DART+ Coastal North

ANNEX 3.2

Technical Optioneering Report: Electrification of the Northern Line between Malahide and Drogheda

SECTION A

OHLE System

ARUP

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Abbreviations

Abbreviation	Definition
BEMU	Battery Electric Multiple Unit
CAF	Common assessment framework
CCE	Chief Civil Engineer's Department
CTC	Centralised Traffic Control
ESB	Electricity Supply Board
ENE-TSI	Energy Technical Specification for Interoperability
FRS	Functional Requirements Specification
HEB	H - section beam, E - European, B – normal series
MCA	Multi-Criteria Analysis
NIR	Northern Ireland Railways
NTCC	National Train Control Centre
OCLZ/CCZ	Overhead Contact Line Zone / Current Collector Zone
OHLE	Overhead Line Equipment
OLE	Overhead Line Electrification
OSI	Ordinance Survey Ireland
SAC	Special Area of Conservation
SCADA	Supervisory control and data acquisition
SET	Signalling, Electrification, and Telecoms
SPA	Special Protected Area
SPA	Special Protected Area
TER	Telecoms Equipment Room
TPH	Track Paralleling Hut
VLD	Voltage limiting device

1 Introduction

The purpose of this report is to provide the technical input to the Preliminary Option Selection Report. This report details the option selection process for the overhead line electrification (OHLE) system. As this aspect of works is defined solely by standards, it is not subject to the same optioneering process of longlist creation, sifting to shortlist and multi-criteria analysis (MCA) – refer to section 1.3.

The report includes:

- An introduction and description of the study;
- A summary of the option assessment approach undertaken;
- A description of the existing situation;
- The requirements;
- The constraints;
- The preferred technical options and sectioning diagrams;

The report sets out general OHLE system principles and constraints in advance of the preliminary OHLE design.

1.1 Packages of work

The scope of work for DART+ Coastal North covers a wide range of interventions on the Northern Line needed in order to meet the Train Service Specification (TSS) requirements. To appropriately assess options against each other, the scope of work has been split into separate work packages. Where appropriate, the works have then been further split down into sections which define the system which has been subject to the optioneering and design process.

This document is an section of the overarching optioneering report for the electrification of the Northern Line between Malahide and Drogheda. Please refer to Table 1-1 for a list of the different sections which make up the electrification package of work.

Table 1-1: List of key documents associated with Electrification of the Northern Line between Malahide and Drogheda

Annex	Section	Title
3.2	A	OHLE system
	B	OHLE foundation solution
	C	OHLE foundation solution at underbridges
	D	Bridge parapet modifications
	E	OHLE Bridge Clearance works
	F	Traction Power Supply (will form part of Public Consultation 2)
	G	User worked level crossing south of Donabate
	H	Fencing and lineside safety

1.2 References

This report should be read in conjunction with the following related optioneering reports:

Table 1-2: List of key documents associated with this report

Annex	Title	Description
N/A	DART+ Coastal North Preliminary Option Selection Report	This is the main report which summarises the optioneering process and the different packages of proposed works on the DART+ Coastal North project.
N/A	DART+ Coastal North Preliminary Option Selection Report – Executive Summary	This report summarises the main Preliminary Option Selection Report.
1	Emerging Preferred Option Maps	Includes drawings for each Emerging Preferred Option, to support the Preliminary Option Selection Report.
2.1	Policy Context	This presents a detailed review of the European, National, Regional and Local policy context for the DART+ Programme and the DART+ Coastal North Project
2.2	Useful Links	Useful links to documents/websites relating to the DART+ Coastal North project.
3.1	Constraints Report	This report reviews the DART+ Coastal North constraints.
3.2	Technical Optioneering Report: Electrification of the Northern Line between Malahide and Drogheda.	The Technical Optioneering Report for the Electrification of the Northern Line between Malahide and Drogheda. The report is divided into a series of sections, as described in Table 1-1.
3.3	Technical Optioneering Report: Works around Drogheda MacBride Station	The Technical Optioneering Report for Works around Drogheda MacBride Station. The report addresses track and station modifications to allow for the increased number of DART services.
3.4	Technical Optioneering Report: Works around Malahide Station	The Technical Optioneering Report for Works around Malahide Station. The report addresses track modifications required to allow trains to be turned back clear of through running services.

Annex	Title	Description
3.5	Technical Optioneering Report: Works around Clongriffin Station	The Technical Optioneering Report for Works around Clongriffin Station. The report addresses track modifications required to allow trains to be turned back clear of through running services.
3.6	Technical Optioneering Report: Works around Howth Junction & Donaghmede Station	The Technical Optioneering Report for Works around Howth Junction & Donaghmede Station. The report addresses the addition of tracks to allow a higher frequency shuttle service.
3.7	Technical Optioneering Report: Howth Branch Level Crossings	The Technical Optioneering Report for the Howth Branch Level Crossings. The report addresses the impacts of all proposed increases in train frequency on existing level crossings on the Howth Branch.

1.3 Option Assessment Approach

In line with the Option Selection Process section of the Preliminary Option Selection Report, elements can be scoped out of the Multi-criteria Analysis (MCA) process based on a number of criteria, one of which is as follows:

'If the type of system to be used is solely governed by IÉ standards and specified by technical requirements, then the CAF/MCA process will not be utilised.'

Since this is true for the selection of OHLE system design the draft emerging preferred options described in this report are not subject to the MCA process and are instead proposed based upon technical requirements as set out within this document.

2 Existing Situation

2.1 Overview

As part of the DART+ Coastal North project, the Northern Line between Malahide and Drogheda is to be electrified. This involves electrifying approximately 38km of track.

The section of railway line between Malahide to Drogheda is not currently equipped with OHLE equipment. The current installation, dating from around 2000, terminates just north of Malahide station. This OHLE extends as far as the Broadmeadow viaduct to enable the use of a set of crossovers located north of the station. A track paralleling hut (TPH) is located east of this section to provide feed redundancy.

Existing signalling is currently not adapted for the electrification with regards to the train detection system. Clearance issues also exist at overbridges along the route that need to be mitigated.

2.2 Structures

2.2.1 Overbridges

There are 29 existing overbridges on the Northern Line between Malahide and Drogheda and three planned future overbridges: one between OBB32A and OBB33, one between OBB54 and OBB55, and one footbridge at Gormanston Station, as shown in the table below. This is reflective of information available at the time of publishing. The OHLE design will be constrained by these overbridges, as indicated in section E of the Electrification report – OHLE Bridge Clearance Works).

Table 2-1: Overbridges between Malahide and Drogheda

Bridge No.	Name	Approx. Location		Function	Clearance (Top of Rail – Soffit)
		Miles	Yards		(mm)
OBB32A	DONABATE BYPASS (CLONBURRIS BRIDGE)	11	0	Road	5800
OBB32B (TBC)	PEDESTRIAN BRIDGE SOUTH OF DONABATE (PLANNED)	11	540	Footbridge	~6000
OBB33	DONABATE STATION ROADBRIDGE	11	727	Road	~5000
OBB33A	DONABATE FOOTBRIDGE	11	784	Footbridge	~5100
OBB35	BEAVERSTOWN GOLF CLUB	12	445	Road	4740
OBB38	ROGERSTOWN LANE	13	999	Road	~5020

Bridge No.	Name	Approx. Location		Function	Clearance (Top of Rail – Soffit)
		Miles	Yards		(mm)
OBB38A	RUSH & LUSK FOOTBRIDGE	13	1564	Footbridge	~5200
OBB39	RUSH & LUSK ROADBRIDGE	13	1644	Road	4776
OBB41	KINGSTOWN/PUBLIC ROAD-	14	438	Road	4703
OBB44	TYRRELSTOWN/PUBLIC ROAD-	14	1437	Road	4585
OBB45	HJ2DA-	15	856	Road	4715
OBB46	BALDONGAN	16	172	Road	4860
OBB47	SKERRIES GOLF CLUB	16	1038	Road	4900
OBB49	GOLF LINKS RD SKERRIES	17	524	Road	4690
OBB51A	SKERRIES FOOTBRIDGE	17	1708	Footbridge	4815
OBB54	LADIES STAIRS	19	1440	Footbridge	~5100
TBC	CASTLELANDS (PLANNED)	20	1170	Road	TBC
OBB55	COUNTY BRIDGE/PUBLIC ROAD	21	304	Road	~4630
OBB57A	BALBRIGGAN FOOTBRIDGE	21	1328	Footbridge	4775
OBB62	FRANKINS/OCCUPATION ROAD	22	1573	Road	~4880
OBB63	-FILGATE'S/OCCUPATION ROAD	23	866	Road	~4735
OBB66	GORMANSTON STATION ROADBRIDGE	24	19	Road	4880
OBB66A (TBC)	GORMANSTON STATION FOOTBRIDGE (PLANNED)	24	120	Footbridge	5274
OBB68	IRISHTOWN/PUBLIC ROAD	24	1757	Road	4920
OBB74A	LAYTOWN FOOTBRIDGE	27	186	Footbridge	~5100
OBB77	PILTOWN/COLP EAST	29	1452	Road	~4850
OBB78	COLPE BRIDGE/PUBLIC ROAD	30	233	Road	4680
OBB80	MCGRATH'S LANE DROGHEDA	31	869	Road	4300
OBB80A		31	758	Road	4207
OBB80B		31	871	Road	4911
OBB81	MACBRIDE STATION	31	1259	Footbridge	4464
OBB81C		31	1258	Footbridge	TBC

2.2.1.1 Underbridges

The Northern Line has 31 underbridges between Malahide and Drogheda. These bridges have relevance to the positioning of OHLE masts and adopted foundation solutions, as outlined in Section C of Annex 3.2 – OHLE Support Solutions at Underbridges.

Table 2-2: Underbridges between Malahide and Drogheda

Bridge No.	Name	Miles	Yards	Function	UB Clearance (m)
UBB30	MALAHIDE VIADUCT-PROTECTED-POSTTENSIONED	9	971	MULTI-SPAN	
UBB31	UBB31 - TIDAL OUTFLOW	10	902	MULTI-SPAN	
UBB32	UBB32 CORBALLIS BACK ROAD - PROTECTED	10	1430	PUBLIC ROAD	3.19
UBB34	BALLISK / BELISK	11	962	PUBLIC ROAD	2.63
UBB36	ROGERSTOWN VIADUCT/ESTUARY - PROTECTED	12	998	MULTI-SPAN	
UBB37	BALLEALLY / ROGERSTOWN - PROTECTED	13	239	PUBLIC ROAD	4.22
UBB40	EFFELSTOWN / STREAM	14	99	RIVER/STREAM	
UBB42	HARRISTOWN / HORESTOWN	14	929	RIVER/STREAM	
UBB48	HACKETSTOWN / SKERRIES GOLF CLUB	17	123	CATTLE PASS	
UBB50	R127 PUBLIC ROAD SKERRIES - PROTECTED	17	1311	PUBLIC ROAD	3.44
UBB51	STN SUBWAY AT SKERRIES	17	1473	SUBWAY	
UBB52	UBB52 KELLYS - PROTECTED	18	1433	CATTLE PASS	
UBB53	BARNEGERA / BARNAGEERAGH - PROTECTED	19	702	PUBLIC ROAD	3.12
UBB55B	UNDERPASS / SUBWAY	21	978	SUBWAY	
UBB56	BALBRIGGAN VIADUCT/11 ARCHES - PROTECTED	21	1112	MULTI-SPAN	
UBB58	CONVENT LANE/PEDESTRIAN SUBWAY	21	1364	SERVICES	
UBB59	NEW RD /BATH RD / PUBLIC RD	21	1635	PUBLIC ROAD	3.7
UBB60	FRETT'S ARCH / CATTLE PASS - PROTECTED	22	205	CATTLE PASS	
UBB61	KING'S ARCH / CATTLE PASS - PROTECTED	22	806	FOOTWAY	
UBB64	FILGATE'S / OCCUPATION RD	23	1122	CATTLE PASS	
UBB65	GORMANSTON VIADUCT/RIVERDELVIN-PROTECTED	23	1300	MULTI-SPAN	
UBB67	COCKS LANE GORMANSTON	24	1180	PUBLIC ROAD	2.9
UBB69	PETERSWELL - CATTLE PASS	25	1192	CATTLE PASS	
UBB70	UBB70 - MOSNEY ACCOMODATION RD	25	1745	MULTI-SPAN	

Bridge No.	Name	Miles	Yards	Function	UB Clearance (m)
UBB71	LEGBERRY CATTLE PASS	26	704	CATTLE PASS	
UBB72	RIVER NANNY, LAYTOWN VIADUCT - PROTECTED	26	1328	MULTI-SPAN	
UBB73	LAYTOWN / PUBLIC RD R 150	27	100	PUBLIC ROAD	3.76
UBB76	UBB76 BETAGHSTOWN / SMITHS	28	1507	PUBLIC ROAD	3.11
UBB79	UNDERPASS AT BACK OF BOYNE VALLEY HOTEL	30	1336	CATTLE PASS	
UBB81B	ACCESS SUBWAY TO DMU DEPOT	31	1410	SUBWAY	
UBB82	UBB82 BOYNE VIADUCT, DROGHEDA	31	1479	MULTI-SPAN	

2.2.2 Permanent Way

The track along the section to be electrified is typically continuously welded rail to UIC 54 on concrete sleepers atop a ballasted formation to IÉ standards. Timber bearers are also used in points and crossing areas. Crossovers are situated between Skerries and Rush & Lusk, between Skerries and Balbriggan and south of Drogheda MacBride station and depot. OHLE installations will be designed according to the track layouts identified as the preferred option. In general, OHLE will be designed around the final track designs as constraints affecting the OHLE design are more limited. This is particularly relevant to the location of the points and crossings where the OHLE electrical sectioning will take into consideration the operational and maintenance requirements.

2.2.3 Other Railway Facilities

2.2.3.1 OHLE

The Northern Line is currently electrified between Connolly and Malahide station, up to 16mi 467yds. This includes an overrun section after Malahide Station to stop electric trains in case of need, which finishes just before the Malahide viaduct.

The electrical section diagram of this area is shown in Figure 2-1 below.

