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A96 DUALLING
HARDMUIR TO FOCHABERS

A96 Dualling

Hardmuir to Fochabers scheme

DMRB Stage 2
Scheme Assessment Report

Volume 1 – Part 2
Engineering Assessment

December 2018

transport.gov.scot/project/
a96-hardmuir-fochabers

A96 Dualling Hardmuir to Fochabers

DMRB Stage 2 Scheme Assessment Report
Volume 1
Part 2 – Engineering Assessment

A96PHF-MMS-GEN-00000-RP-Z-00023

Revision Record

Ver No	Date	Originator	Checker	Approver	Status	Suitability
C03	Dec 2018	Various	Various	JMH	A2	Approved for Stage Complete

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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 the shortlisted options. Refer to Figure 3.11 (Volume 5).

4.1.2. The engineering assessment of the shortlisted options is presented in the following three chapters:

- Chapter 5 - Hardmuir to Hillhead;
- Chapter 6 - Hillhead to Lhanbryde; and
- Chapter 7 - Lhanbryde to East of Fochabers.

4.1.3. The engineering assessment presents key engineering issues and findings. A concluding summary is provided for each engineering issue which identifies if any option is more or less favourable.

4.2 Design Considerations

4.2.1. The following physical features have been considered during the design process and are shown on the figures in Volume 5 of this report:

- **Properties and local communities**: the options have been developed to avoid the need for property demolition and, where possible, potential impacts on communities. Where practicable, the alignments have been developed to minimise severance;
- **Existing topography**: the vertical geometry of each option has been designed to optimise earthworks to achieve an overall earthworks balance where practicable while achieving the required headroom clearances to road, rail, and watercourse crossings, and ensuring appropriate road drainage;
- **Aberdeen - Inverness Railway Line**: following consultation with Network Rail, the design of the railway crossings take into account the necessary headroom and span requirements to accommodate potential improvements to the Aberdeen - Inverness Railway Line including double tracking and electrification;
- **Public utilities**: there are a number of underground and overhead utilities throughout the study area as summarised in Section 4.3;
- **Environmental constraints**: the options have been developed taking into account a number of designated protected areas such as, Special Area of Conservation (SAC), Ramsar sites, Sites of Special Scientific Interest (SSSI), scheduled monuments and listed buildings;
- **Local Road network:** the options have been developed taking account of the existing local road network; and
- **Junctions and accesses**: there are numerous existing direct accesses onto the existing A96 and the local road strategy maintains access to all properties. Details of junctions and accesses are reported in Volume 1, Chapter 2 (Existing Conditions) of this report.

4.2.2. The design of the options has been developed using a ground survey model, produced from a Light Detection and Ranging (LiDAR) survey undertaken in 2017. For the identification of ground features, digital images were collected to create an orthophoto map covering the entire survey area.

4.2.3. A further detailed topographical survey will be undertaken to inform the Design Manual for Roads and Bridges (DMRB) Stage 3 design. This will include a bathymetric survey of the major watercourses within the study area to inform the detailed flood modelling.

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 aim should be to provide drivers with layouts that have consistent Standards and are not likely to confuse them.

4.3.3. For the A96 Inverness to Aberdeen Dualling Programme, to meet the Scottish Government's commitment to connecting Scotland's cities with a high quality transport system, a Category 7A dual carriageway standard has been adopted. Category 7A is the highest category for a dual carriageway all-purpose road, where all junctions shall be grade separated and a smooth flowing alignment is accomplished using a defined set of design principles.

4.3.4. For a Dual 2 Lane Carriageway All Purpose (D2AP) road, the requirements in terms of access and junction treatments for Category 7A are outlined in DMRB (Volume 6, Section 1, Part 1, TD 9/93 Highway Link Design, Table 4) and are reproduced in Table 4.1 below.

Table 4.1 Rural Road Layouts (Based on TD 9/93 Table 4)

Category	Type of Road	Edge Treatment	Access Treatment	Minor Road Treatment	Major Junction Treatment
7A	D2AP	1m hard strips	No access except isolated existing access with left turns only. Clearway.	No minor junctions at-grade. No gaps in the central reserve.	Full grade separation

4.3.5. The options have been designed in accordance with the DMRB, in particular the following technical guidance and design standards as applicable:

- DMRB (Volume 6, Section 1, Part 1, TD 9/93 Highway Link Design);

- DMRB (Volume 6, Section 2, Part 3, TD 16/07 Geometric Design of Roundabouts);
- DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross-Sections and Headrooms);
- DMRB (Volume 6, Section 2, Part 1, TD 22/06 Layout of Grade Separated Junctions);
- DMRB (Volume 6, Section 2, Part 7, TD 41/95 Vehicular Access to All-Purpose Trunk Roads); and
- DMRB (Volume 6, Section 2, Part 6, TD 42/95 Geometric Design of Major/Minor Priority Junctions).

4.3.6. The design of the local roads takes account of Moray Council's Roads and Transport Guidelines for New Developments.

4.3.7. The mainline alignment of all options has been designed to a 120Akph Design Speed in accordance with TD 9/93.

4.3.8. The following Rural All-Purpose Dual Carriageway (D2AP) cross-section has been adopted for the mainline design in accordance with DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross-Sections and Headrooms):

- 7.3m carriageways;
- 1.0m hardstrip on both sides of each carriageway;
- 2.5m central reserve, with widening for visibility where required; and
- 2.5m verges, with widening for visibility where required.

4.3.9. The DMRB Stage 1 Report identified the aspiration that the entire length of the A96 Trunk Road be upgraded to a 20ft High Load Route as part of the A96 Dualling Programme. This determines that new construction headroom for overbridges on the trunk road as outlined in DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross Sections and Headrooms) as 6.45m +S (sag curve compensation).

4.3.10. In relation to underbridges (on the local road network), a standard headroom of 5.3m has been adopted, as agreed with Moray Council Roads Department.

4.3.11. At the western end of the Scheme the proposed dual carriageway will tie into the A96 Dualling Inverness to Nairn (including Nairn Bypass) dual carriageway at Hardmuir.

4.3.12. At the eastern end of the Scheme, the proposed dual carriageway will tie into the existing A96 single carriageway to the east of Fochabers. The tie-in has been designed in accordance with the guidance in DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross Sections and Headrooms) and DMRB (Volume 6, Section 1, Part 1, TD 9/93 Highway Link Design). This tie-in will remain in place until the Central Section (East of Fochabers to Huntly) of the A96 Duallling Inverness to Aberdeen is implemented.

Junctions

4.3.13. The junction configurations shown with each option are indicative layouts at this stage, in accordance with the A96 Dualling Inverness to Aberdeen Junction Strategy. They are

capable of maintaining/improving access between local and strategic connections. The Preferred Option junction configurations will be developed further during DMRB Stage 3.

Local Roads

4.3.14. For each option, an individual local road strategy has been developed for consideration and consultation has been undertaken with Moray Council Roads Department. A consistent approach has been adopted for each local road across all options.

4.3.15. This strategy proposes that the majority of the local roads will continue on their existing alignment over or under the dual carriageway to minimise potential community or agricultural severance. Where this is not practicable it is proposed to provide an appropriate diversion route to ensure connectivity for local roads is maintained.

Departures from Standard

4.3.16. At this stage in the design process, the geometric design standards are all at or above the desirable minimum standards in the DMRB. There are no Relaxations or Departures from Standard. Departures or Relaxations may be introduced during future design development to reduce environmental impacts or improve value for money, as appropriate.

Drainage

4.3.17. A preliminary drainage design has been carried out in accordance with the DMRB to identify potential outfalls, catchment areas and Sustainable Drainage Systems (SuDS) measures to attenuate or treat surface run-off, which will inform the engineering and environmental assessments of each option.

Earthworks

4.3.18. A desk-based assessment of the likely ground conditions has been undertaken. The geotechnical assessment is based on the Preliminary Sources Study Reports (Hardmuir to Newton; and Newton to Fochabers) prepared by Mott MacDonald Sweco in August 2017.

4.3.19. Other data sources include:

- British Geological Survey (BGS) 1:63,360 scale; 1:50,000 scale; 1:10,560 scale and 1:10,000 scale series geological maps for the area, and Memoirs of the Geological Survey Scotland: the Geology of the Elgin District;
- BGS historical borehole records;
- Exploratory hole logs provided by Moray Council;
- Historical mapping;
- Topographical mapping;
- Aerial photography; and
- Site Visits.

4.3.20. The geotechnical assessment was used to determine earthworks slopes to be implemented in the designs. The following earthworks slopes have been adopted for:

- Embankments 1m vertical in 3m horizontal (1V in 3H); and
- All cut slopes: 1V in 3H.

4.3.21. The potential for re-use of excavated material within the works and potential material acceptability has been assessed and is discussed in the geotechnical assessment of each option.

4.3.22. For the purpose of earthworks calculations, it is assumed that the export material from Lhanbryde to East of Fochabers North Option is available for deposition within the Hardmuir to Hillhead and Hillhead to Lhanbryde sections. The Quantified Risk Assessment allows for all alternative scenarios where less material may be available from within the site.

Pavement Design

4.3.23. A preliminary outline pavement design has been carried out to inform the cost estimate. This has been designed in accordance with the DMRB, in particular the following design standards:

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

Utilities

4.3.24. There are a significant number of buried and overhead public and private utility services between Hardmuir and East of Fochabers including:

- Telecommunications – BT overhead and underground network, Vodafone network and mobile communication masts;
- SGN – High, Intermediate, Medium, and Low-pressure gas pipelines;
- SSE – High Voltage, Medium Voltage and Low Voltage overhead and underground services;
- Scottish Water supply network;
- Scottish Water sewer network; 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.

4.3.25. 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 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 potential high cost diversion items.

4.3.26. Where it has not been possible to avoid a clash with major utility apparatus, initial consultation has been undertaken with the relevant provider and outline diversion costs have been received.

Structures

4.3.27. All structure proposals at this stage comply with the DMRB and no Departures from Standard have been identified.

4.3.28. Structures will be required for grade separated junctions, local road crossings, railway crossings, river and watercourses crossings, and drainage features. Outline design options have been prepared for the significant crossings over the Rivers Findhorn, Lossie and Spey. These will be major structures and are significant cost items.

Non-Motorised Users

4.3.29. The following design principles have been adopted in relation to Non-Motorised Users (NMUs):

- The NMU network will be developed to satisfy the A96 Dualling Programme objective (and the Scottish Government's long term vision) of promoting active travel;
- Where practicable and in conjunction with the local authority, NMU facilities will be developed on sections of the former trunk road where superseded by proposed offline A96 corridors;
- Where practicable, NMU facilities will be developed to integrate with public transport facilities;
- The NMU network will be developed taking into account the needs of disabled people (i.e. the NMU network will be developed taking into account the requirements of the Equality Act 2010);
- Where practicable, NMU routes will be as direct as possible along desire lines;
- There will be no NMU at-grade crossings of the proposed A96 as all NMU crossing points will be grade separated;
- Where practicable, NMU crossings in close proximity will be combined; and
- Where practicable, NMU crossing points will make use of other grade separated crossing facilities such as junction overbridges/underpasses and accommodation works overbridges/underpasses.

4.3.30. NMU provision on the Preferred Option will be designed and developed during DMRB Stage 3.

5. Engineering Assessment Hardmuir to Hillhead

5.1 Introduction

5.1.1. This chapter describes the findings of the engineering assessment of the Hardmuir to Hillhead North and South Options. It includes a description of the engineering features of each option including:

- Engineering constraints;
- Engineering description including mainline alignment, proposed junctions and local roads and accesses;
- Topography and land use;
- Geotechnics and earthworks;
- Hydrology and drainage;
- Structures;
- Utilities;
- Non-motorised users; and
- Constructability.

5.2 Engineering Constraints

5.2.1. The options have been designed to take into consideration the following constraints:

- The topography of the area, which is generally low-lying ground to the north of Forres, but rising in areas to the south;
- The existing A96 Aberdeen - Inverness Trunk Road corridor which is discussed in Volume 1, Chapter 2 (Existing Conditions) of this report;
- The existing local road network;
- The Aberdeen - Inverness Railway Line, which runs west to east through the study area, to the north of and broadly parallel to the existing A96;
- The settlements of Brodie and Forres;
- Designated Local Development Plan sites;
- Scattered residential development across the study area;
- Agricultural holdings within the study area;
- The Muckle Burn and its associated flood plain, which flows north-east through Brodie, before discharging into Findhorn Bay;
- The River Findhorn and its associated flood plain, which flows north along the western edge of Forres, before discharging into Findhorn Bay;
- The Burn of Mosset and its associated flood plain, which flows north through Forres, before discharging into Findhorn Bay;
- Public utilities; and

- Environmentally significant areas including Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSI), ancient woodland and cultural heritage aspects such as listed buildings and scheduled monuments (refer to Part 3 – Environmental Assessment).

5.3 Engineering Description – North Option

Mainline Alignment

5.3.1. The Hardmuir to Hillhead North Option is detailed in Figures 5.1, 5.2 and 5.3 (Volume 5). This option is 15.1 kilometres (km) in length.

5.3.2. The route commences at the tie in with the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) Scheme, at the proposed overbridge at Hardmuir of Boath.

5.3.3. Describing from west to east, the route runs adjacent and immediately south of the existing A96 from Wester Hardmuir to Feddan Farm. The route generally follows the existing topography. At Feddan Farm the route diverges from the existing A96 to the south.

5.3.4. The route crosses the Muckle Burn, south of Old Mill Caravan Park at Brodie, before passing north of Tearie Farm.

5.3.5. The route continues north-east and rises through the Forres West Junction, bridging over the existing A96 and the Aberdeen - Inverness Railway Line. After the railway crossing the route continues on embankment north-east over the C8E Banarach Road and C7E Brodie – Dyke - Kintessack Road.

5.3.6. From the C7E crossing the route runs parallel to and north of the Aberdeen - Inverness Railway Line crossing the River Findhorn. Approximately 200m east of the River Findhorn, the route turns in a north-easterly direction away from the railway, passing over the access to Greeshop House.

5.3.7. The route continues north-east on embankment, bridging over the U64E Waterford Road. Turning east, the route passes north of the Benromach Distillery and crosses the existing U62E Sea Park Road on a right-hand curve running immediately south of the 132kV overhead power line.

5.3.8. From the existing U62E the route continues on a right-hand curve, crossing over the Burn of Mosset and the Aberdeen - Inverness Railway Line north of Springfield. Continuing east on embankment, the route crosses over the existing B9011 Forres - Findhorn Road, between Cassieford and Cassieford Cottages.

5.3.9. The route then turns south-east to cross the existing A96 at the U67E Inchdammie Road. The route is lowered into a cutting through the Forres East junction.

5.3.10. East of the junction the route passes north of Hillhead and continues running parallel with the existing A96 following existing topography past Valley View where it ties into the Hillhead to Lhanbryde section of the Scheme.

Junction Layouts

5.3.11. At this stage the junctions have been developed as described below, however this will be refined and developed further during Design Manual for Roads and Bridges (DMRB) Stage 3.

Forres West Junction

5.3.12. The Forres West Junction is located north-east of Tearie Farm, approximately 3.3km west of Forres. The junction maintains connectivity with the existing A96 to the west and east and links the C10E Bogs of Dalvey – Earlsmill – Feddan Road to the south. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected via an underbridge. A local access to Longley on the existing A96 has been incorporated into the northern roundabout.

5.3.13. The northern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 eastbound diverge;
- Proposed A96 eastbound merge;
- Link to the southern roundabout;
- Existing A96 to the west; and
- Access to Longley.

5.3.14. The southern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 westbound diverge;
- Proposed A96 westbound merge;
- Link to the northern roundabout;
- Existing A96 to the east; and
- Realigned C10E.

Forres East Junction

5.3.15. The Forres East Junction is located north of Forres Enterprise Park, approximately 1.7km east of Forres. The junction provides access to the existing A96 to the west and east and to Forres Enterprise Park to the south. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

5.3.16. The northern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound diverge;
- Proposed A96 eastbound merge;
- Link to the southern roundabout; and
- Existing A96 to the east.

5.3.17. The southern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 westbound diverge;
- Proposed A96 westbound merge;
- Link to the northern roundabout;
- Existing A96 to the west; and
- Forres Enterprise Park to the south.

Local Road and Accesses

5.3.18. A strategy has been developed to consider how to deal with the interaction between the route option, the local road network and individual accesses. Moray Council was consulted in the development of the strategy. This will be refined and developed further during DMRB Stage 3.

5.3.19. The strategy follows the following principles:

- Grade separated junctions with the proposed A96 are provided;
- Local roads are maintained with structures to allow the roads to pass over or under the proposed A96 dual carriageway. The local roads may be also realigned to suit;
- Local roads are stopped up at the interface with the proposed dual carriageway as alternative routes are available; or
- Local roads are stopped up and local diversions are provided to connect back into the local road network.

5.3.20. Table 5.1 below describes the proposed local road strategy for the North Option. Accesses that are not affected have been omitted from this table.

Table 5.1: Local Road and Access Strategy

Local Road / Access	Name	Treatment
U3036	Ellands - Hardmuir - Boghole Road (West)	SUA
U3036	Ellands - Hardmuir - Boghole Road (East)	SU
C10E	Bogs of Dalvey - Earlsmill - Feddan Road (West)	SUA/B
Local Access	Communication Mast Access	SUA
U76E	Barleymill - Tearie Road	SU
C10E	Bogs of Dalvey - Earlsmill - Feddan Road (East)	J
Local Access	Longley Access	J
C8E	Banarach Road	B

Local Road / Access	Name	Treatment
C7E	Brodie - Dyke - Kintessack Road	B
Local Access	Greeshop House Access	B
U64E	Waterford Road	B
Local Access	Invererne Access	SUA
U62E	Sea Park Road	SUA
B9011	Forres - Findhorn Road	B
Local Access	Cassieford Access	SU
U67E	Inchdammie Road	SU
Local Access	Tarras / Tarras Cottages Access	SUA
C27E	Forres Enterprise Park	J
Local Access	Grange Hall / South Lodge Access	SUA
Local Access	Hillhead Cottages Access	SUA
Local Access	Access to Chuillin / Hillhead / Rafford Road Cottages	SU
U96E	Scotsburn - New Forres Road	SUA
Local Access	Scotsburn Cottage Access	SUA
Local Access	Valley View / Burgie Lodge Access	SUA

Key to table:
B – Bridge to be provided over or under A96 allowing continuation of road.
J – Road to be diverted /connected to the new A96 grade separated junction.
SU – Road/access to be stopped up. Diversion to be provided via existing road network.
SUA – Road/access to be stopped up. Alternate access to be provided.

5.3.21. Each of the above local roads and accesses are described below:

U3036 Ellands - Hardmuir - Boghole Road (West)

5.3.22. This road heads north from a junction with the A96 approximately 1km north-east of the Wester Hardmuir, providing access to Easter Hardmuir. After approximately 0.5km the U3036 changes to the U74E Cotterton Road at the boundary between Highland Council and Moray Council. Modifications of this junction are proposed as part of the A96 Dualling

Inverness to Nairn (including Nairn Bypass) Scheme which, for the purpose of this assessment, is assumed to be in place.

5.3.23. As part of the Scheme, this junction would revert to a simple T-junction arrangement with the existing A96 similar to its current form.

U3036 Ellands - Hardmuir - Boghole Road (East)

5.3.24. This road heads south from a junction with the A96, 0.3km east of the U3036 western junction. The local road heads south-east towards Boghole Farm.

5.3.25. This junction would be stopped up and the existing road network would be used to access the properties south of the existing A96.

C10E Bogs of Dalvey - Earlsmill - Feddan Road (West)

5.3.26. The western junction for the C10E is at Feddan Farm and has a ghost island right turn lane on the existing A96 and is located approximately 1.0km east of the U3036 South junction. The road heads south towards Earlsmill, crossing the Muckle Burn.

5.3.27. This junction would be stopped up with a new link road between Blinkbonny and Feddan Farm maintaining connectivity between the existing A96 and C10E.

Communication Mast Access

5.3.28. This is an access road from the back of the lay-by 0.3km east of Brodie. The access is for a communications mast south of the existing A96.

5.3.29. A new access would be developed during DMRB Stage 3.

U76E Barleymill to Tearie Road

5.3.30. This is a local road approximately 0.7km east of Brodie connecting the A96 to C10E passing Tearie Farm and Beech Cottage.

5.3.31. This road would be stopped up and alternative access to the existing A96 provided via the realigned C10E.

C10E Bogs of Dalvey - Earlsmill - Feddan Road (East)

5.3.32. From Earlsmill the C10E continues in an easterly direction creating a loop with the second junction on the A96. This eastern junction is approximately 0.2km east of the where the A96 crosses Speedie Burn to the east of Brodie.

5.3.33. The C10E would be realigned to form a new link road, tying into the southern roundabout of Forres West Junction east of Tearie Farm. This maintains connectivity between the existing A96 and C10E. The former section of the C10E would be maintained and access to the realigned C10E would be provided with a T-junction, with its junction to the existing A96 maintained.

Longley Access

5.3.34. This is an access road from the north side of the existing A96 approximately 0.4km west of Speedie Burn.

5.3.35. This would be realigned and would tie-in to the Forres West Junction northern roundabout.

C8E Banarach Road

5.3.36. This local road has a junction with the A96 approximately 0.4km north-east of the Speedie Burn, heads north from the A96, crossing the Aberdeen - Inverness Railway Line and then runs parallel to the railway. After 0.3km the road splits, heading east to Dalvey Smithy Cottages and north-west to Abbotshill.

5.3.37. The route would cross over the C8E to maintain existing access arrangements.

C7E Brodie - Dyke - Kintessack Road

5.3.38. The junction with the A96 is approximately 0.2km north-west of the River Findhorn, where the road heads in a north-west direction to Dalvey House and then north-east towards Moy House.

5.3.39. The route would cross over the C7E to maintain existing access arrangements.

Greeshop House Access

5.3.40. This is an access from West Road within the Greshop Industrial Estate. This passes underneath the existing Aberdeen - Inverness Railway Line.

5.3.41. An underbridge would be provided to maintain access. Headroom would match the existing railway underpass.

U64E Waterford Road

5.3.42. This is a local road heading north-west from Benromach Distillery at the U62E.

5.3.43. A bridge would be provided over the U64E to maintain existing access arrangements.

Invererne Access

5.3.44. This is an access to Invererne from the north side of the U62E.

5.3.45. This would be maintained and access to the realigned U62E would be provided with a T-junction.

U62E Sea Park Road

5.3.46. The U62E heads in a north-east direction from Invererne Road North in Forres, passing Middlefield.

5.3.47. This would be realigned over a length of 350m parallel and to the north of the proposed A96, maintaining access to Middlefield and Lingieston Farms.

B9011 Forres - Findhorn Road

5.3.48. This is the main route connecting Forres to Kinloss and Findhorn. It runs in a north-easterly direction from the Findhorn Roundabout into Kinloss, where it turns north to Findhorn.

5.3.49. A bridge would be provided over the B9011 to maintain existing access arrangements.

Cassieford Access

5.3.50. Cassieford has two accesses, one from the B9011 north of the Findhorn Roundabout, and a second access from the existing A96, east of the Findhorn Roundabout.

5.3.51. The access from the B9011 would be stopped up and the existing access from the A96 would be retained.

U67E Inchdammie Road

5.3.52. This is a local road connecting the A96 to the B9011, west of the Forres Enterprise Park Roundabout.

5.3.53. This road would be stopped up, with access to the existing A96 provided via the B9011.

Tarras / Tarras Cottages Access

5.3.54. This is an access to Tarras and Tarras Cottages from the south side of the existing A96 west of the Forres Enterprise Park.

5.3.55. This access would be realigned, and access to the realigned existing A96 would be provided with a T-junction.

C27E Forres Enterprise Park

5.3.56. This is a local road providing access into Forres Enterprise Park from a roundabout on the existing A96.

5.3.57. This would be realigned to tie-in with Forres East Junction southern roundabout.

Grange Hall / South Lodge Access

5.3.58. This is an access to Grange Hall and South Lodge from the Forres Enterprise Park Roundabout on the existing A96.

5.3.59. This would be realigned, using the existing A96, to tie-in with the realigned A96 at Forres East Junction.

Hillhead Cottages Access

5.3.60. This is an access to Hillhead Cottages from the north side of the existing A96 east of the Forres Enterprise Park Roundabout.

5.3.61. This would be realigned to tie-in with a T-junction to the realigned Grange Hall/South Lodge access.

Access to Chuillin, Hillhead and Rafford Road Cottages

5.3.62. This is an access to the east of the Forres Enterprise Park roundabout, providing access to Chuillin, Hillhead and Rafford Road Cottages. The access connects with the U96E Scotsburn – New Forres Road at Rafford Road Cottages to the south.

5.3.63. This access would be stopped up between Chuillin and Hillhead, with alternative access available via the U96E.

U96E Scotsburn - New Forres Road

5.3.64. The U96E has a junction with the existing A96 at Scotsburn, runs south-west towards the boundary of Forres Enterprise Park.

5.3.65. Access to the existing A96 would be stopped up at Scotsburn and the U96E would be re-aligned to run parallel to the south of the proposed A96.

Scotsburn Cottage Access

5.3.66. This is an access for Scotsburn Cottage from the U96E at the junction with the existing A96.

5.3.67. Access would be maintained from the existing A96 but would be stopped up from the U96E.

Valley View / Burgie Lodge Access

5.3.68. This is an access from the existing A96 to Valley View and Burgie Lodge, east of the C6E junction.

5.3.69. Access would be maintained from the realigned section of the U96E.

5.4 Engineering Description – South Option

Mainline Alignment

5.4.1. The Hardmuir to Hillhead South Option is detailed in Figures 5.4, 5.5 and 5.6 (Volume 5). This option is 16.6km in length.

5.4.2. Describing the option from west to east, it follows the same alignment as the North Option for the first 3km (as outlined in section 5.3.1 - 5.3.4), diverging from this alignment at the Muckle Burn Crossing.

5.4.3. Similar to the North Option, the route passes north of Tearie Farm, and continues east to the Forres West Junction. The route is on embankment through the junction and crosses a minor watercourse and the Speedie Burn.

5.4.4. From the Forres West Junction the route passes between the existing A96 and Woodside, turning south-east through the northern tip of Darnaway Forest at-grade.

