Appendix B

Preliminary Bridge Design Report

Wicklow County Council

Bray Sustainable Transport Bridge

Preliminary Bridge Design Report

RDPTB-ARUP-ZZZ-BRD-RP-CB-0003

P02 | 10 February 2021

Job number 268095-00

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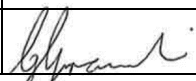
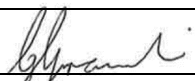
		Signature			
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Contents

Appendices

Appendix A

Drawings

Executive Summary

Structure

Name:	Bray Sustainable Transport Bridge
Location:	N: 219231.000
	E: 326745.000
Primary Function:	To carry the proposed link road between Dublin Road and Bray Station over the River Dargle
Check Category:	Category 3
Loading:	LM1 and LM2, as defined in IS EN 1991-2-2003
	LM3 (SV100 & SV196), as defined in NA to
	IS EN 1991-2-2003
	Tramway loading as defined in this report

Passages

Primary

Number: Link Road (no. TBC) Name: TBC

Future

Luas Line B2 Extension

Recommendations

Arup recommends that the structure be a single-span Bowstring Arch bridge as described by Option C in RDPTB-ARUP-ZZZ-BRD-RP-CB-0001. It is proposed that the bridge be of fully integral construction, with abutments supported by piled foundations. The superstructure will comprise a steel box girder with a composite concrete deck slab. Steel cantilever ribs will extend off the central box to support the deck. The deck will be supported from above by a series of 12 high-strength steel hangers connected into the arch. The arch will consist of twin tubular steel sections, filled with concrete to create a composite arch structure.

Cost

Refer to the Order of Magnitude Cost Estimate Report (RDPTB-ARUP-ZZZ-ZZZ-RP-ZZ-0002).

Constraints

Constraints for this project have been identified and discussed in the Constraints Report (RDPTB-ARUP-ZZZ-BRD-RP-CB-0002).

1 Introduction

1.1 Design Brief

Arup have been appointed by Wicklow County Council as the designer for the Bray Sustainable Transport Bridge.

The Designer's brief is to undertake full consultancy services for the delivery of the bridge, from concept design through to statutory approval, detailed design, tender, construction and handover of the works.

1.2 Background

The Public Transportation Route linking Dublin Road to Bray DART station was first proposed in the '*North Bray & Environs Land Use and Transportation Study*', July 2006, commissioned jointly by Dun Laoghaire Rathdown County Council (DLRCC), WCC & Bray Town Council. In 2006 the Railway Procurement Agency progressed the design of LUAS Line B2, which is the extension of Luas from Cherrywood to Bray. The emerging preferred route corridor included the route of the Public Transportation Link to bray Dart station through the Former Golf Club Lands.

A development proposal brought forward by the owners of the Former Golf Club Lands facilitated the Public Transportation Link by including road infrastructure through the Golf Club Lands in addition to the Public Transportation Bridge over the Dargle as part of the planning design for the scheme. The development proposal was approved by An Bord Pleanála (PL 39.230246) in 2010 with a 10-year permission that remains valid (BTC/WCC 07/194). While the majority of the development proposal has not progressed, a significant portion of the road infrastructure has been implemented as part of a separate planning approval for the recently completed schools development on the Golf Club Lands.

Funding for this project was secured through the Urban Regional Development Fund (URDF) to proceed with the technical consultancy services associated with the design and construction of the public transportation bridge. Arup has been appointed to carry out these consultancy services.

1.3 Previous Studies

The Bray Municipal District Local Area Plan 2018-2024 includes Road Objective 5 (RO5) which identifies linkages through the Bray Golf Club site between Dublin Road and Bray seafront/the DART station. The plan identifies this connection from Dublin Road to Bray Station as being an essential link. Public Transport Objective 3 includes promoting the linkage of the Luas extension or other mass transit to Bray town centre and Bray train station. The preferred strategy of the NTA in the draft 'Bray and Environs Transport Study' includes the Public transport, pedestrian and cycle bridge from the Golf Club Lands to Bray DART station for future use by Luas.