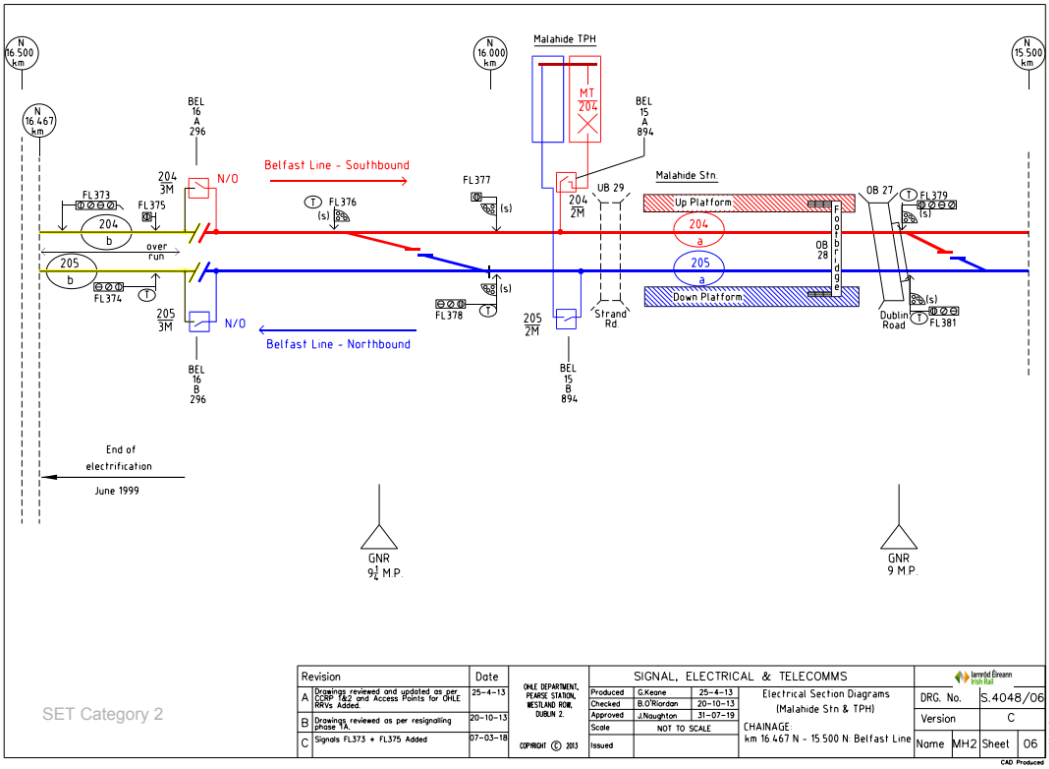


Figure 2-1: Electrical section diagram at Malahide Station

Malahide traction substation is located at about 14mi 650yds, before Malahide station. Malahide TPH is located between the station and Malahide viaduct.

The track layout in Malahide Station is going to be modified as part of the DART+ Coastal North project. Different options are being considered at this stage and therefore the sectioning diagram for Malahide Station will be updated in the next phase of the project according to the preferred option selected.

The OHLE equipment from Malahide Station to the end of the electrified section mostly comprises single-track cantilever masts with insulators at the top.

Existing OHLE consists of:

- Contact wire Cu 107 mm^2;
- Catenary wire Cu 70 mm^2;
- Parallel feeder Cu 95 mm^2;

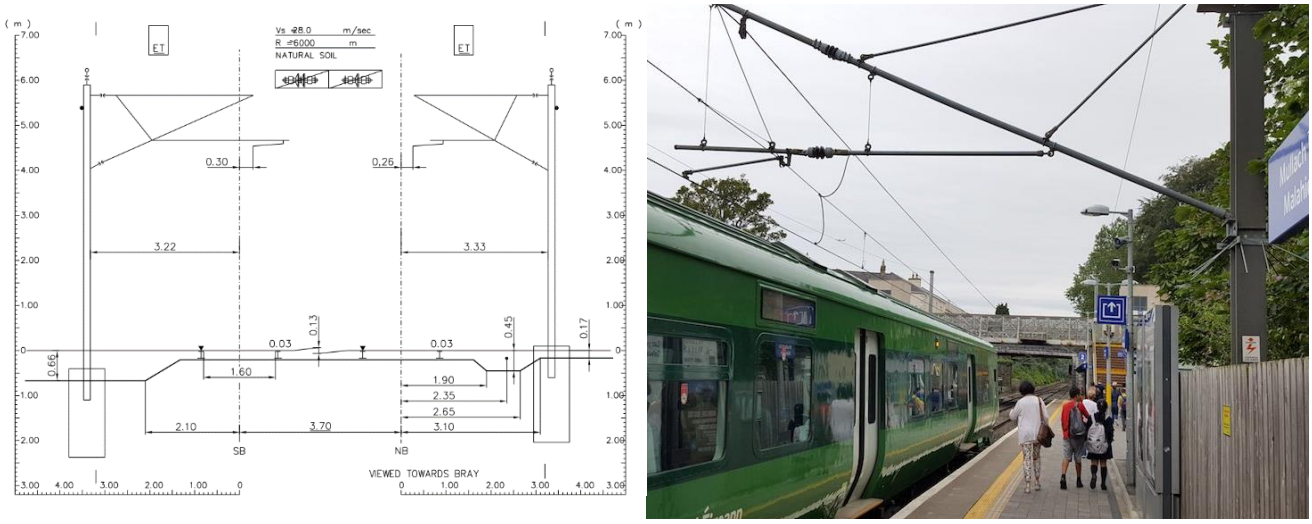


Figure 2-2: Single track cantilever at Malahide Station

2.2.4 Stations

A list of existing elements that may constrain the OHLE is presented below for each station on the Northern Line between Malahide and Drogheda. Constraints and solutions are explained further in section 5.3.

2.2.4.1 Donabate Station

Donabate Station is located at 19mi 525yds. The station site is split into two sections by the railway line. The area to the west contains a carpark, raised signal cabin, waiting room and SET building. The area to the east contains a carpark, the main station building and a validator building.

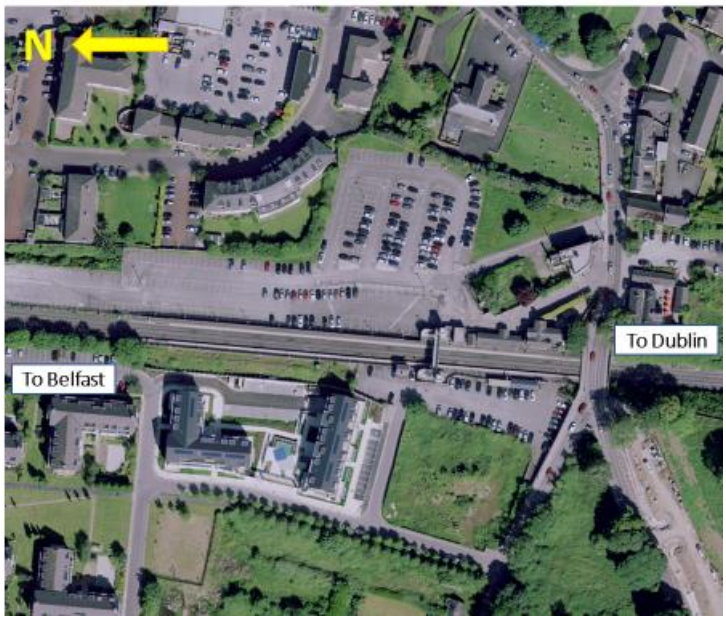


Figure 2-3: General view (Source: OSI aerial imagery)

Overbridges

There are two overbridges located in this station. Overbridge OBB33 is located at the south side of the platforms, with low clearance height (approximately 5.00m) and a width of 12m. Although outside of the platform area, this will constrain the OHLE installation at this end of the station.

Footbridge OBB33A is located 60m from the south end of the platforms. The bridge is served by lifts and stairs at both platforms. The width and soffit height are approximately 2.2m and 5.1m respectively.

Both overbridges constrain the OHLE solution in the southern part of the station and OHLE masts in the platforms will be constrained in the area of the footbridge accesses on each platform.

Figure 2-4: Overbridge OBB33

Figure 2-5: Footbridge OBB33A

Station buildings

There are several buildings located between OBB33 and OBB33A in Platform 1, which need to be considered when locating the OHLE masts in this area. In this area, the minimum Platform 1 width is 2.5m at the staff area building.

On Platform 2, there are also some staff buildings between OBB33 and OBB33A. The minimum platform width is 3.5m in this area. Additionally, on Platform 2 there is a signal cabin 10m from the north side of footbridge OBB33A. The platform width at this point is 2.3m.

Figure 2-6: Plan and view of buildings on Platform 1

Figure 2-7: Platform 1 width at the staff area building

Figure 2-8: Staff buildings in south part of Platform 2

Figure 2-9: Signal cabin on Platform 2

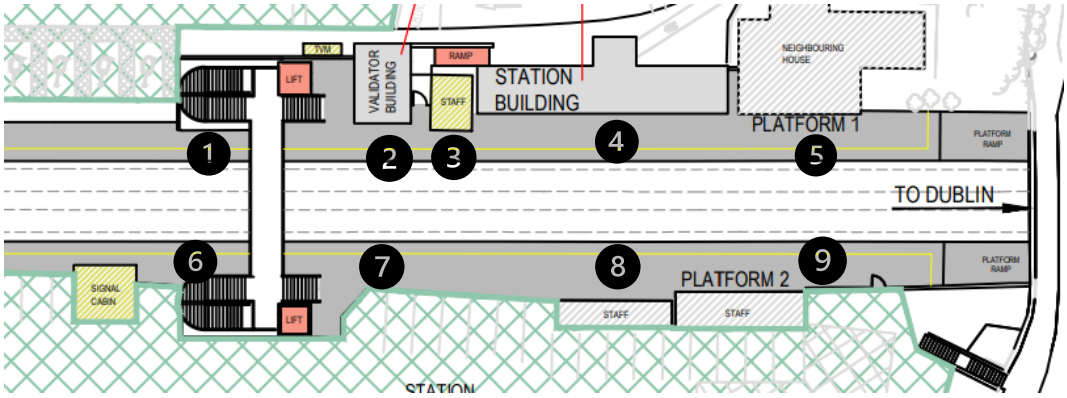
Fences

The station has metallic fences at the rear of Platforms 1 and 2 where buildings do not form the boundary, particularly at the north end of Platforms 1 and 2, from footbridge OBB33A. The minimum platform width in this section is 2.6m.

Figure 2-10: Fences along the back of the platforms at the north side of the station

Platform width

As a consequence of the different pieces of infrastructure on the platforms, the platform width is reduced as described in the sections above. This may constrain the location of the OHLE masts in order to avoid reducing the minimum required platform width without obstacles. The platform width summary for this station is shown below.



1	2	3	4	5	6	7	8	9
3.2m	3m	2.5m	2.8m	3.5m	2.8m	3.8m	4m	3.5m

Figure 2-11: Platform width summary for Donabate Station

2.2.4.2 Rush & Lusk Station

Rush and Lusk Station is located at 23mi 490yds. The ticket office is located within the main building of the station.

Figure 2-12: General View (Source: OSI aerial mapping)

Overbridges

There are two overbridges located in this station. Roadbridge OBB39 is located north of the platforms with a low clearance height (approximately 4.77m) and a width of 10.1m. Although outside of the platform area, this will constrain the OHLE installation at this end of the station.

Footbridge OBB38A is located 65m from the north end of the platforms with lifts and stairs to both platforms. The soffit height is approximately 5.20m and it has a width of about 3m. Platform width is less than 2.5m under the bridge.

This footbridge constrains the OHLE solution in the north part of the station and OHLE masts in the platforms are also constrained in the area of the footbridge accesses.

Figure 2-13: : Roadbridge OBB39 close to Rush and Lusk Station

Figure 2-14: Footbridge OBB38A at the north end of the platforms with lifts and stairs at both sides

Canopies

There is a canopy on both platforms (28m long on Platform 1 and 40m on Platform 2) which could constrain the location of the masts to fit overhead lines. Additional work may be required to respect safety distances as outlined in Section 4.1.3.

