

## 4 ENGINEERING ASSESSMENT

Chapter 4 of the Randalstown to Toome Dualling Stage 1 Report outlines the engineering conditions of the study area, covering assessment of the existing road, geological conditions and services, suggests possible highway structures, and reports the likely construction costs.

### 4.1 Geological Conditions

A preliminary assessment of the geological conditions in the study area was carried out during Stage 1 and has been reported in chapter 4.4 of the Stage 1 Report.

#### *Route Option 9*

The majority of Option 9 lies on boulder clay, except for the areas listed below:

Chainage	Ground Conditions
1000 – 1200	Alluvial Deposits
1900 – 2000	Bedrock
2700 – 2850	Alluvial Deposits
3150 – 3500	Bedrock
4650 – 4750	Alluvial Deposits
4800 – 5100	Alluvial Deposits
5600 – 5800	Peat
5800 – 6000	Bedrock
6300 – 7000	Bedrock

Option 9 is in cuttings and embankments throughout, the largest of these being approximately 11.8m and 6.5m respectively. A major structure is proposed at chainage 4900, where Option 9 crosses the existing A6. This structure is located in an area of ‘river terrace deposits’. These deposits will result in significant settlements, although these will occur rapidly. A major structure is proposed as part of a grade separated junction over the existing A6 at chainage 6700 – 6800. This structure is located in an area of ‘bedrock at or near the surface’. This will give a good founding stratum to the structure, depending on the exact rockhead depth and profile. In addition, this bedrock is likely to be weathered at or near the surface.

#### *Route Option 10*

The majority of Option 10 lies on boulder clay, except for the areas listed below:

Chainage	Ground Conditions
1600 – 1700	Glacial lake deposits
2350 – 2450	River Alluvium
1950 – 3050	River Alluvium
3050 – 3400	Fluvio-glacial sand and gravel
3700 – 3800	Bedrock
3950 – 4000	Bedrock
4650 – 4750	Bedrock
4850 – 5100	River Alluvium
5650 – 5800	Peat
5800 – 6000	Bedrock
6000 – 6050	Peat

Option 10 is in cuttings and embankments throughout, the largest of these being approximately 11m and 6m respectively. A major structure is proposed at chainage 4500 where Option 10 crosses the existing A6. This structure is located in an area of ‘river terrace deposits’. These deposits will result in significant settlements, although these will occur quickly.

The route between Toome and Randalstown has several areas where the geological mapping identifies 'bedrock at or near the surface'; these are listed in the table above. The maximum cutting at these locations is 5m. Major cuttings of 5m would need significant blasting, depending on the exact rockhead level at these locations.

## 4.2 Services

During Stage 1, information provided by the major utility companies was used to assess any impact their apparatus may have upon each of the possible route corridors under consideration. Details of apparatus owned by Northern Ireland Electricity, and Water Service are contained in Chapter 4.5 of the Randalstown to Toome Dualling Stage 1 Report.

### 4.2.1 Northern Ireland Electricity

Details of the existing services within the study area provided by NIE are detailed in the Stage 1 Report. The table below summarises the location of conflicts between this high voltage network and Options 9 and 10:

Route Option	No. of 11kV Crossings	Approximate Locations (Generalised)
9	11	Area at Drumderg and Derryhollagh
10	13	Area at Drumderg, Moneynick and Derryhollagh

### 4.2.2 Water

Details of the existing services within the study area provided by the water suppliers are detailed in the Randalstown to Toome Dualling Stage 1 Report. A watermain is located in the north verge of the existing A6 running southeast from Derryhollagh Cottages. Options 9 and 10 would cross this watermain south of Derryhollagh Road.

Four watermains meet on the existing A6 at the junction with Ballynafey Road and Artlone Road. Option 10 would pass just north of this intersection, crossing the watermains at both Artlone Road and Gloverstown Road.

A watermain is located west of Drumaslough Hill, which runs from the A6 north along Lismaeloskey Road. Option 9 would cross this watermain.

### 4.2.3 Sewerage

Details of the existing services within the study area provided by the Water Suppliers are detailed in the Randalstown to Toome Dualling Stage 1 Report. As the sewer systems run almost alongside existing water mains in these areas, crossing points of the Route Options are assumed to be the same as in 4.2.2 above.

### 4.3 Route Option Cost Estimates

The Stage 1 scheme assessment developed cost estimates for each Route Option. Due to the very preliminary nature of the proposals being considered, only broad brush estimates of cost can be made. Nevertheless, these should allow a meaningful comparison of options. Details of rates used in developing these preliminary cost estimates are outlined in chapter 4.7 of the Randalstown to Toome Dualling Stage 1 Report.

