

Appendix A

A.7.1 Green2 – Blue2 Switch Route Option Report

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Galway County Council
N6 Galway City Transport Project
Green2 - Blue2 Switch Route Option
Report

GCOB-4.04.REP007

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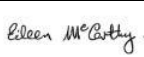



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1 Introduction

1.1 Overview

Arup was appointed to provide multi-disciplinary engineering consultancy services for delivery of Phases 1, 2, 3 and 4 of the NRA Project Management Guidelines (NRA PMG) for the N6 Galway City Transport Project. This appointment includes the examination of studies, documents and court rulings relating to the earlier unsuccessful scheme, followed by feasibility studies, route selection, and design and planning for a revised scheme.

The commission commenced at *Phase 1: Scheme Concept & Feasibility Studies*. As public funding will be required for any future potential scheme, a Preliminary Appraisal was undertaken during Phase 1. The purpose of this appraisal was to ensure that public funds are allocated in an efficient manner by establishing the merits of a proposal using a consistent and comprehensive framework. Phase 1 has now been completed and *Phase 2: Route Selection* is on-going.

1.2 Scheme Background

Consultants were appointed in 1999 to undertake feasibility studies, route selection, design and planning for a Galway City Outer Bypass scheme. The resultant scheme including the Compulsory Purchase Order (CPO) and Environmental Impact Statement (EIS) was submitted to An Bord Pleanála (ABP) in December 2006. This scheme consisted of 21.4km of mainline, 9km of link roads, associated intersections and a major bridge crossing of the River Corrib.

The decision of ABP was split, with an approval on the section east of the N59 to the existing N6 only. The ABP decision granting approval of the eastern section was appealed to the High Court. The High Court undertook a judicial review of the ABP decision. The High Court confirmed ABP approval but allowed an appeal to the Supreme Court. The Supreme Court sought the opinion of the Court of Justice of the European Union (CJEU) on an interpretation of the Habitats Directive. Following receipt of the CJEU opinion, the Supreme Court quashed the earlier ABP decision.

1.3 Purpose of this Report

The current scheme is currently at Phase 2 - Route Selection stage. The objective of this phase is to identify a suitable study area for the examination of alternative routes and transportation solutions, to identify key constraints within this study area, to develop feasible route options and transportation solutions and to carry out a systematic assessment of these options leading to the selection of a preferred route corridor or transportation solution which will form the basis for the detailed design to follow.

As part of this process the feasibility and applicability of a number of options and alternatives need to be considered for inclusion or otherwise in the route option selection process.

This report examines the feasibility of an option which combines the Green2 Route Option to the west of the River Corrib with the Blue2 Route Option to the east of the River Corrib with the provision of the Green2 - Blue2 Switch. This option is known as the Green2 - Blue2 Switch Route Option and is shown on **Figure 1.1**.

1.4 Route Option Description

The Green2 Route Option commences at the R336 to the west of Bearna and proceeds in a north-easterly direction, keeping to the north of Bearna and passing through the townlands of An Chloch Scoilte, Na hAille, Keeraun, Tonabrocky and Bushypark before crossing the River Corrib to the north of Menlo Castle. A new corridor is provided to connect the River Corrib crossing on the Green2 Route Option to the Blue Route2 Option immediately east of the Menlough Road. The route option then enters a tunnel to the east of this point and emerges from the tunnel immediately west of the existing N84. The Blue2 Route Option passes through the townlands of Castlegar and Ballybrit, crosses under Galway Racecourse in a cut and cover tunnel and terminates at the existing N6 in Coolagh.

The Green2 Route Option connects to the R336 with an at-grade roundabout junction approximately 2km to the west of Bearna Village. There are then three at-grade roundabout junctions, at approximately 2km spacing, on the Bearna to Moycullen Road, on Cappagh Road and on Rahoona Road. A grade separated junction is proposed on the N59.

To the east of the River Corrib, the Blue2 Route Option includes a grade separated junction serving the N84 to the south of Ballindooley Lough, and a grade separated junction on the existing N17 in the vicinity of Twomileditch. A further grade separated junction south-east of the existing Briarhill Junction to connect the Blue2 Route Option to the existing N6.

2 Engineering Assessment

2.1 Introduction

This section details the Stage 2 engineering assessment of the Green2 - Blue2 Switch Route Option with respect to the engineering constraints identified in **Chapter 4 of the Route Selection Report**. **Section 2.2** outlines the methodology that was used to carry out the assessment and **Section 2.3** details the engineering assessment. A summary is presented in **Section 2.4**.

2.2 Methodology

The engineering assessment of the Green2 - Blue2 Switch Route Option has been carried out in a similar manner to the engineering assessment of the six route options considered at Route Selection Stage 2, using the same criteria. These criteria are geometry, cross-section, length, junction strategy, structures, topography and earthworks, constructability, and traffic.

The Green2 - Blue2 Switch Route Option has been assessed in two sections as shown on **Figure 1.1**. Section 1 extends from the R336 to Galway City boundary, and Section 2 extends from the city boundary to the tie-in point with the existing N6.

2.3 Assessment

2.3.1 Geometry

A preliminary mainline alignment with associated junctions and link roads has been designed for the Green2 - Blue2 Switch Route Option. The geometric assessment has been carried out on the mainline alignment along the route travelled from where the route connects to the existing R336 to the tie in with the existing N6 Galway to Dublin motorway.

The centreline of the Green2 - Blue2 Switch Route Option meets the NRA Design Manual for Roads and Bridges (DMRB) standards for the horizontal and vertical alignments along its full length. Visibility and superelevation were not assessed at this stage of the design.

2.3.2 Cross-Section

A single carriageway has been assumed from the western tie in at the R336 to the first at-grade junction immediately before the N59 grade separated junction for the Green2 - Blue2 Switch Route Option. From this point east, a Type 2 dual carriageway cross-section has been assumed throughout.

2.3.3 Length

The length parameter is a measure of the Green2 - Blue2 Switch Route Option's length from its westernmost extent, where it connects to the R336 in the vicinity of Bearna, to the tie-in with the existing N6 Galway to Dublin Road. This is the distance which a vehicle would have to travel to go from the westernmost extent to the existing N6.

Table 2.1 Overall Route Option Length

Route Option	Mainline Length (m)
Green2 - Blue2 Switch	13,917

2.3.4 Junction Strategy

This assessment considers the number of junctions along the Green2 - Blue2 Switch Route Option. At-grade junctions will cause delays on the mainline, with the delay increasing as the number of at-grade junctions increases. At-grade junctions also have the potential to increase traffic volumes and delay on the adjoining local road networks. However, it is vital to provide sufficient connectivity via junctions to cater for traffic from the local networks.

Conversely, a higher number of grade separated junctions provides greater connectivity to the mainline with no significant delay experienced by the mainline traffic.

As there are no grade separated junctions in Section 1, the number of at-grade junctions was counted and this is tabulated below in **Table 2.2**.

Table 2.2 Junction Assessment – Section 1

Route Option	Number of At-Grade Signalised Junctions or Roundabouts	Number of At-Grade Priority/Left In Left Out Direct Access Junctions	Number of Grade Separated Junctions
Green2 - Blue2 Switch	2	0	0

For Section 2, the numbers of at-grade and grade separated junctions along the Green2 - Blue2 Switch Route Option were totalled.

One of the key objectives of the project is a requirement to provide connectivity between the N6 and the three existing national routes in the city; the N59, the N84 and the N17. For the Green2 - Blue2 Switch Route Option, a check was carried out on as to whether there is a direct connection between this route option and the existing national routes with a simple yes or no, which is included in **Table 2.3** below along with the number and type of junctions.

Table 2.3 Junction Assessment – Section 2

Route Option	Number of At-Grade Signalised Junctions or Roundabouts	Number of At-Grade Priority/Left In Left Out Direct Access Junctions	Number of Fully Grade Separated Junctions	Direct Connectivity to National Routes
Green2 - Blue2 Switch	2	0	3.5	Y

2.3.5 Structures

The River Corrib and associated Lough Corrib candidate Special Area of Conservation (cSAC) lie in the centre of the scheme study area. The Green2 - Blue2 Switch Route Option crosses over the River Corrib with the mainline on a new bridge structure.

In both Section 1 and Section 2, the total number of bridge structures along the mainline has been quantified as shown below in **Table 2.4** for Section 1 and **Table 2.5** for Section 2. This includes the number of river and stream bridge crossings and the mainline crossing existing roads, either on an overbridge or in an underpass. Fewer bridge crossings, in general, leads to lower construction costs, ongoing structural maintenance costs and causes less impact on the overall overland drainage network.

Table 2.4 Structures Assessment – Section 1

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Total Number of Bridges
Green2 - Blue2 Switch	1	4	0	5

Table 2.5 Structures Assessment – Section 2

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Total Number of Bridges
Green2 - Blue2 Switch	4	9	4	17

The River Corrib Bridge Crossing is included in the figure above and there are a further three significant structures along the Green2 - Blue2 Switch Route Option in Section 2: a 500m long tunnel under Annex I habitat, a 395m long viaduct over Annex I habitat, and a 1200m long tunnel at Galway Racecourse. These are considered to be major structure extents and would add to the cumulative ranking of this option.

2.3.6 Topography and Earthworks

A preliminary assessment of the earthworks quantities was carried out on the mainline for each route option considered as part of Route Selection Stage 2. A summary of the initial volumes is provided below.

Table 2.6 Earthworks Balance – Section 1

Route Option	Total Cut (m3)	Total Fill (m3)	Volume Balance (m3)
Green2 - Blue2 Switch	46,093	-342,386	-296,293

Table 2.7 Earthworks Balance – Section 2

Route Option	Total Cut (m3)	Total Fill (m3)	Volume Balance (m3)
Green2 - Blue2 Switch	1,598,963	-2,109,038	-510,075

2.3.7 Constructability

Due to the extent of existing residential housing, commercial businesses, farms, local roads and accesses throughout the scheme study area, a route option with the greatest length of on-line construction would be the most difficult to construct. The tunnel construction associated on the eastern section of this route option may add a certain complexity to the constructability. As the Green2 - Blue2 Switch Route Option is off-line for the majority of its length, it is envisaged that construction of the mainline would be relatively straightforward.

2.4 Summary

From an engineering point of view, the Green2 - Blue2 Switch Route Option is a feasible option.

3 Environmental Assessment

3.1 Introduction

This section details the Stage 2 environmental assessment of the Green2 - Blue2 Switch Route Option with respect to the constraints identified in **Chapter 4 of the Route Selection Report**. **Section 3.2** outlines the Ecological assessment, **Section 3.3** the Soils and Geology assessment, **Section 3.4** the Hydrogeology assessment, **Section 3.5** Hydrology assessment, **Section 3.6** the Landscape and Visual assessment, **Section 3.7** the Archaeological, Architectural and Cultural Heritage assessment, **Section 3.8** Material Assets – Agriculture, **Section 3.9** Material Assets – Non Agriculture, **Section 3.10** Air Quality, **Section 3.11** Noise and Vibration and **Section 3.12** outlines the Human Beings assessment.

The environmental assessment of the Green2 - Blue2 Switch Route Option has also been carried out in two sections: Section 1, from the R336 to Galway City boundary, and Section 2, from the city boundary to the existing N6 to the east of the city, as shown on **Figure 1.1**.

3.2 Ecology

3.2.1 Introduction

The ecological assessment of the of the Green2 - Blue2 Switch Route Option has been carried out with respect to the ecological constraints identified in **Section 4.3 Ecology of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.1 Ecology** of the **Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.3.1 to 4.3.20** of the **Route Selection Report** and **Figure 3.2.1 to 3.2.7** of this Report.

