range of impacts of the Proposed Scheme. Table 6-2 outlines the forecast traffic models developed for testing the different growth scenarios.

Table 6-2 – Forecast Models

Scenario	Scheme	ID	Years	Assignment Network and Demand Description
Do-Minimum	DM	DM-Core	2027, 2042	No significant changes in network as compared to base, assigned to 2027 and 2042 Core demands.
Do-Minimum High Growth	DM	DM-HG	2027, 2042	No significant changes in network as compared to base, assigned to 2027 and 2042 High Growth demands.
Do-Minimum Low Growth	DM	DM-LG	2027, 2042	No significant changes in network as compared to base, assigned to 2027 and 2042 Low Growth demands.
Do-Something Core	Preferred Route with Sandholes Link Road	DS-Core	2027, 2042	Addition of Preferred Route scheme (Bypass) along with improvement of Sandholes Link Road, assigned to 2027 and 2042 Core demands.
Do-Something	Preferred Route with	DS-HG	2027, 2042	Addition of Preferred Route scheme (Bypass) along with improvement of Sandholes Link Road, assigned to

Scenario	Scheme	ID	Years	Assignment Network and Demand Description
High Growth	Sandholes Link Road			2027 and 2042 High Growth demands.
Do-Something Low Growth	Preferred Route with Sandholes Link Road	DS-LG	2027, 2042	Addition of Preferred Route scheme (Bypass) along with improvement of Sandholes Link Road, assigned to 2027 and 2042 Low Growth demands.

The traffic forecasts were prepared in accordance with the advice set out in TAG Unit M4 (May 2019), the version applicable at the time of forecast model development for SAR3, and were principally determined using local information collected from Mid Ulster District Council on proposed and committed transport interventions and development growth combined with factors obtained from TEMPRO-NI v7.3 and RTF2018 (versions applicable at the time of SAR3 forecast model development).

6.2.2 Cookstown Business Park

Before the forecast models were developed, steps were taken to improve the routeing of traffic near the Cookstown Business Park adjacent to Sandholes Link Road. This was necessary due to the analysis undertaken during the Stage 2 assessment which identified complex traffic patterns observed near the business park that affect the Sandholes Link Road scheme.

Zone (176) was split into four separate zones (167, 168, 169 and 176) and the trips proportionally split between the zones. This zone split was applied to the Base Year model and the subsequent Do-Minimum and Do-Something scenarios. A comparison was made between the previous base model and the updated model with the split of zone 176. Model flows were compared with observed traffic data showing that the zone split model achieved a similar performance. Table 6-3 highlights the number of model counts within the TAG criteria of < 5 GEH of observed flows. Figure 6-2 displays the final zone boundaries after zone 176 had been split.

Table 6-3 – Model Performance - Vehicle Counts within TAG Criteria

Time Period	No. of Counts	Previous Base Model		Zone Split Base Model	
		Model <5 GEH	Pass %	Model <5 GEH	Pass %
AM	88	80	91%	79	90%
IP	88	72	82%	73	83%
PM	88	68	77%	68	77%

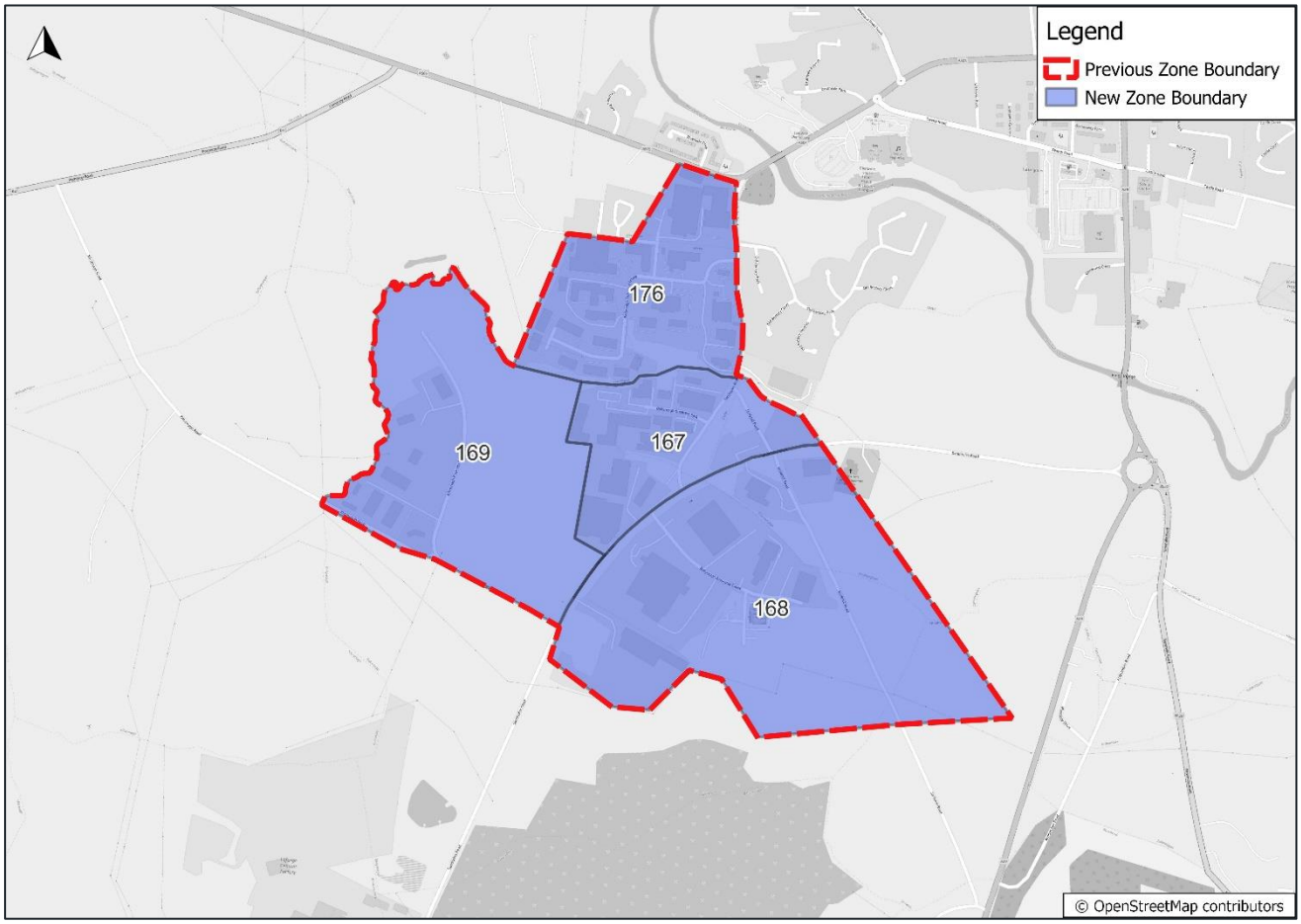


Figure 6-2 – Cookstown Business Park Zone Split

6.2.3 Future Year Network

The forecast highway networks were developed following the methodology set out in TAG Unit M4 (May 2019). The two key factors affecting the future supply are:

- Network wide changes in transport costs represented by economic parameters (including values of time, vehicle operating costs and vehicle occupancies)
- Local network changes resulting from other transport interventions identified within the Uncertainty Log

The Uncertainty Log is a record of assumptions made in the model that will affect travel demand and supply and can include local highways improvement schemes or proposed residential, commercial, or industrial developments. The Uncertainty Log has been developed in consultation with the development team in Mid Ulster District Council.

Do-Minimum networks were created for two forecast years, 2027 (Opening Year) and 2042 (Design Year). Analysis of the Uncertainty Log revealed that there are no committed or Proposed Schemes which are defined as ‘more than likely’ or ‘near certain’ (as defined in TAG Unit M4 (May 2019), Appendix A, Table A2) to be implemented within the model study

area, therefore no explicit highway interventions due to existing background assumptions were made to the calibrated Base Year model for the Do-Minimum.

Since the Stage 2 assessment, existing and proposed speed limits within the Cookstown area have been updated. These speed limit alterations were added to the Do-Minimum networks where appropriate. These changes also applied to the Do-Something forecast networks.

Background growth in traffic and the resulting re-routings due to demand changes, led to the need to optimise some signals for predicted 2027 and 2042 traffic flow levels. The same optimised signal timing has been carried out from Do-Minimum through all Do-Something scenarios for both model years. Economic parameters have been updated in line with TAG Databook v1.18 (May 2022) for each modelled user class, time period and forecast year.

Do-Something networks were developed from the Do-Minimum networks, adding the Stage 3 Bypass alignment and Sandholes Link Road coding, using GIS to compare the final modelled network to the scheme design, as a further level of assurance.

6.2.4 Future Year Demand

The future year demand matrices were developed based on local information on expected traffic generation from the proposed developments within Cookstown, constrained to the appropriate national and regional traffic growth estimates. For LGV and HGV growth, use was made of Road Transport Forecasts 2018 (RTF-2018) produced by the Department for Transport. For car user classes, growth in demand was aligned to TEMPRO-NI v7.3 demand forecasts.

Details of prospective developments were collated from the relevant documentation published within the Mid Ulster District Council planning portal and Cookstown Area Plan 2010, and recorded within the Uncertainty Log together with their prescribed level of uncertainty and expected size.

In line with guidance from TAG Unit M4 Table A1, only those developments located within the core study area and whose likelihood was assessed to be either ‘near certain’ or ‘more than likely’ were considered in the demand forecasts.

