A9/A96 Inshes to Smithton

DMRB Stage 2 Scheme Assessment Report

Volume 1 – Main Report and Appendices

Part 2 – Engineering Assessment

October 2017

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

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4. Engineering Overview

4.1 Introduction

4.1.1 This chapter presents an overview of the relevant engineering design considerations in relation to this scheme.

4.1.2 The engineering assessment presents key engineering issues and the findings of the assessment. A concluding statement is provided in Chapter 6 Engineering Summary for each engineering issue.

4.2 Design Considerations

4.2.1 The following physical features have been considered during the design process and are shown on the relevant engineering drawings in Volume 2 and the environmental figures in Volume 3 of this report:

- **Properties and local communities:** where possible, options have been developed seeking to minimise the need for property demolition and potential direct impacts on properties and communities.

- **Existing topography and land use:** the vertical geometry of each option has been designed to minimise earthworks embankments and attempt to achieve overall earthworks balance while still achieving the required headroom clearances to road, rail and watercourse crossings, ensuring adequate road drainage and where possible screening for adjacent properties.

- **Inverness to Perth Highland Main Line Railway (Highland Main Line Railway):** an initial consultation with Network Rail has been undertaken and the design of the railway crossing takes into account the required headroom clearance and span requirements to accommodate future electrification of the Highland Main Line.

- **Ground conditions:** a desk-based assessment and site walk-over observations were undertaken. The principal natural soil type is glacial till of various types, essentially granular deposits, which mantle the bedrock over the entire route area. There is localised alluvium associated with watercourses.

  There is a glacial outwash channel 3-4m deep in the vicinity of the A9, and there is a Registered Landfill Site in the study area. Section 5.8 describes in detail the existing ground conditions.

- **Hydrology:** there are a number of watercourses located within the study area and within a 1km radius around the proposed options. The watercourses that dominate within the study area are the Inshes Burn, Scretan Burn and Cairnlaw Burn. The options cross these watercourses at various locations. Where it has been identified that the existing watercourse would be affected by the alignment and associated junctions, each location would require detailed investigation that would be carried out at DMRB Stage 3 for the preferred option, with a view to assessing any potential impact on floodplain storage.

- **Public utilities:** there are apparatus belonging to British Telecom (BT), Scottish Water, Vodafone, Scottish and Southern Energy (SSE) and Scotia Gas Networks (SGN) present in the vicinity of the options. Reference should be made to section 4.3.22 of this chapter and section 5.11 of Chapter 5 which describes the identified public utilities in detail.

- **Environmental constraints:** there is a scheduled monument and a Category B listed building within the vicinity of the scheme. Following feedback from the public exhibition held in August 2016, it was highlighted that a number of mature trees were at risk of being impacted by the alignment at Caulfield Road North. This was taken into consideration and an alternative alignment at Cradlehall

Roundabout was designed in order to minimise the impact on the mature trees along Caulfield Road North.

- **Local road network:** the options have been developed taking account of the existing local road network and junctions.

4.3 Design Approach

4.3.1 Preliminary designs for each of the options have been developed for the DMRB Stage 2 assessment. The preferred option will be developed further at the next stage of the assessment process (i.e. DMRB Stage 3 assessment). For the current Stage 2 assessment the following design principles have been applied.

Alignment and Road Layout

4.3.2 The DMRB sets out the principles to be used for coordinating various elements of road design, to ensure the layout as a whole is acceptable in terms of the safety, operation, economics and environmental effects. The type of road, location and layout features required for this scheme involves supplementing the DMRB standards with the requirements as set out in The Highland Council (THC) Roads and Transport Guidelines for New Developments. The application of the DMRB in addition to THC road development guidelines aims to ensure the road meets the requirements for a trunk road and is of a consistent standard to the local road network thereby providing transport facilities that are convenient for all types of road user as well as creating a high quality environment.

4.3.3 The DMRB TD 9/93 Table 4 outlines recommended rural road layouts including access and junction treatments for each road category. For new roads, THC has adopted its own road type classification as defined in the Roads and Transport Guidelines for New Developments. Below Table 4.1 describes THC New Road Type Classification:

Table 4.1: Local Road Layout

Road Type	Typical Capacity and/or Traffic Function	Development Served	Frontage Access +
Local distributor (urban areas)	Urban routes linking Main Distributors and carrying up to 5,000 vehicles per day and will be utilised as a bus route.	Up to 1000 dwellings or an industrial estate or mixed development	May be permitted when speed limit is 30mph and there is provision for vehicle turning within curtilage of properties.
+ Frontage access where permitted is subject to considerations of safety as set out elsewhere in THC guidelines.			

4.3.4 The options have been designed in accordance with the DMRB and THC Roads and Transport Guidelines for New Developments where applicable, in particular the following DMRB technical guidance and design standards are applicable:

- Volume 6, Section 1, Part 1, TD 9/93 Highway Link Design;
- Volume 6, Section 1, Part 2, TD 27/05 Cross-Sections and Headrooms;
- Volume 6, Section 2, Part 1, TD 22/06 Layout of Grade Separated Junctions;
- Volume 6, Section 2, Part 3, TD 16/07 Geometric Design of Roundabouts;
- Volume 6, Section 2, Part 6, TD 42/95 Geometric Design of Major/Minor Priority Junctions.

4.3.5 The main alignment of all options has been designed to a 70Akph design speed in accordance with TD 9/93 Table 2 and agreed with THC as part of the design consultation.

4.3.6 The following cross-section has been adopted for the design in accordance with THC Roads and Transport Guidelines for New Developments:

- 7.3m carriageways;
- 3.0m Non-motorised user (NMU) footway including 0.6m segregation strip;
- 0.5m verges, with widening for visibility and roadside features where required.

4.3.7 The headroom clearance at new structures over existing roads will be a minimum of 5.30m plus sag curve compensation. This provides the minimum headroom clearance at new structures in accordance with the guidance in TD 27/05. For specific options including Options 2A/B which require the existing Inshes Overbridge is to be demolished, there is scope to provide the standard maximum clearance provided for a High Load Route in accordance with TD 27/05 if required. Reference should be made to Section 5.10 of Chapter 5 describing identified structures in detail.

Junctions

4.3.8 At-grade junctions have been provided for connections to the local road network.

4.3.9 All the options tie-in to the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) grade-separated junction at Smithton for which draft Orders have been published.

4.3.10 The southbound carriageway of the A9 south of Raigmore Interchange provides two running lanes and a hardstrip. The existing diverge slip and weaving length to Inshes is sub-standard. The sub-standard diverge lane results in traffic straddling the sub-standard narrow diverge lane and Lane 1 of the A9. In order to improve the traffic operation at Inshes junction, a third lane implemented as a lane gain/drop from Raigmore A9 southbound merge slip is introduced and extends to the Inshes Junction. The close proximity of the two junctions, Raigmore and Inshes, results in weaving length less than 1km, which is below the desirable minimum design standards for weaving lengths for rural All-Purpose roads.

4.3.11 The junction configurations shown with each option are indicative layouts at this stage, capable of maintaining/improving access between local and strategic connections. The preferred option junction configurations will be developed further at the DMRB Stage 3 assessment.

Local Roads

4.3.12 Each option has been developed giving consideration to the local road network and consultation has been undertaken with THC. In general, a consistent approach has been adopted for each local road across all options.

4.3.13 The main local roads identified within the study corridor are:

- B8082 – Sir Walter Scott Drive
- U1267 – Dell of Inshes Road
- B9006 – Culloden Road (B9006 Millburn Roundabout – Culcabock – Castle Hill – Culloden Moor – Croy – Gollanfield – Fort George Road)
- U1058 – Caulfield Road North (Castlehill – Cradlehall – Smithton – Stratton Lodge Road)

- U5096 – Castlehill Road
- U1124 – Caulfield Road
- B9177 – Milton of Leys-Bogbain-Castlehill Road
- C1032 – Barn Church Road

4.3.14 The proposed corridor for the options is bordered by two strategic routes namely; the A9 Perth – Inverness Trunk Road (commonly referred to as "the A9") to the west and the A96 Aberdeen – Inverness Trunk Road (commonly referred to as "the A96") to the north-east. The A9 and the A96 meet at Raigmore grade-separated interchange.

Drainage

4.3.15 A preliminary drainage design has been carried out in accordance with the DMRB and adopts Water Assessment and Drainage Assessment Guide principles, produced by the Sustainable Drainage Systems (SuDS) Scottish Working Party, to identify potential outfalls, catchment areas and SuDS measures to attenuate or treat surface run-off, which would inform the engineering and environmental assessments of each option.

4.3.16 The SuDS proposals for the proposed options would promote the use of source control methods such as filter drains and swales together with outfall controls such as attenuation basins as an essential part of the preliminary drainage design. The DMRB guidance classifies the magnitude of potential impacts on flood level using the 1% Annual Exceedance Probability (AEP) (100 year return period). In Scotland, the design consideration (from SUDS Working Party and Planning Policy) is the 0.5% AEP (200 year return period) plus climate change condition, therefore the attenuation considerations have been designed to cater for a 1 in 200 year flood event subject to further assessment in DMRB Stage 3.

Earthworks

4.3.17 A desk-based assessment and site walk-over observations have been undertaken. The geotechnical assessment will require further assessment to determine earthworks slope types to be implemented in the option designs. At this stage, for all embankments, a 1m vertical in 2m horizontal has been adopted; and for all cut slopes, a 1m vertical in 2m horizontal has been adopted.

4.3.18 The potential for re-use of excavated material within the works and potential material acceptability have been assumed to be 50/50, excluding existing pavement and topsoil. A future ground investigation will provide better site-specific information and may result in higher or lower acceptability. Section 5.8 describes in detail of the existing geotechnical conditions.

Pavement Design

4.3.19 The preliminary design takes account of the principles and specification as described in THC Roads and Transport Guidelines for New Developments, though any direct basis in the DMRB will require consultation with THC. For the purposes of informing the cost, the preliminary pavement design has been based on the DMRB, in particular the following design standards:

- Volume 7, Section 2, Part 1, HD 24/06 Traffic Assessment; and
- Volume 7, Section 2, Part 3, HD 26/06 Pavement Design.

4.3.20 New and reconstructed sections of carriageway are to standard flexible pavement design in accordance with HD 26/06 with a 40 year design life, which is in accordance with THC Roads and Transport Guidelines for New Developments. In addition, THC Roads and Transport Guidelines for New

Developments require a minimum construction to 1.0 million standard axles for all prospectively adoptable roads other than a road classed as a Strategic Route or Main Distributor unless agreed otherwise with the Council.

Road Restraint Systems

4.3.21 An outline design for road restraint systems has been developed for inclusion in the cost estimate. It is assumed that where embankment heights exceed 2.5m at road, rail or watercourse crossings, a road restraint system would be provided.

