Appendix A.4.2

Cyan Route Option Report

A.4.2 Cyan Route Option Report

Galway County Council

N6 Galway City Transport Project

Cyan Route Option

GCOB-4.04.REP005

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Arup
Corporate House
City East Business Park
Ballybrit
Galway
Ireland
www.arup.com

ARUP

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			Prepared by	Checked by	Approved by
		Name	Niamh O' Regan	Mary Hurley	Eileen McCarthy
		Signature			
		Filename			
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			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
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Contents

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, 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.

ABP granted approval for only part of the scheme, the section from the N59 east to the existing N6 and refused permission for the section of the scheme from the R336 west of Bearna to the N59. 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 section of the N6 Galway City Outer Bypass (2006) which received approval to the east of the River Corrib, but with an additional grade separated junction on the existing N17 in the vicinity of Two Mile Ditch, with a revised outer alignment to the west of the River Corrib which seeks to avoid any adverse impact on Tonabrocky Bog. This option is known as the Cyan Route Option and is shown on **Figure 1.1**.

1.4 Route Option Description

The Cyan 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. The Cyan Route Option then follows the path of the 2006 Galway City Outer Bypass, travelling northeast through Menlough to Ballindooley and then southeast to Coolagh before it terminates at the existing N6.

The Cyan 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 Rahoon Road. A grade separated junction is proposed on the N59.

To the east of the River Corrib, there is a grade separated junction to serve the N84 immediately west of the N84 in the townland of Ballindooley, and an additional grade separated junction on the existing N17 in the vicinity of Two Mile Ditch. A further grade separated junction south-east of Coolagh connects the Cyan Route Option to the existing N6. Note that the addition of the junction on the N17 is a change to the 2006 GCOB scheme to the east of the River Corrib.

2 Engineering Assessment

2.1 Introduction

This section details the stage 1 engineering assessment of the Cyan 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 Cyan Route Option has been carried out in a similar manner to the engineering assessment of the six route options considered at Route Selection Stage 1, using the same criteria. These criteria are geometry, cross-section, length, junction strategy, structures, topography and earthworks, constructability, and traffic.

The Cyan Route Option has been assessed in two sections: Section 1, from the R336 to Barr Aille Road, and Section 2, from Barr Aille Road to the existing N6 to the east of the city as shown on **Figure 1.1**. These sections were also used for the Route Selection Stage 1 options assessment.

2.3 Assessment

2.3.1 Geometry

A preliminary mainline alignment with associated junctions and link roads has been designed for the Cyan Route Option, similar to the six route options considered as part of the Route Selection Stage 1 assessment. 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 Cyan 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

For the preliminary design a Type 2 dual carriageway cross-section was assumed for all off-line sections of all routes, i.e. for the full length of the Cyan Route Option.

2.3.3 Length

The length parameter is a measure of the Cyan 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)
Cyan	20169

2.3.4 Junction Strategy

This assessment considers the number of junctions along the Cyan Route Option. At-grade junctions will cause delays on the mainline, with the delay increasing as the number of at-grade junction's 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
Cyan	2	0	0

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

The project objectives outlined in Chapter 1 of the Route Selection Report include a requirement to provide connectivity between the N6 and the three existing national secondary routes in the city; the N59, the N84 and the N17. A check was carried out on the Cyan Route Option 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. In terms of junction configuration the Cyan Route Option performs well as all of the junctions are standard (e.g. dumb-bell) and perform well from a driver comfort and safety point of view.

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
Cyan	2	1	3	N

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 Cyan Route Option crosses over the river with the mainline on a new bridge structure.

The total number of bridge structures along the mainline in Section 1 and Section 2 has been quantified. 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. The number of structures on the Cyan Route Option was quantified as shown below in **Table 2.4** for Section 1 and **Table 2.5** for Section 2.

Table 2.4 Structures Assessment – Section 1

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Total Number of Bridges
Cyan	1	3	0	4

Table 2.5 Structures Assessment – Section 2

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Total Number of Bridges
Cyan	3	9	3	15

An assessment of the extents of significant structures was also included for Section 2. This takes account of the long bridge crossing on the River Corrib, but this was not judged to be a major issue from a structures point of view, given that there are no tunnel or viaduct sections on the Cyan Route Option, and is therefore not included in **Table 2.5** above.

2.3.6 Topography and Earthworks

A preliminary assessment of the earthworks quantities was not carried out for the route options considered as part of Route Selection Stage 1 and was therefore not considered for the Cyan Route Option either.

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. As the Cyan Route Option is entirely off-line, it is envisaged that construction would be relatively straightforward.

2.4 Summary

From an engineering point of view, the Cyan Route Option is a feasible option.

3 Environmental Assessment

3.1 Introduction

This section details the stage 1 environmental assessment of the Cyan Route Option with respect to the constraints identified **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 Cyan Route Option has been assessed in two sections: Section 1, from the R336 to Barr Aille Road, and Section 2, from Barr Aille Road to the existing N6 to the east of the city as shown on **Figure 1.1**. These sections were also used for the Route Selection Stage 1 options assessment.

3.2 Ecology

3.2.1 Introduction

The ecological assessment of the of the Cyan 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 F**igures 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 Cyan Route Option impacts directly on Lough Corrib cSAC at three locations[1]: the crossing point of the River Corrib, to the south west of Menlough Village; in the vicinity of the Coolagh Lakes and the Menlough Road; and, as it crosses the hill between Menlough Village and Ballindooley Lough.

[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.

At the proposed River Corrib crossing, there are two Annex I habitats[2] that will be affected by the bridge construction: an area of *c.*0.39ha of Alkaline fen [7230] and an area of *c.*350m^2 of Hydrophilous tall herb habitat [6430]. Alkaline fen is a Qualifying Interest (QI) Annex I habitat types for which Lough Corrib cSAC has been designated. It may be possible to design and construct a bridge structure which does not result in any direct impacts to these habitat types. Nevertheless, during operation, the presence of a bridge is likely to impact on the habitats underneath due to the effects that shading from the bridge deck and the associated reduction in direct precipitation. The total footprint of the road alignment through this part of the Lough Corrib cSAC, including both Annex I and non-Annex habitats, is approximately 2.4ha.

Near the Coolagh Lakes, the Cyan Route Option impacts on one area comprising *c.*0.72ha of Limestone pavement [*8240] and Calcareous grassland [6210], and a second smaller area (*c.*223m^2) of Limestone pavement to the north. The total footprint of the road alignment through this part of the Lough Corrib cSAC, including both Annex I and non-Annex habitats, is approximately 1.5ha.

As the Cyan Route Option crosses the hillside between Menlough and Ballindooley it will result in the loss of a large area (*c.*4.09ha) of Limestone pavement, which includes pockets of Calcareous grassland, and small areas of Dry heath [4030] and Lowland hay meadow [6510]. The total footprint of the road alignment through this part of the Lough Corrib cSAC, including both Annex I and non-Annex habitats, is approximately 5.65ha.

The Cyan Route Option also lies immediately adjacent to the boundary of Moycullen Bogs NHA at Ballagh and, due to the routes close proximity to wetland and peatland habitats within the NHA boundary, there is the potential for indirect impacts to occur.

Outside of designated areas for nature conservation, this route option impacts on areas of Annex I habitat totalling *c.*10.89ha, comprising the following habitat types: Limestone pavement, Calcareous grassland, Lowland hay meadow, Dry heath, Wet heath [4010], and Residual alluvial forests [*91E0].

The Cyan Route Option is likely to have a significant impact on the Menlough Lesser horseshoe bat population[3] given its close proximity to the maternity roost site, that it will remove a known roosting site (night roost) near Ballindooley Lough, and will result in large scale habitat loss, severance and displacement impacts within their foraging area. It will also result in the loss of two Brown long-eared bat roosts. The Cyan Route Option is also within 500m of a Barn owl nest site and significant impacts to the local population are likely as a result.

[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, *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.

[3] All bat species in Ireland are protected under Annex IV of the EU Habitats Directive; the Lesser horseshoe bat is also listed on Annex II

The watercourse crossings associated with the Cyan Route Option have the potential to impact on aquatic species[4] such as fish species Atlantic salmon, lamprey species and Otter and lamprey, particularly where realignments of river/stream channels are required (as is the case for the Liberty and Bearna Streams).

This route option will also impact on patches of habitat suitable for the Marsh fritillary butterfly; some of which were confirmed as breeding habitat in surveys undertaken in 2014. However, the scale of the impact is not likely to significantly affect the local metapopulation.