A non-exhaustive list of some of the studies that have informed the design of the bridge is given below,

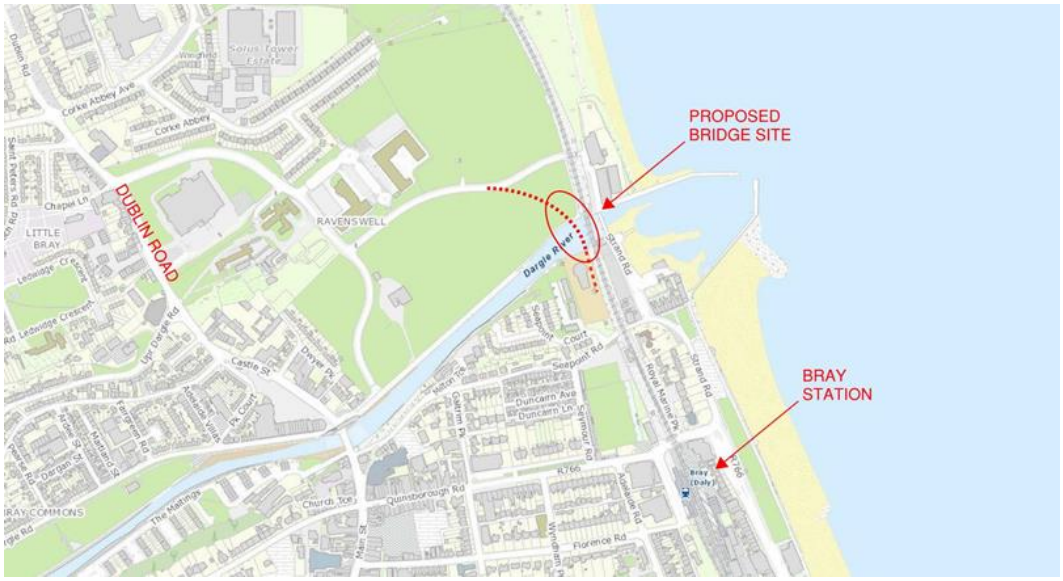
- Environmental Impact Assessment Screening;
- Appropriate Assessment Screening
- Topographical Survey;
- Preliminary and detailed Ground Investigation;
- Flood Risk Assessment
- Constraints Report.

2 Site & Function

2.1 Site Location

The Bray Sustainable Transport Bridge is proposed to cross the River Dargle close to the existing railway bridge, providing a pedestrian, cycleway and public transport link between Dublin Road and Bray DART station.

Figure 1: Site Location



2.2 Function of structure and obstacles crossed

The proposed bridge will carry the public transportation route over the River Dargle and carry the mainline through the narrow corridor of land to the south between the existing railway line embankment and Bray Pumping Station. The proposed bridge will be in close proximity to the existing rail line and the existing water pumping station.

2.3 Choice of location

A development proposal brought forward by the previous owners of the Former Golf Club Lands facilitated a public transportation link by including road infrastructure through the Golf Club Lands in addition to a bridge over the River Dargle. This development proposal was approved by An Bord Pleanála in 2010 with a 10-year permission that remains valid (BTC/WCC 07/194).

Wicklow County Council had previously advised that all lands needed for the construction and operation of the public transportation bridge were within the control and ownership of the project's partners. The Former Golf Club Lands have since been acquired by Ballymore Group. Ballymore will now undertake its own master plan for the land, with the proposed road alignment and bridge arrangement incorporated into their plans.

2.4 Site description and topography

The River Dargle is approximately 57m wide at the location of the proposed crossing.

The Former Golf Club Lands lie to the north and comprise of a semi-greenfield site, with a pedestrian and cycle track running adjacent to the river bank wall. A network of below ground services also run approximately parallel to the river bank wall at this location.

Bray Pumping Station is located to the south, the boundary of which forms a constrained corridor with the railway line.

The existing rail bridge is located directly downstream (east) of the proposed bridge, with an existing road bridge adjacent to that.

The river is tidal in this region and outlets into Bray Harbour to the east.

