The background features a vibrant red field with abstract geometric elements. In the top-left, a green quarter-circle is partially visible. The top-center has a blue shape with a white circle. The top-right shows a dark blue horizontal band and a white circle. The bottom-left contains a blue shape with a white circle. The bottom-right is dominated by a large green quarter-circle and a red shape with a white circle. The text is positioned in the upper-left quadrant of the red field.

Appendix J3
Preliminary Design Report
Ringsend Structure 01

Preliminary Design Report – Consultation

STA-1b

Categories 1, 2 & 3

Scheme

Name and Location: Busconnects Infrastructure Delivery – Project D

Structure(s)

Name and nature of the Structure(s): Ringsend 01 bridge

Preliminary Design Report

Reference BCIDD-ROT-STR-ZZ-0016-XX-00-RP-CB-0015

Revision L01

Date Feb-2022

Submitted by

Signed:



Name: Fernando Fernandez

Position: (Structures Team Leader)

Organisation: Roughan & O'Donovan – TYP SA Consulting Engineers

Date: 23/05/2022

Structures Section confirmation of consultation:

Signed: _____

Name: _____

Position: _____

Date: _____

RINGSEND TO CITY CENTRE CORE BUS CORRIDOR SCHEME

PRELIMINARY DESIGN REPORT – RINGSEND 01

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APPENDIX 4 Other Relevant Documentation/Reports

1. INTRODUCTION

1.1 Brief

Roughan & O'Donovan-TYPSA have prepared this report for the National Transportation Authority (NTA) for the design of the Ringsend 01 bridge as part of the Busconnects Infrastructure Delivery – Project D.

1.2 Background Information

The proposed scheme for Ringsend to City Centre aims to provide enhanced walking, cycling and bus infrastructure, which will enable and deliver efficient, safe and integrated sustainable transport movement to this corridor.

Priority for buses is provided along the entire route consisting primarily of dedicated bus lanes in both directions, with alternative measures proposed at particularly constrained locations along the scheme. Cycle tracks and footpaths will also be provided separated from the bus lanes. At constrained points, it is necessary to build new structures or widen the existing ones to provide adequate space for the new road layout.

This document relates to the Preliminary Design Report in respect of the Ringsend 01 bridge in accordance with DN-STR-03001 (April 2019). A location drawing of this structure within the scheme is provided in the Appendices, as well as a general arrangement drawing of the proposed bridge.

This structure is being proposed to increase the existing road capacity for public transport and pedestrian at North Wall Quay. Cyclist lane will be arranged on the relocated Scherzer's bridges, adjacent to the proposed Ringsend 01.

Photographs of the structure taken during a site visit are included in Appendix 1.

1.3 Previous Studies

Reports prepared and published for this structure to date include:

- BCIDD-ROT-STR-ZZ_0016-XX_00-RP-CB-0011 – Structures Options Report: Ringsend 01
- BCID-ROT-ERW-GI_0016-RP-CR-0001 – Geotechnical Interpretive Report: Ringsend Corridor

2. SITE & FUNCTION

2.1 Site Location

The Ringsend 01 bridge is situated at the location of the existing Scherzer's Bridges, in operation at the time this report is written, at North Wall Quay. Due to their historic and unique nature, the existing bridges are to be relocated adjacent to the proposed bridge, to carry the new cycle lane and footpaths. The site location plan is included in Appendix 2.

2.2 Function of the Structure

The objective of the new bridge is to increase the width of the existing carriageway. This allows unimpeded passage of the bus lanes and a footpath, as well as existing traffic lanes, at North Wall Quay. Proposed lanes for cyclist and southern footpath will be on the relocated Scherzer's Bridges.

2.3 Choice of Location

The location of the structure was chosen to facilitate the proposed Ringsend to city centre corridor taking into account the layout and roadway requirements in terms of space for proposed lanes, footpaths, maximum slopes, etc.

2.4 Site Description and Topography

The site of the proposed structure is located in an urban area, close to Dublin's city centre. Consequently, there are existing buildings and infrastructure in the direct vicinity of the new structure.

2.5 Vertical and Horizontal Alignments

Horizontal and vertical road alignments at the bridge location are described below. The proposed general arrangement drawings are shown in Appendix 2.

Horizontal Alignment

The North Wall Quay is straight across the bridge.

Vertical Alignment

The proposed vertical road alignment at the location of the bridge follows the alignment of the existing road, which is relatively flat.

2.6 Cross-Sectional Dimensions on the Alignments

The proposed mainline cross section at the structure location is shown in Table 2.1.

Table 2.1: Ringsend 01 Cross-Section

| Parameter | Value |
|-------------------------|----------------|
| VRS Upstand | 0.6 m |
| Footpath | 2.0 m |
| Carriageway | 12.0 m |
| Rubbing Strip | 0.5 m |
| VRS Upstand | 0.6 m |
| Out-to-Out Width | 15.70 m |

2.7 Existing Underground and Overground Services

A list of the existing services located in close proximity to the Ringsend 01 is outlined below.

Low and Medium Voltage Electricity Lines

ESB low voltage underground lines are present at the structure's location. These may need to be diverted following discussions with ESB.

High Voltage Electricity Lines

Desktop services tracking to date indicate low and medium voltage underground lines in the vicinity of the structure which may need to be diverted following discussions with the ESB. There appear to be no high voltage lines, however, these will need to be verified by the Contractor on site.

Telecommunications

Desktop services tracking to date indicate some telecommunication cables in the vicinity of the structure which may need to be diverted following discussions with the provider. Exact locations will need to be verified by the Contractor on site.

Water Supply

Desktop services tracking to date indicate water mains at the structures location which may need to be diverted following discussions with Irish Water. Exact locations will need to be verified by the Contractor on site.

Gas Networks

Desktop services tracking to date indicate gas mains at the structures location which may need to be diverted following discussions with Gas Networks Ireland. Exact locations will need to be verified by the Contractor on site.

2.8 Geotechnical Summary

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSi) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

At the date of this report there is a GI contract available that aims to assess the geology of the site and determine the ground properties and conditions to enable the design of Bus Connects Core Bus Corridors.

2.9 Hydrology and Hydraulic Summary

The bridge will have minimal effect on the hydrology in the area. Although it crosses the George's Dock Canal, it will not be affected as the existing headroom is maintained.

2.10 Archaeological Summary

An Environmental Impact Assessment Report (EIAR) is currently being prepared that considers archaeological impacts along the mainline alignment.

2.11 Environmental Summary

An Environmental Impact Assessment Report (EIAR) is currently being prepared and it considered the mainline alignment at the structure location and its impact on the environment and local communities. All likely significant environmental effects are assessed, and mitigation is proposed as necessary in the Environmental Impact Assessment Report.

3. STRUCTURE & AESTHETICS

3.1 General Description of Recommended Structure

The Ringsend 01 bridge shall be a single span fully integral portal frame bridge. The bridge deck consists of precast concrete TY beams with a cast in situ reinforced concrete deck slab.

3.2 Aesthetic Considerations

The structure form is typical for bridges and is a straightforward form of construction.

The width of the bridge meets the intention to design a double bus lane independent of traffic lanes. The level of the existing carriageway has been kept, maintaining the overall aesthetic to the area while providing continuity to the bus and traffic lanes to North Wall Quay.

The parapets proposed are metal vehicle restraint system and will require approval from the Employer's Representative to ensure an appropriate solution is employed in construction.

3.3 Proposals for the Recommended Structure

3.3.1 Proposed Category

The proposed bridge is a Category 2 structure.

3.3.2 Span Arrangements

The bridge is a single span bridge of 16.54m length (c/c bearings) with a deck straight in plan and has a skew angle of approximately 15 degrees.

3.3.3 Minimum Headroom Provided

There is no restriction for headroom requirement as the George's Dock Canal is no longer in use. Nevertheless, the proposed structural depth aims to be no more than the existing Scherzer's Bridges.

