

Wicklow County Council

**N11/M11 Junction 4 to Junction 14
Improvement Scheme**

Option Selection Report
Appendix D2 – Soils and geology

265455-ARP-EGT-SWI-RP-ZX-0005

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1 Soils and geology

1.1 Introduction

This report details the environmental assessment of the Stage 2 Project Appraisal Matrix (PAM) for the N11/M11 Scheme with respect to the Soils and geology constraints identified in **Section 13** (Soils and geology) of **Volume B**.

For the corridor assessment, the overall scheme has been split into two sections, i.e. the Northern Section and the Southern Section and the corridor options assessed are those discussed in **Chapter 8** of **Volume A**.

There are three zones associated with each corridor option referred to in the corridor assessment which will be assessed with respect to soils and geology:

- The potential road "footprint" which is the potential landtake required to construct or improve the road;
- The road "corridor" which is a 200m wide corridor centred around the alignment centre line for all off-line corridors. For the on-line Corridor Options 1 (North), 1 (South) and 5 (South), the width is variable, but is typically narrower than the width of the off-line corridors. The "footprint" sits inside the "corridor" boundary); and
- The option "assessment study area". In line with guidelines each individual corridor option has been assigned an assessment study area which has been set at 250m from the centre line of each corridor. This area is further explained in **Section 1.2**.

A transport scenario assessment forms part of this Stage 2 Project Appraisal Matrix. This assessment is included in **Section 1.6**. The transport scenarios that were assessed are as follows:

- Transport Scenario 5A - Parallel Links + Junction Rationalisation;
- Transport Scenario 5B - N11/M11 Additional Lane(s) + Junction Improvements; and
- Transport Scenario 4 – Bus Service Enhancements.

Section 1.2 outlines the methodology that was used to carry out the assessment, and **Section 1.3** outlines the assessment criteria which were used. The Stage 2 PAM is presented in **Section 1.4** (Corridors) with a summary in **Section 1.5**, and **Section 1.6** (Transport Scenarios), and references are listed in **Section 1.7**.

The corridor options, their corresponding study areas and the constraints considered in the Soils and geology assessment are shown on the figures list in **Table 1.1**.

Table 1.1: List of figures for Appendix D2 - Soils and geology assessment.

Figure Number	Title	Sheet
D2.1 - D2.6	Stage 2 Corridors with Bedrock Geology Map	Sheets 1 to 6
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D2.13 - D2.18	Stage 2 Corridors with Soil Deposits Map	Sheets 1 to 6
D2.19 - D2.24	Stage 2 Corridors with Geological Constraints Map	Sheets 1 to 6

1.2 Methodology

This assessment has been prepared taking cognisance of the requirements of the following guidance:

- Transport Infrastructure Ireland (TII) guidance, formally National Roads Authority (NRA) guidance, Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology on National Road Schemes¹ (herein referred to as TII Guidelines).

with additional reference made to:

- The Environmental Protection Agency (EPA) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports².
- Transport Infrastructure Ireland (TII) guidance, formally National Roads Authority (NRA). Environmental Impact Assessment of National Road Schemes – a Practical Guide³

In line with these guidelines each individual corridor option has been assigned an assessment study area which has been set at 250m from the centre line of each corridor. For the purposes of this Soils and geology assessment, the footprint of the potential corridor design is being considered as the proposed area of works i.e. to accommodate ancillaries and drainage etc.

The TII Guidelines¹ provide useful criteria for ranking the importance of identified soils and geological attributes and the criteria are presented in **Table 13.2 of Section 13** (Soils and geology) of **Volume B**. The attributes used in this assessment are presented in **Section 1.3**. Each individual attribute was assigned an ‘Attribute Importance’, this assigned importance was based on Box 4.1 of the TII Guidelines¹. These are summarised in **Table 1.2** and presented in **Section 1.3**.

¹ National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA 2009.

Available from: <https://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf>

² Environmental Protection Agency (EPA), Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Draft 2017. Available from:

<https://www.epa.ie/pubs/advice/ea/EPA%20EIA%20Guidelines.pdf>

³ National Roads Authority Environmental Impact Assessment of National Road Schemes – a Practical Guide, NRA 2008.

Available from: <https://www.tii.ie/technical-services/environment/planning/Environmental-Impact-Assessment-of-National-Road-Schemes-Practical-Guide.pdf>

The potential impacts that may arise at each attribute have been assessed conservatively based on the information that is currently available.

The nature and timeframe that have been considered against the criteria presented in Box 4.4 of the TII Guidelines¹, are presented in **Table 1.2**.

A ‘Rating of significant impacts’ has been determined from **Table 1.2** based on the importance of an attribute and the potential impacts. The description of the significance of an impact is based on Box 5.4 from the TII Guidelines¹. The attribute importance is defined at the end of **Section 13** (Soils and geology) of **Volume B**. However, following on from the issue of the constraints chapter, the importance of the attributes has been re-assessed for any updates or alterations in corridors. These updates are contained in the assessment tables in **Section 1.4**.

It should be noted that these criteria only consider negative potential impacts, however the potential for positive impacts will also be considered. The language used in the summary tables in **Section 1.5** to describe the magnitude of an impact is that used in Box 5.1 not Box 4.4 of the TII Guidelines¹ as it is more succinct and easier to present in a tabular format.

