DART+ Coastal North

Public Consultation No.2

Annex 3.2 E2: Option Selection OBB44 Report

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Tionscadal Éireann
Project Ireland
2040

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CONTENTS

TABLES

FIGURES

1. INTRODUCTION

This report documents the optioneering assessment for the vehicular bridge (IÉ reference OBB 44) 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 44) is located in Tyrrelstown, East of Lusk and carries the Horestown Road over the Northern Line at approximate chainage 14 mi 1437 yds. This is a minor road which provides local access to properties which can be accessed from alternative routes if required.

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

2.2 Existing structure

The existing structure is a single span (9.169m span) reinforced concrete bridge with precast beams on masonry abutments with concrete extensions. A principal inspection was carried out on all elements of the structure above ground by IÉ on 05/10/2017 and the overall condition was deemed fair.

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

Figure 3: View of eastern 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 (~4585mm) 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 44

Electrical Case	Nominal CW height (mm)	Minimum soffit height for case (mm)	Additional clearance required at structure (mm)
1	4700	5620	1035
2	4700	5420	835
3	4700	5220	635
4	4700	5080	495
5	4600	5295	710
6	4600	5095	510
7	4600	4955	370
8	4500	5170	585
9	4500	4970	385
10	4500	4830	245
11	4400	5070	485
12	4400	4870	285
13	4400	4710	125
14	4350	4640	55
14_OBB44	4320	4585	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 track lowering via tamping to allow 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 4320mm (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	Free Running
Static Clearance (Csc) - 1500Vdc	100mm
Dynamic Clearance (Cdc) - 1500Vdc	80mm
Minimum Position of the Contact Wire (considering tamping)	4215mm
Actual Design Contact Wire Height (Cdcl) (After Tamping)	4320mm
Maximum Design Contact Wire Height [Pre-Tamping]	4370mm
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)	12m
Sag and Ice Load	25mm
Survey Tolerance	5mm
Loading Gauge	4064mm
Mechanical Clearance	80mm
Speed through the structure	160km/h - 100mph
Acceptance - CCE	TMTA 50mm Mech. clearance 80mm
Acceptance - SET	CW<4700mm

Potential OHLE solution	Contenary with zero encumbrance
	Reduced electrical clearances OHLE construction + maintenance tolerance 30mm
Derogation - SET	CWH – 4320mm Post tamping

Table 3: Potential electrical solution parameters with CWH = 4500mm based on design proposal

Potential OHLE solution	Contenary with zero encumbrance
OHLE Arrangement	Free Running
Static Clearance (Csc) - 1500Vdc	150mm
Dynamic Clearance (Cdc) - 1500Vdc	100mm
Minimum Position of the Contact Wire (considering tamping)	4336mm
Actual Design Contact Wire Height (Cdcl) (After Tamping)	4500mm
Maximum Design Contact Wire Height [Pre-Tamping]	4575mm
OHLE System Depth (Csd)	0mm
OHLE Uplift (Cwu)	70mm
OHLE Construction/Installation (Cct) + Maintenance Tolerance (Cmt)	50mm
Structure Construction Tolerance (St)	0mm
Track Maintenance Tamping Allowance (Tla)	75mm
Track Construction Tolerance (Tct)	5mm
Track Maintenance Tolerance (Tmt)	25mm
Considered OHLE span through the overbridge (as per hierarchy cases)	15m
Sag and Ice Load	39mm
Survey Tolerance	5mm
Loading Gauge	4064mm
Mechanical Clearance	107mm
Speed through the structure	160km/h - 100mph
Acceptance - CCE	TMTA 75mm Mech. clearance 107mm
Acceptance - SET	CW<4700mm
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. The existing line in this location is straight with the nearest crossing located ~190m from the structure.

The existing grade of the railway falls on a west to east axis (west high), and on this basis the vertical gradient needs to increased to provide the additional clearance from the top of rail to the soffit of the structure.