3.3.4 Approaches (incl. Run-on Arrangements)

The approaches are generally on a suitable formation or using a compacted acceptable material finished with a capping layer. Full road construction is used over the embankment fill up to the back of the end abutments. It is not proposed to use run on slabs.

3.3.5 Foundation Type

The substructure comprises of embedded foundations, formed by bored in-situ reinforced concrete piles and in-situ reinforced concrete pile caps, where the precast beams will be supported. 7No. Ø0.50m piles are proposed per abutment.

3.3.6 Substructure

The precast beams will be supported on the embedded foundations. Integral connection between superstructure and substructure will be made at both abutments. Proposed embedded foundation will be located at least 0.50m apart from the existing Quay wall.

3.3.7 Superstructure

The bridge deck will be formed from precast concrete TY beams with a cast in situ reinforced concrete deck slab.

3.3.8 Articulation Arrangements (Joints and Bearings)

The structure will be designed to be a fully integral portal frame. There will be no requirement for any articulation of the structure; the precast beams will be tied into the abutments with full monolithic connections. Longitudinal forces acting on the frame due to temperature strains and vehicle loads will be resisted through soil-structure interaction and flexure of the frame. Saw cut joints will be provided in the pavement and footpath at the back of each abutment.

3.3.9 Vehicle Restraint System

All parapets will comply with TII DN-REQ-03034 (historical ref. NRA TD19) and EN 1317. The parapet containment level as well as the approaches / departures and transitions shall be N2 unless otherwise specified by the road authority. Metal vehicle restraint system (VRS) are proposed for this bridge. Where possible, parapets will transition to an approved safety barrier / terminal. Where this is not possible, a bespoke terminal / transition will be adopted which, along with departures from standards, will be agreed with Dublin City Council.

3.3.10 Drainage

Due to the short span, it is not proposed to install combined kerb drains across the bridge; instead, bridge deck drainage will be provided by gullies on both bridge approaches.

3.3.11 Durability

The proposed structure will be designed to achieve the required 120 years design life.

In addition, the specification of suitable materials will enhance durability and reduce the maintenance liability. The following measures are proposed:

- Durable concrete to be provided in accordance with TII DN-STR-03012 (formerly BD 57);
- Exposed concrete to be surface impregnated and buried concrete surfaces to be waterproofed in accordance with the TII Specification for Road Works;
- Stainless steel reinforcement to be provided in elements that are subject to de-icing salts and that are particularly vulnerable;
- Bridge deck to be waterproofed with a spray applied system that has a current BBA / IAB Certificate;
- Exposed formed concrete surfaces to be F4 / F3;
- Provision of a fully maintainable bridge deck drainage system

3.3.12 Sustainability

Sustainable development has been considered for the detailed design of the proposed bridge to enable a cost-effective and sustainable solution which has a minimal impact on the surrounding environment.

The proposed structure is an integral portal frame bridge. The bridge deck consists of precast concrete TY beams with a cast in situ reinforced concrete deck slab which is considered a more sustainable solution than a similar steel structure for the following reasons:

- Concrete is manufactured in Ireland while steel is imported;
- Local cement and aggregates are used in the production of concrete;
- It avoids the requirement for elastomeric bearings and expansion joints (replaceable elements) due to its integral nature;

- Concrete typically requires less ongoing maintenance work than steelwork.

It is proposed to adopt 50% ground granulated blast furnace slag (GGBS) as cement replacement in the mix design for all in-situ concrete which reduces CO2 emissions.

3.3.13 Inspection and Maintenance

The inspection of bridges shall be carried out in accordance with TII procedures by suitably qualified personnel who shall be responsible for providing the relevant equipment and establishing traffic management appropriate to the type of inspection being carried out.

Inspection of most parts of the bridge can be done from finish road level. Inspection of the soffit of the proposed bridge shall be carried out from George's Dock Canal.

The proposed structure is an integral bridge therefore maintenance requirements will be minimal. The top of the structure will be accessible from North Wall Quay. The underside can be inspected from George's Dock Canal.

Superstructure

All external concrete surfaces will be visible for inspection. Structural steelwork and bearings are not proposed therefore maintenance is expected to be minima

Substructures

The substructures consist of in situ reinforced concrete mostly buried, which should not incur any substantial maintenance costs.

Parapets

Galvanised steel vehicle restraint system is proposed, which are virtually maintenance free within their working life.

4. SAFETY

4.1 Traffic Management during Construction

Traffic management will be required during construction. Diversions will be needed in order to build the proposed bridge and to relocate existing Scherzer's bridges.

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".

4.3 Safety in Use

Bridge parapets will be designed for collision loading in accordance with IS EN1317, the headroom and cross section will be designed in accordance with TII DN-GEO-03036 (formerly ref. TD 27).

4.4 Lighting

Lighting under the bridge is not required. Lighting over the bridge will be provided in accordance with BS-5489-1.

5. COST

5.1 Budget Estimate in Current Year (incl. Whole Life Cost)

The estimated cost for the construction of the bridge is 650,000€.

Basis of Cost Estimate

The cost estimate has been produced on the following basis:

- Figures are given in Euro and are based on 2019 rates (excluding VAT) – TII Schedule of Rates 2019 (CC-GMP-00054);
- Excludes land acquisition and rights of way;
- Excludes preliminaries;
- The Construction Cost Estimate does not include for fees associated with the following:
 - Additional SI and Topo;
 - Environmental Assessment;
 - Detailed Design and Checking;
 - Contract Administration;
 - Site Supervision during Construction.

6. DESIGN ASSESSMENT CRITERIA

6.1 Actions

The structure will be designed in accordance with IS EN 1991 Eurocode 1: Actions on Structures and, in particular, Part 1-1: General Actions, Part 1-3: Snow Loads, Part 1-4 Wind Loads, Part 1-5 Thermal Actions, Part 1-6 Execution, Part 1-7 Accidental Actions and IS EN 1991 Part 2 Traffic Loads on Bridges as amended by the relevant Irish National Annexes.

6.1.1 Permanent Actions

The following nominal densities will be adopted:

- Reinforced concrete 25 kN/m³
- Structural steelwork 77 kN/m³
- Pavement 23 kN/m³
- Backfill to structures 20 kN/m³

6.1.2 Snow, Wind and Thermal Actions

Snow action may be ignored due to the geographical location as outlined in IS EN 1990:2002 + NA:2010. Thermal actions Approach 2 will be used in accordance with clause NA.2.3 of the Irish National Annex to IS EN 1991-1-5. Wind load will be assessed in accordance with IS EN 1991-1-4:2005 and the associated National Annex.

6.1.3 Actions relating to Normal Traffic

The structure will be designed for IS EN 1991-2 live load models LM1, LM2 and LM4 as defined in TII IAN 02/11 (including Amendment No. 1 February 2012). Traffic surcharge loading to be applied behind the bridge abutment and wingwalls will be calculated in accordance with IS EN 1991-2.

6.1.4 Actions relating to Abnormal Traffic

The structure will be designed for the live load model SV196 (LM3) as defined in TII IAN 02/11 (including Amendment No. 1 February 2012).

6.1.5 Footway Live Loading

The structure will be designed for footway loading in accordance with IS EN 1991-2 load model LM4 (crowd loading). This consists of a uniformly distributed load (q_{fk}) of 5kN/m² and a concentrated load (Q_{fwb}) of 20kN as defined in section 5 of IS EN 1991-2 and the Irish National Annex.

6.1.6 Provision for Exceptional Abnormal Loads

None.

6.1.7 Accidental Actions

Accidental actions will be considered in accordance with I.S. EN 1991-1-7.

6.1.8 Actions during Construction

The design shall take account of any adverse loading during construction as outlined in IS EN 1991-1-6 and its National Annex. Specifically, the design shall take account of required construction vehicles and the actions will be applied as described in section 6.1.3 above.