#### 4.3.1 Earthworks Cost

Earthworks quantities were derived from the three dimensional MX (MOSS) model used to create the Route Options. It should be noted that these profiles are based on the preliminary ground contour information. It has been assumed that 75% of all excavated material was deemed reusable as fill. No allowance was made for tipping charges, aggregate tax or landfill tax. At this stage, all cutting and embankment slopes are assumed to be 1 in 2 slopes. The cost estimates for all earthworks required by the alignments being considered are detailed below:

Route Option	Total Cut Volume (m <sup>3</sup> )	Total Fill Volume (m <sup>3</sup> )	Excavate, Deposit & Compact (m <sup>3</sup> @ £2.97)	Import Fill & Compact (m <sup>3</sup> @ £8.61)	Excavate & Dispose (m <sup>3</sup> @£12.36)	Total Cost
9	317,000	467,000	238,000	229,000	79,500	£3.66M
10	121,000	377,000	91,000	286,500	30,500	£3.11M

#### 4.3.2 Pavement Costs

Two distinct conditions were considered when estimating the cost of new pavements, i.e. on-line widening or the provision of a completely new carriageway. It was assumed that the existing A6 could be re-used along its length. The lengths of carriageway required were derived from the three dimensional MX model.

Route Option	New Carriageway (m @£599.87)	Carriageway On-line widening (m @£398.71)	Carriageway Resurfacing (m @£178.71)	Total Cost
9	6,750	0	400	£4.12M
10	4,740	2,050	400	£3.73M

#### 4.3.3 New Local Road Cost

In addition to providing a new dual carriageway, other sections of new pavement are also required. Where the proposed dual carriageway is on-line, the existing road may have to be realigned to maintain local access. New roads may have to be provided to maintain access to properties. For on-line options, rather than construct lengths of new carriageway, the existing road network could be upgraded to a satisfactory standard to maintain local access.

Route Option	Realigned Local Road (m @£265.15)	Access Roads (m @£142.55)	Upgrading Existing Roads (m @£62.12)	Total Cost
9	0	0	0	0
10	1,200	450	4,200	£0.64M

#### 4.3.4 Structures and Interchange Costs

Structures will be required where the proposed routes cross the existing road network and where the existing roads are being retained for local access. Depending on the relative levels of the two carriageways, either overbridge or underbridge structures will be required. Structure costs are based on the estimated lengths of the crossings required.

As detailed in chapter 4.7 of the Stage 1 Report, an estimated cost of £1M has been used to cover a grade separated junction.

Route Option	Number of Structures	Cost of Structures along Route	No of Interchanges (@ £1,000,000)	No of Interchanges (@ £600,000)	Total Cost
9	10	£2,481,500	1	0	£3.48M
10	10	£1,684,500	1	0	£2.68M

#### 4.3.5 Ancillary Costs

The cost of 'extras' required along a road construction project have been expressed per linear metre of road. These would include lighting, fencing, signs, lines etc.

Route Option	Ancillary Items (m @£403.02)	Total Cost
9	7,150	£2.88M
10	7,190	£2.90M

#### 4.3.6 Landscaping & Environmental

Landscaping costs have been estimated assuming that 50% of slopes would be planted, assuming that all cutting and embankment slopes are assumed to be at 1 in 2 and profiles and based on preliminary ground contour information. The preliminary estimates shown below are most likely to change during forthcoming detailed assessment.

Route Option	Landscaping & Environmental Cost
9	1,661,000
10	987,500

#### 4.3.7 Statutory Undertakers

Estimating the cost of alterations to Statutory Undertakers equipment is rather difficult at this early stage, and the preliminary estimates shown below are most likely to change during forthcoming detailed assessment.

Route Option	Statutory Undertakers Cost
9	1,200,000
10	1,200,000

#### 4.3.8 Civils Cost

The table below details the cost estimates developed for Route Options 9 and 10. These costs are for comparative purposes only and do not include for inter-alia, traffic management or landfill and aggregate taxes. A summary of the cost estimates for Options 9 and 10 is shown below:

<b>Route Option</b>	Earthworks	Pavement	Local Roads	Structs & Interch	Ancillaries	Environ & Landscaping	Statutory Undtkrs	<b>Civils Cost</b>
<b>9</b>	£3.66M	£4.12M	0	£3.48M	£2.88M	£1.66M	£1.20M	<b>£17.00M</b>
<b>10</b>	£3.11M	£3.73M	£0.64M	£2.68M	£2.90M	£0.99M	£1.20M	<b>£15.26M</b>

#### 4.3.9 Cost Estimate Summary – Scheme Cost

HM Treasury guidance ‘The Green Book – Appraisal and Evaluation in Central Government’ recognises that there is a tendency for all projects to be overly optimistic. To mitigate optimism in project estimates, the Green Book recommends that uplifts should be applied. For preliminary stage estimates a 44% optimism bias uplift is recommended to take account of unquantified risks associated with standard civil engineering projects.

