Appendix J
Structures Preliminary Design Reports

Preliminary Design Report - Retaining Walls

Preliminary Design Report- Consultation

STA-1b

Categories 1, ~~2 & 3~~

Scheme Name

Name and Location – BusConnects Route 2 Swords to City Centre, Dublin

Structure(s)

Name and nature of the Structure(s) – Route 2 Retaining Structures

Preliminary Design Report

Reference - R02-RW010, R02-RW016, R02-RW017, R02-RW018, R02-RW022, R02-RW029

Revision - L02

Date - 18th November 2022

Submitted by

Signed _____

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Position Structural Discipline Lead (Team Leader)

Organisation Jacobs Engineering

Date 18/11/2022

Structures Section confirmation of consultation

Signed _____

Name _____

Position _____

Date _____

* This application should appear as the first page after the cover of the Preliminary Design Report.

Contents

1. Introduction

1.1 Brief

Jacobs have been appointed by the National Transport Authority (NTA) to undertake the Engineering Design Services for the Planning Stage through to the end of the Statutory Process of the BusConnects Radial Core Bus Corridors Infrastructure Upgrade Programme (the Programme). The Project has been split in four packages with Jacobs undertaking Package B.

This report outlines the Preliminary Design for the retaining structures on Core Bus Corridor (CBC) 02 Swords to City Centre. The other routes undertaken by Jacobs shall be covered in separate reports. The scope of this report extends to structures considered within Dublin County Council (DCC) & Fingal County Council maintenance boundary.

1.2 Background

The National Transport Authority (NTA) published the Transport Strategy for the Greater Dublin Area, 2016 – 2035 at the beginning of 2016. The strategy identifies a “Core Bus Network”, representing the most important bus routes within the Greater Dublin area, generally characterised by high passenger volumes, frequent services, and significant trip attractors along the routes. The identified core network comprises sixteen radial bus corridors, three orbital bus corridors and six regional bus corridors.

The Strategy states that it is intended to provide continuous bus priority, as far as is practicable, along the core bus routes. This will result in a more efficient and reliable bus service with lower journey times, increasing the attractiveness of public transport in these areas and facilitating a shift to more sustainable modes of transport. The Swords to City Centre Core Bus Corridor is identified as part of the Core Bus Network.

In March 2018, BusConnects Dublin was launched as part of major investment programme, including Metrolink and the Dublin Area Rapid Transport (DART) Expansion Programme, to improve public transport in Dublin, as part of the National Development Plan 2021-2030. The Swords to City Centre CBC serves the area to the north of Dublin city, creating an improved public transportation link for areas along the corridor.

Figure 1.2: BusConnects Dublin Radial CBC Network

1.3 Previous Studies

The first non-statutory public consultation on the BusConnects CBCs took place on a phased basis between November 2018 and May 2019. The second round of public consultations occurred between March 2020 and April 2020. A third round of public consultations then followed between November 2020 and December 2020.

Consultation with the principal project stakeholders (i.e Dublin City Council, Transport Infrastructure Ireland, Utility companies and the National Transport Authority) has also taken place.

A desktop study was undertaken to identify the existing structures within the project extents, with site inspections undertaken where information was limited.

2. Site & Function

2.1 Site Location

Along Swords to City Centre Core Bus Corridor there are 14 locations within the boundaries of Fingal County Council, identified in the previous stage, that require retaining structures to accommodate the proposed widened cross section. Following development in the preferred highway alignment, 2 locations have been identified as possessing a retained height greater than 1.5 m and fall within the scope of this report. An additional wall will be included in the scope of this report due to its sensitive location.

Along Swords to City Centre Core Bus Corridor there are 3 locations within the boundaries of Dublin City Council and 4 locations within the boundaries of Fingal County Council, identified in the previous stage, that would require retaining structures to accommodate the proposed widened cross section. 5 of these structures have a retained height greater than 1.5 m and fall within the scope of this report.

See Table 2.1 below for walls considered within the scope of this scheme.

Wall Reference	Retained Height (m)	Chainage Start	Chainage End	Definition
R2-RW016	1.5	A 7+220	A 7+290	West side of R132 Swords Road. Supports front garden of residential property.
R2-RW017	1.5	A 7+255	A 7+280	East side of R132 Swords Road. Supports front garden of residential properties.
R2-RW018	1.5	A 7+315	A 7+385	East side of R132 Swords Road. Supports front garden of residential properties
R2-RW029	2**	A 8+560	A 8+640	East side of N1 Swords road north of entrance to Highfield Healthcare. Limited information at widened section.
R2-RW022	2	1+940	1+990	West side of R132 Dublin Road north of Cloghran roundabout. Cutting supports agricultural land.
R2-RW010	2.5	5+550	5+620	West side of R132 Swords Road. Supports car dealership.
R2-RW028*	1	6+410	6+470	West side of R104 Swords Road north of Santry Avenue junction, supports green area which is part of Santry Park
* Denotes walls that are less than 1.5m in retained height, but due to sensitive locations have been included in the scope of this report. ** Height subject to confirmation by topographical survey.				

Table 2.1: Summary of walls within the scope of this report

2.2 Function of Site and Obstacles Crossed

The retaining walls are needed to maintain the required ground level in areas affected by the proposed new elements of the bus corridor, where the height difference is too high to be maintained with an embankment.

2.3 Choice of location

Walls are located where geometric constraints do not allow for traditional earthworks batters to be contained within the site boundaries.

2.3.1 R02-RW010

R2-RW010 is located on the west side of the R132 Swords Road.

2.3.2 R02-RW016

R2-RW016 is located on the west side of the R132 Swords Road. It is proposed to set back the residential wall and provide off-street residential parking at this location.

2.3.3 R02-RW017

R2-RW017 is located on the east side of the R132 Swords Road. The proposed widening at this location encroaches into the front gardens of several residential properties.

2.3.4 R02-RW018

R2-RW018 is located on the east side of the R132 Swords Road. The proposed widening at this location impacts the front gardens of a row of properties.

2.3.5 R02-RW022

R2-RW022 is located on the west side of R132 Dublin Road north of Cloghran roundabout. The proposed widening at this location encroaches on an existing cutting which supports agricultural land.

2.3.6 R02-RW028

R2-RW028 is situated on the west side of the R104 Swords Road north of the Santry Avenue junction. The site currently consists of a roughly 0.5m high stone masonry gravity wall with railings marking the boundary between the highway and Santry Demesne, with the ground sloping upwards into the park. The proposed wall is required to accommodate a new bus island.

2.3.7 R02-RW029

R2-RW029 is located on the east side of the N1 encroaching into fencing that forms the boundary to Highfield Hospital. Directly behind the wall is an access road for the hospital located approximately 2m to 3m above the highway level.

2.4 Site Description and Topography

2.4.1 R02-RW010

The proposed highway cross section encroaches on an existing Graded Slope supporting the forecourt of a car dealership. The height of the Graded Slope varies from 1 m at the North end to 3 m at the South end. The highway is to be widened at this location to accommodate a new bus stop. The retaining structure will need to be capable of supporting a traffic surcharge from activities of the car dealership.

Figure 2.4.1: Photo of wall location R02-RW010

2.4.2 R02-RW016

R2-RW016 is located on the west side of the R132 Swords Road. The gardens are accessed by a set of stairs located on the property. The level difference between the gardens and the carriageway is approximately 1.5m. Access to the properties will need to be maintained during works to limit the impact on the residents of the properties. The existing wall is of blockwork or mass concrete construction with a rendered finish.

Figure 2.4.3: Photo of wall location R02-RW016

2.4.3 R02-RW017

R2-RW017 is located on the east side of the R132 Swords Road. The gardens are accessed by sets of stairs located on the properties . The level difference between the gardens and the carriageway is approximately 1.5m. Access to the property will need to be maintained during works to limit impact for residents. The existing wall is of blockwork or mass concrete construction with a rendered finish.

Figure 2.4.4: Photo of wall location R02-RW017

2.4.4 R02-RW018

The proposed widening at this location impacts the front gardens of a row of properties. The length of property frontage affected is approximately 70m. The level difference between the gardens and the carriageway is approximately 1.5m. Access to the property is provided by stairs that are set back from the front face of the existing wall by 1m. The existing wall construction appears to be blockwork or mass concrete with a rendered finish.

Figure 2.4.5: Photo of wall location R02-RW018

2.4.5 R02-RW022

The proposed widening at this location encroaches on an existing cutting that supports agricultural land. The difference in level between the agricultural land and the carriageway is up to 2m. There are several mature

trees as Naul Road approaches the roundabout and a row of dense hedge rows on the west side of the R132. The site is in a rural area with no buildings in the direct vicinity of the proposed wall.

Figure 2.4.6: Photo of wall location R02-RW022

2.4.6 R02-RW028

The site currently consists of a roughly 0.5m high stone masonry gravity wall with railings marking the boundary between the highway and Santry Demesne. The ground slopes upwards into the park. The proposed wall is required to accommodate a new bus island. The wall is expected to measure 60m in length and retain a height of 1m. land acquirement for construction works is not anticipated to be a significant barrier due to the nature of land behind the wall. There are several trees situated on the green space that would likely be affected through potential root severance.

Figure 2.4.7: Photo of wall location R02-RW028

2.4.7 R02-RW029

The curved rendered wall and short section of visible masonry are considered to have historical significance therefore the highway alignment avoids impacting these sections of the boundary. The existing fencing obscures the features behind it, so it is possible that the historic stone masonry wall continues further north.

Figure 2.4.8: Photo of wall location R02-RW029

2.5 Vertical and Horizontal Alignments

Refer to the road design drawings for the proposed vertical and horizontal road alignments along the scheme.

2.6 Cross Sectional Dimensions

Not applicable for retaining structures.

2.7 Existing Underground and Overground Services

Clashes with existing utilities are potential hazards which would have major impacts on the construction and buildability of the route. Any clashes would need mitigating measures to prevent disruption to the services they provide. The affected services would require diversion prior to and during construction works. Depending on the size of the asset these mitigation works could range broadly in cost and complexity, significantly impacting the construction programmes at each location.

At locations where utilities run parallel to a proposed wall the level of the foundation should be constructed such that no loading is transferred into the assets. This could require additional reductions in foundation level, greater than that needed solely for structural purposes Cover to existing utilities should be confirmed in detail design and the levels of foundations adjusted accordingly. Consequently, a conservative approach has been adopted when estimating land takes at location identified for protection against clashing with utilities assets. Where there is a direct clash with a buried assets and diversion is not practical, the proposed solution should accommodate these assets.

A schedule of identified clashes can be seen in Table 2.7.

Wall Reference	Underground Services	Overground Services
R2-RW010	**Electricity**	**Electricity**

	Clash with medium voltage asset – to be protected (see drawing BCIDB-JAC-UTL_UE-0002_XX_00-DR-CU-0016) **Water** Clash with >225mm DIA water asset – to be retained (see drawing BCIDB-JAC-UTL_UW-0002_XX_00-DR-CU-0016) **Gas** None Identified **Data** Clash with 3 No. EIR asset – to be retained & chambers relocated to north of wall (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0016)	Low Voltage overhead cables along road edge – to be diverted along roadside
R2-RW016	**Electricity** Proximity to medium voltage asset – to be diverted beneath footway (see drawing BCIDB-JAC-UTL_UE-0002_XX_00-DR-CU-0021) **Water** Proximity to >225mm DIA asset – to be diverted to run beneath footway (see drawing BCIDB-JAC-UTL_UW-0002_XX_00-DR-CU-0021) **Gas** Clash with low pressure asset – to be diverted to run beneath footway (see drawing BCIDB-JAC-UTL_UG-0002_XX_00-DR-CU-0021) **Data** Clash with 2 No. EIR assets – 1 No. to be diverted beneath footway & 1 No. to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0021)	**Electricity** Low Voltage overhead cables along road edge – to be diverted over proposed footway (see drawing BCIDB-JAC-UTL_UE-0002_XX_00-DR-CU-0021)
R2-RW017	**Electricity** None Identified **Water** Clash with >225mm DIA asset – to be retained (see drawing BCIDB-JAC-UTL_UW-0002_XX_00-DR-CU-0021) **Gas** Proximity to low pressure asset – to be retained (see drawing BCIDB-JAC-UTL_UG-0002_XX_00-DR-CU-0021) **Data** Clash with EIR asset – to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0021)	**Electricity** Low Voltage overhead cables along road edge – to be diverted over footway (see drawing BCIDB-JAC-UTL_UE-0002_XX_00-DR-CU-0021)
R2-RW018	**Electricity** None Identified **Water** <225mm diameter watermain parallel & crosses – to be diverted to run beneath footway (see drawing BCIDB-JAC-UTL_UW-0002_XX_00-DR-CU-0021) **Gas**	**Electricity** Low Voltage overhead cables along road edge – to be diverted over footway (see drawing BCIDB-JAC-UTL_UE-0002_XX_00-DR-CU-0021)

	Proximity to low pressure asset – to be retained (see drawing BCIDB-JAC-UTL_UG-0002_XX_00-DR-CU-0021) **Data** Clash with 2 No. EIR asset – 1 No. to be diverted beneath footway & 1 No. to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0021)	
R2-RW022	**Electricity** None Identified **Water** Clash with >225mm DIA water asset – to be diverted at southern end (see drawing BCIDB-JAC-UTL_UW-0002_XX_00-DR-CU-0006) **Gas** None Identified **Data** Clash with EIR asset – to be protected (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0006)	None Identified
R2-RW028	**Electricity** None Identified **Water** None Identified **Gas** Clash with high pressure gas asset – to be protected (see drawing BCIDB-JAC-UTL_UG-0002_XX_00-DR-CU-0018) **Data** Clash with BT asset – to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0018) Proximity to EIR asset – to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0018)	None Identified
R2-RW029	**Electricity** 2 No. MV parallel to wall – to be retained (see drawing BCIDB-JAC-UTL_UE-0002_XX_00-DR-CU-0027) **Water** None **Gas** Proximity with 1 No. MP asset – to be retained (see drawing BCIDB-JAC-UTL_UG-0002_XX_00-DR-CU-0027) **Data** Clash with EIR asset – to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0027)	**Electricity** Low Voltage overhead cables passes over wall location – to be retained (see drawing BCIDB-JAC-UTL_UX-0002_XX_00-DR-CU-0027)
Utilities list does not include domestic / privately owned services and supplies for street furniture		

Table 2.7: Summary of existing services

2.8 Geotechnical Summary

A geotechnical desktop study of the area has been undertaken using publicly available information and Ground Investigation reports available through the Geological Survey of Ireland.

Refer to Section 7 for details of the ground conditions at each retaining wall location.

2.9 Hydrology and Hydraulic Summary

Construction of the retaining walls on this scheme is not expected to have any significant impact on the local hydrogeology.

2.10 Archaeological Summary

There is no impact envisaged from these structures.

2.11 Environmental Summary

An Environmental Impact Assessment (EIA) is currently being prepared for the scheme on behalf of the Employer. Outcomes from this EIA will be reviewed and incorporated once determined.

3. Structure & Aesthetics

3.1 General Description of Recommended Structure and Design Working Life

A preferred option for each wall has been recommended based on the evaluation of the site-specific constraints.

Wall Reference	Preferred Wall Solution
R02-RW010	Precast Concrete Retaining Wall
R02-RW016	In-situ Concrete Gravity Wall
R02-RW017	In-situ Concrete Gravity Wall
R02-RW018	In-situ Concrete Gravity Wall
R02-RW022	Precast Concrete Retaining Wall
R02-RW028	In-situ Concrete Gravity Wall
R02-RW029	Precast Concrete Retaining Wall

Table 3.1: Summary of preferred options

3.1.1 R02-RW010

Precast concrete retaining wall is the preferred option at this location as it avoids the challenges associated with the piled options while being quicker to construct than the In-situ option. There is shorter construction time associated with this form of construction and it benefits from a sense of visual consistency as this option is the most commonly recommended on this scheme.

A precast concrete retaining wall will provide sufficient resistance against destabilising forces through the weight of soil acting on the heel of the wall. These are commonly used for heights up to 3m, limited by cranage constraints at larger heights. Sections typically come in 1m or 2m segments that are lifted into position and interlinked.

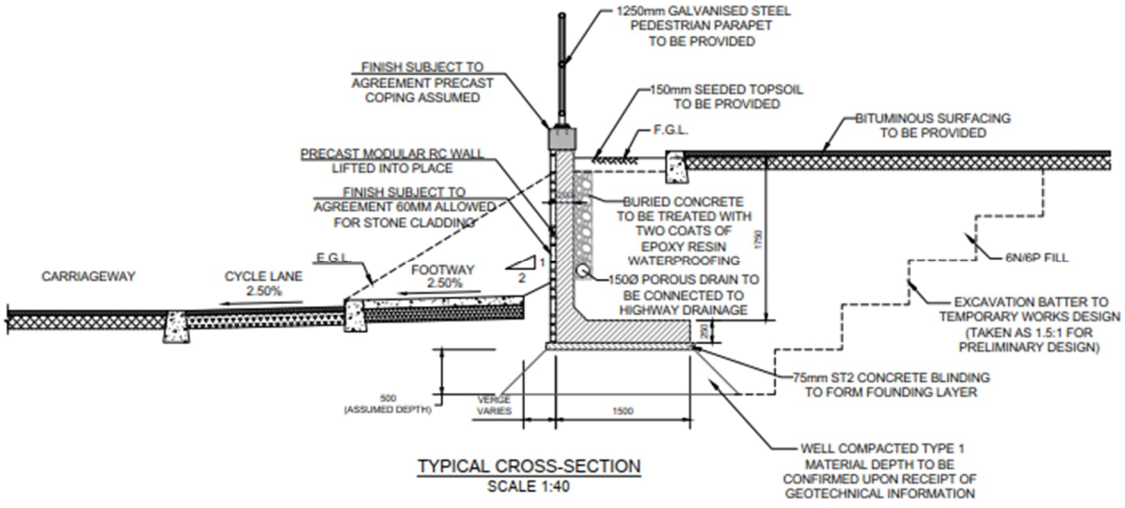


Figure 3.1.1: R02-RW010 Typical Cross-Section

3.1.2 R02-RW016 & R02-RW017 & R02-RW018

The two gravity wall options (precast wall & in-situ concrete gravity wall) are capable of closely resembling the existing arrangement and can easily be rendered to create a large variety of finished surfaces.

However, in-situ concrete gravity wall is the preferred solution as it removes the risk of clashes with overhead services while providing flexibility of the chosen wall for each property. The alignment of the wall involves many non-square corners, complicating the construction of the pre-cast option by increasing the complexity of connections and foundation geometry. the in-situ option provides greater feasibility during construction due to the flexibility when creating the required geometry.

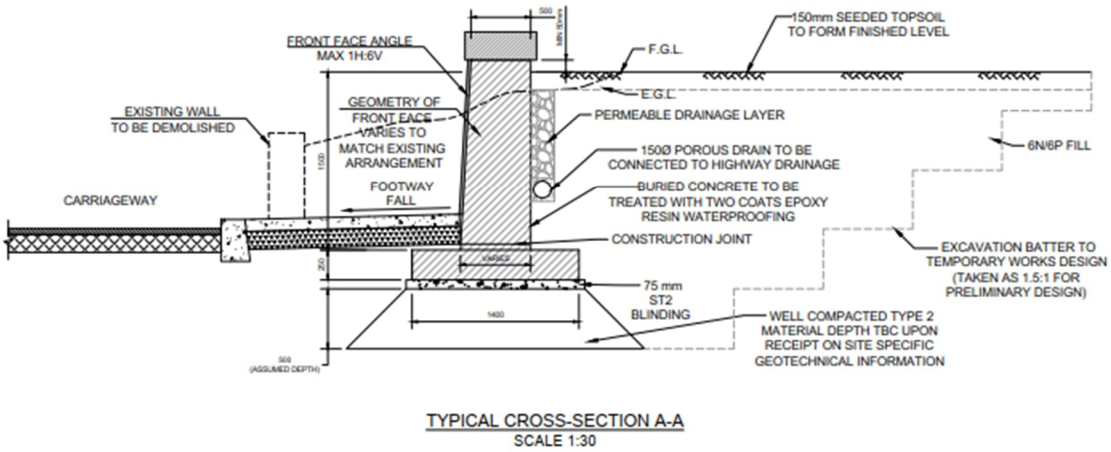


Figure 3.1.3: R02-RW016 Typical Cross-Section

3.1.3 R02-RW022

Precast concrete retaining wall presents itself as the best solution for this location for several reasons: it can be easily constructed with a lower risk to the construction operatives, can be constructed quicker, is more environmentally friendly, and will be able to achieve the required retained height. Additionally, this solution has a lower associated construction risk when compared to the in-situ option due to the utilisation of off-site fabrication and reduced requirement for manual handling resulting in a lower risk of musculoskeletal injuries.

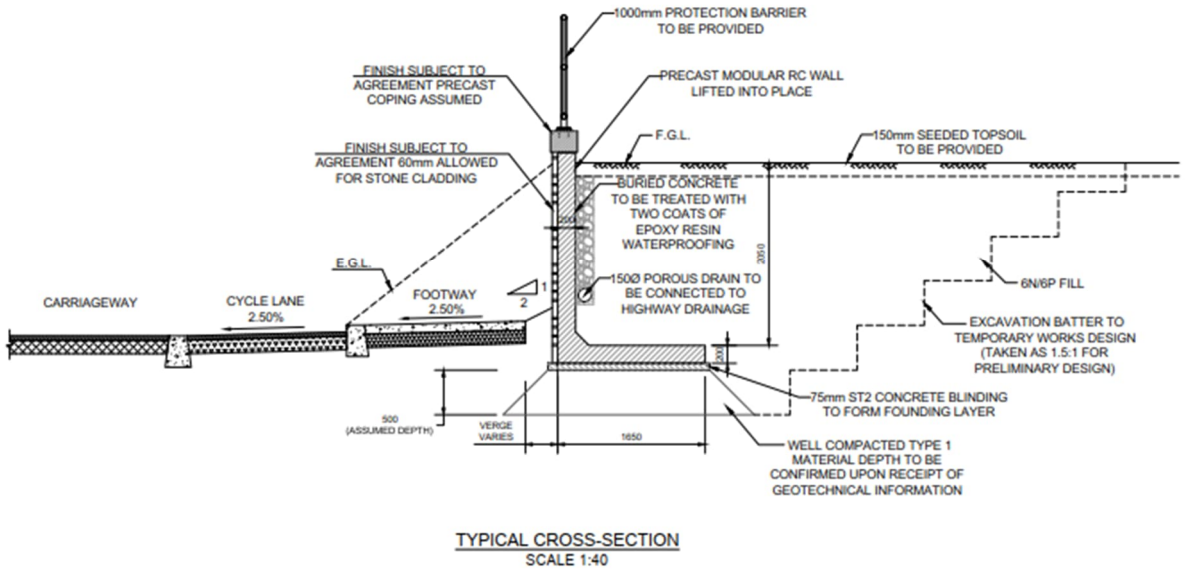


Figure 3.1.4: R02-RW022 Typical Cross-Section

3.1.4 R02-RW028

A high-pressure gas asset has been identified running beneath the existing wall that will clash with new walls proposed location. Diversion of this asset is not proposed; therefore it will need to be accommodated for within the new wall.

In-situ concrete gravity wall is the best option as it allows for greater flexibility in the geometry of the wall, better reflecting the existing arrangement while providing more options for accommodating the high-pressure gas asset. Moreover, the in-situ gravity wall can easily replicate the existing boundary wall through the use of appropriate finishes that match the rest of the wall.

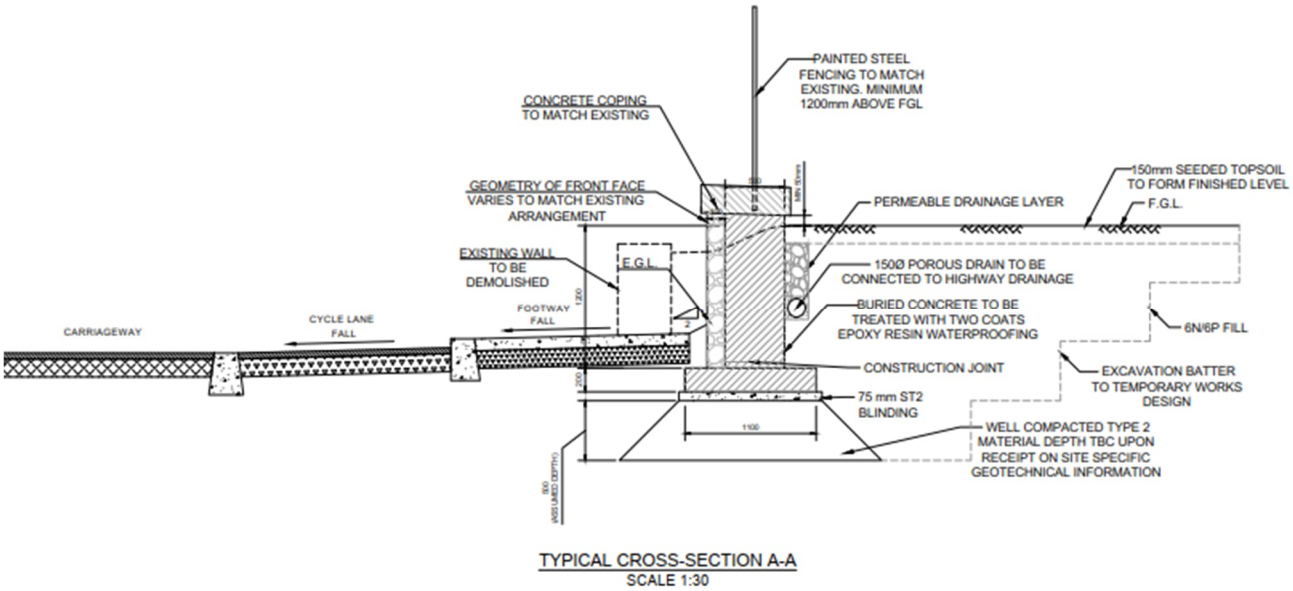


Figure 3.1.5: R02-RW028 Typical Cross-Section

3.1.5 R02-RW029

A precast wall is proposed at this location which will tie into the existing wall at the south end of the proposed location.

A wall height of 2m has been assumed based on available information. Further topographical survey will be required to inform the detailed design and confirm the retained height.

3.2 Aesthetic Considerations

For each of the locations the proposed solution should take into consideration the visual impact on the environment. There are no contractually specified finishes for walls however care should be taken to match existing finishes, in both the immediate locality and on the route in general. Thought should be given to use of feature finishes to break up plain vistas and to improve the visual appearance at locations which present a large exposed front face to the public.

3.2.1 R02-RW010 & R02-RW022

Visual impact at this location is not a governing concern as the wall is situated in a rural area adjacent to fast-moving traffic with limited footfall. No special considerations are required for the finishes to a wall at this location and a standard architectural profile in the face of the wall will be adequate to meet the aesthetic requirements.

An economical option for the precast concrete wall solution is the use of precast concrete panels incorporating a vertical groove feature. The joints between panels also create a featured finish, which breaks up the appearance of the otherwise plain walls.

3.2.2 R02-RW016 & R02-RW017 & R02-RW018 & R02-RW028

The existing wall is of blockwork or mass concrete construction with a rendered finish. The in-situ concrete gravity wall is capable of closely resembling the existing arrangement and can easily be rendered to create a large variety of finished surfaces.

3.2.3 R02-RW029

The existing wall comprises of a masonry stone construction and a rendered return on the south end which forms an entrance into the hospital. The proposed wall shall provide a similar visual appearance with a stone masonry cladding system matching the existing as closely as practical.

3.3 Proposals for the Recommended Structure

3.3.1 Proposed Category

The retained height of all the walls is smaller than 5m, hence the walls are classified as Category 1 structures in accordance with DN-STR-03001.

3.3.2 Span Arrangement

Not applicable.

3.3.3 Minimum Headroom Provided

Not applicable.

3.3.4 Approaches including run-on arrangements

Not applicable.

3.3.5 Foundation Type

If the precast concrete retaining walls comprise of modular systems, then there is no requirement for additional foundations and can be placed directly atop a suitably prepared layer of compacted unbound fill.

If the precast concrete retaining walls comprise of a bolt down wall system, then there is necessary to lift the wall sections onto a reinforced concrete foundation.

In-situ walls will comprise of conventional spread foundations founded on a suitable bedding material.

3.3.6 Substructure

Not applicable.

3.3.7 Superstructure

Not applicable.

3.3.8 Articulation Arrangement

Nominal 20mm vertical movement joints will be used between sections of wall to allow for natural expansion and contraction of the concrete. Stainless steel dowel bars will be used to control differential displacement of the wall sections.

3.3.9 Vehicle Restraint System

No VRS system is proposed to any of the retaining walls.

3.3.10 Drainage

A permeable drainage layer will be provided behind the in-situ concrete retaining walls in accordance with CC-SPW-00500 and will provide positive outfall from one end to the other of the structure and will connect to the mainline road drainage. No weepholes are permitted in the face of the walls.

3.3.11 Durability

The structure will comprise reinforced concrete, which is a highly durable material with a working design life of 120 years (Working Life Category 5). Concrete specification and cover to reinforcement will be in accordance with TII publication DN-STR-03012 (Design for Durability).

3.3.12 Sustainability

Recycled GGBS will be used in the design and construction of some of the concrete elements of the structure leading to a more sustainable structure overall.

3.3.13 Inspection and Maintenance

The proposed structures are of reinforced concrete construction, it is expected that the structure will have minimal maintenance and inspection requirements.

4. Safety

4.1 Traffic Management during construction

To be developed at a further stage of the design.

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).

4.3 Safety in use

No Vehicle Restraint Systems are proposed along any of the walls. Pedestrian parapets and protection barriers shall be provided as appropriate in accordance with TII Publication DN-REQ-03034.

4.4 Lighting

There are no lighting requirements for these structures.

5. Design Assessment Criteria

5.1 Actions

5.1.1 Permanent Actions

Permanent actions in accordance with IS EN 1991-1-1:2002 and the associated National Annex.

5.1.2 Snow, Wind and Thermal Actions

Snow actions are not considered in the design of the retaining walls. Snow load is ignored in accordance with NA to IS EN 1990:2002.

Wind actions shall be in accordance with IS EN 1991-1-4 and the associated National Annex.

Thermal actions will be assessed in accordance with IS EN 1991-1-5 and the associated National Annex.

5.1.3 Actions Relating to Normal Traffic

The application of traffic loads and distribution through the soil will be applied to the retaining walls in accordance with PD 6694-1:2011 (*Recommendations for the design of structures subject to traffic loading to BS EN 1997-1:2004*).

5.1.4 Actions Relating to Abnormal Traffic

Not applicable.

5.1.5 Footway or Footbridge Live Loading

Not applicable.

5.1.6 Provision for Exceptional Abnormal Loads

Abnormal loads not considered, subject to TAA confirmation.

5.1.7 Accidental Actions

Pedestrian parapets shall be designed conform to the requirements of PD CEN/TR 16949:2016.

5.1.8 Actions during Constructions

Not applicable.

5.1.9 Any Special Loading Not Covered Above

A transient surcharge load will be applied to the ground behind the walls. The following non-concurrent loads have been considered in the design depending on the slope of the ground level behind the wall:

- 10 kPa Construction Surcharge (ground profile level behind the wall)
- 10 kPa Design Surcharge for slopes $\beta \leq$ 1V:6H
- 5.0 kPa Design Surcharge for slopes 1V:6H < $\beta \leq$ 1V:3H
- 2.5 kPa Design Surcharge for slopes $\beta >$ 1V:3H

5.2 Authorities consulted and any special conditions required

Principal project stakeholders have been consulted:

- Dublin City Council;
- Transport Infrastructure Ireland;
- National Transport Authority.

The following utilities companies were consulted with on a scheme wide basis:

- ESB;
- GNI;
- Irish Water;
- Eir;
- Virgin Media.

5.3 Proposed Departures from Standards

These are no proposed departures from standards for these structures

5.4 Proposed methods of dealing with aspects not covered in standards

Not applicable.

6. Ground Conditions

6.1 Geotechnical Classification

Retaining walls for this scheme are considered Geotechnical Classification 2.

6.2 Ground Conditions

Ground conditions at each structure location have been assessed using publicly available information including geological maps, hydrogeological information, publicly available ground investigations and historic mapping. The assumed local geology is described for each wall location below.

6.2.1 R02-RW010

The ground conditions at this location are assumed to comprise Till derived from limestones (Dublin Boulder Clay) overlying bedrock geology of dark limestones and shale of the Lucan Formation. Thickness of superficial deposits are unconfirmed, publicly available borehole information indicate a minimum thickness of 10m. A publicly available GI report (GSI External Report Ref: 5,530, Figure 7-1) indicated the superficial geology of the area is generally described as firm to very stiff. The retaining wall is expected to be founded on Dublin Boulder Clay.

Figure 6-1 Extract of GSI mapping showing location of historic GI.

6.2.2 R02-RW016 – R02-RW018

The ground conditions at this location are assumed to comprise Till derived from limestones (Dublin Boulder Clay) overlying bedrock geology of dark limestones and shale of the Lucan Formation. Thickness of superficial deposits are unconfirmed, publicly available borehole information indicate a minimum thickness of 20m. The retaining wall is expected to be founded on Dublin Boulder Clay.

6.2.3 R02-RW022

The ground conditions at this location are assumed to comprise Till derived from limestones (Dublin Boulder Clay), with gravels derived from limestone recorded adjacent to the west of the proposed structure location. The proposed structure location is overlying a fault with the Malahide Formation to the west, north and northeast, with the Waulsortian Limestone to the east, south and southwest. Thickness of superficial deposits are unconfirmed, publicly available borehole information indicate a minimum thickness of 10m. A publicly available GI report (GSI External Report Ref: 1,053, 3,078, Figure 7-3) indicated the superficial geology of the area is generally described as firm to very stiff. The retaining wall is expected to be founded on Dublin Boulder Clay.

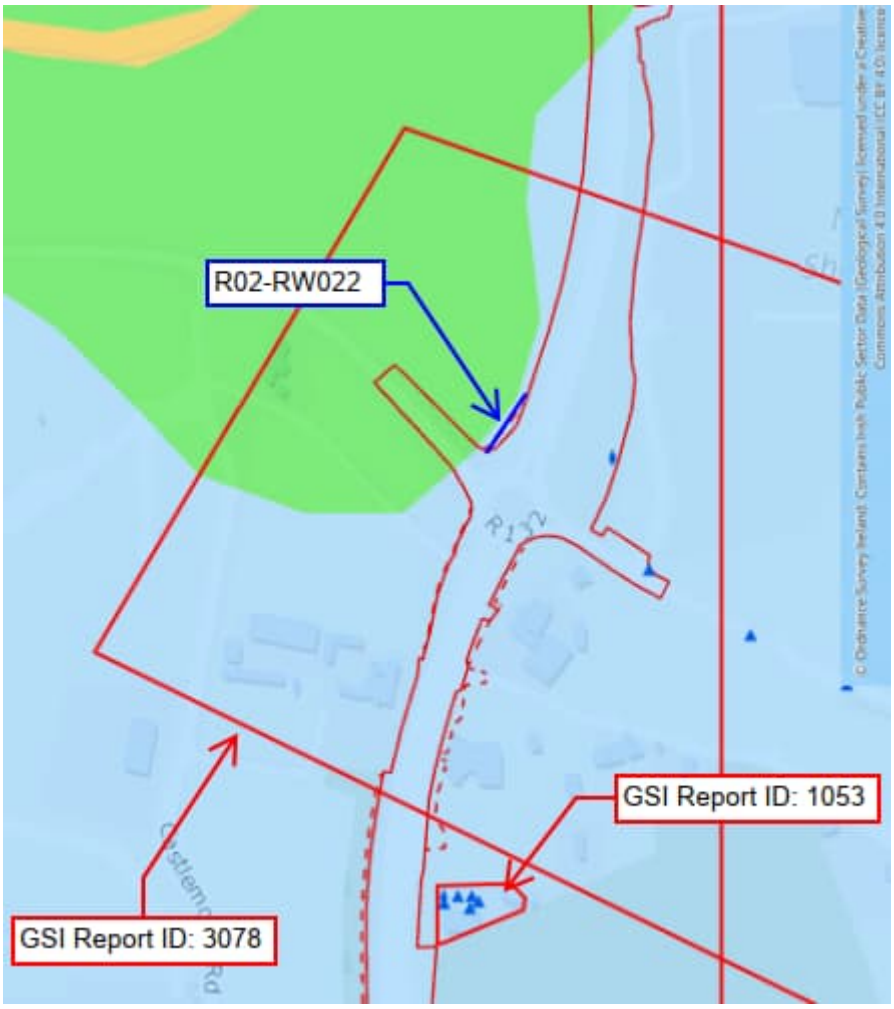


Figure 6-2 Extract of GSI mapping showing location of historic GI.

6.2.4 R02-RW028

The ground conditions at this location are assumed to comprise Till derived from limestones (Dublin Boulder Clay) overlying bedrock geology of dark limestones and shale of the Lucan Formation. Thickness of superficial deposits are unconfirmed, publicly available borehole information indicate a minimum thickness of 10m. A publicly available GI report (GSI Ref: External Report 5,022, Figure 7-2) indicated the superficial geology of the area is generally described as firm to very stiff. The retaining wall is expected to be founded on Dublin Boulder Clay.

6.2.5 R02-RW029

The ground conditions at this location are assumed to comprise Till derived from limestones (Dublin Boulder Clay) overlying bedrock geology of dark limestones and shale of the Lucan Formation. Thickness of superficial deposits are unconfirmed, publicly available borehole information indicate a minimum thickness of 20m. A publicly available GI report (GSI External Report Ref: 5,877, Figure 7-4) indicated the superficial geology of the area is generally described as firm to very stiff. The retaining wall is expected to be founded on Dublin Boulder Clay.

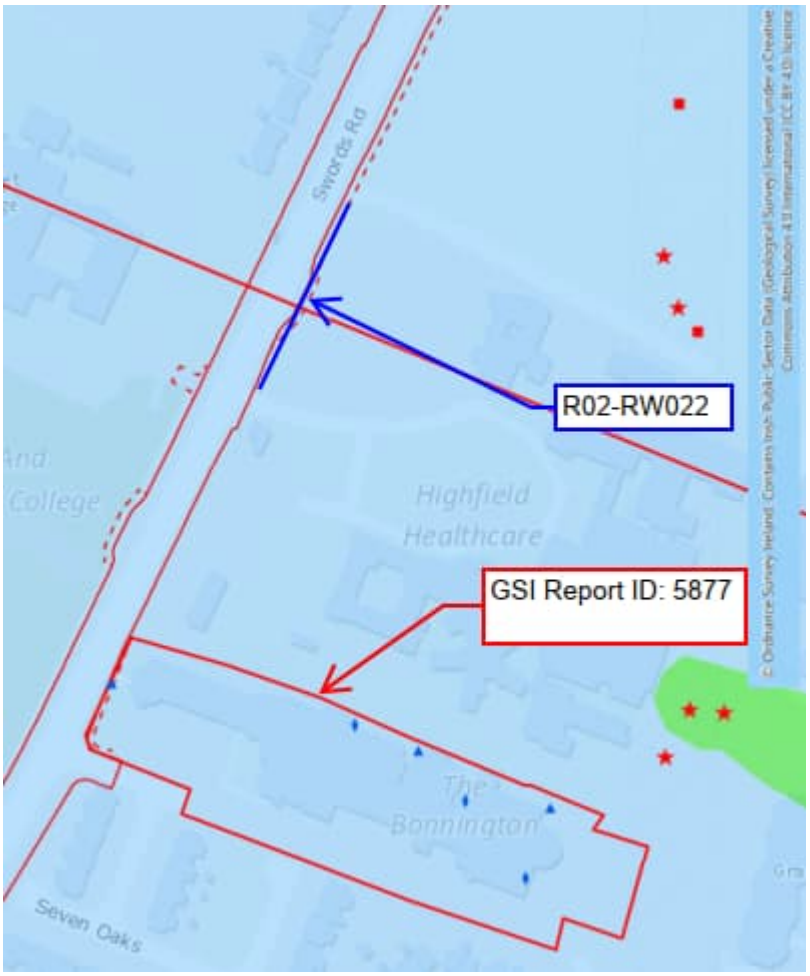


Figure 6-3 Extract of GSI mapping showing location of historic GI.