3.2.3 Summary

Overall, the Cyan Route Option has the potential to result in significant negative impacts to Lough Corrib cSAC. The loss of QI habitats in Lough Corrib cSAC associated with this route option would constitute an adverse effect on the integrity of this European site based on the previous EU judgement as the alignment through here is as per the 2006 GCOB. Therefore, for the Cyan Route Option to be advanced through the planning process in accordance with the requirements of Article 6(4) of the EU Habitats Directive, there must be no feasible alternative solutions and, despite the predicted impact, there must also be imperative reasons of overriding public interest for progressing the option. The close proximity of this route option to the Moycullen Bogs NHA also poses a risk of significant impacts to peatland habitats in that site. Aside from the impacts to designated sites, the Cyan Route Option would also likely result in significant impacts to areas of Annex I habitat, Barn owl and a range of other sensitive ecological receptors, many of which are listed on Annex II and/or Annex IV of the EU Habitats Directive.

3.3 Soils and Geology

3.3.1 Introduction

The soils and geology assessment of the of the Cyan Route Option has been carried out with respect 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 **Figure 3.3.1 to 3.3.12** of this Report.

[4] Otter, Atlantic salmon, lamprey species and the Freshwater pearl mussel are all listed on Annex II of the EU habitats Directive 92/43/EEC; Otter is also listed on Annex IV

3.3.2 Assessment

3.3.2.1 Overview of Solid Geology, Subsoils and Soils

Bedrock geology

The bedrock geology underlying the Cyan Route Option is shown on **Figure 3.3.3** and **3.3.4.** There are two principle forms of bedrock underlying this route. From the R336 to the west of the N59 the bedrock consists of undifferentiated granite and associated rock.

East of the N59, the bedrock changes to the Lower Carboniferous (Visean) Age Burren Limestone. The Limestone underlies the remainder of this option route to the existing N6 tie-in.

Subsoils

The initial section of the Cyan Route Option, up to the N59, consists of either glacial till or sandy gravely clay. This is further complicated by the presence of a thin layer of peaty soil sporadically located along this route. There are many large granite boulders present within the brown stony till.

Along the western banks of the River Corrib, the Cyan Route Option is underlain by soft calcareous or organic clay and peat over limestone bedrock. Upon crossing the river, the Cyan Route Option encounters an area of rock outcrop on the eastern side of the bank. Extensive outcropping of limestone rock extends approximately 3.1km from the east bank of the River Corrib and is present until beyond the townland of Menlough. At Ballindooley, the Cyan Route Option crosses a small area of basin peat. In between the outcropping and the basin peat, shallow glacial till over limestone bedrock is encountered. Several other limestone outcrops are passed from Pollkeen to where the Cyan Route Option ties in with the existing N6.

Soils

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 although the majority of the soils in this area remain poor quality, being peaty in nature. The soil quality improves across the River Corrib, where acid brown earth soils predominate, but this is so shallow in most spots that there is very little tillable land.

Made Ground is typically limited to modifying ground at the River Corrib (e.g. Glenlo Abbey golf course), roadworks and stockpiles from quarry operations.

3.3.2.2 Cuttings and embankments

Areas with a max cutting or embankment depth less than 5m and an overall impact of **Low** have been excluded from the principle cutting and embankment tables in **Tables 3.3.1** and **3.3.2** and are shown on **Figure 3.3.11 and 3.3.12.**

Table 3.3.1 Principal cuttings along the Cyan Route Option

Name	Location	Length	Max cutting depth	Level of impact
C3	An Cloch Scoilte	120	0 - 5	High1
C7	Ballyburke	140	5 - 10	Low
C9	Pairc na gCapall	460	5 - 10	Low
C11	Menlough	160	5 - 10	Low
C12	Coolough Road link	430	5 - 10	Low
C13	Ballindooley	940	> 15	High
C14	Ballindooley	600	5 - 10	Medium2
C15	Ballindooley	900	5 - 10	Medium2
C17	N17 to M6	2750	> 15	High3

In addition to the max cutting depth the location impact is influenced by:

1. Presence of soft ground
2. Presence of a number of Karst Features
3. Length of cutting and the presence of a number of Karst Features

Table 3.3.2 Principal embankments along the Cyan Route Option

Name	**Location**	**Length**	**Max embankment height (m)**	**Level of impact**
E1	Na Foraí Maola Thiar	1440	> 15	High[1]
E2	Trusky East	1000	0 – 5	Medium[1]
E3	Cappagh West	1310	10 – 15	High[2]
E6	Tonabrocky	1260	10 – 15	High[2]
E7	Bushypark	1520	> 15	High[3]
E8	Menlough 1	210	5 – 10	Medium[4]
E9	Menlough 2	210	5 – 10	High[5]
E10	Menlough 3	100	5 – 10	Medium[6]
E11	Menlough 4	920	5 – 10	Low
E12	Ballindooley North	250	5 – 10	Low
E13	Ballindooley East	320	5 – 10	High[5]
E16	Pollkeen	520	> 15	High
E17	Menlough Underpass	110	5 – 10	Medium[6]
E19	N84 South tie-in	1400	> 15	High[7]

In addition to the max embankment height the location impact is influenced by:

1) Length of embankment
2) Length of embankment and presence of soft ground

3) Length of embankment, presence of soft ground and a number of Karst Features
4) Presence of soft ground
5) Presence of soft ground and a number of Karst Features
6) Presence of a number of Karst Features
7) Length of embankment and presence of a number of Karst Features

3.3.2.3 Overview of Ground Conditions and Features in Karst Limestone Areas

The Cyan Route Option is underlain by limestone from the N59 to the eastern end of the route option. The limestone is highly prone to karstification. A range of solution features were found within the scheme study area which are presented and ranked in **Section 4.4**. Desk and field surveys were undertaken in order to identify and classify the karstic features. The report for these surveys is appended to this report (**Appendix A.4.4 Karst Study Report)** and includes tables and figures detailing the type and location of the features identified.

Most of the karstification identified along this route option consists of a weak to well-developed zone of epikarst, ranging from approximately 1.0m to 5.2m in thickness. This epikarst zone tends to be thinner on upland areas with thin superficial deposits and thicker on low-lying areas where superficial deposits are thicker, especially in areas close to or underlying surface streams, rivers or lakes.

In a small number of areas, more intense karstification has led to deeper weathering (below the epikarst zone) and clay infilling of solutionally enlarged features (typically joints). At some of these sites, even more intense karstification has occurred, leading to the development of large closed depressions and sediment infilled cavities.

A dense cluster of karst features have been identified adjacent to embankment section E5 in Kentfield. A number of enclosed depressions (K4, K5, K6, K10, K11, and K12) and springs (K2, K7 and K9) where confirmed in the vicinity of the route option.

East of the River Corrib, a spring (K25) and turlough (K31) were identified in Menlough. Entering the townland of Ballindooley, three enclosed depressions (K50, K66 and K69) are located in close proximity to the route option. After the N84 Junction adjacent to Ballindooley Lough, six enclosed depressions (K82, K83, K85, K94, K98 and K100) and one confirmed well (K92) are located adjacent to the route option.

The route runs adjacent to a number of features as it approaches the N6 tie-in. Four enclosed depressions (K164, K168, K169 and K174) and one confirmed well (K170) are located in Breanloughaun. Four springs (K184, K186, K189 and K192) are all located in Ballintemple.

The impact of karst on the Cyan Route Option is assessed as ***Medium***.

3.3.2.4 Overview of Historical Land Use

This Cyan Route Option passes largely through a rural landscape where historical mapping indicates that the land use has typically remained unchanged. The land is characterised as predominantly agricultural land with sporadic one-off housing along the Cyan Route Option. This route option circumvents the Twomileditch Quarry to the north and does not appear to encounter any previous industrial sites or potentially contaminated sites.

The impact of historical land use along the Cyan Route Option is ***Low***.

3.3.2.5 Overview of Economic Geology

The Cyan Route Option passes to the north of the Roadstone Quarry at Twomileditch. The quarry is the closest source of aggregates and concrete to the city centre. The quarry has adequate stone reserves to continue to supply aggregates for an estimated 30 years according to the operator. The quarry appears to have been developed close to the landowner plot boundaries.

There is likely to be a buffer zone around the Cyan Route Option in which blasting is not permitted to minimise risks from flyrock. This zone typically varies between 75 – 150m and is dependent on the techniques used. Further work would be required to assess the constraints on the buffer zone. This route option is shown as encroaching as close as 40m to the boundary of the quarry. This point is approximately along the line of the existing road so additional restrictions may not be introduced. Provided that appropriate blasting restrictions on the quarrying activities are employed it is possible that the route will not sterilise sections of the quarry.

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 Cyan Route Option on Economic Geology is assessed as ***Medium***.

3.3.3 Overview of Geological Heritage

The Geological Heritage constraints are shown on **Figures 3.3.1** and **3.3.2.** There are unusual rock structures called mushroom stones (GHA03) that are situated north of Menlough Village (approximately 1km north of the Cyan Route Option). These mushroom stones consist of limestone rock that has been eroded into the shape of a mushroom by previously elevated water levels that have receded over time. This stone, and others in the vicinity, have been interpreted as marking the former lake margins of Lough Corrib. This route option is highly unlikely to have any impact on these rocks.

