Appendix A.7.6

BD02 River Corrib Bridge

A.7.6

Galway County Council

N6 Galway City Ring Road

River Corrib Bridge

GCOB-4.04-020-012

Issue 4 | 23 October 2017

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 233985-00

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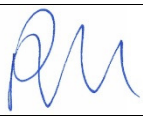
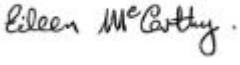
		Signature			
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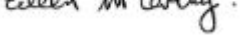
		Signature			
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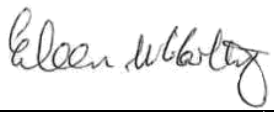
		Signature			
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Contents

Appendices

1 Introduction

1.1 Design Brief

Galway County Council, Galway City Council, Transport Infrastructure Ireland (TII) (formerly NRA)[1] and the National Transport Authority are collaborating to develop a solution to the existing transportation issues in Galway City and its environs. The solution will include a smart mobility component, public transport component and a road component. The N6 Galway City Ring Road (N6 GCRR) is the road component.

As part of the N69 GCRR there are a number of structures envisaged. This report presents the preliminary design for the River Corrib Crossing (Structure S09/01) in accordance with the guidelines detailed within TII DN-STR-03001 (formally NRA BD02).

1.2 Project Background

The N6 Galway City Outer Bypass, an earlier scheme, was previously developed and submitted to An Bord Pleanála (ABP) for approval on 1 December 2006. A brief summary of its history is outlined below.

On 28 November 2008, ABP delivered its decision in respect of the 2006 GCOB. ABP considered that the need for an outer bypass of Galway City connecting the existing N6 on the east to the R336 Coast Road on the west as an essential part of the strategic transport network of the Galway area had been established.

ABP granted approval for the eastern part of the scheme, the section from the N59 Moycullen Road east to the existing N6, inclusive of both junctions at the N59 Moycullen Road and the existing N6. In its decision, ABP noted its consideration of all data presented and granted approval as it considered that the part of the road development being approved would be an appropriate solution to the identified traffic needs of the city and surrounding area. ABP noted that there would be a localised severe impact on the Lough Corrib candidate Special Area of Conservation (cSAC) [2].

However, ABP was not satisfied with the western section of scheme between the N59 Moycullen Road and R336 Coast Road which passed through Tonabrocky Bog. Tonabrocky Bog is:

- part of the Moycullen Bogs Natural Heritage Area (NHA)
- an active Blanket bog listed as an priority habitat in Annex I of the EU Habitats Directive

[1] The Minister for Transport, Tourism and Sport signed the order for the merger of the National Roads Authority (NRA) with the Railway Procurement Agency (RPA) to establish a single new entity called Transport Infrastructure Ireland (TII). The National Roads Authority is known as Transport Infrastructure Ireland (TII) since 1 August 2015.
[2] Reference ABP decision 07.ER.2056

- the site of a population of Slender cotton grass which is a legally protected and vulnerable species

ABP refused permission for the western section of the scheme between the N59 Moycullen Road and R336 Coast Road on the basis that this part of the road development would not be in accordance with the preservation of the Tonabrocky Bog habitat given the potential for significant adverse effects on the environment and that less damaging alternatives may be available[3].

An application was made by a third party to the High Court seeking leave to issue judicial review proceedings against the ABP decision which granted approval of the eastern section of the 2006 GCOB under Article 6(3) of the Habitats Directive (92/43/EEC), as amended. The basis for the request for a review was that ABP had erred in its interpretation of Article 6 of the Habitats Directive (92/43/EEC), as amended, in arriving at the conclusion that the effect of the 2006 GCOB road scheme on the Lough Corrib cSAC designated site would not constitute an adverse effect on the integrity of the site.

The High Court undertook a judicial review of the ABP decision. The High Court decision of 9 October 2009 upheld ABPs decision to approve the eastern part of the scheme. On 6 November 2009, the third party was granted leave to appeal to the Supreme Court against the High Court decision of 9 October 2009. The Supreme Court sought the opinion of the Court of Justice of the European Union (CJEU) on an interpretation of the Habitats Directive.

The opinion of the CJEU was delivered on the 11 April 2013 (Case C-258/11). The opinion concluded on two significant points:

- The 2006 GCOB would have an adverse effect on the integrity of the Lough Corrib cSAC due to the removal of 1.47ha of Limestone pavement (a habitat type for which the cSAC was selected)
- Given that the 2006 GCOB would have an adverse effect on the integrity of the cSAC, the proposed scheme could not be authorised under Article 6(3) of the Habitats Directive. It could only be authorised under Article 6(4) of the Habitats Directive

The CJEU opinion (i.e. Case C-258/11) established that the loss of a relatively small area of Priority Annex I habitat, where it is a habitat for which the Lough Corrib cSAC is selected, would adversely affect the integrity of the Lough Corrib cSAC and that the provisions of Article 6(4) must apply in granting consent for the project i.e.

6(4) "If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted".

Following receipt of the CJEU opinion, the Supreme Court quashed the earlier ABP decision to grant approval of the eastern section of the 2006 GCOB under Article 6(3) of the Habitats Directive, as amended.

As the decision of the Supreme Court was that the original 2006 GCOB scheme could not be granted approval per Article 6(3) of the Habitats Directive, the next recourse to secure planning was to advance the scheme under Article 6(4) of the Habitats Directive. Having reviewed the requirements of Article 6(4), it was decided to reassess the work to date to ensure that all possible alternatives were investigated in advance of proceeding under Article 6(4). Therefore, the process of developing a transportation solution for Galway City and its environs had to recommence from the start at Phase 1, feasibility and concept stage, to ensure that all possible alternatives were fully investigated.

1.3 Previous Studies and their Recommendations

Following on from the initial feasibility studies, a suitable scheme study area was determined. Thereafter the constraints study and route selection process commenced.

Key constraints were identified and examined. These included:

1. The physical form of the city with the limited space available between Lough Corrib and Galway Bay
2. Established communities, commercial and educational facilities
3. Natura 2000 designated sites and Natural Heritage Areas
4. Sites of significant architectural and cultural heritage

Taking cognisance of the judgement of the 2006 GCOB scheme, the Lough Corrib candidate Special Area of Conservation and the key constraints including those listed above, Route Options were developed for further assessment. These options comprised on-line options including an upgrade of existing infrastructure, partial on-line/off-line options and new construction off-line. These options were developed and agreed with TII and refined following public consultation and further studies.

A systematic assessment of these options was undertaken which led to the selection of the Emerging Preferred Route Corridor (EPRC) for the road component and this was published in May 2015. Full details of the route option selection process are outlined in the Route Selection Report for the proposed road development.

Previous studies and documents relevant to this Preliminary Design Report are listed below:

- Galway County Council. Project Brief. Phase 1, Scheme Concept and Feasibility Studies (REF/14/11222, 2 May 2015)
- Galway County Council. Project Brief. Phase 2, Route Selection (REF/14/11222, 6 November 2015)
- GCOB-4.04-009 Route Selection Report, Issue 1, March 2016.
- Galway Transport Strategy, An Integrated Transport Management Programme for Galway City and environs, Technical Report, September 2016

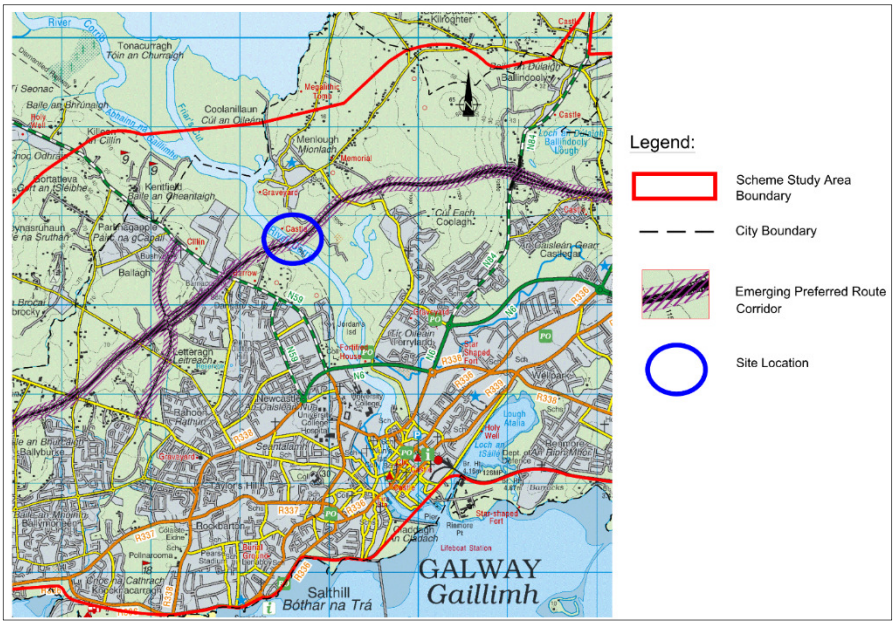
- GCOB-4.04-020-008, River Corrib Options Report, Issue 2, 2 October 2016

2 Site and Function

2.1 Site Location

The River Corrib crossing (**Figure 2.1**) is located to the west of the Menlough Viaduct and to the north of Galway City, on the EPRC for the N6 GCRR.

Figure 2.1: River Corrib Crossing Site Location



2.2 Function of the Structure and Obstacles Crossed

The purpose of the River Corrib Crossing is as follows:

- Provide for a crossing of the River Corrib
- Traverse NUIG recreational facilities and Lough Corrib cSAC

The design of the structure minimises the potential impacts on Menlo Castle and its demesne, Lough Corrib candidate Special Area of Conservation (cSAC), NUI Galway (NUIG) recreational facilities, and the River Corrib itself.

The proposed road development enters NUIG recreational facilities to the north of the existing hockey pitch, athletics track and pavilion building. It passes through the playing fields before crossing the river, with a skew of approximately 25°. East of the river, the proposed road development continues through the Lough Corrib cSAC and through a wooded area.

2.3 Choice of Location

An extensive constraints and route selection study was carried out for the proposed road development and its findings are presented in the N6 Galway City Transport Project Route Selection Report (GCOB-4.04-009).

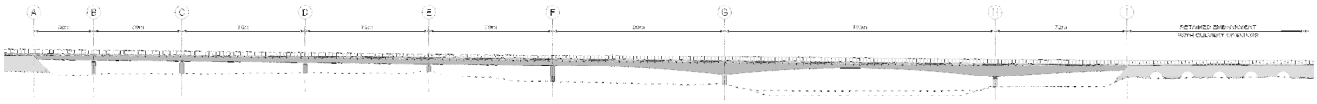
The EPRC was identified through a systematic assessment of the various route options with respect to the different constraints. The EPRC requires the mainline of the proposed road development to cross the River Corrib at the proposed location.

2.4 Site Description and Topography

The River Corrib crossing is situated to the north of Galway City Centre, adjacent to Menlo Castle and traversing NUIG recreational facilities and the Lough Corrib candidate Special Area of Conservation (cSAC). The topography is relatively level at the site. There is a wooded area to the east of the river and on the west are the recreational facilities of NUIG.

Given the exposed location, protection to wind susceptible vehicles may be necessary. An assessment of the wind climate at the Corrib River Bridge and an estimation of benefit to traffic from protection measures (windshields) is recommended at the next stage of design development.

Figure 2.2: Elevation of River Corrib Structure



2.5 Vertical and Horizontal Alignments

The bridge structure is elevated over the River Corrib and on the approaches to each side of the river channel.

The elevation above existing topography is dictated by bridge structural depth, minimum clearance desired below deck in NUIG grounds and the navigational headroom below bridge required for river traffic. The proposed road development is approximately 15.5m above the mean water level in the River Corrib.

The elevated structure has a length of approximately 620m between abutments. To the east, within the wooded area, the embankment is retained to minimise the footprint and incorporates a number of underpass structures to provide sufficient permeability for the movement of wildlife.

The horizontal alignment consists of a horizontal radius of 1440m on the west transitioning to a horizontal radius of 2000m across the river and onto the east river bank. The alignment requires some widening of the cross section for forward stopping sightline distances (SSD) of 215m for 100km/h design speed. This results in a varying cross section at the start of the bridge west of the river within

NUIG lands. There is a super-elevated cross fall of 2.5% over the 1440m curve and normal 2.5% crossfall over the 2000m curve.

The verge widths are reduced from 3.0m to a 0.6m raised verge over the length of the structure. The hard shoulders are reduced from 2.5m to a minimum of 0.5m over the length of the structure, however, due to the SSD requirements the hard shoulder is greater than 0.5m at the start of the bridge west of the river.

The vertical alignment consists of a fall from west to east at a 1% gradient into a 12000m radius sag curve.

Table 2.1: Vertical and Horizontal Alignments.

Name of Structure	N6 Mainline	
	Vertical Alignment	Horizontal Alignment
River Corrib Crossing	Vertical Gradient of 1% Sag Curve of R=12000m	R=1440m transitioning into R=2000m

2.6 Cross Sectional Dimensions

As a result of the curved alignment there are sections along the length of the bridge where the deck needs to be widened to accommodate sightline stopping distances. The minimum deck width is 21.7m (Figure 2.3), widened where required for sightlines. Between gridline A to F, the depth of the box is constant, the length of the cantilever is constant (6.1m) and the width of the box section varies to make up the overall width. The increase in overall width is symmetric to the centreline of the bridge.

Between gridline F to I, the total width of the cross section is constant; the width of the box and the width of the cantilever are constant; the depth of the box section varies.

The geometry of the deck cantilever ribs is constant along the full length of the bridge. The envisaged depth of rib at the connection with the box section is 700mm below deck slab, with a width of 600mm.

The proposed cross section of the bridge deck is given in the drawing GCOB-1700-D-S08-04-002 in Appendix B and summarised in Table 2.2 below. Noise barriers, at each side of the bridge, are located outside the working width of the vehicle parapet.

Figure 2.3: Superstructure Cross-Section at River Crossing

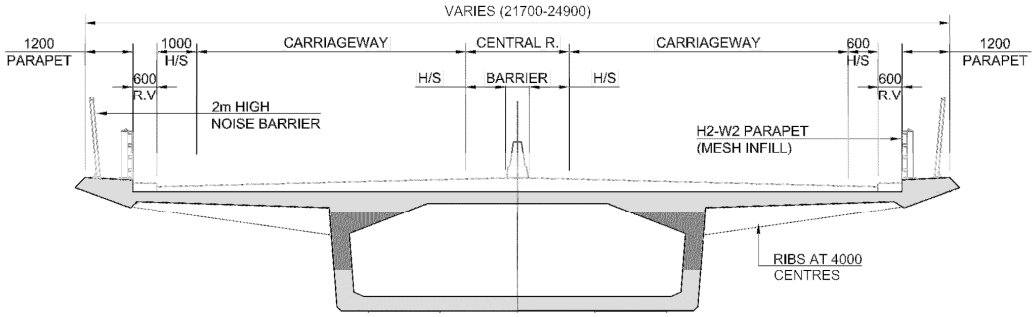


Table 2.2: Dimensions on Bridge Deck (all Dimensions Measured Perpendicular to the Mainline)

Name of Structure	Carriageway Width [3] (m)	Verge [1] Width (m) - Left [2]	Verge [1] Width (m) - Right [2]	Parapet upstand width (m) [Left]	Parapet upstand width (m) [Right]
River Corrib Crossing	21.7 – 24.9	0.6	0.6	1.2	1.2

[1] The width of the verge includes any additional requirements due to sightline visibility.

[2] When considered in the direction of increasing chainage.

[3] Carriageway width measures from outer edge of hardshoulders (includes central reserve)

2.7 Existing Underground and Overground Services

All the utility providers have been consulted during the preliminary design process. The existing services in the vicinity of the proposed structures are outlined in **Table 2.3** below.

Table 2.3: Existing Services

Name of Structure	Existing Services
River Corrib Crossing	SSE – 110kV Proposed Line ESB – 38kV Overhead Line

2.8 Geotechnical Summary

The general ground conditions consists of firm to stiff cohesive glacial till, mixed with granular till, with the vast majority of the area underlain by very strong limestone.

The assessment of the geology, ground conditions and geotechnical aspects of the design and construction of the proposed road development at the River Corrib is bound by the following aspects:

- The fenceline
- The vertical and horizontal alignment
- The available ground investigation data

The ground conditions along the proposed road development were determined using various sources of information including historic data, photographic evidence, observations from site walkovers, intrusive and non-intrusive site investigations, laboratory testing and on site investigation monitoring.

A conservative geotechnical design approach has been adopted for this assessment. In the event that supplementary information is made available the information will be assessed and the results of the assessment may lead to a more efficient design solution.

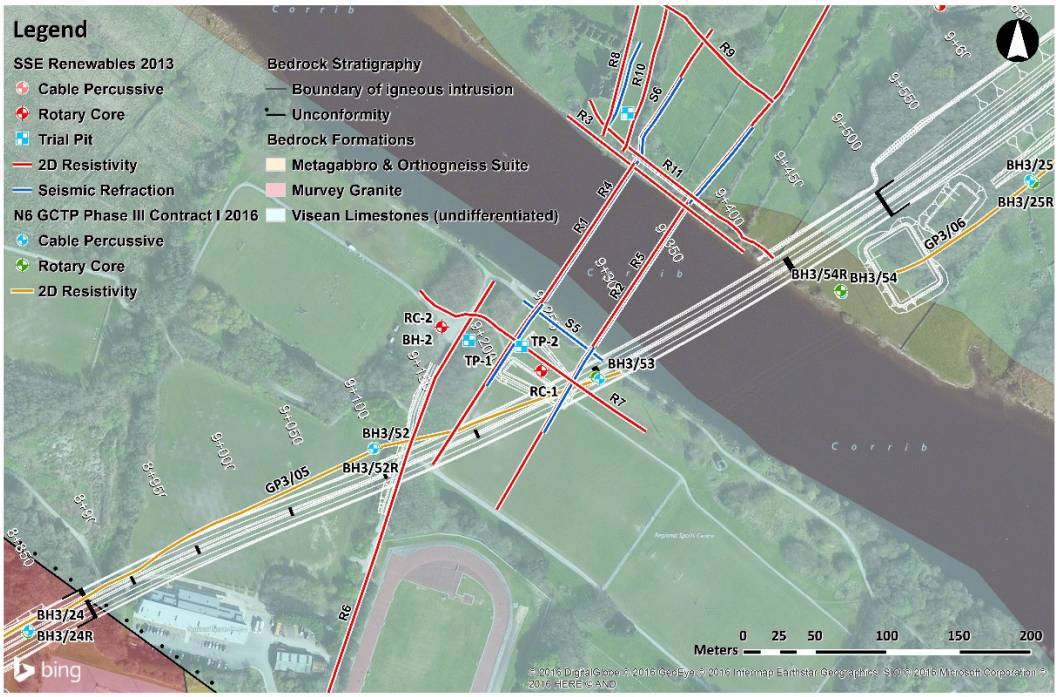
2.8.1 Ground Investigations

Ground investigations were conducted on the west and east approaches to the river crossing and along the river banks. Exploratory locations in the immediate vicinity were considered for establishing the ground conditions for the structure footprint. Investigations formed part of the N6 GCTP Phase III ground investigation (2016) and additional investigation data was sourced from SSE Renewables (2013). These investigations included both intrusive and non-intrusive investigations, which consisted of:

- Seven cable percussive boreholes
- Seven rotary coreholes
- Three trial pits
- Thirteen 2D resistivity profiles
- Nine seismic refraction profiles

The plan location of the ground investigation is provided in Figure Error! Reference source not found.**2.4.**

Figure 2.4: Plan Location of Ground Investigations



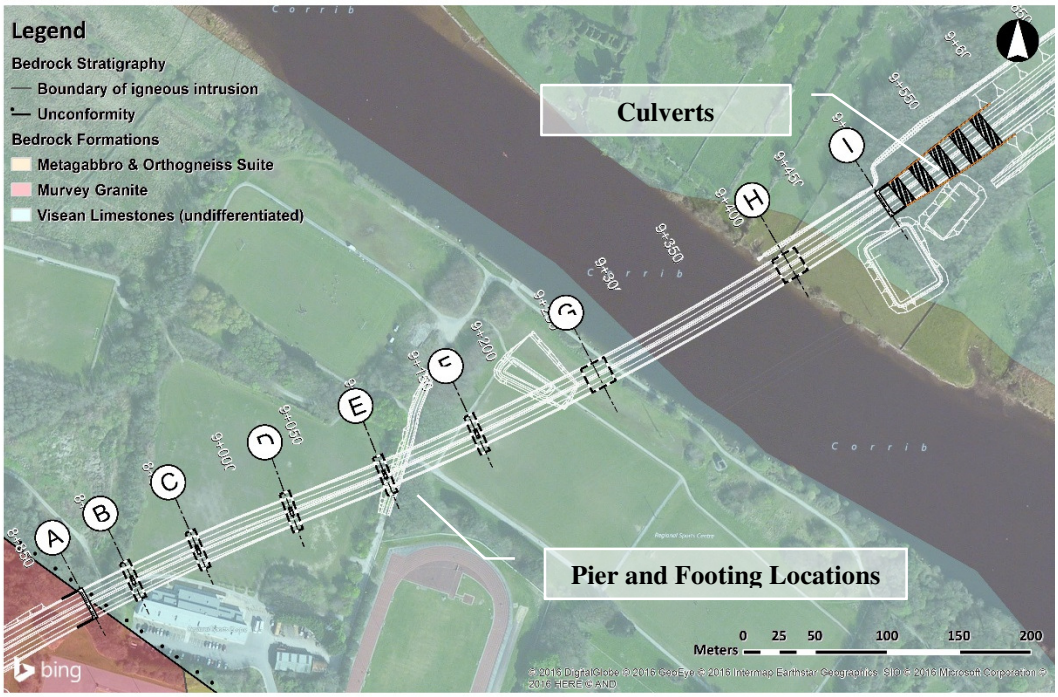
2.8.2 Ground Conditions

The ground conditions are discussed in terms of:

- Topography
- Superficial deposits: Overburden details
- Solid Geology: Bedrock details

The bridge abutments, pier locations, and culverts are used as reference points in the sub sections below and are presented in **Figure 2.5** along with the bedrock geology.

Figure 2.5: Foundation Location Plan



2.8.2.1 Topography

The topography drops significantly at the west abutment. This coincides with the indicative location of the bedrock change. The topography gradually drops towards the river from both abutment locations, with elevations ranging from +19 to +6mOD. The topography of the river bed was not assessed at the location of the river crossing. There is a wooded area to the east of the river and the recreational facilities of NUIG on the west.