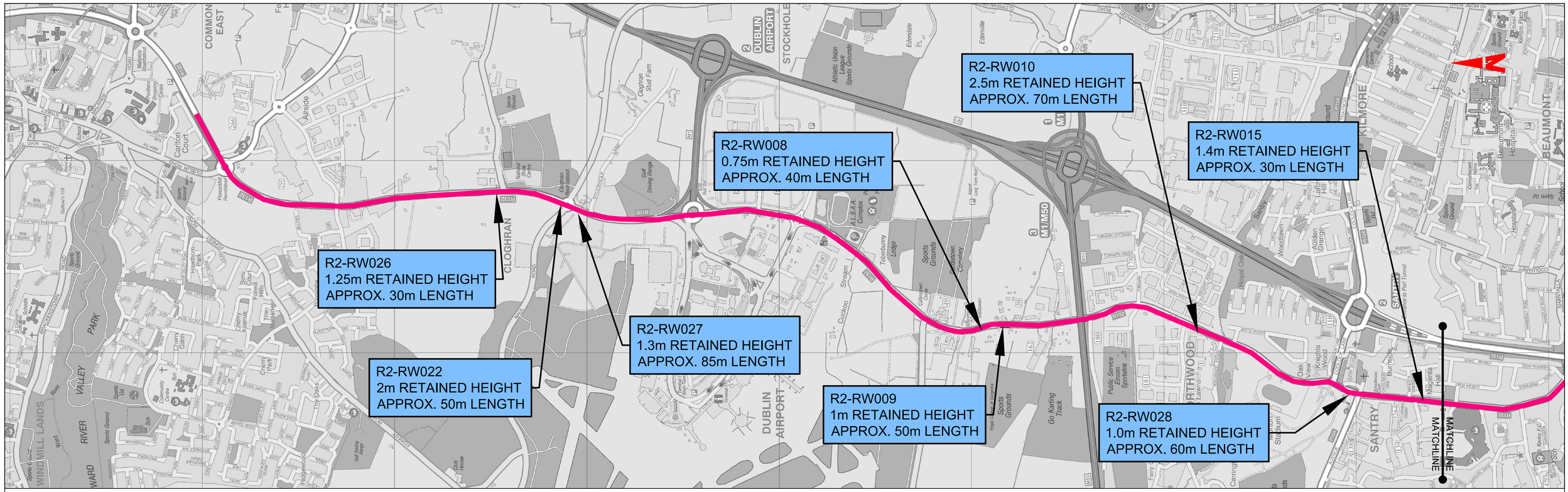
7. Drawings and Documents

7.1 List of All Documents Accompanying the Submission

Drawing Reference	Drawing Title	Revision
BCIDB-JAC-STR_ZZ-0002_RW_00-DR-CB-1001	Site Location Plan	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1101	General Arrangement	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1102	General Arrangement	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1103	General Arrangement	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1105	General Arrangement	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1106	General Arrangement	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1107	General Arrangement	M01
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1108	General Arrangement	M01

Table 8.1.1: List of accompanying drawings

Appendix A. **Drawings**



Project Ireland 2040
Building Ireland's Future

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M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

W.I.P.

Client: NTA — Údarás Náisiúnta Iompair, National Transport Authority

Engineering Designer: Jacobs

Programme Title: BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
RETAINING STRUCTURES
SITE LOCATION PLAN

Date	Scale	Drawn	Checked	Approved
06/04/2023	1:10000 @ A1 1:20000 @ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_ZZ-0002_RW_00-DR-CB-1001	01of 01	A	M01

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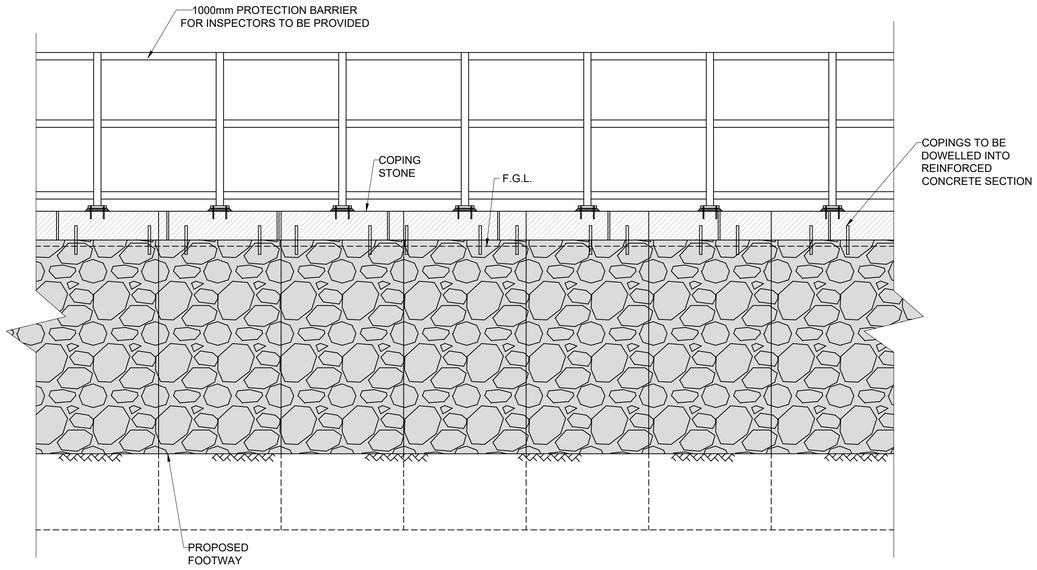
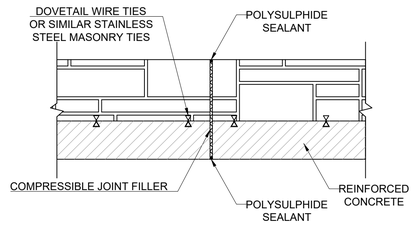
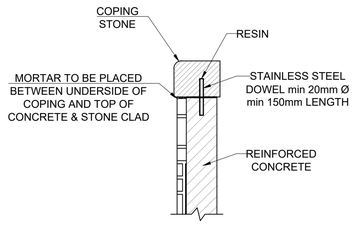


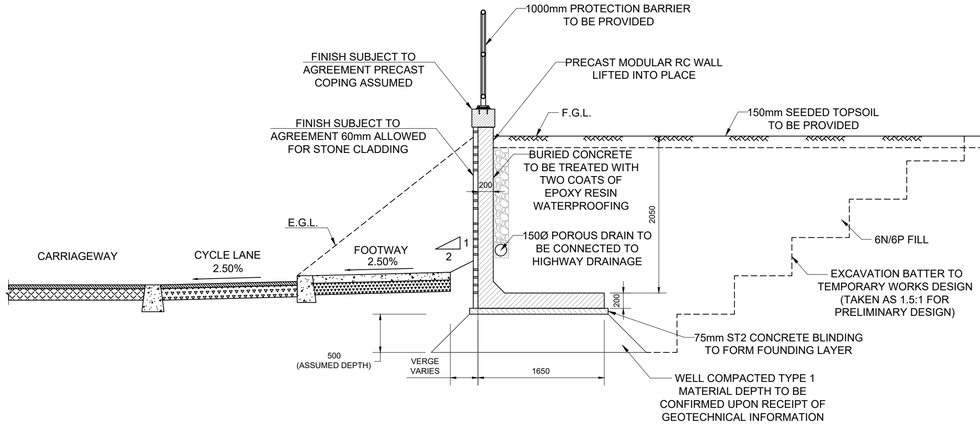
TYPICAL ELEVATION
SCALE 1:25



TYPICAL CROSS SECTION THROUGH
WALL JOINT
SCALE 1:20

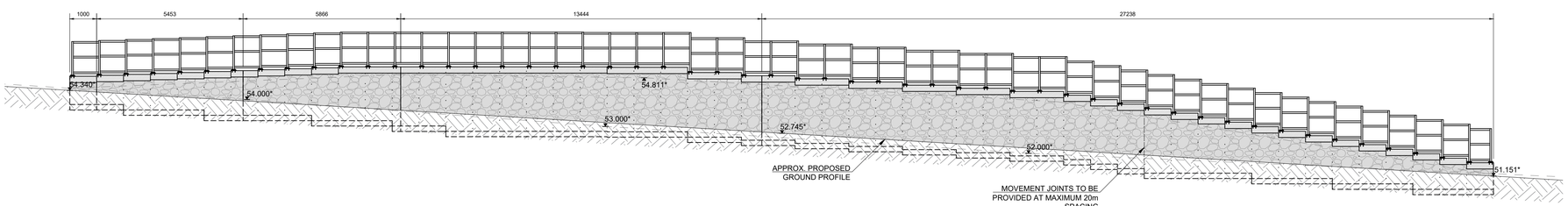


CROSS SECTION THROUGH COPING
STONE TIE IN
SCALE 1:20



TYPICAL CROSS-SECTION
SCALE 1:40

PLAN ON RETAINING WALL
SCALE 1:250



DEVELOPED FRONT ELEVATION
SCALE 1:100

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDINANCE DATUM USING OSi GEOID MODEL (OSGM15) MALIN HEAD.
3. FINISHES:
   - BURIED UNFORMED SURFACES -U1
   - BURIED FORMED SURFACES -F1
   - EXPOSED UNIFORMED SURFACES (EXCLUDING AREA TO BE WATERPROOFED) -U3
   - ALL OTHER EXPOSED FORMED SURFACED -F4
4. MATERIALS:

LOCATION:	CONCRETE GRADE:
RETAINING WALLS	-C32/40 (50% GGBS)
NON-STRUCTURAL CONCRETE:	
LOCATION:	CONCRETE GRADE:
CONCRETE FOR BLINDING	-ST2

5. BURIED CONCRETE SURFACES SHALL BE TREATED WITH TWO COATS OF EPOXY RESIN WATERPROOFING PAINT IN ACCORDANCE WITH TII CC-SPW-01700.
6. ALL EXPOSED CONCRETE SHALL BE IMPREGNATED WITH A HYDROPHOBIC PORE LINER IN ACCORDANCE WITH THE TII CC-SPW-01700.
7. EXTERNAL CONCRETE ARISES TO BE CHAMFERED 25x25 UNLESS NOTED OTHERWISE.
8. LOCALISED SOFT SPOTS, IF PRESENT, TO BE EXCAVATED AND REPLACED WITH 6N/6P.
9. FINAL LEVELS TO BE CONFIRMED IN THE DETAILED DESIGN

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M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair National Transport Authority
Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
06/04/2023	as shown @ A1 as shown @ A3	RG	JM	HO
Project Code: BCIDB	Originator Code: JAC	QMS Code		

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
FIGNAL COUNTY COUNCIL
GENERAL ARRANGEMENT
R2-RW022

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1101	01 of 1	A	M01

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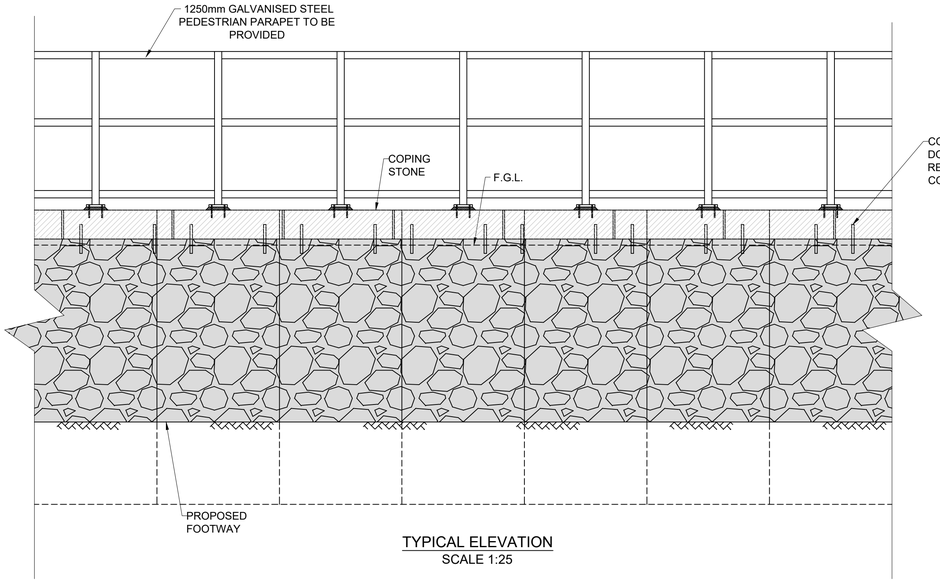

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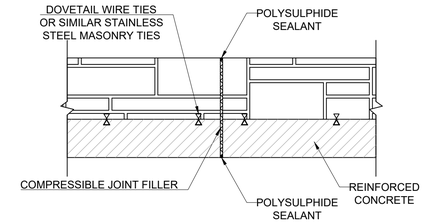
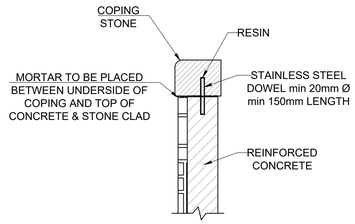


TYPICAL CROSS SECTION THROUGH WALL JOINT
SCALE 1:20



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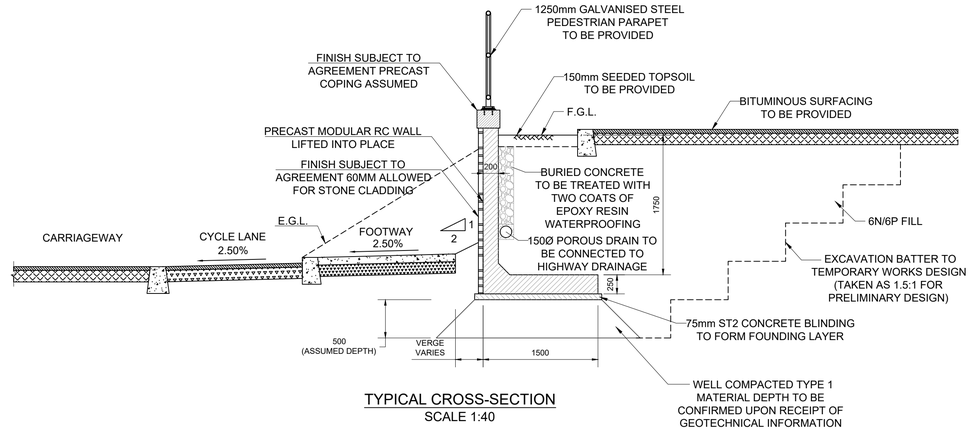
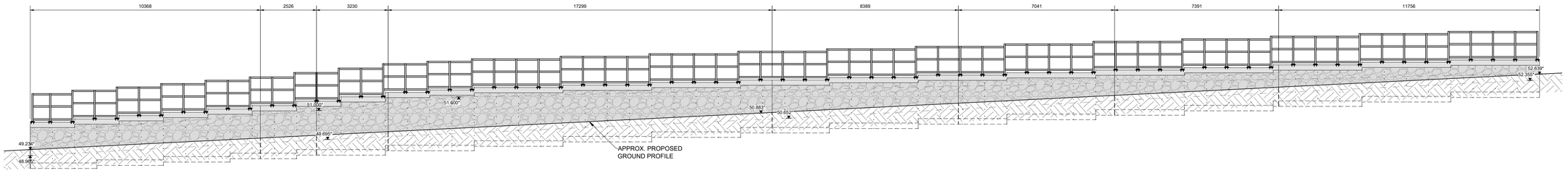
SCALE 1:20



TYPICAL CROSS-SECTION
SCALE 1:40

PLAN ON RETAINING WALL
SCALE 1:250



DEVELOPED FRONT ELEVATION
SCALE 1:100

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDINANCE DATUM USING OSi GEOID MODEL (OSGM15) MALIN HEAD.
3. FINISHES:

BURIED UNFORMED SURFACES	-U1
BURIED FORMED SURFACES	-F1
EXPOSED UNIFORMED SURFACES (EXCLUDING AREA TO BE WATERPROOFED)	-U3
ALL OTHER EXPOSED FORMED SURFACED	-F4

4. MATERIALS:

LOCATION:	CONCRETE GRADE:
RETAINING WALLS	-C32/40 (50% GGBS)
NON-STRUCTURAL CONCRETE:	
LOCATION:	CONCRETE GRADE:
CONCRETE FOR BLINDING	-ST2

5. BURIED CONCRETE SURFACES SHALL BE TREATED WITH TWO COATS OF EPOXY RESIN WATERPROOFING PAINT IN ACCORDANCE WITH TII CC-SPW-01700.
6. ALL EXPOSED CONCRETE SHALL BE IMPREGNATED WITH A HYDROPHOBIC PORE LINER IN ACCORDANCE WITH THE TII CC-SPW-01700.
7. EXTERNAL CONCRETE ARISES TO BE CHAMFERED 25x25 UNLESS NOTED OTHERWISE.
8. LOCALISED SOFT SPOTS, IF PRESENT, TO BE EXCAVATED AND REPLACED WITH 6N6P.
9. FINAL LEVELS TO BE CONFIRMED IN THE DETAILED DESIGN.

Project Ireland 2040 Building Ireland's Future

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Client: NTA Údarás Náisiúnta Iompair National Transport Authority
Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
06/04/2023	as shown @ A1 / as shown @ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
FINGAL COUNTY COUNCIL
GENERAL ARRANGEMENT
R2-RW010

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1102	01 of 1	A	M01

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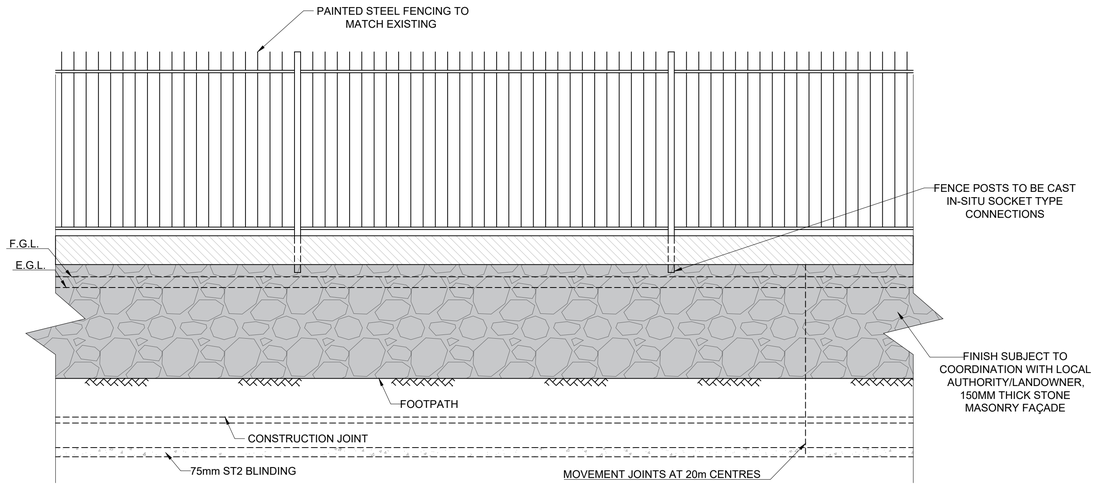

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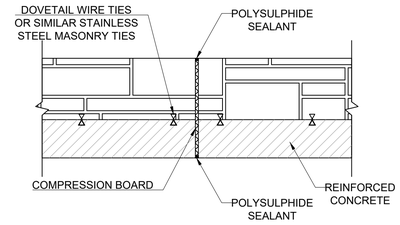

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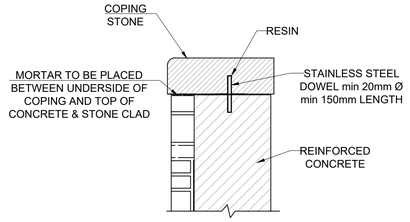
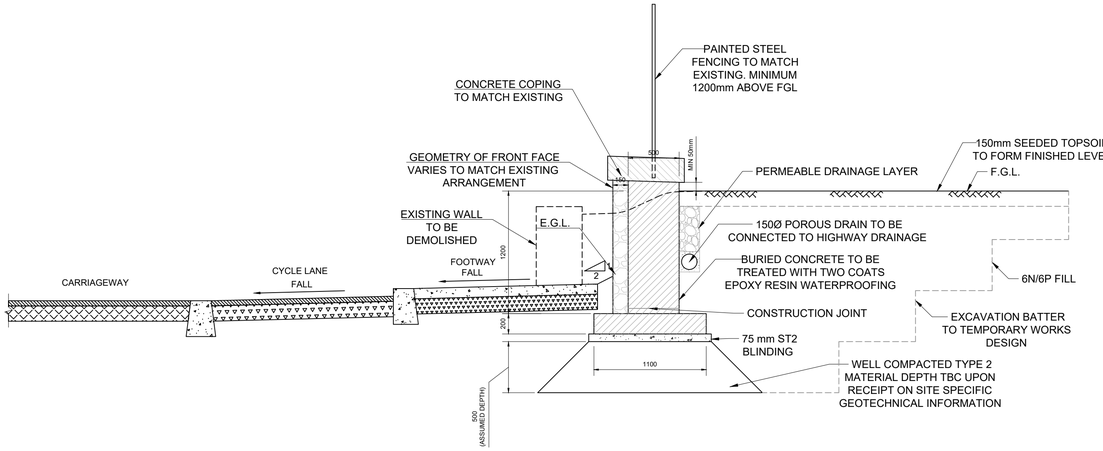
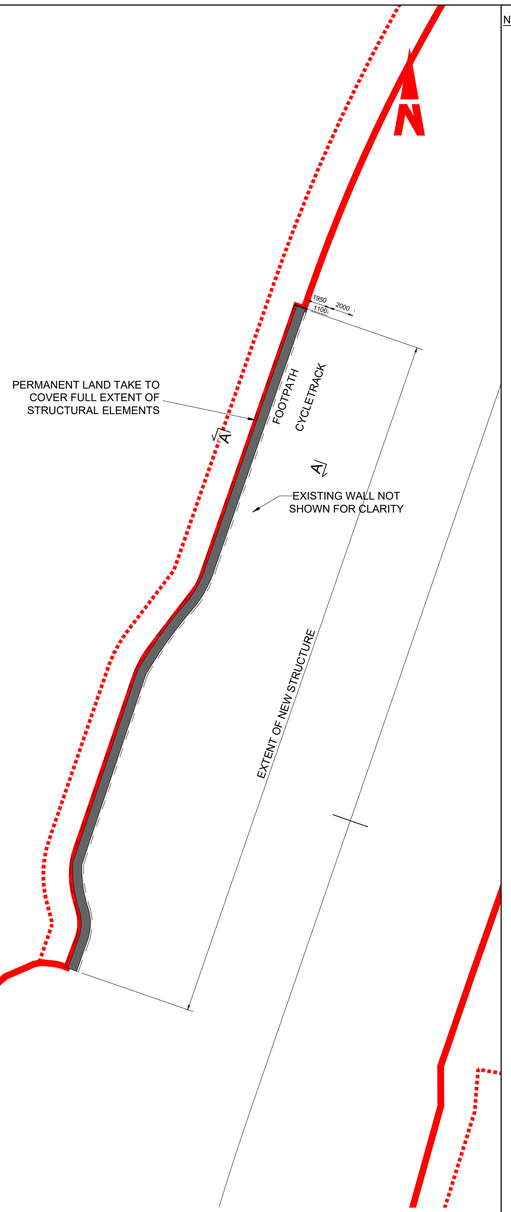
SCALE 1:20



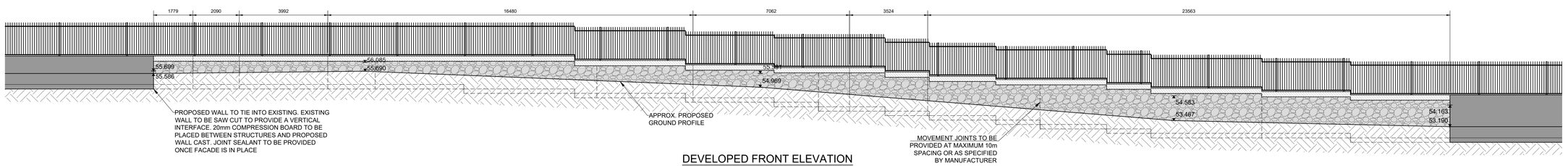
CROSS SECTION THROUGH COPING STONE TIE IN
SCALE 1:20



TYPICAL CROSS-SECTION A-A
SCALE 1:30



PLAN ON RETAINING WALL
SCALE 1:250



DEVELOPED FRONT ELEVATION
SCALE 1:100

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDINANCE DATUM USING OSi GEOID MODEL (OSGM15) MALIN HEAD.
3. FINISHES:
   - BURIED UNFORMED SURFACES -U1
   - BURIED FORMED SURFACES -F1
   - EXPOSED UNIFORMED SURFACES (EXCLUDING AREA TO BE WATERPROOFED) -U3
   - ALL OTHER EXPOSED FORMED SURFACED -F4
4. MATERIALS:

LOCATION:	CONCRETE GRADE:
RETAINING WALLS	-C32/40 (50% GGBS)
NON-STRUCTURAL CONCRETE:	
LOCATION:	CONCRETE GRADE:
CONCRETE FOR BLINDING	-ST2

5. BURIED CONCRETE SURFACES SHALL BE TREATED WITH TWO COATS OF EPOXY RESIN WATERPROOFING PAINT IN ACCORDANCE WITH TII CC-SPW-01700.
6. ALL EXPOSED CONCRETE SHALL BE IMPREGNATED WITH A HYDROPHOBIC PORE LINER IN ACCORDANCE WITH THE TII CC-SPW-01700.
7. EXTERNAL CONCRETE ARISES TO BE CHAMFERED 25x25 UNLESS NOTED OTHERWISE.
8. STONE MASONRY FACING TO BE ANCHORED TO RETAINING WALL USING ANCON POST FIXED STAIFIX UNIVERSAL WALL STARTER SYSTEM AND SD21 125MM WALL TIES OR EQUIVALENT AT 600MM STAGGERED HORIZONTAL AND VERTICAL CENTRES.
9. LOCALISED SOFT SPOTS, IF PRESENT, TO BE EXCAVATED AND REPLACED WITH 6N/6P.
10. FINAL LEVELS TO BE CONFIRMED IN THE DETAILED DESIGN.

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Client: NTA Údarás Náisiúnta Iompair National Transport Authority
Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
06/04/2023	as shown @ A1 as shown @ A3	RG	JM	HO
Project Code: BCIDB	Originator Code: JAC	QMS Code		

Programme Title: BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS
Drawing Title: SWORDS TO CITY CENTRE SCHEME FINGAL COUNTY COUNCIL GENERAL ARRANGEMENT R2-RW028

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1103	01 of 1	A	M01

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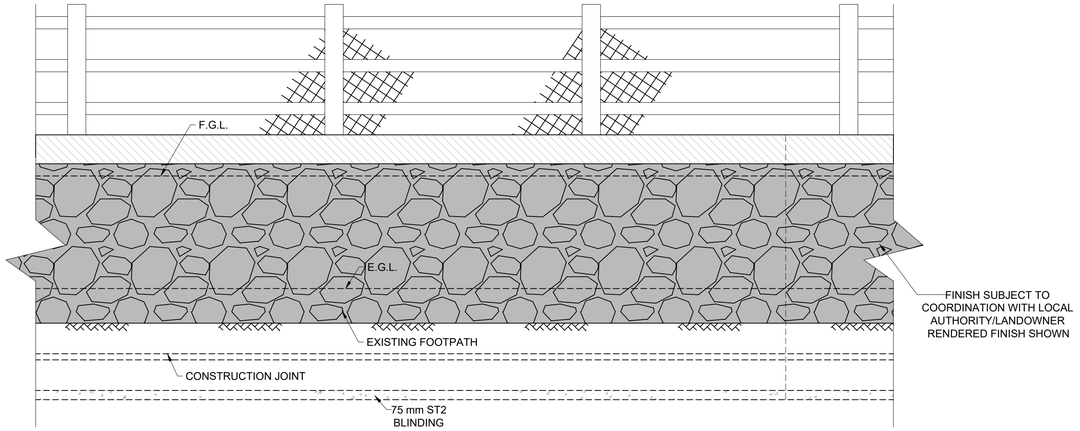

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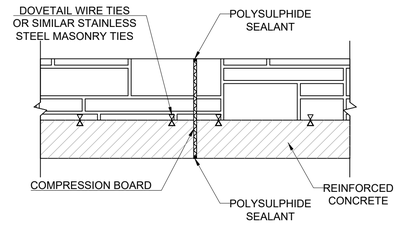
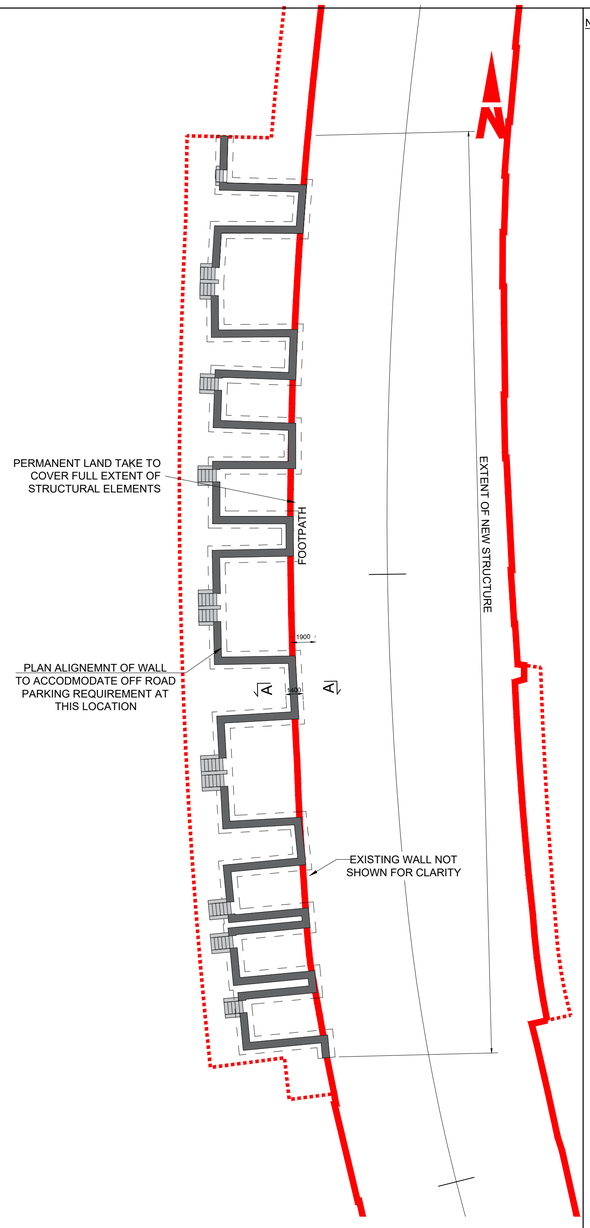
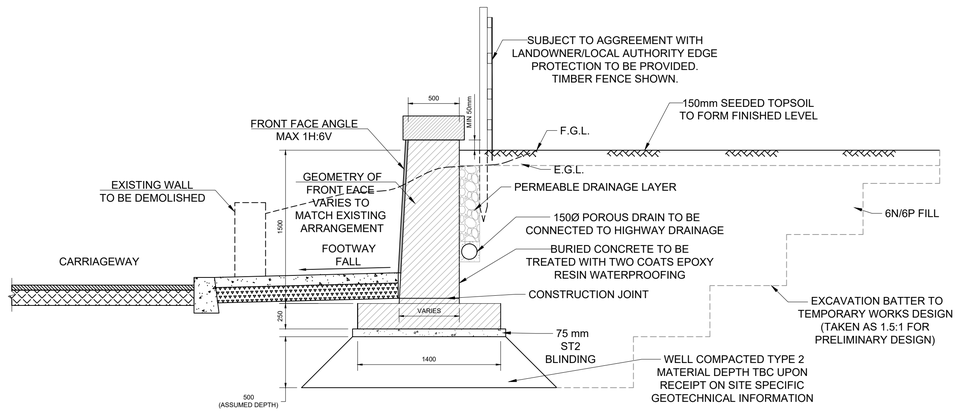


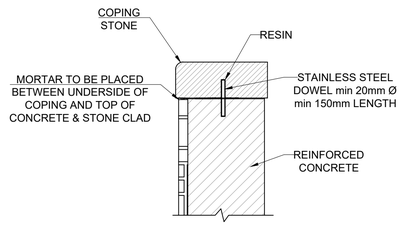
TYPICAL CROSS SECTION THROUGH
WALL JOINT
SCALE 1:20



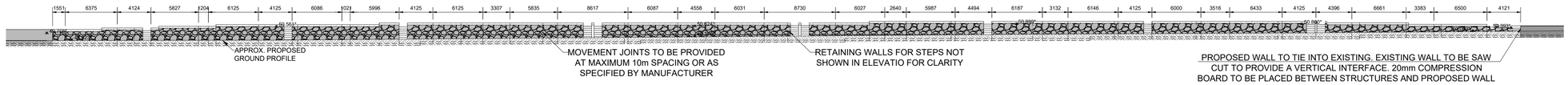
PLAN ON RETAINING WALL
SCALE 1:250



TYPICAL CROSS-SECTION A-A
SCALE 1:30



CROSS SECTION THROUGH COPING
STONE TIE IN
SCALE 1:20



DEVELOPED FRONT ELEVATION
SCALE 1:300

NOTES:

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE SHOWN IN METRES ABOVE ORDINANCE DATUM USING OSi GEOID MODEL (OSGM15) MALIN HEAD.
3. FINISHES:

BURIED UNFORMED SURFACES	-U1
BURIED FORMED SURFACES	-F1
EXPOSED UNIFORMED SURFACES (EXCLUDING AREA TO BE WATERPROOFED)	-U3
ALL OTHER EXPOSED FORMED SURFACED	-F4

4. MATERIALS:

LOCATION:	CONCRETE GRADE:
RETAINING WALLS	-C32/40 (50% GGBS)
NON-STRUCTURAL CONCRETE:	
LOCATION:	CONCRETE GRADE:
CONCRETE FOR BLINDING	-ST2

5. BURIED CONCRETE SURFACES SHALL BE TREATED WITH TWO COATS OF EPOXY RESIN WATERPROOFING PAINT IN ACCORDANCE WITH TII CC-SPW-01700.
6. ALL EXPOSED CONCRETE SHALL BE IMPREGNATED WITH A HYDROPHOBIC PORE LINER IN ACCORDANCE WITH THE TII CC-SPW-01700.
7. EXTERNAL CONCRETE ARISES TO BE CHAMFERED 25x25 UNLESS NOTED OTHERWISE.
8. LOCALISED SOFT SPOTS, IF PRESENT, TO BE EXCAVATED AND REPLACED WITH 6N/6P.
9. FINAL LEVELS TO BE CONFIRMED IN THE DETAILED DESIGN.

