Appendix 6.3 Preliminary Design Report

MOTT MACDONALD

Cork Area Commuter Rail Glounthaune - Midleton Twin Track

Preliminary Design Report

September 2022

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1 Introduction

1.1 Brief

Mott MacDonald has been appointed by Iarnród Éireann as the Consultant responsible for delivering phases 3 to 6 (see phase descriptions below) of the of the Glounthaune - Midleton Twin Track project.

- Phase 3 – Preliminary Design
- Phase 4 – Planning & Statutory Process
- Phase 5 – Detailed Design & Tender Process (to be awarded separately as extension to initial scope)
- Phase 6 – Contract Award, Construction & Implementation (to be awarded separately as extension to initial scope)

1.2 Background Information

The railway network in Cork is a vitally important component of the local and regional transport infrastructure network providing essential Commuter and Intercity services. Prior to Covid-19, the Commuter and Intercity rail business in Cork was flourishing, with strong growth in both segments reported, particularly in recent years.

The rail service offering in Cork has undergone considerable improvements since the early 2000s with a new hourly Cork-Dublin Intercity service in 2007, the re-opening of the Midleton line in 2009 to commuter services and major upgrades to the concourse and booking hall at Kent Station. More recently, a new station entrance facing on to Horgan's Quay opened up the station to a new transport interchange and developments in the City Docklands.

The National Transport Authority (NTA), in partnership with both Cork City and County Councils and Transport Infrastructure Ireland (TII), finalised the ambitious Cork Metropolitan Area Transport Strategy 2040 (CMATS) in early 2020. The strategic vision for Cork City and the broader Metropolitan Area is set out in CMATS covers all transport modes including heavy rail. The strategy for heavy rail includes the following:

- Development of the three existing railway corridors in the Cork area, which penetrate the city at Kent Station interchange, providing a high frequency north-east connection through the city.
- Additional rolling stock to meet the potential of the existing and future demand.
- Multi-modal integrated transport hub for the city provided at Kent Station to promote modal shift from the private car and enhance attractiveness of the City Docklands regeneration and development.
- New stations at prime regeneration sites, Park & Ride interchange points, and new development areas.

The CACR programme is the heavy rail element of CMATS and includes a series of projects that will create a fully integrated metropolitan area rail network for Cork.

The CACR programme involves development and enhancements to the rail network over c.62 km. from Mallow through Cork to Cobh and Midleton. This will include electrification and re-signalling across the 3 main routes primarily over existing alignments which can be summarised as follows:

- Mallow Line - c.30km from Kent Station to Mallow
- Cobh Line - c.20km from Kent Station to Cobh
- Glounthaune to Midleton Line - c.10km from Cobh Jnct. to Midleton

The overall CACR programme consists of a number of separate but interrelated projects which will be developed in Phases in accordance with the IÉ Capital Investment Division Project Management Procedures (PMP):

- Work Package 1 – Kent Station Through Platform
- Work Package 2 – Signalling and Communications Upgrade
- Work Package 3 – Glounthaune - Midleton Twin Track
- Work Package 4 – Per-way, Civils & Structures
- Work Package 5 – Depot
- Work Package 6 – Electrification
- Work Package 7 – Rolling Stock

The National Recovery and Resilience Plan (NRRP) 2021 has prioritized Work Packages 1, 2, and 3 for immediate progress via the EU Recovery and Resilience Facility.

1.3 Previous Studies and Recommendations

Phases 1 (Project Scope & Approvals) and 2 (Concept, Feasibility and Options Study) have been completed for the Glounthaune - Midleton Twin Track project.

Phase 1 (Project Scope & Approvals)

IÉ have developed a Cork Area Rail Development Strategy which, amongst other things, outlines the constraints to expansion of the network along with possible solutions to unlocking them. In addition to this strategy document, A Strategic Assessment Report (SAR) has been developed for the CACR programme. The findings arising from these strategies/reports will be adopted and incorporated into the design, as necessary.

The SAR Public Spending Code (PSC) deliverable, undertaken as a separate contract will be incorporated into the Design.

Phase 2 (Concept, Feasibility and Options Study)

As part of Phase 2 of the CACR programme, AECOM have developed concept designs for the scheme.

1.4 Proposed Development

The proposed development consists of the upgrading of the Glounthaune to Midleton rail line to twin track.

1.4.1 Project Description

The proposed Glounthaune - Midleton Twin Track Project comprises the following:

- Twin tracking of the single-track sections between Glounthaune and Midleton.
- Reconfiguration of the operational track layouts, as required.
- Modification/replacement of existing bridges and level crossings to facilitate the twin tracking.
- Provision of sidings/turn back facility at Midleton, as required.

- Provision of new cable containment routes from Glounthaune to Midleton to facilitate the signalling upgrades and alterations.
- Associated signalling upgrades and alterations (Detailed design to be provided by others in Work Package 2).
- Passive provision for future electrification of the Glounthaune – Midleton line.
- All associated works (drainage, retaining walls, boundary treatments, etc.)

1.4.2 Document Overview

This Preliminary Design Report details the preliminary design of the Preferred Option 3 identified in the Option Selection Report for the Glounthaune - Midleton Twin Track Project.

This Preliminary Design Report (PDR) details the overall layout and general arrangement of the proposed development. The following additional documents should also be considered.

1. Land Take Requirements Report
2. Environmental Impact Assessment Report
3. Preliminary Cost Estimate Report

2 Site & Function

2.1 Site Description

The site is located along the existing rail line between Glounthaune and Midleton, Co. Cork. The site varies in use along track including both rural and urban areas starting at Glounthaune village continuing through Carrigtwohill town and terminating in Midleton town. To the south of the tracks at the start of the scheme is the River Lee inlet which surrounds Harper's Island wetland.

An overview of the site can be seen in Figure 2-1.

Figure 2-1: Site Overview

The rail line runs from Glounthaune station (Chainage 0) between the Lee estuary and the L3004 road for 850m (all distances are approximate). It then runs between the L3004 and open ground to the south for 910m before crossing the L3004 and then follows the L3616 for 2.5km passing between the IDA Industrial Estate and Fota Retail and Business Park before reaching Carrigtwohill station. The line continues along mostly open ground for 6km before terminating at Midleton train station.

There are 3 no. level crossings along the route, and these are located at Water Rock, Knockgriffin and Midleton.

A protected woodland is located south of the rail line at Killacloyne.

A number of structures cross above or below the rail line, and these which are described in Table 2.1 below.

Table 2-1: Structures Description

Structure		Description
Name	**Denotation**	
Culvert	UBY1B	L3004 local road located to north of the culvert. The lands to the north and south are scrubland. The culvert conveys a stream south to Cork Harbour,
Killacoyne	OBY1	Protected woodland located to southwest of structure. Greenfields located to north. L3004 local road which structure carries over rail line is heavily trafficked.
Culvert	UBY1C	L3004 local road located on OBY1 immediately to the west of the culvert. The lands to the north and south are agricultural.
Haly's Bridge	OBY2	L3005 local road which structure carries over rail line is used to access Springhill Business Park and is heavily trafficked by HGVs. Carrigtwohill Community College and Fota Business Park located are located immediately to the southeast of structure. Stream located to east of structure. Agricultural lands located on all other sides.
Culvert	UBY2A	L3005 local road located to west of culvert. Carrigtwohill Community College and Fota Business Park are located immediately to the southeast of structure. The culvert conveys the stream south from the adjacent IDA Open Culvert.
Culvert	IDA Open Culvert	The open drain structure runs parallel to the tracks on the north side of the cut toe between overbridges OBY2 and OBY3. The lands immediately to the north contains an IDA attenuation pond with an outfall structure to the IDA open Culvert.
IDA Bridge	OBY3	The bridge forms a link between the IDA parks north and south of the tracks. The surrounding lands are industrial.
Wise's Bridge	OBY4	Areas to south of structure are primarily residential. Stryker (Anngrove) industrial plant site located to northwest of structure. L3616 local road which structure carries over rail line follows an s-shaped bend profile south of structure.
Ballyadam Bridge	OBY7	L3006 local road which structure carries over rail line follows s-shaped bend profile where the road crosses the rail line. Local road is heavily trafficked. Junction with unnamed local road located approximately 30m north of structure. Wooded area located to south of the structure.
Ballyadam House	OBY8	Bridge located on Ballyadam house property with house and farm building located northwest of bridge. Disused 'Amjen' site located to south of structure. Potential for Celtic Interconnector project to be running through site.
Owenacurra River	UBY11	Millbrook Drive Housing Estate located to southeast of structure. Utilities river crossing located approximately 20m north of structure. Track levels cannot be modified due to location of level crossing to east of structure.

3 Design Assessment Criteria

3.1 Applicable Technical Standards

3.1.1 Technical Standards Adopted

All appropriate Iarnród Éireann standards will be used in the development of the railway design, specifically the following:

- CCE-TMS-300 v1.8 Track Construction Requirements and Tolerances
- CCE-TMS-340 v1.0 Horizontal Curvature Design
- CCE-TMS-341 v1.0 Vertical Curvature Design
- CCE-TMS-344 Requirements for Undertrack Crossings and Pressure Pipelines
- CCE-TMS-345 v1.1 Engineering Requirements for Passenger Platforms and Barrow Paths
- CCE-TMS-347 Technical Standard for Breather Switches
- CCE-TMS-386 Requirements for Buffer Stops.pdf
- CCE-TMS-390 v1.1 Preparation of Drawings (Approval and Certification Process)
- CCE-TMS-410 Civil Engineering Structures Design Standard V 1.1
- I-PWY-1101 v1.1 Requirements for Track and Structures Clearances
- I-PWY-1136 Requirements for Design, Installation and Maintenance of Lineside Drainage

3.1.2 Road Design

The following TII Publication's will used where Iarnród Éireann infrastructure interfaces with public roads:

- DN-GEO-03031 – Rural Road Link Design, April 2017
- DN-GEO-03036 – Cross Sections and Headroom, May 2019
- DN-GEO-03060 – Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated, and compact grade separated junctions), June 2017
- DN-REQ-03034 – The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges, May 2019

In addition to the above design documents further guidance was drawn as necessary from relevant published standards/documents including the following:

- National Transport Authority, National Cycling Manual
- Design Manual for Urban Roads and Streets (DMURS)

3.1.3 Drainage

The drainage design will be undertaken in accordance with best practice. The following standards have been consulted during the design process;

- TII Publications for Drainage
- The Greater Dublin Strategic Drainage Study (GDSDS): Volume 2 New Development, Dublin City Council, March 2005
- CIRIA Guidance Document C753: The SuDS Manual, 2015
- I-PWY-1136 Requirements for Design, Installation and Maintenance of Lineside Drainage

3.2 Proposed Departures from Standards or Derogations

3.2.1 Departure from Standards

Departures from standards will be avoided where practicable. However, it is likely that some departures from 'I-PWY-1101 v1.1 - Requirements for Track and Structures Clearances' will be required. These will be summarised and agreed with Iarnród Éireann as part of the Stage 5 design process. Initial discussions have indicated that the modified GSWR (mGSWR) gauge is acceptable for bridge locations listed in Table 4-6 to allow retention of existing bridges, subject to detailed design verification.

3.3 Proposed Methods of Dealing with Aspects Not Covered by Standards

Not applicable.

4 Permanent Way

4.1 General Description

The existing railway corridor between Glounthaune and Midleton appears to have been constructed with sufficient space for a continuous twin-track railway. However, the current arrangement comprises only short sections of double track connected by a single, bi-directional line, as illustrated in the Table 4-1 below:

Table 4-1: Current Track Arrangement Summary

Chainage (metres)	Track Configuration	Location
0 - 600	Double track	Glounthaune Loop
600 – 3750	Single track	
3750 – 5900	Double track	Carrigtwohill Station
5900 – 9900	Single track	
9900 - 10300	Double track	Midleton Station (Terminus)

The methodology behind this design is to create a continuous twin-track railway by connecting the existing sections of double track using the following principles:

- Optimise the design alignment to make best use of the existing rail corridor.
- To limit development outside of the existing IE boundary.
- Avoid unnecessary demolition of existing assets.
- Retain as much of the existing track asset as is feasible within the above constraints.

The proposed alignment has been designed to achieve 60mph with passive provision for 70mph.

