A9/A96 Inshes to Smithton

DMRB STAGE 3 SCHEME ASSESSMENT REPORT

Engineering, Traffic and Economic Assessment

Volume 1 – Main Report

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A9/A96 Inshes to Smithton

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Glossary of Terms

Alluvium	Sediment deposited by a river.
Assessment	An umbrella term for description, analysis and evaluation.
Attenuation	Increase in duration of flow hydrograph with a consequent reduction in peak flow.
At-grade junction	A junction arrangement at which two or more roads meet at the same level.
Baseline	The existing conditions which form the basis or start point of the environmental assessment.
Bedrock	Hard rock that lies beneath a superficial cover of soils and sediments.
Benefit to Cost Ratio (BCR)	An indicator, used in the formal discipline of cost-benefit analysis that attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms.
Calcareous	Refers to a sediment, sedimentary rock, or soil type which is formed from or contains a high proportion of calcium carbonate.
Compulsory Purchase Order (CPO)	A legal document giving the government (Scottish Ministers) power to compulsorily purchase the areas of land necessary for the construction of the scheme.
Culvert	A metal, wooden, plastic, or concrete conduit through which surface water can flow under or across roads.
Cutting	Typically where part of a hill or mountain is cut out to make way for a road or railway line.
Diverge	A link road departing the main carriageway to a subsidiary road or junction.
Do-minimum	The base situation where there are no modifications to the existing road network. May also refer to the minimum modifications, which will necessarily take place in the absence of a proposed scheme.
Do-Something	The proposed scenario involving construction of a dual carriageway from Inverness to Nairn, including a Nairn bypass.
Dual Carriageway	The principal road being considered, namely the proposed A96 trunk road.
Effect	The result of change or changes on specific environmental resources or receptors.
Element	A component part of the landscape or environment (e.g. roods, hedges, woodlands).
Environmental Impact Assessment (EIA)	The process by which information about the environmental effects of a project is evaluated and mitigation measures are identified.
Fill	Material deposited by man in ground depression or excavated area or to construct an embankment.
Free Flow Alignment	A road layout that allows traffic to join and leave the carriageway at speed.

Glaciofluvial	Pertaining to streams fed by melting glaciers, or to the deposits and landforms produced by such streams.
Glacial Till	Glacial Till is that part of glacial drift which was deposited directly by the glacier. It may vary from clays to mixtures of clay, sand, gravel and boulders.
Grade Separated Junction	A junction arrangement that is separated by level from the through carriageway.
Ground Investigation	Exploratory investigation to determine the structure and characteristics of the ground influenced by a development. The collected information is used to establish or predict ground and groundwater behaviour during, and subsequent to, construction.
Groundwater	Water below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.
Heavy Goods Vehicle (HGV)	Vehicles with 3 axles (articulated) or 4 or more axles (rigid and articulated).
Impact	Any changes attributable to the proposed scheme that have the potential to have environmental effects (i.e. the causes of the effects).
Impermeable	Material that does not allow fluids to pass through it.
Landscape	Human perception of the land, conditioned by knowledge and identity with a place.
Local Road	An A, B or C classified road (non Trunk Road) typically operated by a Local Authority or council.
Made Ground	Material deposited by man i.e. not natural.
Merge	A link road accessing the main carriageway from a subsidiary road or junction.
Mitigation	Term used to indicate avoidance, remediation or alleviation of adverse impacts.
Non-Motorised User (NMU)	Road users other than vehicular traffic, particularly cyclists, pedestrians and equestrians.
Runoff	Water that flows over the ground surface to the drainage system. This occurs if the ground is impermeable or if permeable ground is saturated.
Severance	The separation of communities from facilities and services they use within their community. Alternatively, in relation to agricultural land, the division of plots of land into separate land parcels, potentially affecting access or creating areas that may be impractical for agricultural use.
Slip Road	A connector road facilitating access between one road and another.
Strategic Transport Project Review (STPR)	A review of the Scottish transport network undertaken by Transport Scotland and published in 2008. It identifies and prioritises road, rail and other interventions of national significance, proposed to be taken forward to improve the network.
Superficial Deposits	The youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back 1.8 million years from the present.

Sustainable Drainage Systems (SuDS)	A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.
Trunk Road	Part of the road network connecting major cities, towns, airports and ports for which the Scottish Government is responsible.
Water Environment (Controlled Activities) (Scotland) Regulations	Controls all engineering activity in or near watercourses.
Water Quality	The chemical and biological status of various parameters within the water column and their interactions, for example dissolved oxygen, indicator metals such as dissolved copper, or suspended solids (the movement of which is determined by hydrological process and forms geomorphological landforms).

Abbreviations

AADT	Annual Average Daily Traffic
AOD	Above Ordinance Datum
ATC	Automatic Traffic Count
BCR	Benefit to Cost Ratio
CAR	Water Environment (Controlled Activities) (Scotland) Regulations 2005
CBR	California Bearing Ratio
CEH	Centre for Ecology and Hydrology
CIRIA	Construction Industry Research and Information Association
CLH-PS	CLH Pipeline Systems
COBALT	Cost and Benefit to Accidents – Light Touch software
CPI	Consumer Price Index
CPO	Compulsory Purchase Order
D&B	Design and Build
DfT	Department for Transport
DGI	Detailed Ground Investigation
DM	Do-Minimum
DMRB	Design Manual for Roads and Bridges
DMU	Dry Mammal Underpass
DoS	Degree of Saturation
DS	Do Something
EB	Eastbound
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
FEH	Flood Estimation Handbook
FSR	Flood Studies Report
GDP	Gross Domestic Product
HGV	Heavy Goods Vehicle
HNDA	Housing Needs and Demand Assessment
HPPE	High Performance Polyethylene
IP	Inter Peak
IRIS	Integrated Roads Information Service
JTC	Junction Turning Counts
km	Kilometres
Kph	Kilometres per hour
kV	Kilovolt

LED	Light Emitting Diodes
LGV	Light Goods Vehicles
LTN	Local Transport Note
MFTM	Moray Firth Transport Model
MGV	Medium Goods Vehicles
NB	Northbound
NCN	National Cycle Network
NERC	Natural Environment Research Council
NMU	Non-Motorised User
NRSWA	New Roads and Street Works Act 1991
NTDS	National Traffic Data System
PAN	Planning Advice Note
PCP	Primary Connection Point
PS	Principal Structure
PSV	Polished Stone Value
PVC	Polyvinyl Chloride
RDG	Raeburn Drilling Geotechnical Ltd.
RRRAP	Road Restraint Risk Assessment Process
RSI	Roadside Interview
SB	Southbound
SEPA	Scottish Environment Protection Agency
SHW	Specification for Highway Works
SSE	Scottish and Southern Energy
STAG	Strategic Transport Appraisal Guidance
STPR	Strategic Transport Projects Review
SuDS	Sustainable Drainage Systems
SWFs	Surface Water Features
TAG	Transport Appraisal Guidance
TEE	Transport Economic Efficiency
THC	The Highland Council
TSRGD	Traffic Signs Regulations and General Directions 2016
TUBA	Transport Users Benefit Appraisal
UHI	University of Highland and Islands
VAT	Value-added Tax
WB	Westbound

1 Introduction

1.1 Overview

1.1.1 In January 2017, the £315 million Inverness and Highland City Region Deal was signed. Central to the deal is improving access to and within communities. The deal will improve connectivity through investment in transport infrastructure including the development of the A9/A96 Inshes to Smithton scheme. The A9/A96 Inshes to Smithton scheme (hereafter referred to as the proposed scheme) is interdependent with other projects and plans being progressed by The Highland Council, as well as being dependent on the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. As part of the Inverness and Highland City Region Deal, The Highland Council will improve the local road network at Inshes to provide the infrastructure needed to support development in the local area.

1.1.2 The proposed scheme consists of approximately 3.2km of new single carriageway, running south-west to north-east, as well as approximately 0.7km of carriageway widening on the existing line of the M9/A9 Edinburgh – Stirling – Thurso Trunk Road (hereinafter referred to as the A9), and a new bridge on the B9006 Culloden Road over the A9. It also includes a bridge crossing over the Highland Main Line Railway.

1.1.3 The design and assessment of the proposed scheme has progressed through Design Manual for Roads and Bridges (DMRB) Stage 2 (route option assessment). A preferred option was announced in October 2017. Since then the preferred option has been developed and assessed through DMRB Stage 3. The study area between Inshes and Smithton is shown on Figure 1.1.

1.1.4 This Scheme Assessment Report has been prepared in relation to the proposed scheme, which has been progressed to a 'Stage 3' level of design in accordance with the DMRB. This will inform the basis for the detailed design to be prepared and constructed by the appointed contractor(s), subject to agreement with Transport Scotland and adherence to environmental mitigation identified within the DMRB Stage 3 Scheme Assessment Report, Part 1 Environmental Impact Assessment Report (hereafter referred to as the Environmental Impact Assessment Report (EIAR)).

1.2 Background to the Proposed Scheme

1.2.1 The Strategic Transport Projects Review (STPR) (Jacobs, Faber Maunsell, Grant Thornton and Tribal Consulting 2008) sets out the Scottish Government's transport investment priorities over the coming decades. Specific trunk road interventions that emerged from the review included upgrading the A96 Aberdeen – Inverness Trunk Road (hereinafter referred to as the A96) between Inverness and Nairn to dual carriageway standard and including a new road connecting the A96 and A9 south of Inverness (Intervention 18). It also recommended interventions to the A9 corridor including improving the operational effectiveness of the A9 as it approaches Inverness.

1.2.2 In 2010, Transport Scotland commissioned a DMRB Stage 2 route options assessment in relation to upgrading the A96 between Inverness and Nairn. The assessment considered a number of options for improvements to the A96 corridor and included a new dual carriageway road between Inshes on the A9 and Smithton on the A96. The design work was undertaken to support The Highland Council's Local Development Plan Proposals for the A96 corridor and improve the operation of the trunk road network around Inverness.

1.2.3 Following the initial assessment findings, in February 2012 Transport Scotland and The Highland Council undertook a joint consultation on the emerging Local Development Plan proposals and options for a new dual carriageway trunk road between the A9 at Inshes and the A96 at Smithton. Feedback from the consultation highlighted a number of concerns regarding the scale of the proposals for the dual carriageway between Inshes and Smithton and severance, accessibility and integration aspects of the proposals. Following this feedback, the opportunity was taken to re-examine the wider context of the connection between the A9 and A96.

1.2.4 In 2013 Transport Scotland commissioned Jacobs to undertake the A9/A96 Connections Study (Jacobs 2016). The study reviewed the wider issues on the A9, A96 and A82, and the local road network impacts in consultation with The Highland Council. It was undertaken following Scottish

Transport Appraisal Guidance (STAG) principles which look at all modes of transport including walking, cycling and public transport.

1.2.5 In May/June 2014 Transport Scotland undertook a series of public exhibitions to present, and seek public feedback, on the emerging options under consideration for junction improvements and a new road from the A9 at Inshes to the A96 at Smithton. This was a joint exhibition with The Highland Council who presented the land use and local transport proposals relating to the Inshes and Raigmore Development Brief and Inshes Junction Improvements – Phase 2.

1.2.6 In June 2015 then Cabinet Secretary for Infrastructure, Investment and Cities, Keith Brown MSP, announced the emerging findings of the A9/A96 Connections Study which concluded that further design development should be undertaken for the grade-separation of the A9/A82 Longman Roundabout and two possible options for a single carriageway road connecting the A9 at Inshes across to the A96 at Smithton.

1.2.7 The A9/A96 Connections Study (Jacobs 2016) was published in March 2016. Following this, Transport Scotland commissioned Jacobs to undertake a DMRB Stage 2 option assessment for a single carriageway road connection between the A9 at Inshes and the A96 at Smithton. The grade separation of Longman junction is not included within the scope of this assessment and is being taken forward separately.

1.2.8 On 30 January 2017 the £315 million Inverness and Highland City-Region Deal was formally signed. It will form an important delivery mechanism for the region's economic vision and aims to improve connectivity through investments in transport and includes the development of the A9/A96 Inshes to Smithton Scheme.

1.2.9 As noted in the Inverness and Highland City-Region Deal, The Highland Council are working on enhancements to the local road network around Inshes and this includes the Inshes Junction Improvements - Phase 2 project. The proposed scheme would tie-in to this improvement project and the schemes are inter-dependent on one another. Studies are ongoing regarding the optimum design solution for the Inshes Junction Improvements - Phase 2 project, which aims to provide improvements both to Inshes Junction and to the access to Raigmore Hospital.

1.2.10 The DMRB Stage 2 Scheme Assessment Report (Jacobs 2017) was completed with the preferred option presented to the public at a series of public exhibitions in October and November 2017. The DMRB Stage 2 Scheme Assessment Report (Jacobs 2017) considered A and B alignment variants of each option. It was recognised that the proposed scheme forms an important element of The Highland Council's Inverness East Development Brief, which at the time of the preferred option identification, was in preparation. It was therefore considered appropriate to defer the decision on the A/B variant in order to await progress of the draft Development Brief and undertake further consultation, design development and assessment as early activities in the DMRB Stage 3 process.

1.2.11 Jacobs progressed the DMRB Stage 3 design and assessment of the preferred option, including completion of a DMRB Stage 3 Environmental Impact Assessment (EIA), and to provide services to complete an EIAR and draft Orders for the proposed scheme.

1.2.12 Since completion of the DMRB Stage 2 Scheme Assessment Report (Jacobs 2017), The Highland Council has made progress with the Draft Inverness East Development Brief. On 20 November 2017 the draft brief was approved by the City of Inverness Area Committee for consultation. The formal consultation period for the draft brief closed on Friday 9 March 2018. The Inverness East Development Brief was formally adopted in June 2018. Consultation and design development were undertaken as early activities in the DMRB Stage 3 process. Consultation feedback from statutory consultees and landowners as well as the public feedback received following the public exhibitions held in October and November 2017 has been considered in the assessment of the A and B alignment variants. The outcome of these considerations was that variant B should be progressed for further development and assessment at DMRB Stage 3 and that variant A would not be considered further.

1.2.13 Drop-in sessions were held in May 2018 to provide further information on the early design and assessment work of the preferred option and it's two variant options and to present the outcome of this review.

1.3 Scheme Objectives

1.3.1 The scheme objectives for the A9/A96 Inshes to Smithton scheme are as follows:

- to encourage more effective use of the road network hierarchy and thereby improve the operation of the network for longer distance and local journeys;
- to contribute to The Highland Council's Development Plan aims for development east of the A9, and to complement the benefits arising from the dualling of the A96;
- to improve safety for motorised and non-motorised users where the trunk and local road network interact; and
- to maximise opportunities for active travel and public transport connections arising from the road infrastructure improvements.

1.4 The Proposed Scheme

1.4.1 The DMRB Stage 3 engineering design presented in this report, assessed in the EIA and reported in the EIAR is shown on Figure 1.2, with proposed structures shown on Figure 1.3.

1.4.2 The proposed scheme includes approximately 3.2km of new single carriageway, to improve the road network between the existing A9 and A96. The proposed scheme also incorporates:

- the provision of a lane gain/lane drop arrangement on the A9 southbound carriageway between the Raigmore Interchange and the A9 Inshes Southbound Junction;
- two at-grade roundabouts;
- local road diversions, the provision of new means of access and access for maintenance purposes;
- two principal structures, including a crossing of the over the Highland Main Line Railway and a crossing of the A9;
- provision for Non-Motorised Users (NMUs) consisting of approximately 5.3km of shared use path, 1.3km of footway and 0.7km of cycleway;
- 12 culverts; and
- utility works.

1.4.3 Further details of the proposed scheme are provided in Chapter 3 (Description of the Proposed Scheme).

1.5 DMRB Stage 3 Scheme Assessment Report

1.5.1 This report has been prepared in accordance with the requirements of the DMRB, Volume 5, Section 1, Part 2, TD37/93, Scheme Assessment Reporting (The Highways Agency, The Scottish Office Development Department, The Welsh Office and The Department of The Environment for Northern Ireland 1993) and describes the outcomes of the DMRB Stage 3 development work undertaken in respect of the proposed scheme.

1.5.2 The A9/A96 Inshes to Smithton Scheme Environmental Impact Assessment Report as published in September 2019 forms Part 1 of the DMRB Stage 3 Scheme Assessment Report and covers the environmental aspects of the assessment. This report forms Part 2 of the DMRB Stage 3 Assessment and details the assessment work in relation to engineering, traffic and economics.

1.5.3 Part 1 Environmental Impact Assessment Report and Part 2 Engineering, Traffic and Economic Assessment can be viewed at the Transport Scotland website: https://www.transport.gov.scot/publication/draft-orders-and-environmental-impact-assessment-report-a9a96-inshes-to-smithton/

1.6 Do-Minimum Definition

1.6.1 The situation describing the future conditions, if the scheme is not constructed, is termed the 'Do-Minimum' scenario. The 'Do-Minimum' scenario has been agreed with Transport Scotland and The Highland Council to include other infrastructure improvements that have the required level of commitment to be included. A full definition of the 'Do-Minimum' scenario is given in Section 5.5 (Traffic Modelling).

1.7 References

Jacobs, Faber Maunsell, Grant Thornton and Tribal Consulting *(on behalf of Transport Scotland)* (2009). Strategic Transport Projects Review: Final Report.

Jacobs (2016) *(on behalf of Transport Scotland).* A9/A96 Connections Study: Transport Appraisal Report

Jacobs (2017) *(on behalf of Transport Scotland).* A9/A96 Inshes to Smithton: DMRB Stage 2 Scheme Assessment Report.

The Highways Agency, The Scottish Office Development Department, The Welsh Office and The Department of The Environment for Northern Ireland (1993). Volume 5, Section 1, Part 2, TD37/93, Scheme Assessment Reporting

2 Existing Conditions

2.1 Overview

2.1.1 This section provides an overview of the existing conditions within the area of land between the existing A9 at Inshes and the existing A96 at the Smithton Roundabout. It provides information in relation to existing features including carriageway conditions and structures.

2.1.2 The study area is located between Inshes to the west of the A9 and the proposed A96 Smithton Junction, which will form part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme at Stratton. The study area extends from the existing A96 to the north to the communities of Inshes, Cradlehall and Smithton to the south.

2.1.3 The land within the study area is principally agricultural and comprises open fields used for both grazing and crops. There are a number of industrial estates, communities and settlements located within the study area. The Highland Main Line Railway, running broadly north-west to south-east, dissects the study area. To the north of the railway line, and in the east of the study area is the Inverness Retail and Business Park. Also, north of the railway line, in the centre of the study area, are the Ashton Farm buildings. South of the railway line and to the west of the study area is the University of the Highlands and Islands Inverness Campus (hereafter referred to as Inverness Campus).

2.1.4 The existing road network, structures and associated features are shown on Figure 1.1.

2.2 Man-made Features

Roads

2.2.1 The existing road network is described in Sections 2.3 and 2.4 using the road names given in Table 2.1. Other roads are described by their classification and road name.

Table 2.1: List of Roads

Classification	Full Road Name
A Class Roads	
A96	Aberdeen – Inverness Trunk Road
A9	M9/A9 Edinburgh – Stirling – Thurso Trunk Road
A8082	Inverness Southern Distributor Road (Sir Walter Scott Drive)
B Class Roads	
B9006	Culloden Road (Millburn Roundabout – Culcabock – Castle Hill – Culloden Moor – Croy – Gollanfield – Fort George Road)
B9177	Milton of Leys – Bogbain – Castlehill Road
C Class Roads	
C1032	Barn Church Road
C1036	Tower Road
Unclassified Roads	
U1058	Caulfield Road North (Castlehill – Cradlehall – Smithton – Stratton Lodge Road)
U1124	Caulfield Road
U1267	Dell of Inshes Road
U2820	Eastfield Way
U5096	Castlehill Distributor Road (referred to as Castlehill Road)
U5202	Highlander Way
U4715	Inshes Retail Park Road

Railway

2.2.2 The Highland Main Line Railway is a twin-track railway line as it approaches Inverness, which runs north-west to south-east as it passes through the study area. There are no level crossings of the railway within the study area. Vehicle crossing bridges are present on the A96 at Raigmore and the C1036 Tower Road through Smithton and Cradlehall. A pedestrian footbridge, Drumrosach Bridge, is present south-west of Ashton Farm on the footway between the Inverness Campus and Inverness Retail and Business Park. The railway is generally at grade or in cutting as it passes through the study area.

Residential Properties

2.2.3 The residential areas of Smithton and Culloden are situated to the east of the study area. Other communities include Inshes to the west of the study area and smaller communities can be found at Cradlehall, Westhill and Inshes Wood.

2.2.4 To the north east of the study area residential properties are being constructed as part of the Stratton development.

Agricultural Properties

2.2.5 To the north of the railway line there are three active farms. The largest farm is Ashton Farm, who farm the majority of the land. Both Seafield Farm and Stratton Farm also have land within the study area. Stratton Farm is no longer an active farm.

2.2.6 The agricultural land south of the railway line is owned by Highland and Island Enterprise but is currently leased by a contract farmer.

Commercial Properties

2.2.7 Inshes Retail Park and Beechwood Business Park are commercial developments located to the west of the study area adjacent to the A9 at Inshes. Inverness Retail and Business Park is another commercial development located adjacent to the existing A96 to the north-west of the study area and Cradlehall Business Park is located to the south of the proposed scheme on U1058 Caulfield Road North/U1124 Castlehill Road at Cradlehall.

2.2.8 Inverness Campus is also located in the study area, adjacent to the A9.

2.3 Existing Road Network

Route Description

2.3.1 The route descriptions below focus on describing the existing roads within the study area. There is currently no direct link between Inshes on the A9 and Smithton on the A96, and traffic generally uses the existing local road network to access the east side of Inverness. The key routes below will be impacted as a result of the options considered within this assessment.

A96 Aberdeen – Inverness Trunk Road between Raigmore Interchange and A96 Smithton Junction

2.3.2 This section of the existing A96 commences at Raigmore Interchange, heading in a generally north-easterly direction towards Smithton. The first 0.85km of the route from Raigmore Interchange to the Seafield Roundabout is dual carriageway. East of the Seafield Roundabout the existing A96 is single carriageway and continues for approximately 0.9km to the existing A96 Smithton Junction. It should be noted that the above description is of the existing A96. The scheme assessment takes into account, where appropriate, the proposals for the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme which will affect this section of the existing A96.

M9/A9 Edinburgh – Stirling – Thurso Trunk Road between Raigmore Interchange and A9 Inshes Southbound Junction

2.3.3 This section of the A9 between Raigmore Interchange and A9 Inshes Southbound Junction is approximately 1.3km in length, heading in a southerly direction. It is an existing dual carriageway operating at the national speed limit. There is a southbound merge slip road from Raigmore Interchange onto the A9 and a southbound diverge from the A9 at A9 Inshes Southbound Junction to the B9006 Culloden Road. On the north bound carriageway there is a lane gain/lane drop arrangement between A9 Inshes Northbound Junction and Raigmore Interchange.

2.3.4 The Inshes Overbridge crosses the A9 at a point 1.2km south of Raigmore Interchange. An NMU crossing facility known as the 'Golden Bridge' crosses over the A9 at a point 0.35km south of Raigmore Interchange.

A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)

2.3.5 Within the study area the A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive) commences from Inshes Roundabout, heading in a south-westerly direction for 0.6km to the roundabout with the U4714 Inshes Road, known locally as Eagle Roundabout. This route is a distributor road that carries traffic through the south of Inverness.

B9006 Culloden Road

2.3.6 Within the study area the B9006 Culloden Road commences from the Inshes Roundabout, heading in a generally south-easterly direction for 1.2km to the B9177 Milton of Leys – Bogbain – Castlehill Road junction. It is an urban route with a number of junctions facilitating access to commercial business, Inverness Campus and residential areas, and is one of the main routes into the city from the east.

U1267 Dell of Inshes Road

2.3.7 The U1267 Dell of Inshes commences from Inshes Roundabout, heading south towards Dell of Inshes for approximately 0.2km to the Inshes Retail Park Roundabout. This section of the route is a split single carriageway with trees in the central reserve and to the east. The west side of this section runs parallel to the car park for the Inshes Retail Park.

2.3.8 The U1267 Dell of Inshes Road continues from the Inshes Retail Park Roundabout for approximately 0.2km, heading in an easterly direction to access Dell of Inshes and Ardachy. This section facilitates access to a number of properties and a farm. This section has a rural setting, with the route being a single-track access, lined on either side with mature trees.

U1058 Caulfield Road North/U5096 Castlehill Road

2.3.9 This section of U1058 Caulfield Road North commences from its junction with the B9006 Culloden Road, approximately 0.2km south-east of Inshes Overbridge. This section of the route is approximately 0.2km in length, heading in an easterly direction until the U5096 Castlehill Road Junction. At this point the through route at the junction changes from the U1058 Caulfield Road North to the U5096 Castlehill Road, where it continues for a short section to a roundabout that provides access to Cradlehall Business Park. There is also an access into Inverness Campus from the U1058 Caulfield Road North.

2.3.10 U1058 Caulfield Road North continues from its junction with the U5096 Castlehill Road in a north-easterly direction for approximately 0.6km until the Highland Main Line Railway. The route continues beyond the railway line but prohibits vehicular access beyond this point. This section of the route is rural and forms a single carriageway tree lined access for a significant number of properties in Cradlehall. The route has speed control measures in place to discourage through traffic from U1124 Caulfield Road.

C1032 Barn Church Road

2.3.11 This section of the C1032 Barn Church Road commences from the existing A96 Smithton Junction for approximately 1.3km, heading in a south-easterly direction to the junction with the C1036 Tower Road. This section of the C1032 Barn Church Road is a single carriageway distributor road, in a rural setting passing through agricultural land until reaching Smithton. It should be noted that the C1032 Barn Church Road will be altered as a result of the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme and as such the assessment of the proposed scheme assumes this will be in place**.**

Speed Limits

2.3.12 A 50mph limit is in place on the A96 from Raigmore Interchange to approximately 250m east of the A96 Smithton Junction. The national speed limit applies along the existing section of the A9 covered by the study area.