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Engineering Designer: Jacobs

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Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
DUBLIN CITY COUNCIL
GENERAL ARRANGEMENT
R2-RW016

Drawing File Name	Sheet Number	Status	Rev
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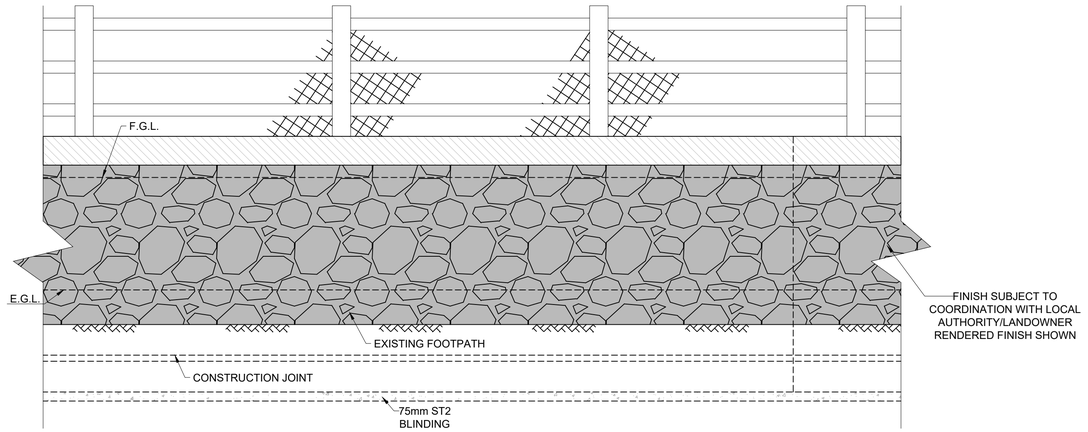
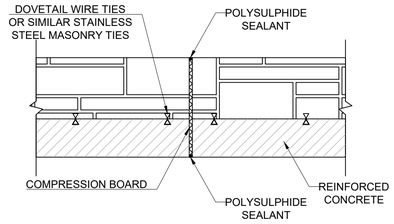
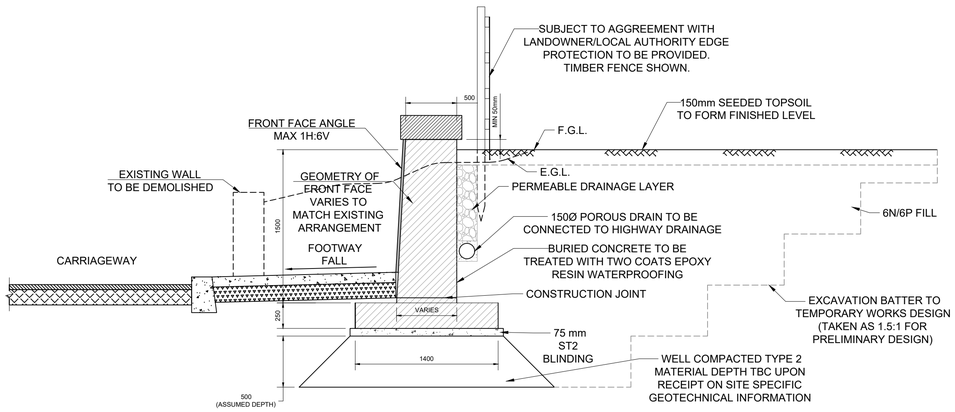


TYPICAL ELEVATION
SCALE 1:25



TYPICAL CROSS SECTION THROUGH
WALL JOINT
SCALE 1:20



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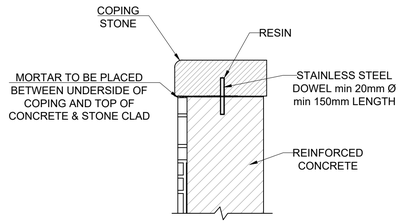
SCALE 1:30



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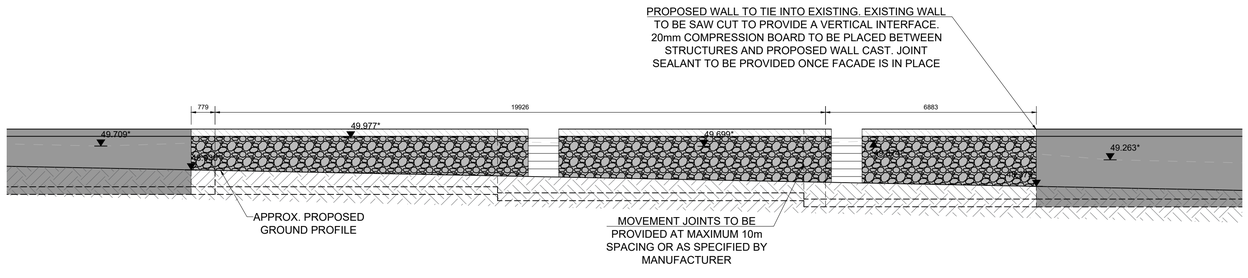
STONE TIE IN
SCALE 1:20



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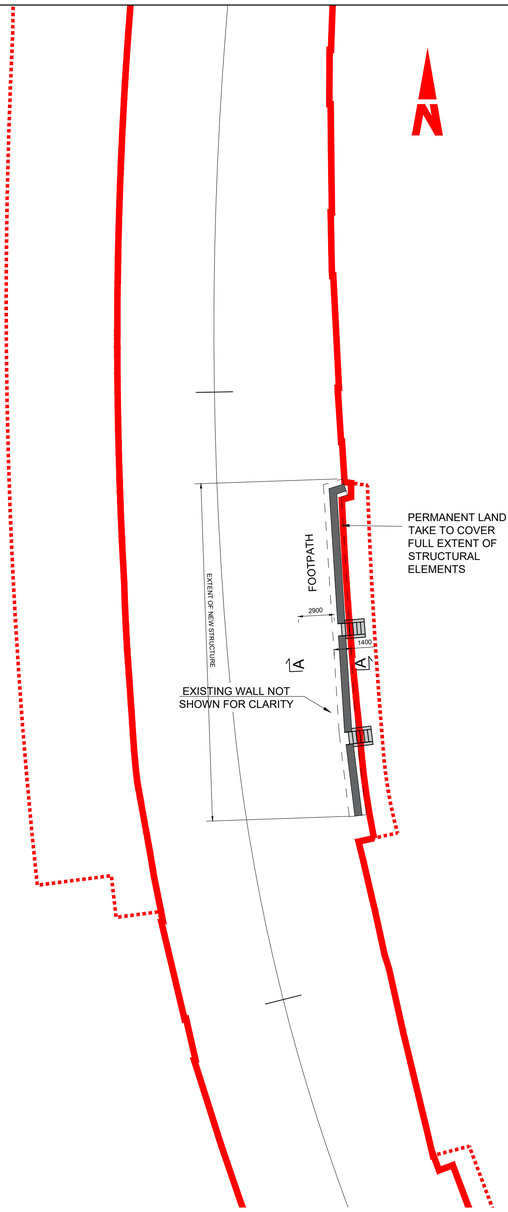

PLAN ON RETAINING WALL
SCALE 1:250

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Project Ireland 2040
Building Ireland's Future

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BCIDB	JAC	

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
DUBLIN CITY COUNCIL
GENERAL ARRANGEMENT
R2-RW017

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1106	01 of 1	A	M01

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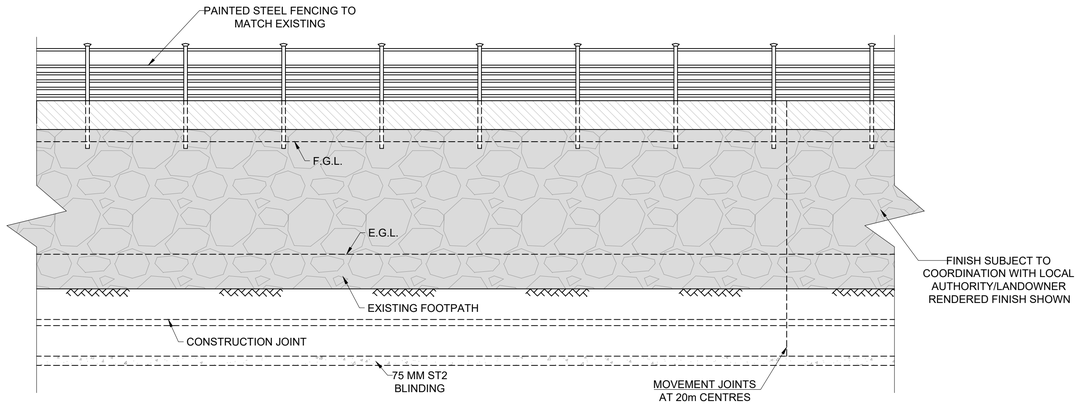

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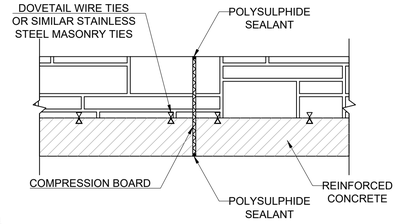

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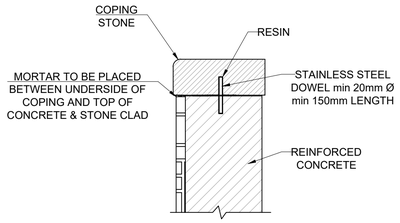

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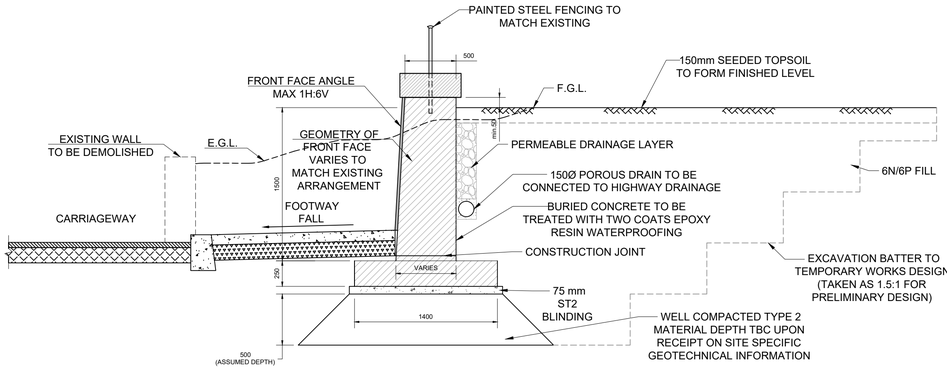

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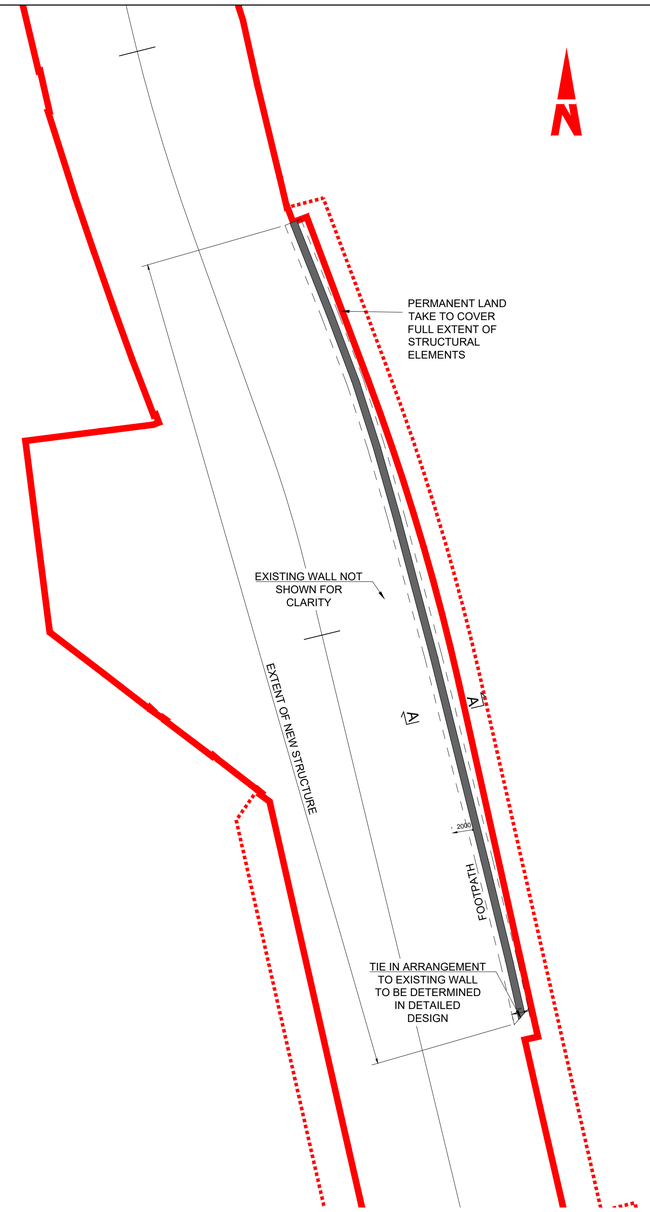
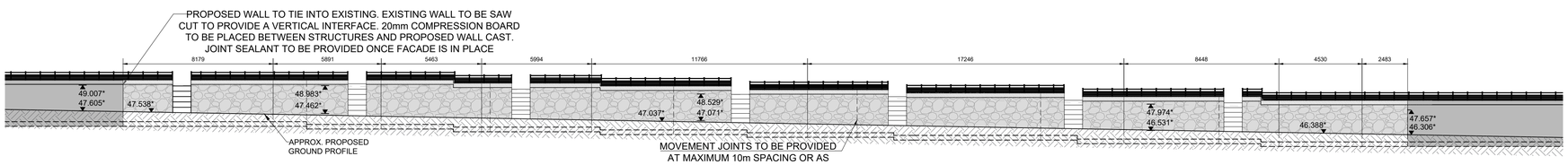


PLAN ON RETAINING WALL
SCALE 1:250



DEVELOPED FRONT ELEVATION
SCALE 1:150

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Programme Title: **BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS**
Drawing Title: SWORDS TO CITY CENTRE SCHEME DUBLIN CITY COUNCIL GENERAL ARRANGEMENT R2-RW018

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1107	01 of 1	A	M01

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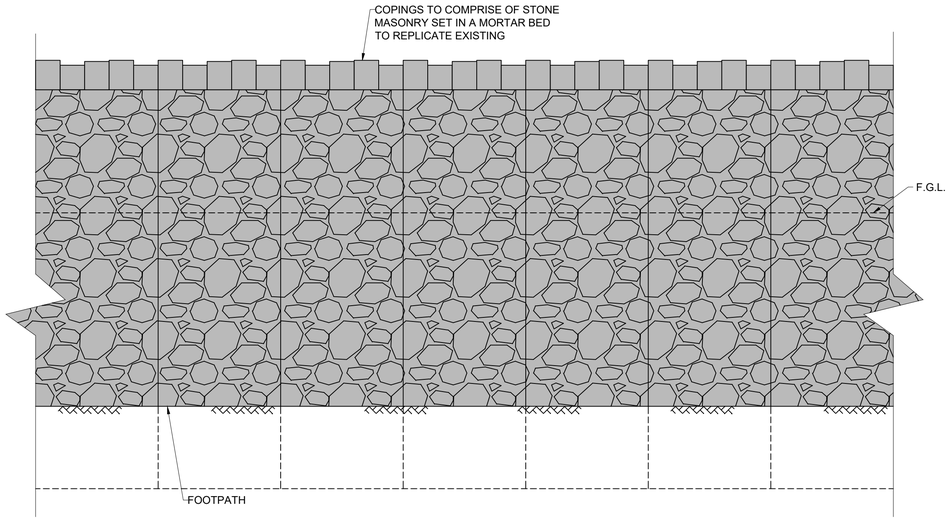

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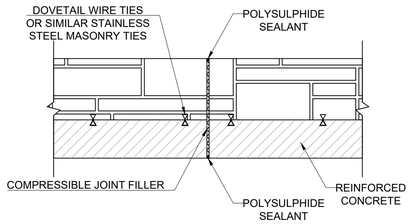

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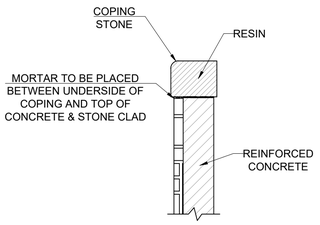

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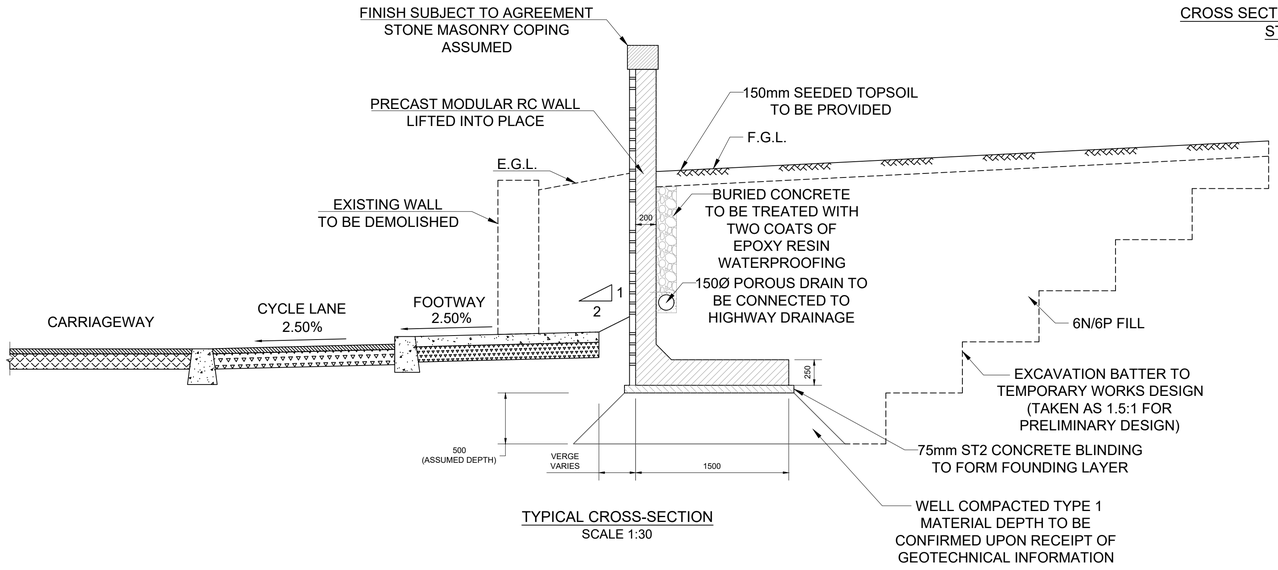

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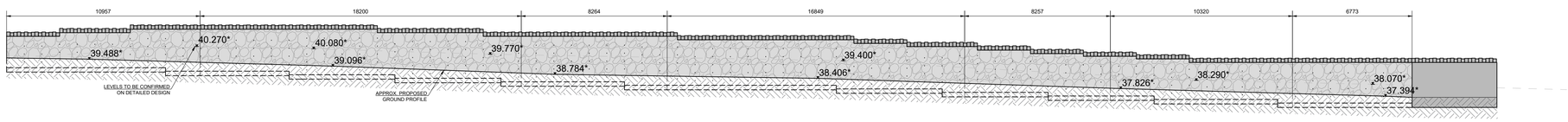

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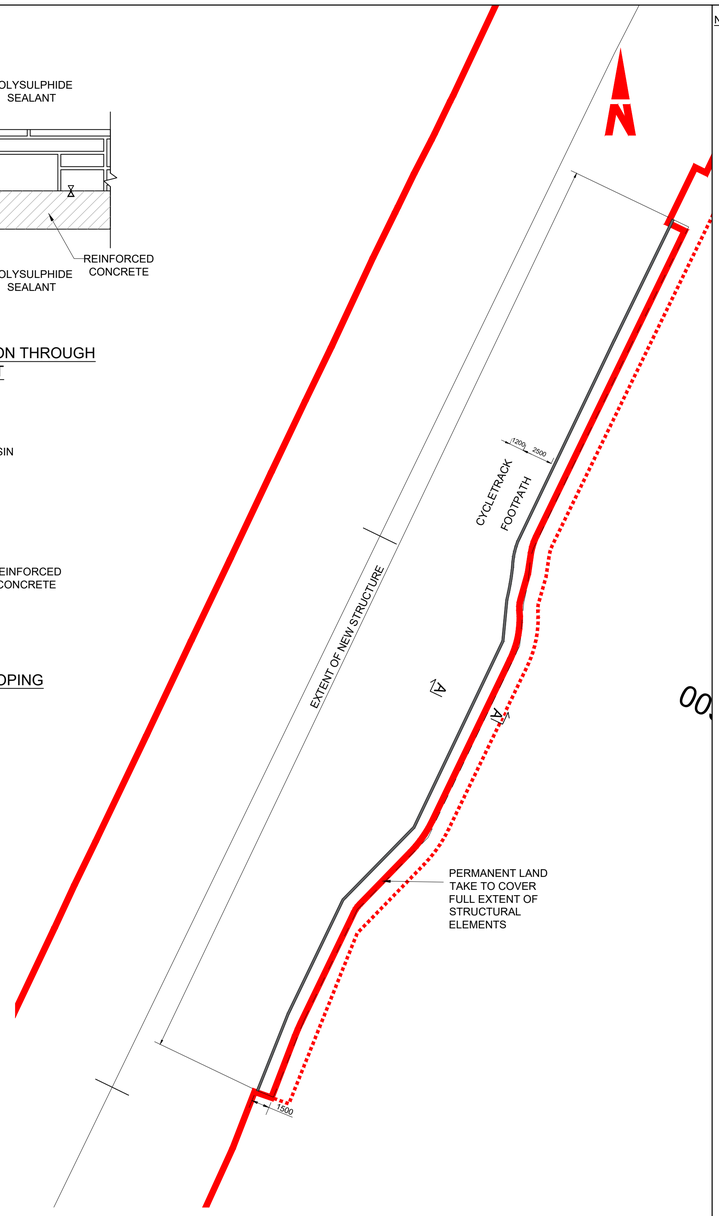

PLAN ON RETAINING WALL
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Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_RW_00-DR-CB-1108	01 of 1	A	M01

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Preliminary Design Report - Frank Flood Bridge

Preliminary Design Report- Consultation

STA-1b

Categories ~~1~~, 2 ~~& 3~~

Scheme Name

Name and Location – BusConnects Route 02 Swords to City Centre, Dublin

Structure(s)

Name and nature of the Structure(s) – Frank Flood Bridge

Structures Options Report

Reference - Frank Flood Bridge

Revision - L03

Date - 12th December 2022

Submitted by

Signed _____

Name John McElhinney

Position Structural Discipline Lead (Team Leader)

Organisation Jacobs Engineering

Date 12/12/2022

Structures Section confirmation of consultation

Signed _____

Name _____

Position _____

Date _____

* This application should appear as the first page after the cover of the Preliminary Design Report.

Contents

1. Introduction

1.1 Brief

Jacobs have been appointed by the National Transport Authority (NTA) to undertake the Engineering Design Services for the Planning Stage through to the end of the Statutory Process of the BusConnects Radial Core Bus Corridors Infrastructure Upgrade Programme (the Programme). The Project has been split in four packages with Jacobs undertaking Package B.

This report outlines the Preliminary Design for the Frank Flood Bridge in Drumcondra on Core Bus Corridor (CBC) 2 Swords to City Centre. The preferred corridor over this section of the route results in the need for widening of the highway cross section at this location which cannot be accommodated over the existing masonry structure.

1.2 Background

The National Transport Authority (NTA) published the Transport Strategy for the Greater Dublin Area, 2016 – 2035 at the beginning of 2016. The strategy identifies a "Core Bus Network", representing the most important bus routes within the Greater Dublin area, generally characterised by high passenger volumes, frequent services, and significant trip attractors along the routes. The identified core network comprises sixteen radial bus corridors, three orbital bus corridors and six regional bus corridors.

The Strategy states that it is intended to provide continuous bus priority, as far as is practicable, along the core bus routes. This will result in a more efficient and reliable bus service with lower journey times, increasing the attractiveness of public transport in these areas and facilitating a shift to more sustainable modes of transport. The Swords to City Centre Core Bus Corridor is identified as part of the Core Bus Network.

In March 2018, BusConnects Dublin was launched as part of major investment programme, including Metrolink and the Dublin Area Rapid Transport (DART) Expansion Programme, to improve public transport in Dublin, as part of the National Development Plan 2021-2030.

Frank Flood Bridge forms part of the preferred route for the Swords to City Centre in Drumcondra which is situated 3 km North of Dublin City Centre. This location presents a bottleneck for the route which will need to be addressed in order to confirm a final alignment for this route. Frank Flood Bridge is managed by Dublin City Council (DCC) who will be responsible for the maintenance of any proposals once constructed.

1.3 Previous Studies

Previous Studies carried out along the proposed route are listed below. The results and findings of these studies have been considered during the development of the preliminary design.

- BRT, Tolka River Upgrade Options Assessment (ARUP, 2015)
- Frank Flood Bridge Principal Inspection Report (Atkins, 2019)
- Remedial Works to Binn's Bridge and Drumcondra Bridge (now known as Frank Flood Bridge) (DCC, 1995)
- BRT, Inspection of Structures (ARUP, 2014)
- Site Investigations, (Jacobs, 2020)
- Topographical Survey, (Jacobs, 2020)
- Route Selection Report (Jacobs, 2020)
- Frank Flood Structures Options Report (Jacobs, 2020)

- Addendum to Frank Flood Structures Options Report (Jacobs, 2021)

It was determined in the options report that it would not be feasible to directly widen the existing masonry arch structure and therefore a new independent structure is to be provided to accommodate the wider highway cross section desired at this location.

2. Site & Function

2.1 Site Location

The proposed location is situated at the intersection of CBC 02 and the Tolka River at approximate chainage 9,950m and is an existing river crossing which comprises of a three-span masonry bridge, constructed circa 1813, which carries the existing N1 over the Tolka River.

Site photographs are in included in Appendix A of the Report and a Location Plan is included in Appendix B.

2.2 Function of Site and Obstacles Crossed

The existing bridge, which carries the Drumcondra Road Lower (N1) over the Tolka River, provides one of the main arterial routes into the centre of Dublin.

A new independent structure is proposed to accommodate the wider highways cross section by conveying pedestrians and cyclists over the Tolka River to the west of the existing bridge.

2.3 Choice of location

This route was determined as the preferred option in the Route Selection Report (Jacobs, July 2020).

The location of the structure is governed by the existing alignment of the N1 and the interface with the Tolka River.

2.4 Site Description and Topography

The site is located in Drumcondra 3 km north of Dublin City Centre (ITM Grid Reference: E716118, N736772). Frank Flood Bridge, also known as the Drumcondra Bridge, is an existing structure which carries the N1 over the Tolka River. It is a three-span masonry arch bridge and the existing carriageway consists of four lanes of traffic. Footways are provided on both sides directly adjacent to the carriageway. There is currently no dedicated bus or cycle infrastructure over this structure.

The location of the structure is governed by the alignment of the N1 and the interface with the Tolka River. The structure is located within the boundaries of Dublin City Council. The proposed alignment and cross section of road requires the construction of a parallel independent structure. The existing and proposed cross sections are described in Table 2.1. See Appendix C for plan arrangements.

The east side of the bridge is constrained by an existing apartment building and terraced houses, which without significant land acquisition through Compulsory Purchase Order (CPO), prevents any bridge widening on this side. On the west side of the bridge there is a public green space that is owned by Dublin City Council. The presence of this green space provides the opportunity to widen the bridge in this direction.

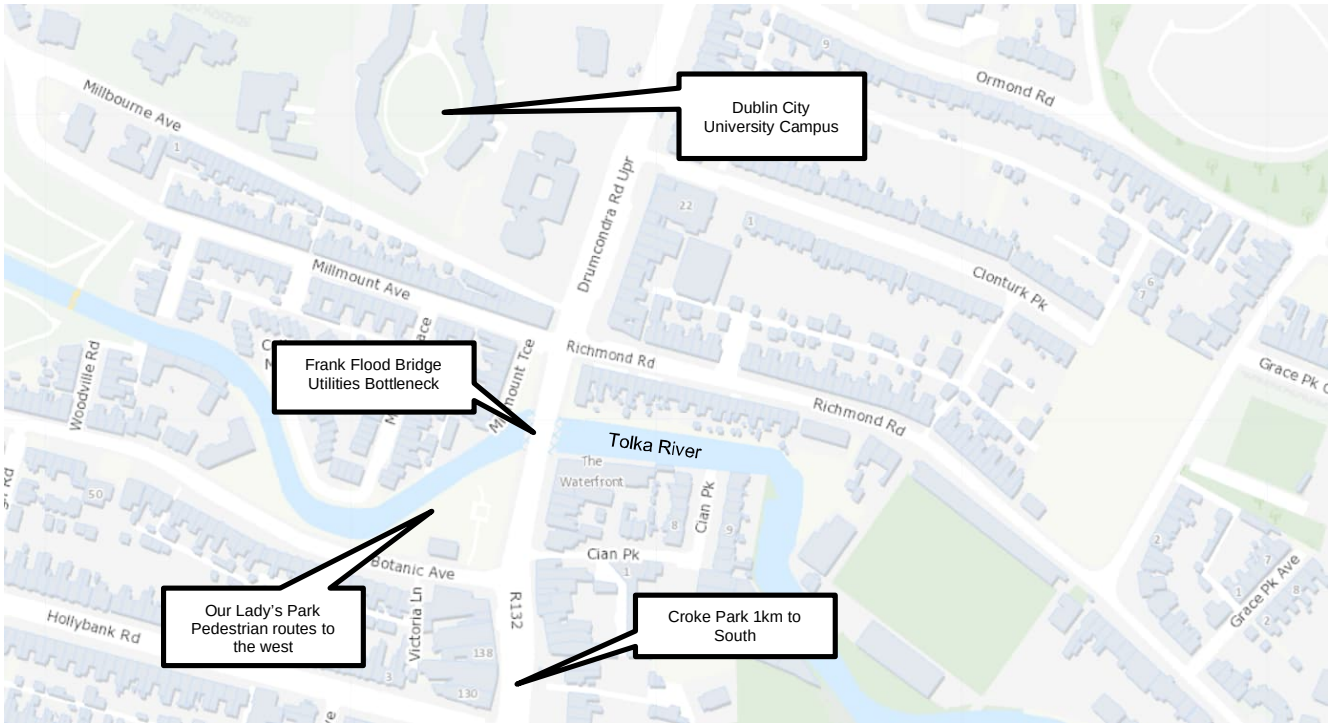


Figure 2.1: Site Location Plan

The River Tolka has been known to flood periodically and flood defence structures are present upstream of the bridge on North and South banks. The north riverbank and sections of Our Lady's Park are considered to be within the flood plain.

There are extensive utilities at the site, within the surfacing of the existing bridge and crossing below the river to the West of the structure. Refer to Section 11 for further discussion on requirements for diversions.

Drumcondra Road Upper / R132 is a significant arterial route into Dublin City Centre, therefore design options progressed shall consider the need to minimise traffic management and highway closures as far as practical.

2.5 Vertical and Horizontal Alignments

The proposed vertical alignment for the new structure is limited by the hydraulic considerations and visual impact to the existing bridge. The structural envelope is therefore defined by the crowns of the arches such that there is no constriction of flow and the top of the existing parapet as shown in Figure 2.2.

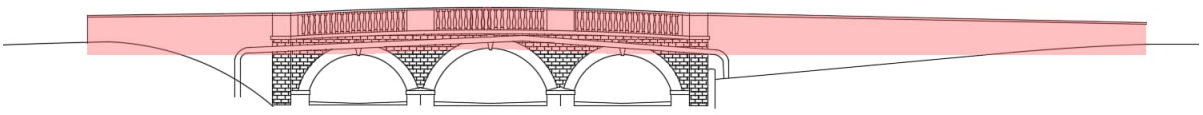


Figure 2.2: Structural envelope in elevation for proposed structure

The deck level of the proposed structure shall align with the level of the carriageway over the existing bridge. A more detailed topographical survey will be required to confirm the vertical alignment of the deck for the TAR stage of design.

The bridge will be curved in plan as a result of the constrained site. This curvature allows for creation of distance between the existing structures and the new bridge to improve the safety for users and improve access for maintenance activities. The curvature also allows the alignment of the bridge on the south bank to remain close to the desire line for pedestrians and cyclists approaching from the south.

2.6 Cross Sectional Dimensions

The existing and proposed cross sections are described in Table 2.1.

Existing Cross Section		Proposed Cross Section	
Parapet copes	2 x 0.3m	Parapet copes	2 x 0.3m
West footway	4.2m	West verge	0.6m
Carriageway	11.1m	Northbound bus lane	3m
East footway	3.4m	Carriageway	8.7m
		Southbound bus lane	3m
		East cycleway	1.8m
		East footway	2m

Table 2.1: Comparison of existing and proposed cross section over the existing bridge

Proposed Footbridge Cross Section	
Edge members	2 x 0.15m
Footway	2m to 3.2m
Central Beam	0.6m
Cycle Way	2.5m

Table 2.2: Proposed cross section for new footbridge

2.7 Existing Underground and Overground Services

There are a large number of underground services crossing the existing Frank Flood bridge particularly on the western side of the bridge. A summary of the identified services is shown in Table 2.3.

Asset Owner	Location/Existing Asset Information	Diversion Required	Requirement for Diversion
ESB	West of bridge under river in trench. Believed to be 4no. ducts.	Yes, new under river bore required to accommodate.	8 No. 125mm ducts for HV
ESB	Located in western footpath. Between 2no. & 4no. ducts.	Yes, preferred option is to relocate in eastern footpath to reduce requirements on the proposed structure.	4 No. 125mm ducts for LV
GNI	250mm PE inserted in 12" pipe located in western footpath.	Yes, relocate to new bridge	1 No. 250mm pipeline
GNI	12" steel pipe attached to western spandrel wall.	Yes, relocate to new bridge	1 No. 350mm pipeline
EIR	Located in western footpath. Believed to be 6no. 100mm ducts.	Yes, relocate to new bridge	6 or 9 No. 100mm ducts
Irish Water	225mm water main located in the western footpath.	Yes, relocate to new bridge	1 No. 225mm main
Irish Water	600mm DI water main located west of the bridge in under river trench.	Yes, new under river bore required to accommodate.	1 No. 600mm main
eNet	2no. ducts believed to be located in western footpath	Yes, preferred option is to relocate to eastern footpath.	2 No. 100mm ducts
Unknown (possibly GNI)	A 250mm main (possibly low-pressure gas) located in western footpath	Possible, need to identify asset to confirm	1 No. 250mm duct
Traffic Signalling	New asset	Preferred option is to install in eastern footpath.	Unknown, anticipated 2 to 4 100mm ducts

Table 2.3: Summary of utilities impacted by proposed works

There is a high concentration of existing utility assets located on the existing Frank Flood Bridge and under the Tolka River to the west of the structure. There are numerous utilities located in both the west and east footway. The most current information was gathered from utility provider records and from previous trial pits dug as a prelude to the protection works undertaken by Dublin City Council in 1994. The current proposal to make the west footway a trafficable lane requires existing utilities within it to be relocated as there would not be sufficient depth from structure to finish level to accommodate large diameter utilities. The proposed arrangement resulting from the 1994 protection works and likely current arrangement of the utilities in both footpaths can be seen in Figure 2.3 below. There remains a risk that unidentified assets have been installed post 1994 however a utility survey including GPR commissioned by the NTA undertaken in 2020 has not indicated additional unknown utilities in the western footway.

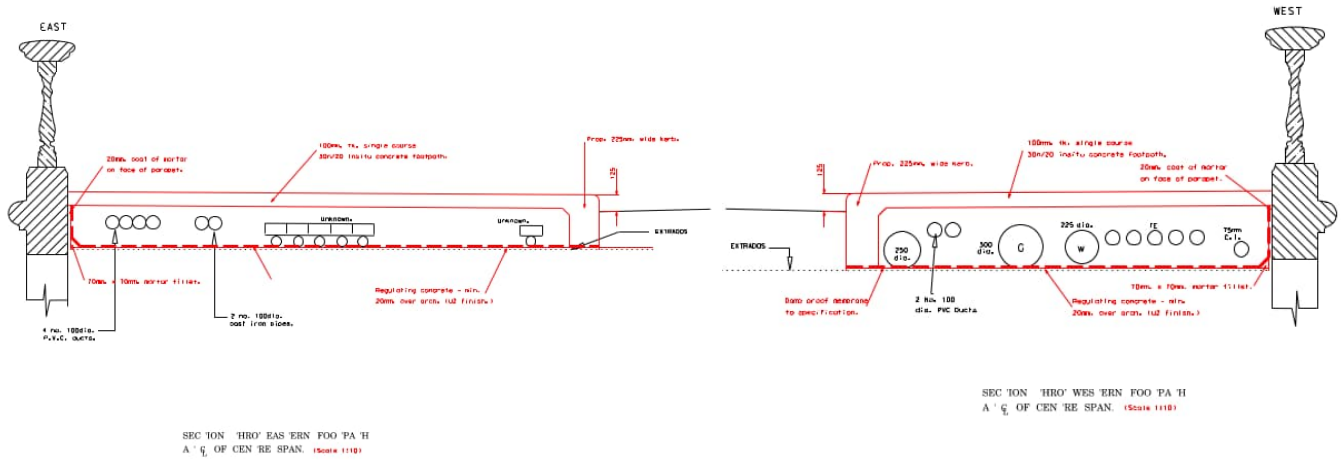


Figure 2.3: Cross section of footways over Frank Flood Bridge circa 1995

A large diameter gas main is attached to the western spandrel wall on the exterior of the bridge, this transitions underground via a vertical pipe section at each side of the bridge and continues north and south of the area as a typical buried service arrangement. It is likely this arrangement arises from the lack of cover over the top of the arch barrels such that there was insufficient space to bury this asset over the bridge.

Figure 2.4: Image of west elevation showing large diameter gas main attached to spandrel wall

There are two fluid filled 38kV high voltage electrical cable circuits to the west of the bridge installed beneath the river. These were historically trenched across the riverbed. These types of cables are extremely sensitive to ground movement and any works within 15m will require co-ordination with ESB the asset owner. The cover slabs over these cable circuits were located by slit trenches in 2020 north and south of the river. ESB have a medium to long term aspiration to replace all such cables due to their age and condition.

Finally, there is a 600mm diameter trunk water main to the west of the bridge installed beneath the river. Irish Water records indicate this main is a ductile iron main installed in the mid 1980's. However, this was unable to be verified during slit trenches in 2020 due to the depth of the water main and further investigation of this asset will be required prior to construction.

2.7.1 Utility Diversion Proposals

The proposed works involve a complete diversion of the existing ESB high voltage circuits and the 600mm water main prior to the commencement of any bridge construction works. This would involve the construction of 3 No. new under river bores further to the west of the existing asset locations by horizontal directional drilling (HDD). The HDD staging area would be located to the south of the river in Our Lady's Park and bore under the river before exiting in Millmount Terrace. The pipe for installation through the bores would need to be welded together north of the intersection of Drumcondra Road Upper and Millmount Avenue in the bus lane which would be temporarily closed to facilitate. The "pipe string" would then be moved into position once a bore is completed under traffic management control and pulled through the completed bore. This process is known as "pipe pulling" and would need to be completed during out of hours working due to significant traffic impact. The HDD drilling rig is then moved to an offset position and the process is repeated until all 3 bores are completed. It is anticipated that the vibrations created from these works would require monitoring such that the existing asset and surrounding buildings do not experience excessive vibrations. Once the new pipelines are in place the service providers will coordinate the connection of new cables and water main to the existing infrastructure and the abandonment of the existing assets.

The remaining utility assets will all remain operational in their existing location until the new structure is in place. The structure has been designed with sufficient voids within the structure to accommodate the installation of replacement utilities. Once the new utility infrastructure is installed in the proposed bridge deck they will be extended from the extremities of the proposed bridge towards their existing alignments. Prior to construction extensive slit trenching will be required to confirm the precise tie in details and location for each asset. During tie in works each utility will be extended as far as required to join into the existing asset during agreed outages with the service providers. Coordination of all tie-ins will need further consideration during detailed design and close consultation with service providers will be required during detailed design and construction. See Appendix G for a technical note regarding the geotechnical feasibility of this option.

2.8 Geotechnical Summary

2.8.1 Desk Study

A desk study was undertaken for CBC02, including Frank Flood Bridge to inform the design a ground investigation for the proposed bridge crossing. The findings of the desk study are discussed below.

Bedrock Geology

The entire site area around the proposed pedestrian footbridge next to the existing Frank Flood bridge lies within a single stratum of bedrock. The whole site lies on Lucan Formation comprising of dark Limestone and Shale.

Quaternary Deposits

The naturally occurring Quaternary deposits within the site area noted within the GSI, shows the site to generally consist of Alluvium encompassing the river and the banks with an intrusion of "Urban" deposits, the alluvium is surrounded and underlain by deposits of Glacial Till.

Historical and Current Land use

A row of cottages known as "The Tolka Cottages" were noted at the south western pier of the Frank Flood Bridge within the 1888-1913 historical maps. This area is the proposed area for the southern pier and abutment.

A former Flour mill was noted in the 1837-1888 maps approximately 40m north of the north abutment/tension pile of the proposed structure at the intersection of Millmount Avenue and Millmount Terrace.

BusConnects Route 02 Proposed Ground Investigation

A ground investigation was undertaken in September 2020, around the proposed pedestrian bridge at the Frank Flood bridge, this included:

- 2no. Rotary Core Borehole (R2-CPRC02-South Embankment)
- 3no. Slit Trenches (SLT01, SLT01A -North Embankment and SLT02-South Embankment)

Borehole R2-CPRC01 on the North Embankment was cancelled due to utilities and access restrictions.

An outline of the ground conditions is provided in section 7. and copies of the borehole logs are presented in Appendix D.

2.9 Hydrology and Hydraulic Summary

2.9.1 Historic Flood Events

There is history of flooding from the River Tolka in the vicinity of the Frank Flood Bridge dating back to 1880. The largest flood in the record occurred in 2002 with peak flow estimated to be 97m^3/s. The River Tolka Flooding Study Final Report prepared for Dublin City Council (2003) indicates that a flood with a 1% Annual Exceedance Probability (AEP), or a 1-in-100 year flood event, has a peak flow of 90m^3/s. Peak flows associated with the most significant floods on the Tolka are presented in Table 8.1 below

Table 2.4: Summary of peak flows from past flood events on Tolka River

Year	Peak Flows (m^3/s)
1880	71
1954	85
1986	57
2002	97

The River Tolka Flood Relief Scheme (FRS) was constructed in 2008/09 to reduce flood risk. Upstream of the Frank Flood Bridge, the scheme includes flood defences along on both the north and south banks. The Area Benefitting from Defence (ABD) from the River Tolka FRS is shown in Figure 2.5 below. The ABD is stated as providing a 1% AEP Standard of Protection. No property flooding has been recorded at this location since the construction of the River Tolka FRS.

