DART+ Coastal North

ANNEX 3.4

Technical Optioneering Report: Works around Malahide Station

ARUP

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Abbreviations

Abbreviation	Definition
ABP	An Bord Pleanála
APIS	Authorisation for Placing in Service
ATP	Automatic Train Protection
CAF	Common Appraisal Framework
CAPEX	Capital expenditure
CAWS	Continuous Audible Warning System
CCE	Chief Civil Engineer's Department
CCTV	Closed Circuit Television
CRR	Commission of Railway Regulation
CSO	Central Statistics Office
CTC	Central Traffic Control
DART	Dublin Area Rapid Transit
DMUs	Diesel Multiple Units
EMUs	Electric Multiple Units
ECS	Empty Coaching Stock
EIR	Eircom Limited
EPA	End Point Assessment
FCC	Fingal County Council
FIHS	Fingal Industrial Heritage Survey
GAA	Gaelic football
GSI	Geological Survey Ireland
GSM-R	Global System for Mobile Communications – Railway
HLU	Half-length unit
IÉ	Iarnród Éireann/Irish Rail
INF	Infrastructure
LI	Locally Important
MAI	Maintenance
MCA	Multi-Criteria Analysis
MHSS	Malahide Skerries
NTA	National Transport Authority
OHLE	Overhead Line Equipment
OPE	Operation and Traffic Management
OPEX	Operational expenditure
OPW	Office of Public Works
OSI	Ordnance Survey Ireland
P&C	Points and Crossings
pNHA	Proposed Natural Heritage Area
RPS	Record of protected structures
RRV	Road / Rail Vehicle

Abbreviation	Definition
RSC	Railway Safety Commission
SAC	Special Area of Conservation
SEB	Signalling Equipment Box
SET	Signalling, Electrification and Telecoms
SDH	Synchronous Digital Hierarchy
SPA	Special Protected Area
SSI	Solid State Interlocking
TER	Telecoms Equipment Rooms
TPH	Trains per hour
TSS	Train Services Specification
UPS	Uninterruptible Power Supply
WFD	Water Framework Directive

1 Introduction

The purpose of the report is to provide the technical input to the Preliminary Option Selection Report. This report provides the technical assessment at Malahide from option selection through to the Draft Emerging Preferred Option, including the options considered and how a Draft Emerging Preferred Option was chosen.

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 required;
- The relevant constraints;
- The option assessment containing:
- Longlist of options;
- Sifting of longlist of options;
- Summary and details of the shortlisted options;
- Multi-criteria analysis (MCA);
- The Draft Emerging Preferred Option.

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, as contained within the various Annexes. Where appropriate, the Annexes have then been further split down into 'Sections' which define the system which has been subject to the optioneering and design process.

This report refers to the optioneering assessment for works at Malahide. The scope is to consider Malahide for suitability as a turnback to achieve the TSS and maximise capacity, and to design any associated re-configuration works. This report considers all feasible long list options with a view to reducing the list via reasoned sifting, including the likes of costs, impact, and the TSS requirements.

1.2 References

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

Table 1-1:: 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.
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.

Annex	Title	Description
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.
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

The works proposed at Malahide have been assessed using the Department of Transport's Common Appraisal Framework for Transport Projects and Programmes (CAF) as the options have the potential to be geographically different from each other and have a material difference on external parties or the environment. Further details can be found in the option selection process section of the Preliminary Option Selection Report.

2 Existing Situation

2.1 Overview

Malahide Station is located on the Dublin to Belfast line at approximate mileage 9 miles. The centre of the station is located at 722443.630E and 746139.450N based on the ITM grid system. The station consists of two platforms: Platform 1 on the Up Main line and Platform 2 on the Down Main line.

North of Malahide Station is the Malahide Estuary, Malahide Marina, Malahide Marina Village and the wastewater treatment works. The railway crosses the estuary by way of a viaduct.

An aerial view of the site is shown in Figure 2-1, with Figure 2-2 showing the area north of the estuary. An expanded view of the station is provided in Figure 2-3.

Figure 2-1: Aerial view of the Malahide area (Source: OSI aerial imagery)

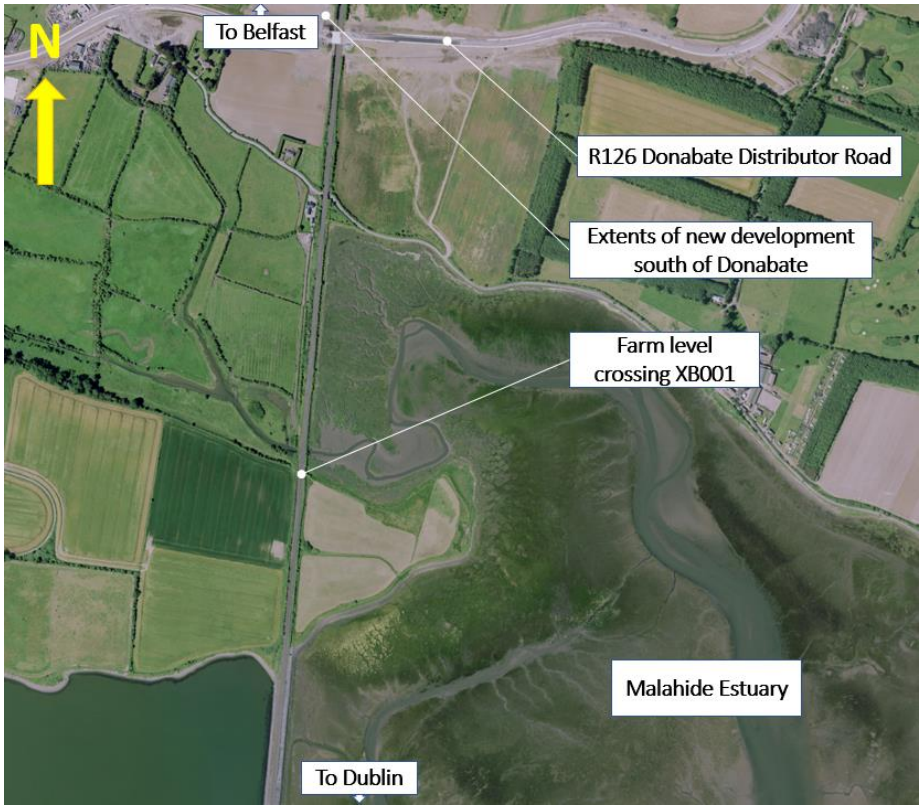

Figure 2-2: Aerial view of section north of estuary (Source: OSI aerial imagery)

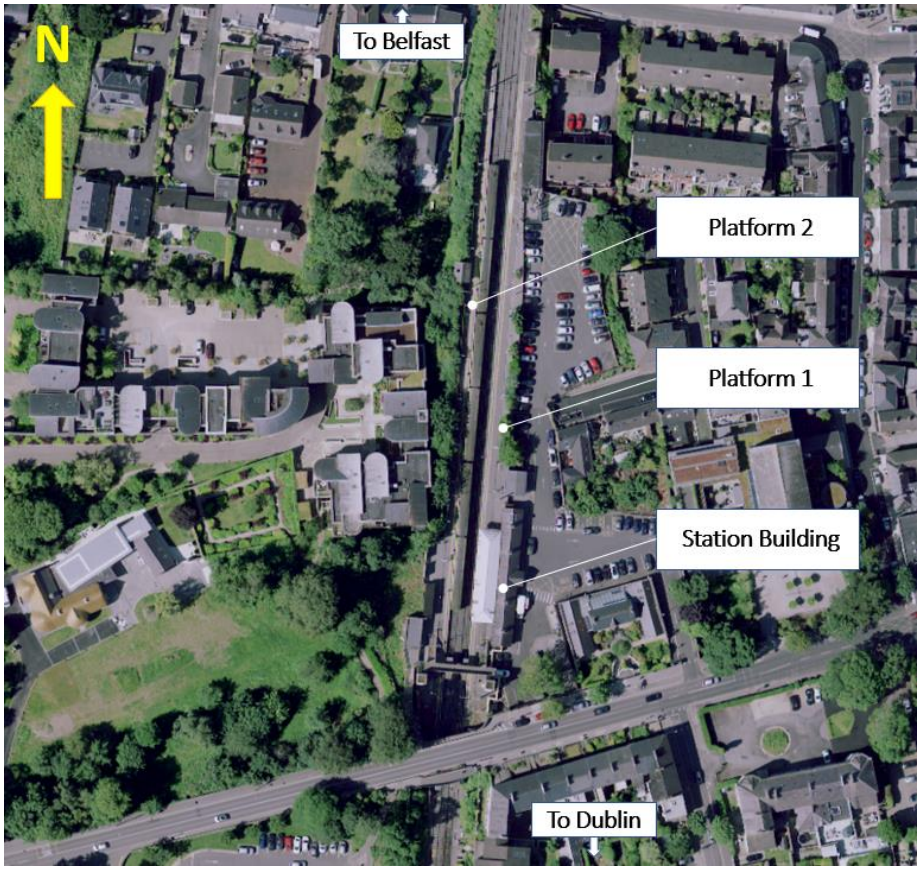

Figure 2-3: View of Malahide Station (Source: OSI aerial imagery)

Figure 2-4: Photograph of the mainline North of Malahide Station with Malahide Marina in the background (source: Arup)

2.2 Structures

There are three existing structures associated with the Malahide turnback, in the vicinity of the existing station, as shown in the following figures and the Emerging Preferred Option Maps 13 to 15 in Annex 1:

- underbridge UBB29 (29 Strand Street)
- underbridge UBB30 (Malahide Viaduct), and
- underbridge UBB31 (Tidal Outflow).

UBB29 is a single 4.5m span masonry arch bridge carrying the railway over the road (Bissett's Strand/Strand Court) - see the following three figures.

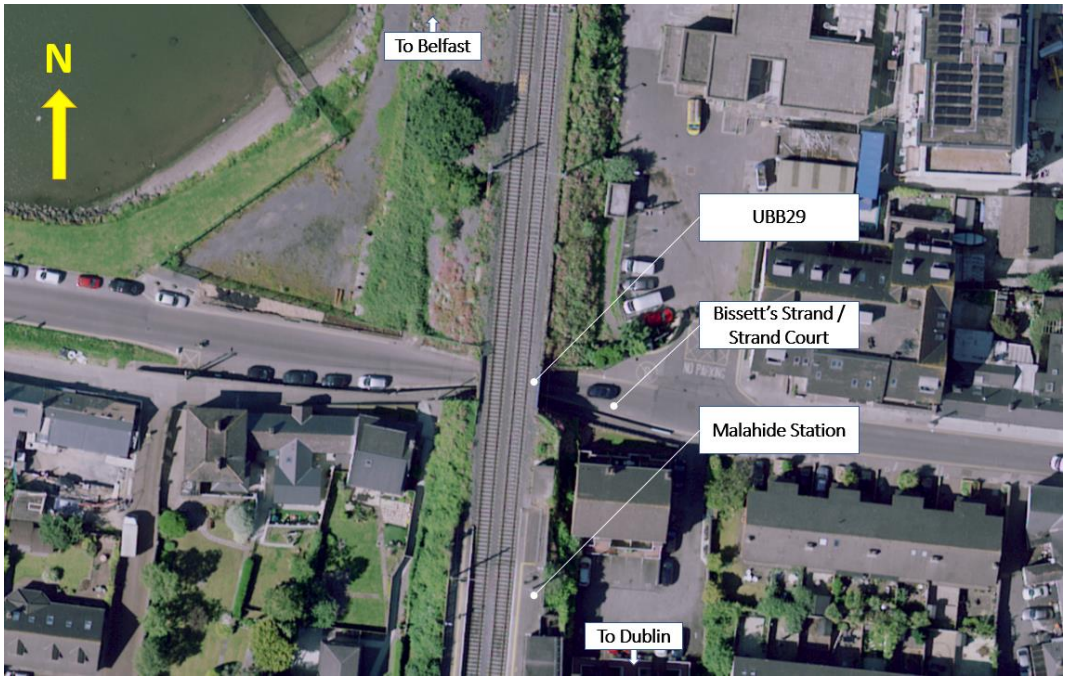

Figure 2-5: Aerial view of UBB29 carrying the Up and Down Belfast lines over the road (source: OSI aerial mapping)

Figure 2-6: View of existing track over UBB29 (source: Arup)

Figure 2-7: View looking west on to UBB29 (source: Irish Rail)

UBB30 is the Malahide Viaduct, a multi-span post-tensioned concrete underbridge carrying the railway over the estuary. It is listed as a Protected structure under Fingal's Record of Protected Structures (RPS) (reference: RPS No. 0420 Appendix 2 'Record of Protected Structures' of the Fingal Development Plan 2017-2023). The overall span is 176m (refer to Figure 2-9 for location). Along the east side of the line between UBB29 and UBB30, there appears to be a masonry wall. Ground levels behind the wall are lower than track level and the covered by vegetation.

Figure 2-8: View south-east near the wastewater treatment plant (source: Arup)

Figure 2-9: Aerial view on UBB30 carrying the Up and Down Belfast lines over the estuary (source: OSI aerial mapping)

Underbridge UBB31 is a 2.4m long 2-span stone arch bridge carrying the railway over a tidal outflow, see Figure 2-10.

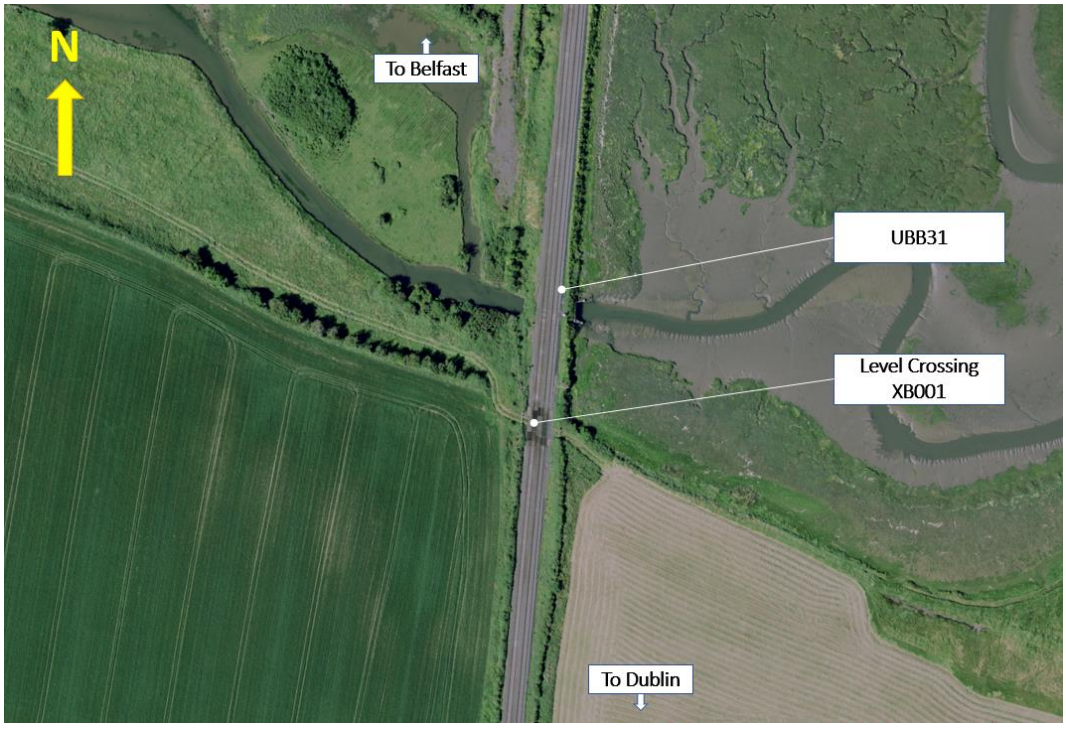

Figure 2-10: Aerial view on UBB31 (source: OSI aerial mapping)

2.3 Permanent Ways and Tracks

Malahide Station is located on the main Dublin to Belfast line at approximately 9 miles. The centre of the station is located at 722443.630 E and 746139.450 N based on the ITM grid system. 2 passing lines are present at the station namely the Down and Up Belfast lines with a line speed of 90mph. Both lines facilitate bidirectional running.

There is a permanent speed restriction through Malahide Station in both the Up and Down Main Lines of 70 mph / 110 km/h. In the Down this is between 8 7/8 miles to 9 1/8 miles. In the Up this is between 9 1/8 miles to 8 7/8 miles.

This may be due to the vertical alignment on approach to Malahide Station going through OBB27 / OBB27Z.

Travelling in a northerly direction prior to Malahide Station PTS 251 A & B are provided to allow traffic to switch between the up and down lines.

Immediately south of Malahide Station and OBB27 a facing cross over, PTS 252B&A is provided in a ladder arrange to allow traffic to enter the existing sidings via PTS253B, with the PTS253A being utilised as a trap unit to provide main line protection.

Dublin bound traffic are only afforded access to the sidings via a double shunt movement. Egress from the sidings is provided onto the Down Line, with traffic wishing to continue in a southerly direction required to carry out a turn back operation within the confines of the station area.

2.4 Other Railway Facilities

2.4.1 Signalling

The Malahide area is controlled from Central Traffic Control (CTC) by the Fingal SSI MHSS as shown in Figure 2-11.

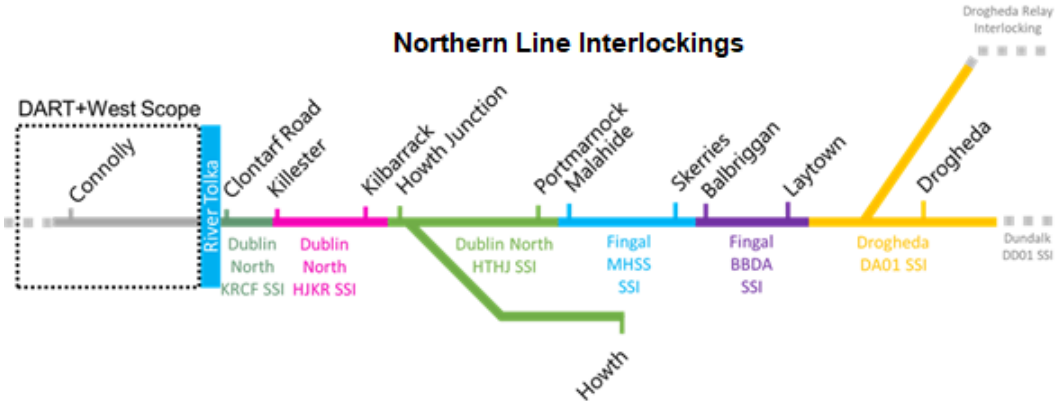

Figure 2-11: Interlocking control areas

The scheme dates from 1990 though there appears to have been more recent work done since then in the Signalling Equipment Box (SEB). The Malahide area controls five running signals a mix of three and four aspect, seven shunt signals,

four crossovers and associated train detection systems to support movements through the area and the down sidings. The signal plan is provided in Figure 2-12.

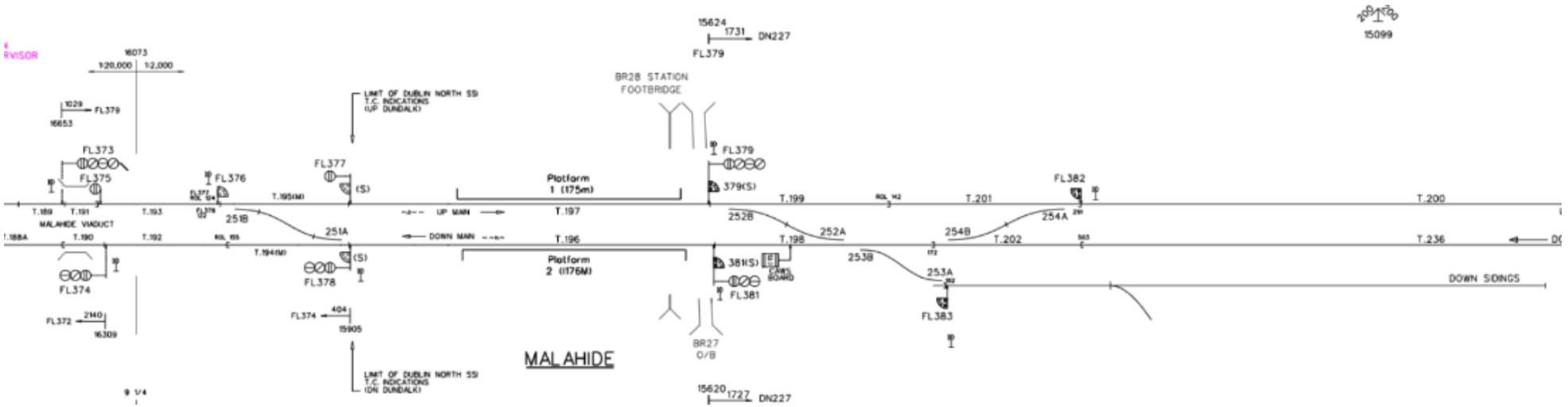

Figure 2-12: Signal Plan for Malahide area

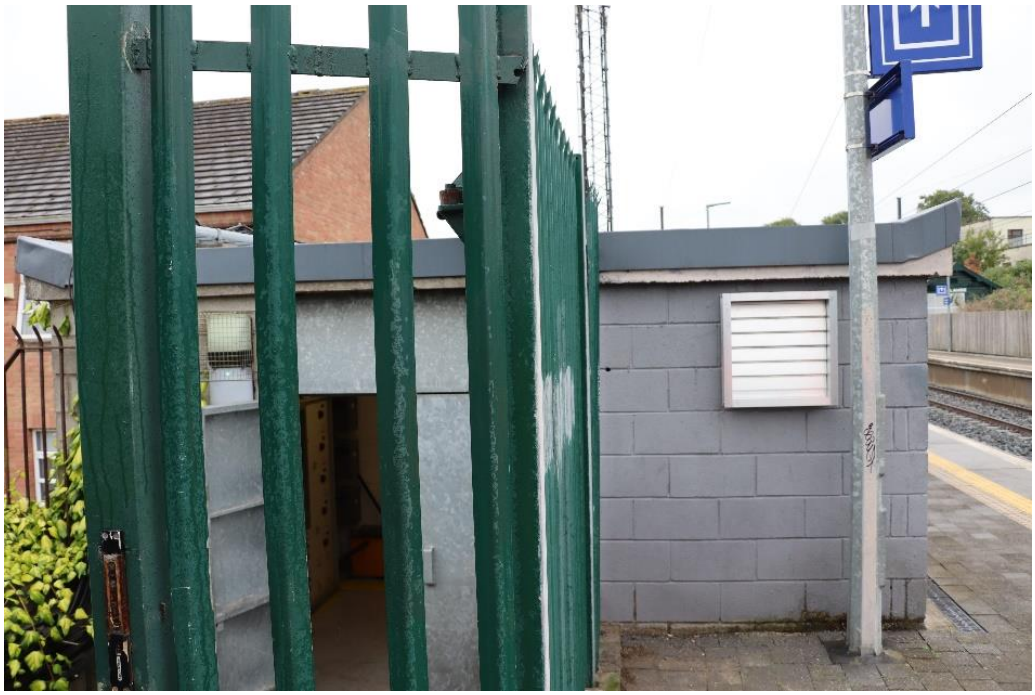

Figure 2-13: Signal Equipment Building controlling Malahide

The SEB for Malahide is located in a constrained area at the end of the Up platform, as shown in Figure 2-13. The SEB includes an adjoining power room with diesel generator set, uninterruptible power supply (UPS) and frequency generators. While there is some space on the racks for additional equipment, overall the room appears to be relatively full and only capable of accommodating limited additional equipment.