Typical examples of the existing single track section of line, new cross section and twin track with adjacent embankments and fencing are shown in Figure 4-1, Figure 4-2, and Figure 4-3 respectively.

Figure 4-1: Typical Example of Single-Track Section of Line

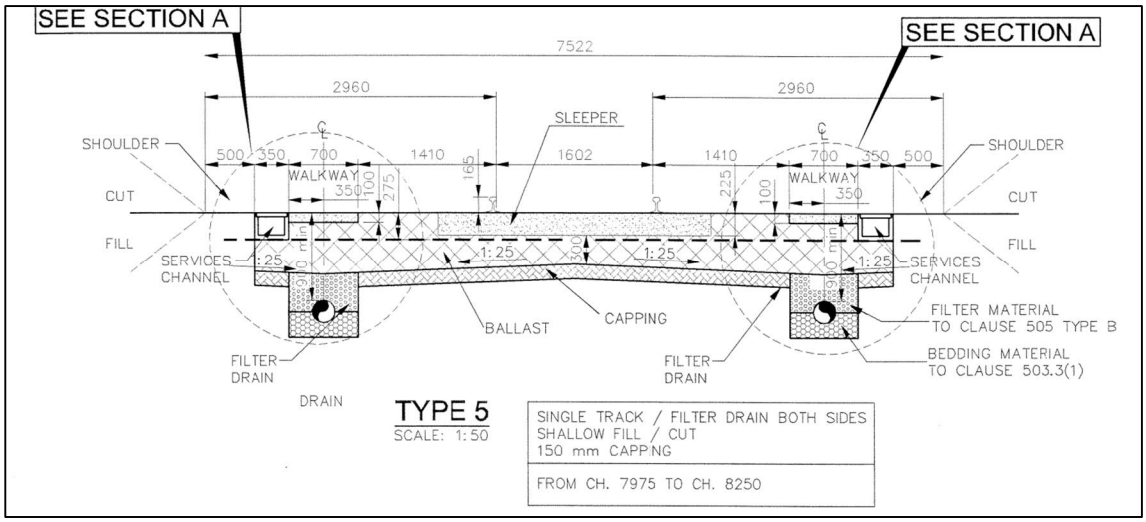


Figure 4-2: New Typical Cross Section of Twin Track

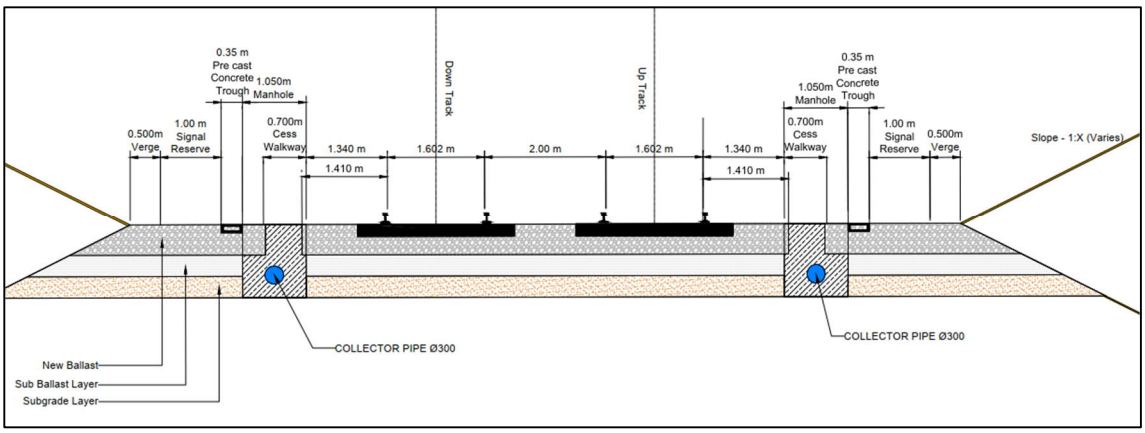
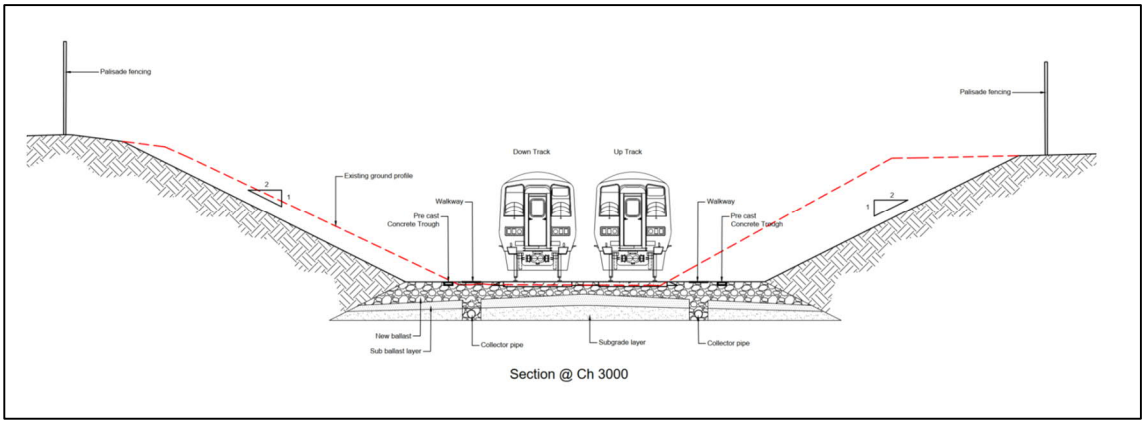


Figure 4-3: Typical Example of Twin Track and adjacent Embankment and Fencing



4.2 Horizontal & Vertical Alignment

The Horizontal and vertical alignment have been developed in line with IE standards to achieve desirable limits for the proposed speed. Where possible, the existing single-track position has been utilised, however there are large sections of the route where this approach is not feasible without demolition of existing bridge structures and acquisition of adjacent land. The track formation has been assumed to require attention when the existing track is required to be moved laterally more than 250mm; this is not a definitive value, but one based on practicality. For track movements up to this value, the design has been labelled as ‘re-alignment' as it is assumed the existing track can be mechanically manipulated into its designed position without wholesale removal. In areas of the design where this threshold has been crossed the design has been labelled as ‘renewal’, on account of the need to remove the existing rails, sleepers & ballast to prepare the formation for the proposed track position. It may be feasible to reinstate some or all of the existing track and sleepers in the proposed design position, subject to condition assessment and the practicalities of the construction methodology.

The proposed design is presented in two sections: Glounthaune to Carrigtwohill & Carrigtwohill to Midleton. The following tables summarise the proposed horizontal and vertical geometry. Vertical alignment for both tracks have been replicated. The horizontal alignments have been designed at a constant track interval of 2000mm between running edges except where tie-in to existing track require minor deviation from this.

Table 4-2: Horizontal Track Proposed Geometry

Glounthaune to Carrigtwohill							
Down Line				Up Line			
Chainage Start (metres)	**Geometric Element Type**	**Geometric Element Length (metres)**	**Applied Cant (mm)**	**Chainage Start (metres)**	**Geometric Element Type**	**Geometric Element Length (metres)**	**Applied Cant (mm)**
380	Straight	54	0	380	Straight	53	0
434.42	Transition Curve	40		433	Transition Curve	40	
474.42	Radius -1539m	392	40	473	Radius -1542m	394	40
866.197	Transition Curve	40		866.67	Transition Curve	40	
906.197	Straight	119	0	906.67	Straight	120	0
1025.471	Transition Curve	40		1026.532	Transition Curve	40	
1065.471	Radius 1844m	398	35	1066.493	Radius 1840.398m	397	35
1463.547	Transition Curve	40		1463.751	Transition Curve	40	
1503.547	Straight	141	0	1503.712	Straight	142	0
1645.037	Transition Curve	30		1645.219	Transition Curve	30	
1675.037	Radius -7220m	295	0	1675.226	Radius -7223.602m	295	0
1970.353	Transition Curve	30		1970.687	Transition Curve	30	
2000.353	Radius -2600m	258	35	2000.715	Radius -2603.602m	259	35
2258.843	Transition Curve	30		2259.572	Transition Curve	30	
2288.843	Radius -3200m	300	35	2289.609	Radius -3203.602m	300	35
2588.414	Transition Curve	40		2589.526	Transition Curve	40	
2628.414	Straight	62	0	2629.549	Straight	62	0
2690.632	Transition Curve	40		2691.738	Transition Curve	40	
2730.632	Radius -2000m	185	50	2731.774	Radius -2003.602m	185	50
2915.328	Transition Curve	40		2916.839	Transition Curve	40	
2955.328	Straight	250	0	2956.875	Straight	250	0
3205.001	Transition Curve	30		3206.532	Transition Curve	30	
3235.001	Radius 9500m	377	0	3236.527	Radius 9496.398m	375	0
3612.076	Transition Curve	30		3611.32	Transition Curve	30	
3642.076	Radius 2143.64m	118	30	3641.32	Radius 2148m	119	30
3760.256	Transition Curve	30		3760.284	Transition Curve	30	
3790.256	Straight	96	0	3790.284	Straight	97	0
3886.517	Transition Curve	30		3887.644	Transition Curve	30	
3916.517	Radius 4766.045m	53	25	3917.633	Radius 4762.348m	53	25

Table 4-3: Horizontal Track Proposed Geometry

Carrigtwohill to Midleton							
Down Line				Up Line			
Chainage Start (metres)	Geometric Element Type	Geometric Element Length (metres)	Applied Cant (mm)	Chainage Start (metres)	Geometric Element Type	Geometric Element Length (metres)	Applied Cant (mm)
5599.993	Radius 3747.824m	85	30	5599.993	Radius 3817.191m	73	30
5685.446	Transition Curve	40		5672.57	Transition Curve	73	
5725.446	Straight	171	0	5745.854	Straight	150	0
5896.111	Transition Curve	40		5895.992	Transition Curve	40	
5936.111	Radius -2890	197	30	5936.022	Radius -2893.602m	198	30
6133.61	Transition Curve	40		6133.788	Transition Curve	40	
6173.61	Straight	133	0	6173.818	Straight	133	0
6307.05	Transition Curve	30		6307.245	Transition Curve	30	
6337.05	Radius 12190.809m	60	0	6337.24	Radius 12187.207m	60	0
6397.05	Transition Curve	30		6397.218	Transition Curve	30	
6427.05	Straight	392	0	6427.214	Straight	392	0
6818.684	Transition Curve	30		6818.845	Transition Curve	30	
6848.684	Radius -6193.222m	125	30	6848.854	Radius -6196.824m	126	30
6974.161	Transition Curve	30		6974.413	Transition Curve	30	
7004.161	Straight	1256	0	7004.422	Straight	1256	0
8259.842	Transition Curve	30		8260.105	Transition Curve	30	
8289.842	Radius 4106.239m	60	15	8290.091	Radius 4102.637m	60	15
8349.842	Transition Curve	30		8350.026	Transition Curve	30	
8379.842	Straight	60	0	8380.013	Straight	60	0
8439.842	Transition Curve	30		8440.011	Transition Curve	30	
8469.842	Radius -3235.106m	60	20	8470.027	Radius -3238.708m	60	20
8529.842	Transition Curve	30		8530.111	Transition Curve	30	
8559.842	Straight	467	0	8560.128	Straight	467	0
9026.822	Transition Curve	30		9027.095	Transition Curve	30	
9056.822	Radius -5000m	429	15	9057.105	Radius -5003.602m	429	15
9485.877	Transition Curve	30		9486.479	Transition Curve	30	
9515.877	Straight	150	0	9516.49	Straight	150	0
9666.372	Transition Curve	30		9666.987	Transition Curve	30	
9696.372	Radius 3769.44m	113	30	9696.973	Radius 3765.838m	113	30
9809.387	Transition Curve	30		9809.866	Transition Curve	30	
9839.387	Straight	42	0	9839.852	Straight	40	0
9881.319	Transition Curve	30		9879.402	Transition Curve	30	
9911.319	Radius 3150m	40	20	9909.402	Radius 3146.5m	40	20
9951.242	Transition Curve	30		9949.247	Transition Curve	30	
9981.242	Straight	29	0	9979.247	Straight	31	0