Utilities

4.3.22 There are a significant number of buried and overhead public and private utility services within the study area including:

- Scottish and Southern Energy – High Voltage, Medium Voltage and Low Voltage overhead and underground services;
- Telecommunications – British Telecom overhead and buried services, Vodafone underground services and Scottish and Southern Energy underground telecom cables;
- Scottish Water Supply Network – Existing and abandoned water mains;
- Scottish Water Sewer Network – Surface, foul water and combined sewers;
- Scotia Gas Networks – Low and intermediate pressure pipelines;
- CLH Pipeline System (formally Government Pipeline and Storage System) – Aviation fuel pipeline; and
- Street Lighting.

4.3.23 In accordance with the New Roads and Street Works Act (1991), C2 notices were issued to each of the utility providers to request details of their networks within the study area. This enabled potential clashes between proposed options and utility infrastructure to be identified. Where such a conflict is unavoidable, a C3 notice will be issued once the preferred option is chosen during the DMRB Stage 3 Assessment. This will request an outline design and costing for any necessary diversion or protection works from the utility provider.

Structures

4.3.24 All structure proposals described in this report comply with the DMRB and it is not envisaged that any Departures from Standard will be required at this stage of the scheme development in relation to the proposed structures.

4.3.25 Structures will be required for strategic and local road crossings, railway crossings and watercourses crossings dependent on size and drainage features.

Non-Motorised Users

4.3.26 The following objectives have been set in terms of Non-Motorised User (NMU) provision for this scheme:

- 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 (EIATC) 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.

4.3.27 NMU Provision on the preferred option will be designed and developed during the DMRB Stage 3 assessment.

5. Engineering Assessment

5.1 Introduction

5.1.1 This section of the report describes the findings of the engineering assessment of the three options with variants A and B to reflect the alternative alignments close to Ashton Farm, between Inshes and Smithton. It includes a description of the engineering features of each option including mainline alignment, proposed junctions and structures. The potential effects of each option are discussed including effects on the local road network, geotechnics and utilities.

5.1.2 The mainline alignments are shown on drawings B2103501-HW-1100-DR-001 to B2103501-HW-3200-DR-005 (Volume 2).

5.2 Engineering Constraints

5.2.1 Each of the three options and the A and B variants for each between Inshes and Smithton have been designed to take into consideration the following physical constraints:

- The topography of the area which is generally low-lying ground, but gradually rising towards the Inshes Overbridge;
- The existing A9 Perth – Inverness Trunk Road;
- The existing Inshes Overbridge;
- The existing local road network;
- Castlehill House (Category B Listed Building);
- The settlements of Inshes, Dell of Inshes, Inverness College (University of the Highlands and Islands Campus), Cradlehall and Smithton;
- The Highland Main Line Railway;
- Ashton Farm Ring Ditch and Pit Circles Scheduled Monument;
- Agricultural holdings which are the predominant land use in the east area;
- Ashton Farm;
- Highland Council Paths and SUSTRANS National Cycle Network;
- Inshes Burn;
- Cairnlaw Burn and its associated floodplain, which flows close to the south-east side of the A96 Smithton Junction, under C1032 Barn Church Road, under the existing A96 near Milton of Culloden, and then under the Aberdeen to Inverness Railway Line and outfalls into the Moray Firth;
- Scretan Burn and its associated floodplain, which flows on the east side of the Inverness Retail and Business Park before continuing north, and passes below the existing A96, before feeding into the Moray Firth;
- Environmentally significant areas (refer to Part 3 – Environmental Assessment) such as Sites of Special Scientific Interest (SSSI), areas of ancient woodland and Special Protected Areas (SPAs);
- Public Utilities.

5.3 Engineering Description of Mainline Alignments

5.3.1 Option 1A/B and Option 2A/B commence at the Inshes Retail Park roundabout on the western side, and will tie into The Highland Council's (THC) Inshes Phase 2 Project. Option 3A/B connects to the local road network at the B9006 Culloden Road/U1058 Caulfield Road North junction and includes the addition of a parallel structure next to the existing Inshes overbridge and its approaches to accommodate two lanes of traffic in each direction. All of the options and their variants will tie into the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) grade separated junction at Smithton at the north east end of the scheme.

5.3.2 A lane gain/drop arrangement on the A9 southbound between Raigmore Interchange and Inshes junction is proposed for all options, similar to the arrangement between Inshes and Raigmore on the A9 northbound carriageway.

5.3.3 The options for the scheme are described in detail below. The descriptions follow the alignments eastbound, from Inshes to Smithton.

Option 1A

5.3.4 Option 1A is shown on drawings B2103501-HW-1100-DR-001 to 005 (Volume 2), the lane gain/drop is shown on drawing B2103501-HW-4100-DR-001 (Volume 2). This option is approximately 2.9km in length.

5.3.5 The option commences at the existing Inshes Retail Park roundabout and passes through the Dell of Inshes settlement, utilising the line of the existing U1267 Dell of Inshes Road, but widened to accommodate the option cross-section. It rises on embankment to pass over the existing A9 on a new structure, passing through Inshes Small Holdings before crossing over B9006 Culloden Road on another new structure. The alignment falls to approximately ground level to form a proposed at-grade roundabout with the existing local road network at Cradlehall. The U1058 Caulfield Road North is realigned to form two arms with the proposed at-grade roundabout.

5.3.6 The option continues in an easterly direction and rises on embankment to pass over the existing Highland Main Line Railway via a new overbridge, passing between the two distinct elements of Ashton Farm Ring Ditch and Pit Circles Scheduled Monument to the west of Ashton Farm. An at-grade roundabout is proposed at Ashton Farm on the east side of the Highland Main Line Railway.

5.3.7 A side road link is proposed from this roundabout to the Inverness Retail and Business Park. This connects to an existing cul-de-sac road on the southern side of the retail park. In addition to this link, the roundabout also includes a stub to provide access to Ashton Farm to the east. The option continues from Ashton Farm in a north-easterly direction to tie-in to the proposed grade-separated A96 Smithton Junction which is part of the A96 Dualling Inverness to Nairn (including Nairn bypass) Scheme.

5.3.8 Under this option, all existing local accesses including Inshes Junction are maintained but the existing grounds and private access to Castlehill House are severed.

5.3.9 The option incorporates a proposed lane gain/drop on the A9 southbound between Raigmore Interchange and Inshes junction. The horizontal alignment, vertical alignment and cross-section would be optimised to maximise the use of the existing alignment of the A9, levels and available cross-section under the Inshes Overbridge. The proposed arrangement would improve the weaving length from 385m to 660m, which would aid the major weaving flow coming from the A9 mainline and exiting at Inshes. The weaving length is measured in accordance with TD22/06, Chapter 4 Geometric Standards Figure 4/10.

Option 1B

5.3.10 Option 1B is shown on drawings B2103501-HW-1200-DR-001 to 005 (Volume 2), the lane gain/drop is shown on drawing B2103501-HW-4100-DR-001 (Volume 2). This option is approximately 2.9km in length.

5.3.11 The alignment for Option 1B is similar to that of Option 1A, except that it passes to the east of the Ashton Farm, farmhouse and steadings, and to the east of Ashton Farm Ring Ditch and Pit Circles Scheduled Monument. This alignment variant was developed to avoid passing between the two distinct elements of the Ashton Farm Ring Ditch and Pit Circles Scheduled Monument.

Option 2A

5.3.12 Option 2A is shown on drawings B2103501-HW-2100-DR-001 to 007 (Volume 2), the lane gain/drop is shown on drawing B2103501-HW-4100-DR-002 (Volume 2). This option is approximately 2.9km in length.

5.3.13 Option 2A is similar to Option 1A. However, this option also includes replacement of the existing A9 southbound diverge and merge slip roads at Inshes junction. The southbound diverge slip alignment rises from a point north of the existing Inshes overbridge on the A9 to connect with the option alignment east of the proposed option A9 overbridge. The southbound diverge and merge form a signalised cross-road junction on the proposed option. The southbound merge falls from the option alignment and ties into the A9 near Balvonie Cottage.

5.3.14 In order to provide the required headroom for the A9 southbound diverge slip road, the existing Inshes Overbridge carrying the B9006 Culloden Road over the A9 will need to be demolished and replaced.

5.3.15 A lane gain/drop between Raigmore and Inshes on the A9 southbound is proposed and will tie into the proposed full standard diverge slip road. The horizontal alignment, vertical alignment and cross-section would be optimised to maximise the use of the existing alignment of the A9. There is no issue with cross-section clearance under Inshes Overbridge as the bridge will be demolished and replaced as part of the option. The proposed arrangement would improve the weaving length from 385m to 530m, which would aid the major weaving flow coming from the A9 mainline and exiting at Inshes. The weaving length is measured in accordance with TD22/06, Chapter 4 Geometric Standards Figure 4/10.

Option 2B

5.3.16 Option 2B is shown on drawings B2103501-HW-2200-DR-001 to 007 (Volume 2), the lane gain/drop is shown on drawing B2103501-HW-4100-DR-002 (Volume 2). The option is approximately 2.9km in length.

5.3.17 The option is similar to Option 2A including all junction configurations, but as per Option 1B, it passes to the east of Ashton Farm farmhouse and steadings, and to the east of Ashton Farm Ring Ditch and Pit Circles Scheduled Monument.

Option 3A

5.3.18 Option 3A is shown on drawings B2103501-HW-3100-DR-001 to 005 (Volume 2), the lane gain/drop is shown on drawing B2103501-HW-4100-DR-001 (Volume 2). The option is approximately 2.4km in length.

5.3.19 The option has the same alignment as Options 1 and 2 between the proposed at-grade Cradlehall roundabout and the tie in with the proposed grade-separated A96 Smithton Junction which is part of the A96 Dualling Inverness to Nairn (including Nairn bypass) Scheme. The U1058 Caulfield Road North is locally realigned and widened from its junction with B9006 Culloden Road to the proposed Cradlehall roundabout. The secondary access in to Inverness College (UHI Campus) is also realigned to tie into U1058 Caulfield Road North. The provision of right turn lane on Caulfield Road North into Inverness College (UHI Campus) secondary access is proposed.

5.3.20 The option includes a proposed parallel structure, immediately to the south of Inshes Overbridge to accommodate two traffic lanes in each direction on the B9006 Culloden Road. The approaches to the bridge are modified to accommodate the additional parallel structure crossing the A9.

5.3.21 The option has the same lane gain/drop configuration as Options 1A/B on the A9 southbound between Raigmore and Inshes Junction, as described in paragraph 5.3.9 above.

Option 3B

5.3.22 Option 3B is shown on drawing B2103501-HW-3200-DR-001 to 005 (Volume 2), the lane gain/drop is shown on drawing B2103501-HW-4100-DR-001 (Volume 2). The option is approximately 2.4km in length.

5.3.23 The option is similar to Option 3A. The difference being that the route is to the east of Ashton Farm, as a result, it avoids passing between the two distinct elements of the Ashton Farm Ring Ditch and Pit Circles Scheduled Monument.