The Roadstone Quarry (GHA01) on the Tuam Road is a designated County Geological Site (CGS) due to its national/local geological heritage importance. The quarry contains clay wayboards, equivalent to the Ailween Member (terraced

limestones) of the Burren formation. The impact of this route option on the attribute is assessed as minimal.

A quarry exposure of Galway Black Marble in the Upper Visean Limestone in the area of Merlin Park, Brachiopod fossils (GHA02) have been recorded, in some shell beds. The quarry was one main source of Galway Black Marble to the stone trade. The constraint is over 800m from the route and will not be impacted.

The impact of the Cyan Route Option on the Geological Heritage is ***Low***.

3.3.4 Summary

The impact of the Cyan 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 – western side of scheme	Low	Loss of low fertility soil over limited section of route	Minor negative
Agricultural soils – east side of scheme	Medium	Loss of medium fertility soil over limited section of route	Minor negative
Exposure of granite bedrock	Medium	Deep cuttings exposing the bedrock will increase the geological heritage	Minor positive
Peat/soft soils – Western part of scheme	Medium	Excavation and replacement likely to be required for shallow deposits. Disposal of peat and soft soils requires identification of suitable disposal site.	Moderately 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
Twomileditch Quarry	High	Potential sterilisation of limited portions of quarry. Modification to extraction techniques likely.	Major negative

3.4 Hydrogeology

3.4.1 Introduction

The hydrogeology assessment of the of the Cyan 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 3.3.11 to 3.3.12** and **3.4.1 to 3.4.2** of this Report.

The Cyan Route Option is divided into two distinct section in terms of hydrogeology:

- Western section (West of the N59) on a 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 Assessment

The Cyan Route Option 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 west of the River Corrib is on an embankment (in fill). However, a number of shallow cuttings (<4 m) 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. 10 m 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 Cyan Route Option east of the N59 has an undulating topography and as a consequence the alignment of design for this route option is composed of embankment in lower lying land and cuttings through the higher ground so as to minimise on the gradient changes. The main cuttings are at Menlough (C10, C11 and C12), Ballindooley (C13 and C14) and Galway Technology Park (C16 and C17) all of which are in limestone (Table 1). There is a potential risk that drawdown at cutting C12 that could impact on groundwater flows to springs feeding Coolagh Lakes (Lough Corrib cSAC) and two turloughs at Bóthar Nua (referenced as EC35 and EC36). Cutting 13 has the potential to impact on Ballindooley Lake (EC39) and the supply well at Clada Water (W50-12) as shown on **Figure 6.5.3.2**. Drawdown

as a result of the cuttings C14 and C15 near Ballindooley have the potential to impact on Ballindooley Lough. Construction phase impacts are possible if dewatering is required from driving the tunnel or excavating the cuttings.

There may also be dewatering if permanent drains are required or from impoundment if flow paths are intercepted and sealed. Assessment would be required for all cuttings to determine the groundwater level so that drawdown quantities and impacts could be assessed.

The risk from run-off and accidental spills would be an important assessment for the eastern section as the groundwater has high vulnerability. This would require assessment of sealed drainage to a discharge point, which could reduce recharge along the footprint of the design for this route option and require assessment of impacts from increased volume at discharge points.

The cuttings by chainage and the closest water dependent habitat and groundwater abstraction wells are summarised in **Table 3.4.1** below.

Table 3.4.1 Cutting and nearby water dependent habitats and groundwater abstraction

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact level
1	Cyan C1 Cnoc na Gréine	500	0 - 5	EC11: Bog	50	Moderate
1	Cyan C2 Na Foraí Maola	200	0 - 5	EC14: Heath / bog	0	Significant
1	Cyan C3 An Cloch Scoilte	120	0 - 5	EC14: Heath / bog	90	Slight
				EC17: Heath / bog / wet grassland	80	Slight
				EC18: Heath / wet grassland	290	Imperceptible
1	Cyan C4 An Cloch Scoilte	40	0 - 5	EC14: Heath	330	Imperceptible
				EC17: Heath / bog / wet grassland	100	Slight

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact level
				EC18: Heath / wet grassland	300	Imperceptible
2	Cyan C5 Aille	20	0 - 5	EC18: Heath / Wet grassland	480	Imperceptible
				EC19: Heath / bog	360	Imperceptible
				EC20: Heath / bog	250	Imperceptible
2	Cyan C6 Bally-burke	160	0 - 5	EC20: Heath / bog	0	Significant
2	Cyan C7 Bally-burke	140	5 - 10	EC20: Heath / bog	0	Significant
2	Cyan C8 Keeraun	240	0 - 5	EC22: Moycullen Bog: Bog / heath / wet grassland.	170	Imperceptible
2	Cyan C9 Pairc na gCapall	460	5 - 10	EC24: Bog / heath / wet grassland	600	Imperceptible
				EC25: Moycullen Bog: Bog / heath / wet grassland	290	Imperceptible
				EC28: Kentfield / NUI Galway wetlands	560	Imperceptible
				Borehole W1000-01	40	Moderate
2	Cyan C10 Menlough	300	0 - 5	Coolin-illaun Wetland cSAC non Annex I habitat	140	Moderate
				EC35: Turlough	400	Slight

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact level
				EC36: Turlough	475	Slight
				Coolagh Lakes (Lough Corrib cSAC)	320	Slight
2	Cyan C11 Menlough	160	5 - 10	Coolagh Lakes (Lough Corrib cSAC)	350	Moderate
				EC35: Turlough	460	Moderate
				EC36: Turlough	350	Moderate
2	Cyan C12 Coolough Road link	430	5 - 10	Coolagh Lakes (Lough Corrib cSAC)	90	Significant
				EC35: Turlough	540	Moderate
				EC36: Turlough	80	Significant
2	Cyan 13 Ballin-dooley	940	15 - 20	EC39: Ballin-dooley Lough Complex	640	Moderate
				EC38: Turlough	300	Moderate
				Borehole W50-12	950	Moderate
2	Cyan C14 Ballin-dooley	600	5 - 10	EC38: Turlough	225	Moderate
				EC39 Ballindooley Lough Complex	0	Significant

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact level
				Borehole W50-10	850	Imperceptible
2	Cyan C15 Ballin-dooley	900	5 - 10	EC39 Ballindooley Lough Complex	70	Significant
2	Cyan C16 Polkeen Road link	280	0 - 5	W100-03	980	Imperceptible
				W100-04	900	Imperceptible
				W100-05	820	Imperceptible
				W100-06	870	Imperceptible
2	Cyan C17 N17 to M6	2750	15 - 20	W100-03	920	Imperceptible
				W100-04	850	Imperceptible
				W100-05	730	Imperceptible
				W100-06	750	Imperceptible
				Borehole W1000-02	700	Imperceptible

3.4.3 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 Cyan 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. There is potential risk to Coolagh Lakes and Ballindooley Lough from up gradient road cuttings and these will need to be assessed for drawdown impacts. There is also a potential to impact on the water supply well at a commercial property to the east of the River Corrib. Assessment will be required of reduced recharge along the line of the Cyan Route Option and assessment will also have to be made on discharge points from the sealed drainage systems.

3.5 Hydrology

3.5.1 Introduction

The hydrology assessment of the of the Cyan Route Option has been carried out with respect 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 F**igures 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 Cyan Route Option intercepts the stream channels of the Sruthán na Liberiti and Trusky Streams. These streams are minor streams having small catchment areas of 1.5km^2 and 3km^2 respectively. Neither stream is ecologically sensitive, they are not considered to be fishery streams, are of little ecological value, generally poorly defined, overgrown and are generally not maintained with sporadic short term out of bank flooding adjacent to the stream channel.

These streams are small and generally unmaintained channels and generally have existing undersized road and field culverts. Their floodplain area is not well defined. Culverting and diverting these watercourses as part of the drainage works for road scheme 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 the proposed scheme.

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 Cyan Route Option is likely to represent slight to moderate local negative impact.

Water Quality

The watercourses encountered by the Cyan Route Option are not salmonid and are not ecologically sensitive streams. They outfall to Galway Bay west of the Galway Bay Complex cSAC. The potential operational impact by this route option on these streams is expected to represent a slight local impact with construction works expected to have the potential for causing a temporary moderate local impact. 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 the this route option on the hydrology of surrounding aquatic sensitive habitats, namely the Annex 1 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 Cyan Route Option avoids the south of the Moycullen Bogs NHA (EC11, EC12, EC13) and is unlikely, given the distance and separation by Dry heaths, grassland, scrub and bracken habitats, to have any indirect impact on the Moycullen Bogs NHA in terms of hydro-ecology.