Table 4-4: Vertical Track Proposed Geometry

Glounthaune to Carrigtwohill				
Down & Up Line				
Chainage Start (metres)	**Geometric Element Length (metres)**	**Grade**	**Radius (metres)**	**Curve Hand**
380.01	711	-0.01%	~	~
1090.747	200	-0.06%	~	~
1291.199	62	~	16046.842	Sag
1352.953	284	0.32%	~	~
1636.972	25	~	15503.832	Sag
1661.972	278	0.48%	~	~
1940.455	40	~	18613.379	Sag
1980.455	190	0.70%	~	~
2170.076	80	~	-16069.136	Hog
2250.076	267	0.20%	~	~
2516.587	35	~	15347.671	Sag
2551.587	310	0.43%	~	~
2862.042	103	0.48%	~	~
2965.21	150	~	-16162.705	Hog
3115.211	71	-0.45%	~	~
3186.01	108	~	16143.392	Sag
3294.059	494	0.22%	~	~
3788.509	17	~	-38502.635	Hog
3805.422	112	0.18%	~	~

Table 4-5: Vertical Track Proposed Geometry

Carrigtwohill to Midleton				
Down & Up Line				
Chainage Start (metres)	**Geometric Element Length (metres)**	**Grade**	**Radius (metres)**	**Curve Hand**
5599.953	20	0.13%	~	~
5619.953	387	0.10%	~	~
6007.287	25	~	23598.727	Sag
6032.288	449	0.21%	~	~
6481.629	228	0.19%	~	~
6709.91	25	~	39319.228	Sag
6734.91	208	0.26%	~	~
6942.832	35	~	-15766.603	Hog
6977.832	143	0.03%	~	~
7120.504	40	~	-16361.072	Hog
7160.504	192	-0.21%	~	~
7352.911	30	~	-17326.305	Hog
7382.911	236	-0.38%	~	~
7618.531	25	~	20742.706	Sag
7643.531	354	-0.26%	~	~
7997.26	25	~	-22536.688	Hog
8022.26	218	-0.37%	~	~
8239.979	337	-0.39%	~	~
8577.423	25	~	27719.163	Sag
8602.423	250	-0.30%	~	~
8852.547	25	~	-20585.59	Hog
8877.547	90	-0.42%	~	~
8967.405	25	~	15757.8	Sag
8992.405	510	-0.26%	~	~
9502.215	25	~	26763.397	Sag
9527.215	297	-0.17%	~	~
9824.492	50	~	-15716.659	Hog
9874.483	149	-0.48%	~	~

4.2.1 Gauging Summary

As discussed above, the characteristics of the existing rail corridor and structures suggest they may have been originally designed to accommodate a twin-track railway. However, whilst this design has demonstrated structural clearance in areas where track work has been proposed, the magnitude of clearance does not align with the requirements for upgraded lines, as defined in modern standards. It is therefore proposed to provide the modified GSWR (mGSWR) gauge in accordance with 'I-PWY-1101 v1.1 - Requirements for Track and Structures Clearances'. A technical note has been submitted to Iarnród Éireann for Approval and will be finalised as part of the Stage 5 design process. Proposed structure gauge clearances are shown in Table 4-6.

Table 4-6: Proposed Structure Gauge Clearance

Overbridge Structure	Track Intervention	Structure Gauge Clearance Achieved
OBY1A	Up & Dn renewed	IRL1
OBY1	Up & Dn renewed	GSWR modified
OBY2	Up & Dn renewed	GSWR modified
OBY3	Up & Dn renewed	IRL1
OBY4	Up & Dn renewed	GSWR modified
OBY5D	*No work*	*As existing*
OBY6	*No work*	*As existing*
OBY7	Up & Dn renewed	IRL1
OBY8	Up retained, Dn renewed	GSWR modified
OBY8a	Up retained, Dn renewed	IRL1
OBY8b	Up & Dn renewed	IRL1
OBY9b	Up & Dn renewed	IRL1

4.2.2 Track quantities

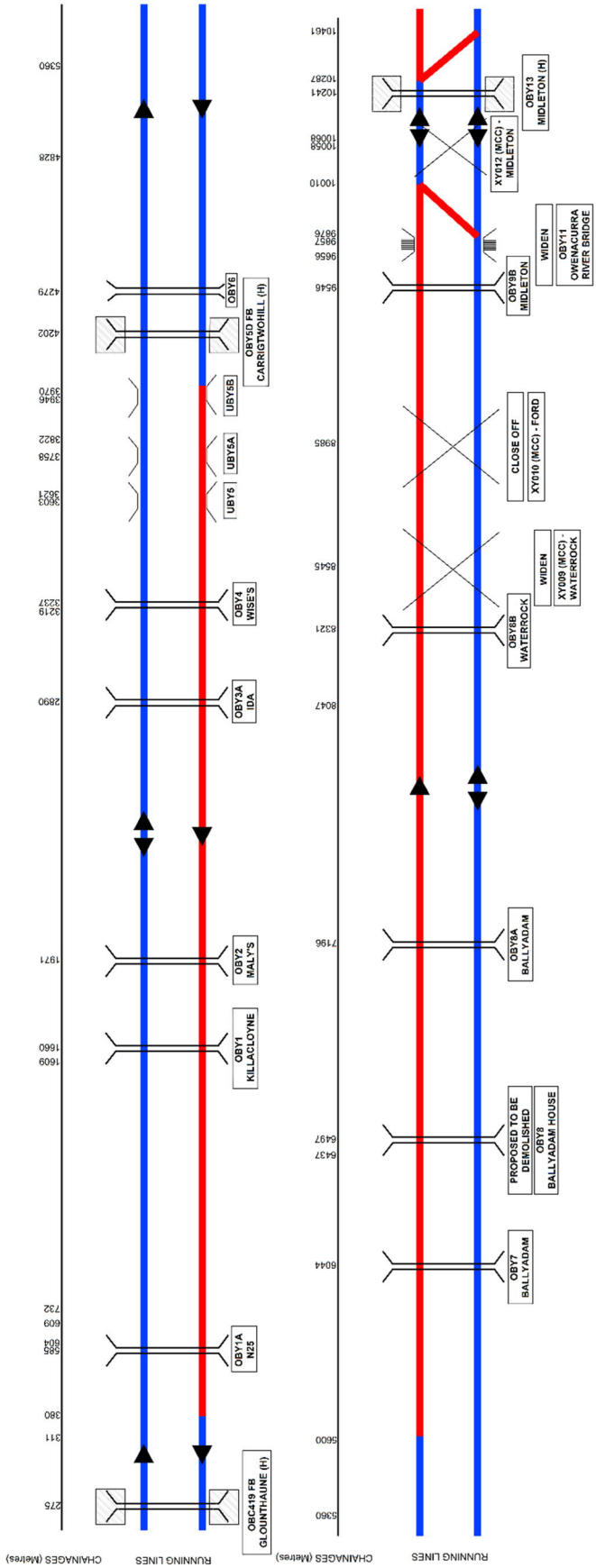
The proposed track schematic is shown in Figure 4-4.

The total length of new track in this design is 12061.6m. This is comprised of formation excavation and preparation, new rail & sleepers, top & bottom ballast.

Total length of slued track in this design is 3939.5m. This is comprised of existing rail & sleepers mechanically repositioned with local re-ballasting as required.

As discussed in above it may be possible to re-use some or all of the existing track materials to reduce the requirement for new rail and sleepers. Cleaning and recycling of track ballast will also be considered.

Figure 4-4: Proposed Track Schematic



4.3 Level Crossings

There are 3 no. level crossings along the route, and proposed works are tabulated in Table 4-7 below.

Table 4-7: Level Crossings

Level Crossing Code/Name	Crossing Type	Works	Chainage
Water Rock CCTV XY009	Remotely controlled	Widen	8600
Ford CCTV XY010	Remotely controlled	To be decommissioned	9000
Mill Road R626 CCTV XY012	Remotely controlled	None	10050

Refer to drawings C745-WP3_03-XX-XX-XXX-DR-MMD-PR-2301 and C745-WP3_03-XX-XX-XXX-DR-MMD-PR-2302 for details.

No works are currently proposed at Mill Road R626 CCTV XY012.

5 Structures

5.1 Proposed Structures Works

The proposed structures work identified for the Preliminary Design are outlined below. The structural solutions proposed, have been determined based on ground conditions from available historical ground investigations. These structural forms may be subject to change following completion of the detailed ground investigation.

The ground conditions described in the geotechnical summaries below, have been inferred from available historical (2006) ground investigations. A detailed ground investigation has been scheduled to specifically target ground conditions and associated geotechnical characteristics to inform detailed design of the proposed structure. The findings of which shall supersede the current geotechnical summary.

Approval in Principle – Design Statements are being finalised and will be submitted to Iarnród Éireann for approval on the structures listed below.

5.1.1 Retaining Walls

Retaining walls listed below in Table 5-1 have been identified as required to minimise impact on adjacent lands due to environmental constraints, or to maintain the tracks within the existing railway corridor. The retaining walls are predominately sheet piled structures due to the reduction in temporary and permanent land take required in comparison to a reinforced concrete gravity retaining wall structures and its increased retention height ability in comparison to gabion basket gravity structures. Gabion basket walls are only proposed where the retained height is relatively low. A typical sheet pile detail is shown in Figure 5-1.

Figure 5-1: Typical Sheet Pile Detail

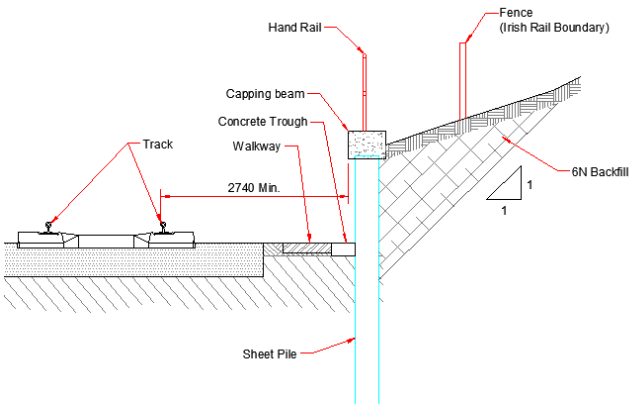


Table 5-1: Proposed Retaining Wall Works

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
RW MP740	720 – 750m	Retention of track embankment fill to the south with 30m of sheet pile wall. The maximum height will be 2.3m. The capping beam will be reinforced concrete with an edge protection handrail. The cable trough will be accommodated in the capping beam.	The structure is not expected to have an impact on the local hydrology.

Geotechnical Summary:

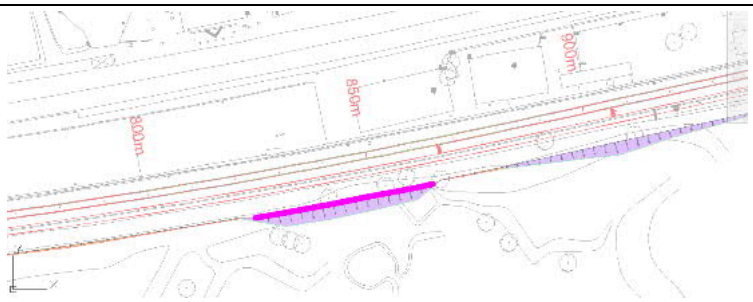
Made Ground: historically recorded between Ch 550m and Ch 800m up to 2m depth, typically comprising clay, gravel, and sand, with cobbles.

Superficial Deposits: comprising a sequence of granular and cohesive materials to a proven depth of 20 to 36m (at Ch 550 – Ch 620). Granular materials typically comprise medium dense to dense, locally loose silty SAND and GRAVEL layers with cobbles and some boulders. Cohesive deposits typically range from firm to stiff, locally very stiff gravelly sandy SILT and CLAY with cobbles and thin localised soft PEAT at depth (0.1m thick at 17.8m depth at c. Ch 615m). Soft sandy silts are encountered at depth c. 8 to 11.5m around Ch 615m.

Bedrock: rockhead profile is recorded to vary between 20m (Ch 610m) and 32.1m depth (Ch 615m). Where encountered, bedrock was recorded as very strong slightly to highly weathered LIMESTONE with local interbedded sandy gravelly SILT. Poor / no core recovery occurs in the weathered upper surface whilst CAVITIES of up to 1.3m are recorded at 26.1m and 28.0m depth at Ch 610m.