3.2.2 Assessment

The Green2 - Blue2 Switch Route Option impacts directly on Lough Corrib cSAC at two locations¹: at the proposed crossing point of the River Corrib and to the west of Lackagh Quarry.

At the location of the proposed River Corrib crossing, the Green2 - Blue2 Switch Route Option has a footprint of *c.*1.93ha within the boundary of the Lough Corrib cSAC, of which *c.*725m² is Alkaline fen [7220]². Alkaline fen is a Qualifying

¹ The current versions of the digital designated area boundaries that can be downloaded from the NPWS website do not always accurately represent the legally defined boundaries, as shown on the official Department of Arts, Heritage and the Gaeltacht boundary maps, as they relate to features on the ground such as field boundaries, road margins etc. This is on account of the scale difference between the 6-inch maps used to originally define the European site boundaries and current larger scale vector mapping/orthophotography. Therefore, references to direct impacts within designated, and any habitat areas calculated therein, are based upon the intersection of the proposed route option alignments provided and the digital designated area boundaries downloaded from the NPWS website (revision 15/01/2015, downloaded in March 2015), and on an interpretation of the legal boundary, from the official Department of Arts, Heritage and the Gaeltacht boundary maps.

² The nomenclature used when referring to Annex I habitat types follows that of the *Interpretation Manual of European Union Habitats EUR28* (CEC, 2013) or, where shortened forms of the Annex I habitat titles are used,

Interest (QI) habitat of the Lough Corrib cSAC. The proposed bridge structure is elevated on piers as the proposed road passes through the cSAC and has been designed to avoid locating any of the supporting piers within the area of Alkaline fen. Although not directly impacted by the construction works, the construction of piers in associated wetland habitats in close proximity to Alkaline fen poses a risk of significant indirect impacts if the existing hydrogeological regime is affected, which could potentially affect the integrity of Lough Corrib cSAC. Species composition and species diversity in the fen area is likely to be affected as a result of shading and a reduction in direct precipitation associated with the bridge deck; an impact that would adversely affect the integrity of Lough Corrib cSAC.

Aside from the Annex I habitats, the other habitats present within the Lough Corrib cSAC boundary at the proposed River Corrib crossing point which lie within the footprint of the proposed road alignment are likely to be directly impacted during construction to install drainage and facilitate building the piers. These include mainly non-Annex I wetland habitats on the west bank, which would be particularly vulnerable to indirect impacts from construction works, (fen, wet grassland, and reed swamp) and woodland, grassland, scrub, and reed swamp on the east bank.

To the west of Lackagh Quarry, the Green2 - Blue2 Switch Route Option tunnels underneath the Lough Corrib cSAC; avoiding any direct impacts. In the vicinity of the proposed tunnel the QI Annex I habitats within the cSAC are Limestone pavement [*8240) and Calcareous grassland [*6210/6210]. None of these habitat types are groundwater dependent and are not likely to be affected in any way by a tunnel excavated underneath, in that regard. The fractured nature of karst limestone does pose some level of risk of subsidence at the surface as a result of tunnelling works. Given the tunnelling methodology proposed the magnitude of any such impact would be extremely low and it can be confidently predicted that any subsidence would not manifest itself at the surface as any perceptible change to the structure or functioning of these habitat types. The tunnel does also carry a risk of both construction and operation impacts to the movement of groundwater and there is the potential for indirect effects to wetland habitats within the Lough Corrib cSAC boundary to the south, in the vicinity of the Coolagh Lakes.

The risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Based upon these appropriate engineering tunnelling techniques and construction controls, the tunnel is unlikely to result in any significant long-term effects to the functioning of the existing hydrological regime that supports the wetland habitats within Lough Corrib cSAC, or adversely affect the integrity of the cSAC. Detailed geotechnical investigations would be required to fully quantify the associated risks, if any.

The Green2 – Blue2 Switch Route Option lies immediately adjacent to the Moycullen Bogs NHA, at the western margin of the site where an agricultural field grades into reed swamp surrounding a small dystrophic lake [3160]. Given the close proximity of the lake to this route option and its current design, there is the potential

The Status of EU Protected Habitats and Species in Ireland 2013 (NPWS, 2013). The use of an asterisk (*) symbol preceding the four digit habitat code denotes that that habitat type is a *priority* habitat type.

for indirect impact to water quality during construction, and potentially effects on the underlying hydrogeology.

The Green2 - Blue2 Switch Route Option will result in the loss of Annex I habitats from within the Ecological Sites and from areas adjacent to the Lough Corrib cSAC boundary³; in total, approximately 4.19ha. West of the River Corrib, this consists of small patches of Wet heath/Dry heath [4010/4030]. To the east, areas of Limestone pavement [*8240], Molinia meadows [6410] and Calcareous grassland [6210] are within the current design of the Green2 - Blue2 Switch Route Option. However in the case of Limestone pavement, most of these areas are underneath the viaduct structure that runs north-east from the Menlough Road, with the piers located outside of the Annex I habitat patches. However, some structures may be located in areas surrounded by Limestone pavement [*8240], and possibly a turlough [*3180], and may need to be crossed to facilitate the construction works. Given that the areas of Limestone pavement are not part of the Lough Corrib cSAC, and that with careful construction methodology it should be possible to access supporting structures/piers without permanently damaging the structure of the Limestone pavement areas, this impact is unlikely to be significant.

The Green2 - Blue2 Switch Route Option will result in the loss of, or modification to, potential Otter habitat, and some level of disturbance/displacement impact, at watercourse crossings between Bearna and the River Corrib; including within the Lough Corrib cSAC at the proposed River Corrib Bridge. It may also result in some level of disturbance/displacement of Otters at Ballindoooley Lough, if present. These impacts have the potential to be significant at the local level if Otter holts/couches are present. However in the case of the Lough Corrib cSAC, based on the findings of the Otter survey carried out, and considering the bridge design proposed (i.e. some habitat modifications likely but no permanent loss of suitable Otter habitat, or severance impacts), the impacts are not likely to be significant.

The Green2 - Blue2 Switch Route Option will also have a significant impact on the local Lesser horseshoe bat population given the scale of habitat loss and severance likely to be associated with this route option within their foraging area, and in the immediate vicinity of the maternity roost at Menlo Castle (c.260m from the mainline of the proposed Green2 Route Option). Based on the findings of the radio-tracking survey, the woodland habitat between the Blue2 and Green2 Route Options supported a relatively higher concentration of Lesser horseshoe bat activity during August and is likely to be a key habitat zone that supports the maternity roost.

At its eastern end in Section 1, the Green2 - Blue2 Switch Route Option is c.1km from a Lesser horseshoe bat roost, two Whiskered bat roosts, and two Leisler's bat roosts. At this distance from roost sites, there is the potential for significant negative impacts to result from habitat loss, severance, and displacement associated with the construction and operation of a road development.

In the west, the Green2 - Blue2 Switch Route Option crosses the Trusky Stream, Liberty Stream, and the Bearna Stream; impacts to the Trusky and Liberty Streams

³ These areas were surveyed as part of the Lough Corrib cSAC habitat survey and are not included within the boundaries of the Ecological Sites as shown on Figure 4.3.2

may require realignments of sections of those streams. This may result in the loss of a significant linear length of potential fisheries and Otter habitat.

The Green2 - Blue2 Switch Route Option will also result in the loss of suitable Marsh fritillary habitat; some of which occurs next to locations that supported breeding colonies in 2014. The loss of habitat associated with this route option is not likely to be significant in relation to the maintenance, and potential expansion, of the local metapopulation.

This route option is in close proximity to a Peregrine falcon nest site at Coolagh and roost site at Tonabrocky, and there is a high potential for associated disturbance and displacement impacts to occur during both construction and operation. It also passes through, or close to, the margins of upland sites which supports Red and Amber listed wintering birds⁴, and wintering bird species listed as qualifying interests of Inner Galway Bay SPA.

As it is within 500m of a Barn owl nest site, and another roost site, the Green2 - Blue2 Switch Route Option is likely to have a significant impact on the local Barn owl population, due to the increased risk of collisions with road traffic.

The Green2 - Blue2 Switch Route Option impacts on c.1.23ha of Limestone pavement [*8240] in EC56 at the N6 Junction. However, the majority of this (c.1.16ha) is described as consisting of small fragmented areas of Annex I habitat.

3.2.3 Summary

Overall, the Green2 - Blue2 Switch Route Option has the potential to result in significant negative impacts to Lough Corrib cSAC. The effects on QI habitats in Lough Corrib cSAC associated with this route option would constitute an adverse effect on the integrity of this European site. It also has the potential to impact on habitats within Moycullen Bogs NHA due to its close proximity to that designated site. The Green2 – Blue2 Switch Route Option will also have a significant negative impact on the Menlough Lesser horseshoe bat population as a result of habitat loss and severance within an important habitat zone that supports the maternity roost at Menlo Castle. Significant impacts to the local Barn owl populations and Peregrine falcon nest/roost sites are also likely to be associated with this route option. There is also the potential for the Green2 - Blue2 Switch Route Option to impact on areas of Annex I habitats outside of designated sites, other bat species, Marsh fritillary and aquatic species.

⁴ From Birds of Conservation Concern in Ireland (Colhoun & Cummins, 2013)

3.3 Soils and Geology

3.3.1 Introduction

The soils and geology assessment of the Green2 - Blue2 Switch Route Option has been carried out with respect to the soils and geology constraints identified in **Section 4.4 Soils and Geology of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.2 Soils and Geology of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.4.1 to 4.4.2 of the Route Selection Report** and **Figures 3.3.1 to 3.3.12** of this Report.

3.3.2 Assessment

The following assessment takes cognisance of modifications to the Blue2 and Green2 Route Options and utilises the methodology described in **Section 7.6.2 of the Route Selection Report**.

3.3.2.1 Overview of the Solid Geology, Subsoils and Soils along the Green-Blue Switch Option

Bedrock Geology

The bedrock geology underlying the Green2 - Blue2 Switch Route Option is shown on Figures 3.3.3 and 3.3.4. There are two principle forms of bedrock underlying this route option. To the west of the N59 the bedrock consists of undifferentiated granite and associated rock. To the east of the N59, the bedrock consists of Lower Carboniferous (Visean) Age Burren Limestone. This underlies the remainder of this route option to the tie-in with the existing N6.

Subsoils

The subsoil underlying this route option is shown in **Figures 3.3.7 and 3.3.8**. In the section of the Green2 – Blue2 Switch Route Option from the R336 to the N59, the subsoils consist of either glacial till derived from granite or sandy gravely clay with a thin layer of peaty soil sporadically located along this route option. There are many large granite boulders present within the brown stony till.

Along the western banks of the River Corrib in the Bushypark/Upper Dangan area, the proposed route option is underlain by soft calcareous or organic clay and peat over limestone bedrock.

On the eastern side of the River Corrib, Limestone pavement is present over much of this route option from Menlough to the western tunnel portal, with pockets of alluvium associated with the flood plain of the River Corrib.

The GSI mapping shows peat associated with Ballindooley Lough encroaching on the design for this route option. Glacial till derived from limestone with occasional granite erratics overlie the limestone bedrock. Made ground dominates the route option from the N84 Headford Road to the N6 tie-in.

Soils

The soils underlying the Green2 - Blue2 Switch Route Option are shown on **Figures 3.3.5 and 3.3.6**.