Mid Ulster District Council was consulted on the final developments to be included in the forecast model. As a result, Phase 2 Cookstown Area Plan developments were excluded as Phase 1 was deemed to provide sufficient numbers of dwellings to meet targets. The council also approved estimations of build out rates (i.e. the number of new dwellings completed per year) which were used to estimate the size of the developments at the time of the forecast years (2027 and 2042).

Figure 6-3 shows the significant new development zones considered, exclusively based on development trips from the Uncertainty Log. These zones were added to the model to

accurately account for the increase of trips and ensure trips are added to the network in the correct location.

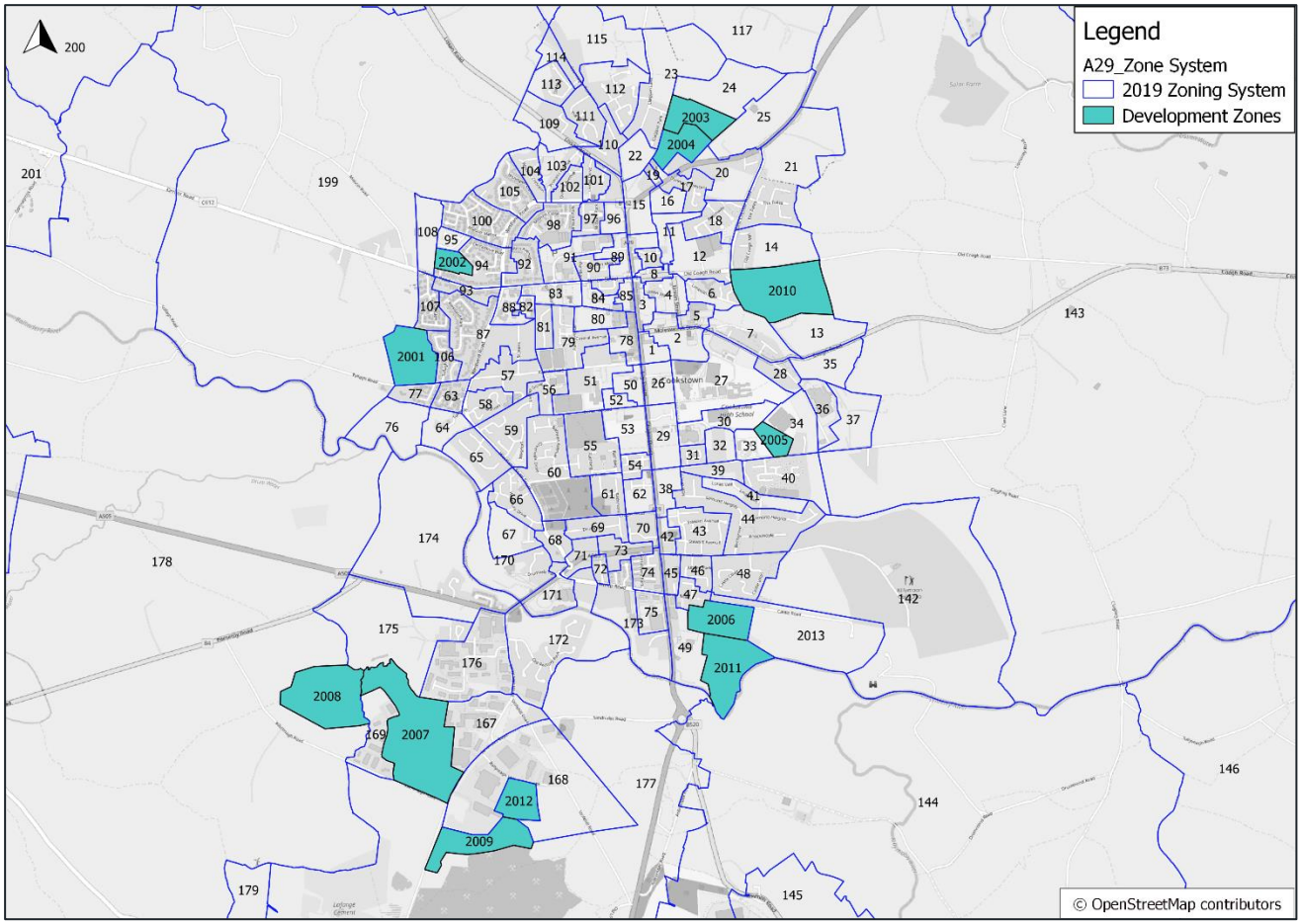


Figure 6-3 – New Development Zones in SATURN Model

For each proposed development, TRICS database (the UK and Ireland's national system of trip generation analysis) was used to estimate trip generation and, arrival and departure profiles. For the economic developments, "Employment Density Guide 2015" by Homes & Communities Agency has been used to estimate employment density and the resulting trip generation was calculated based on TRICS data. The total trips generated (residential and economic developments) from the new developments are presented in Table 6-4 and Table 6-5 respectively for 2027 and 2042.

Table 6-4 – Development Trip Generation – 2027

Time Period	Trips Generated (PCUs/Hr) – 2027						
	Car		LGV		HGV		Total
	Origin	Destination	Origin	Destination	Origin	Destination	
AM	399	215	1	3	1	2	**621**
IP	201	199	1	1	5	5	**413**
PM	244	366	4	1	1	0	**618**

Table 6-5 – Development Trip Generation – 2042

Time Period	Trips Generated (PCUs/Hr) – 2042						
	Car		LGV		HGV		Total
	Origin	Destination	Origin	Destination	Origin	Destination	
AM	674	443	13	33	8	21	**1192**
IP	389	384	8	8	57	54	**901**
PM	512	618	37	11	13	4	**1195**

6.2.5 Traffic Growth and Future Year Matrices

The trip end growth forecasts from TEMPRO-NI v7.3 were used to factor the Base Year trip matrices using growth factors for each time period, trip purpose, and vehicle type, through a Furness procedure. The final forecast matrices were produced using trip generation from new developments constrained to TEMPRO-NI traffic growth. This ensured that all new trip generation was accurately allocated to new developments within Cookstown, but overall growth was controlled to TEMPRO-NI and therefore aligned to the national growth projections.

Impacts of future fuel pricing and income changes on car user demand were incorporated through the application of fuel and income factors, derived from Table M4.2.1 in the TAG Data Book v 1.18 (May 2022).

LGV and HGV growth was based on projections of goods vehicle growth for England published by the Department for Transport, as RTF-2018, which was applicable at the time of traffic forecast development. To account for variation in demand growth between Northern Ireland and England, a secondary factor was applied to RTF-2018 LGV and HGV growth factors, based on a comparison of TEMPRO-NI total vehicle growth projections with the equivalent TEMPRO (GB) projections.

The traffic forecasting undertaken for the SAR3 assessment made use of High and Low growth sensitivity testing around demand forecasts, in line with the guidance set out in TAG Unit M4 (May 2019) which was applicable at the time of forecast model development. The

High and Low growth sensitivity tests assess the Proposed Scheme's robustness in the light of uncertainty in demand levels. These were tested against the national economic uncertainties by adopting Low Growth and High Growth forecasts, achieved through the use of the range criteria around the Core Scenario as set out in TAG Unit M4 (May 2019) section 4.2.

The tests comprise a proportion of Base Year demand to be added to or subtracted from the Core Scenario (loosely described as the ±2.5% rule). In line with TAG the supply (network) for High Growth and Low Growth scenario tests have not been changed from the Core Scenario.

Table 6-6 to Table 6-8 show the resulting hourly matrix totals for each forecast year including the High Growth and Low Growth forecasts. The matrix totals are presented for each purpose, vehicle category and time period for the Opening Year and Design Year. The 2019 Base Year totals are also presented for comparison.

Table 6-6 – Summary of Matrix Totals – AM

Model Year	Total Trips PCUs/Hr					
	AM					
	Car			LGV	HGV	Matrix Total
	Commute	Business	Other			
Base 2019	3,236	594	1,859	529	467	**6,685**
2027 LG	3,292	606	1,945	544	431	**6,818**
2027 Core	3,521	648	2,077	581	464	**7,291**
2027 HG	3,749	690	2,208	619	497	**7,764**
2042 LG	3,727	688	2,297	631	432	**7,775**
2042 Core	4,115	760	2,520	695	487	**8,575**
2042 HG	4,503	831	2,743	758	543	**9,377**

Table 6-7 – Summary of Matrix Totals – IP

Model Year	Total Trips PCUs/Hr					
	IP					
	Car			LGV	HGV	Matrix Total
	Commute	Business	Other			
Base 2019	680	334	3,687	488	547	**5,736**
2027 LG	692	339	3,892	502	504	**5,930**
2027 Core	740	363	4,153	537	543	**6,336**
2027 HG	788	387	4,414	571	582	**6,741**
2042 LG	782	382	4,663	582	523	**6,932**
2042 Core	864	422	5,105	641	578	**7,610**
2042 HG	945	462	5,547	699	644	**8,298**

Table 6-8 – Summary of Matrix Totals – PM

Model Year	Total Trips PCUs/Hr					
	PM					
	Car			LGV	HGV	Matrix Total
	Commute	Business	Other			
Base 2019	2,243	391	3,889	680	338	**7,540**
2027 LG	2,279	398	4,073	699	312	**7,761**
2027 Core	2,438	426	4,348	747	336	**8,294**
2027 HG	2,596	454	4,623	795	359	**8,828**
2042 LG	2,571	451	4,830	811	300	**8,963**
2042 Core	2,840	498	5,296	892	340	**9,867**
2042 HG	3,109	545	5,762	974	381	**10,771**

6.2.6 Analysis of Forecast Results

The traffic model is strategic in nature and represents average peak and inter-peak period conditions on an average weekday. As such, some of the extreme variations observed in Cookstown due to the different uses of the A29 are not always fully reflected in the traffic

model outputs. The scheme impacts are therefore assessed against an equivalent Do-Minimum scenario, both representing average conditions and thereby allowing a like for like comparison to be made. This section presents comparisons of the predicted scheme impacts compared against the Do-Minimum case. These include comparisons of traffic flows along the key links, journey times and network wide performance (in terms of average speed, PCU kilometres and vehicle hours).