2.3.13 The speed limit on the urban road network is generally 30mph. Within the study area a speed limit of 40mph applies to the C1032 Barn Church Road. The speed limit on the B9006 Culloden Road is 40mph south of the U1058 Caulfield Road North.

Junctions

2.3.14 The main junctions within the scheme study area both on the trunk road network and local road network are described below:

Seafield Roundabout

2.3.15 Seafield Roundabout provides access to the Inverness Retail and Business Park from the A96. Street lighting is provided on approaches to the roundabout. A footway/cycleway runs along the south side of the A96 through this junction allowing NMU access to the Inverness Retail and Business Park.

A96 Smithton Junction

2.3.16 The A96 Smithton Junction is a roundabout connecting C1032 Barn Church Road to the existing A96 providing access to Culloden, Smithton and Balloch. Street lighting and illuminated keep left bollards are provided on the physical approach islands on each arm of the roundabout. A footway/cycleway runs along the south side of the existing A96 through this junction with dropped kerbs and a paved area in the splitter island to allow pedestrians and cyclists to cross the C1032 Barn Church Road arm of the roundabout.

Inshes Roundabout

2.3.17 This junction provides access to the Inshes Retail Park from the A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive) and B9006 Culloden Road. Street lighting is provided as well as illuminated bollards on the physical approach islands at the roundabout.

Inshes Southbound Junction

2.3.18 This junction is a left in left out junction between the A9 and the B9006 Culloden Road featuring merge and diverge tapers. A connector road links the A9 Inshes Southbound Junction to the B9006 Culloden Road.

Inverness Retail and Business Park Junction

2.3.19 This junction is a roundabout within Inverness Retail and Business Park. Street lighting is provided as well as illuminated bollards on the physical approach islands at the following arms of the roundabout; the U5202 Highlander Way arm and both U2820 Eastfield Way arms. The U2820 Eastfield Way arm currently terminates approximately 170m from the roundabout, where it interfaces with a walkway from the Inverness Campus.

2.3.20 A9 Southbound Inshes Junction and the A9 Diverge/Culloden Road/Inverness Campus Junction This is a signalised crossroad junction providing access from the A9 southbound onto the B9006 Culloden Road. It also provides access into the Inverness Campus. A number of residential properties take access from the A9 southbound merge and diverge connector road.

U1058 Caulfield Road North/B9006 Culloden Road Junction

2.3.21 This is a signalised T-junction with a physical approach island on the U1058 Caulfield Road North with segregated left turn for traffic turning onto the B9006 Culloden Road. There is an illuminated bollard located on the physical approach island. A footway/cycleway runs along Caulfield Road North with dropped kerbs and a paved area in the splitter island to allow pedestrians and cyclists to cross Caulfield Road North at the junction with Culloden Road.

U1058 Caulfield Road North/Inverness Campus Junction

2.3.22 This is a simple T-junction connecting to the U1058 Caulfield Road North, which provides access to Inverness Campus. The junction is situated 0.2km north-east of B9006 Culloden Road. A footway/cycleway runs along the north side of the U1058 Caulfield Road North through this junction with dropped kerbs to allow pedestrians and cyclists to cross.

U1058 Caulfield Road North/U5096 Castlehill Road Junction

2.3.23 This is a simple T-junction connecting U5096 Castlehill Road to U1058 Caulfield Road North. The junction is situated 0.4km east of B9006 Culloden Road. A footway/cycleway runs along the north side of the U1058 Caulfield Road North with dropped kerbs set back approximately 20m from the junction to allow pedestrians and cyclists to cross.

2.4 Other Carriageway Features

Road Pavement Condition

2.4.1 The existing road pavement type within the study area is constructed as a fully flexible pavement on the A9 and a flexible composite pavement on the Raigmore Interchange southbound A9 merge slip road. As determined from Transport Scotland's Integrated Roads Information System (IRIS), accessed January 2019, the fully flexible pavement consists of between approximately 230mm and 280mm of bituminous material and the flexible composite construction consists of approximately 150mm bituminous material and 110mm hydraulically bound material. There is currently no information regarding the thickness of foundation material. Where required this will be established by the appointed contractor prior to construction.

2.4.2 The residual life of the A9 lane 1 pavement between Raigmore Interchange and B9006 Culloden Road has been determined using deflectograph data from the IRIS database and has been identified as being generally less than 5 years.

2.4.3 It should be noted that the accuracy of the pavement desk study for the A9 within the study area is reliant on the accuracy of the data within IRIS. A thorough pavement investigation would be required to determine the accuracy of the data obtained from IRIS and verify any data discussed in this report.

2.4.4 The existing road pavement type within the side road tie in locations at U2820 Eastfield Way and U1058 Caulfield Road North, as determined from road cores taken May 2018, indicate the pavement is a fully flexible construction with between approximately 200mm and 300mm bituminous material.

2.4.5 There is currently no information available regarding the existing road pavement on the B9006 Culloden Road. Further testing would be required to establish the construction and condition of the existing pavement.

Drainage

2.4.6 The existing A9, A96 and B9006 Culloden Road within the study area have kerbed edges with channel gullies connecting directly into carrier drains. Overall there is no evidence that the surface water is treated before outfalling into the various watercourses.

2.4.7 The proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme within the study area will have kerbed edges with channel gullies connecting directly into carrier drains. These will drain into treatment ponds located between the proposed A96 Smithton Junction and the Aberdeen to Inverness Railway Line, which then discharges into the Scretan Burn to the north of the A96.

2.4.8 The study area is crossed by a number of farm drains which join with the natural water courses in the area. These connect either to the Scretan Burn or the Cairnlaw Burn, depending upon watershed location.

NMU Provision

2.4.9 The National Cycle Network Route 1 (NCN1) is a long-distance cycle route which connects Dover and the Shetland Islands, via the east coast of the British Isles. The NCN1 within the study area passes through Smithton and Cradlehall on the U1058 Caulfield Road North. It then enters Inverness via the B9006 Culloden Road, which it joins at Inshes.

2.4.10 The study area referred to for the NMU provision includes the NMU provision along the existing A96, proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme and the existing B9006 Culloden Road.

2.4.11 The footway along the existing A96 connects to C1032 Barn Church Road and links Culloden to Inverness and the Retail and Business Park. The proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme will maintain this connection with a shared use path from Inverness to Nairn which connects to the existing local NMU facilities at major junctions.

2.4.12 The B9006 Culloden Road has a footway along its north side, connecting the Culloden area to the Inverness Campus, Inshes Retail Park, and into Inverness. Where it crosses the U1058 Caulfield Road North and the Inverness Campus roads the route is controlled by signalised pedestrian crossings.

2.4.13 There is also one core path within the study area, identified by the Highland Council path references as IN08.10. The path is a 1.5km track connecting the A96 to U1058 Caulfield Road North via the Ashton Farm Access Road.

2.4.14 Connecting the Inverness Campus and the Inverness Retail and Business Park is a shared use path over the Drumrosach Bridge.

2.4.15 For further details of the core paths and other NMU routes, refer to Figure 2.1.

Lighting

2.4.16 There is existing street lighting on the C1032 Barn Church Road, B9006 Culloden Road, U1058 Caulfield Road North and A96. Street lighting also exists along the A9 between Raigmore Interchange and Inshes Junction. The A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme will also be illuminated within the study area for the proposed scheme.

Public Transport Facilities

2.4.17 Table 2.2 provides details of the bus services currently operating within the study area, correct as of March 2019.

Table 2.2: Bus Services Currently Operating Within the Study Area

Service No.	Operator	Origin	Destination	Frequency (Daily Service) *
1	Stagecoach	Union Street	Milton of Leys Primary School	2 services per hour between 05:10 and 07:00. Then 4 services per hour in each direction (Mon-Sun).
2	Stagecoach	Craig Dunain	Culloden	2 services per hour between 05:50 and 07:50. Then every 20 minutes in each direction (Mon-Sun).
3	Stagecoach	Craig Dunain	Culloden	3 services per hour in each direction (Mon-Sat). 2 per hour on Sundays.
4	Stagecoach	South Kessock	Milton of Leys Circular	2 services per hour in each direction (Mon-Sat).
5	Stagecoach	Queensgate	Ardersier High Street	4 services per hour in each direction (Mon-Sat).
5	Transport for Tongue	Inverness (Tesco retail park)	Talmine	1 Service per month on last Saturday of month.
S5	D & E Coaches	Inverness (Henderson Drive)	Culloden Academy	3 Morning services on school days only.
8	Stagecoach	Raigmore Estate	Dalneigh Circular	2 services per hour in each direction (Mon-Sat). 1 per hour on Sundays.
10	Stagecoach	Inverness Bus Station	Aberdeen	1 service per hour until 08:00, then every 30 minutes in each direction (Mon-Sun).
11	Stagecoach	Nairn	Inverness Bus Station	1 service per hour in each direction (Mon-Sat).
S21	D & E Coaches	Inshes Tesco	Culloden Academy	1 morning and 1 afternoon service on school days only.
25	Stagecoach	Inverness Bus Station	Inverness	1 service per hour (Mon-Sat) then 1 service every 2 hours on Sundays.
26	Stagecoach	Inverness Bus Station	Cromarty	2 services per hour (Mon-Sat). 1 service every 2 hours (Sun).
34	Stagecoach	Inverness Bus Station	Aviemore	2 services daily in each direction (Mon-Thur).
35	Stagecoach	Inverness Bus Station	Newtonmore	2 services daily (Mon-Fri) and once on a Saturday.
61	D & E Coaches	Inverness (Henderson Drive)	Ullapool	2 daily services (Mon-Fri).
103	Stagecoach	Inverness Campus	Inverness Culloden Academy	1 service daily during term time.
104	Stagecoach	Milton of Leys Primary School	Millburn Academy	1 service daily in each direction on schooldays only.
112	Stagecoach	Inverness Bus Station	Tomatin	1 service daily on school days only in each direction.
113	Stagecoach	Inverness Bus Station	Garbole	3 services daily from Inverness and 5 from Garbole on school days only in each direction.
228	Fishers Tours	Arbroath	Inverness	1 service on Thursdays fortnightly
244	Fishers Tours	Forfar	Inverness	1 service on Thursdays fortnightly
252	D & E Coaches	Inverness (Henderson Drive)	Cawdor	4 services daily
267	Fishers Tours	Cupar	Inverness	1 service on Fridays fortnightly
300A	D & E Coaches	Carsegate Road B&M	Meallmore Lodge	4 services daily
301	D & E Coaches	Whitebridge	Inverness Raigmore Hospital	5 services daily (Mon-Fri). Once on Sat.
303	D & E Coaches	Whitebridge	Inverness Raigmore Hospital	2 services daily in each direction only on school days.
304	D & E Coaches	Inverness (Henderson Drive)	Tomich	1 service on school days in each direction.

Service No.	Operator	Origin	Destination	Frequency (Daily Service) *
410	D & E Coaches	Cromarty	Inverness (Croy Ardcroy Road)	1 evening service (Mon-Sat) in each direction.
919	Stagecoach	Inverness Campus	Fort William Bus Station	2 services daily from Inverness Campus. 5 services daily from Inverness Bus Station

2.5 Existing Structures

2.5.1 Within the study area there are three bridge structures and two culverts which are described in more detail below. See Figure 1.3 for existing structure locations.

Bridge Structures

Inshes Overbridge (Reference No. A9 1300)

2.5.2 Inshes Overbridge is located approximately 1km south of the Raigmore Interchange and carries the B9006 Culloden Road over the A9. It was constructed circa 1981 and comprises a two span simply supported precast concrete M-beam and slab deck. The end supports comprise free standing reinforced concrete cantilever walls supported on spread foundations and the pier comprises a free standing reinforced concrete slab wall supported on spread foundations. The structure has a skew of 22 degrees with skew spans of 14.8m and 16.0m. The carriageway is 9m wide, with two lanes westbound and one lane eastbound traffic. An approximately 3m wide footpath is provided on the north side and an approximately 1.5m wide raised verge is provided on the south side of the bridge. The minimum available headroom to the A9 below is 5.76m as measured on 31 July 2014. Steel parapets are provided on each edge of the deck with the north and south parapets being P2/80 1.4m high and P2/113 0.975m high respectively.

2.5.3 The most recent General and Principal Inspections (2012 and 2014 respectively) identified that the structure was generally in good condition with generally only minor defects. However, three category 3 defects were identified in relation to debris on the bearing shelf brought in by pigeons, abutments were wet due to defective joints above and small areas of concrete are spalling behind parapet posts.

2.5.4 The vehicle containment over the structure does not comply with current standards as it is of insufficient height on the south side.

2.5.5 The structure is recorded as being designed to accommodate full HA loading and 45 units of HB loading. There is no record of an assessment to provide recent verification of its load carrying capacity.

2.5.6 For the purposes of this report the Inshes Overbridge shall be referred to as Principal Structure 01 (PS01) Existing Inshes Overbridge.

Drumrosach Bridge

2.5.7 Drumrosach Bridge provides pedestrian/cycle access across the Highland Main Line Railway and connects the Inverness Campus with the Inverness Retail and Business Park. This historic railway bridge was refurbished and opened as a dedicated pedestrian/cycle bridge in 2016.

2.5.8 The bridge is owned and maintained by Network Rail. No inspection records are available for this structure.

A9 Pedestrian and Cycle Overbridge – The Golden Bridge (Reference No. A9 1305 F)

2.5.9 The Golden Bridge is located approximately 0.25km south of the Raigmore Interchange and carries a pedestrian/cycle route across the A9 at the Inverness Campus. The bridge was constructed in 2013 and comprises a three span simply supported steel bridge deck supported on circular reinforced concrete columns.

2.5.10 The bridge is owned and maintained by Highland and Islands Enterprise. No inspection records are available for this structure.

Culverts

2.5.11 There are two existing culverts within the study area. These culverts carry the Beechwood Burn under the A9 approximately 0.18km north of Inshes Overbridge and under the U1058 Caulfield Road North adjacent to the junction with B9006 Culloden Road.

Retaining Walls

2.5.12 There are no retaining walls on the A9 or A96 which may be affected by the scheme.

2.6 Public Utilities

2.6.1 All relevant public utility companies were contacted in accordance with the New Roads and Street Works Act 1991 (NRSWA). Public utility companies with apparatus that would be affected by the proposed scheme have generally provided a "C3" budget estimate, including preliminary details of the effects on their apparatus and an assessment has been made.

2.6.2 The following sections identify the key utilities between Inshes and Smithton.

Telecoms

2.6.3 Existing telecoms in the study area include the BT line to Ashton Farm from the A96. Along the B9006 Culloden Road there is SSE Telecoms and Vodafone apparatus.

2.6.4 It is understood that the SSE Telecoms asset is within the Vodafone duct network.

Gas

2.6.5 Two Intermediate Gas Mains are within the study area. One runs west to east, to the north of the study area along the existing A96. The second runs north to south along the verge of the northbound lane of the A9.

Electricity

2.6.6 The electrical grid in the study area is controlled by Scottish and Southern Energy (SSE).

2.6.7 A 33kv overhead line runs from Inshes to Ashton Farm, Smithton, Stratton, Seafield Farm, and the Inverness Retail and Business Park.

2.6.8 There are 11kv overhead lines connecting to Stratton Farm, Ashton Farm, and the Inverness Campus to the 33kv lines.

Water Supply and Sewerage

2.6.9 A major combined sewer pipe crosses the study area from west to east. It crosses the proposed scheme twice, close to the Scretan Burn, and close to the Cairnlaw Burn.

2.6.10 A CCTV survey was carried out on the pipe and its line and level in the vicinity of the proposed scheme were confirmed in February 2019.

2.6.11 A combined sewer and water main cross the A9 approximately 400m north of the A9 Inshes Southbound Junction.

2.6.12 A foul sewer and water main follow the Highland Main Line Railway, north of Cradlehall.

2.6.13 Three water mains are present between the Highland Main Line Railway and C1032 Barn Church Road.

CLH Pipeline System (CLH-PS)

2.6.14 The CLH-PS runs east from Inverness through the study area in a generally north-easterly direction. The pipeline is to be diverted as part of the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. The proposed scheme will cross the CLH-PS prior to the C1032 Barn Church Road.

2.7 Existing Traffic Patterns

Traffic Flows

2.7.1 A summary of the observed 2018 two-way Annual Average Daily Traffic flows (AADT) at key locations on the trunk and local road network are shown in Table 2.1. As noted above, the observed traffic information has been obtained from the permanent Automatic Traffic Counters (ATC) from the National Traffic Data System (NTDS). Where possible, data has been used from 2018, however in some locations, 2017 data has been used as 2018 data was not available. Additional ATCs and Junction Turning Counts (JTCs) were installed during February, March and April 2018, as a representative (neutral) month in terms of traffic volumes. The JTCs were undertaken over one day in February, for a 12-hour period. This data has been factored to a 24-hour flow for the day of the survey and should be considered as an approximation of the AADT flow. The source of the traffic data has also been noted in Table 2.3.

2.7.2 In 2017, the two-way AADT flow on the A96 between the Seafield Roundabout and Raigmore Interchange was approximately 36,500 vehicles, based on the ATC data analysis. The two-way AADT flow on the A9 north of Raigmore Interchange was approximately 35,100 vehicles, and on the A9 south of Raigmore Interchange was approximately 30,200 vehicles, however this count is a proxy as it is calculated based on the ATC North of Raigmore Interchange and the JTC at Raigmore Interchange.

Table 2.3 : Automatic Traffic Counter Data within the Study Area (February 2018)

Location	Source	AADT
A9 North of Raigmore Interchange	ATC01008 (2017)	35,100
Seafield Roundabout	ATCNE011 (2017)	36,500
Seafield Roundabout to A96 Smithton Junction	JTC21 (one day count)	29,100
A96 East of Smithton Junction	ATC01066	16,000
A9 South of Raigmore Interchange	Proxy Count based on ATC1008 and JTC10	30,200

2.7.3 The highest traffic flows are recorded on the A9 to the north of Raigmore Interchange and on the A96 between Raigmore Interchange and Seafield Roundabout. Traffic flows reduce on the A96 to the east of Seafield Roundabout.

2.7.4 A number of additional temporary ATCs were also installed along the A96 for a minimum of two weeks between February 2018 and April 2018. The traffic flows at the ATC sites that fall within the study area are detailed within Table 2.4.

Table 2.4 : Temporary Automatic Traffic Counter Data within the Study Area (2018)

Location	Source	AADT
B9177 Milton of Leys – Bogbain – Castlehill Road	ATC22	1,900
U1124 Caulfield Road	ATC24	3,800
C1036 Tower Road	ATC20	8,600
B9006 Culloden Road west of B9177	ATC21	12,900
C1032 Barn Church Road west of C1036 Tower Road	ATC19	11,500

2.7.5 Traffic flows on the local road network are highest on B9006 Culloden Road between Existing Inshes Overbridge and the B9177 Milton of Leys – Bogbain – Castlehill Road and on C1032 Barn Church Road to the south of Smithton Junction.

2.8 Existing Accident Data

2.8.1 The baseline accident data for the A9 and A96 within the proposed scheme study area, for the period of 2012 to 2016, was supplied by Transport Scotland in the form of STATS19 Data in December 2017. In addition, accident data for the local road network within The Highland Council region was extracted online from the road safety dataset in the form of STATS19 Data, which is held by Department for Transport. The five-year period from 2012 to 2016 was used to inform the accident appraisal.

2.8.2 Of the total accidents recorded within the proposed scheme study area, 1% were recorded as Fatal accidents and 10% recorded as Serious accidents. The proportions of Fatal and Serious accidents that have occurred within the study area are therefore below the national average. In total there were 248 recorded accidents between 2012 and 2016 within the proposed scheme study area, with an average of 50 accidents occurring each year.

2.8.3 The DMRB Stage 3 assessment identifies several accident clusters located on the A9 and A96 within the proposed scheme study area, including Raigmore Interchange where 14 accidents occurred, including 11 Slight accidents and 3 Serious accidents.

2.8.4 Further assessment of the existing accident data can be found in Chapter 5 (Traffic Assessment).

2.9 Operational Issues

2.9.1 Congestion occurs in the study area, primarily at junctions, including Raigmore Interchange (A9/A96/ B856 Millburn Road), A96 Smithton Junction (A96/C1032 Barn Church Road), B9006 Culloden Road/Inverness Campus junction (B9006 Culloden Road/A9/Inverness Campus) and the Inshes Roundabout (B9006 Culloden Road/ A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)).

2.9.2 The approaches to Raigmore Interchange experience queues and delays in both the AM and PM Peak periods. Queues and delays are most significant on the A96 approach in the AM Peak period and on the B865 Millburn Road approach in the PM Peak period. Queues are also observed on both the A9 northbound and southbound diverge slip roads. Development proposals to the east of Raigmore Interchange have the potential to further exacerbate congestion and as a result planning conditions require the full signalisation of the junction.

2.9.3 The existing A96 Smithton Junction is an at-grade roundabout where delays and queues can occur during the peak periods. The proposed upgrade of this junction, to a grade separated junction, as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme will address this issue.

2.9.4 The primary access to the Inverness Campus on B9006 Culloden Road has had operational problems with queuing from the junction back on to the A9 at the A9 Inshes Southbound Junction as well as queues forming on the B9006 Culloden Road in the AM Peak. The Highland Council have undertaken work to improve the operation of this junction by widening B9006 Culloden Road as it passes over the

A9, via the Existing Inshes Overbridge, to provide two westbound lanes. This has improved the operation of the junction with a reduced extent of queuing on both the B9006 Culloden Road and the A9.

2.9.5 The Inshes Roundabout is heavily trafficked throughout the day but with more significant queues and delays occurring in both the AM and PM Peak periods. This junction interacts with the Inverness Campus access junction described in paragraph 2.9.4. The Highland Council are currently developing proposals for signalisation of the corridor as part of the with the aim of improving the operational performance of the network. The proposed scheme is dependent on the Inshes Junction Improvements – Phase 2 and will further enhance the operational performance of the network.

2.10 References

New Roads and Street Works Act 1991 (New Roads and Street Works Act (NRSWA). The Stationery Office.

Jacobs (2013) (*on behalf of Transport Scotland).* A9/A96 Connections Study – Problems Objectives Report.

Jacobs (2016) (*on behalf of Transport Scotland).* A9/A96 Connections Study – Transport Appraisal Report.

3 Description of the Proposed Scheme

3.1 Engineering Description

Scheme Procurement

3.1.1 For assessment purposes, it is assumed that the proposed scheme would be procured by means of a Design and Build (D&B) contract. Under the terms of such contracts, the contractor undertakes both the detailed design and construction of the proposed scheme. Following completion of the proposed scheme, responsibility for operating and maintaining the A9 remains with the Scottish Ministers, while responsibility for operating and maintaining local roads passes to The Highland Council.

3.1.2 Under a D&B type contract, a specimen (outline) design is prepared for the proposed scheme by Transport Scotland. Bidders in the D&B process are provided with the specimen design for their information during the process. Following a successful bid process, the appointed contractor(s) produce a detailed design for the proposed scheme. The appointed contractor(s) can optimise this as the detailed design is developed. Such optimisation must be within the constraints imposed by the Environmental Impact Assessment Report (EIAR) including the Schedule of Environmental Commitments (Chapter 20) which contains the mitigation measures identified through the Environmental Impact Assessment (EIA) process, Statutory Orders (such as land acquisition) and any specific limits set within the contract documents. Design changes through optimisation are subject to environmental review to ensure that any residual impacts would not be greater than those reported to ensure that the detailed design is implemented in compliance with the EIAR.

Carriageway Alignment

3.1.3 The proposed scheme, as shown on the plan and profile drawings (Figures 3.1A-D, 3.2 and 3.3) comprises approximately 3.2km of new single carriageway to improve the road network between the A9 and the A96. The proposed scheme also incorporates:

- a lane gain/lane drop arrangement on the A9 southbound carriageway, forming a third lane between Raigmore Interchange and Inshes Southbound Junction;
- two at-grade roundabouts (Cradlehall Roundabout and Eastfield Way Roundabout);
- local road diversions, the provision of new private means of access and access for maintenance purposes;
- two principal structures comprising one crossing of the A9 (PS02 Proposed Inshes Overbridge), and one of the Highland Main Line Railway (PS03 Proposed Cradlehall Railway Bridge);
- the provision of approximately 5.3km of shared use path, 1.3km of footway and 0.7km of cycleway, which has been developed collaboratively with The Highland Council to complement the Inverness East Development Brief;
- 12 culverts; and
- utility works.

3.1.4 The section of the proposed scheme between B9006 Culloden Road and Cradlehall Roundabout is a single carriageway approximately 300m long, consisting of two lanes southbound and one lane northbound.

3.1.5 The Cradlehall Roundabout is a four-arm roundabout connecting the proposed scheme to the local road network. The access to Inverness Campus and the U5096 Castlehill Road would be locally realigned via approximately 240m and 165m, respectfully, of new two lane single carriageway. The Cradlehall Roundabout and Eastfield Way Roundabout would be connected by approximately 660m of new two lane single carriageway. The alignment crosses over the Highland Main Line Railway via a new overbridge and passes to the east of the Scheduled Monument ‘Ashton Farm Cottages, ring ditch and pit circles’ (hereafter known as the Scheduled Monument).

3.1.6 Eastfield Way Roundabout is a four-arm roundabout and provides a single carriageway connection to the Inverness Retail and Business Park to the west, approximately 690m long, and a new a field access to the east. The alignment then continues for approximately 1.1km to the east of Ashton Farm and ties-in to the proposed grade separated A96 Smithton Junction. It should be noted that the A96 Smithton Junction would be delivered as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme.