Table 1.2: Criteria for rating impact significance at route selection stage – Rating of Significant Environmental Impacts at Route Selection Stage (from Box 4.4 of TII Guidelines¹)

Rating of significance of an impact	Attribute Importance				
	Extremely High**	Very High	High	Medium	Low
Profound	Any permanent impact on attribute	Permanent impact on significant proportion of attribute			
Significant	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on Significant proportion of attribute		
Moderate	Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute	
Slight		Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute
Imperceptible			Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute

Rating of significance of an impact	Attribute Importance				
	Extremely High**	Very High	High	Medium	Low

**In rating impacts on an 'European site' account must be taken of Article 6(3) and 6(4) of the Habitats Directive (Council Directive 92/43/EEC). Also see guidance contained within Guidelines for Assessment of Ecological Impacts of National Road Schemes (Rev 2, National Roads Authority, 2008)

Once an impact level had been determined for each attribute, the overall impact rating was assigned to that feature type. For the assessment to meet the requirements of the TII Project Appraisal Guidelines for National Roads Unit 7.0 - Multi-Criteria Analysis (MCA)⁴ (hereafter referred to as TII PAG) the two scoring systems needed to be correlated.

The MCA scoring criteria from Section 2.4 of the TII PAG⁴ is summarised below:

- 7 – Major or highly positive;
- 6 – Moderately positive;
- 5 – Minor or slightly positive;
- 4 – Not significant or neutral;
- 3 – Minor or slightly negative;
- 2 – Moderately negative; or
- 1 – Major or highly negative.

Table 1.3 summarises how the two Guidelines^{1 4}, have been correlated for the purpose of the corridor options assessment. It should be noted that the TII PAG⁴ deals with both positive and negative impacts whereas the TII Guidelines¹ deal with only negative impacts for Soils and geology.

Table 1.3: Correlation of TII Guidelines¹ Significance Rating to an Equivalent TII PAG⁴ Score

Significance Rating (TII guidelines) ¹	Equivalent TII PAG (Description)	Equivalent TII PAG (Value)
Profound	Major or highly negative	1
Significant	Major or highly negative	1
Moderate	Moderately negative	2
Slight	Minor or slightly negative	3
Imperceptible	Not significant or neutral	4

1.3 Assessment criteria

In line with TII Guidelines¹, the soils and geological attributes which have been considered during this corridor options assessment are as follows:

⁴Transport Infrastructure Ireland (TII) Project Appraisal Guidelines for National Roads Unit 7.0 - Multi-Criteria Analysis, 2016. Available from: <https://www.tiipublications.ie/library/PE-PAG-02031-01.pdf>

- Soils;
 - Soils (Agronomic soils)
 - Subsoils
- Bedrock Geology;
- Slope stability – landslides and landslide susceptibility ;
- Contaminated sites –Potential areas of landfill/contamination;
- Geological Heritage Areas/County Geological Sites; and
- Earthworks assessment.

The attributes identified in **Section 13** (Soils and geology) of **Volume B** which have not been considered in the corridor options assessment are as follows:

- Pits, quarries and mines;
- Industrial facilities;
- Crushed rock aggregate potential;
- Granular aggregate potential; and
- Mineral resource locations.

This information has been gathered to provide the wider context of the scheme and the reasons for its exclusion from the corridor options assessment is explained below. The attributes within the study area of the preferred corridor will be considered for further assessment in the EIAR where appropriate.

1.3.1 Pits, quarries and mines

There are no active pits and quarries recorded within the corridor option assessment study areas and none have been reported through review of the Geological Survey of Ireland Online interactive map viewer and the Department of Culture, Heritage and the Gaeltacht Exploration and Mining Viewer. The Ballycorus Lead Mine (**Figure B13.19** in **Volume E**) a former lead mine of mining heritage interest is not impacted by any of the corridor option assessment study areas.

1.3.2 Industrial facilities

There are no EPA licensed facilities recorded within the corridor option assessment study areas.

1.3.3 Crushed rock aggregate potential

The crushed rock aggregate potential is either high or very high for the majority of all the assessment study areas and as such any impacts are similar across the corridor options and do not have a meaningful impact on the overall MCA score.

1.3.4 Granular aggregate potential

In the Northern Section, all the assessment study areas intercept areas of either high or very high granular aggregate potential.

In the Southern Section all the assessment study areas intercept an area of very high granular aggregate potential. Therefore, any impacts are similar across the corridor options and do not have a meaningful impact on the overall MCA score.

1.3.5 Mineral resource locations

No important mineral resource locations have been identified within the corridor option assessment study areas.

1.4 Stage 2 Project Appraisal Matrix – corridor assessment

The following sections summarise the assessment of each type of important attribute in both the Northern and Southern Sections. **Table 1.4** to **Table 1.19** provide a MCA score per important attribute type and assessment study area which is then summarised in **Table 1.20** for the Northern Section and **Table 1.21** for the Southern Section. **Table 1.20** and **Table 1.21** also include the overall MCA score and preference for each corridor option.