On the western side of the River Corrib where outcrops are not present, the soils are of a peaty nature and are of very poor quality from an agricultural perspective. Between the N59 and the River Corrib, there is a small quantity of medium quality soils. However, the majority of the soils in this area remain poor quality, being peaty in nature.

The soils on the eastern side of the River Corrib consist of well drained Glacial till. Made Ground is encountered in the form of residential developments, roads and modifications to the Galway Racecourse. The Green2 - Blue2 Switch Route Option terminates in a greenfield site at Briarhill.

Made ground is encountered in the form of playing fields, commercial development and residential developments across the route option.

3.3.2.2 Cuttings and embankments

Cuttings and embankments for the Green2 - Blue2 Route Option are illustrated on **Figures 3.3.11 and 3.3.12**.

Principal cuttings and embankments are tabulated below for this route option. Areas with a maximum cutting depth or embankment height of less than 5m and an overall impact of Low are excluded from principle cutting and embankment tables outlined below and included on **Figures 3.3.11 and 3.3.12**

Table 3. 3.1 Principal cuttings along the Green - Blue Switch Route Option

Section	Name	Location	Length	Max cutting depth (m)	Level of impact
1	C4	Trusky East	60	0 - 5	High ⁵
2	C11	Keeraun	100	5 - 10	Low
2	C15	Tonabrocky to Ballagh	660	10 - 15	Medium
2	C16	Coolagh	180	10 - 15	Medium
2	C17	Coolagh	50	5 - 10	Low
2	C18	Ballindooley	150	>15	High

⁵ In addition to the maximum cutting depth, the impact is also influenced by presence of soft ground

Section	Name	Location	Length	Max cutting depth (m)	Level of impact
2	C20	Castlegar	520	5 - 10	Low
2 / 3	C21	Parkmore to Doughiska	3170	>15	High ⁶

Table 3.3.2 Principal embankments along the Green - Blue Switch Route Option

Section	Name	Location	Length	Max embankment height (m)	Level of impact
1	E1	Na Foráí Maola Thiar	1300	5 - 10	Medium ⁷
1	E3	Trusky West to East	150	0 - 5	High ⁸
1	E4	Trusky East	30	0 - 5	High ⁸
1 / 2	E6	Trusky East to Cappagh	1510	10 - 15	High ⁷
2	E9	Cappagh to Keeraun	640	5 - 10	Low
2	E11	Keeraun	640	5 - 10	Low
2	E14	Mincloon to Tonabrocky	1030	10 - 15	High ⁹
2	E15	Ballagh to River Corrib	1360	> 15	High ⁸
2	E21	Menlough	1450	5-10	High ⁹

⁶ In addition to the maximum cutting depth, the impact is also influenced by the presence of karst features and length of cutting.

⁷ In addition to the maximum cutting depth, the impact is also influenced by the length of embankment

⁸ In addition to the maximum cutting depth, the impact is also influenced by the presence of soft ground.

⁹ In addition to the maximum cutting depth, the impact is also influenced by the length of embankment and presence of soft ground.

Section	Name	Location	Length	Max embankment height (m)	Level of impact
2	E16	Coolagh to Ballindooley	370	10 - 15	Medium
2	E17	Ballindooley to Castlegar	680	>15	High ⁷
2	E18	Castlegar	310	10 - 15	Medium ¹⁰
2	E19	Castlegar to Parkmore	460	10 - 15	Medium

The following features are associated with the principle cuttings, embankments and associated infrastructure provision for the Green2 - Blue2 Switch Route Option. These have been taken into account in the assessment of the impacts tabulated above, as set out in the methodology in **Section 7.6.2** of the **Route Selection Report**.

In areas where the route option is close to grade in the western extent of the scheme, it is possible that peat and other soft deposits may need to be excavated and replaced with materials to support the roadbed.

The route option travels on an embankment from Mincloon to Tonabrocky with a maximum depth of approximately 11m. The embankment traverses an area of soft compressible ground at Mincloon.

The route option enters a cutting in the Tonabrocky area whose maximum depth would be approximately 10m. The cutting would likely encounter Errisbeg Granite. Further information on the stratification would be required for this area for detailed design stage.

This option travels on embankment in the Ballagh/Buskypark area. The approach embankment to the River Corrib crossing would likely encounter peat and other soft deposits in the flood plain of the river. The high embankment would likely require pile foundations or extensive ground improvement to meet the settlement and stability criteria.

The proposed bridge foundations would likely require pile foundations. Previous studies at the location of the 2006 GCOB proposed River Corrib crossing, north of the Green2 - Blue2 Switch Route Option, suggested that there is a buried glaciated channel. The extent of the glaciated channel has not been determined. If the channel is present under the proposed River Corrib crossing for this route option, longer and/or more piles would likely be required to support the bridge.

The need to use a piling rig also brings impacts in terms of getting the heavy plant safely into position. It may be necessary to consider options such as a temporary

¹⁰ Presence of Karst features

piled structure or placing a heavily reinforced working platform on the soft ground to accommodate the weight of the piles, piling rig and any cranes and beams required to construct the bridge. Alternatively a barge may be moored into position at the foundation location to accommodate the foundation equipment.

To the immediate east of the River Corrib, the route option, outside of the extent of the viaduct in the Menlough area, is on embankment. The foundation soils in this area are largely glacial till over limestone bedrock. Potential geohazards from karst in the limestone would need further investigation at detailed design stage.

A tunnel is proposed adjacent to Lackagh Quarry and underneath the Lough Corrib cSAC. This tunnel is proposed to avoid significant impacts on areas of environmental importance. The tunnel would likely be formed using either drill and blast, roadheader or tunnel boring machine methods. There are a greater number of options for forming the tunnel for this option than the tunnel for the Orange2 Route Option for the following reasons:

- The tunnel would be at a higher elevation than the River Corrib. Groundwater control measures during the construction and design life of the tunnel may not be as problematic as the Orange2 Route Option; and
- The limestone is visibly exposed at Lackagh quarry. The bedding of the rock appears favourable although the presence of faults in the rock face is evident. Support from rock bolts could be used to mitigate these unfavourable conditions.

The tunnel emerges into Lackagh Quarry and is supported on an embankment as the alignment rises. A combination of cuttings against the quarry face on the eastern side and embankment on the western side would be used. The stability of the existing quarry face would require closer assessment and remediation such as rock netting or rock traps.

Travelling eastwards, the route option enters a cut and cover tunnel at the Galway Racecourse. This tunnel would likely involve excavation of glacial till and limestone bedrock. Surface reinstatement requirements would have to be determined through discussions with the Galway Racecourse and relevant stakeholders. Following the cut and cover tunnel the route enters a deep cutting through Briarhill, which is approximately 2km long, and connects to the existing N6. This cutting would likely be in glacial till and limestone and the depth of the cutting would be up to 15m.

Further investigation work would be required in order to determine the Geological profile of the Green2 - Blue2 Switch Route Option.

3.3.2.3 Overview of Ground Conditions and Features in Karst Limestone Areas

The Green2 - Blue2 Switch Route Option passes into a limestone region in the vicinity of the existing N59 at Glenlo Abbey. There are springs in the area (K2, K7, and K9) which likely originate from the granite/limestone interface. Enclosed depressions (K6, K10, K11, and K12) are noted on the west side of the River Corrib.

On the eastern side of the River Corrib, one spring (K25) was identified. A turlough (K31) is located west of Lackagh Quarry in Menlough.

A spring (K45) and a number of enclosed depressions (K59, K61, K62, K64, K67, K70, and K71) are located in the vicinity of Lackagh Quarry, and one additional enclosed depression (K97) is located to the west of the Galway Racecourse.

At the eastern end of the route option, a number of enclosed depressions (K172, K175 and K179) were confirmed. A number of springs were recorded on the GSI karst database (K161, K176, K178, K180 and K181) but unconfirmed/not found during the karst site survey.

The impact of karst on the Green2 - Blue2 Switch Route Option is assessed as **Medium**.

3.3.2.4 Overview of Historical Land Use

This route option passes largely through a rural landscape where historical mapping indicates that the land use has changed little. The land is characterised as predominantly agricultural land with sporadic one-off housing along the Green2 - Blue2 Switch Route Option.

The Green2 - Blue2 Switch Route Option traverses Lackagh Quarry. The quarry has extended into the surrounding agricultural land and is no longer active. The land use between the Lackagh Quarry and Galway Racecourse is predominantly agricultural and residential. Along the N84, there are a series of commercial properties with an adjacent storage yard housing construction equipment. Additional investigations would be required in this area in order to determine if contaminants are present.

The route option passes existing commercial buildings adjacent to the N17 before entering Galway Racecourse lands. Much of the land use to the east of the River Corrib has changed from agricultural to commercial, industrial and residential use.

The impact of historical land use along the Green2 - Blue2 Switch Route Option is **Low**. However, a further investigation at detailed design stage in order to determine if contaminants are present would be required.

3.3.2.5 Overview of Economic Geology

The Green2 - Blue2 Switch Route Option does not impact on existing active quarries or prospective expansion of quarries. The quarry at Lackagh is currently not an active resource. Consequently the impact on economic geology is assessed as negligible.

There are no historic or active quarries present on the western side of the River Corrib along this route option. The development of a quarry or other mining activity on the remaining route corridor is likely to be difficult to develop within the city due to environmental constraints.

The impact of the Green2 - Blue2 Switch Route Option on Economic Geology is assessed as **Low**.

3.3.2.6 Overview of Geological Heritage

The Geological Heritage constraints are shown on **Figures 3.3.1** and **3.3.2**. This route option does not impact on the identified sites. The Green2 - Blue2 Switch Route Option enters Lackagh Quarry and presents panoramic views of extensive rock cuttings on a scale not present on any Irish road. The construction of a cut and cover tunnel and a bored tunnel would also result in a greater understanding of the lithology of the limestone bedrock. This route option would have a positive impact on Geological Heritage.

The impact on Geological Heritage is assessed as **Low**.

3.3.3 Summary

The impact of the Green2 - Blue2 Switch Route Option on attributes identified are summarised in **Table 3.3.3**.

Table 3.3.3 Preliminary assessment of the soil and geology impacts

Attribute	Attribute importance	Impact	Level of impact
Agricultural soils – route wide	Low	Loss of low fertility soil over limited section of route	Minor negative
Exposure of granite bedrock	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Peat/soft soils – route wide	Medium	Excavation and replacement likely to be required for shallow deposits. Disposal of peat and soft soils would require identification of suitable disposal site.	Moderate negative
Peat / soft soils – river crossing	High	Extensive ground improvement and / or excavation and replacement of soft soils. Construction of bridge likely to require extensive temporary works.	Major negative
Karst limestone – scheme wide	Medium	Karst features may require additional engineered solutions to ensure an acceptable risk level for the route during its design life.	Moderately negative

3.4 Hydrogeology

3.4.1 Introduction

The hydrogeology assessment of the of the Green2 - Blue2 Switch Route Option has been carried out with respect to the hydrogeology constraints identified in **Section 4.5 Hydrogeology** of the **Route Selection Report** and uses the same methodology as outlined in **Section 6.5.3 Hydrogeology** of the **Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.5.1 to 4.5.2** of the **Route Selection Report** and **Figure 3.4.1 to 3.4.2** of this Report.

The Green2 - Blue2 Switch Route Option is divided into two distinct sections in terms of hydrogeology:

- * Western section (West of the N59) on granite, which is classified by the Geological Survey of Ireland as a poor aquifer; and
- * Eastern section (East of the N59) on limestone, which is classified by the Geological Survey of Ireland as a regionally important karst aquifer.