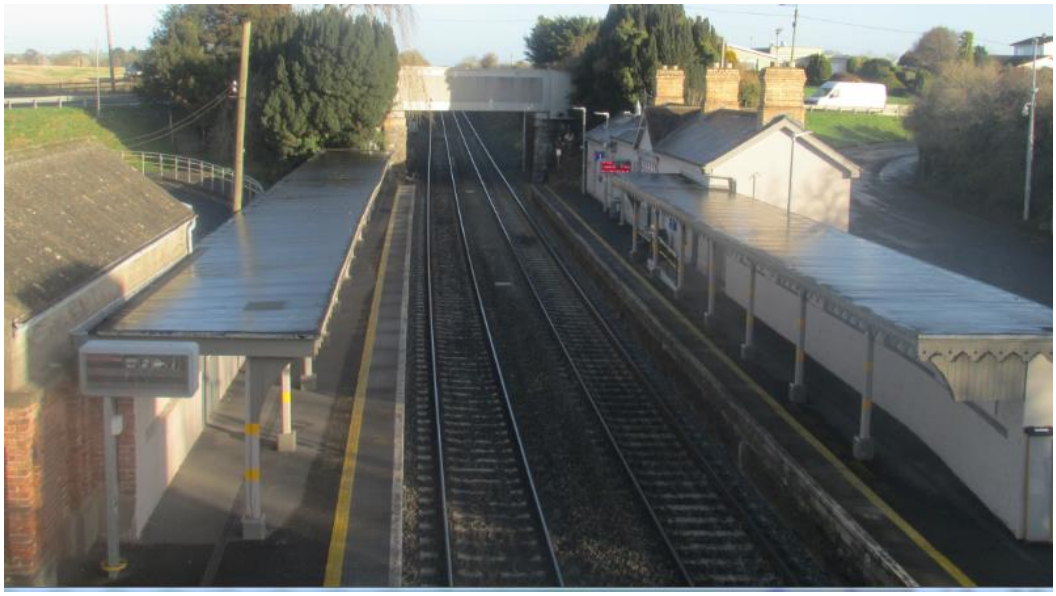


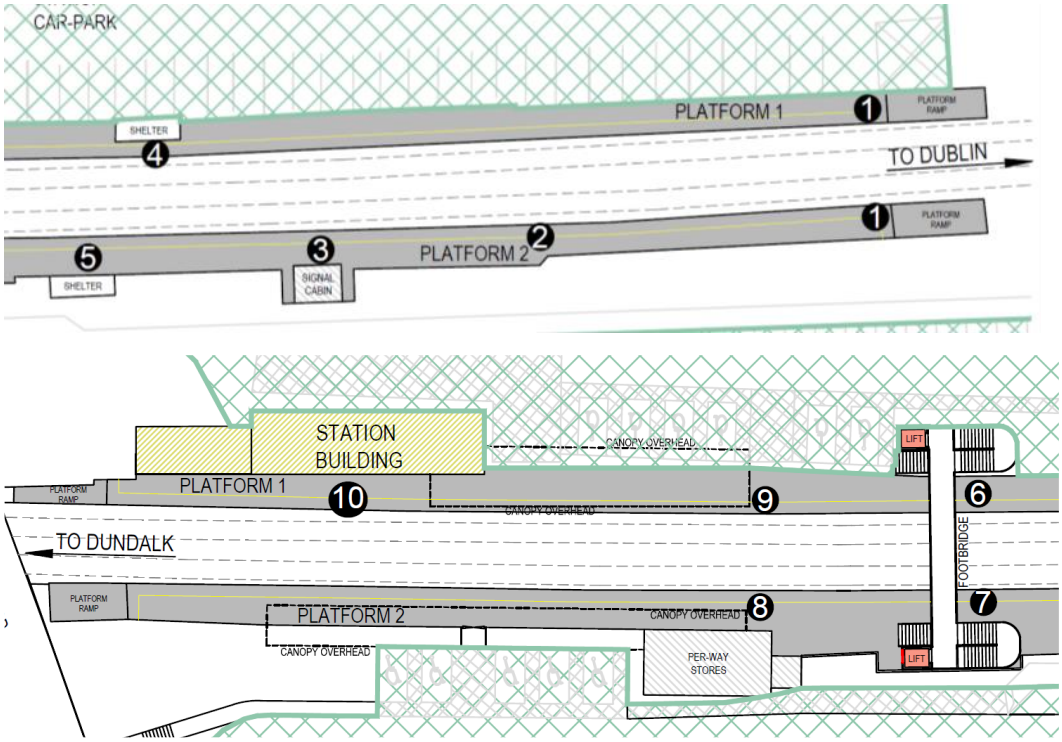
Figure 2-15: Canopy platform at Rush and Lusk Station

Shelters

There are two shelters - one on each platform. Safety distances must be checked for every shelter or station furniture that a person could climb onto.

Platform width

As a consequence of the different elements placed on the platforms, the platform width is reduced as described in the sections above. This may constrain the location of the OHLE masts to avoid reducing the minimum required width without obstacles. The platform width summary for this station is shown in Figure 2-16.



1	2	3	4	5	6	7	8	9	10
2.20m	3.60m	3m	2m	3.7m	3m	2.30m	3.50m	1m (between canopy/tracks)	3m

Figure 2-16: Platform width summary in Rush and Lusk Station

2.2.4.3 Skerries Station

Skerries Train Station is located at 29mi 940yds. The ticket office is located within the main building of the station. There is one carpark which is located to the front of the station.

Figure 2-17: General View (Source: OSI aerial mapping)

Overbridges

Footbridge OBB51A is located at the middle of the station with lifts and stairs to both platforms. The soffit height is 4.815m and it is about 2.25m wide. This footbridge constrains the OHLE solution in the middle of the station and OHLE masts in the platforms are also constrained in the area of the footbridge accesses.

Figure 2-18: Footbridge with stairs and lifts at both sides

Canopies

There is a 20m long canopy on Platform 1 which could constrain the location of the masts. Additional work may be required to fit the overhead lines and respect safety distances as outlined in Section 4.1.3.

Figure 2-19: Canopy at Skerries Station

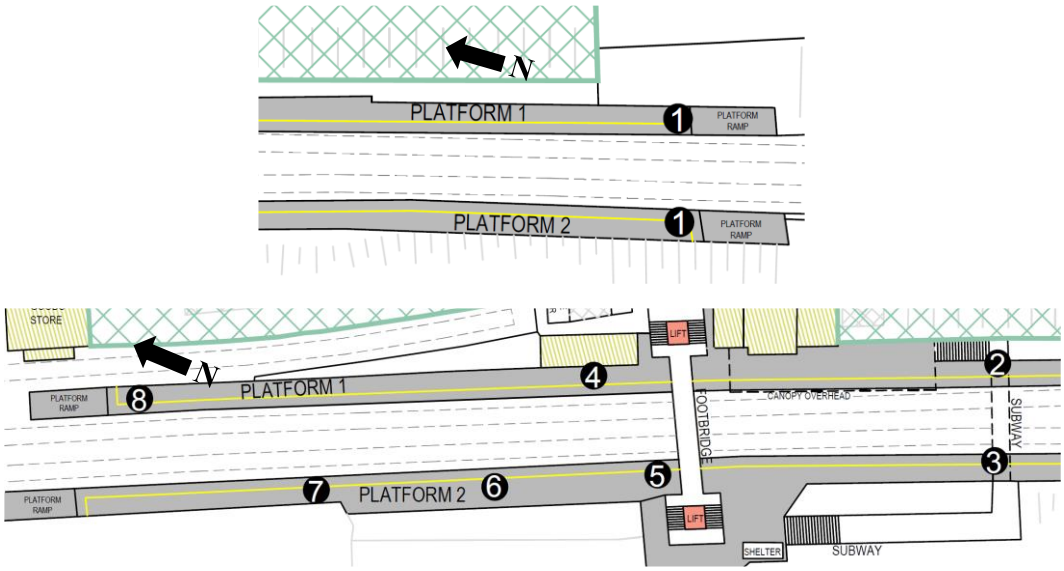
Station buildings

There is a signal box at the north end of the platforms that constrains the location of the masts in this area.

Figure 2-20: Cabin at the end of the platforms

Platform width

Platform width is reduced due to station furniture, as described in the sections above. This may constrain the location of the OHLE masts to avoid reducing the minimum required width without obstacles. The platform width summary for this station is shown below.



1	2	3	4	5	6	7	8
2.5m	3m	3m	2m	2.5m	4m	2.75m	2.2m

Figure 2-21: Platform width summary in Skerries Station

2.2.4.4 Balbriggan Station

Balbriggan Station is located at 36mi 095yds.

Figure 2-22: General view (Source: OSI aerial mapping)

Overbridges

Footbridge OBB57A is located in the middle of the station with lifts and stairs at both platforms. The soffit height is 4.775m and it is approximately 2.40m wide. This footbridge constrains the OHLE solution in the middle of the station and OHLE masts in the platforms are also constrained around the footbridge accesses.

Figure 2-23: Footbridge with stairs and lifts at both platforms

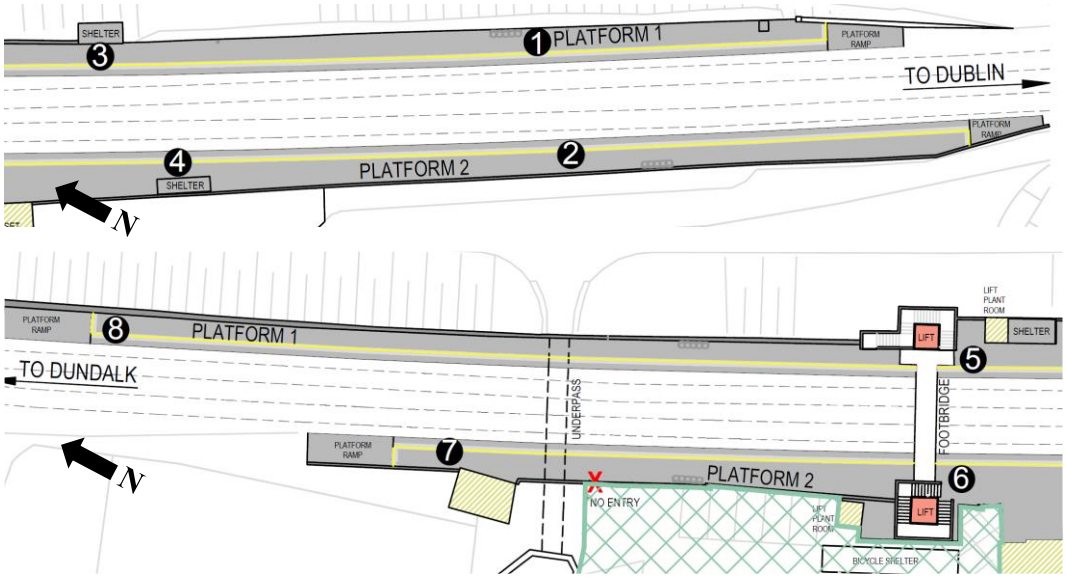
Shelters

There are several shelters on both platforms. Safety distances, as outlined in Section 4.1.3, must be checked for every shelter or piece of station furniture which a person could climb on to.

Figure 2-24: Shelter at Balbriggan Station

Platform width

The platform width is reduced due to the placement of station furniture, as described in the sections above. This may constrain the location of the OHLE masts to not reduce the minimum required width without obstacles. The platform width summary for this station is shown in Figure 2-24.



1	2	3	4	5	6	7	8
2.80m	3.50m	1.60m	2.80m	2m	3.50m	2.40m	2.70m

Figure 2-25: Platform width summary in Balbriggan Station

2.2.4.5 Gormanston Station

Gormanston Railway Station is located at 39mi 760yds. There is one vehicle and pedestrian entrance into the car park for Platform 1 and one pedestrian entrance over the road bridge to Platform 2. The station consists of the main station building, two platforms, a car park, signal cabin and an external electrical building.

Figure 2-26: General view (Source: OSI aerial imagery)

Overbridges

Roadbridge OBB66 is located at the south side of the platforms, with a low soffit height at approximately 4.88m and a width of 4.55m. Platform width is less than 1.5m under the bridge. It is planned to install a new footbridge in late 2021/early 2022, located in the middle of the station (at about 100m from OBB66), with approximately 5.275m of soffit height. It is understood that the bridge will have complaint electrical clearances.

Figure 2-27: Overbridge with low clearance height at the south side of the platforms. Left to right: north elevation, south elevation (Source: Irish Rail)

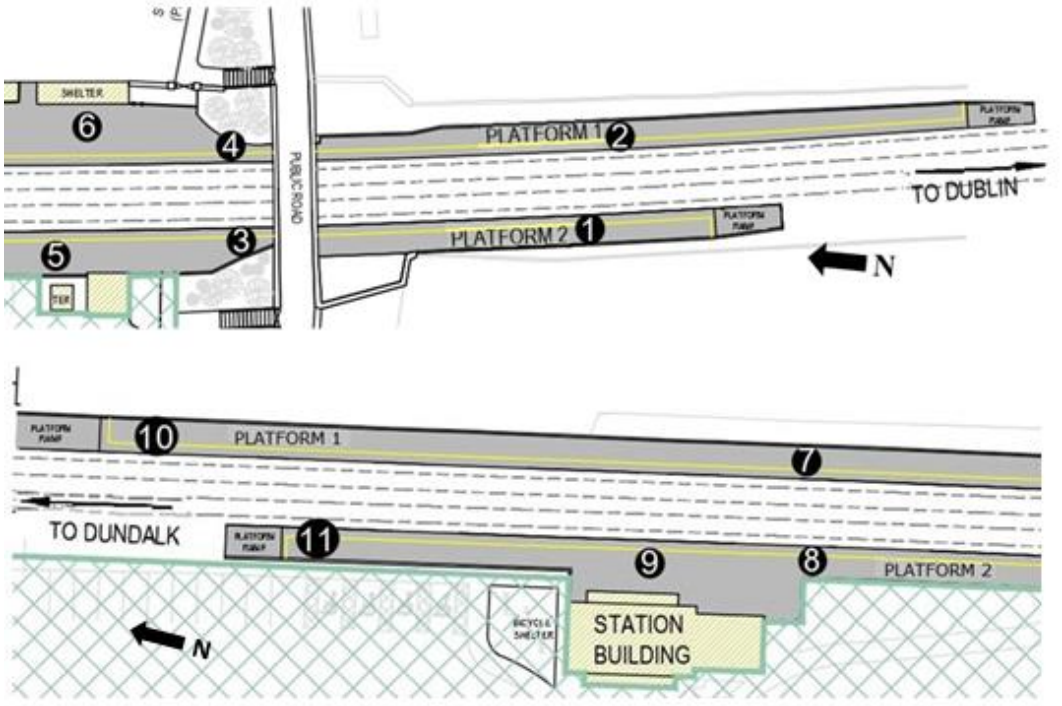
Signal mast

A signal post is located less than 1.2m from the tracks at the north end of the Gormanston station. It constrains the location of the masts in this area.

Figure 2-28: Signal mast close to the tracks at the north side of the station

Platform width

The platform width is reduced due to the placement of station furniture, as described in the sections above. This may constrain the location of the OHLE masts to not reduce the minimum required width without obstacles. The platform width summary for this station is shown in Figure 2-29.



1	2	3	4	5	6	7	8	9	10	11
2.5m	2.5m	<1.5m	<1.5m	5m	5m	3m	3.5m	5m	2m	3.4m

Figure 2-29: Platform width summary at Gormanston Station

2.2.4.6 Laytown Station

Laytown Railway Station is located at 44mi 790yds. There is one vehicle and pedestrian entrance provided into the car park of Platform 2 and a second pedestrian entrance provided for Platform 1. The station consists of the station building, lift footbridge with lifts, car park, and the old station building (bike shed, storage, and TER). The old station building was constructed circa mid-19th century from timber panelling with a painted finish.

Figure 2-30: General view (Source: OSI aerial imagery)

Overbridges

Footbridge OBB74A is located at the middle of the station with lifts and stairs to both platforms. The soffit height is approximately 5.10m and it is approximately 2.80m wide.

This footbridge constrains the OHLE solution in the middle of the station and OHLE masts in the platforms are also constrained around the footbridge accesses. Platform width is less than 3m under the bridge.