6.2.6.1 Flow Difference Summary

Figure 6-4 and Figure 6-5 show the comparison of flows (vehicles/hr) between the Do-Minimum models and Do-Something models for the Core, High Growth and Low Growth scenarios. The figures also present the Average Annual Daily Traffic (AADT) for comparison.

AADT flows on the proposed Bypass in the Core Scenario are predicted to range between 12,660 vehicles and 15,380 vehicles in the opening year and range between 16,090 vehicles and 19,500 vehicles in the Design Year, representing an increase of approximately 27% between 2027 and 2042.

The Bypass scheme attracts traffic away from the existing A29 that runs through the centre of town between A29/B162/Moneymore Road Roundabout to the north of the town and Loughry Roundabout to the south. AADT on the current A29 shows a pattern of relief in the opening year Core forecasts with a flow reduction of 44% on the northern section (between Moneymore Road and Orritor Street), and a reduction of 49% on the southern section (between A505 Drum Road and Loughry Roundabout). In the Design Year, the flow reductions are estimated to be 41% on the northern section, and 54% on the southern section.

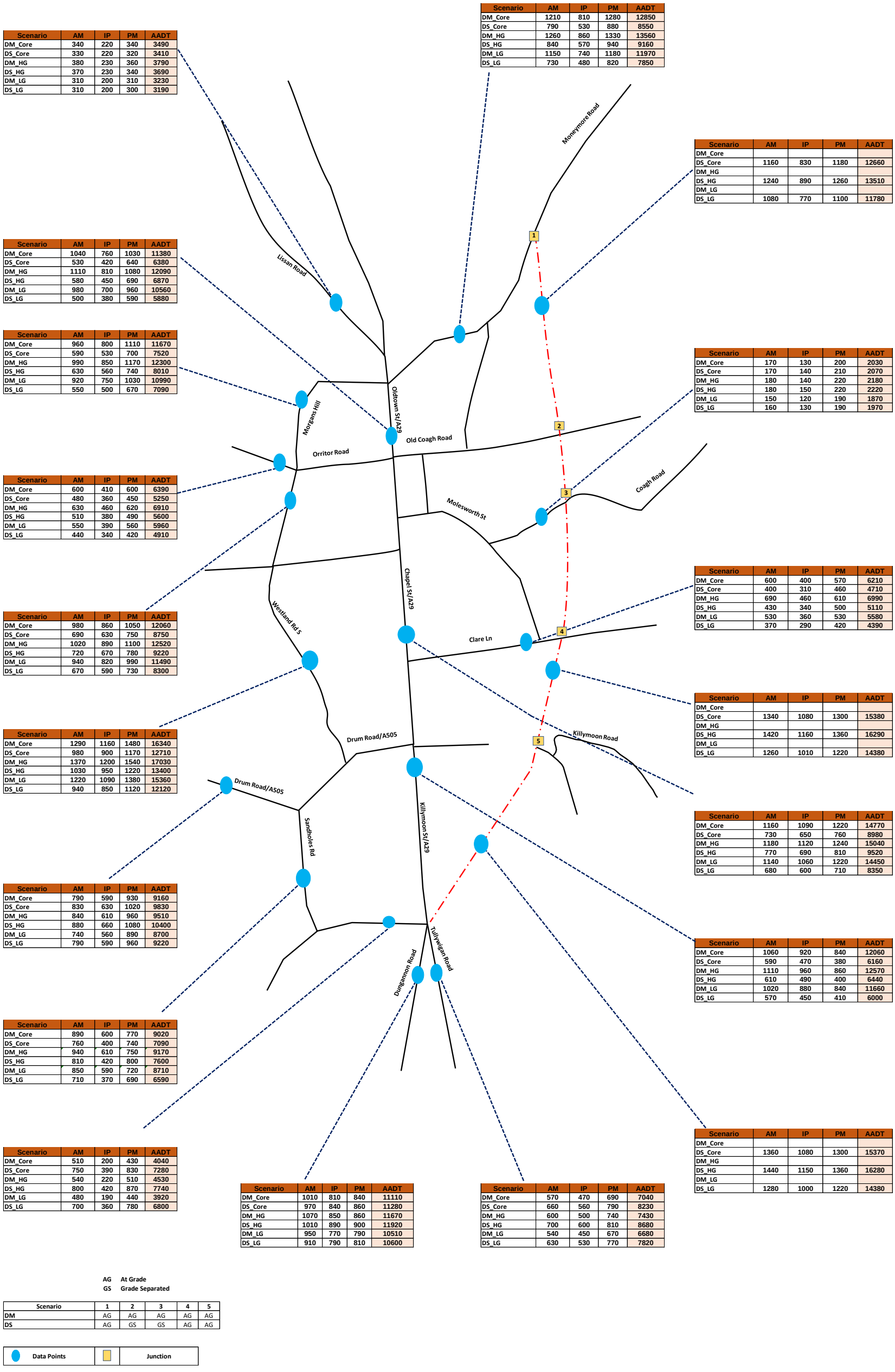
Another part of the town centre that forecasts a reduction in traffic levels when comparing between Do-Minimum and Do-Something scenarios is Westlands Road running to the west of the town. Due to delays in the town centre in the Do-Minimum scenario, traffic currently uses Westlands Road as an alternative route between the north and south of the town. The Bypass will provide a more appropriate alternative route and divert traffic away from Westlands Road. This results in a flow reduction for the Core Scenario of around 27% on the northern section (between Orritor Road and Fairhill Road) and about 22% on the southern section (between Fairhill Road and A505 Drum Road). The range of flow reduction is similar for both Opening Year and Design Year.

In the opening year, the traffic flow on Sandholes Link Road is predicted to decrease by approximately 21%. By the Design Year, the decrease is lower at 13%. This decrease in the Do-Something scenario compared to the Do-Minimum is due to traffic that previously used Westlands Road and Sandholes Road, to avoid routeing through the town centre, now accesses the Bypass exclusively and no longer uses Sandholes Link Road as a rat run. The

proposed junction improvements at the north and south of Sandholes Link Road address the delays predicted at these locations in the Do-Minimum.

As outlined in Section 6.2.3, some of the key junctions within Cookstown town centre required signal optimisation when preparing the forecast networks. This suggests the junctions are currently operating close to capacity, becoming critical as demand increases in future years in the Do-Minimum scenario. The rerouting of traffic from these junctions due to the implementation of the Bypass scheme, means that these junctions are less stressed and are more likely to provide sufficient capacity compared to the Do-Minimum projections. This results in lower delays and queues and improving the overall network performance.

The combination of lowering delays and traffic levels within the town centre would provide journey time reductions for local traffic, improve environmental emissions within the town centre and provide safer journey options for pedestrians and cyclists.



Scenario	AM	IP	PM	AADT
DM_Core	340	220	340	3490
DS_Core	330	220	320	3410
DM_HG	380	230	360	3790
DS_HG	370	230	340	3690
DM_LG	310	200	310	3230
DS_LG	310	200	300	3190

Scenario	AM	IP	PM	AADT
DM_Core	1210	810	1280	12850
DS_Core	790	530	880	8550
DM_HG	1260	860	1330	13560
DS_HG	840	570	940	9160
DM_LG	1150	740	1180	11970
DS_LG	730	480	820	7850

Scenario	AM	IP	PM	AADT
DM_Core				
DS_Core	1160	830	1180	12660
DM_HG				
DS_HG	1240	890	1260	13510
DM_LG				
DS_LG	1080	770	1100	11780

Scenario	AM	IP	PM	AADT
DM_Core	1040	760	1030	11380
DS_Core	530	420	640	6380
DM_HG	1110	810	1080	12090
DS_HG	580	450	690	6870
DM_LG	980	700	960	10560
DS_LG	500	380	590	5880

Scenario	AM	IP	PM	AADT
DM_Core	960	800	1110	11670
DS_Core	590	530	700	7520
DM_HG	990	850	1170	12300
DS_HG	630	560	740	8010
DM_LG	920	750	1030	10990
DS_LG	550	500	670	7090

Scenario	AM	IP	PM	AADT
DM_Core	170	130	200	2030
DS_Core	170	140	210	2070
DM_HG	180	140	220	2180
DS_HG	180	150	220	2220
DM_LG	150	120	190	1870
DS_LG	160	130	190	1970

Scenario	AM	IP	PM	AADT
DM_Core	600	410	600	6390
DS_Core	480	360	450	5250
DM_HG	630	460	620	6910
DS_HG	510	380	490	5600
DM_LG	550	390	560	5960
DS_LG	440	340	420	4910

Scenario	AM	IP	PM	AADT
DM_Core	600	400	570	6210
DS_Core	400	310	460	4710
DM_HG	690	460	610	6990
DS_HG	430	340	500	5110
DM_LG	530	360	530	5580
DS_LG	370	290	420	4390

Scenario	AM	IP	PM	AADT
DM_Core	980	860	1050	12060
DS_Core	690	630	750	8750
DM_HG	1020	890	1100	12520
DS_HG	720	670	780	9220
DM_LG	940	820	990	11490
DS_LG	670	590	730	8300