2.4.2 Telecoms

Like elsewhere, the Telecoms Operational network is a legacy Synchronous Digital Hierarchy (SDH) which is in the process of being fully replaced by IÉ but has potential problems due to the low number of available fibres.

On the supportive network side, the Gigabit network supports station communications equipment such as LED platform indicators, Public Address, CCTV and help points. GSM-R coverage is provided from the cell mast located adjacent to the SEB.

2.4.3 OHLE

Malahide was electrified as part of the extension of the DART system from Howth Junction around 2000, hence the overhead line equipment (OHLE) infrastructure is relatively recent and has undergone significant maintenance of the contact wire etc, in recent times.

There is a track paralleling hut located to the north of the station which allows the Up and Down lines to be both fed from a single feed point. Mast mounted section switches are also located at this point to provide power on the overrun section.

Malahide substation is located approximately 1 km to the south of the station.

2.4.4 High Voltage supply

The traction current for the Malahide area is primarily provided by the substation located at Malahide. This substation is currently operating well below its designed capacity of 2 MVA.

2.4.5 Ancillary Electrical Systems

There are other minor systems that support the train operation including SCADA (Supervisory Control and Data Acquisition) responsible for the remote operation of the traction power supply to the OHLE, the Earthing and Bonding cable system that is required to ensure the safe management of traction return current and prevention of unsafe voltages on adjacent structures, and EMC (Electromagnetic compatibility) that is required to ensure that there are no unintentional generation, propagation or reception of electromagnetic energy which may cause undesirable effects on other equipment. These will be consistent in form and function with the existing installations already present.

2.5 Ground Conditions

2.5.1 Malahide to Underbridge UBB30 (Viaduct)

The railway line to the south of Malahide station is located in a cutting and to the north is located on a causeway extending into the Malahide estuary to UBB30, the Malahide viaduct structure.

Historic mapping (1837) shows that the area was initially agricultural land. The land within the vicinity of the railway line consisted mainly of fields, forests and a quarry. Significant developments comprising Malahide Station as well as numerous residential, commercial and industrial buildings occurred to the east of the site in the twentieth century. Land reclamation occurred to the east of the southern section of the causeway during the same period.

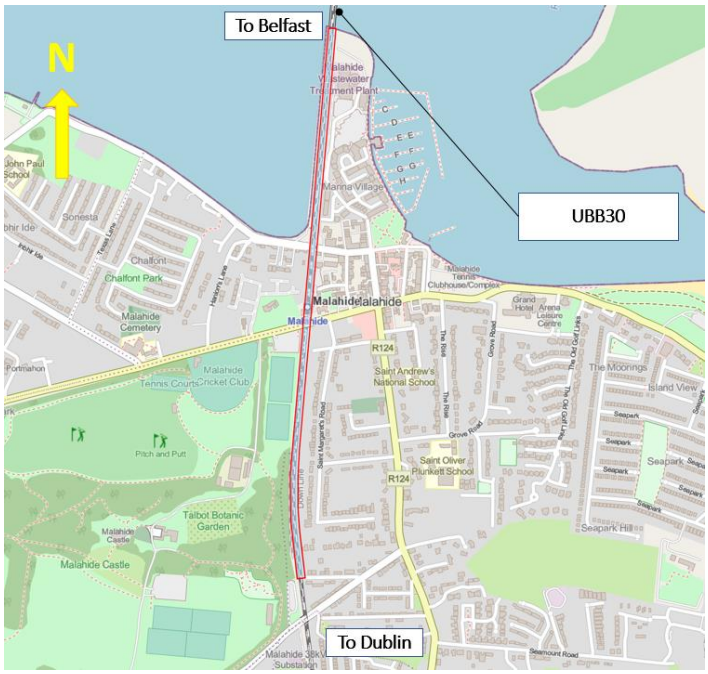

Figure 2-14: Extent of Malahide to UBB30 area considered (red site boundary) (© OpenStreetMap)

The Rivers of Dublin map (Sweeney, 2017) does not indicate any historic or existing rivers crossing or near the site.

From GSI Quaternary sediment mapping the railway south of Malahide station appears to be founded on rock within cutting. Overburden material surrounding the cutting appears to be Irish sea till/till derived from limestones. North of the station, Irish sea till and gravels, both derived from limestone, are present

GSI bedrock mapping shows that the site is underlain by argillaceous bioclastic limestone, shale of the Malahide formation. Additionally, bedrock outcrops within the site were noted. GSI depth to bedrock (Dublin County) mapping indicates bedrock depths of 3 to 5m along the viaduct shallowing to 1 to 3m at the southern portion of the site.

A number of historic ground investigations have been considered and include publicly available and historic ground investigations provided by IÉ. These indicate:

(i) The south of Malahide station is situated within a cutting and the line is most probably founded on weak to medium strong limestone rock. The overburden to the east and west of the line is likely composed of stiff clays to depths of up to 4.5mbgl with occasional soft silts.

(ii) To the north of Malahide Station, information from existing ground investigation was based on reclaimed land shows silts, glacial tills and gravels. Information on the underlying bedrock is limited.

(iii) There exists very limited historic groundwater monitoring information.

(iv) While there is no available geo-environmental information, there is a potential for contamination based on site history and usage.

The composition of the southern causeway is, as yet, unknown. However, from a visual walkover of the causeway, the following was noted:

(i) Along the western foreshore between Malahide town and the viaduct structure, an access track exists. Rock armour is present on either side of this (i) extending from the access track western verge to the water line and (ii) extending from the eastern verge of the access track partially up the railway embankment slope; see Figure 2-15.

(ii) On the embankment above the rock armour, the slope is heavily vegetated.

Figure 2-15: View south towards Malahide along the access track on the west of the causeway (source: Arup)

2.5.2 Underbridge UBB31

Historic mapping (1837) shows that the area south of UBB31 was agricultural fields. To the north, a causeway to cater for the Dublin-Drogheda railway line (now Dublin to Belfast railway line) appears to be partially constructed over the River Pill's estuary. Subsequent mapping indicates the area west of the line was reclaimed as agricultural fields.

GSI Quaternary sediment mappings indicate that the site is located that is underlain by estuarine silts and clays and bedrock mappings indicates argillaceous bioclastic limestone, shale of the Malahide formation. Additionally, GSI depth to bedrock (Dublin County) mapping indicates bedrock depths in the range 3 to 5m.

EPA river network mapping indicates that River Pill passes across UBB31 and therefore, there is the possibility of alluvium deposit at UBB31.

There is no available historic ground investigations information available for this location.

2.5.3 Donabate

Historic mapping (1837) shows that the area was initially undeveloped and indicates an embankment to cater for the Dublin-Drogheda railway line (now Dublin to Belfast railway line) which was under construction.

GSI Quaternary sediment and bedrock mappings indicate that there is the presence of Irish sea till derived from Lower Palaeozoic sandstones and shales that the site is underlain by red coarse sandstone and conglomerate of the Donabate formation. Geological linework notably anticlinal and synclinal axes, unconformity and fault cross the site. Moreover, GSI depth to bedrock (Dublin County) mapping indicates bedrock depths in the range 1 to 3m.

Based on a number of historic ground investigations which include publicly available and historic ground investigations provided by IÉ, the following observations were made:

(i) The downward stratigraphy comprises made ground of up to 2m deep overlying soft to firm glacial till. The latter is underlain by layers of silts and medium dense to dense gravels. At specific regions, soft silts and loose sands of depth not exceeding 5.0m was noted.

(ii) There is no historic information on bedrock or groundwater monitoring information.

(iii) There is no available geo-environmental information. However, there is a potential for contamination regarding the site history and usage.

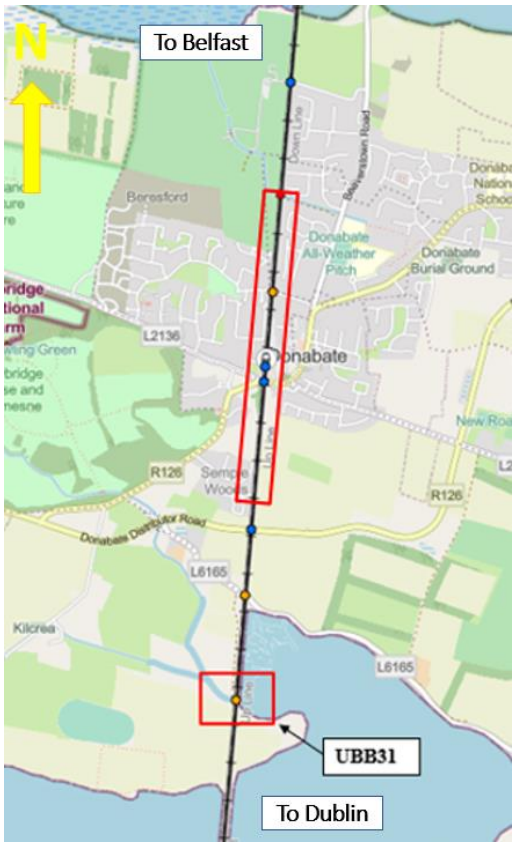

Figure 2-16: Area of Donabate ground conditions considered (© OpenStreetMap)

2.6 Environmental

The study area extends from south of Malahide Station to north of Donabate. The railway line within this area, extends through Malahide Village, across the Malahide Estuary, and northwards through agricultural land to, and beyond Donabate.

There is residential, commercial and amenity development in the vicinity of the railway line in Malahide and to the north of the Malahide estuary in Donabate (including new development south of Donabate).

The railway line passes through the Malahide Estuary Special Protected Area (SPA) and Malahide Estuary Special Area of Conservation (SAC), both of which are European sites. Other European sites in the vicinity, include the Rogerstown Estuary SAC and Rogerstown Estuary SPA to the north of Donabate.

The proposed Broadmeadow Way Greenway by Fingal County Council, a planning approved walkway and cycleway, extends alongside the railway line over the Malahide Estuary. There is also a new road over the railway line (the Donabate Distributor Road, R126) to the north of the estuary, south of Donabate.

A brief overview of the baseline environment, under key environmental criteria, is provided in the following sections.

2.6.1 Traffic and Transportation

The site is accessible by a local road currently providing access to the Malahide Marina Village. The road is approximately 6m wide and serves a residential area, a wastewater treatment plant and some other commercial land uses, some of which are related to the marina. The nearest road link of regional importance is the R106 Swords Road to the west, which links, through an industrial area on the west of the M1, with Junction 3 (R125) on the M1. This road link provides the only access to the site, through the village of Malahide.

Towards the north access to the site will be provided through farmland towards the west of the rail line. The farmland is accessible via local roads. The nearest road link of regional importance is the R126 to the west, which links with Junction 4 on the M1.

A planned walkway and cycleway across Broadmeadow Estuary have been granted planning permission (ref. PL06F.304624). The Broadmeadow Way forms part of the Fingal Coastal Way, the National Transport Authority's (NTA) Greater Dublin Area Cycle Network and East Coast Trail. It is funded by the NTA and Fingal County Council and construction is set to take place between 2022 and 2023. The route will run alongside the rail line currently crossing the estuary and will include a 280m long bridge on the railway viaduct.

2.6.2 Landscape and visual impact

Part of the study area is located on the southern rail line embankment west of Marina Village in Malahide. The railway line is located on an elevated embankment, which defines the western side of a narrow finger of land (formed by historic infilling) projecting north into Broadmeadow Estuary. The established Marina Village residential area lies to the immediate east of the embankment, as does a wastewater treatment plant, a boat yard, and areas of carparking. Malahide Marina and an associated mooring lie along the east side of the infill area.

The east side of the embankment is covered by low scrub and herbaceous plantings. The west side comprises bare rock at the base below a maintenance access track with a mix of low vegetative planting / exposed stone on the higher railway line embankment.

The lands adjoining the embankment are zoned Town and District Centre in the Fingal Development Plan. The Plan also includes an objective to Preserve Views of the estuary from the southern shore (Estuary Road, Caves Strand, The Haven and Bissett's Strand and Coast Road in Malahide).

Malahide Viaduct, located at the northern end of the embankment, is a protected structure (reference: RPS No. 0420 Appendix 2 'Record of Protected Structures' of the Fingal Development Plan 2017-2023). The railway bridge over Bissett's Strand Road, at the southern end of the embankment, is also listed as a protected structure (reference: RPS No. 0423).

The study area also extends northwards, to farmland beyond the northern end of the railway line embankment which carries the railway across Broadmeadow Estuary. The railway line crosses the Pill River and Corballis Cottages Road. The railway

bridge over Corballis Cottages Road is a protected structure (reference: RPS No. 0502).

A level crossing south of the Pill River provides for farm access to the lands on the east side of the rail line. The lands to either side of the rail line are zoned High Amenity. There are objectives to preserve views along Corballis Cottages Road east of the rail line and along the northern shore of the estuary west of the rail line (Sheet No. 7 FCC Development Plan).

As also mentioned in the previous section, a planned walkway / cycleway across Broadmeadow Estuary has been granted planning permission (An Bord Pleanála ref.: 304645) (see Figure 2-17). Construction of the 'Broadmeadow Way Greenway by Fingal County Council' is set to take place between 2022 and 2023. The route will run the west side of the rail line embankment / rail line and will include a 280m long bridge to be placed on existing piers immediately west of the railway viaduct.

Figure 2-17: Proposed Broadmeadow Way Route (Source: Fingal Development Plan 2017-2023).

2.6.3 Archaeological and cultural heritage

There are no archaeological monuments or findings from the area proposed for regrading and railway works. The nearest archaeological monuments are St. Sylvester's RC Church (DU012-023002) and a mound (site of) (DU012-023003) located approximately 100m to the east of the railway line.

Malahide has been the focus for settlement activity for thousands of years, as evidenced by the Mesolithic and Neolithic flint scatters in the wider area. The village itself was based around a Viking landing point, which survived from the eighth century until the arrival of the Anglo-Normans.

The village continued as a fishing port and was also the site of several silk and poplin mills. The building of the Dublin to Drogheda railway viaduct in 1844 was largely responsible for the decline and eventual disappearance of the fishing fleet (Bennett 1991). Rocque's 1756 map of Dublin shows the estuary's oyster beds, which were removed by the railway viaduct less than a hundred years later. The Dublin and Drogheda Railway began operating in 1844 and there were stations at Balbriggan (Fingal Industrial Heritage Site (FIHS) 0040), Skerries (FIHS0223), Rush and Lusk (FIHS0353), Donabate (FIHS0671), Malahide (FIHS0656) and Portmarnock (FIHS0627) within Fingal. Both Balbriggan and Malahide stations were designed by George Papworth.

2.6.4 Architectural heritage

There are a number of structures associated with the railway, in the vicinity of the area proposed for regrading and railway works, which are of architectural heritage interest. These include the Malahide or Broadmeadow viaduct to the north (a Protected Structure - FCC RPS 0420), the railway bridge on Bissets Strand (a Protected Structure of Regional importance for reasons of architectural, social and technical interest (FCC RPS 0423, NIAH 11344015)), and Malahide Station (a Protected Structure of Regional importance for reasons of architectural, artistic, social and technical interest (FCC RPS 0388, NIAH 11344008-9 11344041)).

The Malahide viaduct was originally built in timber and replaced with an iron and masonry structure in 1860. Repairs were required in the 1930s and again in the 1960s when the iron structures were replaced with concrete. Following a partial collapse in 2009, pier strengthening and riverbed restoration were carried out. The viaduct is a protected structure. It is not included in the NIAH but is of Regional importance for reasons of architectural and technical interest.

The railway bridge on Bissets Strand is a single arch limestone bridge comprising coursed snecked limestone. It is a protected structure which is also included in the NIAH where it is rated of Regional importance for reasons of architectural, social and technical interest.

Malahide Railway Station is a nine-bay station building, with a central projecting porch, faced in yellow brick. The platform canopy, cast-iron pedestrian bridge, detached waiting room and house are also of interest. The station is a Protected Structure. It is included in the NIAH where it is rated of Regional importance for reasons of architectural, artistic and social interest. There is a signal box within the station complex which is also listed in the NIAH, where it is rated of Regional importance for reasons of architectural, artistic, social and technical interest.

No additional buildings or features of architectural heritage interest have been noted to date, as part of the provisional desk-top baseline review.

2.6.5 Noise and Vibration

Malahide Station is located in a residential area, near to noise and vibration sensitive houses and commercial premises.

The study area to the north of Malahide Station has residential and commercial premises (including the Malahide Waste Water Treatment Plant) to the east, and the Broadmeadow/Malahide Estuary to the west.

Noise and vibration sensitive receptors in this area are currently subject to noise and vibration from the operation of electric and diesel trains running through Malahide Station.

The study area to the north of the Malahide Estuary, is surrounded by agricultural land, with no nearby noise or vibration sensitive receptors.

2.6.6 Air quality and climate

The nearest EPA air quality monitoring station to the Malahide station is located in Swords. The quality of air in Swords in 2019 was very good with measured concentrations of pollutants well within air quality standards.

The Climate Action and Low Carbon Development (Amendment) Bill 2021 is due to be enacted shortly. It supports Ireland's transition to Net Zero and achieve a climate neutral economy by no later than 2050. It commits to a reduction of 51% in the total amount of greenhouse gas emissions by 31 December 2030, relative to 2018 emissions.

2.6.7 Agricultural and Non-Agricultural

Agricultural Land

Farms in County Dublin are larger than the national average. There are fewer dairy and other livestock farms and more tillage farms. In the environs around Malahide Station there is no agricultural land.

The lands north of Malahide Estuary are agricultural. There are beef and tillage enterprises on the west side of the railway line within the study area in this area. There is also an access road along the western boundary of the railway line.

Table 2-1: Agriculture in County Dublin (2010[1] Agricultural Census, Central Statistics Office)

Farm enterprise type (Table 2, 2010 Ag Census, CSO)	Co Dublin	Nationally
Mainly dairy	3.5	11
Non - dairy grazing livestock (beef cattle) and mixed field	65	72.5
Mainly tillage	25.5	3.5
Mixed crops & livestock	3	2
Other	1	1
Total	100	100
Average size (ha)	47.6	32.7

[1] The proposed 2020 Agri Census was postponed due to Covid-19 and therefore the 2010 is the most recent enterprise type data for County Dublin.

Non-Agricultural land/population assessment

Malahide Station has an entrance onto the R106 Malahide Road and onto Railway Avenue and Old Street, a one-way street in the centre of the town. Malahide Parish Pastoral Centre is located just to the east along with the Malahide Veterinary Clinic.

The Casino Model Railway Museum, formerly in Malahide Castle, has since 2020 been located beyond the west side of the tracks along with residential housing, while to the south-west is Malahide Demesne, including the public parking to the demesne and St. Sylvester's Bridgefield GAA pitch.

Northbound, the railway crosses on an overbridge above Bisset's Strand which runs along the south bank of the estuary along with amenity greenspace. The railway line extends along a spit of land which includes Malahide Marina and the Marina Village apartment development, while the railway is bounded by an access road to the water treatment plant. The Floatation Therapy fitness centre is located just south of the wastewater plant. A short bridge then carries the railway across the estuary onto an aggregate embankment backed by open water on the west side and mudflats on the east. The proposed Broadmeadow Way Greenway by Fingal County Council which has received funding and the relevant statutory consent, will run along the west side of the embankment and the bridge.

2.6.8 Geology and Soils

Malahide to Underbridge UBB30 (Viaduct)

The expected ground conditions at Malahide Station are highlighted in section 2.5.1. The south of the site is situated within a cutting and the railway line is most likely founded on weak to medium strong limestone rock. The overburden the east and west of the line is primarily composed of stiff clays to depths of up to 4.5mbgl with occasional soft silts.

To the north of the station, the line is constructed on an embankment over the estuary and is underlain by silts, glacial tilts and gravels. Land reclamation has occurred immediately to the east of the line between underbridge UBB29 and overbridge UBB30.

The Corine Land Cover 2018 categorises the land use in the area as artificial continuous urban area.

UBB31

The expected ground conditions are detailed in section 2.5.2. Of note, the area to the west of the line is believed to be reclaimed land and alluvium materials are likely present. No available historic ground investigations information available for this location.

The Corine Land Cover 2018 categorises the land use in the area as agricultural areas and non-irrigated arable land.

Donabate

The expected ground conditions are detailed in section 2.5.3. Based on the limited historical information at the location, The stratigraphy consists of made ground, soft to firm glacial till, silts and medium dense to dense gravels with occasional layers of soft silts and loose sands.

The Corine Land Cover 2018 categorises the land use along the site as agricultural areas as well as artificial surfaces with discontinuous urban fabric.

2.6.9 Water resources

Surface water bodies

The study area south of Malahide Bay lies within the Gaybrook_010 sub basin which is in the Mayne_SC_010 river sub-catchment. The Gaybrook stream flows approximately 1.2km west of the site in a northerly direction and discharges into the Broadmeadow Water transitional waterbody (IE_EA_060_0100), which discharges to Malahide Bay coastal waterbody (IE_EA_060_0000). Parts of the study area are located adjacent to the Broadmeadow Water transitional waterbody which is part of the Malahide Estuary SAC, SPA and pNHA.

