Appendix A.7.1

River Corrib Bridge
Constructability Examination

A.7.1

Galway County Council

N6 Galway City Ring Road

River Corrib Bridge Constructability Examination

GCOB-4.03-6.1.77-001

Issue 7 | 26 July 2018

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

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Job number 233985-00

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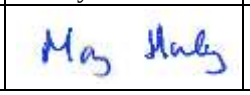
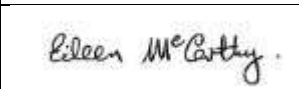
		Signature			
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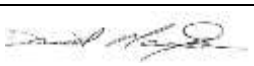
		Signature			
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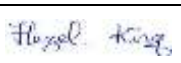
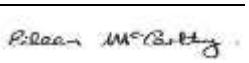
		Signature			
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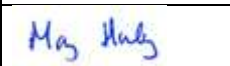
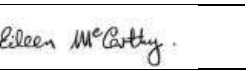
		Signature			
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Contents

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

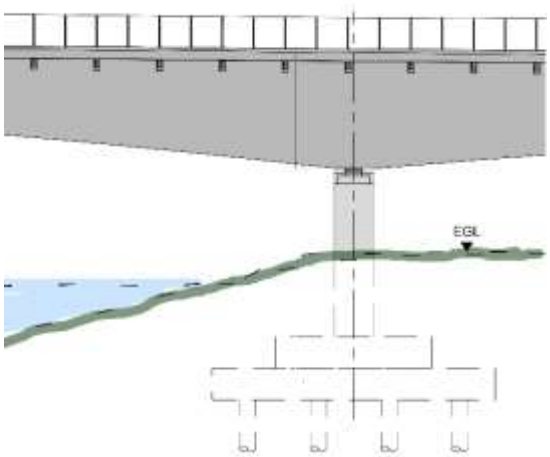
For both methods the following common constructability constraints apply:

1. Construction of the bridge foundations will require specific requirements to be satisfied to ensure that there will be no impact to the groundwater body from the construction. Pouring of the cement for foundations will only be undertaken following inspection and approval by a qualified hydrogeologist that no impact will occur. The inspection will require observation of the full depth and extent of the excavation in order to identify if any karst flow paths, such as conduits, are present.
2. If no karst pathways are evident in the excavation then the hydrogeologist will approve the construction to proceed.
3. If karst pathways are present in the excavation then there is risk that cement could leak into the aquifer, which would have negative impacts on the groundwater body and receptors. The groundwater body underlying the eastern pier of the River Corrib Bridge is at the very western extent of the Lough Corrib Fen 1 (Menlough) GWB whilst the western pier of the Lough Corrib Bridge is located at the eastern extent of the Ross Lake GWB. The only receiving water for groundwater for both piers is the River Corrib. Groundwater Dependant Terrestrial Ecosystems (GWDTE) at Coolagh Lake are upgradient of this location and not at risk of impact. Potential impacts from cement to the groundwater body include restricting or sealing groundwater flow paths or reducing the groundwater quality due to increased turbidity. In order to prevent these potential impacts mitigation measures are detailed in the Construction Environmental Management Plan (CEMP) contained in Appendix A.7.5 of the EIA Report to ensure that karst can be managed if encountered so that no impact to the groundwater body occurs.
4. The design of the mitigation is detailed in the CEMP and comprises of backfilling the karst to ensure that the feature does not lose its connectivity or flow path within the aquifer and then secondly the feature is sealed from the excavation to ensure that cement will not enter or impact the feature.