Figure 2-31: Footbridge with stairs and lifts at both sides

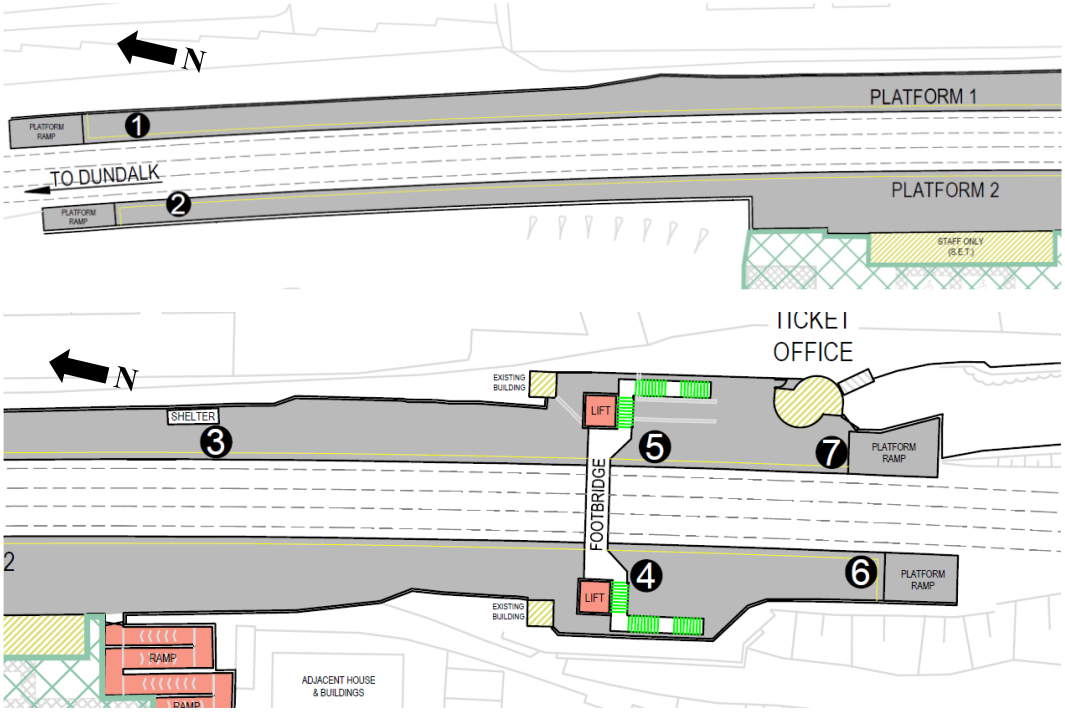
Shelters

There is a shelter on Platform 1. Safety distances, as outlined in Section 4.1.3, must be checked for every shelter or piece of station furniture which a person could climb on to.

Figure 2-32: Shelter at Laytown Station

Platform width

The platform width is reduced due to the placement of station furniture, as described in the sections above. This may constrain the location of the OHLE masts to not reduce the minimum required width without obstacles. The platform width summary for this station is shown below.



1	2	3	4	5	6	7
3m	2.50m	3.50m	2.8m	2.7m	4.2m	3.85m

Figure 2-33: Platform width summary at Laytown Station

2.2.4.7 Drogheda MacBride Station

Drogheda MacBride Station is located at 52mi 200yds. The main station comprises a ticket office with a kitchenette, a staff canteen / mess area, ESB / Telecom rooms, concourse area, staff and public toilet facilities, various stores and offices and 3 platforms which are interconnected by a footbridge with stairs and lifts. The station building is a detached single storey building and was constructed circa mid-19th century from traditional construction.

Figure 2-34: General view (Source: OSI aerial mapping)

Overbridges

There are two overbridges located in this station. Footbridge OBB81 is located at the middle of the station. The soffit height is approximately 4.46m and it has a width of approximately 2.8m. This footbridge constrains the OHLE solution in the middle of the station and OHLE masts in the platforms are also constrained around the footbridge accesses. The minimum platform width under the bridge is about 2 metres.

Roadbridge OBB80/OBB80A/OBB80B is located at the southern throat of Drogheda MacBride Station, with soffit heights of approximately 4.30m, 4.20m and 4.91m for respective spans. The structure is approximately 7.2m wide. Although outside of platform area, this will constrain the OHLE installation at the southern end of the station. It is noted that the soffit clearances do not currently provide sufficient clearance to permit OHLE installation and the chosen solution to address this may remove this constraint. Further discussion is provided in Annex 3.2 Section E.

Figure 2-35: Footbridge OBB81/OBB81A at Drogheda MacBride Station

Figure 2-36: Roadbridge at Drogheda MacBride Station

Canopies

There are 34m long canopies on Platforms 1 and 2. It could constrain the location of the masts and additional work may be required to fit the overhead lines whilst respecting safety distances.

Figure 2-37: Canopies at Drogheda MacBride Station

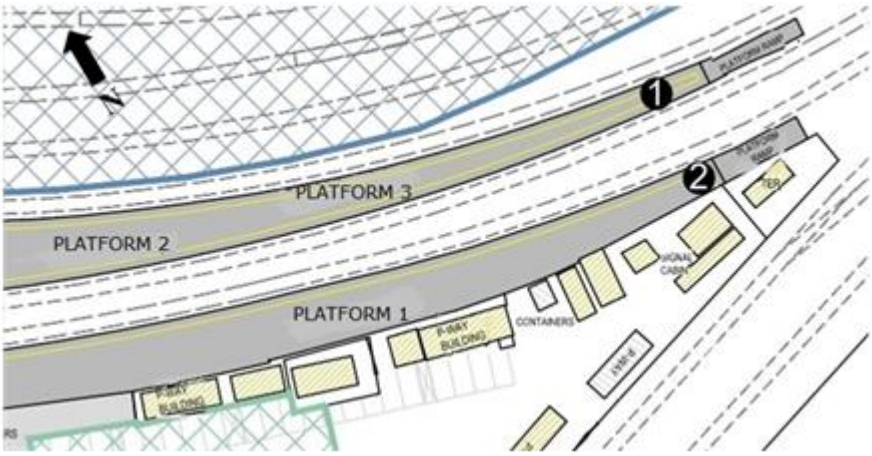
Depot Access

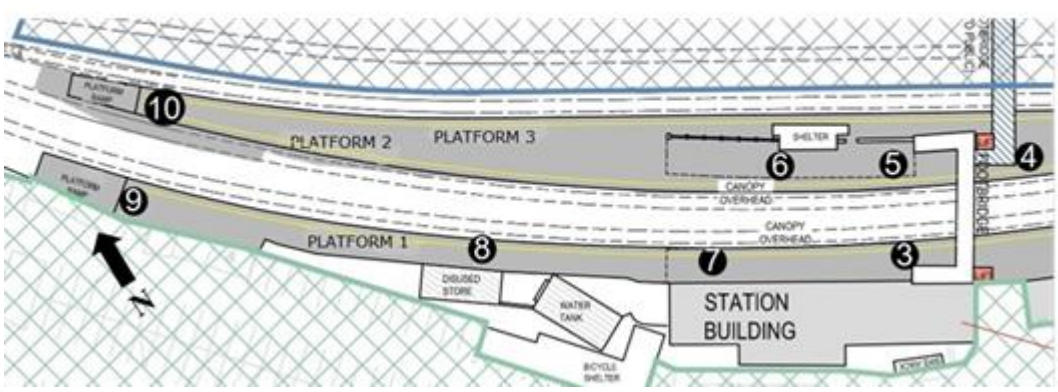
The access to the depot is situated on approach to the station. Several constraints must be considered in the next stages when locating the masts in this area. Installing OHLE portals will be considered.

Figure 2-38: Tracks for depot access from the south end of the station

Platform width

The platform width is reduced due to the placement of station furniture, as described in the sections above. This may constrain the location of the OHLE masts to avoid reducing the minimum required width without obstacles. The platform width summary for this station is shown below.





1	2	3	4	5	6	7	8	9	10
2.6m	2.6m	2.80m	1.90m	2m	1.90m	1.5m	3m	5.2m	3.3m

Figure 2-39: Platform width summary at Drogheda MacBride Station

3 Requirements

3.1 Specific Requirements

An OHLE installation is required that will enable operation of Electrical Multiple Unit (EMU) and Battery EMU type rolling stock to operate over the section. The design of the OHLE system will ensure backward compatibility for the interface with the existing installations at Malahide whilst also complying with the latest standards covering these types of technical systems and as set out in the electrification Functional Requirement Specification (FRS). This is principally in relation to the geometry and environmental performance. The OHLE will also be sufficient to support the level of traffic defined in the Train Service Specification 1C with amendments, meaning that its electrical performance will guarantee a minimum power delivery to the rolling stock pantograph at all locations.

The OHLE will be designed and configured to support all signalled routes in the section. This means that all areas where EMU train movement is anticipated, the OHLE will be designed to provide power to the pantograph. In relation to the interface with the existing OHLE equipment at Malahide, the new OHLE will be designed to provide a compliant interface that ensures that the pantograph operation is unaffected in the transition between the existing and the new sections of OHLE.

Measures will be implemented to protect sections that are not equipped with OHLE from being accidently entered by EMUs. This will include certain areas of Drogheda Depot, Navan branch, at the Boyne Viaduct and any other locations where OHLE is not being proposed.

3.2 Systems Infrastructure and Integration

The OHLE will be designed to integrate with the other interfacing sub-systems within the DART+ system. Among these are the track, signalling, rolling stock, SCADA and adjacent infrastructure along the route. This will ensure that the entire system operates in a way that can support the operational goals which are summarised by the Train Service specification.

3.3 Design Standards

The OHLE will be designed according to IÉ SET standards, the DART+ Electrification FRS and EN standards for this type of equipment. This will ensure that the installation provides the required performance and planned lifecycle. A non-exhaustive list of key standards of note is provided below:

- I-ETR-4020 - Technical Information for 1500V DC Traction Supply and OHLE interface for Rolling stock
- I-ETR-4101 – Maintenance Parameters for 1500Vdc OHLE
- MAY-MDC-ELE-DART-SP-E-0002 - Electricity Functional Requirements Specification System-Wide

- CCE-TMS-410 – Civil Engineering Structures Design Standard
- I-PWY-1101 – Requirements for Track and Structures.

Please note that this list highlights key documents but designs shall be developed in accordance with all IÉ standards.

4 Constraints

4.1 Technical

Primary constraints will arise from the adjacent infrastructure that will require specific solutions to address safety distances and the availability of locations to site masts. Contact wire geometry will be designed to be optimal for the physical constraints imposed by the dimensions of the overbridges while considering the performance limits of the pantograph of the train. Similarly, integration between the OHLE and signalling will be designed to avoid inadvertently routing trains into unpowered sections. SCADA controls and indications will need to be provided to give status indications to configure the OHLE to provide power as required.

4.1.1 Overbridges

The list of existing overbridges on the Northern Line between Malahide and Drogheda is shown in Table 2-1: . The OHLE installation will be constrained by these overbridges.

Risk assessment is needed for overbridges where required contact wire height for feasible OHLE solutions is lower than 4.7m. The required height considers multiple factors such as construction and maintenance tolerances, fixing offsets and required running height for the pantograph. Additionally, in these cases, some alternative options may be considered, as shown below, and Multi-criteria Analysis (MCA) will be developed to select the preferred option for each overbridge:

- OHLE installation with lower contact wire height as per hierarchy of OHLE solutions indicated in the programme-wide Electricity Functional Requirements Specification System-wide (MAY-MDC-ELE-DART-SP-E-0002);
- Track lowering;
- Bridge modification;
- Other bespoke OHLE solutions.

This process is described in detail in section E of the Electrification Report – OHLE Bridge Clearance Works (D+WP56-ARP-P2-NL-RP-GE-000154).

Earthing and bonding of the overbridges shall be considered, in accordance with EN 50122-1. Earthing and bonding and protection against electric shock is described in section 5.2.12 of this document.

4.1.2 Underbridges

For simplicity, OHLE masts are to be avoided on underbridges as much as possible. Therefore, according to the maximum span considered in the Electricity Functional Requirements Specification, masts will be required to be installed on

underbridges longer than 50-55m. The list of underbridges where masts will be required is shown below.

Table 4-1: Underbridges requiring installation of OHLE masts on/near the structure

Bridge ID and name	Approx Location		No. of Spans	Overall Deck Length (m)
	Miles	Yards		
UBB30 - Malahide Viaduct	9	971	12	175
UBB36 - Rogerstown Viaduct	12	998	3	60
UBB56 - Balbriggan Viaduct	21	1112	11	125
UBB65 - Gormanston Viaduct	23	1300	3	45
UBB72 - Laytown Viaduct	26	1328	5	75
UBB82 - Boyne Viaduct	31	1479	18	525

Additionally, the maximum half tensioning length for the proposed OHLE is 800m, so anchors on the underbridges will not be required in general.

Boyne Viaduct is, however, an exception to this because there is a turnout on the viaduct. The final extent of the required wiring is under discussion but, considering the minimum required overrun protection length for the OHLE after the platforms at Drogheda MacBride Station, as per FRS (7.5m per km/h line speed), this turnout will need to be wired. To facilitate the OHLE installation on the viaduct, the final anchor of the overrun wire would need to be placed on the viaduct before the trussed section.

Hence there is a proposed shortened overrun distance of 116m beyond platforms 1 and 2 to avoid masts and tensioning equipment needing to be mounted on the viaduct. This shortened overrun length is not compliant with the minimum overrun protection length of 7.5m per km/h line speed required by FRS.

Supports and foundations solutions for placing masts on underbridges are explained in detail in Section C of Annex 3.2 – OHLE Foundation solutions at underbridges.

4.1.3 Stations

The OHLE design in the stations has to take into account several technical constraints produced by the existing buildings, overbridges, platforms, etc. The main technical constraints to be considered are standing surface clearances, electrical clearances, the distance to platform edge and the earthing and bonding of the conductive parts.

Standing surfaces

Electrical safety distances between standing surfaces and live parts must be respected to avoid any direct contact, following EN 50122-1. These distances are for low voltage traction systems (nominal voltage up to and including DC 1500 V)

are shown in the figure below for public accessible and for restricted areas. These distances constrain the OHLE height and mast position at stations and must be checked to ensure personal safety.