The study area north of Malahide Bay is within the Turvey_010 river sub basin which is in the Ballough Stream_SC_010 sub-catchment. The River Pill flows underneath the railway line and discharges to Malahide Bay. No other surface water features have been identified at the site area.

Under the Water Framework Directive (WFD, 2000/60/EC) the "Ecological Status" of the Broadmeadow Water is classified as Poor. The minimum objectives for a water body under the WFD are to achieve at least Good status (or Good potential for artificial/ highly modified water bodies), and no deterioration of existing status. The Broadmeadow water is classified as At risk, indicating that the waterbody may not maintain or achieve that status. The nearby Malahide Bay coastal waterbody is also classified as At risk and the ecological status is Moderate. The ecological status of the Turvey_010 river water body is unassigned.

Groundwater

There are no significant karst features identified near the study area.

The area is underlain by Dinantian Lower Impure Limestone which is part of the Malahide Formation. The aquifer is classified as a locally important (Ll) aquifer which is Moderately Productive only in Local Zones. The groundwater

vulnerability at the site south of Malahide Bay is classified as extreme and with rock at or near surface. The groundwater vulnerability to the north of Malahide Bay is classified as low to high.

There are two borehole wells within 1km of the study area boundary that provide water for agricultural, domestic or industrial use (ref: 3223NWW002, 3223NWW003). There are no high yielding water supply springs and wells i.e. public water supplies or group water scheme supplies within the site. No Source Protection Zones associated with public or group groundwater supply schemes are located with the site.

The study area south of Malahide Bay lies within the Dublin groundwater body (IE_EA_G_008). The Dublin groundwater body is currently at Good WFD Status for the 2013-2018 monitoring cycle and currently Not at Risk with regard to achieving its WFD objectives.

The study area north of Malahide Bay lies within the Swords (IE_EA_G_011) groundwater body. The Swords groundwater body is currently at Good WFD Status for the 2013-2018 monitoring cycle and currently Not at Risk with regard to achieving its WFD objectives.

Flooding

Historical flooding has been assessed by examining reports and maps from the OPW's (Office of Public Works) National Flood Hazard mapping. There are no records of flood events within the study area. Reoccurring flooding has been reported at Seabank Estate Court, Malahide, 1km east of the site on Malahide Bay.

Risk of coastal flooding at Malahide Bay has been assessed and mapped by the OPW as part of the Fingal East Meath FRAM study. According to the OPW predictive flood maps (floodinfo.ie), parts of the site are located adjacent to areas at risk of tidal or fluvial flooding. Flooding occurs on Strand Street underneath the railway line bridge, 160m north of the Malahide station. According to the maps, the flood level during the 0.5%AEP event south of Malahide Bay is predicted to be 3.07mOD. North of Malahide Bay, the predicted level during the 0.5%AEP event is 3.18mOD, with the 1% AEP fluvial event flood level from the River Pill being significantly lower at 1.25mOD.

At the Strand Street bridge location, the railway line is set at 7.9mOD, well above flood levels. Similarly, the railway line above the River Pill is 4.83m OD, above the extreme tidal or fluvial flood levels.

The level of the railway line within the study area extents is not lower than 4.7mOD. Therefore, there is currently low risk of tidal and fluvial flooding on the railway line.

2.6.10 Biodiversity

The works location for this study pack is set near and within the estuarine environment of the Broadmeadow estuary, and north of the urban centre of Malahide.

The Broadmeadow estuary is designated as a Special Area of Conservation (SAC), a Special Protection Area (SPA) and a proposed Natural Heritage Area (pNHA) as indicated below.

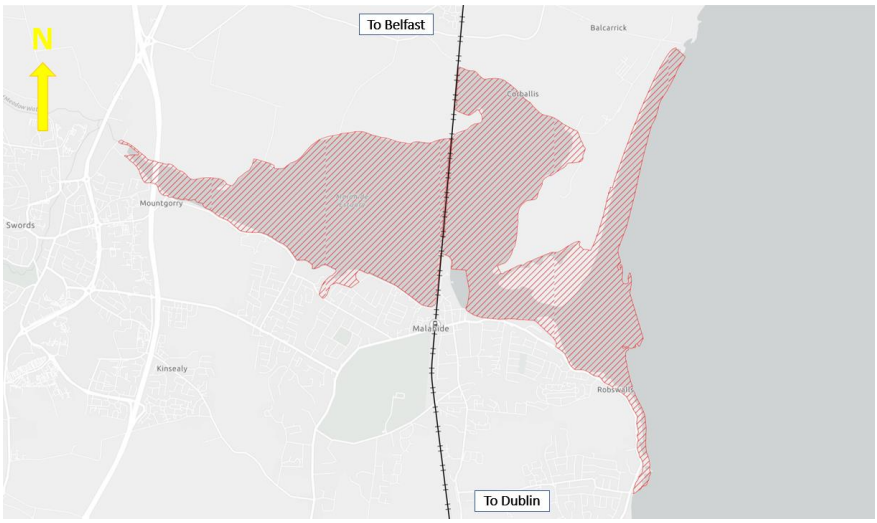

Figure 2-18: Malahide Special Area of Conservation

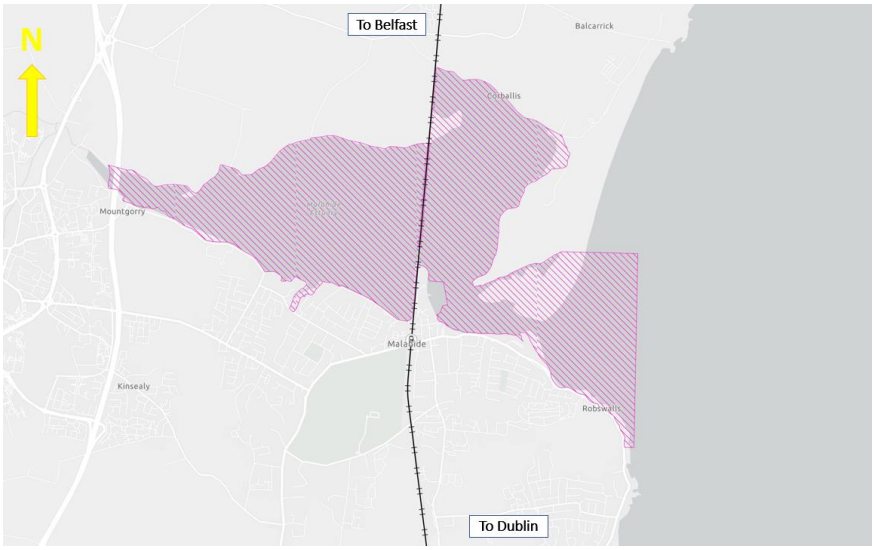

Figure 2-19: Malahide Special Protection Area

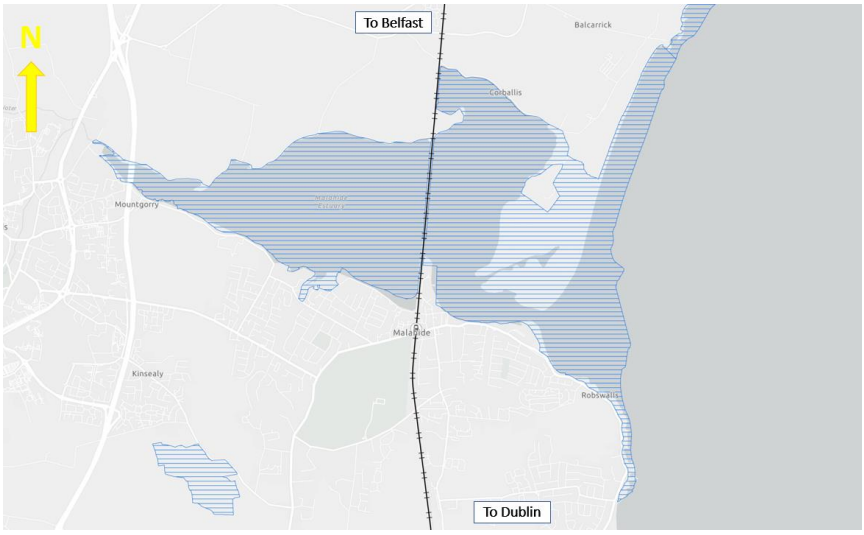

Figure 2-20: Malahide proposed Natural Heritage Area

2.7 Utilities

All utility records have been gathered from the utility providers in the area. The following utility companies have infrastructure within the area of interest (note this list is non-exhaustive):

- Gas Networks Ireland (GNI);
- Irish Water (Water supply);
- Irish Water (Foul Water Sewers)
- Fingal County Council (Storm Water Sewers)
- ESB Networks – Low and Medium Voltage
- Eir;
- ENet
- BT Ireland;
- Lineside cables running parallel along the length of the railway line.

All utility records should be considered indicative only and must be verified prior to any intrusive works occurring, as there may however be uncharted utilities in the vicinity of the railway. It is intended to conduct utility specific surveys during preliminary design (non-intrusive utilities surveys form part of the Stage A2 Northern Topographic and Non-intrusive Utility Survey package).

Most of the utilities within the area cross the railway track at or near existing bridges.

3 Requirements

3.1 Specific Requirements

In addition to the general feasibility requirements of constructability and safety, this section describes the specific requirements for this area to achieve the project Train Service Specification – referred to as TSS 1C. In order to achieve TSS 1C, Malahide Station must, as a minimum, be able to handle the following quantum and pattern of train services in each direction:

- 2 TPH DART terminating/departing services;
- 5 TPH DART through services;
- 2 TPH DMU through services;
- 1 TPH Enterprise non-stop through services

This increase to 8 stopping services and 1 non-stopping service per hour in each direction at Malahide set the key reason for change to the current infrastructure as a result of the DART+ programme

3.2 Systems Infrastructure and Integration

Overall signalling, electrification and telecoms (SET) requirements are defined in the functional requirements specifications for the DART+ Programme. These documents support IÉ SET standards covering the requirements for the signalling, electrification and telecommunications (telecoms) may need some adaptation to the conditions that are specific to Malahide station development.

Changes and additions to the signalling, telecoms and OHLE will be required to support operation over additional and special trackwork and provide for the operational turnback. Signalling will be adapted to enable the safe and efficient use of the new turnback facility so that trains can be easily routed into and out of the turnback with the least influence on the through services.

Similarly, OHLE will be installed and/or adapted to ensure that Electric Multiple Units (EMUs) are able to fully utilise the revised track layout using components that are similar or identical to the existing installation, comprising galvanised masts and suspension equipment providing a nominal contact wire height of approximately 4.7m.

Telecoms changes will be required to support the communication to passengers with enhanced information and considering the new operating patterns that can be provided by the new facility.

3.3 Design Standards

Table 3-1 contains some of the key applicable standards that will be used to develop the design. This list of standards is not exhaustive and other IÉ Standards may be used.

Prior to completing the detailed design Arup will undertake a fully detailed risk assessment in accordance with The Commission of Railway Regulation (CRR) mandatory requirements as set out within the documents listed below:

- CRR-G-009-G: Guideline for the Process of Authorisation for Placing in Service of Railway Sub Systems;
- CRR-G-009-G Sections 2.2.3 – 2.2.4: Guideline providing List of Parameters and Requirements for Authorisation for Placing in Service (APIS) of Heavy Rail INF & related OPE/MAI Parameters.

Table 3-1: Design Standards

Source	Description	Comments
European Commission Regulation	EU/1299/2014	Technical Specification for Interoperability for the 'Infrastructure' subsystem
European Commission Regulation	EU/1302/2014	Technical Specification for Interoperability for the "rolling stock subsystem - Locomotives and passenger rolling stock"
Irish Rail	I-PWY-1101	Requirements for Track and Structures Clearances
Irish Rail	I-PWY-1136	Requirements for Design, Installation and Maintenance of Lineside Drainage
Irish Rail	CCE-TMS-300	Track Construction Requirements and Tolerances
Irish Rail	CCE-TMS-340	Horizontal Curvature Design
Irish Rail	CCE-TMS-341	Vertical Curvature Design
Irish Rail	CCE-TMS-344	Requirements for Undertrack Crossings and Pressure Pipelines
Irish Rail	CCE-TRK-SPN-007	Specification for Track Ballast
Irish Rail	CCE-TRK-SPN-021	Specification for Permanent Way Signs

Source	Description	Comments
Irish Rail	CCE-TRK-SPN-037	Fencing Specification
Irish Rail	CCE-TMS-345	Engineering Requirements for Passenger Platforms and Barrow Paths
Irish Rail	CCE-TMS-410	Civil Engineering Structure Design

4 Constraints

This section describes the constraints that are relevant to this package of works.

4.1 Technical

The technical constraints are described in the following sub-sections.

4.1.1 Permanent Way and Track

Irish Rail have confirmed that 3.4m clearance to adjacent lines is required for rolling stock examinations. Where an option considers the turnback to be between the lines, this is applied to one adjacent line only. Additionally Irish Rail have requested that stepped access is provided to allow the driver to transit from one end of the train to the other without using the train steps. As a minimum, this will require a set of steps/raised walkway to allow the driver to walk between the two (half-length units) HLUs coupled together. A desirable width of 1380mm (1300mm walking width, 80mm handrail) and a minimum width of 1330mm (1280mm walking width, 50mm handrail) have also been specified.

4.1.2 Geotechnical

For all locations, based on the desk study information retrieved from historic ground investigations along the railway line, there is the risk of contamination due to the presence of made ground as highlighted in nearby ground investigations and with respect to the historic and industrial use of the site as a railway. Subsequently, material excavated during the works may not be suitable for reuse on site and subject to testing may require disposal or recovery to a suitably licensed facility.

Malahide to Underbridge UBB30 (Viaduct)For any works required between Malahide and UBB30 there is the potential for soft ground associated with the existing estuary.

At UBB31, there is the possibility of soft ground (alluvium deposit) associated with River Pill and its historic estuary at the site and therefore, this should be considered for any proposed works at the bridge.

For all locations, a site-specific ground investigation is a prerequisite at the location of the proposed works to investigate the current ground and groundwater conditions. limited information on depth to bedrock, groundwater and geo-environmental from existing ground investigations.

4.1.3 Structures

This area currently accommodates a two-track railway. Any reconfiguration of the horizontal track alignment or increase in the number of tracks may require alternation to the structures in the area as described in Table 4-1.

Table 4-1: Structure constraints along the site

Name	ID	Function	Constraint
29 Strand St – Protected Structure	UBB29	Underbridge	Any alteration to the tracks at this location may require a modification to the bridge should additional width be required here.
Malahide Viaduct-Protected Structure-Post-tensioned	UBB30	Underbridge	Any alteration to the tracks at this location may require a modification to the bridge should additional width be required here.
UBB31 - Tidal Outflow	UBB31	Underbridge	Any alteration to the tracks at this location may require a modification to the bridge should additional width be required here.
Lineside Wall	N/A	Lineside wall on Up Side	A stonework wall positioned within IÉ land is present on the East side of the line North of UBB29

4.1.4 Utilities

Utility locations are a consideration when designing and implementing a new turnback or platforms (whether at a station or elsewhere along the railway line), as this usually requires all the existing utilities in the location to be diverted – either temporarily or permanently. Underground services can impact on the placement of OHLE masts, as they must be placed on either side of the utilities and may not be placed on top of them. Above ground utilities that cross the railway line overhead can impact on the minimum clearance required by the OHLE.

There are many utilities traversing and alongside the existing rail corridor within the study area for the works around Malahide Station and Donabate Station. Most utilities that cross the rail corridor in Malahide are concentrated in Malahide Road Bridge (OBB27) and 29 Strand St Bridge (UBB29). In Donabate utilities cross the

rail corridor in the Hearse Road bridge (OBB33) and in the road passing under the railway to the north of the station at Ballisk.

Underground utilities present are medium voltage underground electrical cables, medium pressure gas mains, telecommunications, watermains, wastewater sewers and surface water drainage networks. There are also lineside telecommunications running parallel to the railway in this area.

Options that involve widening of the Malahide Road Bridge to accommodate additional tracks and platforms at Malahide Station will cause disruption to the utilities located in Malahide Road. Options that involve constructing a turnback north of Malahide Station, to the north or south of Donabate Station will impact on the lineside telecommunications and most likely require them to be relocated.

The existing utilities in Malahide, to the north of Malahide Estuary and in Donabate are shown in the figures below. As noted in section 2.7, all utility records should be considered indicative only and it is intended to conduct utility specific surveys during preliminary design (non-intrusive utilities surveys form part of the Stage A2 Northern Topographic and Non-intrusive Utility Survey package).