2.8.2.2 Superficial Deposits

The overburden thickness, to the top of weathered rock ranges from 3.7m to 9.0m below ground level. The overburden thickness on the east of the river is generally 3.7 to 3.8m. The overburden material is typically a cohesive glacial till approaching the river, with lenses of very fine material and becoming a very granular glacial material directly adjacent to the river. The till is derived from limestone.

The exploratory logs classify the material as a soft to stiff sandy gravelly silt/clay. An evaluation of the particle size distribution and atterberg limits indicate that the material is typically well graded and behaves as a clay.

Samples taken from intrusive investigation adjacent to the river show the material as a slightly silty sandy gravel.

Made ground was encountered for the top 0.5m, due to the urban development and leisure facilities in the area.

Typically the softer deposits were found within the top 4.0m, with all exploration showing an increase in strength with depth. In some instances, the cable percussive stopped premature of rockhead due to obstructions.

No intrusive investigation has been conducted in the basin of the river, however it would be assumed that the basin consist of soft alluvial deposits. Non-intrusive investigation up-stream suggests overburden thicknesses of approximately 4m in the basin north of the structure footprint.

2.8.2.3 Solid Geology

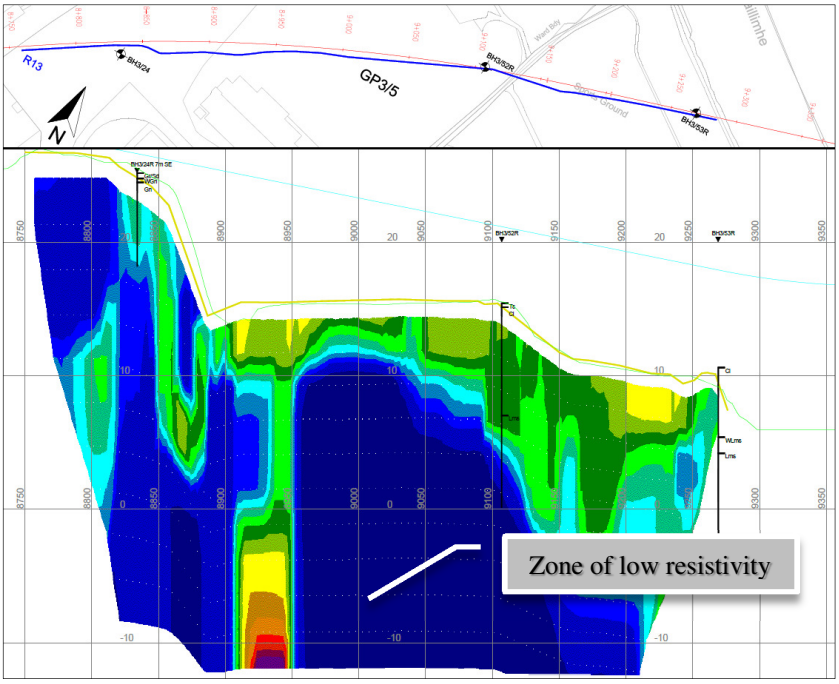
The bedrock formation for the structure footprint is undifferentiated Visean Limestone of the Lower Carboniferous Age. The Geological Survey of Ireland provide an indicative location for the unconformity between the Devonian Granites of the west and the Carboniferous Limestones of the east as illustrated in **Figure 2.4** and **2.5**. It is suggested that the contact between the Limestone and Granite is well defined. However, the vast majority of the structure footprint falls on the undifferentiated Visean Limestone.

The limestone is described as very strong thinly bedded, occasionally thick, fine to coarse grained grey fresh to slightly weathered with medium to closely spaced discontinuities with localised chert and locally fossiliferous. Weathered rock generally ranges from 1.0m to 3.0m in thickness.

Karst

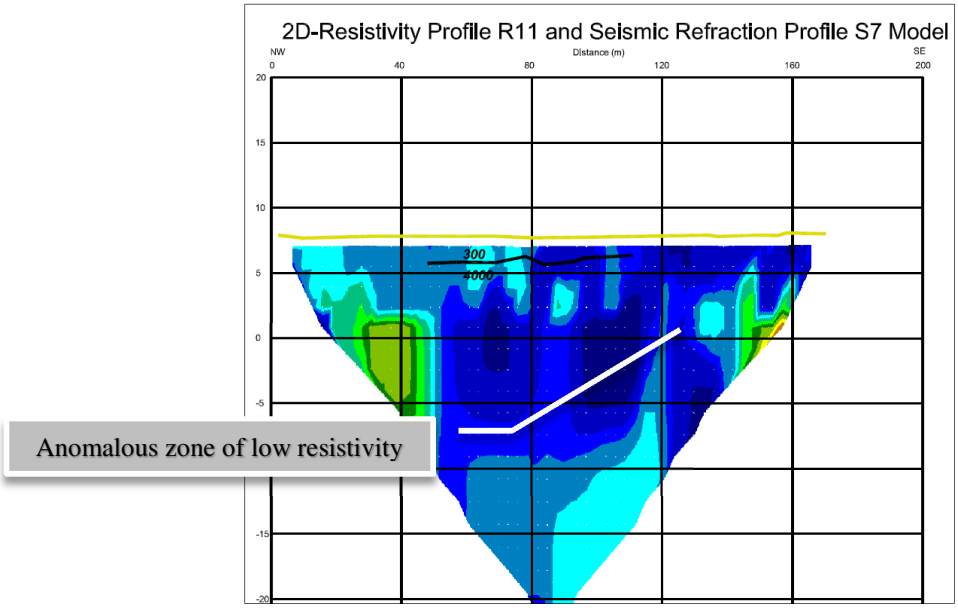
Karst activity in limestone is noted in the general vicinity of the structure. On the limestone side of the unconformity line, indicated in **Figures 2.4 and 2.5**, there is a zone of low resistivity that is up to 40m wide, greater than 20m in depth and extends to the ground surface. The anomalous zone of low resistivity is indicative of a weathered zone or karst zone with clay infill and is presented in **Figure 2.6**. East of the low resistivity anomalous feature the geology sharply reverts to high resistivity, typical of competent limestone, but the rock topography increasingly deepens being buried by thicker overburden so that at the River Corrib the rock head is between 5.0 to 15m below ground level.

Figure 2.6: Anomalous Zone of Low Resistivity



Resistivity profile R11 (SSE Renewable GI 2013), which is located on the eastern bank of the river, highlighted a developing anomaly as it approaches the alignment and eastern bank pier. This particular zone is shown in **Figure 2.7**. BH 3/54, adjacent to the end of the resistivity profile R11, indicated two 250mm clay infilled fractures at 6.1m and 11.3m below ground level.

Figure 2.7: Resistivity Profile R11



2.9 Hydrologeology Summary

As discussed in the section on solid geology above, the majority of the structure footprint falls on limestone bedrock. In terms of the hydrogeology, the limestone is classified by the Geological Survey of Ireland as a regionally important karst aquifer with conduit flow (Rkc). Flow through the aquifer is largely by fracture flow but conduits have been encountered, which confirm the Rkc classification by the GSI.

Groundwater in the limestone aquifer drains to the River Corrib from both the west and east banks. As the river is a groundwater receptor it is sensitive to impacts to the aquifer and the construction design incorporates appropriate supervision to ensure that flow paths through the aquifer to the river will not be impacted.

Groundwater levels in both the west and east banks of the river are controlled by the water level in the river and will respond seasonally in the same manner as the river.

2.10 Hydrology Summary

The consideration of the hydrological impact of the proposed structure will examine the potential flood impact, flood risk to the structure, the normal flow regime of the river and the constructional impacts of the proposed bridge.

The aesthetic merits of the bridge in terms of concrete box section, have no bearing on hydrology. The only issue in respect to hydrology is the presence of supporting piers in proximity to the river channel and to the floodplain, both effective conveyance and flood storage areas.

The impact of piers on the overbank floodplain is of minor consequence in respect to hydrological processes as the floodplain areas at the proposed crossing reach are not very extensive on both banks and the river seldom produces out of channel flow along this reach. The overbanks do not provide any significant flood conveyance or flood storage in terms of causing flow regime change or flooding and flood risk impacts. The proposed bridge has overbank piers and support piers near the river bank edge and the number of piers, size and position in the floodplain will have minimal to negligible effect on hydrology.

The support piers will be sighted on limestone bedrock which may presently or potentially in the future degrade through weathering and therefore foundation design must account for karstification/weathering of the bedrock.

The bridge has sufficient vertical clearance along the entire length of the crossing as to be well above the potential flood level under a full range of return period flood levels, present day and future climate change scenarios. The proposed crossing is located at a straight reach section of the river with a relatively narrow floodplain width on both left and right overbanks and as such will have very limited impact on the flow regime.

The proposed bridge has no supporting piers within the river channel with the eastern pier located in the existing raised embankment area which places it outside of the effective flood plain area. The west bank supporting pier is located within the floodplain area relatively close to the west river channel bank edge. This proposed configuration has minimal to imperceptible impact on the flow regime of the river and flooding. The proximity of the piers, in particular the east bank pier to the river edge has potential construction implications in respect to water quality, such potential impacts can be mitigated for.

2.11 Ecological Summary

The key ecological considerations relevant to the design of the proposed River Corrib crossing are;

1. The Lesser horseshoe maternity and hibernation roost at Menlo Castle
2. Loss of woodland habitat at Menlough both with respect to its function as an important foraging habitat for the Menlo Castle Lesser horseshoe bat population, and from the perspective of habitat loss within Lough Corrib cSAC
3. Loss of woodland habitat at the NUIG recreational facilities
4. The level of collision risk associated with a bridge with respect to birds flying along the river corridor
5. The presence/absence of supporting piers in the river channel
6. The Barn owl nest site at Menlo Castle
7. Potential impacts of the bridge design on Otter

The proposed structure does not have any cable support structure, and therefore has potentially the lowest risk of bird collisions, and has no in-stream piers associated with the design. The eastern incorporates a number of underpass structures to provide sufficient permeability for the movement of wildlife including Lesser horseshoe bats and Barn owl.

2.12 Archaeological Summary

The archaeological, architectural and cultural heritage suitability of the bridge have been considered. The proposed River Corrib crossing is located within a rich cultural heritage landscape. Former demesne landscapes associated with Dangan House and Dangan Cottage are located on the western bank of the River Corrib, whilst the large demesne associated with Menlo Castle is located on the eastern bank.

As part of the current NUIG campus, development within the townland of Dangan Lower, has removed some of the historic features. However, a number of recorded demesne features survive including a summer house, designed landscape features and the later Dangan House. On the eastern bank, although surviving in ruins, Menlo Castle is a landmark structure along the River Corrib corridor and a key archaeological and architectural heritage constraint.

The proposed bridge and associated road alignment are all located 155m to the southeast of Menlo Castle. The proposed bridge will not impact on the river bed, but it will have a negative visual impact on the surrounding cultural heritage resource. The proposed bridge possesses a physical (horizontal) presence within the landscape however the intervisibility between Menlo Castle and the recorded summer house is maintained.

2.13 Environmental Summary

The environmental appraisal was carried out under the following headings by the specialist environmental sub-consultants on behalf of Arup as the bridge design had a significant influence in terms of potential environmental impacts on Menlo Castle, the Lough Corrib cSAC; NUI Galway (NUIG) recreational facilities and the River Corrib itself:

- Landscape and visual (Brady Shipman Martin)
- Archaeology, architecture and cultural heritage (Irish Archaeological Consultancy (IAC))
- Ecology (Scott Cawley Ltd)
- Hydrology (Hydro Environmental Ltd)

These environmental specialists are working as part of the project team for the overall N6 Galway City Transport Project. For further details on the environmental constraints in the vicinity of the River Corrib crossing refer to the N6 Galway City Ring Road Environmental Impact Statement.

2.14 Sustainability

Concrete has been selected as the primary structural material for the bridge. Concrete has a high durability performance and requires little maintenance during the design life (120yrs), where the product is appropriately specified and executed. Portland cement replacements such as ground granulated blast-furnace slag (GGBS) will be used where appropriate.

The continuous concrete deck superstructure minimises the number of movement joints in the deck. This helps reduce the inspection and maintenance requirements compared to simply supported bridge decks.

All structures can be readily demolished at the end of the service life of the bridge, and much of the structural materials (concrete, steel etc.) can be recycled and reused.

3 Structure & Aesthetics

3.1 General Description

The proposed structure comprises of an eight span bridge (35m-50m-70m-70m-70m-95m-153m-72m) carrying the proposed road development over the River Corrib adjacent to a retained embankment with 5 culvert openings on the eastern approach. The proposed structure is a variable depth single concrete box without supports in the river. The structural depth of the 153m main span varies from approximately 7m near the supports and reducing to approximately 3m at mid-span. The adjacent spans consist a variable depth single concrete box increasing in depth from 3m to 7m on approach to the main span. The remaining western approach spans consists of 3m constant depth single concrete box while the remaining eastern approach links into a retaining embankment with 5 culvert openings. The superstructure will be supported on reinforced concrete piers. For aesthetic reasons, inclined webs instead of vertical webs are proposed.

3.2 Aesthetic Considerations

Architectural input into the design of the River Corrib Bridge is being provided by Brownlie Ernst and Marks Limited, who are working on behalf of Arup.

The bridge alignment shows a discrete S-curve running from the NUIG grounds in the west towards the River Corrib, crosses the river at a skewed angle and continues into the woodlands on the eastern bank of the River Corrib. The landscape is level, with vegetation and man-made structures as the only obstruction to far landward views.

The western bank of the river is characterised by the proximity of the sports pavilion, the open sports grounds and the access paths to the fields. The landscape is open, controlled and accessible. Along the western bank of the river, there is a footpath, facilitating access to the river and establishing a walkway along the river, which is of great leisure value. It can be used for walks along the river, kayaking or fishing, to name a few. Also, there is an established pier on the eastern bank, north of the alignment. This underlines the use of the river by paddlers. On site analyses at different dates has shown, that the river is frequented by paddlers and tour boats, pointing at the fact that the bridge will be viewed from the river as well as from alongside its banks.

The eastern bank of the river is more rural and less accessible. The dominating feature here is the ruins of Menlo Castle, to the north of the proposed road alignment. The area between the bridge and the castle is separated by stone walls and vegetation. There are no established paths along the eastern embankment. Access however is provided to the ruins of Menlo Castle, being a point of interest in the area. Hence, it is from Menlo Castle that the bridge will be viewed on the eastern bank.

The development of the architectural features of the bridge are presented in the Options Report (GCOB-4.04-20-008, Issue 2) and are adopted in the proposals presented in this preliminary design report.

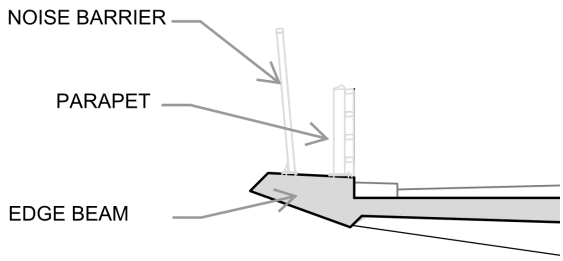
3.2.1 Landscaping

The introduction of the bridge at the local river crossing and the river bank level will represent a significant change in the landscaping and river setting.

The design of the bridge combines the aesthetic principles of proportion, order, simplicity, balance, colour and texture with the physical and geometric components of the bridge. The proposed bridge form exhibits strong visual character and quality, while integrating the bridge structure into the landscape setting.

The detail of the bridge deck, and in particular of the leading cantilevered edge, is defined by a profiled concrete upstand supporting the parapet railing and noise barrier. The concrete upstand incorporates inclined edges that present as a sharper and more striking edge profile that in turn supports the metal railing and the acoustic barrier. The acoustic barrier is inclined outwards and made of transparent material (glass). The transparent material affords a visual lightness, and by being inclined outwards, it will minimise reflection of skylight and maintain its transparent appearance. See **Figure 3.1** for details regarding the edge detailing.

Figure 3.1 Edge detail



The visual experience of the bridge will be dynamic – as the observer moves towards, under and beyond the bridge. On approach, the bridge will be seen in its setting, and the overall form of the superstructure and the rhythm of the supports will be visible within that setting. Closer to the bridge, the experience will be different, as the underside of the bridge deck and the scale of the individual piers become more apparent.

The landscape strategy permits the bridge structure to be viewed in full as it crosses the river – maintaining a clearance above the river corridor and continuing in either direction into the more elevated and vegetated setting beyond the river banks. Mitigation measures address the closer experiences of the piers and embankments, and include the reinstatement of any disturbed riverbank vegetation and the provision of indigenous vegetation to provide a degree of separation between observers and the piers and buttresses.

3.2.2 Materials and Finishes

The concrete shall be properly detailed and constructed to a high standard in accordance with construction best practice. The concrete shall be light in shade

through the use of at least 50% ground granulated blast-furnace slag (ggbs) for the concrete in the supports and the superstructure. The formed finish of the concrete shall be smooth and uniform in texture and appearance. In particular, the parapet edge beam and support slab shall be free of any internal ties or embedded metal parts that would compromise its appearance. However, joints and dummy joints are permitted in the parapet edge beam provided they occur at uniform intervals. On larger areas of formed concrete, such as the bridge deck soffit, abutment wing walls and piers, internal ties and embedded metal ties are permitted but shall be positioned in rebates or other deliberate patterning within the concrete. Any patterning or embossing of formed concrete must be agreed with the Aesthetics Adjudicator. The formwork shall leave no blemishes or stain on the concrete. Any imperfections in the finish shall be made good.

3.3 Proposals for the Recommended Structure

The proposed River Corrib crossing consists of a 620m, 8-span continuous bridge deck supported on bearings at abutments and intermediate supports. The bridge superstructure will consist of cast-insitu post-tensioned box girders supporting a concrete bridge deck. The bridge substructure will comprise of reinforced concrete columns and end abutments.

3.3.1 Proposed Category

The River Corrib Bridge is a Category 3 structure.

3.3.2 Span Arrangements

The structure is a 620m 8-span bridge, with spans varying from 35m to 153m. At the crossing over the River Corrib, the main span is 153m, and has a skewed alignment with respect to the river. The supports adjacent to the River Corrib will be set back by at least 5m from the edge of the river bank.

3.3.3 Approaches Including run-on Arrangements

The approach embankments will be constructed using a compacted acceptable material with Clause 6N material behind end walls.

3.3.4 Substructure

The intermediate supports will comprise of a pair of reinforced concrete columns. The west abutment will consist of a bankseat located on the approach embankment; the east abutment will consist of a bankseat on a retained earth embankment.

3.3.5 Foundation Type

The bridge intermediate support foundations will consist of reinforced concrete piles founded on rock. Refer to GCOB-1700 D-S08-04-001 to 002 in Appendix B for further information.

3.3.6 Superstructure

The bridge superstructure will consist of cast in-situ post-tensioned concrete box girder deck. The main and adjacent spans shall consist of a variable depth single concrete box ranging between approximately 3m and 7m in depth. The superstructure will be approximately 7m in depth at main span supports adjacent to the river.

The overall structural form of the bridge shall not be permitted to vary from span to span. A continuous post tensioned box girder will be provided over the full length of the structure from Gridline A to I.

3.3.7 Articulation Arrangements, Joints and Bearings

The bridge deck superstructure will be continuous. It will be supported on bearings at intermediate supports and abutment bank seats.

At each support location two pot bearings are envisaged to support the concrete box girder. Both bearings at Gridline G will be fixed longitudinally; at all support locations one bearing will be restrained from transverse movement.

Type 6 expansion joints are proposed at either end of the structure. The estimated movement range is 400mm at Gridline A and 230mm at Gridline I. Inspection galleries will be provided at each abutment for the inspection of bearings and expansion joints.

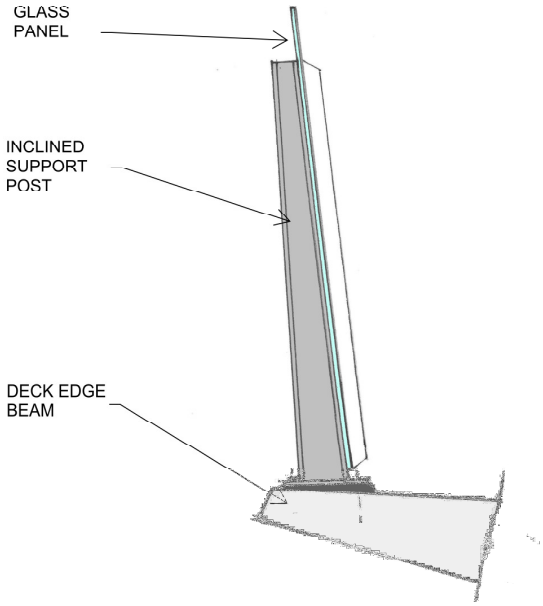
3.3.8 Parapet

Parapet type will be 1250mm high H2-W2, with mesh infill. The approach and departure safety barrier and transitions will be H2 containment.

3.3.9 Noise Barrier

A 2m high noise barrier is to be provided along the full length of the bridge, on both sides of the structure, as indicated in **Figure 3.2** below. The noise barrier will be position behind the parapet on the deck edge beam. The panel material will be toughened glass; where appropriate local frosting or patterns will be provided on the glass. The support posts will be inclined to the vertical plane, and will consist of painted steelwork or aluminium, typically at 2m centres. The posts and the arrangement of the noise barrier shall be given the appropriate architectural treatment for the dominant location of this element.

Figure 3.2 Noise Barrier Typical Arrangement



3.3.10 Waterproofing

Bridge desk waterproofing shall be spray applied, and shall be in accordance with the requirements of BD47/99 and TII DN-STR-03012.

Two coats of epoxy resin waterproofing paint shall be applied to buried concrete surfaces, in accordance with TII CC-SPW-02000.

All exposed concrete will be treated with a surface applied hydrophobic pore lining impregnating material, in accordance with TII DN-STR-03012 and TII CC-SPW-01700.

3.3.11 Inspection and Maintenance

The bridge deck superstructure is continuous. The deck will be supported on bearings at intermediate supports and abutments. Movement joints are proposed at the abutments at either end of the viaduct. Inspection galleries will be provided in the abutments for the inspection of bearings and movement joints. Access to the inspection galleries is envisaged from the mainline of the proposed road development above. Access to the bridge soffit will be from the local road below and will require local diversions and a mobile elevated work platform for access purposes.

Waterproofing systems, joints, parapets etc shall be designed for Working Life Category 2 (replaceable structural parts, up to 50 years design working life).

All other elements of the structure shall be designed for Working Life Category 5 (≥120 years design working life).

Cleaning of the glass noise barriers will required to maintain transparency.

3.4 Construction and Buildability

Given the environmentally sensitive location of the bridge, it's setting and general accessibility to the site, the construction method is an important consideration in the selection of the bridge type.