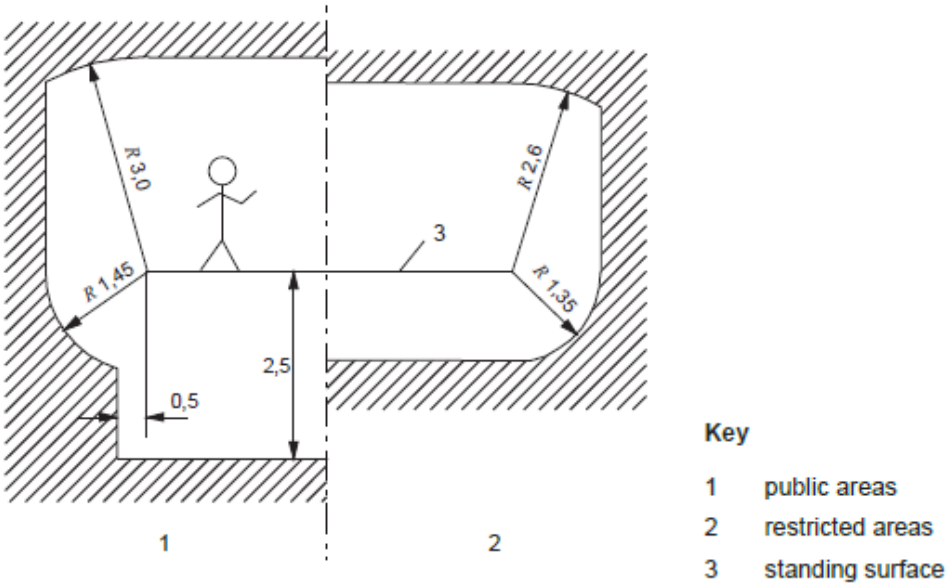


Figure 4-1: Minimum clearances to accessible live parts on the outside of vehicles as well as to live parts of overhead contact line systems from standing surfaces accessible to persons for low voltages (EN 50122-1)

These clearances are minimum values which shall be maintained at all temperatures and in the full range of electrical and mechanical loads of the conductors.

Lateral fencing / parapets accessible to persons, will be at least 1.8m high if the minimum distance to live parts is not met according to EN 50122-1. The 1.8m high obstacle will be sufficiently long (generally in the OHLE mast area) to ensure that, from any standing position, the minimum electrical clearance is in accordance with EN 50122-1. The requirements of the DART+ Programme Electricity FRS will also be met.

Electrical clearances

The electrical clearances between earth and the live uninsulated parts of the contact line or feeders is defined to limit damage to the overhead contact system or earthed infrastructure and to ensure safety.
According to the Electricity Functional Requirements Specification System-wide, electrical clearances for 1.5kV DC to be used for the DART+ programme electrification (based on the current electrical clearances used in the DART electrified lines) are as shown in Table 4-2.

Table 4-2: Electrical clearances for 1.5kV DC

STATIC CLEARANCES (NORMAL)	150 mm
STATIC CLEARANCES (SPECIAL REDUCED)	100 mm
PASSING CLEARANCES (NORMAL)	100 mm
PASSING CLEARANCES (SPECIAL REDUCED)	80 mm

Distance to platform edge

According to the IÉ and NIR Standard Structure Gauge, the distance between masts and the edge of the platform must be greater than 2 metres. The position of masts will be constrained at places where the platform width is less than 2 m, as outlined in section 2.2.4. Furthermore, masts will be located at places that do not block the access to the buildings nor disturb the passage of travellers. They will not interfere with other existing elements of the station, such as streetlights, signals, station systems and fences.

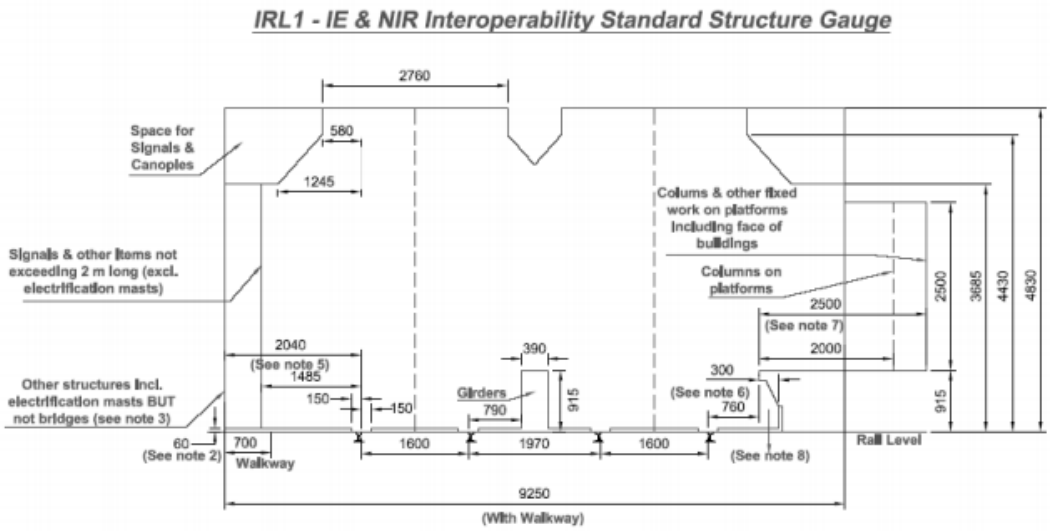


Figure 4-2: Figure extracted from NIR Standard Structure Gauge

Earthing and bonding of the conductive parts

All conductive parts inside the Overhead Contact Line Zone (OCLZ) and Current Collector Zones (CCZ) shall be earthed by connection to earthing wires with a wire of sufficient section to withstand short circuit currents including metallic platform furniture and other large metal items., in accordance with EN 50122-1.

Earthing and bonding and protection against electric shock is described in section 5.2.12 of this document.

4.2 Environmental

The OHLE impacts the visual amenity immediately adjacent to the track. This is particularly the case in locations such as the Broadmeadow Viaduct where the OHLE will be visible. Measures will include minimising the number of masts and locating masts symmetrically in a minimal configuration to limit the impact visual commensurate with the required performance criteria.

The design of the OHLE will also consider electrocution and collision hazards for birds and other wildlife. Materials used in the construction of the OHLE installations will be such that they will not be toxic to wildlife.

For an overview of the existing environmental constraints for DART+ Coastal North refer to Annex 3.1 Constraints Report.

4.3 Planning

The following list covers structures recorded within the National Inventory of Architectural Heritage and Record of Protected Structures which will need to be considered when locating OHLE equipment.

Donabate Railway Station

- Signal Box (NIAH 11336018)
- Station Building (NIAH 11336011)
- Station Masters House (NIAH 11336015)
- Overbridge OBB33 (NIAH 11336016)

Rogerstown

- Rogerstown Viaduct UBB36 (FCC RPS 0516)
- Underbridge UBB37 (FCC RPS 0286)
- Rogerstown Lane Overbridge OBB38 (FCC RPS 0287)

Rush and Lusk Station

- Railway station building including canopies (NIAH 11323016-8)
- Signal Box (NIAH 11323016-8)

Tyrrelstown Big

- Overbridge OBB44 (FCC RPS 0292)
- Overbridge OBB46 (FCC RPS 0246)

Skerries Station

- Underbridge UBB50 (NIAH 11311037)
- Railway station building including canopies
- Underbridge UBB53 (FCC RPS 0879)

Kellys

- Underbridge UBB52 (FCC RPS 0880)

Balbriggan Station

- Balbriggan Railway Viaduct (NIAH 11305021)
- Railway station building (NIAH 11311036), (FCC RPS 0191)
- Station Masters House (NIAH 11311035) (FCC RPS 0192)
- Frett's Arch Underbridge UBB60 (FCC RPS 0876)
- Underbridge UBB61 (NIAH 11304001)

Gormanston Station

- Gormanston Viaduct UBB65 (MH028-114/0001)
- Former railway warehouse building (NIAH 14322016-8)
- Railway station building (NIAH 14322016-8)
- Station Masters House (NIAH 14322016-8)

Laytown Station

- Railway station building (NIAH 14319001)
- Station Masters House (NIAH 14319001), (MH028-302)
- Laytown Viaduct UBB72 (NIAH 14402801)

Drogheda MacBride Station

- Engine shed (NIAH 13902401-6)
- Water tower (NIAH 13902401-6)
- Railway station building including canopies (NIAH 13902401-6)
- Parcel Office (NIAH 13902401-6)
- Ancillary buildings adjacent to platform (NIAH 13902401-6)

5 Options

5.1 Sectioning diagram

The sectioning diagram developed has considered the existing track scheme, as described in previous sections, from the existing electrified section in Malahide to Drogheda. As indicated, modifications to the existing electrified tracks of Malahide will be considered in the subsequent stage of the project.

The new electrified railway line between Malahide to Drogheda will likely be fed from eight traction substations located as in the table below. Locations provided are approximate and subject to completion of the optioneering design.

Table 5-1: Approximate locations of new traction substation locations

Traction Substation	Location
Drogheda TSS (New)	52km 200m
Laytown TSS (New)	46km 900m
Gormanston TSS (New)	41km 180m
Balbriggan TSS (New)	37km 200 m
Baltrana / Ardgillan Castle TSS (New)	32km 500m
Skerries TSS (New)	28km 550m
Rush Lusk TSS (New)	23km 450m
Donabate TSS (New)	19km 230m

The criteria followed for developing the sectioning diagrams in these locations are as provided in the Electricity Functional Requirements Specification System-wide, which takes into account whether traction substations are located in stations or open route.

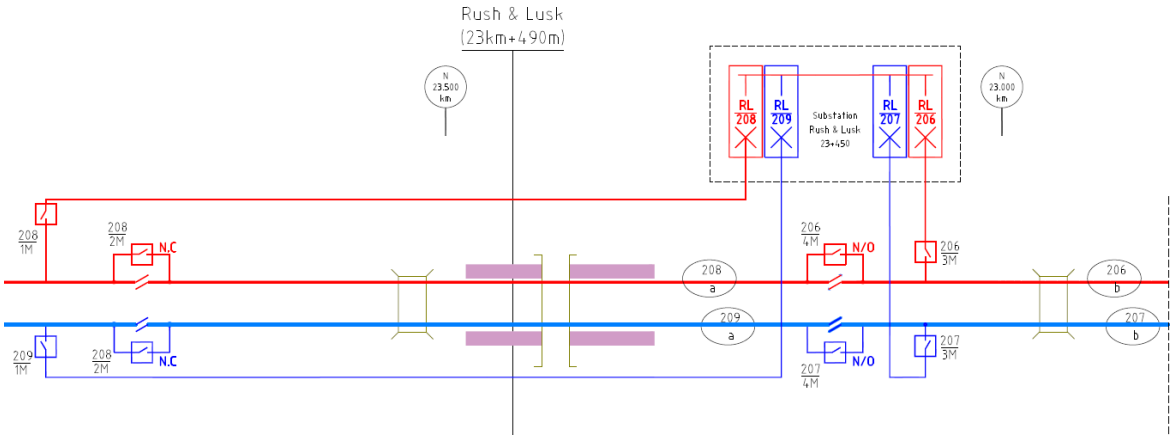


Figure 5-1: Potential sectioning scheme for feeding at traction substations. Substation at station (Rush and Lusk)

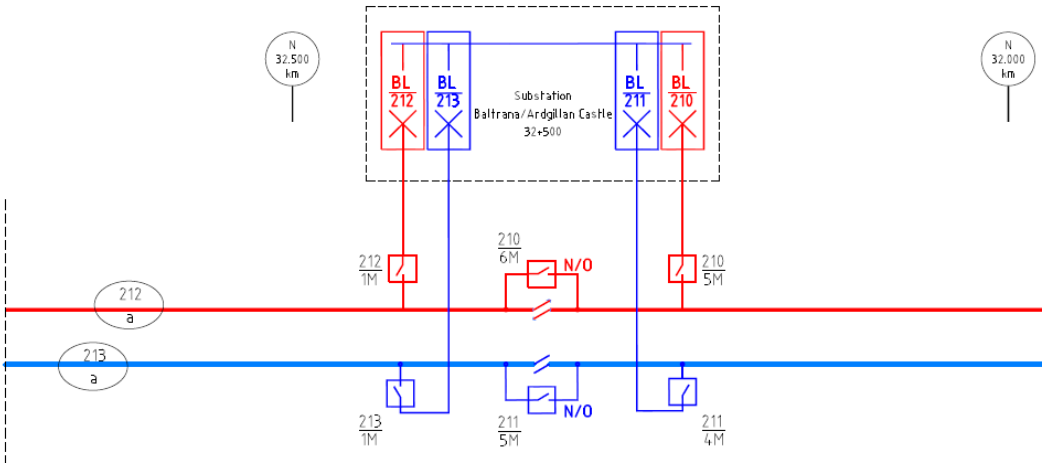
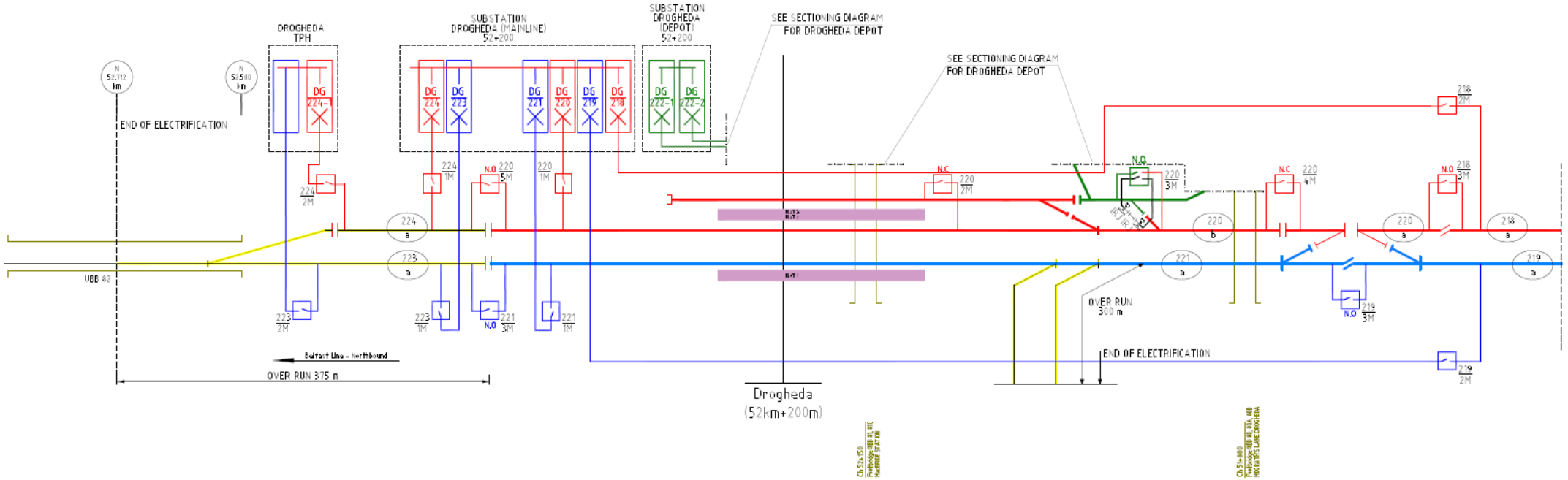


Figure 5-2: Potential sectioning scheme for feeding at traction substations. Substation outside the station (Baltrana/Ardgillan Castle substation)



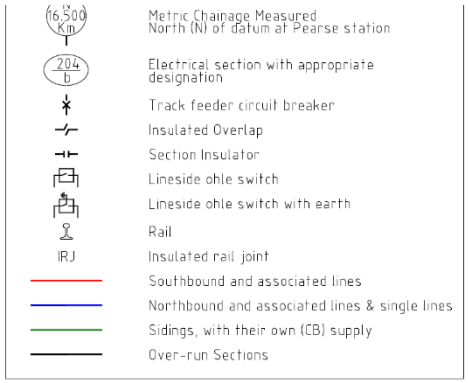


Figure 5-3: Potential sectioning scheme for feeding at Drogheda station.