1.4.1 Soils and subsoils

Where soils are deemed to be well drained on the Teagasc mapping they have been considered to be of high importance from an agronomical/fertility perspective, while poorly drained or peaty soils have been considered to be of low importance.

From a subsoils perspective, poorly drained, soft soils and peaty soils have been considered to be of medium to high importance due to the possible volume of material requiring excavation and potentially unsuitable for direct reuse as engineering fill. In turn, glacial tills and granular subsoils have been considered to be of low importance due to their potential suitability as engineering fill and due to their geotechnical properties, and they typically require less excavation during road construction.

Overall, this tended to balance out in the assessment but there have been notable areas such as the Fen Peat in Kilmacanoge and agricultural land within the off-line corridor option assessment study areas which resulted in some minor differences between the assessment study areas. **Table 1.4** to **Table 1.7** summarise the impacts that would result due to the northern and southern corridor options on the soils from an agronomical point of view and on the subsoils.

It should be noted that the magnitude of the impact is qualitative for the soils and subsoils assessment as the breakdown of volumes per type of soil and subsoil has not been undertaken at this stage. An overall assessment of the impact of

earthworks volumes has been undertaken separately as summarised in **Table 1.18** and **Table 1.19**.

Table 1.4: Summary of soils assessment for the Northern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Alluvial (mineral)	Medium	Negligible	Imperceptible	Not significant or neutral
	Deep well drained mineral (Mainly basic)	High	Negligible	Imperceptible	
	Fen peat	Low	Negligible	Imperceptible	
	Made ground	Low	Negligible	Imperceptible	
	Mineral poorly drained (Mainly acidic)	Low	Negligible	Imperceptible	
	Mineral poorly drained (Mainly basic)	Low	Negligible	Imperceptible	
	Peaty poorly drained mineral (Mainly acidic)	Low	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly basic)	High	Negligible	Imperceptible	
	Deep well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
Corridor Option 1B (North)	Alluvial (mineral)	Medium	Negligible	Imperceptible	Not significant or neutral
	Deep well drained mineral (Mainly basic)	High	Negligible	Imperceptible	
	Fen peat	Low	Negligible	Imperceptible	
	Made ground	Low	Negligible	Imperceptible	
	Mineral poorly drained (Mainly acidic)	Low	Negligible	Imperceptible	
	Mineral poorly drained (Mainly basic)	Low	Negligible	Imperceptible	
	Peaty poorly drained mineral (Mainly acidic)	Low	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly basic)	High	Negligible	Imperceptible	

Table 1.5: Summary of soils assessment for the Southern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Alluvial (mineral)	Medium	Negligible	Imperceptible	Not significant or neutral
	Made ground	Low	Negligible	Imperceptible	
	Mineral poorly drained (Mainly acidic)	Low	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly basic)	High	Negligible	Imperceptible	
	Deep well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
Corridor Option 2 (South)	Alluvial (mineral)	Medium	Moderate Adverse	Moderate	Major or highly negative
	Peaty poorly drained mineral (Mainly acidic)	Low	Moderate Adverse	Slight	
	Shallow poorly drained mineral (Mainly acidic)	Low	Moderate Adverse	Slight	
	Shallow well drained mineral (Mainly acidic)	High	Moderate Adverse	Significant/Moderate	
	Shallow well drained mineral (Mainly basic)	High	Moderate Adverse	Significant/Moderate	
Corridor Option 5 (South)	Alluvial (mineral)	Medium	Negligible	Imperceptible	Not significant or neutral
	Made ground	Low	Negligible	Imperceptible	
	Mineral poorly drained (Mainly acidic)	Low	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
	Shallow well drained mineral (Mainly basic)	High	Negligible	Imperceptible	
	Deep well drained mineral (Mainly acidic)	High	Negligible	Imperceptible	
Corridor Option 6 (South)	Alluvial (mineral)	Medium	Small Adverse	Slight	Moderately negative
	Made ground	Low	Small Adverse	Imperceptible	
	Peaty poorly drained mineral (Mainly acidic)	Low	Small Adverse	Imperceptible	
	Shallow well drained mineral (Mainly acidic)	High	Small Adverse	Moderate/Slight	

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
	Shallow well drained mineral (Mainly basic)	High	Small Adverse	Moderate/Slight	
	Deep well drained mineral (Mainly acidic)	High	Small Adverse	Moderate/Slight	

Table 1.6: Summary of subsoils assessment for the Northern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Alluvium	Medium	Negligible	Imperceptible	Not significant or neutral
	Bedrock outcrop or subcrop	Low	Negligible	Imperceptible	
	Fen Peat (includes Teagasc AminPDPT)	Medium	Negligible	Imperceptible	
	Gravels derived from Limestones	Low	Negligible	Imperceptible	
	Irish Sea Till derived from Limestones	Low	Negligible	Imperceptible	
	Till derived from Cambrian sandstones and shales	Low	Negligible	Imperceptible	
	Till derived from granites	Low	Negligible	Imperceptible	
	Till derived from limestones	Low	Negligible	Imperceptible	
	Till derived from quartzites	Low	Negligible	Imperceptible	
Urban	Medium	Negligible	Imperceptible		
Corridor Option 1B (North)	Alluvium	Medium	Negligible	Imperceptible	Not significant or neutral
	Bedrock outcrop or subcrop	Low	Negligible	Imperceptible	
	Fen Peat (includes Teagasc AminPDPT)	Medium	Negligible	Imperceptible	
	Gravels derived from Limestones	Low	Negligible	Imperceptible	
	Irish Sea Till derived from Limestones	Low	Negligible	Imperceptible	
	Till derived from Cambrian sandstones and shales	Low	Negligible	Imperceptible	
	Till derived from granites	Low	Negligible	Imperceptible	