6.1.9 Any Special Loading not Covered Above

Fatigue Load Model - Fatigue load models shall be in accordance with IS EN 1991-2:2003 Cl. 4.6 and specifically Load Models 1 & 2. In addition, Loads Model 3 will be used to assess fatigue life in accordance with fatigue strength curves defined in EN 1992 to EN 1999. Fatigue Load Models 4 and 5 will not be used.

Fatigue loading shall not be less than the requirements of NA to IS EN 1991-2, Table NA.4 for the type of road.

6.2 Authorities Consulted

The following is a list of Authorities to be consulted as part of the scheme:

- Local Authorities – Dublin City Council;
- ESB;
- Gas Networks Ireland;
- Irish Water;
- Waterways Ireland.

6.3 Proposed Departures from Standards

There are no existing departures applied for at this stage of the design process.

6.4 Proposed Methods of Dealing with Aspects not Covered by Standards

Agreed departures to be incorporated into the design – however at this stage no departures have been applied for.

7. GROUND CONDITIONS

7.1 Geotechnical Classification

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSI) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

A GI contract has recently been completed which aims to assess the geology of the site and determine the ground properties and conditions to enable the design of Bus Connects Core Bus Corridors. The GI includes boreholes, trial pits, dynamic probes, standpipes/piezometer installation and monitoring, in-situ testing, geotechnical and environmental laboratory testing and preparation of a factual report, all in accordance with the “Specification and Related Documents for Ground Investigation in Ireland”.

7.2 Description of the Ground Conditions and Compatibility with Proposed Foundation Design

The following table shows the expected depth to bedrock, based on the data from the Desktop Review, as well as the depth of the encountered bedrock in the GI undertaken. Note that some of the boreholes were terminated at a shorter length, before encountering the bedrock strata.

Table 7.1: Encountered bedrock in the vicinity of Ringsend 01

| Borehole Ref. | Depth to Encountered Bedrock | Depth to N SPT Values of Refusal |
|---------------|------------------------------|----------------------------------|
| R16-CP01 | 10-15m | 5.0m |
| R16-CP02 | 10-15m | 6.0m |

Additional information regarding the geological profile and location of the boreholes can be found on the Geotechnical Interpretation Report, document No. BCID-ROT-ERW_GI-0016-RP-CR-0001. An extract of the Geotechnical Interpretation Report is included in Appendix 3.

Based on the current site investigation information provided, it is proposed to use piled foundations to support the bridge abutments.

8. DRAWINGS & DOCUMENTS

8.1 List of All Documents Accompanying the Submission

Appendix 1 – Photographs:

(4No. of photos)

Appendix 2 – Site Location and Drawings

- BCIDD-ROT-STR_KP-0016_XX_00-DR-SS-0001 – CBC 16 Ringsend to City Centre core Bus Corridor Scheme - Bridges and Retaining Structures - Key Plan
- BCIDD-ROT-STR_ZZ-0016_XX_00-DR-SS-0001 – Ringsend 01 General Arrangement.
- BCIDD-ROT-STR_ZZ-0016_XX_00-DR-SS-0002 – Ringsend 01. Sections

Appendix 3 – Relevant Extracts from Ground Investigation Report

(6No. of pages)

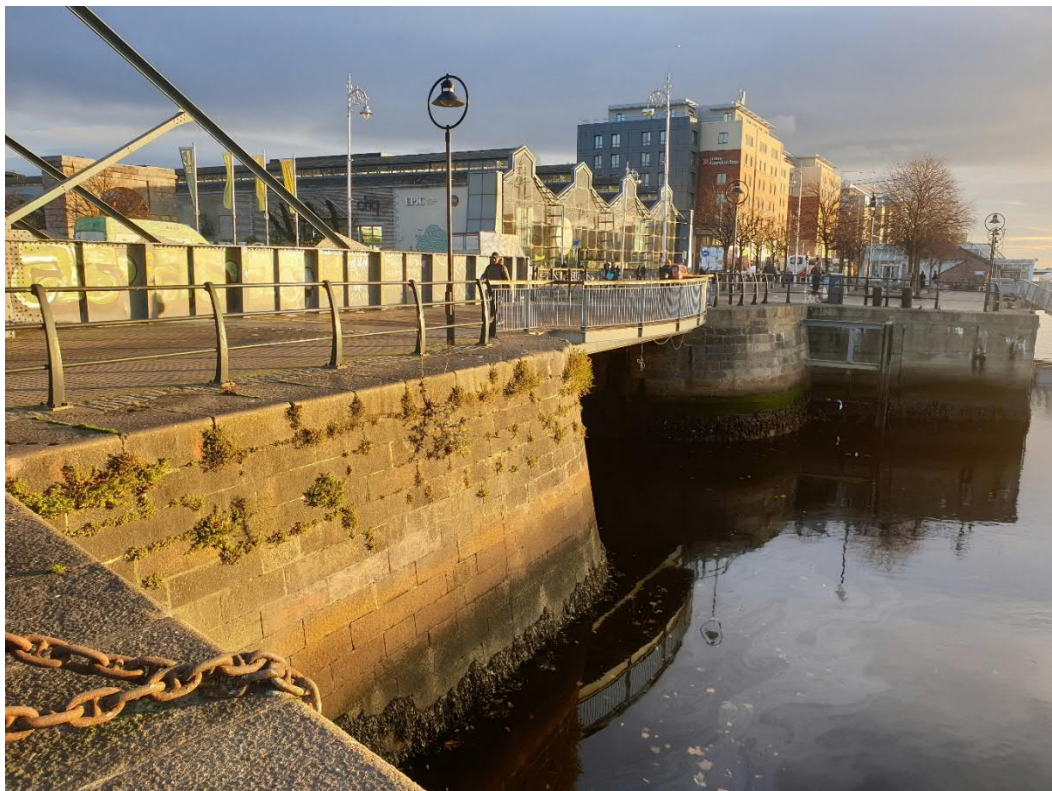
Appendix 4 – Other Relevant Documentation/Reports

(Not Used)