The classification of the granite being a poor aquifer and the limestone being a regionally important aquifer is collaborated by previous ground investigation (2006 GCOB) as well as site walkovers and investigations as part of the N6 GCTP studies.

3.4.2 Hydrogeological Characterisation

To the west of the River Corrib, the granite and associated rock types are crystalline and of a low permeability. Fracturing is present and there may be localised groundwater flows along these features, however these are narrow and localised. Many small-sized basins have formed due to the undulating shape of the granite rock topography. These appear to have trapped perched groundwater that is unable to drain away through the rock but is contained in subsoils and soils. Tonabrocky, for example, shows where wetland habitats have developed around these perched bodies of groundwater. Groundwater flow through the granite is minimal with most discharge from the area being via surface water, which includes flow from the perched soil and subsoil groundwaters that form the wetland habitats.

The limestone bedrock of the eastern landscape is a bedded limestone that has at least one locally continuous chert layer. The limestone topography is undulating and has a number of karst landforms such as enclosed depressions, sinks and risings. Initial indications are that a number of surface water features (such as Ballindooley and Coolagh Lakes) may be in continuity with groundwater when water tables are higher during winter months but that during summer months these surface water features may be perched about low permeability subsoils lining their bases. All indications are that there is significant groundwater flow in the limestone bedrock and that these groundwaters in the scheme study area drain to the River Corrib and Galway Bay.

3.4.3 Assessment

The Green2 - Blue2 Switch Route Option to the west of the N59 avoids most groundwater dependant habitats and as such is unlikely to impact on the integrity of the groundwater system. The majority of the alignment for this route option to the west of the River Corrib is on an embankment. However, a number of shallow cuttings (less than 4m deep) are proposed and involve excavation into the undulating rock topography locally with the potential to cause local drawdown of groundwater levels. A significant cutting (approx. 10m deep) is located on the approach to the River Corrib. This cutting may lead to groundwater inflows and localised groundwater lowering and the impacts of this would require assessment to determine if drawdown would impact on local habitats.

The footprint of this route option crosses Water Dependent Terrestrial Ecology area EC20 on embankment and then enters a cutting north of EC20. Water strikes in excavations are likely but inflows would be moderate to low. This route option also lies on the periphery of EC09, EC17 and EC18. The desk study indicates that these habitats are likely fed by subsoil groundwater rather than bedrock

On the eastern side of the River Corrib, this route option passes to the north of Coolagh Lakes where it enters a tunnel that emerges in Lackagh Quarry. From here this route option passes to the south of Ballindoooley Lough on embankment and then via cuttings into a tunnel below Galway Racecourse. The route option lies on the periphery of EC36, EC37, EC38 and EC39, which are likely to be groundwater fed.

There is a potential for temporary hydrogeological impact if groundwater dewatering is required as part of tunnel or cutting construction. Operation design will accommodate the seasonal groundwater fluctuation by the application of modern tunnelling techniques and construction control.

The potential impact level on the local hydrogeology from the tunnel at Lackagh Quarry and cuttings along the alignment is considered to be moderate, which are temporary impacts. This assessment is made on the understanding that there may be a temporary construction impact if dewatering is required but that using modern techniques and construction control, adverse hydrogeological effects will be as low as reasonably practical.

The cuttings on the alignment and Lackagh Tunnel are assessed below in **Table 3.4.1** for potential impact to hydrogeological receptors. The assessment is based on potential hydrogeological impacts either being temporary or permanent as well as proximity of cutting/tunnel to local groundwater receptors and conceptual understanding of likely pathways between road and receptor. Further ground investigation will be required to examine the local hydrogeology at these locations.

Table 3.4.1 Potential impact level from road cutting/tunnel on groundwater receptors

Section	Name and location	Length	Max cutting depth (m)	Potential impact level
1	Green C1 Na Foraf Maola	500	0 – 5	Imperceptible
2	Green C2 Ballyburke	100	0-5	Imperceptible
2	Green C3 Bushypark Lawns	640	10 - 15	Imperceptible
2	Blue T1 – Lackagh Quarry Tunnel	640	25 - 30	Moderate
2	Blue C6 N84 Headford Road	190	20 – 25	Significant impact on commercial well otherwise moderate.
2	Blue C7 Castlegar	160	0-5	Imperceptible
2	Blue C8 Castlegar	610	5-10	Moderate
2	Blue C9 N17 Galway Racecourse	330	15 – 20	Imperceptible

Section	Name and location	Length	Max cutting depth (m)	Potential impact level
2	Blue C10 N17 Galway Racecourse	690	10 – 15	Slight
2	Blue C11 N17 Galway Racecourse	2000	10 - 15	Slight

3.4.4 Summary

The geology of the region divides the hydrogeological characterisation between west and east of the scheme study area. In the west the underlying granite is a poor aquifer and of low risk, however, the perching of groundwater in the subsoil and soil has generated water dependant habitats that are sensitive. By avoiding these habitats the Green2 - Blue2 Switch Route Option is unlikely to impact on the integrity of the supporting groundwater and the risk is considered relatively low.

The regionally important karst aquifer of the eastern section has high vulnerability groundwater and includes localised surface water features that are in seasonal continuity with groundwater. By the application of modern techniques and construction controls, the risk of the tunnel and cuttings affecting the existing hydrogeological regime the potential impact level to hydrogeology is considered be moderate, which is a temporary impact. This assessment is based on the potential for a temporary construction hydrogeological impact but that with appropriate engineering design permanent impact is unlikely.

There is also a potential for significant impact on the water supply well at a commercial property to the east of the River Corrib.

As with all route options assessment will be required for groundwater recharge along the line of the Green2 - Blue2 Switch Route Option. Recharge assessment will be included as part of the drainage design.

3.5 Hydrology

3.5.1 Introduction

The hydrology assessment of the Green2 - Blue2 Switch Route Option has been carried out with respect to the hydrology constraints identified in **Section 4.6 Hydrology of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.4 Hydrology of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.6.1 to 4.6.2 of the Route Selection Report** and **Figure 3.5.1 to 3.5.6** of this Report.

3.5.2 Assessment

3.5.2.1 Section 1

Flood Risk and Watercourses

The Green2 - Blue2 Switch Route Option intercepts the stream channels of the Bearna Stream, Sruthán na Libertí and Trusky Stream. These are minor streams, having small catchment areas. They are ecologically sensitive and are not considered to be fishery streams. These streams are generally poorly defined, overgrown and are generally not maintained, with sporadic short term out of bank flooding adjacent to the stream channel. Culverting and diverting these watercourses as part of the drainage works for this route option is unlikely to give rise to any significant impacts on Flood Risk both locally and downstream.

The Flood Risk Zones for these streams are not particularly extensive given the small catchment areas and lie immediately adjacent to the stream channel. The Trusky Stream has been identified as posing a potential Flood Risk to the Spiddal Road and a section of Bearna Village due to existing undersized road culverts. This will have implications on the potential to discharge storm water to this stream, requiring full attenuation to be provided for this route option.

Road drainage discharges to these streams will require storm water attenuation to minimise any adverse impact on downstream flooding. The overall impact on flooding and watercourse hydrology for the Green2 - Blue2 Switch Route Option is likely to represent slight to moderate local negative impact.

Water Quality

The watercourses encountered by the Green2 - Blue2 Switch Route Option are not salmonid and are not ecologically sensitive streams. They outfall to Galway Bay west of the Galway Bay Complex cSAC. A slight to moderate local impact is expected on these streams. The potential water quality impact to the Galway Bay Complex cSAC given the mixing available in the receiving coastal waters off Bearna is considered to be slight to imperceptible under construction and operational phases.

Hydro-Ecology

The hydro-ecology assesses the potential impact of this route option on the hydrology of surrounding aquatic sensitive habitats, namely the Annex I habitats Blanket Bog [7130], Transition mire and quaking Bogs [7140], Depressions on peat substrates of the Rhynchosporion [7150], and Northern Atlantic wet heaths with *Erica tetralix* [4010], locally important Wet heaths and Wet grassland habitats.

The Green2 - Blue2 Switch Route Option encounters and is in close proximity along its route to locally important wet grassland, and it traverses a small section of Annex I habitat, North Atlantic wet heath with *Erica Tetralix* [4010], at two locations towards the middle and western end. Within the corridor identified there is sufficient room to avoid or mitigate potential impacts, both direct and indirect, to these Annex I habitats. The main risk to Wet heath and Wet grassland sections is from potential drainage effects on the local water table resulting in a drying effect on these wet habitats.

The impact level on hydro-ecology is considered to represent a locally slight to moderate permanent impact.

3.5.2.2 Section 2

River Corrib Crossing

The Green2 - Blue2 Switch Route Option crosses the River Corrib upstream of Menlo Castle and represents potentially the widest section of floodplain encroachments, measuring c. 480m based on the draft CFRAM flood inundation mapping. The River Corrib channel width at the crossing measures approximately 120 to 130m. The proposed crossing involves a viaduct structure to minimise direct impact to the Lough Corrib cSAC. This option is designed to provide a full span of the River Corrib channel which avoids any in-stream constructional works associated with piers and foundations. The bridge is to be designed to ensure no constraint to river navigation or boat passage and therefore the soffit level of the bridge will be well elevated above the design flood level of the river.

During construction of the viaduct there will be temporary works within and close to the floodplain. There will be no permanent works within the River Corrib channel as there will be no in-stream piers. The proposed structure will fully span the River Corrib channel. The impact magnitude of the proposed River Corrib crossing can be classified as a slight constructional and operational impact assuming good construction management for works within the floodplain area and no temporary works within the River Corrib channel. However, where temporary in-stream works are required to construct the central bridge span (possibly using a pontoon or a barge) then the construction impact level increases to a temporary moderate impact due to it being part of a European site.

Watercourse Crossings

The Green2 - Blue2 Switch Route Option crosses three tributaries of the Bearna Stream and passes to the north of Knocknacarra Stream drainage channels. This route option crosses the Tonabrocky Stream. The Bearna Stream discharges to the Galway Bay Complex cSAC and can be classified as a medium value watercourse.

The potential impact magnitude of the four stream crossings above and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through appropriate culvert design and implementation of storm water management (SuDS). The Bearna Stream has fishery potential and fishery friendly culvert design will be required to avoid impact. However, at the crossing point the streams are steep hillside channels and unlikely to be salmonid.

To the east of the River Corrib the Green2 - Blue2 Switch Route Option avoids the Coolagh Lakes floodplain area and the Terryland River basin. This route option passes to the south of Ballindooley Lough, just avoiding the Flood Zone of the lake. There are no watercourse crossings east of the River Corrib.

Flood Risk

The streams and flood risk areas encountered to the west of the River Corrib are considered to be minor. They are localised to the immediate areas surrounding the channel banks and present little difference in impact level in respect to flood risk and flood impact. The principal flood risk areas are the crossing of the River Corrib and encroachment of the Terryland River basin which is shown to be a defended area in the CFRAM study.

The flood risk has been assessed using a combination of local anecdotal and historical flood information, the OPW pFRA mapping which includes coastal, fluvial, pluvial and groundwater preliminary flood risk areas, and the recent more detailed Draft CFRAM mapping of fluvial and coastal flood risk for the River Corrib and its tributary the Terryland River. The impact level for the route option is determined based on the length of the route option that encroaches a flood risk area, the potential flood risk to the development and potential impact on existing flood risk.