Scenario	AM	IP	PM	AADT
DM_Core				
DS_Core	1340	1080	1300	15380
DM_HG				
DS_HG	1420	1160	1360	16290
DM_LG				
DS_LG	1260	1010	1220	14380

Scenario	AM	IP	PM	AADT
DM_Core	1290	1160	1480	16340
DS_Core	980	900	1170	12710
DM_HG	1370	1200	1540	17030
DS_HG	1030	950	1220	13400
DM_LG	1220	1090	1380	15360
DS_LG	940	850	1120	12120

Scenario	AM	IP	PM	AADT
DM_Core	1160	1090	1220	14770
DS_Core	730	650	760	8980
DM_HG	1180	1120	1240	15040
DS_HG	770	690	810	9520
DM_LG	1140	1060	1220	14450
DS_LG	680	600	710	8350

Scenario	AM	IP	PM	AADT
DM_Core	790	590	930	9160
DS_Core	830	630	1020	9830
DM_HG	840	610	960	9510
DS_HG	880	660	1080	10400
DM_LG	740	560	890	8700
DS_LG	790	590	960	9220

Scenario	AM	IP	PM	AADT
DM_Core	1060	920	840	12060
DS_Core	590	470	380	6160
DM_HG	1110	960	860	12570
DS_HG	610	490	400	6440
DM_LG	1020	880	840	11660
DS_LG	570	450	410	6000

Scenario	AM	IP	PM	AADT
DM_Core	890	600	770	9020
DS_Core	760	400	740	7090
DM_HG	940	610	750	9170
DS_HG	810	420	800	7600
DM_LG	850	590	720	8710
DS_LG	710	370	690	6590

Scenario	AM	IP	PM	AADT
DM_Core	510	200	430	4040
DS_Core	750	390	830	7280
DM_HG	540	220	510	4530
DS_HG	800	420	870	7740
DM_LG	480	190	440	3920
DS_LG	700	360	780	6800

Scenario	AM	IP	PM	AADT
DM_Core	1010	810	840	11110
DS_Core	970	840	860	11280
DM_HG	1070	850	860	11670
DS_HG	1010	890	900	11920
DM_LG	950	770	790	10510
DS_LG	910	790	810	10600

Scenario	AM	IP	PM	AADT
DM_Core	570	470	690	7040
DS_Core	660	560	790	8230
DM_HG	600	500	740	7430
DS_HG	700	600	810	8680
DM_LG	540	450	670	6680
DS_LG	630	530	770	7820

Scenario	AM	IP	PM	AADT
DM_Core				
DS_Core	1360	1080	1300	15370
DM_HG				
DS_HG	1440	1150	1360	16280
DM_LG				
DS_LG	1280	1000	1220	14380

AG At Grade
GS Grade Separated

Scenario	1	2	3	4	5
DM	AG	AG	AG	AG	AG
DS	AG	GS	GS	AG	AG

Data Points | Junction

Figure 6-4 – Flow Comparison for DS Schemes - 2027

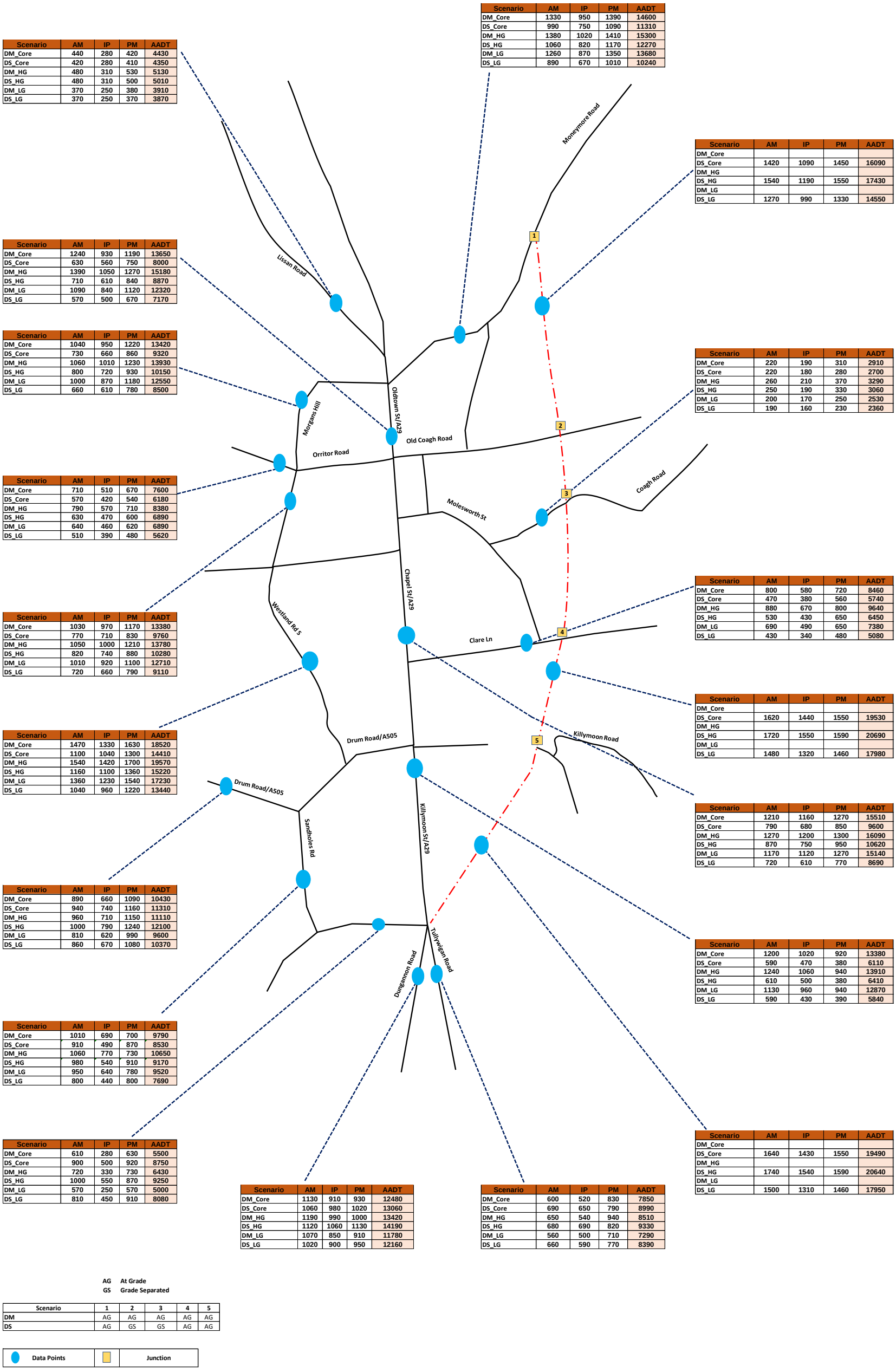


Figure 6-5 – Flow Comparison for DS Schemes - 2042

6.2.6.2 Network Wide Impacts

SATURN provides summary network statistics on the overall performance of each model. These statistics were compared to provide a comparison between the Base, Do-Minimum, Do-Something, Core, High Growth and Low Growth scenarios. This provides insight on how the Bypass and Sandholes Link Road schemes affect overall network performance for the different growth scenarios.

The Base Year's summary of Passenger Car Units Kilometres (PCU-kms), Passenger Car Units Hours (PCU-Hrs) and Average Speed (Km/h) within the Simulation area is presented in Table 6-9.

Table 6-9 – Base 2019 – PCU KM, PCU Hours and Average Speed

Time Period	Simulation Travel Time (Total PCU-hrs)	Simulation Travel Distance (Total PCU-kms)	Simulation Average Speed (km/h)
AM	932	37,837	41
IP	729	29,958	41
PM	995	39,702	40

Table 6-10 summarises the changes in traffic levels between the 2019 Base Year and the future Do-Minimum scenario for each forecast year and growth scenario. Although the increase in vehicle kilometres and vehicle hours are due to the effect of traffic growth, the PCU hours are increasing disproportionately when compared to the PCU kilometres travelled, suggesting an increasing delay in the network without any interventions in place especially in the Design Year 2042.

Table 6-10 – Growth in Travel Time and Travel Distance 2019 to 2042

Scenario	Time Period	Simulation Travel Time (Total PCU-hrs)		Simulation Travel Distance (Total PCU-kms)	
		2019-2027	2019-2042	2019-2027	2019-2042
DM Core	AM	7%	29%	8%	25%
	IP	9%	32%	9%	28%
	PM	10%	36%	9%	29%
DM HG	AM	16%	47%	15%	37%
	IP	17%	48%	16%	40%
	PM	20%	54%	16%	41%
DM LG	AM	-1%	14%	1%	13%
	IP	1%	18%	2%	16%
	PM	0%	19%	2%	16%

Table 6-11 summarises the networkwide changes in terms of PCU hours, PCU kilometres and average speeds between Do-Minimum (DM) and the Do-Something (DS), Core, High Growth (HG) and Low Growth (LG) scenarios for 2027. The table shows a significant increase in average speed across the whole network when the Bypass and Sandholes Link Road schemes are introduced.