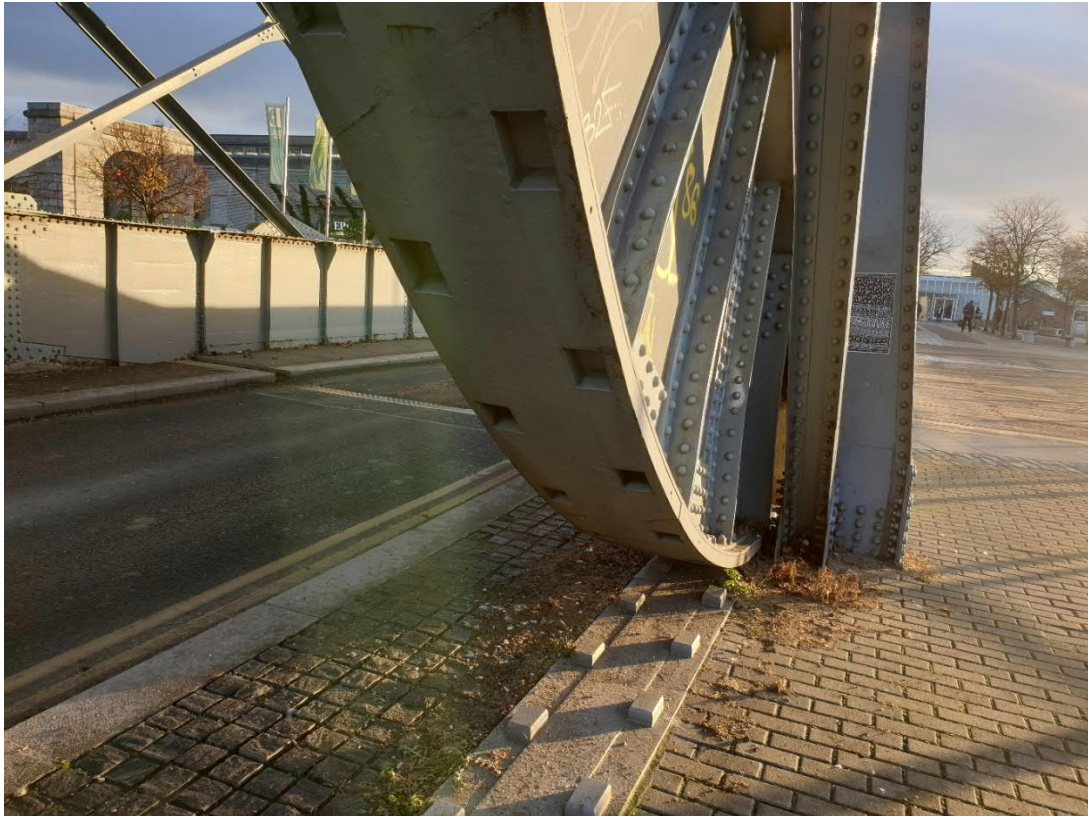
APPENDIX 1 PHOTOGRAPHS



Existing George's Dock Scherzer's bridge to be relocated– looking from the River Liffey



New location of Scherzer bridge next to the River Liffey

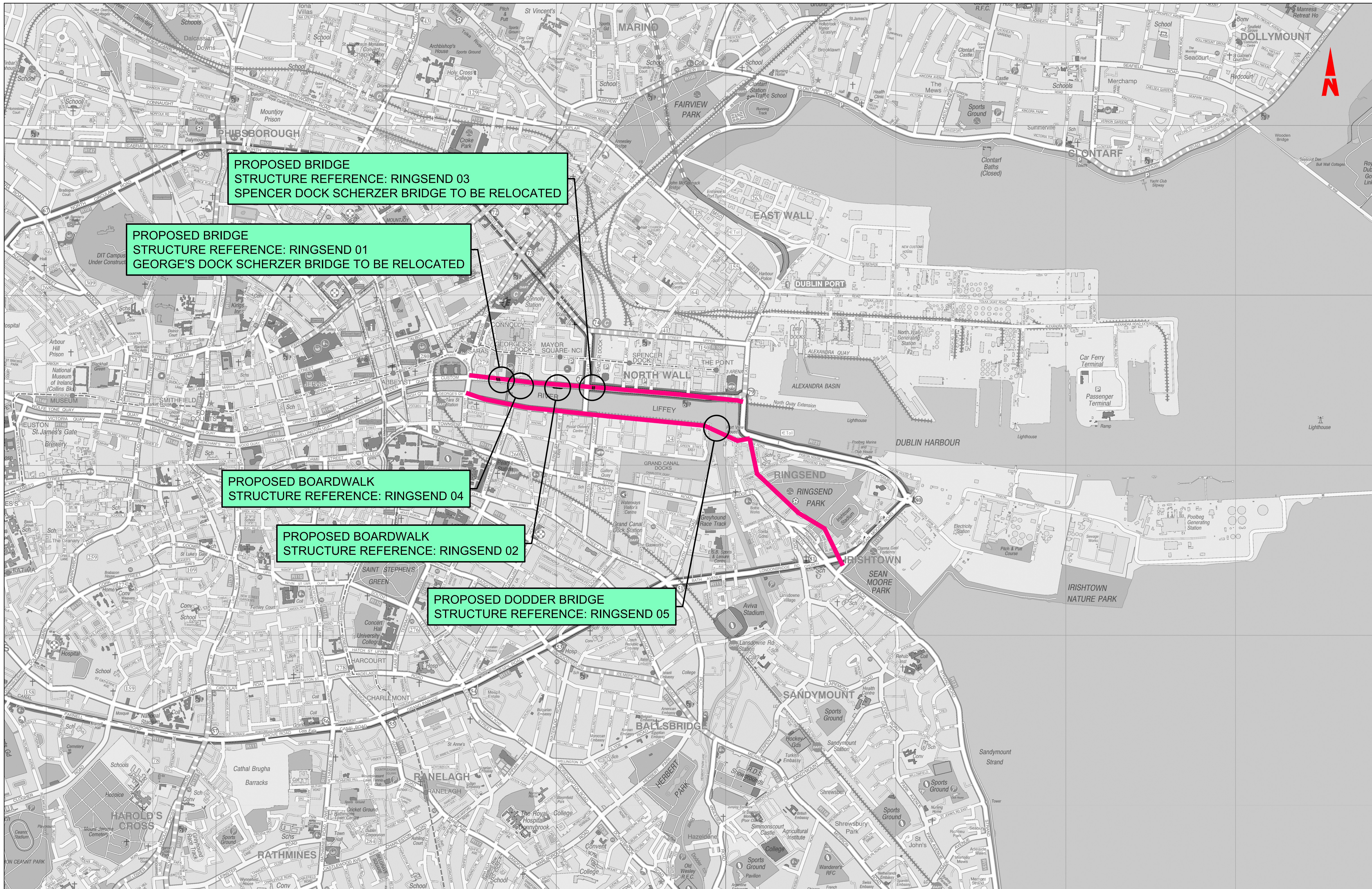


Scherzer's bridge rolling lift mechanism



Location of proposed Ringsend 01 bridge

APPENDIX 2 DRAWINGS



PROPOSED BRIDGE
STRUCTURE REFERENCE: RINGSEND 03
SPENCER DOCK SCHERZER BRIDGE TO BE RELOCATED

PROPOSED BRIDGE
STRUCTURE REFERENCE: RINGSEND 01
GEORGE'S DOCK SCHERZER BRIDGE TO BE RELOCATED

PROPOSED BOARDWALK
STRUCTURE REFERENCE: RINGSEND 04

PROPOSED BOARDWALK
STRUCTURE REFERENCE: RINGSEND 02

PROPOSED DODDER BRIDGE
STRUCTURE REFERENCE: RINGSEND 05

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| Rev | Date | Drn | Chk'd | App'd | Description |
|-----|------------|-----|-------|-------|-----------------------------|
| M01 | 06/04/2022 | JGE | EFD | SMG | ISSUE FOR PHASE 4: PLANNING |