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
	Till derived from limestones	Low	Negligible	Imperceptible	
	Till derived from quartzites	Low	Negligible	Imperceptible	
	Urban	Medium	Negligible	Imperceptible	

Table 1.7: Summary of subsoils assessment for the Southern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Alluvium	Medium	Negligible	Imperceptible	Not significant or neutral
	Bedrock outcrop or subcrop	Low	Small Adverse	Imperceptible	
	Gravels derived from Limestones	Low	Negligible	Imperceptible	
	Irish Sea Till derived from Cambrian sandstones and shales	Low	Negligible	Imperceptible	
	Till derived from Cambrian sandstones and shales	Low	Small Adverse	Imperceptible	
	Till derived from Lower Palaeozoic sandstones and shales	Low	Negligible	Imperceptible	
	Urban	Medium	Negligible	Imperceptible	
Corridor Option 2 (South)	Alluvium	Medium	Moderate Adverse	Moderate	Moderately Negative
	Bedrock outcrop or subcrop	Low	Moderate Adverse	Slight	
	Gravels derived from Limestones	Low	Moderate Adverse	Slight	
	Irish Sea Till derived from Cambrian sandstones and shales	Low	Moderate Adverse	Slight	
	Till derived from Cambrian sandstones and shales	Low	Moderate Adverse	Slight	
	Urban	Medium	Moderate Adverse	Moderate	
Corridor Option 5 (South)	Alluvium	Medium	Negligible	Imperceptible	Not significant or neutral
	Bedrock outcrop or subcrop	Low	Negligible	Imperceptible	
	Gravels derived from Limestones	Low	Small Adverse	Imperceptible	

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
	Irish Sea Till derived from Cambrian sandstones and shales	Low	Negligible	Imperceptible	
	Till derived from Cambrian sandstones and shales	Low	Negligible	Imperceptible	
	Till derived from Lower Palaeozoic sandstones and shales	Low	Small Adverse	Imperceptible	
	Urban	Medium	Negligible	Slight	
Corridor Option 6 (South)	Alluvium	Medium	Small Adverse	Slight	Minor or slightly negative
	Bedrock outcrop or subcrop	Low	Small Adverse	Imperceptible	
	Gravels derived from Limestones	Low	Small Adverse	Imperceptible	
	Till derived from Cambrian sandstones and shales	Low	Small Adverse	Imperceptible	
	Urban	Medium	Small Adverse	Slight	

1.4.2 Bedrock geology

There is a greater impact on the bedrock geology in areas where there is a loss of bedrock as a result of excavation due to the proposed corridor's vertical alignment.

In the Northern Section, Corridor Option 1A (North) and Corridor Option 1B (North) have a neutral impact on the bedrock geology. This is due to the assumption that there will be minimal earthworks in Corridor Option 1A (North) and that there will be little to no bedrock excavation as a result of the cut/fill proposals in Corridor Option 1B (North). A summary of the impact on the bedrock geology for the Northern Section is described in **Table 1.8**.

In the Southern Section, Corridor Option 1 (South) and Corridor Option 5 (South) have a neutral impact on the bedrock geology as minimal earthworks are proposed along these corridor options. Corridor Option 2 (South) and Corridor Option 6 (South) have a *moderately negative* impact on the bedrock geology. This is assuming the cut/fill areas proposed along these options will require bedrock excavation. A summary of the impact on the bedrock geology for the Southern Section is described in **Table 1.9**: Summary of bedrock geology for the

Exposing the underlying bedrock through excavation does create a positive impact on the soils and geology. The addition of new exposures of bedrock results in addition of detail to the geological record. This impact however was not included as a factor in the MCA.

Table 1.8: Summary of the bedrock geology for the Northern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Bray Head Formation	Low	Negligible	Imperceptible	Not significant or neutral
	Glencullen River Formation	Low	Negligible	Imperceptible	
	Maulin Formation	Low	Negligible	Imperceptible	
Corridor Option 1B (North)	Bray Head Formation	Low	Small Adverse	Imperceptible	Not significant or neutral
	Glencullen River Formation	Low	Negligible	Imperceptible	
	Maulin Formation	Low	Negligible	Imperceptible	

Table 1.9: Summary of bedrock geology for the Southern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Bray Head Formation	Low	Negligible	Imperceptible	Not significant or neutral
Corridor Option 2 (South)	Devils Glen Formation	Low	Small Adverse	Imperceptible	Moderately negative
	Bray Head Formation	Low	Large Adverse	Slight/Moderate	
Corridor Option 5 (South)	Bray Head Formation	Low	Negligible	Imperceptible	Not significant or neutral
Corridor Option 6 (South)	Bray Head Formation	Low	Large Adverse	Slight/Moderate	Moderately negative

1.4.3 Slope stability – landslides and landslide susceptibility

1.4.3.1 Landslides

Three landslide events have been recorded within the corridor option assessment study areas. Two have occurred in the Northern Section of the study area which results in a slight impact on Corridor Option 1A (North) and Corridor Option 1B (North), this is due to the proposed road widening in that area. A summary of the landslide assessment is described in **Table 1.10**.