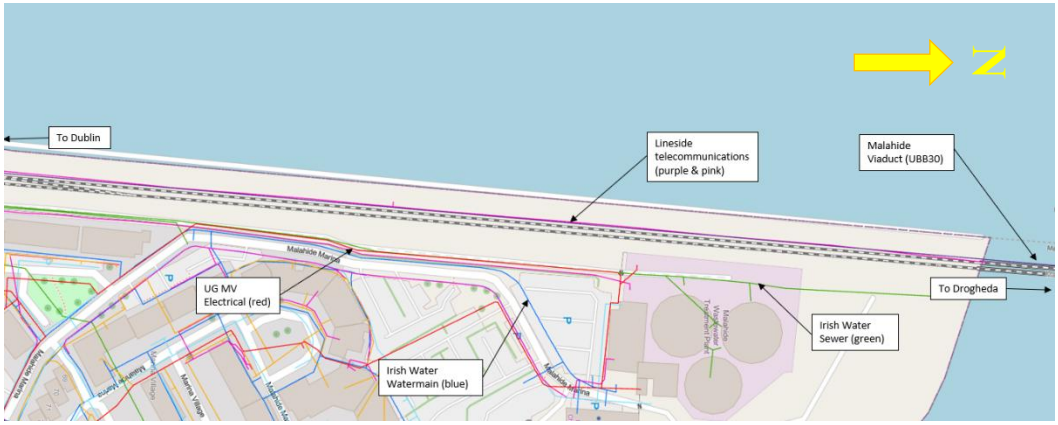

Figure 4-1: Existing Utilities to the south of Malahide Viaduct

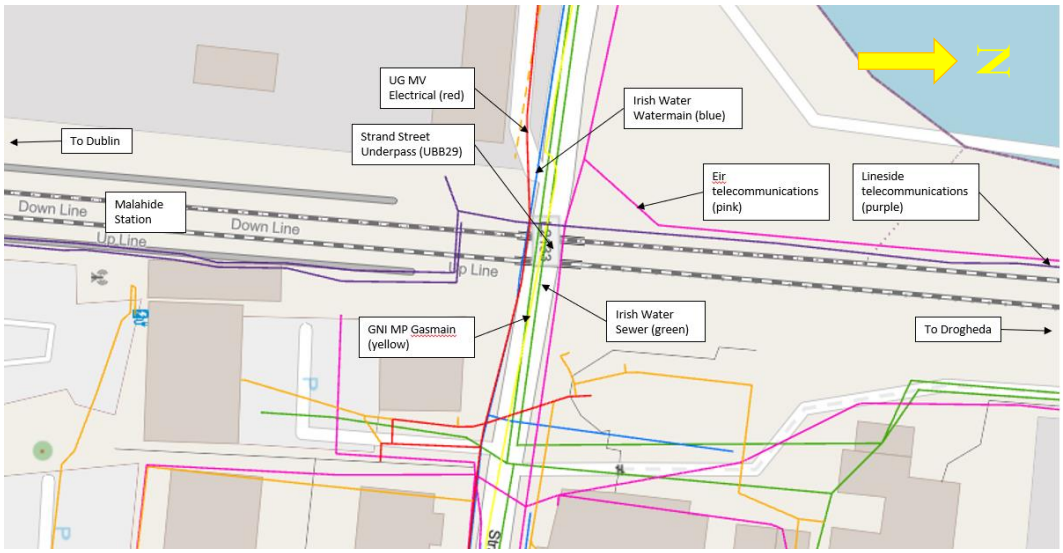

Figure 4-2: Existing Utilities to the north of Malahide Station

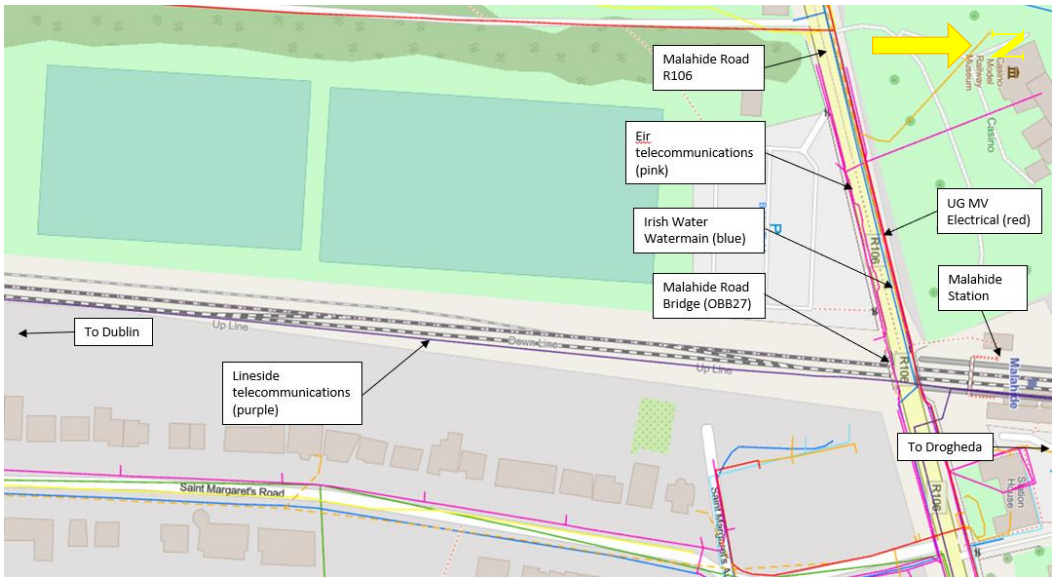

Figure 4-3: Existing Utilities to the south of Malahide Station

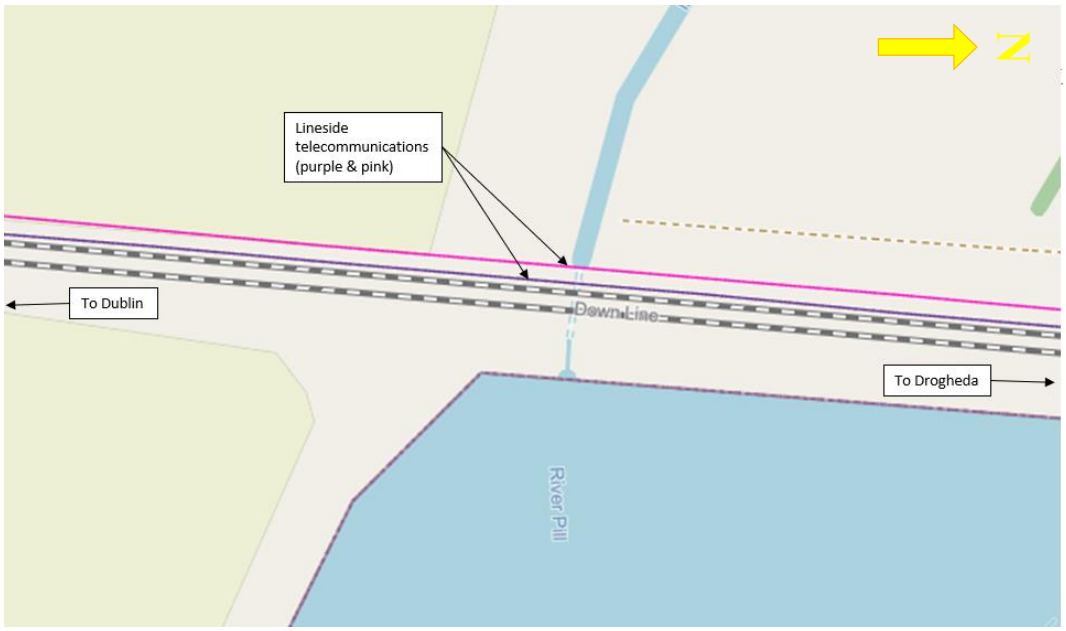

Figure 4-4: Existing Utilities to the north of Malahide Estuary

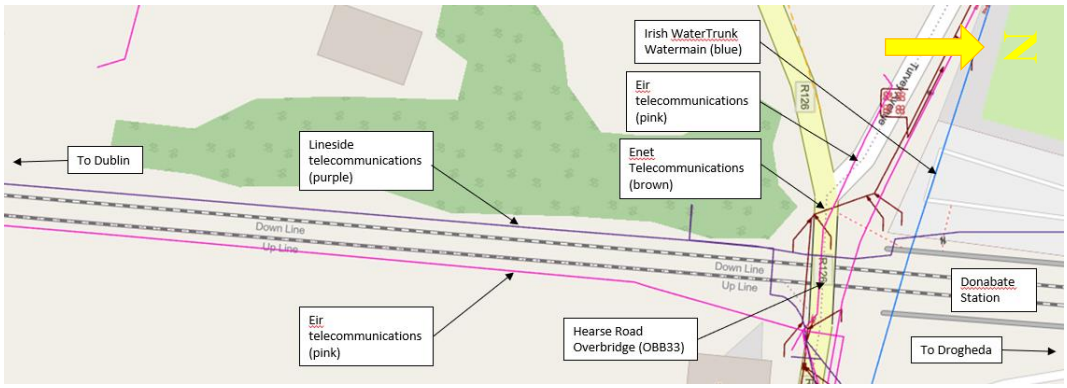

Figure 4-5: Existing Utilities to the south of Donabate Station

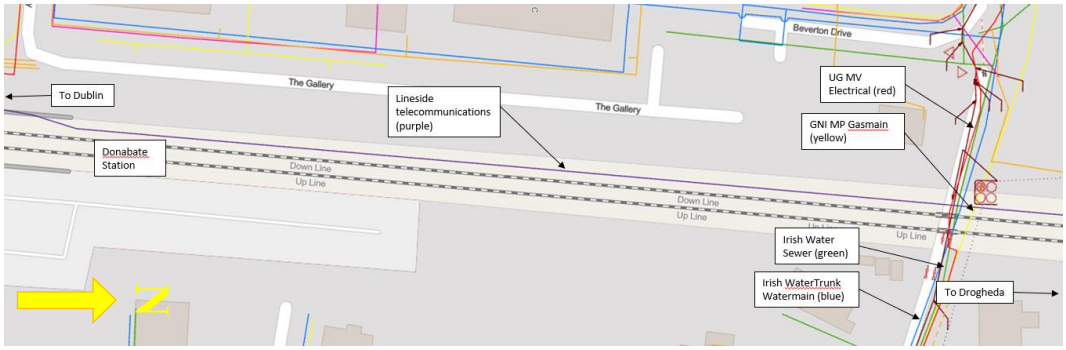

Figure 4-6: Existing Utilities to the north of Donabate Station

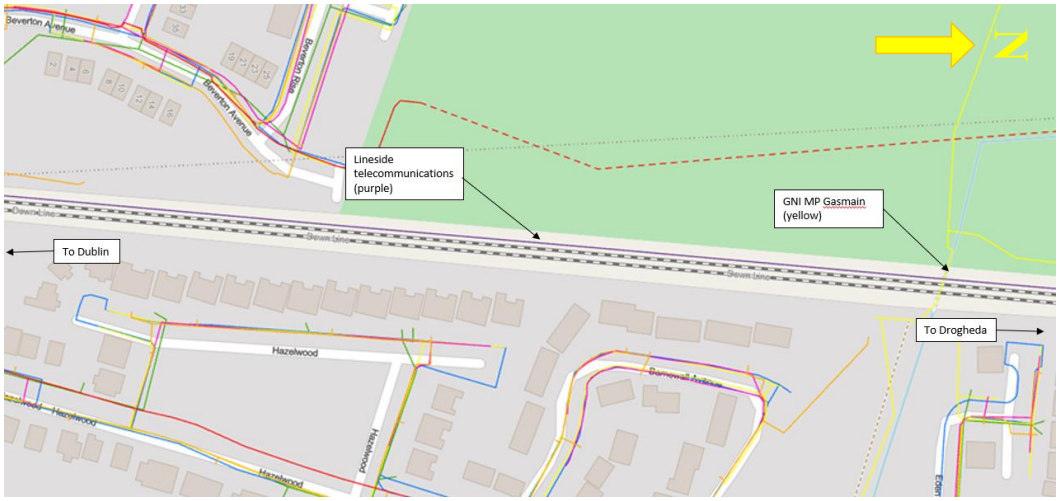

Figure 4-7: Existing Utilities to the north of Donabate Station, continued

4.1.5 Other Railway Facilities

Signalling

The current signalling SSI interlocking is constrained to be only able to take 63 Trackside Functional Modules. This might be an insufficient number depending on the outcome of the chosen solution.

The signalling is also constrained to only be able to operate unidirectionally in its current configuration.

The current Train Protection System CAWS/ATP is obsolete and is difficult to source.

The Signalling Equipment Room is also a constraint in terms its physical size as there is not sufficient space to add a significant amount of equipment.

Telecoms

The main Telecoms constraint is that the Telecoms Operational network is constrained to the low number of available fibres. Currently IÉ only has 12 fibres along the Coastal Line. Upgrades to the fibre optic cable network have been identified which include provision of redundantly configured 2x96 fibre cables for Telecoms, 2x24 fibre cables for signalling and 2x24 fibre cables for electrification services.

Telecoms is also limited by the amount of space available in the TER (Telecoms Equipment Rooms) and any further space requirements will be identified as the design progresses.

OHLE

The OHLE is constrained to the available capacity from the substation. Mast pole placements need to take utilities into account and be place in such a way to allow access to the utility infrastructure in the future. Special considerations will have to be given regarding mast pole placement on the Malahide Viaduct.

4.1.6 Roads

No road constraints have been identified in the permanent scenario. During construction access to the station and nearby residential and business areas must be maintained. Traffic diversions may be necessary.

4.2 Environmental

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

Section 2.6 above describes the baseline environment for the various options being considered under this package of works. Building on this information, the key constraints associated with the options being considered, under the various environmental criteria, are summarised below.

4.2.1 Traffic and Transportation

The low speed and function of the access road to the Malahide Marina Village will need to be considered in the context of construction traffic. The road provides access to residential areas and the Waste Water Treatment Plant. The interface with the planned Broadmeadow Way Greenway and the watercourse to the north will also need to be considered during construction.

The low speed and low traffic character of the surrounding streets will also need to be considered in the context of construction traffic.

4.2.2 Landscape and visual impact

The key landscape and visual constraints are:

- Residential communities / properties at Marina Village east of the rail lines;
- Views from Bissett's Strand and adjoining amenity area (protected view);
- Protected structures of railway bridges and Malahide Viaduct;
- Planned Broadmeadow Way Greenway (by Fingal CoCo) to west of embankment / rail line;
- High amenity lands north of Broadmeadow Estuary; and
- Plantings alongside rail line/embankments.

4.2.3 Archaeology and cultural heritage

The railway and its associated infrastructure at Malahide is of an industrial heritage interest as well as being of architectural heritage significance. As such work in this area will be archaeologically monitored to ensure that all features and finds are appropriately identified and recorded.

4.2.4 Architectural heritage

As mentioned above, the railway and its associated infrastructure at Malahide is of an industrial heritage interest as well as being of architectural heritage significance.

To the north of the area proposed for regrading and railway works, is the Malahide viaduct (FCC RPS 0420), which was originally constructed in 1844, and rebuilt in 1860. It is a protected structure of regional importance for reasons of architectural, social and technical interest. To the south the railway bridge over Bissets Strand is also included in the record of protected structures, and in the National Inventory of Architectural Heritage where it is rated of regional importance for reasons of architectural, social and technical interest (FCC RPS 0423, NIAH 11344015)). Beyond the bridge and further to the south is Malahide Station, which is also a protected structure, included in the NIAH where it is rated of regional importance for reasons of architectural, artistic, social and technical interest (FCC RPS 0388, NIAH 11344008-9 11344041)).

4.2.5 Noise and Vibration

The main constraint to development with respect to noise and vibration is the nearby sensitive receptors.

For options in the vicinity of Malahide, the amenity of sensitive receptors on each side of the rail line must be protected.

For options just north of Malahide Estuary, there are no nearby sensitive receptors to consider.

4.2.6 Air quality and climate

The main air quality constraint to development relates to the proximity of sensitive receptors (dwellings, amenity areas, ecological sensitive sites etc.) to the works during construction. There are a number of residential developments located on either side of the existing tracks. In addition, the Broadmeadow Estuary SPA is located in close proximity. Mitigation measures will be required during the construction phase to minimise dust impacts at sensitive locations.

In general, the modernisation and improvement of rail services will expand train capacity, thereby increasing the attractiveness of rail travel. This will reduce reliance on private car travel and contribute to reductions in carbon emissions.

4.2.7 Agricultural and Non-Agricultural

Agricultural Land

In the environs around Malahide Station there is no agricultural land – and therefore no agricultural constraints.

To the north of Malahide Estuary there are agricultural lands to the west of the railway line and a combination of agricultural grassland and estuary to the east. There will be no additional land-take due to the proposed turnback.

Non-Agricultural land/population assessment

Construction works affecting mostly the west side of the embankment will have an impact on use of the Broadmeadow Way Greenway should the greenway have been opened at this time.

Construction works on the east side of the embankment will affect the occupants of apartments in the Marina Village and possibly the Floatation Therapy centre for which elevated noise could be an issue given the nature of the treatment (although the site is already affected by through train services). Refer to the Noise and Vibration Section for details

4.2.8 Geology and soils

Based on the historic and industrial use of the site as a railway, there are likely to be some sources of contamination within the made ground throughout the study area.

There are no Geological Heritage Areas identified in the study area around the station.

4.2.9 Water resources

The constraints to the development in terms of water resources include the Broadmeadow Water, Malahide Bay, River Pill, the underlying locally important aquifer, areas at medium to high risk of flooding and the protected sites where changes to the watercourse could have a negative impact.

The site is in close proximity to the Malahide Bay SAC, SPA and pNHA. One of the objectives of the SAC relates to the flooding regime, and specifically the natural tidal regime. The pioneer saltmarsh community at the SAC requires regular tidal inundation. Changes to the hydrological regime as part of the proposals could therefore have a negative impact.

4.2.10 Biodiversity

The key ecological constraints in this area are the Malahide Estuary SAC, Malahide Estuary SPA and pNHA designation (located immediately adjacent to and overlapping with the works area) which are designated for marine habitats and overwintering birds. These designated areas are of international and national biodiversity importance.

The qualifying interests (reasons for designation) of the Malahide Estuary SAC and SPA are listed in the table below:

Table 4-2: Reasons for designation of the Malahide Estuary SAC and SPA

Malahide Estuary SAC	Malahide Estuary SPA
• 1140 Mudflats and sandflats not covered by seawater at low tide • 1310 *Salicornia* and other annuals colonising mud and sand • 1320 Spartina swards (*Spartinion maritimae*) • 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) • 1410 Mediterranean salt meadows (*Juncetalia maritimi*) • 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) • 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes)*	• A005 Great Crested Grebe *Podiceps cristatus* • A046 Brent Goose *Branta bernicla hrota* • A048 Shelduck *Tadorna tadorna* • A054 Pintail *Anas acuta* • A067 Goldeneye *Bucephala clangula* • A069 Red-breasted Merganser *Mergus serrator* • A130 Oystercatcher *Haematopus ostralegus* • A140 Golden Plover *Pluvialis apricaria* • A141 Grey Plover *Pluvialis squatarola* • A143 Knot *Calidris canutus* • A149 Dunlin *Calidris alpina alpina* • A156 Black-tailed Godwit *Limosa limosa* • A157 Bar-tailed Godwit *Limosa lapponica* • A162 Redshank *Tringa totanus* • A999 Wetlands

Other potential ecological constraints include:

- The River Pill which drains to the Malahide estuary;
- Potential for roosting bats in the bridge structure crossing the River Pill (depending on the nature and structure of this bridge);
- Vegetation (scrub, hedgerows or treelines) which may provide foraging, nesting, and commuting corridors for fauna species (e.g. birds, bats, small mammals);
- Potential for the railway to support interesting flora species and habitats due to the calcareous nature of the ballast and their often relatively undisturbed nature;
- Potential for invasive species to occur along the railway line.

4.3 Planning

Malahide is located within the administrative area of Fingal County Council. The Fingal Development Plan 2017-2023 sets out the Council's proposed policies and objectives for the development of the County over the Plan period. The Development Plan seeks to develop and improve, in a sustainable manner, the social, economic, environmental and cultural assets of the County.

The Strategic Vision for the plan contains a number of sectoral policies, the following of which are relevant:

"Consolidate urban areas to provide a vibrant, attractive environment for living and working, facilitating efficient movement by sustainable modes of transport throughout the County.

Make better use of key resources such as land, water, energy, waste and transportation infrastructure.

Reduce climate change through settlement and travel patterns and reduced use of non-renewable resources."

The Strategic Vision intends to deliver on the Main Aims of the Plan by, inter alia:

"Seek the development of a high quality public transport system throughout the County and linking to adjoining counties, including the development of the indicative route for New Metro North and Light Rail Corridor, improvements to railway infrastructure including the DART Expansion Programme, Quality Bus Corridors (QBCs) and Bus Rapid Transit (BRT) systems, together with enhanced facilities for walking and cycling."

The following objectives in relation to transportation are also relevant:

"Objective MT01

Support National and Regional transport policies as they apply to Fingal. In particular, the Council supports the Government's commitment to the proposed new Metro North and DART expansion included in Building on Recovery: Infrastructure and Capital Investment 2016-2021. The Council also supports the implementation of sustainable transport solutions.

Objective MT02

Support the recommendations of the National Transport Authority's Transport Strategy for the Greater Dublin Area 2016-2035 to facilitate the future sustainable growth of Fingal.

Objective MT05

Integrate land use with transportation by allowing higher density development along higher capacity public transport corridors.

Objective MT30

Support Iarnród Éireann and the NTA in implementing the DART Expansion Programme, including the extension of the DART line to Balbriggan, the design and planning for the expansion of DART services to Maynooth, and the redesign of the DART Underground."

The railway through Malahide and station itself are unzoned (technically known as 'white land').

The railway line and station area adjacent to the following zoning objectives:

"RA" Residential Area

"TC" Town and District Centre

The plans for Malahide railway station will not contravene any of these zoning objectives. However, careful design will have to be considered in relation to the adjoining zoning objectives.

Malahide Railway Station (ref. 0388) and Malahide Railway Viaduct (ref. 0420) are protected structures. Any works will have to be considered and approved by appropriate conservation experts.

It should also be noted there is an 'Indicative Cycle/Pedestrian Route' adjoining the existing railway line at Malahide Estuary north across Malahide Railway Viaduct.

5 Options

The following section runs through the optioneering process from the longlist of options to the selection of the Draft Emerging Preferred Option.

The option selection process is described in the Preliminary Option Selection Report.

5.1 Longlist of options

This section describes the options which have been considered for Malahide. The discussion is limited to items which will have a bearing on the development or selection of an option. A more detailed technical description of the works is included for the shortlisted options. It should be noted that, for track modifications that are essential to facilitate the increase in train services (i.e. the subject of this report), no 'Do-Minimum' option exists as some intervention is required in order to meet the Project objectives and requirements.

The options which have been considered are summarised in Table 5-1 below.

Table 5-1: Longlist of options considered

Option	Description
Option 0	Do Nothing
Option 1a	Down line slewed to provide central turnback north of Malahide station (down line on divergent route)
Option 1b	Down line slewed to provide central turnback north of Malahide station (turnback on divergent route)
Option 2a	Up line slewed to provide central turnback north of Malahide station (up line on divergent route)
Option 2b	Up line slewed to provide central turnback north of Malahide station (turnback on divergent route)
Option 3a	Turnback on Down side north of Malahide station
Option 3b	Loop on Down side north of Malahide station
Option 4a	Turnback on Up side north of Malahide station
Option 4b	Loop on Up side north of Malahide station
Option 5a	Central turnback south on Donabate station
Option 5b	Central turnback North of Malahide Estuary
Option 5c	Turnback North of Donabate Station
Option 6a	New Platform on Down side South of Malahide station
Option 6b	New Platform on Down side South of Malahide station with Passing Loop
Option 7a	New Down side Platform at Malahide station
Option 7b	New Down side Platform at Malahide station
Option 8	Relocate Station to South with additional Platform

All of the options identified can be supported by modifications to the existing signalling and OHLE equipment to provide safe and efficient use of the new track layout. For those options that require signalling or OHLE changes, the solutions to each will involve various changes to existing equipment and additional equipment to be installed. Specific details differ between the various options.

5.1.1 Option 0 – 'Do Nothing'

'Do-Nothing' represents a scenario where infrastructure works and interventions to meet the Project Objectives and Requirements are absent. For this option there will be no change to the current layout.

5.1.2 Option 1A – Down Line slewed to provide central turnback north of Malahide (Down line on divergent route)

For Option 1A, the Down Line is slewed to the West towards Malahide estuary; this is achieved via the installation of P21/28.5 switch to facilitate the line speed. The divergent route then forms a centre turnback with walkways provided. The Up Line remains as is, with a lower speed turnout presented to allow egress from the turnback road to the Up Line.

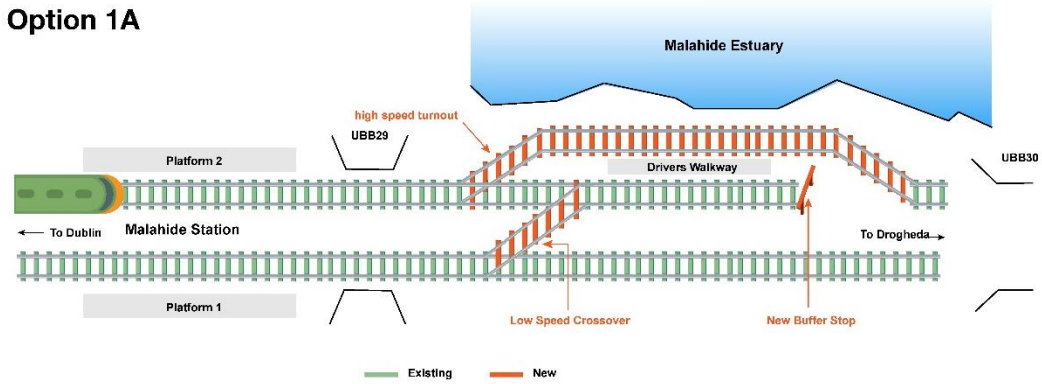

Figure 5-1: Schematic of Option 1A

5.1.3 Option 1B - Down Line slewed to provide central turnback north of Malahide (Turnback on divergent route)

The mainline radius has been increased to slew the line at line speed away from its current location westwards, with a low-speed switch installed from this diverged line to the existing track, which now forms the central turnback road. Access to the Up Line is afforded in a similar manner to Option 1A with the installation of a low-speed point and crossing unit.

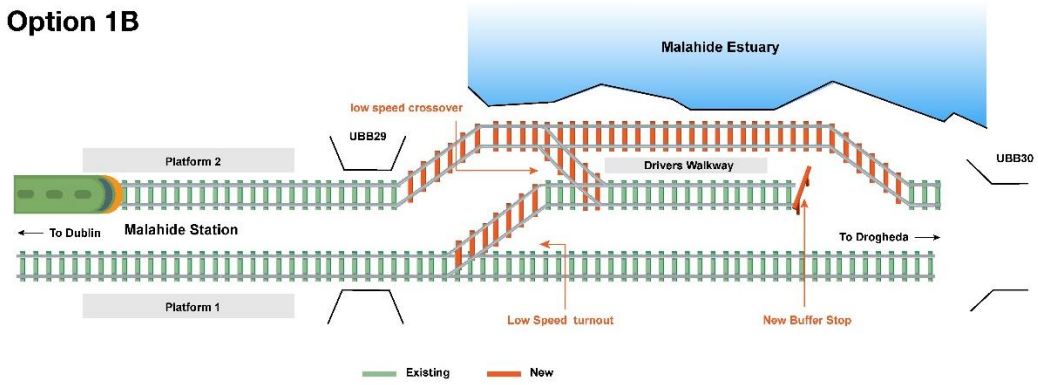

Figure 5-2: Schematic of Option 1B

5.1.4 Option 2A - Up Line slewed to provide central turnback north of Malahide (Up line on divergent route)

This option inverts the layout of Option 1A, whereby the main line is slewed to the east (closer to the existing residential development and sewerage works site). Access to the central turnback is created via a P21/P28.5 switch. The existing crossover north of the station is retained providing access from the north bound line to the central crossover.