5.4.5. The route crosses the River Findhorn between Mundole to the north and a disused airstrip to the south, remaining elevated on the eastern bank of the River Findhorn to retain access to properties to the south via an underpass.

5.4.6. Continuing south-east into a cutting through Limekilns and Fairyhills Wood, the route crosses beneath the A940 Forres - Grantown Road where the Forres South Junction is formed.

5.4.7. At Old Blairs the route returns to existing ground level and continues east, at grade, through Office Wood. At the C14E Mannachie - Rafford Road, the mainline is lowered into a slight cutting to accommodate overbridges for the C14E and the Dava Way.

5.4.8. East of the Dava Way, the route heads north-east at grade, passing Marcassie to the north and under the realigned B9010 Elgin - Rafford - Forres Road.

5.4.9. The route rises onto embankment and crosses over the U94E Brodieshill - Califer Road, between Wester Newforres and Wester Newforres Quarry, before returning to existing ground level to pass under the realigned Easter Newforres access.

5.4.10. Heading east, the route is elevated to cross over the Kinloss Burn.

5.4.11. Through the Forres East Junction the route turns east running parallel to the existing A96, passing between Leys of Hillhead and Scotsburn Cottage, returning to existing ground level.

5.4.12. The route continues running parallel to the south of the existing A96 at-grade, past Valley View where it ties into the Hillhead to Lhanbryde section of the Scheme.

Junction Layouts

5.4.13. At this stage the junctions have been developed as described below, however these will be refined and developed further during DMRB Stage 3.

Forres West Junction

5.4.14. The Forres West Junction is located north-east of Tearie Farm, approximately 3.3km west of Forres. The junction maintains connectivity with the existing A96 to the west and east and links the C10E Bogs of Dalvey – Earlsmill – Feddan Road to the south. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected via an underbridge.

5.4.15. The northern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 eastbound diverge;
- Proposed A96 eastbound merge;
- Link to the southern roundabout;
- Existing A96 to the west; and
- Existing A96 to the east.

5.4.16. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned C10E.

Forres South Junction

5.4.17. The Forres South Junction is located on the existing A940, approximately 1.2km south of Forres. The junction maintains connectivity with the existing A940 to the north and south, and the U82E Mundole Road to the west. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

5.4.18. The northern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 eastbound diverge;
- Proposed A96 eastbound merge;
- Link to the southern roundabout;
- Realigned U82E; and
- A940 into Forres.

5.4.19. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- A940 to the south.

Forres East Junction

5.4.20. The Forres East Junction is located at Hillhead, approximately 2.7km east of Forres. The junction maintains connectivity with the existing A96 to the north and the U96E Scotsburn – New Forres Road to the south. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected via an underbridge.

5.4.21. The northern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 eastbound diverge;
- Proposed A96 eastbound merge;
- Link to the southern roundabout;
- Existing A96 west; and
- Existing A96 east.

5.4.22. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned U96E.

Local Roads and Accesses

5.4.23. This section of the report discusses the existing local road network and accesses and the diversion strategy proposed with regards to the South Option. The strategy is consistent with the North Option as set out in sections 5.3.19 & 5.3.20, which will be refined and developed further during DMRB Stage 3.

5.4.24. Table 5.2 below describes the proposed local road strategy for the South Option. Accesses that are not affected have been omitted from this table.

Table 5.2: Local Road and Access Strategy

Local Road / Access	Name	Treatment
U3036	Ellands - Hardmuir - Boghole Road (West)	SUA
U3036	Ellands - Hardmuir - Boghole Road (East)	SU
C10E	Bogs of Dalvey - Earlsmill - Feddan Road (West)	SUA/B
Local Access	Communication Mast Access	SUA
U76E	Barleymill To Tearie Road	SU
C10E	Bogs of Dalvey - Earlsmill - Feddan Road (East)	J
Local Access	Newton of Dalvey Access	B
Local Access	Disused Airstrip Access	B
U82E	Mundole Road	J
Local Access	Limekilns Cottage Access	SU

Local Road / Access	Name	Treatment
A940	Forres - Grantown Road	J
U85E	Old Blairs Road	SUA
Local Access	Old Blairs Access	SUA
C14E	Mannachie - Rafford Road	B
Local Access	Sanquhar Mains Access	SUA
B9010	Elgin - Rafford - Forres Road	B
Local Access	Mains of Blervie Access	SUA
U94E	Brodieshill - Califer Road	B
Local Access	Easter Newforres Access	B
U96E	Scotsburn - New Forres Road	SUA
Local Access	Scotsburn Cottage Access	SUA
Local Access	Valley View / Burgie Lodge Access	SUA

Key to table:
B – Bridge to be provided over or under A96 allowing continuation of road.
J – Road to be diverted /connected to the new A96 grade separated junction.
SU – Road/access to be stopped up. Diversion to be provided via existing road network.
SUA – Road/access to be stopped up. Alternate access to be provided.

5.4.25. Each of the above local roads and accesses are described below:

5.4.26. The following junctions and accesses are the same as the North Option as described in sections 5.3.23 – 5.3.34 above:

- U3036 Ellands - Hardmuir - Boghole Road (West);
- U3036 Ellands - Hardmuir - Boghole Road (East);
- C10E Bogs of Dalvey - Earlsmill - Feddan Road (West);
- Communication Mast Access;
- U76E Barleymill - Tearie Road; and
- C10E Bogs of Dalvey - Earlsmill - Feddan Road (East).

Newton of Dalvey Access

5.4.27. This is a local road approximately 0.3km south-west of the C7E junction on the A96 providing access to Newton of Dalvey.

5.4.28. Access would be maintained by an overbridge.

Disused Airstrip Access

5.4.29. This is an access from Beech Avenue in Mundole providing local access to the disused Airstrip and associated properties.

5.4.30. Access would be maintained via an underbridge.

U82E Mundole Road

5.4.31. This is a local road that connects the A96 at Bridge of Findhorn to the A940, passing Red Craig and Mundole.

5.4.32. The road would be realigned south of Gean Cottages and would connect with the A940 at the northern roundabout for the Forres South Junction.

Limekilns Cottage Access

5.4.33. This is an access to Limekilns Cottage from the U82E that loops through Limekilns Wood to connect to the A940.

5.4.34. The existing access from the U82E to the north would be stopped up, with the access from the A940 to the east being maintained.

A940 Forres - Grantown Road

5.4.35. This is the southern route into Forres from Grantown-on-Spey.

5.4.36. The A940 would be realigned through the grade separated junction with the proposed A96, south of Forres.

U85E Old Blairs Road

5.4.37. The U85E runs from the Dallas Dhu Distillery on the C14E south-west to the A940.

5.4.38. The road would be realigned north of Old Blairs and run parallel to the north of the route, connecting with the A940 north of the Forres South Junction at a T-junction.

Old Blairs Access

5.4.39. This is an access to Old Blairs from the U85E.

5.4.40. A realigned section of the stopped up U85E south of the proposed A96 mainline maintains access between the A940 and Old Blairs.

C14E Mannachie - Rafford Road

5.4.41. The C14E runs south from Forres from the A940 at Thornhill towards Rafford.

5.4.42. The C14E would be realigned to the west of the existing road and would cross the route with an overbridge.

Sanquhar Mains Access

5.4.43. There is a direct access to Sanquhar Mains from the C14E, approximately 0.3km north-west of the Burn of Mosset.

5.4.44. Access would be maintained from the realigned C14E with a simple T-junction, travel south along the existing C14E and an additional length of track to connect to the existing access.

B9010 Elgin - Rafford - Forres Road

5.4.45. The B9010 runs south-east out of Forres from the B9011 towards Rafford.

5.4.46. The B9010 would be realigned to the west of the existing road to cross over the route with and overbridge.

Mains of Blervie Access

5.4.47. This is an access to Mains of Blervie from the B9010.

5.4.48. Access would be maintained by a new simple T-junction with the realigned B9010.

U94E Brodieshill - Califer Road

5.4.49. The U94E heads east from the B9010 at Cathay towards Califer.

5.4.50. The route would cross over the U94E with an underbridge retaining the existing road.

Easter Newforres Access

5.4.51. This is an access to Easter Newforres from the C27E.

5.4.52. Access would be maintained by an overbridge.

Remaining Junctions / Accesses

5.4.53. The following junctions and accesses are the same as the North Option as described in sections 5.3.65 – 5.3.70 above:

- U96E Scotsburn - New Forres Road;
- Scotsburn Cottage Access; and
- Valley View / Burgie Lodge Access.

5.5 Topography and Land Use

Topography

5.5.1. Both options would introduce changes to the existing topography through the introduction of new road embankments and cuttings, grade separated junctions, local road realignments and structures.

5.5.2. The topography on the North Option generally comprises low relief, locally undulating terrain. Land directly north of the existing A96 is gently sloping towards Findhorn Bay.

5.5.3. The topography on the South Option generally comprises low relief, locally undulating terrain, with elevation gradually increasing towards the woodland areas in the south-east.

Land Use

5.5.4. The North Option is surrounded largely by arable farm land; the South Option by pastoral and arable farmland and areas of woodland.

5.5.5. The largest woodlands in this section are affecting the South Option, namely Darnaway Forest, Limekilns Wood and Fairyhills Wood.

5.5.6. Land Use is considered in further detail in Volume 2, Chapter 12 (People and Communities) and Chapter 13 (Agriculture, Forestry and Sporting Interests) of this report.

5.6 Geotechnics and Earthworks

General

5.6.1. An assessment of the likely ground conditions affecting the options has been determined largely from British Geological Society (BGS) 1:63,360 scale; 1:50,000 scale; 1:10,560 scale and 1:10,000 scale series geological maps for the area, and Memoirs of the Geological Survey Scotland: the Geology of the Elgin District. A search of the BGS Geo Index interactive map and BGS Lexicon was conducted for relevant historical exploratory hole and geology information.

General Ground Conditions

5.6.2. The options are underlain primarily by superficial deposits of Alluvium and Glacial origin, with some small, isolated areas of bedrock at or near the surface. In addition, an area of Raised Marine Deposits is present north of Forres, an area of Lacustrine Alluvium and peat is present along the north-eastern section of the South Option. Superficial deposits within the area are summarised in Table 5.3 below and shown on Figures 5.7, 5.8, 5.9 and 5.10 (Volume 5).

Table 5.3: Superficial Deposits present within the study area

Strata	Typical Description	Distribution
Alluvium	Silty clay with occasional layers of silt, sand, peat and basal gravel	Local to all major watercourses, including Muckle Burn; Speedie Burn, River Findhorn and Burn of Mosset
River Terrace Deposits	Sand and gravel with localised lenses of silt, clay and peat	Local to the River Findhorn and Burn of Mosset
Finglack Till Formation	Sandy silty clay diamicton with clasts of various origin	West of Feddan, and south-east of Western Newforres and Leys and in isolated pockets local to Newton of Dalvey and Hillhead
Glaciofluvial Deltaic Deposits	Variable lithology, typically comprising sand and gravel	Between Speedie Burn and the River Findhorn
Glaciofluvial Ice Contact Deposits	Sand and gravel with localised lenses of silt, clay and organic material	Extensive distribution, particularly along the existing A96
Glaciofluvial Sheet Deposits	Sand and gravel with lenses of silt, clay and organic material	Present locally as isolated pockets typically adjacent to Glaciofluvial Ice Contact Deposits
Glaciomarine Deposits (Ardersier Silts Formation)	Graded, rhythmically-bedded sequence of silty clays, silts, and silty sands	Present locally as an elongated pocket from eastern Forres via Milton of Grange, towards Grange Hall
Glaciolacustrine Deposits (Grange Hill Sand Formation)	Laminated silt and clay with common organic material and localised lenses of peat present	Two localities are present south of the existing A96 at Hillhead and approximately 1.35km east of Hillhead
Raised Marine Deposits	Gravel, sand, silt and clay and commonly present organic debris	North and north-east of Forres, extending towards Grange Hill, predominantly north of the existing A96
Lacustrine – Lake Alluvium	Silt and clay with occasional organic and/ or calcareous muds	Local to the Loch of Blairs (south of Forres); an area south of Chapeltonmoss; and an area between Hillhead and Lochaber in the east
Peat	Partially decayed vegetation or organic matter	Isolated pockets of peat are distributed throughout the study area, generally located within low-lying wetland or upland areas

5.6.3. In addition to strata detailed in Table 5.3 above, it is anticipated that areas of Made Ground are likely to be present locally, associated with the development of infrastructure and residential and farm related properties.

5.6.4. There are several former quarries and pits, which where infilled, and are likely to contain unspecified material. Recorded extents of Made Ground local to the options are included on Figures 5.7, 5.8, 5.9 and 5.10 (Volume 5).

5.6.5. The composition of Made Ground and infilled material is unspecified therefore it is likely to comprise a highly variable mixture of reworked soil, road make-up, engineering fill and man-made material. In addition, remnant buried structures and/ or obstructions are also likely to be present in-situ.

5.6.6. The published geological mapping indicates that much of the study area is underlain by sedimentary strata of the Forres Sandstone Group (part of the Devonian Upper Old Red Sandstone Supergroup). The solid geology recorded across the study area is shown on Figures 5.11, 5.12, 5.13 and 5.14 (Volume 5).

5.6.7. The majority of the study area is underlain by the Kingsteps Sandstone Formation (part of the parent unit, Forres Sandstone Group), comprising pebbly, calcareous cross-bedded sandstone with interbeds of marly mudstones and thin conglomerates. The beds are dipping at varying angles between 6 degrees and 15 degrees towards the north-west and north-east.

5.6.8. Local to the existing A96 within the northern section of the study area (between Kinloss and Newton), bedrock comprises cross-bedded sandstone, with gravelly and conglomeritic units of the Alves Formation. Beds are recorded to dip predominantly to the north and north-east at angles varying between 5 degrees and 16 degrees. The Boathill Limestone Member is present locally at Boathill, west of Forres, with bedrock comprising nodular, partially silicified limestone with interbeds of calcareous sandstone dipping 8 degrees to the north-east.

5.6.9. Grey conglomerate of the Wester Laurenceton Conglomerate Member outcrops locally near Wester Lawrenceton and Lochaber, in the eastern section of the study area.

5.6.10. The Nairn Sandstone Member, comprising cross-bedded sandstone with thin mudstone interbeds, is present locally, south-east of Forres. Grey conglomerate of the Wester Laurenceton Conglomerate Member outcrops locally near Wester Laurenceton and Lochaber, in the eastern section of the study area.

5.6.11. The south-eastern section of the study area is underlain by the Nethybridge Psammite Formation of the Grampian Group. Bedrock typically comprises feldspathic psammite with subsidiary micaceous psammite, semipelite and quartzite and localised bands of calcsilicate-rock. Strata of the Nethybridge Psammite Formation is heavily folded with highly variable dip angles from 14 degrees to 80 degrees in all directions. There is limited rock exposure throughout the study area due to the thickness of the overlying superficial deposits.

Existing Ground Investigation Data

5.6.12. Existing ground investigation coverage within the study area is localised within Forres (specifically in north, west and south-east Forres), and along the River Findhorn. Selected borehole and trial pit logs have been obtained from the BGS archive, and exploratory hole

logs have been provided by Moray Council for the River Findhorn Flood Alleviation Scheme (FAS) area and Forres FAS – Chapelton Storage area.

5.6.13. These are summarised in Table 5.4 and Table 5.5 below for the North and South Options, respectively.

Table 5.4: Existing Ground Investigation Information - North Option

Scheme	Coverage	General Findings
Forres Drainage (BGS archive)	Local to the existing A940, and along the Aberdeen - Inverness Railway Line within northern Forres	Sandy topsoil from ground level to 0.6m, typically underlain by medium dense sand and gravel to a maximum recorded depth of 3m. Made Ground comprising hard core with some gravel was recorded between 0.4m and 0.85m in trial pit TP4, and topsoil with gravel, timber and sawdust was recorded in trial pits TP5 and TP6 from ground level to 1.5m and 0.55m respectively. Groundwater was typically encountered in sands and gravels between depths of 1.8m and 1.95m.
River Findhorn FAS	Northern and western Forres, and local to the River Findhorn	Topsoil underlain by medium dense to dense sand and gravel, with occasional layers of clay, from 0.3m to a maximum recorded depth of 22.1m. Made Ground comprising sand and gravel, and grass over hardcore was recorded in several exploratory holes from ground level to 0.6m. Bedrock typically comprising weathered sandstone is encountered in five boreholes, with depth to rockhead ranging from 9.2m to 17m. Groundwater was typically encountered in sands and gravels between depths of 0.8m and 9m.

Table 5.5: Existing Ground Investigation Information - South Option

Scheme	Coverage	General Findings
River Findhorn FAS	Between Fairyhills Wood and the River Findhorn	Topsoil is recorded from ground level to 0.5m, with Made Ground comprising gravelly sand present locally, from ground level to 0.15-0.45m. Gravelly sand and very sandy gravel with many cobbles and boulders are recorded to underlie the Topsoil/ Made Ground, to a maximum recorded depth of 7.7m.
Forres FAS – Chapelton Storage area	South of Chapelton, surrounding Wright's Hill	Thin layer (0.1 – 0.55m thick) of silty sand with rootlets (topsoil), underlain by dense gravel and cobbles, interbedded with medium dense to dense gravelly sand to a maximum recorded depth of 23.4m. Interbedded layers of sandy silt are recorded in some exploratory holes.

Scheme	Coverage	General Findings
		Peat is recorded in ten exploratory holes, typically within the top 5m. Made Ground comprising sand and gravel of ash, brick and sandstone was recorded in trial pit TPFS-003 from ground level to 0.65m. Bedrock typically comprising weathered sandstone is encountered in four boreholes, with depth to rockhead ranging from 13.5m to 23.4m. Groundwater was typically encountered in sands and gravels between depths of 1.25m and 7.7m.

Identified Geotechnical Constraints

General

5.6.14. The main geotechnical constraints include potential for compressible ground and subsidence, specifically where embankments are to be constructed across these areas. Compressible ground is typically associated with Alluvium, Lacustrine Deposits, Peat and isolated areas of Glaciofluvial Deposits. Subsidence and compressible ground may be encountered associated with potentially infilled land of unknown constituents. The thickness and nature of these deposits will require to be confirmed by means of ground investigation at DMRB Stage 3.

5.6.15. Generally, the mainline for both options is to be constructed on low height embankments, with some sections in cuttings or at-grade. Higher embankments are typically required to convey the option at proposed junctions and watercourse crossings.

North Option

5.6.16. Potential geotechnical constraints (ratings as defined by the BGS) are summarised below and are presented on Figures 5.15 and 5.16 (Volume 5):

- Shallow groundwater levels;
- Very low hazard potential for landslide across much of the study area, with the exception of ground along the river banks of Muckle Burn and the River Findhorn where the landslide potential is low;
- Negligible, or very low hazard potential for shrinking or swelling clay across much of the study area, with low hazard potential for shrinking or swelling clay associated with Glacial Till deposits local to Hillhead;
- Moderate potential for compressible ground associated with Alluvium local to existing watercourses, and isolated areas of Glaciofluvial Deposits typically located on floodplains; and
- Potentially infilled land of unknown constituents, yielding potential sources of contamination (including ground gas) and possible compressible ground and subsidence:
  - Two former quarries located within the study area, potentially infilled;

- Two heaps of unknown constituents;
- Eight infilled quarries or water features; and
- Seven former sand and gravel pits.

5.6.17. Further geotechnical constraints relating to compressibility of the underlying soils are summarised below and are shown on Figures 5.7 and 5.8 (Volume 5):

- Significant deposits of Alluvium underlie the option at the following locations:
  - An embankment associated with approach to Muckle Burn;
  - An embankment associated with approach to the River Findhorn; and
  - A section of the proposed Forres West Junction Underbridge embankment.
- Potentially compressible Glaciofluvial Deposits within the study area are typically located on floodplains at the following location:
  - Significant deposits along a section of cutting east of the proposed Forres East Junction; and
- Recorded Made Ground and potentially infilled land include the following:
  - A former sand and gravel pit underlying the proposed embankment immediately west of the River Findhorn Crossing; and
  - An embankment over landscaped ground, on the northern approach to the proposed Forres East Junction.

South Option

5.6.18. Significant potential geotechnical constraints (ratings as defined by the BGS) are summarised below and are presented on Figures 5.17 and 5.18 (Volume 5):

- Shallow groundwater levels;
- Very low hazard potential for landslide across much of the study area, with the exception of ground along the river banks of Muckle Burn and the River Findhorn where the landslide potential is low;
- Negligible, or very low hazard potential for shrinking or swelling clay across much of the study area, with low hazard potential for shrinking or swelling clay associated with Lacustrine – Lake Alluvium;
- Moderate potential for compressible ground associated with Alluvium local to existing watercourses; Lacustrine Deposits; Peat; and, isolated areas of Glaciofluvial Deposits typically located on floodplains;
- Potentially infilled land of unknown constituents, yielding potential sources of contamination (including ground gas) and possible compressible ground and subsidence:
  - Nine former quarries located within the study area, potentially infilled;
  - Six heaps of unknown constituents;
  - Fourteen infilled quarries or water features; and
  - Eighteen former sand and gravel pits.
- Fairyhills Wood operational sand and gravel quarry south of Forres; and

- New Forres operational rock aggregate quarry in Wester Newforres Wood.

5.6.19. Further geotechnical constraints relating to compressibility of the underlying soils are summarised below and are shown on Figures 5.9 and 5.10 (Volume 5):

- Significant deposits of Alluvium along the option are anticipated to be encountered at the following locations:
  - An embankment associated with approach to Muckle Burn;
  - An embankment associated with approach to the River Findhorn; and
  - An embankment associated with approach to the Burn of Mosset.
- Lacustrine Deposits are recorded to underlie the option at the following location;
  - South of the proposed Forres East Junction. Sections of the option on embankment, are separated by a section of Peat (detailed below).
- Potentially compressible Glaciofluvial Deposits underlie the option at the following locations:
  - A section of the option west of Feddan on embankment; and
  - West of the proposed Forres East Junction a section is on embankment.
- Recorded Made Ground and potentially infilled land are indicated to be present below the option at the following locations:
  - A former sand and gravel pit underlying the proposed cutting west of Hardmuir;
  - A former quarry underlying the proposed embankment along the C10E Bogs of Dalvey – Earlsmill - Feddan Road;
  - A former quarry underlying the proposed embankment, east of the Burn of Mosset crossing; and
  - A former quarry and associated area of worked ground (undivided) underlying the proposed embankment immediately south of the proposed B9010 St Leonards Road Overbridge.
- Significant Peat deposits are only anticipated to be present along a section on embankment, south of the proposed Forres East Junction;
- Peat deposits in this area are surrounded by the previously mentioned Lacustrine Deposits; and
- Peat thicknesses along the option are unknown, however, given the anticipated highly compressible nature of these deposits it is likely that these would require to be removed and replaced with a suitable fill material.

Discussion

5.6.20. Alluvium and Lacustrine Deposits may contain compressible Silts and Clays, and occasionally Peat.

5.6.21. The potentially compressible nature of these deposits may yield significant settlements beneath embankments in the long term, and potential slope stability problems, particularly during the construction phase. Any excavations below the groundwater table in these deposits may be difficult and dewatering might be required.

5.6.22. Potential measures to mitigate any issues associated with compressible ground include embankment slope design, staged construction, removal and replacement, accelerated settlement using band drains and/ or surcharging with drainage layer(s), and the use of structurally supported load transfer platforms, particularly on the approaches to structures.

5.6.23. The selection and design of these measures will depend largely on the thickness and nature of the Alluvium which would be determined by means of a ground investigation, and potentially also programme constraints. Where the option is at-grade or on low height embankment it may be feasible to reinforce the subgrade with geogrids embedded within granular fill.

5.6.24. The construction over areas of Alluvium and/ or Lacustrine Deposits potentially involves greater cost and may have an adverse impact on programme to allow the necessary remedial works to be implemented.

5.6.25. The potential engineering solutions for constructing roads over Glaciofluvial Deposits are essentially the same as for potentially compressible Alluvium and Lacustrine Deposits, as discussed above.

5.6.26. The angle of cut slopes in the Glaciofluvial Deposits will depend on the height of slope, groundwater level and the specific characteristics of the material. If the groundwater is at a high level on slope drainage may be required.

5.6.27. Made Ground is recorded sporadically, in isolated pockets across the study area, on available BGS geological mapping. This assessment is based on those mapped areas of Made Ground only, however it is anticipated that Made Ground will be present in-situ along a greater extent of the options. In addition, it is anticipated that former quarries and pits within the study area may yield possible compressible ground and subsidence. It should be noted that the extent of these former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage.

5.6.28. A comparison of the ground conditions affecting the options (mainline, junctions and local roads) is provided in Table 5.6 below. This identifies lengths of the options where less favourable ground conditions may be anticipated potentially requiring additional engineering measures.

Table 5.6: Comparison of ground conditions

Option	Approximate length of Option underlain by potentially compressible Superficial Deposits					
	Alluvium (m)	Peat (m)	Potentially Compressible Glaciofluvial Deposits (m)	Lacustrine Deposits (m)	Made Ground*/ Worked Ground** (m)	Total (m)
Mainline						
North	2230	-	220	-	10	**2460**
South	880	280	80	910	30	**2180**
Junctions and Side Roads						
North	40	-	-	-	460	**500**
South	-	-	220	-	10	**230**

*Made Ground across the study area is recorded sporadically on available geological mapping. It is anticipated that Made Ground may be present in-situ along a greater extent of the options.
**It has been assumed that where former quarries and pits are present, these have been backfilled with non-engineered fill of unknown origin. The extent of these former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage. For the purposes of this assessment, an assumed 10m length is used.

5.6.29. The comparison of total lengths of potentially unfavourable ground conditions presents a number of limitations as summarised below:

- This assessment is based on recorded areas of Made Ground only. It is anticipated that Made Ground may be present in-situ along a greater extent of the options;
- The extent of these former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage;
- Worked ground may not present a constraint and will depend on the extent of any backfilling and ground disturbance;
- Former quarries and pits may be largely situated above general ground level and may therefore have not been backfilled;
- The nature of the potentially compressible glacial deposits is based on typical descriptions provided on the geological maps and limited available ground investigation data, and may differ significantly from the in-situ nature of the materials;
- Unrecorded areas of soft superficial deposits and / or Made Ground may be present in-situ; and
- The occurrence of the different types of superficial deposits is based on the geological mapping and limited available ground investigation data. In-situ ground conditions will require to be confirmed by means of ground investigation.