Groundwater Conditions: Rapid ingress of water recorded within granular deposits at 0.6m depth (at Ch 650) whilst elsewhere slight to moderate water seepage / flow recorded at 1.4m (Ch 740m) to 2.0m depth (Ch 750m). Water strikes recorded within 3 no. boreholes (Ch 565m, CH 610m, and Ch 615m) from 4.3m rising to 2.4m depth, within granular and cohesive deposits. Groundwater conditions are expected to be tidally influenced and when encountered within shallow granular deposits, promote ground instability.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
RW MP845	820 – 870m	Retention of track embankment fill to the south with 50m of gabion basket wall. The maximum height will be 1m.	The structure is not expected to have an impact on the local hydrology.

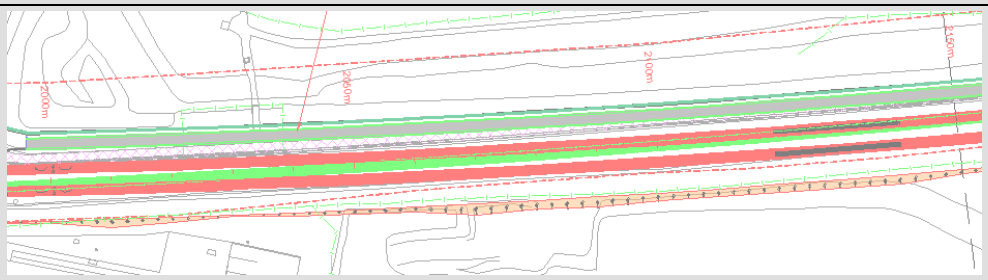


Geotechnical Summary:

Made Ground: historically recorded between Ch 550m and Ch 800m up to 2m depth, typically comprising clay, gravel, and sand, with cobbles.

Superficial Deposits: comprising a sequence of granular and cohesive materials to a proven depth of 20 to 36m (at Ch 550 – Ch 620). Granular materials typically comprise medium dense to dense, locally loose silty SAND and GRAVEL layers with cobbles and some boulders. Cohesive deposits typically range from firm to stiff, locally very stiff gravelly sandy SILT and CLAY with cobbles and thin localised soft PEAT at depth (0.1m thick at 17.8m depth at c. Ch 615m). Soft sandy silts are encountered at depth c. 8 to 11.5m around Ch 615m.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
Bedrock: rockhead profile is recorded to vary between 20m (Ch 610m) and 32.1m depth (Ch 615m). Where encountered, bedrock was recorded as very strong slightly to highly weathered LIMESTONE with local interbedded sandy gravelly SILT. Poor / no core recovery occurs in the weathered upper surface whilst CAVITIES of up to 1.3m are recorded at 26.1m and 28.0m depth at Ch 610m. **Groundwater Conditions:** Rapid ingress of water recorded within granular deposits at 0.6m depth (at Ch 650) whilst elsewhere slight to moderate water seepage / flow recorded at 1.4m (Ch 740m) to 2.0m depth (Ch 750m). Water strikes recorded within 3 no. boreholes (Ch 565m, CH 610m, and Ch 615m) from 4.3m rising to 2.4m depth, within granular and cohesive deposits. Groundwater conditions are expected to be tidally influenced and when encountered within shallow granular deposits, promote ground instability.			
RW MP2071 (IDA Open Culvert)	1+985 – 2+200m	The IDA Open Culvert carries a stream that runs parallel to the north of the existing track between OBY2 and OBY3A (IDA Bridge). The open culvert ties into the existing UBY2A Railway Underbridge at its west end which carries the existing single track over the stream. A 215m length of the existing open culvert is to be repositioned to accommodate the proposed second track. Retention of the track embankment cut to accommodate the realignment is provided with a sheet pile wall with a maximum height of 2.5m.	The structure is not expected to have an impact on the local hydrology as the re-positioned culvert will maintain the same vertical level, slope and channel width as existing. A hydraulic assessment will be undertaken as part of the OPW Section 50 application process.



Geotechnical Summary:

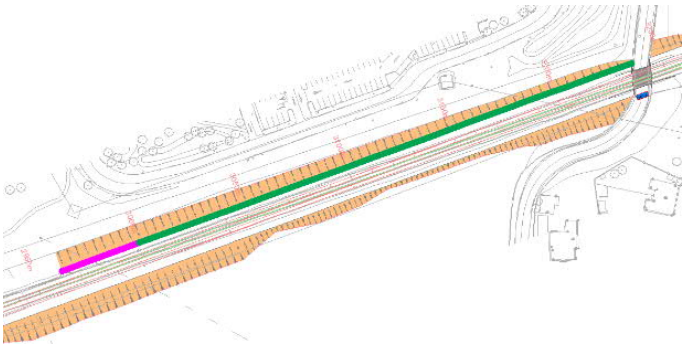
Made Ground: historically recorded between Ch 1780m and Ch 2250m up to 1.5m depth, typically comprising sand and gravel, with cobbles.

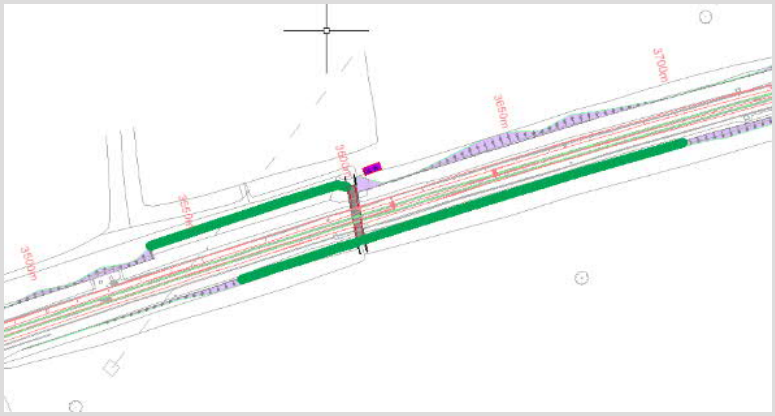
Superficial Deposits: comprising predominantly granular materials described as silty SAND and GRAVEL with cobbles and rare boulders, proven to a depth of 12m. Cohesive deposits described as soft slightly gravelly sandy CLAY with cobbles are recorded locally below GRAVEL deposits (c.130m off-track at Ch 2085). Ground conditions below 12m depth remain unknown.

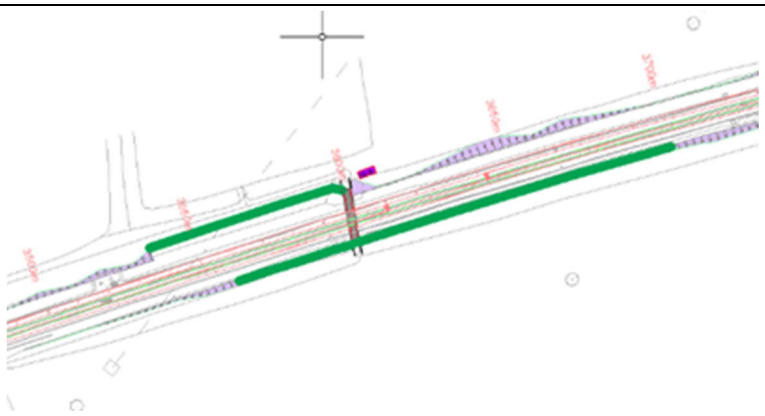
Bedrock: not encountered within trial pit or rotary core records.

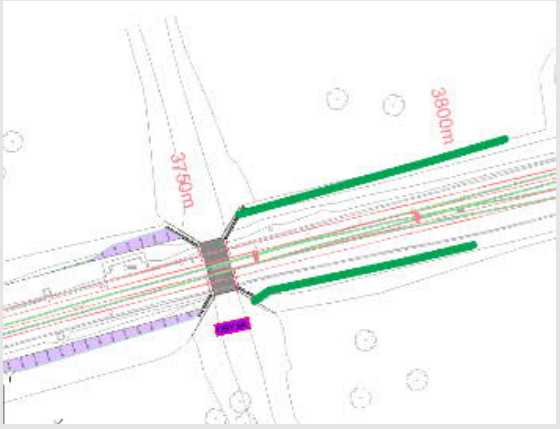
Groundwater Conditions: Rapid water ingress recorded from 1m depth within granular deposits in the area (Ch 1780), promoting unstable ground conditions.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
RW MP3060	2+960 – 3+230m	Retention of the track embankment cut to accommodate the realignment is provided with 40m of gabion basket wall and 230m of sheet pile walls with a maximum height of 2.0m. The sheet pile capping beam will be reinforced concrete with an edge protection handrail.	The structure is not expected to have an impact on the local hydrology.

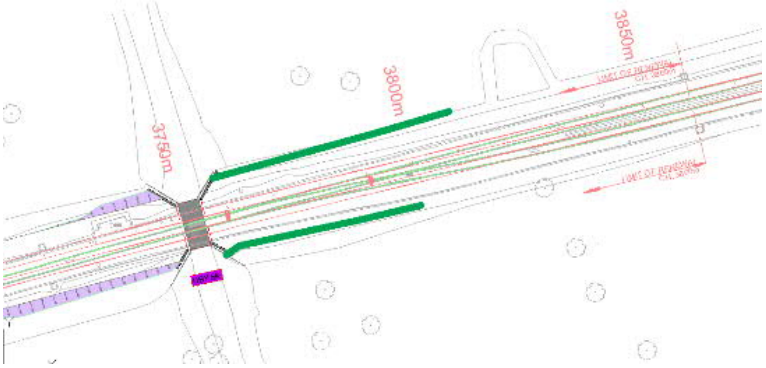


Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
Geotechnical Summary: **Made Ground:** historically recorded between Ch 1780m and Ch 2250m up to 1.5m depth, typically comprising sand and gravel, with cobbles. **Superficial Deposits:** comprising predominantly granular materials described as silty SAND and GRAVEL with cobbles and rare boulders, proven to a depth of 12m. Cohesive deposits described as soft slightly gravelly sandy CLAY with cobbles are recorded locally below GRAVEL deposits (c.130m off-track at Ch 2085). Ground conditions below 12m depth remain unknown. **Bedrock:** not encountered within trial pit or rotary core records. **Groundwater Conditions:** Rapid water ingress recorded from 1m depth within granular deposits in the area (Ch 1780), promoting unstable ground conditions.			
RW MP3553	3+535 – 3+600m	Retention of track embankment fill to the north with 65m of sheet pile wall. The maximum height will be 2m. The capping beam will be reinforced concrete with an edge protection handrail.	The structure is not expected to have an impact on the local hydrology.
			
Geotechnical Summary: **Made Ground:** historically recorded between Ch 3320m and Ch 3750m up to 3.7m depth, typically comprising sand and gravel, with cobbles and local silt. Slag, compact hardcore fill and steel fragments are also recorded locally at Ch 3585m and Ch 3750m. **Superficial Deposits:** comprising a sequence of cohesive and granular materials proven to a depth of 15m in the immediate location of the proposed structure, but up to 33m depth at Ch 3750m. Cohesive materials described as typically firm and stiff sandy SILT and CLAY with very little record of cobbles and boulders. Granular materials are described as medium dense, locally loose silty SAND, with GRAVEL and cobbles recorded to depth at Ch 3750m. **Bedrock:** not encountered within trial pit, borehole, or rotary core records. **Groundwater Conditions:** water strike recorded at 1 no. borehole (Ch 3750m) from 17.2m rising to 10.2m depth.			

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
RW MP3635	3+560 – 3+700m	Retention of track embankment fill to the south with 140m of sheet pile wall. The maximum height will be 2m. The capping beam will be reinforced concrete with an edge protection handrail.	The structure is not expected to have an impact on the local hydrology.
			