Drogheda Depot will be fed from an independent group within the main traction substation. The boundary between main line and depot will be made by section insulators and insulated rail joints located in the connections between the Depot and the Up and Platform 3 tracks, with one disconnector to feed the depot from the main track in case of failure of feeding from depot traction group.

It is proposed to have a reduced overrun protection length for the OHLE just after the Drogheda MacBride Station platforms to minimise the OHLE length installed on the Boyne Viaduct. As a result, the two outgoing feeders proposed in the FRS criteria for this side of the station only would feed the overrun protection length.

Section insulators are proposed to be installed between the OHLE in Drogheda MacBride Station and the overrun sections in order to reduce the length that would be required if an insulated overlap was installed. This is also justified by the expectation that EMUs will not travel beyond the platforms in normal operation (and speed through the station is also limited to 50 km/h).

Additionally, overrun protection lengths have been considered on the tracks of the Navan branch. In stations without a traction substation, insulated overlaps are proposed to be installed at both end of the station, according to the criteria indicated in the FRS.

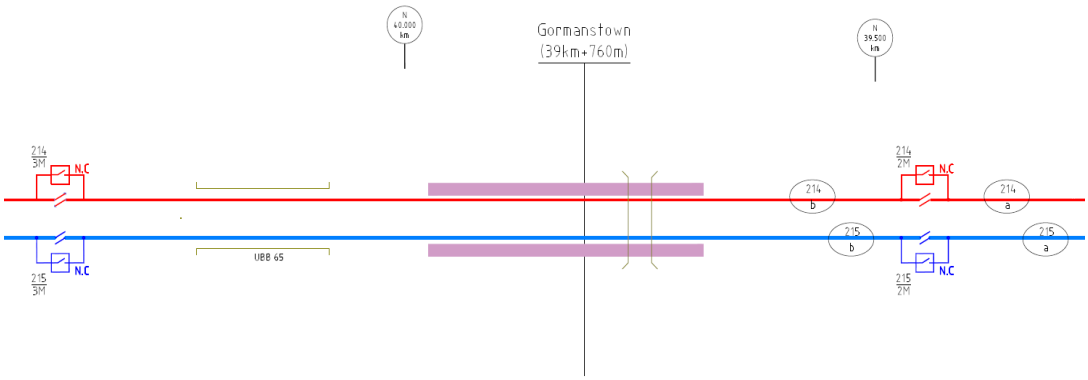


Figure 5-4: Potential sectioning scheme example at Gormanston station.

In Skerries Station, electrification of the siding track has been considered and so an insulated overlap will be located at the north side of the connection with the siding track.

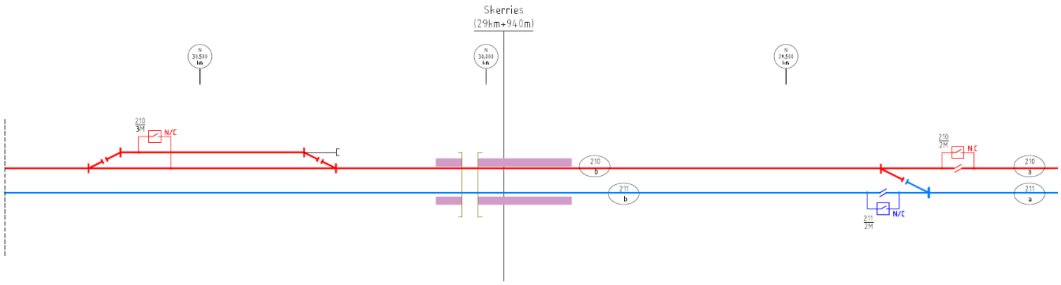


Figure 5-5: Potential sectioning scheme at Skerries Station with insulated overlap in the siding track

Insulated overlaps are also to be considered in areas with crossings between the main tracks. In Drogheda MacBride Station, the existing length between the double crossing existing in the south approach to the station and the turnout for connection with Drogheda Depot is not enough to install an insulated overlap, therefore a section insulator is proposed at this location.

5.2 OHLE system

5.2.1 General description

The OHLE system proposed shall follow the design criteria indicated in the Electricity Functional Specifications System-Wide (MAY-MDC-ELE-DART-SP-E-0002), to achieve the required uniformity and compatibility of equipment and systems across the IÉ network. General criteria and OHLE design parameters not included in this document are covered in the FRS.

The proposed DART+ programme OHLE is an auto-tensioned Overhead Contact System comprised of a single contact wire and single messenger/catenary wire, fed at 1500V DC.

Where required, the OHLE also has a Parallel Feeder as a distribution power cable from each substation attached to, and insulated from, the tops of the masts and used to deliver the 1500V DC power to the Messenger Wire / Contact Wire combination via jumper cables at selected intervals. It also includes an Earth Wire connected directly to every OHLE structure and its primary function is to provide an electrical path to detect short circuit faults on the system.

In general, the nominal contact wire height to be adopted is 4.70m from top of rail, with a maximum height of 5.70m and minimum height of 4.40m (5.60m at level crossings where they exist). The nominal system height will be 1.30m and the minimum system height in open route is 0.50m.

A particular study is developed for overbridges and constrained locations, shown in Section E of Annex 3.2 – OHLE Bridge Clearance Works. According to the FRS, the design contact wire height at overbridges shall aim for 4.70m above top of rail, with anything below requiring risk assessment. If the contact wire height required is below 4.40m it will also require an IÉ SET standard derogation according to SET–AMS–002–012 Iss1.0 *Derogation from SET Technical Standards* to be

presented to IÉ SET Department. In the same way, a reduced system height down to 0mm may be required.

The maximum span for design of new OHLE is 63m on straight alignments, as stated in Table 29 of the FRS. Wind speed and loads for calculation will be considered according to those indicated in the FRS.

5.2.2 OHLE composition

The proposed OHLE for the DART+ programme comprises a single contact wire with a cross sectional area of 120mm^2 hard copper and a single messenger/catenary wire with a cross sectional area of 95mm^2, with 10mm^2 droppers.

Additionally, the FRS considers a stranded copper parallel feeder of 240mm^2, where required, to deliver 1500V DC power to the Messenger Wire / Contact Wire combination via jumper cables at selected intervals. The OHLE also includes an Earth Wire, AAAC 167-AL7, connected directly to every OHLE structure.

The cable cross-sections for each section along the line are summarised in Table 5-2 below according to the Electrical Simulation Study currently being developed. Feeder optimisation is currently being studied for the preliminary design, when the final location of substations will be determined. Chainage values used in the design shall be referenced to the p-way/civil chainage.

The interface between the new and the existing OHLE at Malahide Station shall be defined within the preliminary design phase, according to the preferred option eventually determined for Works around Malahide Station.

Table 5-2: Proposed cable cross-sections

Element	Chainage	Initial PK	Final PK	Feeder (mm^2)	Contact Wire(mm^2)	Messenger Wire(mm^2)	Length (km)
Drogheda TPH (New)	52+200	46+900	52+200	3x240	120	95	5,3
Drogheda TSS (New)	52+200						
Laytown TSS (New)	46+900	41+180	46+900	2x240	120	95	5,72
Gormanston TSS (New)	41+180	23+450	41+180	1x240	120	95	17,73
Balbriggan TSS (New)	37+200						
Baltrasna TSS (New)	32+500						
Skerries TSS (New)	28+550						
Rush-Lusk TSS (New)	23+450	19+631	23+450	2x240	120	95	3,82
Donabate TSS (New)	19+631	16+497	19+631	1x240	120	95	3,13

Interface New-Existing	16+497	15+984	16+497	95	107	70	0,513
Malahide TPH	15+984						
Malahide TSS	14+649	0+265	15+984	95	107	70	15,98

5.2.3 OHLE geometry

5.2.3.1 Contact wire height

Following the Functional Requirements Specification, the contact wire heights adopted are as shown in Table 5-3.

The OHLE vertical maintenance tolerance of contact wire position considered for the DART+ OHLE shall be:

- ±30 mm (open route)
- ±10 mm (crossovers, points and crossings, etc.).
- ±20 mm OHLE construction tolerance

Table 5-3: Adopted contact wire heights

MINIMUM	4,400 mm
NOMINAL	4,700 mm
MAXIMUM	5,700 mm
MINIMUM AT LEVEL CROSSINGS	5,600 mm
MAXIMUM AT LEVEL CROSSINGS	5,700 mm

5.2.3.2 Stagger

The contact wire stagger will be as shown in Table 5-4. Stagger allocation depends on the curve radius as shown in the figure below, according to the FRS.

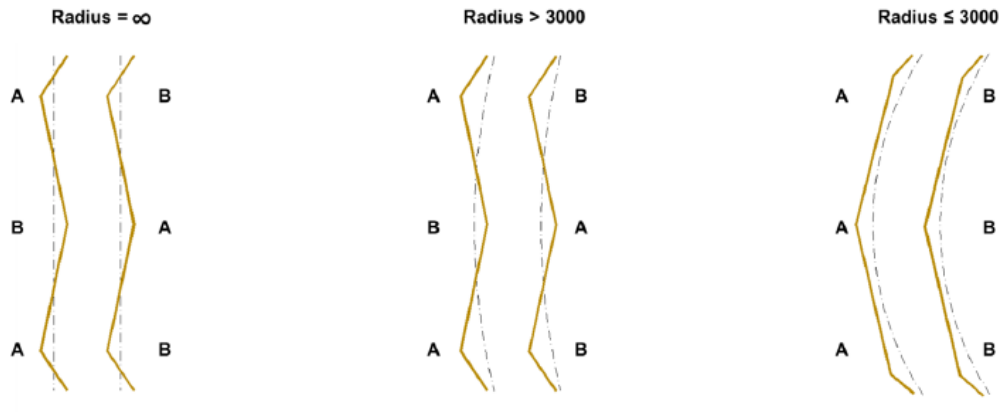


Figure 5-6: DART Stagger allocation as a function of curve radius (A + and B -)

The messenger wire shall be kept vertically in line with the contact wire (0 mm stagger between contact wire and messenger wire). The maximum lateral deviation of the contact wire in relation to the track centerline under action of a cross wind is 400mm, in accordance with the Energy Technical Specification for Interoperability (ENE-TSI).

Table 5-4: Design contact wire staggers

STRAIGHT TRACK	±230 mm
CURVED TRACK	±380 mm

5.2.3.3 Span Length

The span is dimensioned according to the lateral deviation of the contact wire, giving a maximum of 63m.

The standard span value will depend on:

- Track radius;
- Stagger;
- Maximum and minimum radial force;
- Maximum deflection due to wind;
- Obstacles and single points.

Table 5-5: Maximum OLE span as defined by track radius

MINIMUM RADIUS (m)	SPAN(m)
Straight	65
10000	65
9000	64
7000	63
6000	61
5000	60
3000	58
850	55
800	54
600	49
550	48
500	46
450	45
400	43
300	38
200	32
100	20

Span variation due to track radius is summarised in Table 5-5. Where possible, span differential between adjacent spans will be no greater than 10m. Where unpractical, no span design length shall be longer than 2 x the length of the adjacent span, except at fitted bridges, where this can be increased to 4 x adjacent span.

5.2.4 OHLE structures

New OHLE masts to be used for supporting OHLE wires will be HEB steel structures. The height of the masts and their profile depend on the stress they are subjected to and their type, function and location. In general, OHLE pole height shall be between 6.5 and 8.5 metres.

The OHLE arrangement will generally be single-track cantilevers located on either side of both tracks. Where using single track cantilevers for each track is not feasible, (i.e. presence of the canal, geotechnical conditions, stations constraints, etc), twin track cantilevers shall be used. For multi-track areas, portals shall be used.

Design of OHLE support structures shall be in accordance with Section 10 of IÉ standard CCE-TMS-410 (Civil Engineering Structures Design Standard).

5.2.5 OHLE overlaps

OHLE will require overlaps (generally 3 spans) to be created to comply with the maximum section length (1600m).

Overlaps shall preferably be positioned on level wire gradients and should not be located at or near level crossings, under overbridges or on underbridges and viaducts, along station platforms or at crossovers.

5.2.6 OHLE turnout and crossover wiring

The preferred OHLE configuration is tangential wiring, although crossed contact with a crossed contact bar arrangement may be used, subject to IÉ SET acceptance, where tangential wiring is impractical.

The main lines and crossover wire runs shall be supported and registered between the 200mm to 350mm switch opening position of each turnout / crossover set of points. The optimum location for the support and registration structure shall be at the 300mm switch opening.

Cross droppers shall be installed at all crossings, turnouts and diamond crossings where system height and contact separation permit both tangential and crossing arrangements. The cross dropper will be positioned near the point where the contact wire of one track is at an offset of 600mm from the centreline of the other track.