One landslide was recorded in the Glen of the Downs in the Southern Section and there is therefore a risk of re-occurrence which would result in a slight impact for Corridor Option 1 (South) given that it is on-line and does not involve significant earthworks. This same risk of re-occurrence would result in a moderate impact on Corridor Option 5 (South) due to the potential widening associated with this corridor option. A summary of the landslide assessment for the Southern Section can be found in **Table 1.11**. Corridor Option 2 (South) and Corridor Option 5 (South) have no recorded landslide events within their assessment study area, as a result they have not been considered further for this assessment.

Table 1.10: Summary of landslide assessment for the Northern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Landslide 1	Medium	Small Adverse	Slight	Minor or slightly negative
	Landslide 2	Medium	Small Adverse	Slight	

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1B (North)	Landslide 1	Medium	Small Adverse	Slight	Minor or slightly negative
	Landslide 2	Medium	Small Adverse	Slight	

Table 1.11: Summary of landslide assessment for the Southern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Landslides 13	Medium	Small Adverse	Slight	Minor or slightly negative
Corridor Option 2 (South)	Landslides 13	Medium	N/A	N/A	Not significant or neutral
Corridor Option 5 (South)	Landslides 13	Medium	Moderate Adverse	Moderate	Moderately negative
Corridor Option 6 (South)	Landslides 13	Medium	N/A	N/A	Not significant or neutral

1.4.3.2 Landslide susceptibility

The landslide susceptibility mapping of the study area ranges from Low to Very High. In the Northern Section, Corridor Option 1A (North) and Corridor Option 1B (North) have a *moderately negative* impact on landslide susceptibility. This is due to the intercept of proposed cut sections at Junction 7 (Bray South) with an area of moderate landslide susceptibility. The impacts of the northern corridor options are summarised in **Table 1.12**.

In the Southern Section there is an absence of cut/fill proposals in Corridor Option 1 (South) and Corridor Option 5 (South). As a result, they are considered to have a negligible impact on the surrounding landslide susceptibility. Corridor Option 2 (South) and Corridor Option 6 (South) have a profound impact on the landslide susceptibility in the study area, this is due to the intercept of proposed cut/fill sections with high landslide susceptible areas. The impacts of the southern corridor options are summarised in **Table 1.13**.

Table 1.12: Summary of landslide susceptibility assessment for the Northern Section

Corridor Option	Description – Susceptibility	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Moderate Susceptibility	Medium	Moderate Adverse	Moderate	Moderately negative

Corridor Option	Description – Susceptibility	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
	High Susceptibility	High – very High	Imperceptible	Imperceptible	
Corridor Option 1B (North)	Moderate Susceptibility	Medium	Moderate Adverse	Moderate	Moderately negative
	High Susceptibility	High – very High	Imperceptible	Imperceptible	

Table 1.13: Summary of landslide susceptibility assessment for the Southern Section

Corridor Option	Description – Susceptibility	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Low Susceptibility	Low	Negligible	Imperceptible	Not significant or neutral
	Moderate Susceptibility	Medium	Negligible	Imperceptible	
	High Susceptibility	High – very High	Negligible	Imperceptible	
Corridor Option 2 (South)	Low Susceptibility	Low	Large Adverse	Slight	Major or highly negative
	Moderate Susceptibility	Medium	Large Adverse	Moderate	
	High Susceptibility	High – very High	Large Adverse	Profound	
Corridor Option 5 (South)	Low Susceptibility	Low	Negligible	Imperceptible	Not significant or neutral
	Moderate Susceptibility	Medium	Negligible	Imperceptible	
	High Susceptibility	High – very High	Negligible	Imperceptible	
Corridor Option 6 (South)	Low Susceptibility	Low	Large Adverse	Slight	Major or highly negative
	Moderate Susceptibility	Medium	Large Adverse	Moderate	
	High Susceptibility	High – very High	Large Adverse	Profound	

1.4.4 Potential areas of landfill

A number of sites of potential areas of landfill have been identified through consultation and a desk study review as detailed in **Section 13.3.5.1** of **Section 13** (Soils and geology) within **Volume B**. The history, contents and volume of these areas are not known sufficiently to provide accurate quantities. Therefore, a worst-case scenario has been taken, considering the entire plan area of the sites as hazardous waste that would require excavation and disposal.

Of the areas identified in the Constraints Study only three would be impacted by the corridor options:

- Kilmurray North (**Figure B13.20**: Wicklow County Council Potential Area of Fill No. 9-12)
- Drummin Lane (**Figure B13.21**: Wicklow County Council Potential Area of Fill No. 13-16)
- Kilpedder (**Figure B13.21**: Wicklow County Council Potential Area of Fill No. 1)

In the Northern Section (**Table 1.14**), the Kilmurray North potential area of landfill is within the assessment study area of Corridor Option 1A (North) and Corridor Option 1B (North). However, the footprints of these corridor options do not intercept with this area of potential landfill and as a result the impact of the options on Kilmurray North is imperceptible.