A balanced cantilever construction is proposed for this structure, over the river and at the river side spans. Due to the larger span, the superstructure structural depth is significantly larger at the pier locations and varies in depth along the span. This increases the construction complexity of the deck, however the substructure works are simplified by removing the need for piers in the river channel (ref. River Corrib Bridge Constructability Report (GCOB-4.03-6.1.77-001) for further details) given in Appendix D.

Due to the sensitive hydrogeological location, construction of the foundations will require specific requirements to be satisfied. Pouring of the concrete to foundations will only be undertaken when the excavation has been inspected by a qualified hydrogeologist. Inspection of the full depth and extent of the excavation will be undertaken to identify if any significant flow paths, such as the karst enhancement of the bedrock permeability, are present.

If no significant flow paths are present then the pouring of concrete can commence. If significant pathways are present then impacts which may arise from flow along these pathways shall be mitigated against prior to pouring, by installing a high permeability zone to replace the pathways which would be removed by the foundations. The design of the mitigation measures shall be approved by a qualified hydrogeologist to confirm that no poured concrete will enter the aquifer.

4 Safety

4.1 Traffic Management During Construction Including Land for Temporary Diversions

Detailed traffic management proposals will be developed at detail design stage by the appointed Contractor in consultation with their Designers and the consent for the temporary diversions and/or temporary road or access path closures will be sought from the appropriate authority.

4.2 Safety During Construction

The Designer will take account of the General Principles of Prevention, as specified in the Schedule 3 of the Safety, Health and Welfare at Work Act 2005, liaise with the Project Supervisor appointed by the Client for the Design Process and the Project Supervisor appointed for the Construction Stage and carry out all other duties as required by Clause 15 of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).

The Project Supervisor for the Design Process will comply with all the requirements outlined in Clauses 11, 12, 13 & 14 of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).

4.3 Safety in use

Parapets and safety barriers will be provided across the length of the structure and on the approach to, and departure from, the structure.

The River Corrib Bridge will be on a motorway designated route. As a result there will be restrictions on the permitted users (no pedestrians, cyclists etc.).

The potential operational issues associated with wind effects on high sided vehicles is to be assessed and where this is found to be an issue, the provision of wind shielding may be necessary.

4.4 Lighting

There is no proposal to light the bridge structure, or the roadway lighting in the area of the River Corrib Crossing.

5 Cost

5.1 Budget Estimate in Current Year, Including Whole Life Cost

The cost estimates for the River Corrib bridge have been prepared using typical cost per square metre rates for the envisaged bridge configuration, span arrangements, materials, construction methodology and maintenance requirements (**Table 5.1** and **Table 5.2**).

Table 5.1: Basis of Cost Estimate

Construction Option Considered	**Estimated Rate (€/m²)**	
	Lower	Upper
Post-tensioned in situ concrete deck built using travelling formwork over the river and side spans; and using falsework or travelling formwork on approach spans	2750 (main spans + side spans) 2200 (remaining spans)	3000 (main spans + side spans) 2400 (remaining spans)

The cost of the bridge is highly dependent on the construction methodology and the temporary works necessary to build the bridge, in addition to the form of construction.

Table 5.2: Estimated Construction Cost

Description	**Cost [Million Euros] (Excl. VAT)**
River Corrib Bridge	33.2M to 36.2M

6 Design Assessment Criteria

6.1 Normal Loading

Permanent Actions in accordance with IS EN 1991-1-1:2002 and it's associated National Annex.

The structure will be designed for Load Models LM1 and LM2 in accordance with IS EN 1991-2:2003 and it's associated National Annex.

6.2 Abnormal Loading

Load Model 3 up to and including SV196 (where applicable) will be considered in accordance with IS EN 1991-2:2003 and the associated National Annex.

6.3 Footway or Footbridge Live Loading

Where applicable, a footway loading shall be in accordance with Clause 5.3.2.1 of IS EN 1991-2:2003. A nominal $q_{fk} = 5kN/m^2$ will be adopted.

6.4 Provision for Exceptional Abnormal Loads

No exceptional abnormal loads are proposed.

6.5 Any Special Loading not Covered Above

A project specific crowd loading model (LM4) will be specified to include the special situations such as marathons, regattas etc. This load model will be applicable to the static and dynamic design of the structure.

6.6 Heavy or High Load Route Requirements and Arrangements Being Made to Preserve Route

Not applicable.

6.7 Minimum Headroom Provided

A freeboard greater than the 0.3m required by the OPW will be provided. The navigational clearance at the Quincentenary Bridge is 5.0m. The minimum soffit level in the proposed design configuration will be 10m above the mean water level.

6.8 Authorities Consulted and any Special Conditions Required

Consultation with relevant authorities is on-going. The following groups have been contacted as part of the project:

- Transport Infrastructure Ireland (TII)
- Galway County Council (GCoC)
- Galway City Council (GCiC)
- NUIG
- Land and home owners
- Kayakmor
- Corrib Branch Of Inland Waterways Association Ireland
- OPW
- Inland Fisheries Ireland

7 Ground Conditions

The general ground conditions consists of firm to stiff cohesive glacial till, mixed with granular till, with the vast majority of the area underlain by limestone. The rock is very strong with medium to closely spaced discontinuities and some non-intact zones. Refer to **Section 2.8** for further information.

7.1 Geotechnical Compatibility with Proposed Foundation Design

The foundation types proposed for the River Corrib Bridge are presented in **Section 3.3.5.**

Soft to firm deposits were recorded in the exploratory holes, with depths of up to 3.8m recorded. The existence of these soft to firm deposits are encountered in intrusive investigation throughout the extent of the structure footprint. Due to the existence of soft soil deposits, variable rockhead and anomalous features, the foundations will consist of rock socketed piles throughout.

A subsequent ground investigation will inform the foundation design in terms of pile length and accurate depth, quality and integrity of rock at each foundation location.

Ground conditions of note were encountered at some of the foundation locations (presented in **Figure 2.5**) and these are further discussed below.

- The western abutment is located at the indicative location of the change from granite to limestone. The contact between both rock types is described as well defined, however an investigation should be conducted to ascertain the conditions of the transition and as to whether faulting occurs.
- The first intermediate pier support (Support B) from the west is situated over the zone of low resistivity as described in **Section 2.8.2.3**, which is indicative of a weathering zone of karst with clay infilling.
- The two intermediate pier supports (Support F and G) west of the river are located in areas with resistivity anomalies and potential karst activity. The drop in resistivity could also relate to the existence of softer deposits and should be further evaluated at detailed design stage.
- The intermediate support east of the river (Support H) is situated south of an anomaly identified in resistivity profile R11 from the SSE Renewable ground investigation. The extent of the anomaly is unknown but may extend under the pier footing.
- Firm material was recorded to 3.0m below ground level in BH 3/25, adjacent to the indicative culverts on the eastern bank.

A methodology for the evaluation and treatment of karst features shall be conducted in accordance with the Construction Environmental Management Plan

(CEMP) included in the N6 Galway City Ring Road Environmental Impact Statement.

8 Drawings and Documents

8.1 List of all Documents Accompanying the Submission

Document Reference	Description	Appendix
GCOB-1700-D-S08-04-001	River Corrib Bridge General Arrangement Sheet 1	Appendix B
GCOB-1700-D-S08-04-002	River Corrib Bridge General Arrangement Sheet 2	Appendix B
GCOB-1700-D-S08-04-003	Photomontages	Appendix A
GCOB-1700-D-S08-04-004	River Corrib Bridge General Arrangement Sheet 3	Appendix B
GCOB-SK-D-746	River Corrib Bridge Plan and Profile Alignment	Appendix B
	Geotechnical Factual Report	Appendix C
GCOB_4.03_6.1.77_001	Constructability Report	Appendix D

Appendix A

Photomontages

DESIGN REPORT

VIEW No. 1: EAST BANK NORTH OF MENLO CASTLE

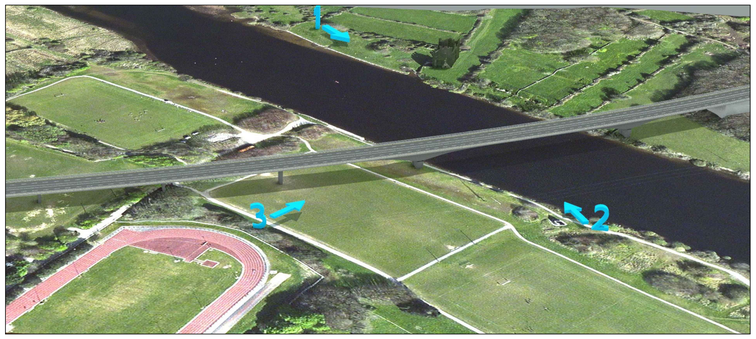
SCALE: N.T.S

VIEW No. 2: WEST BANK TOWARDS MENLO CASTLE

SCALE: N.T.S

VIEW No. 3: WEST BANK N.U.I.G. PITCHES

SCALE: N.T.S



AERIAL VIEW ON PROPOSED BRIDGE

SCALE: N.T.S

Clients

Comhairle Chontae na Gaillimhe
Galway County Council

N6 Galway City Transport Project

An Roinn Iompair Turasóireachta agus Spóirt
Department Transport, Tourism and Sport

Transport Infrastructure Ireland

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Job Title
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Scale: AS SHOWN @ A1

Date: September 2016

Issue	Date	By	Chkd	Appd
I2	30/06/17	PD/FB	PM	MS
I1	23/09/2016	PD/FB	PM	MS

Drawing Title
River Corrib Bridge
Option Development
Option B Sheet 2

Drawing Status
For Information

Job No	Drawing No	Issue
233985	**GCOB-1700-D-S08-04-003**	**I2**

Do not scale

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Appendix B

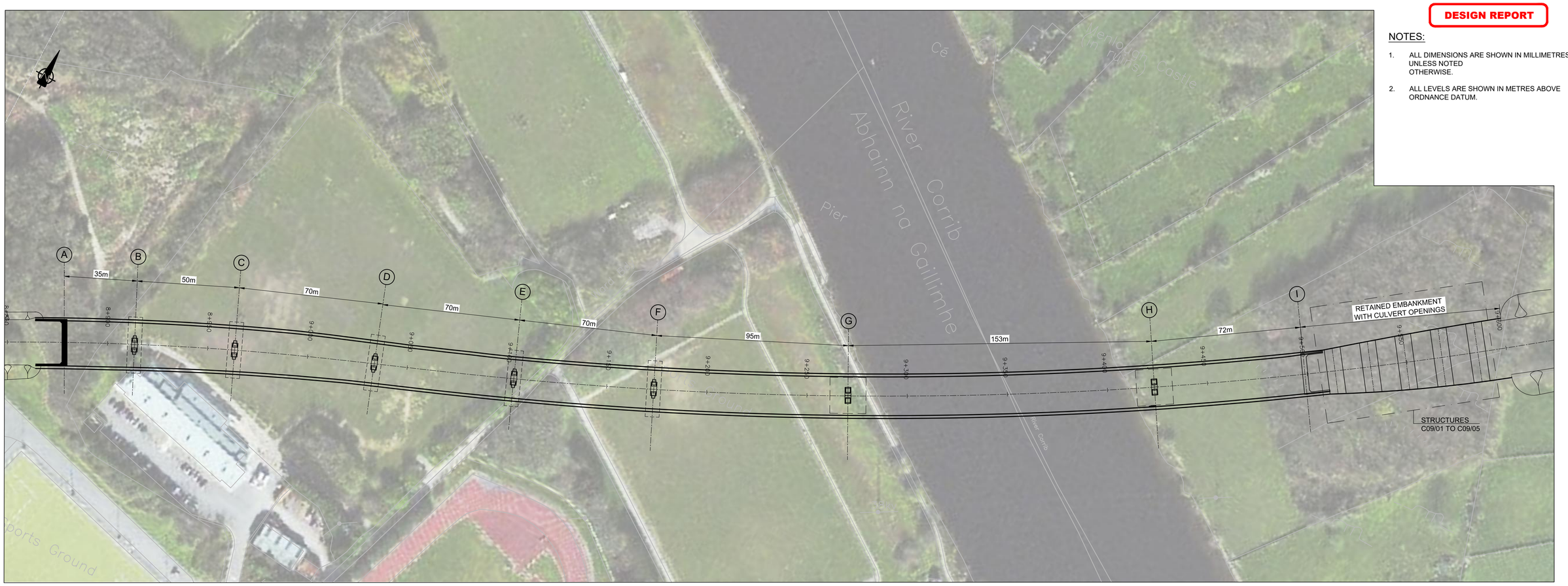
Drawings

A1

DESIGN REPORT

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDNANCE DATUM.



PLAN
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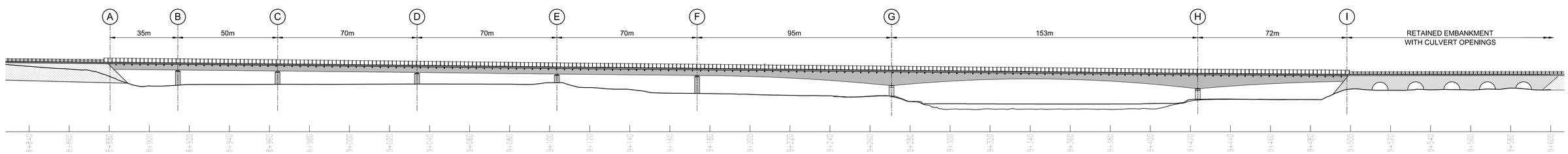

ELEVATION
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San áireamh tá sonraíocht Shuirbhéireacht Ordanáis Éireann arna atáirgeadh faoi Cheadúnas OSi Uimh. 2010/17CCMA/Comhairle Contae na Gaillimhe.
Sáraíonn atáirgeadh neamhúdaraithe cóipcheart Shuirbhéireacht Ordanáis Éireann agus Rialtas na hÉireann. © Suirbhéireacht Ordanáis Éireann, 2010.

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Scale: AS SHOWN @ A1

Date: September 2016

Issue	Date	By	Chkd	Appd
I3	30/06/17	TP	PM	MS
I2	25/05/17	TP	PM	MS
I1	23/09/16	PD/FB	PM	MS

Drawing Title: Structure S08-04 River Corrib Bridge General Arrangement Sheet 1

Drawing Status: **For Information**

Job No	Drawing No	Issue
233985	**GCOB-1700-D-S08-04-001**	**I3**

Do not scale

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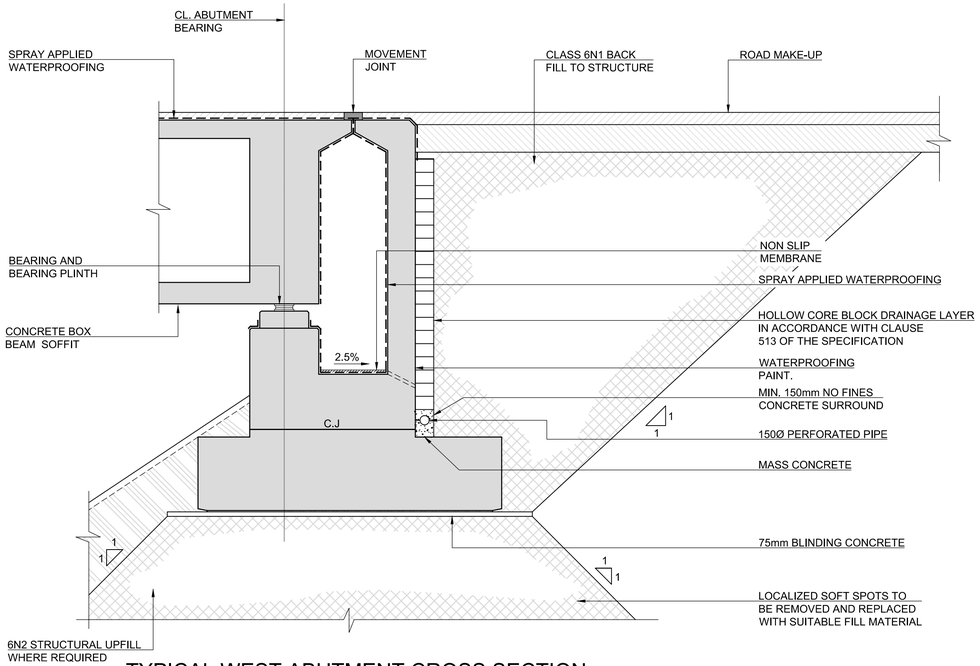
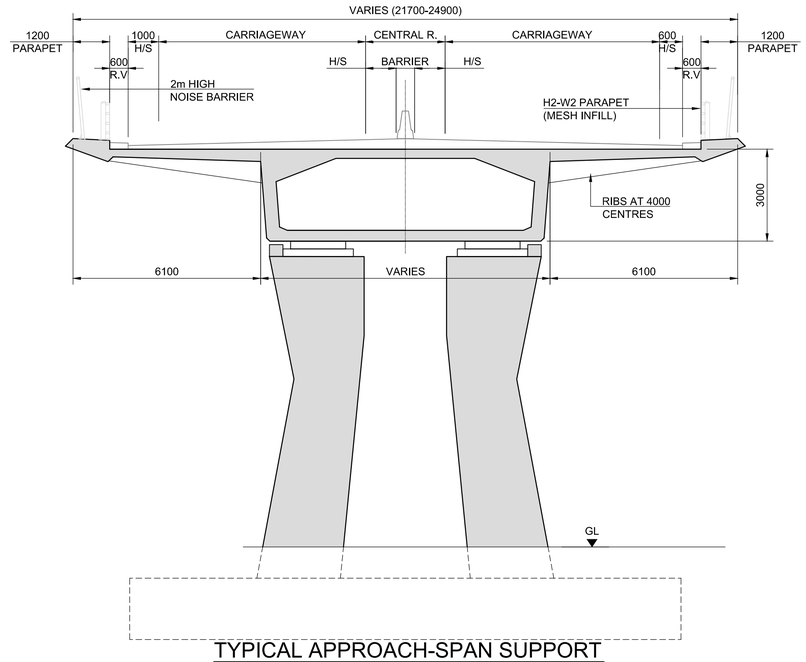
DESIGN REPORT



TYPICAL WEST ABUTMENT CROSS SECTION

SCALE: 1:50



TYPICAL APPROACH-SPAN SUPPORT

SCALE: 1:100

NOTES:

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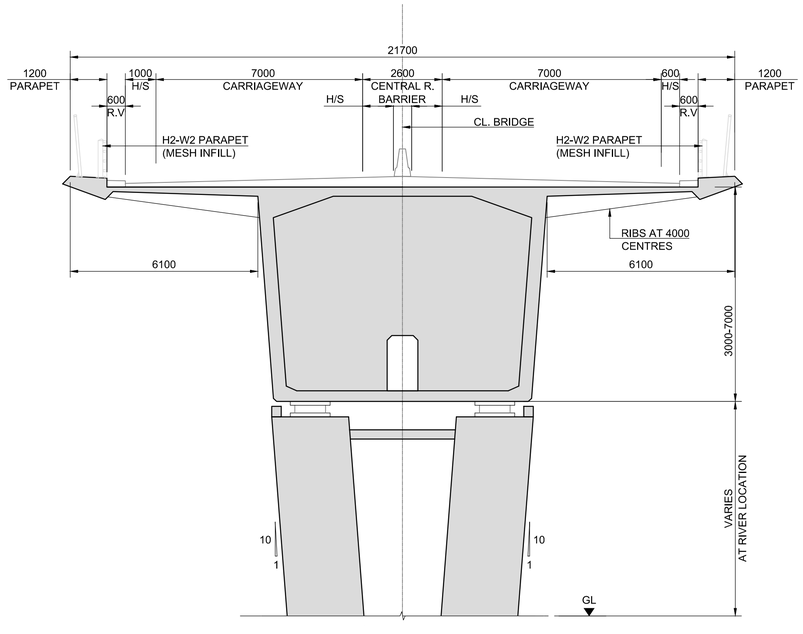
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDNANCE DATUM.