2.5 Vertical and Horizontal alignments

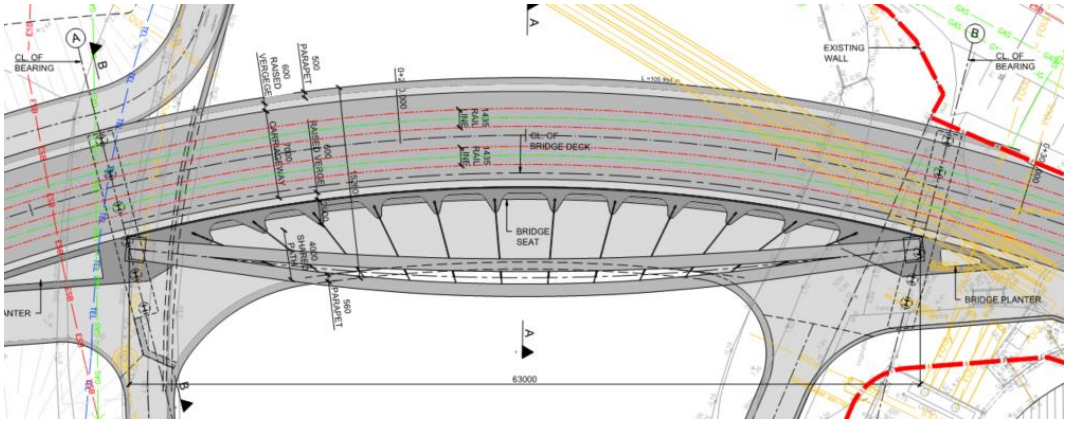
Link Road Mainline alignment

Horizontal – The alignment is on a horizontal curve of radius 133m over the extent of the structure.

Vertical – The alignment is on a vertical crest curve of radius 2,000m over the extent of the structure.

Design Speed – 50 km/h

Figure 2: Horizontal alignment of the proposed bridge



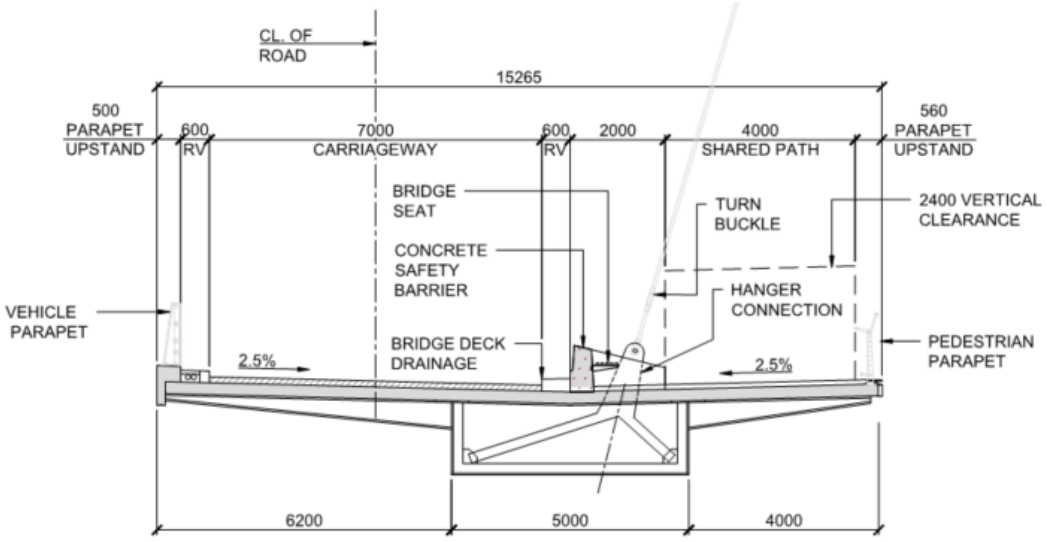
2.6 Cross sectional dimensions on the alignments

Due to the curved nature of the horizontal alignment relative to the supporting arch structure, the bridge cross section varies. Table 1 defines a typical cross section at approximately midspan.

Table 1: Cross sectional dimensions along alignment

Road Cross Section	Width (mm)
Parapet	500
Raised Verge	600
Carriageway	7000
Raised Verge	600
Cable connection (median)	2000
Shared Pedestrian/Cycleway	4000
Parapet	560

Figure 3: Cross section of proposed bridge



2.7 Existing underground and Overground Services

There are multiple services running through the proposed bridge site. On the northern approach, gas, sewer and ESB lines run approximately parallel to the existing river bank wall. These services will be impacted by the proposed foundation works in this area and will require a utilities diversion.

On the southern side of the site, two sewer lines run from Bray Pumping Station in the south towards Shanganagh Waste Water Treatment Plant in the north. These lines run through the proposed location of the southern abutment and beneath the river. These lines are identified as crucial to the performance of the Pumping Station and impose a significant constraint on any proposed bridge foundations in this area.

2.8 Geotechnical Summary

The ground conditions in the area typically consist of a downward sequence of made ground, loose gravels and soft silts and peats, dense gravels and boulder clay with bedrock located approximately 20.5 m below the existing ground level. For ground conditions such as this, shallow (pad) foundations are not considered appropriate and it is proposed that piled foundations are used.

The existing Bray Pumping Station was constructed on a site that was historically used for gas works. Hence, there is potential for contaminated soils at the location of the southern abutment. This will need to be confirmed prior to construction and suitable measures put in place to dispose of this material if encountered.

