Appendix J4
Preliminary Design Report – Structure 04

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): Ballymun 04 Underbridge

Preliminary Design Report

Reference	BCIDD-ROT-STR-ZZ_0003-XX_00-RP-CB-0018
Revision	L04
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Submitted by

Signed: 

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Date: 02/06/2022

Structures Section confirmation of consultation:

Signed: _____

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Position: _____

Date: _____

BUSCONNECTS INFRASTRUCTURE DELIVERY – PROJECT D

PRELIMINARY DESIGN REPORT – BALLYMUN 04

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1. INTRODUCTION

1.1 Brief

Roughan & O'Donovan-TYPSA have prepared this report for the National Transportation Authority (NTA) for the design of the Ballymun 04 underpass as part of the BusConnects Infrastructure Delivery – Project D.

1.2 Background Information

The proposed scheme for Ballymun/Finglas 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 Ballymun 04 underpass 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 accommodate an arterial road (6.2m + 6.2m carriageway) and footpaths at the North Circular Rd, as well as providing north-south passage of the cycle lane and footpath under this street.

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_0003-XX_00-RP-CB-0014 – Structures Options Report: Ballymun 04
- BCID-ROT-ERW-GI_0304-RP-CR-0001 – Geotechnical Interpretive Report: Ballymun/Finglas Corridors

2. SITE & FUNCTION

2.1 Site Location

The Ballymun underpass is situated at the crossing point between the proposed BusConnects corridor and North Circular Road. The site location plan is included in Appendix 2.

2.2 Function of the Structure

The objective of the new underpass is to allow the unimpeded north-south passage of the cycle lane and footpaths under the North Circular Road. The intention is to provide a wide and luminous passage, providing continuity to the green zone of transit towards the library.

2.3 Choice of Location

The location of the structure was chosen to facilitate the proposed Ballymun / Finglas 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.

The level of the existing carriageway at the centreline of the road is at 25.60m and at 25.20m at the west and east abutments, respectively.

2.5 Vertical and Horizontal Alignments

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

Horizontal Alignment

The North circular road 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, falling between the west and east abutment at a constant gradient of 2.24%.

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: Ballymun 04 Cross-Section

Parameter	Value
Parapet Upstand	0.6 m
Raised Verge/Footway	Varies
Carriageway	12.4 m
Raised Verge/Footway	Varies
Parapet Upstand	0.6 m
Out-to-Out Width	**19.20 m**

2.7 Existing Underground and Overground Services

A list of the existing services located in close proximity to the Ballymun 04 underbridge 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 watermains 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 and is not crossing a watercourse.

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 Ballymun underpass shall be a single span precast concrete beam and in-situ concrete slab superstructure made integral at the reinforced concrete end supports.

3.2 Aesthetic Considerations

The bridge form is typical for underpasses and is a straightforward form of construction. The depth of the deck has been minimised as far as practicable to give a slender span-depth ratio.

The width of the underpass meets the intention to design an open and luminous passage to the green zone of transit towards the library. The level of the existing carriageway has been kept, maintaining the overall aesthetic to the area while providing continuity to the green corridor through the underpass at the North Circular Road.

The parapets will require aesthetic 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 underpass is a Category 2 structure.

3.3.2 Span Arrangements

The underpass is a single span bridge of 15.75m length with a deck straight in plan and has a skew angle of approximately 5 degrees.

3.3.3 Minimum Headroom Provided

A minimum vertical clearance of 3 m is to be provided to the footway and cycleway below the structure.

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 cap, where the precast beams will be supported. 12No. piles are proposed per abutment of 0.8 m diameter.

3.3.6 Substructure

Abutments will consist of an in-situ reinforced concrete diaphragm/bank-seat supported by a pile cap connected to a reinforced concrete pile wall. The pile wall shall have an architectural concrete lining at the interior of the underpass.

3.3.7 Superstructure

The bridge deck will be formed from precast prestressed concrete 'TY' beams acting compositely with a cast in-situ reinforced concrete infill deck slab.