The proposed maximum lowering in the area of the line affected is approximately 290mm, 60m to the eastern side of the structure, with 200mm required to the western face.

The proposed rail level reduction of 290mm will require the existing formation to be reprofiled over a length of approximately 400m. From available records the existing drainage is shown as natural drainage; therefore no engineered drainage is provided or will require modification to accommodate the lowering of the trackform. It should be noted that a full review of the existing drainage in the vicinity of the works shall be undertaken as the design moves forward through preliminary and detailed design to ensure positive drainage is provided and the risk of wet bed occurring is prevented.

Given the railway line is located in an open cutting, it is considered that localised reprofiling of the existing cut slopes will be required in the vicinity of the deepest cut section for approximately 40m each way.

Whilst there is scope to reduce the depth of the lowering, this would require the low point of the alignment to be located along with a vertical curve directly beneath OB44; this is not considered good practice both in terms of the civil engineering design and the OHLE design. The lowering of the vertical alignment does not require further intervention with respect to installation of retaining structures, however localised modifications to the invert of the existing track drainage and minor localised reprofiling of the existing cutting slope will be required as discussed above.

Figure 4: Crossings up line and down line of OBB44 (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 feasible to raise the bridge soffit levels to achieve a more favourable electrical solution.

Raising of bridge levels will require road closures during the works. It is considered feasible to close the road during the works as the existing road is a minor road providing local access to properties which can be accessed from alternative routes. The most suitable route appears to be via OBB46 to the North, which would add an additional 16 minutes to the journey time.