Dewatering will 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. Drawing GCOB-3000-D-104 contained in Appendix A.15.1 of the EIA Report shows the locations where access for the university through the development boundary must be maintained for the duration of the construction phase. 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

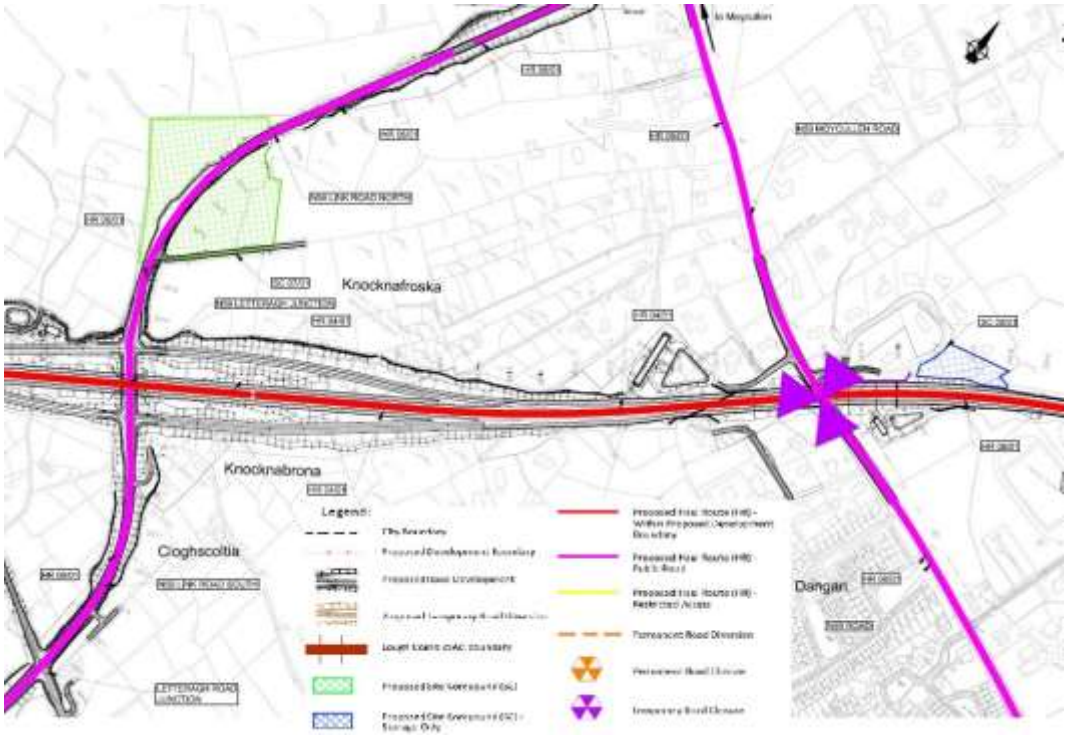
The first stage of construction will be to undertake site clearance works and erect fencing along the proposed development boundary. All site clearance including the demolition of existing structures and vegetation clearance will be managed within the proposed development boundary and all material will 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. For further site sediment and pollution control refer to Section 8 Sediment, Erosion and Pollution Control Plan of the CEMP contained in Appendix A.7.5 of the EIA Report.

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 2.3**, may also be used for storage and large noise inducing works such as rock crushing.