5.2.7 OHLE Tensioning devices

The OHLE is formed by auto-tensioned section lengths by means of a spring tensioning device at both ends and a midpoint anchor in the middle, or fixed-point anchor at one end and spring tensioning device, ensuring a constant tension regardless of the variation of temperature.

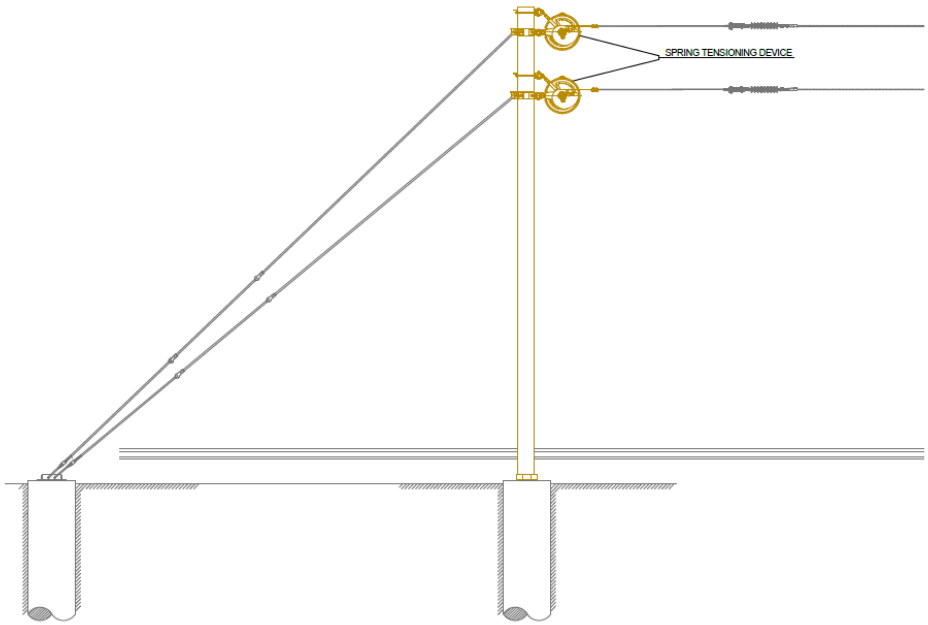


Figure 5-7: Tensioning Device

5.2.8 OHLE lineside switches

OHLE lineside switches shall be motorised. Motorised lineside switches (MOS) shall be electromechanically operated mechanisms with a linear stroke mechanism. They shall allow remote operation from the CTC and NTCC.

5.2.9 OHLE insulators

New insulators for the DART+ programme OHLE shall be Composite / Polymeric type. Composite / Polymeric insulators consist of a glass fibre reinforced resin core to provide the mechanical strength while preventing electrical current flowing.

Composite / polymeric insulators will be chosen/designed to be vandal resistant, lightweight and self-cleanin, providing obvious benefits for initial construction and maintenance, as well as reducing line closures caused by deliberate acts of damage or vandalism.

The creepage distances shown in Table 5-6 shall be met for the OHLE insulators.

Table 5-6: Creepage distances for OHLE insulators

CREEPAGE MINIMUM DISTANCE (OPEN AIR)	200 mm
CREEPAGE MINIMUM DISTANCE (WITHIN 500 m OF THE SEA)	400 mm

5.2.10 OHLE section insulators

Section insulators shall generally be used in crossovers and sidings. They can also be used in sections in the mainline with limited space or speed (up to 70 km/h), as is the case of the section insulator proposed in the Up Main Line in the crossovers near Drogheda MacBride Station. For the rest of the mainline, insulated overlaps are preferable.

Section insulators shall ideally be at the track centre of the crossover to maximise clearance to main line pantographs and to maximise horizontal electrical clearance between different electrical sections.

5.2.11 OHLE Design Speed

As stated in the Electricity Functional Requirements Specification that has been developed for the DART+ Programme of works, the OHLE shall be designed for a maximum speed of 145 km/h .

5.2.12 Earthing and bonding and protection against electric shock

All conductive parts inside the Overhead Contact Line Zone (OCLZ) and Current Collector Zones (CCZ) shall be earthed by connection to earthing wires with a wire of sufficient section to withstand short circuit currents including metallic platform furniture and other large metal items, in accordance with EN 50122-1. In this case, the earth wire cross section shall be 167.5 mm^2.

In general, metallic structures on the line, which could pose a safety hazard as a result of high touch potential, shall be bonded to traction earth via VLDs (Voltage Limiting Devices).

OCLZ/CCZs are shown in the figure below. They are defined as the zones where structures or equipment may accidentally come into contact with a live broken overhead contact line.

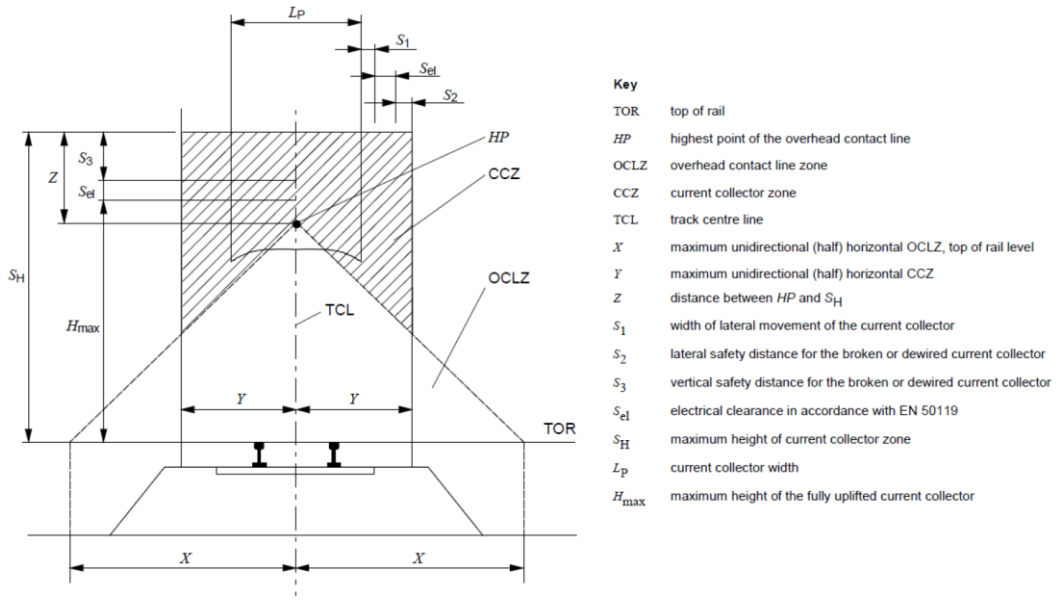


Figure 5-8: Overhead contact line zone and current collector zone

In this case, and in accordance with the Electricity FRS, the value for the parameter X is given as 4m, Y is given as 2m and Z as 2m. The stagger shall be taken into consideration within the dimension of X. Electrical safety of the OHLE and protection against electric shock shall be achieved by compliance with EN 50122-1.

The existing DART network and its structures were designed for a non-electrified line. Therefore, when introducing the OHLE, the existing structures may not comply with the requirements set out in EN 50122-1 regarding protection against direct contact. New OHLE will require increasing the height of the parapet up to 1.8m with the first meter being of solid wall design. This is described further in Section D of the Electrification Report – Bridge Parapet Modifications for OHLE (D+WP56-ARP-P2-NL-RP-GE-000153).

5.2.13 Signal sighting

OHLE Structures will be positioned at a minimum of 5m beyond signals in the normal direction of travel where practicable. Additionally, signals will be positioned to give drivers an approach view for a minimum of 8 seconds and an uninterrupted view for at least 4 seconds.

5.3 OHLE in stations

5.3.1 General description

The type of mast and cantilever is affected by the different constraints existing at each location. For stations, masts with single track cantilever can be used with insulators at the top to avoid live elements over the platforms, such as those currently used in some stations as Malahide or Portmarnock, as shown in Figure 5-10: .

However, if the existing constraints in each station, as mentioned in the next paragraphs (for example canopies), prevent placement of a mast with a single track cantilever, then two track cantilevers, portals or headspans, such as those shown below, can be installed instead.

Figure 5-9: Example of existing single-track cantilever at Malahide Station

Figure 5-10: Example of existing single-track cantilever at Malahide Station

Figure 5-11: Current two track cantilever at Howth Station

Figure 5-12: Existing head span at Kilbarrack Station

Figure 5-13: Existing portal at Clongriffin Station

In stations, the live aerial wires (contact wire, messenger wire and particularly parallel feeder wires) must be located out of the platforms. Parallel feeder wires shall be supported on the OHLE structures or cantilevers along the platforms.

In case of footbridges or overbridges in platforms areas, the parallel feeders will pass under the structures, maintaining the minimum electrical clearance with them, as well as with the aerial earthing wire and not infringing the vehicle/pantograph clearance.

When this is not possible or cannot be guaranteed, it will be passed to an insulated cable and clamped to the structure or by any other means or buried.

This will be studied for all the overbridges and footbridges in the preliminary design stage in a case-by-case basis.

On the other hand, conductive parts (structures, bins, seats, etc.) inside the Overhead Contact Line Zone (OCLZ) and Current Collector Zones (CCZ) shall be earthed in accordance with EN 50122-1, as described in section 5.2.12 of this document.

5.3.2 Donabate Station

To the south side of Donabate station, the masts will be constrained by the existing footbridge and the roadbridge. The final OHLE solution adopted will depend upon final soffit heights of the overbridges according to the different options considered for them, as explained in Section E of Annex 3.2 – OHLE Bridge Clearance Works.

To prevent modifying the overbridges, it is proposed to install bridge arms in OBB33 and additional OHLE supports in this area for each platform, with a free running arrangement for footbridge OBB33A. The single track cantilever structure type could be used in principle for these masts.

Figure 5-14: South side of Donabate Station

Additionally, in this part of the station, there are several buildings on both platforms. Masts will therefore be located at places that do not block the access to the buildings.

To the north side of the station the platform width is approximately 2.5m in places. Masts could be placed inside or outside the station depending on the masts size, the fence and the platform width.

If masts are located outside the fences, they could be placed in the same way as existing streetlights. In this case, where the distance between the masts and the track is big enough, portals or headspans could be installed.

The length from the footbridge to the north end of the platforms is approximately 125m, therefore it is estimated that 3-4 OHLE structures will be placed in this northern region of the platforms away from the footbridge.

Conductive parts of footbridge, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

Figure 5-15: North end at Donabate Station

5.3.3 Rush and Lusk Station

In the north part of the station, the location of the OHLE structures is constrained by footbridge OBB38A and overbridge OBB39. The final OHLE solution adopted will depend upon final soffit heights of the overbridges according to the different options considered for them, as outlined in Section E of Annex 3.2 – OHLE Bridge Clearance Works.

Additionally, existing canopies also constrain the mast locations along part of the platforms. The canopy on Platform 1 is 28m long and could be avoided, although the main station building is also situated along this length of the platform without a canopy. The canopy on Platform 2 is 40m long.

To prevent modifying the soffit heights of the overbridges, it is proposed to install bridge arms on OBB39 and adopt a free running arrangement for OBB38A, centred in a span of about 30m. Additional intermediate OHLE supports will be required in the area of the platforms, so interface with the canopies will need to be assessed to determine the type of OHLE structures to install.

If possible when considering the interface with the main station building, the preferred approach will be to place the masts outside the canopy, so a two-track cantilever mast from Platform 1 could be installed. Otherwise, it will be investigated whether the masts can be placed behind the back of the canopy on Platform 2, within the parking area.

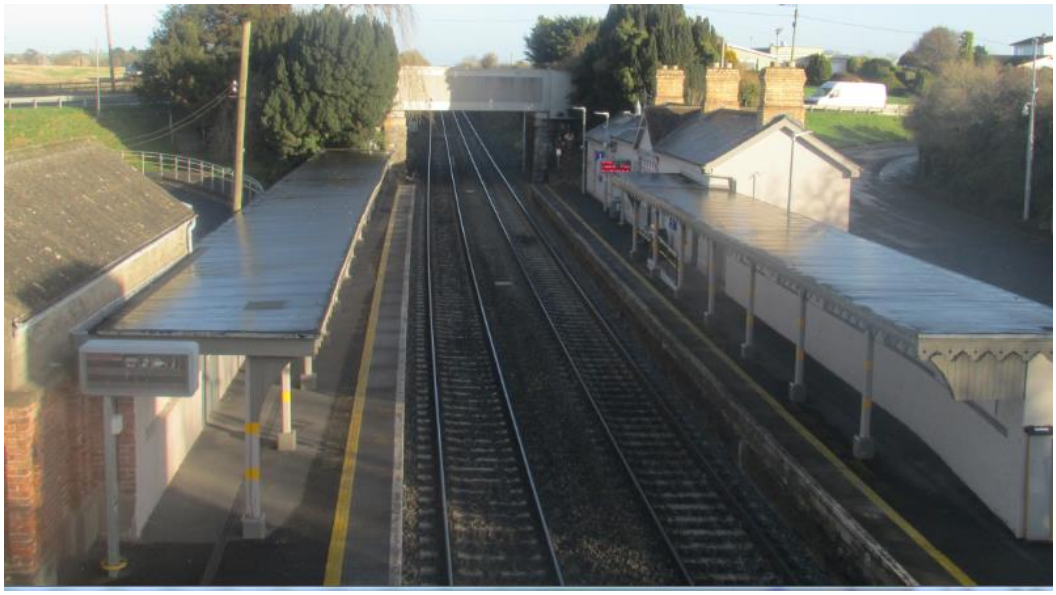


Figure 5-16: Canopies at Rush and Lusk Station

According to available information, there is no envisaged issue with the electrical safety distances between the canopies and the OHLE. In any case, clearances and resulting operations will be studied in greater detail during the preliminary design phase.

From the southern end of the platforms up to footbridge OBB38A, the main constraints for the OHLE masts installation are the existing shelters on each platform and the signal cabin on Platform 2. The OHLE structures shall therefore

be located considering these constraints and placed as far as possible from these elements. The length of this part of the platform is 110 m and so it is estimated that three OHLE structures will be required, considering free running OHLE arrangement for OBB38A. Electrical safety distances between the shelters and the OHLE will need to be checked during the preliminary design to check the risks associated with a person trespassing on the shelter roof.