2.9 Hydrology and Hydraulic Summary

The river flow velocity and levels associated with various flood events were assessed in the flood study undertaken as part of the River Dargle Flood Defence Scheme. The model comprised a physical study, undertaken by HR Wallingford and documented in the "*River Dargle at Bray Eire, Flood Defence Scheme, Physical Model Study, February 2009*".

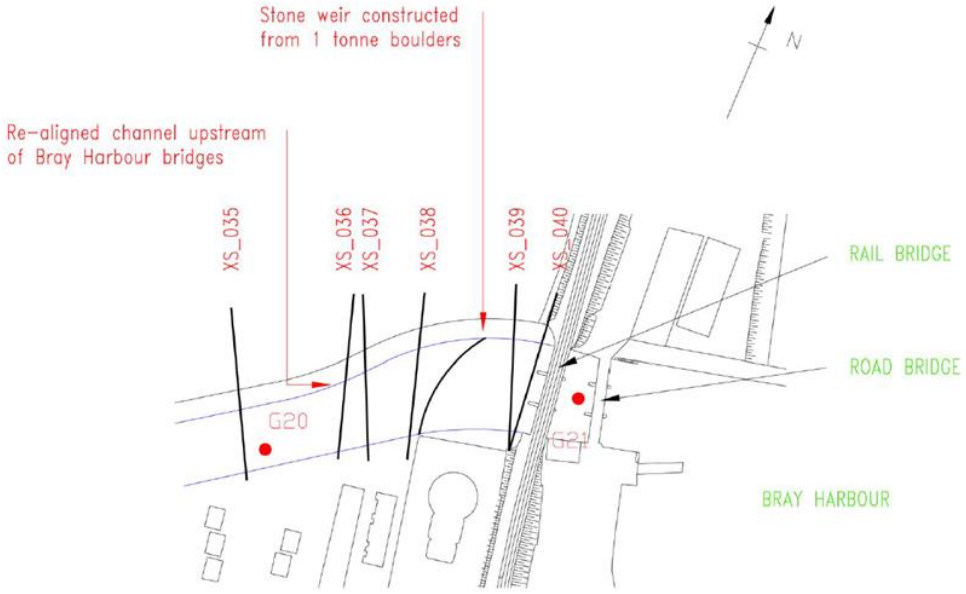
The model considered a number of flood events to capture the effects of both fluvial and tidal flows. These comprised:

- 1-year fluvial with 200-year tidal
- 5-year fluvial with 50-year tidal
- 50-year fluvial with 5-year tidal
- 100-year fluvial with Mean High Water Spring (MHWS) tide
- 300-year fluvial with MHWS tide

The proposed bridge site is located close to the river outlet to Bray Harbour and hence the water levels are influenced by tidal effects. The 200-year tide level was assessed to be 3.50m OD, which includes an allowance for climate change. The MHWS tide level is 1.59m OD. The level of the existing river bank wall is 4.34m OD and comprises the existing flood defence level in this region.

A number of points were located in the physical model to measure the water flows and levels for different scenarios. Figure 4 depicts the modelled location at the proposed bridge site.

Figure 4: Location of flood level measurement points at proposed bridge site (extract from Physical Model Study, Feb 2009)



The resulting design flood levels at the points of interest, G20 and G21, were measured to be 3.61mOD and 3.65mOD respectively. These levels are associated with "*Simulation 10 – Optimised Flood Defence Scheme*" from the Flood Model and comprise the combined 1-year fluvial and 200-year tidal flood event, which represent the worst-case scenario at this location.

A level of 3.65mOD has been adopted as the Design Flood Level at this bridge site.

2.10 Archaeological Summary

An archaeological study of the site was undertaken as part of the EIA screening. This report did not identify any significant archaeological impacts at this bridge site.

2.11 Environmental Summary

Environmental considerations have been central throughout the design process. A key constraint during the design of the bridge has been ensuring that any construction, and subsequent operational works do not have any adverse impact on the flora and fauna in the project area.

An Appropriate Assessment Screening was carried out during the preliminary design stage to assess the potential impact on any nearby Natura 2000 sites. Refer to the Appropriate Assessment Screening Report (RDPTB-ARUP-ZZZ-ZZZ-RP-LE-0001) for details. This report rules out any significant impacts on nearby Natura 2000 sites and recommends that an Appropriate Assessment is not necessary.

Additionally, an Environmental Impact Assessment (EIA) Screening was undertaken. Refer to the Environmental Impact Assessment Screening Report (RDPTB-ARUP-ZZZ-ZZZ-RP-LE-0002) for details. Based on the information provided in this report, it is the opinion of Arup that there is no real likelihood of significant effects on the environment arising from the proposed development and that an EIA is not required.