3.1.7 The PS02 Proposed Inshes Overbridge would run parallel and directly to the south of PS01 Existing Inshes Overbridge. PS02 would accommodate two lanes westbound, with PS01 providing two lanes eastbound, and connect the proposed scheme to The Highland Council's proposed Inshes Junction Improvements – Phase 2.

3.1.8 The carriageway cross-section dimensions for the proposed scheme are shown in Figures 3.4A and 3.4B.

3.1.9 The following sections provide a detailed overview of the main works elements associated with the proposed scheme as shown in Figures 1.2 and 1.3. References are made to chainage (shortened to 'ch', for example ch250), which is a reference to the number of metres along each link of the proposed scheme.

3.1.10 Within the assessment, the section of the proposed scheme to the east of the A9 is split into 'links' for ease of reference. These links are shown in Figure 1.2 and are described as follows:

- Link 1: Culloden Road to Cradlehall Roundabout (ch0 to ch250);
- Link 2: Cradlehall Roundabout to Eastfield Way Roundabout (ch0 to ch644);
- Link 3: Eastfield Way Roundabout to Inverness Retail and Business Park (ch0 to ch693);
- Link 4: Eastfield Way Roundabout to Smithton Junction (ch0 to ch1114);
- Link 5: Cradlehall Roundabout to Inverness Campus (ch0 to ch318); and
- Link 6: Castlehill Road Tie-In (ch0 to ch208).

3.1.11 The proposed lane gain/lane drop arrangement on the southbound carriageway of the A9 is shown in Figure 1.2 and described in the assessment as the A9 lane gain/lane drop.

3.1.12 The speed limit for each link of the proposed scheme is shown in Table 3.1.

Table 3.1: Proposed Speed Limits

Link	Speed Limit (mph)
A9 lane gain/lane drop	50
Link 1: Culloden Road to Cradlehall Roundabout	40
Link 2: Cradlehall Roundabout to Eastfield Way Roundabout	40
Link 4: Eastfield Way Roundabout to Smithton Junction	40
Link 3: Eastfield Way Roundabout to Inverness Retail and Business Park	30
Link 6: Castlehill Road Tie-In	30
PS02 Proposed Inshes Overbridge	30
Link 5: Cradlehall Roundabout to Inverness Campus	20

Junctions

3.1.13 Seven junctions are proposed within the scheme extents: two four-arm roundabouts, three major/minor priority junctions, one dual carriageway diverge and one dual carriageway merge (A9 lane gain/lane drop).

3.1.14 In addition to the above, the existing A96 Smithton Junction would be improved as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme proposals to a fully grade separated

junction. The existing A96 Smithton Junction is proposed to be retained, with a second roundabout located to the south in order to create a dumbbell layout. The proposed scheme would connect to this proposed southern roundabout. This junction provides full access to and from the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme and the C1032 Barn Church Road. As part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, the existing A96 to the north east of the proposed A96 Smithton Junction would be retained as a local road.

3.1.15 Descriptions of the seven junctions are provided below. This does not include accesses for fields, SuDS maintenance or properties.

B9006 Culloden Road/Link 1: Culloden Road to Cradlehall Roundabout

3.1.16 This major/minor junction between Link 1 and B9006 Culloden Road will connect the proposed scheme to the local road network and replace the existing junction between the B9006 Culloden Road and the U1058 Caulfield Road North.

Cradlehall Roundabout

3.1.17 The Cradlehall Roundabout would be a four-arm roundabout providing connections from the proposed scheme to Inverness Campus, the U5096 Castlehill Road and tie-in to the existing U1058 Caulfield Road North. The secondary access to Inverness Campus, the U5096 Castlehill Road and the U1058 Caulfield Road North would be locally realigned.

Eastfield Way Roundabout

3.1.18 The Eastfield Way Roundabout would be a four-arm roundabout allowing for connections between the proposed scheme and the Inverness Retail and Business Park to the west and agricultural land to the east.

Link 6: Castlehill Road Tie-in/U1058 Caulfield Road North Tie-in 1

3.1.19 This major/minor junction connects two side roads, Link 6 and the un-diverted section of U1058 Caulfield Road North at the existing junction with the U1058 Caulfield Road North (Caulfield Road North Tie-in 1).

Link 6: Castlehill Road Tie-in/U1058 Caulfield Road North Tie-in 2

3.1.20 This major/minor junction connects two side roads, Link 6 (as the extended U5096 Castlehill Road) and a re-aligned section of the existing U1058 Caulfield Road North (Caulfield Road Tie-in 2).

A9 Southbound Merge and Diverge

3.1.21 The existing two lanes on the southbound merge slip road between Raigmore Interchange and the A9 would be tapered to one lane prior to forming a lane gain on the A9 southbound carriageway. The additional lane would continue until the A9 Inshes Southbound Junction where a lane drop would supersede the existing taper diverge.

Local Roads

3.1.22 A local road strategy has been developed in consultation with The Highland Council during design development at DMRB Stage 2 and DMRB Stage 3. The solutions for local roads generally follow the principle that where a local road is severed or diverted, it would maintain the same network connections back into the local road network.

U1058 Caulfield Road North

3.1.23 The U1058 Caulfield Road North would be stopped up from its existing junction with the B9006 Culloden Road to its existing junction with the Inverness Campus secondary access. The proposed

scheme connects the B9006 Culloden Road to the Cradlehall Roundabout. The secondary access to Inverness Campus would be realigned to tie-in to Cradlehall Roundabout via Link 5.

U5096 Castlehill Road

3.1.24 The U5096 Castlehill Road would be realigned and tie-in to the proposed Cradlehall Roundabout. The U5096 Castlehill Road/U1058 Caulfield Road North junction would be improved to tie-in to Link 6. The existing western extent of the U1058 Caulfield Road North would be stopped up.

B9006 Culloden Road

3.1.25 The road would be widened with two additional lanes from its junction with the primary Inverness Campus access over the A9. The proposed road terminates at the western bridge abutment to allow future connection with The Highland Council's proposed Inshes Junction Improvements – Phase 2.

U2820 Eastfield Way

3.1.26 The proposed Link 3 ties-in to the eastern extent of the existing U2820 Eastfield Way. To allow sufficient clearance to cross the Beechwood Burn, Link 3 would be higher than the level of the existing U2820 Eastfield Way and would tie-in to the existing U2820 Eastfield Way prior to its junction with the U5202 Highlander Way.

Private Roads

3.1.27 There are three private roads within the scheme extents.

Inverness Campus Secondary Access

3.1.28 The existing Inverness Campus secondary access has an at-grade junction with U1058 Caulfield Road North. This secondary access would be severed by the proposed scheme. An alternative secondary access, Link 5, is proposed in order to connect the realigned Inverness Campus secondary access to the Cradlehall Roundabout.

Inverness Retail and Business Park Access

3.1.29 The existing bell mouth of the private access, from the U2820 Eastfield Way to the service road to the rear of the Inverness Retail and Business Park, would be raised to allow its connection with Link 3 as it crosses the Beechwood Burn watercourse.

Ashton Farm Access Road

3.1.30 The existing private access road at Ashton Farm has direct at-grade access to the existing A96 approximately 300m east of Seafield Roundabout. As part of the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme the existing at-grade access is to be closed and a new access provided off the proposed A96 Smithton Junction (south) roundabout in a south-westerly direction towards Ashton Farm.

3.1.31 Subsequent to the construction of the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, the newly created access track described above would then be realigned to tie-in to Link 4 as part of the proposed scheme.

Structures

3.1.32 Proposed bridges and culverts are listed below in Table 3.2 and Table 3.3 respectively, including any relevant Surface Water Feature (SWF) number. A more detailed description of these structures is provided in Chapter 4: Engineering Assessment. The locations of the proposed structures are shown in Figure 1.3.

Table 3.2: List of Proposed Principal Structures

Structure		Approximate Chainage (m)
Bridges		
PS02	Proposed Inshes Overbridge	ch850 of A9
PS03	Cradlehall Railway Bridge	ch400 of Link 2

Table 3.3: List of Culverts

Structure		Approximate Chainage (m)
Culverts		
C01	Scretan Burn Culvert No1 (SWF04)	ch150 of Link 2
C02	Scretan Burn Tributary Culvert No 1 (SWF05)	ch550 of Link 2
C03	Scretan Burn Tributary Culvert No 2 (SWF05)	ch550 of Link 3
C04	Scretan Burn Culvert No 2 (SWF04)	ch300 of Link 3
C05	Beechwood Burn Culvert No 1 (SWF03)	ch050 of Link 3
C06	Cairnlaw Burn Culvert No 1 (SWF08)	ch075 of Link 4
C07	Cairnlaw Burn Culvert No 2 (SWF08)	ch850 of Link 4
C08	Scretan Burn Culvert No 3 (SWF04)	ch030 of Eastfield Way Roundabout to Drumrosach Bridge NMU Link
C09	Beechwood Burn Culvert No 2 (SWF03)	ch010 of Link 1
C10	Beechwood Burn Culvert No 3 (SWF03)	ch650 of A9
C01A	Flood Relief Culvert	ch080 of Link 2
C01B	Flood Relief Culvert	ch085 of Link 2

Lay-bys

3.1.33 No lay-bys are proposed as part of the proposed scheme.

Public Transport Facilities

3.1.34 The existing public bus routes are largely unaffected by the proposed scheme. The connection of the realigned Inverness Campus secondary access to the proposed scheme facilitates continuity of bus routes through the Inverness Campus. The proposed secondary access ties-in to the existing secondary access in advance of the existing bus shelters and lay-bys and are therefore not impacted by the proposed scheme.

Provision for Non-Motorised Users

3.1.35 Provision for Non-Motorised Users (NMUs) has been included in the scheme design and proposed routes have been integrated into the wider NMU network. NMU proposals are shown in Figure 2.1.

3.1.36 The following objectives were identified in the A9/A96 Inshes to Smithton Non-Motorised User – Objective Setting and Context Report (Jacobs, 2017):

- to maintain continuity of the existing National Cycle Network Route 1 as it passes through the scheme corridor;
- to maintain continuity of the existing core path at Ashton Farm as it passes through the scheme corridor;
- to maintain continuity of other existing NMU routes as they pass through the scheme corridor;
- to take account of the proposed East Inverness Active Travel Corridor in the development of the scheme design; and

- to recognise and exploit opportunities to provide for existing and potential future NMU desire lines that pass through the scheme corridor and the surrounding area.

3.1.37 The above objectives would be achieved through the provision of new facilities, which protect, and where possible enhance, user safety and comfort whilst minimising impacts on each of these routes. The design of such facilities takes account of potential wider developments in the surrounding area.

3.1.38 Shared use paths are proposed adjacent to both sides of Link 1, Link 2, Link 4, and Link 6. On Link 1, the shared use paths tie-in to the existing NMU provision at B9006 Culloden Road. On Link 4, the shared use paths tie-in to the Ashton Farm Access Road Tie-in and the proposed A96 Smithton Junction. The proposed shared use paths described above would be 3.0m wide, comprising a 2.5m wide path and a 0.5m wide segregation strip.

3.1.39 In line with existing NMU provision, NMU routes within Inverness Campus would connect to the proposed NMU network through a shared use path adjacent to the eastbound carriageway of Link 5. This shared use path would be 3.0m wide, comprising a 2.5m wide path and a 0.5m wide segregation strip. Inverness Campus would also be connected to the proposed scheme by a shared used path between the Drumrosach Bridge and the Eastfield Way Roundabout, passing under the PS03 Proposed Cradlehall Railway Bridge. This shared use path would be 3.5m wide, comprising a 2.5m wide path and a 0.5m wide verge on either side.

3.1.40 The Inverness Retail and Business Park would be connected to the proposed scheme by Link 3 which includes a 2m wide footpath adjacent to the eastbound lane. Adjacent to the westbound lane, there is a segregated cycleway and a footpath, into which the existing shared use path to Inverness Campus would connect. The segregated cycleway would be 4.1m wide, comprising a 3.5m wide path and a 0.6m wide kerbed segregation strip, and the footpath would be 2m wide. This design was developed in consultation with The Highland Council to meet the aspirations of the Inverness East Development Brief. The existing NMU route from Drumrosach Bridge to the Inverness Retail and Business Park would, at its western extent, connects to the proposed dedicated cycleway route on Link 3.

3.1.41 Signalised crossing points are proposed at the following locations:

- Link 1, approximately ch15, at the junction with B9006 Culloden Road;
- Link 2, approximately ch20, to the north of Cradlehall Roundabout;
- Link 2, approximately ch620, to the south of Eastfield Way Roundabout; and
- Link 4, approximately ch230, where the proposed scheme crosses core path IN08.10.

3.1.42 Uncontrolled crossing points are proposed at the following locations:

- approximately 10m to the east of Eastfield Way Roundabout on the field access;
- Link 3, approximately ch670, adjacent to Eastfield Way Roundabout;
- Link 3, approximately ch40, at the junction with the access to the Inverness Retail and Business Park;
- Link 4, approximately ch970, at the junction with the Ashton Farm Access Road Tie-in;
- Link 4, approximately ch1100, at the A96 Smithton Junction;
- Link 5, approximately ch266, to the west of Cradlehall Roundabout;
- Link 6, approximately ch110, at the junction with the Caulfield Road North Tie-in; and
- Link 6 at approximately ch150.

3.2 Cost Estimate

Overview

3.2.1 The cost estimate for the proposed scheme is in Pounds Sterling (£) and rates are based on 2015 Quarter 2 prices. This is the cost estimate prepared on the basis of the DMRB Stage 3 design and the

cost estimate remains within the range of £25m to £35m previously identified during DMRB Stage 2. The assessed cost estimate for assessment purposes is calculated as £34.2m, excluding VAT.

3.2.2 The cost estimate is made up of gross costs plus project risk and optimism bias adjustment. The gross cost estimate is made up of two parts, the pre-construction costs and construction phase costs. The cost breakdown is shown in Table 3.4.

Table 3.4: Cost Estimate Breakdown

Element	Estimated Cost at Q2 2015 Price Base
Pre-Construction	
Design and Preparation Costs (incl. Historic Costs)	£5,141,400
Advanced Works	£902,400
Land Costs	£536,200
Sub-total	**£6,580,000**
Construction Phase	
Preliminaries and Indirect Costs	£2,861,300
Roadwork Series Costs	£12,896,700
Structures Costs	£3,934,200
Statutory Undertakers and Authorities	£796,450
Sub-total	**£20,488,700**
Risk and Optimism Bias	
Project Risk & Optimism Bias Adjustment	£7,127,300
Sub-total	**£7,127,300**
Total Scheme Cost	
Total (excluding VAT)	**£34,196,000**

3.2.3 The quantifiable items of the works have been measured and a cost per unit has been applied based on rates from similar schemes. Other works elements have been assessed as a percentage of other costs. Both unit prices and percentage allowances have been based upon knowledge of similar schemes.

3.2.4 Value Engineering has been undertaken during the course of the design development process and would be further undertaken by the appointed D&B Contractor during the tender and subsequent detailed design process.

Pre-construction Costs

3.2.5 Design and preparation costs have been estimated and include estimates for design costs, site supervision costs, geotechnical and topographical survey fees, and an allowance for a potential public local inquiry.

3.2.6 Advanced works costs include an estimate for environmental and ecological advanced works, archaeological works and other pre-construction surveys.

3.2.7 The District Valuer has provided an estimate of land acquisition and compensation costs.

Construction Phase Costs

3.2.8 Preliminaries and indirect costs have been quantified as 17% of the total works costs in line with other, similar schemes. Preliminaries and indirect costs include an allowance for general preliminaries, traffic management, temporary works and insurance.

3.2.9 The roadwork series costs have been developed on the basis of estimated quantities of required materials and appropriate material rates. Quantities of required material have been calculated based on the DMRB Stage 3 design. Material rates have been obtained through comparison with similar

contracts and from standard industry pricing information. Accommodation works costs have been estimated at approximately £200,000.

3.2.10 Structures costs have been individually assessed and estimated based on the type of structure, foundation type and deck area.

3.2.11 Statutory undertaker costs have been taken from C3 budget estimates provided by the relevant companies for carrying out the necessary diversionary and protective measures as a consequence of the proposed scheme.

Risk and Optimism Bias

3.2.12 A list of risks and uncertainties associated with the cost estimate has been developed. These risks and uncertainties have been allocated a probability and cost in order to generate a risk allowance to be applied to the cost estimate.

3.2.13 In accordance with the Supplementary Green Book Guidance: Optimism Bias (HM Treasury 2013), an assessment of optimism bias has been undertaken for the proposed scheme, taking regard of the risk assessment process and of the current stage of the proposed scheme development. An allowance of 15% has been included within the estimate.

Assumptions and Exclusions

3.2.14 As part of the cost estimate the following assumptions have been made:

- adequate labour and plant are available throughout the construction period;
- a source of acceptable fill material can be found within a reasonable distance of the scheme;
- access to the site is available on or before the contract start date and continues to be available throughout the contract period; and
- the proposed scheme is procured on a design and build basis.

3.2.15 The cost estimate does not include for the following:

- future inflation, the cost estimate has been prepared at Q2 2015 prices;
- financing or other charges;
- legal fees; and
- Value Added Tax.

3.3 References

HM Treasury (2013). Supplementary Green Book Guidance – Optimism Bias. The Stationery Office.

Jacobs (2017) *(on behalf of Transport Scotland)*. A9/A96 Inshes to Smithton Non-Motorised User Objective Setting and Context Report [Unpublished].

4 Engineering Assessment

4.1 Engineering Standards

Design Standards

4.1.1 The Design Manual for Roads and Bridges (DMRB) Stage 3 design has been developed in accordance with current design standards and good practice. Reference is made to sections of the DMRB and other standards where relevant.

Alignment and Cross-section

4.1.2 The alignment and cross-section of the proposed scheme (Links 1, 2 and 4) and A9 lane gain/lane drop have been designed in accordance with the following standards:

- DMRB Volume 6, Section 1, Part 1, TD9/93, Highway Link Design (The Highways Agency, Scottish Executive Development Department, The National Assembly for Wales and The Department for Regional Development Northern Ireland 2002) (hereafter referred to as TD9/93);
- DMRB Volume 6, Section 1, Part 2, TD27/05, Cross-Sections and Headrooms (The Highways Agency, Scottish Executive, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2005) (hereafter referred to as TD27/05); and

4.1.3 Other Local Roads have been designed in accordance with Roads and Transport Guidelines for New Developments (The Highland Council 2013), with reference to TD9/93 Part 7.

Junctions

4.1.4 Proposed junctions have been designed in accordance with the following:

- DMRB Volume 6, Section 2, Part 1, TD22/06, Layout of Grade Separated Junctions (The Highways Agency, Scottish Executive, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2006) (hereafter referred to as TD22/06);
- DMRB Volume 6, Section 2, Part 6, TD42/95, Geometric Design of Major/Minor Priority Junctions (The Highways Agency, The Scottish Office Development Department, The Welsh Office, The Department of the Environment for Northern Ireland 1995a) (hereafter referred to as TD42/95);
- DMRB Volume 6, Section 2, Part 3, TD16/07, Geometric Design of Roundabouts (Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2007a) (hereafter referred to a TD16/07); and
- DMRB Volume 6, Section 2, Part 5, TD40/94, Layout of Compact Grade Separated Junctions (The Highways Agency, Scottish Executive, Welsh Assembly Government and The Department for Regional Development Northern Ireland 1994) (hereafter referred to as TD40/94).

4.1.5 Junction layouts have been designed to minimise land-take and make best use of existing infrastructure.

4.1.6 Accesses have been designed in accordance with Roads and Transport Guidelines for New Developments (The Highland Council 2013), with reference to TD9/93 Part 7, and TD41/95, Vehicular Access to All-Purpose Trunk Roads (The Highways Agency, The Scottish Office Development Department, The Welsh Office, The Department of the Environment for Northern Ireland 1995b) (hereafter referred to as TD41/95).

Non-Motorised Users (NMU)

4.1.7 The facilities for NMU have been designed in accordance with Cycling by Design 2010 (Transport Scotland 2011) and Transport Scotland's Roads for All: Good Practice Guide for Roads (Transport Scotland 2013). The NMU proposals have been reviewed in line with guidance in HD 42/17, Walking, Cycling & Horse-riding Assessment and Review (Highways England, Transport Scotland, Welsh

Assembly Government, The Department for Regional Development Northern Ireland 2017)(hereafter referred to as HD42/17).

Relaxations and Departures

4.1.8 To avoid incurring high construction, social or environmental costs it is occasionally necessary to adopt geometric elements of design below the desirable minimum standards recommended by the DMRB. A procedure exists whereby departures from DMRB standards are applied for by the designer to the road authority, the application is independently scrutinised and due diligence is applied in approving or rejecting the application.

4.1.9 In relation to the proposed scheme, Transport Scotland is responsible for the determination of applications for departures from standard in relation to the trunk road network. The Highland Council is responsible for the approval of Local Road departures. No local road departures have been identified within the proposed scheme.

4.1.10 Four Trunk Road departures have been identified as being required within the proposed scheme and have been approved by Transport Scotland. The four departures are associated with the proposed A9 southbound lane gain/lane drop. The locations of the four departures, outlined below, are shown in Figure 4.1.

- Departure A9-A96IS-001: departure on the A9 southbound merge slip road at Raigmore Interchange relating to the replacement of the existing two-lane taper merge layout onto the A9 southbound carriageway with a merge layout not compliant with TD22/06. This departure was required to facilitate the provision of the lane gain, as a standard layout for a two lane taper merge with a lane gain is not provided in TD22/06.

- Departure A9-A96IS-002: departure on the A9 southbound slip road at Raigmore Interchange relating to the existing carriageway cross-section. The width of the existing carriageway and hardstrips is less than that prescribed in TD27/05. To increase the width of the existing carriageway cross-section to satisfy TD27/05 would have resulted in significant additional works and disruption to the travelling public for little benefit.

- Departure A9-A96IS-005: departure at the A9 Inshes Southbound Junction relating to the diverge layout not being compliant with TD22/06. The provision of a diverge layout compliant with TD22/06 would require construction of a new grade separated junction and connector roads, which would have resulted in significant additional works including the demolition of PS01 Existing Inshes Overbridge, traffic disruption and impacts to neighbouring residential and commercial properties.

- Departure A9-A96IS-007: departure on the A9 southbound carriageway, between the A9 southbound merge at Raigmore Interchange and the diverge at the A9 Inshes Southbound Junction, relating to the carriageway cross-section featuring a 1m hardstrip. Hardstrips on an D3UAP Urban All-Purpose Dual Carriageway are considered an increase in cross-section and consequently a departure from TD27/05. The provision of a hardstrip was included as it provides benefits including improved pavement integrity, improved provision for broken down vehicles, additional width for traffic management and an overrun for driver error. It would also better maintain consistency with the A9 south of the Inshes Southbound Junction, where a 0.7m hardstrip is provided.

4.1.11 As mitigation for Departures A9-A96IS-002, A9-A96IS-002 and A9-A96IS-005 the inclusion of suitable traffic signs and road markings is proposed. As mitigation for Departures A9-A96IS-001 and A9-A96IS-005 a speed limit change from the national speed limit to 50mph is proposed on the A9 between the Kessock Bridge and the tip of the merge taper at the Inshes Southbound Junction. As mitigation for A9-A96IS-005 high friction surfacing is proposed on the southbound diverge at A9 Inshes Southbound Junction. Departure A9-A96IS-007 does not result in any safety implications and therefore no specific mitigation has been proposed.

4.2 Climate, Topography and Land Use

Climate

4.2.1 The climate in the study area is typical of the northern highlands. The average minimum monthly temperature range is between 1.1°C and 11.4°C. The average maximum monthly temperature range is between 6.9°C and 18.9°C while the average monthly rainfall is between 39.4mm and 78.1mm. Average rainfall and temperatures are in accordance with Met Office averages between 1981-2010 (Met Office, 2019). It should be noted that the study area receives a higher hourly average of sunshine and a lower than average level of rainfall when compared to the north of Scotland average. In winter months, the local climate can also include sub-zero temperatures and snow.

Topography and Land Use

4.2.2 The land within the study area is generally flat and low lying in nature. The highest ground level is approximately 40m Above Ordinance Datum (AOD) and is located in the vicinity of Inshes Southbound Junction to the south of the study area. The land generally slopes towards the Moray Firth and on approach to the A96 Smithton Junction the ground level is approximately 20mAOD. There are a number of watercourses and associated floodplains within the study area. Landscape and visual impacts are assessed in greater detail in Chapter 9 (Landscape) and Chapter 10 (Visual) of the Environmental Impact Assessment Report (EIAR).

4.2.3 The landscape between Inverness and Culloden is a mixture of commercial and retail developments, and pastoral and arable farmland, with pockets of woodlands spread across the study area. The Stratton Development, a housing development currently under construction, is also within the study area. The area of land required for the construction of the proposed scheme, including environmental mitigation, is approximately 30ha. Land Use is assessed in greater detail in Chapter 15 (People and Communities – Community and Private Assets) of the EIAR. An example of the existing topography and land use is shown in Photograph 4.1.

Photograph 4.1: View of land to the east of Inverness looking east from Inshes towards Smithton

4.3 Geology, Ground Conditions and Earthworks

Superficial Deposits

4.3.1 The published 1:10,000 geological maps (British Geological Survey 1991a,b,c) indicates that the area of the proposed scheme is predominantly underlain by Quaternary age, Late Devensian (circa 10,000 to 26,000 years ago) sediments comprising mainly Glaciofluvial Deposits and Glacial Till. More recent deposits of Flandrian age (circa 10,000 years ago to present) occur locally throughout the area, comprising Alluvium associated with watercourses.

4.3.2 Made Ground is indicated to be present locally in the broader area and is generally limited to areas of existing road or railway embankment. There is no evidence of historical mineral extraction within the vicinity of the proposed scheme.