Earthworks

Excavated Material Acceptability – General

5.6.30. In general cuttings are formed within areas of predominantly granular material of glacial and fluvioglacial origin, based on the available desk study information. The reuse potential has been assessed in two lengths, Hardmuir to the River Findhorn and the River Findhorn to Hillhead.

5.6.31. The other deposits of post glacial origin, and also the Alluvium, may provide acceptable materials depending on their composition and nature. This can only be confirmed by a ground investigation to be carried out during DMRB Stage 3 once a Preferred Option has been selected. This also applies to confirming the percentage acceptable for the fluvioglacial and glacial till deposits.

5.6.32. Rock is generally not anticipated to occur within the proposed shallow cuttings, which are generally less than 5m in depth, although the possibility of localised shallow rock cannot be discounted.

Excavated Material Acceptability – North Option

5.6.33. It is estimated at this stage that between Hardmuir and the River Findhorn that of the order of 50% of these materials may be acceptable for reuse as general engineering fill.

5.6.34. It is estimated at this stage that between the River Findhorn and Hillhead that of the order of 70% of these materials may be acceptable for reuse as general engineering fill.

Excavated Material Acceptability – South Option

5.6.35. It is estimated at this stage that between Hardmuir and the River Findhorn that of the order of 50% of these materials may be acceptable for reuse as general engineering fill.

5.6.36. It is estimated at this stage that between the River Findhorn and Hillhead that of the order of 80% of these materials may be acceptable for reuse as general engineering fill.

Unacceptable Material and Contaminated Land

5.6.37. Unacceptable materials which cannot be used in the main earthworks such as peat, soft clays and silts would require to be disposed of on or off-site. Much of this material would be unsuitable in their natural state for the formation of bunds and in landscaping, although these volumes can be minimised through the use of appropriate in-situ ground improvement techniques where appropriate, particularly for the soft non-organic soils.

5.6.38. Peat deposits are very localised in occurrence and may not be of a significant thickness. Where encountered their disposal on or off-site would require to be appropriately assessed.

5.6.39. Contaminated land is not anticipated to be a significant issue affecting the North Option, largely due to the absence of any major industrial activity in the area. The South Option is predicted to have potentially significant effects with land contamination at the former Forres

RAF Base. Investigation of these areas would be required 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 on the nature of the contamination.

Cut/fill Balance

5.6.40. For the purpose of earthworks assessment, it is assumed that the export material from Lhanbryde to East of Fochabers North Option is available for deposition within the Hardmuir to Hillhead section.

5.6.41. Table 5.7 below summarises the major earthworks quantities as follows:

- Bulk Fill Material Required – The bulk earthworks fill volume as required for the mainline, side roads and grade-separated junctions. This excludes the material required for capping, sub base and topsoil;
- Bulk Excavated Material – The total volume of excavated material including acceptable and unacceptable. Excludes the topsoil strip;
- Acceptable Excavated Material – This constitutes the volume of excavated material deemed acceptable from initial investigations; and
- Cut/fill Balance – The balance of the overall fill requirement, less the potential volume of available acceptable site won material.

Table 5.7: Major Earthworks Quantities

Option	North Option	South Option
Bulk Fill Material Required (m^3)	2,470,000	2,130,000
Bulk Excavated Material (m^3)	520,000	1,700,000
Acceptable Excavated Material (m^3)	320,000	1,300,000
Cut/Fill Balance (m^3)	2,150,000 *(Import)*	830,000 *(Import)*

5.6.42. As expressed in the table above, a positive balance is indicative of an overall import requirement with the result that a volume of engineering fill will be required to be sourced and brought to site. A negative balance indicates that there will be an overall surplus of engineering fill material generated by the work.

5.7 Hydrology and Drainage

5.7.1. The effects of the options on the water environment are considered fully in Volume 2, Chapter 20 (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.

5.7.2. A preliminary assessment of hydrology was made for each option. Following the selection of a Preferred Option, a review of the hydrology and drainage strategy will be undertaken during DMRB Stage 3. This will include review of structural requirements at watercourse crossings.

Watercourses

5.7.3. A number of key watercourses located within the study area are affected, as described below:

Burn of Fedden

5.7.4. The Burn of Fedden runs in a north-east direction originating from the western extent of Wester Hardmuir Wood, passing west of Feddan Farm, crosses the existing A96 and continues north-east along the eastern edge of Hardmuir Wood.

5.7.5. Both options require the existing culvert to be extended.

Muckle Burn

5.7.6. The Muckle Burn flows in a north-east direction to the east of Feddan Farm. The burn then turns north for a short length through a bridge under the existing A96 and the Aberdeen - Inverness Railway Line, before continuing north-east on to Findhorn Bay.

5.7.7. Both options would provide a bridge over the burn directly south of Old Mill Caravan Park.

Speedie Burn

5.7.8. The Speedie Burn flows to the east of Tearie Farm in a northly direction and is crossed by the Forres West Junction. The burn flows under the Aberdeen - Inverness Railway Line by means of a culvert. North of the railway line, the Speedie Burn feeds the Muckle Burn, ultimately flowing towards Findhorn Bay.

5.7.9. For the North Option two culverts would be required, one under the realigned existing A96 and one under the mainline and junction slips of the proposed A96. For the South Option one culvert would be required for the mainline and the slip roads.

River Findhorn

5.7.10. The Findhorn rises in the Monadhliath Mountains and flows in a north-easterly direction for approximately seventy miles entering the Moray Firth at Findhorn Bay to the north of Forres.

5.7.11. A FAS was recently carried out for the River Findhorn in the vicinity of Forres.

5.7.12. Both options cross the River Findhorn flood plain on embankment. The flood plain for the North Option is approximately 180m to the west of the river and extends approximately 210m to the FAS on the eastern bank. The flood plain for the South Option extends to the east approximately 200m. A possible Flood Compensation Area has been identified for the South Option.

5.7.13. The North Option crosses the River Findhorn by means of a bridge structure adjacent to and north of the existing Aberdeen - Inverness Railway Line crossing. The South Option crosses the River Findhorn by means of a bridge west of Mundole.

Burn of Mosset

5.7.14. The Burn of Mosset starts from a weir at C14E Mannachie Road, fed by the Altyre Burn. To the south of Sanquhar Mains, the burn is incorporated into the Forres FAS, and then passes through the centre of Forres before passing under the existing A96 and the Aberdeen - Inverness Railway Line east of Invererne Road. The burn continues in a north-east direction before feeding into Findhorn Bay.

5.7.15. Both options require a structure to span the burn.

Manachy Burn

5.7.16. Manachy Burn starts at Blairs Home Farm and runs northwards, passes Dallas Dhu Distillery and feeds into the Burn of Mosset.

5.7.17. The Manachy Burn does not interact with the North Option. Where the South Option crosses Manachy Burn, a culvert would be required.

Kinloss Burn

5.7.18. Kinloss Burn originates north of Wester Newforres Quarry and runs in a north-east direction and has several tributaries.

5.7.19. The Kinloss Burn does not interact with the North Option. Where the South Option crosses Kinloss Burn (and its tributaries), three culverts would be required.

Drainage

5.7.20. An outline drainage design has been carried out to identify potential outfalls, catchment areas, feasible locations for ponds/basins and their required volume, in order to inform the engineering and environmental assessments of each option. The design of drainage systems will be developed further during DMRB Stage 3.

5.7.21. Design development will incorporate Sustainable Drainage Systems (SuDS) comprising a combination of multiple treatment methods at source as well as larger downstream controls. The intention of such systems is to reduce concentration of pollutants and attenuate surface water run-off as it is conveyed through the drainage network, prior to entering a watercourse.

5.7.22. The level of treatment required is dependent on the location of the catchment and receiving watercourse to which it outfalls. The Scottish Environment Protection Agency (SEPA) require at least two levels of treatment for the majority of catchments within the Scheme extents. Some receiving watercourses may be more environmentally sensitive and an additional level of treatment would be required.

5.7.23. At source SuDS will include filter drains and swales, providing the first level of treatment where possible. Ponds/basins will be utilised downstream of the network as an additional level of treatment and would be capable of attenuating run off volumes during extreme weather events, whilst discharging at a controlled flow rate to the receiving watercourse. Initial pond/basin locations have been identified but are indicative at this stage and will be developed further during DMRB Stage 3.

5.7.24. Drainage capability has been assessed for both options and where necessary, the vertical alignment has been developed to accommodate the required levels. It is not anticipated that either of the options will result in significant problems in regard to discharging runoff into watercourses. Some of the receiving watercourses are particularly small. Using these watercourses may require greater levels of attenuation to avoid increasing flood risk.

5.7.25. Drainage from realigned local roads will be considered in detail during DMRB Stage 3. Any positive drainage systems are likely to be independent of the proposed trunk road drainage network.

5.8 Structures

Introduction

5.8.1. This section describes the structures in outline only, as further details will be developed during DMRB Stage 3. The major river crossings and other significant structures are described in greater detail below.

5.8.2. Generally, the proposals have been developed based on adopting concrete construction, either in-situ or precast where span lengths permit as this is generally the most cost-effective type of construction. Where larger spans are required, steel concrete composite construction is proposed.

Underbridges

5.8.3. The full width of the mainline, including carriageway and hardstrips, would be continued across the decks of the underbridges. In accordance with DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross-Sections and Headrooms, Clause 5.6.1) there would be no reduction in the widths of the verges of the mainline on the underbridge decks.

5.8.4. It is anticipated that underbridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck. For smaller crossings a reinforced concrete portal option would also be considered.

Overbridges

5.8.5. It is anticipated that overbridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck.

5.8.6. The full width of the carriageway and hard strips (where provided) would be carried by the overbridges. Verges to both the local road and the A96 mainline would be continued over

and under the structure in accordance with DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross-Sections and Headrooms, Clause 5.6.1).

5.8.7. The proposed structure locations are shown on Figures 5.1, 5.2, 5.3, 5.4 and 5.6 (Volume 5).

North Option

River Findhorn Crossing

5.8.8. A number of constraints have been considered as follows:

- The width of the flood plain to be spanned was informed by initial flood modelling – approximately 210m;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed that a minimum clearance of 2.6m would be provided between the bridge deck soffit and the existing ground level of any footpath below the bridge.

5.8.9. The Aberdeen - Inverness Railway Line crosses the River Findhorn to the south of the proposed new bridge. The existing structure consists of a three span, half through steel bridge, with box girders forming the main beams of the structure. It supports a single railway line.

5.8.10. At this stage it is proposed that the structure would comprise a single span steel tied arch structure with a span length of approximately 210m. It has been assumed, at this stage, that no substructure supports would be placed in the river channel.

5.8.11. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. However, this will be reviewed when more geotechnical information becomes available.

5.8.12. Structure type and span configurations will be further developed during DMRB Stage 3.

Muckle Burn

5.8.13. A number of constraints have been considered as follows:

- The meandering nature of the river at this location;
- A total bridged length of at least 130 metres is required to span the Muckle Burn and its flood plain; and
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit.

5.8.14. At this stage it is proposed to that the structure would comprise a five-span arrangement, with a length of 130m.

5.8.15. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

5.8.16. Structure type and span configurations will be further developed during DMRB Stage 3.

Railway Crossings

5.8.17. Two railway underbridges would be required on the North Option to cross the Aberdeen - Inverness Railway Line. The railway line currently consists of a single track at both locations and is not currently electrified.

5.8.18. The bridges would be designed to accommodate future double-tracking and electrification of the railway line.

5.8.19. The railway underbridges required for the North Option are detailed in Table 5.8 below.

Table 5.8: North Option - Railway Bridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Aberdeen - Inverness Railway Line (Forres West)	Aberdeen - Inverness Railway Line	25	120
Aberdeen - Inverness Railway Line (Forres East)	Aberdeen - Inverness Railway Line	16	50

Underbridges

5.8.20. The underbridges required for the North Option are as detailed in Table 5.9 below.

Table 5.9: North Option – Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Forres West Junction	Forres West Junction	14	33
C8E Banarach Road	Side Road	8	26
C7E Brodie - Dyke - Kintessack Road	Side Road	23	26
Greeshop House Access	Side Road	8	27
U64E Waterford Road	Side Road	20	26

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Burn of Mosset Crossing	Burn of Mosset	27	26
B9011 Forres-Findhorn Road	B9011	30	26

Overbridges

5.8.21. The overbridges required for the North Option are as detailed in Table 5.10 below.

Table 5.10: North Option – Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
C10E Bogs of Dalvey - Earlsmill - Feddan Road	Side Road	40	10
Forres East Junction	Forres East Junction	69	18

South Option

River Findhorn

5.8.22. A number of constraints have been considered as follows:

- The width of the flood plain to be spanned was informed by initial flood modelling – approximately 190m;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed that a minimum clearance of 2.6m would be provided between the bridge deck soffit and the existing ground level of any footpath below the bridge.

5.8.23. At this stage it is proposed to that the structure would comprise a two-span arrangement, with a length of 190m.

5.8.24. It is assumed the deck would be of a steel composite construction with steel beams and a concrete deck. The spans are also suitable for a segmental precast concrete construction.

5.8.25. It has been assumed that all foundations for the proposed structures would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available and it may be possible to adopt spread foundations for some or all foundations depending on the results of these investigations.

5.8.26. Structure type and span configurations will be further developed during DMRB Stage 3.

Muckle Burn

5.8.27. The proposed structure is similar to that proposed for the North Option, as described in section 5.8.14 – 5.8.17.

Underbridges

5.8.28. The underbridges required for the South Option are as detailed in Table 5.11 below.

Table 5.11: South Option – Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Forres West Junction	Forres West Junction	15	26
Disused Airstrip Access	Side Road	10	26
Burn of Mosset Crossing	Burn of Mosset	135	26
U94E Brodieshill To Califer Road	Side Road	15	28
Forres East Junction	Forres East Junction	14	38

Overbridges

5.8.29. The overbridges required for the South Option are as detailed in Table 5.12 below.

Table 5.12: South Option Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
C10E Bogs of Dalvey - Earlsmill - Feddan Road	Side Road	73	10
Newton of Dalvey Access	Side Road	127	10
Forres South Junction	A940	73	12
C14E Mannachie To Rafford Road	Side Road	74	9
Dava Way	Side Road	75	4
B9010 Elgin - Rafford - Forres Road	B9010	102	10

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Easter Newforres Access	Side Road	59	10

Ancillary Structures

5.8.30. Both options would require the provision of a number of ancillary structures such as culverts and may require accommodation underpasses and overbridges.

Culverts

5.8.31. At this stage, it is assumed that all other watercourses crossed by the option would require a culvert, designed to accommodate the design flood flows and consider environmental stakeholder requirements, including SEPA and Scottish Natural Heritage (SNH). This will be further developed during DMRB Stage 3.

5.8.32. The culverts would generally comprise reinforced concrete pipes or concrete box culverts. Concrete wingwalls and headwalls would also be provided upstream and downstream of the culvert. Pipes less than 2m diameter (less than 0.9m for corrugated steel construction) are not classified as structures and would be considered as part of the drainage system.

5.8.33. Where existing culverts require extending, the extensions would generally be of the same cross section and materials as the existing.

Accommodation Structures

5.8.34. The requirement for accommodation structures has been considered for both options and will be further developed during DMRB Stage 3.

Retaining Walls

5.8.35. The requirement for retaining walls will be assessed during DMRB Stage 3.

Vehicle Containment and Pedestrian Restraint over Structures

5.8.36. Generally, the vehicle containment to be provided over the structures will be in accordance with DMRB (Volume 2, Section 2, Part 8, TD 19/06, Requirement for Road Restraint Systems), and will be developed during DMRB Stage 3.

5.9 Utilities

5.9.1. There are a significant number of buried and overhead public and private utility services between Hardmuir and Hillhead including:

- Telecommunications – BT overhead and underground network, Vodafone network and mobile communication masts;
- SGN – High, Intermediate, Medium, and Low-pressure gas pipelines;

- SSE High Voltage, Medium Voltage and Low Voltage overhead and underground services;
- Scottish Water supply network;
- Scottish Water sewer network; 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.

5.9.2. Public utilities have been identified and key utilities are shown on Figures 2.13, 2.14 and 2.15 (Volume 5). Major towns were not included within the utility search as both options bypass these urban areas.

5.9.3. 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 between Hardmuir and Hillhead to enable 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 potential high cost diversion items.

Telecommunications

Network

5.9.4. Telecommunications infrastructure covers a majority of the area between Hardmuir and Hillhead. The key elements of the network include:

BT Underground Supply Network

5.9.5. This utility is located throughout the area. Cables run adjacent to the existing A96 and many of the local roads in the area. This utility services many of the local settlements. The utility is highly concentrated throughout the densely populated areas between Hardmuir and Hillhead.

BT Overhead Supply Network

5.9.6. This utility is not as prevalent as the underground network. Cables are adjacent to local roads, connecting to either underground cables or nearby properties.

Vodafone

5.9.7. This utility runs adjacent to the existing A96 from Hardmuir to Hillhead. This utility is an underground cable and duct with several chambers spread throughout its length.

Communication Masts

5.9.8. This utility is spread throughout different locations between Hardmuir and Hillhead. There is a higher concentration of this utility where the area is densely populated.

Interfaces

5.9.9. Table 5.13 below summarises the number of interfaces with the telecommunication network for each option.

Table 5.13: Number of interfaces with telecommunications

Option	BT Underground Supply	BT Overhead Supply	Vodafone Network	Communication Masts	Total Interfaces
North	14	2	3	0	19
South	15	1	3	0	19

5.9.10. There are significantly more interfaces on the BT Underground Network than any other telecommunications network.

5.9.11. Both options have the same overall total interfaces on the telecommunications network. Neither option interfaces the communication masts. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

SGN

Network

5.9.12. SGN infrastructure is present in this section. Key elements of the network include:

High Pressure Pipeline

5.9.13. A pipeline enters the study area south of Hardmuir and follows south of the existing A96 until it reaches Forres. Once at Forres the pipeline heads south around Forres and then heads in a north-easterly direction back towards the existing A96.

Intermediate Pressure Pipeline

5.9.14. This utility is not present between Hardmuir and Hillhead.

Medium Pressure Pipeline

5.9.15. This utility is present between Hardmuir and Hillhead; located to the north of Forres, it services some buildings within the local area and follows the existing A96 supplying several properties located alongside the existing A96.

Low Pressure Pipeline

5.9.16. This utility is not present between Hardmuir to Hillhead.

Interfaces

5.9.17. Table 5.14 below summarises the number of interfaces with the SGN network for each option.

Table 5.14: Number of interfaces with SGN

Option	High Pressure Pipeline	Intermediate Pressure Pipeline	Medium Pressure Pipeline	Low Pressure Pipeline	Total Interfaces
North	1	0	6	0	7
South	4	0	1	0	5

5.9.18. The North Option interfaces the SGN Network more than the South Option, however, the South Option interfaces the SGN high pressure pipeline significantly more than the North Option. Neither option interfaces Intermediate or Low-pressure pipeline. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

SSE

Network

5.9.19. SSE electricity supply infrastructure covers a majority of the area between Hardmuir and Hillhead. The key elements of the network include:

132kV Overhead Lines

5.9.20. This utility travels in a north-easterly direction bypassing Forres towards Elgin.

33kV Power lines

5.9.21. This utility travels in a north-easterly direction bypassing Forres and heading towards Kinloss. Once near Kinloss, the line splits off into two directions; one heading into Kinloss with the other heading east towards Elgin.

Overhead and Underground cables

5.9.22. These cables carry the 6.6-11kV and low voltage power into homes and businesses between Hardmuir and Hillhead. The network is spread throughout the area and much of the area is serviced.

Interfaces

5.9.23. Table 5.15 below summarises the number of interfaces with the SSE network for each option.

Table 5.15: Number of interfaces with SSE

Option	132kV line	33kV line	6.6-11kV and Low voltage cables	Total Interfaces
North	1	6	19	26
South	1	0	19	20

5.9.24. The North Option interfaces the SSE network on 26 occasions, six more occasions than the South Option. Both options interface the 132kV network only once, however the North Option has a greater interface at the Forres East Junction.

5.9.25. The North Option impacts the 33kV line on six occasions. The South Option has no interface. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

Scottish Water

Network

5.9.26. Scottish Water infrastructure covers a majority of the area between Hardmuir and Hillhead. The key elements of the network include:

Supply Network

5.9.27. In addition to freshwater supply through water mains, there are several abandoned water mains throughout the area. The network serves homes and businesses throughout the local area.

5.9.28. A number of private water supplies have been identified and these are discussed in Volume 2, Chapter 19 (Geology, Soils, Contaminated Land and Groundwater) of this report.

Sewer Network

5.9.29. The sewer network comprises combined sewer outfalls, foul water sewers and surface water sewers. The network services homes and businesses in the area with the majority of services concentrated in the more densely populated areas such as Forres. Additionally, at the northern end of Forres, there is a wastewater treatment works. From the wastewater treatment works there is a treated effluent pipe which heads north-east to its outfall into the Burn of Mosset.

Interfaces

5.9.30. Table 5.16 below summarises the number of interfaces with the freshwater network for each option.

Table 5.16 Number of interfaces with water utilities

Option	Water Mains	Abandoned Mains	Raw Water Mains	Total Interfaces
North	9	2	0	11
South	8	3	0	11

5.9.31. Both options have the same total amount interfaces on the freshwater network.

5.9.32. Table 5.17 below summarises the number of interfaces with the foul water network for each option.

Table 5.17: Number of interfaces with foul water utilities

Option	Combined Sewer Outfall	Foul water sewers	Rising mains	Treated effluent	Total Interfaces
North	1	1	1	1	4
South	0	0	0	0	0

5.9.33. Only the North Option impacts wastewater infrastructure. This is mainly due to the North Option being closer to Forres and surrounding properties. Additionally, a treated effluent pipe connecting to a Wastewater Treatment Works is interfaced by the North Option.

5.9.34. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

5.10 Non-Motorised Users

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

5.10.2. The effects of the options on all travellers, including NMUs, are considered in Volume 2, Chapter 12 (People and Communities) of this report where the impacts of the options are assessed.

5.10.3. NMU facilities will be considered during design development of the Preferred Option during DMRB Stage 3.

5.11 Constructability

5.11.1. Both options include online construction at the tie-in to the A96 Dualling Inverness to Nairn (including Nairn Bypass) Scheme, and thereafter are generally offline construction. The tie-

in would involve use of the existing carriageway, careful traffic management would be required to minimise disruption to trunk road users.

5.11.2. Within this section there are a number of elements which pose particular constructability challenges as listed below:

North Option

- Interface with high pressure gas main at Forres West Junction;
- Construction of Forres West Junction at the interface with existing A96;
- Crossing of Aberdeen - Inverness Railway Line at west of Forres;
- Construction of the River Findhorn Crossing;
- Crossing of Aberdeen - Inverness Railway Line at east of Forres;
- Construction of Forres East Junction at the interface with existing A96 and Forres Enterprise Park; and
- Interface with 132kV overhead line at Forres East Junction.

South Option

- Interface with high pressure gas main at four locations;
- Construction of the River Findhorn Crossing;
- Construction of Forres South Junction; and
- Interface with 132kV overhead line west of Forres East Junction.

5.11.3. Careful consideration of construction phasing and maintenance of existing access arrangements during the construction period will be undertaken during DMRB Stage 3. A Constructability Audit will be undertaken ahead of the commencement of the Statutory Process.

5.12 Engineering Assessment Summary

5.12.1. A summary is provided below for each engineering issue, which identifies if any option is more or less favourable.

Mainline Alignment and Junction Layouts

5.12.2. Both options have been designed to fully meet DMRB standards without departures or relaxations from Standard at this stage.

Local Roads and Accesses

5.12.3. Effects on local roads and accesses are summarised in Table 5.18 below.

Table 5.18: Local Road and Access Strategy Summary

	North	South
B – Bridge	6	7
J – Connect to Junction	3	3
SU – Stopped Up	5	4
SUA – Stopped Up with alternate access provided	10	9
Total No of local roads and accesses stopped up	**15**	**13**
Total No of local roads and accesses affected	**24**	**23**

5.12.4. The local road and access strategy would retain connectivity of the network and the effects are similar for both options.

Topography and Land Use

5.12.5. Topography and Land Use effects are similar for both options.

Geotechnics and Earthworks

5.12.6. The main geotechnical constraints affecting the options include potential for compressible ground and subsidence, specifically where embankment is to be constructed across these areas. Based on the combined (mainline, junction and local road) proposed route lengths potentially affected by significant areas of compressible ground, the South Option is more favourable.

5.12.7. It is anticipated that the North Option would require more imported material for earthworks construction.

5.12.8. In consideration of the above, the South Option is more favourable overall from a geotechnics and earthworks perspective.

Hydrology and Drainage

5.12.9. A preliminary assessment of hydrology was made for each option and both designs were developed to minimise flooding impacts.

5.12.10. Table 5.19 below provides a summary of the watercourses affected by each option and the proposed treatment.

Table 5.19: Watercourse crossings

Watercourse	North Option	South Option
Burn of Fedden	E/C	E/C
Muckle Burn	B	B
Speedie Burn	C (2 no.)	C
River Findhorn	B	B
Burn of Mosset	B	B
Manachy Burn	-	C
Kinloss Burn	-	C (3 no.)
Total	**6**	**9**

Key to Table:
E/C – Extend existing culvert
C – Watercourse to be culverted
B – Bridge

5.12.11. Both options have a similar number of bridge crossings. The South Option requires more culverts than the North Option making it less favourable.

5.12.12. A preliminary drainage design has been carried out to identify potential outfalls, catchment areas and feasible locations for ponds/basins.

Structures

5.12.13. Table 5.20 below provides a summary of the structures required for each option.

Table 5.20: Structures Summary

Type of Structure	North Option	South Option
Major River Crossing	2	2
Railway Crossing	2	-
Underbridges	7	5
Overbridges	2	7
Total	**13**	**14**

5.12.14. Both options have similar overall structures requirements, however, the North Option is slightly less favourable due to the need for two railway crossings.

Utilities

5.12.15. The comparative interfaces of the options with utilities are summarised in Table 5.21 below.

Table 5.21: Summary of Total No. of Interfaces with Utilities

Utility	North Option	South Option
Telecommunications	19	19
SGN	7	5
SSE	26	20
Scottish Water Supply	11	11
Scottish Water Foul	4	-
Total	**67**	**55**

5.12.16. The utilities that pose the greatest constraint are the high-pressure gas network and the extra high voltage (132kV) overhead lines.