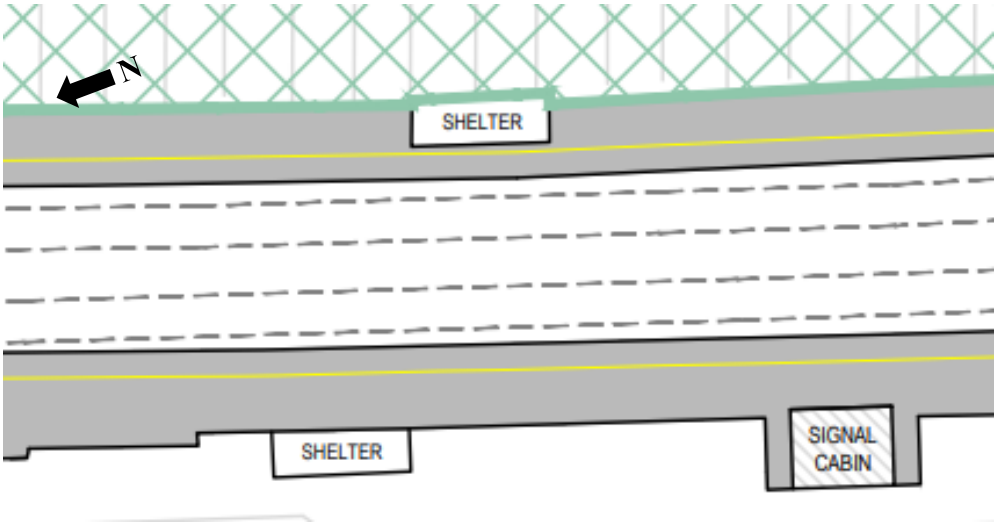


Figure 5-17: Shelters and signal cabin at Rush and Lusk Station

Conductive parts of footbridge, shelters, canopies, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

5.3.4 Skerries Station

To the south end of the station, up to the canopy located on Platform 1, there are no major constraints for placement of the OHLE structures. The platform width is greater than 2.5 m except to the south end of Platform 1. Accordingly, masts could be placed inside or outside the platforms depending on the masts size, the fence and the platform width, in order to maintain the minimum distance required in the IÉ & NIR Standard Structure Gauge. Masts with single track cantilevers with insulators at the top could be used in this area.

The canopy on Platform 1 constrains the mast locations. Considering that the canopy is only 20 m long, the first approach will be placing the masts away from the length of canopy. Should other constraints force a mast to be placed in this region, a two-track cantilever mast on the other platform could be installed.

Figure 5-18: Canopy platform at Skerries station

Footbridge OBB51A is located next to the canopy. The final OHLE solution adopted will depend on the final soffit height of the footbridge according to the different options considered for it, as explained in Section E of Annex 3.2– OHLE Bridge Clearance Works.

In any case, to prevent the need for modification of the soffit height of the footbridge, it is proposed to install a zero-encumbrance free running arrangement approximately centred on a span of 12m and hence masts will be installed close to the footbridge. Interfaces with the structure, accesses, fences and the canopy will determine the best type of OHLE structures to install in this area.

According to the currently available information, it is considered that additional works on the canopy will be required to maintain the electrical safety distances between the canopy and the live parts. In any case, actual distances and required operations will be studied in greater detail during the preliminary design, always minimising the impact on the canopy.

The length of the platform from the footbridge to the south end is approximately 125m, so 3-4 OHLE structures are estimated to be required in each platform in addition to the mast installed close to the footbridge. The OHLE location will avoid interference with the existing subway at the south of the canopy.

To the north end of the station, the platforms are 65m in length from the footbridge, so 2 OHLE structures are estimated to be required in each platform in addition to the mast installed close to the footbridge. The width of Platform 2 in this area is greater than 2.5m in general. In Platform 1 there is a building near the footbridge which reduces the width to approximately 2m in this area, although the platform width is greater than 2.5m beyond the building and reduces again at the north end of the platform. Masts can therefore be placed on the platforms in general, although for the first OHLE structure near the bridge a two-track cantilever mast on Platform 2 could be installed if the width of Platform 1 is reduced too much. A signalling

cabin is located to the north end of Platform 2, so masts will be located considering this structure.

Conductive parts of footbridge, canopy, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

5.3.5 Balbriggan Station

There are several shelters at Balbriggan Station, from the south end of the platforms up to the footbridge OBB57A, which are the main existing constraints in this part of the station. The platforms have a width of approximately 2.8m, so in principle masts can be installed on the back of the platforms to maintain the minimum distance required in the IÉ and NIR Standard Structure Gauge.

On the south end of Platform 1 the narrow width may prevent placing the masts on the platform. If that is the case, a two-track cantilever may be installed on Platform 2. Additionally, the station building is located on Platform 1 adjacent to the footbridge, however the width of the platform in this area is more than 3.5m and so masts will not interfere with the access to the building. In any case, the masts will be located without blocking the access to the building. OHLE structures will be placed on both platforms as far as possible from these structures and also taking into account the existing streetlights, fences etc.

The length of this part of the platform is 90m and so it is estimated that 3 OHLE structures will be required, considering a free running OHLE arrangement for the footbridge. Masts with single track cantilevers with insulators at the top could be used in this area.

Electrical safety distances between the shelters and the OHLE will be checked during the preliminary design stage to mitigate the risk of a person trespassing on the roof of a shelter.

Figure 5-19: Narrow platform near the shelters.

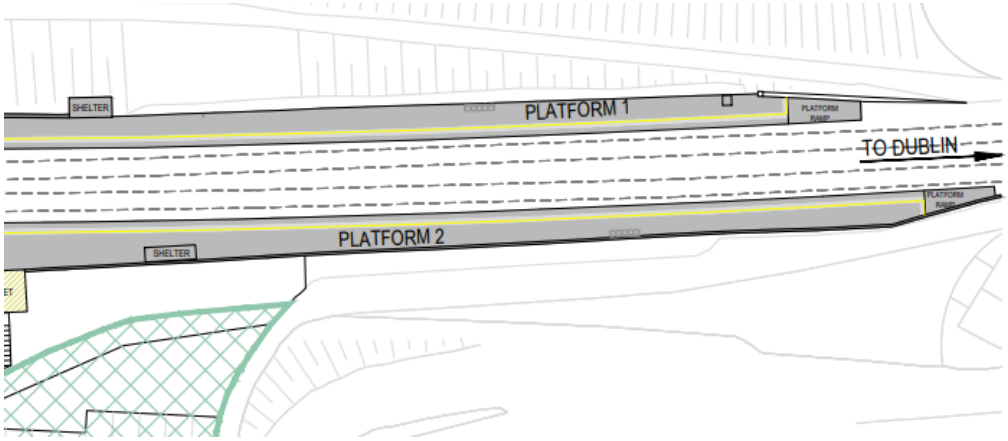


Figure 5-20: Plan view of narrow platform near the shelters.

The masts in the middle of the station are also constrained by footbridge OBB57A. The final OHLE solution adopted will depend on final soffit height of the structure according to the different options considered for it, as explained in Section E of Annex 3.2 – OHLE Bridge Clearance Works.

In any case, considering options for installing the OHLE without modifying the soffit height of the footbridge, it is proposed to install a zero-encumbrance free running arrangement approximately centred with a span of 12m, so masts will be installed close to the footbridge. Therefore the interface with the structure, accesses, and fences will determine the best type of OHLE structures to install in this area.

To the north side of the station, there is an underpass located 25m from the footbridge and a building on Platform 2 to be considered in the location of masts. In any case, the width of platforms in this area is 3.5m, so single-track cantilever masts could be placed at the back of the platforms without interfering with these

elements. It is estimated that 1-2 OHLE structures will be installed on each platform in this area.

Conductive parts of footbridge, shelters, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

5.3.6 Gormanston Station

At the south end of the station, overbridge OBB66 constrains the location of masts. Furthermore, the platform width under the bridge is only 1.5 metres. The final OHLE solution adopted will depend on final soffit height of the overbridge according to the different options considered for it as explained in Section E of Annex 3.2 – OHLE Bridge Clearance.

In any case, considering options for installing the OHLE without modifying the soffit height of the overbridge, it is proposed to install a zero-encumbrance free running arrangement approximately centred with a span of 12m, as proposed in previous sections for the other stations, so masts will be installed close to the overbridge.

An additional footbridge is planned to be built approximately 100m from OBB66, with soffit height of approximately 5275 mm. A free running arrangement will therefore be considered for this footbridge.

Figure 5-21: Overbridge at Gormanston Station. Note the narrow passage under the bridge.

From the overbridge to the north end of the platforms there are no additional significant constraints. Station buildings are located on Platform 2, however the width is 3.5 metres and so in principle it is considered that masts can be placed on the platforms without impact on the accesses or on passenger flow.

Four OHLE structures are estimated to be required in each platform between the two overbridges. From the new planned footbridge 3 additional OHLE structures are estimated to be required in each platform. Single track cantilever masts could be installed on this side of the station. The existing signal mast at the north end of the station is too close to the tracks (~1.2 m) and masts will be avoided in this area.

Figure 5-22: Signal mast at the north end of the station

Conductive parts of overbridges, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

5.3.7 Laytown Station

The footbridge at the south end of the station constrains the location of masts in this area. Solutions adopted in this case are explained in Section E of Annex 3.2 – OHLE Bridge Clearance Works.

In any case, considering options for installing the OHLE without modifying the soffit height of the footbridge, it is proposed to install a zero-encumbrance free running arrangement approximately centred with a span of 12m, so masts will be installed close to the footbridge. Interface with the structure, accesses and fences will therefore determine the best type of OHLE structures to install in this area.

The lengths of the platforms from the footbridge to their ends is approximately 160m and so 4-5 OHLE structures are estimated to be required on each platform. Single track cantilever masts could be installed on this side of the station.

There is a shelter at Laytown Station. Electrical safety distances between the shelters and the OHLE will be checked during the preliminary design to prevent risks should a person climb onto the roof of the shelter.

Figure 5-23: Shelter at Laytown Station

Conductive parts of footbridge, shelters, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

5.3.8 Drogheda MacBride Station

There are several buildings on both platforms. As far as possible, the masts must not block the building access. Placing masts in the area shown in the figure below has to be avoided, especially at the points where the platform width is less than 2m (orange circles):

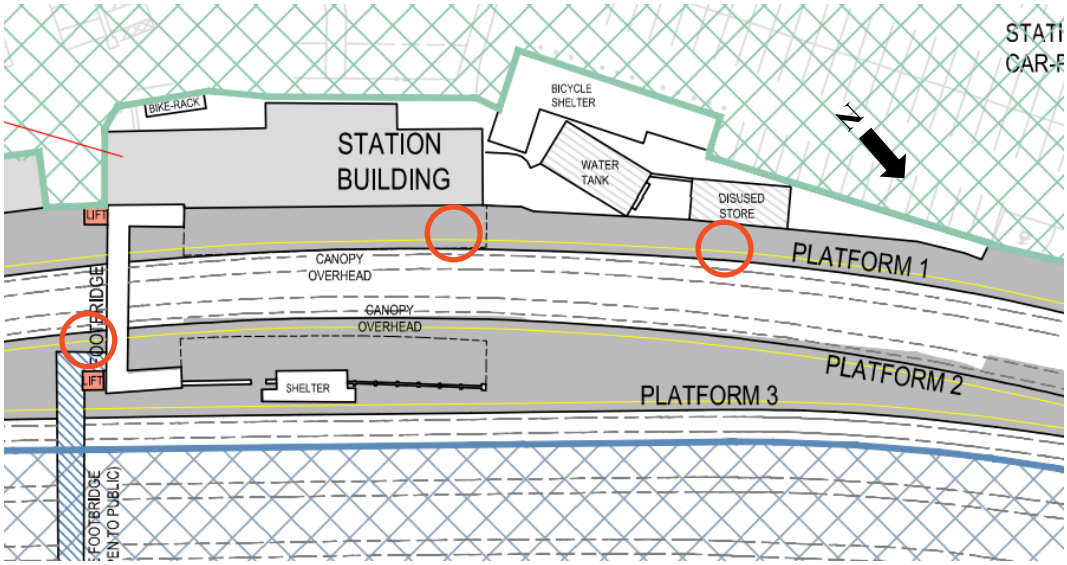


Figure 5-24: Station building constraints at Drogheda MacBride Station

The footbridge shown in the figure also constrains the mast locations. Platform width under the bridge on Platform 2 is less than 2 metres. Solutions adopted in this case are explained in Section E of Annex 3.2 – OHLE Bridge Clearance Works.

In any case, considering options for installing the OHLE without modifying the soffit height of the footbridge, it is proposed to install a zero-encumbrance free running arrangement approximately centred with a span of 10m, so masts will be installed close to the footbridge. Interface with the structure, accesses and fences will therefore determine the best type of OHLE structures to install in this area.

The canopies over platforms constrain the mast locations. Portals may be necessary in this area. Additionally, according to the current available information, it is considered that additional works on the canopy will be required to maintain the electrical safety distances between the canopy and the live parts. In any case, actual distances and required operations will be studied in greater detail during the preliminary design, always minimising the impact on the canopy.

For the depot entrance on approach to Drogheda MacBride Station, considering that there are several tracks and railway points and crossings, the installation of portals/headspans can be considered (see Figure 2-38).

Figure 5-25: Canopies at Drogheda MacBride Station

Conductive parts of footbridges, canopies, metallic platform furniture and other large metal items in the station will be earthed as described in section 5.2.12 of this document.

6 Summary and conclusions

This report outlines how the OHLE will be integrated into the existing infrastructure along the route of DART+ Coastal North and the anticipated adaptations that will be required to ensure that a fully functional train power supply system is constructed.

Whilst there are constraints identified that are related to specific locations - notably at some stations and bridges - in general, the introduction of the OHLE system is feasible. The system can also be constructed compliant with the relevant design parameters specified in the Electricity Functional Requirements Specification System-wide and IÉ standards.

Design solutions may need to be developed for specific locations where special considerations apply regarding the method and arrangement of the structures needed to support the conductors and contact wires. These will be more closely examined in the next phases of the project along with all important criteria affecting OHLE infrastructure design and considerations to support electric train operation.