The Cyan Route Option encounters and is in close proximity along its route to locally important wet grassland and traverses a small section of Annex 1 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 the Annex 1 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 River Corrib crossing for the Cyan Route Option represents a skewed crossing some 530m (based on the 100 year flood estimate) with the river channel width at the crossing point of approximately 125m wide. This route option involves a 500m to 600m wide crossing of the Lough Corrib cSAC. The proposed river crossing would involve a long bridge structure to minimise direct impact to the Lough Corrib cSAC and to avoid any encroachment into the river channel. This route 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 viaduct option is to be designed to ensure no constraint to boat passage and therefore the soffit level of the bridge will be well elevated above the design flood water level of the River Corrib.

The flow conveyance in the River Corrib at the crossing point, even under extreme flooding conditions, is confined to the channel with overbank flows of limited conveyance capacity at the crossing point. The loss of flood storage as a result of the viaduct piers will be inconsequential given the large storage capacity within the upstream lakes and catchment, the damped nature of the flood hydrograph and the small volume associated with the support piers.

During construction of the viaduct there will be temporary works within and close to the flood plain but with no works within the river channel associated with any pier construction.

The impact magnitude of the proposed River Corrib bridge crossing for the Cyan Route Option is 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 channel. Where temporary in-stream works are

required to construct the long bridge span of approximately 125m then the construction impact level increases to a potentially moderate constructional impact.

Watercourse Crossings

To the west of the River Corrib a number of small hill slope drains and streams are encountered which form part of the Knocknacarra and the Bearna Streams. These are minor streams and unlikely to result in any significant flood risk concerns or impacts as a result of this route option. Overall the watercourse crossings and floodplain encroachments are considered to represent a slight negative impact on flooding, flow hydrology and flood risk.

The Cyan Route Option crosses three tributaries of the Bearna Stream (including the Tonabrocky Stream) and passes to the north of Knocknacarra Stream drainage channels. The corridor crosses again the Tonabrocky Stream and passes close to Lough Nabrocky. The Bearna Stream discharges to the Galway Bay Complex cSAC and can be classified as a medium value watercourse. The potential impact magnitude of these four crossings and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management (SUDs). The Bearna Stream has fishery potential and fishery friendly culvert design may be required (i.e. appropriately designed culvert/small bridge). However, at the crossing point the streams are steep hillside channels and unlikely to be salmonid (except well downstream towards it estuarine reach).

The Corridor passes to the north and within the flood zone and recharge zone of Ballindooley Lough. This lough is classified as having a high attribute value and the potential impact to this lough is rated as moderate, from road drainage runoff, encroachment within the flood zone and the potential for interference with groundwater recharge. East of Ballindooley Lough there are no further surface watercourses intercepted due to the karst limestone bedrock with natural drainage via infiltration eventually discharging to groundwater.

Flood Risk

The streams and flood risk areas encountered to the west of the River Corrib are considered to be minor and localised to immediate surrounding channel banks and present little difference in impact level in respect to flood risk and flood impact. The principal flood risk area is the crossing of the River Corrib and encroachment of Coolagh Lakes and Ballindooley Lough Basins.

The flood risk has been assessed using combination of local flood information (flood incidents), the OPW preliminary Flood Risk Assessment (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. The impact level for this route option is determined based on its length that encroaches a flood risk area, the potential flood risk to the development and potential impact on existing flood risk.

The Cyan Route Option represents the second widest crossing length of the River Corrib floodplain and flood zones having a potential encroachment distance of 530m within the River Corrib flood zone.

This route option is shown to encroach slightly the Flood Zone area surrounding the Coolagh Lakes to the northwest and Ballindooley Lough to the north.

To the east of the river, 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.

The flood risk impacts on the minor watercourses to the west of the River Corrib are small and have been included for in the assessment of watercourses above.

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. The encroachment of Ballindooley Lough would also be considered to represent a locally moderate magnitude impact on flood risk that can easily be mitigated to slight through appropriate bridge design.

Hydro-Ecology

Detailed ecological habitat mapping has been carried out for the scheme study area and based on this mapping and site walkovers an assessment of the impact to hydro-ecology of this route option 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 be as a result of 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 options avoids Annex 1 habitats such as Blanket Bog [*7130], Transition mires and quaking bogs [7140] and Northern Atlantic Wet heaths with Erica tetralix [4010] but within close proximity of such habitats. Refer to Section 4.3 of the Route Selection Report for Ecology Constraints and Section 3.2 of this report for the ecological assessment of the Cyan Route Option.

To the east of the River Corrib the type of 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 they were included under water quality.

The Cyan Route Option passes in close proximity to Annex I habitat Blanket bog [*7130], Transition mires and quaking bogs [7140] and Northern Atlantic Wet heaths with Erica tetralix [4010] which are associated with the Moycullen Bog NHA at Tonabrocky EC22 and at Ballagh EC25. The potential indirect impacts of road construction and operation could result in dewatering and drainage impacts to these habitats having a high impact magnitude.

This route option also crosses through sections of Northern Atlantic Wet heaths with Erica tetralix [4010] and European Dry Heaths [4030] associated with EC19 and EC20.

The Northern Atlantic Wet heaths with Erica tetralix [4010] are sensitive to hydrological regime change through drainage and potential dewatering and 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.

The Cyan 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 Section 3.5 Hydrogeology. A potential indirect impact may arise on this habitat and Coolagh Lakes from road drainage discharge which could enter the lakes. The impact of drainage waters on the Lakes can be mitigated through appropriate storm drainage treatment and discharge control reducing impact magnitude from significant to moderate magnitude impact.

The Cyan Route Option also crosses a wet grassland area associated with the Ballindooley Lough riparian Zone EC 39 with the potential for a moderate magnitude impact during construction and operational stages. A potential indirect impact may arise on this habitat and Ballindooley Lough complex from road drainage discharge which can be mitigated through appropriate storm drainage treatment and discharge control. The impact magnitude on Ballindooley Lough (EC39) is considered to be a moderate magnitude impact.

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 constructional pollution. The River Corrib and the Terryland Stream also discharge into the Galway Bay Complex cSAC and therefore area 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 construction and the operational phases of a road.

A major public water supply abstraction is present at Terryland with the abstraction point from the Jordan Island channel on the River Corrib.

Such a large and important water supply which is rated as being 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 River Corrib main channel downstream of Jordan's Island to feed the Terryland water treatment Plant. The Cyan Route Option falls within the source protection area of the supply. The closer the option is to the intake in the upstream direction it is considered to have the greatest potential for impact both during construction and operation given the distance, speed and mixing volume available.

This potentially represents a significant impact on a very high importance attribute both during construction and potentially during the operational phase of the road and represent a significant impact without mitigation.

Lough Atalia is part of the Galway Bay Complex cSAC and is a coastal lagoon priority habitat. The Cyan Route Option is unlikely to result in any significant impact to water quality, salinity or to the hydrological regime within the 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 eastwards eventually discharge into the Galway Bay Complex cSAC which is a sensitive waterbody in respect to water quality. The Terryland Stream by virtue of it disappearing underground and representing a point source to the regionally important karst bedrock aquifer makes it highly sensitive watercourse in respect to pollution.

The Cyan Route Option crosses the River Corrib upstream at the Terryland water supply intake and consequently represents a significant risk to a very high attribute water supply receptor being within 2.15 km of the intake which at a modest flow velocity of 0.5m/s could see a plume reaching the intake within *c*. 90minutes. The proposed crossing of the River Corrib is to be a full spanning structure and therefore avoids any direct in-stream works associated with construction of the piers. Construction impacts of constructing the bridge deck may involve some indirect in-stream works in the form of requiring a barge for access and construction of abutments near the river bank and floodplain piers remain which could potentially cause sedimentation, disturbance of the river bed and construction spillages (concretes, hydrocarbons) released 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 potential pollutant loads.

The Cyan Route Option will involve works adjacent to the Coolagh Lakes which are connected directly to the River Corrib with its confluence 900m upstream of the intake. This combined with the River Corrib crossing increases the works area and road distance that could give rise to serious impact on Lough Corrib cSAC and on the Terryland water supply intake. The potential water quality impact on the Lough Corrib cSAC is assessed as moderate and the potential impact on the Terryland 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 impact on the smaller watercourses has been assessed and included for earlier under the assessment of watercourses. The Cyan Route Option avoids the Terryland River basin but does pass north of Ballindooley Lough with the potential for road drainage discharge to this lough and construction impacts caused by the proximity of the road to the flood zone of Ballindooley Lough.

This is a high attribute receptor and the water quality potential impact is rated as moderate but can be reduced to slight with mitigation in respect to treatment of the road drainage discharge.

3.5.3 Summary

This route option is considered to be acceptable from a hydrological perspective, as it can be constructed and operated without creating the potential for significant hydrological impacts on water quality, flood risk and hydro-ecology receptors. It represents the shorter river channel crossing point of the route options considered but one of the longer floodplain widths of c. 530m (at the 100year flood inundation footprint).

3.6 Landscape and Visual

3.6.1 Introduction

The landscape and visual assessment of the of the Cyan 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 F**igures 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 in the following.