3 Structure & Aesthetics

3.1 General description

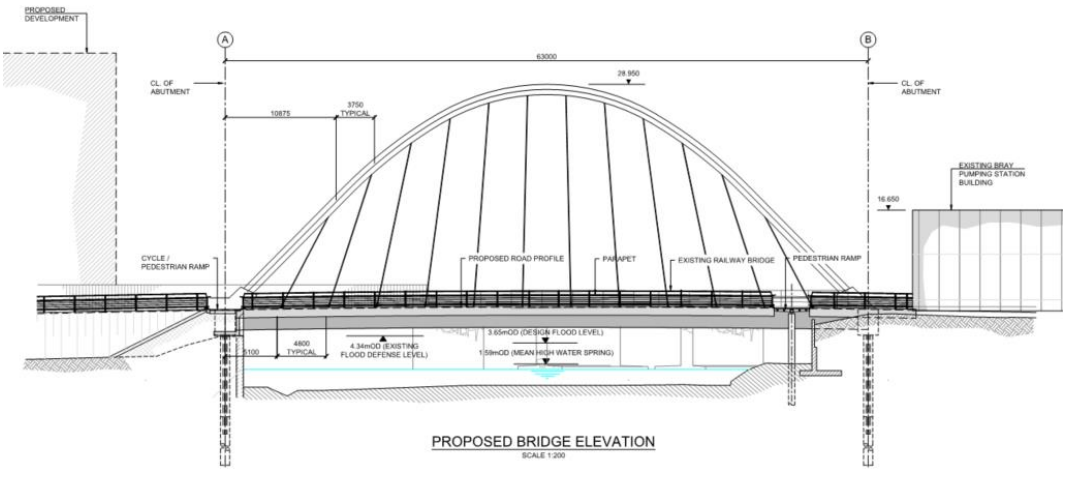
The proposed bridge comprises a single span bow string arch structure, with a span of 63.0m between springing points. The superstructure consists of a steel box girder with a composite concrete deck slab. Steel cantilever ribs will extend off the central box to support the deck. The deck will be supported by a series of high strength alloy steel hangers connected into the steel arch.

It is proposed to make the superstructure fully integral with the abutments. The abutments will be supported on steel columns embedded in bored concrete piles. The steel columns will be sleeved over their top portion to maintain a level of flexibility.

The single arch will be offset from the centre of the bridge. To attain a structurally efficient system, the arch will also be inclined to reduce the load effects within the arch.

It is proposed to use a relatively high-pitched arch geometry (approximetly 22 m in height) to help accentuate its position relative to the surrounding buildings. The high arch also has the benefit of reducing the lateral thrust forces imposed at the ends, which in turn helps to reduce the tie force that needs to be resisted by the curved superstructure. To add additional stiffness to the arch, it is proposed to infill the arch with concrete. Filling the arch with concrete will also provide additional protection to the inside steel faces, which would otherwise be difficult to inspect.

Figure 5: Proposed Bow string arch bridge



3.2 Aesthetic considerations

Aesthetics of the bridge have been identified by Wicklow County Council as one of the principal factors to be considered. The project brief requires the bridge to "*be aesthetically appropriate for its landmark and highly visible location".*

Visual impact on the surrounding landscape and how it sits relative to the existing and proposed structures is also a key consideration.

A single span bridge structure that physically holds its own amongst the dominant surrounds (existing pumping station, railway bridge and proposed developments) is preferred. The view of the bridge when looking down the river promotes a centred geometric form.

A high pitched central arch achieves these effects while at the same time naturally addressing a host of other important factors. The shape of the arch leans away from the new development and the existing pumping station, creating its own space. This allows the bridge to be viewed in its entirety from multiple locations without losing its form or impact. The arch will act as a visual gateway to Bray as seen by rail passengers while at the same time also act as an eye-catcher when viewed from the Main Street bridge upstream.

3.3 Proposals for recommended structure

3.3.1 Proposed Category

Category 3

3.3.2 Span arrangements

The bridge comprises of a single span. The span is 63m in length, measured as a straight line between the arch springing points.

3.3.3 Minimum headroom provided

Due to the curved nature of the arch in plan, the deck is widened at its ends to provide a 2.4 m vertical clearance for the combined pedestrian/cycleway.

3.3.4 Approaches including run-on arrangements

The Approaches to the bridge are contained by small reinforced concrete retaining walls.

It is not proposed to provide run-on slabs for this bridge.

3.3.5 Foundation type

Sleeved steel columns embedded in bored concrete piles, founded on bedrock.

