DART+
Coastal North

Public Consultation No.2

Annex 3.2 E4: Option Selection OBB78 Report

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Project Ireland
2040

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1. INTRODUCTION

This report documents the optioneering assessment for the vehicular bridge (IÉ reference OBB 78) to enable the electrification of the railway line beneath this bridge. The existing vertical clearance beneath this structure is insufficient to accommodate electrical wiring without a derogation or some form of physical intervention (to either the track below or the bridge itself). This report documents the various options considered and recommends a preferred option for progressing to the next stage of the design process.

2. SITE AND LOCATION

2.1 Location

The vehicular bridge (IÉ reference OBB 78) is located in Colpe to the east of Drogheda Station and carries Colpe Road over the Northern Line at approximate chainage 30 mi 233 yds. This is an important access route with essential services located at both sides of the bridge, including schools, a crèche and shopping centre.

Figure 1: Bridge location (Map data © OpenStreetMap contributors, Map layer by Esri)

2.2 Existing structure

The existing structure is a single span (9.144m span) reinforced concrete bridge with precast concrete portal units on reinforced earth wall abutments. A principal inspection was carried out on all elements of the structure above ground by IÉ on 14/11/2019 and the overall condition was deemed fair.

Figure 2: Bridge elevation looking towards Belfast (source: Iarnród Éireann)

Figure 3: View of northern bridge abutment (source: Iarnród Éireann)

3. DESIGN REQUIREMENTS

An assessment of bridge clearances required for electrification of the Northern Line has been carried out at this location based on the topographical survey of the existing rail and bridge arrangement. This assessment has found that the existing clearance from the rails to the underside of the bridge (~4680mm) is sufficient to cater for a case 15 electrical solution (derogation required). The table below shows the additional clearances required to achieve an electrical solution based on the hierarchical cases outlined in the project's functional specification. A contact wire height (CWH) of less than 4.400m will require a derogation. To achieve a CWH greater than 4.400m (no derogation required) min. 4710mm clearance is required.

Table 1: Electrical case hierarchy at OBB 78

Electrical Case	Nominal CW height (mm)	Minimum soffit height for case (mm)	Additional clearance required at structure (mm)
1	4700	5620	1060
2	4700	5420	860
3	4700	5220	660
4	4700	5080	520
5	4600	5295	735
6	4600	5095	535
7	4600	4955	395
8	4500	5170	610
9	4500	4970	410
10	4500	4830	270
11	4400	5070	510
12	4400	4870	310
13	4400	4710	150
14	4350	4640	80
14_OBB78	4290	4555	none
15	4270	4490	none

4. OPTIONS CONSIDERED

A number of options have been considered to enable the electrification of the track beneath this bridge. These options generally consider electrical solutions which would require a derogation, the modification or replacement of the bridge structure and the lowering of the track.

4.1 Electrical solution requiring a derogation

This option involves allowing for a bespoke electrical solution which retains the existing rail and bridge soffit levels. This requires a reduction of some design tolerances to achieve an electrical solution with a nominal contact wire height of 4290 mm (approximately equivalent to a hierarchy case 14); further details of this are provided below. This option would require a derogation.

Table 2: Potential electrical solution parameters with CWH < 4400mm (Derogation required)

Potential OHLE solution	Contenary with zero encumbrance
OHLE Arrangement	Fitted with Elastic Bridge Arms
Static Clearance (Csc) - 1500Vdc	100mm
Dynamic Clearance (Cdc) - 1500Vdc	80mm
Minimum Position of the Contact Wire (considering tamping)	4193mm
Actual Design Contact Wire Height (Cdcl) (After Tamping)	4290mm
Maximum Design Contact Wire Height [Pre-Tamping]	4340mm
OHLE System Depth (Csd)	0mm
OHLE Uplift (Cwu)	50mm
OHLE Construction/Installation (Cct) + Maintenance Tolerance (Cmt)	30mm
Structure Construction Tolerance (St)	0mm
Track Maintenance Tamping Allowance (Tla)	50mm
Track Construction Tolerance (Tct)	0mm
Track Maintenance Tolerance (Tmt)	25mm
Considered OHLE span through the overbridge (as per hierarchy cases)	10m
Sag and Ice Load	17mm
Survey Tolerance	5mm
Loading Gauge	4064mm
Mechanical Clearance	205mm
Speed through the structure	160km/h - 100mph
Acceptance - CCE	TMTA 50mm
Acceptance - SET	CW<4700mm Reduced electrical clearances