3.6.2.1 Construction Stage

The following are the principal aspects of the Cyan Route Option that would give rise to the significant and profound impacts on the landscape/townscape and visual environments during construction:

- Demolition of significant numbers of existing residential properties – particularly at Na Foraí Maola (Bearna), at Ballard, Keeraun, in crossing the N59 at Ballagh/Gortacleva/Bushypark/Dangan Lower, in passing through Ballindooley and in crossing the local road at Ballintemple, see **Section 3.9 Material Assets Non-Agriculture**;
- Demolition of other residential properties at dispersed locations along the route option, see **Section 3.9 Material Assets Non-Agriculture**;
- Direct take/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, *etc.* – most particularly at Na Foraí Maola (Bearna) to either side of the N59 at Bushypark; in passing through Ballindooley, as well as at dispersed locations along the length of the route option;
- Significant new bridging of the River Corrib at remote, naturally attractive setting close to the mouth of Lough Corrib. Bridge crossing also in background of view/setting of Menlo Castle;
- The route option will pass between Menlo Castle and Menlough Village, severing the access avenue, woodland and demesne;
- Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings – particularly in crossing the natural setting of the River Corrib, between Menlough and Ballindooley, and passing Ballindooley Lough, but also in crossing natural stream corridors north of Bearna, and west of Ballyburke;

- Impact on existing amenity/recreation facilities (*e.g.* Equestrian facility at Tonabrocky, Glenlo Abbey Golf Course, and general amenity along the River Corrib)
- 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 construction programme. Works will require construction of new bridging structures and local road re-alignments;
- Impact on Protected County Plan Views Numbers 72 & 74 north of Bearna Village, and View Number 70 at Bushypark, as well as City Plan scenic Views and Prospects V.10 (at N59 Bushypark) and V.19 (at N84, Ballindooley); and
- Potential impact on Greenway proposals - most especially along River Corrib towards Lough Corrib.

It is considered that the individual impacting aspects outlined above will in combination give rise to locally significant negative impacts from construction activity on the natural landscape character of the corridor of the River Corrib; the demesne landscape of Menlo Castle, the limestone pavement landscape between Menlough and Ballindooley and on the community and visual character of Bushypark, the River Corrib corridor, Menlough and Ballindooley Lough.

3.6.2.2 Operation Stage

The following are the principal aspects of the Cyan Route Option that would give rise to the 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 Na Foraí Maola (Bearna); Bushypark, Ballindooley and Ballintemple;
- Provision of major road infrastructure through established residential communities, most especially at Na Foraí Maola (Bearna), Bushypark, Ballindooley and Ballintemple;
- General impact - visual disturbance of road infrastructure, noise issues/barriers, illumination, road lighting *etc*., on residential property at disperse locations along the route option;
- Impact on Protected County Views Number 72 and 74 north of Bearna Village, and View Number 70 at Bushypark, as well as City View V.10 and V19 at Bushypark and Ballindooley; and
- The provision of a bridge over the River Corrib in an existing high quality natural landscape setting close to riverside setting of Menlo Castle.

It is considered that the collective effect of impacts related to the scale of major infrastructure required to be provided - often within established residential community - will give rise to particularly significant and residual adverse impacts

on the landscape/townscape and visual environment of the route option corridor at Bushypark/N59, Menlo Castle demesne and at Ballindooley.

3.6.3 Summary

In summary, the Cyan Route Option has less incidence of significant and profound visual impacts on properties than other route options – especially to the east of the River Corrib – taking as it does a more outer rural alignment east of Galway Technology Park. The route option has a similar high level of landscape impact to that of other routes. The route has a significant impact on the setting of the River Corrib corridor and severs, on embankment, the demesne and avenue to Menlo Castle, however, it has less impact on the visual riverside setting of the castle itself when compared to other route options.

3.7 Archaeological, Architectural and Cultural Heritage

3.7.1 Introduction

The archaeological, architectural and cultural heritage assessment of the of the Cyan 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 uses the same methodology as outlined in **Section 6.5.6 Archaeological, Architectural and Cultural Heritage of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.11.1 to 4.11.2 of the Route Selection Report** and **Figure 3.7.1 to 3.7.4** of this Report.

The assessment has been based on the footprint of the 2006 GCOB to east of the River Corrib and the proposed Green Route to the west of the River Corrib. All measurements have been made from the designed fenceline to the archaeological, architectural or cultural heritage constraint (150m either side of the fenceline). Constraints identified during the initial constraints study consist of the following:

- Recorded Monuments & Places (RMP);
- Sites and Monuments Record (SMR);
- National Monuments;
- Monuments protected with a Preservation Order;
- Protected Structures;
- National Inventory of Architectural Heritage;
- Architectural Conservation Areas;
- Designed Landscapes;
- Previous Archaeological Excavations; and
- Previously unrecorded cultural heritage sites.

3.7.2 Assessment

Table 3.7.1 below identifies the archaeology, architectural and cultural heritage impacts of the Cyan Route Option.

Table 3.7.1 Potential Impacts

ID No.:		Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 1		Redundant record	No	40m east	N/a	N/a
CH 1		Enclosure (2006 EIS)	No	40m east	Indirect	Moderate negative

ID No.:		Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 6		Bushy Park House demesne	**House is in the RPS**	0m	Direct	Moderate negative
DL 5		Glenlo Abbey demesne	No	0m	Direct	Slight negative
BH 100		Thatched cottage	**Yes**	129m NW	Indirect	Imperceptible negative
BH 99		Remains of stone fort	**Yes**	98m north	Indirect	Slight negative
CH 14		Railway track (disused)	No	0m	Direct	Moderate negative
CH 17		Medieval field system? (2006 EIS)	No	0m	Direct	Moderate negative
AH 17		Redundant record	No	25m south	N/a	N/a
AH 6		Burial ground	**Yes**	70m NNE	Indirect	Moderate negative
AH 7		Designed landscape feature	No	14m north	Indirect	Moderate negative
AH 8		Designed landscape feature	No	106m NNE	Indirect	Slight negative
AH 9		Gate house (also BH 3)	**Yes**	124m north	Indirect	Slight negative
BH 3		Gate house (also AH 9)	**Yes**	124m north	Indirect	Slight negative
AH 11		Cairn - clearance cairn	**Yes**	17m south	Indirect	Moderate negative
AH 10		House - 17th century Castle, unclassified (Also BH 2)	**Yes**	141m SSW	Indirect	Moderate negative
BH 2		Menlo Castle (Also AH 10)	**Yes**	141m SSW	Indirect	Moderate negative
DL 10		Menlo Castle demesne	**House is in the RPS**	0m	Direct	Profound negative
CH 18		Regular rectangular cut feature & Possible standing stone (2006 EIS)	No	0m	Direct	Significant negative
CH 19		Vernacular structure, in ruins (2006 EIS)	No	0m	Direct	Significant negative

ID No.:		Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 20		Consumption wall (2006 EIS)	No	0m	Direct	Significant negative
CH 21		Vernacular animal shelter (2006 EIS)	No	0m	Direct	Significant negative
CH 22		Possible prehistoric tomb (2006 EIS)	No	0m	Direct	Significant negative
CH 23		Circular feature? (2006 EIS)	No	0m	Direct	Significant negative
CH 24		Small boulder (2006 EIS)	No	16m NW	Indirect	Moderate negative
CH 25		Possible cairn (2006 EIS)	No	0m	Direct	Significant negative
CH 26		Consumption wall (2006 EIS)	No	29m WNW	Indirect	Moderate negative
AH 120		Enclosure	**Yes**	19m NW	Indirect	Moderate negative
CH 27		Possible corn/turf drying stand, possible ringfort, possible cairn, possible consumption wall, three possible structures (2006 EIS)	No	0m	Direct	Significant negative
CH 28		Possible *fulacht fiadh* (2006 EIS)	No	0m	Direct	Significant negative
CH 29		Possible ringfort (2006 EIS)	No	0m	Direct	Significant negative
CH 30		Rectangular feature (2006 EIS)	No	0m	Direct	Significant negative
CH 31		Vernacular buildings, in ruins (2006 EIS)	No	0m	Direct	Significant negative
CH 40		Burnt mound and ditches? (Geophysical survey 2005)	No	0m	Direct	Significant negative
AH 12		Castle - tower house (Also BH 36)	**Yes**	138m SSW	Indirect	Slight negative