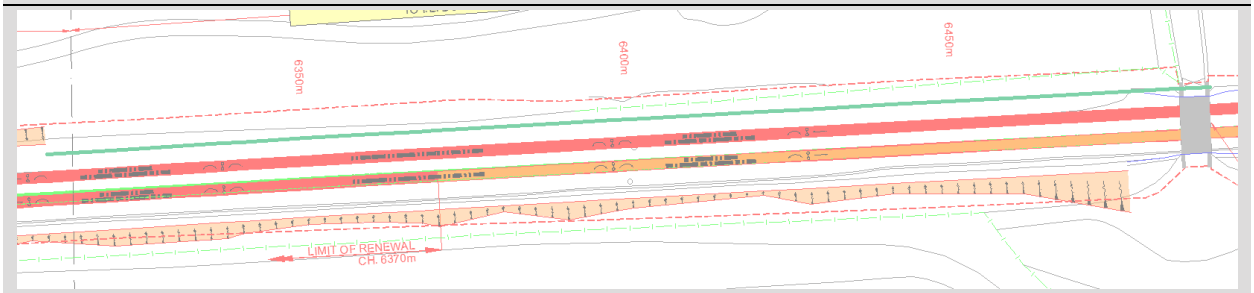
Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
Geotechnical Summary: **Made Ground:** historically recorded between Ch 3320m and Ch 3750m up to 3.7m depth, typically comprising sand and gravel, with cobbles and local silt. Slag, compact hardcore fill and steel fragments are also recorded locally at Ch 3585m and Ch 3750m. **Superficial Deposits:** comprising a sequence of cohesive and granular materials proven to a depth of 15m in the immediate location of the proposed structure, but up to 33m depth at Ch 3750m. Cohesive materials described as typically firm and stiff sandy SILT and CLAY with very little record of cobbles and boulders. Granular materials are described as medium dense, locally loose silty SAND, with GRAVEL and cobbles recorded to depth at Ch 3750m. **Bedrock:** not encountered within trial pit, borehole, or rotary core records. **Groundwater Conditions:** water strike recorded at 1 no. borehole (Ch 3750m) from 17.2m rising to 10.2m depth.			
RW MP3805	3+760 – 3+810m	Retention of track embankment fill to the north with 50m of sheet pile wall. The maximum height will be 2.2m. The capping beam will be reinforced concrete with an edge protection handrail.  	The structure is not expected to have an impact on the local hydrology.
Geotechnical Summary: **Made Ground:** historically recorded between Ch 3750m and Ch 3900 up to 2.1m depth, typically comprising sand and gravel with cobbles Slag and compact hardcore fill are also recorded locally at Ch 3750m. **Superficial Deposits:** comprising cohesive and granular materials proven to a depth of 33m. Cohesive materials recorded in a soils borehole are described as typically firm and stiff sandy SILT and CLAY with very little record of cobbles and boulders to 15.5m thereafter underlain by medium dense SAND. A corresponding rotary borehole records predominantly GRAVEL with cobbles overburden to 33m depth without encountering bedrock. **Bedrock:** not encountered within trial pit, borehole, or rotary core records. **Groundwater Conditions:** water strike recorded at 1 no. borehole (Ch 3750m) from 17.2m rising to 10.2m depth.			

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
RW MP3810	3+760 – 3+860m	Retention of track embankment fill to the south with 100m of sheet pile wall. The maximum height will be 2.0m. The capping beam will be reinforced concrete with an edge protection handrail.	The structures are not expected to have an impact on the local hydrology.



Geotechnical Summary:

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
Made Ground: historically recorded between Ch 3750m and Ch 3900 up to 2.1m depth, typically comprising sand and gravel with cobbles Slag and compact hardcore fill are also recorded locally at Ch 3750m. **Superficial Deposits:** comprising cohesive and granular materials proven to a depth of 33m. Cohesive materials recorded in a soils borehole are described as typically firm and stiff sandy SILT and CLAY with very little record of cobbles and boulders to 15.5m thereafter underlain by medium dense SAND. A corresponding rotary borehole records predominantly GRAVEL with cobbles overburden to 33m depth without encountering bedrock. **Bedrock:** not encountered within trial pit, borehole, or rotary core records. **Groundwater Conditions:** water strike recorded at 1 no. borehole (Ch 3750m) from 17.2m rising to 10.2m depth.			
RW MP6405	6+310 – 6+500m	Retention of track embankment cut to the north with 190m of sheet pile wall. The maximum height will be 2.9m. The capping beam will be reinforced concrete with an edge protection handrail.	The structure is not expected to have an impact on the local hydrology.



Geotechnical Summary:

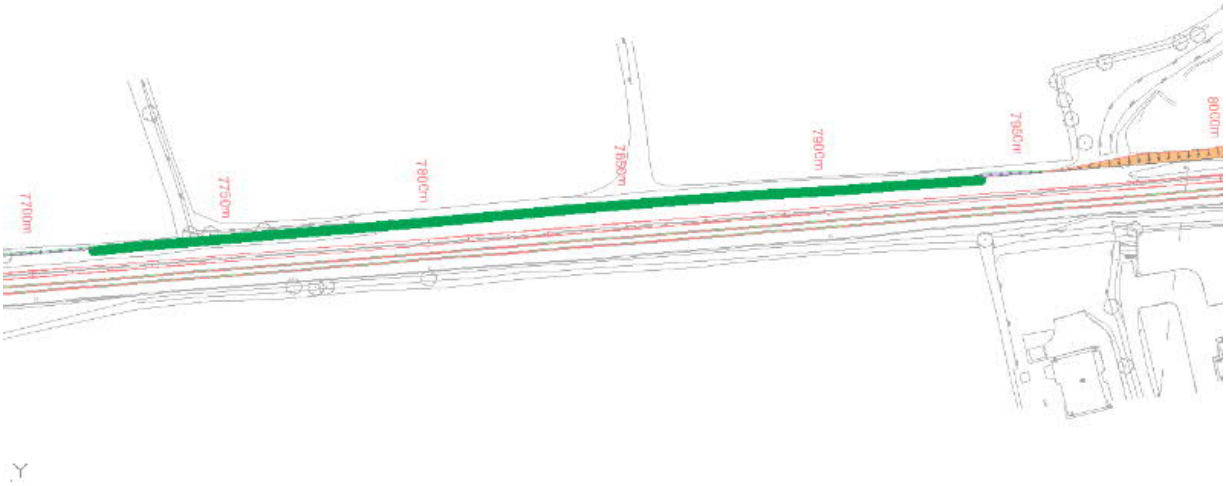
Made Ground: historically recorded between Ch 6265m and Ch 6615m to a depth of 1.2m, typically comprising sand and gravel, with cobbles.

Superficial Deposits: based on very limited information, these are recorded to comprise granular and cohesive materials to a proven depth of 3.5m. Granular materials are typically described as SAND and GRAVEL, with cobbles whilst cohesive materials are described as a soft to firm SILT, with local boulders. Glacial Till and karst features are known to existing in the area however, at present nature and characteristics of ground conditions below 3.5m depth remain unknown.

Bedrock: not encountered in trial pit records.

Groundwater Conditions: not recorded in trial pit records.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
RW MP7828	7+715 – 7+940m	Retention of track embankment fill to the north with 225m of sheet pile wall. The maximum height will be 1.9m. The wall will be reinforced concrete with an edge protection handrail.	The structure is not expected to have an impact on the local hydrology.



Geotechnical Summary:

Made Ground: historically recorded between Ch 7790 and Ch 8000m to a depth of 2.0m, typically comprising sand and gravel, with cobbles and boulders.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
Superficial Deposits: based on very limited information, these are recorded to comprise predominantly granular deposits, described as SAND and GRAVEL with cobbles, to a proven depth of 3.5m. **Bedrock:** not encountered within trial pit records however shallow rock exposures are observed from Ch 7975m to Ch 8110m. Shallow rock was recorded at 0.7m depth within 2 no. rotary probe holes sunk at Ch 8040 and Ch 8045m to investigate geophysical anomalies. Strong / Very strong moderately weathered LIMESTONE was proven to 8m depth. **Groundwater Conditions:** not recorded within trial pit and rotary drilling records.			
RW MP9760	9+710 – 9+805m	Retention of track embankment fill to the south with 95m of gabion basket wall. The maximum height will be 1.1m.	The structure is not expected to have an impact on the local hydrology.

Geotechnical Summary:

Made Ground: historically recorded between Ch 9655m and Ch 9840m, typically comprising sand and gravel, with cobbles and layers of soft friable silts to a depth of 3m. Waste fragments of glass, plastic, timber, gravelly ash, and slag rubble are encountered locally.

Superficial Deposits: comprising predominantly of granular materials described as medium dense to dense SAND and GRAVEL with sandstone cobbles and local silts, proven to 27 to 38m depth.

Bedrock: encountered in a single borehole at Ch 9835m at 28.2 depth, comprising strong slightly weathered grey marbled LIMESTONE. Possible core loss with infill was recorded at 29.6m – 31.3m bgl, with a solution hollow recorded at 31.1 – 31.23m bgl and non-intact core (recovered as silty sand and gravel) at 33.4 – 33.7m bgl.

Supplementary drilling and probing between Ch 9610m and Ch 9620m recorded rockhead between 27.7m (Ch 9610m) and 31m depth (Ch 9620m). Where encountered, bedrock was recorded as very weak completely weathered whitish grey LIMESTONE to a very strong moderately weathered grey marbled massive LIMESTONE.

Groundwater Conditions: water strikes recorded within 2 no. Boreholes (Ch 9840m and Ch 9845m) from 4.7m rising to 3.2m depth, within granular deposits.

5.1.2 Underbridges Works

Proposed underbridge works listed below in Table 5-2 identify locations along the track where existing underbridges/culverts need to be extended to provide the cross section required to carry the twin tracks and lineside infrastructure.

Table 5-2: Proposed Underbridge Works

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
UBY1B (Culvert)	1+350m	The existing culvert is a 14m long box structure. The span is 1.5m and the culvert internal height is 1m. Reinforced concrete wingwalls are provided at both the inlet and outlet. The culvert is to be lengthened by 1m to the north. The cross-section dimensions of the lengthened sections will match the existing cross section. The existing north wingwalls are to be demolished and rebuilt to accommodate the lengthened structure.	The structure is not expected to have an impact on the local hydrology as the soffit level and span arrangement of the lengthened sections will match the existing bridge. A hydraulic assessment will be undertaken as part of the OPW Section 50 application process.
Geotechnical Summary: **Made Ground:** historically recorded in the vicinity of Ch 1350, typically comprising gravelly sand / sandy gravel with cobbles, overlying soft silts with local boulders and concrete, to a depth of 2.1m. These materials are considered to comprise FILL associated with the historical railway and culvert structure. **Superficial Deposits:** comprising of granular and cohesive materials to a proven depth of 3.5m. Granular materials are described as SAND and GRAVEL with cobbles. Cohesive materials described as soft to firm locally friable SILT and CLAY with gravel, cobbles, and rare boulders. Ground conditions below 3.5m depth remain unknown. **Bedrock:** not encountered within trial pit records. **Groundwater Conditions:** Slight water seepage recorded at 1.5m and 3.1m at Ch 1335m within made ground and cohesive materials, respectively.			

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
UBY1C (Culvert)	1+700m	The existing culvert is a 10m long box structure. The span is 2.1m and the culvert internal height is 1m. Reinforced concrete wingwalls are provided at both the inlet and outlet. The culvert is to be lengthened by 1m to the north. The cross section dimensions of the lengthened sections will match the existing cross section. The existing north wingwalls are to be demolished and rebuilt to accommodate the lengthened structure.	The structure is not expected to have an impact on the local hydrology as the soffit level and span arrangement of the lengthened sections will match the existing bridge. A hydraulic assessment will be undertaken as part of the OPW Section 50 application process.
Geotechnical Summary: **Made Ground:** historically recorded in the vicinity of Ch 1700, typically comprising sand and gravel with cobbles to a depth of 0.8m. These materials are considered to comprise FILL associated with the historical railway and culvert structure. **Superficial Deposits:** locally comprising of predominantly of granular materials, described as SAND / SAND and GRAVEL with cobbles, overlying firm silts, to a proven depth of 2.7m. At Ch 1880, granular deposits were proven to extend beyond 12m depth. **Bedrock:** not encountered within trial pit or borehole records. **Groundwater Conditions:** Rapid ingress of water recorded locally from 1.1m depth within granular deposits promoting unstable ground conditions.			