The Green2 - Blue2 Switch Route Option crosses the River Corrib upstream of Menlo Castle, having a total flood zone crossing width of 480m and a channel crossing width of circa 120 to 130m. The Green2 - Blue2 Switch Route Option's bridge crossing of the River Corrib has no proposed in-stream piers. This route option avoids the Coolagh Lakes flood zone and the Terryland River basin. The route option passes close to the Ballindooley Lough flood zone to the south of the lough.

The Green2 - Blue2 Switch Route Option represents the widest crossing length of the River Corrib floodplain and flood zone, having an encroachment distance of approximately 480m within the River Corrib flood zone based on the 100 year predicted flood inundation area from the Draft CFRAM study. This route option is also shown to encroach slightly on the flood zone area surrounding Ballindooley Lough to the north.

To the east of the River Corrib, in the limestone basin, there are no surface watercourses encountered with generally only pluvial and groundwater flood risk being identified for a number of small local depressions which are considered insignificant.

Overall the impact magnitude on flood risk associated with this route option allowing for the bridge through the Lough Corrib cSAC is a slight negative impact.

Hydro-Ecology

Detailed habitat mapping has been carried out for the scheme study area. Based on this mapping and site walkovers an assessment of the impact of this route option on hydro-ecology has been carried out. The main impacts in relation to hydrology are the potential for hydrological regime change and potential for changes to water quality and water chemistry of aquatic habitats. These impacts could result from the road development through its drainage networks and outfall discharges, potential for localised dewatering, and potential for flooding or water quality impact. To the west of the River Corrib the ecological habitat mapping shows this route option avoids Annex I habitats, such as Blanket bog [*7130], Transition mires and Quaking bogs [7140] and Northern Atlantic wet heaths with *Erica tetralix* [4010], but passes within close proximity of such habitats.

To the east of the River Corrib the habitats change due to the limestone bedrock, with sensitive habitats of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* surrounding the Coolagh Lakes off the River Corrib.

The River Corrib as a salmonid water and with the downstream Galway Bay Complex cSAC were not included under this assessment as the impacts on these water bodies have already been considered under the water quality assessment.

There is little impact to hydro-ecological receptors, with only slight direct impact to the Ballindoooley Lough Complex EC39 where a small section of the route option corridor just encroaches on Annex I *Molinia* meadows habitat. Within the route option corridor there is ample width to avoid encroaching upon this habitat. A potential indirect impact may arise on this habitat and the Ballindoooley Lough Complex from road drainage discharge, which can be mitigated through appropriate storm water management (SuDS). The impact on Ballindoooley Lough Complex EC39 is considered to be a moderate magnitude impact.

The Green2 - Blue2 Switch Route Option passes through the recharge zone of the Coolagh Lakes which could impact on the calcareous fens surrounding the lakes. This impact is dealt with and accounted for within the hydrogeology assessment.

The Green2 - Blue2 Switch Route Option passes in close proximity to habitats of high ecological value, such as Blanket bog, Wet heath and Transition mire and Quaking bog habitats, to the west of the River Corrib. These habitats are associated with the Moycullen Bog NHA at Tonabrocky EC22 and at Ballagh EC25. There is potential for dewatering and high magnitude drainage impacts to these habitats during both construction and operation.

This route option crosses through a section of Wet and Dry heath associated with EC20 which have attribute values of low to high. The Wet heath complex is sensitive to hydrological regime change through drainage and potential dewatering. The potential impact of the road on this receptor is classified as moderate to high, and through appropriate drainage design this impact can be reduced to slight to moderate.

At the River Corrib crossing this route option comes in close proximity to Alkaline fens [7230] on both sides of the river, crossing through Annex I aquatic sensitive habitat on the western river bank.

Water Quality

The River Corrib is classified as Salmonid Waters which is a qualifying interest of the Lough Corrib cSAC. The Bearna Stream and the Knocknacarra Stream outflow into the Galway Bay Complex cSAC and are considered sensitive to both operational and construction pollution. The River Corrib and the Terryland Stream also discharge into the Galway Bay Complex cSAC and therefore are also considered sensitive to potential water quality impacts. A water quality impact to these watercourses represents a moderate to significant impact and requires mitigation to avoid contaminated discharges, both during the construction and operational phases of the road.

A major public water supply abstraction point, feeding the Terryland Water Works, is located in the channel adjacent to Jordan's Island on the River Corrib. Such a large and important water supply, which is rated as having a very high attribute value, is highly sensitive to water quality impacts both during construction and operational phases of a road project (i.e. in the event of routine road runoff discharges and accidental spillages). There are plans by Irish Water to relocate the abstraction point out into the Corrib main channel downstream of Jordan's Island. The Green2 - Blue2 Switch Route Option falls within the source protection area of the existing supply and proposed new abstraction point. The closer the option is to the intake in the upstream direction, the greater the potential for impact it is considered to have, both during construction and operation, given the distance, speed and mixing volume available. This potentially represents a significant impact without mitigation on a very high importance attribute both during construction and potentially during the operational phase, from road runoff via road drainage outfalls, of the road.

The proposed crossing of the River Corrib will be a full spanning structure and therefore avoids any in-stream works associated with construction of the piers. Construction impacts of constructing the bridge deck, which may involve some in-stream works from a barrage, and the floodplain piers remain. These could potentially cause sedimentation, disturbance of the river bed and construction spillages (concretes, hydrocarbons etc.) into the River Corrib. During the operation stage the road drainage presents a significant risk to the intake and to the Salmonid Waters in respect to accidental spillages. Mitigation will be required to minimise or eliminate this risk by preventing direct untreated discharge of road drainage to the River Corrib. Routine road runoff is unlikely to cause a significant impact to the water quality given the high dilution available within the River Corrib relative to road drainage discharges and pollutant loads.

The Green2 - Blue2 Switch Route Option involves works adjacent to the Coolagh Lakes which are connected directly to the River Corrib 900m upstream of the intake. The potential water quality impact on the Lough Corrib cSAC is assessed as moderate and the potential impact on the Terryland Water Works potable water supply intake is assessed as high both for construction and operational phases. Operation phase impacts can be mitigated to a slight and moderate impact through

preventing direct discharge of road drainage to the River Corrib and the Coolagh Lakes area and providing spillage containment and treatment.

The Green2 - Blue2 Switch Route Option is unlikely to result in any significant impact to water quality, salinity or to the hydrological regime within the Lough Atalia coastal lagoon. The overall impact, provided appropriate mitigation is carried out, is likely to have an imperceptible impact on the Galway Bay Complex cSAC.

The Bearna Stream and all watercourses encountered moving eastwards toward the N6 eventually discharge into the Galway Bay Complex cSAC, which is a sensitive waterbody in respect to water quality. The Terryland River, by virtue of it disappearing underground and representing a point source to the regionally important karst bedrock aquifer, is a highly sensitive watercourse in respect to pollution.

3.6 Landscape and Visual

3.6.1 Introduction

The landscape and visual assessment of the of the Green - Blue Switch Route Option has been carried out with respect to the landscape and visual constraints identified in **Section 4.7 Landscape and Visual of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.5 Landscape and Visual of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.7.1 to 4.7.2 of the Route Selection Report** and **Figure 3.6.1 to 3.6.2** of this Report.

3.6.2 Assessment

The principal aspects of the route option most likely to give rise to significant and profound negative impacts are set out below.

3.6.2.1 Construction Stage

The alignment of the Green – Blue Switch Route Option passes outside of, and in parts through, the outer suburbs of the city. The principal aspects of this route option most likely to give rise to the greatest level of significant and profound negative impacts on the landscape/townscape and visual environments during construction are set out as follows:

- Demolition of significant numbers of existing residential properties* – particularly at Na Forái Maola Thiar, in crossing the N59 at Ballagh/Bushypark/Upper Dangan , in crossing the N84 Headford Road and in passing through Castlegar and Coolagh/Briarhill;
- Direct take/removal of retained residential amenities, including property boundaries, portions of gardens, etc. – most particularly at Na Forái Maola, to either side of the N59 at Bushypark, Coolagh-Menlough and in crossing the R339 at Ballybrit;

- Significant new bridging of the River Corrib encroaching on the naturally attractive setting of Menlo Castle and Demesne;
 - Very significant/profound impact on setting of Galway Racecourse;
 - Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, and plantings – particularly in crossing the natural setting of the River Corrib and in passing Castlegar, but also in running alongside a stream north of Bearna, and in crossing Ballybrit and Coolagh;
 - General disturbance, excavation, earthworks, construction activity, lighting and related noise, dust effects etc., including removal of existing boundaries and vegetation, soil stripping and storage, raising of embankments, cutting of slopes, and construction traffic;
 - Significant level of interim local traffic management/re-allocation/diversion/temporary works over phases of the construction programme. Works will require construction of new bridging structures and local road re-alignments;
 - Impact on Protected County Views Nos. 72 & 74 north of Bearna Village and No. 70 from the N59 at Bushypark, as well as Scenic City Views V.10 at N59 Bushypark, V.19 at the N84, and V.6 at Ballinfoyle; and
 - Potential impact on Greenway proposals - most especially along the River Corrib.
- * Total demolitions on the Blue Route Option are outlined in Section 6.5.8 Material Assets – Non- Agricultural.

It is considered that the individual impacting aspects outlined above will, in combination, give rise to locally significant negative impacts from construction activity. These impacts will be on the natural landscape character of the corridor of the River Corrib, the demesne of Menlo Castle, and on the community and visual character of Bushypark, Castlegar and Coolagh/Briarhill.

3.6.2.2 Operation Stage

The following are the principal aspects of the Green - Blue Switch Route Option that would give rise to significant and profound landscape/townscape and visual impacts during operation:

- The direct and indirect effect of the loss of a significant number of existing residences from within the communities at Bearna, Bushypark, Ballindoooley, Castlegar, Briarhill, and elsewhere along the route option;
- Provision of major road infrastructure through established residential communities at Bearna, Bushypark, Castlegar and Coolagh/Briarhill;
- Impact of major road infrastructure on existing established facility/amenity at Galway Racecourse;
- General impact - visual disturbance of road infrastructure, noise issues/barriers, illumination, road lighting etc., on residential property at dispersed locations along the route option;

- Impact on Protected County View Nos. 72 and 74 north of Bearna Village, and o. 70 from the N59 at Bushypark, as well as Scenic City Views V.19 and V.6 at Ballinfoyle; and
- The provision of a bridge over the River Corrib in an existing high quality natural landscape setting, close to the riverside setting of Menlo Castle.

Again, whilst individual impacting aspects are outlined above, it is considered that the collective effect of the scale of this major infrastructure will give rise to very significant and residual negative impacts on residential property and on the landscape character of the corridor - most particularly to either side of the N59 through Upper Dangan, in crossing the River Corrib corridor, and at Castlegar.

Overall Landscape/Townscape Effects - Profound to Significant Adverse.

Overall Visual Effects - Profound to Significant Adverse.

3.6.3 Summary

It is considered that the collective effect of impacts related to the scale of the proposed major infrastructure - often within established residential communities - will give rise to particularly significant and residual adverse impacts on the landscape/townscape and visual environment of the road corridor between Na Foráí Maola, Bushypark/N59, the River Corrib Corridor, Menlo Castle Demesne and Castlegar.

3.7 Archaeological, Architectural and Cultural Heritage

3.7.1 Introduction

The archaeological, architectural and cultural heritage assessment of the Green2 - Blue2 Switch Route Option has been carried out with respect to the archaeological, architectural and cultural heritage constraints identified in **Section 4.11 Archaeological, Architectural and Cultural Heritage of the Route Selection Report** and **Section 7.6.6 Archaeological, Architectural and Cultural Heritage of the Route Selection Report**, and uses the same methodology as outlined in **Section 7.6.6.2 Archaeological, Architectural and Cultural Heritage of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 7.6.6.1 to 7.6.6.6 of the Route Selection Report** and **Figures 3.7.1 to 3.7.4** of this Report.