ID No.:		Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 36		Castle - tower house (Also AH 12)	**Yes**	138m SSW	Indirect	Slight negative
AH 149		Crannog (Also BH 70)	**Yes**	119m south	Indirect	Slight negative
BH 70		Crannog (Also AH 149)	**Yes**	119m south	Indirect	Slight negative
AH 163		Castle, 17th C House, Inscribed stone	**Yes**	41m WNW	Indirect	Moderate negative
AH 20		Quarry	No	83m E & W	Indirect	Slight negative
AH 21		Redundant record	No	97m east	N/a	N/a
CH 32		Consumption wall (2006 EIS)	No	25m NNW	Indirect	Slight negative
CH 33		Raised natural Limestone platform with possible hut (2006 EIS)	No	42m NNW	Indirect	Slight negative
AH 13		Quarry	No	143m SW	Indirect	Imperceptible negative
CH 45		Upright stone (2006 EIS)	No	12m NE	Indirect	Moderate negative
CH 48		Burnt mound? (Geophysical survey 2005)	No	0m	Direct	Significant negative
CH 34		Possible standing stone, isolated boulder, three raised areas of archaeological potential, possible cairn (2006 EIS)	No	0m	Direct	Significant negative
CH 35		Raised stone circular area (2006 EIS)	No	0m	Direct	Significant negative
CH 36		Group of vernacular buildings (2006 EIS)	No	10m west	Indirect	Significant negative
CH 37		Possible stone dump with boulders and trees (2006 EIS)	No	57m SW	Indirect	Slight negative

ID No.:		Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 46		Burnt mound? (Geophysical survey 2005)	No	0m	Direct	Significant negative
CH 47		Two Burnt mounds? (Geophysical survey 2005)	No	0m	Direct	Significant negative

3.7.3 Summary

The Cyan Route Option would impact considerably upon the cultural heritage resource. Whilst it is acknowledged that many of the sites identified in or within the immediate vicinity of scheme to the east of the River Corrib, were identified during the 2006 GCOB EIS and 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 Cyan Route Option

Profound negative	Significant negative	Moderate negative	Slight negative	Imperceptible negative
DL 10 (Menlo Castle demesne)	**CH 18** (Rectangular feature, poss. standing stone) **CH 19** (V. building) **CH 20** (Consumption wall) **CH 21** (V. animal shelter) **CH 22** (Poss. PH tomb) **CH 23** (Circular feature) **CH 25** (Poss. cairn) **CH 27** (Multiple sites) **CH 28** (Poss. *fulacht fiadh*) **CH 29** (Poss. ringfort) **CH 30** (Rectangular feature) **CH 31** (V. building) **CH 40** (Burnt mound/ ditches?) **CH 48** (Burnt mound?) **CH 34** (Multiple features) **CH 35** (Raised stone area) **CH 36** (V. buildings)	**CH 1** (Enclosure) **DL 6** (Bushy Park demesne) **CH 14** (Railway line) **CH 17** (Medieval field system) **AH 6** (Burial ground) **AH 7** (DLF) **AH 11** (Cairn) **AH 10/ BH 2** (Menlo Castle) **CH 24** (Small boulder) **CH 26** (Consumption wall) **AH 120** (Enclosure) **AH 163** (Castle) **CH 45** (Upright stone)	**DL 5** (Glenlo Abbey demesne) **BH 99** (Remains of stone fort) **AH 8** (DLF) **AH 9/ BH 3** (Gate house) **AH 12/ BH 36** (Tower house) **AH 149/ BH 70** (Crannog) **AH 20** (Quarry) **CH 32** (Consumption wall) **CH 33** (Platform & hut?) **CH 37** (Stone dump, boulders)	**BH 100** (Cottage) **AH 13** (Quarry)

Profound negative	Significant negative	Moderate negative	Slight negative	Imperceptible negative
	CH 46 (Burnt mound?) **CH 47** (Two burnt mounds)			

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.

There are a total of 19 significant impacts upon sites which were identified as part of the N6 Galway City Outer Bypass EIS (2006) and during geophysical survey of for that scheme.

3.8 Material Assets – Agriculture

3.8.1 Introduction

The material assets -agriculture assessment of the of the Cyan Route Option has been carried out with respect the material assets -agriculture 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 Cyan Route Option.

Table 3.8.1 Material Assets - Agricultural Impacts

	Section 1	Section 2
Agricultural land (ha)	16.5	99
Good quality agricultural land (ha)	0	50
Area of land parcels (ha)	105	645
No of farm yards/farm structures	1	9
No of Equine enterprises	0	1

The Cyan Route Option will take approximately 16.5 hectares in Section 1, and 99 hectares of agricultural land and approximately 35 hectares of this land is classified as medium - 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 – medium. The Cyan Route Option affects 1 farm yards/structures and affects approximately 105 hectares of land parcels in Section 1 and 9 farm yards/structures and affects 645 hectares of land parcels in Section 2. It also affects 1 no. equine farm yard in Section 2.

3.9 Material Assets – Non Agriculture

3.9.1 Introduction

The material assets – non agriculture assessment of the of the Cyan Route Option has been carried out with respect the material assets – non agriculture constraints identified in **Section 4.13 Material Assets -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 3.9.4** of this Report.

3.9.2 Assessment

The assessment for the number of properties directly impacted by the Cyan 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 within the Cyan Route Option means that this route option has large direct impacts on residential properties with the full acquisition of 16 residential properties, and partial landtake from a further 16 residential properties.

Table 3.9.1 Property Assessment - Section 1

Location	Residential Acquisitions	Residential Partial Landtake
Within the fenceline	16	4
Within the Corridor	-	12

The assessment for the number of conflicts with utilities for the Cyan 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 Cyan 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.

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 73 residential properties and five commercial directly impacted in Section 2, including the full acquisition of 25 residential properties and no commercial properties.

Table 3.9.3 Property Assessment - Section 2

Location	Residential Acquisitions	Residential Partial Landtake	Commercial Acquisitions	Commercial Partial Landtake	Planning Permissions
Within the fenceline	25	5	-	3	1
Within the Corridor	-	43	-	2	-

The assessment for the number of conflicts with utilities for the Cyan 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. It also crosses the SSE 110kV lines at two locations.

Table 3.9.4 Utilities Assessment – Section 2

Utility	No. of Conflicts
E-Net	2
ESB HV OH	11
ESB HV UG	1
ESB MV OH	14
ESB MV/LV UG	4
Eircom	16
Bord Gáis	3
UPC	1
Council Watermain – 300mm	2
Council Watermain – 450mm	0
Council Watermain – 500mm	1
Foul Pipes	1
Surface Drainage	0
Trunk Sewer	2
SSE	2

3.9.3 Summary

In summary the Cyan Route Option mostly impacts on residential properties with the full acquisition of 41 residential properties and partial landtake from a further

48 residential properties. There will be no full acquisition of commercial demolitions, however three commercial sites lie within the footprint of the design and will require some land acquisition. The Cyan Route Option has a low number of utility impacts largely due its rural location outside densely populated city areas.

3.10 Air Quality and Climate

3.10.1 Introduction

A preliminary Stage 1 impact assessment for the Cyan 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 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 Cyan Route Option follows an alignment predominately towards the outskirts of the city, traversing a large number of local and regional roads, 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 Cyan 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 Cyan Route Option.

3.11 Noise and Vibration

3.11.1 Introduction

A preliminary Stage 1 impact assessment for the Cyan 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

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

Apart from residential dwellings, there are no significant other noise or vibration constraints identified along the proposed alignment. The distribution of residential properties along the length of this corridor is, for the majority, ribbon style housing along local roads. The route alignment traverses a large number of small local and regional roads particularly to the west of the River Corrib crossing.

In order to assess the potential noise impact of the Cyan Route Option on the surrounding environment, an indicative 60dB L_{den} contour has been mapped along the length of the alignment taking account of the vertical profiles, traffic flows and speeds etc. discussed in the methodology outlined in **Section 6.5.8 Noise and Vibration of the Route Selection Report**. The contour has been used in conjunction with OS mapping to assess the potential number of properties likely to fall within this contour band.

To the west of the scheme study area, between Bearna and na hAille, lower traffic flows along this section of the route results in a smaller 60dB L_{den} footprint compared to the remainder of the route option, however due to the number of local roads traversed in this area and the distribution of ribbon style housing along these roads, a number of residential properties are calculated to fall within the mapped contour line.

Between the Western Distributor Road and the Rahoon 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 expected to fall within the contour line.

To the east of the River Corrib, the route traverses the village of Ballindooley with the inclusion of a large interchange and realigned N84.

At this location, a large number of properties are calculated to fall within the 60dB L_{den} noise contour line.

East of Ballindooley the route alignment passes at further distances from noise sensitive properties. This combined with the vertical alignment within cutting for the majority of this section of the route, leads to lower predicted noise impacts and fewer properties lying within the 60dB L_{den} contour line. The exception to this being at Ballintemple where the proposed alignment passes across two local roads and passes by in close proximity to a number of residential dwellings.

On review of the Cyan Route Option alignment, there are of the order of 500 properties which have the potential to fall within the 60dB L_{den} noise contour along its alignment. A large proportion of these properties are positioned along the western section of the route option. Due to the distribution of properties in linear development along local roads in addition to clusters of properties at crossing points and villages along the route option, the requirement for noise mitigation along this route will be substantial. 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.

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.

Overall, the Cyan Route Option alignment will have a significant noise impact on the local environment through which it passes, particularly those areas currently set back from existing road traffic noise. The number of properties likely to require noise mitigation is likely to be significant along the length of the route.