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
UBY2A	1+985m	The existing culvert is a 12m long twin cell structure. The spans are 2.4m and 2.1m and the culvert internal height is 1.2m. Reinforced concrete wingwalls are provided at both the inlet and outlet. The culvert is to be lengthened by 2m to the north and 2m to the south. The cross-section dimensions of the lengthened sections will match the existing cross section. The existing north and south wingwalls are to be demolished and rebuilt to accommodate the lengthened structure.	The structure is not expected to have an impact on the local hydrology as the soffit level and span arrangement of the lengthened sections will match the existing bridge. A hydraulic assessment will be undertaken as part of the OPW Section 50 application process.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary

Geotechnical Summary:

Made Ground: historically recorded between Ch 1780m and Ch 2250m, typically comprising sand and gravel, with cobbles, to a depth of 1.5m.

Superficial Deposits: comprising predominantly granular materials described as silty SAND and GRAVEL with cobbles and rare boulders, proven to a depth of 12m. Cohesive deposits described as soft slightly gravelly sandy CLAY with cobbles, encountered locally c.130m off-track at approximate Ch 2085.

Bedrock: not encountered within trial pit or rotary core records.

Groundwater Conditions: Slight water seepage noted at 1.5m and rapid ingress of water noted at 2.0m at 1 no. trial pit located c.130m off-track at approximate Ch 2085.

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary
UBY11 (Owen-acurra River Bridge)	9+870m	The proposed widening to Railway Underbridge UBY11 is a three span continuous deck with integral abutments. The bridge crosses the Owenacurra River at 0^0 skew. The span lengths from west to east are 10.850m, 7.160m and 10.850m. The widening structure span arrangement, structural form and articulation will match the existing bridge. The widening deck consists of precast prestressed concrete beams with an insitu infill concrete deck which is to be stitched to the existing deck. The bankseat widenings are supported on continuous flight auger piles. The existing pier capping beams are to be widened to accommodate the proposed deck. The existing north walkway is to be removed and reinstated on the widened deck. The existing reinforced concrete northern wingwalls are to be demolished and rebuilt to accommodate the widened deck to Chainage 9+800.	The structure is not expected to have an impact on the local hydrology as the widening soffit level and span arrangement will match the existing bridge. A flood risk assessment is being undertaken as part of the OPW Section 50 application process.

Geotechnical Summary:

Made Ground: historically recorded between Ch 9655m and Ch 9840m, typically comprising sand and gravel, with cobbles and layers of soft friable silts to a depth of 3m. Waste fragments of glass, plastic, timber, gravelly ash, and slag rubble are encountered locally.

Superficial Deposits: comprising predominantly of granular materials described as medium dense to dense SAND and GRAVEL with sandstone cobbles and local silts, proven to 27 to 38m depth.

Bedrock: encountered in a single borehole at Ch 9835m at 28.2 depth, comprising strong slightly weathered grey marbled LIMESTONE. Possible core loss with infill was recorded at 29.6m – 31.3m bgl, with a solution hollow recorded at 31.1 – 31.23m bgl and non-intact core (recovered as silty sand and gravel) at 33.4 – 33.7m bgl.

Supplementary drilling and probing between Ch 9610m and Ch 9620m recorded rockhead between 27.7m (Ch 9610m) and 31m depth (Ch 9620m). Where encountered, bedrock was recorded as very weak completely weathered whitish grey LIMESTONE to a very strong moderately weathered grey marbled massive LIMESTONE.

Groundwater Conditions: water strikes recorded within 2 no. Boreholes (Ch 9840m and Ch 9845m) from 4.7m rising to 3.2m depth, within granular deposits.

5.1.3 Overbridges Works

Proposed Overbridge Works listed below in Table 5-3 identify locations along the track where the existing overbridges cross section will not allow the IRL 1 layout and a derogation will be required to provide modified GSWR structure gauge.

The preliminary design has also identified OBY8 (Ballyadam Bridge) which technically can be removed as it does not have a functional requirement.

Table 5-3: Proposed Overbridge Works

Code	Chain.	Proposed Works	Hydrology and Hydraulic Summary	Geotechnical Summary
OBY1 (Killacoyne Bridge)	1+660m	Derogation for a modified GSWR structure gauge.	Not applicable.	Not applicable.
OBY2 (Maly's Bridge)	1+970m	Derogation for a modified GSWR structure gauge.	Not applicable.	Not applicable.
OBY4 (Wise' Bridge)	3+240m	Derogation for a modified GSWR structure gauge.	Not applicable.	Not applicable.
OBY7 (Ballyadam Bridge)	6+040m	Derogation for a modified GSWR structure gauge.	Not applicable.	Not applicable.
OBY8 (Ballyadam Bridge)	6+500m	Demolition of existing bridge.	Not applicable.	Not applicable.

5.2 Corrosion Protection, Waterproofing, Impregnation

All buried concrete surfaces will be waterproofed. The proposed UBY11 bridge deck widening and culverts will have a spray applied waterproof membrane.

Concrete exposure classes and cover will be in accordance with DN-STR-03012 and IS EN 206.

All exposed concrete surfaces will be impregnated with a hydrophobic pore liner.

Sacrificial steel thickness shall be the method of corrosion protection for the sheet pile walls.

The sheet pile walls shall be constructed so as to prevent the passage of ground water. This is to be achieved through the use of sealants at the sheet pile clutches.

The design life of all structures is 120 years.

5.3 Drainage

The widening to Railway Underbridge UBY11 will have an average longitudinal fall of 1% from west to east which will allow effective drainage of the superstructure.

Back of wall drainage will be provided in accordance with Cl. 513 (CC-SPW-00500) of the TII Specification for Road Works with a 150mm diameter perforated drainage pipe located behind the bank seats, retaining walls and wingwalls.

Back of wall drainage to all structures will have rodding facilities that will be easy to access for maintenance and cleaning.

5.4 Inspection and Maintenance Provisions

On UBY11 the bridge parapets provide protection for inspection and maintenance staff. Boat access will be required for pier and deck soffit inspections. In-river scaffolding or MEWP access from riverbank will be required for maintenance of the piers and deck soffit. The bankseats will be accessed from the riverbanks. The use of an integral deck reduces the level of ongoing maintenance required.

The parapets at the culvert openings provide protection for inspection and maintenance staff. The culvert channels are confined spaces so inspection will need to be undertaken using remote camera access.

Maintenance for the sheet pile retaining wall structures is expected to be minimal. The majority of the walls are both visible and accessible from trackside in areas of cut and the maintenance strip in areas of fill. Inspection of retaining wall RW MP740 will be undertaken using boat access as there is insufficient room to position a maintenance strip at the harbour edge. Inspection of retaining wall RW MP2071 will be undertaken in the maintenance strip between the IDA culvert and the wall. Handrails will be provided to the capping beams as fall protection to inspection and maintenance staff.

5.5 Loading

All loading shall be in accordance with CCE-TMS-410 – Civil engineering Structures Design Standard.

Permanent actions shall be categorised into two different types for this type of structure:

- Permanent Actions – self weight
- Super-Imposed Actions - weight of the ballast and track materials above the structures which is applied as a uniformly distributed load to the decks as well as weight of the soil on each side of the structure.

IS EN 1991-1-3 -Snow loads do not include special aspect of snow loading, for example snow loads on bridges. Hence IS EN 1991-1-3 is normally not applicable to bridge design for the persistent design situations. Snow load consideration can be omitted in Ireland in accordance with IS EN 1990.

IS EN1991–1–4 gives rules for the determination of quasi-static effects of natural wind actions for the structural design of bridges. Simultaneous effects of wind and temperature can be omitted according to IS EN 1990. Thermal actions may have a significant effect on the structures due to contraction and expansion. Values of these action will be determined from IS EN 1991-1-5 and its National Annex.

Thermal Actions will be applied in accordance with IS EN 1991, Part 1-4.

Bridge UBY11 and the culverts will be designed for Load Models 71 and SW/0 in accordance with IS EN 1991-2:2003 and the National Annex.

UBY11 will be assessed for dynamic forces in accordance with CCE-TMS-410 Clause 5.2.5.

Bridge UBY11 and the culverts will be designed for traction and braking forces in accordance with IS EN 1991-2:2003 and the Irish National Annex.

Rail collision forces on the superstructures will be to IS EN 1991-1-7:2006 and Irish National Annex.

Fatigue effects will be assessed in accordance with IS EN 1992-1-1 and IS EN 1992-2.

Hydrodynamic effects of the Owenacurra River on UBY11 will be in accordance with IS EN 1991 Part 1-6.

Differential settlement of 10mm between adjacent supports of UBY11 shall be considered in the design. Differential settlement of 5mm between opposing ends of the existing and new substructure elements shall be considered in the design i.e. 5mm differential movement between the north and south elevations.

6 Safety

6.1 Railway Safety Assurance

The safety assurance plan for the CACR programme is under development by IÉ. The Glounthaune Midleton Twin tracking project will have to comply with this plan.

The key features will be:

- The management of the design and construction of the twin tracking including particular features such as the localised route widening, the gauge clearances through existing bridges, the widening of the Owenacurra Bridge, the modification to the points and crossings, the sidings at Midleton.
- the Management of the design and construction planning process between Glounthaune-Midleton Twin Tracking Project and the CACR Signalling and Telecommunications Project.
- Any provisions for future CACR projects
- Interfaces with other ongoing IÉ projects, such as TPS and NTCC

6.2 Safety During Construction

The Designer will comply with the General Principles of Prevention (of accidents) as specified in the Third Schedule of the Safety, Health and Welfare at Work Act 2005 and liaise with the Project Supervisor appointed by the Client for the Design Process and the Project Supervisor appointed for the Construction Stage as required by the 'Safety, Health and Welfare at Work (Construction) Regulations 2013'. The Project Supervisor will comply with all the design process requirements outlined in Clauses 11, 12, 13 & 14 of S.I. No. 291 of 2013 of the 'Safety, Health and Welfare at Work (Construction) Regulations 2013'.

6.3 Security

In areas identified as trespass and vandalism risks there shall be additional measures such as fencing and barriers to control the risk.

Compounds shall be constructed to provide a safe holding facility at key locations or known route crime hot spots. Although intended initially to mitigate trespass and vandalism risks during construction, these facilities may be used in the future to store items such as strategic spares, other plant and materials.

Compounds and storage areas shall be arranged so that as far as is reasonably practicable access from the highway is achieved without going on or near the line'

6.4 Safety in Use

Refer to Section 5.4 for details of inspection and maintenance of the structures crossing the track.

Bridge parapets and transitions will be designed for collision loading in accordance with IS EN 1317. Wingwalls, abutments and bridge decks will be designed for vehicle/rail impact loads to IS EN 1991-1-7 and Irish Rail CCE-TMS-410.

7 Geotechnical Summary

7.1 Geotechnical Summary

It is proposed to undertake the following geotechnical works:

- Construct earthworks where land take permits
  - within the preliminary design it is considered that Cut and Formed Embankment slopes will be formed at current slope angles in 1 in 1.5 to 1 in 2 gradients.
  - embankments will be formed using site won materials predominantly comprising granular deposits and locally cohesive deposits where the necessary compaction is achievable (i.e. soft silts will unlikely prove to be acceptable within new embankments)
  - Embankment fills will expect to be compacted to 95% relative density / less than 5% air voids, benched into existing railway earthworks. Permissible earthworks classifications for re-usable site-won materials are considered to be Class 1 and Class 2 General Fills, and Class 6N/6P Granular Structural Fills.
  - Groundwater management may be required locally within cut slopes with local drainage requirements to be determined once more detailed information on the underground groundwater regime is determined within the scheduled detailed ground investigation.
- Construct retaining structures to minimise Land Take
  - within the preliminary design sheet pile retaining structures have been adopted with embedment expected to be of the order of twice the retained height.
  - Sheet piled solutions are to be adopted where ground conditions are considered favourable to driving (i.e. in alluvial sediments, loose sands and gravels, in absence of cobbles and boulders, stiff / very stiff glacial till, shallow rock)
  - Where ground conditions and working areas / strips permit ground bearing solutions, gabion walls and / or mass gravity structures are to be adopted.
  - In the absence of detailed ground investigation and therefore a thorough understanding of the prevailing ground conditions and engineering parameters, other retaining solutions such as soil nailed cut slopes and reinforced earth embankments are currently not discounted at this stage, and all options shall be considered based on the project requirements and ground / site conditions once detailed ground investigations have been completed.
  - in the absence of shallow rock, it is suitably angled.
- Design and construct appropriate foundations to support overwater Bridge Structure UBY11
  - Piled foundations into the underlying bedrock are currently being considered to support the proposed rail crossing, pending confirmation of the underlying ground conditions and structural loading and performance of the bridge structure.
  - Shallow ground bearing foundations may be considered if/where ground conditions permit (i.e. very stiff glacial till, shallow rock, absence of karst risk)

7.2 Description of the Ground Conditions

Ground conditions along the proposed development have been derived using the following sources of information:

- Geological Survey of Ireland (GSI), 2022, found online at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228
- Environmental Protection Agency, Ireland (EPA) Geoportal, found online at: https://gis.epa.ie/EPAMaps/Water
- Irish Drilling Limited, Glounthaune to Midleton Railway Scheme, Site Investigation Factual Report, dated June 2006.
- Irish Drilling Limited, Glounthaune to Midleton Railway Scheme, Additional Works, Site Investigation Factual Report, dated August 2006.