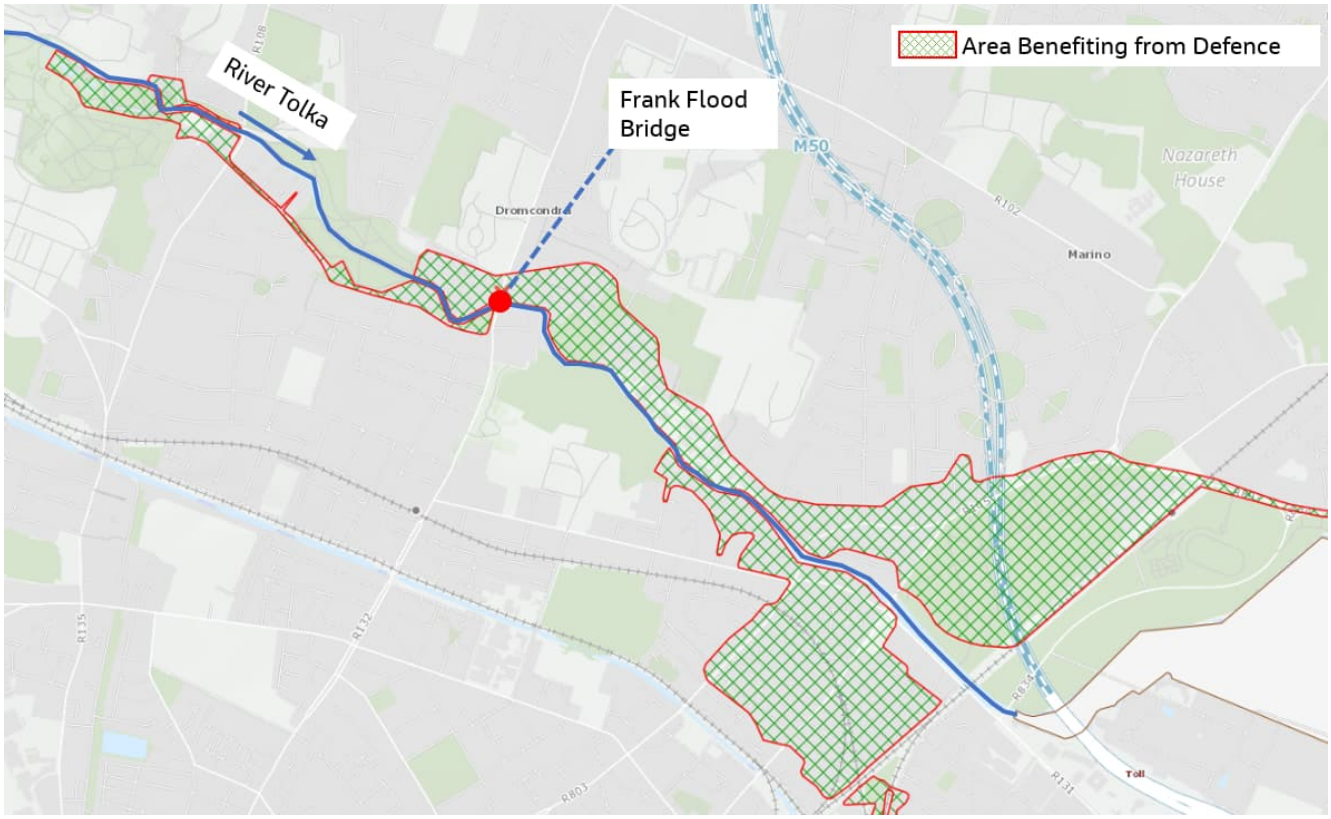


Figure 2.5: – River Tolka FRS Area Benefitting from Defence (ABD); *Source: www.floodinfo.ie*

2.9.2 Hydraulic Analysis

2.9.2.1 Existing Situation

Frank Flood Bridge (Figure 2.4) was constructed around 1813 and comprises a three-span masonry bridge. The arches are approximately 4m wide and 6m high. The three arches have soffit levels of approximately 7.00m AOD, 7.33m AOD, and 7.01m AOD on the northern, middle, and southern arches respectively.

Frank Flood Bridge is a significant restriction to flow along the River Tolka with the effective flow area through the bridge approximately 60m^2. During flood conditions, flows are backed-up by the bridge as the hydraulic capacity is limited by the three bridge arches.

Existing flood defences are located on the north and south bank of the River Tolka up stream of Frank Flood Bridge. The defences have a crest level of 7.77mOD and are stated to provide a 1% AEP standard of flood protection. The defences are designed to allow for backing-up of flows by the bridge during flood conditions.

2.9.2.2 Proposed Works

The proposed works comprise construction of a two-opening bridge located approximately 3m upstream of the existing Frank Flood crossing. The existing Frank Flood Bridge is retained and not modified.

The key hydraulic design features for the new bridge are as follows:

- The proposed soffit level is 7.421m OD, 7.568m OD, and 7.489m OD above the north, centre, and south arches respectively. The design of the bridge soffit has been limited by the requirement for the bridge to

meet existing road/pavement levels on the north/south bank where it meets the R132. The proposed soffit levels still exceed the existing maximum soffit level of Frank Flood Bridge of 7.33mOD

- The effective flow area through the bridge is approximately 120m^2. This compares to an effective flow area through the existing Frank Flood Bridge of approximately 60m^2.

- The floodplain beneath the proposed bridge span on the south bank is to be lowered. This will provide additional floodplain storage and will increase the effective channel section flow area immediately upstream of Frank Flood Bridge by approximately 13m^2.

- The existing flood defence level of 7.77mOD on both banks of the river will be maintained by the new bridge.

The proposed bridge will not impact on flood levels and will have only a marginal impact on the existing hydraulic channel characteristics of the River Tolka. This is because the flow area and soffit levels of the existing Frank Flood Bridge are significantly less and below those proposed for the new bridge respectively. This will mean that in a flood, flows will continue to be backed-up by the existing Frank Flood Bridge when its existing soffit levels are reached before the new bridge could have any hydraulic effect.

Lowering of the floodplain beneath the new bridge on the south bank has the potential to reduce flood levels upstream of the bridge. Any change in flood levels upstream will be relatively minor however, as flood levels will continue to be controlled by the hydraulic capacity and backwater effect of Frank Flood Bridge. The overall increase in floodplain storage provided by the floodplain lowering works is also small in the context of typical flood volumes on the River Tolka.

There will be no change in flood levels downstream of Frank Flood Bridge. This is because flows passing downstream will be continued to be controlled by the existing capacity of Frank Flood Bridge.

There will be no change in the standard of flood protection provided by the existing flood defences. This is because the height of the defences was determined based on the hydraulic capacity of the existing Frank Flood bridge. As noted, flood levels will continue to be determined by the existing capacity of Frank Flood Bridge following completion of the new crossing.

The OPW do not have a current model of the River Tolka. Detailed hydraulic modelling of the proposed bridge is currently ongoing; however, it is not anticipated to give rise any design change as the proposed flow capacity beneath it, significantly exceeds that of the existing bridge.

2.9.3 Scour and debris impact

Localised scour is evident on the northwest abutment of the existing Frank Flood Bridge. This is expected given its location on the outside of a bend where flow velocities are highest. It is unknown however whether this bank is subject to active scour or if the bank form has now stabilised given the time since the original bridge was built.

The proposed bridge includes a deep, piled foundation to allow for potential scour of the bank. Localised scour protection measures will still be required to prevent washout of the bank whilst new bankside vegetation establishes. It is noted however that given that the proposed bridge has a much larger effective flow area than the existing bridge, the proposed bridge will result in little change in existing in-channel hydraulics.

The proposed bridge's foundations are designed to allow for debris impact. The risk of a blockage of the new bridge is very low as the effective flow area beneath is significantly larger than that provided by the existing arches beneath Frank Flood Bridge downstream. The risk of a blockage of the existing Frank Flood Bridge will remain the same as no works are to be undertaken to the existing bridge that will later its existing hydraulic capacity.

2.9.4 Temporary Works

It is anticipated that a temporary working platform/pontoon will be erected within the river channel to permit construction of the new bridge. The platform will be located immediately upstream of Frank Flood Bridge and has the potential to result in a temporary loss of channel capacity. Temporary works will also be required for provision of access to the Western spandrel wall of the existing bridge, this may also require supports within the river channel. The following measures will be implemented to ensure no increase in flood risk:

- It will be required that any in stream works will be undertaken from 1st July to 30th September when flows would be expected to be at their lowest. This also aligns with ecological restrictions on the works due to Salmon and Kingfisher habitats.

- It will be required that the platform be designed so that it can be removed from the channel at short notice in the event of flood warning. The platform would be in place for a maximum of 12 weeks assuming no requirement for it to taken down, removed and re-erected.

- It will be required that the existing gauging station at Drumcondra (ref 9019) will be continually monitored for changes in river level. A rate of rise analysis of the gauging station will be completed at detailed design to determine a trigger level when the existing platform needs to be removed due to the risk of flooding.

2.9.5 OPW Consultation

The OPW were consulted on the proposed design. The OPW did not state any preference for the proposed bridge form and advised that its main requirement was to ensure that the bridge has sufficient conveyance capacity to convey the design flow with 300mm freeboard allowance. The design of the proposed bridge with its soffit levels exceeding that of the existing bridge was noted as the existing bridge will to determine flood levels in this location.

A fully completed Section 50 application will be required for the new crossing subject to acceptance of the scheme's planning application.

2.10 Archaeological Summary

The bridge resides within the Tolka River Conservation Area. The CA encompasses the course of the Tolka River, the Frank Flood Bridge over the Tolka and the adjoining Park to the west which is located on the corner of Botanic Avenue and Drumcondra Road. This is considered to be of regional Significance and high sensitivity to disturbance.

The Frank Flood bridge itself however is a three-span granite and limestone masonry bridge over the Tolka River c.1820 with cast iron and granite balustrades and cast-iron lamp stands, and is considered of local, and medium sensitivity to disturbance. The structure is registered on the National Inventory of Architectural Heritage as a protected structure of regional importance (Reg no: 50120266).

The wrought iron parapet balustrades and iron light fixings shall be retained/reinstated as a result of any of the proposed works.

A Marian statue resides within the adjacent park to the Frank Flood Bridge, that may require protection or potential removal during the works. This statue is of local importance and standard mitigation has been proposed, which specifies a methodology for recording, taking down and reinstating statues which should mitigate negative impacts.

2.11 Environmental Summary

An EIA is currently being prepared for the scheme on behalf of the Employer. The EIA will assess the works to the bridge under a number of topics; archaeology, architectural heritage, ecology, flood risk, noise, air quality and impacts on users. The works will lead to environmental impacts prior to mitigation being put in place, however the works can be constructed and programmed accordingly to reduce the environmental impact of the enabling works, works to the bridge and the construction of the new structure. Please see the EIAR that will support the planning application for this scheme for further details.

Recent ecological surveys have indicated presence of salmonoids and kingfishers. Consequently, impact to the riverbed shall be limited during active periods. Therefore, in stream works for the construction of the proposed footbridge and works to the existing structure shall be limited to the months of July to September to mitigate any potential impacts.

3. Structure & Aesthetics

3.1 General Description of Recommended Structure and Design Working Life

The proposed footbridge structure is a two-span steel bridge with an intermediate support located on the southern bank of the river channel. The pier will be set back from the existing river wall such that it is accessible for maintenance activities. A tie down plate is located to the immediate north of the structure which will provide moment restraint at the north abutment allowing for a more slender deck and improved dynamic behaviour. The tie down will only be required to limit SLS deflections and accelerations and not to be relied upon for the ULS loadcase. The southern span has been sized to avoid impact to the flood plain which extends up the southern bank to top of slope. The plan alignment has been governed by the limited space on the north bank to land the bridge and the need for space between the existing structure and the proposed structure to discourage access between the structures and provided sufficient space for maintenance. The southern part of the proposed structure has been widened as it approaches the park to provide better integration and create a better sense of continuity between the park and the structure.

The length of the main span is approximately 38 m with a south span of approximately 12m. A 4m back span is provided at the north of abutment to accommodate the moment restraint at this location.

The highway alignment over the existing structure is to be shifted to the west in order to accommodate dedicated bus lanes over the bridge. This will result in an increase in the surcharge to the western spandrel wall. This increase in loading should be mitigated where practical to ensure that the proposed changes to the bridge have no detrimental long-term effects. A number of ground improvement / load alleviation options have been considered to this effect and will need to be developed further in detailed design.

3.2 Aesthetic Considerations

The design intent is to provide a well-detailed structure that complements the existing historical bridge and local surroundings.

The form of the bridge has been chosen to maintain views of the existing structure as far as possible. This requirement has been balanced against the other key design constraints (a need for sufficient structural depth to contain the required services and the need to avoid any increased risk of local flooding).

A central beam of varying depth is proposed with a consistent soffit profile to avoid encroachment on the flood zone. The beam tapers in depth as the bridge spans across the river and increases in height over the North abutment and Pier supports to provide sufficient stiffness. The profile of the central beam has been designed to maintain the view of the wrought iron parapets on the existing bridge from the approaches to the west.

The central beam extends beyond the North abutment to a tie-down. This element, required to improve dynamic behaviour of the bridge, has been carefully detailed to be an identifiable feature of the structure.

Placing the spine beam centrally allows for slender parapets, these have been carefully designed to be as transparent as possible to achieve a sense of openness. The parapet detailing would allow pedestrians and cyclists a clear view of the existing bridge to the East and River to the West.

Edge members have been minimised to create a slender appearance with particular attention paid to the more visible western edge member. Top and bottom flanges of the edge members have been angled to break up the elevation of the bridge and create the illusion of a thinner structure. The transverse members of the west side of the structure have been tapered to further increase the sense of slenderness when viewing the structure for the west. The less visible east transverse members will maintain their depth across the full width to provide space for the larger utilities.

Substructure has been designed to minimise its visibility utilising bank seat type abutments with a minimum height. A small leaf pier is provided for the central restraint with a minimal width to accommodate the bearings. Grooves, 800mm wide, have been provided in the faces of the substructure to coincide with the central beam and create a sense of continuity between the different elements. Additionally, characteristics of the edge members have been continued onto the south abutment wingwalls. Screen walls have been provided at the central pier to hide the bearings from the elevations due to them being positioned near eye level for users of Our Lady's Park.

Preliminary considerations of finishes and colours have been undertaken at this stage with visualisations produced showing the envisioned finishes as seen in Appendix A. A two-tone colour scheme has been adopted which will create distinction between the central girder and the edge member preventing it appearing monolithic. The central girder is to be coloured oxide red which reflects the dark red brick colour in some of the buildings in proximity to the bridge. Stainless steel strips are proposed along the length of the bridge to act as demarcation for the two sides and help break up the visual environment. The soffit of the bridge shall be painted black to create a shadow effect improving the appeared slenderness of the edge member. The infill mesh and central rails in the parapet shall be stainless steel.

The bridge deck is proposed to be an anti-slip surface consisting of aggregate bonded together with an epoxy resin. This surface continues to the junction with Millmount Terrace to provide a consistent application of the same material. The cycle way section will be coloured 'Tuscan Terrracotta' resin or similar in order that it appears as a tone that complements the standard cycle ways. The footway section will be coloured in a grey resin in order that it complements the new paved footways in the area. It is proposed that a rounded beach cobble surfacing is installed below the deck on the south side to discourage anti-social behaviour.

Figure 3.1: West elevation of proposed bridge with an oxide red colour scheme

A summary of the proposed finishes can be seen in Table 3.1.

Element	Finish/Material
Parapet top rail and post	Powered coated light grey (RAL 7035)
Parapet mesh infill	Stainless steel fine mesh (2mm wire in diamond pattern)
Parapet middle and bottom rail	Stainless steel
Edge member	Powder coated light grey (RAL 7035)
Transverse Member	Black
Deck Soffit	Black
Central Girder	Slate Grey (RAL 7015) or Oxide Red (RAL 3009)
Pier	Concrete with additional admixture to give Slate grey colour
Abutments	Concrete
Paving under south span	Rounded beach cobble paving
Cycleway	Epoxy resin-based surfacing coloured Tuscan Terracotta
Footway	Epoxy resin-based surfacing coloured Dark Grey

Table 3.1: Summary of proposed finishes

3.3 Proposals for the Recommended Structure

3.3.1 Proposed Category

Category 2

3.3.2 Span Arrangement

The span arrangements are to be two spans of 38m and 12m continuous over a central pier and simply supported at the abutments. A short back-span with a tie down arrangement will be provided 4m north of the north abutment.

3.3.3 Minimum Headroom Provided

A minimum of 1.5m headroom below the deck soffit will be provided at the abutments and pier to facilitate inspection and maintenance activities at all support locations.

3.3.4 Approaches including run-on arrangements

The parapet over the footbridge will continue on the northern approach immediately adjacent to the footway to mitigate any risk due to the level difference between the proposed alignment and Millmount terrace.

Parapets on the Southern Approach will extend to end of wingwalls where adjacent ground will coincide with the level of the proposed alignment.

3.3.5 Foundation Type

Foundations to both abutments and the pier will comprise cast in-place reinforced concrete bored piles, founded within competent glacial till or rockhead. All piles will be vertical (within the tolerances given by the CC-SPW-01600).

A tension pile has been designed for the north of the structure to resist tensile forces. This will be a reinforced concrete pile utilising the shaft resistance of the pile.

Wing walls located immediately behind the south abutment will be monolithic with the abutment and act as cantilevered elements.

3.3.6 Substructure

North abutment consists of a reinforced concrete abutment beam supported by reinforced concrete piled foundations and a steel tie down arrangement 4m to the north supported by reinforced concrete tension piles.

The central pier consists of a reinforced concrete leaf pier supported by reinforced concrete piles.

The south abutment comprises of a conventional reinforced concrete bank seat abutment with perpendicular wing walls immediately behind.

3.3.7 Superstructure

The superstructure comprises of a varying depth central spine steel box girder with a steel deck supported by transverse steel I sections spaced at 2m centres. Smaller built up box sections form the edge members which will also form integrated kickplates for the deck. The main girder depth is greatest at the pier locations at 1800mm and reduces to 550mm at mid span to meet deck level. The structural depth at the mid span is governed by the need to accommodate a large amount of services below the deck limiting the minimum depth to 550mm.

The central box girder is continued to the north forming a backspan above deck level varying from a depth of 950mm and a width of 600mm at the curtain wall of the north abutment to a depth of 400mm and width of 400mm at the location of the tie down.

Deck plates will be fixed to the transverse members via countersunk bolted connections after erection of the main steelwork.

3.3.8 Articulation Arrangement

The bridge deck is continuous over the central pier and simply supported at the abutments and pier. A tie down arrangement is provided to the north of the structure to create a moment restraint at the north abutment.

The structure will be articulated on pot bearings with a sliding plate expansion joint at the south abutments to allow for expansion and contraction of the deck and abutment movement. Fixity in the longitudinal direction will be provided by the fixed bearing at the north abutment. Jack locations for bearing replacement are to be located adjacent to bearing locations at the abutment and beneath the central spine beam at the pier location.

3.3.9 Vehicle Restraint System

Physical measures in the form of lockable bollards are anticipated to be provided at both approaches to the bridge to prevent vehicular access.

The parapet will be composed of painted steel members infilled by stainless steel mesh panels utilising a tensioned cable system to increase transparency. The height of the parapet top rail will be 1.45m to accommodate cyclists with a 400mm gap between the top rail and the top of the infill panel.

The parapet member sizing shall be carried out in accordance with the requirements of DN-STR-03005, including the sizing of the mesh used to form the infill. A kicker plate will be provided at the deck level to prevent debris and litter falling from the edge of the deck. The edge protection will be continuous between the bridge deck and the approaches with a transition detail to accommodate any longitudinal movement at the south abutment.

3.3.10 Drainage

Surface runoff will be directed along the deck via long falls and cross falls which will be collected at regularly spaced gully located along the edge of the deck and at channel drains provided at both abutments. These will discharge into the river below in such a way to avoid staining of the steelwork.

Back of wall drainage will be provided at the abutments and wing walls and drainage will be provided at the bearing shelf to prevent pooling around the bearing plinths.

3.3.11 Durability

All buried concrete will be provided with two coats of epoxy resin waterproof paint in accordance with Section 1 of the CC-SPW-02000.

All exposed concrete surfaces will be coated with a hydrophobic pore liner in accordance with CC-SPW-01700 Specification for Road Works Series 1700.

Stainless steel elements will be provided for parts of the parapets. Care shall be taken in the specification and detailing of these elements to avoid bi-metallic corrosion via contact between dissimilar metals.

3.3.12 Sustainability

The preliminary design of the structure has considered sustainability in the selection of the preferred structure.

Steel as a construction material, provides benefits in terms of sustainability through the recycling of materials at the end of the life of the structure and recycling of waste materials from the girder fabrication process which is also an off-site process.

The use Ground Granulated Blast-furnace Slag (GGBS) as a cement substitute material enhances the durability of the concrete, reduces the lifetime maintenance, and also reduces the carbon emissions when compared to conventional cement. Pouring of concrete for the works will be carried out in the dry and allowed to cure for 48 hours.

The number of joints on the structure has been minimised by providing a continuous bridge deck over the intermediate pier reducing the maintenance requirements of the structure.

The contractor will store, handle, and transport pile arisings in accordance with best practice guidelines - Construction code of practice for the sustainable use of soils on construction sites, (DEFRA) 2009.

3.3.13 Inspection and Maintenance

Access to the north abutment bearing shelf for inspection and maintenance activities shall be provided from the north approach with a lockable accessible section of the parapet to allow access to the planted area between the existing Millmount Terrace wall and the proposed ground beam supporting the parapet. Access to the inspection platform can then be gained via the riverbank supported by the west cheek wall.

Detailed design should include consideration of the need for safe access down the batter slope to the inspection platform. This may include provision of stone-pitched paving or geotextile reinforcement to the batter slope.

Access to the pier and the south abutment shall be via the park. Planting on the south bank should be strategically location to deter access from the general public but allow access to operatives without difficulty. In addition to the planting the installation of textured paving to deter rough sleepers and anti-social behaviour.

Sufficient space shall be provided between the new and existing structures to allow for future maintenance activities. Which would include but not be limited to re-application of the paint system on the footbridge and repointed of the mortar on the existing bridge.

4. Safety

4.1 Traffic Management during construction

The construction of the proposed structure can be undertaken largely from the green areas to the north and south.

Limited road closures would be required during the delivery of bridge sections which are proposed on the west side of the existing bridge. It is proposed that the lift of the main river span be conducted under full closure of the bridge at night or the weekend due to the size of the section increasing the risk of it swinging out over traffic and to help limit distraction to drivers.

A lane closure on the West side of the Existing bridge and approaches will be required during utilities diversions and works to the West parapet. A temporary vehicle restraint system would be required to protect this lane closure.

See the anticipated construction sequencing in Appendix C.

4.2 Safety during construction

The Designer will comply with the General Principles of Prevention (of accidents) as specified in the First Schedule of the Safety, Health and Welfare at Work (General Application) Regulation and liaise with the Project Supervisor for the Design Stage (PSDP) appointed by the Client and the Project Supervisor appointed for the Construction Stage as required by the "*Safety, Health and Welfare at Work (Construction) Regulations, 2013*".

Construction of the bridge will be undertaken using conventional construction techniques. The structure type is a common form of structure for river bridges, health and safety risks associated with this form of construction should be apparent to a competent contractor

The Contractor shall manage construction activities in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2013.

Particular risks to be managed during the detailed design and construction phases are as follows:

- Working at height over the River;
- Heavy lifting operations and piling;
- Working within the watercourse;
- Utilities diversions.

4.3 Safety in use

Cycle friendly parapets will be provided in accordance with the requirements of DN-STR-03005-02.

Inspection of the south abutment and the central pier can be conducted from the south bank with no additional requirements for access. Inspection of the north abutment will require incursion into the river course to access the north bank. Stepped access from the river level to the north abutment shall be provided to improve access.

Access to the girders over the river will need to be provided by suitable equipment in order to facilitate the inspection regime.

It is proposed that a textured paving solution be deployed under the structure on the south bank to discourage anti-social activities.

Following DN-STR-03005-02, *"a 2m gap shall be maintained between structures where possible. Where this cannot be provided, adequate alternative safety precautions should be taken to minimise the risk of persons falling through the gap"*. A 2m gap is provided except at the North end where space (between the existing bridge and existing flood wall) is limited. It is considered that 1.45m parapets incorporating anti-climb measures are sufficient mitigation against this risk.

4.4 Lighting

It is anticipated that lighting will be provided over the bridge deck in the form of integrated lighting installed in the deck.

As the alignment of the path is offline of the existing highway corridor additional lighting should be provided on the approaches and in the park to provide a greater sense of security for the users. The lighting provided at this location should tie into the overall lighting strategy adopted on this scheme. The existing wrought iron light fixings on the existing bridge shall be retained.

The level of light on the structure should be designed with particular focus on the central beam ensuring that it is well lit on both sides.

5. Cost

5.1 Budget Estimates in Current Year

Refer to the Structures Options Report for preliminary cost estimates used for comparison of options. Early estimates for the capital and whole life cost can be seen in the table below.

Capital Cost	Whole Life Cost (€)
€ 2,300,000[1 2]	€ 2,540,000[1 2]

1 Includes an additional € 50,000 uplift to account for the temporary works requirements
2 No allowance for the utilities diversion works included

6. Design Assessment Criteria

6.1 Actions

6.1.1 Permanent Actions

Material densities and load factors for permanent actions will be taken from IS EN 1991-1-1 and IS EN 1990 respectively as modified by their Irish National Annex.

Horizontal earth pressures acting behind the abutments and wingwall will be considered in accordance with IS EN 1997-1 and as modified by its Irish National Annex.

6.1.2 Snow, Wind and Thermal Actions

Snow load is ignored in accordance with NA to IS EN 1990:2002.

Loading due to wind actions in accordance with IS EN 1991-1-4 as modified by the associated Ireland National Annex.

Loading due to thermal actions in accordance with IS EN 1991-1-5 as modified by the associated Ireland National Annex.

Combination of wind and thermal actions is ignored in accordance with NA to IS EN 1990:2002.

6.1.3 Actions Relating to Normal Traffic

Bollards are proposed on the approaches to the footbridge to prevent any public vehicles accessing the deck. Maintenance vehicles are not currently proposed to be allowed on the deck subject to review with the Technical Approval Authority.

6.1.4 Actions Relating to Abnormal Traffic

Not Applicable.

6.1.5 Footway or Footbridge Live Loading

Normal footway loading on the bridge deck will be load model LM4 in accordance with IS EN 1991-2 as implemented by the associated Ireland National Annex (NA) to IS EN 1991-2.

Vibration serviceability shall be considered in accordance with IS EN 1990 and IS EN 1991-2. The footbridge shall be considered as a Class C bridge for urban routes subject to significant variation in daily usage. For the crowd loading scenario, a crowd density of 0.8 persons/m^2 will be applied between the parapets over the full length of the bridge. The maximum vertical acceleration limit is in accordance with NA 2.49.6 with the following factors:

- k_1, equal to 1.0 (major urban centre).
- k_2 equal to 1.3 (alternative routes readily available)
- k_3, equal to 1.1 (less than 4m height).
- k_4 equal to 1.0 (median value).

For Geotechnical design, live loading partial factors are taken from IS EN1990:2002 Table NA4.

6.1.6 Provision for Exceptional Abnormal Loads

Not applicable.

6.1.7 Accidental Actions

Accidental actions on the superstructure will be determined in accordance with the requirements of IS EN 1991-1-7 and IS EN 1991-2, as amended by the respective Irish National Annexes.

Accidental actions due to vehicles on the footways will be in accordance with IS EN 1991-2 Clause 4.7.3 and PD 6688-2 Clause 3.13.2.

Collision load may be reduced by 50% when checking against sliding and bearing capacity for piled foundation in accordance with DN-STR-03013 Clause 2.11

6.1.8 Actions during Constructions

Control of cracking caused by restrained deformation in concrete in accordance with CIRIA C766.

Compaction behind wingwalls in accordance with PD 6694-1.

Actions during construction, excluding accidental actions, will be considered as a transient design situation in accordance with Clause 3.2 of IS EN 1990 and will be determined in accordance with IS EN 1991-1-6 and the associated Irish National Annex.

6.1.9 Any Special Loading not Covered Above

Debris and hydraulic forces acting on the substructure during flood events will be considered in accordance with DMRB CD 356 – Design of highway structures for hydraulic action.

Frictional forces due to restraint at bearings will not be considered in combination with any other deck variable actions. Coefficients of friction between moving surfaces will be determined from manufacturers' specifications for newly fabricated elements plus an allowance of 50% for long term degradation.

6.2 Authorities Consulted and any Special Conditions Required

NIAH

Inland Fisheries Board

OPW

6.3 Proposed Departure from Standards

None

6.4 Proposed Methods of Dealing with Aspects not Covered by Standards

If there is a requirement for consideration of dynamic response from lateral pedestrian loading, actions may be reviewed be in accordance with Setra Technical Guidance "Footbridges: Assessment of vibrational behaviour of footbridges under pedestrian loading"

7. Ground Conditions

7.1 Geotechnical Classification

Geotechnical Category 2

7.2 Ground Model

As the historical GI within the site extents is limited, the development of the Ground model to undertake a feasibility study for pile design has been taken from the BusConnects exploratory holes taken around the existing Frank Flood bridge.

The ground model for the stratum at the pedestrian footbridge is taken from R2-CPRC02 and is as follows:

- 0 to 3.5m MADE GROUND
- 3.5 to 4m Firm Clay
- 4 to 6.5m Very Stiff Clay (Upper Layer)
- 6.5 to 13.05m Very Stiff Clay (Lower layer)
- >13.05m Limestone

Due to the limited amount of exploratory data available the ground model developed from R2-CPRC02 has been assumed to underlie the entire site.

This ground model is compatible with the proposed cast in-place reinforced concrete bored piles and tension piles. For the tension pile for the north of the structure, a suitable pile diameter and length should be selected to ensure the mobilisation of adequate skin friction. Bored piles for the south of the structure may be socketed in bedrock if glacial till does not provide adequate bearing capacity.

7.2.1 Soil and Rock Parameters

The ground conditions for the clay were taken from triaxial testing undertaken at samples of Glacial Till from 5.05m and 8.05m depth. Using the results of the triaxial test the following cu values have been derived:

Table 7.1: Soil Cu parameters from triaxial test

Soil Type	Depth (m)	C_u	γ_{sat}	γ_{dry}
Firm Clay (No Tri-axial test)	3.5-4	30	21	19
Very Stiff Clay (Upper Layer)	4-6.5	230	23	21
Very Stiff Clay (Lower layer)	6.5-13.05	300	23	21

The strength of the rock was determined using Uniaxial Compression Strength (UCS) tests, these tests were taken at samples from depths 16.55m and 19.10m and the following results were obtained:

Table 7.2: Rock parameters from UCS test

Hole ID	Depth Top (m)	Depth Base (m)	UCS (MPa)
R2-CPRC02	16.55	16.80	21.7
R2-CPRC02	19.10	19.85	18.5

The UCS value for rock was taken as the average of these two values and rock has been treated as a singular property of rock. The average UCS value was taken as 20.1 MPa.

8. Drawings and Documents

8.1 List of All Documents Accompanying the Submission

Drawing Reference	Drawing Title	Revision
BCIDB-JAC-STR_ZZ-0002_BR_00-DR-SS-0001	Site Location Plan	M01
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0101	General Arrangement Sheet 1 of 3	M01
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0102	General Arrangement Sheet 2 of 3	M01
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0103	General Arrangement Sheet 3 of 3	M01
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0104	Miscellaneous Details	M01
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0701	Anticipated Construction Sequence and Phasing Sheet 1 of 2	M01
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0702	Anticipated Construction Sequence and Phasing Sheet 2 of 2	M01
BCIDB-JAC-STR_GA-0002_BR_00-SK-CB-0001	Sub Option A Grout Injection	L04
BCIDB-JAC-STR_GA-0002_BR_00-SK-CB-0002	Sub Option B Partial Fill Replacement	L04

Table 8.1: List of accompanying drawings

Document Reference	Document Title	Revision
BCIDB-JAC-STR_ZZ-0002_BR_00-RP-CB-0006	Requirements for Investigation	M01

Table 8.2: List of accompanying documents

Appendix A. **Photographs and Photomontages**

gle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

ect: Bus connects Jacobs

photography: 06-04-2021 12:15
Canon 5D Mark II
24 mm Lens

location: Swords

viewpoint: **View 40** **Proposed**

issued: 28-09-2021

MODE
WORK

gle of View 73^{O} Horizontal (24 mm Lens)

Angle of View 39^{O} Horizontal (50 mm Lens)

ect: Bus connects Jacobs

photography: 06-04-2021 12:34
Canon 5D Mark II
24 mm Lens

location: Swords

viewpoint: **View 41** **Proposed**

issued: 29-10-2021

MODE
WORK

gle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

ect: Bus connects Jacobs

photography: 06-04-2021 12:20
Canon 5D Mark II
24 mm Lens

location: Swords

viewpoint: **View 42** **Proposed**

issued: 28-09-2021

MODE
WORK

gle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

ect: Bus connects Jacobs

photography: 06-04-2021 12:05
Canon 5D Mark II
24 mm Lens

location: Swords

viewpoint: **View 43** **Proposed**

issued: 28-09-2021

MODE
WORK

gle of View 73° Horizontal (24 mm Lens)

Angle of View 39° Horizontal (50 mm Lens)

ect: Bus connects Jacobs

photography: 06-04-2021 12:42
Canon 5D Mark II
24 mm Lens

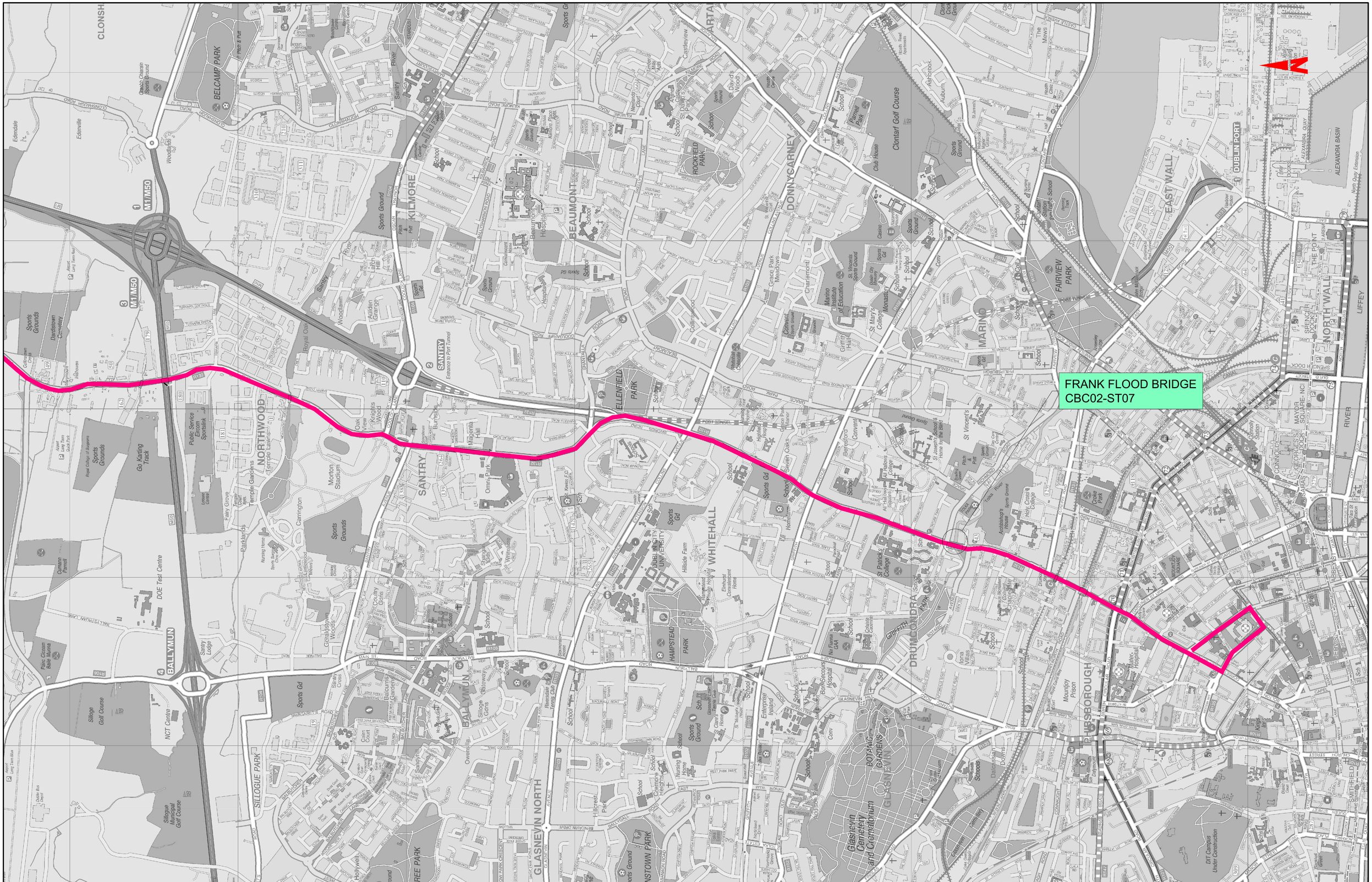
location: Swords

viewpoint: **View 44** **Proposed**

issued: 28-09-2021

MODE
WORK

Appendix B. **Site Location Plan**



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d. Information concerning the position of apparatus shown on this drawing is based on drawings supplied by the utility owners and/or the utility works contractor, whilst every care has been taken in the preparation of this drawing, positions should be taken as approximate and are intended for general guidance only and no representation is made by the NTA as to the accuracy, completeness, sufficiency or otherwise of this drawing and the position of the apparatus.The information contained herein does not purport to be comprehensive or final as the apparatus is subject to being altered and/or superceded. Recipients should not rely on this information. Any liabilities are hereby expressly disclaimed.