3.7.2 Assessment

Section 1

Table 3.7.2.1 Archaeological Heritage – Green2 -Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 1	Redundant record (also AH 1)	No	40m east	N/a	N/a

Table 3.7.2.2 Cultural Heritage – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 51	Vernacular buildings, in ruins	No	0m	Direct	Significant negative
CH 52	Vernacular building	No	191m east	Indirect	Imperceptible negative
CH 1	Enclosure (2006 EIS) (also AH 1)	No	40m east	Indirect	Moderate Negative
CH 136	Vernacular buildings	No	107m east	Indirect	Slight negative
CH 53	Vernacular buildings	No	149m SE	Indirect	Slight negative
CH 140	Possible famine bridge	No	186m NNW	Indirect	Imperceptible negative
CH 54	Site of PM sheep fold	No	0m	Direct	Significant negative
CH 55	Vernacular farmstead	No	8m SE	Indirect	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 56	Vernacular buildings	No	153m NW	Indirect	Imperceptible negative
CH 57	Ruinous vernacular settlement of An Chloch Scoilte	No	53m NW	Indirect	Moderate negative

Table 3.7.2.3 Areas of Archaeological Potential – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 1	Stream (also TB 1)	No	0m	Direct	Moderate negative
AAP 2	Stream (also TB 5)	No	0m	Direct	Moderate negative

Table 3.7.2.4 Townland Boundaries – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 1	Townland & parish boundary (also AAP 1)	No	0m	Direct	Moderate negative
TB 2	Townland boundary	No	0m	Direct	Moderate negative
TB 3	Townland boundary	No	0m	Direct	Moderate negative
TB 4	Townland boundary	No	0m	Direct	Moderate negative
TB 5	Former townland boundary (19 th C) (also AAP 2)	No	0m	Direct	Moderate negative
TB 6	Townland boundary	No	0m	Direct	Moderate negative
TB 7	Townland boundary	No	0m	Direct	Moderate negative

No recorded Built Heritage sites or Designed Landscapes are located within Section 1 of the Green2 - Blue2 Switch Route Option Corridor.

Section 2

Table 3.7.2.5 Archaeological Heritage – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 17	Redundant record	No	25m south	N/a	N/a
AH 7	Designed landscape feature	No	0m	Direct	Profound negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 8	Designed landscape feature	No	35m north	Indirect	Moderate negative
AH 9	Gate house (Also BH 3)	Yes	45m north	Indirect	Significant negative
AH 6	Burial ground	Yes	98m north-west	Indirect	Slight negative
AH 11	Menlo Castle (also BH 2)	Yes	285m south	Indirect	Slight negative
AH 10	Clearance cairn	No	181m south	Indirect	Slight negative
AH 118	Enclosure	Yes	187m north	Indirect	Slight negative
AH 18	Enclosure	No	67m south-east	No impact	N/a
AH 19	Ringfort - unclassified	No	10m SSE	No impact	N/a
AH 20	Quarry	No	177m north	Indirect	Imperceptible negative
AH 74	Tower House (also BH 72)	Yes	193m south	Indirect	Imperceptible negative
AH 148	Redundant record	No	45m north	N/a	N/a
AH 146	Children's Burial ground	Yes	139m SSW	Indirect	Slight negative
AH 147	Quarry	No	150m SSW	No impact	N/a
AH 32	Earthwork	No	91m WSW	Neutral	N/a
AH 33	Designed landscape feature	No	140m south	Neutral	N/a
AH 27	Ringfort – rath House - indeterminate date	Yes	24m west	Indirect	Slight negative
AH 24	Settlement deserted - medieval	Yes	28m SW	Neutral	N/a
AH 25	Tower castle (also BH 6)	Yes	89m SW	Neutral	N/a
AH 26	Enclosure	Yes	147m SW	Neutral	N/a

Table 3.7.2.6 Built Heritage – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 11	Thatched Cottage	Yes	105m ESE	Indirect	Moderate negative
BH 5	Bushy Park House	Yes	176m south	Indirect	Moderate negative
BH 100	Thatched cottage	Yes	129m NW	Indirect	Imperceptible negative
BH 99	Remains of stone fort	Yes	98m north	Indirect	Slight negative
BH 9	Thatched cottage	Yes	70m north	Indirect	Slight negative
BH 2	Menlo Castle (also AH 11)	Yes	285m south	Indirect	Slight negative
BH 3	Gate house (Also AH 9)	Yes	45m north	Indirect	Significant negative
BH 10	Thatched cottage	Yes	145m north	Indirect	Slight negative
BH 73	House	Yes	10m north	Indirect	Significant negative
BH 72	Tower House (also AH 74)	Yes	193m south	Indirect	Imperceptible negative

Table 3.7.2.7 Designed Landscapes – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 5	Glenlo Abbey demesne, including extant demesne wall	No	0m	Direct	Significant negative
DL 6	Bushy Park House demesne	House is in the RPS	0m	Direct	Significant negative
DL 10	Menlo Castle demesne	House is in the RPS	0m	Direct	Profound negative
DL 25	Ballybrit House demesne	No	0m	Neutral	N/a

Table 3.7.2.8 Cultural Heritage – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 58	Vernacular buildings	No	0m	Direct	Significant negative
CH 59	Vernacular buildings	No	150m NW	Indirect	Slight negative
CH 60	Vernacular buildings, in ruins	No	93m SE	Indirect	Slight negative
CH 61	Site of vernacular buildings	No	0m	Direct	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 62	Vernacular building, in ruins	No	21m SE	Indirect	Moderate negative
CH 63	Vernacular building, in ruins	No	63m SE	Indirect	Slight negative
CH 64	Vernacular buildings	No	74m NW	Indirect	Slight negative
CH 65	Vernacular building, in ruins	No	5m NW	Indirect	Significant negative
CH 66	Vernacular building	No	142m NW	Indirect	Slight negative
CH 67	Vernacular buildings	No	197m NW	Indirect	Imperceptible negative
CH 68	Site of vernacular building	No	0m	Direct	Significant negative
CH 69	Vernacular buildings	No	40m east	Indirect	Moderate negative
CH 70	Site of vernacular building	No	0m	Direct	Significant negative
CH 71	Vernacular buildings	No	90m EME	Indirect	Slight negative
CH 72	Vernacular settlement of Tonabrocky	No	0-150m WNW	Direct	Significant negative
CH 73	Vernacular building, in ruins	No	76m east	Indirect	Slight negative
CH 137	Possible mass rock	No	0m	Direct	Significant negative
CH 74	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 75	Site of vernacular building	No	0m	Direct	Significant negative
CH 14	Railway track (disused)	No	0m	Direct	Moderate negative
CH 17	Medieval field system? (2006 EIS)	No	To immediate north	Indirect	Slight negative
CH 18	Regular rectangular cut feature & Possible standing stone (2006 EIS)	No	29m south	Indirect	Moderate negative
CH 20	Consumption wall (2006 EIS)	No	143m SSE	Indirect	Slight negative
CH 19	Vernacular structure, in ruins (2006 EIS)	No	92m SSE	Indirect	Slight negative
CH 21	Vernacular animal shelter (2006 EIS)	No	188m SSE	Indirect	Slight negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 23	Circular feature? (2006 EIS)	No	101m south-east	Indirect	Moderate negative
CH 24	Small boulder (2006 EIS)	No	0m	Direct	Significant negative
CH 25	Possible cairn (2006 EIS)	No	5m NNW	Indirect	Moderate negative
CH 76	Site of limekiln	No	90m north	Indirect	Imperceptible negative
CH 141	Vernacular settlement of Menlough	No	200m north	Indirect	Moderate negative
CH 124	Site of vernacular buildings	No	5m southeast	Indirect	Slight negative
CH 26	Consumption wall (2006 EIS)	No	145m north	Indirect	Slight negative
CH 125	Site of PM settlement of Castlegar	No	0m	Direct	Significant negative
CH 126	Vernacular buildings, in ruin	No	10m west	Indirect	Moderate negative
CH 127	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 128	Vernacular building	No	161m NNE	Indirect	Slight negative
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NE	Indirect	Moderate Negative
CH 135	Mass Rock?	No	10-200m SW	Indirect (?)	Moderate negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of Cashel	No	0m	Neutral	N/a

Table 3.7.2.9 Areas of Archaeological Potential – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 4	Stream	No	0m	Direct	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 5	Site of Lough Nacreeva	No	0m	Direct	Significant negative
AAP 6	Stream (also TB 13)	No	0m	Direct	Moderate negative
AAP 7	Lough Nabrocky (original extent)	No	0m	Direct	Significant negative
AAP 8	Loughaunnafraska (original extent)	No	0m	Direct	Significant negative
AAP 9	River Corrib & margins	No	0m	Direct	Significant negative

Table 3.7.2.10 Townland boundaries – Green2 - Blue2 Switch Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 9	Townland boundary	No	0m	Direct	Moderate negative
TB 10	Townland boundary	No	0m	Direct	Moderate negative
TB 11	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 12	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 13	Townland boundary (also AAP 6)	No	0m	Direct	Moderate negative
TB 14	Townland boundary	No	0m	Direct	Moderate negative
TB 15	Townland boundary	No	0m	Direct	Moderate negative
TB 16	Townland boundary	No	0m	Direct	Moderate negative
TB 17	Townland boundary	No	0m	Direct	Moderate negative
TB 18	Townland & parish boundary (also AAP 9)	No	0m	Direct	Moderate negative
TB 57	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 22	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 58	Townland boundary	No	0m	Direct	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 59	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 60	Townland boundary	No	0m	Direct	Moderate negative
TB 61	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 62	Townland boundary, site of	No	0m	Neutral	N/a
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

3.7.3 Summary

The Green2 - Blue2 Switch Route Option would impact considerably upon the cultural heritage resource. Whilst it is acknowledged that some of the sites identified in or within the immediate vicinity of scheme to both the east and west of the River Corrib receive no specific statutory protection, this route option would impact considerably on the recorded archaeological, architectural and cultural heritage resource. Impacts are summarised below:

Table 3.7.2 Summary of Impacts on the Green2 - Blue2 Switch Route Option

Profound Negative	Significant negative	Moderate negative	Slight negative	Imperceptible negative
AH 7 (DLF) DL 10 (Menlo demesne)	AH 9/ BH 3 (Gate house) BH 73 (House) DL 5 (Glenlo Abbey) DL 6 (Bushy Park House) CH 51 (V. buildings, in ruins) CH 54 (Site of PM sheep fold) CH 55 (V. farmstead) CH 58 (V. buildings) CH 65 (V building) CH 68 (V building, site of) CH 70 (V. buildings) CH 72 (Tonabrocky settlement)	AH 8 (DLF) BH 11(Thatched Cottage) BH 5 (Bushy Park House) CH 1 (Enclosure) CH 57 (Settlement of An Chloch Scoilte) CH 62 (V. buildings) CH 69 (V. buildings) CH 14 (Railway track) CH 18 (Multiple potential features) CH 23 (Circular feature?) CH 25 (Cairn)	AH 6 (Burial ground) AH 11/ BH 2 (Menlo Castle) AH 10 (Cairn) AH 118 (Enclosure) AH 146 (Children's burial ground) AH 27 (Ringfort) BH 99 (Remains of stone fort) BH 9 (Thatched cottage) BH 10 (Thatched cottage) CH 136 (V buildings) CH 53 (V buildings) CH 59 (V. buildings) CH 60 (V. buildings)	AH 20 (Quarry) AH 74/ BH 72 (Quarry) BH 100 (Thatched cottage) CH 52 (V. building) CH 140 (Poss. famine bridge) CH 56 (V. buildings) CH 67 (V. buildings) CH 76 (Site of lime kiln) CH 138 (Staddle stones)

Profound Negative	Significant negative	Moderate negative	Slight negative	Imperceptible negative
	CH 137 (Possible mass rock) CH 74 (V. buildings) CH 75 (V. building) CH 24 (Small boulder) CH 125 (Castlegar settlement) CH 127 (V. buildings site) CH 100 (V. buildings) Three AAPs	CH 141 (Menlough Settlement) CH 126 (V. buildings) CH 101 (Coolagh settlement) CH 135 (Mass rock?) Five AAPs 26 Townland boundaries	CH 61 (Site of V. buildings) CH 63 (V. building) CH 64 (V. building) CH 66 (V. building) CH 71 (V. buildings) CH 73 (V. building) CH 17 (Medieval field system?) CH 20 (Consumption wall) CH 19 (V. building) CH 21 (V. building) CH 124 (V. buildings) CH 26 (Consumption wall) CH 128 (V. building)	

A total of 11 sites were identified where there was no impact, or the impact was defined as neutral.