A summary of the geological and hydrogeological conditions along the proposed development is presented in Table 7-1 below.

Table 7-1: Geology Summary

Aspect	Details [(1)]
Superficial Geology	The superficial geology along the route is recorded to vary, generally comprising the following: ● **Alluvium** between Ch 0m – 370m, Ch 9620m – Ch 9900m ● **Estuarine Silts and Clays** between Ch 410m – Ch 600m ● **Till,** derived from Devonian aged sandstones, between Ch 370m – Ch 410m, Ch 600m – Ch 740m, Ch 3320m – Ch 7840m, and Ch 8480m – Ch 8670m ● **Gravels,** derived from Devonian aged sandstones, between Ch 740m – Ch 3320m, Ch 7840m – Ch 8480m, and Ch 8670m – Ch 9620m
Solid Geology	The bedrock geology along the route is recorded to comprise: ● Waulsortian Limestone Formation: Carboniferous pale grey, fine grained, massive or crudely bedded carbonate mud limestone. Encountered at Ch 0m – Ch 70m, Ch 150m – Ch 2690m, and Ch 5300m – Ch 9900m ● Ballysteen Formation: Carboniferous irregularly bedded clay rich bioclastic limestone (wackstones and packstones) with interbedded fossiliferous calcareous shales. Encountered at Ch 70m – Ch 150m and Ch 2690m – Ch 5300m
Structural Geology	The site is intersected by three faults, all of which are orientated roughly N-S, at the following locations: ● Ch 70m, Ch 2690m, and Ch 9820m
Hydrology [(2)] and Hydrogeology	Hydrology See Section 1.3 Hydrogeology The site is underlain by a number of aquifers: ● Regionally Important Aquifer – Karstified with diffuse flow (Ch 0m – Ch 2800, Ch 5300m – Ch 10600m) ● Locally Important Aquifer – Bedrock moderately productive in localised zones (2800m – Ch 5300m) ● Carrigtwohill Gravel Aquifer – locally important (Ch 750m – Ch 3250m) ● Midleton Gravel Aquifer – locally important (Ch 9150m – Ch 10250) ● Abstraction wells associated with Carrigtwohill Gravel Aquifer (location accurate to 50m or less) – One well 30m north of track Ch 20m – Thirteen wells within 500m (nearest 110m), predominantly south of track, Ch 2000m – Ch 2900m – One well 120m south of track Ch 4440m

Aspect	Details [1]
	● Other abstraction wells (location accurate to 50m or less): – One well 7m south of track Ch 8850m – One well 1m north of track Ch 9495m – Five wells 100-200m north of track Ch 10200m – Ch 10350m There are sections of the rail line where karst geology / bedrock is recorded at the surface, or the groundwater is recorded as being extremely vulnerable, at approximate Ch 6100m, Ch 7300m – 7900m, and Ch 8400m – 8800m.
Karst features	Numerous dissolution/karst features are recorded to be present along the route, as follows: ● Caves and a swallow hole approximately 250m south of the track at Ch 4930m ● Two turloughs are located approximately 150m north of the track (Ch 6150m) and underlying or adjacent to the track (Ch 6280m). ● Two enclosed depressions and a swallow hole are located roughly 250m south of the track ● Two enclosed depressions 300m south of track (Ch 6150m and 63400m) ● One swallow hole 300m south of track (Ch 6550m) ● One swallow hole 300m south of Ch 4750m (may be connected to spring at Ballinturbid within Great Island Channel SAC) ● One swallow hole adjacent to track (Ch 8500m) ● One spring 630m south of track (Ch 8600m) ● Two caves c. 200m north of Midleton station ● Three caves 25m south of track (Ch 8550m) (one has water flowing into it) ● One cave 260m south of track (Ch 4850m) ● One cave 250m south of track (Ch 5050m) ● Karstified bedrock outcrop approximately 180m south of the track between Ch 5030m – Ch 5220m, 70m south of the track between Ch 5700m - Ch 5800m, 70m north to the track between Ch 6270m – Ch 6280m ● Karstified bedrock outcrop between Ch 8080m - Ch 8120m and Ch 8520km – Ch 8600km Several of the karst features that were identified within the published geological mapping (described in S1.6.1) were also identified during the historical GI undertaken by IDL in 2006. As part of the original GI, a geophysical survey was undertaken along the length of the railway line which identified a number of anomalies within the bedrock which were considered to be potentially indicative of sub-surface cavities / voids. Following this survey, a further borehole / probing investigation was undertaken as part of the additional GI works to specifically target these anomalies. The exact location of these anomalies, and the findings and interpretation of the additional GI works are reported within the AGEC Interpretative Report, and are also summarised below: ● A spring 50m north of the track c. Ch 4400m ● Surface depression/pond 50m south of the track c. Ch 3600m ● 6 no. swallow holes 250m ‑ 500m south of the track c. Ch 6000m ‑ Ch 6500m ● 9 no. swallow holes 0 ‑ 150m north of the track c. Ch 8800m ‑ Ch 9700m ● 5 no. swallow holes 50 ‑ 300m south of the track c. Ch 8800m ‑ Ch 9300m ● 2 no. swallow holes 300m north of Midleton station

Source:

1. Geological Survey of Ireland (GSI), 2022, found online at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228
2. Environmental Protection Agency, Ireland (EPA) Geoportal, found online at: https://gis.epa.ie/EPAMaps/Water

7.3 Key Ground Risks to the Proposed Works

From review of the above information, the key risks to the proposed development are detailed below.

- Soft ground deposits, potentially at depth, associated with the coastal / inter-tidal environment, potentially impacting:
  - ground stiffness characteristics below track bed requiring geotextile reinforcement
  - performance & stability of ground bearing structures with potentially intolerable long-term settlements leading to deeper foundations and retaining wall solutions
  - re-use in earthworks due to inherently high moisture contents and poor compaction qualities
- Presence of cobbles and boulders impacting pile driving (sheet piles / pre-cast piles) potentially promoting soil nailing solutions in earthworks slopes and rotary bored piles at UBY11
- Shallow groundwater promoting ground instability, running sands, etc potentially problematic for shallow excavations at culvert extension works. Ground support and groundwater management will expect to be required to facilitate construction.
- Karst risk recorded at several locations within close proximity of the works for Ch 5000 to Midleton Station.
- Potential for ground contamination leading to offsite disposal of spoil / contaminated arisings.

These risks shall be managed through civil engineering design of appropriate solutions and adoption of good construction working practices.

8 Drainage

This chapter outlines the preliminary drainage design for the Glounthaune to Midleton Twin Track upgrade. The design philosophy is presented, together with the basis for design which adopts current best practice guidelines. The conveyance systems proposed include kerb and gully (at level crossings), filter drains and open v-ditches The provision of outfall treatment is also discussed, including the environmental measures required to ensure the integrity of water quality in the receiving waters.

8.1 Design Philosophy

The drainage design for the scheme will achieve three primary objectives;

- The speedy removal of surface water to provide safety and minimum nuisance.
- The provision of effective sub-surface drainage to maximise longevity of the pavement, rail tracks and its associated earthworks.
- Minimisation of the impact of runoff on the receiving environment.

The drainage design aims to achieve these primary objectives in line with the ideals of sustainable development collectively referred to as Sustainable Drainage Systems (SuDS). Appropriately designed, constructed and maintained SuDS are more sustainable than conventional drainage methods due to their ability to mitigate many of the adverse effects of urban stormwater runoff on the environment.

A review of existing drainage along the route has been undertaken. It is expected that where the railway tracks are being retained, the existing drainage system will be retained along these sections of tracks.

8.2 Conveyance Systems Used

A combination of drainage systems will be used to drain the track and any associated impermeable surfaces. The route comprises of a sequence of cuttings and embankments, with earthworks drainage provided in the form of open v-ditches to intercept surface water and sub-surface water where the adjoining land slopes towards the track.

The principal types of drainage systems proposed are as follows:

8.2.1 Filter Drain

The drainage system consists of an open jointed, porous or perforated pipe laid in a trench which is backfilled with a porous media used for conveyance and source control (attenuation Surface water runs off the track enters the top surface of the trench, passing through the filter material and into the pipe at the base of the trench. Generally, filter drains are low maintenance and provide long ranging performance and are used where the track is at grade or in cuttings.

A summary of the approximate lengths of existing filter drain retained, removed and proposed are shown in Table 8-1 below.

Table 8-1: Approximate Filter Drain Quantities

	Retain Existing Filter Drain	Remove Existing Filter Drain	Proposed Filter Drain
Total (m)	8080	9135	9580

8.2.2 Open V-Ditch

Where surface water and sub-surface water from adjoining land may flow towards the track corridor, it will be intercepted by the construction of drains. These drains will take the form of V-ditches due to their capacity and cost-effectiveness construction.

8.2.3 Sub-surface Drainage

Sub-surface drainage will comprise of the provision of filter drains to drain the capping layer within cut areas, in areas of embankment the capping layer can be extended to provide over the edge drainage of sub formation.

8.3 Design Criteria

The design of the surface water drainage system will depend on a number of variables, including the intensity, duration and frequency of the rainfall, together with the size and type of area contributing the run-off. Design is generally based on the rainfall intensity of short duration high intensity storm events occurring in summer, which may overload the storm sewer system in contrast to the long duration low intensity storm events occurring in winter.

8.3.1 Storm Return Period

The overall system will be designed to meet the following conditions:

- Longitudinal sealed carrier drains will be designed to accommodate a 1 in 1 year storm in-bore without surcharge. The design will be checked against a 1 in 5-year storm intensity to ensure that surcharge levels do not exceed the levels of chamber covers.
- As filter drains are being proposed along the track, no attenuation storage facilities are required to cater for flows during the critical storm period.

8.3.2 Pipe Sizing

The Modified Rational Method will be used to determine pipe size diameters at detail design stage. Simulation modelling will be used to assess flood risk for extreme events and to justify pipe size and gradients, while also ensuring adequate levels of service. Table 8-2 summaries the criteria which is applied for the drainage design.

Table 8-2: Pipe Design Summary

Parameter	Surface Water Carrier Pipes
Minimum Depth	1.2m min for pipe crossing 0.9m min cover
Maximum Depth	5.0m
Minimum Pipe Diameter	200m
Maximum Spacing Between Chambers	30m
Runoff Factors for Pipe Sizing	100% paved areas and roof surfaces 70% of the plan area of cuttings 0% of pervious areas
Rainfall for Initial Pipe Sizing	50mm/hr rainfall intensity
56uMaximum Velocity (pipe full)	2.5m/s at discharge points
Minimum Velocity (pipe full)	1.0m/s (may be relaxed to 0.75m/s)
Pipe Roughness (kS)	0.6mm

[1]Cover may be reduced with appropriate bedding and surround i.e. concrete

8.3.3 Climate Change

Rainfall intensities will be factored by 20% to account for the future effects of climate change in accordance with Design Assessment Criteria Section 3.1.3 Drainage.

8.4 Disposal of Collected Drainage

No new outfalls are proposed, all existing outfalls (outlined in Table 8-3) will be reused. Refer to drawings C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0001 to C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0028 for drainage proposals.