5.4 Junction Layouts

5.4.1 Preliminary junction layout designs have been prepared for each proposed junction location. The proposed junction configuration varies dependent on option. The junction layout designs for the preferred option will be developed further during the DMRB Stage 3 assessment. Table 5.1 below shows the junction configuration at the following locations:

Table 5.1: Proposed Junction and Option

Location	Option	Junction	Type
Inshes Retail Park	1A/B; 2A/B	THC Inshes Phase 2 Project (TBC)	At-grade
A9 Southbound Inshes Junction	1A/B; 3A/B	Lane gain/drop	Grade-separated (Non-Standard)
A9 Southbound Inshes Junction	2A/B	Slip Road and lane gain/drop	Grade-separated
Cradlehall	1A/B; 2A/B; 3A/B	Roundabout	At-grade
Inverness College (UHI Campus) Access	1A/B; 2A/B; 3A/B	Major/Minor Priority Junction	At grade
Ashton Farm	1A/B; 2A/B; 3A/B	Roundabout	At-grade
A96 Smithton Junction (tie-in)	1A/B; 2A/B; 3A/B	A96/Barn Church Roundabout	Grade-separated

5.4.2 A description of the layout and design assumptions made in the development of the outline design of each proposed junction is provided below.

Inshes Retail Park Roundabout

5.4.3 The Inshes Retail Park roundabout tie-in applies to Options 1A/B and 2A/B. The roundabout is located to the west of Inshes Junction and the A9. The existing roundabout provides access to the following:

- Inshes Retail Park;
- Tesco Extra;
- U1267 Dell of Inshes Road; and
- Inshes Road.

5.4.4 The detail of the roundabout tie-in at this location is yet to be determined as it forms part of THC's Inshes Phase 2 Project.

A9 Southbound Inshes Junction

5.4.5 The existing junction configuration is partly retained for Options 1 and 3. In Option 3 a new parallel structure next to the existing Inshes overbridge will be constructed to accommodate 2 lanes of traffic in each direction. The proposed lane gain/drop from Raigmore Interchange drops at Inshes junction to form part of the existing contiguous corner into the minor road. Further south of the junction, the existing merge taper of the junction is retained. The combined arrangement of lane drop with the existing layout, weaving length and cross-section results as a Departure from Standard described in detail in Section 5.6.

5.4.6 The proposed grade-separated junction applies to Option 2. It is approximately 0.5km further south of the existing junction and will replace the existing junction. The proposed junction includes diverge and merge slip roads that will directly connect to the proposed link between Inshes Retail Park and Cradlehall, resulting in a signalised cross-roads.

5.4.7 The proposed grade-separated junction will require the existing Inshes Junction Overbridge to be demolished and replaced to accommodate the new diverge slip to achieve required headroom clearance. The existing A9 merge/diverge will be stopped up however local access will be maintained to properties on this road.

5.4.8 The lane gain/drop will also form part of this option as per Options 1 and 3, however the lane drop will form as part of the new southbound diverge slip road.

Cradlehall Roundabout

5.4.9 The proposed Cradlehall Roundabout is common to all options. It is approximately 0.3km east of the B9006 Culloden Road and offline of the existing U1058 Caulfield Road North. The roundabout and new links are above existing ground level. Options 1 and 2 will have four arms. Option 3 will have three arms as a result of not including the link between Inshes Retail Park and Cradlehall. The proximity of the proposed roundabout to the U1058 Caulfield Road North will require minor realignment of U1058 Caulfield Road North to the proposed roundabout. Similarly, the proximity of the proposed roundabout to the Inverness College (UHI Campus) access will require a minor realignment to form a junction with U1058 Caulfield Road North.

5.4.10 For Options 1 and 2, the proposed roundabout will be a four arm roundabout connecting to:

- U1058 Caulfield Road North (eastwards);
- U1058 Caulfield Road North (westwards);
- Proposed link between Inshes Retail Park and Cradlehall; and
- Proposed link between Cradlehall and Ashton Farm.

5.4.11 For Option 3, the proposed roundabout will be a three arm roundabout connecting to:

- U1058 Caulfield Road North (eastwards);
- U1058 Caulfield Road North (westwards); and
- Proposed link between Cradlehall and Ashton Farm.

Ashton Farm Roundabout

5.4.12 The proposed Ashton Farm roundabout applies to all options. The location of the roundabout is dependent on variant A or B. For A variants where the alignment passes between identified Ashton Farm Ring Ditch and Pit Circles Scheduled Monument, the roundabout is approximately 0.25km east of the Highland Main Line Railway. For B variants where the alignment avoids passing through the identified Ashton Farm Ring Ditch and Pit Circles Scheduled Monument, the roundabout is approximately 0.15km east of the Highland Main Line Railway.

5.4.13 The proximity of the roundabout to the Highland Main Line Railway will require the roundabout to be constructed on embankment in order to provide the required headroom for crossing the railway, via an overbridge. For A variants, the roundabout is approximately 3m above existing ground level. For B variants, the roundabout is approximately 6m above existing ground level, due to its closer proximity to the railway.

5.4.14 For Options 1A/2A/3A, the proposed roundabout will be a four arm roundabout connecting to:

- Proposed link between Cradlehall and Ashton Farm;
- Proposed link between Ashton Farm and Inverness Retail and Business Park;
- Proposed link between Ashton Farm and the A96 Smithton Junction;
- Ashton Farm access as a stub.

5.4.15 For Options 1B/2B/3B, the proposed roundabout will be a three arm roundabout connecting to:

- Proposed link between Cradlehall and Ashton Farm;
- Proposed link between Ashton Farm and Inverness Retail and Business Park;
- Proposed link between Ashton Farm and the A96 Smithton Junction.

5.4.16 Access to Ashton Farm is directly off the proposed link between Ashton Farm and the proposed A96 Smithton Junction which is part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme.

A96 Smithton Junction

5.4.17 All options tie-in to the proposed A96 Smithton Junction, which forms part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. It is approximately 1.5km east of Raigmore Interchange, near Smithton and Culloden.

5.4.18 The proposed junction includes a dumb-bell arrangement, that is, a roundabout on each side of the proposed dual carriageway, connected by a short link road. The roundabouts and link are at existing ground level, and the dual carriageway is raised over the link road. The proposed options tie-in to the roundabout to the south, which provides access to the existing C1032 Barn Church Road

5.4.19 The roundabout will be a five arm roundabout connecting to:

- Proposed link between Ashton Farm and the A96 Smithton Junction;
- The proposed westbound merge to the A96;
- The proposed link to the northern roundabout;
- The proposed westbound diverge from the A96;
- The C1032 Barn Church Road

5.5 Local Roads and Private Accesses

5.5.1 This section of the report discusses the existing local road network and private accesses within the study corridor and with regard to eachoption.

Existing Local Road Network and Private Access

5.5.2 There are a number of B class, C class and unclassified local roads within the study corridor. Castlehill House access and Ashton Farm access are the two identified private accesses. The existing local road network is shown on Drawing B2103501-HW-0000-DR-002 (Volume 2).

5.5.3 The U1267 Dell of Inshes Road is a local access for properties in the Dell of Inshes. It connects to the Inshes Retail Park roundabout and also serves as a cycle route.

5.5.4 The B9006 Culloden Road is the arterial local road that directly links the west of Inverness to the east of Inverness in the Inshes area. It commences at Inshes Roundabout passing over the A9 via the Inshes Overbridge and leads to Westhill. It also provides connection to the A9 southbound and Inverness College (UHI Campus).

5.5.5 A section of the road forms part of the on-road National Cycle Network (NCN 1).

5.5.6 Castlehill Private Access provides access to Castlehill House, a Category B Listed Building. The private access road forms a junction with the B9006 Culloden Road approximately 0.4km south-east of the Inshes Overbridge.

5.5.7 The U1058 Caulfield Road North is a local road that links the B9006 Culloden Road and U5096 Castlehill Road. The U1058 provides local access into Cradlehall.

5.5.8 The U5096 Castlehill Road is a local road that links between U1058 Caulfield Road North and Caulfield Road (U1124). It provides access to communities in Castlehill and Castlehill Business Park.

5.5.9 A section of the U1058 forms part of the on-road National Cycle Network (NCN 1).

5.5.10 The Inverness College (UHI Campus) access is a local access road that provides access to the Inverness College (UHI Campus) and businesses. The access provides one of two accesses onto the Campus. The access is located approximately 0.15km east of B9006 Culloden Road.

5.5.11 The Ashton Farm private access road is approximately 0.3km east of Inverness Retail and Business Park junction, commencing from its junction with the A96 in a south-easterly direction towards Ashton Farm. The access forms part of THC's Core Path network, providing a route between Seafield and Cradlehall for NMU traffic.

5.5.12 C1032 Barn Church Road is a local road linking the communities of Culloden and Balloch to the existing A96 at two locations: a roundabout at the C1032 western junction and a ghost island T-junction at the C1032 eastern junction. The two junctions are approximately 3.4km apart.

Local Road and Private Access Strategy

5.5.13 There are several local roads that could be affected by the options and the impact is dependent on option. A preliminary local road strategy has been developed for each option and consultation is ongoing with THC. The road strategy for local roads, private accesses and field accesses for the preferred option would be refined and developed further in consultation with THC and affected landowners during the DMRB Stage 3 assessment. The existing road network is shown on Drawing B2103501-HW-0000-DR-002 (Volume 2).

5.5.14 The strategy adopted for individual local roads within the study corridor broadly fits into one of the following categories:

- Private accesses are maintained or realigned where required;
- Local road network is maintained or realigned where required;
- At-grade junction with the proposed options provided.

5.5.15 The extent of interfaces with the local road network differs for each option and a consistent approach has been adopted for each instance where options are similar. Table 5.2 describes the proposed local road strategy for each option. Private accesses within the study corridor that are not affected by any of the options have been omitted from this Table.

Table 5.2: Local Road and Private Access Strategy

Local Road/Private Access	Options	Description
U1267 Dell of Inshes Road	1A/B; 2A/B	Retained and widened to accommodate proposed options.
B9006 Culloden Road	2A/B	Existing Inshes Overbridge to be demolished and replaced.
B9006 Culloden Road	3A/B	New parallel structure adjacent to the existing Inshes Overbridge to accommodate two lanes in both directions on the B9006 Culloden Road.
B9006 Culloden Road	1A/B; 2A/B	Bridge over to allow continuation of options.
Castlehill House Access	1A/B; 2A/B	Access to be stopped up and alternate access to be provided.
U1058 Caulfield Road North	1A/B; 2A/B; 3A/B	Splits and realigned with each end forming an arm to the proposed Cradlehall Roundabout.
Inverness College (UHI Campus) Access	1A/B; 2A/B, 3A/B	Realigned to tie into new U1058 Caulfield Road North. Existing major/minor priority layout to be retained.
Ashton Farm Access	1A; 2A; 3A	Stopped-up and new access forms an arm to the proposed roundabout at Ashton Farm.
Ashton Farm Access	1B; 2B; 3B	Stopped-up and new access off proposed link between Ashton Farm and the A96 Smithton Junction.
U2820 Inverness Retail and Business Park access	1A/B; 2A/B; 3A/B	Existing access dead-end to be connected to proposed roundabout at Ashton Farm.
C1032 Barn Church Road	1A/B; 2A/B; 3A/B	Road to be connected with the proposed A96 Smithton grade-separated junction, maintaining connectivity to the A96.
U1267 Dell of Inshes Road	1A/B; 2A/B	Retained and widened to accommodate proposed options.