4.3.3 A description of each of the superficial deposits, as identified on the published geological maps and in the regional memoir (BGS, 1996), is provided in Table 4.1.

Table 4.1: Description of Superficial Deposits

Geological Age		Geological Unit	Sub-unit	Typical Description
Anthropocene		Made Ground	-	Composition Unspecified. Deposits likely to be in relation to road and railway construction.
Quaternary, Flandrian		Alluvium	Floodplain Alluvium	Deposits of present river floodplains (mainly gravel).
			Lacustrine Alluvium	Deposits of enclosed basins (mainly sand, silt and clay).
Quaternary, Late Devensian		Raised Marine Deposits (Quaternary, Late Devensian)	Raised Marine Deposits, Undifferentiated	Shingle, sand, gravel and silty clay
			Raised Marine Tidal Flat Deposits	Mainly pale olive-grey clayey silt including some freshwater alluvium.
			Raised Marine Shoreface Deposits	Sand, gravel, shingle, diamicton
		Glaciomarine Deposits	Undifferentiated	Mainly clay-bound rounded gravel interstratified with diamicton, sand, silt and clay
		Glaciofluvial Deposits	Sheet Deposits of the Raigmore Terrace	Sand and gravel, coarsening upwards.
		Glacial Tills	Hummocky Glacial Deposits	Dense clayey gravelly diamicton and numerous boulders
	Note: Typical descriptions taken from the BGS 1:10,000 geological maps (NH64NE, NH64SE, NH74SW)			

Solid Geology

4.3.4 The published geological information (BGS 1991a,b,c, BGS 1996) indicates that the proposed scheme is underlain by Middle Devonian age sedimentary rocks belonging to the Hillhead Sandstone Formation of the Inverness Sandstone Group. The published geological information describes this Formation as comprising red coarse-grained sandstones, flaggy siltstones, calcareous mudstone and thin shaly mudstones with fish remains.

4.3.5 Bedrock is indicated to be below a thickness of superficial deposits within the vicinity of the proposed scheme apart from a small area of rock outcrop indicated within the Cairnlaw Burn channel in the proximity of A96 Smithton Junction. No information is provided on the dip and dip direction of the strata, however, regionally within the Moray Firth area, dips of the sedimentary strata are indicated to be low, typically <10 degrees towards the north / north east.

4.3.6 No geological faults are indicated within the vicinity of the proposed scheme. However, the Inverness area is regionally influenced by the Highland Boundary Fault which stretches from Fort William to Inverness. It is therefore possible that some minor faulting or shearing of the bedrock may be present locally.

Summary of Ground Conditions

4.3.7 A detailed ground investigation (DGI) was undertaken for the proposed scheme between March and May 2018 (Causeway Geotechnical Ltd 2018). Further relevant historical ground investigation information was obtained through a search on the British Geological Survey Geoindex website (BGS 2017). Information regarding two other ground investigations undertaken within the vicinity of the proposed scheme were obtained from The Highland Council. The first report is in relation to a ground investigation undertaken in 2008 for the Inverness Trunk Link Road project (SML 2008), and the second was undertaken in 2008 in relation to the East Beechwood Masterplan project (JPB 2008). Information from the above noted sources has been used to compile the following summary of ground conditions for the proposed scheme.

4.3.8 The ground conditions encountered along the proposed scheme generally confirmed the anticipated sequence and distribution of superficial deposits as indicated from the published geological information. The exploratory holes typically encountered variable thicknesses of silty and very silty sands and gravels, or sandy and gravelly silts with variable cobble and boulder content. Occasional clay strata were also recorded. The nature of the drilling and sampling processes however, did not allow these deposits to be subdivided according to their geological depositional environment due to disturbance, but these deposits appear to have been laid down in a variety of glacial/late glacial environments. The superficial deposits were proved to reach a maximum thickness of 21.3m in a borehole located adjacent to the proposed scheme tie-in at C1032 Barn Church Road.

4.3.9 It is considered that a significant proportion of the superficial deposits within the proposed scheme area could be assigned to the Glaciofluvial Deposits of the Raigmore Terrace, Glaciofluvial Sheet Deposits and Hummocky Glacial Deposits; as indicated on the geological map. These deposits are described in the published geological information as largely coarse-grained in composition. The geological map indicates that an area of the proposed scheme between the Ashton Farm Access Road and A96 Smithton Junction is underlain predominantly by Raised Marine Tidal Flat Deposits. The geological map records these deposits as comprising pale olive grey clayey silt, however, the material encountered in this area during the ground investigation recorded variable soil compositions including very gravelly very silty sands as well as sandy clays and silts.

4.3.10 Localised areas of possible Alluvium were encountered within the vicinity of the Scretan Burn and at the tributary of the Cairnlaw Burn near A96 Smithton Junction. These deposits typically comprise soft slightly gravelly sandy silts or clays, typically of limited thickness (<1.4m) but were recorded up to 3.4m locally.

4.3.11 Made Ground deposits were encountered locally within the vicinity of A96 Smithton Junction at the north end of the proposed scheme, where thicknesses of up to 2.50m were recorded. It should be noted that the area within the vicinity of A96 Smithton Junction was also investigated as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme (Raeburn 2017, Raeburn 2018) and that Made Ground was recorded up to depths of 3.6m during these investigations. It is unknown what historical activities this Made Ground is associated with, however, the deposits are not anticipated to be widespread. Deposits in this area were found to typically comprise gravelly silty fine to coarse sand with ash.

4.3.12 Made Ground deposits were encountered locally within the vicinity of the proposed scheme tie-in at the Inverness Retail and Business Park, where thicknesses of up to 2.60m of Made Ground were recorded. The Made Ground in this area was found to vary in composition between clay and gravel, however all strata were noted to contain fragments of pottery.

4.3.13 Localised deposits of Made Ground were also encountered within the vicinity of the proposed A9 lane gain/lane drop and at the PS01 Existing Inshes Overbridge. The Made Ground in these areas is likely to have been associated with the construction works for the A9.

4.3.14 The rock encountered in the boreholes during the Detailed Ground Investigation (DGI) was found to comprise predominantly sandstone, with limestone breccia layers encountered locally in two boreholes at the PS01 Existing Inshes Overbridge. Rockhead level was found to vary between 4.5m below ground level near Ashton Farm, and 21.3m below ground level near the A96 Smithton Junction.

4.3.15 Groundwater monitoring data from the 2018 DGI indicates that groundwater levels vary across the site but are typically shallower than 3.5m below ground level. Occasionally deeper groundwater was encountered, particularly at the northern extent of the proposed scheme where three boreholes recorded groundwater in excess of 6.0m below ground level.

General Earthworks Design Issues

4.3.16 The proposed scheme is formed predominantly on embankment, which has a maximum height of approximately 9.20m adjacent to PS03 Cradlehall Railway Bridge. Embankment widening is proposed at the approach road to the PS01 Existing Inshes Overbridge to facilitate the approach road to PS02 Proposed Inshes Overbridge. Widening of the A9 to accommodate the proposed lane gain/lane drop would require forming a cutting within the existing A9 carriageway earthworks. The maximum cutting depth proposed in this area is 1.9m. Localised areas of cutting up to 1.7m deep, are proposed as part of the earthworks on Link 4: Eastfield Way Roundabout to Smithton Junction.

4.3.17 For the purpose of the DMRB Stage 3 earthworks design, slope gradients of 1(V):3(H) have been adopted for all cuttings.

4.3.18 There is a limited amount of cutting proposed across the proposed scheme, and the areas of cut that have been proposed are typically shallow (<1.7m). As such, the proposed cuttings would be formed in soil. Due to the relatively limited depths of the cuttings within the proposed scheme, it is unlikely that there would be significant draw-down of the groundwater which can lead to settlement of the adjacent ground. Groundwater levels are generally high across the site and may intercept the cuttings, even if they are at shallow depth. Any water ingress should be managed by installing adequate drainage at cutting locations.

4.3.19 For embankments, the gradients given in Table 4.2 have generally been adopted in the earthworks design.

Table 4.2: Summary of Adopted Embankment Gradients

Embankment Height	Side Slopes
<5.0m	1(V):2(H)
5m to 10m	1(V):2.5(H)
>10m	1(V):3(H)

4.3.20 In localised areas where soft ground deposits have been encountered, the limited thickness of these soils should allow for excavation and replacement, followed by ‘normal’ construction of the overlying embankment.

4.3.21 Similarly, there are a number of areas where Made Ground deposits may require excavation and replacement with suitable engineered fill where road construction is required or beneath the footprints of the embankments. It is possible that some of the Made Ground could be re-used as general fill or landscape fill.

4.3.22 In relation to the potential re-use of excavated materials from the proposed cuttings, it is likely that due to the shallow nature of the cuttings, that a large percentage of the excavated material will comprise topsoil and would be unsuitable for use in earthwork construction. Of the remaining material, it is likely that a significant proportion of the material would fall into Class 1 (General Granular Fill) or Class 2 (General Cohesive Fill) material, as defined in the Specification for Highway Works (SHW) Series 600, although their acceptability for re-use would depend on moisture content. The remaining unacceptable material could be re-used as landscape fill (Class 4 – SHW), or potentially rendered acceptable through modification or through air drying. It is noted that the soils generally contain a significant silt content making them moisture susceptible which presents limitations for earthworking activities in unfavourable weather conditions.

Earthworks Volumes/Balance

4.3.23 A summary of the estimated earthworks quantities for the construction of the proposed scheme is provided in Table 4.3. While it is a key aim of the design to utilise as high a proportion as practicable of 'site won' material for construction of embankments and for landscaping purposes, the requirement for the import of bulk earthworks materials is unavoidable for the proposed scheme due to the cut fill balance. The higher import volumes are a result of the proposed scheme design being generally formed on embankment as the existing topography is generally flat.

Table 4.3: Estimated Earthworks Quantities

Import/Export (disposal)	Volume (m^3)
Bulk earthworks materials required	329,000
Estimated "site won" bulk earthworks materials	114,000
Estimated earthworks materials import	215,000
Estimated earthworks for disposal	0

4.4 Drainage and Hydrology

General

4.4.1 The DMRB Stage 3 drainage design for the proposed scheme has been designed in accordance with current design standards and good practices. The design standards used are:

- DMRB Volume 4, Section 2, Part 1, HA78/96, Design of Outfalls for Surface Water Channels (The Highways Agency, The Scottish Office Development Department, The Welsh Office and The Department of The Environment for Northern Ireland 1996) (hereafter referred to as HA78/96);
- DMRB Volume 4, Section 2, Part 1, HA103/06 – Vegetated Drainage Systems for Highways Runoff (The Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2006b) (hereafter referred to as HA103/06);
- DMRB Volume 4, Section 2, Part 1, HA106/04 Drainage of Runoff from Natural Catchments (The Highways Agency, Scottish Government, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2004a) (hereafter referred to as HA106/04);
- DMRB Volume 4, Section 2, Part 3, HD33/06, Surface and Sub-Surface Drainage Systems for Highways (The Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2006c) (hereafter referred to as HD33/06); and
- DMRB Volume 4, Section 2, Part 7, HA107/04, Design of Outfall and Culvert Details (The Highways Agency, Scottish Executive, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2004b) (hereafter referred to as HA107/04).

4.4.2 Other standards and guidance used include:

- BRE Digest 365 Soakaway design (Building Research Establishment 2003);
- Flood Estimation Handbook (FEH) (Centre for Ecology & Hydrology (CEH) 2009);
- Flood Studies Report (FSR) (Natural Environment Research Council (NERC 1975);
- Institute of Hydrology Report No.124 Flood estimation for small catchments (DCW Marshall & AC Bayliss 1994);
- Planning Advice Note (PAN) 79: Water and Drainage (Scottish Executive 2006);
- Scottish Environment Protection Agency (SEPA) Guidance Note 2: Planning advice on Sustainable Urban Drainage (SEPA 2010);
- The Water Environment (Controlled Activities) (Scotland) Regulation 2011 (CAR). Scottish Environment Protection Agency (SEPA 2016);

- SuDS for Roads (SuDS Working Party 2008);
- Sustainable urban Drainage Systems (SuDS) Manual C753 (Construction Information Research and Information Association (CIRIA) 2015) (hereafter referred to as CIRIA C753); and
- Technical Flood Risk Guidance for Stakeholders (SEPA 2015).

4.4.3 The following key stakeholders have been consulted as part of the drainage design process:

- SEPA; and
- The Highland Council.

4.4.4 The DMRB Stage 3 drainage design, based on the principle of providing two levels of treatment for carriageway runoff within each drainage catchment, has been agreed with SEPA. In general, this has been achieved through the use of swales, enhanced swales, wetlands and filter drains. The Drainage Overview on Figure 4.2 shows each drainage catchment for the proposed scheme, as well as surface water features and the location of swales and wetlands.

4.4.5 SuDS proposed for drainage outfalls from the proposed scheme would be designed with an impermeable liner to reduce any identified risk of pollution to groundwater, unless otherwise agreed between SEPA and the Contractor. The proposed SuDS for some selected local road drainage networks may infiltrate into the ground.

4.4.6 The local roads generally have a separate drainage system to that of the trunk road network. This is good practice due to ownership and maintenance. The drainage system for the trunk road network, the A9 and A96, would be owned and maintained by Transport Scotland, with the local road network owned and maintained by The Highland Council. Drainage catchment A for Link 4: Eastfield Way Roundabout to Smithton Junction, shown on Figure 4.2, would outfall into SuDS proposed as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme.

Drainage Features

4.4.7 The components described below are proposed to manage surface water runoff. Further information on these components is available in Chapter 13 (Road Drainage and the Water Environment) of the EIAR.

Pre-earthworks Drainage

4.4.8 Pre-earthworks drainage would be provided at the top of cuttings and the base of embankments where the slope height exceeds 1.0m. The purpose of the pre-earthwork's drainage is to collect surface runoff from the natural catchments and convey overland flow to the nearest watercourse. Once operational this system does not require treatment or attenuation prior to discharge. The pre-earthworks drainage would be designed in accordance with HA106/04 to a 1 in 75-year storm event.

Carriageway Drainage Systems - Filter Drains

4.4.9 Filter drains are proposed to collect surface water runoff from the A9 carriageway together with surface water runoff from cutting slopes and any sub-surface drainage present in areas of cutting. Such systems typically comprise perforated pipes placed at the base of free draining stone material, through which the surface water filters to enter the pipe. This filtration process provides one level of treatment in removing pollutants arising from the surface water runoff.

Carriageway Drainage Systems - Kerb and Gully Drains

4.4.10 A kerb and gully system is proposed to collect surface water runoff from local road carriageways together with surface water runoff from cutting slopes and any sub-surface drainage present in areas of cutting. Such systems typically comprise a kerbed carriageway edge and gully pots in the adjacent carriageway. The gully pots are connected by a solid pipe to a larger network which conveys the water to a SuDS feature for attenuation and treatment. Kerb and gully drain are proposed on all local roads.

Swales

4.4.11 Swales comprise a grassed channel that conveys and treats runoff. Treatment is provided by the grassed channel via infiltration and sediment settling. Swales are proposed at the following locations:

- drainage catchment A and B, adjacent to Link 4: Eastfield Way Roundabout to Smithton Junction;
- drainage catchment C, adjacent to Eastfield Way Roundabout;
- drainage catchment F, adjacent to Link 3: Eastfield Way Roundabout to Inverness Retail and Business park;
- drainage catchment G, adjacent to Link 5: Cradlehall Roundabout to Inverness Campus; and
- drainage catchment H, within the circulatory carriageway at Raigmore Interchange.

Enhanced Swales

4.4.12 Enhanced swales comprise a grassed channel and underlying filter drain. This system provides two levels of treatment; the first level is provided by the grassed channel (infiltration and sediment settling) and the second level is provided by the filter drain (removal of pollutants). Enhanced swales can be incorporated into a treatment train in areas where cover to pipes is limited such as at the connection from retention pond to receiving watercourse. Enhanced swales are proposed at the following locations:

- drainage catchment D, adjacent to Link 2: Cradlehall Roundabout to Eastfield Way Roundabout; and
- drainage catchment G, adjacent to Link 5: Cradlehall Roundabout to Inverness Campus.

Wetlands

4.4.13 Wetlands receive water from drainage systems immediately prior to discharge into the receiving watercourse. This component has two principal functions. Firstly, it is designed to reduce the rate at which water outfalls into the receiving watercourse to the pre-development discharge rate. The ponds are designed to attenuate the runoff rate from the carriageway drainage in events up to the 1:200 year to the 1 in 2-year pre-development runoff rate. This prevents the flow rate in receiving watercourse exceeding the existing flow rate during a 1 in 200-year event. In addition, the ponds have sufficient freeboard above the maximum attenuated water level. The second principal function is to enable the removal of pollutants contained in sediment from the 'first flush' of carriageway runoff through settlement such that the quality of the water discharged is at an acceptable level in terms of the receiving watercourse. Wetlands have smaller shallower bodies of permanent water and are highly effective at treating runoff laden with winter rock salts, particularly applicable to Highland roads. Wetlands are proposed at the following locations:

- east of proposed Cradlehall Roundabout;
- north of proposed Eastfield Way Roundabout;
- western extent of proposed Link 3: Eastfield Way Roundabout to Inverness Retail and Business park; and
- northern extent of proposed Link 4: Eastfield Way Roundabout to Smithton Junction.

Carriageway Drainage Networks

4.4.14 The drainage catchments for the proposed scheme are defined by the high and low points along the road vertical alignment and the location of existing Surface Water Features (SWF). Each drainage catchment has a corresponding drainage network.

4.4.15 The drainage networks developed for the proposed scheme have been designed to accommodate a 1 in 1-year return period rainfall event without surcharging and 1 in 5-year return period rainfall event up to a maximum surcharge level of 400mm without impacting the formation layers of the road pavement.

4.4.16 The drainage features for each drainage catchment, as shown on Figure 4.2, are as follows:

- Catchment A - Surface water collected via kerb and gully, treatment via swale and retention pond (retention pond within proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme) before discharging to Cairnlaw Burn (SWF08).
- Catchment B - Surface water collected via kerb and gully, treatment via swale and wetland before discharging to Cairnlaw Burn (SWF08).
- Catchment C - Surface water collected via kerb and gully, treatment via swale and wetland before discharging to Cairnlaw Burn (SWF08).
- Catchment D - Surface water collected via kerb and gully, treatment via enhanced swale before discharging to Scretan Burn (SFW04).
- Catchment E - Surface water collected via kerb and gully, treatment via wetland before discharging to Scretan Burn (SFW04).
- Catchment F - Surface water collected via kerb and gully, treatment via swale and wetland before discharging to Beechwood Burn (SFW03).
- Catchment G - Surface water collected via kerb and gully, treatment via enhanced swale before discharging to Beechwood Burn (SFW03).
- Catchment H - Surface water collected via filter drain, treatment via filter drain and swale before discharging to the Inner Moray Firth (Estuary).

Watercourse Crossings

4.4.17 The impact of the proposed scheme on the alignment of existing SWFs has been assessed and realignment of watercourses is proposed where required. Structural culverts would be located where the proposed alignment crosses a watercourse to convey the flow under the carriageway. Where existing structural culverts are to remain in place, they are to be extended in length to cater for the additional width of the proposed alignment. The proposed culverted watercourse crossings are provided in Table 4.4. Structure locations are shown on Figure 1.3 with details included in Section 4.6. SWFs are shown on Figure 4.2.

Table 4.4: Watercourse Crossings

Watercourse	Culvert Reference
SWF 03 – Beechwood Burn	C05, C09, & C10
SWF 04 – Scretan Burn	C01, C04 & C08
SWF 05 – Tributary of Scretan Burn	C02 & C03
SWF 08 – Cairnlaw Burn	C06 & C07

4.4.18 In addition to the above watercourse crossings there are two flood relief culverts which are not associated with an existing watercourse. These would lie on the flood path between Cradlehall Roundabout and the Scretan Burn.

4.4.19 The potential impacts of the proposed scheme on the local SWF have been identified and detailed in Chapter 13 (Road Drainage and the Water Environment) of the EIAR.

4.5 Public Utilities

General

4.5.1 Public utility companies were contacted in accordance with the New Roads and Street Works Act 1991 (NRSWA) to identify locations of existing plant and details of preliminary proposals for diversions and budget costs. The following public utility companies own apparatus that conflict with the proposed scheme requiring diversionary and/or protection measures to be provided prior to and during construction.

4.5.2 NRSWA C3 budget estimates have been provided by each organisation owning apparatus impacted by the proposed scheme. A NRSWA C4 detailed estimate will allow for a more detailed design of utility apparatus protection or diversionary works to be undertaken in advance of the proposed scheme construction. A list of affected public utilities and potential diversion routes are summarised below.

Openreach

4.5.3 There are existing Overhead and Underground Openreach cables which interact with the proposed scheme at three areas.

4.5.4 Underground telecommunication cables are likely to be impacted by the proposed western abutment and embankment of the PS02 Proposed Inshes Overbridge. In addition, there is potentially a telecommunications cable within the westbound lane of the PS01 Existing Inshes Overbridge. Information received from Openreach indicates that these telecommunication cables, including those over the structure, have since been diverted. The current location is to be determined through further consultation with Openreach at the next stage of design development.

4.5.5 Along U1058 Caulfield Road North, and the existing secondary Inverness Campus access there are two underground cables. Openreach has proposed a series of temporary diversions, with the final diverted cables under the scheme footway. The Primary Connection Point (PCP) telecoms cabinet at the existing Inverness Campus Secondary Access and U1058 Caulfield Road North junction to the university can be diverted during the works to a new position adjacent to an electrical connection.

4.5.6 At the Inverness Retail and Business Park where the proposed scheme ties-in to the existing U2820 Eastfield Way, an underground cable in the existing footway and carriageway is proposed to be lowered and protected.

Scottish Water

4.5.7 Existing combined sewers, foul sewers and water mains are affected by the proposed scheme.

4.5.8 A major concrete combined sewer pipe, maintained and operated by Veolia, crosses the study area in a south-west direction from the A96 Smithton Junction towards the southern extents of the Inverness Retail and Business Park, from where it continues in a north-west direction towards Raigmore Interchange. It crosses the proposed scheme at approximately ch60 of Link 3: Eastfield Way Roundabout to Inverness Retail and Business Park, where it is 750mm diameter. North of the Cairnlaw Burn it crosses the proposed scheme twice, at approximately ch897 (750mm diameter) and ch1050 (900mm diameter) of Link 4: Eastfield Way Roundabout to Smithton Junction, respectively. The levels of the road and the sewer allow the possibility of protecting insitu with slab and filling material protection.

4.5.9 A 300mm diameter vitrified clay foul sewer and 180mm polyvinyl chloride (PVC) water main cross the proposed alignment at the PS03 Cradlehall Railway Bridge, parallel to the Highland Main Line Railway, at approximately chainage ch400 of Link 2: Cradlehall Roundabout to Eastfield Way Roundabout. A diversion under the embankment, perpendicular to the road, through a multiple pipe culvert would be required.

4.5.10 A 525mm diameter concrete combined sewer and a 25mm diameter high performance polyethylene (HPPE) water main crosses the existing A9 at approximately chainage ch450, where the proposed lane gain/lane drop would be constructed. The combined sewer would require temporary protection during the construction of the new carriageway and the embankment cutting. The water main would require a localised diversion to maintain cover depth at the cutting.

4.5.11 Three water mains cross the alignment on Link 4 between chainages ch50 and ch600 and require minor local diversions to provide suitable depth to protect the pipe under the carriageway.

Scottish and Southern Energy (SSE)

4.5.12 There are SSE cables located on, or in the vicinity of, many of the roads throughout the proposed scheme. Within the scheme extent the existing SSE apparatus is located largely in open fields and crosses the proposed scheme at several locations within the study area.

4.5.13 There are two crossings of the existing A9 which are proposed to be diverted as part of the proposed lane gain/lane drop. An existing 11kV underground line would be realigned to a perpendicular crossing of the carriageway, and the 33kV overhead line would terminate and be diverted to run under the carriageway parallel to the 11kV line.

4.5.14 At four locations the proposed scheme intersects an overhead 33kV line:

- at Link 6: Castlehill Road Tie-in and the adjacent wetlands;
- at the PS03 Cradlehall Railway Bridge southern embankment; and
- at the field access spur off the proposed Eastfield Way Roundabout.

4.5.15 SSE have proposed a new terminal adjacent to the alignment and diversion of the 33kV line to run under the carriageway at each location.

4.5.16 On Link 4 chainage 800 the carriageway also interests a 33kV overhead line. SSE noted through the C3 Notice process that this line was in the process of being dismantled.

SGN

4.5.17 A 180mm diameter polyethylene intermediate pressure gas main runs adjacent to the northbound carriageway of the A9. This intersects with the proposed scheme at the PS02 Proposed Inshes Overbridge western abutment. SGN have proposed a minor diversion or protection works may be acceptable depending on the exact position of the pipeline, and the final design and construction the abutment.

4.5.18 A 125mm diameter spur off this intermediate pressure gas pipeline crosses the A9 and would be intersected by the proposed lane gain/lane drop on the southbound carriageway. SGN have proposed a minor diversion or protection works may be acceptable depending on the exact position of the pipeline, and the final design and construction the carriageway and earthworks.

CLH Pipeline System (CLH-PS)

4.5.19 The proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme diversion of the CLH-PS fuel pipeline runs through the study area in a generally easterly direction. The diverted pipeline would be affected by the proposed scheme near its connection with the proposed A96 Smithton Junction.

Vodafone

4.5.20 The scheme impacts Vodafone apparatus along the length of the PS02 Proposed Inshes Overbridge and embankment. Vodafone have indicated that a localised diversion would be required.

4.6 Structures

4.6.1 Structures have been designed in accordance with the DMRB and Eurocodes. There are two new principal structures which are required as part of the proposed scheme, these are PS02 Proposed Inshes Overbridge and PS03 Proposed Cradlehall Railway Bridge. PS01 is the Existing Inshes Overbridge.