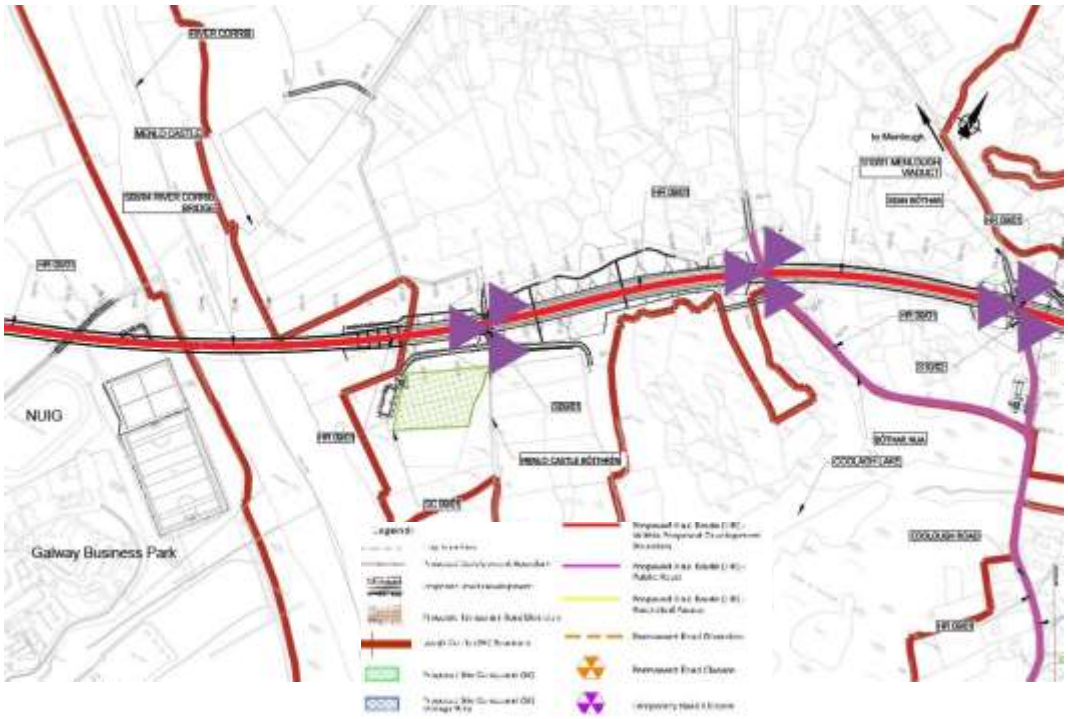
Figure 2.2: Western Bank Access and Site Compound



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 2.3**. 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 2.3** 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 2.3: 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 2.4** and **2.5** below.

Figure 2.4: Plan of Western Approach Spans

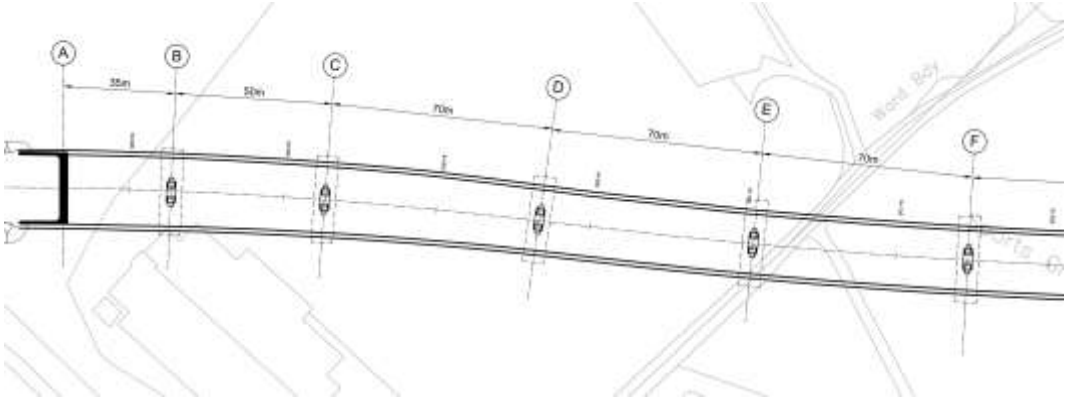
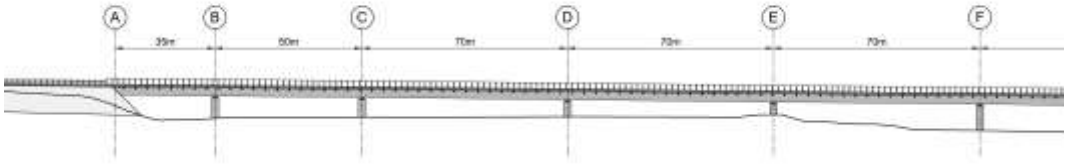
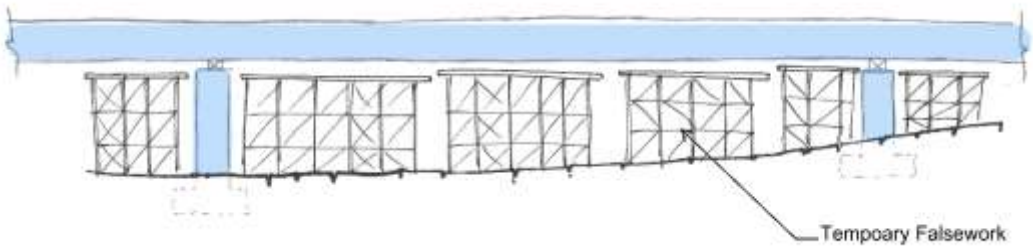