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M01	06/04/2023	RG	AR	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair / National Transport Authority

Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
06/04/2023	1:10000 @ A1 1:20000 @ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title:
SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
SITE LOCATION PLAN

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_ZZ-0002_BR_00-DR-SS-0001	01 of 01	A	M01

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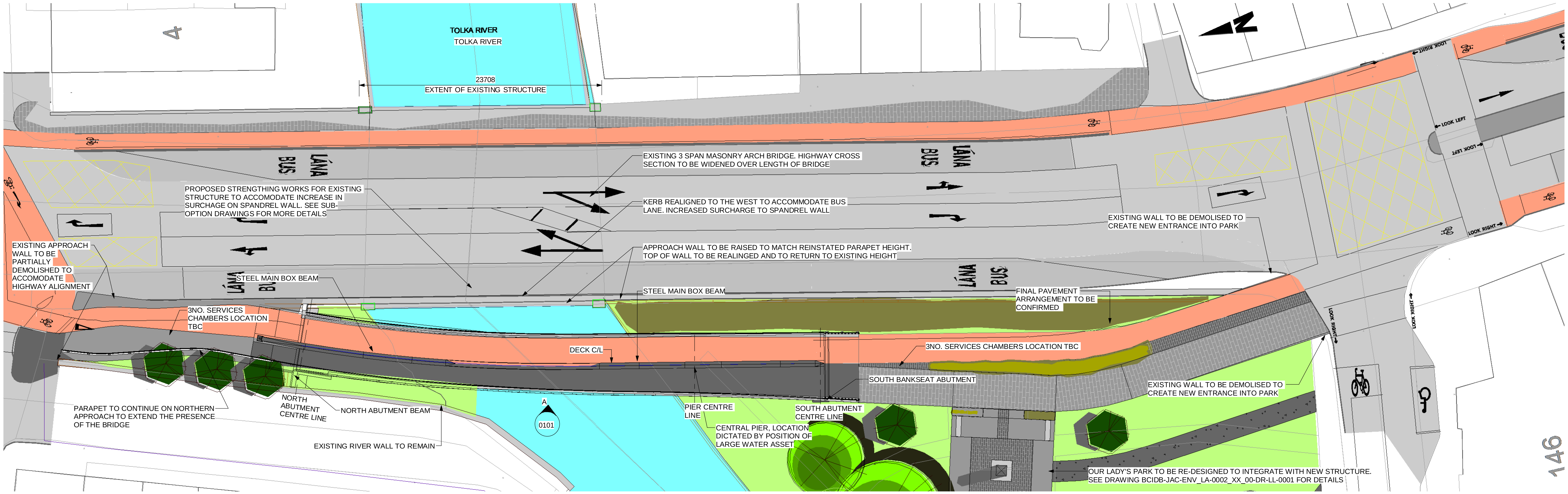
Appendix C. **Preliminary Design Drawings**

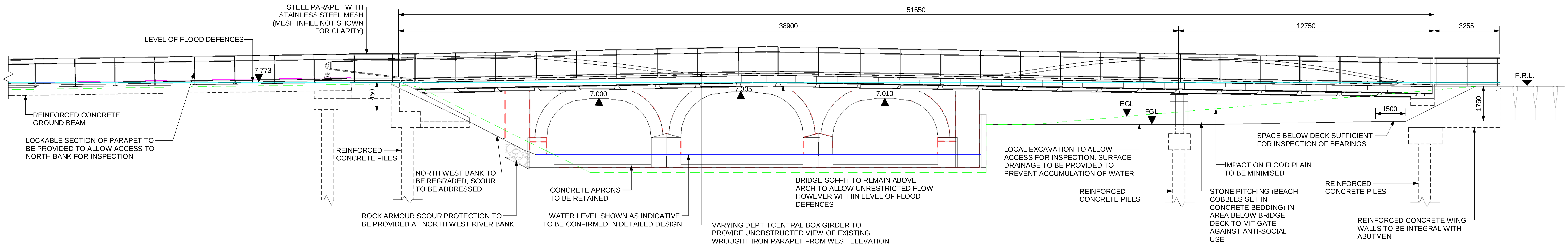
NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All levels and chainages are in metres unless noted otherwise.
3. All details shown on this drawing are indicative only and subject to development.



PLAN

(Scale 1 : 200)



ELEVATION A

(Scale 1 : 100)

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M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: Jacobs

Programme Title: BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing title: SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
GENERAL ARRANGEMENT SHEET 1 OF 3

Date	Scale	Drawn	Checked	Approved
06/04/2023	As indicated @ A1	RG	JM	HO

Project Code	Originator Code	QMS Code	Drawing File Name	Sheet Number	Status	Rev
BCIDB	JAC		BCIDB-JAC-STR_GA-0002_BR_00-DR-CB- 0101	1 of 3	A	M01

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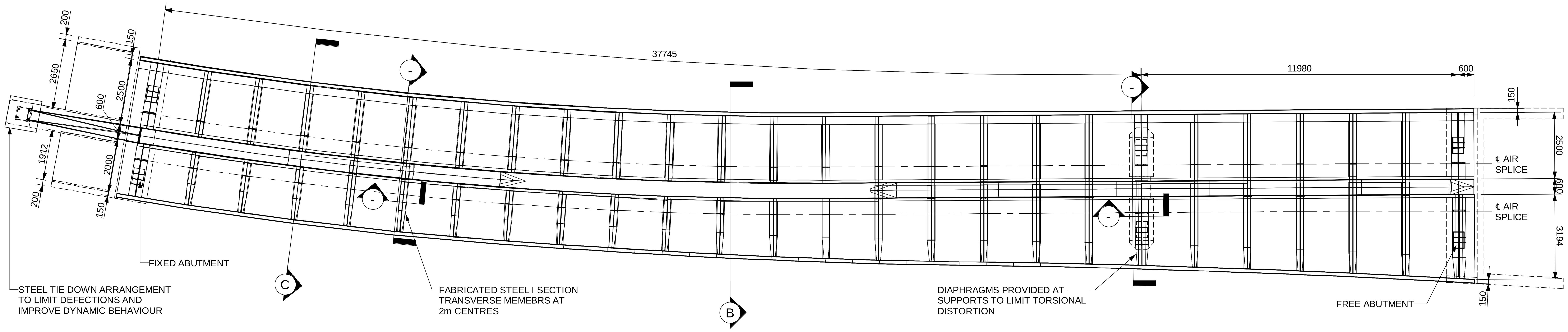
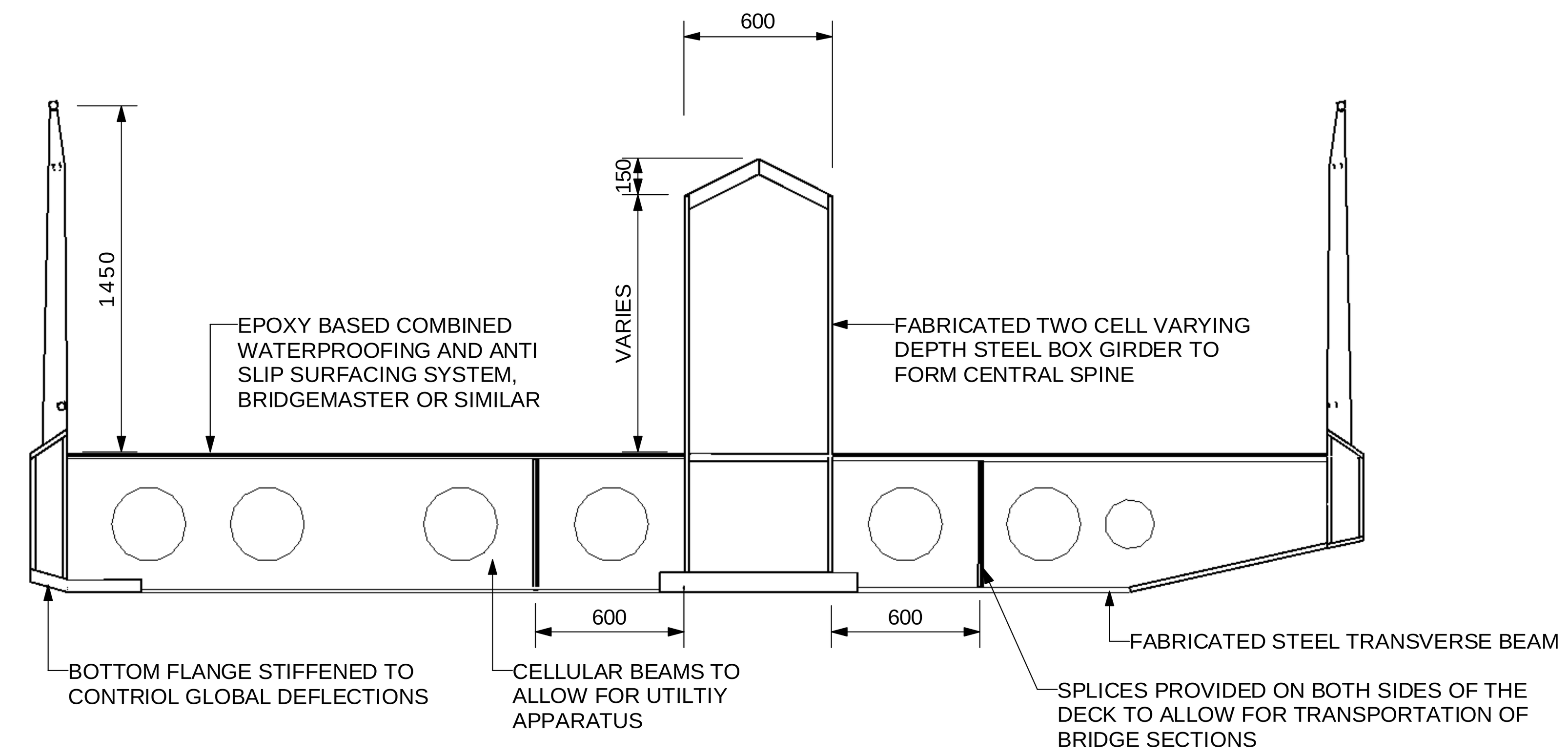
NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All levels and chainages are in metres unless noted otherwise.
3. All details shown on this drawing are indicative only and subject to development.



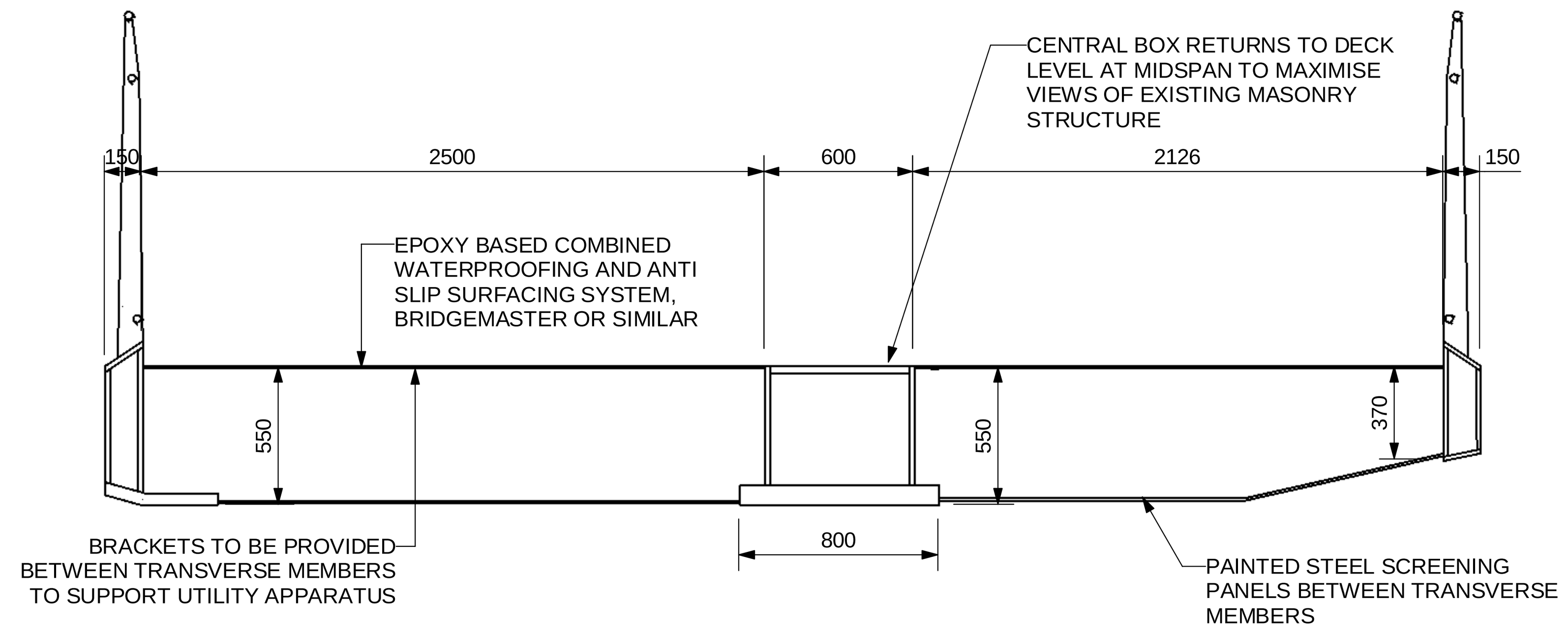
STRUCTURAL PLAN

(Scale 1 : 100)



SECTION C

(Scale 1 : 25)



SECTION B

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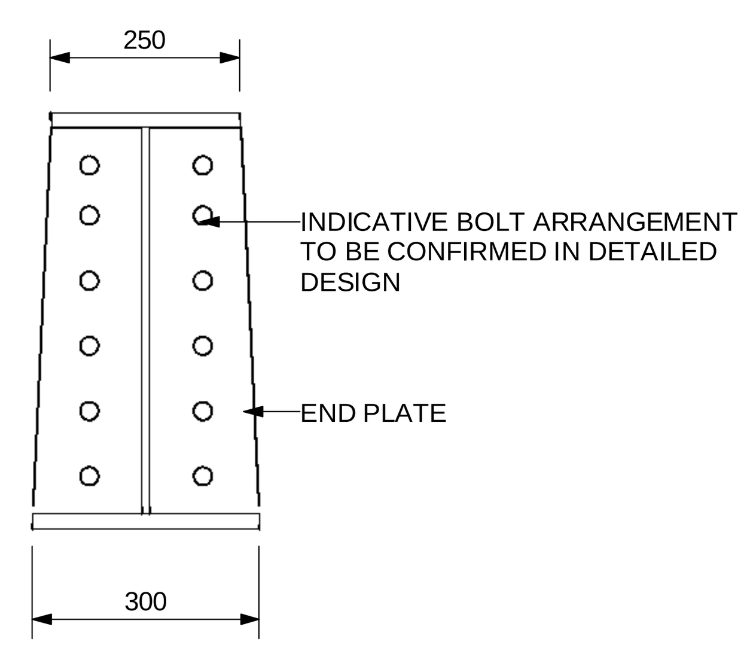
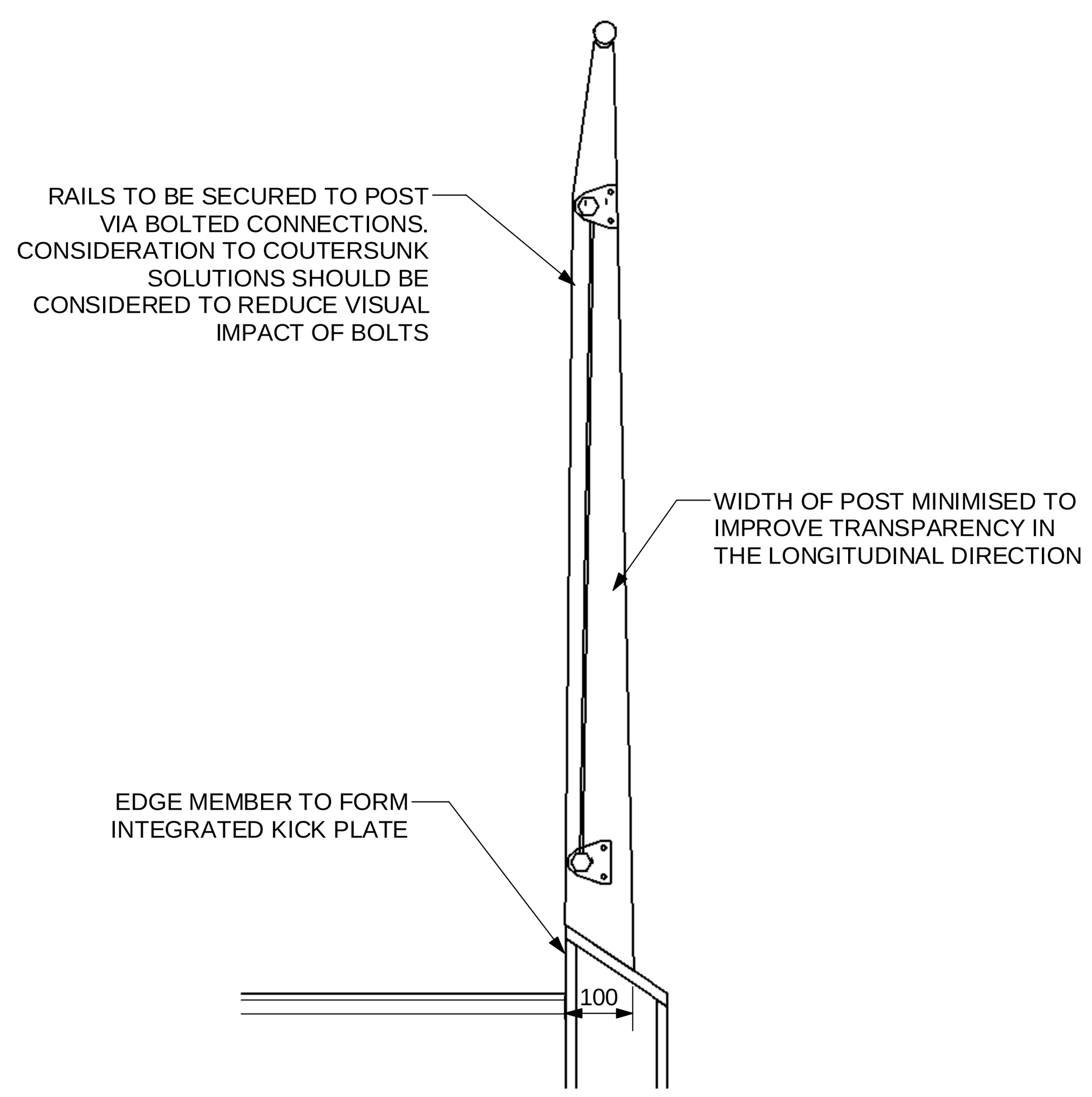


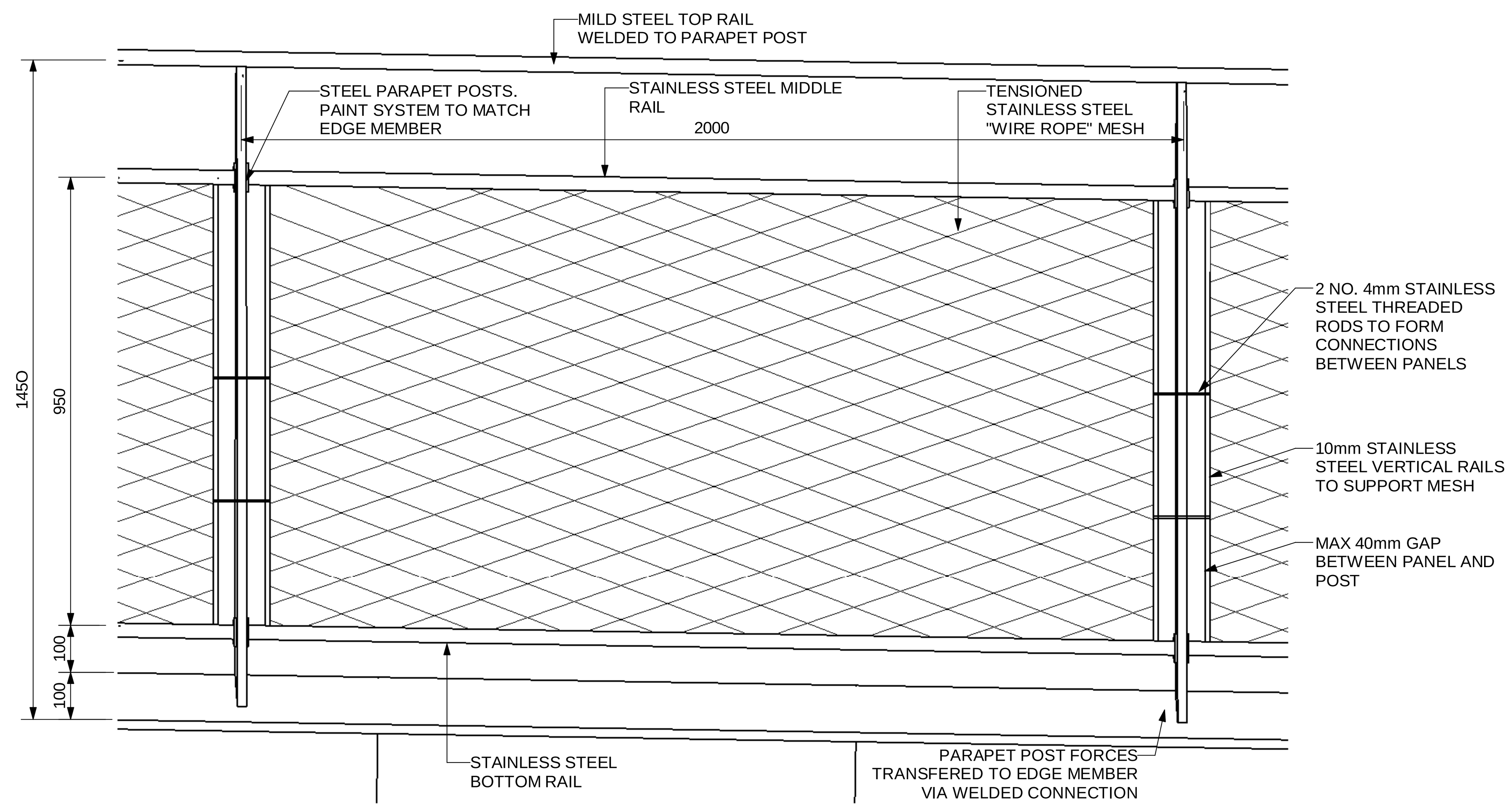
TYPICAL TRANSVERSE MEMBER SPLICE DETAIL

(Scale 1 : 10)



TYPICAL PARAPET POST

(Scale 1 : 10)



PARAPET DETAIL

(Scale 1 : 10)

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M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: Jacobs

Programme Title: **BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS**

Drawing title: SWORDS TO CITY CENTRE SCHEME FRANK FLOOD BRIDGE GENERAL ARRANGEMENT SHEET 2 OF 3

Date	Scale	Drawn	Checked	Approved
06/04/2023	As indicated @ A1	RG	JM	HO

Project Code	Originator Code	QMS Code	Drawing File Name	Sheet Number	Status	Rev
BCIDB	JAC		BCIDB-JAC-STR_GA-0002_BR_00-DR-CB- 0102	2 of 3	A	M01

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NOTES:

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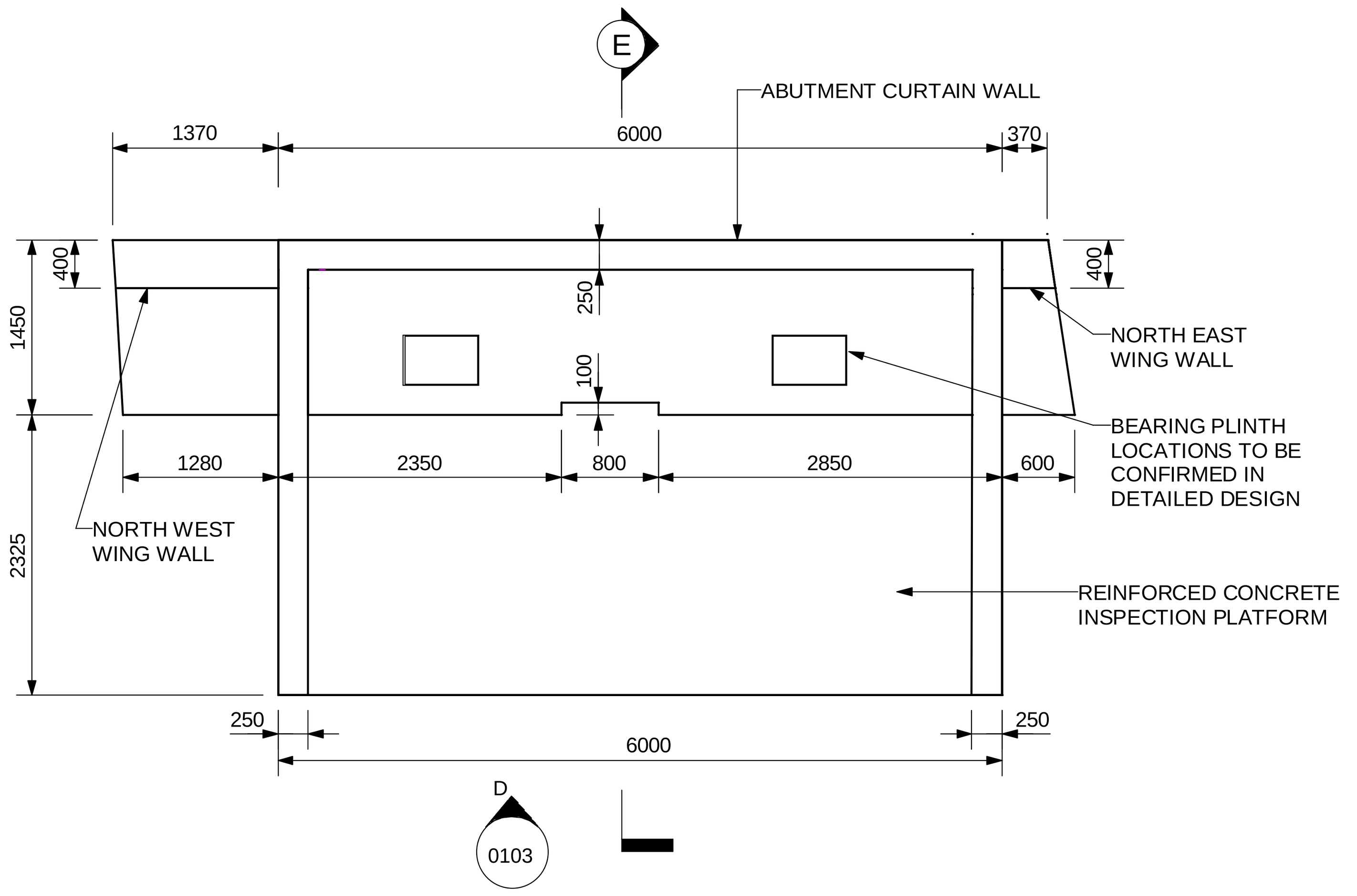

NORTH ABUTMENT PLAN
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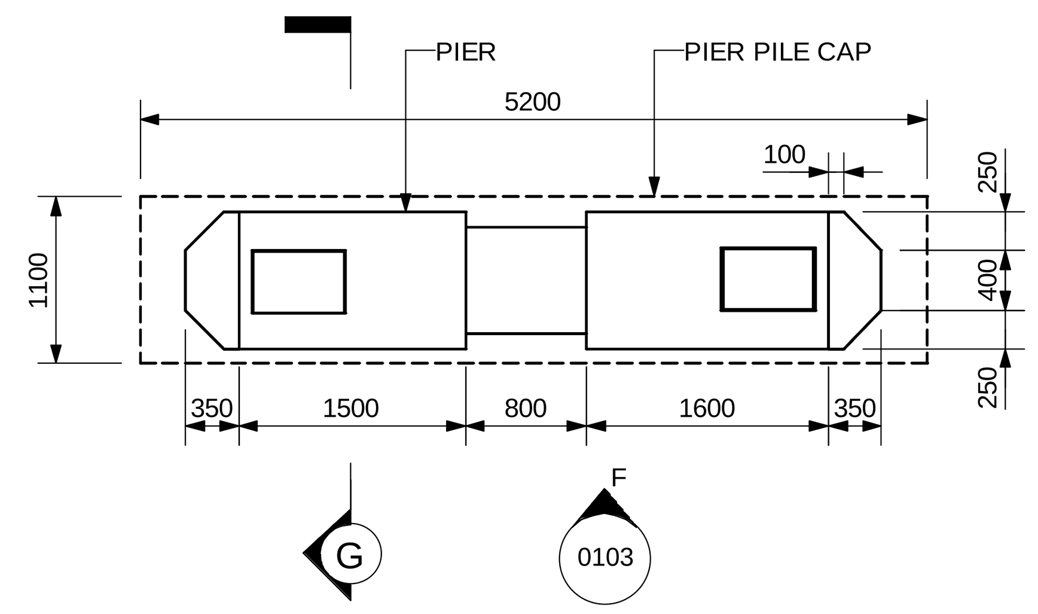
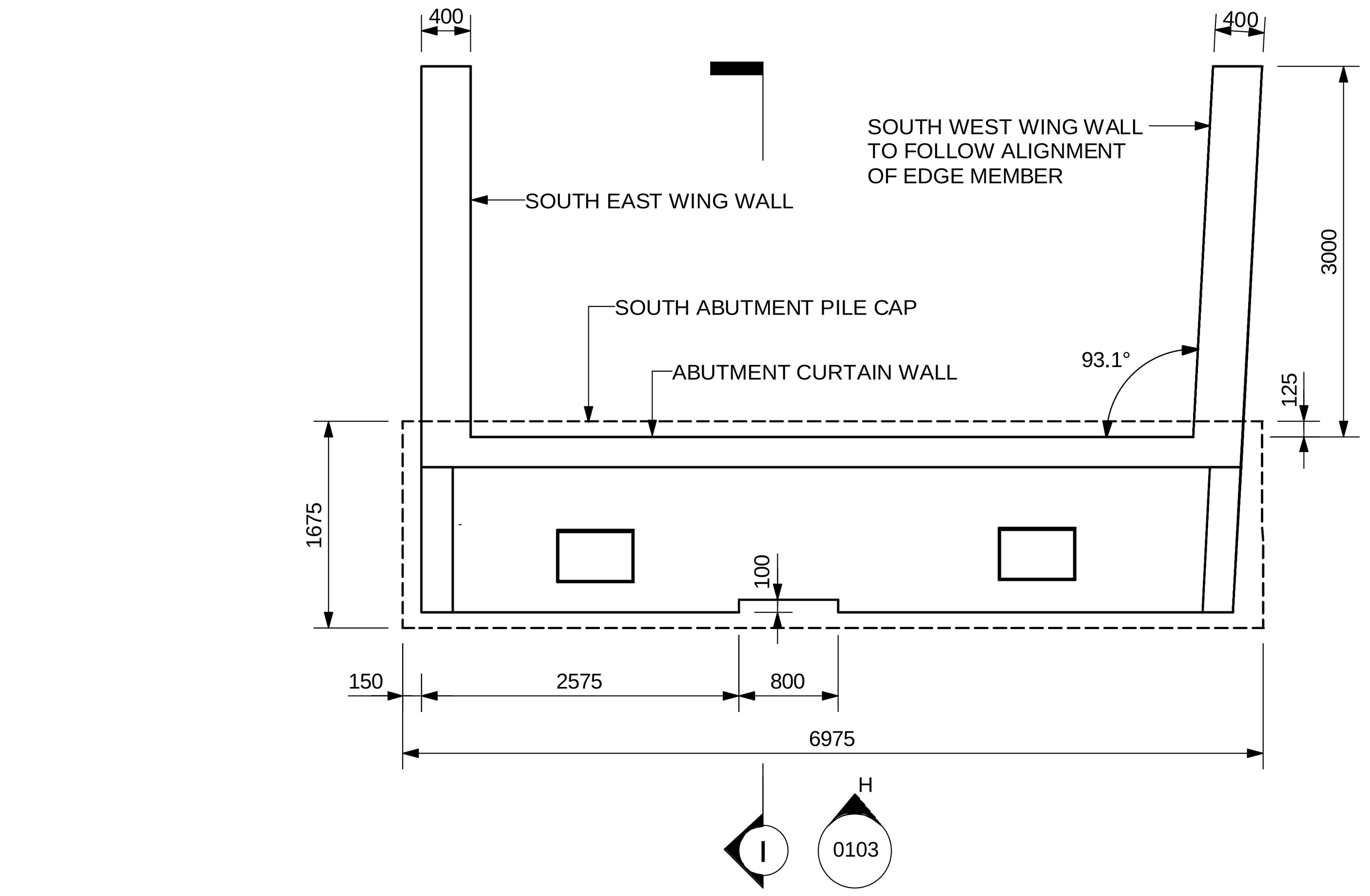
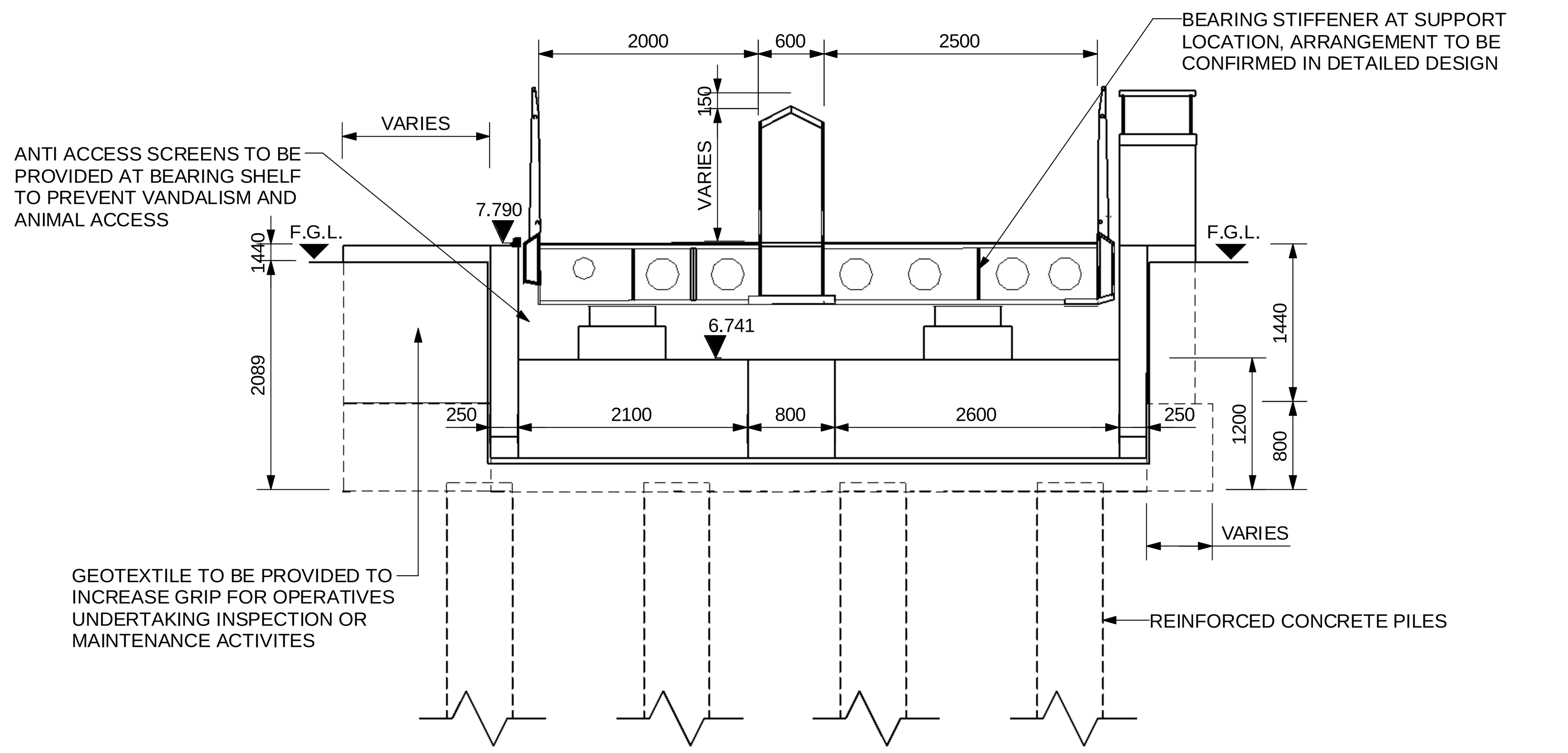


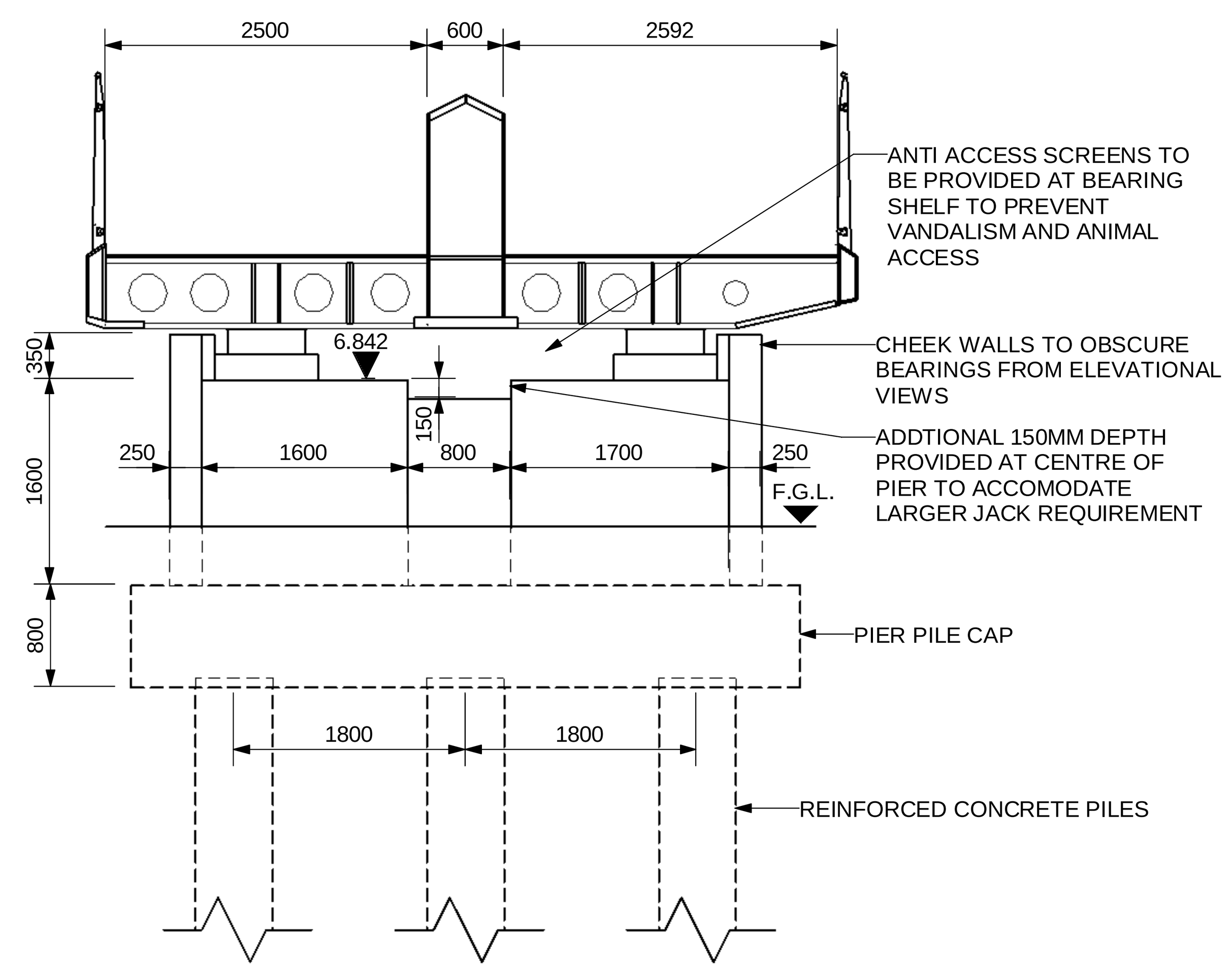
PIER PLAN
(Scale 1 : 50)



SOUTH ABUTMENT PLAN
(Scale 1 : 50)



ELEVATION D
(Scale 1 : 50)