4.6.2 There are eight new culverts, one culvert replacement and one culvert extension. In addition, two flood relief culverts are proposed in the floodplain southwest of Scretan Burn Culvert No. 1 (C01). There is

also one proposed dry mammal underpass which would be provided to maintain connectivity for wildlife.

PS02 Proposed Inshes Overbridge

4.6.3 The new structure would be constructed immediately to the south of PS01 Existing Inshes Overbridge (Reference No. A9 1300) and would carry the two westbound lanes of the B9006 Culloden Road over the A9. PS01 Existing Inshes Overbridge would be used to carry the two eastbound lanes.

4.6.4 It is proposed that the new structure be a two-span structure with full height abutments and an intermediate leaf pier. The structure would have a clear skew span of approximately 14.5m to the west and a varying clear skew span of approximately 16.6m to 20.9m to the east. The superstructure would comprise a precast prestressed concrete beam and slab deck supported on a cast in situ reinforced concrete substructure.

4.6.5 The structure would span the A9 at a skew angle of approximately 22 degrees at the west abutment and intermediate pier and approximately 38 degrees at the east abutment. The skew is greater at the east abutment which is positioned to maximise stopping sight distance on the A9 southbound on approach to Inshes Southbound Junction.

4.6.6 The additional lanes on the B9006 Culloden Road carriageway are proposed to be two 3.65m wide lanes with a 2m verge offset to the north parapet and a 3m verge offset to the south parapet.

4.6.7 The cross-section of the A9 below the structure is two carriageways wide. The proposed southbound carriageway would have three lanes totalling 11m, these are offset from the central pier by 0.8m and from the east abutment by a varying amount up to 7.4m. The northbound carriageway has two carriageways totalling 7.3m wide, these are offset from the central pier by 1.4m and 3.1m from the west abutment.

4.6.8 A 1.0m high N2 parapet would be provided on the north side of the structure and a 1.4m high N2 parapet would be provided on the south side of the structure. Both parapets would include mesh infill panels.

PS03 Cradlehall Railway Bridge

4.6.9 The PS03 Cradlehall Railway Bridge carries the proposed scheme over the Highland Main Line Railway. A single span portal type structure is proposed with a minimum clear span of 28.8m between abutment walls to accommodate the existing twin track and 4.5 minimum clearance from the outer rails to the adjacent abutment walls. The clear span would also accommodate signal sighting on the curved track through this structure. The cross-section over the structure would comprise a 7.3m wide carriageway with a 3.0m wide shared use path incorporating a 0.5m wide separation on each side. End supports would comprise cast insitu concrete abutments and wing-walls supported on spread footings whilst the deck is proposed to be precast pre-stressed beams with a reinforced concrete deck slab. A minimum head room clearance of 5.35m, from the top of the rail, would be provided at the new structure which would allow for future electrification of the track.

4.6.10 A parapet would be provided over the structure on each side. The parapet is likely to be 1.8m high H4a parapet.

Culverts

4.6.11 A list of the culverts within the proposed scheme is provided in Table 4.5. Culvert locations are also shown on Figure 1.3.

Table 4.5: List of Culverts

Culvert Reference	Approximate Chainage (m)	Engineering Description
C01 Scretan Burn Culvert No 1	Link 2 ch150	Precast concrete closed box culvert with embedded invert: 4.5m wide by 2.1m high.
C02 Scretan Burn Tributary Culvert No 1	Link 2 ch 550	Precast concrete closed box culvert with embedded invert: 3.0m wide by 1.7m high.
C03 Scretan Burn Tributary Culvert No 2	Link 3 ch550	Precast concrete closed box culvert with embedded invert: 2.5m wide by 1.6m high.
C04 Scretan Burn Culvert No 2	Link 3 ch300	Precast concrete closed box culvert with embedded invert: 5.5m wide by 1.8m high.
C05 Beechwood Burn Culvert No 1	Link 3 ch050	Precast concrete closed twin barrel box culvert with embedded invert: 2 x 4.0m wide by 1.3m high.
C06 Cairnlaw Burn Culvert No 1	Link 4 ch075	Precast concrete closed box culvert with embedded invert: 3.5m wide by 1.7m high.
C07Cairnlaw Burn Culvert No 2	Link 4 ch850	Precast concrete closed box culvert with embedded invert: 3.0m wide by 1.7m high.
C08 Scretan Burn Culvert No 3	Eastfield Way Roundabout to Drumrosach Bridge NMU Link ch415	Precast concrete closed box culvert with embedded invert: 4.0m wide by 2.2m high.
C09 Beechwood Burn Culvert No 2	Link 1 ch010	Replacement of existing culvert with new, 0.8m diameter pipe culvert.
C10 Beechwood Burn Culvert No 3	A9 ch650	Downstream extension of the existing culvert under the A9.
C01A Flood Relief Culvert No 1	Link 2 ch80	Precast concrete closed box culvert with embedded invert: 2m wide by 1.5m high.
C01B Flood Relief Culvert No 2	Link 2 ch85	Precast concrete closed box culvert with embedded invert: 2m wide by 1.5m high.

Dry Mammal Underpass (DMU)

4.6.12 One DMU is anticipated for the proposed scheme as indicated in Table 4.6. The location is shown on Figure 1.3.

Table 4.6: List of Dry Mammal Underpasses

DMU Reference	Location	Engineering Description
DMU1	Ch180 of Castlehill Road Tie-in	Precast concrete pipe 0.9m internal diameter, approximately 30m in length

Retaining Walls

4.6.13 No retaining walls are proposed.

4.7 Fencing and Environmental Barriers

Fencing

4.7.1 Mammal resistant fencing is proposed at various locations throughout the proposed scheme as an environmental mitigation measure. The use of mammal fencing is discussed in detail in Chapter 11 (Ecology and Nature Conservation) of the EIAR and indicative locations of mammal fencing are shown in Figure 9.5 of the EIAR.

4.7.2 Fencing may be provided as accommodation works for individual landowners. Whilst much of the land bounding the proposed scheme is arable in nature, stock proof fencing may be required in some areas.

4.7.3 Prior to commencing construction, temporary fencing would be necessary to delineate and/or secure the land required for the proposed scheme.

Environmental Barriers

4.7.4 No environmental barriers are proposed. The requirements for noise mitigation measures are discussed in Chapter 8 (Noise and Vibration) of the EIAR.

4.8 Traffic Signs and Road Markings, Traffic Signals and Lighting

Traffic Signs and Road Markings

4.8.1 As part of the DMRB Stage 3 design, a signing strategy has been developed to establish signing requirements for the proposed scheme. The traffic signs required for the proposed scheme would be designed in accordance with relevant design standards, with key reference to:

- The Traffic Signs Regulations and General Directions 2016 (TSRGD) (The Department for Transport 2016);
- Traffic Signs Manual (The Department for Transport 2006);
- Local Transport Note (LTN) 1/94 - Design and use of directional informatory signs (The Department for Transport 1994); and
- Trunk Road and Motorway Tourist Signposting Policy and Guidance (Transport Scotland 2006).

4.8.2 The detailed sign design would be the responsibility of the selected Contractor and subject to compliance with the contract documents. As part of the detailed design process the Contractor would consult with Transport Scotland, The Highland Council, VisitScotland and other appropriate stakeholders with regards to the provision of the required signage. The use of bilingual signs is proposed through consultation with The Highland Council and Transport Scotland.

4.8.3 Brown tourist signs would be provided to advise drivers of VisitScotland accredited local tourist attractions that meet relevant requirements. Proposed signs would link into the existing network of brown tourist signage.

Lighting

4.8.4 Proposed road lighting on public roads has been designed in accordance with:

- DMRB Volume 8, Section 3, TA49/07 - Appraisal of New and Replacement Lighting on the Strategic Motorway and All-Purpose Trunk Road Network (The Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2007c);
- DMRB Volume 8, Section 3, TD34/07 - Design of Road Lighting for the Strategic Motorway and All-Purpose Trunk Road Networks (The Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2007d);
- BS 5489-1: 2013 – Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas (British Standards 2013); and
- with reference to CIE 115/2010 - Lighting of roads for motor and pedestrian traffic (International Commission on Illumination 2010), TD16/07, and TD22/06.

4.8.5 Road lighting is proposed at the following locations:

- Link 1: Culloden Road to Cradlehall Roundabout;
- Link 6: Castlehill Road Tie-in;
- Link 6: Castlehill Road Tie-in/Caulfield Road North Tie-in 1;
- Link 6: Castlehill Road Tie-in/Caulfield Road North Tie-in 2;

- Cradlehall Roundabout;
- Eastfield Way Roundabout; and
- existing A9 central reserve, south of the A9 Inshes Southbound Junction, to coincide with commencement of proposed 50mph zone.

4.8.6 The road lighting is expected to use emerging technologies such as Light Emitting Diodes (LEDs) to achieve energy cost savings. In addition, further energy cost savings could be achieved through the provision of an Intelligent Lighting Control System to enable the lighting to be dynamically controlled according to real-time traffic conditions.

4.9 Lay-bys

4.9.1 No lay-bys are proposed or affected by the proposed scheme.

4.10 Road Restraint Systems

4.10.1 As part of the DMRB Stage 3 design, a Road Restraints Risk Assessment Process (RRRAP) has been carried out to determine requirements for safety barriers in accordance with DMRB Volume 2, Section 2, Part 8, TD19/06, Requirement for Road Restraint Systems (The Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2006a) (herein referred to as TD19/06).

4.10.2 The RRRAP is suitable for roads with a speed limit of 50mph or more and therefore only applies to the proposed A9 lane gain/lane drop. It is proposed that the existing safety barrier is retained along the length of the existing A9 within the central reserve, with proposed barriers in front of structures and relevant street furniture.

4.10.3 The vehicle restraint systems for sections of local roads with a speed limit of less than 50mph have been designed in accordance with TD19/06 Appendix 2, Roads and Transport Guidelines for New Developments (The Highland Council 2013) and Design & Maintenance Guidance for Local Authority Roads – Provision of Road Restraint Systems on Local Authority Roads, UK Roads Liaison Group and the Department for Transport, October 2011.

4.10.4 In addition to the provision of parapets on PS02 Proposed Inshes Overbridge and PS03 Cradlehall Railway bridge as detailed in section 4.6, safety barriers are also proposed at the locations of proposed culverts and on Link 3: Cradlehall Roundabout to Eastfield Way Roundabout.

4.11 Road Pavement

4.11.1 The type and specification of road pavement surfacing will be agreed through consultation with relevant parties in advance of the preparation of tender documents. Surfacing material will vary between Local Authority and Transport Scotland roads, which may include a thin wearing course system such as Stone Mastic Asphalt.

4.11.2 Initial indicative pavement designs have been produced for assessment and estimation purposes in accordance with DMRB Volume 7, Section 2, Part 3, HD26/06, Pavement Design, (The Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2006).

4.11.3 The minimum Polished Stone Value (PSV) required across proposed local roads would vary depending on location and traffic loading for the design year. PSV will be in accordance with DMRB Volume 7, Section 5, Part 1, HD36/06, Surfacing Materials for New and Maintenance Construction (The Highways Agency, Transport Scotland, Welsh Assembly Government and The Department for Regional Development Northern Ireland 2006d).

4.11.4 For the purpose of developing an initial pavement design, a California Bearing Ratio (CBR) of 5% has been assumed across the proposed scheme.

4.12 Indicative Construction Sequence

4.12.1 Construction of the proposed scheme can only commence if the scheme is approved under the statutory procedures and thereafter a timetable for progress can be determined. However, for assessment purposes the construction of the proposed scheme is expected to take place over approximately 24 months. An indicative construction programme is shown in Table 4.7 below.

4.12.2 It is anticipated that the construction of the scheme may sensibly be split into sections as follows:

- B9006 Culloden Road to A96 Smithton Junction – those sections of the works between the B9006 Culloden Road and the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme;
- PS02 Proposed Inshes Overbridge – the construction of the PS02 Proposed Inshes Overbridge structure and the eastern earthworks adjacent to the existing B9006 Culloden Road and PS01 Existing Inshes Overbridge; and
- A9 lane gain/lane drop – the proposed additional lane and slip road works between the Raigmore Interchange and Inshes Southbound Junction along the A9.

4.12.3 The indicative construction programme is broken down into phases to reduce the impact on road users and neighbouring communities. The anticipated phasing of the construction works is as follows:

- Advanced Works – Undertake archaeological works, establish work area, and set-up traffic management. This may include temporary road closures and diversion of traffic to undertake initial site clearance and advanced service diversions.
- Main Contracts Works Phase 1 – Reconfiguration of traffic management. Undertake service diversions. Construction of PS03 Cradlehall Railway Bridge and PS02 Proposed Inshes Overbridge abutment structures and decks.
- Main Contracts Works Phase 2 – Construction of works north of the Highland Main Line Railway, including earthworks, culverts, and drainage swales and outfalls. Reconfiguration of traffic management. Undertake service diversions.
- Main Contracts Works Phase 3 – Construction of works south of the Highland Main Line Railway and along the existing A9, including earthworks, culverts, and drainage swales and outfalls. Reconfiguration of traffic management. Undertake service diversions.
- Main Contracts Works Phase 4 – Construction of work on U1058 Caulfield Road North, including tie-ins to the B9006 Culloden Road and the U5096 Castlehill Distributor Road. U1058 Caulfield Road North to be closed and traffic management reconfigured. Undertake service diversions. Pavement and finishes on PS02 Proposed Inshes Overbridge and the A9 lane gain/lane drop.
- Main Contracts Works Phase 5 – Reconfiguration of traffic management. Pavement and finishes between Inshes and Smithton.

4.12.4 The construction details proposed provide an outline of anticipated construction activities. These details are subject to change by the selected Contractor.

Advanced Works

4.12.5 A number of advanced works, including environmental mitigation works, archaeological excavation, and advanced service diversions may be carried out before the main works commence.

Traffic Management

4.12.6 The majority of the proposed scheme is offline and can be constructed with minimal disturbance to the travelling public. For sections of the proposed scheme which affect existing roads, traffic management systems would be implemented to maximise safety for both drivers and construction workers. Indicative construction programme is provided in Table 4.7.

Table 4.7: Indicative Construction Programme

Phasing	**Timescale**	
Preliminaries & Advanced Works	Commencement Year	Typical Duration (month)
Preliminaries & Advanced Works	Year 0	3
B9006 Culloden Road to A96 Smithton Junction Section	Commencement Year	Typical Duration (month)
Mobilisation	Year 1&2	3
Enabling works		
Service diversions		
Site clearance		
Fencing		14
Ground improvement		
Earthworks		
Structures		
Drainage		
Road Pavement	Year 2	3
Finishing		
PS02 Inshes Overbridge Section	**Commencement Year**	**Typical Duration (month)**
Mobilisation	Year 1	1
Enabling works		
Service diversions		
Site clearance		
Fencing		
Ground improvement		12
Earthworks		
Structures		
Drainage		
Road Pavement	Year 2	2
Finishing		
A9 Lane Gain/Lane Drop Section	**Commencement Year**	**Typical Duration (month)**
Mobilisation	Year 2	3
Enabling works		
Service diversions		
Site clearance		
Fencing		
Ground improvement		
Earthworks		
Structures		
Drainage		
Road Pavement		3
Finishing		
Note: Some typical durations are assumed to run concurrently		

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5 Traffic Assessment

5.1 Introduction

5.1.1 This chapter of the Design Manual for Roads and Bridges (DMRB) Stage 3 Scheme Assessment report provides an overview of the transport model development, traffic forecasting and potential impacts of the proposed scheme, compared to a Do-Minimum scenario. The economic appraisal of the proposed scheme and the economic results are presented in Chapter 6: Economic Assessment.

5.1.2 The traffic and economic assessment of the proposed scheme has been undertaken using an updated version of the Moray Firth Transport Model (MFTM). The MFTM is a regional, four-stage, multi-modal forecasting model that was originally developed for The Highland Council in 2009. The model has since undergone a series of updates that are summarised in the following paragraphs.

5.1.3 As part of the first update, the MFTM Base model was updated using additional traffic data collected in 2014 along the A96 corridor, and utilised existing traffic data collected in and around Inverness. As a further refinement to the MFTM, a specific Inter Peak model was also developed to provide assessments based on the representation of the 2014 AM Peak, PM Peak and Inter Peak periods in the traffic modelling.

5.1.4 The MFTM (2014) update was undertaken to provide the traffic modelling and economic appraisal inputs to the DMRB Stage 3 Scheme Assessment for the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, and the DMRB Stage 2 Scheme Assessment for the A9/A96 Inshes to Smithton scheme.

5.1.5 The MFTM has undergone a further update in preparation for the DMRB Stage 2 Scheme Assessment for the A9/A82 Longman Junction Improvement and the DMRB Stage 3 Scheme Assessment for the A9/A96 Inshes to Smithton scheme. This update to the MFTM comprised a comprehensive update of the Base and Future Year traffic models and has included updating the Base model to represent 2018 traffic conditions and developing updated future year planning data inputs in close collaboration with The Highland Council planning officers.

5.1.6 Figure 5.1a and Figure 5.1b shows the relevant area of the MFTM Base transport model that was used to produce forecasts of multi-modal travel demand. The model was used to determine the effect of the proposed scheme compared to the Do-Minimum scenario, for the future years of 2022, as the assumed opening year, and 2037, as the assumed design year (15 years post-opening year).

5.1.7 Key performance indicators for the proposed scheme, such as changes to traffic flows, speeds, journey times and travel distances, have been assessed using the updated MFTM (2018). The outputs from the MFTM were then input into the Department for Transport's (DfT) Transport Users Benefits Appraisal (TUBA) Version 1.9.9 software to identify the economic benefits for the proposed scheme compared to the Do-Minimum scenario. The infrastructure included in the agreed Do-Minimum scenario is described in Section 5.5 of this chapter. The MFTM outputs have also been provided for the respective air quality, and traffic noise and vibration assessments as part of the Environmental Impact Assessment.

5.1.8 In addition to the updated MFTM, an operational traffic model was also developed using micro-simulation software to assess the detailed operational performance of the proposed scheme. The operational model was also used to assess the impacts arising from the likely traffic management arrangements for the main construction phases for the proposed scheme, for inclusion in the economic appraisal of the options.

5.1.9 The following sections of this chapter describe the structure of the modelling system, including an overview for the models, inputs and forecasting assumptions. The chapter also contains an assessment of the proposed scheme in order to determine the effect it may have on the road network within the study area.

5.2 Model Inputs and Assumptions

Base Model Update

5.2.1 The MFTM Base Model was updated to include observed origin-destination data using a combination of Census 2011 data, Scottish Household Survey data, Roadside Interview (RSI) Survey data, and traffic count data collected at key locations on the road network. The data was used as part of the process to update the MFTM Base Model origin-destination trip matrices and the planning data inputs used to generate updated traffic forecasts for the modelled future years. In order to provide Transport Scotland with the required level of technical assurance, the work undertaken to update the Base Year and Future Year Models, and the economic appraisal work, will be subject to an independent audit.

5.2.2 The additional data collection consisted of 24 temporary Automatic Traffic Counts (ATCs) ranging in duration from two weeks to 10 weeks, 21 12-hour Junction Turning Counts (JTCs) and five RSI Surveys. The locations of these surveys are shown in Figure 5.2.

5.2.3 Observed Journey Time datasets were also obtained from TomTom International B.V. as part of the data collection programme and analysed for a series of key routes on both the trunk road and local road network for the model validation process. The TomTom data provided an average journey time for 2017.

5.2.4 In addition to this data collection programme, use was also made of the existing 18 permanent ATC sites located throughout the model area, that are installed on the Trunk Road network and maintained by Transport Scotland through National Traffic Database System (NTDS). The ATC counters that lie within the study area are identified in Figure 5.3.

5.2.5 The MFTM Base Model update was focused on Inverness and the A82 Dallnottar – Inverness Trunk Road (A82), the M9/A9 Edinburgh – Stirling – Thurso Trunk Road (A9) and the A96 Aberdeen – Inverness Trunk Road (A96) corridors, however it also covers all major commuting catchments to the city and strategic movements from the rest of Scotland. The model has been calibrated to a base year of 2018. The forecast years that have been developed for the proposed scheme are 2022, as the assumed Year of Opening, and 2037, as the assumed Design Year.

5.2.6 The model has been developed to represent the following time periods:

- AM Peak 08:00-09:00 hours;
- Inter Peak average hour 10:00-16:00 hours; and
- PM Peak 17:00-18:00 hours.

5.3 Existing Traffic Operational Review

5.3.1 The study area incorporates the A9 and A96 trunk roads connecting via a grade separated roundabout at Raigmore Interchange. The A96 is a 60mph speed limit rural single carriageway on approach to the A96 Smithton Junction, where the speed limit reduces to 50mph east of A96 Smithton Junction and applies on this section of the A96 route through to Raigmore Interchange. The A96 remains single carriageway until the Seafield Roundabout, where it changes to a dual carriageway standard between Seafield Roundabout and Raigmore Interchange.

5.3.2 The A9 is a dual carriageway where it passes through the study area and operates under a 70mph national speed limit, until a point approximately 480m south of the A9/A82 Longman Junction. From this point the A9 operates under a 50mph speed limit north as it crosses the Kessock Bridge.

5.3.3 On the local road network, the B9006 Culloden Road is a key single carriageway distributor route for traffic accessing Inverness from the East and the Smithton, Culloden and Balloch areas, and is subject to a national 60mph speed limit to a point just to the east of Viewmount Brae. From Viewmount Brae eastwards, the B9006 Culloden Road operates under a 40mph speed limit until a point just to the east

of the junction with the C1058 Caulfield Road North where a 30mph speed limit applies as the route enters the Inshes urban area.

5.3.4 The C1032 Barn Church Road is a key local distributor road and provides a key access route for the Smithton, Culloden and Balloch areas to the A96. The route is subject to a 40mph speed limit along the section that passes the main Balloch and Culloden residential areas between Upper Cullernie Court and the U1124 Caulfield Road. The eastern and western sections of the C1032 Barn Church Road approaching the A96 junctions are subject to a 60mph speed limit.

5.3.5 A summary of the observed 2018 two-way Annual Average Daily Traffic (AADT) flows at key locations on the trunk and local road network are shown in Table 5.1. As noted above, the observed traffic information has been obtained from the permanent ATC from the NTDS. Where possible, data has been used from 2018, however in some locations, 2017 data has been used as 2018 data was not available. Additional ATCs and JTCs were installed during February, March and April 2018, as a representative (neutral) month in terms of traffic volumes. The JTCs were undertaken over one day in February, for a 12-hour period. This data has been factored to a 24-hour flow for the day of the survey and should be considered as an approximation of the AADT flow. The source of the traffic data has also been noted in Table 5.1.

5.3.6 In 2018, the two-way AADT flow on the A96 between the A96 Smithton Junction and Raigmore Interchange was approximately 36,500 vehicles, based on the ATC data analysis. The two-way AADT flow on the A9 north of Raigmore Interchange was approximately 35,100 vehicles, and on the A9 south of Raigmore Interchange was approximately 30,200 vehicles, however this count is only a proxy as it is based on the ATC North of Raigmore and the JTC at Raigmore Interchange. The two-way AADT flows at key locations on the local road network are also shown in Table 5.1.

Table 5.1: Observed two-way AADT Flows

Locations	Source	2-Way AADT
A9 North of Raigmore (2017)	ATC01008	35,100
A9 South of Raigmore	Proxy Count based on ATC1008 and JTC10	30,200
A96 Approach to Raigmore (2017)	ATCNE011	36,500
A96 West Seafield to Smithton	JTC21 (one day count)	29,100
A96 East of Smithton	ATC01066	16,000
C1032 Barn Church Road	ATC19	11,500
C1036 Tower Road	ATC20	8,600
B9006 Culloden Road East of U1124 Caulfield Road	ATC21	12,900

5.3.7 The observed data was used to establish existing journey time information within the study area in the AM Peak, Inter Peak and PM Peak periods. The observed journey time data for traffic movements passing through Raigmore Interchange and along the B9006 Culloden Road corridor are of particular interest for the proposed scheme assessment. The data analysed for the key movements is shown in Table 5.2, Table 5.3 and Table 5.4 for the AM Peak, Inter Peak (IP) and PM Peak respectively. The journey time routes are shown in Figure 5.4.