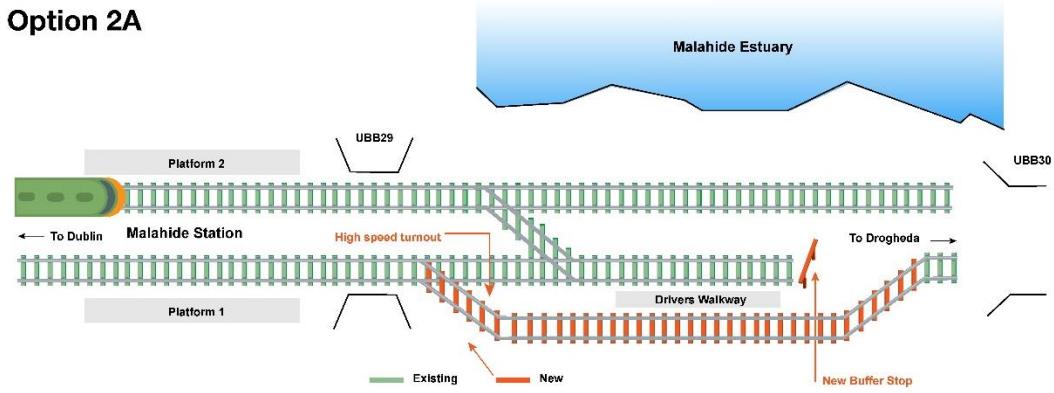

Figure 5-3: Schematic of Option 2A

5.1.5 Option 2B - Up Line slewed to provide central turnback north of Malahide (Turnback on divergent route)

In a similar manner to Option 2A, this option is in keeping with Option 1B with the slewing inversed to be present on the eastern side rather than the west towards the causeway.

The alignment of the track over UBB29 is a critical pinch point for this option and without topographic survey information it is not currently able to be confirmed if this option can be achieved without affecting clearances to the Up side bridge parapet. This could necessitate additional civil engineering works to the bridge and as such a subset of this option exists which removes the risk of these bridge works but involves the replacement/relocation of the existing crossover between the Up and down lines. This option has been documented later in Section 5.4 as Option 2C.

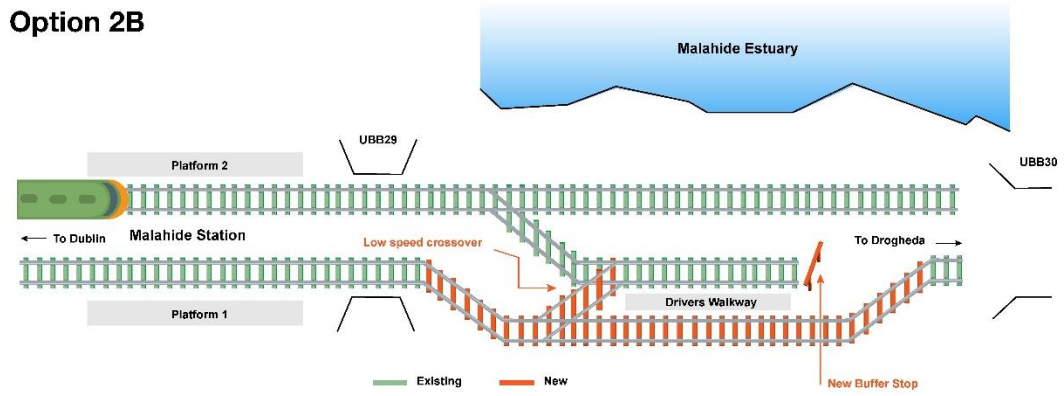

Figure 5-4: Schematic of Option 2B

5.1.6 Option 3A – Turnback on Down Side north of Malahide

This option provides a turnback facility to the western side of the existing main line tracks. The existing mainline tracks are held in their current location, with installation of a ladder arrangement provided for vehicles egressing from the turnback wishing to enter the down main alignment. Trains heading in a southerly direction could facilitate use of the turnback via a newly installed low speed switch, however this will require a double shunting movement and wrong line running.

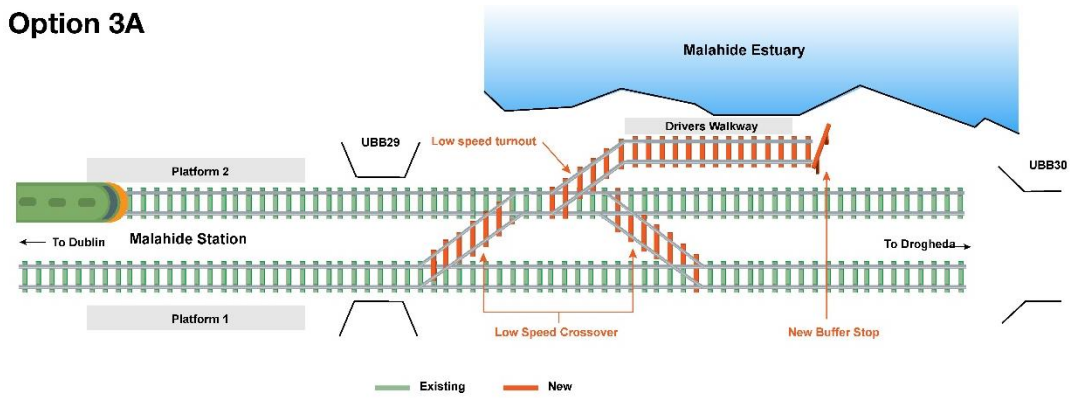

Figure 5-5: Schematic of Option 3A

5.1.7 Option 3B - Loop on Down Side north of Malahide

In this option the turnback is extending to form a loop and is accessed via a ladder arrangement. This eliminates the requirement for any double shunting movements to occur.

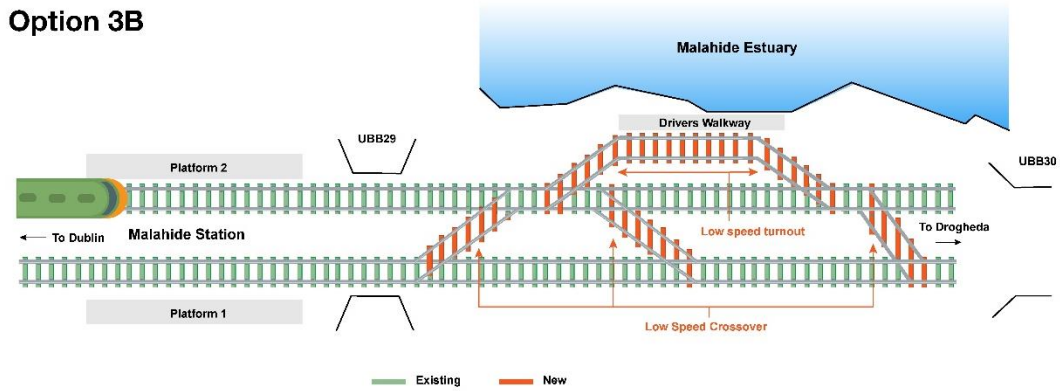

Figure 5-6: Schematic of Option 3B

5.1.8 Option 4A –- Turnback on Up Side north of Malahide

This option mirrors Option 3A with the turnback located to the east of the existing running lines. The existing cross over from the Down to the Up Line is maintained and forms part of the ladder arrangement.

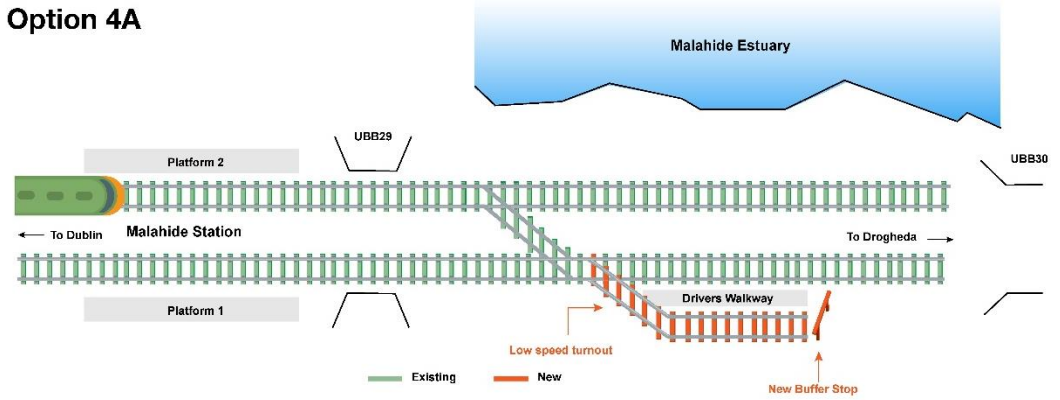

Figure 5-7: Schematic of Option 4A

5.1.9 Option 4B - Loop on Up Side north of Malahide

As per Option 4A, this solution mirrors Option 3B with the installation of a loop to the eastern side of the current running lines. The existing switch north of the station is maintained to provide a ladder arrangement.

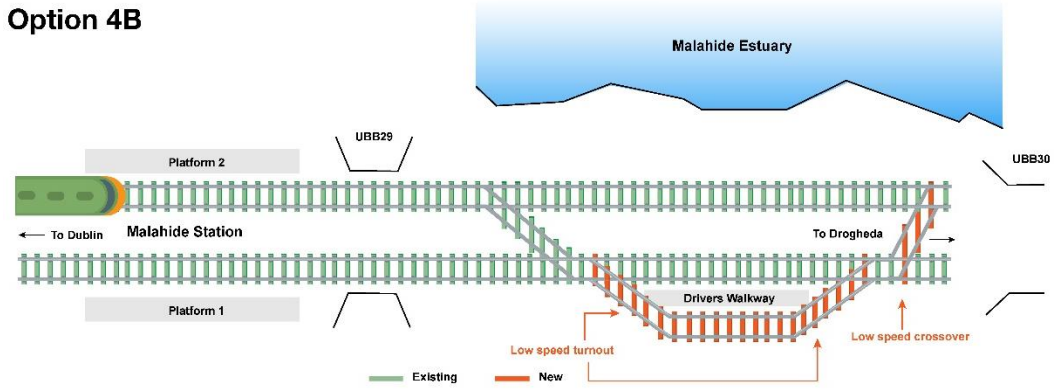

Figure 5-8: Schematic of Option 4B

5.1.10 Option 5A – Central turnback South of Donabate station

This option sees the turnback facility relocated to the north of the existing estuary crossing. The layout and arrangement shown is that in Option 1B but in an alternative geographical location. The mainline radius has been increased to slew the line at line speed away from its current location westwards with a low speed switch installed from this diverged line to the existing track, which now forms the central turnback road.

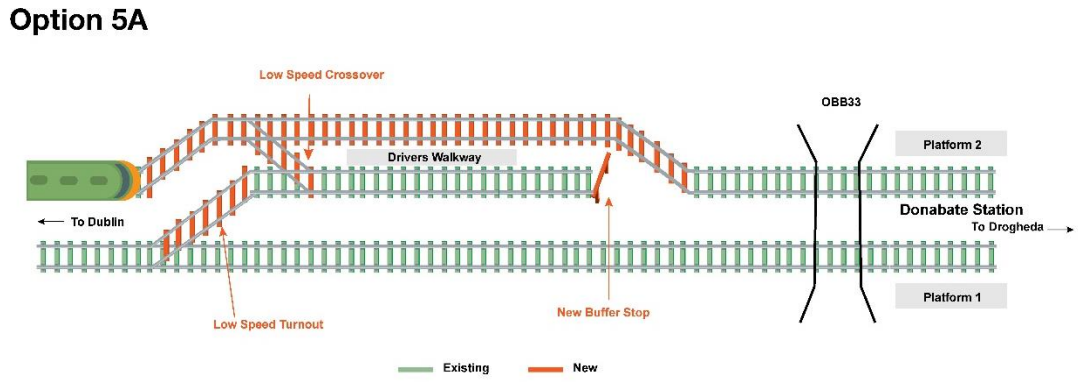

Figure 5-9: Schematic of Option 5A

5.1.11 Option 5B – Central turnback North of Malahide Estuary

This option sees the turnback facility relocated to the north of the existing estuary crossing. The layout and arrangement shown is that in Option 1B but in an alternative geographical location. The mainline radius has been increased to slew the line at line speed away from its current location westwards with a low speed switch installed from this diverged line to the existing track, which now forms the central turnback road.

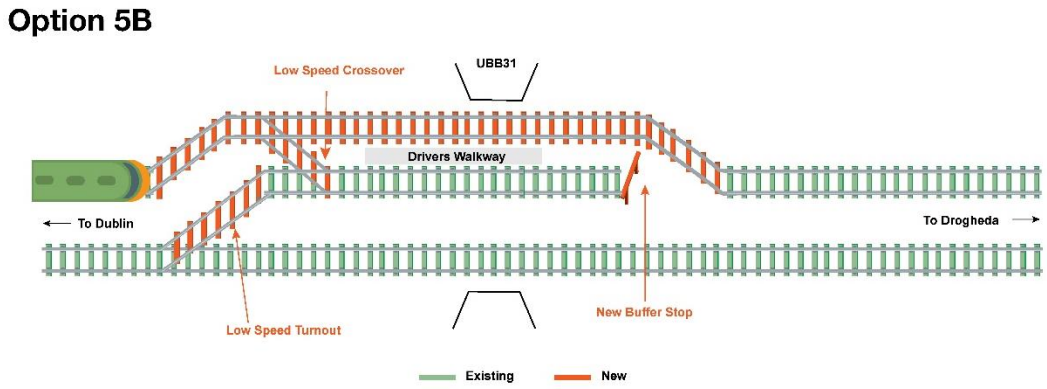

Figure 5-10: Schematic of Option 5B

5.1.12 Option 5C – Turnback North of Donabate

This option provides a turnback north of Donabate either centrally or on the Down or Up side (Down side shown).

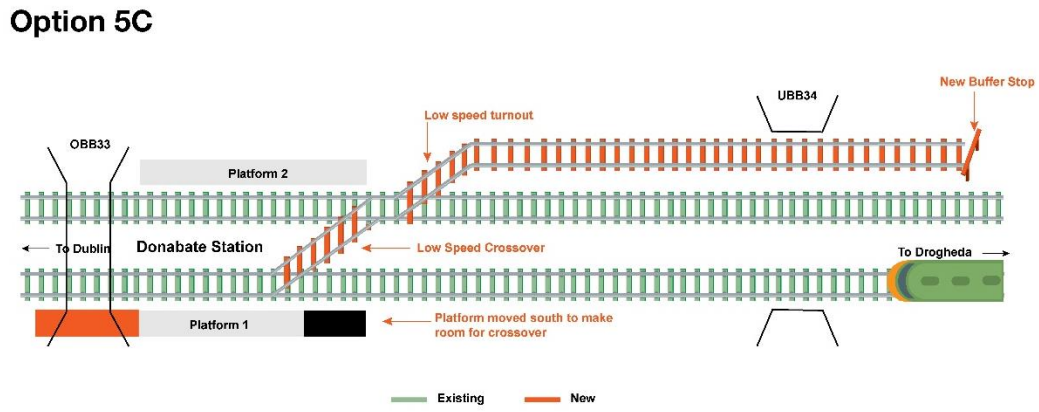

Figure 5-11: Schematic of Option 5C

5.1.13 Option 6A – New Platform on Down side South of Malahide

This option sees the turnback arrangement provided to the south of the existing station, with a new platform provided. The utilisation of the existing sidings in this location has is optimised and reconfigured to allow for two roads to be retained (if required). The existing Mainline will remain as installed. However, three additional switch and crossing units will be required.

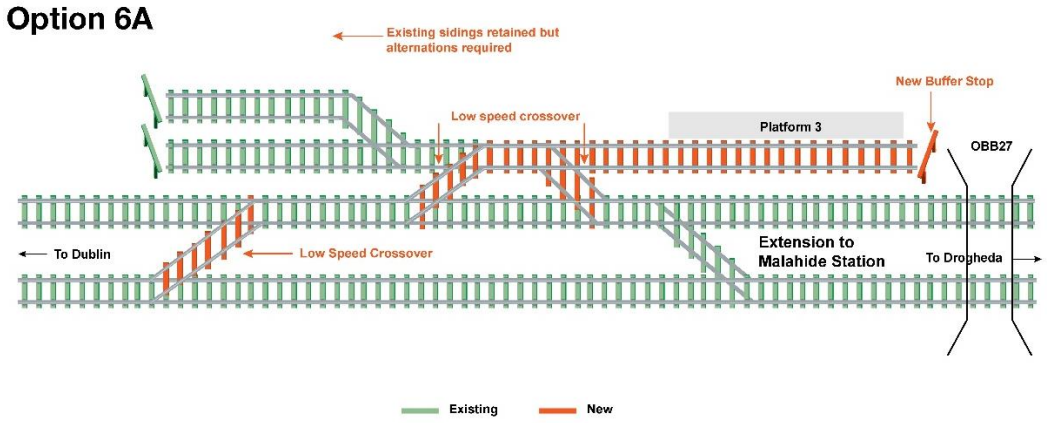

Figure 5-12: Schematic of Option 6A

5.1.14 Option 6B – New Platform on Down side South of Malahide with Passing Loop

This option is similar to Option 6A but replaces one of the north facing sidings with a passing loop which allows an in boarding terminating service to be held clear of the mainline in the event of the platform being occupied.

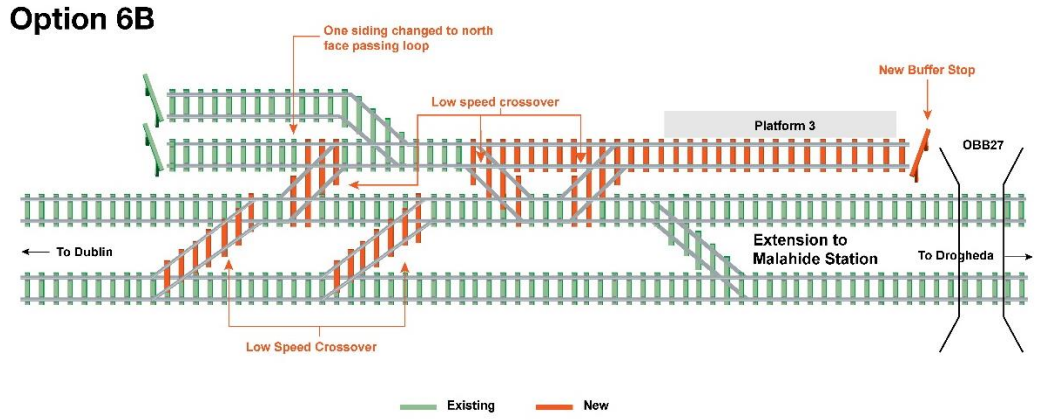

Figure 5-13: Schematic of Option 6B

5.1.15 Option 7A – New Down side Platform at Malahide

This option provides an island platform on the Down side which can be used as a turnback platform.

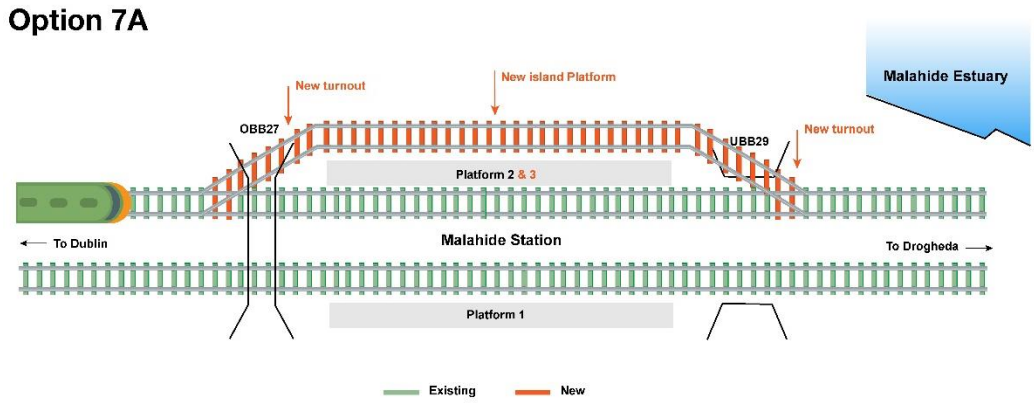

Figure 5-14: Schematic of Option 7A

5.1.16 Option 7B - New Up side Platform at Malahide

This option provides an island platform on the Up side which can be used as a turnback platform.

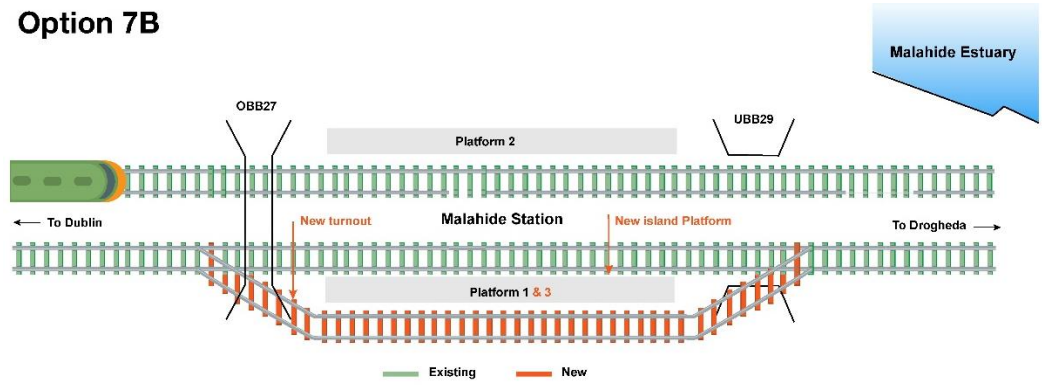

Figure 5-15: Schematic of Option 7B

5.1.17 Option 8 – Relocate station to South with additional platform

This option relocates the station south and introduces a new island platform which can be used as a turnback platform.