In the Southern Section (**Table 1.15**), Drummin Lane potential area of landfill is intercepted by Corridor Option 1 (South), Corridor Option 5 (South) and Corridor Option 6 (South) resulting in a moderate/significant impact. Corridor Option 2 (South) intercepts Kilpedder potential area of landfill resulting in a moderate impact.

Table 1.14: Summary of potential areas of landfill assessment for the Northern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Kilmurray north	Medium	Negligible	Imperceptible	Not significant or neutral
Corridor Option 1B (North)	Kilmurray north	Medium	Negligible	Imperceptible	Not significant or neutral

Table 1.15: Summary of potential areas of landfill assessment for the Southern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Drummin Lane	High	Moderate Adverse	Significant/ Moderate	Major or highly negative
Corridor Option 2 (South)	Kilpedder	Medium	Moderate Adverse	Moderate	Moderately negative
Corridor Option 2 (South)	Drummin Lane	High	Moderate Adverse	Significant/ Moderate	Major or highly negative
Corridor Option 5 (South)	Drummin Lane	High	Moderate Adverse	Significant/ Moderate	Major or highly negative

1.4.5 Geological Heritage Areas/County geological sites

In the Northern Section (**Table 1.16**), the Enniskerry Delta county geological site is intercepted by Corridor Option 1A (North) and Corridor Option 1B (North). There is a proposed cut area at this intersection, the resulting impact is *major or highly negative*.

In the Southern Section (**Table 1.17**), the Glen of the Downs county geological site is intercepted by Corridor Option 1 (South) and Corridor Option 5 (South). There are no significant earthworks proposed along Corridor Option 1 (South) as a result the overall impact is neutral. Potential widening associated with Corridor Option 5 (South) suggests that there will be landtake from the Glen of the Downs county geological site, resulting in a *major or highly negative* impact. Although Corridor Option 6 (South) does not intercept the Glen of the Downs county geological site, there will be a significant impact on the site during the construction phase of the tunnel due to the potential risks associated with the ground investigation required for the tunnel.

It has been assumed that ground investigations (GI) would be required in order to progress the design and construction of the tunnel option (part of Corridor Option 6 (South)). These can either be achieved through vertical boreholes, which are likely to result in direct impacts on Glen of the Downs SAC, or inclined boreholes, which may avoid direct impacts on the SAC but would result in increased cost. In carrying out GI works (either vertical or inclined boreholes), there is a risk that GI plant movements and operation may trigger slope instability, due to the high landslide susceptibility of the area, and this assumption has been considered during the Stage 2 Assessment.

All corridor options in the Southern Section intercept the Wicklow Service Area county geological site, however there is no proposed earthworks here resulting in a *not significant or neutral* impact.

Table 1.16: Summary of county geological sites assessment for the Northern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Enniskerry Delta	High	Moderate Adverse	Significant/Moderate	Major or highly negative
Corridor Option 1B (North)	Enniskerry Delta	High	Moderate Adverse	Significant/Moderate	Major or highly negative

Table 1.17: Summary of county geological sites assessment for the Southern Section

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
	Glen of the Downs	High	Negligible	Imperceptible	Not significant or neutral

Corridor Option	Description	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Wicklow Service Area	High	Negligible	Imperceptible	Not significant or neutral
Corridor Option 2 (South)	Wicklow Service Area	High	Negligible	Imperceptible	Not significant or neutral
Corridor Option 5 (South)	Glen of the Downs	High	Moderate Adverse	Significant/Moderate	Major or highly negative
	Wicklow Service Area	High	Negligible	Imperceptible	Not significant or neutral
Corridor Option 6 (South)	Glen of the Downs	High	Small	Imperceptible	Not significant or neutral

1.4.6 Earthworks assessment

An earthworks assessment has been carried out to estimate the potential cut/fill earthworks volumes for the various corridor options. The assumptions used for the earthworks assessment are set out below:

- Bulk earthworks volumes have been estimated based on the current road geometries produced as part of the corridor options assessment;
 - Cut volumes are based on a 1:2 slope;
 - Fill volumes are based on a slope of 1:2;
- Volumes are a bulk estimate based on the aforementioned cut and road geometries and do not consider topsoil removal, overdigging, temporary works or construction compounds etc.;
- Where the proposed corridor is considered to remain at grade or minimal cut/fill is required for this stage of the assessment, earthworks volumes have not been assessed and a qualitative assessment has been undertaken;
- Volumes relate to bulk material volumes only and have not been classified into material types;
- Volumes relate to in-situ volumes only, material bulking factors have not been applied; and
- Where the proposed design is at grade on the existing N11/M11 and additional lanes are added, the earthworks quantities are only for the section that extends beyond the existing pavement.

Where there is a surplus of cut material that potentially would not be used directly on site as there is no material or fill requirement, there is a profound impact noted.

In the Northern Section (**Table 1.18**) the impact of the cut/fill balance for the Corridor Option 1A (North) is considered to be a profound/significant impact.