3.12 Human Beings

3.12.1 Introduction

A preliminary Stage 1 impact assessment for the Cyan 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 principle impacts in Section 1 of the Cyan Route Option 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 levels and associated severance on R336 into Galway City.

The Cyan Route Option would commence on the R336 west of Bearna and from here head directly north across low intensity grazing land. The option would lead to the loss of some residential properties on a cul-de-sac off Na Foraí 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.

On operation, the Cyan Route Option would require local traffic in Bearna to make a journey of one kilometre or more westwards for journeys back east into Galway City.

By capturing much of the traffic arriving on the R336 from the west, this route option would reduce the amount of non-local traffic using Bearna main village street and also provide relief from community severance.

3.12.2.2 Section 2 – Principle Impacts

West of the River Corrib

The principle impacts in Section 2 west of the River Corrib for the Cyan Route Option are as follows:

- Construction impact and loss of existing equestrian facility at Tonabrocky;
- Impact on residential property in Ballagh and Bushy Park followed by general amenity and social severance impact on operation;
- Connectivity to Western Distributor Road via Cappagh Road and to Moycullen Road, Rahoon Road and N59 for access into Galway City;
- Impact on part of Glenlo Abbey Golf Course;
- Impacts to amenity in the vicinity of Menlough graveyard;
- Significant construction impacts due to proposed interchange at Ballindooley with implications for social severance, albeit with opportunities to provide relief from severance between the historic village, the castle and lands to the east;
- Good connectivity provided by interchange with N17;
- Lower opportunity for improved traffic flow than other route options with consequent reduced journey time benefits and journey amenity benefits on operation for pedestrians and cyclists on existing R338 and for junctions at Browne Roundabout, Newcastle Road, Bodkin Roundabout, Kirwan Roundabout and N17 Junction; and
- Lower assumed reductions in traffic on the N6 east of Kirwan Roundabout with consequent lower benefits impacts for journey time, journey amenity and severance.

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 Gortnacleva 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 Bushy Park 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**).

In the operational phase, the Cyan Route Option would pass beside a residential estate off Ballymoneen Road. At Ballagh and Bushy Park, the route 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 Park golf course.

The Cyan 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 Green 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 Blue and Pink Route Options. This would introduce slight new severance to community facilities and built-up sections of the road to the south.

East of the River Corrib

To the east of the River Corrib, the Cyan Route Option crosses the river just below Menlough Graveyard which is a local heritage amenity. The route option then cuts across the demesne between the historic community of Menlough and Menlo Castle. While this alignment avoids significant direct impacts on the community itself it would introduce a degree of social or psychological severance in the operational phase between the community and the castle.

The Cyan Route Option would cut across the Coolough Road and include a junction with the N84 at Ballindooley. Ballindooley is a dispersed community adjacent to the Headford Road which has a slight concentration of houses to the north. Although located to the west of the heart of this dispersed community of Ballindooley, the provisional location for the southern spurs of the interchange would contribute further to the social severance of the two parts of the community. The interchange would, however, contribute to a transfer of much traffic from the existing N84 and this would reduce severance between Ballindooley, Ballindooley Castle, the lough and the landscape east towards Castlegar (see also Section 3.6, Landscape & Visual). The net impact would likely tend to the negative, but could be mitigated.

The route option then heads west towards, and just inside, the boundary of the scheme study area connecting with the N17 at an interchange just to the north of the road serving the Parkmore and Galway Racecourse Business Parks. It is likely that there would be some residential demolitions in Ballintemple during construction, but socio-economic impacts are avoided by the connection with the N6 to the east of Coolagh.

The Cyan Route Option avoids some established communities and areas of built development, although there are still construction and operation phase impacts on Bushy Park and Ballindooley. The relative weakness of the option is that by taking a route to the edge of the scheme study area it would be less successful at capturing both through and intra-city traffic than options closer to Galway City. This factor is discussed in Section 4 below, but can be expected to affect local journey times, journey amenity and severance in the city during the operational phase. More traffic would continue to utilise the existing N6 and R338 in the city with the effect that reductions in journey time for local traffic, improvements in journey amenity for pedestrian and cyclists, and potential relief from severance for communities and community facilities would be inferior to that achieved by other options.

Table 7.12.1 Summary of Construction Impacts

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
Severance & general amenity	Ballagh / Bushy Park	N/a	Severance and amenity impacts	Major negative	Medium
Severance & general amenity	Ballindooley	N/a	Severance and amenity impacts	Major negative	Medium

Table 7.12.2 Summary of Operational Characteristic

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
Journey time and connectivity					
Connectivity	Junction with Cappagh Road in vicinity of Western Distributor Road	N/a	Useful connection into western city suburbs onto suitable road	Moderate positive	Medium
Connectivity	Bearna	Congestion at peak times	Option collects local Bearna traffic but requirement for 1km+ diversion west or use of minor Bearna-Moycullen Road.	Slight positive	Medium
Connectivity	N59	N/a	Useful connection with local road and with primary road	Major positive	High
Journey time, journey amenity and severance	N6 between Kirwan Roundabout and Coolagh	Heavy traffic	Transfer of traffic to route options with reductions in journey time, improvements in journey amenity and relief form severance	Assume moderate positive	Very high
Amenity – Journey amenity					

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
Improved journey amenity	N6, Seamus Quirke Road and Bishop O'Donnell Road	Congestion and high traffic volumes	A proportion of traffic transferred to proposed scheme	Slight positive	Very high
Reduced delay and hazard	Bodkin Roundabout	Delay and congestion for pedestrians and vehicles. No cycle facilities	Separation of local and through traffic	Moderate positive	Very high
Reduced delay and hazard	Kirwan Roundabout	Delay and congestion for pedestrians and vehicles. No cycle facilities	Separation of local and through traffic	Moderate positive	Very high
Improved safety	Ballindooley	Hazardous connections to local road	Transfer of much traffic to link road	Moderate positive	Medium
Amenity – General Amenity					
Severance and amenity	Bearna	Moderate traffic volumes. Higher in holiday period.	Reduced severance along with improved residential amenity and parking opportunity	Moderate positive	High
Equestrian centre	Tonabrocky	Private business community facility	Loss of facility	Slight negative	Low
Golf course	Glenlo Abbey	N/a	Impact on south-western corner of course	Moderate negative	Low
Environmental	Menlough	Historic graveyard	No direct impact, but close proximity	Slight negative	Medium
Relief from Severance					

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
Relief from severance	Bearna Centre	Congestion especially at peak times and holiday periods	Though traffic and much local traffic transferred to options	Moderate positive	High
Relief from severance	R336 and R337 into Galway City	High traffic volumes	Transfer of proportion of traffic	Moderate positive	High
Relief from severance	Seamus Quirke Road	Busy road providing access to local facilities and to west	Non-local traffic taken below ground with surface traffic limited to access to residential estates, retail and community facilities.	Slight positive	Very high
Relief from severance	Tuam Road (Bóthar Thuama)	High severance	Reduced traffic contributing to relief from severance for community facilities such as Colaiste Na Coiribe	Slight positive	Medium
Relief from severance	Ballindooley	Social/psychological severance due to busy N84	Link with community improved by transference of some traffic	Moderate positive	Medium
New Severance					
New severance	Cul-de-sac north of Bearna	Recent ribbon development along cul-de-sac	Social severance of end of cul-de-sac and loss of several houses	Slight negative	Low
New severance	Ballard West	Ribbon development	New severance (social)	Slight negative	Low
New severance	Bushy Park	Established linear development	New severance combined with loss of several established properties (social)	Moderate negative	Medium

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
New severance	Ballindooley	dispersed established community	Social severance introduced by proposed route and link roads to N84.	Major negative	Medium
Economic					
Impact on business	Tonabrocky	single business	Loss of facility	Major negative	Low

4 Traffic Assessment

4.1 Existing traffic

The Census 2011 data showed that Galway City currently has a population of approximately 75,500, an increase of 4.3% since the 2006 census. Galway County (including Galway City) has a population of approximately 250,000, an increase of 8.2% since the 2006 census. The population of Galway west of the River Corrib is approximately 77,000. Of this, 39,625 people live within the city boundary. Therefore, the areas west of the city have a population of approximately 37,375; this population is dispersed from Moycullen and Spiddal in the south to Leenaun on the Mayo boundary in the north.

As part of the scheme concept and feasibility studies an examination of the existing travel patterns and demand was undertaken. Part of this resulted in the production of desire line diagrams. Figure 4.1 below shows the desire line diagram produced for Galway City. This diagram shows traffic from east and west of the city travelling cross city and into the city and also details inner city movements. The following should be noted when interpreting Figure 4.1:

- Sectors are delineated by solid grey lines;
- Journeys from one sector to another sector are aggregated together and shown as a single line. The thickness of the line highlights the level of demand and includes both directions of travel;
- The aggregated journeys are shown from the centre of one sector to the centre of the destination sector(s);
- Journeys undertaken and completed internally within sectors are not shown;
- Desire lines shown are not road based;
- Green lines denote journeys which commence and end without crossing the River Corrib; and
- Red lines denote journeys which include crossing the River Corrib.