A9 Mainline Strategy

5.5.16 The existing A9 southbound between Raigmore Interchange and Inshes Junction is a Dual-2-Lane carriageway All-Purpose road (D2AP). Traffic merges onto the A9 southbound from Raigmore Interchange by means of a Type A taper merge. At Inshes Junction, it includes a sub-standard major/minor priority junction with nearside diverge lane. On the northbound between Inshes Junction and Raigmore Interchange, it changes from D2AP to a Dual-3-Lane carriageway All-Purpose road (D3AP) by means of a major/minor priority junction with a nearside lane gain/drop. The D3AP reduces to a D2AP by dropping the nearside lane gain/drop at Raigmore Interchange by means of a Type C lane drop at taper diverge.

5.5.17 The extent of interfaces with the A9 differs between options. Table 5.3 describes the proposed A9 strategy for each option.

Table 5.3: The A9 Strategy

Trunk Road	Options	Description
A9 Mainline	1A/B; 2A/B	Bridge over to allow continuation of options. In order to improve the traffic operation at Inshes junction a third lane is to be implemented as a lane gain/drop from Raigmore A9 southbound merge slip to the Inshes Junction.
A9 Mainline	3A/B	New parallel structure adjacent to existing Inshes Overbridge to carry 2 lanes in each direction on B9006 Culloden Road over the mainline. In order to improve the traffic operation at Inshes junction a third lane is to be implemented as a lane gain/drop from Raigmore A9 southbound merge slip to the Inshes Junction.

5.5.18 Table 5.4 summarises the effect of each option on the existing road network and private accesses.

Table 5.4: Local Road and Private Access Strategy Summary

Option	1A	1B	2A	2B	3A	3B
Bridge	1	1	2	2	1	1
Connect to Junction	5	5	5	5	4	4
Stopped-up with alternate access provided	2	2	2	2	1	1

5.5.19 Table 5.5 summarises the effect of each option on the existing A9 mainline

Table 5.5: A9 Mainline Summary

Option	1A	1B	2A	2B	3A	3B
Bridge	1	1	1	1	1	1
Connect to Junction	-	-	1	1	-	-
Lane gain/drop	1	1	1	1	1	1

5.5.20 None of the B, C and unclassified roads bisected by the scheme would require to be stopped-up for any of the options. For all options, Ashton Farm access would require an alternate access. Option 3 would not require the Castlehill House (Category B Listed Building) access to be stopped-up whilst Options 1 and 2 proposes the access to be stopped-up and a new alternate access provided.

5.6 Departures from Standard

5.6.1 The design hierarchy described in DMRB permits relaxations to be introduced at the discretion of the Designer where such relaxations can be justified on environmental and economic grounds without adversely affecting safety and level of service. In situations of exceptional difficulty, which cannot be overcome by Relaxations, it may be possible to overcome them by Departures from Standard. Departures from Standard require approval from the Overseeing Organisation before being incorporated into a design layout to ensure that safety is not significantly reduced.

5.6.2 Anticipated Departures from Standard in all the options relate to the A9 southbound lane gain/drop arrangement between Raigmore Interchange and Inshes junction. For Options 1 and 3, the proposed layout configuration of the lane drop and cross-section will require Departures from Standard. For Options 1, 2 and 3, the weaving length will require a Departure from Standard.

5.6.3 The proposed layout of a lane gain/drop between Raigmore Interchange and Inshes Junction is considered an over provision and a Departure from Standard based on the forecast mainline and diverging traffic flows, as a 'Type A' taper diverge arrangement would suffice. However, the proposed

lane gain/drop would allow increased opportunity for diverging traffic to reduce speed on the lane drop without conflicting or impeding with mainline traffic, and diverge safely. The existing situation is less than satisfactory as the capacity of the connection to the local road network is insufficient at times and results in queuing along the A9 mainline on approach to the junction.

5.6.4 The existing diverge and connection to the local road network does not comply with current design standards due to the radius curve and the presence of private property accesses.

5.6.5 The proposed lane drop arrangement for Options 1 and 3 is shown on Drawing B2103501-HW-4100-DR-001 and B2103501-HW-4100-DR-002 (Volume 2). Further refinement of the design will be undertaken as part of the DMRB Stage 3 Scheme Assessment.

5.7 Topography and Land Use

5.7.1 The land within the study area is generally flat and low lying in nature. The highest ground level is approximately 40mAOD and is located in the vicinity of Inshes junction to the south of the study area. The land uniformly slopes towards the Moray Firth and on approach to the A96 Smithton Junction the ground level is approximately 20mAOD. There are number of watercourses and associated floodplain to the east of the Highland Main Line Railway.

5.7.2 All options would introduce changes to the existing topography through the introduction of new road embankments and minor cuttings, local road re-alignments and structures.

5.8 Geotechnics and Earthworks

Existing Ground Conditions

5.8.1 An assessment of the likely ground conditions affecting the various options has been determined from the British Geological Survey (BGS) maps for the area, at both 1:50,000 scale (Scotland Sheet 84W) and 1:10,000 scale (NH64SE, NH64NE and NH74NW), together with the Memoir "Geology of the Fortrose and Eastern Inverness District" accompanying the 1:50,000 scale map. Reference has been made during the study to the BGS website and the existing ground investigation (GI) coverage within the area of interest; these are summarised in Table 5.6.

Table 5.6: Existing Ground Information for Study Area

Scheme	Coverage	General Findings
Raigmore to Smithton Junction, Highland Regional Council, 1987.	Limited number of exploratory holes in the vicinity of Smithton Roundabout.	Localised soft clay/silt and peat to a maximum depth of 1.2m, followed by silty sands and gravels. Bedrock at a minimum depth of 21mBGL.
Inverness Trunk Link Road (2008), undertaken by Soil Mechanics for Scott Wilson on behalf of THC.	Investigation of a previous alignment of the current scheme (similar to Option 1A to the north of the railway line). GI consisted 38 boreholes and 18 trial pits.	Dense sands and gravels. Tends to be glacio-fluvial deposits close to the surface, overlying glacial till at depth. Bedrock at a maximum depth of 22mBGL.
A9 construction GI works (1979) by Frank Saynor and Associates.	Boreholes and trial pits available via the British Geological Survey website, along the line of the current A9.	Ground Investigation for Inshes Overbridge, plus boreholes in vicinity of proposed Dell of Inshes bridge: dense granular Till. Bedrock not encountered, but at least 15.5mBGL.
A96 Dualling Inverness to Nairn (including Nairn bypass) Improvement 2016.	Ground Investigation for Smithton Junction.	Ground Investigation works were carried out during Spring 2016 –records indicate depth to rockhead of 29.6mBGL.

5.8.2 The study area extends from the coastal lowland backing the southern shores of the Moray Firth, to the lower slopes of the south-west to north east trending ridge of Drummossie Muir. The area is extensively

covered by superficial deposits; exposures of rock are rare; one is recorded in the deeply incised stream bed at Stratton, approximately 500m to the north-east of Ashton Farm, where the Hillhead Sandstone Formation is exposed.

5.8.3 The three options each have an A and B variant to the north-east of the proposed Cradlehall Roundabout, which traverse the coastal lowland passing either side of Ashton Farm. This environment also underlies the A9 southbound lane gain/drop between the Raigmore and Inshes Junction. The three options to the south of the proposed Cradlehall Roundabout are on the north-western slope of the Drummossie Muir ridge.

5.8.4 An extract from the 1:50,000 scale geological map, with the options overlaid is presented in Drawing B2103501-GE-0000-DR-001 (Volume 2).

5.8.5 The options are primarily underlain by significant depths of glacial and late glacial superficial deposits. The variations in the glacial deposits are presented in Table 5.7 below:

Table 5.7: Late Glacial/Glacial Deposits Present in the Study Area

Geological Unit	General Description
Raised Shoreface and Beach Deposits	Mainly medium sand and well-rounded shingle.
Raised Tidal Flat Deposits	Fine sand, silt and clay with lenses of gravel.
Raised Glacomarine deposits (Ardersier Silts Formation)	Mainly silty diamicton with lenses of gravel and clay, capped by rhythmically bedded silt and fine sand; locally contorted glacio-tectonically.
Glaciofluvial sheet deposits	Mainly terraced spreads and mounds of gravel with lenses of sand.
Hummocky Glacial Deposits	Poorly stratified sandy diamicton, sand, gravel, silt and rock debris.
Tills (undifferentiated)	Stiff, stony, clayey diamicton, typically massive, but stratified and more sandy locally, including lenses of gravel.

Note: Diamicton – defined as poorly sorted sediment with a wide clast size range (non-diagenetic term).

5.8.6 More recent (Flandrian) drift deposits occur in the form of alluvium, related to the streams traversing the site such as the Cairnlaw Burn and Scretan Burn. Localised Made Ground would also be anticipated, associated with the existing road and rail infrastructure.

5.8.7 In terms of the current options, ground conditions are generally anticipated to be favourable, being dominated by mainly granular deposits. Glacial deposits such as Raised Tidal Flat deposits and Raised Glaciomarine deposits (Ardersier Silts Formation) may present engineering difficulties in terms of their fine grained nature and potential compressibility, although these are subordinate in occurrence to the more granular deposits. The actual nature, thickness and distribution of these deposits will require to be confirmed at the Ground Investigation stage (DMRB Stage 3). The presence of Alluvium is only likely to be a localised constraint, as it is only anticipated to affect small sections of the various options, as shown on Drawing B2103501-GE-0000-DR-002 (Volume 2).

5.8.8 The bedrock underlying the majority of the site belongs to the Hillhead Sandstone Formation (HSa), which is part of the Inverness Sandstone Group (InS), of Middle Devonian age. The unit generally dips towards the north-west, at relatively shallow angles of between 5 and 30 degrees. The formation consists of red coarse grained sandstones, flaggy siltstones, calcareous mudstones and thin shaley mudstones.

5.8.9 The Hillhead Sandstone Formation is underlain by the Inshes Flagstones (InF) Formation, with the junction of the two formations running perpendicular to the alignment of the A9 to the south-east of Simpsons Garden Centre. This formation comprises grey and purplish-red flaggy sandstones and siltstones, with numerous dark grey and greenish-grey shaley mudstones containing thin limestones.