This is due to the large amount of fill material required for Corridor Option 1A (North). The overall impact of the cut/fill balance for Corridor Option 1B (North) is considered to be profound. This is due to the large cut volume required for Corridor Option 1B (North). For the purpose of this assessment a cut requirement has been interpreted to have a larger negative impact than that of a fill requirement, as a cut requirement will result in a greater loss to the surrounding soils and geology.

In the Southern Section (**Table 1.19**) the impact of the cut/fill balance for Corridor Option 1 (South) is considered to be imperceptible as minimal earthworks are required. The overall TII PAG impact score of Corridor Option 2 (South), Corridor Option 5 (South) and Corridor Option 6 (South) is considered to be *major or highly negative* due to the large cut volumes required.

Table 1.18: Summary of the earthworks assessment for the Northern Section

Corridor Option	Description	Vol (m ³)	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1A (North)	Cut (m ³)	18,000	High	Large Adverse	Profound/ Significant	Major or highly negative
	Fill (m ³)	229,000				
	Cut/ Fill Balance (m ³)	-211,000				
Corridor Option 1B (North)	Cut (m ³)	164,000	Very High	Large Adverse	Profound	Major or highly negative
	Fill (m ³)	4,000				
	Cut/Fill Balance (m ³)	+160,000				

Table 1.19: Summary of the earthworks assessment for the Southern Section

Corridor Option	Description	Vol (m ³)	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Corridor Option 1 (South)	Cut (m ³)	0	Low	Negligible	Imperceptible	Not significant or neutral
	Fill (m ³)	0				
	Cut/Fill Balance (m ³)	0				
Corridor Option 2 (South)	Cut (m ³)	2,927,000	Very High	Large Adverse	Profound	Major or highly negative
	Fill (m ³)	953,000				
	Cut/Fill Balance (m ³)	+1,974,000				
Corridor Option 5 (South)	Cut (m ³)	68,000	High	Large Adverse	Profound/Significant	Major or highly negative
	Fill (m ³)	8,000				

Corridor Option	Description	Vol (m ³)	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
	Cut/Fill Balance (m ³)	+60,000				
Corridor Option 6 (South)	Cut (m ³)	684,000	High	Large Adverse	Profound/Significant	Major or highly negative
	Fill (m ³)	2,000				
	Cut/Fill Balance (m ³)	+682,000				

1.5 Summary

1.5.1 Northern Section

In the Northern Section (**Table 1.18**) Corridor Option 1A (North) has a fill requirement that results in a profound/significant impact on the soils and geology. Corridor Option 1B (North) has a large cut requirement resulting in a profound impact on the soils and geology. Cut is considered to be more impactful than fill and this results in Corridor Option 1A (North) being the preferred corridor option for the Northern Section. The key differentiator in this assessment is the earthworks assessment.

Table 1.20: Summary assessment table Northern Section

Assessment Criteria	Corridor Option 1A (North)	Corridor Option 1B (North)
Soils	Not significant or neutral	Not significant or neutral
Subsoils	Not significant or neutral	Not significant or neutral
Bedrock	Not significant or neutral	Not significant or neutral
Landslides	Minor or slightly negative	Minor or slightly negative
Landslide susceptibility	Moderately negative	Moderately negative
Potential Areas of Landfill	Not significant or neutral	Not significant or neutral
County Geological Sites	Major or highly negative	Major or highly negative
Earthworks Assessment	Major or highly negative	Major or highly negative

Assessment Criteria	Corridor Option 1A (North)	Corridor Option 1B (North)
Overall TII PAG Qualitative Assessment	Major or highly negative	Major or highly negative
MCA Score	1	1
Preference	Preferred	Least preferred

1.5.2 Southern Section

In the Southern Section (**Table 1.21**) Corridor Option 1(South) is the preferred corridor option, Corridor Option 5 (South) and Corridor Option 6 (South) are of intermediate preference and Corridor Option 2 (South) is the least preferred. The reasons are as follows:

- Corridor Option 1 (South) has the least impact on the subsoils and on earthworks, and the lowest impact on the agricultural soils resulting in it being the preferred corridor option despite it intercepting Drummin Lane potential area of landfill. It intercepts the Glen of the Downs county geological site, but no earthworks are proposed resulting in a *neutral* impact overall.
- Corridor Option 5 (South) has a larger impact on soils, subsoils and on the earthworks than Corridor Option 1 (South) resulting in it being an intermediate corridor option. This is despite it intercepting the Drummin Lane potential area of landfill as on balance it performs better than Corridor Option 2 (South). It has a greater impact than Corridor Option 1 (South) due to the potential widening along the road within the Glen of the Downs county geological site, this results in a *major or highly negative* impact on the site and a *moderately negative* impact in the landslides assessment due to Landslide event 13.

It has been assigned as *major or highly negative* in the earthworks assessment, the volume of earthworks required is not as large as Corridor Option 6 (South) and Corridor Option 2 (South), as a result Corridor Option 5 (South) is more preferable.