5.12.17. Both options affect the high-pressure gas network; the North Option is favoured in this regard due to interface at one location whilst the South Option is interfaced at four locations.

5.12.18. Both options also interface the 132kV overhead line only once. The South Option is favourable due to greater impact of the North Option at the Forres East Junction.

NMUs

5.12.19. There are no significant engineering issues associated with the NMUs. NMU facilities will be designed and developed during DMRB Stage 3.

Constructability

5.12.20. The North Option poses seven particular constructability challenges compared with four for the South Option. Giving consideration to both the number and complexity of these issues, the South Option is considered more favourable.

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6. Engineering Assessment Hillhead to Lhanbryde

6.1 Introduction

6.1.1. This chapter describes the findings of the engineering assessment of the Hillhead to Lhanbryde North and South Options. It includes a description of the engineering features of each option including:

- Engineering constraints;
- Engineering description including mainline alignment, proposed junctions and local roads and accesses;
- Topography and land use;
- Geotechnics and earthworks;
- Hydrology and drainage;
- Structures;
- Utilities;
- Non-motorised users; and
- Constructability.

6.2 Engineering Constraints

6.2.1. The options have been developed to take into consideration the following constraints:

- The topography of the area, which is generally low-lying ground to the north of Elgin, but rising in areas to the south;
- The existing A96 Aberdeen - Inverness Trunk Road corridor which is discussed in Volume 1, Chapter 2 (Existing Conditions) of this report;
- The existing local road network;
- The Aberdeen - Inverness Railway Line which runs west to east through the study area, to the north of and broadly parallel to the existing A96 as far as Alves, before crossing under the trunk road and continuing parallel on the southern side;
- The settlements of Alves, Newton, Elgin and Lhanbryde;
- Designated Local Development Plan sites;
- Scattered residential development across the study area;
- Agricultural holdings within the study area;
- The River Lossie and its associated flood plain, which flows north along the west side of Elgin, turning in an easterly direction through Elgin, before continuing north and discharging into the Moray Firth at Lossiemouth;
- Scotsburn reservoir, a flood alleviation measure upstream and to the south of Lhanbryde, consisting of a storage reservoir;
- Public utilities; and

- Environmentally significant areas including ancient woodland and cultural heritage sites such as listed buildings and scheduled monuments (refer to Part 3 – Environmental Assessment).

6.3 Engineering Description – North Option

Mainline Alignment

6.3.1. The Hillhead to Lhanbryde North Option is detailed in Figures 6.1, 6.2, 6.3 and 6.4 (Volume 5). This option is 22.6 kilometres (km) in length.

6.3.2. The route commences at the tie in with the proposed Hardmuir to Hillhead options to the north of Burgie Lodge and Glenburgie Distillery.

6.3.3. Describing from west to east, the route commences immediately south of the existing A96. The route is raised on embankment approaching the Kinloss Burn and thereafter the Burgie Burn and C4E Brodieshill - Cloves - Lochinver Road (West).

6.3.4. The route continues eastwards, diverging from the line of the existing A96, heading to the south of Alves Wood.

6.3.5. The route heads in an easterly direction through a substantial cutting, crossing under an existing private road which provides access to Morayscairn and Birchbrae.

6.3.6. As the route passes through farmland to the south of Alves Wood, it turns through a right-hand curve on a gentle gradient to pass below 132kV overhead lines and continues easterly to cross over U101E Church Road.

6.3.7. Between the U101E and Sweethillock Cottages the route turns through a left-hand curve. The route then continues on a straight and rises sharply on embankment to pass over the C4E and the Aberdeen - Inverness Railway Line.

6.3.8. Heading east the route turns through a left-hand then right-hand curve and the profile falls to create a significant cutting to accommodate the proposed grade separated Elgin West Junction. To the east of the junction the route passes between the existing A96 and Newton Nursery.

6.3.9. The route turns through a left-hand curve on embankment to pass over the existing B9013 Newton - Burghead Road.

6.3.10. As the route continues in a north-easterly direction to the north of Quarrelwood it follows the existing topography in steep sidelong ground.

6.3.11. To the south of Dykeside the route is in deep cutting enabling it to pass below the 132kV overhead lines.

6.3.12. The route continues on a right-hand curve and crosses both the U47E Loanhead Road and B9012 Duffus Road slightly above existing ground level.

6.3.13. Heading east the route is on a small embankment to provide clearance over the flood plain near the Spynie Canal and associated tributaries.

6.3.14. To the north of Findrassie Wood the route continues on a right-hand curve and on embankment crosses over the C24E Elgin – Westerfolds - Duffus Road.

6.3.15. The route then turns in a south-easterly direction and crosses the existing A941 Lossiemouth – Elgin Road in a cutting, where the Elgin North Junction is formed.

6.3.16. The route continues in a south-easterly direction on embankment and crosses over the U34E Wester Calcots Road. The route then follows the existing topography before crossing the dismantled railway and U37E Pitgaveny Road.

6.3.17. The route turns through a left-hand curve rising on embankment to cross over the C23E Woodside – Calcots Road and then continues south-east to pass around Kirkhill Wood on a right-hand curve. The route is in slight cutting as it passes Kirkhill.

6.3.18. The route continues on a left-hand curve and crosses the River Lossie, a Non-Motorised User (NMU) route, and the C19E Scotstonhill – Fernyfield Road on an embankment. The Elgin East Junction is formed on the locally higher ground immediately to the north of the existing A96.

6.3.19. The route turns through a left-hand curve on large embankment to cross over the Aberdeen - Inverness Railway Line before returning to cutting under the B9103 Lossie - Sherrifston - Orton - Mulben Road and passing between the Coxton Tower area and Easter Coxton Farm buildings.

6.3.20. Heading east, the route passes beneath 132kV overhead lines and runs parallel to, and south of, the railway line. The route runs in deep cutting and then shallow embankment to the south of Lhanbryde where it crosses the Lhanbryde Burn and then ties into the Lhanbryde to East of Fochabers options for the Scheme.

Junction Layouts

6.3.21. At this stage the junctions have been developed as described below, however these will be refined and developed further during Design Manual for Roads and Bridges (DMRB) Stage 3.

Elgin West Junction

6.3.22. The Elgin West Junction is located at Ardgye, where the route crosses the existing A96, approximately 5km west of Elgin. The junction maintains connectivity with the existing A96 to the west and east. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge. A local access to Ardgye has been incorporated into the northern roundabout.

6.3.23. The northern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 eastbound merge;

- Proposed A96 eastbound diverge;
- Link to the southern roundabout;
- Private access to Ardgye cottages to the north; and
- Realigned existing A96 to the west.

6.3.24. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned existing A96 to the east.

Elgin North Junction

6.3.25. The Elgin North Junction is located at Myreside, where the route crosses the existing A941, approximately 1km north of Elgin. The junction maintains connectivity with the existing A941 to the north and south. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

6.3.26. The northern roundabout, to be constructed slightly offline of the existing A941, would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;
- Link to the southern roundabout; and
- Realigned A941 to the north.

6.3.27. The southern roundabout, to be constructed completely offline of the existing A941 in the adjacent agricultural land, would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned A941 to the south.

Elgin East Junction

6.3.28. The Elgin East Junction is located to the west of Sherrifston, approximately 1.5km east of Elgin, where the route crosses the existing A96. The junction maintains connectivity with the existing A96 to the west and east. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

6.3.29. The northern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound merge;

- Proposed A96 eastbound diverge;
- Link to the southern roundabout; and
- Realigned existing A96 to the east.

6.3.30. The southern roundabout, to be constructed partially on the line of the existing A96, would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned existing A96 to the west.

Local Roads and Accesses

6.3.31. A strategy has been developed to consider how to deal with the interaction between the option, the local road network and individual accesses. Moray Council was consulted in the development of the strategy. This will be refined and developed further during DMRB Stage 3.

6.3.32. The strategy follows the following principles:

- Grade separated junctions with the proposed A96 are provided;
- Local roads are maintained with structures to allow the road to pass over or under the proposed A96 dual carriageway. The local roads may be also realigned to suit;
- Local roads are stopped up at the interface with the proposed dual carriageway as alternative routes are available; or
- Local roads are stopped up and local diversions are provided to connect back into the local road network.

6.3.33. Table 6.1 below describes the preliminary local road strategy for the North Option.

Table 6.1: Local Road and Access Strategy

Local Road / Access	Name	Treatment
Local Access	Mains of Burgie Access	SUA
C4E	Brodieshill – Cloves – Lochinver Road (West)	B
Local Access	Birchbrae Access	B
U101E	Church Road	B
C4E	Brodieshill – Cloves – Lochinver Road (East)	B
Local Access	Ardgye Access	SUA
B9013	Newton – Burghead Road	B

Local Road / Access	Name	Treatment
Local Access	Pinewood Cottage and Rosebrae Access	SUA
Local Access	Dykeside Access	B
U47E	Loanhead Road	B
B9012	Duffus Road	B
C24E	Elgin – Westerfolds – Duffus Road	B
A941	Lossiemouth – Elgin	J
Local Access	Spynie House Access	SU
U34E	Wester Calcots Road	B
U37E	Pitgaveny Road	B
C23E	Woodside - Calcots Road	B
Local Access	Kirkhill Access	B
C19E	Scotstonhill – Fernyfield Road	B
U123E	Moss of Barmuckity Road	SU
B9013	Lossie – Sherrifston – Orton – Mulben Road	B
Local Access	Easter Coxton Farm Access	SUA
C1E	Garmouth – Lhanbryde – Fogwatt Road	SU

Key to table:

B – Bridge to be provided over or under proposed A96 allowing continuation of road.

J – Road to be diverted /connected to the new A96 grade separated junction.

SU – Road/access to be stopped up. Diversion to be provided via existing road network.

SUA – Road/access to be stopped up. Alternate access to be provided.

6.3.34. Each of the above local roads and accesses are described below:

Mains of Burgie Access

6.3.35. This is an access from the existing A96, located approximately 0.5km west from the C4E (West) junction at Glenburgie Distillery. It provides access to the properties at Mains of Burgie.

6.3.36. The access from the existing A96 would be stopped up. The realigned U96E Scotsburn – New Forres Road runs parallel to the south of the proposed dual carriageway linking the

C4E (West) and the Hardmuir to Hillhead section. A junction would be provided on the U96E to reinstate the Mains of Burgie access.

C4E Brodieshill – Cloves – Lochinver Road (West)

6.3.37. The C4E (West) runs south from a junction with the existing A96, past Glenburgie Distillery.

6.3.38. The proposed dual carriageway crosses over the C4E (West) with an underbridge maintaining the existing road.

Birchbrae Access

6.3.39. This is an access from the C4E (West), located south-west of Alves Wood, that provides access to properties at Birchbrae.

6.3.40. The access road would cross over the proposed dual carriageway with an overbridge and a junction would be formed with the C4E.

U101E Church Road

6.3.41. The U101E runs south from a junction with the existing A96, adjacent to the eastern edge of Alves Wood. It connects the existing A96 to the C4E at Monaughty.

6.3.42. The proposed dual carriageway crosses over the U101E with an underbridge. The existing road requires lowering to accommodate the bridge.

C4E Brodieshill – Cloves – Lochinver Road (East)

6.3.43. The C4E (East) runs south from a junction with the existing A96, past Alves Railway Station towards Cloves.

6.3.44. The proposed dual carriageway crosses over the C4E (East) with an underbridge maintaining the existing road.

Ardgye Access

6.3.45. This is an access from the existing A96, located approximately 0.5km east from the proposed location of the Elgin West Junction. It provides access to the properties at Ardgye.

6.3.46. The access from the existing A96 would be stopped up. A new access would be provided from the Elgin West Junction northern roundabout.

B9013 Newton – Burghead Road

6.3.47. The B9013 runs north-west from a junction with the existing A96 towards Newton Nursery.

6.3.48. The proposed dual carriageway crosses over the B9013 with an underbridge maintaining the existing road.

Pinewood Cottage Access

6.3.49. The access to Pinewood Cottage runs north from the C26E Miltonduff – Lochside Road.

6.3.50. The access would be stopped up and a new access from the B9013 would be constructed.

Rosebrae Access

6.3.51. The access to Rosebrae runs north from the C26E Miltonduff – Lochside Road.

6.3.52. The access would be stopped up and a new access from the B9013 would be constructed.

Dykeside Access

6.3.53. The access to Dykeside runs north from the C26E Miltonduff – Lochside Road.

6.3.54. An overbridge would be provided to maintain access.

U47E Loanhead Road

6.3.55. The U47E runs north-west from a junction with the C26E on the north-western edge of Quarrelwood.

6.3.56. The existing road would be realigned and cross over the proposed dual carriageway with an overbridge.

B9012 Duffus Road

6.3.57. The B9012 runs from the north-west to the south-east connecting in to the north-western edge of Elgin.

6.3.58. The existing road would be realigned and cross over the proposed dual carriageway with an overbridge.

C24E Elgin – Westerfolds – Duffus Road

6.3.59. The C24E runs from north to south, located adjacent to Findrassie Wood to the north-west of Elgin.

6.3.60. The proposed dual carriageway would cross over the C24E with an underbridge maintaining the existing road.

A941 Lossiemouth – Elgin Road

6.3.61. The A941 runs north to Lossiemouth from Elgin connecting to the existing A96 with a roundabout in the centre of Elgin.

6.3.62. The existing A941 would be realigned to connect into the proposed roundabouts at Elgin North Junction. An overbridge would be provided for the existing A941 to cross the proposed dual carriageway.

Spynie House Access

6.3.63. This is an access road running south-west to north-east from a junction with the existing A941 approximately 0.7km north of Elgin.

6.3.64. The road is to be stopped up. Alternative access is available via the U34E Wester Calcots Road.

U34E Wester Calcots Road

6.3.65. The U34E runs north-east, towards Pitgaveny Farm from its junction with Lesmurdie Road in Elgin.

6.3.66. The proposed dual carriageway would cross the U34E with an underbridge maintaining the existing road.

U37E Pitgaveny Road

6.3.67. The U37E runs north-east, towards Pitgaveny Wood from its junction with Newmill Road in Elgin.

6.3.68. The existing road would cross over the proposed dual carriageway with an overbridge.

C23E Woodside – Calcots Road

6.3.69. The C23E runs east to west from Elgin to a junction with the B9103 Lossie – Sherrifston – Orton – Mulben Road.

6.3.70. The proposed dual carriageway would cross the U34E with an underbridge maintaining the existing road.

Kirkhill Access

6.3.71. This is an access running east to west from the properties at Kirkhill to Kirkhill Wood.

6.3.72. The access road would cross over the proposed dual carriageway with an overbridge.

C19E Scotstonhill – Fernyfield Road

6.3.73. The C19E runs north-east from a T-junction on the existing A96, to the east of Elgin.

6.3.74. The proposed dual carriageway would cross the C19E (and the River Lossie) with an underbridge maintaining the existing road.

U123E Moss of Barmuckity Road

6.3.75. The U123E runs in a loop from Barmuckity to Sherrifston Cottages, with junctions on the existing A96.

6.3.76. The road would be stopped up at Greens of Coxton.

B9103 Lossie – Sherrifston – Orton – Mulben Road

6.3.77. The B9103 runs south-east from a junction with the existing A96 to the west of Lhanbryde.

6.3.78. The existing road would cross over the proposed dual carriageway with an overbridge.

Easter Coxton Farm Access

6.3.79. This is an access running north-east from a junction with the B9103 at Coxton Tower.

6.3.80. The access would be stopped up. A new access would be provided north of the proposed dual carriageway running parallel to the south of the Aberdeen - Inverness Railway Line.

C1E Garmouth – Lhanbryde – Fogwatt Road

6.3.81. The C1E runs south-west from a junction with the existing A96 south of Lhanbryde.

6.3.82. The road would be stopped up. Alternative access would be available via the B9103.

6.4 Engineering Description – South Option

Mainline Alignment

6.4.1. The Hillhead to Lhanbryde South Option is detailed in Figures 6.5, 6.6, 6.7 and 6.8 (Volume 5). This option is 20.0km in length.

6.4.2. The route commences at the tie in with the proposed Hardmuir to Hillhead options to the north of Burgie Lodge and Glenburgie Distillery.

6.4.3. Describing from west to east, the route runs adjacent and immediately south of the existing A96. The route option is raised on embankment approaching the Kinloss Burn and thereafter the Burgie Burn and C4E Brodieshill - Cloves - Lochinver Road.

6.4.4. Between Glenburgie Distillery and Alves Wood, the route continues parallel to the existing A96. There is a localised drop in the landform to the west of Alves Wood, where the road is raised on embankment.

6.4.5. Through Alves Wood, the route runs adjacent to the existing A96 with shallow earthworks. At the eastern end of Alves Wood, the route raises up on embankment to cross over the U101E Church Road.

6.4.6. Heading east the route deviates away from the existing A96 and runs south of and parallel to the Aberdeen - Inverness Railway Line on a near straight. The route drops into cutting to pass under the 132kV overhead line and to pass under the C4E and the U105E Garrowslack Road by Carsehill.

6.4.7. The route continues to run parallel to the Aberdeen - Inverness Railway Line on a slight embankment.

6.4.8. As the route passes north of Lochinver the embankment height increases to cross over the C26E Miltonduff – Lochside Road and Mosstowie Canal.

6.4.9. The route heads south-east on a right-hand then left-hand curve and drops gradually in elevation crossing the existing C4E at-grade. The route then extends into cutting to the north of Lochinver Quarry where the Elgin West Junction is formed.

6.4.10. Heading south-east the route crosses the C3E Elgin - Pluscarden - Rafford Road at grade and then rises onto embankment to cross over the Black Burn and the B9010 Elgin – Rafford – Forres Road.

6.4.11. The route continues on a left-hand curve on high embankment and crosses over the River Lossie, its associated flood plain and two existing access tracks.

6.4.12. Heading east the route lowers into cutting through a localised high point by Duffus Hillock. The route continues east on slight embankment, passing north of Burnside of Birnie.

6.4.13. Continuing on a left-hand curve, the route moves into a cutting to pass below the existing A941 Elgin – Dufftown Road. The Elgin South Junction is formed in cutting.

6.4.14. The route continues east through Birkenhill Wood in cutting to pass beneath the dismantled railway.

6.4.15. The route continues following the existing topography. As the route passes south of Troves it turns north-east, in a shallow cut under the C20E Linkwood – Troves – Elgin Road.

6.4.16. The route continues north-east, generally in cut and crosses under the B9103 Lossie – Sherrifston – Orton – Mulben Road.

6.4.17. Approaching the south of Lhanbryde the route turns easterly into a right-hand curve. The Elgin East Junction is formed to the south-east of Easter Coxton Farm. The route runs in deep cutting and then shallow embankment to the south of Lhanbryde where it crosses the Lhanbryde Burn and then ties into the Lhanbryde to East of Fochabers options for the Scheme.

Junction Layouts

6.4.18. At this stage the junctions have been developed as described below, however this will be refined and further developed during DMRB Stage 3.

Elgin West Junction

6.4.19. The Elgin West Junction is located at Lochinver, approximately 2km south-west of Elgin, with a single carriageway link road provided to connect the junction with the existing A96. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected with an overbridge. Local accesses to properties at Lochinver and Inverlochty, respectively, have been incorporated into the

northern roundabout. The realigned C4E Brodieshill – Cloves - Lochinver Road has been incorporated into the southern roundabout.

6.4.20. The link road would run north-east from the proposed junction to join the existing A96 at the Morriston Road Junction. The link road bridges the River Lossie and Aberdeen - Inverness Railway Line, with the road raised on embankment. The road also bridges the River Lossie at Bruceland, with the road elevated on embankment.

6.4.21. The northern roundabout would be a six-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;
- Link to the southern roundabout;
- Private access to Lochinver cottages to the north-west;
- Private access to Inverlochty cottages to the north-east; and
- Link Road to Elgin West to the north.

6.4.22. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned C4E to the south.

Elgin South Junction

6.4.23. The Elgin South Junction is located on the A941 between The Neuk and Burnside of Birnie, approximately 1.5km from Elgin. The junction maintains connectivity with the existing A941 to the north and south. The junction is a grade separated dumb-bell arrangement with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

6.4.24. The northern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;
- Link to the southern roundabout; and
- Existing A941 to the north.

6.4.25. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- Realigned A941 to the south, which includes a junction providing access for properties at Burnside of Birnie.

Elgin East Junction

6.4.26. The Elgin East Junction is located south-east of Easter Coxton Farm at Lhanbryde, approximately 3.5km from Elgin, with a dedicated single carriageway link road provided to connect the junction with the existing A96 to the north. The C1E Garmouth - Lhanbryde – Fogwatt Road is realigned to tie in to the south side of the junction. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

6.4.27. The new link road is proposed to connect the junction to the existing A96 east of Elgin and west of Lhanbryde. The link road would run north-west from the proposed junction re-joining the existing A96 on the western section of the Lhanbryde bypass. The link road crosses over the Aberdeen - Inverness Railway Line with the road raised on embankment.

6.4.28. The northern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;
- Link to the southern roundabout; and
- Link Road to Elgin (East) to the north.

6.4.29. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- C1E via a short link.

Local Roads and Accesses

6.4.30. This section of the report discusses the existing local road network and accesses and the diversion strategy proposed with regards to the South Option. The strategy is consistent with the North Option as set out in sections 6.3.31 and 6.3.32, which will be refined and developed further during Design Manual for Roads and Bridges (DMRB) Stage 3.

6.4.31. Table 6.2 below describes the preliminary local road strategy for the South Option.

Table 6.2: Local Road and Access Strategy

Local Road / Access	Name	Treatment
Local Access	Mains of Burgie Access	SUA
C4E	Brodieshill – Cloves – Lochinver Road (West)	B
Local Access	Morayscairn Access	B

Local Road / Access	Name	Treatment
U101E	Church Road	B
C4E	Brodieshill – Cloves – Lochinver Road (Central)	B
U105E	Garrowslack Road	B
Local Access	Amenity Fishing Ponds Access	SUA
C26E	Miltonduff – Lochside Road	B
C4E	Brodieshill – Cloves – Lochinver Road (East)	J
C3E	Elgin – Pluscarden – Rafford Road	B
B9010	Elgin – Rafford – Forres Road	B
C2E	Elgin – Birnie Road	B
A941	Elgin – Dufftown Road	J
C20E	Linkwood – Troves – Elgin Road	B
B9103	Lossie – Sherrifston – Orton – Mulben Road	B
C1E	Garmouth – Lhanbryde – Fogwatt Road (North) and St Andrews Road	J
C1E	Garmouth – Lhanbryde – Fogwatt Road (South)	J
Local Access	Greenfields and Glenesk Access	SUA

Key to table:

B – Bridge to be provided over or under proposed A96 allowing continuation of road.

J – Road to be diverted /connected to the new A96 grade separated junction.

SU – Road/access to be stopped up. Diversion to be provided via existing road network.

SUA – Road/access to be stopped up. Alternate access to be provided.

6.4.32. Each of the above local roads and accesses are described below.

6.4.33. The following junctions and accesses are the same as the North Option as described in sections 6.3.35 – 6.3.38 above:

- Mains of Burgie Access; and
- C4E Brodieshill – Cloves – Lochinver Road (West).

Morayscairn Access

6.4.34. This is an access from the existing A96, located west of Alves Wood, that provides access to properties at Morayscairn.

6.4.35. The access road would be realigned and would cross over the proposed A96 dual carriageway with an overbridge and a junction would be formed with the existing A96.

U101E Church Road

6.4.36. The U101E runs south from a junction with the existing A96, adjacent to the eastern edge of Alves Wood. It connects the existing A96 to the C4E at Monaughty.

6.4.37. The proposed dual carriageway crosses over the U101E with an underbridge.

C4E Brodieshill – Cloves – Lochinver Road (Central)

6.4.38. The C4E runs south from a junction with the existing A96, past the Alves station cottages towards Cloves.

6.4.39. The existing road would cross over the proposed dual carriageway with an overbridge.

U105E Garrowslack Road

6.4.40. The U105E runs north from a junction with the C4E approximately 0.7km east of Cloves.

6.4.41. The existing road would cross over the proposed dual carriageway with an overbridge.

Amenity Fishing Pond Access

6.4.42. This is an access road running north from a junction with the C4E, located approximately 1.5km east of Cloves.

6.4.43. This access road would be stopped up and a realigned track would be provided running parallel and south of the Aberdeen - Inverness Railway Line.

C26E Miltonduff – Lochside Road

6.4.44. The C26E runs south from a junction with the existing A96 at Newton.

6.4.45. The proposed dual carriageway crosses over the C26E with an underbridge maintaining the existing road.

C4E Brodieshill – Cloves – Lochinver Road (East)

6.4.46. The C4E runs east from a junction with the C26E, located approximately 2km south of Newton. It is also the site of the Elgin West Junction.

6.4.47. The existing road would be stopped up and a realigned link road to the roundabouts of the Elgin West Junction would be provided.

C3E Elgin – Pluscarden – Rafford Road

6.4.48. The C3E runs south-west from its junction with the B9010 Elgin – Rafford – Forres Road, located adjacent to Easter Pittendreich.

6.4.49. The existing road would cross over the proposed dual carriageway with an overbridge.

B9010 Elgin – Rafford – Forres Road

6.4.50. The B9010 runs south from the south-western edge of Elgin towards Pittendreich.

6.4.51. The proposed dual carriageway crosses over the B9010 with an underbridge maintaining the existing road.

C2E Elgin – Birnie Road

6.4.52. The C2E runs south from a roundabout on the A941 Lossiemouth – Elgin – Dufftown – Rhynie Road in the south of Elgin.

6.4.53. The existing road would be stopped up and realigned offline to cross the proposed dual carriageway with an overbridge.

A941 Elgin – Dufftown Road

6.4.54. The A941 runs north to south towards Fogwatt from the centre of Elgin and is the site of the Elgin South Junction, located adjacent to Birkenhill Wood.

6.4.55. The existing road would be realigned to connect to the dumb-bell roundabouts of the Elgin South Junction. An overbridge would be provided for the A941 to cross over the proposed dual carriageway.

C20E Linkwood – Troves – Elgin Road

6.4.56. The C20E runs west from a junction with the C1E Garmouth – Lhanbryde – Fogwatt Road, located approximately 1km south of the Greens of Coxton.