Table 6-11 – DM Vs DS – PCU KM, PCU Hours and Average Speed – 2027

	DM Core	DS Core	DM HG	DS HG	DM LG	DS LG
	AM					
Travel Time (PCU-hrs)	997	878	1,083	945	919	813
Travel Distance (PCU-kms)	40,770	42,597	43,417	45,301	38,153	39,811
Average Speed (km/h)	40.9	48.5	40.1	47.9	41.5	49.0
	IP					
Travel Time (PCU-hrs)	794	699	853	749	735	650
Travel Distance (PCU-kms)	32,663	33,894	34,688	36,091	30,581	31,702
Average Speed (km/h)	41.1	48.5	40.6	48.2	41.6	48.8
	PM					
Travel Time (PCU-hrs)	1,095	964	1,191	1,038	993	892
Travel Distance (PCU-kms)	43,298	45,230	46,173	48,124	40,465	42,330
Average Speed (km/h)	39.5	46.9	38.8	46.3	40.8	47.5

Table 6-12 summarises the changes in travel time and travel distance per vehicle between the Do-Minimum and Do-Something Core, High Growth and Low Growth scenarios. This table shows that there are net reductions in travel time and slight increase in PCU kilometres travelled as a result of the Proposed Scheme. The reduction in travel time is facilitated by the increase in speed on the proposed route and also due to the reduction in the junction delays via the town centre routes. The slight increase in vehicle kilometre is caused by some of the trips travelling longer to access the scheme to take advantage of the shorter journey times.

Table 6-12 – Change in PCU KM, PCU Hours between DM and DS – 2027

	DS Core	DS HG	DS LG
	AM		
Travel Time	-11.9%	-12.7%	-11.6%
Travel Distance	4.5%	4.3%	4.3%
	IP		
Travel Time	-12.0%	-12.2%	-11.5%
Travel Distance	3.8%	4.0%	3.7%
	PM		
Travel Time	-12.0%	-12.8%	-10.2%
Travel Distance	4.5%	4.2%	4.6%

Table 6-13 summarises the networkwide changes in terms of PCU hours, PCU kilometres and average speeds between Do-Minimum and various Do-Something scenarios for 2042.

Table 6-13 – DM Vs DS – PCU KM, PCU Hours and Average Speed – 2042

	DM Core	DS Core	DM HG	DS HG	DM LG	DS LG
	AM					
Travel Time (PCU-hrs)	1,207	1,047	1,370	1,177	1,062	929
Travel Distance (PCU-kms)	47,210	49,337	51,825	53,763	42,811	44,759
Average Speed (km/h)	39.1	47.1	37.8	45.7	40.3	48.2
	IP					
Travel Time (PCU-hrs)	959	842	1,080	929	857	756
Travel Distance (PCU-kms)	38,234	40,290	41,820	43,906	34,780	36,619
Average Speed (km/h)	39.9	47.9	38.7	47.3	40.6	48.4
	PM					
Travel Time (PCU-hrs)	1,357	1,171	1,534	1,306	1,183	1,042
Travel Distance (PCU-kms)	51,280	53,157	56,054	57,688	46,178	48,442
Average Speed (km/h)	37.8	45.4	36.5	44.2	39.0	46.5

Table 6-14 summarises the changes in travel time and travel distance per PCU between the D0-Minimum and various Do-Something scenarios for 2042.

Table 6-14 – Change in PCU KM and PCU Hours between DM and DS – 2042

	DS Core	DS HG	DS LG
	AM		
Travel Time	-13.2%	-14.1%	-12.5%
Travel Distance	4.5%	3.7%	4.6%
	IP		
Travel Time	-12.2%	-13.9%	-11.8%
Travel Distance	5.4%	5.0%	5.3%
	PM		
Travel Time	-13.7%	-14.8%	-11.9%
Travel Distance	3.7%	2.9%	4.9%

Similar to the 2027 network statistics, the above table also indicates that, there are net reductions in travel time and slight increase in vehicle kilometres, as a result of the Proposed Schemes. When compared to the change in PCU-km and PCU-hours for 2027, the results for 2042 are of a similar proportion. This suggests that the schemes have sufficient capacity to offset the increase of demand in 2042 and provide the same travel time savings, this is also the case for the High Growth scenario.

6.2.6.3 Journey Time Summary

A comparison of the average speed in the overall network was included to determine whether an improvement in journey times was observed.

Table 6-15 and Table 6-16 summarise the change in average speed within the simulation area for 2027 and 2042 respectively for each of the growth scenarios.

Table 6-15 – Change in Average Speed (DS-DM) – 2027

	Core	HG	LG
	AM		
Simulation Average Speed (km/h) - DM	40.9	40.1	41.5
Simulation Average Speed (km/h) - DS	48.5	47.9	49.0
Difference	**7.6**	**7.8**	**7.5**
	IP		
Simulation Average Speed (km/h) - DM	41.1	40.6	41.6
Simulation Average Speed (km/h) - DS	48.5	48.2	48.8
Difference	**7.4**	**7.5**	**7.2**
	PM		
Simulation Average Speed (km/h) - DM	39.5	38.8	40.8
Simulation Average Speed (km/h) - DS	46.9	46.3	47.5
Difference	**7.4**	**7.6**	**6.7**

Table 6-16 – Change in Average Speed (DS-DM) – 2042

	Core	HG	LG
	AM		
Simulation Average Speed (km/h) - DM	39.1	37.8	40.3
Simulation Average Speed (km/h) - DS	47.1	45.7	48.2
Difference	**8.0**	**7.8**	**7.9**
	IP		
Simulation Average Speed (km/h) - DM	39.9	38.7	40.6
Simulation Average Speed (km/h) - DS	47.9	47.3	48.4
Difference	**8.0**	**8.5**	**7.8**
	PM		
Simulation Average Speed (km/h) - DM	37.8	36.5	39.0
Simulation Average Speed (km/h) - DS	45.4	44.2	46.5
Difference	**7.6**	**7.6**	**7.4**

When examining the average speed across the network for forecast scenarios, a higher average speed represents a more efficient network. It is clear from the above tables that, the average speeds in the simulation area increases across all the growth scenarios for Do-Something (from Core, High Growth and Low Growth). The increase in speed is notable in all three time periods and in the Opening Year and Design Year. The increase in average speed is due to journey time savings across the entirety of the simulation area.

Additional journey time analysis was conducted comparing journey times along the existing A29 before the introduction of the Bypass (Do-Minimum) and after the introduction of the Bypass (Do-Something). Table 6-17 provides the journey time in seconds for the Opening Year and Design Year for the Core Scenario. This shows that the Bypass would provide an alternative route to the traffic currently routeing through Cookstown town centre, more than halving the time taken to travel between Moneymore Road and Dungannon Road via the Bypass, with the greatest savings forecast in the 2042 PM peak. Traffic that continues to use the existing A29 will also experience a reduction in journey time of up to 2.5 minutes in the opening year and up to 4 minutes in the Design Year.

Table 6-17 – Journey Time(s) for the Core Scenario

Route	Journey Time(s)			
	DM 2027	DS 2027	DM 2042	DS 2042
	AM			
Dungannon-Moneymore Road via A29 (NB)	675	622	718	659
Moneymore-Dungannon Road via A29 (SB)	705	625	757	641
Dungannon-Moneymore Road via A29 Bypass Scheme (NB)	N/A	312	N/A	351
Moneymore-Dungannon Road via A29 Bypass Scheme (SB)	N/A	310	N/A	330
	IP			
Dungannon-Moneymore Road via A29 (NB)	676	613	705	619
Moneymore-Dungannon Road via A29 (SB)	654	612	687	623
Dungannon-Moneymore Road via A29 Bypass Scheme (NB)	N/A	298	N/A	309
Moneymore-Dungannon Road via A29 Bypass Scheme (SB)	N/A	288	N/A	299
	PM			
Dungannon-Moneymore Road via A29 (NB)	769	621	866	640
Moneymore-Dungannon Road via A29 (SB)	690	649	736	674
Dungannon-Moneymore Road via A29 Bypass Scheme (NB)	N/A	311	N/A	327
Moneymore-Dungannon Road via A29 Bypass Scheme (SB)	N/A	288	N/A	299

6.2.7 Overall Summary

The Do-Minimum scenarios show that without significant intervention the issue of congestion and traffic within the town centre becomes progressively more severe as demand increases in the future forecast years. As the traffic volume increases it adds strain on the operation of the signalised junctions within Cookstown which could lead to an increase in delays and journey times.

The introduction of the Bypass and Sandholes Link Road schemes show a significant improvement in network-wide performance when compared to the Do-Minimum scenarios. One of the key impacts is the rerouting of traffic away from the town centre resulting in less congestion and an improved town centre environment.

The efficiency of the Do-Something network increases with a decrease in journey times through the town centre and an overall increase in average speed across the entire network.

The improvements to congestion and journey times are proportional to the level of demand. Additionally testing of the High Growth scenario showed that, the scheme has sufficient capacity to accommodate higher demands.

6.3 Economic Performance of Scheme

6.3.1 Methodology

The economic appraisal of a highway scheme is an assessment of the net benefits to users and the wider community as a result of road network alteration, set against the construction and operational costs, incurred over a 'whole life' period.

The economic assessment of the A29 Cookstown Bypass comprises the direct economic impacts on road users, government and other related economic impacts and is in accordance with 'The Green Book - Appraisal and Evaluation in Central Government'.

The economic assessment process involved estimating the following components:

- Scheme Cost: Defined as the total amount of money spent in constructing and maintaining the scheme. It includes the preparation cost (planning and designing), land acquisition cost, construction costs, supervision, and maintenance costs over the 60 year period
- Scheme Benefits: The core (established) scheme benefits comprise of four components:
    a. Economic benefits to road users, including time savings and vehicle operating costs (referred to as economic efficiency benefits)
    b. Accident savings and associated economic benefits
    c. Monetised benefits/disbenefits from changes to air quality, noise, and greenhouse gas emissions
    d. Benefits to road users resulting from a reduction in delays during periods of maintenance and disbenefits due to delays during construction of the scheme.