3.3.8 Articulation Arrangements (Joints and Bearings)

The structure will be designed to be a fully integral 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 TD 19) 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. 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

The proposed longitudinal gradient of the road is a 2.24% fall from west to east along the carriageway. 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 the eastern approach to the bridge. Gullies will also be provided on the western approaches to collect surface water on the western approach.

Back-of-wall drainage will be provided behind the abutments and will discharge to the nearest drainage network under the bridge.

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 concrete beam and infill slab type deck bridge 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.

The proposed structure is an integral bridge therefore maintenance requirements will be minimal. The top of the structure will be accessible from north circular road. The underside can be inspected from the proposed cycle track running underneath the bridge.

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, which should not incur any substantial maintenance costs.

Parapets

Galvanised steel parapets are 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. Due to the importance of the existing carriageway, it is envisaged that the construction of this structure is undertaken in two phases, with approximately half of the bridge width constructed in each phase. This will allow traffic flow to be maintained during construction, albeit with restrictions.

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".

As it is envisaged that the construction of this structure is undertaken in two phases, with approximately half of the bridge width constructed in each phase, temporary edge protection will be required.

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 (historical ref. TD 27).

4.4 Lighting

Lighting under the bridge will be provided in accordance with BS-5489-1.

5. DESIGN ASSESSMENT CRITERIA

5.1 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.

5.1.1 Permanent Actions

The following nominal densities will be adopted:

- Reinforced concrete 25 kN/m^3
- Structural steelwork 77 kN/m^3
- Pavement 23 kN/m^3
- Backfill to structures 20 kN/m^3

5.1.2 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.

5.1.3 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.

5.1.4 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).

5.1.5 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_{fwk}) of 20kN as defined in section 5 of IS EN 1991-2 and the Irish National Annex.

5.1.6 Provision for Exceptional Abnormal Loads

None.

5.1.7 Accidental Actions

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

5.1.8 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.

5.1.9 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.

5.2 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;
- Iarnród Éireann;
- Irish Water.

5.3 Proposed Departures from Standards

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

5.4 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.

6. GROUND CONDITIONS

6.1 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".

6.2 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 6.1: Encountered bedrock in the vicinity of Ballymun 04

Borehole Ref.	Depth to Encountered Bedrock	Depth to N SPT Values of Refusal
R3-RC01	18.5m	9.5m
R3-RC02	18.5m	6.5m
R3-RC03	18.5m	8m
R3-WS01	-	-
R3-WS02	-	-
R3-CP14	-	5m

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-0304-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.

7. DRAWINGS & DOCUMENTS

7.1 List of All Documents Accompanying the Submission

Appendix 1 – Photographs:

(4No. of photos)

Appendix 2 – Site Location and Drawings

- BCIDD-ROT-STR_KP-0304_XX_00-DR-SS-0001 – Bridges and Retaining Structures Key Plan
- BCIDD-ROT-STR_ZZ-0304_XX_00-DR-SS-0007 – Ballymun 04 General Arrangement Sheet 1
- BCIDD-ROT-STR_ZZ-0304_XX_00-DR-SS-0008 – Ballymun 04 Sections