5.8.10 Information available from existing ground investigation works indicate extensive depths of medium dense to very dense granular fluvio-glacial deposits, consisting of sands and gravels, with occasional

clayey horizons. The Alluvium indicated on the geological maps has not been identified in ground investigation holes where it would be anticipated.

5.8.11 Bedrock is only proven in four boreholes (Soil Mechanics 2008) in the area, the depth of cover varying from 5.5 to 29.58m, as shown in the following table (Table 5.8):

Table 5.8: Depth to Bedrock in the Study Area

Location of Bedrock	Rockhead Depth (mBGL)	Rockhead Elevation (mAOD)
Immediately north of the proposed bridge over the Highland Main Line Railway (BH114)	22	12.64
Immediately north-west of Ashton Farm (BH118)	5.5	21.63
Immediately south of C1032 Barn Church Road at Smithton roundabout location (BH123)	21.3	-5.91
Immediately north of C1032 Barn Church Road at Smithton roundabout location (BH124)	29.58	-14.68

Options

5.8.12 The options alignment assessments are based upon the following drawings:

- Option 1A/B – B2103501-HW-0000-DR-001
- Option 2A/B – B2103501-HW-0000-DR-002
- Option 3A/B – B2103501-HW-0000-DR-003

Inshes Retail Park to Cradlehall Roundabout – A9 Overbridge: Option 1 and 2 A and B Variants

5.8.13 The option in this section is largely on embankment due to crossing the A9 Perth – Inverness Trunk Road and B9006 Culloden road.

5.8.14 Ground conditions beneath this section consist of Hummocky Glacial Deposits, overlying Glacial Till, with bedrock of the Hillhead Sandstone Formation. Ground investigation information close to the site of the existing Inshes bridge over the A9 indicates dense to very dense silty sand and gravels, which is located at the southern limit of the Hummocky Glacial Deposits.

5.8.15 There is a glacial outwash channel identified on the hillside to the north-west of Simpsons Garden Centre, resulting in a linear depression up to 4m deep. The alignment of the proposed embankment leading to the A9 Overbridge coincides with the glacial outwash channel, which will result in an increased volume of fill being required in order to construct an embankment at this location, which is already of a significant height.

5.8.16 Immediately adjacent to the carriageway of the A9 southbound is an area of made ground, in the form of an embankment across the glacial outwash channel. This appears to have been placed by the developers of the adjacent garden centre site (using arisings from when they extended their site to the south-east), although the purpose of this infill is unknown. It is unknown whether the fill has been placed and compacted as an engineering fill.

5.8.17 It is anticipated that the proposed bridge foundation conditions will comprise undifferentiated Glacial Deposits overlying sandstone bedrock; it is anticipated that spread foundations will probably be sufficient for the B9006 bridge. No details are currently available for the proposed bridge over the A9, but either a single or twin span are possible; the span and resultant loadings will impact on foundation design.

5.8.18 In Option 2 the diverge slip road from the A9 southbound will be constructed on embankment, which will start to the north of the existing Inshes Junction in order to reduce the steepness of the gradient. The

A9 diverge slip will be constructed over Hummocky Glacial Deposits, whilst the A9 southbound merge slip will also feature an embankment, constructed over undifferentiated Glacial Till.

Cradlehall Roundabout – Smithton Junction – Ashton Farm: All Options

5.8.19 From the Cradlehall roundabout the main option follows a straight alignment heading northwards, rising on an embankment to pass over the railway line, and then continuing on embankment to meet the Ashton Farm Roundabout. From Ashton Farm Roundabout to the tie-in at the A96 Proposed Smithton Junction the A variant passes to the west of Ashton Farm and the B variant to the East of Ashton Farm.

5.8.20 In terms of ground conditions, the majority of the Ashton Farm area to the north of the Highland Main Line Railway is anticipated to be underlain by Raised Marine Tidal Flat Deposits and Glacio-fluvial Sheet Deposits, with tracts of Alluvium in close proximity to the watercourses. South of the Highland Main Line Railway, the alignment follows a tract of Alluvium over Hummocky Glacial Deposits. Although Alluvium is identified on the geological maps, it was not identified within the 2008 ground investigation exploratory holes.

5.8.21 The link to Inverness Retail and Business Park, whilst predominantly over Glacio-fluvial Sheet Deposits, will pass over a tract of Alluvium in the vicinity of the watercourses.

5.8.22 Ground investigation boreholes indicate that the proposed Highland Main Line Railway bridge founding conditions are likely to consist of dense to very dense sands and gravels, with occasional boulders and cobbles; spread foundations are likely to be viable for the structure.

5.8.23 A number of small culverts will be required to accommodate the Cairnlaw Burn and its tributaries; spread foundations are anticipated.

A96 Smithton Junction Roundabout: All Options

5.8.24 All options will tie into the A96 at the proposed new Smithton Junction. The roundabout will be at or close to the level of the existing C1032 Barn Church Road.

5.8.25 Immediately south-east of the roundabout is the course of the deeply incised Cairnlaw Burn, which flows from south-west to north-east – the route of the new link will be in close proximity to this and earthworks may need to extend into this 'channel' feature. The superficial deposits exposed in this area include Raised Marine Tidal Flat Deposits and Raised Marine Shoreface Deposits, as well as more recent Alluvium present along the floor of the channel adjacent to the burn.

B9006 Culloden Road – Proposed Parallel Inshes Overbridge: Option 3 A and B Variants

5.8.26 A new bridge over the A9 next to the existing Inshes bridge, will require the adjacent embankments to be widened towards the east and west in order to accommodate the additional carriageway.

5.8.27 Foundation conditions for any embankments are anticipated to be glacial till over the Inshes Flagstone Formation (sandstone). It is unknown what material was used to construct the highway embankment, but steep side slopes suggest a granular fill may have been used.

5.8.28 Based upon the existing ground investigation information for the bridge, the foundation conditions for any future works are in excess of 15.5m of Glacio-fluvial Sheet Deposits (sand and gravel) over the Hillhead Sandstone Formation; with reference to the As-built drawings, it is known that the existing bridge is supported on spread foundations.

A9 southbound lane gain/drop: All Options

5.8.29 The lane gain/drop is to provide an additional southbound lane to the A9 dual carriageway between Raigmore Junction and Inshes Junction. In Options 1 and 3, the lane gain/drop will end at the existing Inshes Junction diverge slip road, and the width can be accommodated by the existing Inshes Junction

Overbridge. For Option 2, the lane gain/drop will lead into the proposed A9 southbound diverge slip road. The existing Inshes Junction overbridge will need to be demolished and reconstructed in order to provide headroom clearance to the new slip road.

5.8.30 The existing A9 along this section is in shallow cutting; in order to accommodate the additional lane, the cutting will need to be widened, by excavating the existing batter. This excavation work will mainly encounter Glacio-fluvial Sheet Deposits (sand and gravel); bedrock, in the form of Hillhead Sandstone Formation is anticipated at significant depth and should not impact on widening works. The high ground at the north end of this section where the Golden Bridge (footbridge) is located as capped with Raised Beach Deposits, comprising sand, gravel, shingle and diamicton.

Discussion

5.8.31 All of the options require the use of embankments to cross over the Highland Main Line Railway, and Options 1 and 2 require embankments to cross over B9006 Culloden Road and the A9. There is very little in the way of excavation (cuttings) proposed, so a net import of earthworks general fill will be required.

5.8.32 Assuming the majority of the fill will need to be imported, then a Class 1 general fill is recommended that will allow 1V:2H embankment side slopes to be constructed in order to minimise both the volume and footprint of the earthworks, and consequently also reduce the required land-take to a minimum. The optimised volumes will reduce the number of lorry movements required to import fill to site.

5.8.33 The Geotechnical Constraints Plan, Drawing B2103501-GE-0000-DR-002 (Volume 2) indicates the areas where the ground conditions may adversely affect the scheme proposals. These elements are specifically:

- Presence of alluvium: Alluvium as identified on the geological maps and from the available ground investigation information; this material may result in localised soft ground, leading to settlement and/or instability of overlying construction (embankments and structures).

- Glacial Outwash Channel: This feature is identified at the proposed location of the bridge carrying the new road over the A9 in Options 1 and 2 Because of the presence of the channel the A9 is on a 4m high embankment at this location. Consequently, significant quantities of fill will be required to construct the highway embankment, as the channel will need to be infilled. This may impact on the design of the proposed A9 overbridge foundations.

- Made Ground infilling the Glacial Outwash Channel alongside the A9: This feature is identified at the proposed location of the bridge carrying the new road over the A9 in Options 1 and 2. The fill appears to have been placed as the arisings from an excavation to the south of Simpsons Garden Centre. At present it is unknown whether the fill was placed and compacted as an engineering fill, and whether it will be able to support additional earthworks without re-engineering or improvement. It is possible that this fill may contain contamination.

- Contaminated Ground: Recognised potential contamination in proximity to the route has been identified in the form of a licensed Pet Cemetery to the rear of the veterinary practice on Culloden Road. Its location will only affect the A9 diverge slip embankment in Option 2, which will encroach into the area of the licensed site.

5.8.34 The incidence of alluvium will affect all options, while the presence of the glacial outwash channel will affect Options 1 and 2. The known contaminated ground issue only impacts on the A9 southbound diverge included in Option 2.

Earthworks Volumes and Materials

5.8.35 It is not appropriate to fully work up the volumes for earthworks at Stage 2, but some preliminary assessments giving comparative volumes (shown in Table 5.9) have been generated (to the nearest 1,000m^3) for comparative purposes:

Table 5.9: Earthworks Volumes per Option

	Option 1A	Option 1B	Option 2A	Option 2B	Option 3A	Option 3B
Fill (m3)	313,000	378,000	383,000	449,000	152,000	219,000
Cut (m3)	6,900	12,000	7,500	12,600	7,600	12,600

5.8.36 The majority of the fill will be required for the embankments south of Cradlehall Roundabout in Options 1 and 2, the difference in fill between the two options being related to the A9 slip roads in Option 2. The significant approach embankments on both sides of the bridge over the Highland Main Line Railway are common to all options.

5.8.37 To the north of Cradlehall Roundabout, the routes east of Ashton Farm (B Variant) will require more fill than the options to the west (A Variant); this is primarily because the length of the link to Inverness Retail Park is increased whilst on embankment.

5.8.38 It is anticipated that Topsoil (Class 5A) will be re-usable on the scheme.

5.8.39 It is anticipated that the materials to be excavated from site will be:

- Topsoil = Class 5A
- Shallow excavations for road pavement construction (at / close to grade) = Class 4; it is possible that some of this material could be processed to become Class 1 / 2.
- Poor formation materials (soft spots) beneath embankments = Class 4 / U1A.
- Excavation for A9 Widening = Class 4; Possibly Class 1 / 2.
- Excavation for drainage ponds = Class 4; Possibly Class 1 / 2.
- Drainage, Communications, etc. arisings = Class 4; Possibly Class 1 / 2.