The benefits from these four categories were combined and compared to scheme costs to produce a Benefit to Cost Ratio (BCR), so that the Proposed Scheme could be assessed in Value for Money (VfM) terms.

6.3.2 TUBA Assessment

The calculation of transport economic efficiency impacts on road users (excluding accident benefits) was undertaken using the Department for Transport's (DfT) TUBA (Transport Users Benefit Appraisal) program. TUBA v1.9.17 (version applicable at the time of the assessment) was used to assess the road user benefits arising from changes in journey

times and vehicle operating costs which are calculated separately for Business Users and Consumer Users.

As its principal input, TUBA takes zone to zone matrices of trip numbers, travel times and distances travelled to calculate the net road user benefits over a 60-year appraisal period.

For the appraisal of road user benefits, standard values of time, operating cost and other related economic parameters for traffic appraisal are applied, using the standard 'economic parameter data' based on TAG Data Book v1.18 (May 2022).

The journey time and vehicle operating costs represent the economic benefits that accrue to road travellers as a result of the scheme. They include savings in journey time and changes in vehicle operating costs, to Business Users and Consumer Users. The vehicle operating costs are both distance and speed related, and include fuel costs and non-fuel costs, e.g., tyres, maintenance, depreciation, etc.

The benefits are calculated for all users of the network and include those who travel on the new road and those travelling on all existing roads. For example, while users of the Scheme could experience time savings, users of the existing road network will also experience time savings as a result of traffic relief offered by the increased network capacity.

The transport user benefits of the scheme calculated from TUBA are presented in Table 6-18.

Table 6-18 – Transport User Benefits from TUBA Assessment (£000s)

	Low	**Core**	**High**
Consumer Benefits Commuting	26,421	31,622	33,162
Consumer Benefits Other	28,690	35,467	42,348
Business User Benefits	36,103	42,590	48,280
Total Benefits	**91,214**	**109,679**	**123,789**

Table 6-18 presents the scheme benefits for the three different forecast growth scenarios, disaggregated by user type. The scheme is shown to provide benefits exceeding £109 million over the 60-year appraisal period. The Low Growth and High Growth forecasts show that benefits can range between approximately £90 million and £124 million. Business Users are shown to gain the greatest benefit from the scheme due to their relatively high values of time. The scheme also offers considerable benefits to commuters and other consumer users.

The Bypass offers a high capacity, more efficient route around the town when compared to the current A29 route through the town. User benefits are accrued by traffic routing along the Bypass and away from the congested town centre. The removal of strategic traffic from

the town centre would assist in reducing congestion within the town centre, generating benefits to local residents and other road users making trips within Cookstown.

6.3.3 Accident Assessment

An assessment of accident benefits was undertaken using COBALT (Cost and Benefit to Accidents – Light Touch), version 2.3, a DfT cost benefit analysis program that assesses the monetary benefits from accident savings. The program forecasts the number of Personal Injury Accidents (PIA) and casualties by severity and also forecasts the changes in the monetised accident costs for inclusion in the Analysis of Monetised Costs and Benefits (AMCB) table.

Accident data was obtained for the Cookstown area between 17th April 2013 and 31st March 2021, the full data set for the five-year period between 2015 and 2019 was used in the accident assessment. 2020-21 data was discarded as this data was largely impacted by the COVID-19 travel restrictions. COBALT default accident rates were used across the network for links where actual observed accident data were unavailable. COBALT was run in combined link and junction mode using link specific accident rates; other inputs like forecast AADT traffic volumes and link lengths were obtained from the traffic model.

COBALT calculates a severity split using standard factors which estimate the number of accidents classified by injury severity, either fatal, serious, or slight. COBALT then applies the appropriate costs per accident to establish the economic cost of accidents over the appraisal period. The latest COBALT economic parameter file has been updated based on TAG Data Book v1.18 (May 2022) and used to calculate accident impacts in line with TAG guidance.

Guidance in the COBALT manual states that the accident appraisal area should extend far enough from the improvement to include all links on which there is a substantial difference in the assigned traffic flows between ‘Do-Minimum’ and ‘Do-Something’ networks. This was identified based on a standard criterion of ±10% change in AADT flows relative difference between DM and DS flows based on 2042 model outputs.

The COBALT analysis indicates that the combination of the Bypass and Sandholes Link Road schemes provide a net reduction in the number of accidents and casualties over 60-year assessment period. It also shows that across the three different growth scenarios tested, the scheme continues to offer a reduction in the number of accidents and casualties, as illustrated in Table 6-19 and Table 6-20.

Table 6-19 – Accident and Casualty Savings over 60 years

Scenario	Forecasted Accidents	Forecasted Casualties			Accident Saved by Scheme	Casualties Saved by Scheme		
		Fatal	Serious	Slight		Fatal	Serious	Slight
DM Low	2829	23.8	373	3342	-	-	-	-
DM Core	3095	26.0	408	3655	-	-	-	-
DM High	3372	28.2	445	3980	-	-	-	-
DS Low	2452	23.5	334	2909	376	0.3	39	433
DS Core	2691	25.7	367	3191	404	0.2	42	464
DS High	2937	28.0	400	3482	435	0.2	45	497

Table 6-20 – Present Value of Accident Savings (£000s)

Scheme	Accident Costs	Savings in Accident Costs
DM Low	113,604	
DM Core	124,070	
DM High	134,932	
DS Low	101,285	12,318
DS Core	110,906	13,165
DS High	120,818	14,115

As shown in Table 6-20, the scheme offers approximately £13 million in accident savings for the Core Scenario.

6.3.4 Construction Impacts

TAG recommends impacts to road user during construction are assessed using appropriate models. The construction scenarios for the Sandholes Link Road and A29 Cookstown Bypass have been modelled using the traffic model and the impacts were monetised using TUBA.

Indicative Traffic Management (TM) with eleven phases were identified for the construction of the scheme, with some of the phasing overlapping each other to create eight TM scenarios. The details of the traffic management phases / scenarios and their durations are presented in Table 6-21.

Table 6-21 – Construction scenarios tested with Cookstown strategic traffic model

TM Scenarios	TM numbers	Description (TM number in brackets)	Duration (months)	Comments / Assumptions
1	1	Sandholes Road (1) works only	2	TM numbers 1, 2, 3 & 4 It is anticipated that the permanent works on Sandholes Road (1) will be constructed in phases utilising temporary traffic signals to keep the road open. However, it does require some temporary works to be undertaken. Given the additional temporary works required and the inefficiencies of undertaking works in non-continuous phases (to tie-in with the roundabout works at either end) results in an anticipated duration of approx. seven months under traffic signals. Drum Rd Roundabout (3) & Sandholes Roundabout (4) works are expected to take around 3 months each and will also be constructed utilising temporary traffic signals. These are a fairly conservative programme estimates of the works and may be able to compress slightly.
2	1, 2, 5 & 6	Sandholes Road (1) works plus Fairy Burn Culvert (2) partial closure and single file traffic, works at Loughry Roundabout (5) and works on Castle Road (6)	4	
3	1, 3, & 5	Sandholes Road (1) works plus Drum Road Roundabout (3) and Loughry Roundabout (5)	3	
4	1 & 8	Sandholes Road (1) works plus Cloghog Road (8) closure	1	
5	1, 4, 8, 9 & 11	Sandholes Road works (1) plus Sandholes Roundabout (4), Cloghog Road (8) closure (8), Coagh Road (9) closure and Moneymore Roundabout (11) works	1	
6	1, 4, 7, 8, 9 & 11	Sandholes Road (1) works plus Sandholes Roundabout (4), temporary access road to Killymoon Golf Club (7), Cloghog Road (8) closure, Coagh Road (9) closure and Moneymore Roundabout (11) works	2	

TM Scenarios	TM numbers	Description (TM number in brackets)	Duration (months)	Comments / Assumptions
7	7, 10 & 11	Temporary access road to Killymoon Golf Club (7) plus Old Coagh Road (10) closure and Moneymore Roundabout (11) works	2	<u>TM number 7</u> It is anticipated that the temporary access road to Killymoon Golf Club (7) will take 1 month to construct. <u>TM numbers 8, 9 & 10</u> Side road closures for the construction of bridge structures at Coagh Rd (9) & Old Coagh Rd (10) or roundabouts (at Cloghog Rd (8) are anticipated to last 4 months. Permanent works at Killymoon Roundabout will be undertaken offline once the temporary access road has been completed. <u>TM numbers 5 & 11</u> It is anticipated that both Moneymore Roundabout (11) & Loughry Roundabout (5) works will be constructed utilising temporary traffic signals to keep the existing A29 open. However, it does require some temporary works to be undertaken. Given the additional temporary works required and the inefficiencies of undertaking works in phases in an anticipated duration of approx. six months under traffic signals. This is a fairly conservative
8	10 & 11	Old Coagh Road (10) closure plus Moneymore Roundabout works	2	

TM Scenarios	TM numbers	Description (TM number in brackets)	Duration (months)	Comments / Assumptions
				programme estimate of the works and may be able to compress slightly.

Each of the proposed traffic management phases were coded into the traffic model to simulate the physical changes to the network brought about by the construction works. Results from the TM scenario models were assessed against an equivalent 2027 Do-Minimum model scenario using TUBA to monetise the impact of delays to users caused by the construction works. The results are presented in Table 6-22.

Table 6-22 – PVB Disbenefit by TM scenario

Construction Model Scenario	Present Value Benefits (PVB) (£,000s)
TM scenario 1	-59
TM scenario 2	-199
TM scenario 3	-142
TM scenario 4	-40
TM scenario 5	-71
TM scenario 6	-144
TM scenario 7	-64
TM scenario 8	-64
Total	**-783**

The overall road user disbenefit during constriction is estimated to be around £0.8 million.