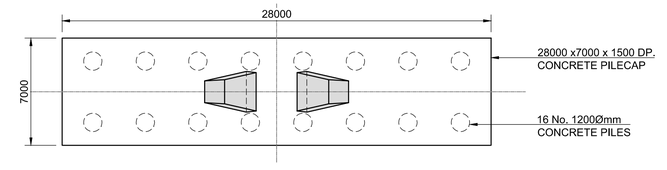


TYPICAL MAIN-SPAN CROSS SECTION

SCALE: 1:100

TYPICAL MAIN-SPAN INTERMEDIATE SUPPORT ELEVATION

SCALE: 1:100



PLAN ON TYPICAL INTERMEDIATE SUPPORT FOUNDATION

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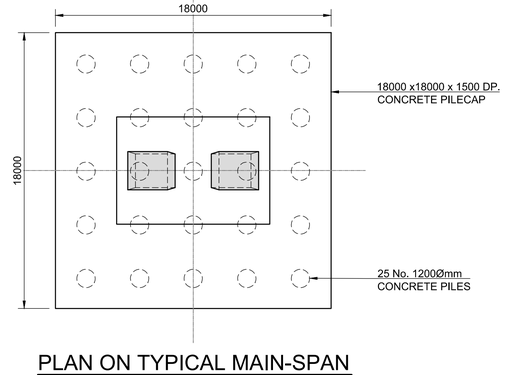

PLAN ON TYPICAL MAIN-SPAN INTERMEDIATE SUPPORT FOUNDATION

SCALE: 1:200

Clients

Comhairle Chontae na Gaillimhe Galway County Council

N6 Galway City Transport Project

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Tii Bonneagar Iompair Éireann Transport Infrastructure Ireland

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Job Title: N6 Galway City Ring Road

Scale: AS SHOWN @ A1

Date: November 2016

Issue	Date	By	Chkd	Appd
I3	28/06/17	TP	PM	MS
I2	22/05/17	TP	PM	MS
I1	23/09/2016	PD/FB	PM	MS

Drawing Title: Structure S08-04 River Corrib Bridge General Arrangement Sheet 2

Drawing Status: **For Information**

Job No	Drawing No	Issue
233985	GCOB-1700-D-S08-04-002	I3

Do not scale

J:\233000\233985-004 Internal\4-02 Drawings\4-02-8 Highways\8.3 Design Rep\1700 STR\GCOB-1700-D-S08-001-004.dwg

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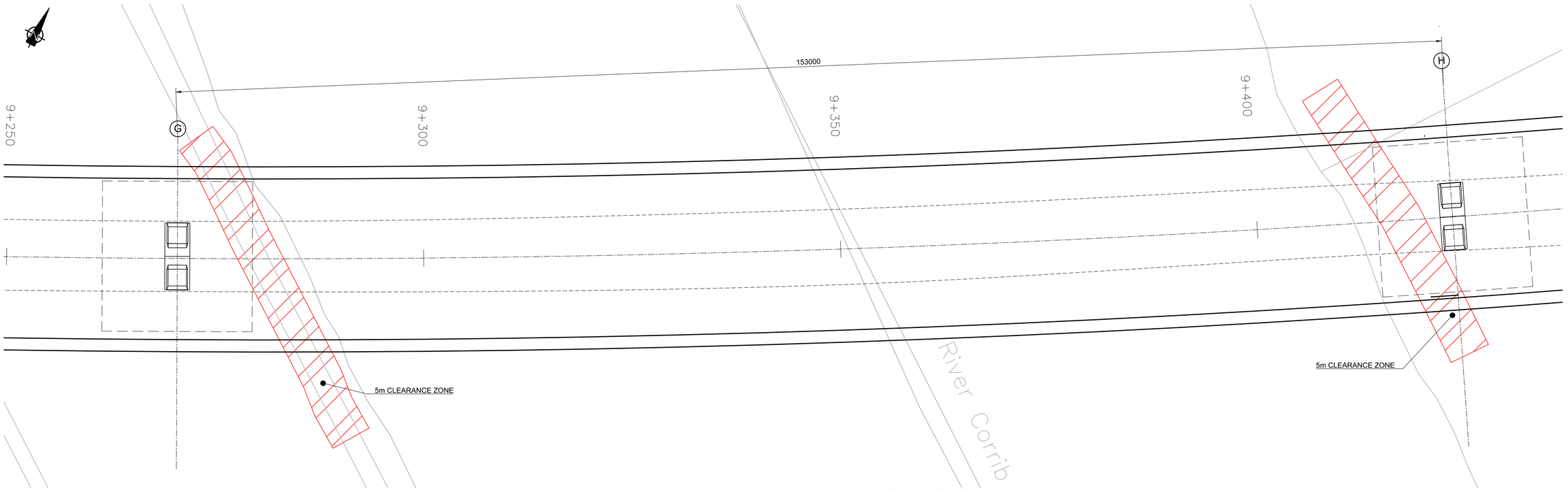
DESIGN REPORT

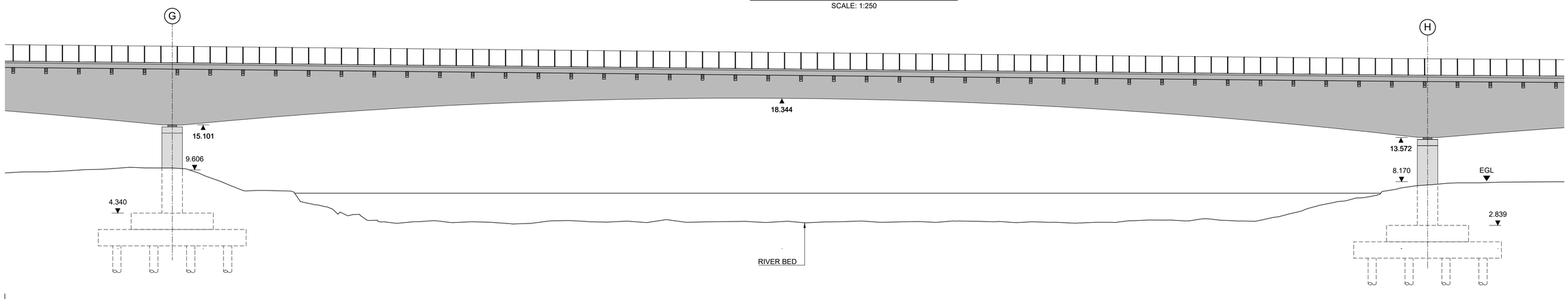
NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDNANCE DATUM.



PLAN ON PROPOSED BRIDGE

SCALE: 1:250



ELEVATION ON PROPOSED BRIDGE

SCALE: 1:250

San úireamh tá sonraíocht Shuirbhéireacht Ordanáis Éireann arna atáirgeadh faoi Cheadúnas OSI Uimh. 2010/17CCMA/Comhairle Contae na Gaillimhe.
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Clients

Comhairle Chontae na Gaillimhe
Galway County Council

N6 Galway City Transport Project

An Roinn Iompair Turasóireachta agus Spóirt
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Job Title
N6 Galway City Ring Road

Scale AS SHOWN @ A1

Date: September 2016

Issue	Date	By	Chkd	Appd
I3	30/06/17	TP	PM	MS
I2	25/05/17	TP	PM	MS
I1	15/05/2016	TP	PM	MS

Drawing Title
Structure S08-04 River Corrib Bridge
General Arrangement
Sheet 3

Drawing Status
For Information

Job No	Drawing No	Issue
233985	**GCOB-1700-D-S08-04-004**	**I3**

Do not scale

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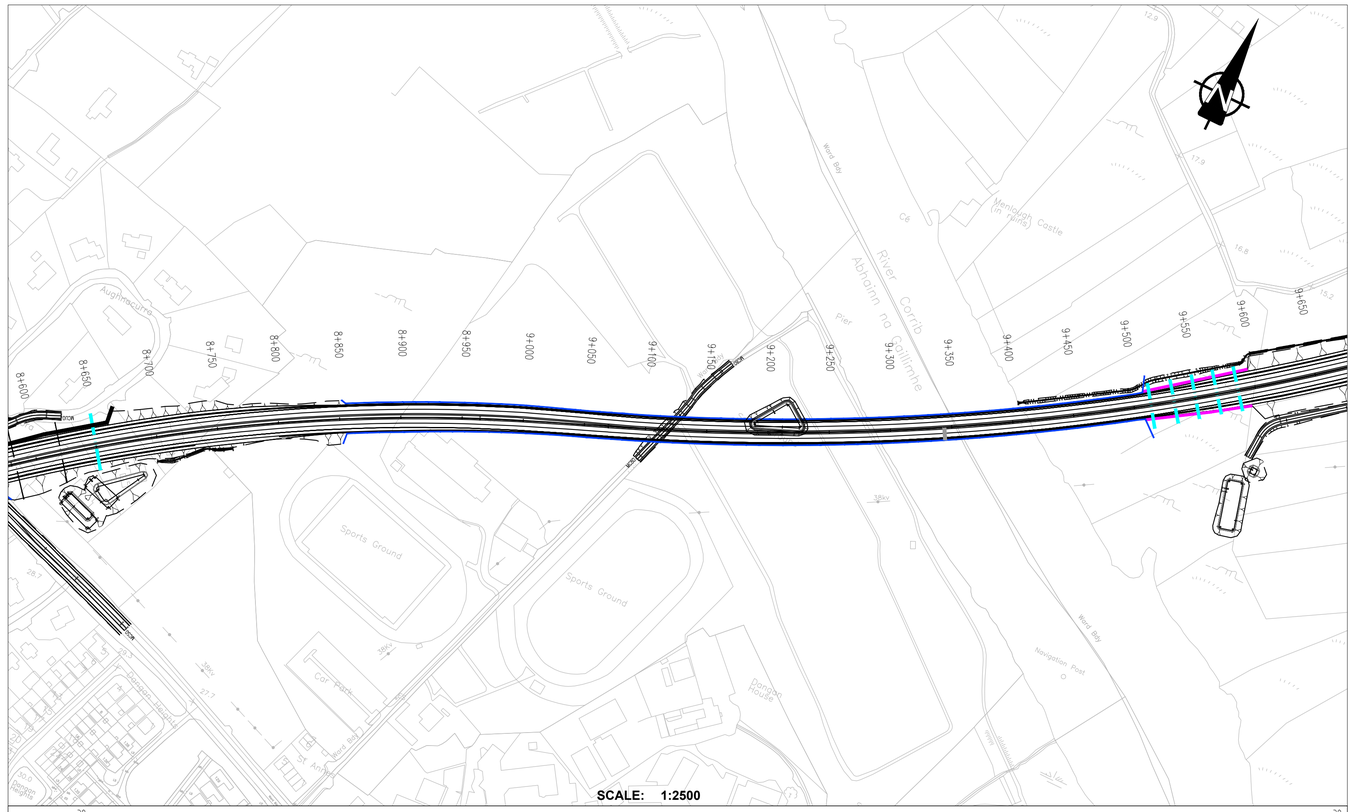
\\ieblwgeurope\Dublin\Jobs\233000\233985-004_Internal\4-02 Drawings\4-02-8 Highways\8.3 Design Res\1700 STR\GCOB-1700-D-S08-001-004.dwg



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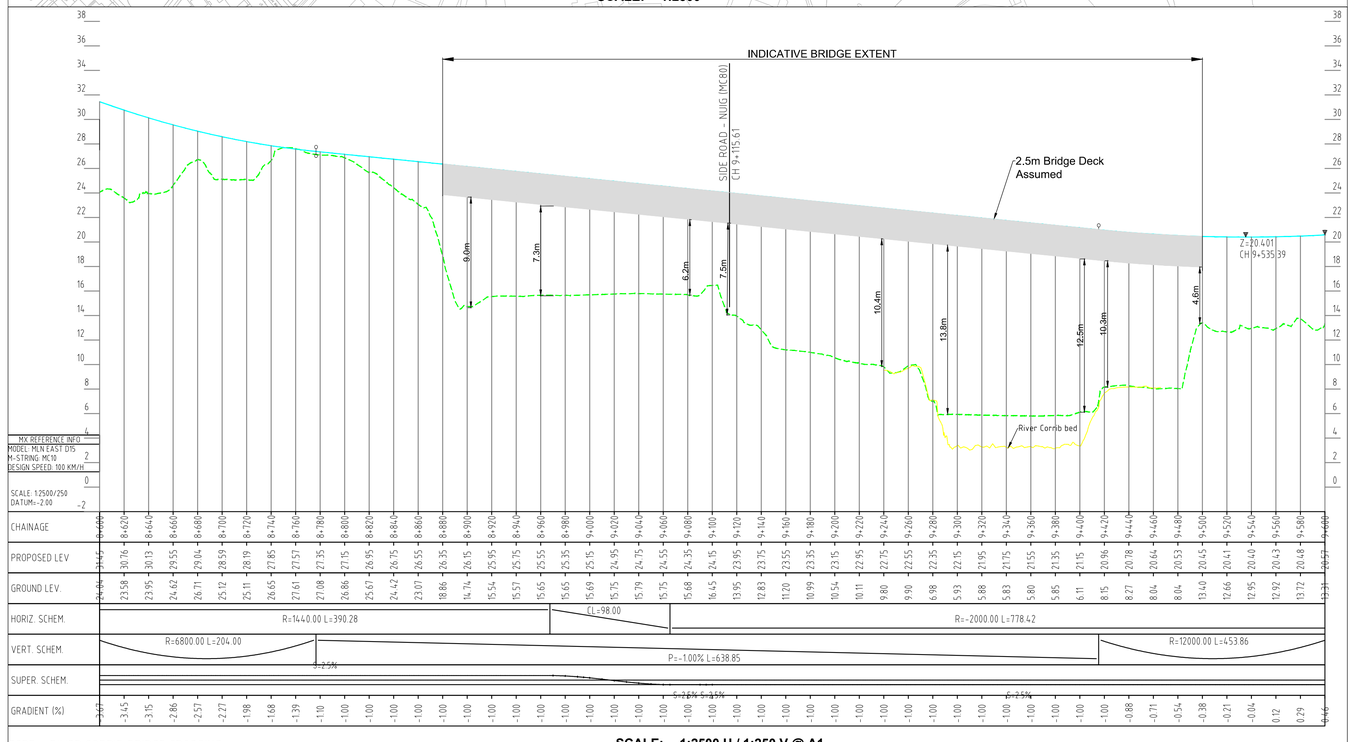

SCALE: 1:2500 H / 1:250 V @ A1

GCRR - RIVER CORRIB BRIDGE CROSSING

P□□SE □ □DESIGN

Legend:

Plan view

- Proposed Geometry Plan
- Structure
- Proposed Earth Retention Wall
- Proposed Mammal Underpass
- Proposed Attenuation Pond / Infiltration Basin

Profile view

- Existing Ground Level
- Proposed Road Level
- Bridge Deck

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Nóta Séanta:
Tá an Dearadh ina bhfoirm dréacht, d'fhéadfaí athraithe teacht air. Is mar toradh ar mheasúnaithe níos mionchruinne, ar staidéar leaninach agus ar eolas ón bpobal a dhéanfaí athruithe teacht ar an Dearadh ina iomláine nó ar chuid de. D'fhéadfadh ag aon athrú ar an Dearadh tionchar a bheith aige ar an eolas eile.

Clients

Comhairle Chontae na Gaillimh
Galway County Council

N6 Galway City Transport Project

An Roinn Iompair Turasóireachta agus Spóirt
Department Transport, Tourism and Sport

Transport Infrastructure Ireland

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Job Title
N6 Galway City Transport Pro□ect

Scale: As shown @ A1
Date: May 2017

Issue	Date	By	Chkd	Appd
I2	11/05/2017	GOD	HK	EMC
I1	27/09/2016	GOD	HK	EMC

Drawing Title
Current Design
River Corrib Bridge
Plan □ Pro□le

Drawing Status
For Information

Job No	Drawing No	Issue
233985-00	GCOB-SK-D-746	I1

Do not scale

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Appendix C

Geotechnical Factual Report

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/24R**
		SHEET	Sheet 1 of 1
CO-ORDINATES	528,036.05 E 727,520.61 N	**DATE DRILLED**	03/03/2016
GROUND LEVEL (mOD)	25.16	**DATE LOGGED**	03/03/2016
CLIENT	Galway County Council	**DRILLED BY**	S. Petersen
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as TOPSOIL.	0.20	24.96		
								SYMMETRIX DRILLING: No recovery, observed by driller as brown gravelly sand	0.40	24.76		
								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	0.70	24.46		
1	1.30							SYMMETRIX DRILLING: No recovery, observed by driller as rock	1.30	23.86		
		100	95	51				Very strong to strong, thickly to thinly banded, light green/dark green mottled, porphyritic, fine to medium-grained, GRANITE, fresh to locally slightly weathered.				
2	2.60							Dips are 20° to locally 70°. Discontinuities are medium to closely spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
		100	100	55				2.57-2.66m - Clay-filled fracture				
3	3.40											
		100	76	52								
4	4.30											
		100	100	79		770						
5	5.80											
		100	93	78		690						
6	7.00								7.00	18.16		
7								End of Borehole at 7.00 m				
8												
9												

REMARKS

Hole cased 0.00-1.30m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type
03-03-16	6.50	2.50	7.00	50mm SP

IGSL RC FI 10M 18963.GPJ IGSL.GDT 17/8/16

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**BOREHOLE NO.**	**BH3/25**
		SHEET	Sheet 1 of 1
CO-ORDINATES	528,732.55 E 727,834.69 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	12.60	**BOREHOLE DEPTH (m)**	3.80
		DATE COMMENCED	01/02/2016
		DATE COMPLETED	01/02/2016
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
ENGINEER	ARUP	**ENERGY RATIO (%)**	
		BORED BY	WC
		PROCESSED BY	JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
0	Gravelly TOPSOIL		12.30	0.30						
1	Firm light grey mottled brown silty very sandy GRAVEL with some cobbles		11.00	1.60	AA43893	B	0.50-1.00			
					AA43894	B	1.00-1.45		N = 16 (3, 3, 4, 3, 4, 5)	
2	Firm becoming firm to stiff light brown slightly sandy gravelly SILT. Gravel is angular.		9.60	3.00	AA43895	B	2.00-2.45		N = 18 (4, 4, 3, 4, 5, 6)	
3	Firm becoming firm to stiff light brown slightly sandy gravelly SILT with many cobbles. Gravel is angular.		8.80	3.80	AA43896	B	3.00-3.45		N = 20 (3, 3, 4, 4, 4, 8)	
4	Obstruction End of Borehole at 3.80 m									
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.7	3.8	0.75	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS Borehole backfilled upon completion. Borehole scheduled for rotary follow-on coring.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18963.GPJ IGSL.GDT 16/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/25R**
		SHEET	Sheet 1 of 2
CO-ORDINATES	528,734.81 E 727,833.14 N	**DATE DRILLED**	26/02/2016
GROUND LEVEL (mOD)	12.85	**DATE LOGGED**	29/02/2016
CLIENT	Galway County Council	**DRILLED BY**	IGSL
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
RIG TYPE	Comacchio		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as made ground consisting of Shell & Auger material				
									3.80	9.05		
4	4.10							SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	4.10	8.75		
		100	100	100		940		Very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), fresh to slightly weathered.				
5	5.10							Dips are 20° to locally 40°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
		100	93	73		810						
6	6.70											
		100	100	100		1000						
7						510.000000000001						
8	8.30											
		100	100	100		629.999999999999						
9						680.000000000001						
	9.90											

REMARKS

Hole cased 0.00-4.10m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18963.GPJ IGSL.GDT 17/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/25R**
		SHEET	Sheet 2 of 2
CO-ORDINATES	528,734.81 E 727,833.14 N	**DATE DRILLED**	26/02/2016
GROUND LEVEL (mOD)	12.85	**DATE LOGGED**	29/02/2016
RIG TYPE	Comacchio		
FLUSH	Air/Mist		
CLIENT	Galway County Council	**DRILLED BY**	IGSL
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.30	100	100	100				End of Borehole at 10.30 m	10.30	2.55		
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS

Hole cased 0.00-4.10m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments
29-02-16	10.30	4.10	9.60	Water level measured 10 mins after end of drilling

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**BOREHOLE NO.**	**BH3/52**
		SHEET	Sheet 1 of 1
CO-ORDINATES	528,276.23 E 727,648.14 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	15.45	**BOREHOLE DEPTH (m)**	3.80
		DATE COMMENCED	16/03/2016
		DATE COMPLETED	16/03/2016
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
		BORED BY	WC
ENGINEER	ARUP	**ENERGY RATIO (%)**	
		PROCESSED BY	JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL: Soft dark brown sandy gravelly CLAY		15.15	0.30						
1	Soft to firm becoming firm light brown slightly sandy gravelly CLAY with a medium cobble and boulder content				AA48884	B	0.50			
					AA48885	B	1.00-1.45		N = 10 (1, 2, 2, 2, 3, 3)	
2			13.45	2.00						
	Firm light grey brown slightly sandy slightly gravelly SILT				AA48886	B	2.00-2.45		N = 15 (2, 2, 3, 3, 4, 5)	
3			12.45	3.00						
	Stiff light grey and brown silty sandy GRAVEL				AA48887	B	3.00-3.45		N = 23 (2, 2, 3, 5, 6, 9)	
4			11.65	3.80						
	Obstruction End of Borehole at 3.80 m									
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.7	3.8	0.75	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 2hrs getting plant and equipment to borehole location. 1.0hr getting off position.

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18963.GPJ IGSL.GDT 16/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/52R**
		SHEET	Sheet 1 of 2
CO-ORDINATES	528,277.05 E 727,648.55 N	**DATE DRILLED**	09/03/2016
GROUND LEVEL (mOD)	15.42	**DATE LOGGED**	09/03/2016
CLIENT	Galway County Council	**DRILLED BY**	S. Petersen
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
RIG TYPE	Knebel		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as TOPSOIL.	0.30	15.12		
1								SYMMETRIX DRILLING: No recovery, observed by driller as light grey silty sandy clay				
2									2.50	12.92		N = 32 (4, 5, 9, 10, 6, 7)
3								SYMMETRIX DRILLING: No recovery, observed by driller as light grey silty gravelly clay with angular cobbles clay				N = 50/90 mm (9, 16, 39, 11)
4												
5												N = 50/40 mm (25, 50)
6												
7												N = 50/185 mm (8, 13, 16, 19, 15)
8									8.40	7.02		N = 50/170 mm (7, 8, 21, 18, 11)
	8.60							SYMMETRIX DRILLING: No recovery, observed by driller as rock	8.60	6.82		
9		100	89	74								
	9.90											

REMARKS

Hole cased 0.00-8.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
8.50	8.50	N/S	8.00	20	Moderate

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/52R**
		SHEET	Sheet 2 of 2
CO-ORDINATES	528,277.05 E 727,648.55 N	**DATE DRILLED**	09/03/2016
GROUND LEVEL (mOD)	15.42	**DATE LOGGED**	09/03/2016
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway County Council	**DRILLED BY**	S. Petersen
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10		100	100	100		1050		Very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), fresh to slightly weathered. Dips are horizontal to locally 45°. Discontinuities are medium to closely spaced, rough to locally smooth, planar to occasionally undulose. Apertures are wide, locally clay-filled. *(continued)*				
11	11.20					600.0000000000						
12		100	100	100								
	12.70											
13		100	100	100		600						
	14.00											
14		100	100	100		1030						
15	15.30								15.30	0.12		
								End of Borehole at 15.30 m				
16												
17												
18												
19												

REMARKS

Hole cased 0.00-8.60m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
8.50	8.50	N/S	8.00	20	Moderate

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18963

CONTRACT N6 Galway City Transport Project - Phase 3

BOREHOLE NO. **BH3/53**
SHEET Sheet 1 of 1

CO-ORDINATES 528,433.41 E
727,696.60 N
GROUND LEVEL (m AOD) 10.31

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm) 200
BOREHOLE DEPTH (m) 2.20

DATE COMMENCED 21/03/2016
DATE COMPLETED 21/03/2016

CLIENT Galway County Council
ENGINEER ARUP

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY WC
PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	Soft dark brown sandy gravelly CLAY with a low boulder content		9.81	0.50						
	Medium dense light grey brown silty sandy GRAVEL		9.51	0.80	AA48888	B	0.50			
1	Medium dense to dense light grey brown silty sandy GRAVEL with some cobbles				AA48889	B	1.00-1.45		N = 44 (4, 6, 8, 11, 11, 14)	
2			8.11	2.20					N = 50/75 mm (19, 6, 43, 7)	
	End of Borehole at 2.20 m									
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
2	2.2	0.75	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1.5hrs getting plant and equipment to borehole location

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18963.GPJ IGSL.GDT 16/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/53R**
		SHEET	Sheet 1 of 2
CO-ORDINATES	528,431.27 E 727,697.66 N	**DATE DRILLED**	08/03/2016
GROUND LEVEL (mOD)	10.06	**DATE LOGGED**	08/03/2016
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway County Council	**DRILLED BY**	S. Petersen
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as TOPSOIL.	0.10	9.96		
								SYMMETRIX DRILLING: No recovery, observed by driller as made ground consisting of clause 804 material and boulders				
1												
2												N = 24 (5, 6, 9, 4, 7, 4)
3												
												N = 31 (4, 5, 3, 9, 12, 7)
4												
5									5.20	4.86		N = 50/115 mm (8, 13, 27, 23)
								SYMMETRIX DRILLING: No recovery, observed by driller as possible weathered rock				
6									6.10	3.96		
	6.40							SYMMETRIX DRILLING: No recovery, observed by driller as rock with clay bands	6.40	3.66		
						569.999999999999		Very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites, common quartz veining), fresh to slightly weathered.				
7		100	100	100		630		Dips are 20° to locally 40° & 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
	7.85											
8		100	100	95		660						
9	9.35					559.999999999999						