Potential OHLE solution	Contenary with zero encumbrance
	OHLE construction + maintenance tolerance 30 mm
Derogation - SET	CWH – 4290mm Post tamping

Table 3: Potential electrical solution parameters with CWH = 4400mm based on design proposal

Potential OHLE solution	Contenary with zero encumbrance
OHLE Arrangement	Fitted with Elastic Bridge Arms
Static Clearance (Csc) - 1500Vdc	100mm
Dynamic Clearance (Cdc) - 1500Vdc	80mm
Minimum Position of the Contact Wire (considering tamping)	4275mm
Actual Design Contact Wire Height (Cdcl) (After Tamping)	4400mm
Maximum Design Contact Wire Height [Pre-Tamping]	4450mm
OHLE System Depth (Csd)	0mm
OHLE Uplift (Cwu)	50mm
OHLE Construction/Installation (Cct) + Maintenance Tolerance (Cmt)	50mm
Structure Construction Tolerance (St)	0mm
Track Maintenance Tamping Allowance (Tla)	50mm
Track Construction Tolerance (Tct)	5mm
Track Maintenance Tolerance (Tmt)	25mm
Considered OHLE span through the overbridge (as per hierarchy cases)	12m
Sag and Ice Load	25mm
Survey Tolerance	5mm
Loading Gauge	4064mm
Mechanical Clearance	208mm
Speed through the structure	160km/h - 100mph
Acceptance - CCE	TMTA 50mm
Acceptance - SET	CW<4700mm Reduced electrical clearances OHLE Uplift 50mm
Derogation - SET	No

4.2 Track lowering

This option involves lowering of the tracks to allow for a more favourable electrical solution whilst retaining the existing bridge levels. This requires the removal of tracks and ballast, lowering of the formation and reinstatement of the tracks at a lower level. Based on the information available it is considered feasible to lower the track to achieve a more favourable electrical solution. One culvert (UBB78A) crosses the track in close proximity to the bridge ~30m to the north, however the depth of cover to this culvert is ~2m and it is therefore not considered an issue for track lowering. Culvert UBB77A is located ~200m to the south, however this has currently not been identified on site and is the subject of a planned survey. Given the position and size this is unlikely to impact track lowering. It is assumed that the bridge foundation is at least 200mm below ballast formation level.

The proposed geometry for the track lowering has allowed for a maximum clearance from the top of rail to soffit level of 4.8m which will require a lowering of 117mm directly under the east face of the structure, with a maximum lower of 167mm occurring approximately 50m to the east of the structure to facilitate a suitable vertical sag curve for the existing line speed; in considering the design proposal, all low spots have been removed from the underside of the structure. However, further investigations with respect to the foundation level on OBB78 are required, as the need may arise for the existing foundations to be strengthened or underpinned.

Consideration needs to be given with respect to localised minor reprofiling of the existing cutting to facilitate the track lowering where the deepest lowering occurs, and similarly to localised adjustment to any existing trackside drainage. Depending on ground conditions, new drainage may need to be installed if none is currently present.

It is noted that some wayside equipment current exists. New foundations should be provided for these in areas where track lowers are taking place if the ballast cannot be graded out in these locations.