Client: **NTA**
 Údarás Náisiúnta Iompair
 National Transport Authority

Engineering Designer: **IJROD**
 TIVISA

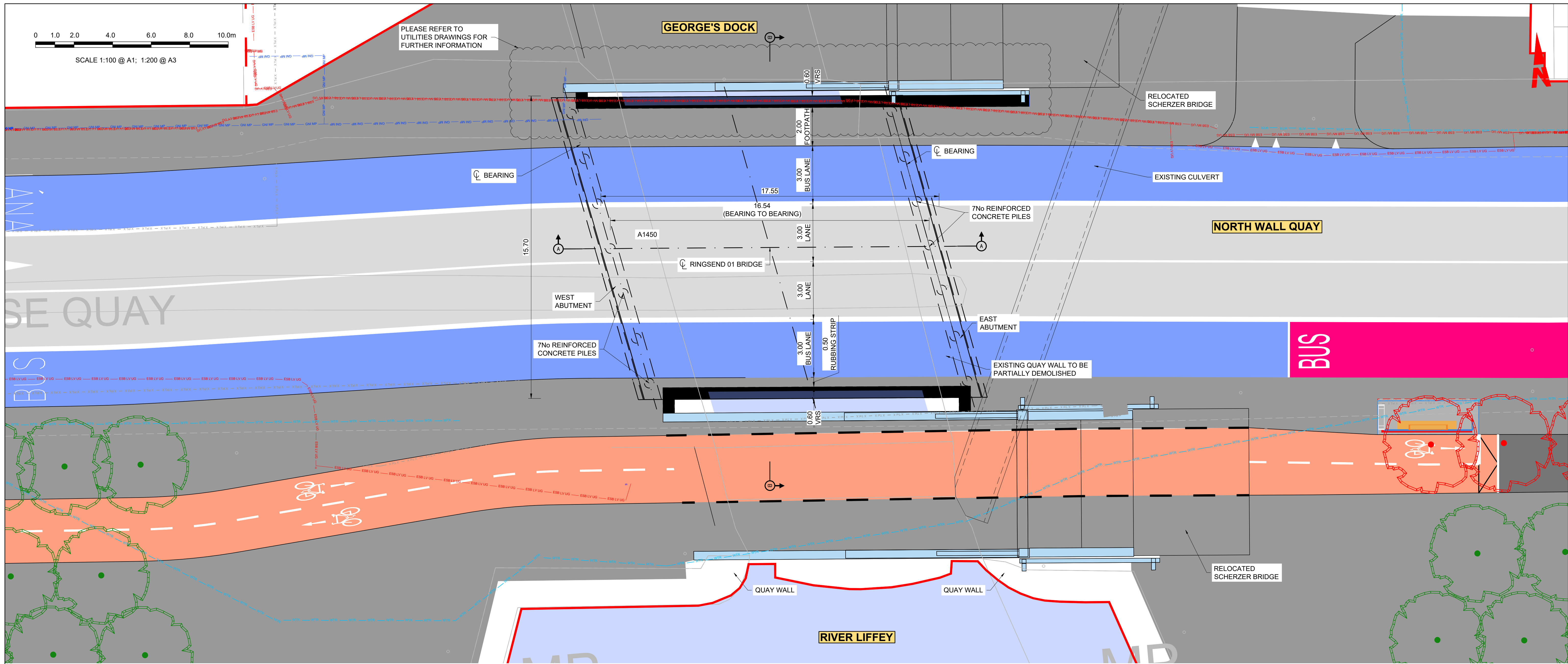
Date: 06/04/2022
 Scale: 1:10000 @ A1
 1:20000 @ A3

Drawn: JGE
 Checked: EFD
 Approved: SMG

Project Code: BCIDD
 Originator Code: NTA

QMS Code:

| Programme Title | | | |
|--|--|--------------|--------|
| BUSCONNECTS DUBLIN | | | |
| CORE BUS CORRIDORS INFRASTRUCTURE WORKS | | | |
| Drawing Title | | | |
| CBC 16 | | | |
| RINGSEND TO CITY CENTRE CORE BUS CORRIDOR SCHEME | | | |
| BRIDGES & RETAINING STRUCTURES | | | |
| KEY PLAN | | | |
| Drawing File Name | | Sheet Number | Status |
| BCIDD-ROT-STR_KP-0016_XX_00-DR-SS-0001 | | 01 of 01 | A |
| Rev | | | |
| M01 | | | |



GENERAL PLAN
SCALE 1:100

NOTES:

- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
- THE GENERAL ARRANGEMENT IS INDICATIVELY ONLY.
- PRIOR TO THE EXECUTION OF THE WORKS, THE CONTRACTOR MUST CHECK ON SITE THE GEOMETRY AND DIMENSIONS OF THE EXISTING STRUCTURAL ELEMENTS. SHOULD THE CONTRACTOR FIND ANY DISCREPANCY WITH THOSE INDICATED IN THE DRAWINGS, THEN IT SHALL BE COMMUNICATED IMMEDIATELY TO THE PROJECT DIRECTOR PRIOR COMMENCING CONSTRUCTION WORKS.
- TEMPORARY FENCING SHOULD BE ERECTED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
- ALL BURIED SURFACES TO BE WATERPROOFED IN ACCORDANCE WITH THE TII SPECIFICATION FOR ROAD WORKS.
- FOUNDATION DETAILS SUBJECT TO CONFIRMATION OR RECEIPT OF G.I.
- SAFETY BARRIER IN ACCORDANCE WITH DN-REG-03034
- PRECAST BEAM STRENGTH:
- C45/55 @ TRANSFER
- C57/70 @ 28 DAYS
- SERVICES SHOWN INDICATIVELY ONLY. THE CONTRACTOR SHALL IDENTIFY THE SERVICES ON SITE PRIOR COMMENCING CONSTRUCTION WORKS.



KEY PLAN

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| Rev | Date | Drn | Chk'd | App'd | Description |
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| M01 | 06/04/2022 | JGE | EFD | SMG | ISSUE FOR PHASE 4: PLANNING |

Client
NTA
Údarás Náisiúnta Iompair
National Transport Authority

Engineering Designer
IROD
TYPSA

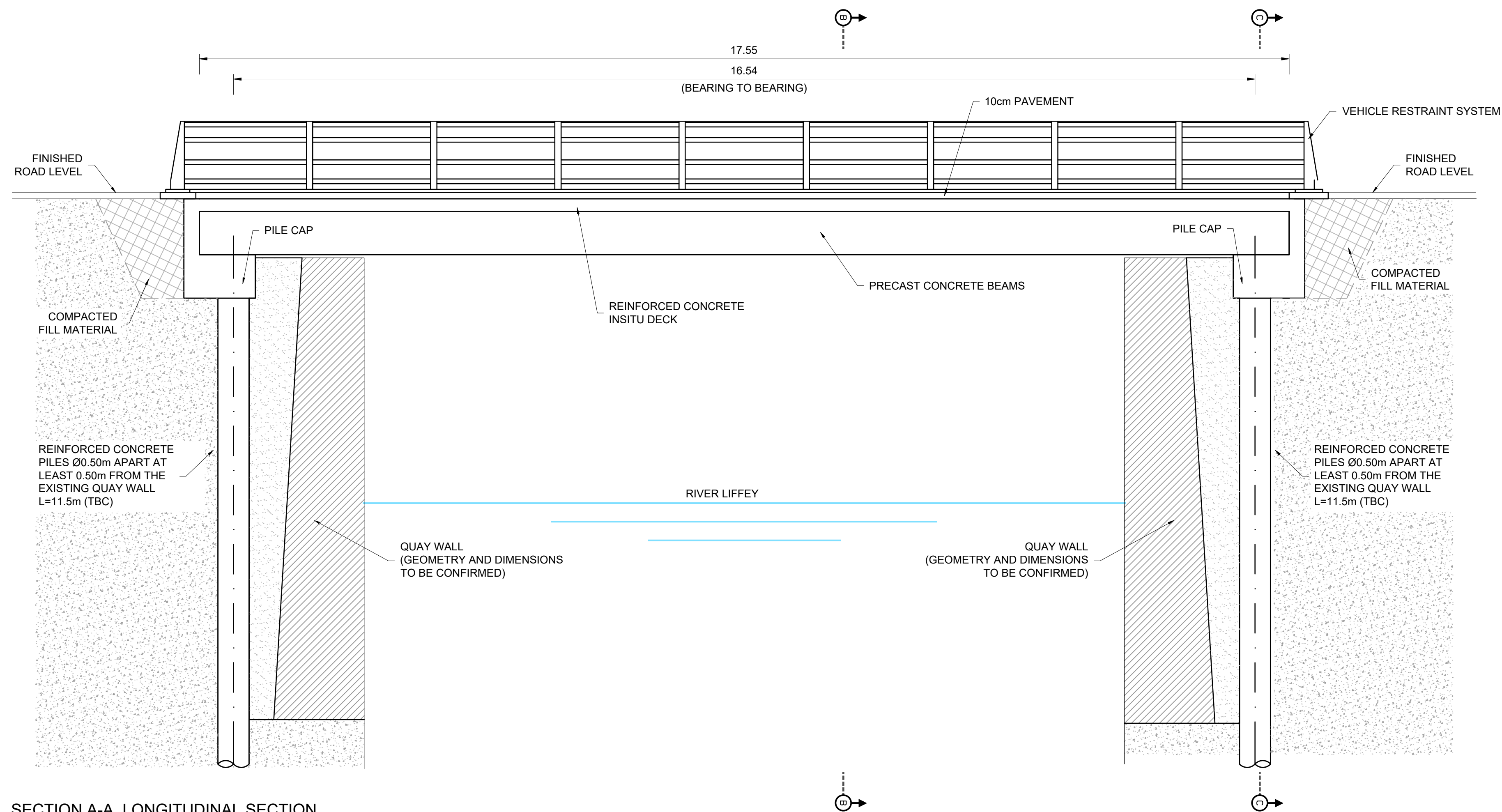
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| Date | Scale | Drawn | Checked | Approved |
| 06/04/2022 | 1:100 @ A1 1:200 @ A3 | JGE | EFD | SMG |
| Project Code | Originator Code | QMS Code | | |
| BCIDD | ROT | | | |