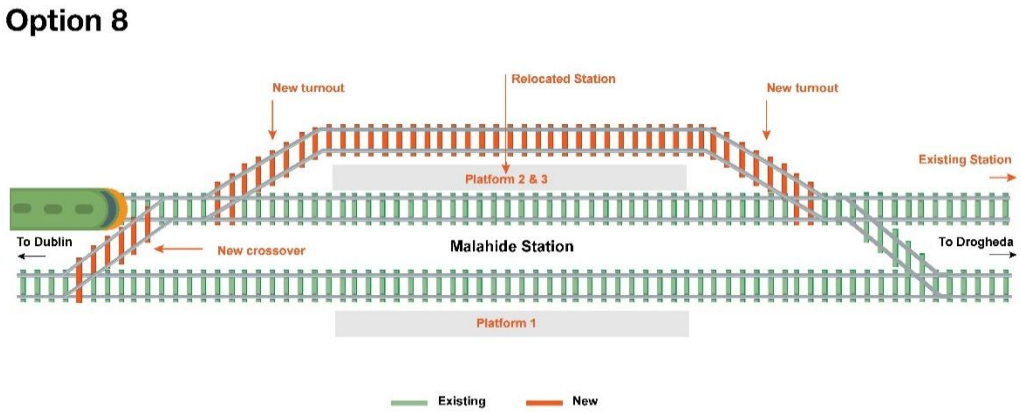

Figure 5-16: Schematic of Option 8

5.2 Sifting of Longlist of Options

This sifting process considers the project objectives and project requirements. Each option presented in section 5.1 will be assessed on its ability to meet the project objectives and requirements.

The results of this sifting process are presented in Table 5-2 to Table 5-5.

Table 5-2: Assessment of long list of options against project objectives and requirements (Options 0 to 2B)

Project objectives and requirements	**Description**	**Option 0** Do Nothing		**Option 1A** Down line slewed to provide central turnback north of Malahide (Down line on divergent route)		**Option 1B** Down line slewed to provide central turnback north of Malahide (Turnback on divergent route)		**Option 2A** Up line slewed to provide central turnback north of Malahide (Up line on divergent route)		**Option 2B** Up line slewed to provide central turnback north of Malahide (Turnback on divergent route)	
		Pass/ fail	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale
Project objective	To deliver a higher frequency, higher capacity, reliable, electrified route to enable increased DART service frequency between Drogheda and Central Dublin.	**Fail**	• Does not deliver the TSS	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the West. • Max 95kmh through the switch on the downline will limit the track speed (current line speed is 110kmh in down direction) • Limited ability to use as stabling due to need to cross running lines to access the turnback siding	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the West. • Longer solution but offers flexibility. Ability to run at 110kmh (benefits the non-stop services) • Limited ability to use as stabling due to need to cross running lines to access the turnback siding	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the East • Upline currently 80kmh. Switch speed no an issue compared to Option 1A as no planned speed reduction • Limited ability to use as stabling due to need to cross running lines to access the turnback siding	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the East • Limited ability to use as stabling due to need to cross running lines to access the turnback siding
Project objective	To deliver solutions which improve the passenger experience where passenger infrastructure interventions are required to meet the Train Service Specification.	**Pass**	• No change from existing	**Pass**	• No significant improvements to passenger experience	**Pass**	• No significant improvements to passenger experience	**Pass**	• No significant improvements to passenger experience	**Pass**	• No significant improvements to passenger experience
Project objective	To deliver a sustainable, low carbon and climate resilient design solution including making use of existing infrastructure where possible with targeted improvement works	**Pass**	• Minimal impacts	**Pass**	• Minimal impacts	**Pass**	• Minimal impacts	**Pass**	Minimal impacts	**Pass**	• Minimal impacts

Project objectives and requirements	Description	Option 0 Do Nothing		Option 1A Down line slewed to provide central turnback north of Malahide (Down line on divergent route)		Option 1B Down line slewed to provide central turnback north of Malahide (Turnback on divergent route)		Option 2A Up line slewed to provide central turnback north of Malahide (Up line on divergent route)		Option 2B Up line slewed to provide central turnback north of Malahide (Turnback on divergent route)	
		Pass/ fail	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale
Project objective	To identify cost-effective solutions from a capital, operations, and maintenance perspective.	**Pass**	• No capital cost expenditure	**Pass**	• Large P&C unit (speed of switch/track speed) • Retaining structure required on downward side • Down line being on the divergent route at the turnout could create wear and maintenance issues	**Pass**	• Retaining structure required on downward side • Smaller switch unit required (when compared with 1a)	**Pass**	• Large P&C unit (speed of switch/track speed) • Smaller retaining structure but more constraints to build when compared to 1A and 1B options. This includes possible access issues. • Down line being on the divergent route at the turnout could create wear and maintenance issues	**Pass**	• Smaller retaining structure but more constraints to build when compared to 1A and 1B options. This includes possible access issues. • Smaller switch unit (compared to 2A)
Project objective	To minimise adverse impacts on the natural and built environment associated with construction, operation and maintenance of the project	**Pass**	• No works during construction, no change to operations	**Pass**	• Construction close to estuary -mitigation required during construction • Lighting required for train driver walkway – assume greenway will also have lighting.	**Pass**	• Construction close to estuary -mitigation required during construction • Lighting required for train driver walkway – assume greenway will also have lighting.	**Pass**	• Working adjacent to residential areas: Consideration to construction traffic and mitigating impact on the local residents, for example restricted working hours. • Lighting required for train driver walkway – assume greenway will also have lighting.	**Pass**	• Working adjacent to residential areas: Consideration to construction traffic and mitigating impact on the local residents, for example restricted working hours. • Lighting required for train driver walkway – assume greenway will also have lighting.
Project objective	To minimise adverse impacts on existing rail services, road users and landowners associated with the construction, operation and maintenance of the project.	**Pass**	• No works during construction, no change to operations	**Pass**	• Impact on cycleway during construction will need to be managed/mitigated • Max 95kmh through the switch on the downline will limit the track speed (current line speed is 110kmh in down direction)	**Pass**	• Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Impact to access to treatment plant during construction – would need to mitigate during construction	**Pass**	• Impact to access to treatment plant during construction – would need to mitigate during construction

Project objectives and requirements	Description	Option 0 Do Nothing		Option 1A Down line slewed to provide central turnback north of Malahide (Down line on divergent route)		Option 1B Down line slewed to provide central turnback north of Malahide (Turnback on divergent route)		Option 2A Up line slewed to provide central turnback north of Malahide (Up line on divergent route)		Option 2B Up line slewed to provide central turnback north of Malahide (Turnback on divergent route)	
		Pass/ fail	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale
Project objective	To provide efficient and cost-effective integration of systems with the other DART+ projects.	**Pass**	• No new systems required	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage
Project requirement	To design in accordance with IÉ Standards and relevant national and EU standards and guidelines.	**Pass**	• No change from current design or need for new departures from standards	**Pass**	• Compliant • Down line being on the divergent route at the turnout is unusual	**Pass**	• Compliant	**Pass**	• Compliant • Down line being on the divergent route at the turnout is unusual	**Pass**	• Compliant
Project requirement	Designs shall comply with the Minimum Employer's Functional Requirements and meet the Train Service Specification	**Fail**	• Fails to meet the minimum functional requirements regarding capacity and the train service specification	**Pass**	• Compliant • Down line being on the divergent route at the turnout is unusual	**Pass**	• Compliant	**Pass**	• Compliant • Down line being on the divergent route at the turnout is unusual	**Pass**	• Compliant

Project objectives and requirements	**Description**	**Option 0** Do Nothing		**Option 1A** Down line slewed to provide central turnback north of Malahide (Down line on divergent route)		**Option 1B** Down line slewed to provide central turnback north of Malahide (Turnback on divergent route)		**Option 2A** Up line slewed to provide central turnback north of Malahide (Up line on divergent route)		**Option 2B** Up line slewed to provide central turnback north of Malahide (Turnback on divergent route)	
		Pass/ fail	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale	Pass/	Rationale
Project requirement	Provision of new turnback infrastructure at Malahide which will meet the Train Service Specification.	**Fail**	• Does not deliver the TSS	**Pass**	• Delivers the TSS • One turnback located in the middle • Max 95kmh through the switch on the downline will limit the track speed (current line speed is 110kmh in down direction) • Limited ability to use as stabling due to need to cross running lines to access the turnback siding	**Pass**	• Delivers the TSS • One turnback located in the middle • Longer solution but offers flexibility. Ability for through trains to run at 110kmh (benefits the non-stop services) • Limited ability to use as stabling due to need to cross running lines to access the turnback siding	**Pass**	• Delivers the TSS • One turnback located in the middle • Upline currently 80kmh. Switch speed not an issue compared to Option 1A as no planned speed reduction • Limited ability to use as stabling due to need to cross running lines to access the turnback siding	**Pass**	• Delivers the TSS • One turnback located in the middle • Limited ability to use as stabling due to need to cross running lines to access the turnback siding
Project requirement	To take cognisance of the planned Broadmeadow Estuary Greenway and not to do anything which would preclude the construction of the Greenway.	**Pass**	• No works	**Pass**	• Does not preclude the construction but there will be an interface to consider. • Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Does not preclude the construction but there will be an interface to consider. • Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Limited interface with the Greenway	**Pass**	• Limited interface with the Greenway

Table 5-3: Assessment of long list of options against project objectives and requirements (Options 3A to 5A)

Project objectives and requirements	**Description**	**Option 3A** Turnback on Down Side north of Malahide		**Option 3B** Loop on Down Side north of Malahide		**Option 4A** Turnback on Up Side north of Malahide		**Option 4B** Loop on Up Side north of Malahide		**Option 5A** Central turnback South of Donabate	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a higher frequency, higher capacity, reliable, electrified route to enable an increased DART service frequency between Drogheda and Central Dublin.	**Fail**	• Turnback siding creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • Arriving service can drop into the turnback siding without delaying up services • Could be used as stabling location	**Fail**	• Turnback siding creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • Arriving service can drop into the turnback siding without delaying up services • Could be used as stabling location	**Fail**	• Turnback siding creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • Arriving service cannot drop into the turnback siding without delaying up services • Could be used as stabling location	**Fail**	• Turnback siding creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • Arriving service cannot drop into the turnback siding without delaying up services • Could be used as stabling location	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the East • Limited ability to use as stabling due to need to cross running lines to access the turnback siding • Northerly location will require increased ECS moves and result in a reduced turnaround time, with performance impacts • Arriving service can drop into the turnback siding without delaying up services
Project objective	To deliver solutions which improve the passenger experience where passenger infrastructure interventions are required to meet the Train Service Specification.	Pass	• No significant improvements to passenger experience	Pass	• No significant improvements to passenger experience	Pass	• No significant improvements to passenger experience	Pass	• No significant improvements to passenger experience	Fail	• The services will terminate a short distance south of Donabate Station. This will be cause a negative experience for passengers at Donabate who will be able to see terminating services from the platform but will be unable to use them

Project objectives and requirements	**Description**	**Option 3A** Turnback on Down Side north of Malahide		**Option 3B** Loop on Down Side north of Malahide		**Option 4A** Turnback on Up Side north of Malahide		**Option 4B** Loop on Up Side north of Malahide		**Option 5A** Central turnback South of Donabate	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a sustainable, low carbon and climate resilient design solution including making use of existing infrastructure where possible with targeted improvement works.	**Pass**	• Minimal impacts	**Pass**	• Minimal impacts	**Pass**	• Minimal impacts	**Pass**	• Minimal impacts	**Pass**	• Slight increased journey time compared to other options therefore over time leads to increased fuel usage
Project objective	To identify cost-effective solutions from a capital, operations, and maintenance perspective.	**Pass**	• Additional crossovers to construct (compared to 1A) • 5 new points end required which is 2 more point ends compared with option 1A. • The above points to increased costs (capital and maintenance) compared to other options	**Pass**	• Increased cost from 3a • Total of 6 point ends (1 greater than 3a) • Very little benefit from options 1 & 2 for the increased cost • Additional infrastructure and systems interfaces	**Pass**	• Additional crossovers to construct (compared to 1a) • 5 end points which is 2 more point ends compared with option 1a. • The above points increased costs compared to other options	**Pass**	• Increased cost from 4a • Total of 6 point ends (1 greater than 3a) • Very little benefit from options 1 & 2 for the increased cost • Additional infrastructure and systems interfaces	**Pass**	• Northly location will require increased ECS moves and result in a reduced turnaround time, with performance impacts • Potential significant retaining structures • No operational benefit over other options

Project objectives and requirements	Description	Option 3A Turnback on Down Side north of Malahide		Option 3B Loop on Down Side north of Malahide		Option 4A Turnback on Up Side north of Malahide		Option 4B Loop on Up Side north of Malahide		Option 5A Central turnback South of Donabate	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To minimise adverse impacts on the natural and built environment associated with construction, operation and maintenance of the project	Pass	• Construction close to estuary - mitigation required during construction • Lighting required for train driver walkway – assume greenway will also have lighting.	Pass	• Construction close to estuary - mitigation required • Lighting required for train driver walkway – assume greenway will also have lighting.	Pass	• Working adjacent to residential areas: Consideration to construction traffic and mitigating impact on the local residents, for example restricted working hours. • Lighting required for train driver walkway – assume greenway will also have lighting.	Pass	• Working adjacent to residential areas: Consideration to construction traffic and mitigating impact on the local residents, for example restricted working hours. • Lighting required for train driver walkway – assume greenway will also have lighting.	Fail	• Adjacent to areas documented in the local plan as housing development sites. Works are likely to impinge or negatively impact with these proposed plans
Project objective	To minimise adverse impacts on existing rail services, road users and landowners associated with the construction, operation and maintenance of the project.	**Pass**	• Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Impact on cycleway during construction will need to be managed/mitigated	**Pass**	•	**Pass**	•	**Pass**	• Working adjacent to residential areas: Consideration to construction traffic and mitigating impact on the local residents, for example restricted working hours. Note this option is situated in a cutting, allowing simple noise mitigation solutions
Project objective	To provide efficient and cost-effective integration of systems with the other DART+ projects.	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage

Project objectives and requirements	**Description**	**Option 3A** Turnback on Down Side north of Malahide		**Option 3B** Loop on Down Side north of Malahide		**Option 4A** Turnback on Up Side north of Malahide		**Option 4B** Loop on Up Side north of Malahide		**Option 5A** Central turnback South of Donabate	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project requirement	To design in accordance with IÉ Standards and relevant national and EU standards and guidelines.	**Pass**	• Compliant	**Pass**	• Compliant • P&C over a bridge. Could be relocated north to avoid	**Pass**	• Compliant • P&C over a bridge. Could be relocated north to avoid	**Pass**	• Compliant • P&C over a bridge. Could be relocated north to avoid	**Pass**	• Compliant
Project requirement	Designs shall comply with the Minimum Employer's Functional Requirements and meet the Train Service Specification	**Pass**	• Compliant	**Pass**	• Compliant	**Pass**	• Compliant	**Pass**	• Compliant	**Pass**	Compliant
Project requirement	Provision of new turnback infrastructure at Malahide which will meet the Train Service Specification	**Fail**	• Does not reliably deliver the TSS	**Fail**	• Does not reliably deliver the TSS	**Fail**	• Does not reliably deliver the TSS	**Fail**	• Does not reliably deliver the TSS	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the East • Limited ability to use as stabling due to need to cross running lines to access the turnback siding • Northerly location will require increased ECS moves and result in a reduced turnaround time, with performance impacts • Arriving service can drop into the turnback siding

Project objectives and requirements	Description	Option 3A Turnback on Down Side north of Malahide		Option 3B Loop on Down Side north of Malahide		Option 4A Turnback on Up Side north of Malahide		Option 4B Loop on Up Side north of Malahide		Option 5A Central turnback South of Donabate	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
											without delaying up services
Project requirement	To take cognisance of the planned Broadmeadow Estuary Greenway and not to do anything which would preclude the construction of the Greenway	**Pass**	• Does not preclude the construction but there will be an interface to consider. • Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Does not preclude the construction but there will be an interface to consider. • Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Limited interface with the Greenway	**Pass**	• Limited interface with the Greenway	**Pass**	• Limited interface with the Greenway

Table 5-4: Assessment of long list of options against project objectives and requirements (Options 5B to 7A)

Project objectives and requirements	**Description**	**Option 5B** Central turnback North of Malahide Estuary		**Option 5C** Turnback North of Donabate		**Option 6A** New Platform on Down side South of Malahide		**Option 6B** New Platform on Down side South of Malahide with Passing Loop		**Option 7A** New Down side Platform at Malahide	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a higher frequency, higher capacity, reliable, electrified route to enable an increased DART service frequency between Drogheda and Central Dublin.	**Pass**	• Delivers the TSS • One turnback located in the middle, passing loop on the West. • Limited ability to use as stabling due to need to cross running lines to access the turnback siding • Northerly location will require increased ECS moves and result in a reduced turnaround time, with performance impacts	**Fail**	• The option goes significantly beyond the TSS in introducing additional services to Donabate • The additional train diagram length and reduced turnaround time will negatively impact on the performance and reliability of the TSS	**Fail**	• Turnback platform on western side – south of Malahide • Turnback platform creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility	**Fail**	• Turnback platform on western side – south of Malahide • Turnback platform creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility • The loop in advance of the platform allows greater regulation of services (especially in time so perturbation)	**Pass**	• Delivers the TSS • Central road can be used as the turnback road with appropriate P&C installed at southern end • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility
Project objective	To deliver solutions which improve the passenger experience where passenger infrastructure interventions are required to meet the Train Service Specification.	Pass	• No significant improvements to passenger experience	Pass	• Provides additional service benefit for passengers from Donabate	Pass	• Provides some benefit through the introduction of an additional platform to increase boarding times • Provides some disbenefit through the fact not all Dublin services will leave from the same platform	Pass	• Provides some benefit through the introduction of an additional platform to increase boarding times • Provides some disbenefit through the fact not all Dublin services will leave from the same platform	Pass	• Provides some benefit through the introduction of an additional platform to increase boarding times • Provides some disbenefit through the fact not all Dublin services will leave from the same platform

Project objectives and requirements	Description	Option 5B Central turnback North of Malahide Estuary		Option 5C Turnback North of Donabate		Option 6A New Platform on Down side South of Malahide		Option 6B New Platform on Down side South of Malahide with Passing Loop		Option 7A New Down side Platform at Malahide	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a sustainable, low carbon and climate resilient design solution including making use of existing infrastructure where possible with targeted improvement works	**Pass**	• Bridge and embankment widening will require new infrastructure to be installed	**Pass**	• Bridge and embankment widening will require new infrastructure to be installed	**Pass**	• Increased embodied carbon due to the increased amount new infrastructure required	**Pass**	• Increased embodied carbon due to the increased amount new infrastructure required	**Pass**	• Increased embodied carbon due to the increased amount new infrastructure required
Project objective	To identify cost-effective solutions from a capital, operations, and maintenance perspective.	**Pass**	• Will require widening of bridge structure over watercourse • Will require long lengths of retaining structure	**Pass**	• Will require bridge and embankment widening works	**Pass**	• Substantial capital costs associated with the following: ○ New platform ○ New retaining structure ○ New underpass ○ Works to existing cuttings	**Pass**	• Substantial capital costs associated with the following: ○ New platform ○ New retaining structure ○ New underpass ○ Works to existing cuttings	**Pass**	• Substantial capital costs associated with the following: ○ New platform ○ New retaining structures ○ Bridge works ○ Works to existing cuttings ○ Land purchase
Project objective	To minimise adverse impacts on the natural and built environment associated with construction, operation and maintenance of the project	Pass	• Lighting and noise will impact on the estuary (noting however that the Greenway will also have lighting) • Bridge widening over watercourse – impacts on watercourse and natural environment would need to be assessed and mitigated	Pass	• The turnback will be in close proximity to residential properties	Pass	• Significant construction works impacting the adjacent built environment • Construction works will require significant storage/compound areas • Further away from residential areas	Pass	• Significant construction works impacting the adjacent built environment • Construction works will require significant storage/compound areas • Further away from residential areas	Fail	• Land purchase required (of residential buildings and property) • Disruption to local; highway during bridge works Impacts • Significant construction works impacting the adjacent built environment and residential properties

Project objectives and requirements	Description	Option 5B Central turnback North of Malahide Estuary		Option 5C Turnback North of Donabate		Option 6A New Platform on Down side South of Malahide		Option 6B New Platform on Down side South of Malahide with Passing Loop		Option 7A New Down side Platform at Malahide	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To minimise adverse impacts on existing rail services, road users and landowners associated with the construction, operation and maintenance of the project. .	**Pass**	• Impact on cycleway during construction will need to be managed/mitigated	**Pass**	• Construction of retaining infrastructure may need to be undertaken from rail side due to close proximity of residential properties	**Pass**	• The construction on the new platform /underpass will likely require full line closure for works to be carried out and therefore have a large impact on current services	**Pass**	• The construction on the new platform /underpass will likely require full line closure for works to be carried out and therefore have a large impact on current services	**Pass**	• Disruption to local; highway during bridge works • The construction on the new platform/retaining walls/bridge works will likely require full line closure for works to be carried out and therefore have a large impact on current services
Project objective	To provide efficient and cost-effective integration of systems with the other DART+ projects.	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage
Project requirement	To design in accordance with IÉ Standards and relevant national and EU standards and guidelines.	**Pass**	• Compliant	**Pass**	• Compliant	**Pass**	• Compliant	**Pass**	• Compliant	**Pass**	• Compliant
Project requirement	Designs shall comply with the Minimum Employer's Functional Requirements and meet the Train Service Specification	Pass	• Compliant	Pass	• Compliant	Pass	• Compliant	Pass	• Compliant	Pass	• Compliant