6.4.57. The existing road would cross over the proposed dual carriageway with an overbridge.

B9103 Lossie – Sherrifston – Orton – Mulben Road

6.4.58. The B9103 runs south-east from a junction with the existing A96 to the west of Lhanbryde.

6.4.59. The existing road would cross over the proposed dual carriageway with an overbridge.

C1E Garmouth – Lhanbryde – Fogwatt Road (North) and St Andrews Road

6.4.60. The C1E St Andrews Road runs east from the Lhanbryde West roundabout on the existing A96 providing access to Lhanbryde.

6.4.61. The existing road would form a junction with the link road to Elgin East Junction at the location of the existing roundabout. A new connection would be provided from the C1E to the existing A96 to the west.

C1E Garmouth – Lhanbryde – Fogwatt Road (South)

6.4.62. The C1E runs south-west from a junction with the existing A96 south of Lhanbryde.

6.4.63. The existing road would be stopped up and would be connected to the southern roundabout of Elgin East Junction.

Greenfields and Glenesk Access

6.4.64. This is an access from a junction on the existing A96 (within the adjacent Lhanbryde to East of Fochabers section), providing access to Glenesk and Greenfields.

6.4.65. The access road would be stopped up and a new link road connecting to the C1E to the west would be provided.

6.5 Topography and Land Use

Topography

6.5.1. Both options would introduce changes to the existing topography through the introduction of new road embankments and cuttings, grade separated junctions, local road realignments and structures.

6.5.2. The topography surrounding the North Option generally comprises low relief, locally undulating terrain. The land to the north is generally a low-lying and fertile coastal plain, forming part of the area called the Laich Of Moray.

6.5.3. The topography surrounding the South Option generally comprises low relief, locally undulating terrain. The elevation gradually increases further to the south forming several small hills.

Land Use

6.5.4. Both options are surrounded largely by pastoral and arable farm land, of which much is prime agricultural land (particularly in the north), as well as areas of woodland and a number of small communities and scattered properties.

6.5.5. The largest woodlands in vicinity of the North Option include Quarrelwood, Findrassie Wood and Kirkhill Wood. The largest woodlands in vicinity of the South Option include Alves Wood, Birkenhill Wood and Mayne Wood.

6.5.6. Land use is considered further detail in Volume 2, Chapter 12 (People and Communities) and Chapter 13 (Agriculture, Forestry and Sporting Interests) of this report.

6.6 Geotechnics and Earthworks

General

6.6.1. An assessment of the likely ground conditions affecting the options has been determined largely from British Geological Survey (BGS) 1:63,360 scale; 1:50,000 scale; 1:10,560 scale and 1:10,000 scale series geological maps for the area, and Memoirs of the Geological Survey Scotland: the Geology of the Elgin District. A search of the BGS GeoIndex interactive map and BGS Lexicon was conducted for relevant historical exploratory hole and geology information.

General Ground Conditions

6.6.2. The options are underlain primarily by superficial deposits of Alluvium and Glacial origin, with some small, isolated areas of bedrock at or near the surface. In addition, an area of Raised Marine Deposits is present north-west of Elgin, and, areas of Lacustrine Alluvium are present east of Cloddach and south of Barmuckity. Superficial deposits within the area are summarised in Table 6.3 below and shown on Figures 6.9, 6.10, 6.11, 6.12, 6.13 and 6.14 (Volume 5).

Table 6.3: Superficial Deposits present within the study area

Strata	Typical Description	Distribution within Study Area
Alluvium	Silty clay often with layers of silt, sand, peat and basal gravel	Local to all major watercourses including Kinloss Burn; Spynie Canal; Monaughty Burn; Mosstowie Canal; Black Burn; River Lossie; Burn of Linkwood and, Lhanbryde Burn
Glacial Till	Boulder clay	Present surrounding Alves Wood and Carden Hill; north-west of Elgin surrounding Quarrelwood; and in isolated pockets adjacent to Glaciofluvial Deposits across the study area
Glaciofluvial Ice Contact Deposits	Sand and gravel with localised lenses of silt, clay and organic material	Extensive distribution north, and west of Elgin
Glaciofluvial Sheet Deposits	Sand and gravel with lenses of silt, clay and organic material	North of Glenburgie and south-east of Elgin
Glaciolacustrine Deposits	Silt and clay with organic and/or calcareous muds	In an isolated area surrounding Glenburgie Distillery in the western most section of the study area
Lacustrine – Lake Alluvium	Silt and clay with occasional organic and/or calcareous muds	An isolated area south of Barmuckity and east of Cloddach Quarry

Strata	Typical Description	Distribution within Study Area
Peat	Partially decayed vegetation or organic matter	Isolated pockets of peat are distributed throughout the study area, generally located within low-lying wetland or upland areas
Raised Marine Deposits	Gravel, sand, silt and clay and commonly present organic debris	North-west of Findrassie Wood and north of Spynie

6.6.3. In addition to strata detailed in Table 6.3, it is anticipated that areas of Made Ground are likely to be present across the study area associated with the development of infrastructure and residential and farm related properties.

6.6.4. There are several former quarries and pits across the study area, which where infilled and are likely to contain unspecified material. Recorded extent of Made Ground across the study area is included on Figures 6.9, 6.10, 6.11, 6.12, 6.13 and 6.14 (Volume 5).

6.6.5. The composition of infilled and Made Ground is unspecified therefore it is likely to comprise a highly variable mixture of reworked soil, road make-up, engineering fill and man-made material. In addition, remnant buried structures and/or obstructions are also likely to be present in-situ.

6.6.6. There is limited rock exposure throughout the study area due to the thickness of the overlying superficial deposits. The solid geology recorded across the study area is shown on Figures 6.15, 6.16, 6.17, 6.18, 6.19 and 6.20 (Volume 5).

6.6.7. Solid geology underlying the study area predominately comprises sedimentary strata of the Inverness Sandstone Group (part of the Devonian Middle Old Red Sandstone Supergroup) and the Forres Sandstone Group (part of the Devonian Upper Old Red Sandstone Supergroup).

6.6.8. Pebbly or gravelly sandstones of the Alves Formation underlies the western extent of the study area from Hillhead to Elgin. An unconformity separates the Alves Formation from the Hopeman Sandstone Formation, present within two isolated areas within Quarrelwood. Local to Quarrelwood and Findrassie, solid geology comprises sandstone of the Rosebrae Beds, part of the Upper Old Red Sandstone Supergroup. Bedrock is recorded to dip between 6 and 10 degrees towards the north-west at this locality.

6.6.9. North of Midtown, an isolated area of sandstone interbedded with siltstone of the Dunrobin Bay Formation is present. Immediately east of this unit, local to Lochside Cottages, sandstone chert and limestone of the Stotfield Cherty Rock Formation is recorded.

6.6.10. Bedrock underlying the study area surrounding Elgin comprises calcareous, marly sandstones containing calcite and chert of the Elgin Calcrete Formation. The unit is recorded to dip 15 to 25 degrees north-west at New Elgin. The Scaat Craig Beds of the Upper Old Red Sandstone Supergroup are recorded local to Lhanbryde. Rocks of this unit are described as pebbly or gravelly sandstones.

6.6.11. Conglomerates and sandstones of the Kingsteps Sandstone Formation underlie the study area north-east of Barnhill and south-west of Pittendreich local to Miltonduff. The Scaat Craig Beds of the Upper Old Red Sandstone Supergroup underlie the easternmost section of the study area, extending north and south of Lhanbryde. Rocks of this unit are described as pebbly or gravelly sandstones.

Existing Ground Investigation Data

6.6.12. Existing ground investigation coverage within the study area is limited and localised, with the majority of the available exploratory hole records surrounding Lhanbryde. Selected borehole and trial pit logs have been obtained from the BGS archive.

6.6.13. These are summarised in Table 6.4 and Table 6.5 below for the North and South Options, respectively.

Table 6.4: Existing Ground Investigation Information - North Option

Scheme	Coverage	General Findings
Glenburgie Distillery	Local to Glenburgie Distillery, at the westernmost extent of the Scheme	Topsoil underlain by sand and gravel to 2.3/ 10.9m depth. Bedrock comprising sandstone and conglomerate is recorded from 2.3/ 10.9m depth to a maximum recorded depth of 31m.
Rosebrae Farm	Local to Rosebrae Farm, north-west of Quarrelwood	Sandy boulder clay with fragments of sandstone and metamorphic rock types recorded from ground level to 4.2m depth. Underlying bedrock comprises sandstone and conglomerate, with a weathered horizon at rockhead. Bedrock is recorded to a maximum depth of 15.8m depth.
Spynie Quarry	At Spynie Quarry, north of Elgin	Sandstone interbedded with siltstone is recorded from ground level to 71.6m depth.
Lhanbryde Bypass	Along the existing A96, south of Lhanbryde	Topsoil underlain by loose to medium dense sand and gravel to 9m depth. Sandstone bedrock is recorded to underlie the superficial deposits, with depths to rockhead recorded from 7.3m depth to 18.5m depth. Groundwater strikes were recorded at various depths within the granular superficial deposits.
Lhanbryde FAS	South of Lhanbryde, local to Lhanbryde Burn	Topsoil underlain by interbedded layers of soft silt, loose to medium dense sand and gravel, medium dense gravel and firm to very stiff clay. Superficial deposits are present to a maximum recorded depth of 16.27m depth. Made Ground comprising topsoil, slightly organic sand and gravelly sand with cobbles is recorded from ground level to 1.8m depth in two exploratory holes.

Scheme	Coverage	General Findings
		Bedrock comprising very weak, highly weathered micaceous sandstone is recorded in one borehole from 10.25m depth to 10.5m depth. Groundwater strikes were recorded at various depths, typically within the granular layers.
Lhanbryde School	North of the existing A96, within north-eastern Lhanbryde	Topsoil underlain by loose to medium dense sand to a maximum recorded depth of 4.3m depth.

Table 6.5: Existing Ground Investigation Information - South Option

Scheme	Coverage	General Findings
Glenburgie Distillery	Local to Glenburgie Distillery, at the westernmost extent of the Scheme	Topsoil underlain by sand and gravel to 2.3/ 10.9m depth. Bedrock comprising sandstone and conglomerate is recorded from 2.3/ 10.9m depth to a maximum recorded depth of 31m.
Pittendreich New Bridge	At Wester Pittendreich Bridge over Black Burn	Sandy, gravelly topsoil underlain by sand and gravel to a maximum recorded depth of 8m. A thin layer of peat is recorded between 2.74m depth and 3m depth, interbedded with the granular deposits.
Lhanbryde Bypass	Along the existing A96, south of Lhanbryde	Topsoil underlain by loose to medium dense sand and gravel to 9m depth. Sandstone bedrock is recorded to underlie the superficial deposits, with depths to rockhead recorded from 7.3m depth to 18.5m depth. Groundwater strikes were recorded at various depths within the granular superficial deposits.
Lhanbryde FAS	South of Lhanbryde, local to Lhanbryde Burn	Topsoil underlain by interbedded layers of soft silt, loose to medium dense sand and gravel, medium dense gravel and firm to very stiff clay. Superficial deposits are present to a maximum recorded depth of 16.27m depth. Made Ground comprising topsoil, slightly organic sand and gravelly sand with cobbles is recorded from ground level to 1.8m depth in two exploratory holes. Bedrock comprising very weak, highly weathered micaceous sandstone is recorded in one borehole from 10.25m depth to 10.5m depth. Groundwater strikes were recorded at various depths, typically within the granular layers.
Lhanbryde School	North of the existing A96, within north-eastern Lhanbryde	Topsoil underlain by loose to medium dense sand to a maximum recorded depth of 4.3m depth.

Identified Geotechnical Constraints

General

6.6.14. The main geotechnical constraints affecting the options include potential for compressible ground and subsidence, specifically where embankments are to be constructed across these areas. Compressible ground is typically associated with Alluvium, Lacustrine Deposits and Peat.

6.6.15. Subsidence and compressible ground may be encountered associated with potentially infilled land of unknown constituents. The thickness and nature of these deposits will require to be confirmed by means of ground investigation at DMRB Stage 3.

6.6.16. Generally, the mainline for both options is to be constructed on embankments of varying heights with some sections in cuttings or at-grade.

North Option

6.6.17. Potential geotechnical constraints (ratings as defined by the BGS) are summarised below and are presented on Figures 6.21, 6.22 and 6.23 (Volume 5).

- Shallow groundwater levels;
- Very low hazard potential for landslide across much of the study area, with the exception of ground along the river banks of the River Lossie where the landslide potential is low to moderate;
- Negligible, or very low hazard potential for shrinking or swelling clay across much of the study area, with low hazard potential for shrinking or swelling clay associated with Lacustrine – Lake Alluvium;
- Moderate potential for compressible ground associated with Alluvium local to existing watercourses; Lacustrine Deposits; and, Peat; and
- Potentially infilled land of unknown constituents, yielding potential sources of contamination (including ground gas) and possible compressible ground and subsidence:
  - Twenty-eight former quarries located within the study area, potentially infilled;
  - Two heaps of unknown constituents;
  - Six infilled quarries or water features; and,
  - Twenty former sand and gravel pits.
  - Spynie operational sandstone quarry north of Elgin; and,
  - Kirkhill operational sand quarry east of Elgin.

6.6.18. Further geotechnical constraints relating to compressibility of the underlying soils are summarised below and are shown on Figures 6.9, 6.10 and 6.11 (Volume 5).

- Significant deposits of Alluvium along the North Option include:
  - A section on embankment south of the proposed Elgin North Junction;

  - A section on embankment north of the proposed U34E Wester Calcots Road underbridge;
  - A section on embankment north and north-east of Kirkhill Wood;
  - A section on embankment along the approaches to the River Lossie Crossing;
  - A section on embankment along the proposed southern approach to the Elgin East Junction; and,
  - A section on embankment local to the proposed Lhanbryde Burn Crossing.
- East of the B9012 Duffus Road overbridge, a section is underlain by Glaciolacustrine Deposits. The option is predominantly on very low embankment or at-grade along this section.
- Lacustrine Alluvium is recorded immediately south of the proposed Aberdeen - Inverness Railway Line underbridge, along a section on embankment.
- Recorded potentially infilled land comprises a former quarry underlying the option immediately east of the proposed NMU overbridge.

South Option

6.6.19. Potential geotechnical constraints (ratings as defined by the BGS) are summarised below and are presented on Figures 6.24, 6.25 and 6.26 (Volume 5).

- Shallow groundwater levels;
- Very low hazard potential for landslide across much of the study area, with the exception of ground along the river banks of the River Lossie where the landslide potential is low to moderate;
- Negligible, or very low hazard potential for shrinking or swelling clay across much of the study area, with low hazard potential for shrinking or swelling clay associated with Lacustrine – Lake Alluvium;
- Moderate potential for compressible ground associated with Alluvium local to existing watercourses; Lacustrine Deposits; and, Peat; and
- Potentially infilled land of unknown constituents, yielding potential sources of contamination (including ground gas) and possible compressible ground and subsidence:
  - Fourteen former quarries located within the study area, potentially infilled;
  - One heap of unknown constituents;
  - Four infilled quarries or water features; and,
  - Twenty-three former sand and gravel pits.
  - Lochinver operational sand and gravel quarry south-west of Elgin; and,
  - Cloddach operational silt, sand and gravel quarry south of Elgin.

6.6.20. Further geotechnical constraints relating to compressibility of the underlying soils are summarised below and are shown on Figures 6.12, 6.13 and 6.14 (Volume 5).

- Significant deposits of Alluvium along the South Option include:
  - A section on embankment or at-grade within Alves Wood;

  - A section on embankment or at-grade between Cloves and Burnside Farm;
  - A section on embankment west of the proposed Elgin West Junction;
  - Sections on embankment local to the River Lossie along the proposed Link Road to Elgin West;
  - A section on embankment associated with the River Lossie Crossing;
  - A section on embankment local to the Burn of Linkwood; and,
  - A section on embankment local to the proposed Lhanbryde Burn Crossing.
- East of Cloddach Quarry, Lacustrine – Lake Alluvium is recorded along a section of the option on embankment.
- Recorded Made Ground and potentially infilled land along the South Option includes:
  - A heap of unknown constituents immediately south of the option, located west of the proposed C4E Brodieshill – Cloves – Lochinver Road overbridge;
  - A former sand and gravel pit located immediately east of the proposed U105E Garrowslack Road in cutting;
  - A former sand and gravel pit underlying the western approach embankment to the proposed Elgin West Junction;
  - A former sand and gravel pit underlying the cutting for the proposed C2E Elgin - Birnie Road overbridge; and,
  - A former sand and gravel pit underlying the cutting approaching the proposed Elgin East Junction.

Discussion

6.6.21. Alluvium and Lacustrine Deposits may contain compressible Silts and Clays, and occasionally peat.

6.6.22. The potentially compressible nature of these deposits may yield significant settlement beneath embankments in the long term, and potential slope stability problems, particularly during the construction phase. Any excavations below the groundwater table in these deposits may be difficult and dewatering might be required.

6.6.23. Potential measures to mitigate any issues associated with compressible ground include embankment slope design, staged construction, removal and replacement, accelerated settlement using band drains and/or surcharging with drainage layer(s), and the use of structurally supported load transfer platforms, particularly on the approaches to structures.

6.6.24. The selection and design of these measures will depend largely on the thickness and nature of the Alluvium which would be determined by means of a ground investigation, and potentially also programme constraints. Where the option is at-grade or on low height embankment it may be feasible to reinforce the subgrade with geogrids embedded within granular fill.

6.6.25. The angle of cut slopes in the Alluvium and Lacustrine Deposits will depend on the height of slope, groundwater level and the specific characteristics of the material. If the groundwater is at a high level on slope drainage may be required.

6.6.26. The construction over areas of Alluvium and/or Lacustrine Deposits potentially involves greater cost and may have an adverse impact on programme to allow the necessary remedial works to be implemented.

6.6.27. Made Ground is not recorded within the study area on available BGS geological mapping but is anticipated to be encountered local to the Aberdeen - Inverness Railway Line, existing roads, and residential and farm related properties. Made Ground was recorded locally, in historical ground investigation works.

6.6.28. It is anticipated that former quarries and pits within the study area may yield possible compressible ground and subsidence. It should be noted that the extent of these former quarries and pits is unknown, therefore areas of the options at risk is uncertain at this stage.

6.6.29. The nature and extent of the Made Ground and potentially infilled land recorded to potentially underlie the options is unknown. A ground investigation will be required to determine the nature and thickness of the backfill materials including any contamination that may be present. Depending on the nature and composition of the deposits recorded in-situ, potential measures include in-situ treatment to improve the engineering properties of the material or dig out and replace.

6.6.30. A comparison of the ground conditions affecting the options (mainline, junctions and side roads) is provided in Table 6.6 below. This identifies lengths of the options where less favourable ground conditions may be anticipated potentially requiring additional engineering measures.

Table 6.6: Comparison of ground conditions

Options	Approximate Length of Option Underlain by Potentially Compressible Superficial Deposits			
	Alluvium (m)	**Lacustrine Deposits (m)**	**Worked Ground* (m)**	**Total (m)**
Mainline				
North	1,600	610	10	**2,220**
South	5,880	660	20	**6,560**
Junctions and Side Roads				
North	125	-	-	**125**
South	510	-	30	**540**

*It has been assumed that where former quarries and pits are present, these have been backfilled with non-engineered fill of unknown origin. The extent of these former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage. For the purposes of this assessment, an assumed 10m length is used.

6.6.31. The comparison of total lengths of potentially unfavourable ground conditions presents a number of limitations as summarised below:

- Made Ground is not recorded within the study area on available geological mapping, but is anticipated to be encountered local to the Aberdeen - Inverness Railway Line, existing roads, and residential and farm related properties;
- The extent of former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage;
- Worked ground may not present a constraint and will depend on the extent of any backfilling and ground disturbance;
- Former quarries and pits may be largely situated above general ground level and may therefore have not been backfilled;
- Unrecorded areas of soft superficial deposits and/or Made Ground may be present in-situ;
- Locally, isolated areas of Glaciofluvial Deposits on floodplains may yield potentially compressible ground. This has not been considered in this assessment; and,
- The occurrence of the different types of superficial deposits is based on the geological mapping and limited available ground investigation data. In-situ ground conditions will require to be confirmed by means of ground investigation.

Earthworks

Excavated Material Acceptability - General

6.6.32. In general, where cuttings are to be formed, typically these lie within areas of predominantly granular materials of glacial and fluvioglacial origin, based on the available desk study information examined. The reuse potential has been assessed in two lengths, Hillhead to the River Lossie and the River Lossie to Lhanbryde.

6.6.33. The other deposits of post glacial origin, and also the alluvium, may provide acceptable materials depending on their composition and nature. This can only be confirmed by a ground investigation to be carried out during DMRB Stage 3 once a Preferred Option has been selected. This also applies to confirming the percentage acceptable for the fluvioglacial and glacial till deposits.

6.6.34. Rock is generally not anticipated to occur within the proposed shallow cuttings, which are generally less than 5m in depth, although the possibility of localised shallow rock cannot be discounted.

Excavated Material Acceptability – North Option

6.6.35. It is estimated at this stage that between Hillhead and the River Lossie that of the order of 70% of these materials may be acceptable for reuse as general engineering fill.

6.6.36. It is estimated at this stage that between the River Lossie and Lhanbryde that of the order of 90% of these materials may be acceptable for reuse as general engineering fill.

Excavated Material Acceptability – South Option

6.6.37. It is estimated at this stage that between Hillhead and the River Lossie that of the order of 80% of these materials may be acceptable for reuse as general engineering fill.

6.6.38. It is estimated at this stage that between the River Lossie and Lhanbryde that of the order of 90% of these materials may be acceptable for reuse as general engineering fill.

Unacceptable material and Contaminated Land

6.6.39. Unacceptable materials which cannot be used in the main earthworks such as peat, soft clays and silts would require to be disposed of on or off-site. Much of this material would be unsuitable in their natural state for the formation of bunds and in landscaping, although these volumes can be minimised through the use of appropriate in-situ ground improvement techniques where appropriate, particularly for the soft non-organic soils.

6.6.40. Peat deposits are very localised in occurrence and may not be of a significant thickness. Where encountered their disposal on or off-site would require to be appropriately assessed.

6.6.41. Contaminated land is not anticipated to be a significant issue affecting the North Option, largely due to the absence of any major industrial activity in the area. There are some potentially significant contamination issues affecting the South Option, as there are large areas of infilled ground in the vicinity of Cloddach Quarry, and it crosses a former RAF base. Investigation of these areas would be required 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 on the nature of the contamination.

Cut/Fill Balance

6.6.42. For the purpose of earthworks assessment, it is assumed that the export material from Lhanbryde to East of Fochabers North Option is available for deposition within the Hillhead to Lhanbryde section.

6.6.43. Table 6.7 below summarises the major earthworks quantities as follows:

- Bulk Fill Material Required – The bulk earthworks fill volume as required for the mainline, side roads and grade separated junctions. This excludes the material required for capping, sub base and topsoil;
- Bulk Excavated Material – The total volume of excavated material including acceptable and unacceptable. Excludes the topsoil strip;
- Acceptable Excavated Material – This constitutes the volume of excavated material deemed acceptable from initial investigations; and
- Cut/Fill Balance – The balance of the overall fill requirement, less the potential volume of available acceptable site won material.

Table 6.7: Major Earthwork Quantities

Option	North Option	South Option
Bulk Fill Material Required (m^3)	3,479,000	2,670,000
Bulk Excavated Material (m^3)	2,626,000	2,480,000
Acceptable Excavated Material (m^3)	1,903,000	2,140,000
Cut/Fill Balance (m^3)	1,576,000 (import)	530,000 (import)

6.6.44. As expressed in the table above, a positive balance is indicative of an overall import requirement with the result that a volume of engineering fill will be required to be sourced and brought to site. A negative balance indicates that there will be an overall surplus of engineering fill material generated by the work.

6.7 Hydrology and Drainage

6.7.1. The effects of the options on the water environment are considered fully in Volume 2, Chapter 20 (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.

6.7.2. A preliminary assessment of hydrology was made for each option. Following the selection of a Preferred Option, a review of the hydrology and drainage strategy will be undertaken during DMRB Stage 3. This will include a review of structural requirements at watercourse crossings.

Watercourses

6.7.3. A number of key watercourses located within the study area are affected, as described below.

Kinloss Burn

6.7.4. Kinloss Burn is a small watercourse/artificial field drain that rises to the south-east of Forres and flows north through a culvert under the existing A96 west of C4E Brodieshill – Cloves - Lochinver junction. The watercourse then flows into Findhorn Bay at Kinloss.

6.7.5. Both options cross the Kinloss Burn west of the C4E and a culvert would be provided on both.

Burgie Burn

6.7.6. The Burgie Burn is a small watercourse/drain which originates from Burgie Wood and flows north under a culvert to cross the existing A96 West of C4E Junction. The watercourse then discharges into Kinloss Burn at the existing A96 crossing.

6.7.7. Both options cross the Burgie Burn south of the C4E junction on a structure (C4E Crossing).

Tributaries of Mosstowie

6.7.8. These tributaries are located south of the Aberdeen - Inverness Railway Line, to the west of Burnside Farm. They flow eastward and outfall into Mosstowie Canal.

6.7.9. The tributaries of Mosstowie do not interact with the North Option. The South Option would provide a culvert and channel realignment where the option crosses the tributaries.

Mosstowie Canal

6.7.10. The Mosstowie Canal flows eastward from the Monaughty Burn. This watercourse discharges into the River Lossie at Aldroughty, which is located west of Elgin.

6.7.11. The Mosstowie Canal does not interact with the North Option. The South Option crosses Mosstowie Canal east of the C26E Miltonduff - Lochside Road on a structure.

Tributary of Spynie Canal

6.7.12. This tributary is a small modified watercourse located north of Elgin at Findrassie. It flows in a north-easterly direction and outfalls into the Spynie Canal.

6.7.13. The North Option crosses this watercourse north of Findrassie. A culvert and channel realignment are provided. The tributary of Spynie Canal does not interact with the South Option.

Black Burn

6.7.14. The Black Burn is a medium sized watercourse which starts south of the existing A96 at Blackhillock. The watercourse flows in a north-easterly direction and goes under a culvert along the Aberdeen - Inverness Railway Line then outfalls into the River Lossie.