The area that would suffer the greatest impact runs from Killeen to Menlough. This area is characterised by demesne landscapes and large houses, which were established by the landed gentry who were keen to utilize the picturesque River Corrib landscape within the settings of their houses. As such this route option directly impacts on three large demesnes, with the impact at Menlo Castle demesne considered to be profound. Here the route option runs in close proximity to the castle itself and severely truncates the principal structure from attendant features. The impact on the demesne can be considered to be profoundly negative due to the level of truncation and the nature and extent of the direct impact.

This route would also have an impact on features associated with the Ballybrit landscape, where a tower house, a deserted medieval settlement and two enclosures are further protected with Preservation Orders. Whilst the route would be tunnelled through the course, there is the potential for a direct significant impact on geophysical features of archaeological potential, which were noted within the race course at Ballybrit. It is possible that additional features survive in this area with no geophysical footprint, or which have been concealed due to modern disturbance.

3.8 Material Assets – Agriculture

3.8.1 Introduction

The material assets – agricultural assessment of the of the Green2 - Blue2 Switch Route Option has been carried out with respect to the material assets - agricultural constraints identified in **Section 4.12 Material Assets – Agriculture of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.7 Material Assets – Agriculture of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.12.1 to 4.12.2 of the Route Selection Report** and **Figure 3.8.1 to 3.8.2** of this Report.

3.8.2 Assessment

Table 3.8.1 below identifies the potential agricultural impacts for the Green2 - Blue2 Switch Route Option.

Table 3.8.1 Material Assets - Agricultural Impacts

	Section 1	Section 2
Agricultural land (ha)	16.5	45
Good quality agricultural land (ha)	0	18
Area of land parcels (ha)	105	350
No. of farm yards / farm structures	1	2
No. of Equine enterprises	0	1

The Green2 - Blue2 Switch Route Option will take approximately 16.5 hectares of agricultural land in Section 1. In section 2, 45 hectares of agricultural land will be required and approximately 18 hectares of this land is classified as medium to good quality agricultural land. However the quality of land at the western end is very poor from an agricultural point of view – the majority of it being Blanket bog – and the sensitivity of the agricultural environment is low. The sensitivity of the agricultural environment further east is low to medium. The Green2 - Blue2 Switch Route Option affects 1 no. equine farm yard in Section 2.

3.9 Material Assets – Non Agriculture

3.9.1 Introduction

The material assets – non agricultural assessment of the Green2 - Blue2 Switch Route Option has been carried out with respect to the material assets – non agricultural constraints identified in **Section 4.13 Material Assets – Non-Agriculture of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.8 Material Assets – Non Agriculture of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.13.1 to 4.13.4 of the Route Selection Report** and **Figures 3.9.1 to 3.9.9** of this Report.

3.9.2 Assessment

The assessment for the number of properties directly impacted by the Green2 - Blue2 Switch Route Option in Section 1 is presented below in **Table 3.9.1**. There are no direct impacts on commercial properties in Section 1. The high number of one-off rural housing along the Green2 - Blue2 Switch Route Option means that this route option has large direct impacts on residential properties, with the full acquisition of 17 residential properties and partial landtake from a further 5 residential properties.

Table 3.9.1 Property Assessment - Section 1

Location	Residential Acquisitions	Residential Partial Landtake
Within the fenceline	17	5

The assessment for the number of conflicts with utilities for the Green2 - Blue2 Switch Route Option within Section 1 is presented in **Table 3.9.2** below. These impacts range from crossing of the road footprint to diversions of kilometres of service ducts and pipelines. There are no conflicts with E-Net, Gas Networks Ireland, UPC, Galway City and County Council watermains, surface drainage, foul sewer or trunk sewers and as such they are excluded from **Table 3.9.2** below. The Green2 - Blue2 Switch Route Option in Section 1 is in a rural setting and therefore has a low number of conflicts (ESB & Eircom) with little or no disruption to major water utilities and other services. There are no impacts on waste facilities in Section 1.

Table 3.9.2 Utilities Assessment – Section 1

Utility	No. of Conflicts
ESB HV OH	1
ESB HV UG	0
ESB MV OH	6
ESB MV/LV UG	0
Eircom	6

The assessment for the number of properties directly impacted in Section 2 is presented below in **Table 3.9.3**. There are 86 residential properties and 7 commercial properties within the fenceline in Section 2, including the full acquisition of 62 residential properties and 2 commercial properties. The number of residential acquisitions on the Green2 - Blue2 Switch Route Option is higher than either the Green2 Route Option, with 59 residential acquisitions, or the Blue2 Route Option, with 48 residential acquisitions. However, in the categories of residential and commercial partial landtake and commercial acquisitions, the Green2 - Blue2 Switch Route Option impacts on fewer properties than either the Green2 Route Option or the Blue2 Route Option.

Table 3.9.3 Property Assessment - Section 2

Location	Residential Acquisitions	Residential Partial Landtake	Commercial Acquisitions	Commercial Partial Landtake
Within the fenceline	62	24	2	5

The assessment for the number of conflicts with utilities for the Green2 - Blue2 Switch Route Option within Section 2 is presented in **Table 3.9.4** below. These impacts range from crossing of the road footprint to diversions of kilometres of service ducts and pipelines. The highest numbers of utility conflicts are across Eircom and ESB services. This route option also crosses the SSE 110kV lines at a single location. There are no impacts on waste facilities in Section 1.

Table 3.9.4 Utilities Assessment – Section 2

Utility	No. of Conflicts
E-Net	2
ESB HV OH	10
ESB HV UG	3
ESB MV OH	18
ESB MV/LV UG	7
Eircom	20
Bord Gáis	1
UPC	2
Council Watermain – 300mm	1
Council Watermain – 500mm	1
Foul Pipes	2
Surface Drainage	1
Trunk Sewer	2
SSE	1

3.9.3 Summary

In summary, over the entire length of the Green2 - Blue2 Switch Route Option, it mostly impacts on residential properties with the full acquisition of 79 residential properties and partial landtake from a further 29 residential properties. There will be full acquisition of 2 commercial properties, with a further 5 commercial properties lying within the footprint of the design and will require some land acquisition. The Green2 - Blue2 Switch Route Option has a low number of utility impacts largely due to its rural location outside densely populated city areas.

3.10 Air Quality and Climate

3.10.1 Introduction

A preliminary Stage 2 impact assessment for the Green - Blue Switch Route Option has been undertaken to assess the potential air quality and climate impacts of this route option on the atmospheric environment. This assessment has been carried out with respect to the air quality and climate constraints identified in **Section 4.14 Air Quality and Climate of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.9 Air Quality and Climate of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 3.10.1 to 3.10.2** of this Report.

3.10.2 Assessment

The Green2 – Blue2 Switch Route Option follows an alignment predominately towards the outskirts of the city, traversing a large number of local and regional roads, areas of greenfield land, and villages, all of which have clusters of residential properties in close proximity.

Pollutant concentrations recorded by the EPA are well within air quality standards and the assimilative capacity of the air within the scheme study area is considered good.

In general, the Green - Blue Switch Route Option avoids large residential areas and communities but runs adjacent to clusters of houses where it crosses the local and regional roads.

Due to the expected traffic volumes and the existing assimilative capacity of the scheme study area, no air quality standards are likely to be exceeded as a result of the Green - Blue Switch Route Option.

3.11 Noise and Vibration

3.11.1 Introduction

A preliminary Stage 2 impact assessment for the Green - Blue Switch Route Option has been undertaken to assess the potential noise and vibration impacts of this route option on the surrounding environment. This assessment has been carried out with respect to the constraints identified in **Section 4.15 Noise and Vibration of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.10 Noise and Vibration of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.15.1 to 4.15.2 of the Route Selection Report** and **Figure 3.11.1 to 3.11.2** of this Report.

3.11.2 Assessment

In Section 1, the Green2 - Blue2 Switch Route Option has the greatest predicted potential noise impact, with a count of 72 properties likely to require noise mitigation (i.e. exceeding 60dB L_{den}). The noise sensitive properties in this area are dispersed typically in ribbon style development along the local roads across which this route option passes. The use of a low noise surface (LNRS) and a significantly high number of acoustic barriers along the road boundary would likely be imposed as mitigation.

In Section 2, between the Western Distributor Road and the Ragoon Road, the route option passes in close proximity to a number of residential estates with a large number of properties potentially falling within the 60dB L_{den} noise contour line in this area.

Moving further north, a significant number of properties in the vicinity of Páirc na gCapall at the N59 crossing point are also calculated to fall within the contour line. This would likely result in a requirement for a greater number of individual acoustic barriers located along the length of the route. The Green2 – Blue2 Switch Route Option alignment east of the River Corrib passes in close proximity to the village of Menlough, with approximately 22 properties falling into the 60dB L_{den} contour line in this area, and hence requiring noise mitigation. Moving east, the alignment continues through a tunnel in the townland of Menlough, enters Lackagh Quarry and continues west following the alignment of the Blue2 Route Option. This continues south east towards the townland of Ballybrit, passing to the north of residential estates at Ballinfoyle and Castlegar and passing in close proximity to a number of individual properties along the N84 and adjoining local roads, with a number of properties being acquired in this area. The route option crosses Galway Racecourse within a cut and cover tunnel and re-emerges to the south of Briarhill Business Park and ties back into the existing N6. This section of the route is largely set back from, or screened by cut and cover tunnel sections from, noise sensitive properties. The total count for properties likely to require noise mitigation within Section 2 of this route option is 210 properties.

In order to suitably reduce traffic noise emissions from the proposed alignment to within the specified design goal of 60dB L_{den} set out by the NRA for new national roads, the mitigation measures available for the route will be limited to selection of the road surface and the use of barrier screening.

Overall, the Green2 - Blue2 Switch Route Option alignment is ranked intermediate compared to the other Stage 2 Route Options, scoring higher in preference than the Red2, Orange2, Yellow2 and Green2 Route Options but scoring lower compared to the Blue2 and Pink2 Route Options. The key areas of concern are between the Western Distributor Road and the N59 where local roads and clusters of residential properties are crossed in addition to the alignment in the vicinity of Menlough Village and the N84 and N17 crossing locations.