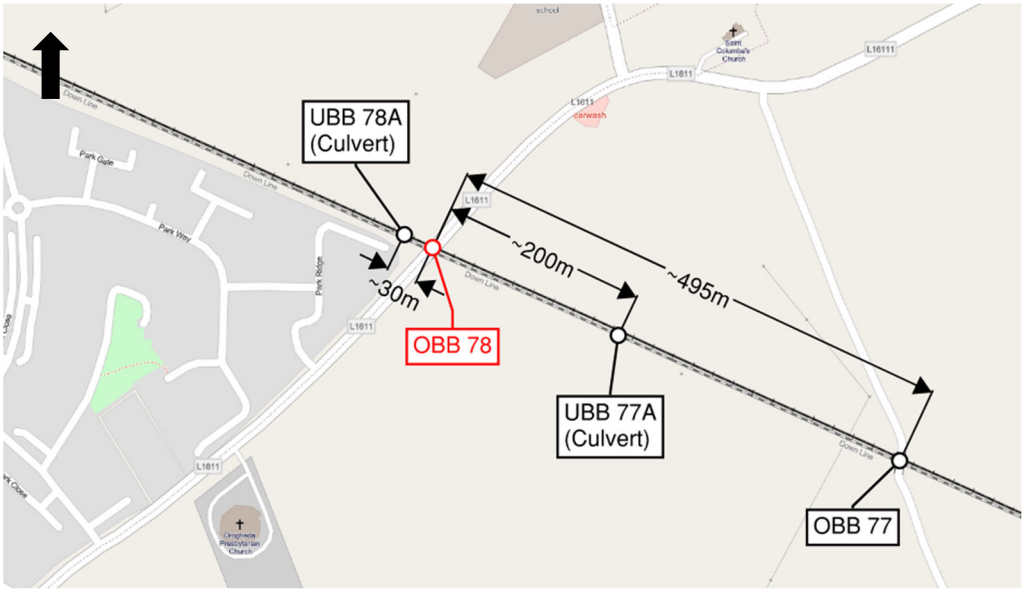

Figure 4: Crossings up line and down line of bridge (Map data © OpenStreetMap contributors, Map layer by Esri)

4.3 Bridge Modification (Raise Superstructure or Demolish and Reconstruct Bridge)

This option involves the raising of the existing bridge soffit levels. This can be done by extending the abutment heights and jacking or replacing the bridge deck or by demolishing and reconstructing the bridge entirely. Based on the information available it is difficult to raise the bridge soffit levels to achieve a more favourable electrical solution.

Raising of bridge levels will require road closures during the works. The existing road is an important access route with important services located at both sides of the bridge (e.g. schools, crèche and shopping centre). There are several alternative routes which can be used to access these services (for example via OB77), however these routes may not be suitable for some vehicles such as buses. Bus routes cross this bridge (910 bus).