Project objectives and requirements	**Description**	**Option 5B** Central turnback North of Malahide Estuary		**Option 5C** Turnback North of Donabate		**Option 6A** New Platform on Down side South of Malahide		**Option 6B** New Platform on Down side South of Malahide with Passing Loop		**Option 7A** New Down side Platform at Malahide	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project requirement	Provision of new turnback infrastructure at Malahide which will meet the Train Service Specification.	**Pass**	• Delivers the TSS • Northerly location will require increased ECS moves and result in a reduced turnaround time, with performance impacts	**Fail**	• The option goes significantly beyond the TSS in introducing additional services to Donabate • The additional train diagram length and reduced turnaround time will negatively impact on the performance and reliability of the TSS	**Fail**	• Turnback platform on western side – south of Malahide • Turnback platform creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility	**Fail**	• Turnback platform on western side – south of Malahide • Turnback platform creates 2 additional conflicting moves per hour (from 12 to 14). The additional conflicting moves will prevent a reliable TSS being achieved • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility	**Pass**	• Delivers the TSS • Central road can be used as the turnback road with appropriate P&C installed at southern end • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility
Project requirement	To take cognisance of the planned Broadmeadow Estuary Greenway and not to do anything which would preclude the construction of the Greenway	**Pass**	• Significant Interface through embankment widening and bridge widening adjacent to proposed Greenway route	**Pass**	• No impact	**Pass**	• No impact	**Pass**	• No impact	**Pass**	• No impact

Table 5-5: Assessment of long list of options against project objectives and requirements (Options 7B to 8)

Project objectives and requirements	Description	Option 7B New Up side platform at Malahide		Option 8 Relocate station to south with additional platform	
		Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a higher frequency, higher capacity, reliable, electrified route to enable an increased DART service frequency between Drogheda and Central Dublin.	**Pass**	• Delivers the TSS • Central road can be used as the turnback road with appropriate P&C installed at southern end • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility	**Pass**	• Delivers the TSS • Central road can be used as the turnback road with appropriate P&C installed at southern end • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility
Project objective	To deliver solutions which improve the passenger experience where passenger infrastructure interventions are required to meet the Train Service Specification.	Pass	• Provides some benefit through the introduction of an additional platform to increase boarding times • Provides some disbenefit through the fact not all Dublin services will leave from the same platform •	Pass	• The relocation of the station further south will move the station further away from the town centre and destinations. •
Project objective	To deliver a sustainable, low carbon and climate resilient design solution including making use of existing infrastructure where possible with targeted improvement works.	**Pass**	• Increased embodied carbon due to the increased amount new infrastructure required	**Pass**	• Increased embodied carbon due to the increased amount new infrastructure required
Project objective	To identify cost-effective solutions from a capital, operations, and maintenance perspective.	**Pass**	• Substantial capital costs likely to be associated with the following: o New platform o New retaining structures o Bridge works o Works to existing cuttings o Land purchase	**Pass**	• Substantial capital costs likely to be associated with the following: o New platforms o New retaining structures o Works to existing cuttings o New Station access o New platform bridge o Land purchase for access route • Potential for existing station site to be sold
Project objective	To minimise adverse impacts on the natural and built environment associated with construction, operation and maintenance of the project	Fail	• Land purchase required (of residential buildings and property) • Disruption to local; highway during bridge works Impacts • Significant construction works impacting the adjacent built environment and residential properties •	Fail	• New station access would either be required via new access through third party land. This would have significant impacts on the built environment. • Station to the south will bring passengers into conflict with new residential areas (noise issues etc).
Project objective	To minimise adverse impacts on existing rail services, road users and landowners associated with the construction, operation and maintenance of the project.	**Pass**	• Disruption to local; highway during bridge works • The construction on the new platform/retaining walls/bridge works will likely require full line closure for works to be carried out and therefore have a large impact on current services	**Pass**	• Works will cause significant disruption to existing rail services

Project objectives and requirements	Description	Option 7B New Up side platform at Malahide		Option 8 Relocate station to south with additional platform	
		Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To provide efficient and cost-effective integration of systems with the other DART+ projects.	**Pass**	• No integration issues identified at this stage	**Pass**	• No integration issues identified at this stage
Project requirement	To design in accordance with IÉ Standards and relevant national and EU standards and guidelines.	**Pass**	• Compliant	**Pass**	• Compliant
Project requirement	Designs shall comply with the Minimum Employer's Functional Requirements and meet the Train Service Specification	**Pass**	• Compliant	**Pass**	• Compliant
Project requirement	Provision of new turnback infrastructure at Malahide which will meet the Train Service Specification.	**Pass**	• Delivers the TSS • Central road can be used as the turnback road with appropriate P&C installed at southern end • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility	**Pass**	• Delivers the TSS • Central road can be used as the turnback road with appropriate P&C installed at southern end • The additional platform reduces the platform occupancy levels of the current platforms improving reliability of through services/greater pathing flexibility
Project requirement	To take cognisance of the planned Broadmeadow Estuary Greenway and not to do anything which would preclude the construction of the Greenway	**Pass**	• No impact	**Pass**	• No impact

5.3 Summary of Longlist Sifting

The outcome of the longlist sifting is summarised in **Table 5-6.**

Table 5-6: Summary of Long List Sifting

Option	Description	Screening Result	Summary
Option 0 -Do Nothing	Existing situation	Fail	This option fails to deliver the TSS requirements
Option 1A	Down Line slewed to provide central turnback north of Malahide (Down line on divergent route)	**Pass**	Met project objectives and requirements
Option 1B	Down Line slewed to provide central turnback north of Malahide (Turnback on divergent route)	**Pass**	Met project objectives and requirements
Option 2A	Up Line slewed to provide central turnback north of Malahide (Up line on divergent route)	**Pass**	Met project objectives and requirements
Option 2B	Up Line slewed to provide central turnback north of Malahide (Turnback on divergent route)	**Pass**	Met project objectives and requirements
Option 3A	Turnback on Down Side north of Malahide	Fail	The introduction of train conflicting moves means this option fails to reliably deliver the TSS
Option 3B	Loop on Down Side north of Malahide	Fail	The introduction of train conflicting moves means this option fails to reliably deliver the TSS
Option 4A	Turnback on Up Side north of Malahide	Fail	The introduction of train conflicting moves means this option fails to reliably deliver the TSS
Option 4B	Loop on Up Side north of Malahide	Fail	The introduction of train conflicting moves means this option fails to reliably deliver the TSS

Option	Description	Screening Result	Summary
Option 5A	Central turnback south of Donabate	Fail	The introduction of a service terminating just south of Donabate Station will cause a significant negative experience for passengers at Donabate Station. Furthermore the turnback is located in an area of designated in the local authority plan as for residential development
Option 5B	Central turnback north of Malahide Estuary	Pass	Met project objectives and requirements
Option 5C	Turnback north of Donabate	Fail	The option provides service to one station further than what the TSS requires (trains would terminate at Donabate rather than Malahide). While from a passenger experience standpoint this would be beneficial, from a rail operations standpoint the additional train diagram length and reduced turnaround time required to facilitate travelling for one extra station would negatively impact the performance and reliability of the service.
Option 6A	New platform on Down side south of Malahide	Fail	The introduction of train conflicting moves means this option fails to reliably deliver the TSS
Option 6B	New platform on Down side south of Malahide with passing loop	Fail	The introduction of train conflicting moves means this option fails to reliably deliver the TSS
Option 7A	New Down side platform at Malahide	Fail	This option fails due to the significant negative impacts on the built environment
Option 7B	New Down side platform at Malahide	Fail	This option fails due to the significant negative impacts on the built environment
Option 8	Relocate station to south with additional platform	Fail	This option fails due to the significant negative impacts on the built environment

5.4 Shortlisted Options

The following sections describe the shortlisted options in further detail.

5.4.1 Option 1A description

Refer to section 5.1.2 for an overview of the option. Detail is provided below under the following disciplines: Track, OHLE, Signalling and Civils/Structures.

Track

For Option 1A, the Up Line is slewed to the west towards Malahide estuary; this is achieved with the installation of P21/28.5 switch to facilitate the line speed to the north and the south, in essence creating a high speed passing loop via switch control. Configuration of these switches should be further considered with respect to a standard or inverted opening to allow the dominant manoeuvre free movement thus reducing potential maintenance due to excessive switch movements.

With the installation of the divergent route, a new centre turnback with walkways is formed and thus provided.

The Up Line remains as is, with a lower speed turnout presented to allow egress from the turnback road to the Up Line.

A lower speed switch (suitable for train operational speed) is proposed to tie the newly formed central turnback to the Down Line.

A lit walkaway with raised drivers' access platforms to allow drivers to transfer from one HLU to another will be provided alongside the turnback.

Refer to drawing D+WP56-ARP-ZZ-NL-DR-PW-SK0009 in Appendix B for further details.

OHLE

OHLE masts and a variety of support structures will be needed to provide the revised OHLE configuration required for the new track layout. Additional headspans or portal frames will be used to span the tracks to support feeders, catenary and contact wires. Cantilevers from the existing masts may be used in locations where these are suitable.

The five shortlisted options only have minor differences from an OHLE perspective. All options may require foundations to be fixed to proposed retaining structures where space constraints exist.

This option requires the removal of existing OHLE structures on the Down Line for a distance of approximately 500m north of UB29 and installation of new ones for new Down Line and turnback track.

Additionally, it also requires the modification of some existing OHLE structures on the Up Line along a section approximately 200m north of UB29 according to modification of the existing crossover.

This option requires approximately 850m of new OHLE, the movement of 470m of OHLE to new supports and the dismantling of 500m of existing OHLE.

Signalling

There will be a number of additional signals and point machines to be controlled. Additional signalling trackside location cases will be needed to connect these signals, axle counter blocks and point machines to the interlocking via the SEB. The greater differential between the main and loop routes will entail some speed control on approach requirements to ensure that trains take the diverging routes at the correct speed.

The five shortlisted options do not vastly differ from a signalling perspective.

Civils/Structures

This option requires a new retaining structure approximately 350m and up to 3m high long running along the west side of the tracks. It is likely that this retaining wall will need to be designed with derailment protection in mind, this will be investigated further at preliminary design stage. None of the existing bridge structures will be impacted by this option.

5.4.2 Option 1B description

Refer to section 5.1.3 for an overview of the option. Detail is provided below under the following disciplines: Track, OHLE, Signalling and Civils/Structures.

Track

In a similar manner to Option 1A, Option 1B provides an additional highspeed loop to the west of the existing Up Line. The route is created via fixed geometry rather than the installation of switches, thus providing a more robust solution in terms of future maintenance. It should be noted, however, that a northerly connection to the Up Line following the turnback is not provided; this could be retrofitted at a later date should the need arise, as the central siding will act purely as a central turnback facility.

Connection to the turnback is provided from the Up Line via a suitability sized switch compatible with the operational and braking requirements of the DART unit.

A new buffer stop shall be installed within the turnback. Whilst it is anticipated that this will be a friction buffer stop, due to length of track occupancy this could be installed as a hydraulic buffer should the need arise.

Connection to the Down Line is made in a similar manner via a lower speed switch direction from the turnback to the main line. Installation of this unit should be a complete crossover as opposed to a single point and crossing to provide provision of main line protection.

A lit walkaway with raised drivers' access platforms to allow drivers to transfer from one HLU to another will be provided alongside the turnback.

Refer to drawing D+WP56-ARP-ZZ-NL-DR-PW-SK0010 in Appendix B for further details.

OHLE

OHLE masts and a variety of support structures will be needed to provide the revised OHLE configuration required for the new track layout. Additional headspans or portal frames will be used to span the tracks to support feeders, catenary and contact wires. Cantilevers from the existing masts may be used in locations where these are suitable.

The five shortlisted options only have minor differences from an OHLE perspective. All options may require foundations to be fixed to proposed retaining structures where space constraints exist.

The impact on existing OHLE structures is similar to Option 1A, however because this option impacts 100m more track than Option 1A, it is expected that two additional existing OHLE structures must be replaced with new ones on the Down Line. Impact on existing OHLE structures is similar than option 1a.

A greater length of new OHLE wires needs to be installed and a greater length of existing OHLE wires will need to be dismantled than in Option 1A.

Signalling

There will be a number of additional signals and point machines to be controlled. Additional signalling trackside location cases will be needed to connect these signals, axle counter blocks and point machines to the interlocking via the SEB. The greater differential between the main and loop routes will imply some speed control on approach requirements to ensure that trains take the diverging routes at the correct speed.

The five shortlisted options do not vastly differ from a signalling perspective.

Civils/Structures

This option requires a new retaining structure approximately 450m long and up to 3m high running along the west side of the tracks. It is likely that this retaining wall will need to be designed with derailment protection in mind, this will be investigated further at preliminary design stage. None of the existing bridge structures will be impacted by this option.

5.4.3 Option 2A description

Refer to section 5.1.4 for an overview of the option. Detail is provided below under the following disciplines: Track, OHLE, Signalling and Civils/Structures.

Track

For Option 2A, the Down Line is slewed to the east towards Malahide Estuary; this is achieved via the installation of P21/28.5 switch to facilitate the line speed to the north and the south, in essence creating a high speed passing loop via switch control. Configuration of these switches should be further considered with respect to a standard or inverted opening to allow the dominant manoeuvre free movement, thus reducing potential maintenance due to excessive switch movements.

With the installation of the divergent route, a new centre turnback with walkways is formed and thus provided.

The Up Line remains as is, with the existing lower speed turnout allowing access and egress from the turnback road to the Up Line.

A lower speed switch (suitable for train operational speed) is proposed to tie the newly formed central turn back to the Down Line.

A lit walkaway with raised drivers' access platforms to allow drivers to transfer from one HLU to another will be provided alongside the turnback.

Refer to drawing D+WP56-ARP-ZZ-NL-DR-PW-SK0011 in Appendix B for further details.

OHLE

OHLE masts and a variety of support structures will be need to be provide the revised OHLE configuration required for the new track layout. Additional headspans or portal frames will be used to span the tracks to support feeders, catenary and contact wires. Cantilevers from the existing masts may be used in locations where these are suitable.

The five shortlisted options only have minor differences from an OHLE perspective. All options may require foundations to be fixed to proposed retaining structures where space constraints exist.

This option has a similar impact on existing OHLE structures on the Up Line than Option 1A has on existing OHLE structures of Down Line, however Option 2A does not impact on structures on the Down Line as far as the existing crossover is maintained.

For the same reason it requires less new OHLE installation and existing OHLE dismantle.

Signalling

There will be a number of additional signals and point machines to be controlled. Additional signalling trackside locations will be needed to connect these signals, axle counter blocks and point machines to the interlocking via the SEB. The greater differential between the main and loop routes will imply some speed control on approach requirements to ensure that trains take the diverging routes at the correct speed.

The five shortlisted options do not vastly differ from a Signalling perspective.

Civils/Structures

This option requires a new retaining structure approximately 490m long and up to 4m high running along the east side of the tracks. It is likely that this retaining wall will need to be designed with derailment protection in mind, this will be investigated further at preliminary design stage. None of the existing bridge structures will be impacted by this option.

5.4.4 Option 2B description

Refer to section 5.1.5 for an overview of the option. Detail is provided below under the following disciplines: Track, OHLE, Signalling and Civils/Structures

Track

In a similar manner to Option 2A, Option 2B provides an additional highspeed loop is provided to east of the existing Up Line. How the route is created via fixed geometry rather than the installation of Switches, thus providing a more robust solution in terms of future maintenance. It should be noted however a northerly connection to the Up line following the turnback is not provided, however this could be retro fitted at a later date should the need arise, as the central siding will act purely as a central turn back facility only.

Connection to the turn back is provided from the Up line, via the existing facing cross over.

A new buffer stop shall be installed within the turn back, whilst it is anticipated this will be a friction buffer stop, due to length of track opponency, this could be installed as a hydraulic buffer should the need arise.

Connection to the Down Line is in a similar manner made via a lower speed switch direction from the turnback to the main line. Installation of this unit should be a complete crossover as opposed to a single point and crossing to provide provision of main line protection.

A lit walkaway with raised drivers' access platforms to allow drivers to transfer from one HLU to another will be provided alongside the turnback.

Refer to drawing D+WP56-ARP-ZZ-NL-DR-PW-SK0012 in Appendix B for further details.

As noted in Section 5.1.5 the alignment of the track over UBB29 is a critical pinch point for this option and without topographic survey information it is not currently able to be confirmed if this option can be achieved without affecting clearances to the Up side bridge parapet. This could necessitate additional civil engineering works to the bridge and as such a subset of this option has been created which removes the risk of these bridge works but involves the replacement/relocation of the existing crossover between the Up and Down lines. Refer to drawing D+WP56-ARP-ZZ-NL-DR-PW-SK0029 in Appendix B for further details.

Option 2C provides very few material changes compared to Option 2B and has been produced to demonstrate that an alternative option exists to avoid bridge works should they be needed upon receipt of the topographic survey. It has therefore not been appraised on its own as an option.

OHLE

OHLE masts and a variety of support structures will be needed to provide the revised OHLE configuration required for the new track layout. Additional headspans or portal frames will be used to span the tracks to support feeders,

catenary and contact wires. Cantilevers from the existing masts may be used in locations where these are suitable.

The five shortlisted options only have minor differences from an OHLE perspective. All options may require foundations to be fixed to proposed retaining structures where space constraints exist.

This option has more impact on the existing OHLE of the Up Line, but it does not impact on the Down Line. On the other hand, it requires more new OHLE wires to be installed and dismantled than Option 1A.

Signalling

There will be a number of additional signals and point machines to be controlled. Additional signalling trackside location cases will be needed to connect these signals, axle counter blocks and point machines to the interlocking via the SEB. The greater differential between the main and loop routes will entail some speed control on approach requirements to ensure that trains take the diverging routes at the correct speed.

The five shortlisted options do not vastly differ from a signalling perspective.

Civils/Structures

This option requires a new retaining structure approximately 400m long and up to 4.0m high running along the east side of the tracks. It is likely that this retaining wall will need to be designed with derailment protection in mind, this will be investigated further at preliminary design stage. Existing underbridge UBB29 may need to be modified to accommodate the track alignment of Option 2B, hence why a subset of this option named 2C has been provided.

5.4.5 Option 5B description

Refer to section 5.1.11 for an overview of the option. Detail is provided below under the following disciplines: Track, OHLE, Signalling and Civils/Structures.

Track

Option 5B requires the proposed turn back facility to be relocated north of the existing viaduct, whereby the Up line is slewed to the West; this is achieved via fixed geometry, to the south and north of the turnback, thus, creating a high-speed passing loop via switch control.

Connection to the turn back is provided from the Up Line via a newly installed switch. A new buffer stop shall be installed within the turnback. Whilst it is anticipated this will be a friction buffer stop, due to length of track opponency this could be installed as a hydraulic buffer should the need arise.

With the installation of the divergent route, a new centre turnback with walkways is formed and thus provided.

A lower speed switch (suitable for train operational speed) is proposed to tie the newly formed central turn back to the Down Line.

A lit walkaway with raised drivers' access platforms to allow drivers to transfer from one HLU to another will be provided alongside the turnback.

Refer to drawing D+WP56-ARP-ZZ-NL-DR-PW-SK0013 in Appendix B for further details.

OHLE

OHLE masts and a variety of support structures will be needed to provide the revised OHLE configuration. Additional headspans or portal frames will be used to span the tracks to support feeders, catenary and contact wires. Cantilevers from the existing masts may be used in locations where these are suitable.

The five shortlisted options only have minor differences from an OHLE perspective. All options may require foundations to be fixed to proposed retaining structures where space constraints exist.

This option considers the installation of the turnback facility located out of the currently electrified section. Assuming the turnback installation works will be complete before the electrification works for Malahide - Drogheda section, this option will not require any modification of existing OHLE, only new OHLE installation for the new track configuration.

Signalling

There will be a number of additional signals and point machines to be controlled. Additional signalling trackside location cases will be needed to connect these signals, axle counter blocks and point machines to the interlocking via the SEB. The greater differential between the main and loop routes will entail some speed control on approach requirements to ensure that trains take the diverging routes at the correct speed.

The five shortlisted options do not vastly differ from a signalling perspective.

Civils/Structures

This option requires a new retaining structure approximately 450m long and up to 3.5m high running along the west side of the tracks. It is likely that this retaining wall will need to be designed with derailment protection in mind, this will be investigated further at preliminary design stage. Existing tidal overflow underbridge UBB31 will also require widening on the west side to accommodate the new horizontal track alignment.

5.5 Multi-criteria analysis

5.5.1 Methodology

For each shortlisted option an assessment against the MCA criteria has been carried out. Each option has been relatively compared against each other based on the five-point colour coded ranking scale shown in Table 5-9.

5.5.2 MCA summary table

A Multi-Criteria Assessment table is presented in this section. This has been developed to reflect the relative rankings for all sub-criteria assessed for each of the options, and is presented as a summary of the key issues considered.

The scoring has been reviewed and moderated with IÉ during an optioneering workshop.

A more detailed table is provided in a separate appendix with the full detailed rationale behind the scoring of each criteria and option.

Table 5-7: MCA sub-section summary table

Criteria	Sub-Criteria	Option 1a *Down line slewed to provide central turnback north of Malahide (Down line on divergent route)*	Option 1b *Down line slewed to provide central turnback north of Malahide (Turnback on divergent route)*	Option 2a *Up line slewed to provide central turnback north of Malahide (Up line on divergent route)*	Option 2b *Up line slewed to provide central turnback north of Malahide (Turnback on divergent route)*	Option 5b *Turnback facility relocated to the north of the existing estuary crossing*
Economy	CAPEX					
	OPEX					
	Train operations functionality/economic benefit					
	Traffic functionality and associated economic activities and opportunities					
Safety	Employer's Safety					
	Public safety					
Environment	Landscape and Visual Quality					
	Biodiversity					
	Noise and Vibration					
	Water resources					
	Archaeology, Architectural and Cultural Heritage					
	Geology and Soils (includes waste)					
	Agricultural and non-agricultural					
	Air Quality & Climate Change					
Accessibility & Social Inclusion	Accessibility					
	Social Inclusion					
Integration	Adaptability in the future					
	Transport Integration					
	Land Use Integration					
	Government policy integration					
	Geographical integration					
Physical Activity	Walking/cycling opportunities					

Table 5-8: Overall criteria MCA summary table

Criteria Summary	Option 1a	Option 1b	Option 2a	Option 2b	Option 5b
	Down line slewed to provide central turnback north of Malahide (Down line on divergent route)	*Down line slewed to provide central turnback north of Malahide (Turnback on divergent route)*	*Up line slewed to provide central turnback north of Malahide (Up line on divergent route)*	*Up line slewed to provide central turnback north of Malahide (Turnback on divergent route)*	*Turnback facility relocated to the north of the existing estuary crossing*
Economy					
Safety					
Environment					
Accessibility & Social Inclusion					
Integration					
Physical Activity					

Table 5-9: Legend for MCA Summary Tables

Significant comparative advantage over other options
Some comparative advantage over other options
Comparable to other options / neutral
Some comparative disadvantage over other options
Significant comparative disadvantage over other options

5.5.3 Economy

Economy has been divided into four sub-criteria which are considered below.