3.3.6 Substructure

Reinforced concrete abutments supported on steel columns embedded in bored concrete piles.

3.3.7 Superstructure

The superstructure comprises a steel box girder with a composite concrete deck slab. Steel cantilever beams extend of the box girder to form ribs to support the deck slab.

The arch is composed of two circular elements, which are offset from each other in plan, widening out at the crown of the arch to provide additional lateral stability. It is proposed to make the arch composite by filling the tubular sections with concrete.

3.3.8 Articulation arrangements, joints and bearings

The bridge will be designed as an integral structure, hence no bearings are proposed at the abutments.

A small saw cut joint between the abutment and road pavement will be provided to accommodate the small movements associated with bridge elongations.

A small movement joint will be provided between the deck and the adjoining footways along the western edge of the structure.

3.3.9 Vehicle Restraint System

The bridge barriers are designed in accordance with DN-STR-03011 *The Design of Vehicle and Pedestrian Parapets*.

The bridge parapets along the eastern edge of the bridge will comprise steel post and rail barriers with an H2 containment level, a maximum working width of W4 and an impact severity Level B.

A concrete median barrier, integral with the bridge deck will be provided along the western edge of the carriageway, separating the bus lanes from the shared path and also acting as a protective barrier to the arch support cables. This barrier will be designed as a bespoke concrete barrier. Following guidelines outlined in the TII design standards.

3.3.10 Drainage

Surface drainage requirements will be confirmed upon detailed design.

Subsurface drainage will be in accordance with DN-STR-03012.

3.3.11 Durability

Bridge structures in Ireland are designed and detailed to Eurocode Standards, which typically provide a 120-year design life.

The durability and maintenance requirements of bridges is particularly important due to the long design life and the environments bridge structures are exposed to.

This is particularly relevant for structures in marine environments, where the increased quantity of chlorides due to coastal waters present an additional corrosion risk.

When properly detailed, concrete elements are more favourable to steel due to the limited maintenance required to achieve the designated design life.

3.3.12 Sustainability

Concrete is a highly durable material and the concrete elements of this structure are expected to require minimal maintenance during its 120-year design life. 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. The steelwork will be painted with a system complying with DN-STR-03007 to improve its durability and reduce maintenance.

3.3.13 Inspection and maintenance

Bridge structures in Ireland are designed and detailed to Eurocode Standards, which typically provide a 120-year design life.

The durability and maintenance requirements of bridges is particularly important due to the long design life and outdoor environments bridges structures are exposed to. This is particularly relevant for structures in marine environments, where the increased quantity of chlorides due to coastal waters present an additional corrosion risk.

The responsibility for this maintenance will be with the Local Authority (Wicklow County Council) and as such, details of the inspection and maintenance requirements for these walls shall be included in a separate Technical Acceptance Report.

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

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

The structure will be inspected from foot and mobile platforms, if required.

4 Safety

4.1 Traffic management

Detailed traffic management proposals will be developed at detail design stage by the appointed Contractor in consultation with their Designers and the consent for the diversions and/or road closures will be sought from the appropriate local authority. It is anticipated that disruption to existing traffic will be minimal during construction, as the bridge is not located in the immediate vicinity of any currently open roads.

4.2 Safety during construction

Constructing a temporary pier in the river will require a cofferdam, or similar, to enable the river bed to be excavated and to pour foundations and piers. This significantly increases the risks associated with working in and near water.

Composite decks comprising steel ribs and concrete deck slab construction require the installation of significant permanent formwork between ribs at height, introducing additional risks.

4.3 Safety in use

The bridge shall be constructed with several safety measures. A vehicle parapet will be provided along the exterior edge of the carriageway to protect errant vehicles from entering the river. A concrete barrier shall be provided on the inside of the carriageway to protect the bridge cables from impact from vehicles. A pedestrian handrail will be installed along the pedestrian/bike path.

4.4 Lighting

New ducting will be incorporated in the bridge to accommodate lighting.

Further details will be developed in conjunction with the Bridge Architect during the detailed design stage.

5 Cost

An order of magnitude cost estimate was carried out on the proposed bridge works. Refer to report number RDPTB-ARUP-ZZZ-ZZZ-RP-ZZ-002 for information on the estimated costs.

6 Design Assessment Criteria

6.1 Actions

6.1.1 Permanent Actions

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

6.1.2 Snow, Wind and Thermal Actions

Wind load will be assessed in accordance with IS EN 1991-1-4:2005 and the associated National Annex.

Thermal actions will be assessed in accordance with IS EN 1991-1-5:2003 and the associated National Annex.