REMARKS

Hole cased 0.00-6.40m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

IGSL RC FI 10M 18963.GPJ IGSL.GDT 17/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/53R**
		SHEET	Sheet 2 of 2
CO-ORDINATES	528,431.27 E 727,697.66 N	**DATE DRILLED**	08/03/2016
GROUND LEVEL (mOD)	10.06	**DATE LOGGED**	08/03/2016
RIG TYPE	Knebel		
FLUSH	Air/Mist		
CLIENT	Galway County Council	**INCLINATION (deg)**	-90
ENGINEER	ARUP	**CORE DIAMETER (mm)**	80
		DRILLED BY	S. Petersen
		LOGGED BY	D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10		100	100	100		1470		Very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites, common quartz veining), fresh to slightly weathered. Dips are 20° to locally 40° & 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing. *(continued)*				
	10.90											
11		100	100	98		980						
12	12.35											
		100	79	79		1230						
13	13.55											
		100	100	100		580						
14						520						
15	15.10								15.10	-5.04		
								End of Borehole at 15.10 m				
16												
17												
18												
19												

REMARKS

Hole cased 0.00-6.40m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

GEOTECHNICAL BORING RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**BOREHOLE NO.**	**BH3/54**
		SHEET	Sheet 1 of 1
CO-ORDINATES	528,601.86 E 727,756.28 N	**RIG TYPE**	Dando 3000
		BOREHOLE DIAMETER (mm)	200
GROUND LEVEL (m AOD)	8.05	**BOREHOLE DEPTH (m)**	3.70
		DATE COMMENCED	30/03/2016
		DATE COMPLETED	31/03/2016
CLIENT	Galway County Council	**SPT HAMMER REF. NO.**	
		BORED BY	WC
ENGINEER	ARUP	**ENERGY RATIO (%)**	
		PROCESSED BY	JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples: Ref. Number	Samples: Sample Type	Samples: Depth (m)	Samples: Recovery	Field Test Results	Standpipe Details
0	TOPSOIL with COBBLES and BOULDERS and some dark grey brown slightly silty slightly sandy GRAVEL (Possible MADE GROUND)		7.35	0.70	AA9	B	0.50			
1	Dense grey brown silty sandy GRAVEL with a medium cobble content				AA10	B	1.00-1.45		N = 40 (6, 9, 12, 14, 8, 6)	
2					AA11	B	2.00-2.45		N = 49 (5, 7, 8, 11, 14, 16)	
3					AA12	B	3.00-3.45		N = 50/200 mm (3, 4, 6, 17, 27)	
			4.35	3.70						
4	End of Borehole at 3.70 m									
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING

From (m)	To (m)	Time (h)	Comments
3.7	3.7	0.75	

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike

GROUNDWATER PROGRESS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1.0hr getting plant and equipment to borehole location

Sample Legend
D - Small Disturbed (tub)
B - Bulk Disturbed
LB - Large Bulk Disturbed
Env - Environmental Sample (Jar + Vial + Tub)
UT - Undisturbed 100mm Diameter Sample
P - Undisturbed Piston Sample
W - Water Sample

IGSL BH LOG 18963.GPJ IGSL.GDT 16/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/54R**
		SHEET	Sheet 1 of 2
CO-ORDINATES	528,601.20 E 727,757.95 N	**DATE DRILLED**	31/03/2016
GROUND LEVEL (mOD)	8.29	**DATE LOGGED**	01/04/2016
CLIENT	Galway County Council	**DRILLED BY**	IGSL
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
RIG TYPE	Casagrande		
FLUSH	Air/Mist		
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as gravelly clay				
1									1.20	7.09		
								SYMMETRIX DRILLING: No recovery, observed by driller as sandy gravelly clay with occasional cobbles				
2												
3									3.20	5.09		
								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock				
4	4.20								4.20	4.09		
		100	94	94				Medium strong to very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), slightly weathered. Dips are 20° to locally 40° & 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing. 6.11-6.35m - Clay-filled fracture				
5												
	5.70											
6		100	97	97								
						810						
7	7.20											
						660						
		100	99	99								
8						940						
	8.70											
9												
		100	99	99		770.000000000001						

REMARKS

Hole cased 0.00-4.20m.

WATER STRIKE DETAILS

Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type

IGSL RC FI 10M 18963.GPJ IGSL.GDT 17/8/16

GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER 18963

CONTRACT	N6 Galway City Transport Project - Phase 3	**DRILLHOLE NO**	**BH3/54R**
		SHEET	Sheet 2 of 2
CO-ORDINATES	528,601.20 E 727,757.95 N	**DATE DRILLED**	31/03/2016
GROUND LEVEL (mOD)	8.29	**DATE LOGGED**	01/04/2016
RIG TYPE	Casagrande		
FLUSH	Air/Mist		
CLIENT	Galway County Council	**DRILLED BY**	IGSL
ENGINEER	ARUP	**LOGGED BY**	D. O'Shea
INCLINATION (deg)	-90		
CORE DIAMETER (mm)	80		

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 250 500	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.20					600		Medium strong to very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), slightly weathered. Dips are 20° to locally 40° & 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing. *(continued)* 11.25-11.40m - Clay-filled fracture				
11		100	92	92		650						
	11.70					639.9999999999999						
12		100	94	94		699.9999999999999						
13	13.20	100	100	100								
14	14.20					2430						
		100	100	100								
15	15.20								15.20	-6.91		
								End of Borehole at 15.20 m				
16												
17												
18												
19												

REMARKS

Hole cased 0.00-4.20m.

WATER STRIKE DETAILS

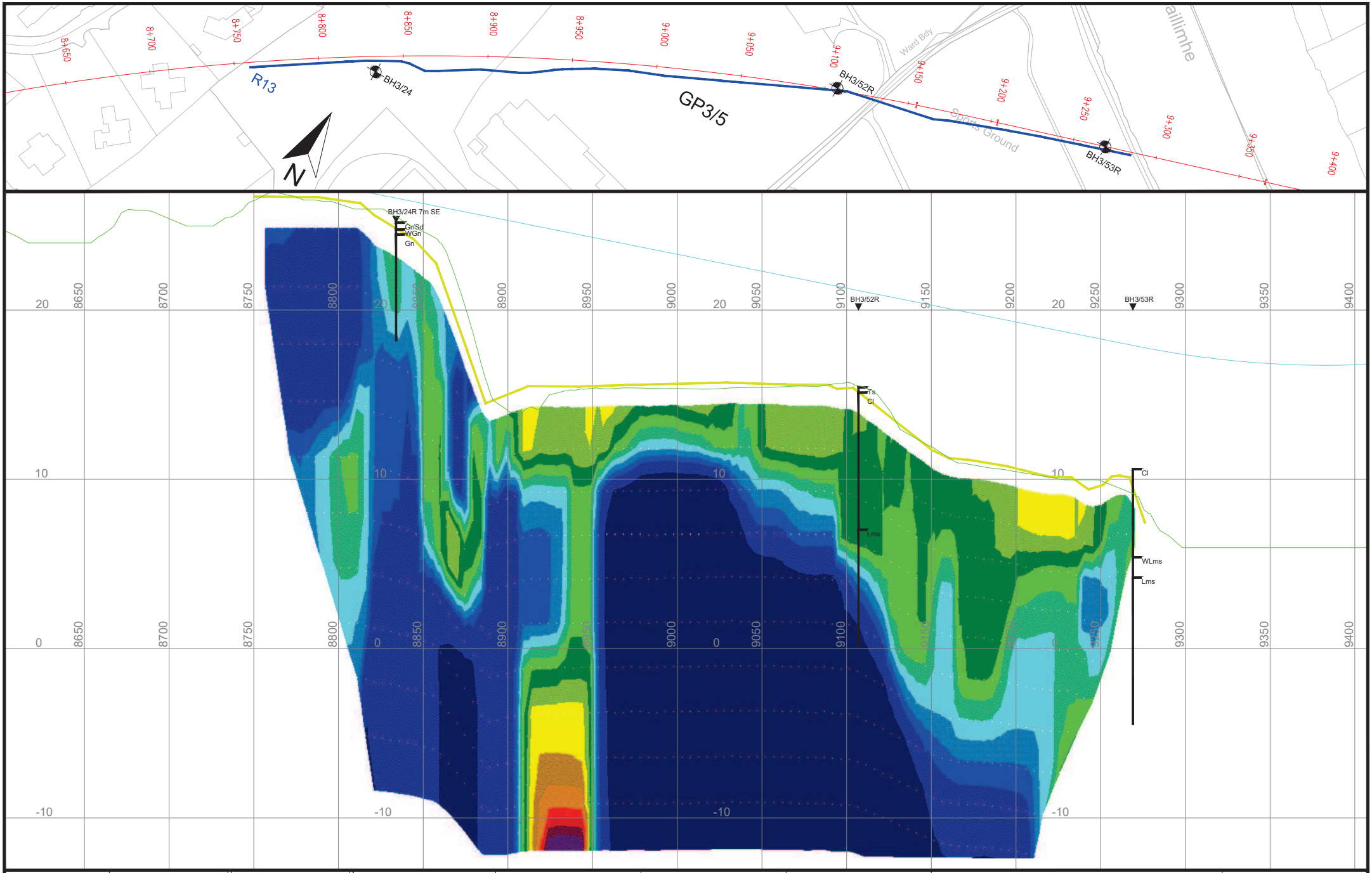
Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded

GROUNDWATER DETAILS

Date	Hole Depth	Casing Depth	Depth to Water	Comments

INSTALLATION DETAILS

Date	Tip Depth	RZ Top	RZ Base	Type



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CLIENT:	IGSL ARUP
PROJECT:	N6 GCTP Phase 3 Geophysical Survey
TITLE:	Plan 1d: Survey Locations and Models for GP3/05

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/06/2016
MGX FILE:	6031f_Plans.dwg
STATUS:	Final

LEGEND: Geophysical Survey Locations:
R2 2D-Resistivity Profile
S1 Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016
Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

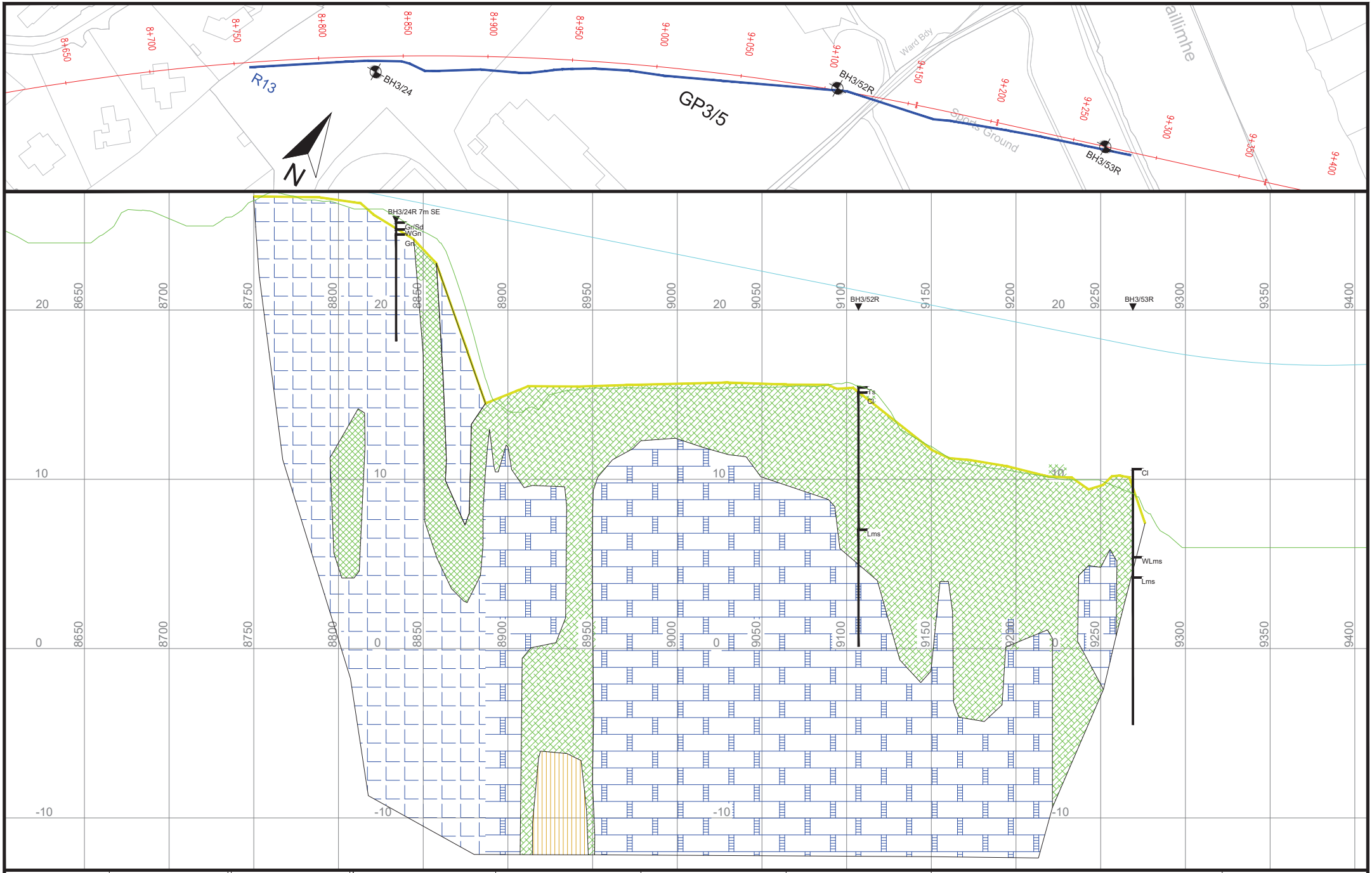
Geophysical Survey Locations:
Ground Surface along Survey Profile
Existing Ground Level along Centre Line
Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

2D-Resistivity Model Values:
Resistivities (Ohmm) for 2D-Resistivity Model

Abbreviated GI Logs:
BH3/18R Borehole Name and Location

Pt	Peat	Si	Silt
Cl	Clay	Lms	Limestone
Ts	Topsoil	WLms	Weathered Limestone
Mg	Made Ground	Gn	Granite
Gr	Gravel	WGn	Weathered Granite
Sd	Sand		



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CLIENT:	IGSL ARUP
PROJECT:	N6 GCTP Phase 3 Geophysical Survey
TITLE:	Plan 2d: Survey Locations and Interp for GP3/05

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/06/2016
MGX FILE:	6031f_Plans.dwg
STATUS:	Final

LEGEND:

Geophysical Survey Locations:
- R2 — 2D-Resistivity Profile
- S1 — Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016
Locations are in Irish Transverse Mercator. Elevations are in mOD (Malin Head)

Geophysical Survey Locations:
- Ground Surface along Survey Profile
- Existing Ground Level along Centre Line
- Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

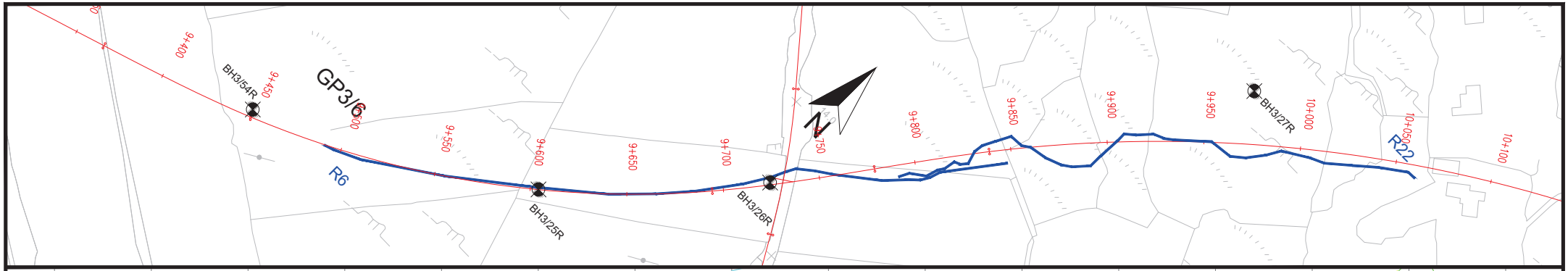
Interpretation:

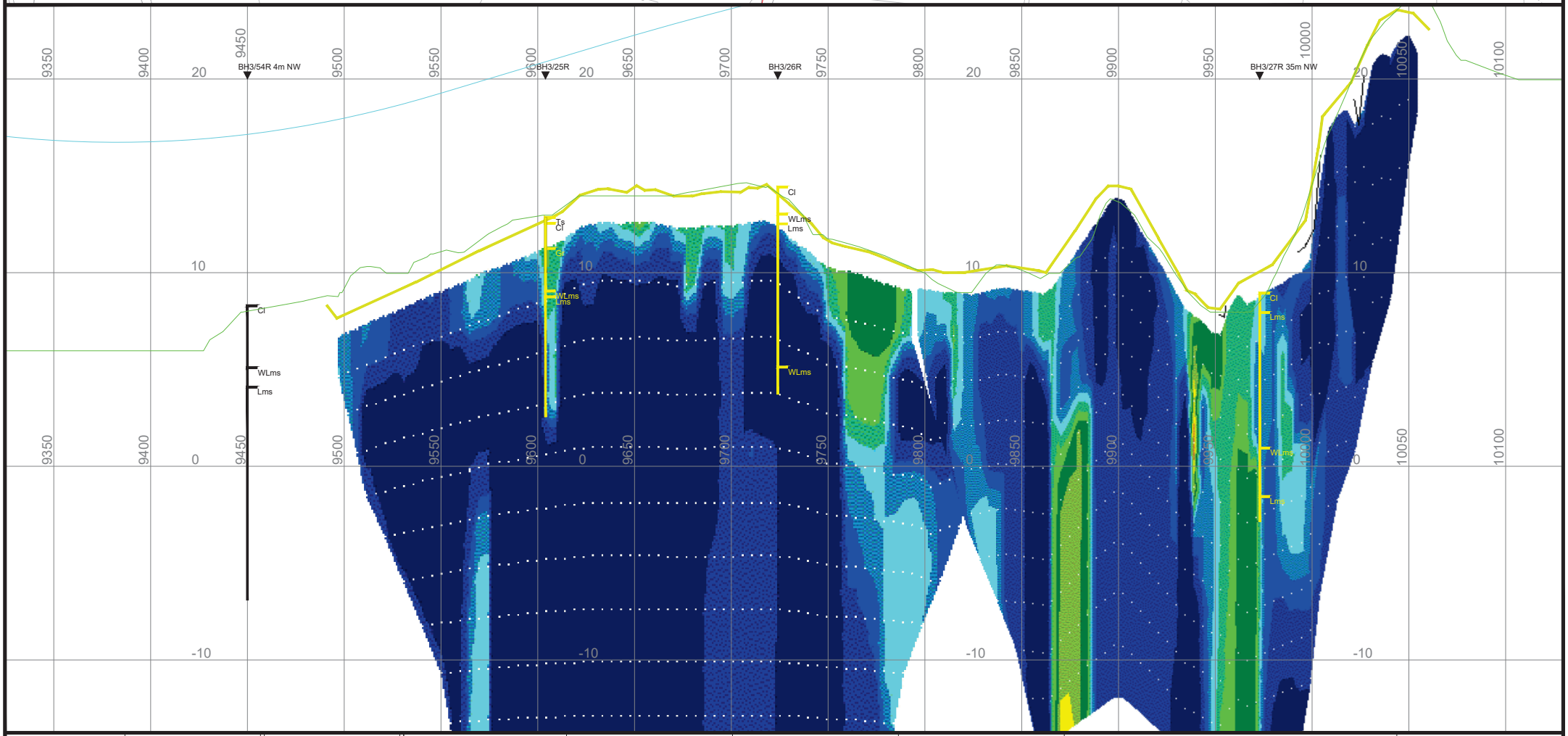
Granite Area (to approx. CH8890)
- G1 Soft or loose Topsoil or Overburden
- G2a Fair to Good Rock with some weathered zones
- G2b Fair to Good Rock

Limestone Area (from approx. CH8890)
- A Overburden (Clay or Silt) or Clay Filled Limestone
- B Overburden (Gravelly Clay) or Infilled Limestone
- C Overburden (Sand or Gravel) or Fresh Limestone

Abbreviated GI Logs:
BH3/18R Borehole Name and Location

Pt	Peat	Si	Silt
Cl	Clay	Lms	Limestone
Ts	Topsoil	WLms	Weathered Limestone
Mg	Made Ground	Gn	Granite
Gr	Gravel	WGn	Weathered Granite
Sd	Sand		





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CLIENT:	IGSL ARUP
PROJECT:	N6 GCTP Phase 3 Geophysical Survey
TITLE:	Plan 1e: Survey Locations and Models for GP3/06

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/06/2016
MGX FILE:	6031f_Plans.dwg
STATUS:	Final

LEGEND:

Geophysical Survey Locations:

R2 2D-Resistivity Profile

S1 Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

Geophysical Survey Locations:

Ground Surface along Survey Profile

Existing Ground Level along Centre Line

Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

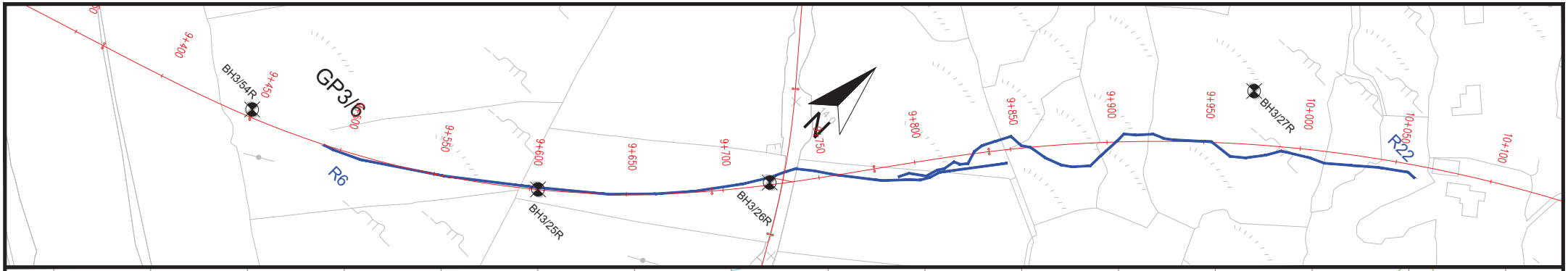
2D-Resistivity Model Values:

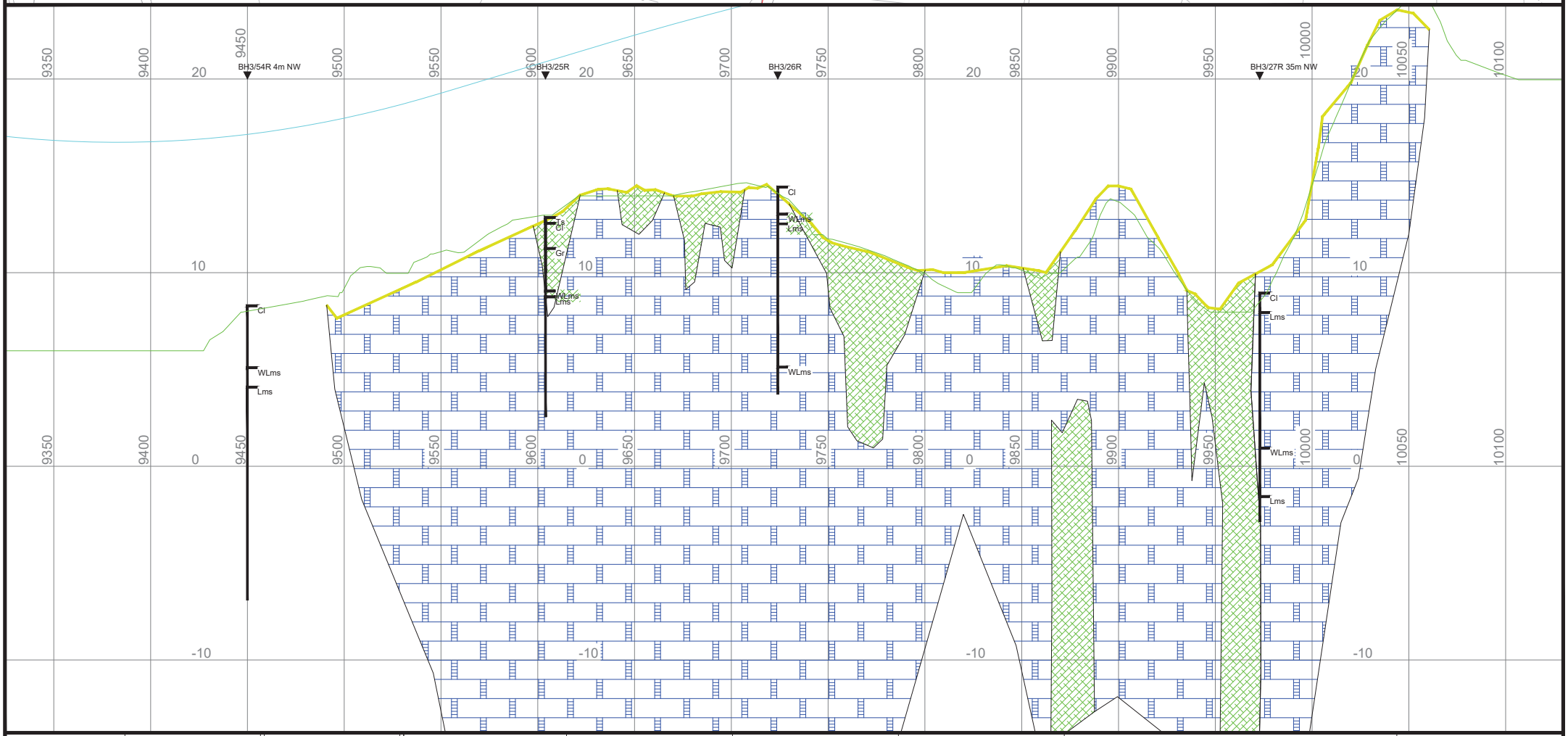
Resistivities (Ohmm) for 2D-Resistivity Model

Abbreviated GI Logs:

BH3/18R Borehole Name and Location

Pt	Peat	Si	Silt
Cl	Clay	Lms	Limestone
Ts	Topsoil	WLms	Weathered Limestone
Mg	Made Ground	Gn	Granite
Gr	Gravel	WGn	Weathered Granite
Sd	Sand		





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CLIENT:	IGSL ARUP
PROJECT:	N6 GCTP Phase 3 Geophysical Survey
TITLE:	Plan 2e: Survey Locations and Interpretation for GP3/06

SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10
PROJECT:	6031
DRAWN:	RJ
DATE:	18/06/2016
MGX FILE:	6031f_Plans.dwg
STATUS:	Final

LEGEND:

Geophysical Survey Locations:

R2 2D-Resistivity Profile

S1 Seismic Refraction Profile

Chainage based on Alignment received 12.02.2016

Locations are in Irish Transverse Mercator, Elevations are in mOD (Malin Head)

Geophysical Survey Locations:

Ground Surface along Survey Profile

Existing Ground Level along Centre Line

Proposed Vertical Alignment Centre Line

2D Resistivity and Seismic Refraction results are projected onto the Centre Line

Interpretation:

A Overburden (Clay or Silt) or Clay Filled Limestone

B Overburden (Gravelly Clay) or Infilled Limestone

C Overburden (Sand or Gravel) or Fresh Limestone

Abbreviated GI Logs:

BH3/18R Borehole Name and Location

Pt	Peat	Si	Silt
Cl	Clay	Lms	Limestone
Ts	Topsoil	WLms	Weathered Limestone
Mg	Made Ground	Gn	Granite
Gr	Gravel	WGn	Weathered Granite
Sd	Sand		

IDL

BOREHOLE LOG

Project	Location	BOREHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	**BH-1**

Job No	Date	Ground Level (m)	Co-Ordinates ()
	22-10-13 22-10-13	9.53	E 128,426.7 N 227,673.5

Engineer	GROUNDWATER STRIKES	Sheet
RBL	Water strikes: Rose to (@ 20 min.): Sealed at: 1st: dry 2nd: 3rd:	1 of 1 Rev.

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	D1			9.33		0.20	TOPSOIL: Brown slightly sandy CLAY.		
							Dense grey very silty SAND and GRAVEL with cobbles.		
1.00	CPT	N = 45 (3, 4, 4, 13, 14)				(1.50)			
1.00-1.50	B1								
1.50-2.00	D2			7.83		1.70			
							Firm dry light brown CLAY.		
2.00	CPT	N = 12 (4, 3, 3, 3, 3, 3)				(1.00)			
2.00-2.50	B2								
				6.83		2.70			
2.70-3.20	U	25 blows NR		6.63		2.90	Greyish green gravelly CLAY.		
2.70-3.00	D3						Medium dense grey silty very sandy GRAVEL with angular limestone cobbles.		
3.50-4.00	B3					(1.55)			
4.00	CPT	N = 68 (7, 13, 13, 17, 19, 19)					4.00m; becoming very dense.		
4.00-4.40	B4			5.08		4.45			
4.00-4.40	D5						BH terminated at 4.45m bgl - refusal as possible rock.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water (bgl) Depth, m	From	To	Hours	From	To	
						4.4	4.40	1			BH backfilled.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Dando 2000	Bit Design	Driller DK	Logged By DK

IDL AGS3 UK BH RIVER CORRIB CROSSING CORE ETC NOV 1 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

IDL

BOREHOLE LOG

Project	Location	BOREHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	**BH-2**

Job No	Date	Ground Level (m)	Co-Ordinates ()
	21-10-13 21-10-13	8.60	E 128,357.3 N 227,704.1

Engineer	GROUNDWATER STRIKES	Sheet
RBL	Water strikes: Rose to (@ 20 min.): Sealed at: 1st: dry 2nd: 3rd:	1 of 1 Rev.

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.50	D1			8.30		0.30	MADE GROUND: Gravel path over cobbles.		
							Stiff grey sandy gravelly SILT/CLAY with rounded limestone cobbles.		
1.00	CPT	N = 24 (4, 3, 7, 4, 9, 4)					1.0-1.50m: grey very silty very gravelly sand.		
1.00-1.50	B1					(2.15)			
1.50-2.00	D2								
2.00	CPT	N = 64 (7, 16, 13, 16, 16, 19)					2.00m: becoming hard.		
2.00-2.40	B2			6.15		2.45			
							BH terminated at 2.45m bgl - refusal as possible rock.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water (bgl) Depth, m	From	To	Hours	From	To	
						2.4	2.40	1			BH backfilled.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Dando 2000	Bit Design	Driller DK	Logged By DK

IDL AGS3 UK BH RIVER CORRIB CROSSING CORE ETC NOV 1 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

IDL

BOREHOLE LOG

Project	Location	BOREHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	BH-3

Job No	Date	Ground Level (m)	Co-Ordinates ()
	29-10-13 29-10-13	8.11	E 128,511.9 N 227,936.3

Engineer	GROUNDWATER STRIKES	Sheet / Rev.
RBL	Water strikes: Rose to (@ 20 min.): Sealed at: 1st: dry 2nd: 3rd:	Sheet 1 of 1 Rev.

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				7.71		0.40	TOPSOIL: Dark brown slightly sandy CLAY.		
0.40-0.50 0.50-1.20	D1 B1			7.61		0.50	Orangish brown slightly sandy gravelly CLAY with high cobble content.		
						(0.70)	Grey clayey GRAVEL with angular limestone cobbles.		
1.00 1.20	CPT CPT	25 for 0 mm (7, 5, 25) 25 Seating Blows for 0 mm (25, 0)		6.91		1.20	BH terminated at 1.20m bgl - refusal as possible rock.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water (bgl) Depth, m	From	To	Hours	From	To	
						1.2	1.20	2			BH backfilled.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Dando 2000	Bit Design	Driller DK	Logged By DK

IDL AGS3 UK BH RIVER CORRIB CROSSING CORE ETC NOV 1 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

IDL

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-1

Job No	Date	Ground Level (m)	Co-Ordinates ()
	24-10-13 25-10-13	9.53	E 128,426.7 N 227,673.5

Engineer	Sheet	Rev.
RBL	1 of 3	

RUN DETAILS						STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'ed Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities	DESCRIPTION: Detail	DESCRIPTION: Main	Geology / Instrument/ Backfill
0.00						0.00		Open hole drilling - no recovery.	
	0 (-)	NA			(5.30)				
5.30			4.23		5.30				
	71 (-)				(1.70)			Limestone BOULDERS with a little greenish grey clay.	
7.00			2.53		7.00				
7.80	88 (-)	NA						Orange brown slightly sandy gravelly CLAY with cobbles and boulders. Sand is fine and medium. Gravel is subrounded and subangular fine to coarse of limestone.	
	100 (-)				(2.00)				
9.00			0.53		9.00				
	100 (79) 32	NI				9.00 m to 12.40m: Non-intact as weathered rock.		Possible weathered LIMESTONE rock. Recovered as angular fine to coarse gravel cobble and boulder sized clasts with some light orangish brown clay.	

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	
								0 10.9	10.90	water	<100%	BH backfilled.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit Design HQ	Driller DK	Logged By EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-1

Job No	Date	Ground Level (m)	Co-Ordinates ()
	24-10-13 25-10-13	9.53	E 128,426.7 N 227,673.5

Engineer	Sheet	Rev.
RBL	2 of 3	

RUN DETAILS				STRATA				
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Geology / Instrument/ Backfill
10.20								
10.90	100 (24) 0				(3.40)		Core run - 9.00m to 10.20m: 2 No light grey limestone boulders x220mm and 201mm in length. Possible weathered LIMESTONE rock. Recovered as angular fine to coarse gravel cobble and boulder sized clasts with some light orangish brown clay. *(continued)*	
11.90	100 (26) 0	NI/NR						
12.30	75 (28) 0		-2.87		12.40			
13.90	100 (91) 85	3 2				12.40 m to 25.10m: Medium spaced, dipping 20 to 22°, irregular, locally undulating, interlocking, rough, with a little dark grey silt.	Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE. 12.5-12.70m: medium strong.	
15.50	100 (98) 97	2 1						
16.90	100 (100) 100	0				16.85 m to 17.02m: Joint: subvertical dip, undulating, smooth, with a little orange brown clay, open.		
18.50	100 (95) 93	1 0			(12.70)			
20.00	100 (98) 97	1						

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
	25.10	water	100%

GENERAL REMARKS

BH backfilled.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit Design HQ	Driller DK	Logged By EAT

IDL AGS3 UK DH RIVER CORRIB CROSSING CORE ETC NOV 1 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-1

Job No	Date	Ground Level (m)	Co-Ordinates ()
	24-10-13 25-10-13	9.53	E 128,426.7 N 227,673.5

Engineer	Sheet	Rev.
RBL	3 of 3	

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'ed Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail / Main	Geology	Instrument/ Backfill
	100 (98) 97	1				Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE. *(continued)*		
21.60		1						
	100 (99) 98	1						
23.00								
	100 (100) 100	0						
24.60		1						
25.10	100 (98) 97		-15.57		25.10	BH terminated at 25.10m bgl on REs instruction.		

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	BH backfilled.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit Design HQ	Driller DK	Logged By EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-2

Job No	Date	Ground Level (m)	Co-Ordinates ()
	23-10-13 24-10-13	8.60	E 128,357.3 N 227,704.1

Engineer	Sheet	Rev.
RBL	1 of 3	

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Geology / Instrument/ Backfill
0.00						0.00 m to 2.40m: Non-intact as weathered rock.	Open hole drilling - no recovery.	
	0 (-) -	NA			(2.40)			
2.40			6.20		2.40			
	100 (84) 64	1				2.40 m to 25.00m: Medium spaced, dipping 12 to 14°, irregular, locally undulating, interlocking, rough, with a little greenish grey clay.	Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE.	
3.20	100 (98) 0	5						
3.30								
	100 (98) 84	3				4.30 m to 4.50m: Joint: subvertical dip, undulating, smooth, with a little light brown clay, open.		
4.90								
	100 (98) 92	3						
6.50		1						
	100 (98) 97	1				7.40 m to 7.55m: Joint: subvertical dip, undulating, smooth, with a little light brown clay, open.		
7.90								
	100 (98) 97	2						
9.50		1						

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	3.30	water	<100%
3.3	25.00	water	100%

GENERAL REMARKS

50mm standpipe installed to 25.00m depth.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit Design HQ	Driller DK	Logged By EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-2

Job No	Date	Ground Level (m)	Co-Ordinates ()
	23-10-13 24-10-13	8.60	E 128,357.3 N 227,704.1

Engineer	Sheet	Rev.
RBL	2 of 3	

RUN DETAILS					STRATA				
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities	Detail	Main	Geology	Instrument/ Backfill
10.90	87 (98) 97	2						Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE. *(continued)*		
12.50	80 (98) 97	1 1								
13.90	100 (98) 94	2			(22.60)			13.00-13.25m: strong.		
15.50	100 (98) 96	1 0								
16.90	100 (98) 98	1								
18.50	100 (98) 97	0 1						18.50m to 18.55m: brown mottled grey clay.		
20.00	100 (98) 79	3				19.40 m to 19.70m: Joint: subvertical dip, 'V' shaped, undulating, rough, clean, open.				

Drilling Progress and Water Observations							
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

50mm standpipe installed to 25.00m depth.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit Design HQ	Driller DK	Logged By EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-2

Job No	Date	Ground Level (m)	Co-Ordinates ()
	23-10-13 24-10-13	8.60	E 128,357.3 N 227,704.1

Engineer	Sheet	Rev.
RBL	3 of 3	

RUN DETAILS						STRATA				
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Discontinuities	Detail	Main	Geology	Instrument/ Backfill
	100 (98) 98	1						Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE. *(continued)*		
21.60		1								
	100 (98) 95	5								
23.00						22.80 m to 22.86m: Joint: subvertical dip, undulating, smooth, with an orange brown clay smear, open.				
	88 (81) 59	1								
		3				24.15 m to 24.55m: Joint: vertical dip to 24.40m, then subvertical dip, irregular, locally undulating, rough, with an orange brown clay smear and minor orange brown iron stain, open.				
24.70	100	NR?						24.70m to 24.73m: orange brown clay.		
25.00	(100)		-16.40		25.00	24.50 m to 24.70m: No recovery - probable area of core loss as wash out of fines during drilling.		BH terminated at 25.00m bgl on REs instruction.		
	100	0								

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	50mm standpipe installed to 25.00m depth.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit HQ Design	Driller DK	Logged By EAT

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	**RC-3**

Job No	Date	Ground Level (m)	Co-Ordinates ()
	30-10-13 31-10-13	8.11	E 128,511.9 N 227,936.3

Engineer	Sheet	Rev.
rbl	1 of 3	

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Geology / Instrument/ Backfill
0.00	0 (-) -	NA	6.91		(1.20) 1.20	0.00 m to 1.20m: overburden.	Open hole drilling - no recovery.	
2.00	100 (94) 71	4				1.20 m to 25.20m: Medium spaced, locally closely spaced, dipping 32 to 34°, irregular, interlocking, rough, with minor orange brown iron stain.	Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE.	
3.60	100 (97) 81	5 5			(3.30)	2.20 m to 2.30m: Joint: dipping 60°, undulating, smooth, locally rough, with a little orange brown clay and minor orange brown iron stain, open.		
5.00	64 (62) 44	7 NR	3.61 3.11		4.50 (0.50) 5.00	4.40 m to 4.50m: Joint: dipping 60°, irregular, rough, with a yellowish white calcitic smear and orange and orange brown iron stain, wide to 50% of diameter. 4.50 m to 5.00m: CAVITY. No recovery.	CAVITY.	
6.50	100 (97) 67	8 4				5.00 m to 5.50m: Joint: subvertical dip, irregular, locally planar, rough, with minor orange brown iron stain, open.	Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE.	
8.00	100 (97) 85	5				7.20 m to 7.35m: Joint: subvertical dip, undulating, smooth, locally rough, with orange brown clay and minor orange brown iron stain, open.		
9.60	100 (97) 53	7 12				8.22 m to 8.28m: Joint: dipping ~46°, planar, rough, with a. orange brown clay smear 4mm wide. 8.65 m to 8.75m: Joint: dipping 60°, undulating, rough, with an orange brown clay smear 1 to 2mm wide. 8.80 m to 9.50m: Joint: subvertical dip, undulating, smooth, with a milky white calcitic smear and orange and		
	100							

Drilling Progress and Water Observations							
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From (m)	To (m)	Type	Return (%)
0	25.20	water	0%

GENERAL REMARKS

50mm standpipe installed to 25.20m depth.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit HQ Design	Driller DK	Logged By EAT

IDL AGS3 UK DH RIVER CORRIB CROSSING CORE RC3 NOV 5 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-3

Job No	Date	Ground Level (m)	Co-Ordinates ()
	30-10-13 31-10-13	8.11	E 128,511.9 N 227,936.3

Engineer	Sheet	Rev.
rbl	2 of 3	

RUN DETAILS						STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
10.60	(74) 21	NI				orange brown iron stain, open. 10.00 m to 10.60m: Non-intact as weathered rock. 10.00 - 10.70 m to 10.70m: Joint: subvertical dip, irregular, rough, with a little orangish brown clay smear and minor orange brown iron stain, open - non-intact.	Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE. *(continued)*		
12.00	100 (97) 76	3 3							
12.90	100 (96) 20	11				12.10 m to 12.90m: Joint: subvertical dip, undulating, locally planar, rough, locally smooth, with a little light orange brown clay and minor orange iron stain, open.			
14.00	100 (93) 86	2							
15.60	100 (98) 95	3 1			(20.20)				
17.00	100 (95) 77	3				16.10 m to 16.40m: Joint: subvertical dip, planar, locally irregular, rough, with an orange brown sandy clay smear 2 to 3mm wide.			
18.40	100 (97) 94	2 3				17.30 m to 17.42m: Joint: subvertical dip, planar, locally irregular, rough, with an orange brown sandy clay smear 2 to 3mm wide.	17.80 to 17.90m: fine gravel sized - vuggy with a 1 to 3mm grey silty fine sand smear.		
20.00	100 (99) 98	3							

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	50mm standpipe installed to 25.20m depth.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit Design HQ	Driller DK	Logged By EAT

IDL AGS3 UK DH RIVER CORRIB CROSSING CORE RC3 NOV 5 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

IDL

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Galway Wind Park - River Corrib Crossing	Co Galway	RC-3

Job No	Date	Ground Level (m)	Co-Ordinates ()
	30-10-13 31-10-13	8.11	E 128,511.9 N 227,936.3

Engineer	Sheet	Rev.
rbl	3 of 3	

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Geology / Instrument/ Backfill
	100 (97) 95	3					Very strong thinly bedded grey coarse grained sparry bioclastic LIMESTONE. *(continued)*	
21.60		2				21.20 m to 21.34m: Joint: subvertical dip, undulating, smooth, clean, open.		
	100 (95) 80	4				22.65 m to 23.05m: Joint: subvertical dip, undulating, locally irregular, smooth, with a little black silt to 22,78m, then with an orange brown clay smear, open.		
23.00								
	100 (98) 97	3						
24.50								
	100 (98) 94	2				24.80 m to 24.95m: Joint: subvertical dip, undulating, smooth, with minor orange and orange brown iron stain, open. 24.90 m to 25.20m: Joint: subvertical dip, undulating, with minor orange and orange brown iron stain, tight.		
25.20			-17.09		25.20		BH terminated at 25.20m bgl on REs instruction.	