CAPEX

Construction of Option 1A/1B is constrained by being alongside the water, although these options are further from buildings which provide constraints to Option 2A/2B; these options are therefore considered comparable from a constructability perspective. It should be noted that Option 1A/B would impair the cycleway during construction. It has comparative advantage over Option 5B because Option 5B requires construction alongside and over water as well as bridge widening works.

Regarding trackwork, Options 1A and 2A use long high-speed switches, giving them a comparative disadvantage over Options 1B, 2B and 5B which offer better performance and reduce capital costs.

The OHLE interventions in Option 5B perform best comparatively as, assuming the turnback installation works will be done before the electrification works for Malahide - Drogheda section, this option will not require any modification of existing OHLE, only new OHLE installation for the new track configuration.

Option 5 is therefore considered as the option with lower cost from an OHLE point of view. Option 1B has a significant disadvantage against Option 5B as it has the greatest impact on existing OHLE and new OHLE wires and structures.

From the signalling point of view, the track layout is significantly modified in all options. However, Option 1A and 1B remove an existing crossover which options 2A retains. Hence, Option 2A has some comparative advantage of signalling delivery cost performance over the other options.

Option 5B requires potential modification to an existing bridge and may also require a structure associated with the existing level crossing nearby. The existing bridge carries the rail over a 2-span masonry arch tidal overflow. This option is considered to have a comparative disadvantage when compared to options 1A, 2A and 2B, which have no proposed impact on existing structures.

In conclusion, Options 1A, 2A and 2B have some comparable advantage over Option 1B and Option 5B.

OPEX

Option 5 has the longest ECS (Empty Coaching Stock) with an extra 4km of each turnback for two trains per hour. This option therefore has a significant comparative disadvantage.

Options 1A and 2A use long high-speed switches which pose a difficulty with respect to maintenance given the need for the long length of co planar track to exist. Also, the higher speed main route is on the diverging route which will increase wear on the switches.

Options 1B and 2B use standard components throughout, giving them a significant comparative advantage over Options 1A and 2A.

Train operations functionality/economic benefits

All of the options deliver the TSS and allow for conflict free moves.

Option 5B has a longer ECS move which could reduce turnaround time and impact performance.

Option 1A introduces a speed limit of 95KPH down from 110KPH and hence is has a comparative disadvantage.

Traffic functionality and associated economic activities and opportunities

All options will have to focus mitigation measures in two areas and therefore, given the available information, the construction impact is assumed to be of similar scale. Option 1A and 1B will have to focus mitigation measures on the construction impact on the estuary and the Broadmeadow Way Greenway. Option 2A and 2B will have to focus mitigation measures on the construction impact on the residential areas and the wastewater treatment plant. Option 5B will have to focus mitigation measures on the construction impact on the watercourse and the Broadmeadow Way Greenway.

Construction activities on all options considered are expected to generate a relatively low number of additional vehicular journeys and therefore will, at most, have a minor temporary impact on the traffic conditions of the local road network.

5.5.4 Safety

Safety has been divided into two sub-criteria which are considered below. It should be noted that all options are safe, but some will have the potential for greater residual risks to remain. This criterion considers relative advantages of each option on the criteria of safety.

Employer's Safety

All options have a centrally located maintenance walkway and access platform which is compliant to IÉ standards for clearances to adjacent rails. No drivers are expected to cross any tracks as part of the operational process. Hence all options are considered comparable.

Public safety

All works will be carried out away from the public limits, closed site, with significant level difference to where the public may be present. There is therefore no material comparative difference between the options.

5.5.5 Environment

Section 2.6 sets out a description of the existing environment, under key environmental criteria, while section 4.2 considers the key environmental constraints associated with this study area. Below is a summary of the key findings of the MCA under the various environmental criteria, with an emphasis on differentiating aspects for the options considered.

Landscape and Visual Qualitative

Option 1A and 1B have some comparative advantages over options 2A and 2B as they are within or adjoin the existing railway corridor and there is no change to existing landscape / visual character and minimal loss of trees, hedgerows.

Option 5B works are also within, or adjoin, the existing railway corridor and like Options 1A and 1B, there is no change to the existing landscape's (High Amenity) visual character. There will be some loss of trees and hedgerows, but less than that for Options 2A and 2B, and the visual impact for properties east of the railway will also be less than these options. Option 5B therefore has some comparative advantages over Options 2A and 2B.

Option 2A and 2B works are within or adjoin the existing railway corridor and there is no change to existing landscape / visual character. The works will require some loss of hedgerows and there is a potential increase in visual impact for properties east of the railway. As a result, these options have some comparative disadvantage over Options 1A, 1B and 5B.

Biodiversity

All of the proposed options have potential to indirectly impact on the Malahide Estuary SAC, SPA and pNHA and three of the five options have potential for direct impacts on these internationally and nationally important designated sites. Potential direct impacts include works within the designated site boundaries, potentially involving habitat removal as a result of new track, new stepped access, and new retaining structure. Potential indirect impacts include construction related impacts (e.g. potential for water quality impacts or disturbance to birds) and new lighting which could impact on birds. The potential for these impacts is greater in Options 1A, 1B and 5B and lesser in Options 2A and 2B.

Option 5B includes modifications to the railway bridge structure over the River Pill which drains to the Malahide estuary. These modifications could involve works affecting the adjacent intertidal habitats which on the eastern side fall within the Malahide Estuary SAC, and on the western site fall outside of any designation but nonetheless are likely to comprise Annex I habitat types. These impacts on habitats could be both direct (i.e. works directly removing/impacting on habitat within the works footprint) and indirect (e.g. construction stage impacts on water quality, or removing/altering the non-return flap valve which could either permanently or temporarily alter hydrological flow/morphology which define the intertidal habitats). Depending on whether the structure has potential to support bats, works to this structure could also impact on bats.

Determining the precise location of the Malahide Estuary SAC and SPA boundaries would be important for Options 1A, 1B and 5B given that works for these options will come in close proximity to, or possibly may be within, these designated sites. Establishing the precise boundaries of these designated sites may take time and require consultation with the NPWS and even then it may be difficult to establish.

Figure 5-17: Designated sites in the vicinity of Options 1A, 1B, 2A and 2B

Figure 5-18: Designated sites in the vicinity of Option 5B

There are a number of other potential ecological constraints, however these are similar across all options and do not differentiate the preference between options. These include:

- Vegetation removal with potential for removal of habitat of value (scrub, hedgerows or treelines) and which may provide foraging, nesting, and commuting corridors for fauna species (e.g. birds, bats, small mammals);

- All options involve some level of works on the existing tracks. Railway lines can often support interesting flora species and habitats due to the calcareous nature of the ballast and their often relatively undisturbed nature. If any such habitat is present the level of impact is likely to be similar across all options and might not be a significant differentiator between options;

- It is not known whether invasive species may occur along the railway line. If present then there would be risk of spreading these to adjacent areas with the adjacent Malahide Estuary SAC and SPA being particularly sensitive receptors. Even if it were the case that invasive species are present in this area, the level of impact is likely to be similar across all options and might not be a significant differentiator between options.

Also of note are Fingal County Council's proposals for the Broadmeadow Greenway adjacent to the railway line, which will link Malahide and Donabate. The environmental assessments for the Broadmeadow Greenway set out specific environmental and ecological mitigation and any works in this area should be cognisant of those plans and ensure there are no conflicts between the Irish Rail works and the Broadmeadow Way Greenway proposals (e.g. timings of works to avoid sensitive period for species). There may be opportunities for biodiversity enhancement measures to be incorporated into the proposed works which will tie in with the objectives for the Broadmeadow Way Greenway. This opportunity is considered equal across all options.

Noise and Vibration

Option 5B is favourable from a noise and vibration point of view, as construction noise and vibration will have less impact on sensitive residents or commercial properties.

Options 1A, 1B, 2A and 2B are similar in terms of impact on nearby sensitive receptors from a construction and operational point of view. Options 1A and 1B are slightly more favourable as the new railway line is positioned further away from sensitive receptors, and the option for incorporating a noise wall (if this is necessary) may be easier on the west side of the track.

Water resources

The comparative differences across the five options relate mainly to development adjacent to or within areas at flood risk and the impact this might have on other properties. Furthermore, consideration is given to the proximity of the site to Malahide Bay SAC/SPA/pNHA and the impact this might have in terms of tidal flood regime and water pollution.

Options 1A and 1B are proposing the construction of retaining walls within areas that could be at risk of coastal flooding. It is anticipated that the construction of the retaining walls will not have a significant impact on the tidal flood regime. However, there is a risk of pollution of the Broadmeadow Water transitional water body or disturbance of the Malahide Bay (designated site). These risks can be mitigated through careful design and construction methodology.

Option 5B requires bridge widening over the River Pill. The new bridge has the potential to impact the flow regime and water quality in the watercourse and result in impacts with regards to flooding and the downstream water dependant SAC. The above concerns can be mitigated through design however this would need a full assessment.

As such from a Water Resources perspective, Options 1A, 1B and 5B are deemed to have some comparative disadvantage over other options.

Archaeology, Architectural & cultural heritage

In relation to Options 2A and 2B, there are no recorded monuments in the vicinity of the proposed works. While more information is needed to advise on the impact of these options on any extant historic fabric, from an archaeological, architectural and cultural heritage perspective there are comparative advantages between these options and other options. Should Option 2B be found to impact on UBB29 following completion of the topographic survey then the alternative sub option 2C is likely to be taken forward.

By contrast, Options 1A, 1B and 5B have comparative disadvantages in relation to these options. In respect of Options 1A and 1B, the railway bridge (FCC RPS 423) at Bissetto Strand and the Malahide Viaduct (FCC RPS 420) are protected structures and while the sensitivity of the fabric between the two structures has not yet been assessed, the widening of the tracks on this side will have a greater visual impact on the protected structures than Options 2A and 2B.

In respect of Option 5B, there is some archaeological potential in the vicinity. Furthermore, this option includes for widening an existing bridge to the north of the Malahide Estuary. It should be noted that the bridge in question is incorrectly marked NIAH 11336027. This listing for this feature relates to the bridge over Corballis Cottages, which is also included in the RPS (FCC RPS 0502).

While the existing bridge to the north of the Malahide Estuary has not yet been assessed, it is shown on the 1907 OS map, and is potentially of architectural heritage interest.

While the bridge in the question is not properly included in any existing inventories, and has not yet been assessed, it is anticipated that the proposed widening would have a significant negative impact on the fabric and setting of what is potentially an historic structure.

Geology and Soils

The comparative differences across the five options relate mainly to construction activities and the expected interaction with the underlying geology and soils as opposed to the operational considerations where there are no discernible differences.

The main construction impact relates to widening of the existing railway bridge, the construction of a retaining structure and the earthworks required for the proposed option and the potential generation of earthworks material requiring recovery or disposal on or off the site.

Some of the options involve widening of the embankment and in one case alterations of the existing bridge structure; as such this will require soft ground engineering solutions that will be associated with works within or directly adjacent to the estuary.

For Options 1A and 1B respectively, it was noted that the retaining structure will be constructed on the estuary side, where soft ground is more likely to be encountered. Alternatively, the embankment may need to be extended and this could reduce the existing access road or if the access road is required for maintenance, then these works may encroach into the estuary with potential environmental implications. For Options 2A and 2B respectively, the retaining structure will be located on the same side as the wastewater treatment plant.

In Option 5B, it is envisaged that the existing railway bridge over the river would need to be widened and therefore, soft ground associated with the estuary will be encountered.

For all options, there is also the risk for Made Ground/contaminated land to require excavation, as well as land/topsoil/growing soil, associated with new track and track replacement.

As such, from a Geology and Soils perspective, while there are clear advantages for Options 2A and 2B further information on the proposed engineering design and associated earthworks would be required to assess the comparative disadvantage of Options 1A, 1B and 5B respectively (from a construction perspective).

Agricultural and Non-Agricultural

There are no comparative differences between any of the options for agriculture and non-agriculture.

Air quality and climate

As sensitive receptors are positioned on both sides of the turnback for options south of the estuary, and there are also sensitive receptors (albeit less) to the north of the estuary, there are no comparative differences from an air quality perspective. As all options will generate more efficient rail services, there are no comparative differences on climate.

5.5.6 Accessibility and Social Inclusion

There are only slight impacts due to any option in terms of accessibility and social inclusion. The greenway (if open) will mainly be used for amenity, and journey amenity will be a lesser criterion for the minority of users who are commuters. Any closure of the greenway during construction is likely to have a minor impact given its recent opening (if open) and as long as any closure is short term.

5.5.7 Integration

Integration is assessed using the five sub-criteria described below.

Adaptability in the future

Options 1A, 1B and 5B have some comparative disadvantage against options 2A and 2B because mitigation measures will be required to accommodate the future Broadmeadow Way Greenway, particularly during construction.

Transport Integration

Options 2A and 2B will have a temporary impact on the existing local roads providing access to the Waste Water Treatment Plant and Malahide Marina Village so have some comparative disadvantage against Options 1A, 1B and 5B.

Land Use Integration

In all options the proposal complies with regional and local policies to improve public transport services including DART services, encouraging modal shift and allowing for increased density of development in certain areas. The development is contained within the existing 'envelope' of the railway line. There is no impact on existing land uses.

Government policy integration

All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.

Geographical integration

All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.

5.5.8 Physical Activity

All options are comparable. For Options 1A, 1B and 5B it is assumed that the Broadmeadow Way Greenway would be safely accommodated and then there is no temporary or long-term impact foreseen on walking or cycling opportunities. For Options 2A and 2B there is a temporary impact on the existing local road providing walking and cycling access to the Malahide Marina Village.

5.6 Construction Considerations

Constructability considerations for the shortlisted options at Malahide are as follows:

5.6.1 Options 1A and 1B

The new retaining wall for both Options 1A and Bb needs to be constructed through the upper part a rock/rubble covered embankment (see Figure 5-19).

Figure 5-19: Approximate position of Options 1A and 1B retaining wall on west of the embankment (source: Arup)

No design calculations have been undertaken to assess the size of retaining wall required. As such, it is not known how much of the embankment will need to be altered during construction, but in any event, there is a potential risk of disturbance to the existing tracks during the works. The design and construction proposals will mitigate such risks through the use of appropriate design solutions and construction sequences, for example undertaking short stretches of wall construction; Option 1A is thus more favoured than Option 1B as it is only 250m long versus 350m long for the latter.

If the retaining wall is to be an embedded piled wall, this will need suitable piling equipment. The presence of large boulders on the face of the embankment (see Figure 5-19) means RRV (Road Rail Vehicle) mounted equipment may not have sufficient capacity to construct the wall through the embankment without first moving obstructing boulders. As designs progress, options for enabling works to move the boulders will need to be factored in, whilst considering the size, nature and accessibility of construction plant needed. Some additional temporary works

may be required to allow larger plant to access the location, this being either at the lower road track level or up at the rail track level.

One possible piling method is the use of combined static press-in and rotary methods. The method uses tubular piles with cutting heads which have the capability to pile through hard/dense strata and obstructions. The method utilises previously installed piles to generate the reaction forces required to install the subsequent pile; in this case some temporary works would be required to remove boulders at the surface along the line of the pile wall and install an initial reaction frame from which the first number of piles would be installed, thereafter the system would become self-contained. Crane attendances for the method could be provided from the access track at the base of the rail embankment, which may need to be strengthened for width and/or load capacity reasons. Associated works would then need appropriate environmental approval with regards to the estuary, and safety precautions for working alongside open water.

For any pile solutions the support of the track and engineering fill on the retained side may be achieved by either close spacing of the piles similar to a contiguous pile wall or piles at a wider spacing with infill panels.

The access track on the west of the causeway could be used for delivery of construction materials, plant and labour (as well as to construct the new stepped access down the embankment). Suitable precautions will need to be made for working alongside water. Impacts to the cycleway may need to be discussed with the county council.

Once preliminary piling design details and further information on the ground conditions present are available, a review of the location of the wall and working space required for its installation would be needed to assess suitable piling methods and construction sequences.

All works will need to consider the residential properties nearby, especially with regard to noise and movement of construction plant and materials. The cycleway would be disrupted during construction but mitigating measures including a diversion could be arranged. Impact to public traffic during construction could be mitigated by restricting lorry movements to certain times of day and the week. It is envisaged that some works will be by day (especially at weekends) and some by night. Consequently Scenario 3 of working with track possessions would be applicable: “3. Disruptive possessions of the railway and isolation of the OHLE (where required).”

Construction access for contractors’ road/rail plant could be arranged from an access point at Donabate, a short distance to the north. There would also be a local worksite compound near to the works to support the construction.

5.6.2 Options 2a and 2b

In some constructability respects these options are better than Options 1a and 1b as works would be further from the water and cycleway and require less work on a steep embankment slope. However, works would be closer to various buildings

which may lead to access constraints for the buildings, and heightened noise issues due to their closer proximity to the works.

Option 2b would be preferable over Option 2c due to the minor reduction in length of wall required (450m compared to 490m)

No design calculations have been undertaken to assess the size of retaining wall required. Similar embedded retaining wall solutions to Options 1a and 1b could be used. As the wall location appears to be aligned closer to the bottom of the embankment than the top, a gravity type retaining wall may be possible following review of actual topography and space proofing check.

There is an access route to the wastewater treatment works between the foot of the embankment and the public road which will inevitably be disrupted and at times blocked by construction. Alternative arrangements would be investigated to provide access, which could be from the Marina development access road.

Once preliminary piling design details are available, a review of the location of the wall and working space required for its installation would be needed to inform suitable piling methods. There may also need to be works required to safeguard properties alongside if they are found to be sufficiently close to the railway works to merit such, or alternatively a need to move the wall further from properties

The risk of working alongside water would be significantly less than Options 1a and 1b.

The level of impact to local road users would be marginally greater than with Options 1a and 1b but still relatively slight. It is envisaged that some works will be by day (especially at weekends) and some by night. Consequently Scenario 3 of working with track possessions would be applicable: "3. Disruptive possessions of the railway and isolation of the OHLE (where required)."

Construction access for contractors' road/rail plant could be arranged from an access point at Donabate, a short distance to the north, as with Options 1a and 1b. There would also be a local worksite compound near to the works to support the construction.

5.6.3 Option 5b

Option 5b has the relative benefit over the other options of being close to none of water, properties and cycle path. These aspects are all balanced, however, by needing to widen the existing small bridge carrying the tracks over a watercourse and to widen the embankment. Both of these construction aspects would need to be undertaken by accessing along the tracks as there are no roads nearby. Until the design is progressed it is not clear how much resource will be needed to be brought to site and therefore how long the tracks would need to be possessed for but it is gauged to be similar to the periods for other options. Consequently Scenario 3 of working with track possessions would be applicable: "3. Disruptive possessions of the railway and isolation of the OHLE (where required)."

Construction access for contractors' road/rail plant could be arranged from an access point at Donabate, a short distance to the north, as with other options. There

would also be a local worksite compound near to the works to support the construction.

5.6.4 All Options

For all options there is a need to understand the impact to and from the nearby Waste Water Treatment Plant (WWTP) including the temporary access road proposed. Liaison with Irish Water is planned to take place to factor in this influence.

There is also a need to understand the impact to and from the proposed nearby Broadmeadow Way project. Plans will be sought from the developer, with discussions also taking place if need be.

It may be that, in due course, retaining wall are not piled (but for example cantilever structures are used instead) especially if this reduces the impact to the railway and local residents during construction. For all scenarios, construction methodology and schedules would be developed to help decide the overall optimum solution.

6 Summary and conclusions

6.1 Non-preferred options

Option 1a is not preferred due to:

- the high maintenance switch unit, construction of retaining wall on west of the causeway would be challenging and disruptive to the proposed cycleway and the lack of many advantages over option 1b.

Option 1b is not preferred due to:

- construction of retaining wall on west of the causeway would be challenging and disruptive to the proposed cycleway and the increased environmental impacts when compared to option 2b

Option 2a is not preferred due to:

- the high maintenance switch unit and the lack of advantages over option 2b.

Option 5b is not preferred due to:

- the wider environmental issues when compared to other options and the increased cost associated with ECS moves

6.2 Draft Emerging Preferred Option

Option 2b has been chosen as the Draft Emerging Preferred Option as it:

- has a standard switch arrangement over options 1a and 2a which will reduce running and installation costs
- performs better from an environmental and operations perspective than Option 5b
- has some marginal benefits over 1b and some marginal disadvantages but on balance it is considered that 2b outperforms 1b due to:
    - Reduced impact on the Greenway. While 2b includes an interface with the wastewater treatment work it is considered that there a more options to mitigate this on the east side of the corridor than the west.
    - Whilst there are potentially more noise and vibration impacts this will be very slight considering the relative distances involved.
    - There is less risk for impact on sensitive environmental receptors on the east side of the corridor.
    - There is less cost risk associated with 2b due to smaller infrastructure changes required.

6.3 Key Risks/Next Steps

The following risk have been identified:

- The topographic survey needs to be completed to confirm:

- The need to undertake any works to UBB29 to maintain suitable clearances to the existing parapet. If it is identified that works would be required a subset option 2C as drawn up on D+WP56-ARP-ZZ-NL-DR-PW-SK0029 in Appendix B is likely to be taken forward. This option is largely similar but introduces the need to reposition/replace the existing crossover as a trade-off for works to the existing bridge.
- The exact extents of the retaining wall and boundary treatment require particularly adjacent to the wastewater treatment works and in proximity to the residential buildings.

- Discussions with local stakeholders regarding temporary access and disruption during construction. This is likely to involve, Irish Water, Local Residents association, The Marina and Fingal County Council (for the proposed Broadmeadow Way Greenway).
- Determination of the requirements and mitigation options for derailment protection and impact on the retaining wall footprint