Allowances for preliminaries and contingencies have been estimated using a standard cost multiplier applied to the estimated Civils cost for each Route Option. For preliminaries, 15% of the Civils cost was added. A factor of 10% was included for contingencies, to give the Construction cost.

Estimating the Land and Property costs accurately is rather difficult at this early stage. Assistance has been sought from various qualified personnel, including Roads Service Lands Branch, Valuation and Lands Agency and information from recent roads projects has also been used. The preliminary estimates of Construction & Land costs shown below are most likely to change during forthcoming detailed assessment.

<b>Route Option</b>	Civils Costs	Preliminaries	Contingencies	<b>Construction Cost</b>	Land Cost	<b>Construction &amp; Land Cost</b>
<b>1</b>	15,755,500	2,363,500	1,575,550	<b>£19.69M</b>	2,478,000	<b>£22.17M</b>
<b>2</b>	15,625,000	2,344,000	1,562,500	<b>£19.53M</b>	1,500,000	<b>£21.03M</b>
<b>3</b>	14,063,000	2,109,500	1,406,500	<b>£17.58M</b>	4,434,500	<b>£22.01M</b>
<b>4</b>	16,511,000	2,476,500	1,651,000	<b>£20.64M</b>	3,116,000	<b>£23.75M</b>
<b>5</b>	15,108,500	2,266,500	1,511,000	<b>£18.89M</b>	1,723,000	<b>£20.61M</b>
<b>6</b>	16,040,500	2,406,000	1,604,000	<b>£20.05M</b>	998,000	<b>£21.05M</b>
<b>7</b>	15,885,500	2,383,000	1,588,500	<b>£19.86M</b>	1,274,500	<b>£21.13M</b>
<b>8</b>	15,150,000	2,272,500	1,515,000	<b>£18.94M</b>	1,388,500	<b>£20.33M</b>
<b>9</b>	17,002,500	2,550,500	1,700,500	<b>£21.25M</b>	843,500	<b>£22.10M</b>
<b>10</b>	15,256,500	2,288,500	1,525,500	<b>£19.07M</b>	914,000	<b>£19.98M</b>

In accordance with COBA, 9% and 5% are added to the Construction & Land cost for scheme Preparation and Supervision respectively, which determines the Scheme cost. Finally a 44% optimism bias is added to give the Total Scheme cost.

<b>Route Option</b>	<b>Construction &amp; Land Cost</b>	<b>Preparation</b>	<b>Supervision</b>	<b>Scheme Cost</b>	<b>Optimism Bias</b>	<b>Total Scheme Cost</b>
<b>1</b>	22,172,500	1,995,500	1,108,500	<b>£25.28M</b>	11,121,500	<b>£36.40M</b>
<b>2</b>	21,031,500	1,893,000	1,051,500	<b>£23.98M</b>	10,549,500	<b>£34.52M</b>
<b>3</b>	22,013,500	1,981,000	1,100,500	<b>£25.10M</b>	11,042,000	<b>£36.14M</b>
<b>4</b>	23,755,000	2,138,000	1,187,500	<b>£27.08M</b>	11,915,500	<b>£39.00M</b>
<b>5</b>	20,608,500	1,855,000	1,030,500	<b>£23.49M</b>	10,337,500	<b>£33.83M</b>
<b>6</b>	21,048,500	1,894,500	1,052,500	<b>£24.00M</b>	10,558,000	<b>£34.55M</b>
<b>7</b>	21,131,500	1,902,000	1,056,500	<b>£24.09M</b>	10,599,500	<b>£34.69M</b>
<b>8</b>	20,326,000	1,829,500	1,016,500	<b>£23.17M</b>	10,195,500	<b>£33.37M</b>
<b>9</b>	22,096,500	1,988,500	1,105,000	<b>£25.19M</b>	11,083,500	<b>£36.27M</b>
<b>10</b>	19,984,500	1,798,500	999,000	<b>£22.78M</b>	10,024,500	<b>£32.81M</b>