Figure 2.5: Elevation of Western Approach Spans



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 2.6**. 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 2.6: 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 2.7** and **2.8**, 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 2.7: Plan of Main Span and Adjacent Spans

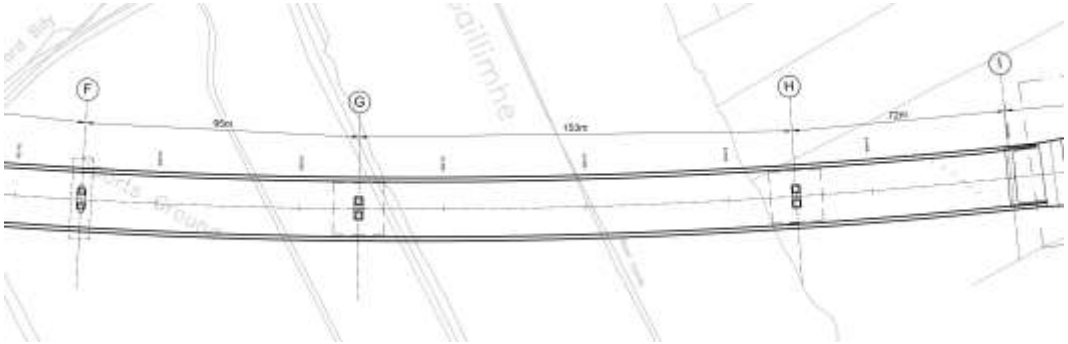
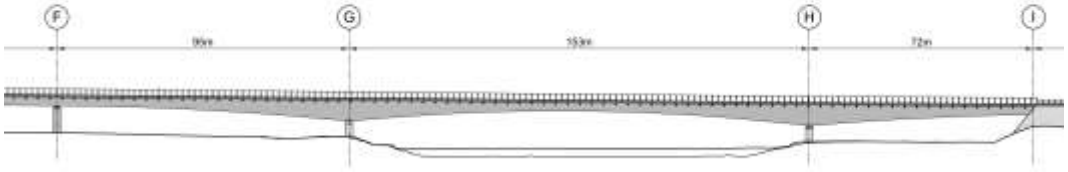


Figure 2.8: Elevation of Main Span and Adjacent Spans



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 2.9** and **2.10** 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 2.9: Balanced Cantilever Construction

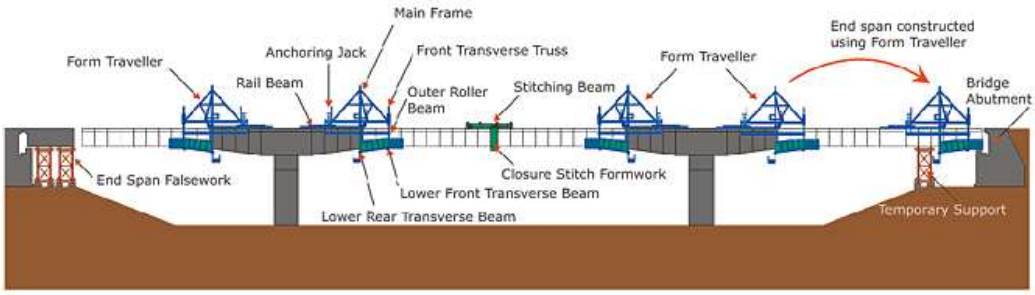


Figure 2.10: Travelling Formwork

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 2.7** and **2.8**. On the eastern side the end span will tie into the retained embankment with culvert openings as shown below in **Figures 2.11** and **2.12**.