ELEVATION F
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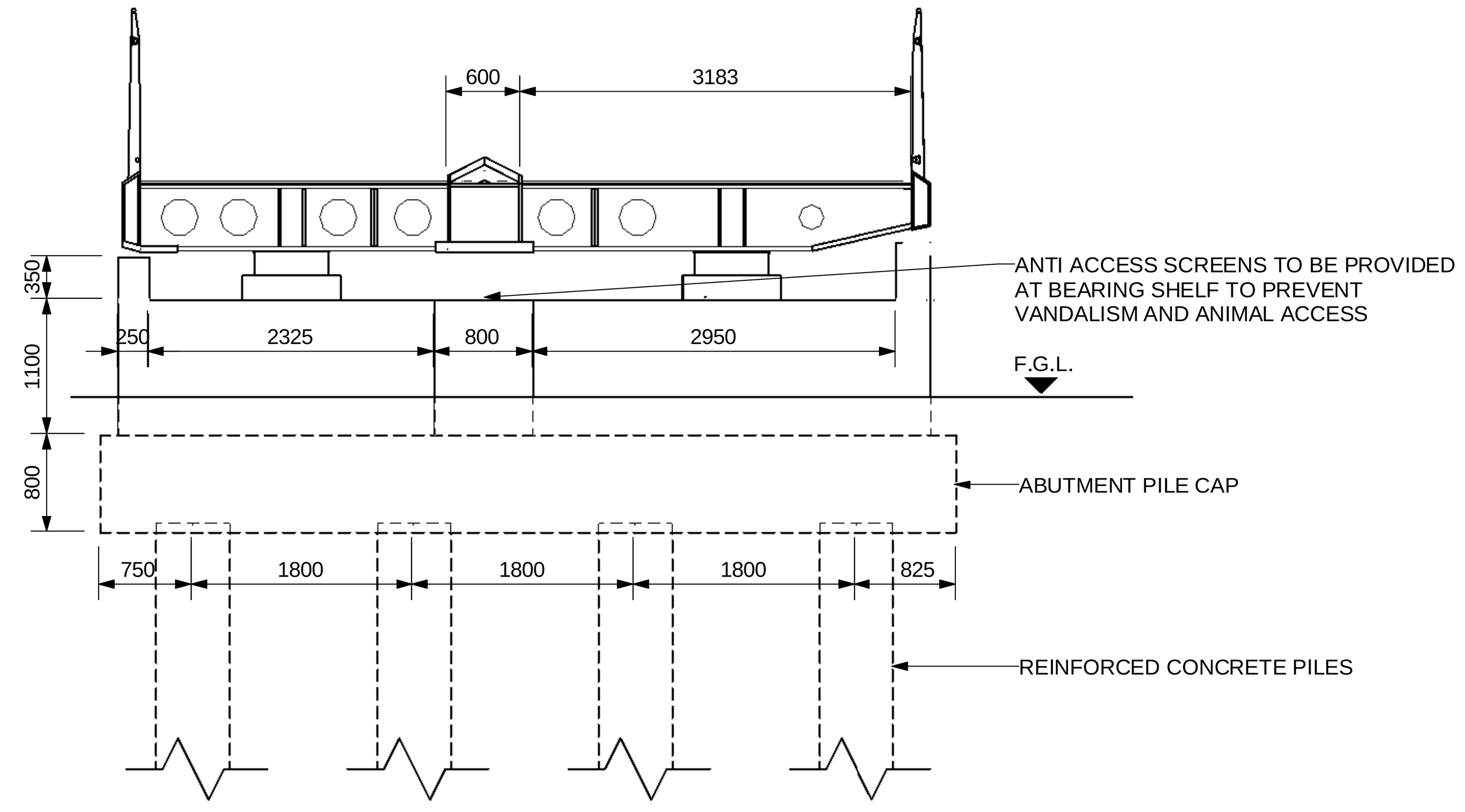
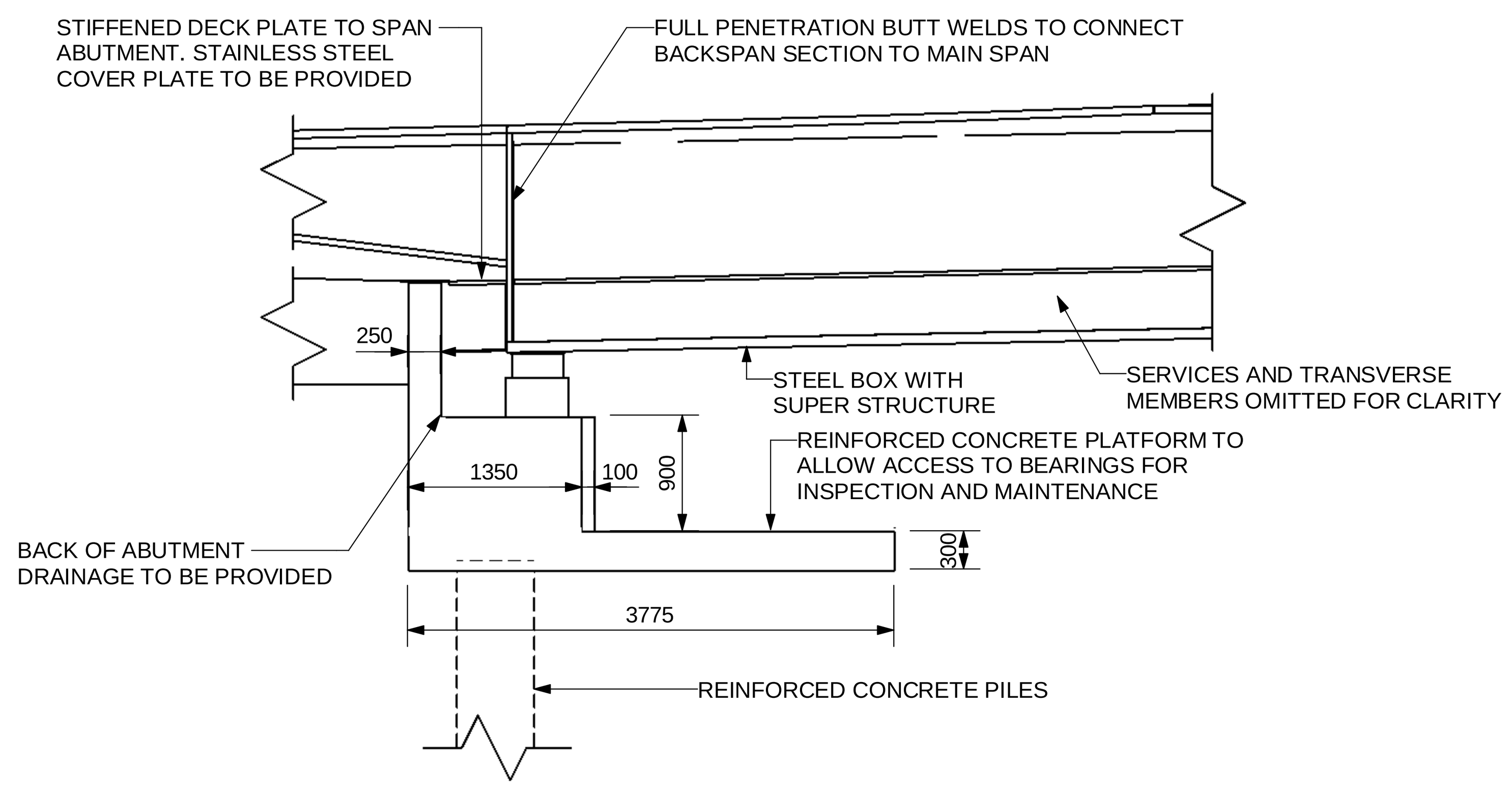


ELEVATION H
(Scale 1 : 50)



SECTION E
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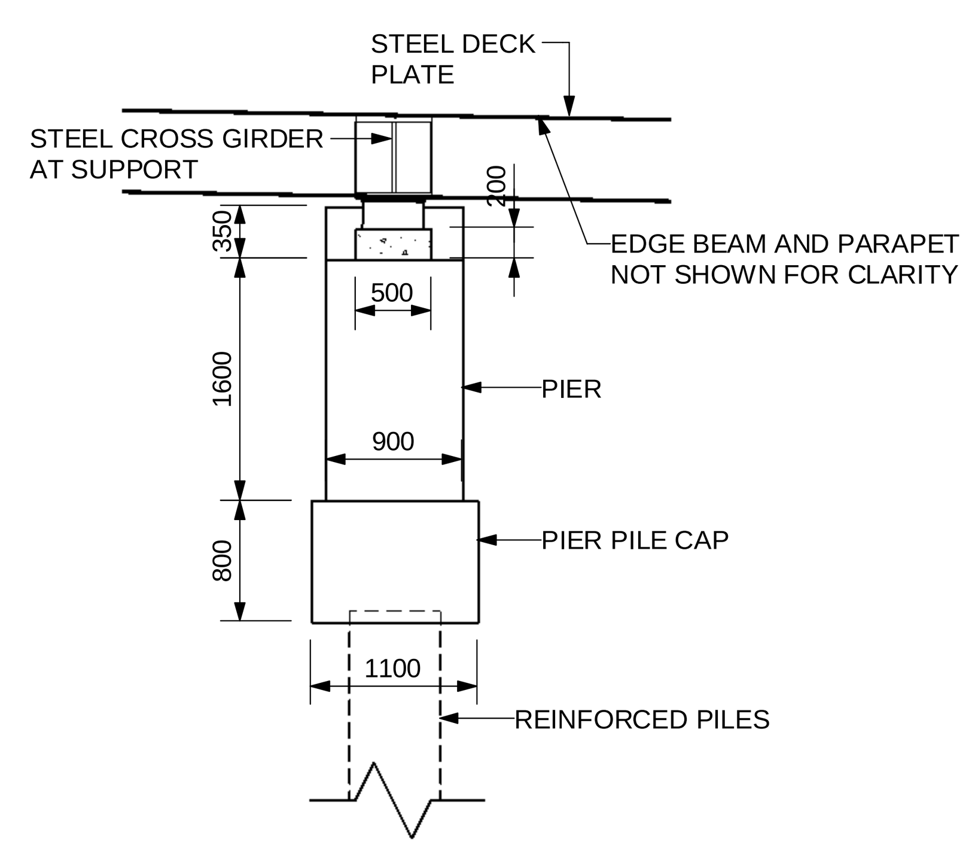

SECTION G
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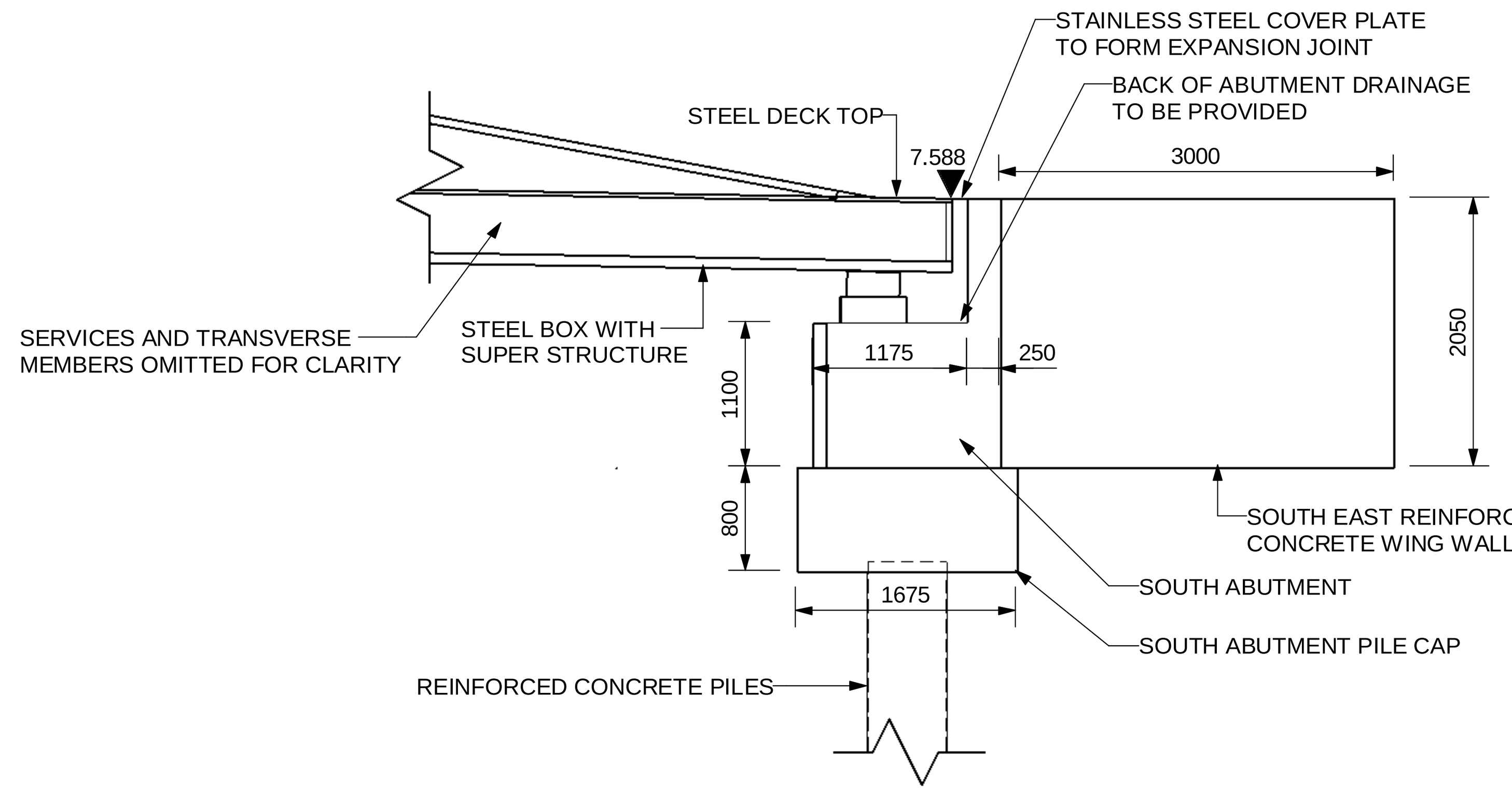

SECTION I
(Scale 1 : 50)

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M01	06/04/2021	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: Jacobs

Programme Title: BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing title: SWORDS TO CITY CENTRE SCHEME FRANK FLOOD BRIDGE GENERAL ARRANGEMENT SHEET 3 OF 3

Date	Scale	Drawn	Checked	Approved
06/04/2023	1 : 50 @ A1	RG	JM	HO

Project Code	Originator Code	QMS Code	Drawing File Name	Sheet Number	Status	Rev
BCIDB	JAC		BCIDB-JAC-STR_GA-0002_BR_00-DR-CB- 0103	3 of 3	A	M01

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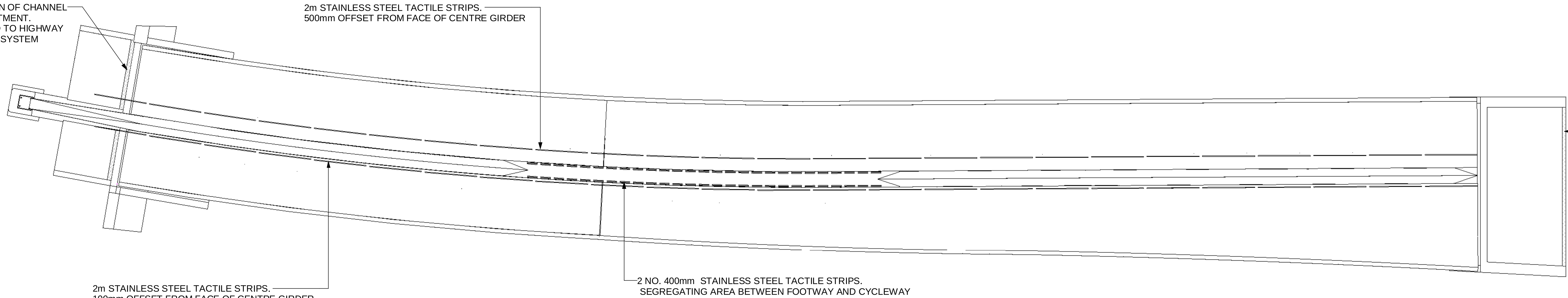
NOTES:

1. All dimensions are in millimetres unless noted otherwise.
2. All levels and chainages are in metres unless noted otherwise.
3. All details shown on this drawing are indicative only and subject to development.
4. Lighting anticipated to be provided by spotlights placed at deck level. Locations to be coordinated with the parapet post set out. Subject to review and confirmation in detailed design.
5. Intermediate drainage to be provided by penetrations in deck with vertical pipes to soffit outlets. Locations to be coordinated with the lighting and parapet post set out. Subject to review and confirmation in detailed design.



DECK PLAN
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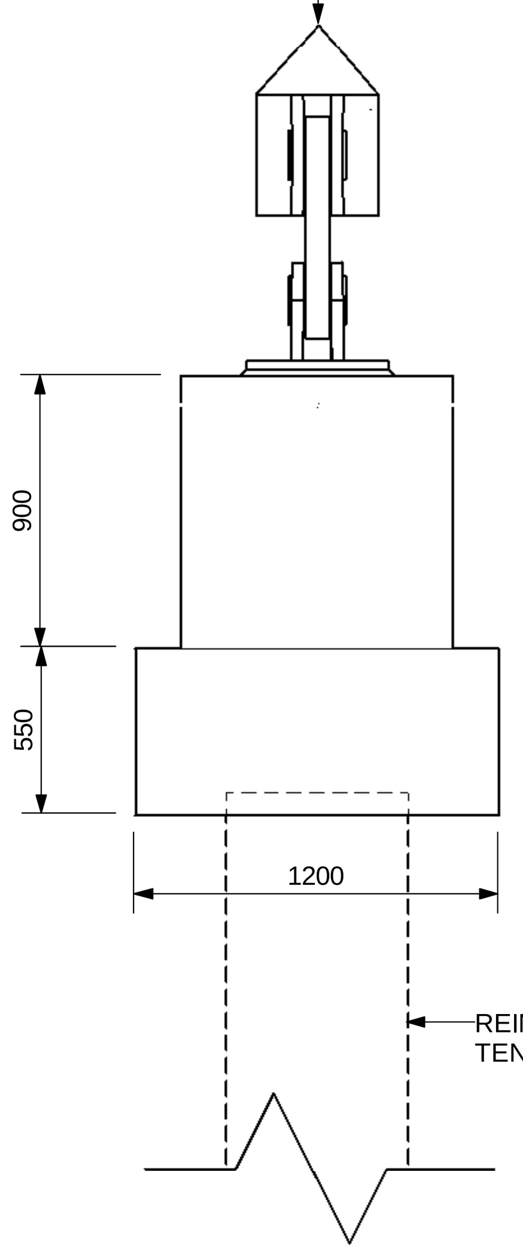

PIN DETAIL
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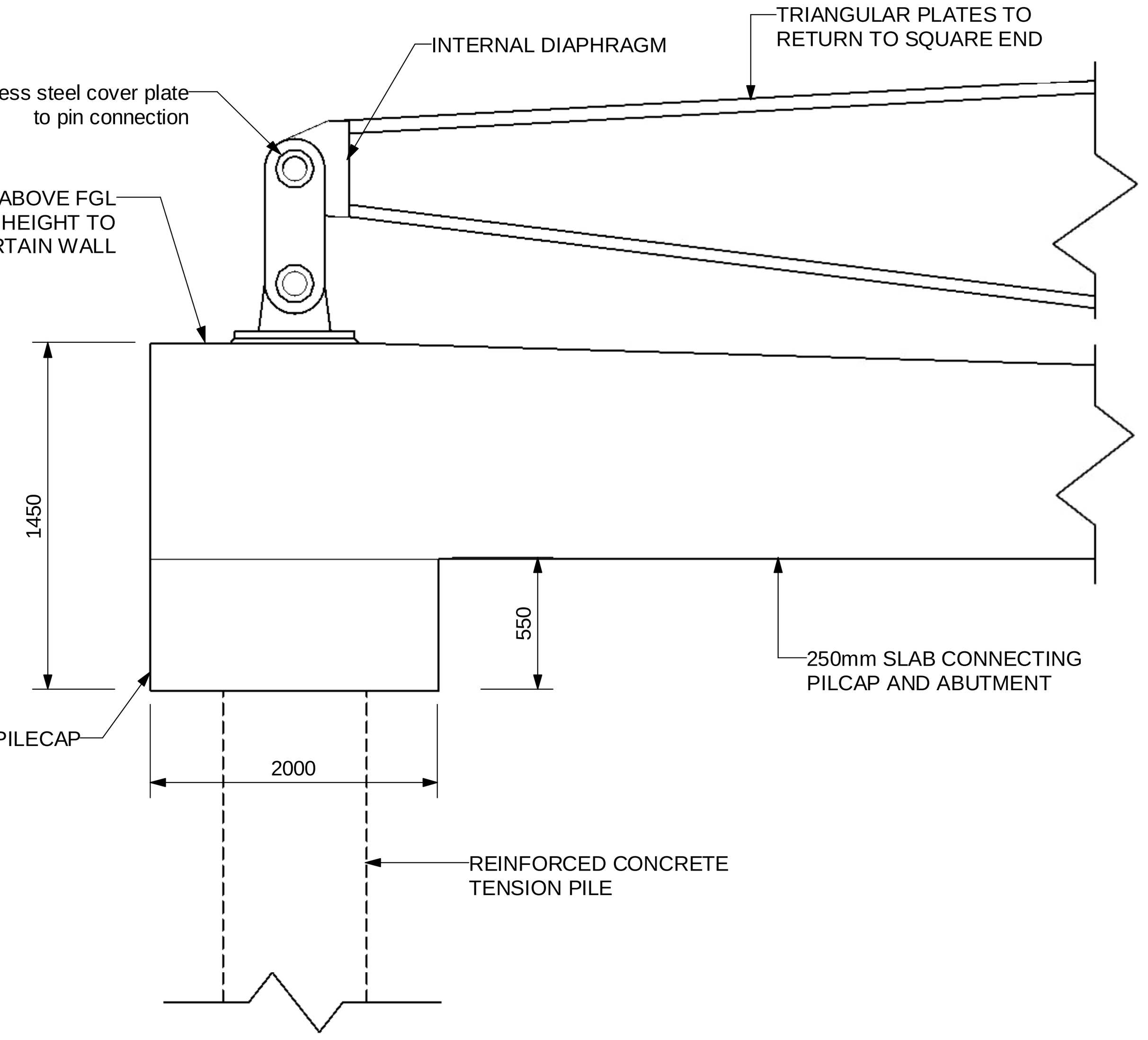

PIN CONNECTION DETAILS
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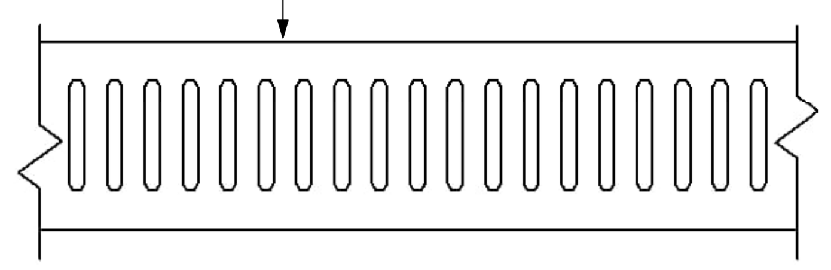

STAINLESS STEEL GRATE UNIT
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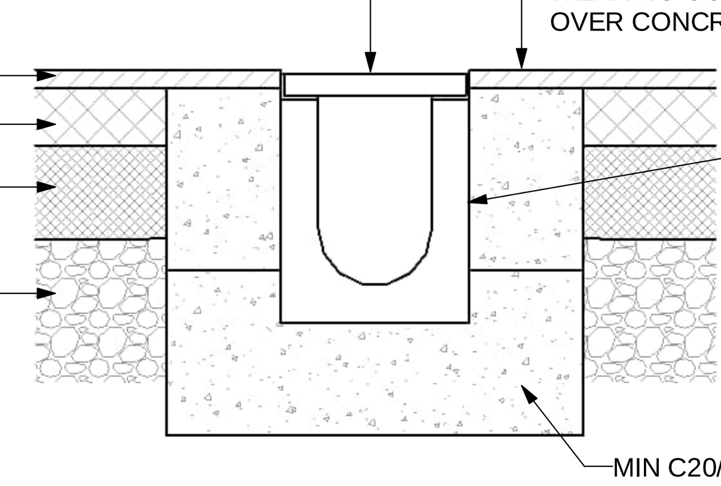
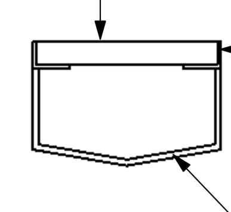


SOUTH ABUTMENT CHANNEL DRAIN DETAIL
(Scale 1 : 10)



NORTH ABUTMENT CHANNEL DRAIN DETAIL
(Scale 1 : 10)

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M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

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Engineering Designer: Jacobs

Programme Title: BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing title: SWORDS TO CITY CENTRE SCHEME FRANK FLOOD BRIDGE MISCELLANEOUS DETAIL

Date	Scale	Drawn	Checked	Approved
06/04/2023	As indicated @ A1	RG	JM	HO

Project Code	Originator Code	QMS Code	Drawing File Name	Sheet Number	Status	Rev
BCIDB	JAC		BCIDB-JAC-STR_GA-0002_BR_00-DR-CB- 0104	1 of 1	A	M01

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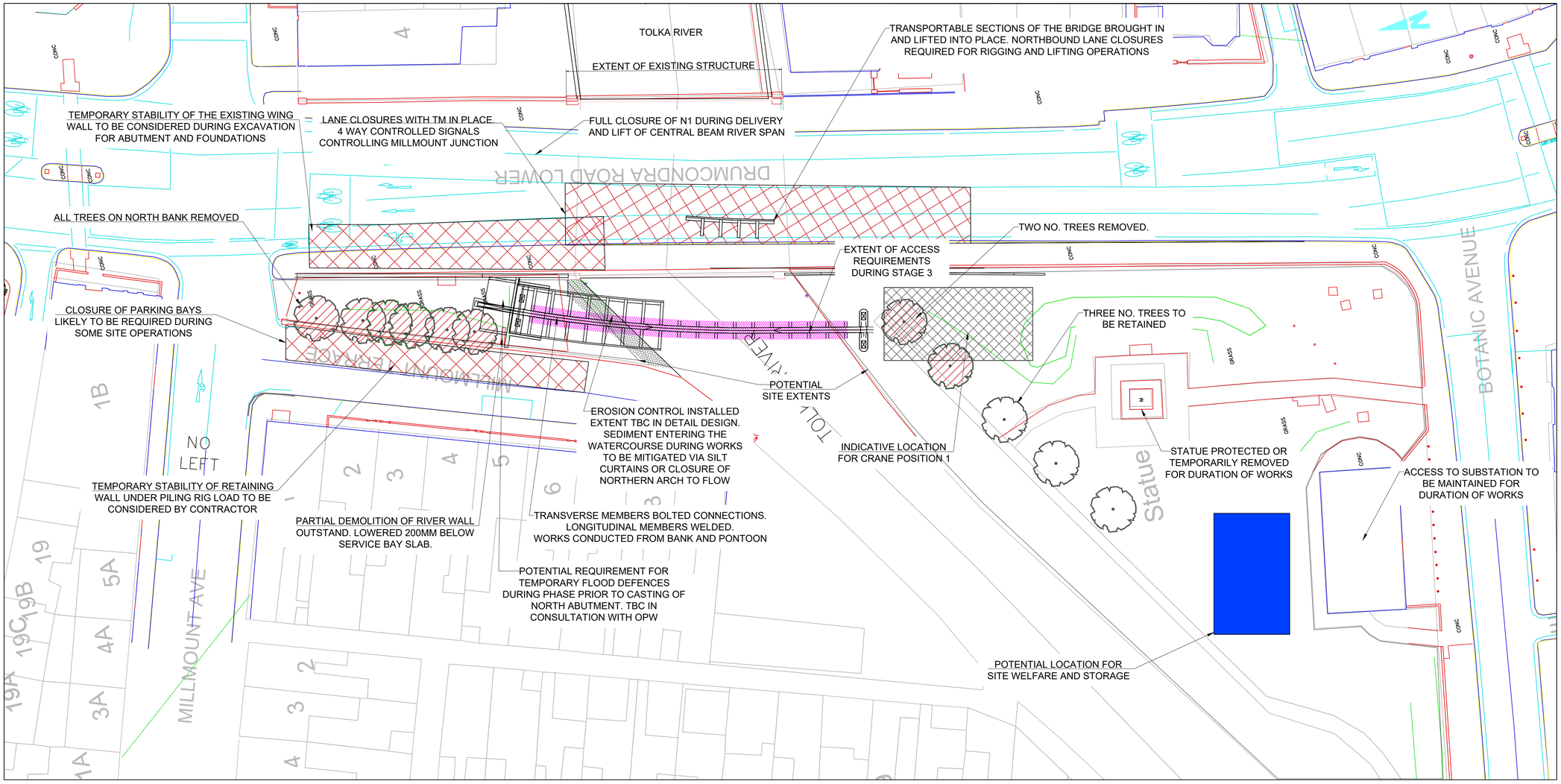


ANTICIPATED CONSTRUCTION STAGES 1-3

SCALE 1:250 @ A1

ANTICIPATED SEQUENCE OF WORKS

STAGE 1 -
DEMOLITION OF EXISTING WALL AT SOUTH END OF OUR LADY'S PARK. SOUTH BANK AND NORTH BANK REGRADED TO FGL TO ALLOW FOR PILING RIG ACCESS AND INSTALLATION OF ROCK ARMOUR. NORTH ABUTMENT AND PIER PILES INSTALLED. NORTH ABUTMENT AND PIER CONSTRUCTED, AND NORTH ABUTMENT BACKFILLED. CRANE MAT PREPARED SOUTH OF PIER LOCATION.

STAGE 2 -
ESTABLISH CRANE AT POSITION 1 SOUTH OF PIER. DELIVER CENTRAL BEAM RIVER SPAN TO EXISTING BRIDGE UNDER FULL CLOSURE. SITE WELDED CONNECTIONS OF PREFABRICATED BEAM LENGTHS MAY BE REQUIRED. LIFT CENTRAL BEAM INTO POSITION AND SECURE WITH TEMPORARY SUPPORTS.

STAGE 3 -
IMPLEMENT ACCESS SOLUTION BELOW RIVER SPAN (DETAILS OF FINAL ARRANGEMENT TO BE CONFIRMED BY THE CONTRACTOR) TRANSPORTABLE SECTIONS OF RIVER SPAN DELIVERED TO EXISTING BRIDGE UNDER NORTHBOUND LANE CLOSURES. SECTIONS LIFTED INTO PLACE WORKING NORTH TO SOUTH. BOLTED SPLICE CONNECTIONS COMPLETED ON TRANSVERSE MEMBERS AND WELDED CONNECTIONS COMPLETE ON LONGITUDINAL MEMBERS. IN-STREAM WORKS PERMITTED FOR THE MONTHS OF JULY TO SEPTEMBER.

STAGE 4 -
RIVER SPAN INSTALLED. CRANE DEMOBILISED AND RIVER ACCESS REMOVED.SOUTH ABUTMENT PILES INSTALLED AND SOUTH ABUTMENT CONSTRUCTED. CRANE ESTABLISHED AT POSITION 2 SOUTH OF SOUTH ABUTMENT. CENTRAL BEAM BACKSPAN LIFTED INTO PLACE AND TEMPORARILY SUPPORTED. TRANSPORTABLE SECTIONS OF BACK SPAN DELIVERED TO EXISTING BRIDGE UNDER NORTHBOUND LANE CLOSURES. SECTIONS LIFTED INTO POSITION AND SPLICED AS PER STAGE 3 FROM THE SOUTH BANK.

STAGE 5 -
CRANE DEMOBILISED AND LANDSCAPE ACTIVITIES COMMENCING IN OUR LADY'S PARK. WEST FOOTWAY AND SINGLE NORTHBOUND TRAFFIC LANE CLOSED ON EXISTING BRIDGE UTILITIES DIVERTED FROM WESTERN FOOTWAY TO NEW STRUCTURE. FULL ENCAPSULATION OF THE WEST PARAPET WITH SCAFFOLD SUPPORTED BY THE EXISTING BRIDGE, NO IMPACT TO THE BRIDGE ELEVATION. WORKS WITHIN THE RIVER RESTRICTED TO THE MONTHS OF JULY TO SEPTEMBER. WORKS TO WEST PARAPET UNDERTAKEN. SURFACING OF FOOTBRIDGE AND APPROACHES.

STAGE 6 -
REALIGNMENT OF WEST KERBLINE AS PER HIGHWAY DESIGN. PREFERRED STRENGTHENING SOLUTION TO BE UNDERTAKEN WITH SEQUENTIAL LANE CLOSURES ACROSS THE STRUCTURE. WORKS TO WEST OF STRUCTURE TO COINCIDE WITH PARAPET WORKS.

0 5 10 15 20
SCALE 1:250 (A1)
SCALE 1:500 (A3)
METRES

NOTES :

1. THE FOLLOWING PROCEDURE IS AN INDICATIVE SEQUENCE FOR THE CONSTRUCTION OF FRANK FLOOD BRIDGE. DETAILS TO BE CONFIRMED IN DETAILED DESIGN.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE REFERRED TO ORDNANCE SURVEY DATUM, MALIN HEAD.
4. THIS DRAWING IS ONLY TO BE USED FOR THE DESIGN ELEMENT IDENTIFIED IN THE TITLE BOX. ALL OTHER INFORMATION SHOWN ON THE DRAWING IS TO BE CONSIDERED INDICATIVE ONLY.
5. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DESIGN DRAWINGS

Project Ireland 2040 Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair National Transport Authority
Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
06/04/2023	AS SHOWN @ A1 AS SHOWN @ A3	RG	JM	HO

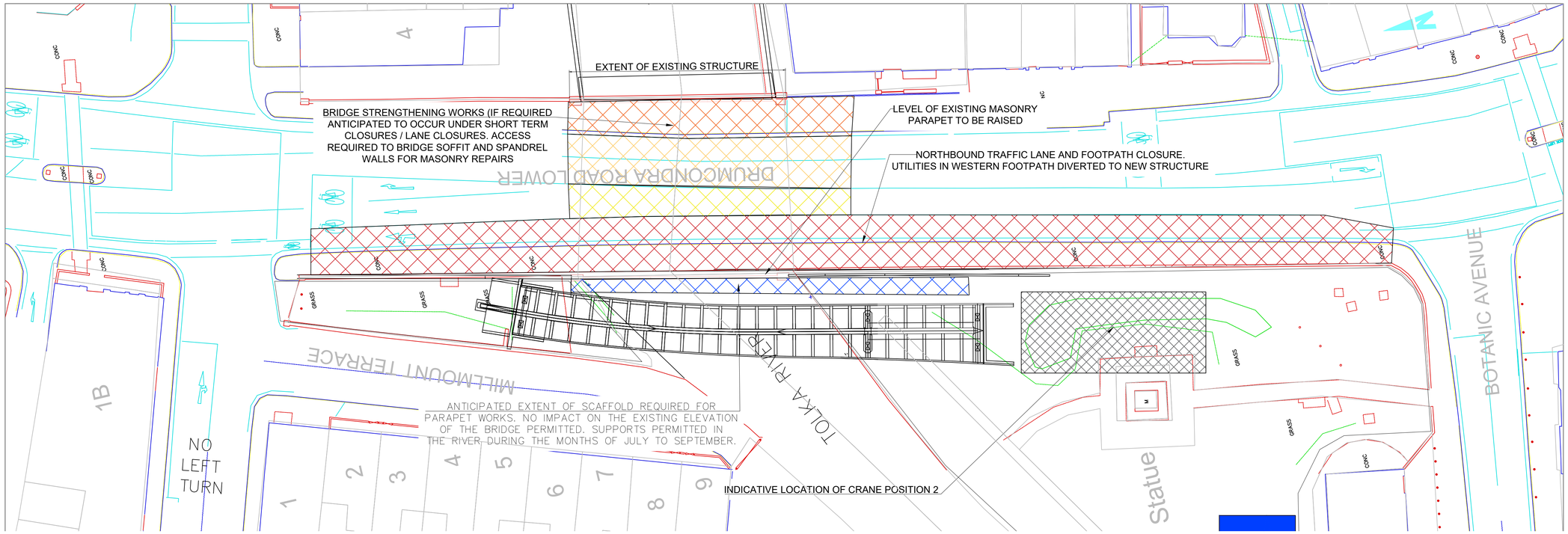
Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
ANTICIPATED CONSTRUCTION SEQUENCE AND PHASING

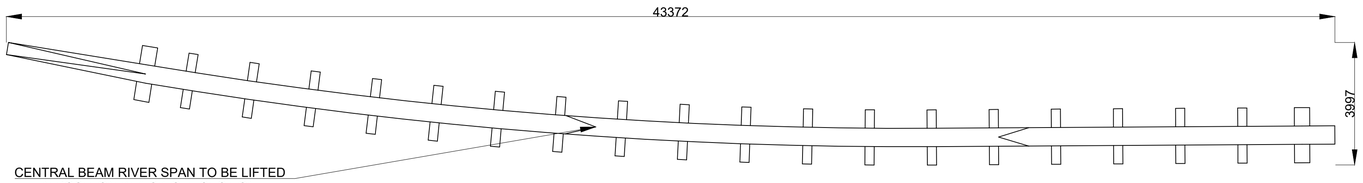
Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0701	1of 2	A	M01

DO NOT SCALE USE FIGURED DIMENSIONS ONLY



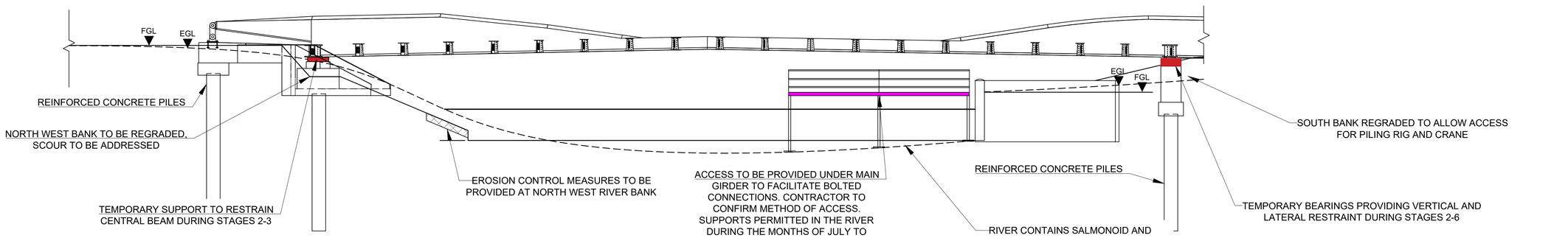
ANTICIPATED CONSTRUCTION STAGES 4-6

SCALE 1:250 @ A1



PLAN OF STAGE 2 BRIDGE LIFT

SCALE 1:100 @ A1



ELEVATION OF BRIDGE DURING STAGE 3

SCALE 1:100 @ A1

0 5 10 15 20
SCALE 1:250 (A1)
SCALE 1:500 (A3)
METRES

0 5 10
SCALE 1:100 (A1)
SCALE 1:200 (A3)
METRES

NOTES :

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5. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DESIGN DRAWINGS

Project Ireland 2040 Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
M01	06/04/2023	RG	JM	HO	ISSUE FOR PHASE 4 PLANNING

Client: NTA Údarás Náisiúnta Iompair National Transport Authority
Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
06/04/2023	1:250 @ A1, 1:500 @ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
ANTICIPATED CONSTRUCTION SEQUENCE AND PHASING

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_BR_00-DR-CB-0702	2 of 2	A	M01