6.1.3 Actions relating to normal traffic

The structure will be designed for Load Models LM1, LM2 and LM4 in accordance with IS EN 1991-2:2003 and the associated National Annex.

6.1.4 Actions relating to abnormal traffic

The structure will be designed for SV196 Load Model 3 in accordance with IS EN1991-2:2003 & associated Irish National Annex.

6.1.5 Footway or Footbridge live loading

Footway and cycle track loading shall be in accordance with Clause 5.3.2.1 of IS EN 1991-2:2003. A nominal q_{fk} = 5kN/m^2 will be adopted.

6.1.6 Provision for exceptional abnormal loads

N/A

6.1.7 Accidental actions

Accidental wheel loading will be taken into account in the design of the deck slab. Vehicular impact loading will be used in the design of the bridge parapets.

6.1.8 Actions during construction

Subject to detailed design and construction planning.

6.1.9 Any special loading not covered above

The bridge will be designed to cater for the potential future Luas Line B2 extension to Bray Station.

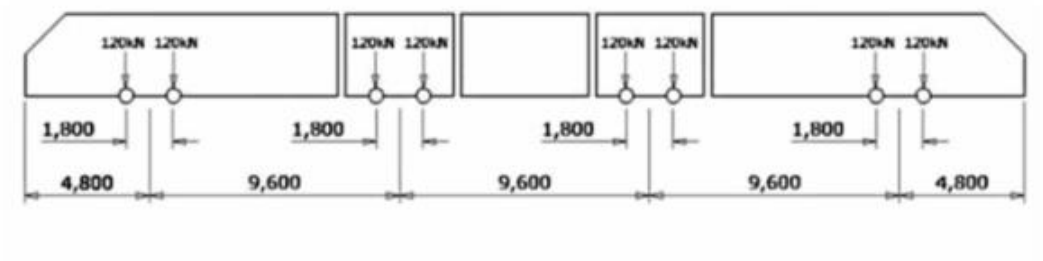
The loading described below is based on guidance given in the RPA document for the Luas Line B1 Assessment (B1_SAr_0001-02).

Tramway loading shall comprise the following non-concurrent loads:

- 38.4 m long tram vehicle comprising 8 axles with a maximum axle load of 120 kN/axle, spaced as shown in the figure below. It is assumed the axle loads are equally spread between wheels. A maximum of 6 No. vehicles shall be considered coupled at any given time, with the vehicles butted hard up against each other.
- Track load of 25 kN/m per track (divided equally between rails).

The above loads can be applied to either a single track or both tracks concurrently, whichever produces the worst effect.

Figure 6: Tram Vehicle Loading Configuration



A dynamic amplification factor of 1.5 will be adopted.

Longitudinal and centrifugal loading will be considered with reference to IS EN 1991-2:2003.

6.2 Authorities Consulted & Any Special Conditions Required

Several meetings have been held with Wicklow County Council (WCC). These meetings have included initial project start-up meetings, site walkovers, steering meetings and project update meetings. A representative from the DBO operators of Bray Pumping Station was present during the site walkover carried out in May.

In addition to the meetings, information on existing services has been obtained from the relevant utility providers.

Further consultation is required with the following bodies:

- Inland Fisheries Ireland (IFI)
- Irish Rail
- Luas
- Office of Public Works (OPW)
- Utility Providers - ESB, Irish Water, Gas Networks Ireland, Eir

6.3 Proposed Departures from Standards

None expected.

6.4 Proposed methods of dealing with aspects not covered by Standards

N/A

7 Ground Conditions

7.1 Site History

Available historical mapping and aerial photographs of the location have been reviewed to provide an overview of the site history. Table 2 provides information of the most relevant changes in the area since 1800s to date.

The existing Bray Pumping Station was constructed on a site that was historically used for gas works. Therefore, there is potential for contaminated soils at the location of the southern abutment. This will need to be confirmed prior to construction and suitable measures put in place to dispose of this material if encountered.

Table 2: Site History

Date	Source	Comments
1837-1842	Historic 6 inch Colour	Greenfield site – river estuary with a smaller tributary running to the east of the site.
1888-1913	Historic 25 inch	Gasworks on the southern side, rail line to the east with rail bridge. Sand and shingle shown in river, with a road shown on the northern bank of the river but land beyond road undeveloped.
Late 1800s	Historic 6 inch Cassini6 inch Cassini	Gasometer on southern side shown as disused.
1980s	Historic GI	Ground investigation completed for pumping station.
1995	Aerial photograph	Golf course shown on the north side of the river. Housing developed on the south bank to the southwest of the site. Bray Pumping Station shown on southern side of the site.
2016	Aerial photography (Google Earth)	Works commenced on Bray Flood Relief scheme, including installation of anchored sheet pile retaining wall on the northern bank, behind existing river wall.
2018	Aerial photography (Google Earth)	Retaining wall works completed, with the cyclepath on top of retaining wall and landscaping completed to the north of the retaining wall.