5.8.40 Anticipated imported fill materials will be:

- Class 1 Granular General Fill – Class 1 is required on the assumptions of 1V:2H side slopes to earthworks (to limit footprint / land-take)
- Class 6F Capping – when pavement at/close to grade on poorer ground.
- Class 6N / 6P – Backfill to 'conventional' structures.
- Class 6N1 / 6P1 – Backfill to integral structures (no bearings).
- Lining for drainage attenuation lagoons (geo-composite or Class 2A fill).

<u>Unacceptable material and Contaminated Land</u>

5.8.41 Any arisings not required or acceptable for on-site use will need to be disposed of, either on-site or elsewhere; the imposition of Landfill Tax suggests that on-site disposal into environmental bunds and/or landscaping would be preferable.

5.8.42 Contaminated materials are not anticipated in any significant quantities, but material identified as such must be investigated in order to determine any special measures required to address any contaminants present. This could involve in-situ treatment or removal to a licensed disposal site depending upon the nature of the contamination.

5.9 Hydrology

5.9.1 The effects of the options on the water environment are considered fully in Part 3, Chapter 14 (Road Drainage and the Water Environment) of this report. This section provides a summary of the engineering issues related to watercourse crossings and road drainage.

5.9.2 A preliminary assessment of hydrology was made for each option. Following the selection of a preferred option, a review of the drainage and flood risk strategy would be undertaken during the DMRB Stage 3 assessment.

Watercourses

5.9.3 There are a number of watercourses located within the study area that are affected by the proposed options.

The Inshes Burn

5.9.4 The Inshes Burn flows from the south of Balvonie Wood and through the Dell of Inshes where it is culverted under the U1267 Dell of Inshes Road. It follows northwards crossing the B9006 Culloden Road and a number of local roads, the A9 near Raigmore Interchange, the Highland Main Line Railway, and continues through the Inverness Retail and Business Park, before forming a tributary to the Scretan Burn.

The Scretan Burn and its associated floodplain

5.9.5 The Scretan Burn flows from the south of Bogbain and has a number of tributaries, crossing the B9006 Culloden Road where it is culverted, before continuing through the Cradlehall community. It crosses the Highland Main Line Railway and flows on the east side of Inverness Retail and Business Park before continuing north through a culvert under the A96 and Aberdeen to Inverness Railway Line, before outfalling into the Moray Firth.

The Cairnlaw Burn and its associated floodplain

5.9.6 The Cairnlaw Burn flows from the south of Cradlehall and has a number of tributaries, crossing the B9006 Culloden Road and C1036 Tower Road where it is culverted. It passes through the Cradlehall community, crossing the Highland Main Line Railway and continues through on the east side of Ashton Farm. The Cairnlaw Burn flows close to the south-east side of the proposed A96 Smithton Junction, culverted under the C1032 Barn Church Road, followed by the A96 near Milton of Culloden and then the Aberdeen to Inverness Railway Line, before outfalling into the Moray Firth.

5.9.7 There are also a number of unnamed drainage ditches / indirect tributary networks which flow into Scretan Burn and Cairnlaw Burn.

5.9.8 Table 5.10 indicates the watercourses affected by each option and the proposed treatment.

Table 5.10: Watercourse Crossings

Option	Activity	1A	1B	2A	2B	3A	3B
Inshes Burn	Number of crossings	1	1	1	1	0	0
	Extend/re-construct existing culvert	0	0	0	0	0	0
	Watercourse to be culverted	1	1	1	1	0	0
Scretan Burn	Number of crossings	2	2	2	2	2	2
	Extend/re-construct existing culvert	0	0	0	0	0	0
	Watercourse to be culverted	2	2	2	2	2	2

Option	Activity	1A	1B	2A	2B	3A	3B
Tributary of Scretan Burn (1)	Number of crossings	1	1	2	2	2	2
	Extend/re-construct existing culvert	0	0	1	1	1	1
	Watercourse to be culverted	1	1	1	1	1	1
Tributary of Scretan Burn (2)	Number of crossings	2	2	2	2	2	2
	Extend/re-construct existing culvert	0	0	0	0	0	0
	Watercourse to be culverted	1	1	1	1	1	1
Cairnlaw Burn	Number of crossings	2	2	2	2	2	2
	Extend/re-construct existing culvert	0	0	0	0	0	0
	Watercourse to be culverted	1	2	1	2	1	2
Total crossings		8	8	9	9	8	8

5.9.9 The options have a broadly similar number of watercourse crossings. Option 2 has the largest number with 9 watercourse crossings, and Options 1 and 3 have the least with 8 crossings.

Drainage

5.9.10 A preliminary drainage design has been carried out to identify potential outfalls, catchment areas and treatment pond sizes to inform the engineering and environmental assessments of each option. The design of drainage systems will be developed further as part of the DMRB Stage 3 assessment, once a preferred option has been identified.

5.9.11 The design will incorporate Sustainable Drainage Systems (SuDS) which will include the provision of measures such as swales, filter drains, and ponds or basins. The intention of such systems is to limit the rate of surface water discharging from the carriageway into existing watercourses in all but extreme weather situations and provide treatment to reduce the concentration of pollutants entering the watercourses. This will be achieved through the provision of detention basins at frequent intervals, containing the surface water runoff generated by the proposed scheme and allowing a controlled flow into the watercourse.

5.9.12 On approach to the proposed Ashton Farm roundabout and the A96 Smithton Junction, the proposed Options 1, 2, and 3 cross the Scretan Burn and Cairnlaw Burn floodplain on an embankment. Between all options, the A variant has the least reduction to floodplains compared with the B variant, due to the proximity of the B variant to the Cairnlaw Burn functional floodplain. The vertical alignment would be reconsidered during DMRB Stage 3 to help mitigate the risk of flooding in this area

5.10 Structures

Introduction

5.10.1 This section provides a general overview of the requirements for structures between Inshes and Smithton. Whilst there is a degree of repetition between the requirements for the various options where they follow generally the same alignment, e.g. Options 1A and 1B between the A9 and the Highland Main Line Railway, the requirements for each option have been stated fully for ease of reading and to avoid confusion.

5.10.2 Where individual structures are described, only outline details have been provided as further details will be developed during the DMRB Stage 3 assessment following preferred option selection. All structure proposals described below comply with the DMRB and it is not envisaged that any Departures from Standard will be required at this stage of the scheme development in relation to the proposed structures.

5.10.3 The proposals are based on concrete construction, either cast insitu or precast, where span lengths permit as this is generally the most cost effective type of construction. However, where larger spans cannot be avoided, steel concrete composite construction is proposed.

5.10.4 In addition, wherever possible, integral construction has been proposed to minimise long term maintenance requirements and costs where the overall length of the structure does not exceed 60m and the skew does not exceed 30 degrees. In other cases, bearings and movement joints will be provided in conjunction with abutment inspection galleries where integral construction is not appropriate.

Underbridges

5.10.5 The carriageway and hard strips of the mainline will be continued over decks of underbridges. In addition, verges of the mainline carriageway shall be carried over underbridge decks with no reduction of width in accordance with Clause 5.6 of TD 27/05 of the DMRB.

Overbridges

5.10.6 The carriageway and where provided, hard strips, of side roads will be continued over the decks of overbridges. In addition, the verges of side roads carried by overbridges shall be continued across overbridges and verges to the mainline below overbridges shall be continued through the structure with no reduction of width in accordance with Clause 5.6 of TD 27/05 of the DMRB.

5.10.7 At certain locations, it may be necessary to widen bridge decks of both underbridges and overbridges and to lengthen overbridges and increase the spans of underbridges to cater for sightline requirements where road alignments involve sufficiently low radius curves or where structures are located in the vicinity of junctions. In each case, widening would be accomplished by increasing the width of the verge(s) and central reserve as appropriate.

Option 1

5.10.8 Option 1 requires the provision of one overbridge, one underbridge and one railway overbridge between Inshes in the south and the Smithton Junction in the north and these structures can be summarised as follows:

A9 Overbridge (Option 1)

5.10.9 This structure carries the proposed A9/A96 Inshes to Smithton road over the existing A9 Trunk Road and consists of a three span structure comprising precast beam and slab type construction. Intermediate supports will comprise circular columns or slab wall piers whilst the end supports will comprise free standing bankpad abutments with inspection galleries and wingwalls on spread footings. The cross section over the structure will comprise a 7.3m wide carriageway and a 3.0m wide NMU route incorporating a 0.6m wide separation.

B9006 Culloden Road Underbridge (Option 1)

5.10.10 This structure carries the proposed A9/A96 Inshes to Smithton road over the existing B9006 Culloden Road and consists of a single span structure comprising precast beam and slab type construction. End supports will comprise half height integral abutments and wingwalls on spread footings. The cross section over the structure will comprise a 7.3m wide carriageway and a 3.0m wide NMU route incorporating a 0.6m wide separation.

Cradlehall Railway Bridge (Option 1)

5.10.11 This structure carries the proposed A9/A96 Inshes to Smithton road over the Highland Main Line Railway and consists of a single span portal type structure with a minimum clear span of 19.0m for variant A and 22m for variant B, between abutment walls to accommodate the existing twin track and 4.5m minimum clearance from the outer rails to the adjacent abutment walls. The clear span will also accommodate

signal sighting on the curved track through this structure. The cross section over the structure will comprise a 7.3m wide carriageway, a 3.0m wide NMU route incorporating a 0.6m wide separation and 2.0m wide verge on each side. End supports will comprise cast insitu concrete abutments and wingwalls supported on spread footings whilst the deck will consist of precast prestressed beams with solid infill in order to minimise works over the railway. Consultation with Network Rail will be required to confirm aspects such as vertical and horizontal clearances and parapet requirements along with requirements for working adjacent to and over the railway during construction.

Option 2

5.10.12 Option 2 requires the provision of two overbridges, one underbridge and one railway overbridge between Inshes in the south and the Smithton Junction in the north and these structures can be summarised as follows.

Inshes Overbridge (Option 2)

5.10.13 This structure carries the existing B9006 Culloden Road over the existing A9 Trunk Road to replace the existing Inshes Overbridge (A9 1330) and consists of a three span structure comprising steel concrete composite type construction. Intermediate supports will comprise circular columns or slab wall piers whilst the end supports will comprise free standing bankpad abutments with inspection galleries and wingwalls on spread footings. The cross section over the structure will comprise a 7.3m wide carriageway and a 3.0m wide NMU route incorporating a 0.6m wide separation.

A9 Overbridge (Option 2)

5.10.14 This structure carries the proposed A9/A96 Inshes to Smithton road over the existing A9 Trunk Road and consists of a three span structure comprising precast beam and slab type construction. Intermediate supports will comprise circular columns or slab wall piers whilst the end supports will comprise free standing bankpad abutments with inspection galleries and wingwalls on spread footings. The cross section over the structure will comprise a 7.3m wide carriageway and a 3.0m wide NMU route incorporating a 0.6m wide separation.