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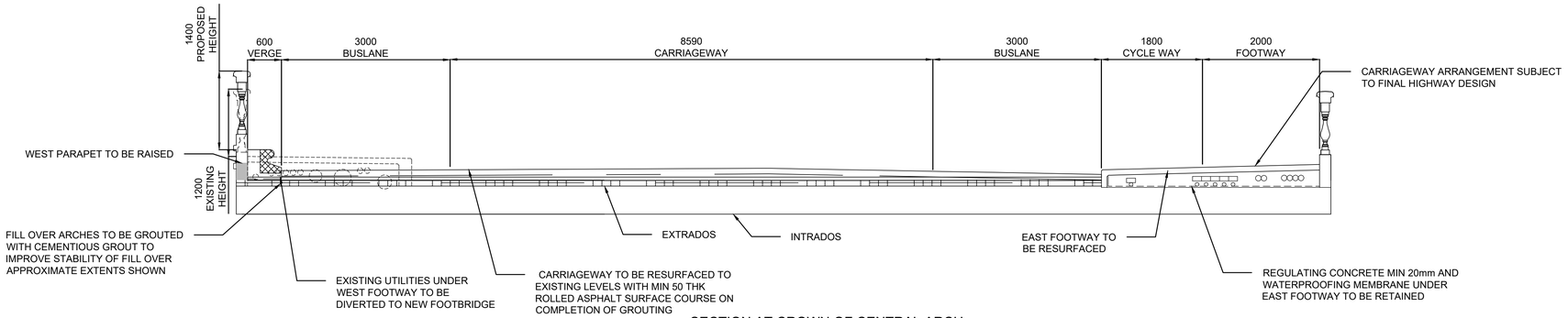
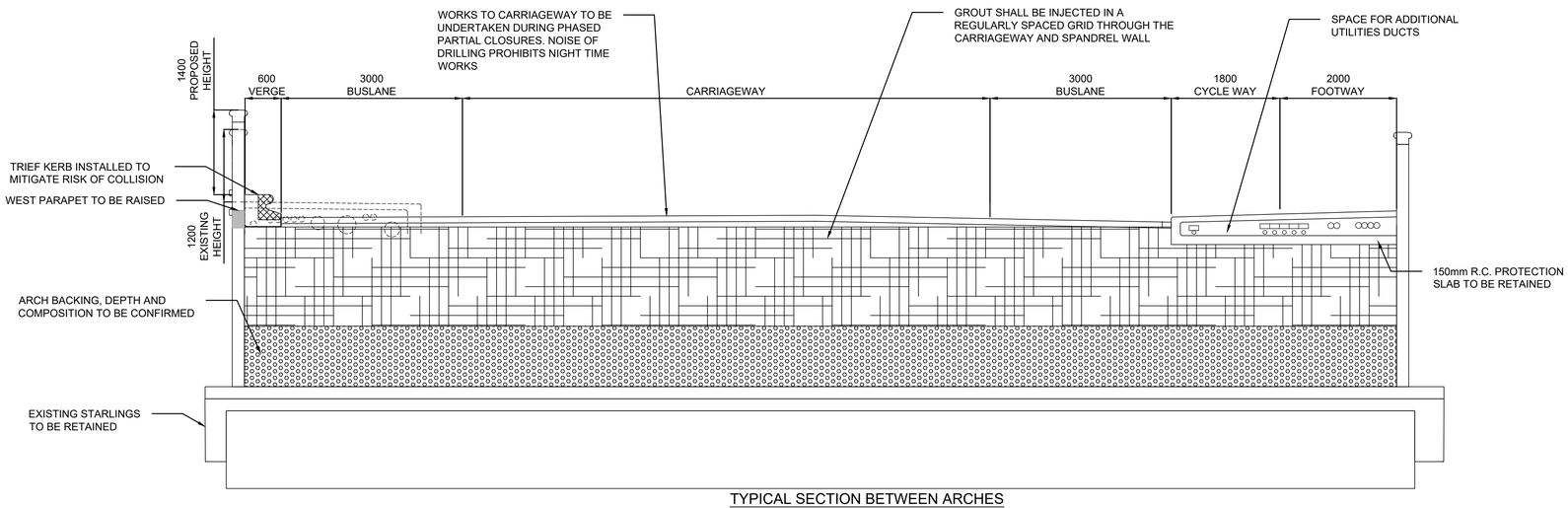


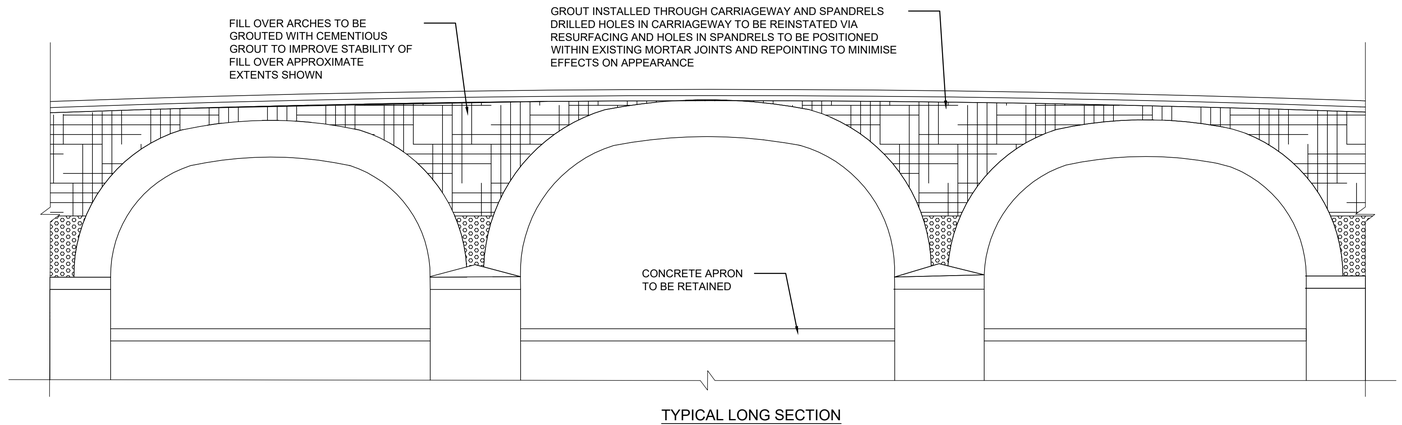
SECTION AT CROWN OF CENTRAL ARCH

(SCALE 1 : 50)



TYPICAL SECTION BETWEEN ARCHES

(SCALE 1 : 50)



TYPICAL LONG SECTION

(SCALE 1 : 50)

Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L01	08/09/2020	RG	JM	HO	SUITABLE FOR INFORMATION
L02	26/02/2021	DS	JM	HO	UPDATE TO PARAPET PROPOSALS
L03	10/12/2021	RG	JM	HO	ISSUE FOR PHASE 3: PRELIMINARY DESIGN
L04	12/12/2022	RG	JM	HO	ISSUE FOR PHASE 3: PRELIMINARY DESIGN

W.I.P.

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: Jacobs

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

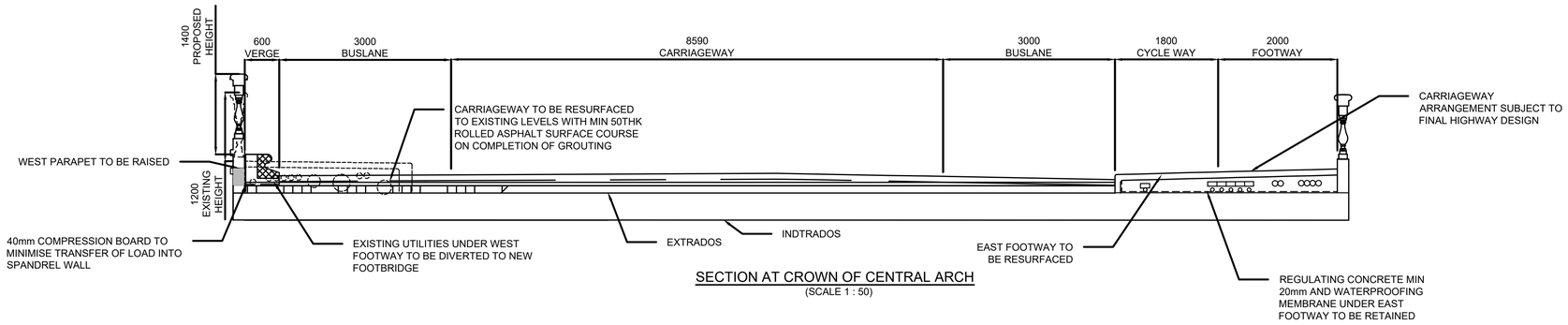
Drawing Title:
SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
SUB OPTION A GROUT INJECTION

Date	Scale	Drawn	Checked	Approved
08/09/2020	1:25@ A1 1:50@ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

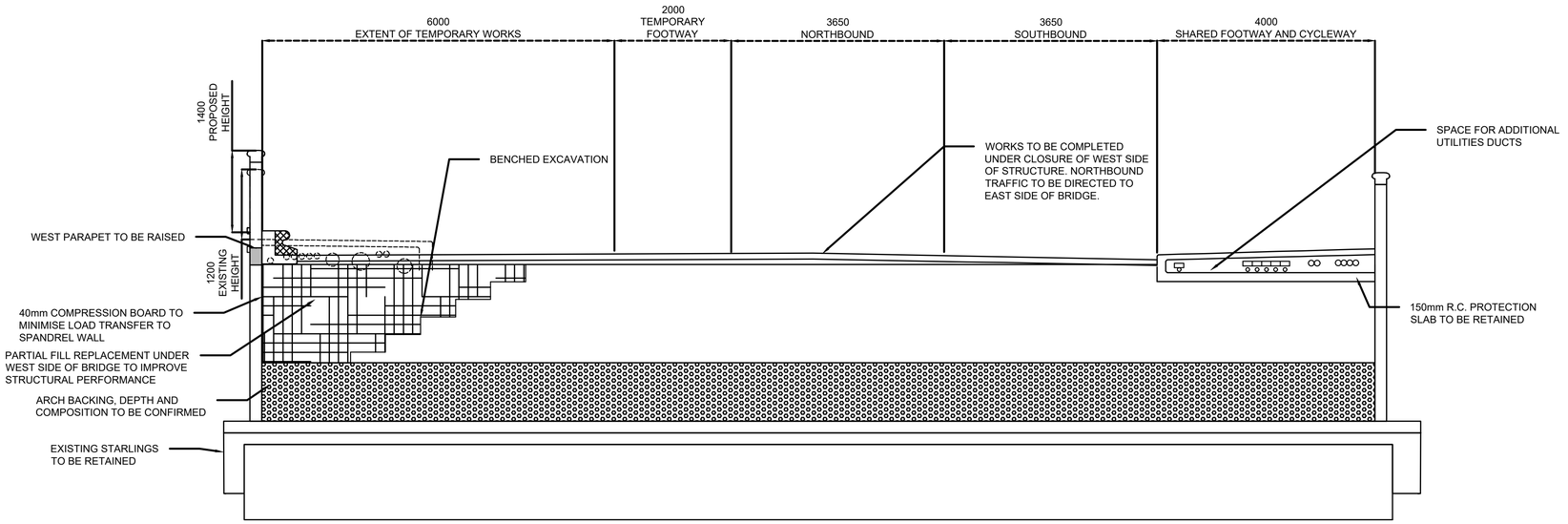
Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_BR_00-SK-CB-0001	01of 01	A	L04

DO NOT SCALE USE FIGURED DIMENSIONS ONLY



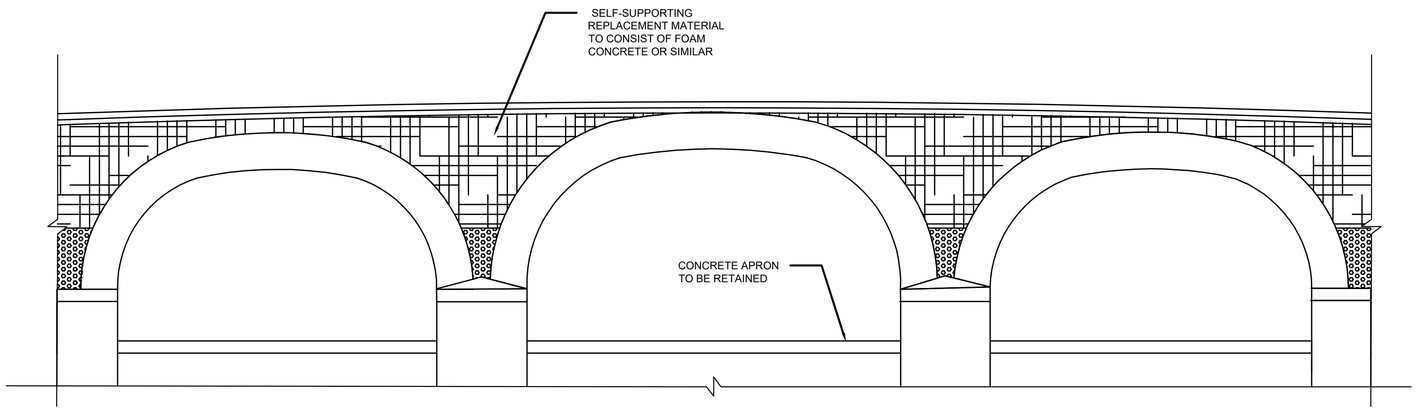
SECTION AT CROWN OF CENTRAL ARCH

(SCALE 1 : 50)



TYPICAL SECTION BETWEEN ARCHES

(SCALE 1 : 50)



TYPICAL LONG SECTION

(SCALE 1 : 50)

Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L01	08/09/2020	RG	JM	HO	SUITABLE FOR INFORMATION
L02	26/02/2021	DS	JM	HO	UPDATE TO PARAPET PROPOSALS
L03	10/12/2021	RG	JM	HO	ISSUE FOR PHASE 3: PRELIMINARY DESIGN
L04	12/12/2022	RG	JM	HO	ISSUE FOR PHASE 3: PRELIMINARY DESIGN

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
08/09/2020	1:25 @ A1 1:50 @ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title:
SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
SUB OPTION B PARTIAL FILL REPLACEMENT

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_BR_00-SK-CB-0002	01of 01	A	L04

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

Appendix D. **Relevant Extracts from Ground Investigation Report**

Extracted from the Factual Report: BusConnects Route 2 Swords to City Centre – Ground Investigations, December 2020

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399A	Bus Connects Route 2 Swords to City Centre	R2-CPRC02
	Client: National Transport Authority (NTA)	
	Client's Rep: Jacobs	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	6.00	
Rotary Drilling	Beretta T44	6.00	6.50	716090.75 E
Rotary Coring	Beretta T44	6.50	20.00	736734.13 N

Final Depth:	20.00 m	Start Date:	26/10/2020	Driller:	BM+GT	Sheet 1 of 3
Elevation:	7.48 mOD	End Date:	28/10/2020	Logger:	GH+NP	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					7.38	0.10		TOPSOIL
0.50	B1							MADE GROUND: Firm brown to brownish black slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
0.50	ES2							
1.00	B4							
1.00	ES							
1.00	ES5							
1.20	D3							
1.20 - 1.65	SPT (S)	N=13 (3,4/3,3,3,4) Hammer SN = 0643	1.00	Dry				
2.00	B6							
2.00	D8							
2.00	ES7							
2.00 - 2.45	SPT (S)	N=14 (5,5/4,3,3,4) Hammer SN = 0643	1.50	Dry				
3.00	B9							
3.00	D11							
3.00	ES							
3.00	ES10							
3.00 - 3.45	SPT (S)	N=9 (2,3/2,2,2,3) Hammer SN = 0643 Strike at 3.30m	3.00	Dry	3.98	3.50		Firm brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
4.00	B12				3.48	4.00		Very stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
4.00	D13							
4.00	ES14							
4.00 - 4.45	SPT (S)	N=30 (10,12/10,8,6,6) Hammer SN = 0643	4.00	Dry				
5.00	B16							
5.00	ES17							
5.00 - 5.45	U19	Ublow=50 100% Strike at 5.00m	4.50	Dry				
5.50	D15							
6.00	B18				1.48	6.00		Very stiff grey sandy gravelly CLAY. (Driller's description)
6.00 - 6.45	SPT (S)	N=47 (6,7/9,9,12,17) Hammer SN = 0643	4.50	Dry				
6.50	C15	100 NI			0.98	6.50		Very stiff greyish brown becoming grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies including sandstone and limestone.
8.00			6.50			(4.00)		
8.00	C15							
8.00 - 8.29	SPT(S) N=50 (14,20/50 for 140mm) Hammer SN = 0209	97						

TCR | SCR | RQD | FI

Water | Backfill

Water Strikes			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.30		20	3.20
5.00			

Casing Details	
To (m)	Diam (mm)
6.50	200

Water Added	
From (m)	To (m)

Chiselling Details		
From (m)	To (m)	Time (hh:mm)

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	17/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399A	Bus Connects Route 2 Swords to City Centre	R2-CPRC02
	Client: National Transport Authority (NTA)	
	Client's Rep: Jacobs	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	6.00
Rotary Drilling	Beretta T44	6.00	6.50
Rotary Coring	Beretta T44	6.50	20.00

Coordinates: 716090.75 E, 736734.13 N

Final Depth:	20.00 m	Start Date:	26/10/2020	Driller:	BM+GT	Sheet 2 of 3
Elevation:	7.48 mOD	End Date:	28/10/2020	Logger:	GH+NP	Scale: 1:50
						FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.50						6.50							
9.50	C15										Very stiff greyish brown becoming grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies including sandstone and limestone.		
9.50 - 9.67	SPT(S) N=50 (42 for 140mm/50 for 30mm) Hammer SN = 209	100											
								-3.02	10.50				
11.00						6.50					Very stiff grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of various lithologies including sandstone and limestone.		
11.00	C												
11.00 - 11.27	SPT(S) N=50 (14,20/50 for 120mm) Hammer SN = 0209	100			NI				(2.00)				
12.50						6.50		-5.02	12.50				
12.50	C15										Very stiff grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of limestone.		
12.50 - 12.85	SPT(S) N=50 (18,20/50 for 200mm) Hammer SN = 0209	100	63	8	NI				(0.55)				
								-5.57	13.05		Medium strong thinly bedded dark grey LIMESTONE with widely spaced beds of weak dark grey MUDSTONE. Partially weathered: slightly reduced strength, closer fracture spacing with dark grey clay deposits. Discontinuities; 1. 5 to 15 degree bedding fractures, closely spaced (15/70/240), planar and slightly undulating, smooth with grey clay deposits on fracture surfaces. 2. At 13.25m to 13.75m, 13.50m to 14.25m and 14.65m to 14.80m: 70 to 90 degree joints, undulating, smooth with grey clay deposits on joint surfaces.		
14.00					14	6.50			(1.85)				
14.00 - 14.20	SPT(S) N=50 (25 for 40mm/50 for 160mm) Hammer SN = 0209	100	100	43									
14.90	C							-7.42	14.90		Medium strong (locally weak) medium bedded dark grey LIMESTONE with widely spaced beds of weak dark grey MUDSTONE. Partially weathered: slightly reduced strength, slightly closer fracture spacing with dark grey clay deposits. Discontinuities: 1. 5 to 15 degree bedding fractures, closely spaced (15/135/775), planar and slightly undulating, smooth with patchy grey clay deposits on fracture surfaces. 2. At 16.20m to 16.40m: 80 to 90 degree joint, undulating, smooth with grey clay deposits on joint surface. *15.55m to 15.90m: 85 to 90 degree incipient joint, undulating.*		
15.40	C												
15.50		100	100	75									
16.55 - 16.80	C				6				(5.10)				
17.00													
17.10	C	100	100	75									
18.20	C												
18.50													
		TCR	SCR	RQD	FI								

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.30		20	3.20
5.00			

Casing Details

To (m)	Diam (mm)
6.50	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	17/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
20-0399A	Bus Connects Route 2 Swords to City Centre	R2-CPRC02
	Client: National Transport Authority (NTA)	
	Client's Rep: Jacobs	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	6.00
Rotary Drilling	Beretta T44	6.00	6.50
Rotary Coring	Beretta T44	6.50	20.00

Coordinates: 716090.75 E, 736734.13 N

Final Depth: 20.00 m | Start Date: 26/10/2020 | Driller: BM+GT

Elevation: 7.48 mOD | End Date: 28/10/2020 | Logger: GH+NP

Sheet 3 of 3 | Scale: 1:50 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
19.10 - 19.85	C	100	100	74							Medium strong (locally weak) medium bedded dark grey LIMESTONE with widely spaced beds of weak dark grey MUDSTONE. Partially weathered: slightly reduced strength, slightly closer fracture spacing with dark grey clay deposits. Discontinuities: 1. 5 to 15 degree bedding fractures, closely spaced (15/135/775), planar and slightly undulating, smooth with patchy grey clay deposits on fracture surfaces. 2. At 16.20m to 16.40m: 80 to 90 degree joint, undulating, smooth with grey clay deposits on joint surface.		
20.00								-12.52	20.00		End of Borehole at 20.00m		

TCR	SCR	RQD	FI

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.30		20	3.20
5.00			

Casing Details

To (m)	Diam (mm)
6.50	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
SK6L	Polymer	Terminated at scheduled depth.	17/12/2020

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
20-0399A	Bus Connects Route 2 Swords to City Centre	R2-SLT01
Coordinates 716110.92 E 736790.80 N	**Client:** National Transport Authority (NTA)	
Method: Slit Trenching	**Client's Representative:** Jacobs	Sheet 1 of 1 Scale: 1:25
Plant: 3T Tracked Excavator	**Elevation** 7.63 mOD / **Date:** 15/10/2020 / **Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			7.52	0.10		TOPSOIL	
0.50 0.50	B3 ES1					MADE GROUND: Firm greyish brown slightly sandy gravelly CLAY with medium cobble and low boulder content, fragments of glass, plastic, concrete and red brick. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles and boulders are angular of mixed lithologies.	
1.00 1.00	B4 ES2						
			5.52	2.10		MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are rounded of mixed lithologies.	
			4.92	2.70		MADE GROUND: Firm mottled brown and black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Grave is subangular fine to coarse of mixed lithologies. Cobbles are angular of mixed lithologies.	
			4.53	3.10		End of trial pit at 3.10m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 3.10
Width: 0.55
Length: 3.75

Remarks:
No groundwater encountered.

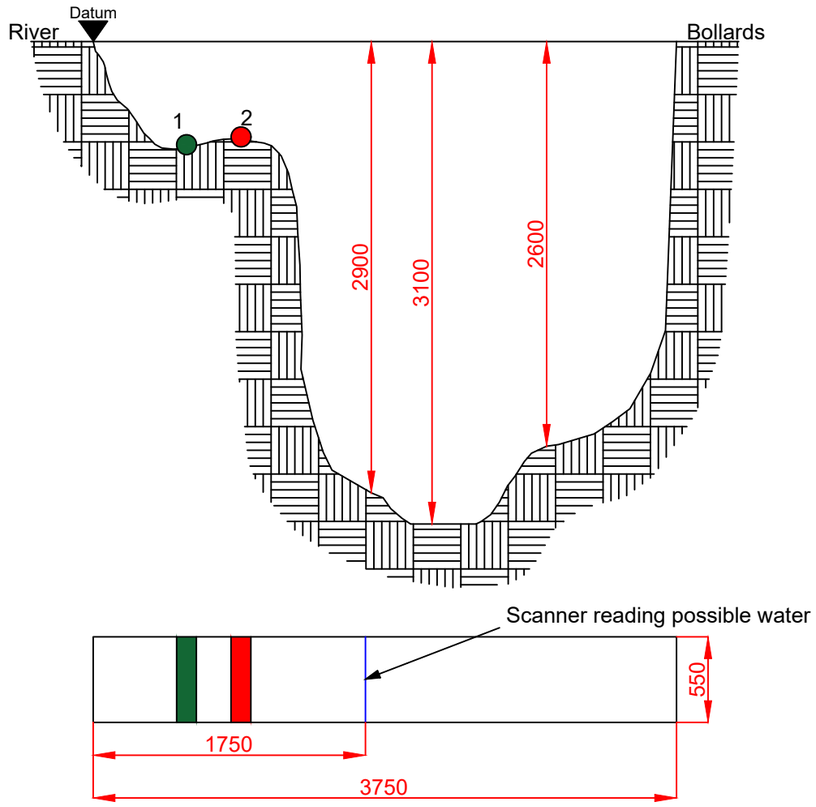
Stability:	Termination Reason:	Last Updated
Stable	Terminated at scheduled depth.	17/12/2020

AGS

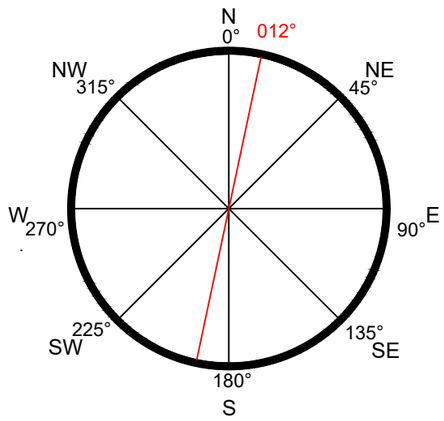
JOB NUMBER: 20-0399A	JOB NAME: Bus Connects	LOCATION: R2 - ST01

CLIENT:	CLIENTS REPRESENTATIVE:	CREW: GH	PLANT & EQUIPMENT 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 012° FROM NORTH

COORDINATES: DATUM WALL

EASTING: - 716111.148

NORTHING: - 7367790.780

ELEVATION: - 7.573

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	Unknown	127	0.60	0.60	127mm Green Duct Unknown
02	Unknown	127	0.50	0.95	127mm Red Duct Unknown
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 3.75

TRENCH DEPTH (m) : 3.10

TRENCH WIDTH (m) : 0.55

STABILITY: Stable

GROUNDWATER: None

SCALE: NTS@A3

DRAWN: BS

CHECKED: CH

DATE EXCAVATED: 15-10-2020

CAUSEWAY GEOTECH

Project No. 20-0399A	**Project Name:** Bus Connects Route 2 Swords to City Centre		**Trial Pit ID** R2-SLT01A
Coordinates 716112.14 E 736806.44 N	**Client:** National Transport Authority (NTA)		
Method: Slit Trenching	**Client's Representative:** Jacobs		Sheet 1 of 1 Scale: 1:25
Plant: 3T Tracked Excavator	**Elevation** 7.16 mOD	**Date:** 15/10/2020	**Logger:** GH	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			6.96	0.20		TOPSOIL	
			6.86	0.30		MADE GROUND: Grey slightly sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse. Cloth layer underneath.	
0.50	B3					MADE GROUND: Firm greyish brown slightly sandy slightly gravelly SILT with medium cobble content, pieces of plastic, red brick and glass. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are angular of mixed lithologies.	
0.50	ES1						
1.00	B4						
1.00	ES2						
			5.66	1.50		End of trial pit at 1.50m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.50
Width: 0.55
Length: 2.70

Remarks: No groundwater encountered.

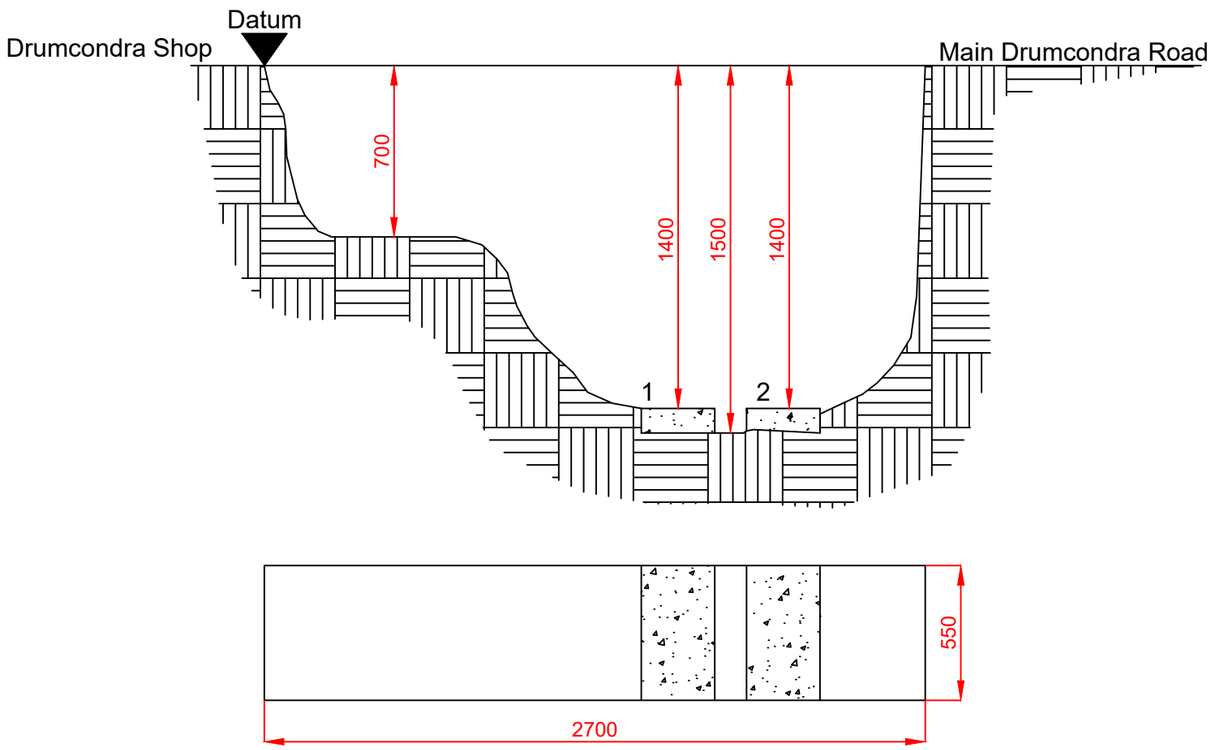
Stability:	Termination Reason:	Last Updated
Stable	ESB services exposed.	17/12/2020

AGS

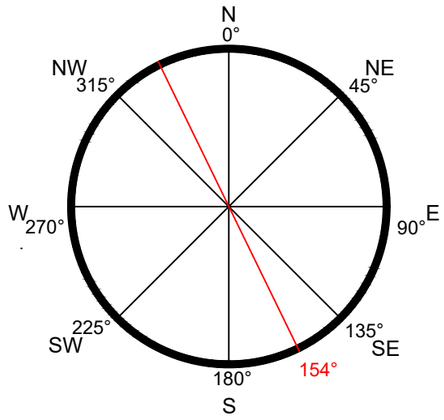
JOB NUMBER: 20-0399A	JOB NAME: Bus Connects	LOCATION: R2 - ST01A

CLIENT:	CLIENTS REPRESENTATIVE:	CREW: GH	PLANT & EQUIPMENT 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 154° FROM NORTH

COORDINATES: DATUM WALL

EASTING: - 716112.138

NORTHING: - 736806.439

ELEVATION: - 7.160

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	ESB	300	1.40	1.54 - 1.84	300mm Concrete ESB Slab
02	ESB	300	1.40	1.97 - 2.27	300mm Concrete ESB Slab
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 2.70

TRENCH DEPTH (m) : 1.50

TRENCH WIDTH (m) : 0.55

STABILITY: Stable

GROUNDWATER: None

SCALE: NTS@A3

DRAWN: BS

CHECKED: CH

DATE EXCAVATED: 15-10-2020

CAUSEWAY GEOTECH	**Project No.** 20-0399A	**Project Name:** Bus Connects Route 2 Swords to City Centre	**Trial Pit ID** R2-SLT02
	Coordinates 716099.87 E 736735.41 N	**Client:** National Transport Authority (NTA)	
Method: Slit Trenching		**Client's Representative:** Jacobs	Sheet 1 of 1 Scale: 1:25
Plant: 3T Tracked Excavator	**Elevation** 7.42 mOD	**Date:** 29/09/2020	**Logger:** RS FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50	ES1					MADE GROUND: Stiff greyish brown slightly sandy gravelly CLAY with cobble sized pieces of concrete and red brick. Sand is fine to coarse. Gravel is subrounded fine to coarse of mixed lithologies.	
1.00	ES2						
			5.26	2.15		End of trial pit at 2.15m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

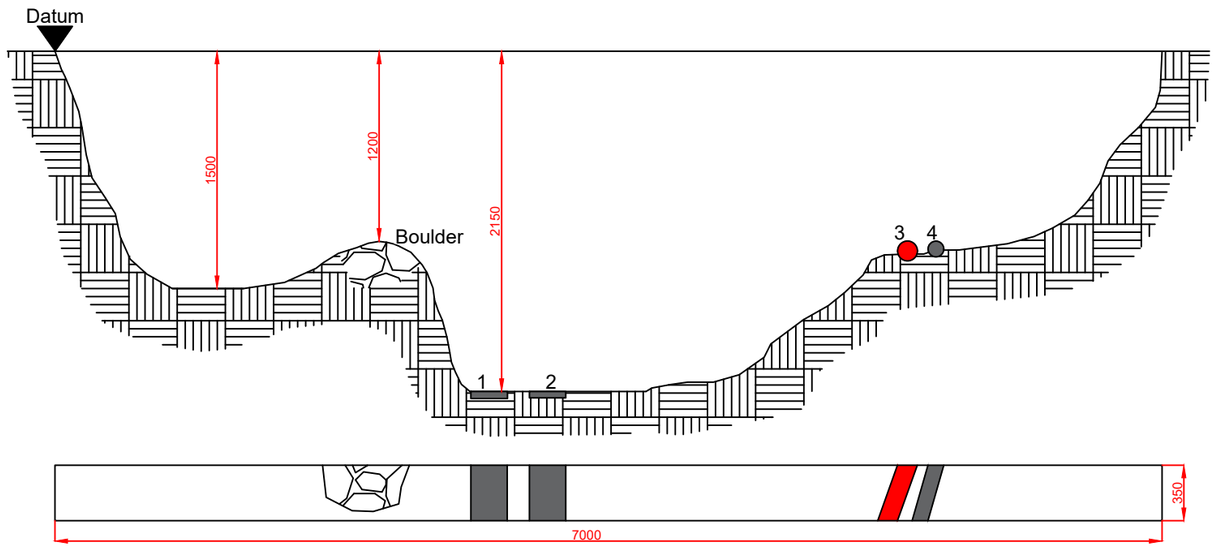
Water Strikes			
Struck at (m)	Remarks		
		Depth: 2.15	**Remarks:** No groundwater encountered.
		Width: 0.35	
		Length: 7.00	

Stability:	**Termination Reason:**	**Last Updated**	AGS
Stable	ESB services exposed.	17/12/2020	

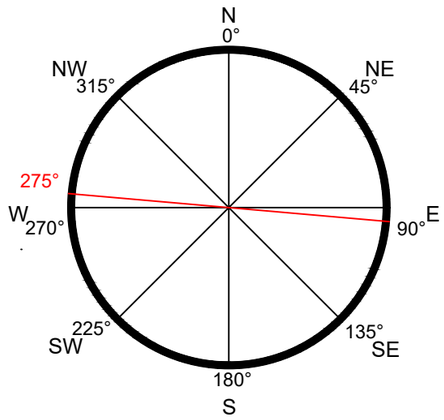
JOB NUMBER: 20-0399A	JOB NAME: Bus Connects	LOCATION: R02-SLT02

CLIENT:	CLIENTS REPRESENTATIVE:	CREW: RS	PLANT & EQUIPMENT 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 275° FROM NORTH

COORDINATES: DATUM WALL

EASTING: - 716099.867

NORTHING: - 736735.425

ELEVATION: - 7.412

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	ESB	230	2.15	2.63 - 2.86	230mm ESB Slab
02	ESB	230	2.15	3.00 - 3.23	230mm ESB Slab
03	Unknown	125	1.20	5.39	125mm Red PVC Duct Unknown
04	Unknown	100	1.20	5.57	100mm Grey PVC Duct Unknown
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 7.00

TRENCH DEPTH (m) : 2.15

TRENCH WIDTH (m) : 0.35

STABILITY: Stable

GROUNDWATER: None

SCALE: NTS@A3

DRAWN: BS

CHECKED: CH

DATE EXCAVATED: 29/09/2020

Appendix E. **Parapet Risk Assessment**

VRS Justification Sheet	Date: 13/01/2021	Completed by: Avril Regan
	Location ID/Description:	Swords to City Centre Scheme – Frank Flood Bridge
	Site Survey Conducted (Y/N): N	

	Hazard Type (Start and End Co-ordinates)	Is Hazard within the Clear Zone (Y/N)	Can the Hazard be Mitigated? (Y/N)	Hazard Ranking	Sinuosity Index	Sinuosity Ranking	Collision Rate Threshold	Collision Rate Ranking	Risk of a Vehicle Leaving the Road	Overall Risk Rating	Distance of Hazard	VRS to be Installed (Y/N) Start and End Coordinates	Reasons for Installing/Not Installing the Safety Barrier
1	Bridge Parapets Ch A9925 to A10000	Not applicable to urban situations as per Section 4 of DN-REG-03079	N	High	1.008	Medium	Not available on TII website for this road. From review of RSA collision data a threshold of LOW is assumed due to only 2 minor accidents from 2012 to 2016	Low	Low	Medium	73m	If the overall risk rating is Medium, the hazard, if it is within 2m of the carriageway edge shall be mitigated or a VRS shall be provided to meet the requirements of this standard	

L = Low, M = Medium, H = High

(1) Hazard Ranking as per Appendix C
High/Very High (H) as per Appendix C
Medium (M) as per Appendix C
Low (L) as per Appendix C

(2) Sinuosity Ranking
High (H) > 1.02
Medium (M) = 1.004 ≤ SI ≤1.02
Low (L) < 1.004

(3a) Collision Rate Threshold
(1) Twice above Expected Rate
(2) Above Expected Rate
(3) Below Expected Rate
(4) Twice Below Expected Rate

(3b) Collision Rate Ranking
High (H) = Twice above Expected Rate
Medium (M) = Above Expected Rate
Low (L) = Below Expected Rate and Twice Below Expected Rate

(4) Risk of a Vehicle Leaving the Road		Collision Rate Ranking		
		H	M	L
Sinuosity Ranking	H	H	H	M
	M	H	M	L
	L	M	L	L

(5) Overall Risk Rating		Hazard Ranking		
		H	M	L
Risk of a Vehicle Leaving the Road	H	H	H	M
	M	H	M	L
	L	M	L	L

Appendix F. **Structural Investigation Scope**

Contents

1. Introduction

Jacobs are undertaking the Engineering Design Services for the Planning Stage through to the end of the Statutory Process of the BusConnects Radial Core Bus Corridors Infrastructure Upgrade Programme (the Programme).

During the development of the preliminary design report it has been identified there is a need for a change in highway alignment over the existing Frank Flood Bridge. In addition to a new independent structure to the west the existing carriageway over the bridge will be widened with the introduction of a bus lane immediately adjacent to the west parapet. This will result in increased loading to the west spandrel wall which will need to be mitigated via strengthening or load alleviation measures.

To facilitate the new design, confirmation of existing structural details and an assessment of the existing structure is required.

Dublin City Council (DCC) are the asset owner and are responsible for management of the existing structure. They should be consulted on any proposals for investigation and are assumed to act as Technical Approval Authority for Assessments and designs relating to the structure.

The structure was constructed circa 1813. Currently no as-built information for the structure is available, however there are some details available from works undertaken in 1995 to install a protection slab under utilities apparatus. The most recent principal inspection (2019) shows that the structure is in a good condition.