Table 5.2: Observed AM Peak Journey Times

Start Point	End Point	Peak	Journey Times (mm:ss)
A96 East of Smithton	A9 Kessock Bridge	AM	04:34
A9 Kessock Bridge	A96 East of Smithton	AM	08:16
A96 East of Smithton	B865 Millburn Road	AM	04:53
B865 Millburn Road	A96 East of Smithton	AM	03:46
A96 East of Smithton	B9006 West of Inshes Junction	AM	08:29
B9006 West of Inshes Junction	A96 East of Smithton	AM	06:20
A96 East of Smithton	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	AM	08:05
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	A96 East of Smithton	AM	07:41
A96 East of Smithton	A9 South	AM	05:20
A9 South	A96 East of Smithton	AM	05:31
C1032 Barn Church Road	B865 Millburn Road	AM	05:28
B865 Millburn Road	C1032 Barn Church Road	AM	04:01
C1032 Barn Church Road	B9006 West of Inshes Junction	AM	09:03
B9006 West of Inshes Junction	C1032 Barn Church Road	AM	06:35
B9006 Culloden Road East of the C1036 Tower Road	B9006 West of Inshes Junction	AM	06:56
B9006 West of Inshes Junction	B9006 Culloden Road East of the C1036 Tower Road	AM	06:24
B9006 Culloden Road East of the C1036 Tower Road	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	AM	06:32
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	B9006 Culloden Road East of the C1036 Tower Road	AM	06:50

Table 5.3 Observed Inter Peak Journey Times

Start Point	End Point	Peak	Journey Times (mm:ss)
A96 East of Smithton	A9 Kessock Bridge	IP	04:22
A9 Kessock Bridge	A96 East of Smithton	IP	07:15
A96 East of Smithton	B865 Millburn Road	IP	04:45
B865 Millburn Road	A96 East of Smithton	IP	04:27
A96 East of Smithton	B9006 West of Inshes Junction	IP	07:55
B9006 West of Inshes Junction	A96 East of Smithton	IP	07:23
A96 East of Smithton	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	IP	07:37
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	A96 East of Smithton	IP	06:56
A96 East of Smithton	A9 South	IP	05:00
A9 South	A96 East of Smithton	IP	05:49
C1032 Barn Church Road	B865 Millburn Road	IP	04:38
B865 Millburn Road	C1032 Barn Church Road	IP	04:19
C1032 Barn Church Road	B9006 West of Inshes Junction	IP	07:47
B9006 West of Inshes Junction	C1032 Barn Church Road	IP	07:15
B9006 Culloden Road East of the C1036 Tower Road	B9006 West of Inshes Junction	IP	06:28
B9006 West of Inshes Junction	B9006 Culloden Road East of the C1036 Tower Road	IP	06:50
B9006 Culloden Road East of the C1036 Tower Road	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	IP	06:11
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	B9006 Culloden Road East of the C1036 Tower Road	IP	06:05

Table 5.4: Observed PM Peak Journey Times

Start Point	End Point	Peak	Journey Times (mm:ss)
A96 East of Smithton	A9 Kessock Bridge	PM	04:42
A9 Kessock Bridge	A96 East of Smithton	PM	06:53
A96 East of Smithton	B865 Millburn Road	PM	05:06
B865 Millburn Road	A96 East of Smithton	PM	04:26
A96 East of Smithton	B9006 West of Inshes Junction	PM	08:44
B9006 West of Inshes Junction	A96 East of Smithton	PM	07:00
A96 East of Smithton	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	PM	08:26
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	A96 East of Smithton	PM	07:02
A96 East of Smithton	A9 South	PM	05:34
A9 South	A96 East of Smithton	PM	05:45
C1032 Barn Church Road	B865 Millburn Road	PM	04:32
B865 Millburn Road	C1032 Barn Church Road	PM	04:44
C1032 Barn Church Road	B9006 West of Inshes Junction	PM	08:10
B9006 West of Inshes Junction	C1032 Barn Church Road	PM	07:18
B9006 Culloden Road East of the C1036 Tower Road	B9006 West of Inshes Junction	PM	06:45
B9006 West of Inshes Junction	B9006 Culloden Road East of the C1036 Tower Road	PM	07:01
B9006 Culloden Road East of the C1036 Tower Road	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	PM	06:27
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	B9006 Culloden Road East of the C1036 Tower Road	PM	06:14

5.4 Accident Summary

Accident History

5.4.1 Accident data for the A9, A96 and A82 trunk corridors through and approaching Inverness was supplied by Transport Scotland in the form of STATS19 Data in December 2017. In addition, accident data for the local road network within The Highland Council region was extracted online from the road safety dataset in the form of STATS19 Data, which is held by DfT.

5.4.2 Figure 5.5 shows the location and severity of personal injury accidents during the identified five-year period. Fatal accidents (Red) are recorded where the level of injuries sustained cause death within 30 days of the accident. Serious accidents (Blue) are recorded where a casualty is detained in hospital or sustains fractures, concussion, severe cuts or where death occurs 30 or more days after the accident. Slight accidents (Green) are recorded when a casualty sustains a sprain, bruise or slight cut.

5.4.3 There were 248 accidents in total within the study area between 2012 and 2016, which equates to an average of approximately 50 accidents per year. Table 5.5 summarises the yearly total and severity of accidents that occurred in the accident area of interest over the five-year period.

Table 5.5 Accident Data by Year and Severity

Year	Slight	Serious	Fatal	Total
2012	53 *(84%)*	10 *(16%)*	0 *(0%)*	63
2013	55 *(87%)*	7 *(11%)*	1 *(2%)*	63
2014	54 *(93%)*	3 *(5%)*	1 *(2%)*	58
2015	32 *(91%)*	3 *(9%)*	0 *(0%)*	35
2016	27 *(93%)*	2 *(7%)*	0 *(0%)*	29
Total	221 *(89%)*	25 *(10%)*	2 *(1%)*	248
National Average - All Road types %age Split	81%	17%	2%	-

5.4.4 It is shown in Table 5.5 that the number of reported accidents on the network has decreased since 2012 (63) with the total accidents more than halving compared to 2016 (29). Over the five-year period accidents within the study area have declined yearly from 2013. This is also reflected in the severity of the accident with data categorised as 'slight' making up more than 90% of the total from 2014 onwards.

5.4.5 There were two fatal accidents reported over the five-year period occurring in 2013 and 2014. Both accidents took place on local roads one near Church Street in the city centre area and the other where C1193 Kingsmills Road meets the B853 Culcabock Road. The proportions of fatal and serious accidents that have occurred within the study area were below the national average of 19% for all road types roads during the period 2012 to 2016 inclusive, calculated from Table 5a in Reported Road Casualties Scotland 2016 (Transport Scotland 2017).

5.5 Traffic Modelling

Introduction

5.5.1 This section provides an overview of the transport model methodology, including the development of the Base Model and the future year traffic forecasting. As noted previously, the MFTM was the primary tool that has been used to assess the proposed scheme. To support the wider traffic modelling and economic assessment undertaken using the MFTM, a micro-simulation model was developed using the S-Paramics software to assess the detailed operational performance of the proposed scheme in the future forecast year of 2037.

5.5.2 The following sections present details of the traffic and operational assessment of the proposed scheme.

5.5.3 The relevant transport modelling and economic appraisal aspects will be subject to a separate independent audit process.

Moray Firth Transport Model

5.5.4 The original version of the MFTM had a base year of 2009 and covered a geographical area that broadly encompasses the Inverness Travel to Work area. It included all Trunk Roads and non-Trunk principal roads, as well as a significant part of the key local road network. The model was developed and maintained for The Highland Council by their transport modelling consultants, for use as a planning and forecasting tool for developments in the Inverness area including the West Link project.

5.5.5 As noted in Section 5.2 the MFTM Base Model was updated to include observed origin-destination data using a combination of Census 2011 data, Scottish Household Survey data, Roadside Interview (RSI) Survey data, and traffic count data collected at key locations on the road network, to reflect traffic conditions in 2018. To provide Transport Scotland with the required level of technical assurance, the work undertaken to update the Base Model is subject to independent audit.

5.5.6 Further details on the MFTM Base Model update process, and the model calibration and validation results are presented in the MFTM Calibration and Validation Report - 2018 (Jacobs 2019).

Base Model

5.5.7 The updated MFTM Base year (2018) AADT flows on the A9, A96 and A82, and key locations on the local road network, are shown in Table 5.6.

Table 5.6 MFTM Base Year Model Annual Average Daily Traffic Flows

Location	Dir	Base	%HGVs
A96 East of Raigmore Interchange	EB	19,700	4%
A96 East of Raigmore Interchange	WB	18,900	4%
A96 Seafield Roundabout to Smithton Junction	EB	17,400	4%
A96 Seafield Roundabout to Smithton Junction	WB	16,600	4%
A96 East of A96 Smithton Junction	EB	10,200	6%
A96 East of A96 Smithton Junction	WB	10,100	6%
C1032 Barn Church South of Smithton Junction	NB	6,700	1%
C1032 Barn Church South of Smithton Junction	SB	6,100	1%
C1058 Caulfield Road North	NB	1,900	1%
C1058 Caulfield Road North	SB	1,200	0%
B9006 Culloden Road between University of Highlands and Islands Inverness Campus (Inverness Campus) Junction and Caulfield Road North	EB	6,900	1%
B9006 Culloden Road between Inverness Campus Junction and Caulfield Road North	WB	6,600	2%
B9006 Culloden Road Overbridge	EB	6,700	2%
B9006 Culloden Road Overbridge	WB	14,400	2%
B9006 Culloden Road West of Inshes Junction	EB	6,400	3%
B9006 Culloden Road West of Inshes Junction	WB	7,200	2%
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	NB	7,200	2%
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	SB	6,200	1%
A9 between Raigmore Interchange and A9 Inshes Junction	NB	15,900	4%
A9 between Raigmore Interchange and A9 Inshes Junction	SB	15,400	6%
A9 NB Diverge at Raigmore Interchange	NB	6,900	5%
A9 SB Merge at Raigmore Interchange	SB	6,000	6%
A9 South of Longman Roundabout	NB	15,700	4%
A9 South of Longman Roundabout	SB	20,200	5%
A9 North of Longman Roundabout	NB	17,200	7%
A9 North of Longman Roundabout	SB	19,200	7%
C1248 Stadium Rd	EB	2,700	10%

Location	Dir	Base	%HGVs
C1248 Stadium Rd	WB	3,900	6%
A82 West of Longman Roundabout	EB	13,700	7%
A82 West of Longman Roundabout	WB	12,500	7%
C1036 Tower Road	NB	4,000	1%
C1036 Tower Road	SB	4,100	1%
B9006 Culloden East of the C1036 Tower Road	EB	3,200	1%
B9006 Culloden East of the C1036 Tower Road	WB	3,900	3%
B9006 Culloden West of the C1036 Tower Road	EB	5,100	3%
B9006 Culloden West of the C1036 Tower Road	WB	5,100	2%
B9006 Culloden East (west of B9177)	EB	5,600	3%
B9006 Culloden East (west of B9177)	WB	5,300	2%
B865 Milburn Road	EB	11,400	4%
B865 Milburn Road	WB	15,400	3%
U5096 Castlehill Road	EB	2,300	2%
U5096 Castlehill Road	WB	2,200	0%

5.5.8 The Base Model traffic flows generally compare well to the observed flows on the A9, A96 and A82 during the AM Peak, Inter Peak and PM Peak periods. Further details on the MFTM Base Model calibration and validation results are presented in the MFTM Calibration and Validation Report - 2018 (Jacobs 2019).

Consideration of the Do-Minimum Scenario

5.5.9 The MFTM is intended to assess the impact of the proposed scheme by comparing the Do-Something (with Scheme) scenario with the Do-Minimum (without Scheme) scenario, such that the difference between the two identifies the likely impacts.

5.5.10 It was therefore necessary to define the committed and most likely changes that will be made to the transport network between 2018 and each of the future appraisal years (2022 and 2037) to obtain the most representative appraisal results. The Do-Minimum scenario represents the likely future conditions if the proposed scheme was not constructed. The Do-Minimum scenario includes other infrastructure improvements that have the required level of commitment to be included and was agreed with Transport Scotland and The Highland Council.

5.5.11 The Do-Minimum interventions included within the MFTM are listed below:

- New Rail Station at Dalcross;
- Inverness West Link Road Phase 2;
- Inshes Junction Improvements - Phase 2;
- Raigmore Interchange Signalisation;
- C1032 Barn Church Road widened to 2 lanes in each direction on approach to the A96 Smithton Junction;
- A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme; and
- A9/A82 Longman Junction Improvement (2037 only).

Core Planning Scenarios

5.5.12 Future year planning data inputs were developed in close collaboration with The Highland Council planning officers to determine a realistic view of development within the area over the coming years. The information provided reflects the emerging Housing Needs and Demand Assessment (HNDA) being undertaken by The Highland Council. Employment opportunities were also considered and developed in conjunction with The Highland Council. From the planning information available, a number of sites were identified as employment sites. The number of jobs associated with these employment sites resulted in a level of growth in line with The Highland Council's. This level of growth therefore forms the Core scenario on which the development of future year traffic forecasts has been based.

5.5.13 Full details of the planning scenarios are contained in the Moray Firth Transport Model Traffic Forecast Report (Jacobs 2019).

Sensitivity Tests – Low and High Planning Scenarios

5.5.14 The Core growth scenario uses current best evidence and is therefore the most appropriate basis for decision-making. However, there is no guarantee that the outturn will match the assumptions, and as a result, in accordance with Transport Appraisal Guidance (TAG) separate Low growth and High growth scenarios were developed.

5.5.15 The Low Growth and High Growth scenarios were derived in accordance with TAG unit M4, whereby a proportion of the base matrix is added or subtracted from the future year demand matrices. The proportion of the base was calculated using the following formula:

$$\text{Proportion of Base} = \sqrt{(\text{number of years from the base year})} * P$$

Where P is 2.5% for national models.

5.5.16 This approach resulted in 5% of the base matrices being added (for High Growth) and subtracted (for Low Growth) in 2022, and 11% in 2037. However, in the Low growth scenario, in applying this methodology the resultant 2022 matrices contained less trips than the Base matrices. Therefore the 2022 Low growth matrices were derived by calculating the difference between the Base and the 2022 Core Growth matrix for each user class, dividing the resultant matrices by two, and subtracting this from the Core Growth matrices. This produced a set of Low growth matrices for 2022 that lay between the Base matrices and the 2022 Core Growth matrices.

5.5.17 For the purposes of scheme assessment, each growth scenario was utilised for a different purpose. The High Growth Scenario provides the "worst-case" scenario in terms of Environmental Impacts and was therefore provided for use in the Environmental Impact Assessment. The Low Growth Scenario provides the "worst-case" in terms of the economic assessment as the traffic volumes and levels of congestion are lower, meaning the journey time benefits are likely to be lower. The Core Growth scenario is the most likely scenario and has therefore been used for the operational assessment.

5.6 Proposed Scheme Description

5.6.1 The proposed scheme consists of a single carriageway road connecting to the B9006 Culloden Road via the C1058 Caulfield Road North. The C1058 Caulfield Road North would be widened to provide two lanes southbound on the approach to the junction with the B9006 Culloden Road, and realigned to connect to the proposed roundabout at Cradlehall. The single carriageway road would then continue northeast to connect to the southern dumbbell roundabout of the proposed grade separated A96 Smithton Junction which is proposed as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. The proposed scheme includes an intermediate junction between the Cradlehall Roundabout and the A96 Smithton Junction that provides an additional connection to the Inverness Retail and Business Park, and a connection to the planned development area. The proposed scheme provides two lanes in each direction on the B9006 Culloden Road as it crossed the A9 via a parallel structure adjacent to the PS01 Existing Inshes Overbridge. The proposed scheme also includes

provision for a lane gain/lane drop on the southbound A9 between Raigmore Interchange and the A9 Southbound Inshes Junction.

5.6.2 The proposed scheme is shown in Figure 1.2 and was appraised using the MFTM for the future years 2022 as the Opening Year, and 2037 as the Design Year (Year of Opening plus 15 years).

5.7 Traffic Forecasting

5.7.1 The forecasting of future traffic demand was derived from the MFTM model. This 4-stage model represents the following responses in the order given below:

- trip generation;
- mode choice;
- trip distribution; and
- route choice (assignment).

5.7.2 The model makes use of the planning scenario data that was provided by The Highland Council and projected changes in population, households and employment levels.

5.7.3 The traffic demand for the assessment of the proposed scheme was developed for the following years:

- proposed scheme Opening Year of 2022; and
- proposed scheme Design Year of 2037 (15 years after the Opening Year).

The traffic growth forecasts in terms of the matrix totals by journey purpose derived from the MFTM are shown in Table 5.7, Table 5.8 and Table 5.9 respectively for the modelled AM Peak, Inter Peak and PM Peak time periods under the High Growth scenario, as used for the Environmental Impact Assessment.

Table 5.7 Do-Minimum High Growth AM Peak

AM Peak	Base	DM 2022	DM 2037	Base ↗ 2022	2022 ↗ 2037
Car Commute	14,212	14,649	18,550	3%	27%
Car In-Work	1,260	1,410	1,769	12%	25%
Car Others	4,109	4,652	6,517	13%	40%
LGV	2,053	2,191	2,498	7%	14%
HGV	660	738	965	12%	31%

Table 5.8 Do-Minimum High Growth Inter Peak

Inter Peak	Base	DM 2022	DM 2037	Base ↗ 2022	2022 ↗ 2037
Car Commute	6,358	5,933	7,507	-7%	27%
Car In-Work	1,425	1,531	1,945	7%	27%
Car Others	8,708	9,841	14,740	13%	50%
LGV	1,767	2,250	2,557	27%	14%
HGV	695	771	974	11%	26%

Table 5.9 Do-Minimum High Growth PM Peak

PM Peak	Base	DM 2022	DM 2037	Base ↗ 2022	2022 ↗ 2037
Car Commute	10,537	10,726	13,419	2%	25%
Car In-Work	1,131	1,268	1,607	12%	27%
Car Others	8,680	9,933	13,979	14%	41%
LGV	1,737	1,996	2,450	15%	23%
HGV	311	354	520	14%	47%

5.8 Operational Model Traffic Forecasts

5.8.1 Following the completion of the MFTM future year 2022 and 2037 forecast models, output data was extracted from the MFTM forecast models to develop 2037 traffic data for input to the detailed operational models, developed using the S-Paramics micro-simulation software.

5.8.2 As the MFTM is a strategic model covering a large area, a cordon was applied that allowed the extraction of traffic data from the MFTM for the smaller area modelled in the detailed operational model. The exact boundary of the cordon was defined based upon the location of zones within the detailed operational model and the representation of the road networks in the MFTM. The links included in the MFTM cordon area are shown in Figure 5.7.

5.8.3 The road network represented in the detailed operational model covers the A9 from the Kessock Bridge to south of the A9 Milton of Leys junction; the A96 from Raigmore Interchange to east of the A96 Smithton Junction; and the A82 from west of the U4023 Harbour Road Roundabout to Longman Roundabout. The local road network within the B9006 Culloden Road corridor, the U1267 Dell of Inshes and the C1032 Barn Church Road have also been included, as have the B865 Millburn Road, U4023 Harbour Road, U4618 Shore Street, U4619 Cromwell Street, U4108 Longman Drive and the C1248 Stadium Road.

5.8.4 Further details on the methodology adopted for the development of the forecast traffic demand for the operational model are contained in the Future year Demand and Generation Methodology Report (Jacobs 2017).

5.9 Effects of the Proposed Scheme

5.9.1 The AADT flows from the MFTM for the Do-Minimum and Do-Something High Growth scenario, in the design year 2037, are shown in Table 5.10, and on Figures 5.8a and Figure 5.8b respectively.

Table 5.10 AADT flows for the Do-Minimum and Do-Something

Location	Dir	DM 2037	DS 2037	Difference	%Difference
A96 East of Raigmore Interchange	EB	31,400	28,000	-3,400	-11%
A96 East of Raigmore Interchange	WB	32,000	29,800	-2,200	-7%
A96 Seafield Roundabout to Smithton Junction	EB	28,400	26,500	-1,900	-7%
A96 Seafield Roundabout to Smithton Junction	WB	27,100	24,600	-2,400	-9%
A96 East of A96 Smithton Junction	EB	20,500	22,200	1,700	8%
A96 East of A96 Smithton Junction	WB	21,200	22,800	1,600	7%
C1032 Barn Church South of Smithton Junction	NB	9,600	12,300	2,700	28%
C1032 Barn Church South of Smithton Junction	SB	8,100	9,800	1,700	20%
C1058 Caulfield Road North	NB	2,800	7,000	4,200	151%
C1058 Caulfield Road North	SB	1,400	6,100	4,700	346%
B9006 Culloden Road between Inverness Campus Junction and Caulfield Road North	EB	9,400	11,700	2,400	25%
B9006 Culloden Road between Inverness Campus Junction and Caulfield Road North	WB	9,100	11,800	2,700	29%
B9006 Culloden Road Overbridge	EB	9,600	12,000	2,400	25%
B9006 Culloden Road Overbridge	WB	18,900	20,200	1,300	7%
B9006 Culloden Road West of Inshes Junction	EB	7,600	8,200	600	8%
B9006 Culloden Road West of Inshes Junction	WB	9,200	9,600	300	4%
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	NB	9,600	9,600	0	0%
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	SB	7,300	7,700	400	5%
A9 between Raigmore Interchange and A9 Inshes Junction	NB	23,700	21,000	-2,700	-11%
A9 between Raigmore Interchange and A9 Inshes Junction	SB	23,200	20,600	-2,500	-11%
A9 NB Diverge at Raigmore Interchange	NB	8,800	6,900	-1,900	-22%
A9 SB Merge at Raigmore Interchange	SB	7,200	3,800	-3,400	-47%

Location	Dir	DM 2037	DS 2037	Difference	%Difference
A9 South of Longman Roundabout	NB	32,800	32,200	-500	-2%
A9 South of Longman Roundabout	SB	36,200	34,300	-1,900	-5%
A9 North of Longman Roundabout	NB	28,100	28,700	700	2%
A9 North of Longman Roundabout	SB	31,000	30,900	-100	0%
C1248 Stadium Rd	EB	4,900	5,100	200	4%
C1248 Stadium Rd	WB	5,600	5,500	0	0%
A82 West of Longman Roundabout	EB	25,100	24,400	-700	-3%
A82 West of Longman Roundabout	WB	25,200	24,900	-400	-1%
C1036 Tower Road	NB	7,700	3,900	-3,900	-50%
C1036 Tower Road	SB	6,300	2,800	-3,500	-56%
B9006 Culloden East of the C1036 Tower Road	EB	3,900	3,700	-200	-5%
B9006 Culloden East of the C1036 Tower Road	WB	4,800	3,500	-1,300	-26%
B9006 Culloden West of the C1036 Tower Road	EB	7,800	5,700	-2,100	-26%
B9006 Culloden West of the C1036 Tower Road	WB	7,900	6,200	-1,700	-22%
B9006 Culloden East (west of B9177)	EB	8,300	6,700	-1,600	-19%
B9006 Culloden East (west of B9177)	WB	7,100	5,700	-1,400	-20%
B865 Milburn Road	EB	15,600	16,300	700	5%
B865 Milburn Road	WB	19,800	20,400	600	3%
U5096 Castlehill Distributor Road	EB	3,500	2,700	-800	-23%
U5096 Castlehill Distributor Road	WB	2,200	3,900	1,600	73%
Eastfield Way Roundabout to Smithton Junction	NB	N/A	6,200	N/A	N/A
Eastfield Way Roundabout to Smithton Junction	SB	N/A	6,900	N/A	N/A
Eastfield Way Roundabout to Inverness Retail and Business Park	EB	N/A	3,300	N/A	N/A
Eastfield Way Roundabout to Inverness Retail and Business Park	WB	N/A	2,900	N/A	N/A
Cradlehall Roundabout to Eastfield Way Roundabout	NB	N/A	9,900	N/A	N/A
Cradlehall Roundabout to Eastfield Way Roundabout	SB	N/A	11,100	N/A	N/A

5.9.2 In terms of the key traffic flow changes, Table 5.10 shows that compared to the Do-Minimum scenario, the Do-Something would reduce the number of vehicles on the A96 Westbound approach to Raigmore Interchange by 7%, with a forecast reduction in AADT of 2,200 vehicles. Traffic volumes decrease by

11% eastbound on the A96 approaching the Seafield Roundabout, with a forecast reduction in AADT of 3,400. The Do-Something would also result in a reduction in traffic on the A9 between Raigmore Interchange and the A9 Inshes Southbound Junction, with forecast traffic levels reducing by approximately 11% (or 2,500 vehicles) southbound and 11% (2,700 vehicles) northbound, as traffic travelling via the A96 and the A9 under the Do-Minimum transfers to travel via the proposed scheme.

5.9.3 As the proposed scheme includes the provision of the additional structure parallel to the existing B9006 Culloden Road overbridge, providing two lanes in each direction, it is anticipated that there would be an increase in traffic at this location of approximately 25% eastbound and 7% westbound (2,400 vehicles and 1,300 vehicles respectively) compared to the Do-Minimum. The increase in traffic volumes on the overbridge is a direct result of the proposed scheme connecting to the B9006 Culloden Road via the upgraded C1058 Caulfield Road North, where traffic flows also increase significantly, with an approximate increase 4,200 northbound and 4,700 southbound (or 151% and 346%), when compared to the Do-Minimum. In addition to parallel structure over the A9, the traffic signals along the corridor were optimised in order to maximise the throughput at each junction.

5.9.4 With the introduction of the proposed scheme, connecting the C1058 Caulfield Road North and U5096 Castlehill Road with the A96 Smithton Junction (Figure 2.1), traffic levels on the U5096 Castlehill Road are also forecast to increase westbound by approximately 1,600 vehicles. This anticipated increase is a result of vehicles accessing the proposed scheme from the Inshes Wood and Cradlehall residential areas to the east, as the most direct route is to travel via the U1124 Caulfield Road and the U5096 Castlehill Road. There is however a significant decrease in traffic levels on the U5096 Castlehill Road eastbound, with forecast daily traffic levels anticipated to reduce by approximately 800 vehicles. This reduction is due to vehicles originating in the Inverness Campus travelling eastbound, transferring from the U5096 Castlehill Road onto the proposed scheme.

5.9.5 The proposed scheme would also provide benefits to the local road network as a proportion of traffic that travels through the Smithton and Westhill residential areas in the Do-Minimum transfers onto the new road. From Table 5.10 it is evident that traffic levels on the C1036 Tower Road would reduce by approximately 50% in both directions, with a reduction in daily traffic flows of approximately 3,900 northbound and 3,500 southbound. This traffic would contribute to an increase in traffic travelling on the C1032 Barn Church Road to the proposed A96 Smithton Junction, with traffic forecast to increase by approximately 2,700 vehicles northbound (28%) and 1,700 vehicles southbound (20%).

5.9.6 The introduction of the proposed scheme would also reduce the traffic volumes of the B9006 Culloden Road to the east of the proposed scheme, with daily traffic volumes reducing by approximately 20% to 30% around the C1036 Tower Road and the B9177 Milton of Leys – Bogbain – Castlehill Road. The reduction in daily traffic volumes on the B9006 Culloden Road to the east of the C1036 Tower Road and a corresponding increase in traffic volumes on the A96 to the East of Smithton indicates that a proportion of traffic travelling from the east to the Inshes area utilises the A96 and the proposed scheme in the Do-Something scenario, where previously in the Do-Minimum, this traffic would leave the trunk road further east and use the side road network to access the B9006 Culloden Road to the east of the C1036 Tower Road.