Figure 4.1 shows the demand towards the city, with a strong demand coming from all over the county to the city. It also shows many red desire lines which commence from sectors outside the city and terminate in sectors outside the city on the opposite side of the river, demonstrating the trips that are forced through the city to cross the river as part of their longer journey beyond the city.

Figure 4.1 highlights the significant amount of traffic which is drawn towards Galway City. It also highlights the fact that the further the proposed route is from the city the less attractive it would be to motorists accessing the city. Any proposal to introduce a viaduct across Lough Corrib would at a minimum be located 4.5km from the existing cross city route – the N6 and R338. There is therefore limited benefit from a traffic perspective to locating the potential crossing point across Lough Corrib.

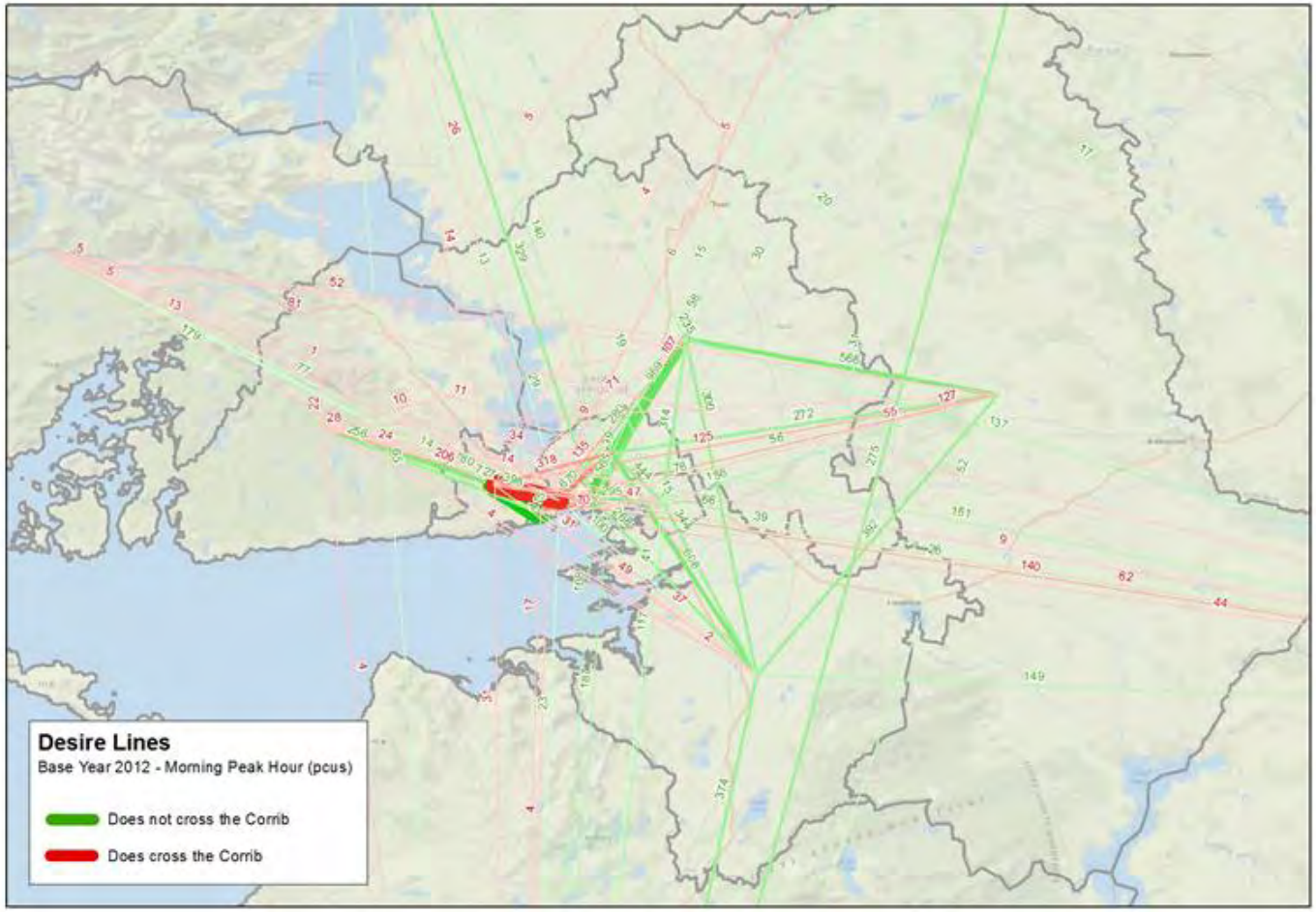

Figure 4.1: Desire Lines

4.2 Future Traffic

The Cyan 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 Stage 2 Green Route Option and the 2006 GCOB were both modelled using the Galway Interim Model. The Cyan Route is identical to the Green Route Option in the West and is very similar to the Green Route Option in the East with respect to junction connectivity, i.e. the Green contains a junction at the N84, the N17 and a junction at the tie in to the N6. Therefore in terms of traffic, the Green Route Option would provide the most relevant traffic numbers at key locations in the city, which were compared for both options to establish the traffic numbers on the new road and the relief provided for existing roads.

The Cyan Route Option is similar in length to the 2006 GCOB Route Option in the East but the 2006 GCOB Route Option lacks the connectivity at the N17. It is likely that the traffic figures for the Cyan Route Option would lie somewhere in between the two sets of results, and most likely closer to the Green Route Option due to the provision of the additional junction at the N17 and exact alignment to the west of the river.

4.2.1 Assessment

The assessment carried out compared the AADT numbers for the Do-Minimum scenario, the Green Route Option, the 2006 GCOB 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, 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	Green Route Option 2019	GCOB Route Option 2019	Do-Minimum 2034	Green Route Option 2034	GCOB Route Option 2034
Quincentenary Bridge	35,000	30,500	33,200	34,800	31,000	34,100
Salmon Weir Bridge	15,100	13,000	13,300	16,700	15,100	15,400
O'Brien's Bridge	7,900	6,700	7,500	9,100	7,800	8,300
Wolfe Tone Bridge	19,200	16,500	17,600	20,800	17,600	18,200
Bearna Village	11,600	4,800	6,500	13,400	5,200	7,300
Seamus Quirke Road	11,600	7,400	8,600	11,500	7,600	8,700
Headford Road (between Bodkin Junction and Kirwan Roundabout)	28,700	28,600	30,000	29,900	30,600	31,300
Bóthar na dTreabh	31,600	18,800	24,100	33,800	20,900	25,700

Location	Do-Minimum 2019	Green Route Option 2019	GCOB Route Option 2019	Do-Minimum 2034	Green Route Option 2034	GCOB Route Option 2034
Dublin Road (between Moneenageisha Junction and Skerritt Roundabout)	19,800	17,100	17,400	18,600	18,400	18,400

The implementation of the Cyan 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 to the city, the Cyan Route Option provides greater relief in 2019 and 2034 than the Do-Minimum scenario.

5 Conclusion

Whilst the Cyan Route Option meets the project objectives outlined in **Chapter 1 of the Route Selection Report** there are significant impacts to human beings amenity value and natural landscape and visual setting of the River Corrib, Glenlo Abbey Golf Course, and the Demesne of Menlo Castle. The Cyan Route Option has a profound impact on the curtilage of Menlo Castle from a Cultural Heritage perspective. Additionally, this route option has potentially a large impact on flood risk in the vicinity of the River Corrib and its floodplains. The location of the River Corrib bridge crossing presents a major negative in terms of impact of soils & geology due to the presence of soft & peat soils in the area.

The Cyan Route Option has a significant impact on Annex I habitat, Limestone pavement [* 8240] within the Lough Corrib cSAC which would impact on the integrity of the Lough Corrib cSAC.

From a socio-economic and human beings perspective, there are a number of major severance effects on communities associated with the Cyan Route Option at Bushy Park and at Ballindooley.

In terms of Ecological impacts, the Cyan Route Option east of the River Corrib has the potential to result in significant negative impacts to Lough Corrib cSAC. The loss of Qualifying Interest (QI) habitats in Lough Corrib cSAC associated with this route option would constitute an adverse effect on the integrity of this European site.

Whilst the traffic assessment shows a slight improvement to congestion with the implementation of the Cyan Route Option, the other route options assessed as part of the Stage 1 assessment of options have the potential to provide a greater level of relief.

From the perspective of the integrity of the Lough Corrib cSAC there are less damaging alternatives available east of the River Corrib. The path followed by the Cyan Route Option west of the River Corrib is the same as that of the Green Route Option and therefore the Cyan Route Option was discounted from further analysis.