6.7.15. The Black Burn does not interact with the North Option. The South Option crosses the Black Burn north of Miltonduff on a structure.

River Lossie

6.7.16. The River Lossie originates from the hills above Dallas and flows east past Kellas before turning north at Leanoch towards Elgin. The River Lossie flows east through Elgin town centre before turning north again before discharging into the Moray Firth at Lossiemouth.

6.7.17. The North Option provides a structure (180m long) to cross the River Lossie at Kirkhill, east of Elgin. The North Option also provides flood relief culverts through the embankments either side of the River Lossie Crossing.

6.7.18. The South Option provides a structure (380m long) to cross the River Lossie at Cloddach Quarry, South of Elgin. The South Option also provides flood relief structures, culverts and an area of land is to be reprofiled in order to assist in the flow of flood water. These are all provided on the west side of the River Lossie crossing at Cloddach Quarry. The South Option also requires two bridges over the River Lossie to carry the link road to Elgin West.

Burn of Linkwood

6.7.19. The Linkwood Burn is a small/medium sized watercourse which flows from south to north running parallel to the A941 and flows into Elgin from the south. The watercourse continues in a northerly direction before falling into the River Lossie.

6.7.20. The Burn of Linkwood does not interact with the North Option. The South Option crosses the burn on the west side of the Elgin South Junction, with a culvert provided beneath the eastbound diverge, the mainline and the westbound merge.

Lhanbryde Burn

6.7.21. The Lhanbryde Burn originates from Blackhills, south of Lhanbryde, and flows in a northerly direction. The burn passes underneath the existing A96 and the Aberdeen - Inverness Railway Line before flowing into a confluence with the Innes Canal and subsequently the River Lossie.

6.7.22. Both options cross the Lhanbryde Burn at Greenfields, south of Lhanbryde. For both options a culvert is provided.

Drainage

6.7.23. An outline drainage design has been carried out to identify potential outfalls, catchment areas, feasible locations for ponds/basins, and their required volume, to inform the engineering and environmental assessments for each option. The design of drainage systems will be developed further during DMRB Stage 3.

6.7.24. Design development will incorporate Sustainable Drainage Systems (SuDS) comprising a combination of multiple treatment methods at source as well as larger downstream controls. The intention of such systems is to reduce concentration of pollutants and attenuate surface water run-off as it is conveyed through the drainage network, prior to entering a watercourse.

6.7.25. The level of treatment required is dependent on the location of the catchment and receiving watercourse to which it outfalls. Scottish Environmental Protection Agency (SEPA) require at least two levels of treatment for most catchments within the Scheme extents. Some receiving watercourses have been deemed more environmentally sensitive and an additional level of treatment will be included.

6.7.26. At source SuDS will include filter drains and swales, providing the first level of treatment where possible. Ponds/basins will be utilised downstream of the network as an additional level of treatment and will be capable of attenuating run off volumes during extreme weather events, whilst discharging at a controlled flow rate to the receiving watercourse. Initial pond/basin locations have been identified but are indicative at this stage and will be further developed during DMRB Stage 3.

6.7.27. Drainage capability has been assessed for both options and where necessary, the vertical alignment has been refined to accommodate the required levels. It is not anticipated that either of the options will result in significant problems regarding discharging runoff into watercourses. Some of the receiving watercourse are particularly small. Using these watercourses may require greater levels of attenuation to avoid increasing flood risk.

6.7.28. Drainage from realigned local roads will be considered in detail during DMRB Stage 3. Any positive drainage systems are assumed to be independent of the proposed trunk road drainage network.

6.8 Structures

Introduction

6.8.1. This section describes the structures in outline only, as further details will be developed during DMRB Stage 3. The major river crossings and other significant structures are described in greater detail below.

6.8.2. Generally, the proposals have been developed based on adopting concrete construction, either in situ or precast, where span lengths permit, as this is generally the most cost-effective type of construction. Where larger spans are required, steel concrete composite construction is proposed.

Underbridges

6.8.3. The full width of the mainline, including carriageway and hardstrips, shall be continued across the decks of the underbridges. In accordance with DMRB (Volume 6, Section 1, Part 2, TD 27/05 Cross-Sections and Headrooms, Clause 5.6.1) there would be no reduction in the widths of the verges of the mainline on the underbridge decks.

6.8.4. It is anticipated that underbridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck. For smaller crossings a reinforced concrete portal option would also be considered.

Overbridges

6.8.5. It is anticipated that overbridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck.

6.8.6. The full width of the carriageway, and hard strips (where provided) would be carried by the overbridges. Verges to both the local road and the proposed A96 mainline would be

continued over and under the structure in accordance with DMRB (Volume 6, Section 1, Part 2, TD27/05 Cross-Sections and Headrooms, clause 5.6.1).

6.8.7. The proposed structure locations are shown on Figures 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7 and 6.8 (Volume 5).

North Option

River Lossie Crossing / C19E Scotstonhill – Fernyfield Road

6.8.8. A number of constraints have been considered as follows:

- The width of the floodplain to be spanned was informed by initial flood modelling – approximately 180m;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed that a minimum clearance of 5.7m would be provided between the bridge deck soffit and the existing road level below the bridge.

6.8.9. At this stage it is proposed to that the structure would comprise a three-span arrangement, with a length of 180m.

6.8.10. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available and it may be possible to adopt spread foundations for some or all foundations depending on the results of these investigations.

6.8.11. Structure type and span configurations will be further developed during DMRB Stage 3.

Railway Crossings

6.8.12. Two railway underbridges would be required on the North Option to cross the Aberdeen - Inverness Railway Line. The railway currently consists of a single track at both locations. The line is not currently electrified.

6.8.13. The bridge would be designed to accommodate future double-tracking and electrification of the railway line.

6.8.14. It is anticipated that the railway bridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck. Precast beam construction would allow quick and straightforward construction of the deck, minimising disruption to the railway. Full height concrete abutments on piled foundations would be adopted.

6.8.15. A portal structure has been assumed, with the beams perpendicular to the railway line. A traditional beam and deck type bridge could also be considered, with the beams following the line of the road and crossing the railway line at the same skew as the road.

6.8.16. Structure type and span configurations will be further developed during DMRB Stage 3.

6.8.17. The railway bridges required for the North Option are detailed in Table 6.8 below.

Table 6.8: North Option – Railway Bridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Aberdeen - Inverness Railway Line (Alves)	Aberdeen - Inverness Railway Line	18	48
Aberdeen - Inverness Railway Line (Lhanbryde)	Aberdeen - Inverness Railway Line	9	76

Underbridges

6.8.18. The underbridges required are as detailed in Table 6.9 below.

Table 6.9: North Option - Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
C4E Brodieshill – Cloves – Lochinver Road (West)	Side Road and Small Watercourse	33	26
U101E Church Road	Side Road	10	33
C4E Brodieshill – Cloves – Lochinver Road (East)	Side Road	12	47
B9013 Newton – Burghead Road	B9013	12	43
C24E Elgin – Westerfolds – Duffus Road	Side Road	15	39
U34E Wester Calcots Road	Side Road	7	30
C23E Woodside - Calcots Road	Side Road	11	59

Overbridges

6.8.19. The overbridges required are as detailed in Table 6.10 below.

Table 6.10: North Option - Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Birchbrae Access	Access	64	10
NMU Route (at Alves)	NMU Route	101	4
Elgin West Junction	Elgin West Junction	64	15
Dykeside Access	Access	129	6
U47E Loanhead Road	Side Road	67	10
B9012 Duffus Road	B9012	64	10
Elgin North Junction	Side Road	76	11
U37E Pitgaveny Road	Side Road	66	10
Kirkhill Access	Access	68	9
Elgin East Junction	Elgin East Junction	61	15
B9103 Lossie – Sherrifston – Orton – Mulben Road	B9103	73	10

South Option

River Lossie Crossing – Main Carriageway

6.8.20. A number of constraints have been considered as follows:

- The width of the floodplain to be spanned was informed by initial flood modelling – approximately 390m;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed that a minimum clearance of 2.6m would be provided between the bridge deck soffit and the existing ground level of any footpath below the bridge.

6.8.21. At this stage it has been assumed that the proposed structure comprises a nine-span arrangement of overall length approximately 390m.

6.8.22. It is assumed that the deck would comprise of the pre-stressed beams and in-situ slab.

6.8.23. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

6.8.24. Structure type and span configurations will be further developed during DMRB Stage 3.

River Lossie Crossing – Link Road to Elgin West

6.8.25. A number of constraints have been considered as follows:

- The width of the floodplain to be spanned was informed by initial flood modelling – approximately 160 m;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed that a minimum clearance of 2.6m would be provided between the bridge deck soffit and the existing ground level of any footpath below the bridge.

6.8.26. At this stage it is proposed to that the structure would comprise a three-span arrangement, with a length of 160m.

6.8.27. It is assumed that the deck would comprise steel beams and in-situ concrete deck slab.

6.8.28. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available and it may be possible to adopt spread foundations for some or all foundations depending on the results of these investigations.

6.8.29. Structure type and span configurations will be further developed during DMRB Stage 3.

River Lossie / Aberdeen - Inverness Railway Line / Link Road to Elgin West

6.8.30. A number of constraints have been considered as follows:

- The width of the floodplain to be spanned was provided as a result of initial flood modelling – approximately 250m;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed that a minimum clearance of 2.6m would be provided between the bridge deck soffit and the existing ground level of any footpath below the bridge.

6.8.31. At this stage it has been assumed that the proposed structure comprises a three-span arrangement of overall length 250m. The southern end span would cross the Aberdeen - Inverness Railway Line, and the northern end span would cross the River Lossie.

6.8.32. It is assumed that the deck would comprise the steel beams and in-situ concrete deck cast on permanent formwork.

6.8.33. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available and it may be possible to adopt spread foundations for some or all foundations depending on the results of these investigations.

6.8.34. Structure type and span configurations will be further developed during DMRB Stage 3.

Railway Crossings

6.8.35. In addition to the railway crossing provided for the Link Road to Elgin (West) as described above, a further railway underbridge would be required on the link road to Elgin (East) to cross the Aberdeen - Inverness Railway Line, at Lhanbryde. The railway currently consists of a single track at this location. The line is not currently electrified.

6.8.36. The bridge would be designed to accommodate future double-tracking and electrification of the railway line.

6.8.37. Structure type and span configurations will be developed during DMRB Stage 3.

6.8.38. The railway underbridges required are listed in Table 6.11 below.

Table 6.11: Railway Underbridges - Hillhead to Lhanbryde South

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Aberdeen - Inverness Railway Line (Link Road to Elgin East)	Aberdeen - Inverness Railway Line	15	32

Underbridges

6.8.39. The underbridges required are as detailed in Table 6.12 below.

Table 6.12: South Option - Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
C4E Brodieshill – Cloves – Lochinver Road (West)	Side Road	63	26
Morayscairn Access	Access	9	26
U101E Church Road	Side Road	8	26
C26E Miltonduff – Lochside Road	Side Road	12	26
Mosstowie Canal Crossing	Mosstowie Canal	87	26
Black Burn Crossing	Black Burn	90	26
B9010 Elgin – Rafford – Forres Road	B9010	109	26
Flood Relief and Farm Access Bridge	Field and Farm Access	10	52

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Flood Relief and Farm Access Bridge	Field and Farm Access	10	37

Overbridges

6.8.40. The overbridges required are as detailed in Table 6.13 below.

Table 6.13: South Option - Overbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
C4E Brodieshill – Cloves – Lochinver Road (East)	Side road	64	10
U105E Garrowslack Road	Side road	60	7
Elgin West Junction	Elgin West Junction	60	14
C3E Elgin – Pluscarden – Rafford Road	Side road	68	6
C2E Elgin – Birnie Road	Side road	62	11
Elgin South Junction	A941 Lossiemouth – Elgin – Dufftown – Rhynie Road	60	11
NMU Route (at Dismantled Railway)	NMU Route	81	6
C20E Linkwood – Troves – Elgin Road	Side road	87	10
B9103 Lossie – Sherrifston – Orton – Mulben Road	Side road	72	10
Elgin East Junction	Elgin East Junction	69	11

Ancillary Structures

6.8.41. Both options would require the provision of a number of ancillary structures such as culverts and may require accommodation underpasses and overbridges.

Culverts

6.8.42. At this stage it is assumed that all other watercourses crossed by the option would require a culvert, designed to accommodate the design flood flows and consider environmental stakeholder requirements, including SEPA and Scottish Natural Heritage (SNH). This will be further developed during DMRB Stage 3.

6.8.43. The culverts would generally comprise reinforced concrete pipes or concrete box culverts. Concrete wingwalls and headwalls would also be provided upstream and downstream of the culvert. Pipes less than 2m diameter (less than 0.9m for corrugated steel construction) are not classified as structures and will be considered as part of the drainage system.

6.8.44. Where existing culverts require extending, the extensions would generally be of the same cross section and materials as the existing.

Accommodation Structures

6.8.45. The requirement for accommodation structures has been considered for both options and will be developed further during DMRB Stage 3.

Retaining Walls

6.8.46. The requirement for retaining walls will be assessed during DMRB Stage 3.

Vehicle Containment and Pedestrian Restraint over Structures

6.8.47. Generally, the vehicle containment to be provided over the structures will be in accordance with DMRB (Volume 2, Section 2, Part 8, TD 19/06, Requirement for Road Restraint Systems), and will be developed during DMRB Stage 3.

6.9 Utilities

6.9.1. There are a significant number of buried and overhead public and private utility services between Hillhead and Lhanbryde including:

- Telecommunications – BT overhead and underground network, Vodafone network and O2 masts;
- SGN – High, Intermediate, Medium, and Low-pressure gas pipelines;
- SSE High Voltage, Medium Voltage and Low Voltage overhead and underground services;
- Scottish Water supply network;
- Scottish Water sewer network;
- 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.

6.9.2. Public utilities have been identified and key utilities are shown on Figures 2.14, 2.15 and 2.16 (Volume 5). Major towns were not included within the utility search as both options bypass these urban areas.

6.9.3. 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 between Hillhead and Lhanbryde to enable 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 potential high cost diversion items.

Telecommunications

Network

6.9.4. Telecommunications infrastructure covers a majority of the area between Hillhead and Lhanbryde. The key elements of the network include:

BT Underground Supply Network

6.9.5. This utility is located throughout the area. Cables run adjacent to the existing A96 and many of the local roads in the area. This utility services many of the local settlements.

BT Overhead Supply Network

6.9.6. This utility is not as prevalent as the underground network. Cables are adjacent to local roads, connecting to either underground cables or nearby properties.

Vodafone

6.9.7. This utility runs adjacent to the existing A96 from Hillhead to Lhanbryde. This utility is an underground cable and duct with several chambers spread throughout its length.

Communication Masts

6.9.8. This utility is spread throughout different locations between Hillhead and Lhanbryde. There is a higher concentration of this utility where the area is densely populated.

Interfaces

6.9.9. Table 6.14 below summarises the number of interfaces with the telecommunication network for each option

Table 6.14: Number of interfaces with telecommunications

Option	BT Underground Supply	BT Overhead Supply	Vodafone Network	Communication Masts	Total Interfaces
North	17	3	2	0	22
South	19	3	2	0	24

6.9.10. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

SGN

Network

6.9.11. SGN infrastructure is present in this section. Key elements of the network include:

High Pressure Pipeline

6.9.12. A pipeline enters the area south of the existing A96 and travels in an easterly direction towards Elgin but heads south-east near Mosstowie. South of Elgin the High-Pressure Pipeline travels in a north-easterly direction until it reaches a Transmission Reducing Station (TRS) to the south of New Elgin. The pipeline leaves the TRS and travels in a south-easterly direction.

Intermediate Pressure Pipeline

6.9.13. There are two Intermediate Pressure Pipelines in the area. Both pipelines enter/leave a TRS south of Elgin. One pipeline travels north through Elgin towards Lossiemouth while the other travels south towards settlements further south of Elgin.

Medium Pressure Pipeline

6.9.14. There are two Medium Pressure Pipelines between Hillhead and Lhanbryde. One pipeline comes from a Gas Distribution Station near Forres Enterprise Park. This pipeline travels north until it reaches the existing A96. It then follows the existing A96 west to supply Forres and east until it reaches the C4E junction and then it moves south to supply settlements within the area. The other pipeline comes from within Elgin and follows the existing A96 east and west to supply local settlements in the area.

Low Pressure Pipeline

6.9.15. There are two Low Pressure Pipelines in between Hillhead and Lhanbryde. Both pipelines branch off existing Medium Pressure Pipelines. One pipeline comes from Elgin and travels west. The other pipeline travels east along the local road C4E Brodieshill – Cloves Road.

Interfaces

6.9.16. Table 6.15 below summarises the number of interfaces with the SGN network for each option

Table 6.15: Number of interfaces with SGN

Option	High Pressure Pipeline	Intermediate Pressure Pipeline	Medium Pressure Pipeline	Low Pressure Pipeline	Total Interfaces
North	0	2	2	1	5
South	2	1	4	1	8

6.9.17. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

SSE

Network

6.9.18. SSE electricity supply infrastructure covers a majority of the area between Hillhead and Lhanbryde. The key elements of the network include:

132kV Overhead Lines

6.9.19. This utility travels in a north-easterly direction towards Elgin. Once near Elgin the utility changes direction and travels in a south-easterly direction through Elgin then south of Lhanbryde.

33kV Power Lines

6.9.20. A single line follows the existing A96 into Elgin. Four overhead lines travel in a north direction north of Elgin. Two lines travel from Elgin in an easterly direction following the existing A96 to Lhanbryde.

Overhead and Underground cables

6.9.21. These cables carry the 6.6-11kV and low voltage power into homes and businesses in the area.

Interfaces

6.9.22. Table 6.16 below summarises the number of interfaces with the SSE network for each option

Table 6.16: Number of interfaces with SSE

Option	132kV Line	33kV Line	6.6-11kV and Low Voltage Cables	Total Interfaces
North	4	8	17	29
South	2	6	24	32

6.9.23. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

Scottish Water

Network

6.9.24. Scottish Water infrastructure covers a majority of the area between Hillhead and Lhanbryde. The key elements of the network include:

Supply network

6.9.25. In addition to freshwater supply through water mains, there are several abandoned water mains and raw water mains throughout the area. The network serves homes and businesses throughout the local area.

6.9.26. Several private water supplies have been identified and these are discussed in Volume 2, Chapter 19 (Geology, Soils, Contaminated Land and Groundwater) of this report.

Sewer network

6.9.27. The sewer network comprises of combined sewer outfalls, foul water sewers and surface water sewers. The network services homes and businesses in the area with most services concentrated in the more densely populated areas such as Elgin. There is a sewer system leaving Elgin via the C2E Birnie Road and heading south. There is a Rising Main following the existing A96 that travels towards Lhanbryde. Additionally, there is a private sewer leaving the north-eastern end of Elgin that heads north towards Lossiemouth.

Unknown Infrastructure

6.9.28. On C2 information provided by Scottish Water, there is an unidentified main located to the north of Elgin.

Interfaces

6.9.29. Table 6.17 below summarises the number of interfaces with the freshwater network for each option

Table 6.17: Number of interfaces with water utilities

Option	Water Mains	Abandoned Mains	Raw Water Mains	Total Interfaces
North	19	2	0	21
South	21	5	1	27

6.9.30. Table 6.18 below summarises the number of interfaces with the foul water network for each option

Table 6.18: Number of interfaces with foul water utilities

Option	Surface Water	Foul Water Sewers	Rising Mains	Sewers	Unknown Infrastructure	Total Interfaces
North	1	0	1	1	5	8
South	0	1	0	0	0	1

6.9.31. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

6.10 Non-Motorised Users

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

6.10.2. The effects of the options on all travellers, including NMUs, are considered in Volume 2, Chapter 12 (People and Communities) of this report where the impacts of the options are assessed.

6.10.3. NMU facilities will be considered during design development of the Preferred Option during DMRB Stage 3.

6.11 Constructability

6.11.1. Both options are predominantly offline construction. Traffic management would only be required at interfaces with the local road network.

6.11.2. Within this section there are a number of elements which pose particular constructability challenges as listed below:

North Option

- Crossing of Aberdeen - Inverness Railway Line at Alves;
- Construction of Elgin West Junction at the interface with the existing A96;
- Construction of the River Lossie Crossing;
- Construction of the Elgin East Junction at the interface with the existing A96;
- Crossing of Aberdeen - Inverness Railway Line to the west of Lhanbryde; and
- Interface with 132kV overhead lines at four locations.

South Option

- Elgin West Link Road crossings of Aberdeen - Inverness Railway Line and River Lossie;
- Construction of the River Lossie Crossing;
- Elgin East Link Road crossing Aberdeen - Inverness Railway Line;

- Construction of the Elgin East Link Road at its interface with the existing A96;
- Interface with 132kV overhead lines at two locations; and
- Interface with the SGN high pressure gas main at two locations.

6.11.3. Careful consideration of construction phasing and maintenance of access arrangements during the construction period will be undertaken during DMRB Stage 3. A Constructability Audit will be undertaken ahead of the commencement of the Statutory Process.

6.12 Engineering Assessment Summary

6.12.1. A summary is provided below for each engineering issue, which identifies if any option is more or less favourable.

Mainline Alignment and Junction Layouts

6.12.2. Both options have been designed to fully meet DMRB standards without departures or relaxations from Standard at this stage.

Local Roads and Accesses

6.12.3. Effects on local roads and accesses are summarised in Table 6.19 below.

Table 6.19: Local Road and Access Strategy Summary

	North	South
B – Bridge	15	11
J – Connect to Junction	1	4
SU – Stopped Up	3	0
SUA – Stopped Up with alternate access provided	5	3
Total No of local roads and accesses stopped up	**8**	**3**
Total No of local roads and accesses affected	**24**	**18**

6.12.4. The local road and access strategy would retain connectivity of the network and the effects are similar for both options.

Topography and Land Use

6.12.5. Topography and Land Use are similar for both options.

Geotechnics and Earthworks

6.12.6. The main geotechnical constraints affecting the options include potential for compressible ground and subsidence, specifically where embankment is to be constructed. Based on the

total route lengths potentially affected by significant areas of compressible ground, the North Option is more favourable.

6.12.7. It is anticipated that the North Option would require the most imported material for earthworks construction. In terms of the earthworks balance, the South Option is more favourable.

6.12.8. In consideration of the above, the South Option is more favourable overall from a geotechnics and earthworks perspective.

Hydrology and Drainage

6.12.9. A preliminary assessment of hydrology was made for each option and both designs were developed to minimise flooding impacts.

6.12.10. Table 6.20 below provides a summary of the watercourses affected by each option and the proposed treatment.

Table 6.20: Watercourse crossings

Watercourse	North Option	South Option
Kinloss Burn	C	C
Burgie Burn	B	B
Tributaries of Mosstowie	-	C
Mosstowie Canal	-	B
Tributaries of Spynie Canal	C	-
Black Burn	-	B
River Lossie	B	B (3 no.)
Linkwood Burn	-	C
Lhanbryde Burn	C	C
Total	**5**	**10**

Key to Table:
E/C – Extend existing culvert
C – Watercourse to be culverted
B – Bridge

6.12.11. Both options have a similar number of culvert crossings. The South Option requires more bridge crossings than the North Option making it less favourable.

6.12.12. A preliminary drainage design has been carried out to identify potential outfalls, catchment areas and feasible locations for ponds/basins.

Structures

6.12.13. Table 6.21 below provides a summary of the structures required for each option.

Table 6.21: Structures Summary

Type of Structure	North Option	South Option
Major River Crossing	1	3
Railway Crossing	2	2
Underbridges	7	9
Overbridges	11	10
Total	**21**	**24**

6.12.14. Both options have similar overall structures requirements, however the South Option is less favourable due to the additional number of structures and the added complexity associated with the major river crossings.

Utilities

6.12.15. The comparative interfaces of the options with utilities are summarised in Table 6.22 below.

Table 6.22: Summary of Total No. of Interfaces with Utilities

Utility	North Option	South Option
Telecommunications	22	24
SGN	5	8
SSE	29	32
Scottish Water Supply	21	27
Scottish Water Foul	8	1
Total	**85**	**92**

6.12.16. The utilities that pose the greatest constraint are the high-pressure gas network and the extra high voltage (132kV) overhead lines.

6.12.17. The South Option interfaces with the high-pressure gas network at two locations; the North Option has no interface and is therefore favoured in this regard.

6.12.18. Both options interface the 132kV network; the North Option in four locations and the South Option twice. The South Option is therefore favoured in this regard.

NMUs

6.12.19. There are no significant engineering issues associated with the NMUs. NMU facilities will be designed and developed during DMRB Stage 3.

Constructability

6.12.20. Both North and South Options pose six particular constructability challenges.

6.12.21. Both Options comprise three junctions each, interface with high risk utilities and include multiple structures. The structures associated with the South Option are mostly single carriageway crossings, compared with the North Option, which conveys the proposed mainline over the Aberdeen - Inverness Railway Line at two locations. The South Option can be constructed with less disruption to A96 road users at the Elgin East Junction. The South Option is therefore considered more favourable.

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7. Engineering Assessment Lhanbryde to East of Fochabers

7.1 Introduction

7.1.1. This chapter describes the findings of the engineering assessment of the Lhanbryde to East of Fochabers North and South Options. It includes a description of the engineering features of each option including:

- Engineering constraints;
- Engineering description including mainline alignment, proposed junctions and local roads and accesses;
- Topography and land use;
- Geotechnics and earthworks;
- Hydrology and drainage;
- Structures;
- Utilities;
- Non-motorised users; and
- Constructability.

7.2 Engineering Constraints

7.2.1. The options have been developed to take into consideration the following constraints:

- The topography of the area, which is undulating to the west falling to generally low-lying ground in the vicinity of Mosstodloch and Fochabers, but rising in areas to the east and south-east, particularly to the east of the River Spey and to the east of Fochabers;
- The existing A96 Aberdeen - Inverness Trunk Road corridor which is discussed in Volume 1, Chapter 2 (Existing Conditions) of this report;
- The existing local road network;
- The Aberdeen - Inverness Railway Line which runs north-west to south-east through Threapland Wood;
- The settlements of Mosstodloch, Fochabers and Ordiequish;
- Designated Local Development Plan sites;
- Scattered residential development across the study area;
- Agricultural holdings within the study area;
- The River Spey, and its associated floodplain, which flows passing under the existing A96 Spey crossing between Mosstodloch and Fochabers;
- Spey Abstraction Scheme, to the south of Fochabers;
- Public utilities; and

- environmentally significant areas including Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSI), ancient woodland and cultural heritage sites such as listed buildings and scheduled monuments (refer to Part 3 – Environmental Assessment).