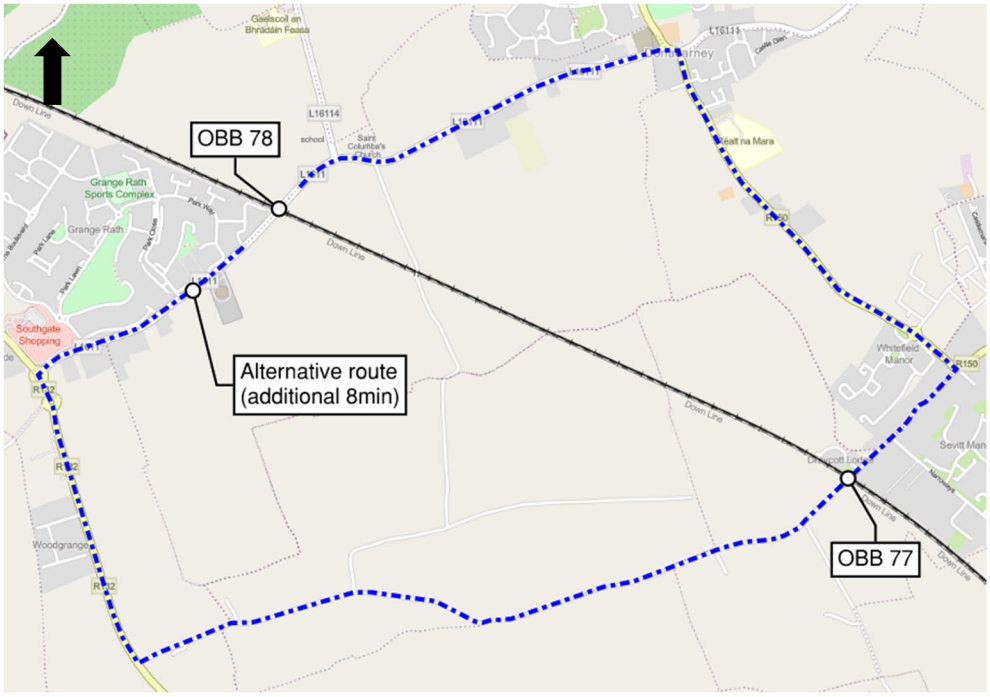

Figure 5: Road diversion option (Map data © OpenStreetMap contributors, Map layer by Esri)

Raising of bridge levels will also require raising of road levels on approaches to the bridges. Access to adjacent properties is ~150m from the bridge and the existing road is not compliant with current design standards. Whilst developing the option of a raised bridge, design standards have been followed for the vertical geometry, however in order to achieve a sensible impact on neighbouring properties, a departure from standard is required as the proposal contains a hidden dip. To remove the hidden dip the vertical alignment must be regraded back over 500m in a northerly direction with the introduction of a new retaining structure to each side of the carriageway which will require significant additional land take. A vehicle restraint system with a low working width must also be installed. Road restraint systems associated with any replacement bridge works will need to comply with DN-REQ-03034 (The design of road restraint systems for roads and bridges).

The current cross section of the bridge structure does not consider any usage by vulnerable road users (VRUs): no cycleway lanes are provided on the structure - nor pedestrian walkways. Further discussions should be held with the local authorities with respect to installation of these as the design progresses forward.

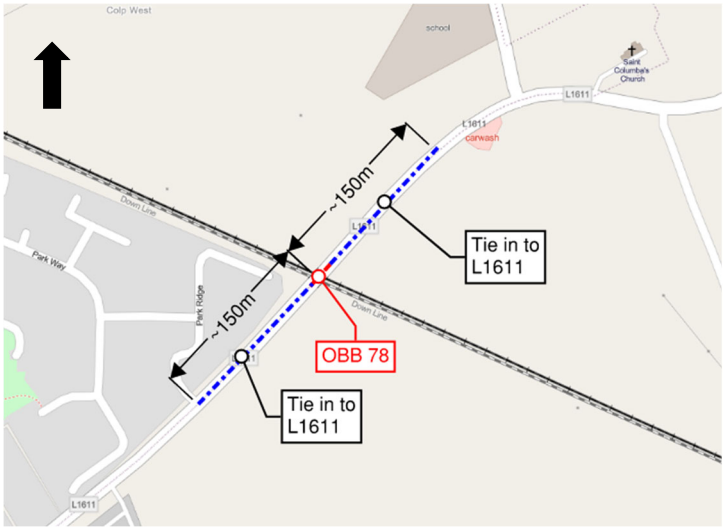

Figure 6: OBB 46 approach road tie ins (Map data © OpenStreetMap contributors, Map layer by Esri)

Figure 7: Approach to OBB 78 from the North East (source: Iarnród Éireann)

5. CONCLUSIONS AND RECOMMENDATIONS

As detailed in Appendix A, lowering of the track is a feasible option with limited impact to the existing infrastructure.

Raising of bridge levels will cause significant disruption given the importance of this route - thus temporary closure will impact on the local roads networks as diversionary routes will be required to be presented and approved by the local authority. The capital costs for the installation of a raised bridge deck and associated retaining structures are substantially more expensive that the track lowering, whilst offering no comparative advantage in terms of function.

If a derogation is not an acceptable solution then a track lowering in this location is recommended.

APPENDIX A

Drawings