B9006 Underbridge (Option 2)

5.10.15 This structure carries the proposed A9/A96 Inshes to Smithton road over the existing B9006 Culloden Road and consists of a single span structure comprising precast beam and slab type construction. End supports will comprise half height integral abutments and wingwalls on spread footings. The cross section over the structure will comprise a 7.3m wide carriageway and a 3.0m wide NMU route incorporating a 0.6m wide separation.

Cradlehall Railway Bridge (Option 2)

5.10.16 This structure carries the proposed A9/A96 Inshes to Smithton road over the Highland Main Line Railway and consists of a single span portal type structure with a minimum clear span of 19.0m for variant A and 22m for variant B, between abutment walls to accommodate the existing twin track and 4.5m minimum clearance from the outer rails to the adjacent abutment walls. The clear span will also accommodate signal sighting on the curved track through this structure. The cross section over the structure will comprise a 7.3m wide carriageway, a 3.0m wide NMU route incorporating a 0.6m wide separation and 2.0m wide verge on each side. End supports will comprise cast insitu concrete abutments and wingwalls supported on spread footings whilst the deck will consist of precast prestressed beams with solid infill in order to minimise works over the railway. Consultation with Network Rail will be required to confirm aspects such as vertical and horizontal clearances and parapet requirements along with requirements for working adjacent to and over the railway during construction.

Option 3

5.10.17 Option 3 requires the provision of a new parallel structure, to the existing Inshes overbridge and the provision of one railway overbridge between Inshes in the south and the Smithton Junction in the north and these structures can be summarised as follows.

Inshes Overbridge (Option 3)

5.10.18 A new parallel structure, to the existing Inshes overbridge will be required to provide a dual carriageway cross section which will comprise two 7.3m wide carriageways, and a 3.0m wide NMU route incorporating a 0.6m wide separation.

Cradlehall Railway Bridge (Option 3)

5.10.19 This structure carries the proposed A9/A96 Inshes to Smithton road over the Highland Main Line Railway and consists of a single span portal type structure with a minimum clear span of 19.0m for variant A and 22m for variant B, between abutment walls to accommodate the existing twin track and 4.5m minimum clearance from the outer rails to the adjacent abutment walls. The clear span will also accommodate signal sighting on the curved track through this structure. The cross section over the structure will comprise a 7.3m wide carriageway a 3.0m wide NMU route incorporating a 0.6m wide separation and 2.0m wide verge on each side. End supports will comprise cast insitu concrete abutments and wingwalls supported on spread footings whilst the deck will consist of precast prestressed beams with solid infill in order to minimise works over the railway. Consultation with Network Rail will be required to confirm aspects such as vertical and horizontal clearances and parapet requirements along with requirements for working adjacent to and over the railway during construction.

5.10.20 Table 5.11 below shows a summary of the number of structures required on the different corridor options.

Table 5.11: Number of Structures required for each Option

Option	No. of Road Bridges	No. of River Bridges	No. of Rail Bridges	No. of Underpasses	No. of Retaining Walls	No. of Culverts
Option 1A	2	0	1	0	0	6
Option 1B	2	0	1	0	0	7
Option 2A	3	0	1	0	0	6
Option 2B	3	0	1	0	0	7
Option 3A	1	0	1	0	0	5
Option 3B	1	0	1	0	0	6

Ancillary Structures

5.10.21 All options require the provision of a number of ancillary structures such as culverts, retaining walls and farm accommodation underpasses and overbridges which shall have the following general structural arrangements. In addition, all structures will require the provision of vehicle parapets and pedestrian protection as described below.

Culverts

5.10.22 At present it has been assumed that all watercourses crossing the line of the options will require a culvert which shall be sized to accommodate the required design flood flows as described in Section 5.9 above. Culverts shall generally consist of reinforced concrete pipes or either precast or cast insitu concrete box construction thus minimising construction and maintenance costs. Wingwalls provided at each end of

a culvert may consist of either precast or cast insitu reinforced concrete. Where pipes of less than 2.0m diameter are provided, these are not classified as a structure but shall form part of the drainage system except that corrugated steel buried structures of span of 0.9m or greater shall be classified as structures in accordance with Clause 3 of BD 2/12 of the DMRB.

5.10.23 Where existing culverts require to be extended the extensions shall generally be of the same cross section and materials as the existing culvert where practicable.

Retaining Walls

5.10.24 Where retaining walls are required, these may be of reinforced concrete cantilever construction or alternatively, may be constructed using bored piles depending on the ground conditions pertaining at each location. Bored pile walls would be faced with either an insitu concrete facing or a masonry facing to provide an acceptable finish. In the case of reinforced concrete walls, these would have either a pattern profile finish or a masonry facing finish.

Farm Accommodation Underpasses

5.10.25 Where required, farm accommodation underpasses shall be of either precast or cast insitu reinforced concrete elements placed together with the internal carriageway and verge widths and vertical clearances determined to suit the particular agreement with the affected landowner.

5.10.26 Where precast concrete type structures are provided, these may be of a bespoke design prepared by manufacturers of proprietary type structures.

Farm Accommodation Overbridges

5.10.27 Where required, farm accommodation overbridges shall be of a similar type of construction as side road overbridges with the carriageway and verge widths determined to suit the particular agreement with the affected landowner.

Vehicle Containment and Pedestrian Restraint over Structures

5.10.28 Generally, vehicle containment over structures shall consist of 1.0m high N2 (Normal Containment Level) parapets of metal construction with mesh infill in accordance with Clause 4 of TD 19/06 of the DMRB. However, in the case of accommodation bridges, the parapet height shall be increased to 1.5m and where parapets are located adjacent to NMU routes, the parapet height shall be 1.4m to accommodate both cyclists and pedestrians.

5.10.29 In the case of structures crossing over railway lines, containment shall be H4a (Very High Containment Level) parapets of either metal construction with solid infill or concrete construction and be 1.5m high. Where concrete parapets are adopted, these may be of either cast insitu or precast concrete construction. In the case of both metal and concrete parapets over railways, a steeple cope will be provided to prevent pedestrian access on top of the parapet. The final form and details of the parapets shall be agreed with Network Rail.

5.10.30 In all cases, suitable transitions and connections shall be made between parapets over structures and safety barriers on the approach and exit ends to each structure in accordance with Clause 6 of TD 19/06 of the DMRB.

5.10.31 Where retaining walls, underpasses and culverts are provided, pedestrian restraint systems shall be provided at the top of headwalls and wingwalls in accordance with Clause 9 of TD 19/06 of the DMRB. In addition, pedestrian restraint systems shall also be provided at the top of wingwalls to bridges where these are not protected by vehicle restraint systems.

5.11 Utilities

5.11.1 There are significant number of buried and overhead public and private utility services within the study area including:

- Scottish and Southern Energy (SSE) – high voltage, medium voltage and low voltage overhead and underground services;
- Telecommunications – British Telecom overhead and buried services, Vodafone underground services and Scottish and Southern Energy underground telecom cables;
- Scottish Water supply network – existing and abandoned water mains;
- Scottish Water sewer network – surface, foul water and combined sewers;
- Scotia Gas Networks – low and intermediate pressure pipelines;
- CLH pipeline system (formerly government pipeline and storage system) – aviation fuel and pipeline; and
- Street lighting – there are areas of the existing road network that feature street lighting and will therefore include underground power cables in the vicinity of the lighting.

5.11.2 The key utilities in the study area are shown on Drawing B2103501-UT-0000-DR-001 (Volume 2).

5.11.3 In accordance with the New Roads and Street Works Act (1991) C2 notices were issued to each of the utility providers to provide details of their networks within the study area to enable all potential clashes between options and utility infrastructure to be clearly identified. Where possible, the vertical and horizontal alignments have been developed to avoid or minimise clashes with key strategic elements of each provider's network. Due to similarities in the alignments, the majority of the scheme extents have similar effects on utilities.

5.11.4 Where it has not been possible to avoid a clash with key strategic parts of the utility providers, a further consultation would be undertaken with the relevant provider during DMRB Stage 3, having identified a preferred option and C3 notices issued requesting an outline design and costing for resolution of key utility clashes.

5.11.5 A broad-based assessment has been undertaken for cost estimating purposes at this stage of the scheme development.

Scottish and Southern Energy (SSE)

Network

5.11.6 SSE electricity supply infrastructure covers large areas both in and around the study area. The key elements of the network include:

33kV (high voltage) power lines

5.11.7 This utility generally travels in an easterly direction through the study area passing over the Inverness to Highland Main Line Railway, east of the A9. There is a branch off of this line towards Inverness Retail and Business Park.

Overhead and underground cables

5.11.8 These cables carry the 11kV (medium voltage) and low voltage power into homes, businesses and educational facilities in the study area. The majority of the underground cables service the more densely populated areas in the study area.

Impacts

5.11.9 Table 5.12 summarises the number of interfaces with the SSE network for each options

Table 5.12: Number of interfaces with SSE

Option	Impacts on 132kV Line	Impacts on 33kV Overhead Line	Impacts on 33kV Underground Line	Impacts on 11kV Overhead Line	Impacts on 11kV Underground Line	Total
1A	0	4	1	1	0	6
1B	0	4	1	2	0	7
2A	0	4	1	1	0	6
2B	0	4	1	2	0	7
3A	0	4	1	1	0	6
3B	0	4	1	2	0	7

5.11.10 The options broadly have similar number of impacts, with options on the east side of Ashton Farm accounting for the difference. Options 1A/2A/3A impact the SSE network in 6 locations and Options 1B/2B/3B impact the SSE network in 7 locations. It should be noted that each impact varies in length, but this assessment considers interfaces and the potential disruption to the network. The estimated overall length of diversions and detail would be considered during the DMRB Stage 3 development.

Telecommunications

Network

5.11.11 Telecommunications infrastructure covers the majority of the study area. The key elements of the network include:

British Telecom (BT) underground supply network

5.11.12 The utility is located throughout the study area. There are apparatus adjacent to the local roads network and the private access leading to Ashton Farm, servicing homes, businesses and educational facilities.

BT overhead (O/H) supply network

5.11.13 This utility is not as prevalent as the underground supply network. The overhead apparatus connects to the underground services along the local roads network.

Vodafone

5.11.14 This utility is not as prevalent as the BT apparatus in the study area. It runs along the B9006 Culloden Road.

Scottish and Southern Energy (SSE) - Telecom underground supply network

5.11.15 This utility is not as prevalent as the BT apparatus in the study area. It runs along the B9006 Culloden Road.

Impacts

5.11.16 Table 5.13 summarises the number of interfaces with the telecommunications network for each option:

Table 5.13: Number of interfaces with telecommunications

Option	Impacts on BT U/G network	Impacts on BT O/H network	Impacts on Vodafone U/G cable	Impacts on SSE U/G cable	Total
1A	13	2	1	1	17
1B	12	2	1	1	16
2A	14	2	2	2	20
2B	13	2	2	2	19
3A	8	1	1	1	11
3B	7	1	1	1	10

5.11.17 There are significantly more impacts between Options 1A/B and 2A/B and the BT underground network than any other element of the telecommunications utility network.