Once operational, there are no significant vibration impacts associated with road traffic along well maintained roads. This is not considered to be an issue for the operational phase of this road.

During the construction phase, standard road construction methods would be used along the majority of this route. Tunnel works in the vicinity of Lackagh Quarry in Menlough are well set back from noise sensitive properties and similarly the proposed cut and cover works across Galway Racecourse are well set back from noise sensitive properties. This assumes racing activities within the Galway Racecourse would not be operational during the construction works. Whilst the standard road construction would occur in close proximity to a number of noise sensitive properties, the nature of the works is likely to be mitigated to within the appropriate construction noise and vibration limits, and the duration of the works in the vicinity of any one area would be relatively short-term.

3.12 Human Beings

3.12.1 Introduction

A preliminary Stage 2 impact assessment for the Green2 – Blue2 Switch Route Option has been undertaken to assess the potential human being impacts of this route option on the surrounding environment. This assessment has been carried out with respect to the constraints identified in **Section 4.17 Human Beings of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.11 Human Beings of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.17.1 to 4.17.2 of the Route Selection Report** and **Figure 3.12.1 to 3.12.2** of this Report.

3.12.2 Assessment

3.12.2.1 Section 1 – Principle Impacts

The principal impacts of the Green2 - Blue2 Switch Route Option in Section 1 are as follows:

- Impacts on individual rural residential properties during construction;
- Avoidance of new community severance in Bearna and some relief from existing severance; and
- Reduction in traffic on R337 into Galway City due to link with Cappagh Road.

The Green2 -Blue2 Switch Route Option commences on the R336 west of Bearna and from here heads directly north across low intensity grazing land. The option does not include junctions with minor roads and there is the loss of some residential properties on a cul-de-sac to the east of Na Foráí Maola Road. This impact would be combined with an element of social severance for other properties at the end of this cul-de-sac representing a slight negative impact, but one that can potentially be reduced by a re-alignment of the entrance to the cul-de-sac. The removal of residential properties on a minor road characterised by ribbon development at Ballard West would potentially present a slight negative impact in terms of social severance from neighbouring properties and Bearna to the south.

By capturing much of the traffic arriving on the R336 from the west, this route option significantly reduces the amount of non-local traffic using the main street in Bearna along with providing relief from community severance.

3.12.2.2 Section 2 – Principle Impacts

The principle impacts in Section 2 for the Green2 – Blue2 Switch Route Option are as follows:

- Construction impact and loss of existing equestrian facility at Tonabrocky
- Direct construction impacts on some individual businesses at N84 and N17
- Impact on residential property in Bearna, Bushy Park, Castlegar and Coolagh / Briarhill followed by general amenity and social severance impact on operation;
- Good connectivity to Western Distributor Road and N59;
- Potential economic impact during and shortly after construction of cut-and-cover tunnel under the Galway Racecourse;
- Positive impact on operation, in terms of new access to Ballybrit Business Park and Galway technology Park from N17;
- Opportunity for improved traffic flow with journey time benefits and journey amenity benefits on operation for pedestrians and cyclists on existing R338 and for the junctions on the N6 at Browne Roundabout, Newcastle Road, Bodkin Junction, Kirwan Roundabout and the N17 Junction;
- Significant projected increase in traffic on the N84 into Galway from the junction at Ballindoooley with implications for journey time and amenity; and
- Significant projected reductions in traffic on the existing N6 route east of the Kirwan Roundabout with positive impacts for journey time, journey amenity and severance.

West of the River Corrib

To the west of the River Corrib, the construction phase would include a direct significant amenity impact on an equestrian centre off Tonabrocky Road near to the crossroads with the Gortacleva Road. This route option would also cut across the end of a residential cul-de-sac in Ballagh and impact on a number of residential properties at Bushypark on the N59. The option would pass through the middle of the community and directly impact on a length of established houses on the N59. The proposed landtake needed to accommodate the junction on the N59 would involve a significant socio-economic impact by virtue of the number of houses that would need to be demolished (see also **Section 3.6 Landscape & Visual of the Route Selection Report**).

In the operational phase, the Green2 – Blue2 Switch Route Option would pass beside a residential estate off Ballymoneen Road. At Ballagh and Bushypark, this route option would present a significant impact on general amenity and social severance, although no community facilities are directly affected. There would also be an amenity impact to a corner of the Glenlo Abbey Hotel Golf Course.

The Green2 – Blue2 Switch Route Option includes a junction on to the Cappagh Road and is therefore close to the end of the Western Distributor Road, to the benefit of connectivity and reducing journey time into the western city. The option also includes a useful direct connection to the N59. The traffic analysis for the related Green2 Route Option suggests that the change in traffic volumes on the N59 south of this junction would increase slightly in contrast to reductions of similar scale projected for the Blue2 and Pink2 Route Options. This would introduce slight new severance to community facilities and built-up areas on sections of the road to the south.

East of the River Corrib

In the construction phase, the Green2 – Blue2 Switch Route Option includes a junction to the east of the N84. This location would present a direct impact on several houses located on the N84 and on part of a commercial site, representing an economic impact.

At the N17 Junction, the route option would impact directly on a large car sales business and the An Post distribution centre.

In addition an economic impact would likely arise from the construction of a cut-and-cover tunnel beneath the Galway Racecourse. The works could be accelerated and programmed to avoid interruption to the race calendar, but a risk remains for impacts on one or more racing events and there is a risk to the perceptions of the turf on the track. These factors could in turn have knock-on economic impacts for the reputation of the Galway Racecourse and for the wider city.

A further construction and operation impact occurs to environmental amenity due to the proximity to Coolagh Village and the residential area of An Sean Bhaile in Briarhill, but these impacts are more appropriately addressed by the sections on noise and visual impacts (**see Section 7.6.5.Landscape & Visual and 7.6.10 Noise and Vibration of the Route Selection Report**).

The Green2 – Blue2 Switch Route Option cuts across the northern half of Lackagh Quarry which is currently inactive. The significance of this route option for economic and employment impacts depends on how the possible future functioning of the quarry is affected and whether any permanent sterilisation of the excavation lands is introduced.

In the operational phase, the option includes a junction with the N84 in Ballindoooley. This junction would have the effect of significantly increasing projected traffic into Galway on this road, with some consequent additions to severance in the urban section, but these would mostly improve access out of adjoining residential estates, and therefore journey time and amenity. This route option passes through the dispersed community of Castlegar including the end of an unsurfaced laneway, known locally as Spellman's Bóithrín, which provides access between two areas of the village community and the houses on School Road below Castlegar National School. A positive impact on the village would be the reduction in traffic levels experienced on School Road itself in the vicinity of the national school and the added community benefits associated with this. A major positive impact is presented on operation by the inclusion of proposed access

between the northbound N17 and the Ballybrit Business Park and Galway Technology Park.

Southbound traffic on the N17 travelling west continues south on the N17, before turning right onto the westbound slip road to the mainline of the Green2 – Blue2 Switch Route Option. Eastbound traffic continues south on the N17 and uses the existing infrastructure to travel east, joining the N6 at Coolagh if necessary. The junction provides good connectivity for westbound trips, but would be accompanied by an increase in traffic on the N17 to the south of the proposed junction. Although there are no community facilities between the proposed junction and the existing N17 Junction, the increased traffic would impact on journey amenity to businesses and on exits from the minor road to Castlegar Village. However, the option offers a reduction in traffic on the N6 between the N17 and Kirwan Roundabout and adjacent to the Ballybrit Business Park.

There are no particular socio-economic impacts for the proposed tie in junction with the existing N6.

4 Traffic Assessment

4.1 Existing traffic

The existing traffic is outlined in the **Chapter 3** of the **Route Selection Report**.

4.2 Future Traffic

The Green2 - Blue2 Switch Route Option was not modelled using the Galway Interim Model. An assessment was carried for traffic using the two closest GIM modelled route options. The Green2 Route Option and the Blue2 Route Option were both modelled using the Galway Interim Model.

4.2.1 Assessment

The assessment carried out compared the AADT numbers for the Do Minimum scenario, the Green2 Route Option, and the Blue2 Route Option, for 2019 as the opening year and for 2034. The locations chosen include the existing bridge crossings of the River Corrib, as well as main roads on both sides of the River Corrib, on the periphery of the city. These figures are shown in the **Table 4.2.1** below.

Table 4.2.1 AADT Figures

Location	Do Minimum 2019	Green2 Route Option 2019	Blue2 Route Option 2019	Do Minimum 2034	Green2 Route Option 2034	Blue2 Route Option 2034
Quincentenary Bridge	35,000	30,500	28,600	34,800	31,000	29,000
Salmon Weir Bridge	15,100	13,000	12,700	16,700	15,100	15,000
O'Brien's Bridge	7,900	6,700	6,600	9,100	7,800	7,800
Wolfe Tone Bridge	19,200	16,500	16,700	20,800	17,600	17,400
Bearna Village	11,600	4,800	2,100	13,400	5,200	3,800
Seamus Quirke Road	11,600	7,400	5,900	11,500	7,600	5,700
Headford Road (between Bodkin Junction and Kirwan Roundabout)	28,700	28,600	28,200	29,900	30,600	31,600
Bóthar na dTreabh	31,600	18,800	18,100	33,800	20,900	20,800
Dublin Road (between Moneenageisha Junction and Skerritt Roundabout)	19,800	17,100	17,200	18,600	18,400	18,700

Drawing on the trend in figures for both the Green2 and Blue2 Route Options, the implementation of the Green2 - Blue2 Switch Route Option would show a reduction in traffic on all four bridge crossings in 2019 and in 2034 compared to the Do-Minimum scenario. In addition, on almost all of the roads leading into the city, the Green2 - Blue2 Switch Route Option would provide greater relief in 2019 and 2034 than the Do-Minimum scenario.

5 Summary

The Green2 - Blue2 Switch Route Option meets the project objectives outlined in **Chapter 1** of the **Route Selection Report**. The Green2 - Blue2 Switch Route Option has a profound impact on the curtilage of Menlo Castle from the Cultural Heritage evaluation but also has impacts from a Landscape and Visual and Human Being amenity value perspective. Additionally this route option has potentially a large impact on flood risk in the vicinity of the River Corrib and its floodplains. Due to the presence of soft and peat soils, the location of the Corrib River bridge crossing presents a major negative in terms of impact of soils and geology.

There are a number of major severance effects on communities associated with the Green2 - Blue2 Switch Route Option, notably at Bearna, Bushypark and Castlegar.

In terms of Ecological impacts, the Green2 - Blue2 Switch Route Option would result in significant impacts to a QI habitat (Alkaline fen) on the west bank of the River Corrib in Lough Corrib cSAC and would adversely affect the integrity of the cSAC. Using appropriate engineering tunnelling techniques and construction controls, the tunnel at Lackagh Quarry is unlikely to result in any significant long-term effects to wetland habitats within, or adversely affect the integrity of, Lough Corrib cSAC. This route option is potentially the most damaging with respect to the local Lesser horseshoe bat population given its proximity to Menlo Castle and the core foraging area.

From the perspective of the Non-Agricultural Material Assets, the Green2 - Blue2 Switch Route Option has the highest number of residential acquisitions when compared to the Green2 Route Option or the Blue2 Route Option. However it is the preferred option for the other categories when compared to the Green2 Route Option and the Blue2 Route Option.

The benefits of this route option include the avoidance of impacts to NUIG recreational facilities and reduction of direct impacts on the Dangan area west of the River Corrib, and the avoidance of Menlough Village to the east of the River Corrib.

This route option is included in the pair-wise comparison in the process of selecting the emerging preferred route corridor.