Figure 2.11: Plan of Retained Embankment Tie-in

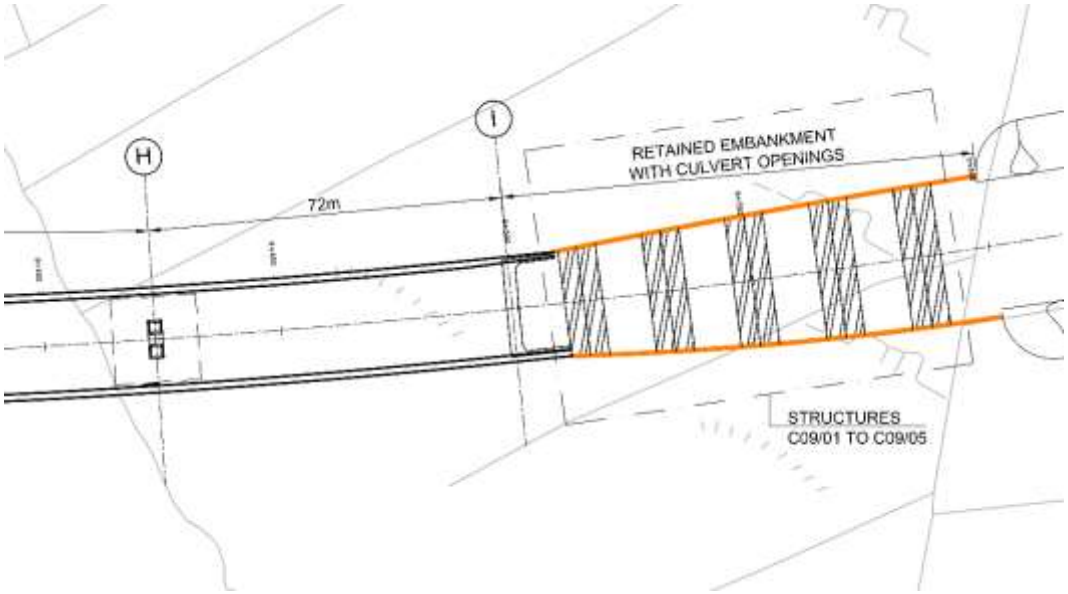
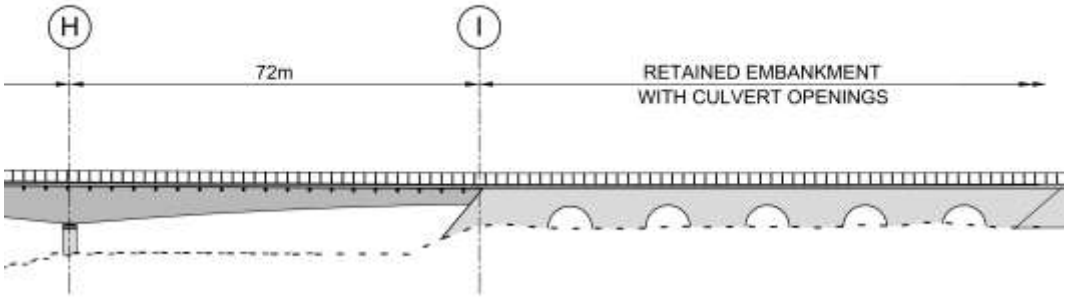


Figure 2.12: Elevation of Retained Embankment Tie-in



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]