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	50mm standpipe installed to 25.20m depth.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used Hydreq	Bit HQ Design	Driller DK	Logged By EAT

IDL AGS3 UK DH RIVER CORRIB CROSSING CORE RC3 NOV 5 2013.GPJ IDL TP TEMPLATE.GDT 9/12/13

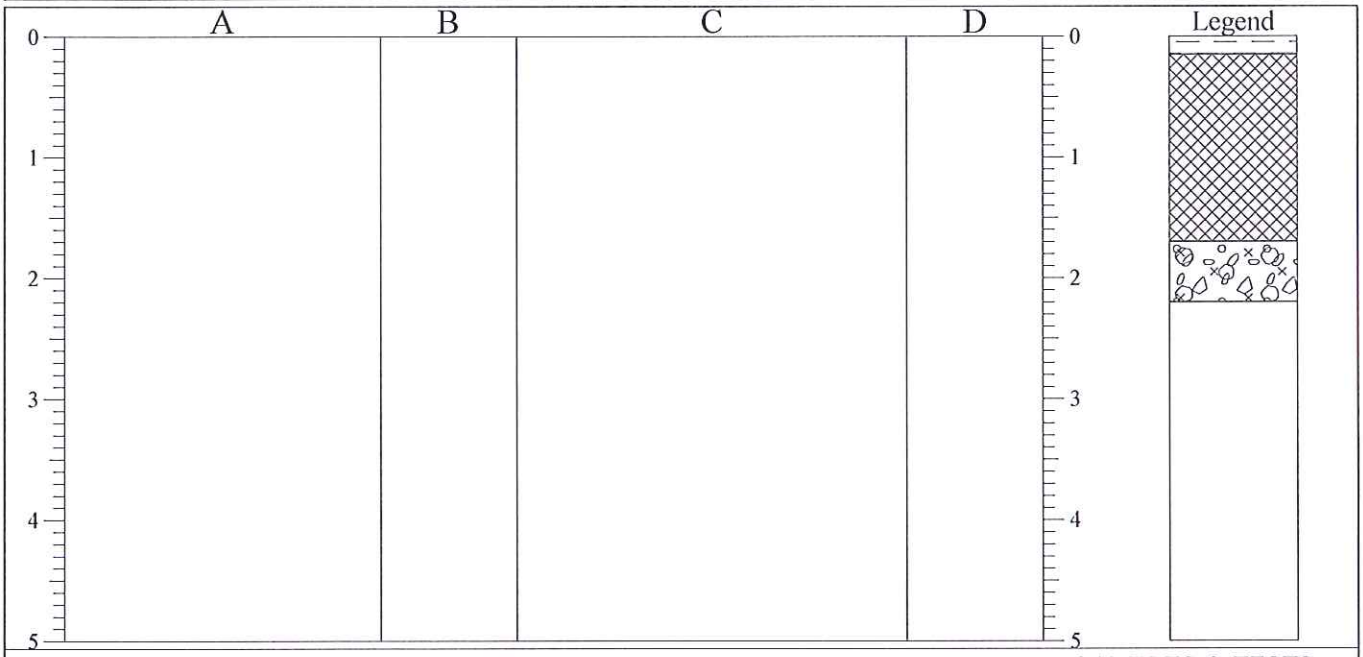
IDL

TRIAL PIT LOG

Project	Location	TRIAL PIT No
Galway Wind Park - River Corrib Crossing	Co Galway	TP-1

Job No	Date	Ground Level (m)	Co-Ordinates ()
	22-10-13 22-10-13	9.29	E 128,376.4 N 227,694.7

Engineer	GROUNDWATER STRIKES	Sheet
RBL	Water strikes: Rose to (@ 20 min.): Sealed at: 1st: dry 2nd: 3rd:	Rev. 1 of 1

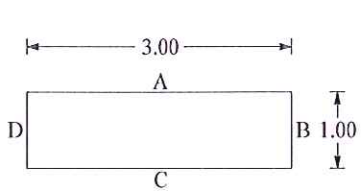


STRATA

SAMPLES & TESTS

Depth	No	DESCRIPTION	In Situ Tests	Water	Depth (m)	No	Remarks/Tests
0.00-0.15		TOPSOIL: Brown slightly sandy CLAY.					
0.15-1.70		MADE GROUND: Brown silty gravelly SAND with kerb stones bricks timber and with medium cobble content and low boulder content. Cobbles and boulders are subrounded and subangular.			1.20-1.30	B1	
1.70-2.20		Grey silty very sandy medium GRAVEL with high cobble content. Cobbles are subangular.			2.00-2.20	B2	
2.20		TP terminated at 2.20m bgl - obstruction.					

Shoring/Support: N/A
Stability: Pit stable.



GENERAL REMARKS

Pit dry on excavation.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used New Holland E70SR	Bit Design	Driller DOR	Logged By DOR

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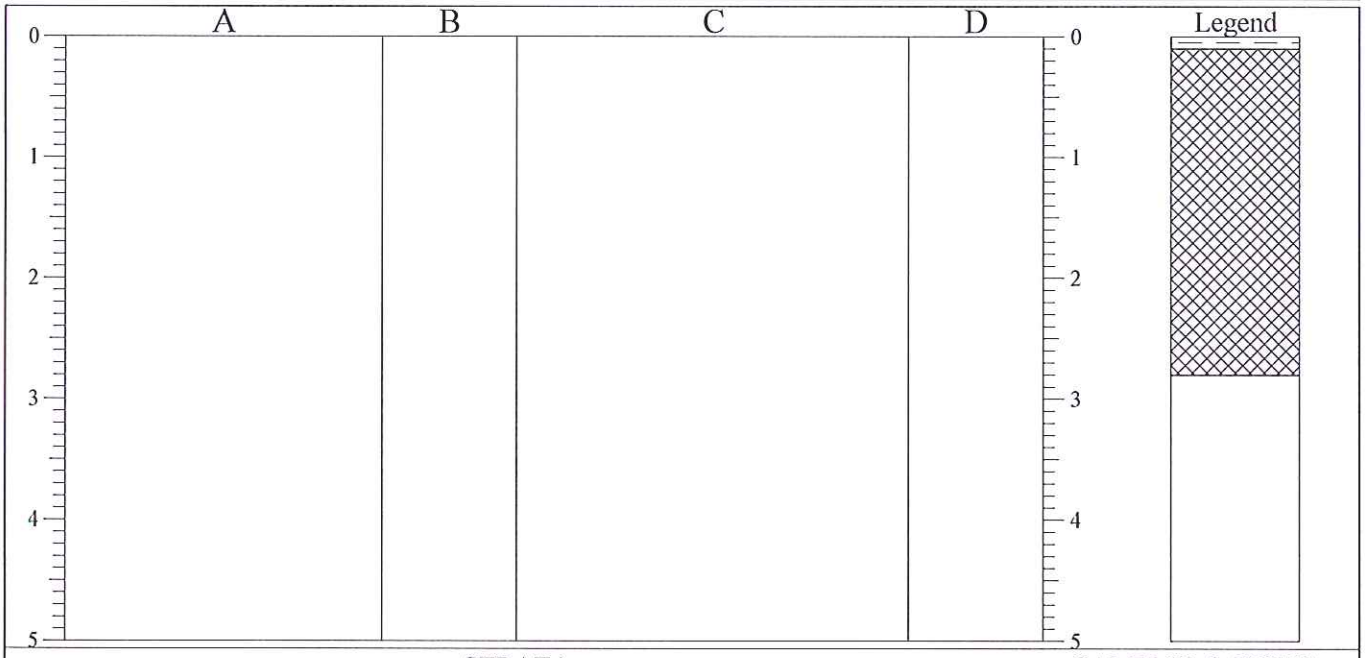
IDL

TRIAL PIT LOG

Project	Location	TRIAL PIT No
Galway Wind Park - River Corrib Crossing	Co Galway	**TP-2**

Job No	Date	Ground Level (m)	Co-Ordinates ()
	22-10-13 22-10-13	9.57	E 128,412.9 N 227,690.6

Engineer	GROUNDWATER STRIKES	Sheet
RBL	Water strikes: 1st: 1.80m 2nd: 3rd: Rose to (@ 20 min.): Sealed at:	Rev. 1 of 1

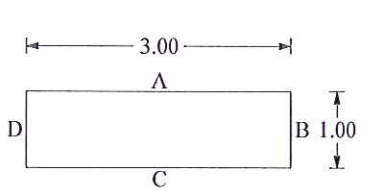


STRATA

SAMPLES & TESTS

Depth	No	DESCRIPTION	In Situ Tests	Water	Depth (m)	No	Remarks/Tests
0.00-0.10		TOPSOIL: Brown slightly sandy CLAY.					
0.10-2.80		MADE GROUND: Grey silty very sandy coarse GRAVEL with medium cobble content and low boulder content. Cobbles and boulders are subrounded and subangular.			1.00-1.10	B1	
1.80		1.80m: becoming moist.		▼1	2.00-2.10	B2	
2.80		TP terminated at 2.80m bgl. Sidewall collapse - unable to keep TP open.			2.70-2.80	B3	

Shoring/Support: N/A
Stability: Pit unstable.



GENERAL REMARKS

Moist from 1.80m bgl.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used New Holland E70SR	Bit Design	Driller DOR	Logged By DOR

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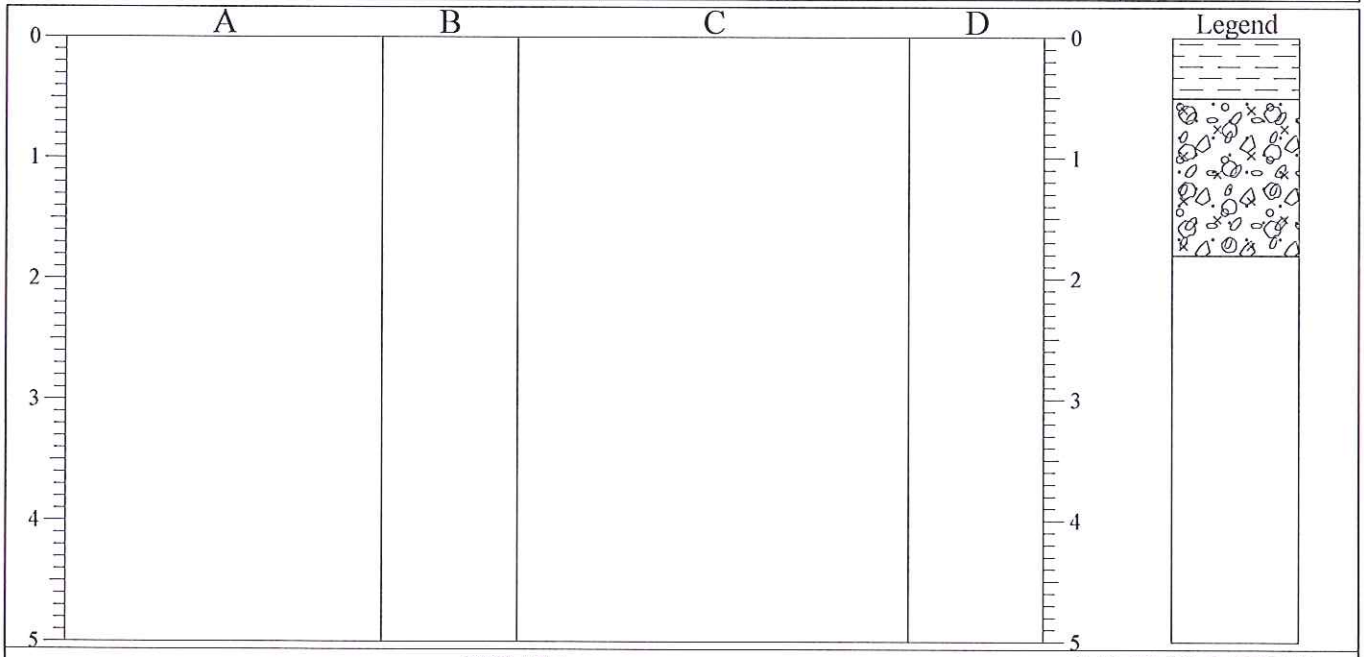
TRIAL PIT LOG

Project	Location	TRIAL PIT No
Galway Wind Park - River Corrib Crossing	Co Galway	TP-3

Job No	Date	Ground Level (m)	Co-Ordinates ()
	30-10-13 30-10-13	9.30	E 128,486.7 N 227,852.6

Engineer	GROUNDWATER STRIKES	Water strikes: Rose to (@ 20 min.): Sealed at:	Sheet
RBL		1st: dry 2nd: 3rd:	Rev. 1 of 1

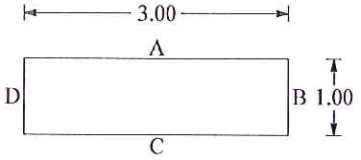


STRATA

SAMPLES & TESTS

Depth	No	DESCRIPTION	In Situ Tests	Water	Depth (m)	No	Remarks/Tests
0.00-0.50		TOPSOIL: Brown slightly sandy CLAY with roots.					
0.50-1.80 0.70		Light brown very silty very sandy medium GRAVEL with high cobble content and medium boulder content. Cobbles are angular and subangular. Boulders are subangular. 1 No boulder x600mm x 550mm x950mm in size. 0.70m: Possible archaeological structure as noted by archaeologist.			1.00-1.10	B1	
1.80		TP terminated at 1.80m bgl - obstruction as possible rock.			1.70-1.80	B2	

Shoring/Support: N/A
Stability: Pit stable.



GENERAL REMARKS

Pit dry on excavation.
Possible archaeological structure at 0.70m bgl.

All dimensions in metres Scale 1:62.5	Client SSER	Method/ Plant Used New Holland E70SR	Bit Design	Driller DOR	Logged By DOR

IDL_AGS3 UK TP RIVER CORRIB CROSSING CORE ETC NOV 1 2013.GPJ AGS 3_1.GDT 9/12/13

Appendix D

Constructability Report

Galway County Council

N6 Galway City Ring Road

River Corrib Bridge Constructability Examination

GCOB-4.03-6.1.77-001

Issue 3 | 1 June 2017

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 233985-00

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Document Verification

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Job title		N6 Galway City Ring Road		Job number 233985-00
Document title		River Corrib Bridge Constructability Examination		File reference
Document ref		GCOB-4.03-6.1.77-001		
Revision	Date	Filename	GCOB_4 03-6 1 77-001 River Corrib Bridge Construction_D5 Text only AOT.docx	
Issue 1	21 Dec 2016	Description	First issue	
			Prepared by	Checked by	Approved by
		Name	Daniel Mangan	Finian Burke/Mary Hurley	Eileen McCarthy
		Signature			
Issue 2	02 Apr 2017	Filename			
		Description	Second issue		
			Prepared by	Checked by	Approved by
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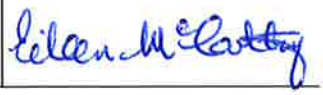
		Signature			
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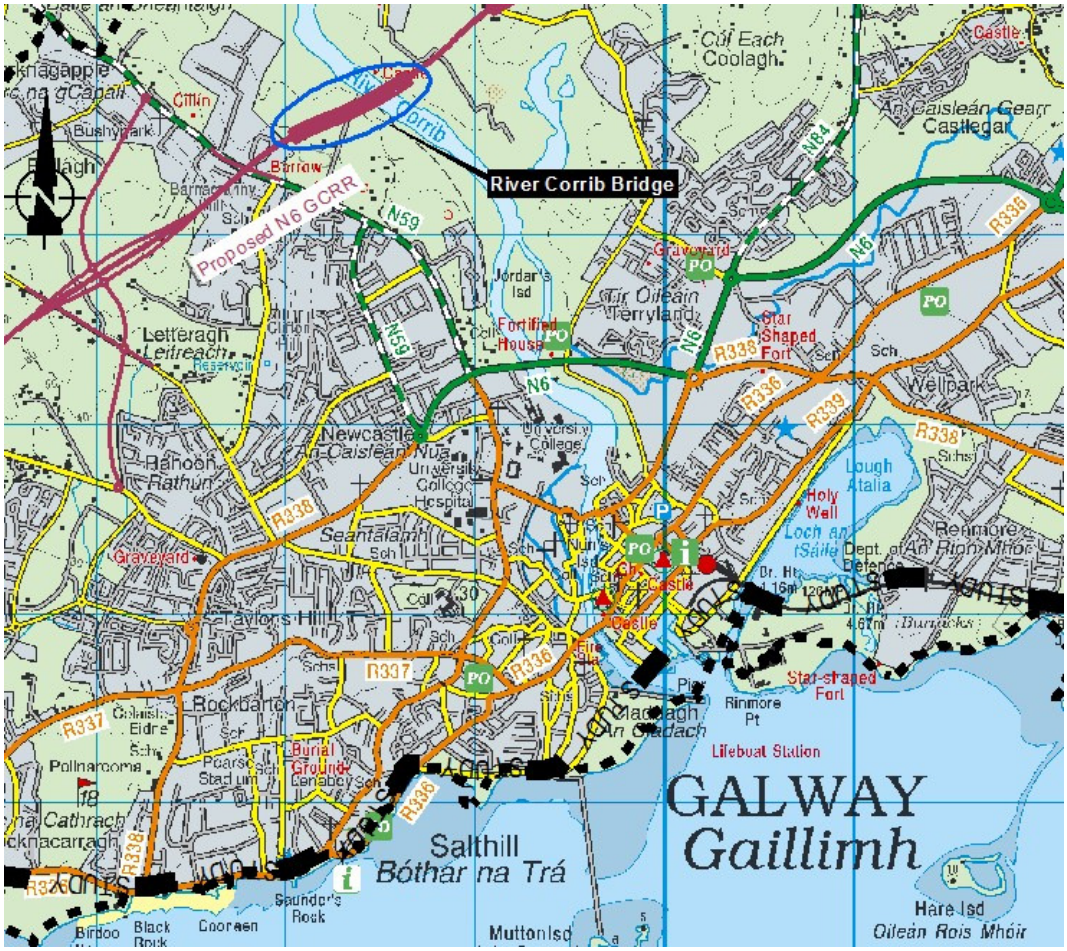
Contents

1 Introduction

1.1 Site Location

The N6 Galway City Ring Road (GCRR), hereafter referred to as proposed road development, incorporates the design of a bridge structure, known as the River Corrib Bridge between the townlands of Dangan and Menlough to the north of Galway city as shown in **Figure 1.1** below. The structure is located over the NUIG Recreational Facilities and over the River Corrib between the N59 Letteragh Junction to the west and the Menlough Viaduct to the east.

Figure 1.1: Site Location – River Corrib Bridge



The proposed structure passes through the NUIG Recreational Facilities to the north of the existing hockey pitch, athletics track and sports pavilion building. The structure traverses the playing fields before crossing the River Corrib and the Lough Corrib candidate Special Area of Conservation (cSAC), with a skew of approximately 25°. On the east of the river the proposed road development continues over the eastern river bank adjacent to Menlo Castle and continues eastwards through the wooded area on an embankment, as shown in **Figures 1.2** and **1.3** below.

Figure 1.2: Plan of River Corrib Bridge

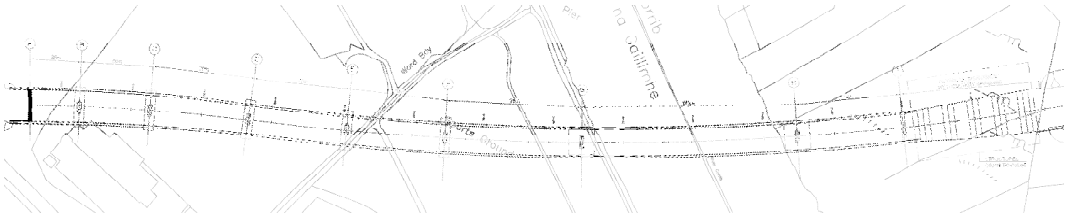
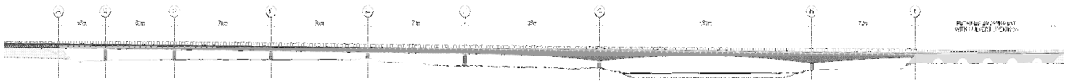


Figure 1.3: Elevation of River Corrib Bridge



1.2 Overview of bridge and its purpose

The purpose of the River Corrib Bridge is to provide a crossing of the River Corrib and has been designed to minimise the potential impacts on Menlo Castle and its demesne, Lough Corrib cSAC, NUIG Recreational Facilities, and the River Corrib itself.

The proposed River Corrib crossing consists of a 620m, 8-span continuous bridge deck supported on bearings at abutments and intermediate supports. The span lengths vary from 35m to 153m, and has a skewed alignment with respect to the river. The supports adjacent to the River Corrib will be set back by at least 5m from the edge of the river bank.

The bridge superstructure will consist of cast in-situ post-tensioned concrete box girder deck. The main and adjacent spans shall consist of a variable depth single concrete box ranging between approximately 3m and 7m in depth. The superstructure will be approximately 7m in depth at main span supports adjacent to the river. The remaining western approach spans consists of 3m constant depth single concrete box while the remaining eastern approach links into a retaining embankment with five culvert openings to provide sufficient permeability for the movement of wildlife. The structure will be supported on reinforced concrete piers. For aesthetic reasons, inclined webs are proposed instead of vertical webs.

The minimum clearance below the deck soffit for the entire width of the river is approximately 8m, which is greater than the 0.3m freeboard required by the OPW. It also provides adequate clearance below the deck soffit for river navigation. River navigation must be considered during construction to cater for the commercial and recreational users of the river. With this in mind, the contractor shall develop a method to cater for the needs of all river users during construction. This shall be done in consultation with the relevant parties.

1.3 Purpose of report

Given the environmentally sensitive location of the structure, its setting and general accessibility to the site, the construction methods are an important aspect to be considered at this stage. This report describes the proposed method of construction for the bridge envisaged in the preliminary design and the measures taken to protect

the Lough Corrib cSAC and to maintain the accessibility of the NUIG Recreational Facilities (**Section 2**). A summary of the findings of this report are outlined in (**Section 3**).

2 Proposed Construction

The River Corrib Bridge can be constructed using a combination of two different construction methods as follows:

1. Cast in-situ on temporary falsework (Method 1) – It is anticipated that the western approach structure over NUIG lands will be constructed cast in-situ from ground level using temporary formwork and falsework
2. In-situ balanced cantilever (Method 2) – It is envisaged that the main river span and the adjacent spans either side of the river will be constructed using a balanced cantilever method with no works taking place within the main river channel

For both methods the following common constructability constraints apply:

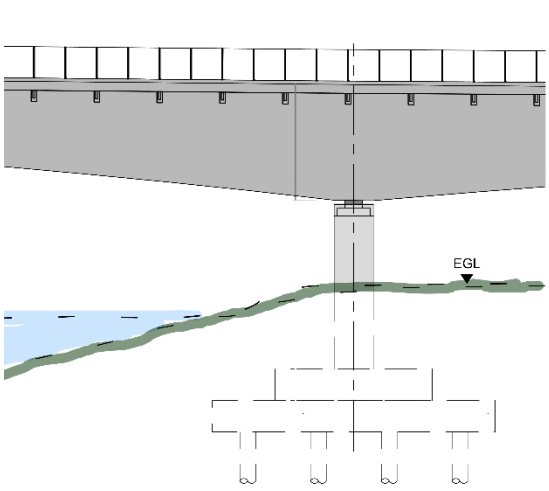
3. The construction of the structure foundations will be subject to specific requirements. Pouring of the concrete to bridge pier foundations will only be undertaken when the excavation has been inspected by a qualified hydrogeologist. The inspection of the full depth and extent of the excavation will be undertaken to identify if any karst flow paths exist
4. If no significant flow paths are present then the pouring of concrete will commence. If significant pathways are present then impacts which may arise from flow along these pathways shall be mitigated against prior to pouring by installing a high permeability zone to replace the pathways which are likely to be removed by the foundations. The design of the mitigation shall be approved by a qualified hydrogeologist to confirm that no poured concrete will enter the aquifer

Some dewatering may be required for the construction of the River Corrib Bridge. Where dewatering is required, it shall be overseen and approved by a qualified hydrogeologist and treated appropriately where necessary prior to outfall. In addition to considering and incorporating the navigational and recreational requirements of the River Corrib, the requirements of the NUIG Recreational Facilities must also be considered during construction. The facilities include walking paths which cross under the proposed structure. With this in mind, permeability through the construction zone shall be retained along the prescribed pathways as set out in the mitigation measures to facilitate NUIG patrons and members of the public that utilise the walking facilities during construction. These mitigation measures have been agreed in consultation with NUIG and other relevant parties.