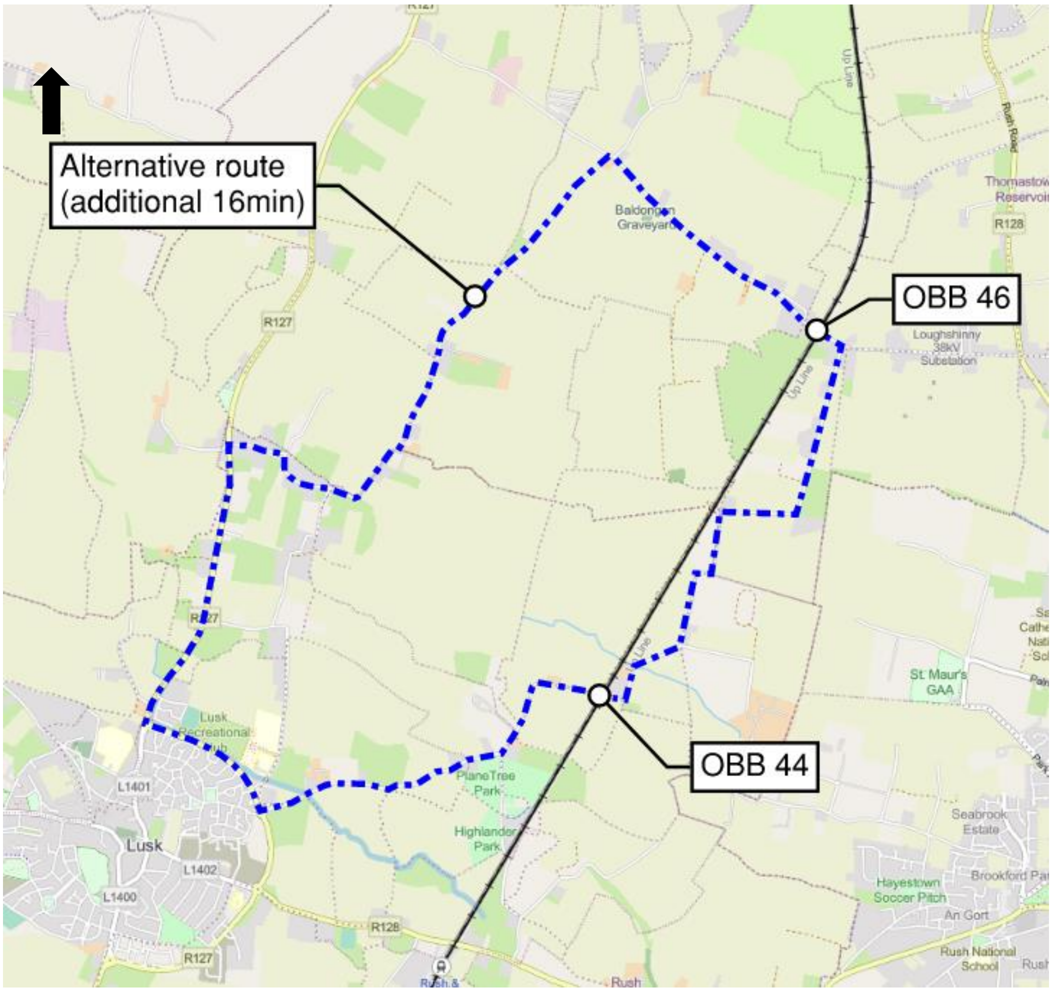

Figure 5:Road diversion option (Map data © OpenStreetMap contributors, Map layer by Esri)

Raising of bridge levels will also require raising of road levels on approaches to the bridges. Access to the adjacent property is ~50m from the bridge which is sufficient to provide tie in in road levels. Electrical services are located in close proximity to bridge, which may need diversion during works.

The existing highway geometry is substandard and does not comply with any current standards with respect to the cross-section width nor the vertical geometry: no vertical curves and limited forward sight visibility currently exists.

In order to develop a highway solution to accommodate lifting the bridge deck 1m, approximately 200m of road alignment will be required to be regraded. This value may be reduced if departures from standard are sought and obtained; however, given these pertain to vertical curves, it is unlikely that these will be approved without further mitigation measures such as speed reductions being in place.

The compliant design requires approximately 500m of new retaining structures to be installed which will reach a maximum of 2.5m in height to all sides of the highway and to each side of the existing overbridge. Regrading of access for one local resident would be required to facilitate this solution.

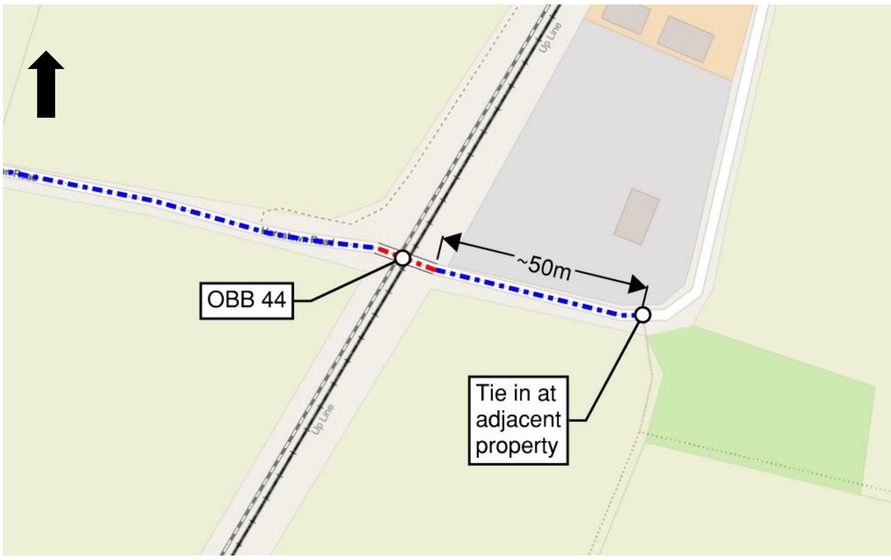

Figure 6: OBB 44 approach road tie ins (Map data © OpenStreetMap contributors, Map layer by Esri)

Figure 7: Approach to OBB 44 from the West (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, a track lowering in this location is recommended.

APPENDIX A

Drawings