5.9.7 Traffic levels on the local road network to the south and west of Inshes remain relatively consistent between the Do-Minimum and Do-Something Scenario, with daily traffic volumes on the B9006 Culloden Road to the west of Inshes increasing by 600 vehicles eastbound (8%) and 300 vehicles westbound (4%). Similarly, daily traffic volumes on the A8082 Sir Walter Scott Drive remains the same in both scenarios northbound and increases by 400 southbound (5%).

5.9.8 The forecast changes in journey times for key movements under the proposed A9/A96 Inshes to Smithton Scheme compared to the Do-Minimum are shown in Table 5.11, Table 5.12 and Table 5.13 for the AM Peak, Inter Peak and PM Peak hours respectively. The points selected for the Journey Time routes are identified in Figure 5.4.

Table 5.11 AM Peak High Growth Journey Time Comparison

High Growth - Journey Time AM Peak		DM 2037	DS 2037	Difference
Start Point	End Point			
A9 Kessock Bridge	A96 East of Smithton	00:08:06	00:08:09	+00:00:03
A96 East of Smithton	A9 Kessock Bridge	00:13:30	00:10:54	-00:02:36
B9006 west of Inshes Junction	A96 East of Smithton	00:07:58	00:09:07	+00:01:09
A96 East of Smithton	B9006 west of Inshes Junction	00:13:33	00:12:14	-00:01:19
A9 South	A96 East of Smithton via Inshes to Smithton Scheme (DM via A96 and A9)	00:07:34	00:07:28	-00:00:05
A96 East of Smithton to	A9 South via Inshes to Smithton Scheme (DM via A96 and A9)	00:11:39	00:08:08	-00:03:31
A9 South	A96 East of Smithton	00:07:34	00:09:04	+00:01:30
A96 East of Smithton	A9 South	00:11:39	00:10:21	-00:01:18
B865 Millburn Road	A96 East of Smithton	00:04:31	00:04:23	-00:00:08
A96 East of Smithton	B865 Millburn Road	00:10:00	00:07:10	-00:02:50
B865 Millburn Road	C1032 Barn Church	00:04:15	00:04:14	-00:00:01
C1032 Barn Church	B865 Millburn Road	00:09:07	00:06:20	-00:02:48
B9006 west of Inshes Junction	C1032 Barn Church	00:07:44	00:08:02	+00:00:18
C1032 Barn Church	B9006 west of Inshes Junction	00:14:32	00:10:33	-00:03:59
B9006 west of Inshes Junction	B9006 Culloden Road west of B9177	00:04:30	00:04:33	+00:00:03
B9006 Culloden Road west of B9177	B9006 west of Inshes Junction	00:05:13	00:05:19	+00:00:06
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	B9006 Culloden Road west of B9177	00:04:18	00:04:34	+00:00:15
B9006 Culloden Road west of B9177	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	00:04:33	00:04:42	+00:00:09

Table 5.12 Inter Peak High Growth Journey Time Comparison

High Growth - Journey Time Inter Peak		DM 2037	DS 2037	Difference
Start Point	End Point			
A9 Kessock Bridge	A96 East of Smithton	00:08:11	00:09:15	+00:01:05
A96 East of Smithton	A9 Kessock Bridge	00:09:17	00:08:52	-00:00:26
B9006 west of Inshes Junction	A96 East of Smithton	00:08:35	00:08:17	-00:00:19
A96 East of Smithton	B9006 west of Inshes Junction	00:09:16	00:08:37	-00:00:39
A9 South	A96 East of Smithton via Inshes to Smithton Scheme (DM via A96 and A9)	00:08:03	00:07:43	-00:00:20
A96 East of Smithton to	A9 South via Inshes to Smithton Scheme (DM via A96 and A9)	00:06:58	00:06:34	-00:00:24
A9 South	A96 East of Smithton	00:08:03	00:09:01	+00:00:58
A96 East of Smithton	A9 South	00:06:58	00:07:54	+00:00:56
B865 Millburn Road	A96 East of Smithton	00:05:18	00:05:07	-00:00:11
A96 East of Smithton	B865 Millburn Road	00:05:43	00:05:09	-00:00:34
B865 Millburn Road	C1032 Barn Church	00:04:43	00:04:28	-00:00:15
C1032 Barn Church	B865 Millburn Road	00:04:25	00:03:53	-00:00:32
B9006 west of Inshes Junction	C1032 Barn Church	00:08:02	00:07:39	-00:00:23
C1032 Barn Church	B9006 west of Inshes Junction	00:07:58	00:08:07	+00:00:09
B9006 west of Inshes Junction	B9006 Culloden Road west of B9177	00:05:09	00:04:54	-00:00:15
B9006 Culloden Road west of B9177	B9006 west of Inshes Junction	00:05:16	00:05:24	+00:00:08
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	B9006 Culloden Road west of B9177	00:04:56	00:04:55	-00:00:01
B9006 Culloden Road west of B9177	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	00:05:07	00:05:15	+00:00:07

Table 5.13 PM Peak High Growth Journey Time Comparison

High Growth - Journey Time PM Peak		DM 2037	DS 2037	Difference
Start Point	End Point			
A9 Kessock Bridge	A96 East of Smithton	00:13:06	00:12:13	-00:00:53
A96 East of Smithton	A9 Kessock Bridge	00:13:06	00:11:35	-00:01:32
B9006 west of Inshes Junction	A96 East of Smithton	00:11:04	00:10:31	-00:00:33
A96 East of Smithton	B9006 west of Inshes Junction	00:11:34	00:09:59	-00:01:35
A9 South	A96 East of Smithton via Inshes to Smithton Scheme (DM via A96 and A9)	00:10:26	00:09:13	-00:01:13
A96 East of Smithton to	A9 South via Inshes to Smithton Scheme (DM via A96 and A9)	00:09:05	00:07:44	-00:01:21
A9 South	A96 East of Smithton	00:10:26	00:10:09	-00:00:17
A96 East of Smithton	A9 South	00:09:05	00:09:22	+00:00:17
B865 Millburn Road	A96 East of Smithton	00:07:48	00:06:57	-00:00:51
A96 East of Smithton	B865 Millburn Road	00:07:50	00:06:28	-00:01:22
B865 Millburn Road	C1032 Barn Church	00:06:58	00:06:11	-00:00:47
C1032 Barn Church	B865 Millburn Road	00:06:36	00:05:08	-00:01:28
B9006 west of Inshes Junction	C1032 Barn Church	00:10:16	00:08:47	-00:01:29
C1032 Barn Church	B9006 west of Inshes Junction	00:10:20	00:08:44	-00:01:36
B9006 west of Inshes Junction	B9006 Culloden Road west of B9177	00:05:42	00:05:34	-00:00:08
B9006 Culloden Road west of B9177	B9006 west of Inshes Junction	00:04:26	00:04:40	+00:00:14
A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	B9006 Culloden Road west of B9177	00:05:57	00:06:56	+00:00:59
B9006 Culloden Road west of B9177	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)	00:04:17	00:04:34	+00:00:18

5.9.9 From Table 5.13, it is evident that the journey time on the A96 approach to Raigmore Interchange would reduce, with journey times for the A96 East of Smithton to the B865 Millburn Road exhibiting a reduction of approximately three minutes in the AM Peak, 30 seconds in the Inter Peak and one and a half minutes in the PM Peak, compared to the Do-Minimum. Similarly, the journey times between the A96 East of Smithton and the A9 South, travelling through Raigmore Interchange, would reduce by approximately three and a half minutes in the AM Peak, 30 seconds in the Inter Peak and one and a half minutes in the PM Peak, indicating that there would also be a reduction in journey time on the A9 between Raigmore Interchange and Inshes Southbound Junction, particularly in the AM Peak, where journey times reduce by a further minute.

5.9.10 The journey time over the PS01 Existing Inshes Overbridge remains similar in both the Do-Minimum and Do-Something scenarios, with the journey time between the B9006 Culloden Road west of the B9177 Milton of Leys – Bogbain – Castlehill Road and the B9006 Culloden Road west of Inshes being within 10 seconds of the Do Minimum in the AM Peak, 15 seconds in the Inter Peak and 15 seconds in the PM Peak. This indicates that whilst traffic levels are increasing to the west of the B9006 Culloden

Road/C1058 Caulfield Road North Junction, the provision of additional capacity eastbound over the A9 and the efficient control of traffic via the signalised junctions are anticipated to maintain similar levels of travel times as those experience in the Do-Minimum.

5.10 Operational Modelling

5.10.1 The operational model has been developed to allow the assessment of the complex interaction between local and longer distance traffic within the study area. The model's extents span to the A9 Kessock Bridge in the north, the A9/B9006 Culloden Road junction to the south, the A96 Smithton Junction to the east and covers U4108 Longman Road, B865 Millburn Road and Fluke Junction to the west. The A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme (which includes the grade separation upgrades planned at A96 Smithton Junction), has been assumed to be in place in both the Do-Minimum and Do-Something Scenarios. Also included in both scenarios are the upgrades to the B9006 Culloden Road corridor planned by The Highland Council (Inshes Junction Improvements - Phase 2).

5.10.2 The detailed operational model was key in assessing the operation of the proposed scheme. Specifically, it was used to assess what impact the proposed scheme would have (in terms of operation) on key areas; primarily the A96 Smithton Junction and the B9006 Culloden Road Corridor but also considered the operation of other junctions on the A9 and A96 in detail. These included the Seafield Roundabout and Raigmore Interchange on the A96 and the A9 between Raigmore Interchange and the A9 Inshes Southbound Junction. The assessment considered how traffic volumes and journey times in these areas would change and was used to quantify the proposed schemes impact and manage the road network accordingly.

5.10.3 S-Paramics was used as an assessment tool to aid in the design development of the proposed scheme and assess the performance of key junctions on both the trunk road and local road networks and in particular to determine whether the network can maintain a suitable level of operation once the proposed scheme is in place. Both signalised and priority junctions were reviewed in detail in the design development and assessment process.

5.10.4 Signalised junctions were assessed by comparing how each junction operates in the Do-Minimum and Do-Something scenarios, with the Degree of Saturation (DoS) determined for use as a performance indicator at each key signalised junction. The key signalised junctions identified are:

- The grade separated A96 Smithton Junction;
- Seafield Roundabout;
- Raigmore Interchange;
- C1058 Caulfield Road North/B9006 Culloden Road Junction;
- Inverness Campus/B9006 Culloden Road Junction;
- B9006 Culloden Road/Tesco Access Junction; and
- Proposed Inshes Signalised Junction.

5.10.5 These key junctions have been identified as those with the greatest potential to be affected by the introduction of the proposed scheme. Specifically, the proposed scheme has the potential to change the volume of traffic using these junctions and the direction traffic approaches each junction.

5.10.6 To quantify how the junctions, operate under the Do-Minimum and Do-Something scenarios, the DoS has been calculated for each junction using information from the operational model. DoS is a metric that is typically used to quantify how traffic lanes on approach to signalised junctions operate. The calculation uses the lane saturation flow, which is how much traffic a lane can accommodate under free flow conditions, signal time information and traffic flow information. The higher the DoS, the poorer performing the link. Typically, links with a DoS value of over 85% can be considered to be operating over capacity.

5.10.7 As DoS value has been reported for each junction as a whole. This was by determined by calculating the DoS value for each signalised lane on every approach to the key junctions identified and reporting the maximum DoS value as representative of each junction's performance.

5.10.8 Whilst the DoS has been reported for all lanes on the approaches to each junction, the maximum value has been chosen as key metric as it will be the most sensitive to any changes brought about by the introduction of the proposed scheme and provides a good indicator of whether the operation of each junction is improving or deteriorating following the introduction of the proposed scheme.

5.10.9 Table 5.14 summarises the DoS on the approach to each junction in both the Do-Minimum (DM) and the Do-Something (DS) scenarios for the AM and PM Peak hours (0800-0900 and 1700-1800 respectively).

Table 5.14 DoS at Key Junctions

Junction	Approach	DM AM	DS AM	DM PM	DS PM
Grade separated Smithton Junction on the A96	A96 SB Diverge	-	57%	-	67%
	Circulating Carriageway	-	26%	-	35%
	Max	-	57%	-	67%
Seafield Roundabout	Circulating Carriageway	84%	40%	69%	59%
	A96 WB	100%	77%	68%	73%
	Max	100%	77%	69%	73%
Raigmore Interchange	A9 SB Diverge	144%	131%	196%	184%
	A96 WB	131%	76%	103%	82%
	B865 Millburn Road EB	181%	85%	217%	115%
	A9 NB Diverge	151%	122%	154%	124%
	Max	181%	131%	217%	184%
C1058 North Caulfield Road/B9006 Culloden Road	North Caulfield Road SB	50%	57%	65%	74%
	B9006 Culloden Road WB	52%	41%	35%	17%
	B9006 Culloden Road EB	37%	36%	57%	46%
	Max	52%	57%	65%	74%
Inverness Campus/B9006 Culloden Road	Inverness Campus Access	190%	110%	83%	84%
	B9006 Culloden Road WB	80%	101%	72%	92%
	B9006 Culloden Road EB	37%	68%	99%	98%
	A9 Off Slip	97%	69%	76%	75%
	Max	190%	110%	99%	98%
B9006 Culloden Road/Tesco Access Junction	B9006 Culloden Road WB	84%	83%	75%	76%
	B9006 Culloden Road EB	25%	35%	34%	30%
	Tesco Link	85%	50%	73%	64%
	Max	85%	83%	75%	76%

Junction	Approach	DM AM	DS AM	DM PM	DS PM
Inshes Signalised Junction	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive)SB	17%	22%	26%	26%
	B9006 Culloden Road WB	77%	92%	110%	107%
	B9006 Culloden Road EB	106%	119%	80%	81%
	A8082 Inverness Southern Distributor Road (Sir Walter Scott Drive) NB	118%	115%	82%	95%
	Max	118%	119%	110%	107%

5.10.10 With the proposed scheme in place, partial signalisation is required at the southern roundabout forming the dumbbell arrangement of the A96 Smithton Junction (where it is priority controlled in the Do-Minimum). The signals control the A96 westbound diverge and circulating traffic streams. As a result, there are no DoS values shown for this movement in the Do Minimum. As The proposed scheme ties into the southern dumbbell roundabout of the proposed A96 Smithton Junction and therefore results in more traffic from the A96 to the east of the A96 Smithton Junction choosing to leave the A96 at this location and travel via the proposed scheme towards the B9006 Culloden Road (which requires signals to control the conflict at A96 Smithton Junction). As a result of this transfer, traffic volumes on the A96 to the west of the A96 Smithton Junction reduce, and this is reflected in the corresponding reductions in the DoS at both the Seafield Roundabout and Raigmore Interchange in the AM Peak and Raigmore Interchange in the PM Peak.

5.10.11 The reduction in traffic at Raigmore Interchange and the corresponding decrease in the DoS is a key point to consider as part of the assessment process. Reducing traffic volumes on the A96, freeing up capacity at Raigmore Interchange and reducing traffic volumes on the A9 between Raigmore Interchange and the A9 Inshes Southbound Junction are some of the key rationales behind developing the proposed scheme and can be directly linked to the Scheme Objectives.

5.10.12 The C1058 Caulfield Road North/B9006 Culloden Road junction shows a minor increase in DoS despite the proposed scheme delivering an increase in the volume of traffic travelling through the junction. This is in part due to the inclusion of an additional lane on the C1058 Caulfield Road North providing additional capacity but is also in part due to the change in conflict at the adjacent Inverness Campus/B9006 Culloden Road junction, with a reduction in the volume of traffic approaching the Inverness Campus/B9006 Culloden Road Junction from the A9 diverge and an increase in traffic approaching from the B9006 Culloden Road east.

5.10.13 The proximity of the Inverness Campus/B9006 Culloden Road junction to the C1058 Caulfield Road North/B9006 Culloden Road junction results in some operational issues during the Do-Minimum AM Peak. The two heaviest traffic streams travelling through the Inverness Campus/B9006 Culloden Road junction are originating from the B9006 Culloden Road east and from the A9 southbound diverge. Traffic on these approaches predominantly travel through the junction to the B9006 Culloden Road west and continue westbound toward destinations in Inverness. As a result, these two traffic streams directly conflict with one another and so there is a limit to how efficiently the signalised junction can operate. To an extent, this conflict limits the amount of green time that can be provided to the B9006 Culloden Road east approach, resulting in queuing on this approach, which interacts with the C1058 Caulfield Road North/B9006 Culloden Road junction. Additionally, the connection here with the A9 southbound diverge means that a suitable proportion of the overall green time must be allocated to the A9 diverge for safety reasons. Without suitable green time allocated to the A9 southbound diverge, queues develop that extend from the junction onto the A9; a situation that presents a safety hazard. To mitigate against this, the signal timings at the junction have been configured to manage the queue lengths on this approach in order to avoid this situation from occurring. This additional pressure, together with the conflicting traffic streams as described above means that the junction is operating at capacity which results in some operational issues.

5.10.14 Introducing the proposed scheme reduces the level of conflict at the Inverness Campus/B9006 Culloden Road junction as it changes the direction from which traffic approaches the junction. With the

proposed scheme in place, the volume of traffic travelling from the A96 to the B9006 Culloden Road via the A96 and A9 route reduces as traffic chooses to travel to via the proposed scheme instead, increasing the proportion of traffic approaching the Inverness Campus/B9006 Culloden Road junction from the east. The level of conflict at the junction therefore reduces as a higher volume, and therefore a higher proportion, of traffic approaches the junction from the east, and a lower volume approaches from the A9 southbound diverge. This allows a higher proportion of the green time to be allocated to the east/west movement, improving the efficiency of the junction.

5.10.15 Overall, the assessment shows that there is a significant reduction in traffic at Raigmore Interchange and the corresponding increase in the DoS. This is a key point to consider as part of the assessment process in the context of the scheme objectives. The inclusion of the proposed scheme provides an alternative route for local trips and provides additional capacity to the trunk road network; by reducing traffic on the A96 and at Raigmore Interchange allows for road users to make more effective use of the road network as journey times are reduced and additional route options are made available. The proposed scheme also helps to rationalise conflict at the A9 Inshes Southbound Junction which in turn provides an opportunity to mitigate against queues forming on the A9 southbound leading to improved safety for motorised users where the trunk and local road networks interact.

5.10.16 In addition, the Inverness Campus/B9006 Culloden Road junction shows a large reduction in DoS in the AM Peak, following the implementation of the proposed scheme and little change in the PM Peak. The C1058 Caulfield Road North/B9006 Culloden Road junctions shows little change in both peaks, indicating the increased levels of traffic along the corridor would lead to an improvement in the operation of the corridor in the AM Peak and a no net detriment situation in terms of traffic operation in the PM Peak.

5.10.17 In terms of the operation of the two new roundabouts introduced as part of the proposed scheme, the operational assessment was undertaken through a visual inspection of the model operating to confirm there are no significant operational issues associated with either roundabout.

5.11 Summary of Performance Against Objectives

5.11.1 This section provides a summary of the performance of the proposed scheme against the relevant scheme objectives, based primarily on quantitative outputs extracted from the traffic models. The objectives for the scheme are:

1. to encourage more effective use of the road network hierarchy and thereby improve the operation of the network for longer distance and local journeys;
2. to contribute to The Highland Council's Development Plan aims for development east of the A9, and to complement the benefits arising from the Dualling of the A96;
3. to improve safety for motorised and non-motorised users where the trunk and local road network interact; and
4. to maximise opportunities for active travel and public transport connections arising from the road infrastructure improvements.

5.12 Objective 1

5.12.1 Traffic modelling undertaken as part of the DMRB Stage 3 assessment shows that the introduction of the new road between Inshes and Smithton, and associated new side roads, would provide an alternative route for local journeys that would otherwise use the trunk road network. The proposed scheme would improve the road hierarchy by providing an alternative route to travel between the Smithton and Inshes areas. The local road network through Smithton would experience a reduction in traffic flows as local trips transfer onto the new connection between the B9006 Culloden Road and the A96 Smithton Junction to access areas in south Inverness and the A9.

5.12.2 The transport modelling assessment indicates that traffic levels on the A96 passing through Raigmore Interchange would reduce in the westbound direction during the AM Peak by 4%, and in the eastbound direction in the PM Peak by 10%. The reduction in traffic volumes at this location is a result of the introduction of the proposed scheme with 21% of traffic travelling westbound from the A96

East of Smithton transferring onto the proposed scheme from the A96 in the AM Peak. In addition, 33% of northbound traffic on the C1032 Barn Church Road would also transfer from both the A96 and C1036 Tower Road to the proposed scheme.

5.12.3 Similarly, in the PM Peak, 14% of trips travelling eastbound on the A96 to the east of Smithton transfer onto the proposed scheme from the A96 and 31% travelling southbound on the C1032 Barn Church Road transfer onto the proposed scheme from both the A96 and C1036 Tower Road. This would therefore result in a reduced level of local traffic using the A96 approach to Raigmore Interchange, contributing to the objective of encouraging more effective use of the road hierarchy in this area.

5.12.4 The proposed scheme is also anticipated to improve journey times between the A96 and the B865 Millburn Road by approximately 27% (2min 45 secs) in the AM Peak and 16% (1 min 16 secs) in the PM Peak. Similarly, journey times are anticipated to reduce in the opposite direction by approximately 13% (59 secs) in the PM Peak.

5.12.5 The proposed scheme also improves the operation of the B9006 Culloden Road corridor through the provision of an additional structure to provide two lanes in each direction over the A9. In addition, the signalised junctions along the corridor are optimised as part of the proposed scheme to increase the throughput at each of these junctions and improve the efficiency of the corridor. The combination of these upgrades provides the additional capacity required to accommodate the increased traffic volumes travelling along the corridor to access the new connection between the C1058 Caulfield Road North and Smithton Junction. The MFTM assessment indicates these enhancements would reduce journey times by approximately two and a half minutes in the AM Peak and one minute in the PM Peak. The additional capacity on the overbridge increases the attractiveness of the local road network for local traffic, reducing the reliance on the strategic road network for local traffic and therefore contributing to this objective.

5.13 Objective 2

5.13.1 The proposed scheme would facilitate the Scottish Government's drive for sustainable economic growth by assisting the realisation of The Highland Council's plan for urban expansion of Inverness to the east of the A9 as set out in the Inner Moray Firth Local Development Plan (2015) and Inverness East Development Brief (2018), as part of the wider Inverness to Nairn Growth Area. The proposed scheme would enable access to the proposed development land to the east of the A9 and connects this area to local amenities within Inverness and further afield.

5.13.2 The proposed scheme has been designed to tie in to the proposed A96 Smithton Junction which forms part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme and provides a safe and efficient local connection for journeys between the existing and planned residential and commercial areas of East Inverness and the wider A96 growth corridor.

5.13.3 The proposed scheme also complements the benefits that arise from the dualling of the A96 as it would have a positive impact on A96 journey times through the traffic reductions gained between the A96 Smithton Junction and Raigmore Interchange, and therefore contributes to the wider journey time benefits accrued as a result of the dualling of the A96. The new connection between Inshes and Smithton would improve the operation of Raigmore Interchange and reduce the congestion on the eastern approach to the junction, reducing the journey time by approximately two and a half minutes in the AM Peak and one and a half minutes in the PM Peak. The proposed scheme therefore complements the benefits arising from the dualling as it is anticipated to further improves the journey time into Inverness from the east.

5.14 Objective 3

5.14.1 The proposed scheme would reduce the traffic levels on the diverge at the A9 Inshes Southbound Junction and improve the operation of the local road network along the B9006 Culloden Road corridor. Together these improvements would reduce the risk of queuing extending along the diverge slip road and on to the A9 itself. The safety concerns related to this queuing would be further alleviated through the provision of the lane gain/lane drop on the A9 southbound carriageway between Raigmore Interchange and Inshes.

5.14.2 The traffic attracted to the proposed scheme would also result in a reduction in traffic levels on the local road network within the Smithton and Culloden residential areas. This would be expected to reduce potential NMU conflicts with traffic and thus improve the safety environment for NMUs. In addition, the provision of new NMU facilities along the proposed new roads would improve the safety environment for NMUs and open up routes that allow local NMU trips to avoid travelling along the A96 and through Raigmore Interchange.

5.14.3 These benefits may be partially offset as the new connection provided by the proposed scheme between Inshes and Smithton would lead to a slight overall increase in vehicle kilometres travelled. This may therefore slightly increase the opportunities for accidents to occur in future years.

5.15 Objective 4

5.15.1 The proposed scheme has been designed to incorporate 7.3 km of new NMU infrastructure including:

- a 3m wide shared use facility adjacent to both sides of the main carriageway over its full length;
- a 3.5m dedicated cycleway along one side of the new link to Inverness Retail and Business Park together with a 2m footway on both sides;
- an NMU facility adjacent to the Highland Main Line Railway to tie into the existing facilities between Inverness Campus and Inverness Retail and Business Park; and
- continuity of National Cycle Network Route 1 has been maintained.

5.15.2 These facilities would improve accessibility for NMUs and make active travel options more attractive for commuters and recreational users. The forecast reduction in traffic on local roads within the Smithton and Culloden residential areas would be expected to reduce potential NMU conflicts with traffic and help encourage active travel.

5.15.3 The facilities have been designed to complement The Highland Council's proposals for an Inverness East Active Travel Corridor and will create NMU routes that allow users to avoid travelling along the A96 and through Raigmore Interchange, particularly for trips between the Smithton/Cradlehall area and the centre of Inverness.

5.15.4 The proposed scheme would provide new opportunities for public transport connectivity to the proposed development to the east of the A9 and an alternative route for access to Inverness Campus, the Inverness Retail and Business Park, the Inshes area and south Inverness.