The investigation shall include:

- A full dimensional survey;
- Investigation of existing waterproofing over deck
- Determination of the composition of the back fill
- Confirmation of wall and arch thickness

2. Location

Frank Flood Bridge is located approximately 2km North of Dublin City Centre. It carries the N1 over the River Tolka and forms part of one of the arterial routes into the city.

Table 2.1 Location & Description of Frank Flood Bridge

Identity	Irish OS Grid	ITM Grid	Description	Authority
Frank Flood Bridge	316172E 236739N	716113E 736763N	3 span masonry bridge carries the N1 over the River Tolka. Construction of current structure circa 1813. Requires widening or provision of a separate pedestrian structure.	Dublin City Council

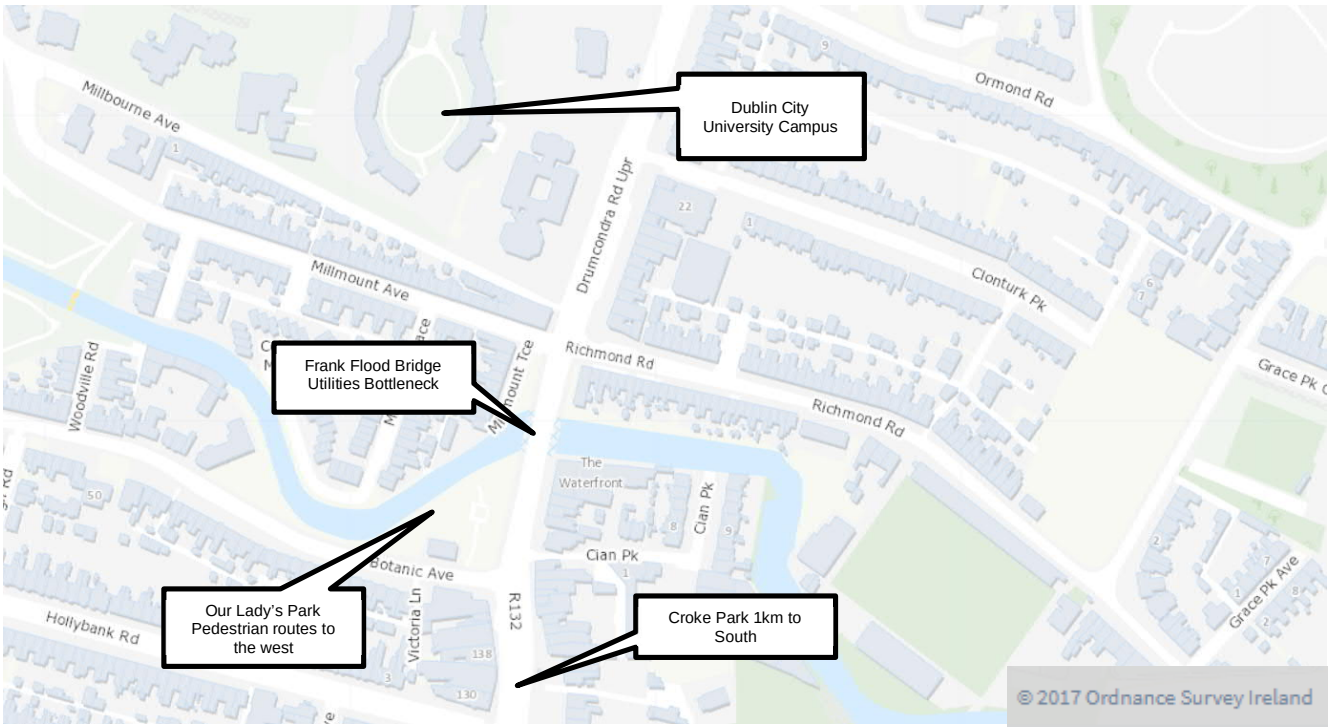


Figure 2.1 Location Plan

3. Survey Requirements

Frank Flood Bridge is a 3 span masonry arch structure. A full dimensional survey will be completed to measure the key dimensions of the structure as detailed in Table 3.1.

It should be possible to measure most of the structure without any intrusive works; however, some excavation and coring will be required:

- Coring required adjacent to the west parapet to measure the thickness of the spandrel wall.
- Excavation required to determine the depth of the fill over the arches.
- Results of dimensional survey shall be provided on pdf drawings at 1:200 scale showing plan, elevation and section of the existing structure.
- Details of the parapet coping stones and balustrade shall be provided on pdf drawings at 1:10 scale.

Table 3.1 Dimensional survey

Structural Element		Dimension (mm)
Overall Span of structure [1]		
Overall width of structure [2, 3]		
Span of Arch [4]		
Rise of Arch at crown [4]		
Rise of Arch at quarter points [4]		
Springing height above mudline [4]		
Thickness of arch barrel [4]		
Spandrel Wall Thickness[5]		
Wing wall retained height	Depth	
Parapet height		
Parapet balustrade dimensions		
Parapet coping dimensions		

1. The measurement shall be taken from the extrados of the outside arches. Skew angle to be confirmed.
2. The measurement shall be taken from the exterior of the spandrel walls
3. The measurement shall be taken square to the structure.
4. The measurement shall be taken for each of the three arches, Skew angle to be confirmed.
5. The measurement shall be taken from the cores.

4. Intrusive Investigation

The following intrusive surveys should be undertaken to obtain the required information in order to progress the design in future design stages.

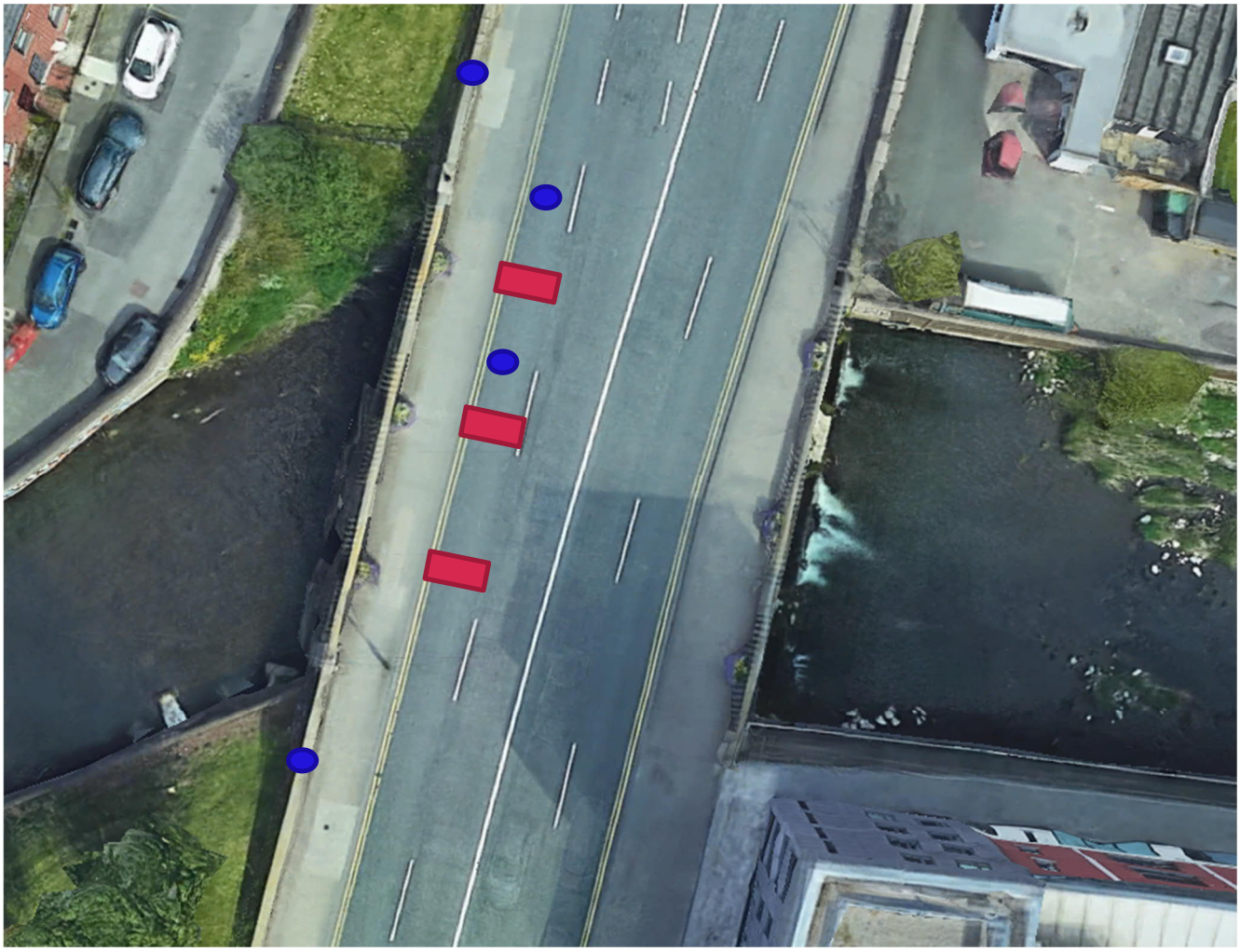


Figure 4.1: Locations of small diameter bore holes (blue) and Trial pits (Red) for investigation.

Confirmation of material backfill to comprise of 3 No. trial pits (500mm x 1000mm) on the existing bridge deck to coincide with the crowns of all three arches and 2 No. small diameter boreholes (150mm dia) to confirm build-up of materials between the arches. The trial pits should be excavated to the depth of the extrados of the arch and the boreholes should extend close to the springing point but not penetrate the arch barrel. Properties of the excavated material should be recorded to inform assessment parameters and the layer reinstatement. These works will require as a minimum the closure of the west lane to traffic for the duration of the works.

Two further small diameter horizontal cores are required in the elevation of the of the bridge at each bank to confirm thickness of spandrel wall. Cores should be taken at a minimum of 600mm below road level to avoid clashes with utilities in the western footway. The Contractor shall propose methods reinstate to minimise the visual impact on structure. A dry coring system shall be used and the first 50mm of the core shall be reinstated on completion with a mortar paste manufactured from the same masonry to minimise any change in appearance.

Consideration may be given to alternative methods to take measurements and reinstate to minimise impact on structure. The Contractor may provide alternative proposals for acceptance.

See Appendix A for drawings showing indicative locations of cores and trial pits required to obtain the relevant information.

4.1.1 Methodology

1. Ensure traffic management has been set up as appropriate
2. Mark out areas for excavation,
3. Undertake CAT scan and locate existing services;
4. Photograph and measure excavated area;
5. Undertake excavation as appropriate
6. Measure fill depth to extrados of arch barrel and confirm thickness of spandrel wall and arch barrel.
7. Sample of backfill to be tested to determine composition and soil parameters.
8. Reinstate excavated area as appropriate, trial pits above structure to be reinstated as per 4.2
9. Remove TM when appropriate

4.2 Reinstatement of Waterproofing

Waterproofing, if encountered, shall be repaired with an approved product in accordance with Manufacturer's instructions. The waterproofing protection, if required, shall be reinstated with a like for like material in accordance with Manufacturer's instruction. Reinstatement of fill shall not be carried out until waterproofing protection is in place. The hard verge shall be repaired to match the existing construction.

The Contractor shall confirm their proposals for reinstatement of waterproofing, waterproofing protection, and fill reinstatement for the acceptance of Jacobs and the Highway Authority prior to commencement of reinstatement.

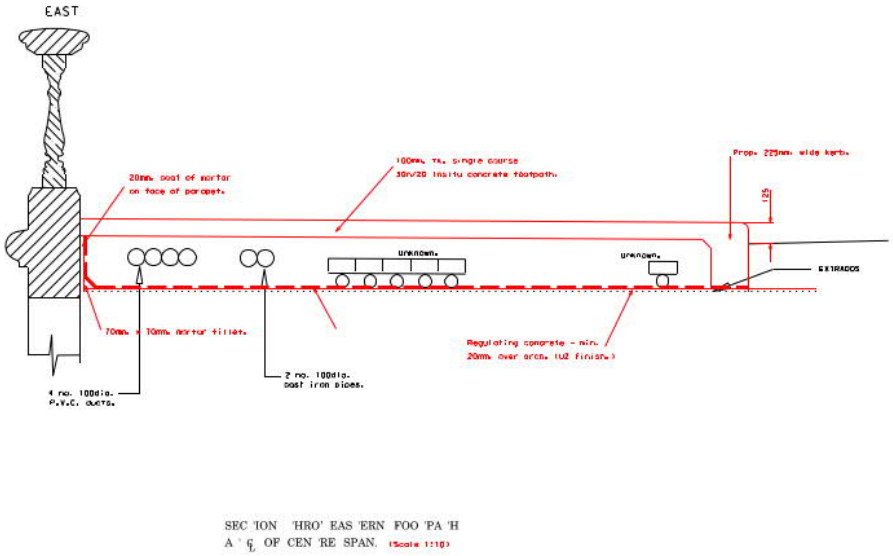
4.3 Equipment (envisaged but not limited to, Contractor to ensure appropriate equipment will be used)

- Mini excavator
- Breaker
- Dumper
- General hand tools
- Machine for footway and embankment reinstatement
- Floor saw / pavement saw
- Coring machine
- Access provisions

4.4 West Footway Constraints

There are extensive utility assets under the western footway where the proposed trial pit to measure the spandrel wall is proposed. These were protected with an in-situ slab in works undertaken in 1995, this may impact access to the interior of the spandrel wall. For this reason trial pits were discounted as an effective method to obtain spandrel wall measurements and it is recommended that the measurements are obtained via coring. Any damage to the waterproofing or mortar bedding should be made good prior to reinstatement of fill. See Figure 4.2 for a section through the footway from the 1995 protection works. Table 4.1 summaries the utilities identified in the footway at this stage of design.

Figure 4.2: Section through west footway.



SEC 'ION 'HRO' EAS 'ERN FOO 'PA 'H A ' ℄ OF CEN 'RE SPAN. (Scale 1:10)

Table 4.1: Summary of utilities in western footway

Asset Owner	Requirement	Location
ESB	4 No. 125mm ducts for LV	Located in western footpath
GNI	1 No. 250mm pipeline	Located in western footpath
EIR	6 or 9 No. 100mm ducts	Located in western footpath
Irish Water	1 No. 225mm main	Located in western footpath
eNet	2 No. 100mm ducts	Located in western footpath
Unknown	1 No. 250mm duct	Located in western footpath

4.5 Investigation report

The investigation report shall present the findings in a clear and concise manner with interpretation of the results against accepted criteria. The site results shall be tabulated and supported by clear diagrams / sketches showing dimensions, positions of referenced trail holes and reference photos taken during the works and reinstatement. All laboratory test certificates shall be included in an appendix along with a copy of their INAB accreditation schedule clearly identifying each test is listed. Core logs shall be taken with associated photos laid out to show the as-extracted material from the cores.

5. Health and Safety

The Contractor shall undertake the following as a minimum to reduce the health and safety risk associated with the works. Any hand-held excavations to be undertaken in accordance with the Health and Safety Authority Code of Practice For Avoiding Danger From Underground Services guidelines*.*

The existing waterproofing system may potentially have asbestos due to the age of the structure. The Contractor shall undertake an asbestos survey, using appropriately qualified staff, to confirm if asbestos is present prior to any intrusive works to existing waterproofing.

The Contractor shall confirm the proposals for their asbestos survey for the acceptance of Jacobs and the Highway Authority prior to the commencement of works.

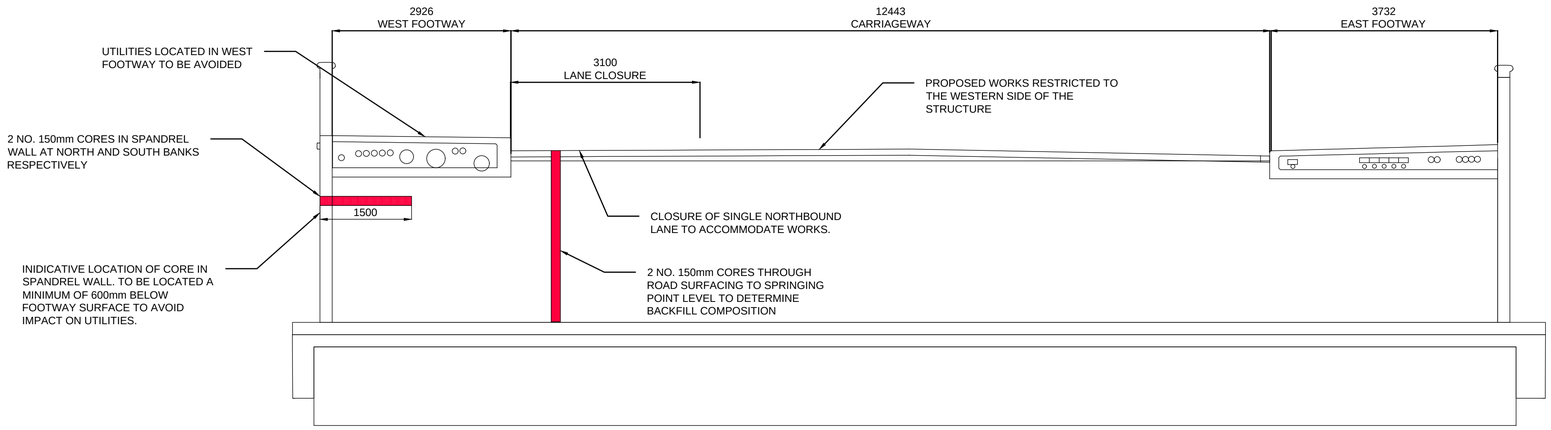
In the event that asbestos is found to be present the scope of further work should be agreed with Jacobs and the Highway Authority.

The actions listed below are considered appropriate minimum measures for Health and Safety. The Contractor should review the Designer's risk assessment and plan an appropriate safe method of work.

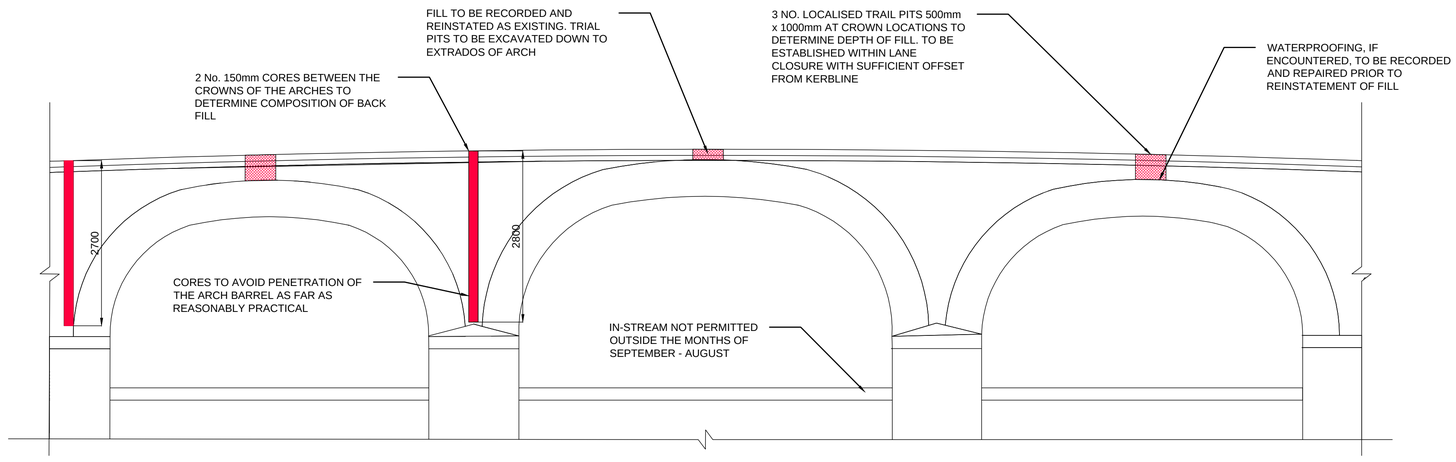
- Set up appropriate exclusion zones and traffic management as needed for the safe undertaking of the survey.
- Undertake CAT scans prior to breaking out/excavating as part of a 'permit to break ground' system.
- Monitor the use of vibrating tools in line with current industry best practice.
- Reduce the risks of falling from height.
- Reduce the risks of manual handling by limiting loads (as far as practical) carried to 20kg.
- Use tools with built in dust suppression.
- Ensure that excavations are made safe.
- Ensure that debris from the works does not enter the watercourse

A Designer's Risk Assessment has been completed for this investigation and detailed in Appendix B.

Appendix A. **Investigation Drawing**



TYPICAL SECTION BETWEEN ARCHES
(SCALE 1 : 50)



TYPICAL LONG SECTION
(SCALE 1 : 50)

NOTES :

1. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE REFERRED TO ORDNANCE SURVEY DATUM, MALIN HEAD.
3. THIS DRAWING IS ONLY TO BE USED FOR THE DESIGN ELEMENT IDENTIFIED IN THE TITLE BOX. ALL OTHER INFORMATION SHOWN ON THE DRAWING IS TO BE CONSIDERED INDICATIVE ONLY.
4. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DESIGN DRAWINGS
5. CONTRACTOR TO REINSTATE WORKS IN ACCORDANCE WITH THE SPECIFICATION AS AGREED WITH THE DESIGNER

Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L01	05/07/2021	RG	JM	HO	SUITABLE FOR INFORMATION

W.I.P.

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: Jacobs

Date	Scale	Drawn	Checked	Approved
05/07/2021	1:25 @ A1 1:50 @ A3	RG	JM	HO

Project Code	Originator Code	QMS Code
BCIDB	JAC	

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: SWORDS TO CITY CENTRE SCHEME
FRANK FLOOD BRIDGE
INTRUSTIVE INVESTIGATIONS
SPECIFICATION DRAWING

Drawing File Name	Sheet Number	Status	Rev
BCIDB-JAC-STR_GA-0002_BR_00-SK-CB-0005	01of 01	S3	L01

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

Appendix B. **Designers Risk Assessment**

Jacobs

HAZARD ELIMINATION & RISK REDUCTION REGISTER (ROI)

Document Number: BCIDB-JAC-STR_SU-0002_BR_00-RA-CB-0001

Project Name: BusConnects Radial Core Bus Corridors Infrastructure Upgrade Programme –Frank Flood Bridge

Project Number: 32110901

Client: National Transport Authority

Project Manager: Stuart Nicol

Engineering Discipline for this HERR: Structures

Design Package for this HERR:

Lead Designer for this HERR: John McElhinney

PSDP Lead for this Project: Ruchi Sharma

Revision	Issue Date	Revision Description	Prepared By	Checked By	Approved By
L01	09-Jul-21	For Review and Comment	RG	JM	HO

Cont'd from page 1

Revision	Issue Date	Revision Description	Prepared By	Checked By	Approved By

Jacobs

Project Name:	Upgrade Programme –Frank Flood Bridge
Project Number:	32110901 BCIDB-JAC-STR_SU-0002_BR_00-RA-CB-0001
Client:	National Transport Authority

HAZARD ELIMINATION & RISK REDUCTION (ROI)
REGISTER OF FORMAL DESIGN REVIEWS

DESIGN REVIEW DESCRIPTION	DATE HELD	ATTENDEES	MINUTES REFERENCE
Below are the Disciplines and team members that carried out the Hazard Registers.			
Structures HR	Jul-21	Reece Glennon, John McEhinnery	N/A

Jacobs

L01

DESIGN HAZARD ELIMINATION AND RISK REDUCTION REGISTER (ROI)

Latest Review Date	

Phase	
C	Construction
M	Maintain / Clean
U	Use as Workplace
D	Demolish

Project Name:	Upgrade Programme –Frank Flood Bridge
Project Number:	32110901
Design Package:	St Laurence Structural Investigations
Client:	National Transport Authority

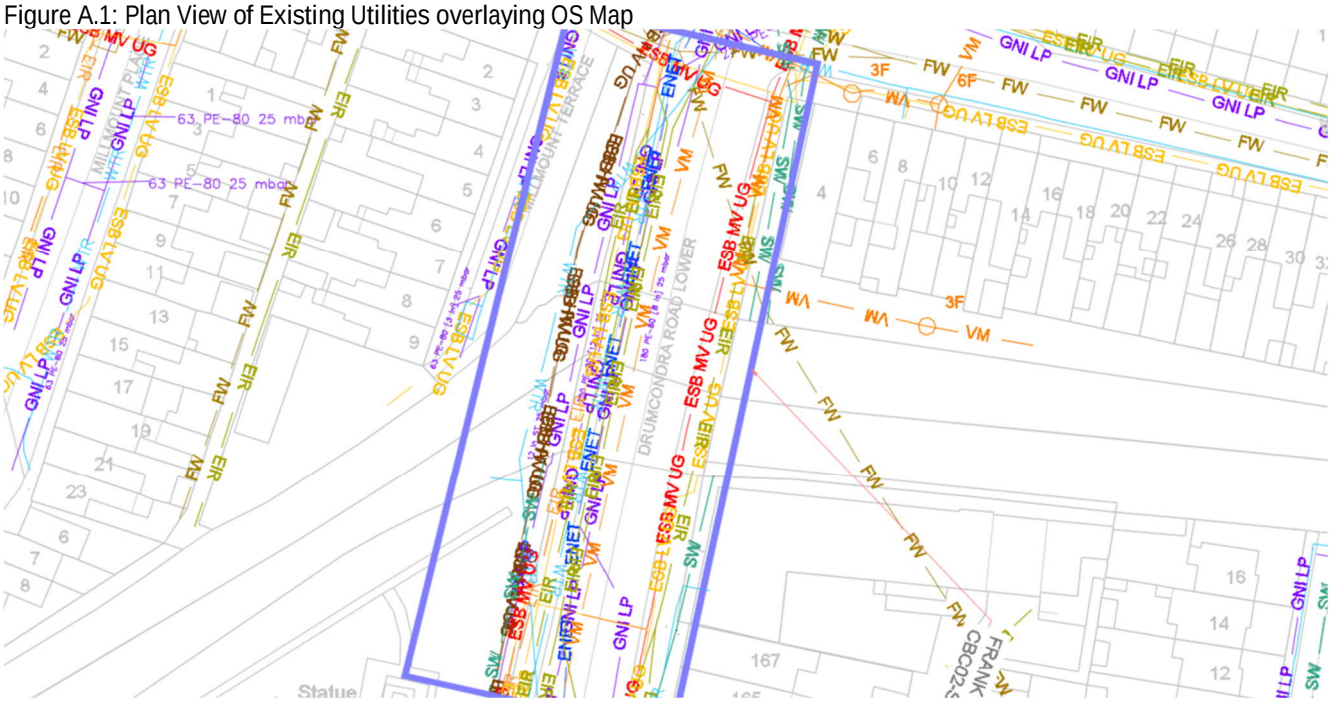
WORK IN PROGRESS

Probability	Worst Potential Severity (WPS) of Impact	Risk Rating
1: Highly Unlikely 2: Unlikely 3: Possible 4: Likely 5: Highly Likely	1: Nil or slight injury / illness, property damage or environmental issue. 2: Minor injury / illness, property damage or environmental issue. 3: Moderate injury or illness, property damage or environmental issue. 4: Major injury or illness, property damage or environmental issue. 5: Fatal or long term disabling injury or illness. Significant property damage or environmental issue. 10. Multiple fatalities and catastrophic event	NOTE: The purpose of Risk Rating is to determine which risks are significant. It is a subjective assessment and not an absolute or precise determination

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Risk ID.	Formal Review Description	Phase	Particular or Non-Particular Risk (if applicable)	Activity	Potential Hazard	Person(s) Most at Risk	Prob	WPS	Initial Risk Rating	Discipline	Design Measures to Eliminate Hazards	Design Measures to Reduce Risk	Residual Prob	Residual WPS	Residual Risk Rating	Residual Risk Description	Included on Drawing No(s) or other doc. (give ref.)	Action By (Name or Role)	Target Date	Revised Target Date	Date Action Complete	Tracker Status	Comments	Primary Legislation
1	5: Design Stage Review	C	Not Applicable	Excavation of trial pits	Hitting Embedded services	Construction	3	5	15	Civil / Structural	None - Works required	Available information on existing utilities to be made available prior to excavation. Trial pits positioned in the carriageway to minimise interface with known services in footways.	1	5	5	Residual risk remains of service strike. Contractor to develop appropriate safe method of work in accordance with approved Code of Practice for Avoiding Danger from Underground Services	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
2	5: Design Stage Review	C	13. Interaction with traffic	Works near the highway	Vehicle-Vehicle or Vehicle-Pedestrian collision	Construction	3	4	12	Civil / Structural	Unavoidable, protection slab and utilities require trail pits in the carriageway	Reduce number of trail pits required. Exclusion zones and traffic management	1	3	3	Residual risk remains. Contractor to develop appropriate safe method of work and Temporary Traffic Management Plan	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
3	5: Design Stage Review	C	Not Applicable	Breaking and cutting of surfacing materials	Inhalation of silica and other dust pollution.	Construction	3	3	9	Civil / Structural	None - Works required	Area of excavation limited to that required.	1	3	3	Residual risk remains. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
5	5: Design Stage Review	C	1. Falling from height	Investigation of the bridge deck	Injury or death from falls	Construction	1	5	5	Civil / Structural	Select areas of investigations away from potential unprotected drops.	Existing edge protection adequate	1	5	5	Residual risk remains. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
6	5: Design Stage Review	C	20. Interaction with the public	Incursion into works area	Injury to member of public in works area	Public	2	4	8	Civil / Structural	Works area to be clearly defined	Area of excavation limited to that required.	1	4	4	Residual risk remains. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
7	5: Design Stage Review	C	4. Chemical or biological substances	General Works	Exposure to needles and other drug paraphernalia	Construction	1	4	4	Civil / Structural	None - Works required	Potential risk communicated to contractor	1	4	4	Residual risk remains. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
8	5: Design Stage Review	C	Not Applicable	Use of percussion tools	Hand Arm Vibration Syndrome (HAVS) aka vibration white finger	Construction	4	3	12	Civil / Structural	None - Works required	Area of break out limited to that required.	1	3	3	Residual risk remains. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
9	5: Design Stage Review	C	4. Chemical or biological substances	General Works	Possible exposure to asbestos containing materials.	Construction	3	5	15	Civil / Structural	None - Works required	Asbestos survey of the waterproofing has been specified to identify if they are asbestos containing materials. The RAMS and scope will need to be updated following the completion of the assessment	1	5	5	Residual risk remains. Contractor shall undertake an asbestos survey, confirm if asbestos is present prior to any intrusive works to existing waterproofing. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)
10	5: Design Stage Review	C	2. Burial under earthfalls	Collapse of earthworks	Injury or death from collapsed excavation, partial structural collapse	Construction	2	5	10	Civil / Structural	None - Works required	Area of excavation and depth of excavation limited to that required.	2	5	10	Residual risk remains. Contractor to develop appropriate safe method of work	N/A	Contractor	TBC	TBC	TBC	Open	No further comments.	2013 Const Regs (PSDP)

Appendix C. **Plan of Existing Utilities**

Figure A.1: Plan View of Existing Utilities overlaying OS Map



Appendix G. **HDD Geotechnical Technical Note**

Jacobs

Memorandum

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Subject	**Frank Flood Bridge HDD Option - Geotechnical Review**	**Project Name**	BusConnects Route 2 - Swords
Attention	<Name>	**Project No.**	32110900
From	Megan Nugent		
Date	2 June 2021		
Copies to	<Name>		

1. Introduction

The Dublin Geotechnical team was requested to review the feasibility of the proposed HDD option for installing a water main and ESB and communications HDPE Ducting below the Tolka River at Frank Flood Bridge. The proposed diameter of ducting under consideration ranges from 450mm to 710mm.

The following sources of information have been considered in this assessment:

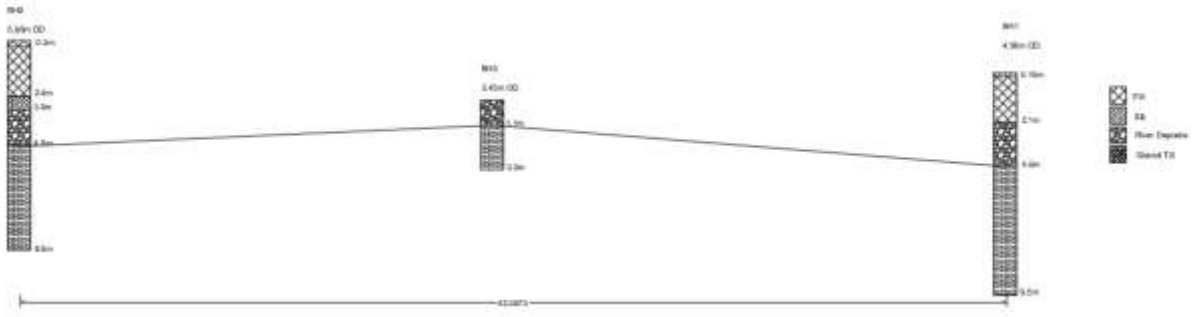
- BusConnects Route 2 Preliminary Ground Investigation – R2-CPRC02.
- GSI Geotechnical Report ID 944 – Report on Site Investigation at Ballybough Bridge Dublin 3; and
- BusConnects Structures Cross Sections and General Arrangements.

The following assumptions have been made for the purposes of this assessment:

- HDD Boring will commence and terminate 1.5m below existing ground level.
- Maximum inclination of HDD boring is 14°; and
- Maximum change in inclination is 3° every 6m.

2. Geotechnical Assessment

A borehole approx. 20m south of the riverbank, carried out for BusConnects Planning GI, and three historic boreholes carried out downstream at the location of Ballybough Bridge were reviewed to determine the probable ground model for the extent of the HDD bore. The historic boreholes indicated that downstream there was 1.1m to 1.9m thickness of river deposits of coarse gravel with cobbles and boulders overlying stiff Glacial Till, as shown in Figure 1.



A thickness of 1.9m of coarse grained river deposits has been used for this assessment. It should be noted that there is significant variation in river morphology between the two locations with the river channel being narrower upstream and downstream of Frank Flood Bridge.

The cross section of the proposed ground model, shown in Figure 2, indicates that the HDD boring will likely be progressed through made ground to approx. 3.5m bgl then advancing through stiff to very stiff Glacial Till. Provided a maximum thickness of river deposits of 1.9m it is expected that there will be approx. 4-5m of coverage of stiff Glacial Till above the HDD to reduce the risk of break through of bentonite into the river during boring. It is anticipated that, based on the results of testing of the Glacial Till that this should provide sufficient cover for the works.

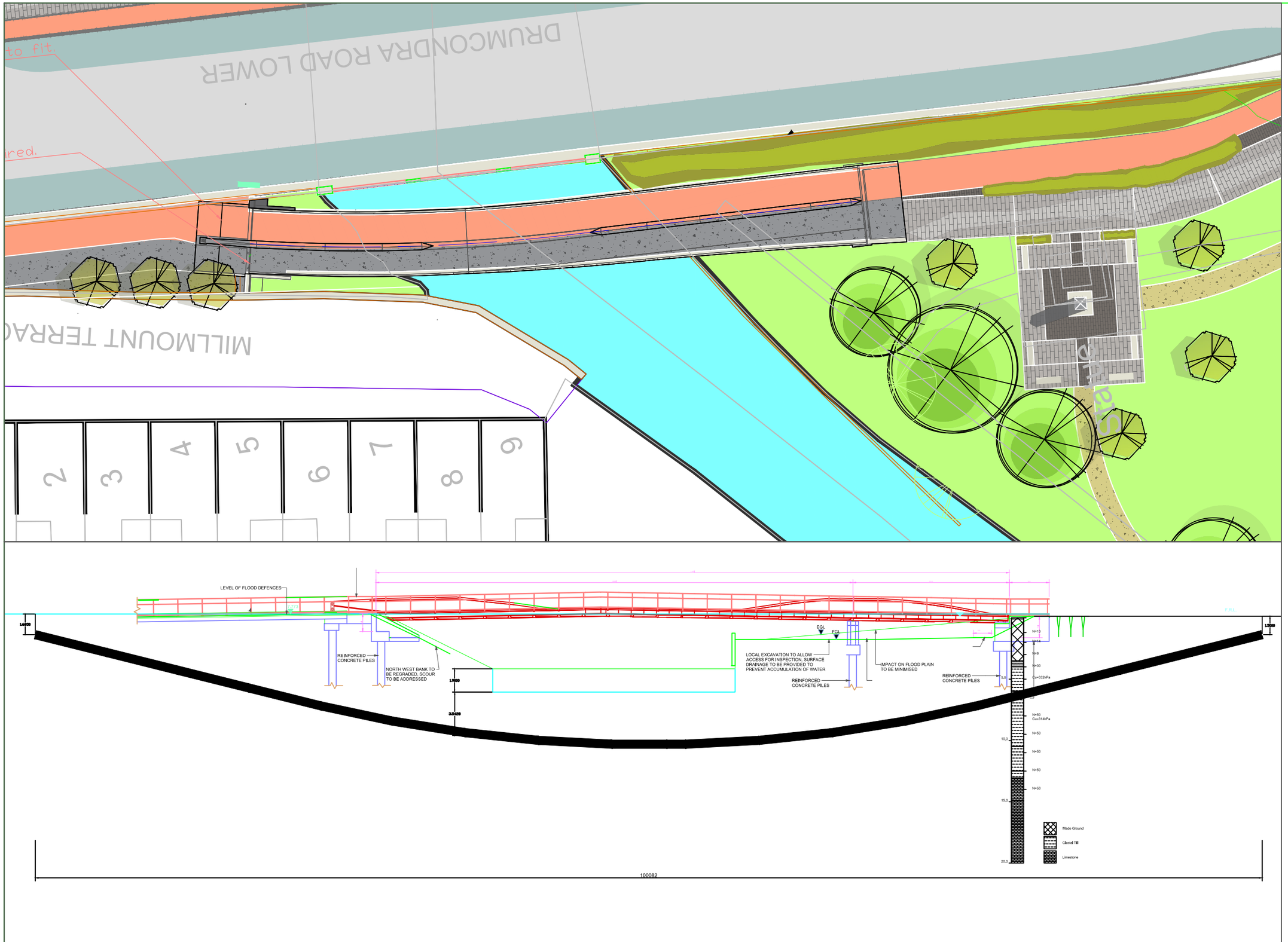
3. Residual Risks and Recommendations

Following the geotechnical review of the feasibility of the HDD bore option the following residual risks have been identified to be addressed at design stage:

- Lack of information on thickness and composition of river deposits within Tolka River channel resulting in unknown risk of bentonite break through during boring.
- Lack of information on ground conditions of north bank to confirm ground model.

The following actions are recommended to address the above residual risks:

- Intrusive or geophysical investigation of the river bed to determine thickness and composition of the river deposits.
- Intrusive investigation of the north riverbank to confirm ground conditions.



Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L01	03/06/2021	MN	IM	DM	SUITABLE FOR INFORMATION

W.I.P.

Client: NTA Údarás Náisiúnta Iompair / National Transport Authority

Engineering Designer: Jacobs

Date: JUN. 2021
Scale: NTS @ A1 NTS @ A3
Drawn: MN
Checked: IM
Approved: DM
Project Code: BCIDB
Originator Code: JAC
QMS Code:

Programme Title: **BUSCONNECTS DUBLIN**
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title:
CBC 02
SWORDS TO CITY CENTRE
FRANK FLOOD BRIDGE
HDD PROPOSED BORE PLAN

Drawing File Name: BCIDB-JAC-GEO_GA-0002_BR_00-SK-CB-0001
Sheet Number: 01 of01
Status: S0
Rev: L01

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