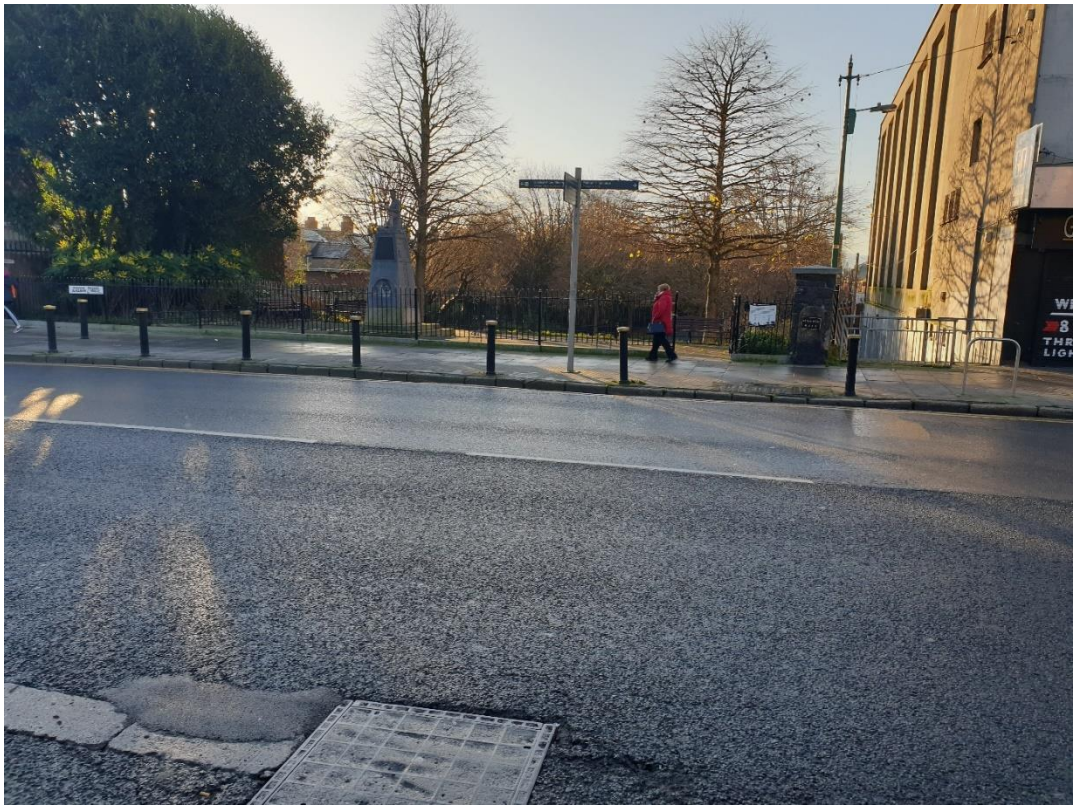
Appendix 3 – Relevant Extracts from Ground Investigation Report

(8No. of pages) Extract GIR - BCID-ROT-ERW_GI-0304-RP-CR-0001

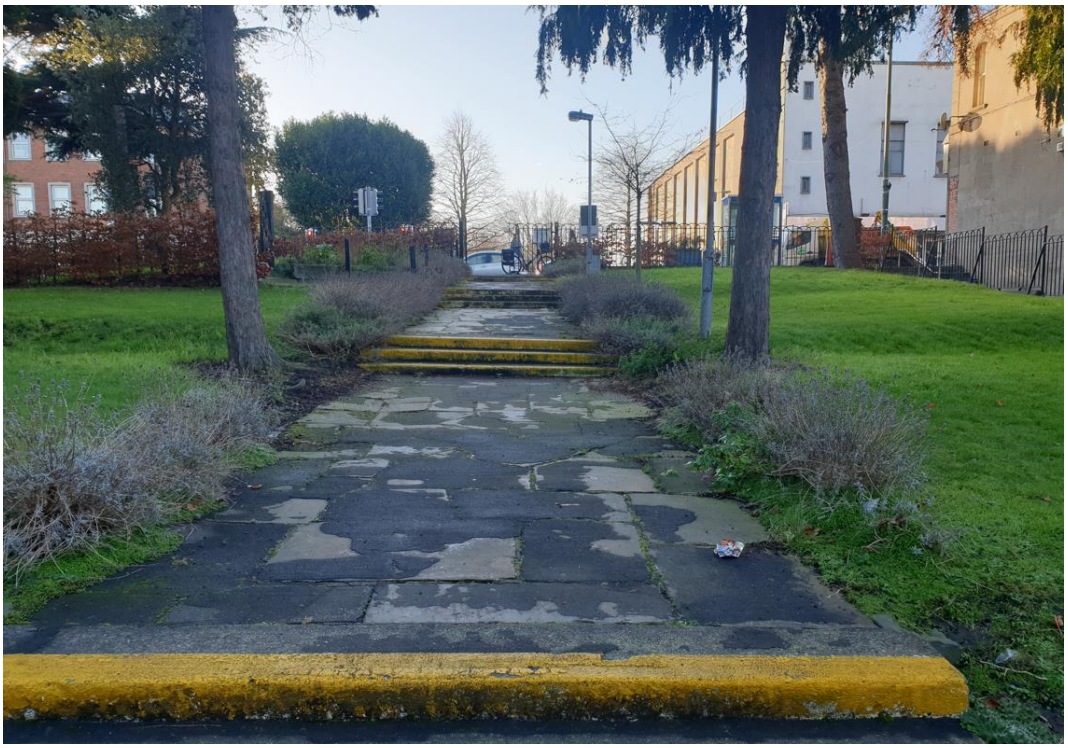
Appendix 4 – Other Relevant Documentation/Reports