- Corridor Option 6 (South) has been classed as intermediate preference as it has a lesser negative impact on the underlying soils and geology than Corridor Option 2 (South). Corridor Option 6 (South) has a higher negative impact on agricultural soils and subsoils than Corridor Option 1 (South) and Corridor Option 5 (South). It intercepts an area of potential landfill (Drummin Lane) resulting in a *major or highly negative* impact (as do Corridor Option 1 (South) and Corridor Option 5 (South)). It has been assigned as *major or highly negative* in the earthworks assessment, however the volume of earthworks required is not as large as that of Corridor Option 2 (South), as a result Corridor Option 6 (South) is more preferable.
- Corridor Option 2 (South) is the least preferred corridor option. This is due to the following reasons: it has a *major or highly negative* impact on soils and landslide susceptibility.

It has a *moderately negative* impact on subsoils, bedrock, and potential areas of fill. The earthwork requirements for Corridor Option 2 (South) result in a greater negative impact on the surrounding soils and geology than that of any other corridor option. Overall, it has the largest negative impact on the existing soils and geology.

Table 1.21: Summary assessment table Southern Section

Assessment Criteria	Corridor Option 1 (South)	Corridor Option 2 (South)	Corridor Option 5 (South)	Corridor Option 6 (South)
Soils	Not significant or neutral	Major or highly negative	Not significant or neutral	Moderately Negative
Subsoils	Not significant or neutral	Moderately Negative	Not significant or neutral	Minor or slightly negative
Bedrock	Not significant or neutral	Moderately negative	Not significant or neutral	Moderately negative
Landslides	Minor or slightly negative	Not significant or neutral	Moderately negative	Not significant or neutral
Landslide susceptibility	Not significant or neutral	Major or highly negative	Not significant or neutral	Major or highly negative
Potential Areas of Landfill	Major or Highly Negative	Moderately Negative	Major or Highly Negative	Major or Highly Negative
Geological Heritage Area	Not significant or neutral	Not significant or neutral	Moderately Negative	Not significant or neutral
Earthworks Assessment	Not significant or neutral	Major or highly negative	Major or highly negative	Major or highly negative
Overall Qualitative Assessment	Major or highly negative	Major or highly negative	Major or highly negative	Major or highly negative
MCA Score	1	1	1	1
Preference	Preferred	Least Preferred	Intermediate	Intermediate

1.6 Stage 2 Project Appraisal Matrix – transport assessment

The Stage 2 Project Appraisal Matrix for the transport scenario assessment is summarised in **Table 1.22**. Transport Scenario 5A, Transport Scenario 5B and Transport Scenario 4 have been assessed in relation to landslide susceptibility and earthworks assessment.

Transport Scenario 5A is considered to have a *moderately negative* impact on the underlying soils and geology. This is due to the cut requirements intercepting moderately high landslide susceptibility areas (North and South of Junction 6 (Bray/Fassaroe)). As well as this, Transport Scenario 5A has larger cut and fill areas along the scheme which results in a larger impact on the soils and geology.

The earthworks assessment carried out to quantify the cut/fill volume for Transport Scenario 5A suggests that the earthworks will have a *major or highly negative impact* on the underlying soils and geology (**Table 1.22**).

Transport Scenario 5B is also considered to have a *moderately negative impact* on the underlying soils and geology. Transport Scenario 5B does not propose any cuts in areas of moderate landslide susceptibility, as a result it has a negligible impact on landslide susceptibility making it more preferable than Transport Scenario 5A in this regard. The required cut and fill areas to accommodate the additional lane and other infrastructure associated with this transport scenario will result in loss of the underlying soil. The earthworks assessment carried out to quantify the cut/fill volumes for Transport Scenario 5B suggest that the works will have a *major or highly negative impact* on the underlying soils and geology (**Table 1.22**).

Table 1.22: Earthworks volumes for Transport Scenario 5A and 5B

Corridor Option	Description	Vol (m ³)	Importance of attribute	Magnitude of Impact	Significance of Impact	Overall MCA Score (Description)
Transport Scenario 5A	Cut (m ³)	158,000	High	Large Adverse	Profound / Significant	Major or highly negative
	Fill (m ³)	74,000				
	Cut/Fill Balance (m ³)	+84,000				
Transport Scenario 5B	Cut (m ³)	99,000	High	Large Adverse	Profound / Significant	Major or highly negative
	Fill (m ³)	10,000				
	Cut/Fill Balance (m ³)	+89,000				

Transport Scenario 4 is a supplemental scenario to Transport Scenario 5A or 5B. It involves investment in bus services suggesting there is no earthworks requirement for Transport Scenario 4. As a result, there is a *not significant or neutral impact* for Transport Scenario 4 on the surrounding soils and geology.

Table 1.23: Transport assessment summary table

Assessment Criteria	Transport Scenario 5A	Transport Scenario 5B
Landslide susceptibility	Moderately negative	Not significant or neutral
Earthworks Assessment	Major or highly negative	Major or highly negative
Qualitative Assessment	Major or highly negative	Major or highly negative
Preference	Least Preferred	Preferred

1.7 References

Environmental Protection Agency (EPA), Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Draft 2017. Available from: <https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf> [Accessed: 09 April 2020]

National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA 2009.

Available from: <https://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf>

Transport Infrastructure Ireland (TII) Project Appraisal Guidelines for National Roads Unit 7.0 - Multi-Criteria Analysis, 2016. Available from: <https://www.tiipublications.ie/library/PE-PAG-02031-01.pdf>