Programme Title
BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

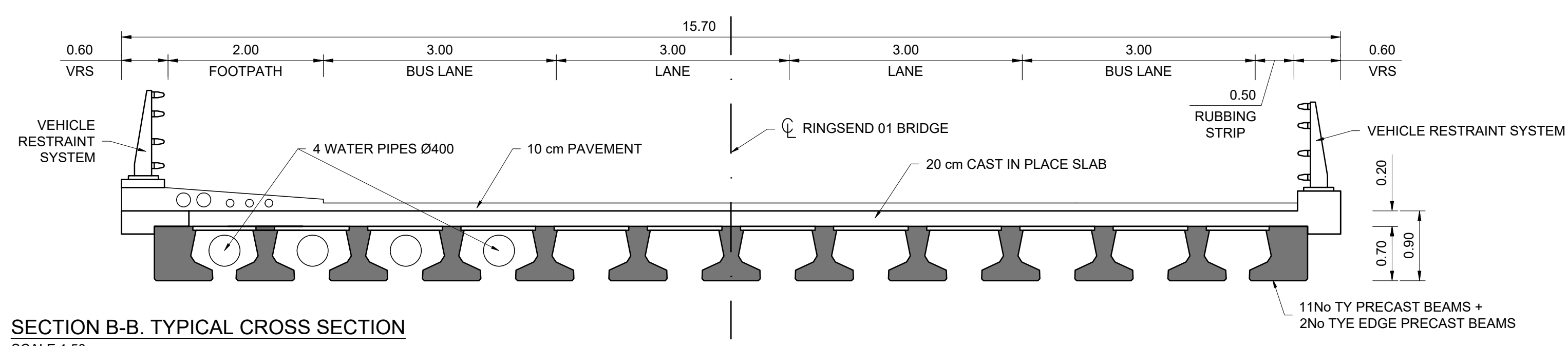
Drawing Title
RINGSEND TO CITY CENTRE CORE BUS CORRIDOR SCHEME
STRUCTURES
RINGSEND 01. GENERAL ARRANGEMENT

| | | | |
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| Drawing File Name | Sheet Number | Status | Rev |
| BCIDD-ROT-STR_ZZ-0016_XX_00-DR-SS-0001 | 01 of 02 | A | M01 |

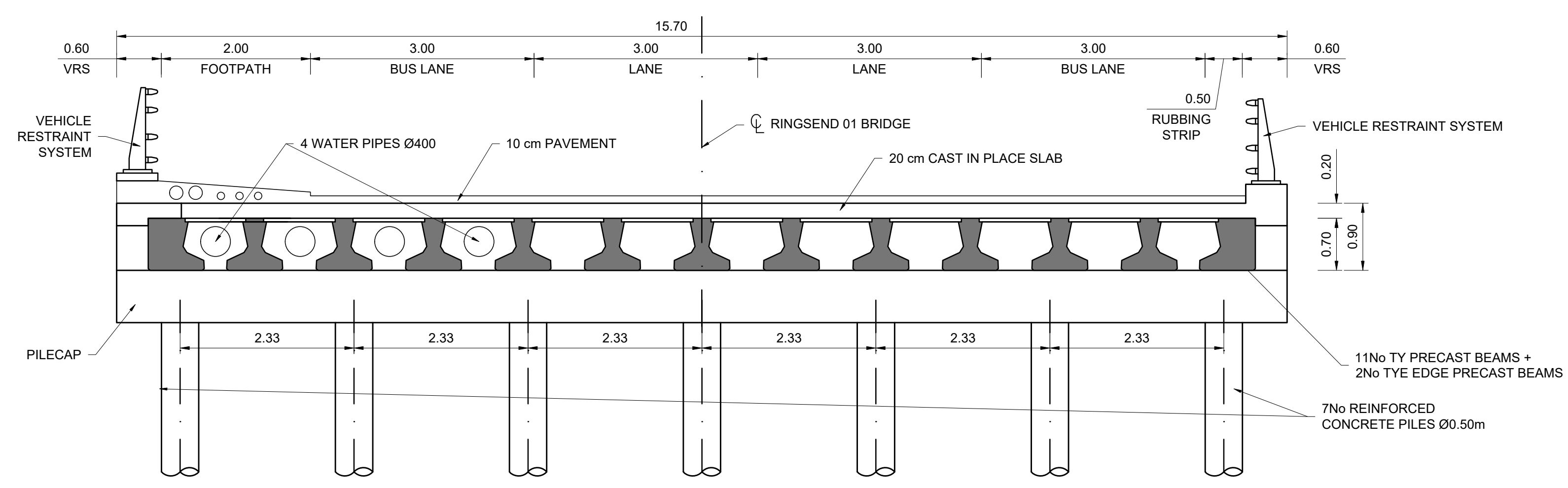
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SECTION A-A. LONGITUDINAL SECTION
SCALE 1:50



SECTION B-B. TYPICAL CROSS SECTION
SCALE 1:50



SECTION C-C. TYPICAL CROSS SECTION AT ABUTMENTS
SCALE 1:50

- NOTES:**
- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
 - THE GENERAL ARRANGEMENT IS INDICATIVELY ONLY.
 - PRIOR TO THE EXECUTION OF THE WORKS, THE CONTRACTOR MUST CHECK ON SITE THE GEOMETRY AND DIMENSIONS OF THE EXISTING STRUCTURAL ELEMENTS. SHOULD THE CONTRACTOR FIND ANY DISCREPANCY WITH THOSE INDICATED IN THE DRAWINGS, THEN IT SHALL BE COMMUNICATED IMMEDIATELY TO THE PROJECT DIRECTOR PRIOR COMMENCING CONSTRUCTION WORKS.
 - TEMPORARY FENCING SHOULD BE ERECTED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
 - ALL BURIED SURFACES TO BE WATERPROOFED IN ACCORDANCE WITH THE TII SPECIFICATION FOR ROAD WORKS.
 - FOUNDATION DETAILS SUBJECT TO CONFIRMATION OR RECEIPT OF G.I.
 - SAFETY BARRIER IN ACCORDANCE WITH DN-REG-03034
 - PRECAST BEAM STRENGTH:
- C45/55 @ TRANSFER
- C57/70 @ 28 DAYS
 - SERVICES SHOWN INDICATIVELY ONLY. THE CONTRACTOR SHALL IDENTIFY THE SERVICES ON SITE PRIOR COMMENCING CONSTRUCTION WORKS.