7.2 Site Geology

A review of the available Geological Survey Ireland (GSI) mapping provides the following overview of the site geology:

- Alluvium on north bank of river, with made ground on the southern side of the site;
- Gravel present as unconsolidated sediments;
- GSI 100k bedrock mapping shows the site to be underlain by the Maulin Formation, with a single fault to the south of the site with the Bray Head Formation present.

An assessment of the ground conditions at the site is shown in Bray Town Centre Development, IGSL, 2008.

Both sides of the river typically comprise made ground over loose gravels and soft silts, underlain by stiff gravels and boulder clay with bedrock encountered around 20.5 m below ground level. The depth to bedrock has not been proven on the south side.

Table 3. This has been drawn from the following sources:

- Bray Sewerage Scheme, GSI Report 1740, 1984;
- Bray Golf Course Development, IGSL, 2003;
- Bray Town Centre Development, IGSL, 2008.

Both sides of the river typically comprise made ground over loose gravels and soft silts, underlain by stiff gravels and boulder clay with bedrock encountered around 20.5 m below ground level. The depth to bedrock has not been proven on the south side.

Table 3: Ground Conditions

Stratum	North Side			South Side		
	Description	Depth to Top (mBGL)	Thickness (m)	Description	Depth to Top (mBGL)	Thickness (m)
Made Ground	Topsoil overlying firm brown gravelly sandy clay with occasional cobbles	0	1.7	Fill, brown silty clay with cinders, bricks, boulders etc	0	2.4
Gravel	Medium dense, silty sandy gravel	1.7	1.4	Fine to coarse gravel with some sand	2.4	3.6
Silt & Peat	Very soft grey sandy Silt over	2.9	7.7	Black soft clayey silt with traces of decayed	6	5

Stratum	North Side			South Side		
	Description	Depth to Top (mBGL)	Thickness (m)	Description	Depth to Top (mBGL)	Thickness (m)
	soft brown silty Peat			vegetable matter		
Gravel	Dense grey fine to coarse gravel with occasional cobbles	10.6	4.3	Sandy dense fine to coarse Gravel with cobbles and boulders	11	6.4
Boulder clay	Stiff to very stiff brown to grey black gravelly clay with large cobbles	14.9	5.3	Black hard sandy gravelly silty boulder clay	17.4	3.1
Bedrock	Greywacke with highly weathered bands	21.2	Unknown	N/A	20.5	Unknown

The following assessment of the groundwater at the site has been inferred from available information:

- Site is on a "Locally Important Aquifer – Bedrock" which is moderately productive only in local zones;
- Groundwater levels are likely to be in hydraulic connectivity with the River Dargle. Mean High Water (Spring) is 1.59mOD.

7.3 Preliminary Engineering Assessment

An initial assessment of the proposed structure suggests that piled foundations are the appropriate foundation solution. Due to the limited thickness of boulder clay present at the site, the piles will need to be founded within the bedrock.

Rotary bored piles, constructed with temporary casing through the overburden, are likely to be the most appropriate solution.

7.4 Proposed Additional Investigations

At the time of writing a site-specific ground investigation is currently in progress. The ground investigation comprises cable percussive and rotary boreholes; trial pits and slit trenching; insitu testing and geotechnical, geo-environmental and geo-chemical laboratory testing.

The findings of these GI works will be included in the Detailed Design Report.

8 Drawings and Documents

The relevant documents which are included as appendices to this report are summarised below.

Appendix A – Drawings

The following drawings are included as part of this submission.

Table 4: Drawing List

Drawing Number	Drawing Title
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9000	Site Location Plan
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9001	General Arrangement Sheet 1
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9002	Northern Abutment Approach Works Sheet 1
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9003	Northern Abutment Approach Works Sheet 2
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9004	Southern Abutment Approach Works Sheet 1
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9005	Southern Abutment Approach Works Sheet 2
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9010	Construction Sequence Sheet 1
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9011	Construction Sequence Sheet 2
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9012	Construction Sequence Sheet 3
RDPTB-ARUP-ZZZ-ZZZ-DR-CB-9015	Bridge Photomontage

Appendix A

Drawings