7.3 Engineering Description – North Option

Mainline Alignment

7.3.1. The Lhanbryde to East of Fochabers North Option is detailed in Figures 7.1 and 7.2 (Volume 5). This option is 11.3 kilometres (km) in length.

7.3.2. The route commences on a right-hand curve at the tie in with the Hillhead to Lhanbryde options to the south of Lhanbryde and east of Lhanbryde Burn.

7.3.3. Describing from west to east, the route runs adjacent and immediately south of the existing A96, passing to the north of Elgin Kart Raceway. The route enters a shallow cutting passing Greenfields.

7.3.4. The route continues into a left-hand curve passing south of the property at Pittensair where the route is in substantial cutting.

7.3.5. The route continues east through Threapland Wood, crossing over the Aberdeen - Inverness Railway Line. The route crosses over a Non-Motorised User (NMU) track (which also serves as access for a sand and gravel pit) through the eastern side of Threapland Wood before entering a cutting.

7.3.6. Continuing east the route continues on a right-hand curve as it passes south of Wester Marchfield and, further east, passes between properties at Wester Bauds and Meadowside as it enters a near straight section. The route falls on a shallow gradient whilst still in significant cutting.

7.3.7. The route continues east towards Mosstodloch, passing through Balnacoul Wood at grade. The route turns north-east on a left-hand curve and crosses the existing B9015 Rothes – Kingston Road, where the proposed grade separated Mosstodloch Junction is formed to the east.

7.3.8. The route continues east and enters a right-hand curve from a deep cutting to cross over the River Spey valley.

7.3.9. Continuing east, the route runs along the line of the existing A96 passing the Gatehouse of the Gordon Castle Estate. The route is in shallow cutting, before rising as it crosses over the access for Gordon Castle Farm. The route then continues into a right-hand curve as it enters Leitch's Wood on the Hill of Fochabers and the grade separated Fochabers Junction is formed where the route crosses over the existing Fochabers East Roundabout.

7.3.10. From the junction route rises at a steep grade and heads south-east through Leitch's Wood on a left-hand curve. The profile becomes shallower before tying in with the existing A96.

Junction Layouts

7.3.11. At this stage the junctions have been developed as described below, however these will be refined and developed further during Design Manual for Roads and Bridges (DMRB) Stage 3.

Mosstodloch Junction

7.3.12. The Mosstodloch Junction is located approximately 800m south-west of Coul Brae Roundabout in Mosstodloch; and east of where the route crosses the B9015 Rothes - Kingston Road. Connectivity is maintained to the existing A96 via the realigned B9015 between the proposed junction and Coul Brae Roundabout. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge.

7.3.13. The northern roundabout would be a five-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;
- Link to the southern roundabout;
- Properties at Balnacoul; and
- Realigned B9015 connecting to Coul Brae Roundabout, to the north.

7.3.14. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge; and
- Link to the northern roundabout; and
- Realigned B9015, to the south.

Fochabers Junction

7.3.15. The Fochabers Junction is located at the existing Fochabers East Roundabout. The junction maintains connectivity with the A98 Fochabers – Cullen - Fraserburgh Road to the north. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected via an underbridge.

7.3.16. The northern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;

- Link to the southern roundabout; and
- A98 to the north.

7.3.17. The existing southern roundabout would be retained and would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- B9104 to the west.

Local Roads and Accesses

7.3.18. A strategy has been developed to consider how to deal with the interaction between the option, the local road network and individual accesses. Moray Council was consulted in the development of the strategy. This will be refined and developed further during DMRB Stage 3.

7.3.19. The strategy follows the following principles:

- Grade separated junctions with the proposed A96 are provided;
- Local roads are maintained with structures to allow them to pass over or under the proposed A96 dual carriageway. The local roads may be also realigned to suit;
- Local roads are stopped up at the interface with the proposed dual carriageway as alternative routes are available; or
- Local roads are stopped up and local diversions are provided to connect back into the local road network.

7.3.20. Table 7.1 below describes the preliminary local road strategy for the North Option.

Table 7.1: Local Road and Access Strategy North

Local Road / Access	Name	Treatment
Local Access	Greenfields and Glenesk Access	SUA/B
Local Access	Loch na Bo Access	B
Local Access	Wester Bauds Access	SUA/B
Local Access	Easter Bauds Access	B
B9015	Rothes – Kingston Road	J
U19E	Dipple Road	B

Local Road / Access	Name	Treatment
B9104	Fochabers – Spey Bay Road	B
Local Access	Gordon Castle Access	B
Local Access	Gordon Castle Farm Access	B
A98	Fochabers – Cullen - Fraserburgh Road	J

Key to table:
B – Bridge to be provided over or under A96 allowing continuation of road.
J – Road to be diverted /connected to the new A96 grade separated junction.
SU – Road/access to be stopped up. Diversion to be provided via existing road network.
SUA – Road/access to be stopped up. Alternate access to be provided.

7.3.21. Each of the above local roads and accesses are described below

Greenfields and Glenesk Access

7.3.22. This is an access that runs south from a junction with the existing A96, located south of Lhanbryde crossing the Aberdeen - Inverness Railway Line, after which the access for Glenesk branches to the west, to access business and properties at Greenfield and Glenesk.

7.3.23. The existing access would cross over the proposed dual carriageway with an overbridge. The access to Glenesk would be stopped up with a realigned track provided to run parallel and south of the proposed dual carriageway.

Loch na Bo Access

7.3.24. This is an access that runs south from a junction with the existing A96, located north-east of Loch na Bo that provides access to Loch na Bo House.

7.3.25. The access road would cross over the proposed dual carriageway with an overbridge.

Wester Bauds Access

7.3.26. This is an access that runs south from a junction with the U23E Loch Oire Road, located north-east of Threapland Wood serving properties at Meadowside and Wester Bauds.

7.3.27. The existing access would be stopped up with access to Meadowside maintained. A realigned access would run west from Wester Bauds to the boundary of Threapland Wood and connect to the existing residential access. This would cross over the proposed dual carriageway with an overbridge.

Easter Bauds Access

7.3.28. This is an access that runs south-west from a junction with the existing A96, located approximately 1km west of Cowfords Roundabout.

7.3.29. The access road would cross over the proposed dual carriageway with an overbridge.

B9015 Rothes – Kingston Road

7.3.30. The B9015 runs south from Coul Brae Roundabout in Mosstodloch.

7.3.31. The existing road would be realigned to connect into the proposed roundabouts of the Mosstodloch Junction. An overbridge is provided for the realigned B9105 to cross over the proposed dual carriageway.

U19E Dipple Road

7.3.32. The U19E runs south-west from a junction with the existing A96, located by Inchberry Place in Mosstodloch.

7.3.33. The existing road would cross over the proposed dual carriageway with an overbridge.

B9104 Fochabers – Spey Bay Road

7.3.34. The B9104 runs through Fochabers and north-west between the Fochabers East Roundabout and the Spey Bay Roundabout.

7.3.35. The proposed dual carriageway crosses over the B9104 with an underbridge maintaining the existing road.

Gordon Castle Access

7.3.36. This is an access that runs north-east from a junction with the B9104 in Fochabers. The access crosses over the existing A96.

7.3.37. The access would be realigned to cross over the proposed dual carriageway with an overbridge.

Gordon Castle Farm Access

7.3.38. This is an access that runs north-east from Castle Street in Fochabers providing access to Gordon Castle Farm. The access crosses under the existing A96.

7.3.39. The proposed dual carriageway crosses over the access with an underbridge maintaining the existing road.

A98 Fochabers – Cullen – Fraserburgh Road

7.3.40. The A98 runs north-east from the Fochabers East Roundabout and is located on the north-eastern edge of Fochabers.

7.3.41. The A98 would tie in to the northern roundabout of the Fochabers Junction. The proposed dual carriageway crosses over the A98 with an underbridge maintaining the existing road.

7.4 Engineering Description – South Option

Mainline Alignment

7.4.1. The Lhanbryde to East of Fochabers South Option is detailed in Figures 7.3 and 7.4 (Volume 5). This option is 11.2km in length.

7.4.2. The route follows the same alignment as the North Option (as set out in sections 7.3.1 to 7.3.6) until it passes Meadowside where it runs on a right-hand curve towards the south-east.

7.4.3. At Easter Bauds where the route is at grade the Mosstodloch Junction is formed.

7.4.4. Continuing south-east the route runs on slight embankment on a left-hand curve and passes along the southern boundary of Balnacoul Wood. The route enters a significant cut to pass beneath the existing B9015 Rothes - Kingston Road.

7.4.5. Turning on a left-hand curve the route rises on high embankment to cross over the U19E Dipple Road before a structure carries the route over the River Spey at a shallow gradient.

7.4.6. The route passes north of Ordiequish and then turns on a left-hand curve, passing under the U14E Ordiequish Road in a shallow cutting. Continuing east the route climbs on a steep gradient through Castle Hill in a deep cutting.

7.4.7. As the route passes through Slorach's Wood it turns on a right-hand curve in deep cutting. It crosses the valley of the Burn of Fochabers, where the proposed Fochabers Junction is formed. East of the junction the route climbs sharply to tie in with the existing A96.

Junction Layouts

7.4.8. At this stage the junctions have been developed as described below, however these will be refined and developed further during Design Manual for Roads and Bridges (DMRB) Stage 3.

Mosstodloch Junction

7.4.9. The Mosstodloch Junction is located north of Easter Bauds, approximately 1.5km west of Mosstodloch. Connectivity is maintained to the existing A96 via a roundabout and a link road. The junction is a grade separated dumb-bell arrangement, with a roundabout on each side of the proposed dual carriageway connected by an overbridge. The northern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 eastbound merge;
- Proposed A96 eastbound diverge;
- Link to the southern roundabout; and
- Link road to the existing A96, to the north.

7.4.10. The southern roundabout would be a four-arm roundabout connecting to the:

- Proposed A96 westbound merge;
- Proposed A96 westbound diverge;
- Link to the northern roundabout; and
- New access for Easter Bauds.

Fochabers Junction

7.4.11. The Fochabers junction is located in Slorach's Wood approximately 1km to the south-east of Fochabers. The junction maintains connectivity with the existing A96 to the north via a link road. The junction is a grade separated hook and loop arrangement on the southern side and slip roads to the north, connected via an underbridge.

Local Roads and Accesses

7.4.12. This section of the report discusses the existing local road network and accesses and the diversion strategy proposed with regards to the South Option. The preliminary strategy is consistent with the North Option as set out in sections 7.3.17 & 7.3.18, which will be developed further during DMRB Stage 3.

7.4.13. Table 7.2 below describes the preliminary local road strategy for the South Option.

Table 7.2: Local Road and Access Strategy South

Local Road / Access	Name	Treatment
Local Access	Greenfields and Glenesk Access	SUA
Local Access	Loch na Bo Access	B
Local Access	Wester Bauds Access	SUA/B

Local Road / Access	Name	Treatment
Local Access	Easter Bauds Access	J
U21E	Millhill Road	SUA
B9015	Rothes – Kingston Road	B
U19E	Dipple Road	B
U14E	Ordiequish Road	B

Key to table:
B – Bridge to be provided over or under A96 allowing continuation of road.
J – Road to be diverted /connected to the new A96 grade separated junction.
SU – Road/access to be stopped up. Diversion to be provided via existing road network.
SUA – Road/access to be stopped up. Alternate access to be provided.

7.4.14. Each of the above local roads and accesses are described below.

7.4.15. The following junctions and accesses are the same as the North Option as described in sections 7.3.21 – 7.3.26 above:

- Greenfields and Glenesk Access;
- Loch na Bo Access; and
- Wester Bauds Access.

Easter Bauds Access

7.4.16. This is an access that runs south from a junction with the existing A96, located approximately 1km west of Cowfords Roundabout.

7.4.17. The existing access road to Easter Bauds would be stopped up to accommodate the Mosstodloch Junction link road with a bridge crossing over the proposed dual carriageway and a small link provided to connect Easter Bauds to the Mosstodloch Junction south roundabout.

U21E Millhill Road

7.4.18. The U21E runs west from a junction with the B9015 Rothes – Kingston Road, located on the southern edge of Balnacoul Wood.

7.4.19. The existing road would be stopped up and realigned to form a new T-junction with the B9015 to the north-west, connecting back in to the U21E.

B9015 Rothes – Kingston Road

7.4.20. The B9015 runs south from Coul Brae Roundabout in Mosstodloch.

7.4.21. The existing road would cross over the proposed dual carriageway with an overbridge, located on the south-eastern edge of Balnacoul Wood.

U19E Dipple Road

7.4.22. The U19E runs south-west from a junction with the existing A96 in Mosstodloch.

7.4.23. The proposed dual carriageway crosses over the U19E with an underbridge maintaining the existing road.

U14E Ordiequish Road

7.4.24. The U14E runs south-west from a junction with the B9104 in Fochabers to provide access to properties on the east bank of the River Spey.

7.4.25. The existing road would be stopped up and realigned to cross over the proposed dual carriageway with an overbridge.

7.5 Topography and Land Use

Topography

7.5.1. Both options would introduce changes to the existing topography through the introduction of new road embankments and cuttings, grade separated junctions, local road realignments and structures.

7.5.2. The topography west of the River Spey in the vicinity of the options is undulating (particularly further to the south) and slopes down towards the River Spey floodplain.

7.5.3. The North Option crosses the narrow part of the floodplain skirting the settlement of Fochabers and Gordon Castle Estate before rising steeply up to Whiteash Hill Wood.

7.5.4. The South Option crosses the River Spey at one of its widest points, before rising steeply up Castle Hill.

Land Use

7.5.5. Both options are surrounded by pastoral and arable farm land, as well as large areas of woodland and communities (notably Lhanbryde, Mosstodloch and Fochabers) and scattered properties.

7.5.6. The largest woodlands in this section are east of Fochabers, namely Leitch's Wood, Slorach's Wood and Wood of Ordiequish, as well as Threapland Wood and Balnacoul Wood to the west of the River Spey.

7.5.7. Land-use is considered in further detail in Volume 2, Chapter 12 (People and Communities) and Chapter 13 (Agriculture, Forestry and Sporting Interests) of this report.

7.6 Geotechnics and Earthworks

General

7.6.1. An assessment of the likely ground conditions affecting the options has been determined largely from British Geological Survey (BGS) 1:63,360 scale; 1:50,000 scale; 1:10,560 scale and 1:10,000 scale series geological maps for the area, and Memoirs of the Geological Survey Scotland: the Geology of the Elgin District. A search of the BGS GeoIndex interactive map and BGS Lexicon was conducted for relevant historical exploratory hole and geology information.

General Ground Conditions

7.6.2. The options are underlain primarily by superficial deposits of Alluvium (and River Terrace Deposits) and Glacial origin, with some small, isolated areas of bedrock at or near the surface. Superficial deposits within the area are summarised in Table 7.3 below and shown on Figures 7.5, 7.6, 7.7 and 7.8 (Volume 5).

Table 7.3: Superficial Deposits present within the study area

Strata	Typical Description	Distribution
Alluvium	Soft to firm consolidated, compressible silty clay often with layers of silt, sand, peat and basal gravel	Local to Dipple Burn
Alluvium and River Terrace Deposits		Local to the River Spey and the Burn of Fochabers
Glacial Till	Boulder clay of sandy pebbly clay, and slightly clayey sand	Surrounding the Alluvium and River Terrace Deposits along the River Spey, and local to Whiteash Hill Wood in the east
Glaciofluvial Ice Contact Deposits	Sand and gravel locally with lenses of silt, clay and organic material	From the western extent of the study area, to Easter Bauds, and in isolated pockets in the easternmost section of the study area
Glaciofluvial Sheet Deposits	Sand and gravel, with lenses of silt, clay or organic material	Surrounding Balnacoul Wood and Mosstodloch, and local to Fochabers
Peat	Partially decayed vegetation or organic matter	Isolated pockets of peat are distributed throughout the study area, generally located within low-lying wetland or upland areas

7.6.3. In addition to strata detailed in Table 7.3, it is anticipated that areas of Made Ground are likely to be present across the study area associated with the development of infrastructure and residential and farm related properties.

7.6.4. There are several former quarries and pits present across the study area, which where infilled and are likely to contain unspecified material. Recorded extent of Made Ground across the study area is included on Figures 7.5, 7.6, 7.7 and 7.8 (Volume 5).

7.6.5. The composition of infilled and Made Ground is unspecified therefore it is likely to comprise a highly variable mixture of reworked soil, road make-up, engineering fill and man-made material. In addition, remnant buried structures and/ or obstructions are also likely to be present in-situ.

7.6.6. There is limited rock exposure throughout the study area due to the thickness of the overlying superficial deposits. The solid geology recorded across the study area is shown on Figures 7.9, 7.10, 7.11 and 7.12 (Volume 5).

7.6.7. The published geological mapping indicates that much of the study area is underlain by sedimentary strata of the Inverness Sandstone Group (part of the Devonian Middle Old Red Sandstone Supergroup) and the Forres Sandstone Group (part of the Devonian Upper Old Red Sandstone Supergroup).

7.6.8. Solid geology underlying the western extent of the study area from Threapland Wood to Easter Bauds comprises pebbly or gravelly sandstones of the Scaat Craig Beds. East of this unit, bedrock is recorded to comprise sandstone with sporadic silty calcareous mudstones of the Fochabers Sandstone Formation, part of the Middle Old Red Sandstone Supergroup. Inclination of the bedding is recorded to dip between 4 and 10 degrees north-east to north-west at Fochabers, and between 10 and 22 degrees west local to Warren Wood.

7.6.9. Sandstones and conglomerates of the Spey Conglomerate Formation underlie the south-eastern and eastern section of the study area, east of Fochabers and south of Dipple. Inclination of the bedding of this unit is recorded to be horizontal east of Fochabers, and bedding is recorded to dip between 4 and 20 degrees west local to the Burn of Fochabers at Aulthash.

Existing Ground Investigation Data

7.6.10. Existing ground investigation coverage within the study area is limited and localised, with the majority of the available exploratory hole records local to the existing A96 at Mosstodloch and Fochabers. Selected borehole and trial pit logs have been obtained from the BGS archive.

7.6.11. These are summarised in Table 7.4 and Table 7.5 below for the North and South Options, respectively.

Table 7.4: Existing Ground Investigation Information - North Option

Scheme (BGS archive)	Coverage	General Findings
A96 Fochabers – Mosstodloch (including Mosstodloch Bypass)	Local to the existing A96 from the Mosstodloch Cowfords Roundabout to the eastern extent of the existing A96 dual carriageway, east of Fochabers	Topsoil underlain by medium, to very dense sand and gravel interbedded with stiff gravelly sandy clay and sandy silt to a maximum recorded depth of 30m depth. Made ground comprising clayey gravel with occasional cobbles is recorded underlying topsoil, to a maximum recorded depth of 2.4m depth in twenty-five exploratory holes. Bedrock comprising weathered sandstone and siltstone is recorded, with rockhead ranging from 4.6m depth to 9m depth. Groundwater strikes were recorded at various depths within the granular superficial deposits.
Fochabers New Bridge	Local to the existing A96 (Fochabers) bridge across the River Spey	Superficial deposits not recorded due to drilling techniques. Bedrock comprising silty sandstone interbedded with siltstone and conglomerate recorded from 2.7m depth to a maximum recorded depth of 19.5m depth.
Kennieshillock	Local to the existing A96 at Kennieshillock	Topsoil underlain by interbedded layers of sandy gravel, clayey sand, clayey gravel and silt to a maximum recorded depth of 22.5m depth. Groundwater was encountered at 17.5m depth in a layer of clayey sand.

Table 7.5: Existing Ground Investigation Information - South Option

Scheme (BGS archive)	Coverage	General Findings
A96 Fochabers – Mosstodloch (including Mosstodloch Bypass)	Local to the eastern extent of the existing A96 dual carriageway, east of Fochabers	Topsoil underlain by loose to medium dense (becoming very dense with depth) sand and gravel with occasional cobbles and boulders to a maximum recorded depth of 21m depth. Thin, interbedded layers of firm sandy slightly gravelly silt are recorded in some exploratory holes. Made Ground comprising hardcore and dense base course recovered as gravel is recorded in two boreholes from ground level to 0.3m depth.
	Local to the Ordiequish Burn within Slorach's Wood	Topsoil underlain by medium to very dense slightly silty gravelly sand to a maximum recorded depth of 10.5m depth.

Identified Geotechnical Constraints

General

7.6.12. The main geotechnical constraints affecting the options include potential for compressible ground and subsidence, specifically where embankments are to be constructed across these areas. Compressible ground is typically associated with Alluvium and River Terrace Deposits and Peat. Subsidence and compressible ground may be encountered associated with potentially infilled land of unknown constituents. The thickness and nature of these deposits will require to be confirmed by means of ground investigation at the next stage.

7.6.13. Generally, the mainline and junctions for both options would be constructed in relatively deep cutting (typically more than 8m), with some sections on embankment or at-grade.

North Option

7.6.14. Potential geotechnical constraints (ratings as defined by the BGS) are summarised below and are presented on Figures 7.13 and 7.14 (Volume 5).

- Shallow groundwater levels;
- Very low hazard potential for landslide across much of the study area, with the exception of ground along the river banks of the Dipple Burn and the River Spey immediately north and south of Fochabers New Bridge, where the landslide potential is low to moderate;
- Negligible, or very low hazard potential for shrinking or swelling clay across the study area;

- Moderate potential for compressible ground associated with Alluvium and River Terrace Deposits local to existing watercourses; and
- Potentially infilled land of unknown constituents, yielding potential sources of contamination (including ground gas) and possible compressible ground and subsidence:
  - One heap of unknown constituents;
  - One infilled quarry or water features; and
  - Ten former sand and gravel pits.

7.6.15. Further geotechnical constraints relating to compressibility of the underlying soils are summarised below and are shown on Figures 7.5 and 7.6 (Volume 5).

- Significant deposits of Alluvium and River Terrace Deposits along the option include:
  - A section underlying the proposed Spey Crossing;
  - B9104 Fochabers – Spey Bay Road underbridge;
  - Flood Relief Structure; and
  - The western approach to the Gordon Castle access overbridge which is on embankment.
- Significant Peat deposits include area section on embankment immediately east of the proposed Aberdeen - Inverness Railway underbridge, and area section in cutting west of Wester Marchfield.
- Recorded potentially infilled land comprises:
  - Former sand and gravel pit located immediately west of the southern approach to the proposed Mosstodloch Junction;
  - Former sand and gravel pit immediately north of the proposed Gordon Castle Farm access underbridge; and
  - Former sand and gravel pit underlying the proposed Fochabers Junction.

South Option

7.6.16. Potential geotechnical constraints (ratings as defined by the BGS) are summarised below and are presented on Figures 7.15 and 7.16 (Volume 5).

- Shallow groundwater levels;
- Very low hazard potential for landslide across much of the study area, with the exception of ground along the river banks of the Dipple Burn and the River Spey immediately north and south of Fochabers New Bridge, where the landslide potential is low to moderate;
- Negligible, or very low hazard potential for shrinking or swelling clay across the study area;
- Moderate potential for compressible ground associated with Alluvium and River Terrace Deposits local to existing watercourses; and

- Potentially infilled land of unknown constituents, yielding potential sources of contamination (including ground gas) and possible compressible ground and subsidence comprising ten former sand and gravel pits.

7.6.17. Further geotechnical constraints relating to compressibility of the underlying soils are summarised below and are shown on Figures 7.7 and 7.8 (Volume 5).

- Alluvium and River Terrace Deposits underlie the option at the following areas:
  - A section underlying the proposed Spey Crossing;
  - West of U19E Dipple Road;
  - A section east of the River Spey;
  - A cutting immediately east of the proposed U14E Ordiequish Road overbridge; and
  - A section on embankment at the Fochabers Junction.

7.6.18. A section of the option to the west of Wester Marchfield is underlain by Peat. This area coincides with a cutting west of Wester Marchfield.

Discussion

7.6.19. Alluvium and River Terrace Deposits may contain compressible Silts and Clays, and occasionally Peat.

7.6.20. The potentially compressible nature of these deposits may yield significant settlements beneath embankments in the long term, and potential slope stability problems, particularly during the construction phase. Any excavations below the groundwater table in these deposits may be difficult and dewatering might be required.

7.6.21. Potential measures to mitigate any issues associated with compressible ground include embankment slope design, staged construction, removal and replacement, accelerated settlement using band drains and/ or surcharging with drainage layer(s), and the use of structurally supported load transfer platforms, particularly on the approaches to structures.

7.6.22. The selection and design of these measures will depend largely on the thickness and nature of the Alluvium and River Terrace Deposits which would be determined by means of a ground investigation, and potentially also programme constraints. Where the option is at-grade or on low height embankment it may be feasible to reinforce the subgrade with geogrids embedded within granular fill.

7.6.23. The angle of cut slopes in the Alluvium and River Terrace Deposits will depend on the height of slope, groundwater level and the specific characteristics of the material. If the groundwater is at a high level on slope drainage may be required.

7.6.24. The construction over areas of Alluvium and/ or River Terrace Deposits potentially involves greater cost and may have an adverse impact on programme to allow the necessary remedial works to be implemented.

7.6.25. Peat thicknesses along the options are unknown. Given the anticipated highly compressible nature of these deposits it is likely that these would require to be removed and replaced with a suitable fill material.

7.6.26. Made Ground is not recorded within the study area on available BGS geological mapping but is anticipated to be encountered local to the Aberdeen - Inverness Railway Line, existing roads, and residential and farm related properties. In addition, Made Ground was recorded locally in historical ground investigation records pertinent to the North Option. There are no recorded areas of potentially infilled land underlying the South Option within the study area.

7.6.27. It is anticipated that former quarries and pits within the study area may yield possible compressible ground and subsidence. It should be noted that the extent of these former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage.

7.6.28. A ground investigation will be required to determine the nature and thickness of the backfill materials including any contamination that may be present. Depending on the nature and composition of the deposits recorded in-situ, potential measures include in-situ treatment to improve the engineering properties of the material or dig out and replace.