5.11.18 Option 2A impacts on telecommunications network on 20 occasions, the most of all options, compared with the 10 impacts on Option 3B, the least of all options. It should be noted that each impact varies in length, but this assessment considers the total number of impacts, and so the potential disruption to the network.

Scottish Water

Network

5.11.19 Scottish Water infrastructure covers the majority of the study area. The key elements of the network include:

Freshwater supply

5.11.20 In addition to the freshwater supply through the water mains, there are a number of abandoned water mains in the study area. The network serves homes, educational facilities and businesses throughout the study area.

Wastewater infrastructure

5.11.21 The wastewater network comprises combined sewer outfalls, foul water sewers and surface water sewers. The network services homes, educational facilities and businesses in the study area, with the majority of the network concentrated in the more densely populated Inshes and Cradlehall areas.

Impacts

Table 5.14 summarises the number of interfaces with the water mains network for each option:

Table 5.14: Number of interfaces with water mains

Option	Impacts on water mains	Impacts on abandoned water mains	Total
1A	7	1	8
1B	7	2	9
2A	8	2	10
2B	8	3	11
3A	6	0	6
3B	6	1	7

5.11.22 Options 2A/B impact on the freshwater supply network on 8 occasions, the most of all options. Options 3A/B impact on the freshwater supply network on 6 occasions, the least of all options.

5.11.23 Table 5.15 summarises the number of interfaces with the foul water network for each option:

Table 5.15: Number of interfaces with foul water utilities

Option	Impacts on combined sewer	Impacts on Foul Water Sewer	Impacts on abandoned water mains	Total
1A	3	0	1	4
1B	2	0	1	3
2A	3	0	1	4
2B	2	0	1	3
3A	3	0	1	4
3B	2	0	1	3

5.11.24 All proposed options impact on the wastewater network commonly in two locations on the immediate approach to the proposed A96 Smithton Junction. This is significantly less than the number of impacts on freshwater network.

Scotia Gas Networks (SGN)

Network

5.11.25 SGN infrastructure is not prevalent in the study area and predominantly along the A9, A96 and main local roads. Key elements of the network include:

Intermediate pressure mains

5.11.26 This utility is predominantly along the west side of the A9 and the south side of the A96, and also present on Caulfield Road.

Low pressure mains

5.11.27 The utility is predominantly in the communities of Castlehill and Cradlehall areas.

Impacts

5.11.28 Table 5.16 summarises the number of interfaces with the gas network for each option:

Table 5.16: Number of interfaces with gas utilities

Option	Impacts on Intermediate Pressure mains	Impacts on Low Pressure Mains	Total
1A	2	1	3
1B	2	1	3
2A	2	1	3
2B	2	1	3
3A	2	1	3
3B	2	1	3

5.11.29 All the options impact the SGN infrastructure on 3 occasions. It should be noted that each impact varies in length, but this assessment considers the total number of impacts, and so the potential disruption to the network.

5.11.30 The interface with the SGN infrastructure along the A9 is primarily dependent on the location of abutment of proposed overbridges. It should be noted that any SGNs diversionary work where required would only occur during a summer period of April to September.

CLH Pipeline System (formally Government Pipeline and Storage System (GPSS))

Network

5.11.31 The Inverness – Lossiemouth fuel pipeline is located to the south of the A96 and runs in a generally north-easterly direction, adjacent to the study area.

5.11.32 The proposed diversionary works under the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme at the proposed A96 Smithton Junction is likely to interface with all the options. The proposed diversionary route has been considered as part of this study.

5.12 Constructability

5.12.1 All options include lengths of both online and offline construction, with majority of the sections largely offline. Online construction generally involves using the existing carriageway to construct the new road which can be parallel to the existing or widening the existing. A continuous traffic management system would be required throughout construction to maintain the existing traffic movement.

5.12.2 There are critical safety issues with online construction, such as working adjacent to a live carriageway, which will be considered in more detail during the development of the preferred option.

5.12.3 Options 1, 2 and 3 contain online sections as a result of the proposed A9 southbound lane gain/drop between Raigmore Interchange and Inshes Junction. In addition to the proposed A9 southbound lane gain/drop, Options 1 and 2 contain online sections at U1267 Dell of Inshes Road and Option 3 contains an online section at B9006 Culloden Road where it requires the existing carriageway to be widened to accommodate two lanes in both directions. Options 1, 2 and 3 contain online sections at U1058 Caulfield Road North.

5.12.4 Offline construction, where the new road is constructed in a different corridor from the existing road, does not have the same traffic management issues as online construction. For offline construction, traffic management would only be required at junctions where the proposed road intersects with the existing road network, where the proposed road ties-in with the existing road, or where the proposed road ties-in with site accesses. For all options, the proposed arrangement on the east side of the Highland Main Line Railway is offline, traversing mainly agricultural land.

5.12.5 There are several elements which may pose particular constructability issues. These include the construction of bridges over the A9 and the Highland Main Line Railway.

5.12.6 Construction of bridges over the A9 would require traffic management which may involve temporary road closures and traffic diversion between specific times during the works. Option 2 would require the demolition and replacement of the existing Inshes Overbridge, which would pose a significant constructability issue due to the lack of an available diversion route for the B9006 Culloden Road which crosses the A9 on this structure.

5.12.7 To alleviate this issue, a construction phasing plan can be adopted by building the proposed overbridge on the A9 and associated links into Dell of Inshes and Cradlehall, located further south of the existing junction, which would form part of the proposed grade-separated junction. The proposed overbridge on the A9 and associated links could then be used for temporary traffic management while work on the existing Inshes Overbridge is undertaken.

5.12.8 Consultation with Network Rail will be required to confirm structural details for the bridge over the Highland Main Line Railway in addition to planning any temporary line possessions during construction.

5.12.9 A further construction issue through the study area is the presence of high voltage overhead electrical cables and poles, which are in close proximity to the study area and interfaces with all of theoptions. Where possible, the high voltage overhead electrical cables would require isolating or re-routing from the works area.

5.12.10 At the next stage of the scheme development, careful consideration of construction phasing plan and the maintaining of access during the construction period would be considered.

5.13 Non-Motorised Users

5.13.1 For ease of reference, the term Non-Motorised Users (NMUs) is used to describe pedestrians, cyclists and equestrians.

5.13.2 The effects of the options on all travellers, including NMUs, are considered in Part 3, Chapter 16 (Effects on All Travellers) of this report where the impacts of the options are assessed.

5.13.3 The following objectives have been set in terms of NMU provision for the scheme:

- 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 (EIATC) 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.

5.13.4 In order to meet the objectives for NMUs and address the impacts identified in Part 3, Chapter 16 (Effects on all Travellers) of this report, NMU improvements will be considered during design development of the preferred option during DMRB Stage 3.

5.14 References

Geological Maps:

Fortrose, Scotland Sheet 84(W), Solid and Drift Edition, 1997, 1:50,000, BGS

Sheet NH64SE, Solid and Drift Edition, 1991, Inverness South, 1:10,000, BGS

Sheet NH64NE, Solid and Drift Edition, 1991, Inverness North, 1:10,000, BGS

Sheet NH74NW, Solid and Drift Edition, 1991, Smithton, 1:10,000, BGS

Geology of the Fortrose and Eastern Inverness District, memoir for 1:50,000 Geological Sheet 84W (Scotland), HMSO, 1996

A96 Dualling Inverness to Nairn (including Nairn Bypass), DMRB Stage 2 Scheme Assessment Report, Part 2: Engineering Assessment, Jacobs UK (On behalf of Transport Scotland), 2014

6. Engineering Summary

6.1 Introduction

6.1.1 This chapter summarises the findings in Chapter 4 Engineering Overview and Chapter 5 Engineering Assessment. A Summary of each engineering issue is provided which identifies if any options are more or less favourable with regard to that issue.

6.2 Road Geometric Design

6.2.1 Each option has been assessed for compliance with the design standards relating to geometry and anticipated Departures from Standard. The anticipated Departures from Standard are associated with the proposed A9 southbound lane gain/drop arrangement between Raigmore and Inshes Junction and is common to all options. The anticipated Departures from Standard have been described in detail in Section 5.6.

6.3 Local Roads

6.3.1 Option 2 will affect the local road network to a greater extent than Options 1 and 3. Option 3 would least affect the local road network.

6.4 Geotechnics and Earthworks

6.4.1 The options can be split into two areas, north and south of the proposed Cradlehall Roundabout. To the north of the proposed Cradlehall Roundabout, the options feature similar ground conditions, and both options require a net import of general fill material. Based on the import of general fill material, the preferred option is to the west of Ashton Farm, as the volume of import is reduced (primarily due to the reduction in length of the embankment providing access to the Inverness Retail and Business Retail Park).

6.4.2 To the south of the proposed Cradlehall Roundabout, all of the options are different and as such, require differing engineering requirements. Consequently, the 'do least option' (Option 3) is preferred, whilst the most challenging engineering option (Option 2) is the least preferred.

6.5 Hydrology

6.5.1 The environmental issues associated with drainage and hydrology are discussed in Part 3, Chapter 14 (Road Drainage and the Water Environment) of this report.

6.5.2 All options have a broadly similar number of watercourses and associated flood plain crossings. The option selected as the preferred option, will require further detailed flood assessment to be undertaken at DMRB Stage 3. There may also be a need for compensatory flood storage.

6.6 Structures

6.6.1 Options 1 and 2 require greater number of road structures and culverts than Options 3. All options require the construction of a bridge over the Highland Main Line Railway. The main differentiating factor between the options is the requirement of demolition and replacement of the existing Inshes Overbridge for Options 2, which will increase the engineering complexity of these options.

6.7 Utilities

6.7.1 The utility that poses the greatest constraint is the high voltage overhead lines there are significantly more impacts in Option 1 and 2. There are interfaces with Scottish Water, Option 2 impacts the freshwater supply network on 8 occasions, the most of all options. Option 2A also impacts on the telecommunication network on 20 occasions, again the most of all options.

6.8 NMU

6.8.1 There are no significant engineering issues associated with NMU's. NMU provision on the preferred option will be designed and developed during the DMRB Stage 3 assessment.

6.9 Constructability

6.9.1 From the perspective of constructability, all Options entail the construction of a bridge over the Highland Main Line Railway. Construction of the Culloden Road Overbridge and the A9 Overbridge is necessary for Options 1 and 2. The most significant technical challenge likely to be experienced on the proposed scheme are the works required to either demolish or add to the existing Inshes Overbridge. These works are associated with Options 2 and 3. Option 3 requires the technically challenging works to Inshes Overbridge, including the addition of a new parallel structure next to the existing Inshes overbridge to accommodate provision of a dual-2-lane carriageway. Option 3 is therefore considered to impact upon feasibility to a greater extent than Option 1 but to a lesser extent than Option 2.

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