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| M01 | 06/04/2022 | JGE | EFD | SMG | ISSUE FOR PHASE 4: PLANNING |

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|--|-----------------------------------|--|----------------|-----------------|
| Client NTA Údarás Náisiúnta Iompair National Transport Authority | | Engineering Designer IROD TYPSA | | |
| Date 06/04/2022 | Scale 1:100 @ A1 1:200 @ A3 | Drawn JGE | Checked EFD | Approved SMG |
| Project Code BCIDD | Originator Code ROT | QMS Code | | |

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|--|--------------------------|-------------|------------|--|
| Programme Title BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS | | | | |
| Drawing Title RINGSEND TO CITY CENTRE CORE BUS CORRIDOR SCHEME STRUCTURES RINGSEND 01. SECTIONS | | | | |
| Drawing File Name BCIDD-ROT-STR_ZZ-0016_XX_00-DR-SS-0002 | Sheet Number 02 of 02 | Status A | Rev M01 | |

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APPENDIX 3

RELEVANT EXTRACTS FROM GROUND INVESTIGATION REPORT

1. INTRODUCTION AND DESKTOP REVIEW

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSI) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

The following selection of published papers has found to be of relevance to estimate the lithology and geotechnical properties:

- “Geotechnical properties of Dublin boulder clay”. Authors: Long, Michael M and Menkiti, Christopher O. Sept 2007, *Géotechnique* 57 (7): 595-611. Published by the ICE.
- Ground Investigation Report of the National Pediatric Hospital Project, Dublin. Roughan & O’Donovan Consulting Engineers, January 2015.

1.1 Overview of geotechnical conditions along the Project.

Quaternary sediments cover up to 80% of the Dublin region. Quaternary thicknesses at the city area range from 5 to 20m. Maximum thicknesses are recorded along a Tertiary channel occurring on the north shore of the River Liffey valley, reaching 45m, and along a channel-like feature running along the south margin of the Dodder valley Quaternary sediments, with a thickness of 15 to 25 m.

The most commonly occurring Quaternary deposit in the area has been termed locally as the Dublin Boulder Clay. It is a glacial deposit derived from the Lower Carboniferous Limestone and it is classified by its two main members: the Black Boulder Clay (BkBC) and the Brown Boulder Clay (BrBC). The Brown Boulder Clay is less consolidated and since it overlies the Black Boulder Clay it has been interpreted as its weathered upper layer.

The Upper Brown Boulder Clay (UBrBC) is the outcome of the oxidation of the clay particles in the top 2m to 3m of the UBkBC, resulting in a change in colour from black to brown and a lower strength material. It is usually described as thick stiff to very stiff brown, slightly sandy clay, with rare silt / gravel lenses and some rootlets, particularly in the upper metre.

The Upper Black Dublin Boulder Clay (UBkBC) is a very stiff, dark grey, slightly sandy clay, with some gravel and cobbles. It is typically 4 m to 12 m thick.

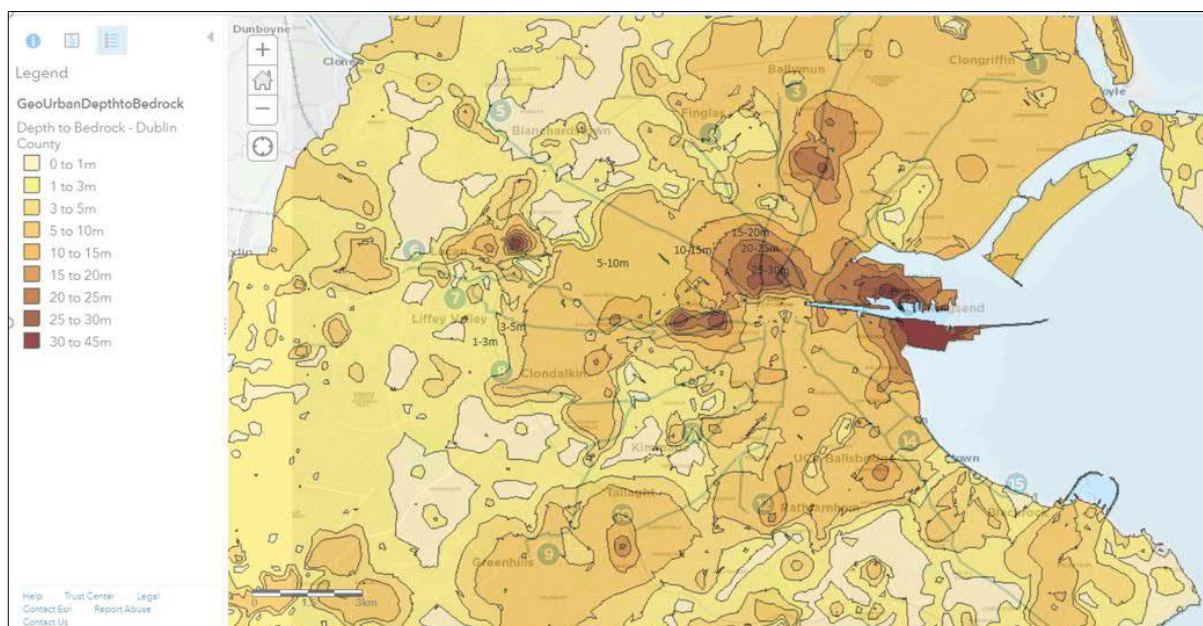
The Lower Brown Dublin Boulder Clay (LBrBC) exists as a 5 m to 9 m thick hard, brown, silty clay, with gravel, cobbles and boulders. It has previously been called the “sandy boulder clay” as it is similar to but siltier than the UBkBC above.

The Lower Black Dublin Boulder Clay (LBkBC) is a patchy layer of hard slightly sandy gravelly clay with an abundance of boulders. Its thickness does not exceed 4 m and is typically less than 2 m.

Note that not all four distinct formations of the Dublin Boulder Clay are always present. The upper two units though have been proven at all investigation sites across the city.

Bedrock close to the surface occurs mostly along the main riverbeds as well as the coastline and the higher ground areas of the Howth peninsula. The bedrock map of Ireland shows a wide variety of rock types which have originated at different periods of geological time. Underlying the project area consists of Lower Carboniferous Limestone of the Lucan Formation (Calp), which is typically described as a dark grey to black fine grained limestone.

The following image from the Geological Survey Ireland website shows the expected depth to Bedrock.



Depth of Bedrock from the Geological Survey Ireland website

The water pressures correspond to hydrostatic conditions with a groundwater table about 2m below ground level.

- *Summary of Desktop Review.*

The following preliminary lithology and geotechnical properties has been assumed based on the Desktop Review:

| Layer | Depth | Thickness | Undrained shear strength, c_u (kPa) |
|---------------------------------|------------|-----------|---------------------------------------|
| Made ground / Urban / Alluvium | 0 to 1 m | 1 | 0 |
| Upper Brown Boulder Clay, UBrBC | 1 to 3 m | 2 | 80 |
| Upper Black Boulder Clay, UBkBC | 3 to 10 m | 7 | 200 |
| Lower Brown Boulder Clay, LBrBC | 10 to 18 m | 8 | 400 |
| Lower Black Boulder Clay, LBkBC | 18 to 22 m | 4 | 600 |
| Bedrock | >22 m | N/A | >600 |

The expected depth to bedrock has been included in Section 2.

2. SUMMARY OF GROUND INVESTIGATION CONTRACT

At the date of this document, there are two GI contracts underway. Lot 1, which includes projects C and D , and Lot 2, which covers A and B projects.

Proposed ground investigation works aim to assess the geology of the site and determine the ground properties and conditions to enable the design of Bus Connects Core Bus Corridors. The GI provides for boreholes, trial pits, dynamic probes, standpipes/piezometer installation and monitoring, in-situ testing, geotechnical and environmental laboratory testing and preparation of a factual report, all in accordance with the “*Specification and Related Documents for Ground Investigation in Ireland*”.

At the Project D schemes (Ballymun/Finglas to City Centre, Kimmage to City Centre and Ringsend to City Centre), there are 21 proposed investigation points, consisting of Cable Percussion (CP) and Rotary Core (RC) boreholes as well as few windowless dynamic samples (WS) in restricted space areas. The location of these points can be found in the form of drawings in the “*BusConnects Detailed Ground Investigation – Stage 1 – LOT 1*”, February 2020.