5.16 References

TAG unit M4 Section 4 –

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6 Economic Assessment

6.1 Introduction

6.1.1 This chapter presents details of the economic assessment for the proposed scheme. It is based on the comparison of the Do-Minimum (without the proposed scheme) scenario and the Do-Something (with the proposed scheme) scenario, including changes in traffic flows, average journey times, vehicle speeds and travel distance. A road-based assessment has been undertaken that comprises Cars, Light Goods Vehicles (LGVs), Medium Goods Vehicles (MGVs) and Heavy Goods Vehicles (HGVs) vehicle types.

6.1.2 The economic evaluation of the proposed scheme has been undertaken using the Department for Transport's (DfT) Transport User Benefit Appraisal (TUBA) software version 1.9.9. The TUBA software has been used to calculate the user benefits for the proposed scheme based on travel time savings and changes in vehicle operating costs. The necessary inputs to the TUBA software were generated from the Moray Firth Transport Model (MFTM) for the Do-Minimum scenario and the Do-Something scenario.

6.1.3 The impact that the proposed scheme would have on accidents in the study area has been assessed using the DfT's Cost and Benefit to Accidents – Light Touch (COBALT) software version 2013.02, in conjunction with the May 2018.1 TAG parameters file.

6.1.4 In accordance with Her Majesty's Treasury 'Green Book' guidance and TAG guidance, the benefits stream is calculated over a 60-year appraisal period. The summed monetised units of the final Transport Economic Efficiency (TEE) benefits calculated are expressed in 2010 prices and values, and for each appraisal year are discounted to 2010 at 3.5 per cent per annum for the first 30 years, and at 3.0 per cent per annum thereafter.

6.2 Proposed Scheme Costs

6.2.1 The target construction cost estimate for the proposed scheme is £34,196,000 (excluding VAT) and is based on 2015 Q2 prices. It should be noted that the single value target costs have only been used for the purposes of the economic appraisal, however in line with standard practice for this stage of assessment, cost ranges are set out in Chapter 3. For economics assessment purposes, Non-Recoverable VAT, the real element of construction price inflation and operational and maintenance costs have been added to the construction cost estimate. Prior to the addition of these items, sunk costs were removed.

6.2.2 The real element of construction price inflation is the difference between the assumed construction price inflation and average inflation in the UK economy as measured by the Consumer Price Index (CPI) based Gross Domestic Product (GDP) deflator. Sunk costs are those costs that have already been incurred and are non-recoverable. All costs incurred prior to 31 December 2018 have been assumed to be non-recoverable. For the purposes of the economic appraisal and the required TUBA input data it has been assumed the construction period, and hence sped profile, would commence in 2020 and end in 2021.

6.3 Accident Benefits

6.3.1 As noted in Section 6.1, the accident assessment has been undertaken using the COBALT software, with the potential accidents benefits of the Do-Something evaluated against the Do-Minimum scenario.

6.3.2 The COBALT software calculates the number of accidents that would occur in the Do-Minimum and Do-Something using either a set of default accident rates for different road classes applied to both scenarios or using a set of locally derived accident rates to apply to the Do-Minimum scenario and the existing roads within the Do-Something scenario. The default accident rates are national rates derived for the different road classes using UK wide accident data records and are not specific to the area. This could result in an over or under estimation in the number of casualties saved and therefore the accident benefits.

6.3.3 As a result, the accident benefits for the proposed scheme have been evaluated using both default rates and a set of locally derived rates applied to the existing A9 and A96 routes as well as the local road network. It should be noted that the Do-Minimum includes the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, which would provide a dual carriageway route from the Seafield Roundabout to the east of Nairn. As this scheme has not yet been constructed, the links that comprise the upgraded section of the A96 have been assessed using default accident rates in the local accident assessment as well as the default accident assessment. In addition, as the traffic levels and traffic composition is anticipated to change significantly on the existing A96, to the east of the A96 Smithton Junction, as a result of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, a default accident rate has also been applied to the links associated with the sections of the existing A96 route, to the east of the A96 Smithton Junction, that remain following the construction of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme.

6.3.4 The software calculates the number of Fatal, Serious and Slight casualties that would occur on each link using the defined accident rates, in conjunction with the traffic flows contained in the Do-Minimum and Do-Something Scenarios. The difference between the scenarios is calculated and presented as the accident benefit. The software also outputs the difference in the number of casualties compared to the Do-Minimum over the 60-year appraisal period. This has been divided by 60 to calculate an annual difference across all links included in the COBALT assessment.

6.3.5 Table 6.1, 6.2 and 6.3 show the number of casualties predicted to occur in the Do-Minimum and the Do-Something, and difference in the number of casualties compared to the Do-Minimum, under the Core, Low and High traffic growth scenarios, respectively. The Core Growth scenario was developed working in close collaboration with The Highland Council and represents the most likely level of future development. The Low and High Growth scenarios were there derived from the Core Growth Scenario. This assessment was based on applying the locally derived accident rates to the A9, the existing section of the A96 between the Seafield Roundabout and Raigmore Interchange and the local road network.

Table 6.1 Average number of casualties saved per year – Core Growth – Local Accident Assessment

Core Growth	Fatal	Serious	Slight
DM Casualties (60 Years)	46.1	469.7	3,853.9
DS Casualties (60 Years)	46.5	481.0	3,976.0
Casualties Saved (60Years)	-0.4	-11.3	-122.1
Average Casualties Saved	0.0	-0.2	-2.0

Table 6.2 Average number of casualties saved per year – Low Growth – Local Accident Assessment

Low Growth	Fatal	Serious	Slight
DM Casualties (60 Years)	43.3	439.1	3,602.2
DS Casualties (60 Years)	43.9	451.7	3,730.1
Casualties Saved (60Years)	-0.5	-12.6	-127.9
Average Casualties Saved	0.0	-0.2	-2.1

Table 6.3 Average number of casualties saved per year – High Growth – Local Accident Assessment

High Growth	Fatal	Serious	Slight
DM Casualties (60 Years)	48.8	500.0	4,104.8
DS Casualties (60 Years)	49.4	513.1	4,244.3
Casualties Saved (60Years)	-0.6	-13.1	-139.5
Average Casualties Saved	0.0	-0.2	-2.3

6.3.6 The monetised cost of accidents and the resulting benefits based on the number of accident casualties saved from the accident appraisal for the Core, Low and High traffic growth scenarios are shown in Table 6.4.

Table 6.4 Accident Benefits (60 Years) – Local Accident Assessment

Local Accident Assessment	Core Growth	Low Growth	High Growth
Total DM Accident Cost	£151,534	£142,019	£161,047
Total DS Cost	£155,422	£146,171	£165,557
Accident Benefit	-£3,889	-£4,152	-£4,511

6.3.7 The results show slight dis-benefits under all growth scenarios from the local accident assessment that has been undertaken. This is driven by the additional length of road that the proposed scheme adds to the road network and an increase in the level of traffic within the area, as the proposed scheme relieves one of the main sources of congestion in the area and increases the capacity of the road network. As a result, the total vehicle-kilometres increase under the Do-Something Scenario, leading to a slight accident dis-benefit. In addition, under the local accident assessment, traffic is transferring from areas of the network subject to a lower than default accident rate, such as the A96 on approach to Raigmore Interchange and the C1036 Tower Road, onto the proposed scheme, which is subject to the default accident rate. This leads to more accidents being recorded overall, as the accident reduction calculated using the local accident rate is not as high as the accidents recorded on the proposed scheme, which is subject to the higher, default accident rate. This is due to the mechanistic nature of COBALT and is expected to be a worst-case assessment. The proposed scheme is designed to current standards and is therefore not anticipated to make the accident situation worse.

6.3.8 As noted previously, an accident assessment using default accident rates applied to the existing A9 and A96 has also been undertaken. As the default accident rate is higher than the locally derived accident rates, this assessment produces a higher level of accident benefits. The difference in the number of casualties compared to the Do-Minimum for the assessment using default accident rates under the Core, Low and High traffic growth are shown below in Table 6.5, Table 6.6 and Table 6.7.

Table 6.5 Average number of casualties saved per year – Core Growth – Default Accident Assessment

Core Growth	Fatal	Serious	Slight
DM Casualties (60 Years)	95.8	1,082.4	8,853.6
DS Casualties (60 Years)	95.9	1,084.6	8,896.6
Casualties Saved (60Years)	-0.1	-2.3	-43.0
Average Casualties Saved	0.0	0.0	-0.7

Table 6.6 Average number of casualties saved per year – Low Growth – Default Accident Assessment

Low Growth	Fatal	Serious	Slight
DM Casualties (60 Years)	89.4	1,004.9	8,217.2
DS Casualties (60 Years)	89.9	1,012.9	8,301.8
Casualties Saved (60Years)	-0.5	-8.0	-84.6
Average Casualties Saved	0.0	-0.1	-1.4

Table 6.7 Average number of casualties saved per year – High Growth – Default Accident Assessment

High Growth	Fatal	Serious	Slight
DM Casualties (60 Years)	102.1	1,157.1	9,485.7
DS Casualties (60 Years)	102.4	1,161.9	9,534.7
Casualties Saved (60Years)	-0.3	-2.9	-49.1
Average Casualties Saved	0.0	0.0	-0.8

6.3.9 The monetised cost of accidents and the resultant benefits derived from the number of accident casualties saved using the default accident rates for the Core, Low and High traffic growth scenarios are shown in Table 6.8.

Table 6.8 Accident Benefits (60 Years) – Default Accident Assessment

Default Accident Assessment	Core Growth	Low Growth	High Growth
Total DM Accident Cost	£345,953	£321,978	£369,932
Total DS Cost	£346,957	£324,575	£370,896
Accident Benefit	-£1,004	-£2,596	-£964

6.3.10 The results also show slight dis-benefits under all growth scenarios from the default accident assessment that has been undertaken, however not to the same extent as the local accident rate assessment.

6.3.11 The accident dis-benefit is driven by the additional length of road and an increase in the level of traffic within the area, as the proposed scheme relieves one of the main sources of congestion in the area and increases the capacity of the road network. As a result, the total vehicle-kilometres would increase under the Do-Something scenario, leading to an accident dis-benefit.

6.4 TUBA Assessment

6.4.1 The required inputs to the Transport Users Benefit Appraisal (TUBA) software comprise traffic demand, time and distance (and if relevant toll) 'skim' matrices for the Do-Minimum and Do-Something scenarios, extracted from the MFTM. The scheme benefits are calculated by comparing, for each pair of transport model zones, the total costs of travel (including travel time, vehicle operating costs and tolls) for the Do-Minimum and the Do-Something scenarios.

6.4.2 The calculated TUBA benefits from the Core, Low and High traffic growth scenarios are summarised in Table 6.9.

Table 6.9 TUBA Benefits

TUBA Benefits	Monetary Value in 2010 Market Prices (£000)		
	Core Growth	Low Growth	High Growth
Travel Time	£86,108	£67,217	£105,830
Vehicles Operating Cost	£16,042	£12,237	£19,157
Indirect Tax	-£6,922	-£5,554	-£8,044
Greenhouse Gases	£3,263	£2,642	£3,846
Present Value Benefits	£99,780	£77,528	£122,357

6.4.3 Table 6.9 show that the Do-Something would produce positive travel benefits under all three growth scenarios, with the High Growth providing the most benefits and the Low Growth the lowest level of benefits. This indicates that the proposed scheme provides some relief to the areas of congestion in the model, particularly the A96 to the east of Raigmore Interchange. Additionally, removing traffic from areas of the local road network also provides some journey time benefits as traffic transfers onto a more direct route, freeing up capacity in other areas of the local road network.

6.5 Monetisation of Construction Delay

6.5.1 The evaluation of the cost of delay to road users from the construction phasing of the scheme has been undertaken as part of the economic assessment process. The impacts from the indicative traffic management arrangements for the construction phases have been assessed using the operational models and applying the opening year (2022) demand. Outputs from the operational modelling have been input into the TUBA software package and compared against the Do-Minimum scenario to determine the monetised cost associated with the changes in trip distance and travel time. This monetised value was used to quantify the cost per phase of construction. The output provided is the cost to road users per day that was then expanded to cover the duration of time that the construction phase is expected to take.

6.5.2 Five construction phases are planned as part of the scheme. Table 6.10 outlines each phase as well as the estimated duration.

Table 6.10 Construction Phases and Estimated Duration

Construction Phase	Estimated Duration (Months)
Preliminaries and Advanced Works	3
Phase 1	6
Phase 2	5
Phase 3	4
Phase 4	3
Phase 5	3
Total Estimated Duration	24

6.5.3 Works related to Construction Phases 1, 3 and 4 were anticipated to impact on the operation of the network, as these phases include an element of online work. The assessment has been designed to quantify the level of impact the construction phases will have on the operation of the road network. Construction Phases 2 and 5 are entirely offline and have therefore been assumed to have no impact on traffic operation. As a result, delays associated with construction Phases 1, 3 and 5 have been assessed within the operational model and monetised using TUBA.

6.5.4 During construction Phase 1, works related to the construction of the PS03 Proposed Cradlehall Railway would be completed offline and would not impact traffic operations. The only contributor to vehicle delays in construction Phase 1 is the widening of the Inshes overbridge. To allow for the widening works to commence, one westbound lane would be closed on the existing overbridge, leaving one lane operational in each direction. Traffic management would be implemented within the vicinity of these works, reducing the speed limit within the vicinity of the works to 20mph on the B9006 Culloden Road and the diverge at the A9 Inshes Southbound Junction and 40mph on the A9.

6.5.5 The construction works during construction Phase 3 relate to works south of the Highland Main Line Railway and in relation to the A9 lane gain/lane drop. As the works associated with the Highland Main Line Railway are to be undertaken offline, they would not have an impact on the operation of traffic and hence have not been assessed in the operational model. The A9 lane gain/lane drop would see the provision of an additional lane in the southbound direction on the A9 between Raigmore Interchange and the southbound diverge at the A9 Inshes Southbound Junction. For the works on the A9 to commence, one lane would be closed on the A9 southbound merge from Raigmore Interchange and on the A9 between Raigmore Interchange and the A9 Inshes Southbound Junction. The traffic management during construction would also reduce the speed limit to 40mph on the A9 in the vicinity of works, which would have an impact on the operation of the transport network.

6.5.6 Construction Phase 4 includes the construction of the tie-in of the new the new connection between the C1058 Caulfield Road North and A96 Smithton Junction with the B9006 Culloden Road and Cradlehall Roundabout. The tie-in to the U5096 Castlehill Road will connect the U5096 Castlehill Road and remaining U1058 Caulfield Road North to the new network at the Cradlehall Roundabout. Construction works associated with construction Phase 4 were assessed and found to have a negligible impact on the operation of the network, and hence traffic delays.

6.5.7 As the construction of the PS02 Proposed Inshes Overbridge in construction Phase 1 and the A9 lane gain/lane drop in construction Phase 3 were found to be the only works likely to have an impact on the operation of the network and therefore result in delays to vehicles, construction delay costs associated with both phases were calculated based upon the modelled level of delay and the estimated duration of works.

6.5.8 Table 6.11 shows the weekday, weekend, weekly and total delay costs to road users associated with each phase as a result of the construction works.

Table 6.11 Construction Road User Delay Costs

	Weekdays	Weekends	Weekly Total	Duration (weeks)	Phase Costs
Phase 1	£44,679	£11,914	£56,593	12	£679,116
Phase 3	£46,322	£12,353	£58,675	12	£704,100
				Total Cost	£1,383,216

6.6 Key Economic Assessment Results

6.6.1 The results of the economic assessment are summarised in Table 6.12 and Table 6.13 for the Core, Low and High traffic growth scenarios for the local and default accident assessments, respectively.

Table 6.12 Economic Assessment Results – Local Accident Rates (2010 Market Prices discounted to 2010)

Impact	Monetary Value in 2010 Market Prices (£000)		
	Core Growth	Low Growth	High Growth
Present Value of Benefits (TUBA)	£99,780	£77,528	£122,357
Local Accident Benefits (COBALT)	-£3,889	-£4,152	-£4,511
Construction Impacts	-£1,383	-£1,383	-£1,383
Total Present Value of Benefits	£94,508	£71,993	£116,463
Present Value of Costs	£35,008	£35,008	£35,008
Net Present Value	£59,500	£36,985	£81,455
Benefit to Cost Ratio	2.7	2.1	3.3

Table 6.13 Economic Assessment Results – Default Accident Rates (2010 Market Prices discounted to 2010)

Impact	Monetary Value in 2010 Market Prices (£000)		
	Core Growth	Low Growth	High Growth
Present Value of Benefits (TUBA)	£99,780	£77,528	£122,357
Default Accident Benefits (COBALT)	-£1,004	-£2,596	-£964
Construction Impacts	-£1,383	-£1,383	-£1,383
Total Present Value of Benefits	£97,393	£73,549	£120,010
Present Value of Costs	£35,008	£35,008	£35,008
Net Present Value	£62,385	£38,541	£85,002
Benefit to Cost Ratio	2.8	2.1	3.4

6.6.2 The preceding tables show that the proposed scheme would generate a positive Net Present Value, even under the low traffic growth scenario. The overall Benefit to Cost Ratio (BCR) would be greater than one for all growth scenarios, with the Core Growth having a BCR of 2.7, Low Growth 2.1 and High Growth 3.3 under the local accident assessment. A similar level of BCR is achieved under the default accident assessment, with the Core Growth assessment having a BCR of 2.8, Low Growth 2.1 and High Growth 3.4.

6.6.3 Based on the results in Table 6.12 and Table 6.13 it is evident the proposed scheme is anticipated to provide value for money, with the level of benefits accrued being higher than the estimated costs.

7 Conclusion

7.1 Engineering Considerations

7.1.1 The proposed scheme has been developed as part of the £315 million Inverness and Highland City-Region Deal. Central to the Deal is improving access to and within communities. The Deal aims to improve connectivity through investment in transport including the development of the prosed scheme.

7.1.2 The proposed scheme has been designed in accordance with the DMRB and comprises approximately 3.2km of new single carriageway. The proposed scheme also includes carriageway widening on the A9 southbound, two roundabouts, two principal structures, approximately 5.3km of NMU facilities, 12 culverts and utility works.

7.1.3 As part of the design development, Departures from Standard have been approved for the proposed A9 southbound lane gain/lane drop. Local road realignments and new accesses have been designed in accordance with relevant standards through consultation with The Highland Council.

7.1.4 Facilities for NMUs are an integral feature of the proposed scheme, incorporating a new shared-use path adjacent to either side of the proposed carriageway, to facilitate safe pedestrian and cycle travel between B9006 Culloden Road and the proposed A96 Smithton Junction. In addition, the proposed scheme incudes:

- shared use path maintaining access to the Inverness Campus and Cradlehall;
- shared use path passing under the scheme, adjacent to the Highland Main Line Railway between the Eastfield Way Roundabout and the existing path network; and
- dedicated footway and cycleway provision between Eastfield Way Roundabout and the Inverness Retail and Business Park.

7.1.5 Proposed SuDS have been designed in accordance with relevant design standards and in line with best practice. SuDS have been developed through consultation with SEPA and The Highland Council. The SuDS design provides a minimum of two levels of treatment, on the proposed local roads and A9 lane gain/lane drop, and meets the required water quality and water quantity requirements for carriageway runoff through the provision of filter drains, wetlands and swales.

7.1.6 Consultation with public utility companies has taken place in accordance with the New Roads and Street Works Act 1991 (NRSWA) to identify locations of existing apparatus and identify conflicts with the proposed scheme. Preliminary proposals for required diversions and budget costs have been obtained.

7.1.7 As part of the proposed scheme two overbridges are required, one over the A9 and one over the Highland Main Line Railway. In addition, eight new culverts, one culvert replacement and one culvert extension are required to carry the proposed scheme over existing watercourses. Two flood relief culverts are also proposed.

7.1.8 Road lighting is proposed on the A9, each of the two proposed roundabouts, Link 1: Culloden Road to Cradlehall Roundabout and Link 6: Castlehill Road Tie-in.

7.1.9 The predominantly offline alignment of the proposed scheme will minimise disruption to the existing road network during construction.

7.2 Scheme Objectives

7.2.1 The DMRB Stage 3 design, as detailed in this report, has been developed to meet the scheme objectives set out in Section 1.3. Detailed below are the scheme objectives and how the proposed scheme meets these objectives.

To encourage more effective use of the road network hierarchy and thereby improve the operation of the network for longer distance and local journeys

7.2.2 The proposed scheme meets this objective through the provision of an alternative route for local journeys that would otherwise use the trunk road network for travel between the Smithton and Inshes areas, reducing the need for local traffic to utilise the Raigmore Interchange. The proposed scheme also improves the operation of the B9006 Culloden Road corridor through the provision of an additional structure to provide two lanes in each direction over the A9. In addition, the signalised junctions along the corridor are optimised as part of the proposed scheme to increase the throughput at each of these junctions and improve the efficiency of the corridor. The combination of these upgrades provides the additional capacity required to accommodate the increased traffic volumes travelling along the corridor to access the new connection between the U1058 Caulfield Road North and A96 Smithton Junction.

7.2.3 The proposed A9 southbound lane gain/lane drop improves the operation of the A9 south of the Raigmore Interchange and allows vehicles to leave the carriageway more safely at the A9 Inshes Southbound Junction.

To contribute to The Highland Council's Development Plan aims for development east of the A9, and to complement the benefits arising from the dualling of the A96

7.2.4 The proposed scheme achieves this objective through the enhancement of the local road network, improving links between Inshes and Smithton, while tying-in to the Inshes Junction Improvements - Phase 2 and A96 Dualling Inverness to Nairn (Including Nairn Bypass) schemes. This, in conjunction with the proposed NMU provisions will contribute to The Highland Council's Development Plan.

7.2.5 The proposed scheme would facilitate the Scottish Government's drive for sustainable economic growth by assisting the realisation of The Highland Council's plan for urban expansion of Inverness to the east of the A9 as set out in the Inner Moray Firth Local Development Plan (2015) and Inverness East Development Brief (2018), as part of the wider Inverness to Nairn Growth Area by enabling access to the proposed development land to the east of the A9.

7.2.6 The proposed scheme has been designed to tie-in to the proposed A96 Smithton Junction on the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme and provides a safe and efficient local connection for journeys between the existing and planned residential and commercial areas of East Inverness and the wider A96 growth corridor.

7.2.7 The proposed scheme would also complement the benefits that arise from the dualling of the A96 as it would have a positive impact on A96 journey times through the traffic reductions gained between the A96 Smithton Junction and Raigmore Interchange, and therefore contributes to the wider journey time benefits accrued as a result of the dualling of the A96. The new connection between Inshes and Smithton improves the operation of Raigmore Interchange and reduces the congestion on the eastern approach to the junction, therefore complementing the benefits arising from the dualling as it is anticipated to further improve the journey time into Inverness from the east.

To improve safety for motorised and non-motorised users where the trunk and local road network interact

7.2.8 The proposed scheme would reduce the traffic levels on the A9 southbound diverge at the A9 Inshes Southbound Junction and improve the operation of the local road network along the B9006 Culloden Road corridor. Together these improvements reduce the risk of queuing extending along the diverge slip road and on to the A9. The safety concerns related to this queuing are further alleviated through the proposed A9 southbound lane gain/lane drop between Raigmore Interchange and A9 Inshes southbound Junction.

7.2.9 The traffic attracted to the proposed scheme would also result in a reduction in traffic levels on the local road network within the Smithton and Culloden residential areas. This would be expected to reduce potential NMU conflicts with traffic and thus improve the safety environment for NMUs. In addition, the provision of new NMU facilities along the proposed new roads would improve the safety

environment for NMUs and open up routes that allow local NMU trips to avoid travelling along the A96 and through Raigmore Interchange.

To maximise opportunities for active travel and public transport connections arising from the road infrastructure improvements

7.2.10 Facilities for NMUs are an integral feature of the proposed scheme, consisting of approximately 5.3km of new shared path, 1.3km of new footway and 0.7km of new cycleway, to facilitate safe pedestrian ad cycle travel.

7.2.11 The proposed NMU facilities would improve accessibility for NMUs and make active travel options more attractive for commuters and recreational users. The forecast reduction in traffic on local roads within the Smithton and Culloden residential areas is expected to reduce potential NMU conflicts with traffic and help encourage active travel.

7.2.12 The facilities have been designed to complement The Highland Council's proposals for an Inverness East Active Travel Corridor and will open up NMU routes that allow users to avoid travelling along the A96 and through Raigmore Interchange, particularly for trips between the Smithton/Cradlehall area and the centre of Inverness.

7.2.13 The proposed scheme would provide new opportunities for public transport connectivity to the proposed development to the east of the A9 and an alternative route for access to Inverness Campus, the Inshes area and south Inverness.

7.3 Value for Money

7.3.1 The cost estimate for the proposed scheme is in Pounds Sterling (£) and rates are based on 2015 Quarter 2 prices. This is the cost estimate prepared on the basis of the DMRB Stage 3 design and the cost estimate remains within the range of £25m to £35m previously identified during DMRB Stage 2. The assessed cost estimate for assessment purposes is calculated as £34.2m, excluding VAT.

7.3.2 At a cost of £34.2m the proposed scheme has a Benefit to Cost Ratio (BCR) between 2.1 and 3.3. The proposed scheme represents value for money for the tax payer and provides a vital upgrade to the road network in line with the Inverness and Highland City-Region Deal.

7.4 References

Jacobs, Faber Maunsell, Grant Thornton and Tribal Consulting (*on behalf of Transport Scotland*) (2009). Strategic Transport Projects Review: Final Report. Transport Scotland.

Scottish Government (2011). Infrastructure Investment Plan. Scottish Government.

Legislation

New Roads and Street Works Act 1991 (New Roads and Street Works Act (NRSWA). The Stationery Office.