6.3.5 Maintenance Impacts

The introduction of the schemes will provide extra road capacity around Cookstown, and it will provide a natural alternate in case of any maintenance to the existing A29 and surrounding networks. This will help reduce the user delay during any regular maintenance schedules across the appraisal period.

These potential benefits have been excluded from the scheme assessment and this would result in a conservative BCR for the scheme.

6.3.6 Monetised Environmental Benefits

6.3.6.1 Greenhouse Gases

TAG Unit A3 - Environment Impact Appraisal states that it is important to consider the impact of a proposed transport scheme on greenhouse gas (GHG) emissions, whether they are increased or decreased. As such, consideration of greenhouse gas emissions has been undertaken following guidance in TAG UNIT A3.

6.3.6.2 Local Air Quality

The air quality appraisal has also been undertaken in accordance with TAG Unit A3. This guidance defines a step-by-step approach for appraising local air quality based on quantification of the change in concentration of traffic-related pollutants NO2 and PM10. This has been undertaken for properties within 200m of the affected road network as defined within the DMRB Volume 11, Section 3, Part 1: Air Quality Guidance and interim advice notes.

6.3.6.3 Noise Assessment

Chapter 2: Noise impacts of TAG Unit A3 outlines a step-by-step process by which noise implications of road schemes can be appraised. This guidance refers to the assessment guidance contained within DMRB Volume 11, Section 3, Part 7, Noise and Vibration. This guidance has been followed for the appraisal and quantification of the noise impacts.

6.3.6.4 Monetised Environmental Impacts

The GHG, air quality and noise assessments were undertaken following the methodologies set out above with the resulting benefits/disbenefits presented in Table 6-23, in 2010 values and prices.

Table 6-23 – Present Value of GHG, Air quality and Noise assessments (£000)

Environmental Impact Category	Quantified Benefits (£000)
Greenhouse Gases	3,282
Local Air Quality	5,225
Noise	8,291
Total	**16,798**

6.3.7 Investment costs

For the economic appraisal, a whole life Present Value Cost (PVC) of the scheme is required. This includes Capital cost (or investment cost) and Operation and Maintenance (O&M) costs 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

The main components of the capital or investment costs for the scheme are:

- Preparation and supervision costs
- Land and property costs, including compensation
- Construction costs, including main works, ancillary works, statutory undertakings, site supervision and testing

The expenditure profiles are based upon cost estimates for each financial year prepared in 2022 Q4 prices and then inflated to outturn costs using projected construction-related inflation. The capital cost of the schemes in 2022 Q4 price base and the corresponding PVC in 2010 price base and values, are presented in Table 6-24.

Table 6-24 – Capital Cost Estimate (£000s)

Scheme	Scheme Cost at 2022 at Q4 Price Base	Cost at 2010 Prices (Discounted to Present Value 2010)
Bypass and SHL	58,963	30,501

In addition to investment costs, it is necessary for the economic assessment to take account of the cost of maintaining the new section of the A29 Cookstown Bypass and Sandholes Link (SHL) Road schemes over the 60-year assessment period. The Operation and Maintenance (O&M) cost for the scheme has been estimated based on unit prices, adjusted to market prices and discounted to 2010 using standard treasury discount rates to a PVC. The O&M costs is presented in Table 6-25.

Table 6-25 – Operation and Maintenance Cost Estimate (£000)

Scheme	Cost at 2010 Prices (Discounted to Present Value 2010)
Bypass and SHL	3,714

6.3.8 Economic Assessments

A full cost benefit analysis was carried out to assess the Proposed Scheme options in VfM terms. The appraisal included an assessment of economic benefits to road users referred to

as the Transport Economic Efficiency (TEE) benefits; an assessment of accident savings; and the monetised benefits from changes to greenhouse gas emissions, air quality and noise.

The benefits from these three categories were combined to give a Present Value Benefits (PVB) for each option. These were compared to Present Value Costs (PVC) of each option to produce a Net Present Value (NPV) and a Benefit to Cost Ratio (BCR) for each assessed option. This informed the Value for Money assessment which was undertaken with reference to the Value for Money Framework published by the DfT in July 2017.

The results of the economic assessment are presented using the following standard TAG tables:

- Appraisal Summary Table (AST)
- Transport Economic Efficiency (TEE)
- Public Accounts (PA)
- Analysis of Monetised Costs and Benefits (AMCB)

6.3.8.1 Appraisal Summary Table (AST)

The AST presents all the evidence from the scheme economic appraisal in a single table. It records all the monetised impacts which have been assessed and described in this section and also includes quantitative or qualitative information on non-monetised environmental impacts of the scheme. The AST is presented in Appendix C.

6.3.8.2 Transport Economic Efficiency (TEE) Table

The TEE Table 6-26 lists out the users and provides economic benefits by mode (Road, Bus, Rail etc.) separately. It does not report the benefits arising from the reduction in accidents with the scheme, nor environmental benefits.

The TEE table presents only the Road user benefits, since impacts on Bus, Rail and Other modes were considered to be marginal and therefore have not been quantified as part of the current assessment.

The TEE table also includes user charges, benefits/disbenefits during construction and maintenance. The assessment of the road user disbenefits' associated with delays during construction of the scheme has been included in this assessment. The benefits/disbenefits resulting from delays during periods of maintenance was not carried out for this assessment as a conservative approach was adopted.

The Tee table shows the present value of the total TEE benefits of nearly £109 million for the Core Scenario. This table shows that there are significant travel time savings and general savings related to vehicle operating costs as a result of the schemes.

Table 6-26 – Transport Economic Efficiency (TEE) Table (2010 prices in £000)

Area of Assessment		Low Growth	Core	High Growth
Non-Business - Commuting	Travel time	26,293	31,098	32,354
	Vehicle Operating Costs	128	525	808
	User charges	-	-	-
	Net Non-Business - Commuting	26,421	31,622	33,162
Non-Business - Other	Travel time	28,774	35,158	41,508
	Vehicle Operating Costs	-84	309	840
	User charges	-	-	-
	Net Non-Business - Others	28,690	35,467	42,348
Business User Benefits	Travel time	31,514	36,790	41,426
	Vehicle Operating Costs	4,589	5,800	6,854
	User charges	-	-	-
	Net Business	36,103	42,590	48,280
User Delay During Construction: Business and Non-business users		-783	-783	-783
Total TEE Benefits (2010 prices in £000**)**		90,431	108,896	123,006

As the level of demand increases (between Low, Core and High Growth scenarios) the amount of scheme benefits also proportionately increases, suggesting that the scheme provides sufficient capacity to cater for future demands.

6.3.8.3 Public Accounts (PA) Table

The ‘Public Accounts’ (PA) relate to the costs faced by Government (either local or central) to implement the scheme. This includes investment costs, operating costs, revenue, developer and other contributions, if any, grant/subsidy payments, if any; and indirect tax revenues to the government e.g. through fuel duty that results from the scheme.

In the PA table the costs appear as positive numbers, while revenues and ‘Developer and Other Contributions' appear as negative numbers. All entries are discounted present values in 2010 prices.

Table 6-27 – Public Accounts (PA) Table (2010 prices in £000)

Cost Category		Low Growth	Core	High Growth
Local Government Funding	Revenue	-	-	-
	Operating Costs	-	-	-
	Investment Costs	-	-	-
	Developer Contributions	-	-	-
	Grant/Subsidy Payments	-	-	-
	NET IMPACT	**0**	**0**	**0**
Central Government Funding	Revenue	0	0	0
	Operating Costs	3,714	3,714	3,714
	Investment Costs	30,501	30,501	30,501
	Developer Contributions	0	0	0
	Grant/Subsidy Payments	0	0	0
	NET IMPACT	34,215	34,215	34,215
Central Government - Indirect Tax Revenues		1,955	2,563	3,116
Totals (£000)	**Broad Transport Budget**	34,215	34,215	34,215
	Wider Public Finances	1,955	2,563	3,116

This table shows the discounted value of the operating costs are approximately £3.7 million and investment cost approximately £30.5 million giving a net impact of £34.2 million. The same values were retained for both the Low Growth and High Growth scenarios as investment and operational costs are consistent regardless of the level of demand.

The value of indirect tax revenues ranges between £1.9 and 3.1 million. The positive values reported for indirect tax revenues indicate a reduction in government's tax revenue (through fuel duty) because of the scheme.

6.3.8.4 Analysis of Monetised Costs and Benefits (AMCB) Table

The overall AMCB includes TEE benefits, accident benefits, greenhouse gas emissions, air quality and noise benefit / disbenefits because of the scheme. Negative values for these impacts would denote an increase in accident numbers, greenhouse gas emissions, air pollutants and noise levels.

Table 6-28 – AMCB Table (2010 prices in £000)

Benefit and Cost Category	Low Growth	Core	High Growth
Local Air Quality	5,225	5,225	5,225
Greenhouse Gases	3,282	3,282	3,282
Noise	8,291	8,291	8,291
Accidents	12,318	13,165	14,115
Economic Efficiency: Consumer Users (Commuting)	26,421	31,622	33,162
Economic Efficiency: Consumer Users (Other)	28,690	35,467	42,348
Economic Efficiency: Business Users and Providers	36,103	42,590	48,280
Wider Public Finances (Indirect Taxation Revenues)	-1,955	-2,563	-3,116
Construction and Maintenance	-783	-783	-783
Present Value Benefits (PVB) (£000)	117,592	136,296	150,803
Broad Transport Budget	34,215	34,215	34,215
Present Value Costs (PVC) (£000)	34,215	34,215	34,215
Net Present Value (NPV) (£000)	83,377	102,081	116,588
BCR	3.44	3.98	4.41

The NPV of the scheme is the difference between PVB and PVC. All the growth scenarios provide a positive NPV, which indicates a positive return on investment. The total benefits are compared with the total costs from the public accounts identified above, to determine the BCR and the VfM of the schemes.