(Not Used)

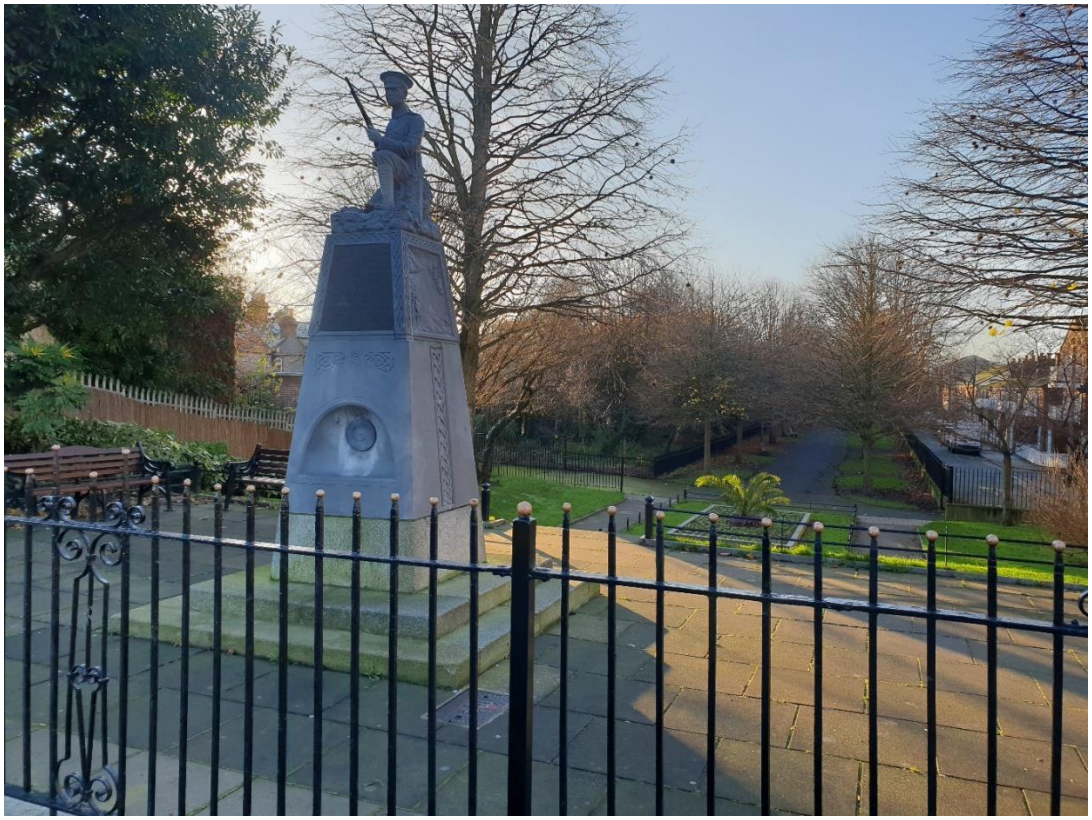
APPENDIX 1
PHOTOGRAPHS



Location of proposed Ballymun 04



View from the Library to location of proposed Ballymun 04



End of the walk at Blessington Street Park – proposed Ballymun 04 to allow unimpeded passage to the Library

Library – Proposed Ballymun underpass to allow unimpeded passage from Blessington Street Park

APPENDIX 2
DRAWINGS

APPENDIX 3
RELEVANT EXTRACTS FROM GROUND INVESTIGATION REPORT

APPENDIX 4
OTHER RELEVANT DOCUMENTATION/REPORTS

(Not used)