In situ tests mainly include standard penetration tests. Laboratory tests mainly include particle size distribution, Atterberg limits, density and moisture content to identify soils and direct shear strength, triaxial CU or UU and uniaxial compression to determine the strength of the soil/rock.

For more details see the “*BusConnects Detailed Ground Investigation – Stage 1 – LOT 1*”, February 2020.

For the Ringsend to City Centre Core Bus Corridor Scheme, the following investigation points have been proposed:

| Borehole Ref. | Expected Depth to Bedrock | Borehole Depth (m) – Cable Percussion | Borehole Depth (m) – Rotary Core |
|---------------|---------------------------|---------------------------------------|----------------------------------|
| R16-CP01 | 10-15m | 15 | - |
| R16-CP02 | 10-15m | 15 | - |
| R16-CP03 | 15-20m | 15 | - |
| R16-CP04 | 15-20m | 15 | - |

3. SUMMARY OF FACTUAL REPORT

The following factual report was issued as part of the Lot 1 GI:

- Detailed Stage 1 Lot 1 Route 16. June 2021

Completed investigation points are as summarised below:

| Structure | Borehole Ref. | Expected Depth to Bedrock | Borehole Depth (m) – Cable Percussion | Borehole Depth (m) – Rotary Core | Notes |
|-------------|---------------|---------------------------|---------------------------------------|----------------------------------|-------|
| Ringsend 01 | R16-CP01 | 10-15m | 5.0 | - | |
| | R16-CP02 | 10-15m | 9.1 | - | |
| Ringsend 03 | R16-CP03 | 15-20m | 12.3 | - | |
| | R16-CP04 | 15-20m | 13.5 | - | |

The GI works undertaken comprise 4 No. Cable Percussion Boreholes to a maximum depth of 13.5m BGL; 22 SPT tests at 1 metre intervals alternating with disturbed samples and 6 GWL recordings.

13 disturbed samples were taken at each change of soil consistency or between SPT tests and 4 undisturbed samples (UT100) where ground conditions permit. Geotechnical testing consisting of 13 moisture content, 2 Atterberg limits, 2 Bulk Density and 9 Particle Size Distribution. Soil strength testing consisted of 4 Vane tests and 4 Shear Box.

Environmental & Chemical testing consisted of 19 Suite E samples and 1 pH and organic matter content test.

4. OVERVIEW OF SOIL CLASSIFICATION

4.1 Made ground

Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to depths of between 2.50m and 5.30m BGL.

Made ground deposits were described generally as either brown, sandy gravelly Clay with cobbles or greyish brown clayey gravelly Sand with occasional cobbles and contained occasional fragments of concrete, plastic, red brick and wood.

Note that a culvert was encountered in borehole R16-CP02 between 3.0 and 5.3m, which was noted as a void on the log.

The Particle Size Distribution tests confirm that generally the Made ground deposits are well-graded with percentages of sands between 22% and 53% and percentages of gravels between 31% and 69%.

PH and total organic carbon (TOC) were determined at R16-CP04 at 0.5m depth. Organic matter content (OMC) was estimated from TOC. PH, TOC and OMC values were 9.3, 1.6% w/w C and 2.8% w/w respectively.

Asbestos was detected at 0.5m depth at borehole R16-CP03.

4.2 Cohesive deposits

Cohesive deposits were encountered beneath the Made Ground or interbedded with Granular Deposits and were described typically as grey slightly sandy silty CLAY.

The strength of the cohesive deposits was typically very soft till depths of 11.7mBGL.

Cohesive deposits found to be a CLAY of high plasticity, with a plasticity index ranging between 29% and 31%. Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 11% and 15% and 2% and 5%, respectively.

4.3 Granular deposits

Granular deposits were encountered interbedded with cohesive deposits in the majority of holes and were typically described as either greyish sandy sub rounded to rounded fine to coarse GRAVEL with occasional cobbles or gravelly fine to coarse SAND.

Based on the SPT N values the deposits vary from loose to dense.

Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 18% and 58% and 33% and 69%, respectively.

5. SUMMARY OF GROUND INVESTIGATION INTERPRETATIVE REPORT

For Ringsend to City Centre CBC scheme, the following lithology and soil strength properties has been assumed based on the GI findings:

| Layer | Depth (m) | SPT | Undrained shear strength, c_u (kPa) |
|--|-----------------------------|-----|---------------------------------------|
| Topsoil, Concrete | 0 to 0.5 | - | - |
| Made Ground: Brown Clay (possibly UBrBC) / Sand / Gravel | 0.5 to 6 | 6 | 40 |
| Very soft silty Grey Clay (only found in 2 out of 4 boreholes) | 6 to 12 | 3.5 | 20 |
| Gravel | Top level between 6 and 12m | 50 | 325 |

- 2 Vane tests at Made Ground Sand layer, defined as brown very sandy Gravel or brown very gravelly Sand, have shown Peak shear strength values higher than 146 kPa.
- 2 Vane tests at soft silty clay layer, shown Peak shear strength values between 11 and 13 kPa.
- 2 Shear Box tests at Made Ground Sand layer, defined as brown silty (very) gravelly Sand, shown angle of peak shearing resistant values between 34 and 44 degrees and effective cohesion values between 4 and 13 kPa.

The geological geotechnical ground profile can be found at Appendix 1.

Ground parameters from in situ and lab tests are shown in Appendix 2.

6. HIDROGEOLOGY

Groundwater was noted during the investigation although the exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime. However, standpipes were installed to allow the equilibrium groundwater level to be determined.

Groundwater levels recorded during the GI works are summarized below:

| Date: | 20/4/21 | 16/6/21 |
|----------|---------|---------|
| R16-CP01 | 4.46 | 4.72 |
| R16-CP02 | 5.03* | - |
| R16-CP03 | - | 2.47 |
| R16-CP04 | 3.73 | 4.40 |

* Water depth might be unrepresentative due to culvert

7. GEOTECHNICAL INPUT TO STRUCTURES

The following table shows the expected depth to bedrock, based on the data from the Desktop Review, as well as the depth of the encountered bedrock in the GI undertaken.

Note that most of the boreholes were terminated at a shorter length, before encountering the bedrock strata. Therefore, the expected depth to bedrock could not be confirmed.

| Structure | Permanent loads / Variable loads (KN) | Borehole Ref. | Expected Depth to Bedrock | Depth to encountered Bedrock | Depth to N_{SPT} values of Refusal | Piles estimated length (m) |
|-----------------------|---------------------------------------|---------------|---------------------------|------------------------------|--------------------------------------|----------------------------|
| Ringsend 01 D=0.5m | 294 / 623 | R16-CP01 | 10-15m | - | 5m | 11.0 |
| | | R16-CP02 | 10-15m | - | 6m | 11.5 |
| Ringsend 02 D=0.2m | 50 | R16-CP03 | 15-20m | - | 12.5m | 11.5 |
| | | R16-CP04 | 15-20m | - | 12.5m | 12.5 |
| Ringsend 03 D=0.5m | 210 / 604 | R16-CP03 | 15-20m | - | 12.5m | 15.5 |
| | | R16-CP04 | 15-20m | - | 12.5m | 16.5 |

A preliminary number of the characteristic compressive resistance of piles has been obtained following the alternative procedure in accordance with the Eurocode 7 and the Irish National Annex. This procedure makes use of the ground parameters (such as the undrained shear strength, c_u) to estimate the shaft and base compressive resistance of piles.

c_u values have been derived from SPT values obtained in each borehole following the SPT- c_u relationship proposed by Stroud and Butler (1975). Calcs can be found at Appendix 3.

In Ringsend 01 and 03 0.5m diameter driven piles embedded in the Dublin boulder clay and Ringsend 02 0.2m piles, the estimated piles length that satisfies the ULS is as detailed in the table above.

APPENDIX 4 OTHER RELEVANT DOCUMENTATION/REPORTS

(Not used)