The support columns for the bridge span across the river are setback from the river bank as shown in **Figure 2.1** below. The support foundations will be located below the level of the river bed/bank. The construction process will implement standard best practices to ensure the continued operation of the river and to avoid any negative environmental impact of the works. It is envisaged that the foundation

will be constructed within a temporary cofferdam, which will permit the installation of piles and the construction of the pilecaps within the cofferdam construction. All materials, both temporary and permanent will need to be clean and will be approved for use by the relevant authorities.

Figure 2.1 Support adjacent to River Corrib



2.1 Sequence of Construction

2.1.1 Introduction

The construction of the structure will be completed using a combination of construction methods as outlined above and completed in a number of stages.

The stages of the construction are as follows:

- Stage 1 – Site access, temporary site compounds and enabling works
- Stage 2 – Construction of structure
- Stage 3 – Completion of works

2.1.2 Stage 1 – Site access and temporary site compounds and enabling works

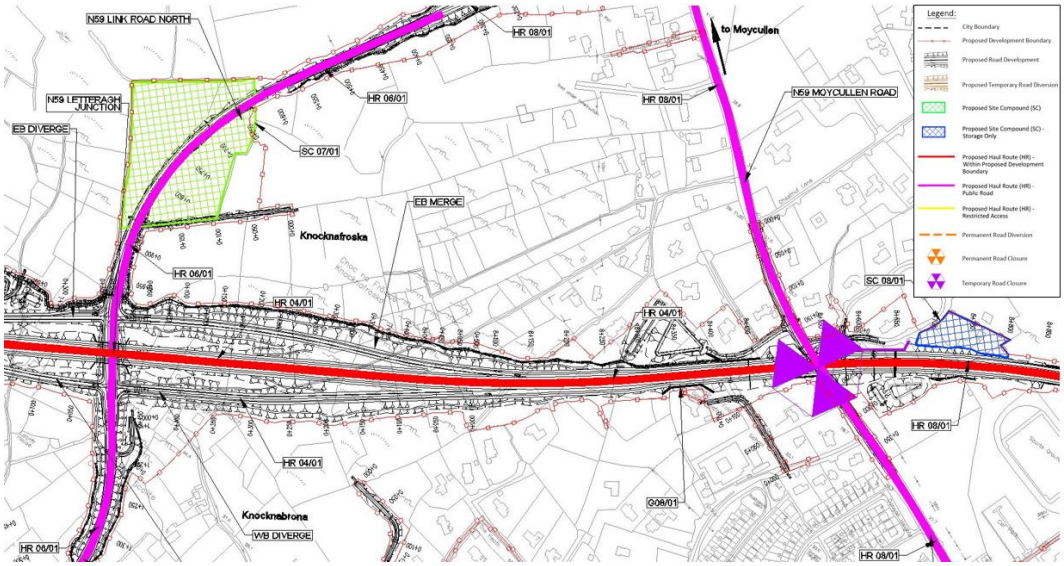
The first stage of construction will be to undertake site clearance works and erect fencing along the proposed development boundary. All site clearance including the demolition of existing structures and vegetation clearance will be managed within the proposed development boundary and all material will be disposed of using the appropriate methods to a licensed or permitted landfill. Trees will be protected where practicable when construction accesses are formed. The presence and nature of items of heritage significance will be recorded and preserved offsite where possible. Archaeological monitoring and investigations will also be undertaken in order to record and preserve offsite where possible any buried findings in the area.

Site compounds and working areas will be sectioned off where required. Working areas in proximity to the River Corrib shall be set back a minimum of 5m from the edge of the river in accordance with the requirements of Inland Fisheries Ireland (IFI). Drainage ponds and interceptor ditches will be constructed in advance of embankment and bridge construction to collect, treat and discharge all surface water runoff during construction. Construction run-off will need to be considered for the construction area around the River Corrib Bridge due to its proximity to the River Corrib. Protection of this water body from construction runoff and silt load shall be carried out through the use of reserved grassed buffer areas, timber fencing with silt fences, earthen berms or similar approved to provide adequate treatments of site runoff waters before reaching the watercourse. Protection from silt load may also be carried out through the use of the wetlands and attenuation ponds adjacent to the River Corrib on either river bank. It is possible that a combination of these methods could be used.

2.1.2.1 Western River Bank

Site access for the western river bank will be provided by the haul route, HR 08/01, via N59 Moycullen Road, as shown in **Figure 2.2**. The site compound, SC 08/01, for the River Corrib Bridge on the western river bank is located to the north of the proposed road development adjacent to hockey pitch, as shown in **Figure 2.2** below. This site compound may only be used for storage of equipment and materials. It may not be used for works that will cause excessive noise due to its close proximity to housing. Rock crushing or other noise inducing works could be undertaken in the nearby site compound, SC 07/01, on the N59 Northern Link road. Lackagh Quarry site compound, SC 11/01 shown in **Figure 2.2**, may also be used for storage and large noise inducing works such as rock crushing.

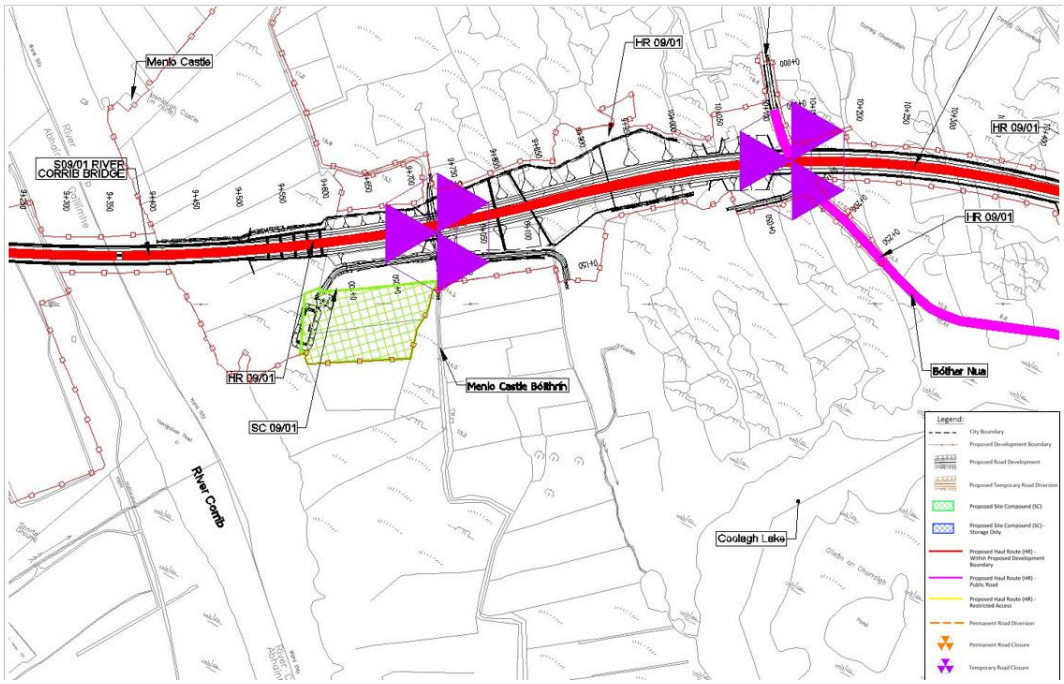
Figure 2.2: Western Bank Access and Site Compound



2.1.2.2 Eastern river bank

Site access for the eastern river bank will be provided by the haul route, HR 09/01, via Bóthar Nua, as shown in **Figure 2.1**. The site compound, SC 09/01, for the River Corrib Bridge on the eastern river bank is located to the south of the proposed road development, as shown in **Figure 2.1** below. In addition, Lackagh Quarry site compound, SC 11/01, may also be used for storage and larger works requirements such as rock crushing etc.

Figure 2.1: Eastern Bank Access and Site Compound



2.1.3 Stage 2 – Construction of structure

The western section of the bridge structure will be constructed using a cast in-situ method (Method 1 outlined below). The 153m main span across the river and the two adjacent spans (95m western span and 72m eastern span) will each be constructed using the balanced cantilever method (Method 2 outlined below). In total, it is anticipated that construction of the structure will take 18-24 months.

2.1.3.1 Method 1: Cast in-situ construction

The western approach spans will be constructed by casting the structure in-situ. The span lengths range from 35m to 70m, as shown in **Figures 2.3** and **2.4** below.

Figure 2.3: Plan of Western Approach Spans

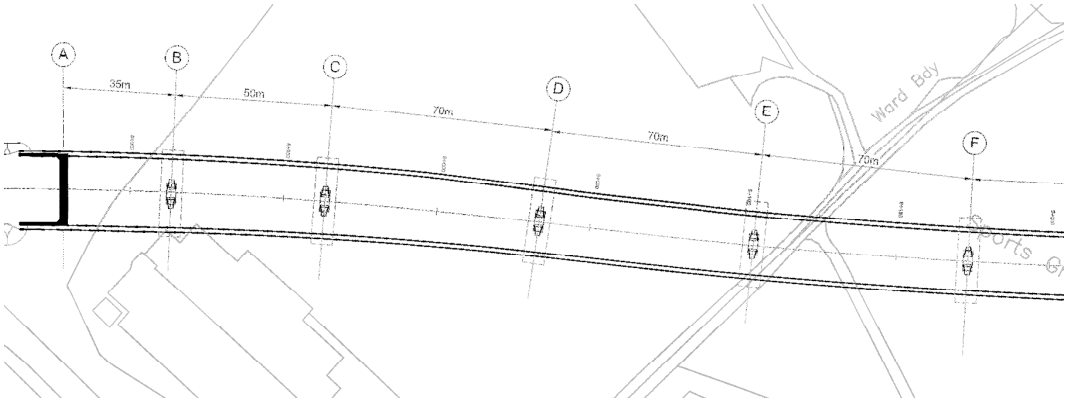
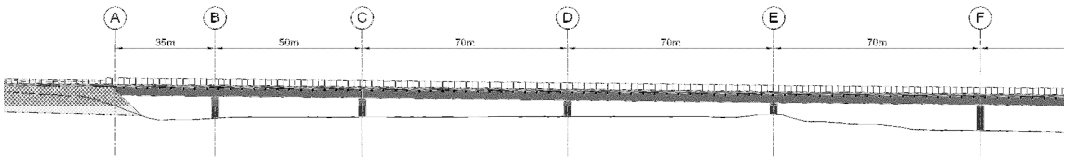
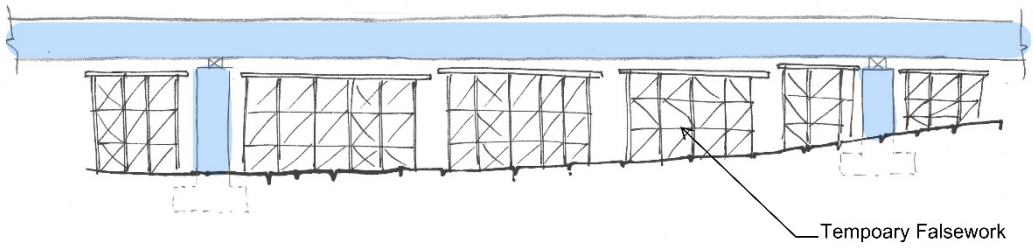


Figure 2.4: Elevation of Western Approach Spans



Firstly the bridge piers will be cast in-situ using the required formwork. Temporary falsework will then be constructed on the existing ground a short distance below the soffit of the bridge deck as shown in **Figure 2.5**. This will allow the necessary construction platform to construct the structure. The concrete will be poured in-situ and then post-tensioned. The remaining construction elements such as road surfacing, drainage, erection of noise barriers etc. can then be completed.

Figure 2.5: Temporary falsework



As noted above, the requirements of the NUIG Recreational Facilities and its patrons need to be considered. As a result, detailed traffic management proposals in accordance with the mitigation measures will be developed at detail design stage by the appointed Contractor in consultation with their Designers. The consent for the temporary diversions and/or temporary road or access path closures will be sought from the appropriate authority.

2.1.3.2 Method 2: In-situ balanced cantilever construction

The 153m main span and the adjacent spans (95m western span and 72m eastern span), as shown in **Figures 2.6** and **2.7**, will be constructed using the cast in-situ balanced cantilever method. Due to the larger span, the structural depth is significantly larger at the pier locations and varies in depth along the span. This increases the construction complexity of the deck, however the substructure works are simplified by removing the need for piers in the river channel. Construction works will not be permitted within the River Corrib itself as it forms part of the Lough Corrib cSAC and from this perspective the balanced cantilever method is preferred.

Figure 2.6: Plan of Main Span and Adjacent Spans

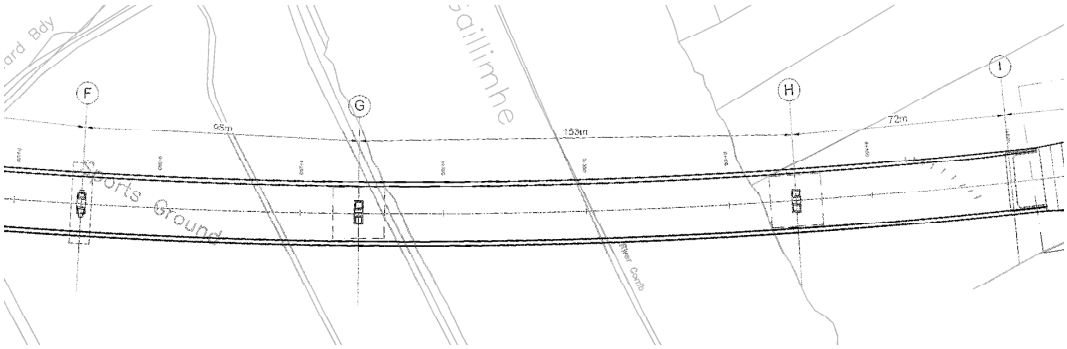
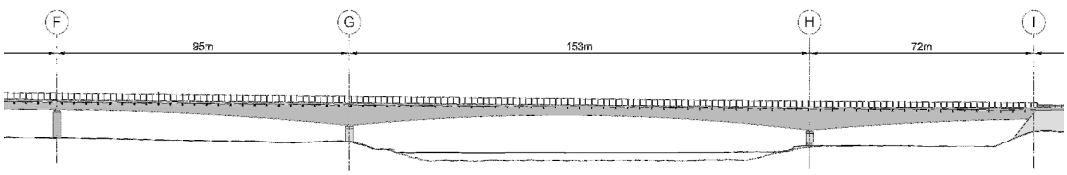


Figure 2.7: Elevation of Main Span and Adjacent Spans



Similar to the construction of the western approach spans, the first element to be constructed will be bridge piers using the required formwork and casting the piers in-situ. The complete pier segment is then used as an erection platform and launching base for all subsequent travelling formwork and concrete segment construction, as shown in **Figures 2.8** and **2.9** below. The cast-in-situ segments can measure up to 5m in length with formwork moving in tandem with each segment.

Segmental construction proceeds until the midpoint is reached and the balanced cantilevers meet. Once the span is complete, the remaining cantilevers meet.

After the construction of the first segment the typical construction cycle for each segment will involve the following:

- Removal of stop end form and form ties
- Installation of strand
- Post tension stressing of the cantilever
- Stripping of outer, inner and bottom form
- Launching and fixation of rail beam
- Launching and fixation of main frame
- Cleaning of form panels
- Rolling back of inner web forms
- Adjust/close outer and bottom forms
- Placing post tensioning ducts/inserts for bottom slab/web
- Launch inner web forms, adjust/close inner web forms
- Placing of reinforcement/post tensioning ducts/insert for upper deck and cantilever wing
- Final survey/check of level/ alignment
- Pour concrete
- Curing – Traveller #1
- Curing – Traveller #2
- Repeat cycle

As works will not be permitted within the River Corrib, the necessary mitigation measures shall be in place to mitigate against objects or materials falling into the river. The travelling formwork platform itself will act as a barrier for materials falling into the river. In addition to the platform, netting, as shown in **Figure 2.9**, or polyethylene can be installed under the platform to act as an additional barrier.

Figure 2.8: Balanced Cantilever Construction

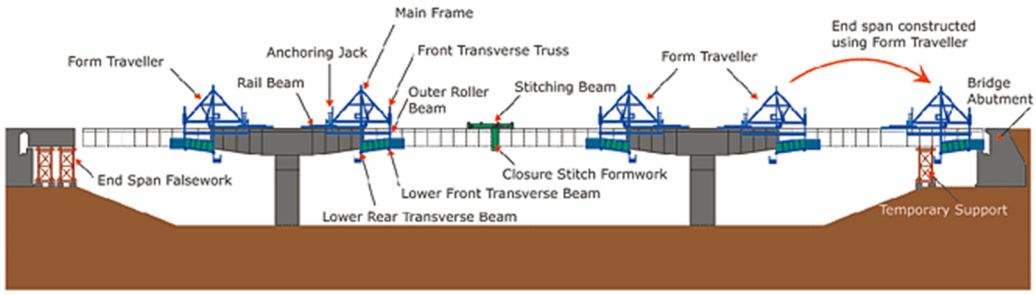


Figure 2.9: Travelling Formwork

Stability of the end cantilever is maintained by using temporary pier supports as the end span is begun. On the western side the end span will tie into a pier (Pier F), as shown above in **Figures 2.5** and **2.6**. On the eastern side the end span will tie into the retained embankment with culvert openings as shown below in **Figures 2.9** and **2.10**.

Figure 2.9: Plan of Retained Embankment Tie-in

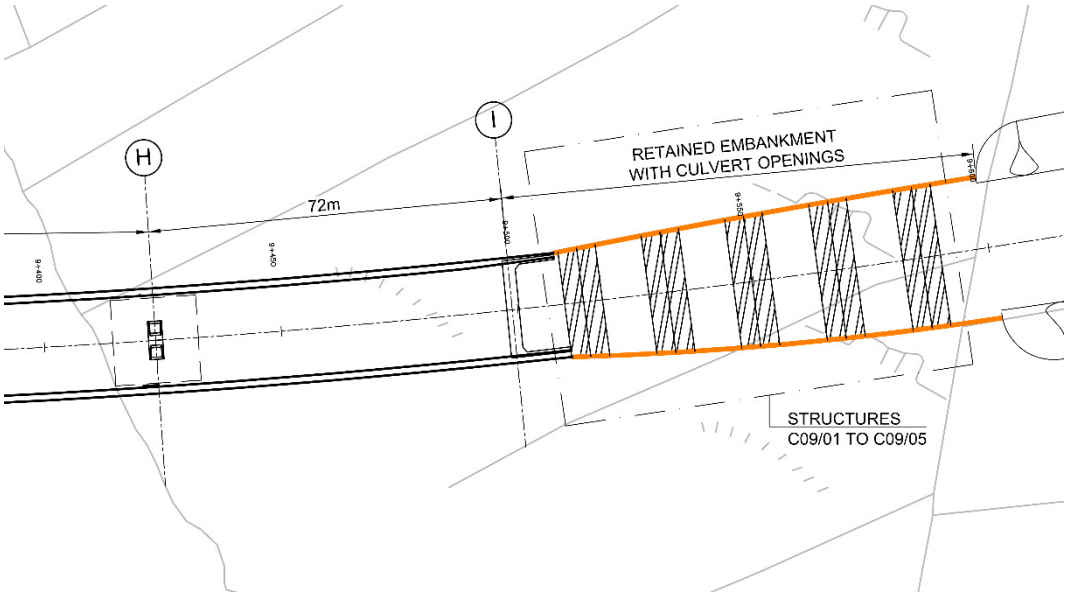
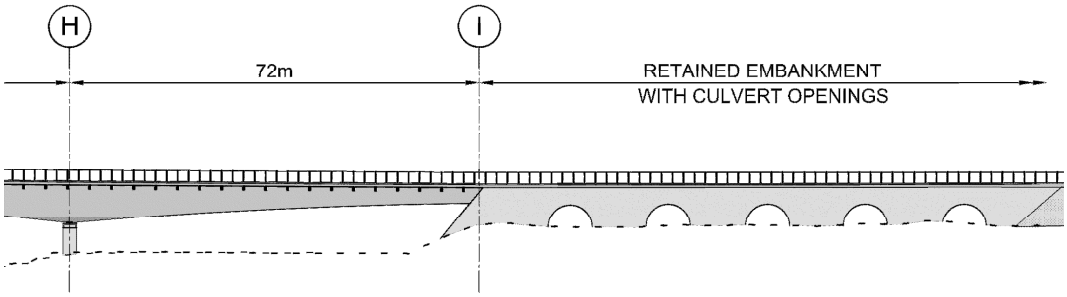


Figure 2.10: Elevation of Retained Embankment Tie-in



As noted above, the requirements of the NUIG Recreational Facilities and its patrons and the navigational requirements of the River Corrib need to be considered. A traffic management proposal will be developed at detail design stage in accordance with the mitigation measures by the appointed Contractor in consultation with their Designers. The consent for the temporary diversions and or temporary road or access path closures will be sought from the appropriate authority.

2.1.4 Stage 3 – Completion of works

All construction related material will be removed following completion of the works. The form travellers and temporary falsework will be deconstructed and protective netting will also be removed on completion of the river crossing construction. Again, care shall be taken when deconstructing equipment over the River Corrib as to not allow any objects or materials to fall into the river.

3 Summary and Conclusions

This report outlines the construction methods for constructing the River Corrib Bridge as a whole and also outlines the associated constraints and requirements. The cast in-situ on temporary falsework method (Method 1) is proposed for the construction of the structure on the western approach over the NUIG Recreational Facilities. The in-situ balanced cantilever method (Method 2) is proposed for the construction of the river span and the adjacent spans either side of the river which involves the use of form travellers and casting the spans in-situ.

As demonstrated in the report the River Corrib Bridge can be built without in-stream works and does not pose a risk of construction material entering the river during construction.

4 References

VSL International Ltd. (2007) *Bridge Construction Partner* [Figure 2.8, 2.9]