The AMCB table presented in Table 6-28 shows the NPV for the Core Scenarios is approximately £102 million for the 60-year appraisal period. As demand increases the PVB of the scheme is also increasing proportionately, so does the NPV. For the Low Growth scenario, the NPV is approximately 18% lower than the Core and for the High Growth scenario the NPV is approximately 14 % higher when compared with Core.

The overall balance between benefits and costs is positive across all the growth scenarios. The calculated BCR for the Core Scenario is 3.98. The Low Growth scenario produces a BCR value of 3.44 and the High Growth scenario produces a BCR of 4.41.

The BCR is used as a basis for determining the scheme's VfM category. Six VfM categories are defined within the DfT Value for Money Framework (July 2017), ranging from Very High (BCR greater than or equal to 4) to Very Poor (BCR less than or equal to zero).

The Low Growth scenarios is approximately in the middle of the High VfM category at 3.44. The High Growth scenario is comfortably within the Very High VfM category at 4.41, whilst the Core Scenario at 3.98 is at the upper boundary of High VfM category.

Additional VfM sensitivity tests were conducted, based on the guidance provided by 'VfM Supplementary Guidance on Categories' (July 2017), to determine if the analysis of High VfM for the scheme based on the Core Scenario BCR is a suitable overall classification.

The first test is to determine the switching values for the scheme. This is PVB or PVC value required for the VfM classification to change. To achieve a Very High VfM, the Core Scenario PVB would need to be £136.9 million; an increase of just £0.6 million and percentage difference of 0.4% compared to the Core Scenario. To be reduced to a Medium VfM categorisation, the PVB would need to be £68.4 million; a reduction of £67.9 million and a percentage decrease of 50% of the Core PVB. Alternatively, the PVC would need to lower to £34.07 million (a reduction of £0.14 million) to improve the Core Scenario VfM category to Very High; or increase to £68.15 million (an increase in PVC of £33.93 million) to reduce the VfM to Medium, if the value of PVB remained consistent with the Core projection. In both instances of testing variation in the PVB or the PVC, a significantly smaller change is required to achieve the Very High VfM category than the Medium, this implies that a High VfM classification is suitable to define the VfM category of the scheme.

The second test assumes that each of the Core, High Growth and Low Growth scenarios is equally as likely. The average of the PVB values for each of the scenarios was calculated to be £134.9 million. This average PVB value was used with the scheme PVC value to generate a BCR, which is 3.94 and represents a High Value for Money. This average BCR is marginally lower than the Core BCR of 3.98.

One further sensitivity test was undertaken to reflect the updates to economic parameters and traffic growth projections released by the DfT and DfI after the completion of traffic forecasting for SAR3. These include:

- an update to TEMPro-NI which was made available by DfI in summer 2023;
- DfT release of National Road Traffic Projections (NRTP) 2022, which replaced the previous RTF18 projections; and
- an update to the DfT's Fuel and Income factors affecting travel demand.

To test the cumulative impact of these changes the SAR3 traffic model was rerun updating the above parameters and an economic assessment was undertaken. The economic assessment of this sensitivity test was limited to the appraisal of transport economic efficiency benefits, accident benefits and indirect tax revenues only, which form in excess of 85% of core scheme benefits. This is reported in greater detail in Appendix E of the SAR3. The outputs of this additional sensitivity test show that even with the updated economic parameters and demand projections, the scheme BCR remains within the range of Low and High Growth assessments (presented above) and that the scheme would continue to provide High VfM.

Overall, the results of the additional sensitivity testing reveal that the scheme represent a High VfM, even when considering the impacts of uncertainty around demand growth represented by the Low Growth and High Growth scenarios and the updates to national projections.

6.4 Economic Performance Summary

The economic appraisal comprised an assessment of the net benefits to users and the wider community because of the scheme, set against the capital construction and operational costs, all as incurred over a 'whole life' period. A full cost benefit analysis was required so that the Proposed Scheme could be assessed in 'Value for Money' terms. The appraisal included an assessment of economic benefits to road users (TEE benefits), including time savings and vehicle operating costs; an assessment of accident savings; and the monetised benefits from changes to greenhouse gas emissions, air quality and noise.

The final PVB of the scheme for the Core Scenario is about £136 million. Dependent on the level of demand tested the value of PVB ranged between £117-151 million.

The PVC for each of the demand scenarios was calculated to be £34 million, this included both the initial investment capital costs and the regular maintenance costs across the 60-year assessment period.

The PVB of the scheme were compared with the PVC to produce a NPV and BCR. The BCR of the scheme informed the VfM assessment which was undertaken with reference to the Value for Money Framework published by the DfT.

The overall NPV for the Core Scenario was calculated at £102 million. Between the demand scenarios the NPV ranges from £83 million to £117 million.

With reference to the DfT Value for Money categorisation the scheme represents a High VfM with a BCR of 3.98. This was also the case for the Low Growth demand scenario with a BCR of 3.44. The High Growth scenario represented a Very High VfM with a BCR of 4.41. Further sensitivity testing undertaken to estimate the impact of updated national demand growth parameters on the scheme economic performance, together with the VfM analyses based on High and Low growth scenarios, indicate that the scheme represent a High VfM.

7 Conclusions and Recommendations

7.1 Development of the Preferred Route Option

The development of the Preferred Route has been carried out in accordance with the requirements of the Department, complies with the relevant standards, and meets the A29 Cookstown Bypass Scheme Objectives set out in Section 1.2.

Further consideration has been given to aspects such as road safely, climate change, active travel, alignment optimisation, statutory bodies (including statutory undertakers) and key affected stakeholders including Cookstown and surrounding residents and landowners.

7.2 Road Design and Engineering Assessment

The scheme has undergone further review of the road design and engineering assessment as presented in Sections 3 and 5.

Since the SAR2, the scheme has been developed to analyse the key road geometry and technical engineering aspects for suitability of the Proposed Scheme. The geometric design of the Bypass, junctions and side roads have been reviewed to confirm compliance with the current standards, while further minimising impact to stakeholders, surrounding fields and residential and commercial properties. Some Relaxations and Departures from Standards have been recommended, as described within Section 5.7.

The existing geotechnical ground conditions indicate that the cohesive glacial deposits on site will provide suitable founding strata for the Bypass embankments, with some ground improvements and slope strengthening measures also likely being required.

Flexible pavements are proposed for the Bypass along the entire mainline and roundabouts, with the mainline adopting a low-noise road surfacing between Loughry Roundabout and Old Coagh Road. Sandholes Link Road will undergo planing and resurfacing and widening where required. Side roads will also undergo reconstruction works to suit the proposed realignments and changes to levels.

Section 3.5 provides an overview of the key structures that are proposed, including several underbridges, foot/cycle overbridges, underpasses, culverts, retaining structures and a flood protection wall. Each structure has been selected with consideration of the benefits specific to each location and value for money, and have been specified with a 120-year design life.

Existing and future flood risk assessments have been documented within the Flood Risk Assessment, with appropriately sized bridges, culverts, diversions, storage areas and a flood defence wall proposed to minimise flooding impacts. Drainage networks, open channels, swales, and SuDS ponds have been designed fit for purpose whilst treating water pollutants.

Lighting and public utility impacts have been assessed with asset owners, service providers and key stakeholders with most services affected located on the existing road network requiring only minor diversionary works. The scheme will be illuminated with road lighting nominated at each of the roundabouts and arms, requiring lighting columns (nominal height ranging from 10m-12m), feeder pillars, earth electrodes and road lighting chambers.

7.3 Scheme Cost, Traffic and Economic Assessment

Chandler KBS's high-level SAR3 scheme cost estimate approximates £62 million. In addition, approximately £8 million has been spent on the scheme as part of historical expenditure, providing a total scheme cost of approximately £70 million.

The traffic assessment indicates that the Proposed Scheme will provide an alternative route to the traffic currently routeing through Cookstown town centre, more than halving the time taken to travel between Moneymore Road and Dungannon Road via the Bypass. Secondary and incidental routes in the surrounding areas would also benefit from reduced journey times upon completion of the Bypass.

Accident savings are predicted to range between £12-£14 million with approximately 400 fewer accidents and 500 fewer casualties predicted over 60 years.

The scheme is forecast to generate significant levels of user benefits with a Present Value Benefits ranging between £117-£151 million. After consideration of Present Value Costs, the overall Net Present Value for the Core Scenario was approximately £102 million. Between the demand scenarios the Net Present Value ranges from £83-£117 million.

The SAR3 economic assessment confirmed the SAR2 findings remain valid, and the Proposed Scheme continues to offer high value for money with a Benefit Cost Ratio of 3.98.

7.4 Recommendations

Implementation of the Proposed Scheme will improve conditions for both strategic and local road users by enhancing the transport network.

The scheme will minimise the impact on the natural and built environment, alleviate traffic congestion, whilst enhancing the economic growth of the Cookstown and wider network, and demonstrates high value for money with fewer accidents and casualties predicted.

It is recommended that the Proposed Scheme be taken forward through to the next Statutory Orders publication stage.

Appendix A

Drawings

Appendix B

Traffic Model Verification Note

Appendix C

Appraisal Summary Table

Appendix D

Departures and Relaxations

Appendix E

Demand Sensitivity Test

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