7.6.29. A comparison of the ground conditions affecting the options (mainline, junctions and local roads) is provided in Table 7.6 below. This identifies lengths of the options where less favourable ground conditions may be anticipated potentially requiring additional engineering measures.

Table 7.6: Comparison of ground conditions

Option	Approximate Length of Option underlain by potentially compressible Superficial Deposits			
	Alluvium and River Terrace (m)	Peat (m)	Worked Ground* (m)	Total (m)
Mainline				
North	730	255	10	**995**
South	1,975	35	-	**2,010**

Option	Approximate Length of Option underlain by potentially compressible Superficial Deposits			
	Alluvium and River Terrace (m)	Peat (m)	Worked Ground* (m)	Total (m)
Junctions and Side Roads				
North	-	-	20	**20**
South	100	-	-	**100**

*It has been assumed that where former quarries and pits are present, these have been backfilled with non-engineered fill of unknown origin. The extent of these former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage. For the purposes of this assessment, an assumed 10m length is used.

7.6.30. The comparison of total lengths of potentially unfavourable ground conditions presents a number of limitations as summarised below:

- Made Ground is not recorded within the study area on available geological mapping, but is anticipated to be encountered local to the Aberdeen - Inverness Railway Line, existing roads, and residential and farm related properties;
- The extent of former quarries and pits is unknown, therefore the area of the option at risk is uncertain at this stage;
- Worked ground may not present a constraint and will depend on the extent of any backfilling and ground disturbance;
- Former quarries and pits may be largely situated above general ground level and may therefore have not been backfilled;
- Unrecorded areas of soft superficial deposits and/ or Made Ground may be present in-situ;
- Locally, isolated areas of Glaciofluvial Deposits on floodplains may yield potentially compressible ground. This has not been considered in this assessment; and
- The occurrence of the different types of superficial deposits is based on the geological mapping and limited available ground investigation data. In-situ ground conditions will require to be confirmed by means of ground investigation.

Earthworks

Excavated Material Acceptability - General

7.6.31. In general, where cuttings are to be formed, typically these lie within areas of predominantly granular materials of fluvioglacial and glacial origin, based on the available desk study information examined.

7.6.32. The other deposits of post glacial origin, and the alluvium, may provide acceptable materials depending on their composition and nature. This can only be confirmed by a ground investigation to be carried out during DMRB Stage 3 once a Preferred Option has been selected. This also applies to confirming the percentage acceptable for the fluvioglacial and glacial till deposits.

7.6.33. Rock is generally not anticipated to occur within the proposed shallow cuttings, which are generally less than 5m in depth, although the possibility of localised shallow rock cannot be discounted. The deeper cuts to the east of the River Spey are likely to encounter rock, however this can only be confirmed by ground investigation.

Excavated Material Acceptability – North and South Options

7.6.34. It is estimated at this stage, that in the order of 90% of these materials may be acceptable for reuse as general engineering fill.

Unacceptable Material and Contaminated Land

7.6.35. Unacceptable materials which cannot be used in the main earthworks such as peat, soft clays and silts would require to be disposed of on or off-site. Much of this material would be unsuitable in their natural state for the formation of bunds and in landscaping, although these volumes can be minimised through the use of appropriate in-situ ground improvement techniques where appropriate, particularly for the soft non-organic soils.

7.6.36. Peat deposits are very localised in occurrence and may not be of a significant thickness. Where encountered their disposal on or off-site would require to be appropriately assessed.

7.6.37. Contaminated land is not anticipated to be a significant issue affecting any of the options, largely due to the absence of any major industrial activity in the area. If areas of potentially contaminated ground were identified, they would undergo investigation to identify any special measures required to address contamination risks. This could involve in-situ treatment or removal to a licensed disposal site depending on the nature of the contamination.

Cut/fill Balance

7.6.38. For the purpose of earthworks assessment, it is assumed that any surplus material from Lhanbryde to East of Fochabers is available for deposition within the other sections of the Scheme.

7.6.39. Table 7.7 below summarises the major earthworks quantities as follows:

- Bulk Fill Material Required – The bulk earthworks fill volume as required for the mainline, side roads and grade separated junctions. This excludes the material required for capping, sub base and topsoil;

- Bulk Excavated Material – The total volume of excavated material including acceptable and unacceptable. Excludes the topsoil strip;
- Acceptable Excavated Material – This constitutes the volume of excavated material deemed acceptable from initial investigations; and
- Cut/Fill Balance – The balance of the overall fill requirement, less the potential volume of available acceptable site won material.

Table 7.7: Major Earthwork Quantities

Option	North Option	South Option
Bulk Fill Required (m^3)	1,290,000	974,000
Bulk Excavated Material (m^3)	2,884,000	1,656,000
Acceptable Excavated Material (m^3)	2,595,000	1,490,000
Cut/Fill Balance (m^3)	-1,305,000 (surplus)	-516,000 (surplus)

As expressed in the table above, a positive balance is indicative of an overall import requirement with the result that a volume of engineering fill will be required to be sourced and brought to site. A negative balance indicates that there will be an overall surplus of engineering fill material generated by the work.

7.7 Hydrology and Drainage

7.7.1. The effects of the options on the water environment are considered fully in Volume 2, Chapter 20 (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.

7.7.2. A preliminary assessment of hydrology was made for each option. Following the selection of a Preferred Option, a review of the hydrology and drainage strategy will be undertaken during DMRB Stage 3. This will include a review of structural requirements at watercourse crossings.

Watercourses

7.7.3. A number of key watercourses located within the study area are affected, as described below.

Black Burn.

7.7.4. The Black Burn flows from south to north, commencing at Brown Muir Hills. The watercourse continues in a northerly direction along the western edge of Balnacoul

Wood before joining the Stripe Burn north of the existing A96. The Stripe Burn discharges into Spey Bay.

7.7.5. Both North and South Options cross the burn on the western edge of Balnacoul Wood, with a culvert provided beneath the mainline.

Dipple Burn

7.7.6. The Dipple Burn flows from south to north, commencing north of Westerton Farm. The watercourse continues in a northerly direction parallel to the U19E Dipple Road before discharging into the River Spey.

7.7.7. The North Option includes a large structure, which crosses both the Dipple Burn and River Spey. The South Option crosses the burn south of Dipple, with a culvert provided beneath the mainline.

River Spey

7.7.8. The River Spey flows from north to south, commencing at Loch Spey in the Highlands and flowing through the Cairngorms. The watercourse continues in a northerly direction before discharging into the Moray Firth at Spey Bay.

7.7.9. The North Option includes a large structure to cross the River Spey west of Fochabers and including crossing the Dipple Burn. The South Option provides a large structure to cross the River Spey west of Ordiequish.

Burn of Fochabers

7.7.10. The Burn of Fochabers commences south-east of Fochabers in Slorach's Wood. The watercourse continues west passing through Fochabers before discharging into the River Spey.

7.7.11. The Burn of Fochabers does not interact with the North Option. The South Option provides a large structure to cross the burn south-east of Fochabers conveying the proposed mainline across a cutting.

Ordiequish Burn

7.7.12. Ordiequish Burn is a small burn commencing in the Wood of Ordiequish, flowing north-west towards Fochabers and discharging into the River Spey.

7.7.13. The Ordiequish Burn does not interact with the North Option. The South Option crosses the burn at Ordiequish, which would necessitate diversion of the burn to the west and provision of a culvert beneath the mainline.

Drainage

7.7.14. An outline drainage design has been carried out to identify potential outfalls, catchment areas, feasible locations for ponds/basins and their required volume, to inform the engineering and environmental assessments of each option. The design of drainage systems will be developed further during DMRB Stage 3.

7.7.15. Design development will incorporate Sustainable Drainage Systems (SuDS) comprising a combination of multiple treatment methods at source as well as larger downstream controls. The intention of such systems is to reduce concentration of pollutants and attenuate surface water run-off as it is conveyed through the drainage network, prior to entering a watercourse.

7.7.16. The level of treatment required is dependent on the location of the catchment and receiving watercourse to which it outfalls. The Scottish Environment Protection Agency (SEPA) require at least two levels of treatment for the majority of catchments within the Scheme extents. Some receiving watercourses may be more environmentally sensitive and an additional level of treatment would be required.

7.7.17. At source SuDS would include filter drains and swales, providing the first level of treatment where possible. Ponds/basins would be utilised downstream of the network as an additional level of treatment and would be capable of attenuating run off volumes during extreme weather events, whilst discharging at a controlled flow rate to the receiving watercourse. Initial pond/basin locations have been identified but are indicative at this stage and will be developed further during DMRB Stage 3.

7.7.18. Drainage capability has been assessed for both options and where necessary, the vertical alignment has been refined to accommodate the required levels. It is not anticipated that either of the options would result in significant problems in regard to discharging runoff into watercourses. Some of the receiving watercourse are particularly small. Using these watercourses may require greater levels of attenuation to avoid increasing flood risk.

7.7.19. Drainage from realigned local roads will be considered in detail during DMRB Stage 3. Any positive drainage systems are assumed to be independent of the proposed trunk road drainage network.

7.8 Structures

Introduction

7.8.1. This section describes the structures in outline only, as further details will be developed during DMRB Stage 3. The major river crossings and other significant structures are described in greater detail below.

7.8.2. Generally, the proposals have been developed based on adopting concrete construction, either in situ or precast, where span lengths permit, as this is generally

the most cost-effective type of construction. Where larger spans are required steel concrete composite construction is proposed.

Underbridges

7.8.3. The full width of the mainline, including carriageway and hardstrips, would be continued across the decks of the underbridges. In accordance with DMRB (Volume 6, Section 1, Part 2, TD27/05 Cross-Sections and Headrooms, Clause 5.6.1) there would be no reduction in the widths of the verges of the mainline on the underbridge decks.

7.8.4. It is anticipated that underbridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck. For smaller crossings a reinforced concrete portal option would also be considered.

Overbridges

7.8.5. It is anticipated that overbridges would generally be of concrete construction, with precast, prestressed concrete beams supporting the bridge deck.

7.8.6. Similarly, the full width of the carriageway, and hard strips (where provided) would be carried by the overbridges. Verges to both the local road and the A96 mainline would be continued over and under the structure in accordance with DMRB (Volume 6, Section 1, Part 2, TD27/05 Cross-Sections and Headrooms, Clause 5.6.1)

7.8.7. The proposed structure locations are shown on Figures 7.1, 7.2, 7.3 and 7.4 (Volume 5).

North Option

River Spey Crossing

7.8.8. A number of constraints have been considered as follows:

- The width of the flood plain to be spanned was established from initial flood modelling;
- A minimum freeboard of 0.6m would be provided between the flood level and the bridge deck soffit; and
- It has been assumed at this stage that no infrastructure would be placed within the boundary of the SAC associated with the River Spey.

7.8.9. At this stage, it is proposed that the structure would comprise a six-span arrangement, with a total length of approximately 460m.

7.8.10. It is assumed that the deck would comprise in-situ post-tensioned balanced cantilever concrete boxes.

7.8.11. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

7.8.12. Structure type and span configurations will be further developed during DMRB Stage 3.

Railway Crossings

7.8.13. A railway underbridge would be required to cross the Aberdeen - Inverness Railway Line. The railway line currently consists of a single track at this location and is not currently electrified.

7.8.14. The bridge would be designed to accommodate future double-tracking and electrification of the railway.

7.8.15. Structure type and span configurations will be developed during DMRB Stage 3.

7.8.16. The railway underbridges required are listed in Table 7.8 below.

Table 7.8: North Option - Railway Bridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
Aberdeen - Inverness Railway Line (at Lhanbryde)	Aberdeen - Inverness Railway Line	82	26

Underbridges

7.8.17. The underbridges required are as detailed in Table 7.9 below.

Table 7.9: North Option - Underbridges

Name	Crossing	Approximate Length (metres)	Approximate Width (metres)
NMU Route (at Threapland Wood)	NMU Route	4	29
B9104 Fochabers - Spey Bay Road	Side Road	10	41
Flood Relief Structure	Field	107	31
Gordon Castle Farm Access	Access	12	55
Fochabers Junction	Junction	48	38

Overbridges

7.8.18. The overbridges required are as detailed in Table 7.10 below.

Table 7.10: North Option - Overbridges

Name	Carrying	Approximate Length (metres)	Approximate Width (metres)
Greenfields and Glenesk Access	Access	51	7
Loch na Bo Access	Access	75	7
Wester Bauds Access	Access	72	8
Easter Bauds Access	Access	62	8
Mosstodloch Junction	Junction Link Road	60	10
U19E Dipple Road	Side Road	97	7
Gordon Castle Access	Access	62	9

South Option

River Spey Crossing

7.8.19. A number of constraints have been considered as follows:

- The width of the flood plain to be spanned was established from initial flood modelling;
- It has been assumed at this stage that no infrastructure would be placed within the boundary of the SAC associated with the River Spey; and
- It has been assumed that the headroom clearance over the existing U19E (Dipple Road) would be a minimum of 5.7m in accordance with DMRB (Volume 6, Section 1, Part 2, TD27/05 Cross-Sections and Headrooms) Table 6.1.

7.8.20. At this stage it is assumed that the proposed structure comprises a multi- span arrangement, with a total length of approximately 1200m.

7.8.21. At this stage it is assumed that the deck would comprise in-situ post-tensioned balanced cantilever concrete boxes with variable depth due to the span lengths of the structure.

7.8.22. At this stage it has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

7.8.23. Structure type and span configurations will be further developed during DMRB Stage 3.

Burn of Fochabers Crossing

7.8.24. A number of constraints have been considered as follows:

- Several separate structures are required to cross the Burn of Fochabers carrying the mainline and the slip roads; and
- Piers have been placed to avoid the Burn of Fochabers.

7.8.25. It is proposed that the deck would comprise steel-concrete composite construction with boxed girders due to the shape and span lengths of the structure.

7.8.26. It has been assumed that all foundations for the proposed structure would require to be supported on piles installed to a suitable founding stratum. This will be reviewed when more geotechnical information becomes available.

7.8.27. Structure type and span configurations will be further developed during DMRB Stage 3.

Railway Crossings

7.8.28. The structure is similar to the North Option as described in 7.8.13 to 7.8.16.

Underbridges

7.8.29. The underbridges required for the South Option are as detailed in Table 7.11 below.

Table 7.11: South Option - Underbridges

Name	Crossing	Approximate length/span (metres)	Approximate width (metres)
NMU Route (at Threapland Wood)	NMU Route	4	29

Overbridges (standard)

7.8.30. The overbridges required are as detailed in Table 7.12 below.

Table 7.12: South Option - Overbridges

Name	Carrying	Approximate length/span (metres)	Approximate width (metres)
Loch na Bo Access	Access	76	7
Wester Bauds Access	Access	72	8

Name	Carrying	Approximate length/span (metres)	Approximate width (metres)
Mosstodloch Junction	Junction Link	60	14
B9015 Rothes – Kingston Road	Side road	61	11
U14E Ordiequish Road	Side road	70	7

Ancillary Structures

7.8.31. Both options would require the provision of a number of ancillary structures such as culverts and may require farm accommodation underpasses and overbridges.

Culverts

7.8.32. At this stage, it is assumed that all other watercourses crossed by the option would require a culvert, designed to accommodate the design flood flows and consider environmental stakeholder requirements, including SEPA and Scottish Natural Heritage (SNH). This will be further developed during DMRB Stage 3.

7.8.33. The culverts would generally comprise reinforced concrete pipes or concrete box culverts. Concrete wingwalls and headwalls would also be provided at the entrance and exit of the culvert. Pipes less than 2m diameter (less than 0.9m for corrugated steel construction) are not classified as structures and will be considered as part of the drainage system.

7.8.34. Where existing culverts require extending, the extensions would generally be of the same cross section and materials as the existing.

Accommodation Structures

7.8.35. The requirement for accommodation structures has been considered for both options and will be developed further during DMRB Stage 3.

Retaining Walls

7.8.36. The requirement for retaining walls will be assessed during DMRB Stage 3.

Vehicle Containment and Pedestrian Restraint over Structures

7.8.37. Generally, the vehicle containment to be provided over the structures will be in accordance with DMRB, (Volume 2, Section 2, Part 8, TD 19/06, Requirement for Road Restraint Systems) and will be developed during DMRB Stage 3.

7.9 Utilities

7.9.1. There are a significant number of buried and overhead public and private utility services between Lhanbryde and Fochabers including:

- Telecommunications – BT overhead and underground network, mobile communication masts;
- SGN – High, Intermediate, Medium, and Low-pressure gas pipelines;
- SSE High Voltage, Medium Voltage and Low Voltage overhead and underground services;
- Scottish Water supply network;
- Scottish Water sewer network;
- 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.

7.9.2. Public utilities have been identified and key utilities are shown on Figures 2.14, 2.15 and 2.16 (Volume 5). Major towns were not included within the utility search as both options bypass these urban areas.

7.9.3. 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 between Lhanbryde and Fochabers to enable potential clashes between the option and utility infrastructure to be clearly identified. Where possible, the vertical and horizontal alignments have been developed to avoid or minimise clashes with potential high cost diversion items.

Telecommunications

Network

7.9.4. The key elements of the network include:

BT Underground Supply Network

7.9.5. This utility is located throughout the area. Cables run adjacent to the existing A96 and many of the local roads in the area. This utility services many of the local settlements.

BT Overhead Supply Network

7.9.6. This utility is not as prevalent as the underground network. Cables are adjacent to local roads, connecting to either underground cables or nearby properties.

Vodafone

7.9.7. This utility runs adjacent to the existing A96 from Lhanbryde to Fochabers. This utility is an underground cable and duct with several chambers spread throughout its length.

Communication Masts

7.9.8. This utility is spread throughout different locations between the Lhanbryde and Fochabers area. There is a higher concentration of this utility where the area is densely populated.

Interfaces

7.9.9. Table 7.13 below summarises the number of interfaces with the telecommunication network for each option

Table 7.13: Number of interfaces with telecommunications

Option	BT Underground Supply	BT Overhead Supply	Vodafone Network	Communication Masts	Total Interfaces
North	13	0	3	2	18
South	7	1	1	0	9

7.9.10. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

SGN

Network

7.9.11. Key elements of the network include:

Medium Pressure Pipeline

7.9.12. This utility is present between Lhanbryde and Fochabers: there is a pipeline to the north of the existing A96.

Interfaces

7.9.13. Table 7.14 below summarises the number of interfaces with the SGN network for each option

Table 7.14: Number of interfaces with SGN

Option	High Pressure Pipeline	Intermediate Pressure Pipeline	Medium Pressure Pipeline	Low Pressure Pipeline	Total Interfaces
North	0	0	1	0	1
South	0	0	1	0	1

7.9.14. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

SSE

Network

7.9.15. The key elements of the network include:

33kV power lines

7.9.16. This utility travels in a general south-easterly direction from Lhanbryde until the River Spey. The utility then heads south of the existing A96.

Overhead and underground cables

7.9.17. These cables carry the 6.6-11kV and low voltage power into homes and businesses between Lhanbryde and Fochabers. The network is spread throughout the area between Lhanbryde and Fochabers and much of the area is serviced.

Interfaces

7.9.18. Table 7.15 below summarises the number of interfaces with the SSE network for each option.

Table 7.15: Number of interfaces with SSE

Option	132kV Line	33kV Line	6.6-11kV and Low Voltage Cables	Total Interfaces
North	0	3	10	13
South	0	3	11	14

7.9.19. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

Scottish Water

Network

7.9.20. The key elements of the network include:

Supply network

7.9.21. In addition to freshwater supply through water mains, there are several abandoned water mains and raw water mains throughout the area. The network serves homes and businesses throughout the local area.

7.9.22. Several private water supplies have been identified and these are discussed in Volume 2, Chapter 19 (Geology, Soils, Contaminated Land and Groundwater).

7.9.23. There is a Scottish Water covered reservoir to the East of Fochabers that the North Option impacts near the existing Fochabers East roundabout.

7.9.24. Scottish Water operates a groundwater abstraction scheme adjacent to the Spey to the south of Fochabers, which supplies public drinking water to large parts of Moray. The Spey Abstraction Scheme comprises 36 production boreholes, all located approximately 50 - 100m to the west of the River Spey. There is also an infiltration gallery on the eastern bank at Ordiequish.

Sewer network

7.9.25. The sewer network comprises of combined sewer outfalls, foul water sewers and surface water sewers. The network services homes and businesses in the area with the majority of services concentrated in the more densely populated areas such as Mosstodloch and Fochabers. Additionally, the local network feeds into waste water treatment works (WWTW) north of the existing A96 at Mosstodloch.

7.9.26. Neither of the options impact the sewer network therefore no table required to show impacts.

Interfaces

7.9.27. Table 7.16 below summarises the number of interfaces with the freshwater network for each option.

Table 7.16: Number of interfaces with water utilities

Option	Water Mains	Abandoned Mains	Raw Water Mains	Total Interfaces
North	9	10	0	19
South	8	2	2	12

7.9.28. It should be noted that each interface varies in length, but this assessment only considers the total number of interfaces, and so the potential disruptions to the network.

7.9.29. The North Option is likely to require the re-location of the Scottish Water covered reservoir.

7.9.30. The complexity of the interface with both the North and South Options with the Spey Abstraction Scheme will require further design development during DMRB Stage 3.

7.10 Non-Motorised Users

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

7.10.2. The effects of the options on all travellers, including NMUs, are considered in Volume 2, Chapter 12 (People and Communities) of this report where the impacts of the options are assessed.

7.10.3. NMU facilities will be considered during design development of the Preferred Option during DMRB Stage 3.

7.11 Constructability

7.11.1. Both options are predominantly offline construction. Traffic management would be required for the North Option on the existing Fochabers Bypass. Both options would include online construction at the tie-in to the existing A96 East of Fochabers. The tie-in would involve use of the existing carriageway and careful traffic management would be required to minimise disruption to trunk road users.

7.11.2. Within this section there are a number of elements which pose particular constructability challenges as listed below:

North Option

- Crossing of Aberdeen - Inverness Railway Line at Threapland Wood;
- Construction of Mosstodloch Junction at the interface with the B9015 Rothes – Kingston Road;
- Construction of the Spey Crossing;
- Construction activities in the vicinity of the Spey Abstraction Scheme;
- Construction of Fochabers Junction at the interface with the existing A96;
- Online construction along the existing Fochabers Bypass; and
- Eastern tie-in to existing A96 at Dramlachs.

South Option

- Crossing of Aberdeen - Inverness Railway Line at Threapland Wood;
- Construction of the Spey Crossing;
- Construction activities in the vicinity of the Spey Abstraction Scheme;
- Construction of the Fochabers Junction at the interface with the existing A96; and
- Eastern tie-in to existing A96 at Dramlachs.

7.11.3. Careful consideration of construction phasing and maintenance of access arrangements during the construction period will be undertaken during DMRB Stage 3. A Constructability Audit will be undertaken ahead of the commencement of the Statutory Process.

7.12 Engineering Assessment Summary

7.12.1. A summary is provided below for each engineering issue, which identifies if any option is more or less favourable.

Mainline Alignment and Junction Layouts

7.12.2. Both options have been designed to fully meet DMRB standards without departures or relaxations from standard at this stage.

Local Roads and Accesses

7.12.3. Effects on local roads and accesses are summarised in Table 7.17 below.

Table 7.17: Local Road and Access Strategy Summary

	North	South
B - Bridge	8	5
J – Connect to Junction	2	1
SU – Stopped Up	0	0
SUA - Stopped Up with alternate access provided	2	3
Total No. of local roads and accesses stopped Up	**2**	**3**
Total No. of local roads and accesses affected	**12**	**9**

7.12.4. The local road and access strategy would retain connectivity of the network and the effects are similar for both options.

Topography and Land Use

7.12.5. Topography and Land Use effects are similar for both options.

Geotechnics and Earthworks

7.12.6. The main geotechnical constraints affecting the options include potential for compressible ground and subsidence, specifically where embankment is to be constructed across these areas. Based on the combined (mainline, junction and local road) proposed route lengths potentially affected by significant areas of compressible ground, the North Option is more favourable.

7.12.7. It is anticipated that the North Option would generate the most material for earthworks construction. In terms of the earthworks balance, the North Option is more favourable.

7.12.8. In consideration of the above, the North Option is more favourable overall from a geotechnics and earthworks perspective.

Hydrology and Drainage

7.12.9. A preliminary assessment of hydrology was made for each option and both designs were developed to minimise flooding impacts.

7.12.10. Table 7.18 below provides a summary of the watercourses affected by each option and the proposed treatment.

Table 7.18: Watercourse crossings

Watercourse	North Option	South Option
Black Burn	C	C
Dipple Burn	B	C
River Spey	B	B
Burn of Fochabers	-	B
Ordiequish Burn	-	C
Total	**3**	**5**

Key to Table:
E/C – Extend existing culvert
C – Watercourse to be culverted
B – Bridge

7.12.11. Both options have a similar number of bridge crossings. The South Option requires more culvert crossings than the North Option making it less favourable.

7.12.12. A preliminary drainage design has been carried out to identify potential outfalls, catchment areas and feasible locations for ponds/basins.

Structures

7.12.13. Table 7.19 below provides a summary of the structures required for each option.

Table 7.19: Structures Summary

Type of Structure	North Option	South Option
Major River Crossing	1	2
Railway Crossing	1	1
Underbridges	5	1
Overbridges	7	5
Total	**14**	**9**

7.12.14. Although the South Option has fewer structures, the size of those required add complexity, particularly the Fochabers Junction and the extent of the River Spey Crossing. Overall the North Option is the more favourable option.

Utilities

7.12.15. The comparative interfaces of the options with utilities are summarised in Table 7.20 below.

Table 7.20: Summary of Total No. of Interfaces with Utilities

Utility	North Option	South Option
Telecommunications	18	9
SGN	1	1
SSE	13	14
Scottish Water Supply	19	12
Total	**51**	**36**

7.12.16. The utilities that pose the greatest constraint are the high-pressure gas network and the extra high voltage (132kV) overhead lines.

7.12.17. Neither option interfaces with the extra high voltage (132kV) overhead lines, or the high-pressure gas main.

NMUs

7.12.18. There are no significant engineering issues associated with the NMUs. NMU facilities will be designed and developed during DMRB Stage 3.

Constructability

7.12.19. The North Option poses seven particular constructability issues compared with five for the South Option. Giving consideration to both the number and complexity of these issues, the South Option is considered more favourable.

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Published by Transport Scotland December 2018.

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