Table 8-3: Location of Outfalls Summary

Track Side	Chainage (m)	Track Crossing/Outfall
Left	950	Retain existing outfall to ditch
Left	8575	Retain existing outfall to stream
Left	9840	Retain existing outfall to watercourse
Right	630	Retain existing outfall to stream
Right	740	Retain existing outfall to stream
Right	1325	Retain existing outfall to stream
Right	1340	Retain existing outfall to stream
Right	1700	Retain existing outfall to watercourse
Right	1975	Retain existing outfall to stream
Right	3290	Retain existing outfall to stream
Right	4025	Retain existing outfall to watercourse

8.5 Environmental Measures

Environmental drainage measures include the provision of filter drains along the track, petrol interceptors to be provided in accordance with I-PWY-1136 'Requirements for Design, Installation and Maintenance of Lineside Drainage'

8.6 Culverts

Culverts along the railway line requiring modification are listed in Table 8-4 below*:*

Table 8-4: Culvert Summary

NGR (Easting/ Northing)	Chainage (m)	Description	Proposed Works during Dualling
179153 073241	1350	UBY1B Culvert – precast concrete box, currently single-track section, span length 1.5m	No works proposed
179506 073239	1700	UBY1C Culvert Killacloyne – precast concrete box at the start of the IDA side channel, currently single-track section, span length 2.1m	No works proposed
179792 073240	1985	UBY2A Culvert – precast concrete box, currently single-track section, span length 4.8m	Section of the culvert to be realigned.
	1700 to 2900	IDA drainage channel along the north side of the track. The channel drains the Anngrove area, which is an identified source of fluvial flooding in Section 4.2.2	Open channel section to be re-positioned
181686 073722	3950	UBY5E Carrigtwohill – concrete precast pipe, currently dual-track section, span length 0.60m	No works proposed
181763 073738	4020	UBY5C Culvert Carrigtwohill – concrete pre-cast box, currently dual-track section, span length 1.8m	No works proposed
183042 073916	5300	UBY6B Culvert – concrete pre-cast box, currently dual-track section, span length 1.5m.	No works proposed
183185 073925	5460	UBY6C Culvert – concrete pre-cast box, currently dual-track section, span length 2.1m	No works proposed

NGR (Easting/ Northing)	Chainage (m)	Description	Proposed Works during Dualling
186248 074100	8520	Water Rock watercourse – no culvert identified	No works proposed

8.7 Hydrology and Hydraulic Summary

Hydrology and Hydraulic assessment requirements will be undertaken in consultation with the Office of Public Works.

A summary of the Hydrology/Hydrogeology is outlined in Table 8-5. A Section 50 application will be prepared for structures listed in Table 8-6.

Table 8-5: Hydrology/Hydrogeology Summary

Hydrology and Watercourses	The nearest open water body is within the western area of the site, from Ch 0m to Ch 750m, where the rail line runs parallel to the foreshore of the Cork Harbour Foreshore and is in close proximity (within 25m) to the Glounthaune Estuary / Slatty Water Complex and the Lough Mahon (Harper's Island) Transitional Water Body. A number of water courses are also present within the site, as follows: The Killacloyne River crosses beneath the railway track in a NE-SW orientation through culvert UBY1C at bridge structure OBY1 (Ch 1660m) and flows parallel to the track until bridge structure OBY2 (Ch 1970m). The Tibbotstown River flows south and meets the norther area of the rail line immediately east of OBY3 (Ch 2900m). From here, the river is culverted and flows in a westerly direction parallel of the rail line until it meets at the east side of OBY2 (Ch 1980m), where it turns to pass south west beneath the rail line. The Owennacurra River passes beneath the railway track in a N-S orientation at bridge structure UBY11 (Ch 9850m).
Hydrogeology	Hydrogeology The site is underlain by a number of aquifers: Regionally Important Aquifer – Karstified with diffuse flow (Ch 0m – Ch 2800, Ch 5300m – Ch 10600m) Locally Important Aquifer – Bedrock moderately productive in localised zones (2800m – Ch 5300m) Carrigtwohill Gravel Aquifer – locally important (Ch 750m – Ch 3250m) Midleton Gravel Aquifer – locally important (Ch 9150m – Ch 10250) Abstraction wells associated with Carrigtwohill Gravel Aquifer (location accurate to 50m or less) One well 30m north of track Ch 20m Thirteen wells within 500m (nearest 110m), predominantly south of track, Ch 2000m – Ch 2900m One well 120m south of track Ch 4440m Other abstraction wells (location accurate to 50m or less): One well 7m south of track Ch 8850m One well 1m north of track Ch 9495m Five wells 100-200m north of track Ch 10200m – Ch 10350m There are sections of the rail line where karst geology / bedrock is recorded at the surface, or the groundwater is recorded as being extremely vulnerable, at approximate Ch 6100m, Ch 7300m – 7900m, and Ch 8400m – 8800m.

8.7.1 Section 50 Applications

Section 50 Applications will be required for the detailed design of the culverts and bridges listed in Table 8-6 below.

Table 8-6: Culverts & Bridges Section 50 Summary

Structure		Chainage	Function	Works required
Name	Denotation			
Culvert	UBY2A or CV3	1+985m	Carries the rail line over a local water course	Culvert to be extended
Culvert	IDA Culvert	1+985	Carries local watercourse adjacent to the track.	Section of the culvert to be realigned.
Owenacurra River	UBY11	9+870m	Carries the rail line over the Owenacurra River	Extend the deck of the bridge onto the existing piers

8.8 Flood Risk Assessment

A Flood Risk Assessment Stage 1 for the Proposed Development of Glounthaune to Midleton has been carried out.

This included a desk-based screening of the available data for potential sources of flooding in the subject area. All potential flood sources have been assessed, with the following findings:

8.8.1 Coastal flooding

The initial section of the Proposed Development, i.e. Chainage 0 – 1500m, is at risk from coastal flooding. The review of the track levels suggest that track elevation is as low as 3m OD at Chainage 1300, and this section is at risk of coastal flooding from the 1% AEP (or 1 in 100 year) coastal flood event considering the present day flood water levels.

The remaining sections after Chainage 1500 are higher and outwith the coastal flood risk.

It is recommended that the low elevations of the track at its initial section at Glounthaune are considered when developing the design. Possible mitigation measures could be proposed to protect the low sections of the track from coastal flooding. The proposed mitigations would need further hydraulic assessment.

8.8.2 Fluvial flooding

The Proposed Development is at risk from fluvial flooding from a small watercourse at the Anngrove area and from the River Owenacurra in Midleton.

It is proposed to extend the railway culvert and re-position the open channel at Anngrove and also extend the railway bridge over the river Owenacurra. The proposed changes of the existing structures and open channel will need to be further assessed in the hydraulic model to find out the potential impact on flood risk.

8.8.3 Pluvial flooding

No pluvial flood maps are available for the track area. It is understood that the existing track and drains currently intercept all rainfall runoff. All modified track areas will be assessed for risk of pluvial flooding, and the expected surface water run-off will be captured by a modified drainage system.

8.8.4 Groundwater flooding

The Proposed Development is in the area of limestone outcrops with potential for groundwater flooding. It is proposed to further investigate the impact of the Proposed Development on the groundwater flooding.

8.8.5 Flooding from artificial drainage system and artificial infrastructure

There are no water holding or water conveying infrastructure that could potentially cause further flood risk to the new track.

Therefore, the Proposed Development is deemed not to be at risk flooding from the artificial drainage system of infrastructure failure. As the new track is proposed along the same route as the old track, the new development will not increase flood risk elsewhere.

8.8.6 Past flood events

The existing records of flooding in the Glounthaune to Midleton area have been reviewed. Past food events have occurred in the area but there is no information to suggest that the railway was affected.

8.8.7 Justification test

As the Proposed Development is located in the flood zones, the planning process requires to undertake the Justification Test. The Plan Making Justification Test and Development Management Justification have been assessed and passed, and no further investigation of the flood risk in the form of a Stage 2 FRA is required.

9 Utilities

9.1 Utilities

9.1.1 Existing Services

A review of existing cable trough along the route has been undertaken. It is expected that where the railway tracks are being retained, cable troughs will also be retained along these sections of tracks.

All key utility providers within the project area were contacted to establish the potential impact of the planned works on their installations. No diversions are currently planned.

9.1.1.1 Eir

Eir have provided an online portal for project use to provide drawings of their network over specific areas. The drawings were collated and arranged to form a comprehensive map along the whole project area. No impact on EIR infrastructure was identified.

9.1.1.2 ESB Network

ESB network data is provided to Mott MacDonald on a 6 monthly basis for all projects. A local copy of relevant area maps was taken from the data provided to Mott MacDonald on the 17th of January 2022. Both HV and MV/LV data were combined to give a comprehensive map along the route. No impact on ESB infrastructure was identified.

9.1.1.3 Gas Network

Gas Network were contacted to provide information of their services within the project area. All relevant gas transmission network information was provided with the advice that 14m wide wayleaves are to be left undisturbed by works. No impact on Gas Network Ireland infrastructure was identified.

9.1.1.4 Irish Water

A request was made to Irish Water for detailed information on their network in the project area. All clean and foul water information was provided to the project in drawing form. No impact on Irish Water infrastructure was identified.

9.1.1.5 Virgin Media

Virgin media were contacted to confirm if their services were present in the areas covered in this project. They confirmed they had no known installations in this area. No impact on Virgin Media infrastructure was identified.

10 Boundary Treatment

10.1 Fencing

In general, existing fencing will be retained along Iarnród Éireann property line. Where existing fencing will have to relocate to facilitate the works this will be installed along Iarnród Éireann property line or the CPO boundary.

All fencing details will be in accordance with Transport Infrastructure Ireland Standard Construction Details - Series 300.

Alternative, fencing arrangements such as mammal fence and accommodation works fencing will be finalised under consultation with relevant landowner at detailed design.

11 Interface Management

11.1 Summary

Technical interfaces between Work Package 3 – Glounthaune - Midleton Twin Track project and the other work packages within CACR are being managed to ensure that: responsibilities are clearly defined between interfacing parties; effective communication and information exchange is maintained; and activities between the parties are managed. Details of each interface have been captured, including:

- Context related to the interface.
- Responsibilities of the interfacing parties.
- Information exchange that is required to/from the interfacing parties
- Requests for Information or Change Orders that have been produced relating to the interface.
- Record of any discussions/ emails that relate to the interface.

11.2 Work Package 2 – Signalling and Communications Upgrade

“Work Package 2 – Signalling and Communications Upgrade” is running in parallel to WP3 and presents a significant interface. The interfaces that have been identified have been outlined below:

- S&T design
- S&T construction and implementation
- GSM-R site locations
- Signalling relocation to allow construction of second track
- Construction schedules
- Level crossings
- S&T compounds
- S&T power supplies
- S&T cable routes and containment
- Undertrack crossings
- Under road crossings
- Land take for S&T assets (signalling poles, bases and cabinets)

11.2.1 Principle of Interface Agreement

WP3 is responsible for the design and installation of primary cable containment (main concrete troughing along both sides) along the line. WP2 is responsible for defining the space and EMC requirements associated to this. WP2 is also responsible for the design and install of the secondary ducting and the LV power associated to their equipment.

WP3 is responsible for the design and installation of the under-track crossings and the under-road crossings. WP2 is responsible for providing the space and EMC requirements associated to these.

WP2 is responsible for the design and installation of the signalling poles, bases and cabinets. WP3 are responsible for reserving space for that equipment where there are existing property permits.

Signals along the Glounthaune – Midleton line will have to be relocated to enable WP3 civils work to commence. The signals which will need to be relocated are CE 483, CE R488, CE 488, CE R491 and CE 491. WP2's and WP3's construction strategies have been discussed and aligned in order that these signals can be relocated before commencement of WP3's construction works. WP2 require that, at the time of this signalling relocation, the existing line remains operationally and functionally equivalent in order to avoid signal interlocking logic changes.

11.3 Work Package 4 – Per-way, Civils & Structures

Work Package 4 is future work and will consist of all other associated permanent way and civils upgrades for rest of the CACR network. Although this work package has not yet commenced, the most significant interfaces that have been identified are:

- New train stations
- Upgrade to existing train stations
- Retaining structures around the new and existing stations
- Existing bridges
- New bridges

There are two new stations proposed along the Glounthaune – Midleton line (Carrigtwohill West and Waterrock). Phase 2 Station designs (Ref CACR-XX-XX-DR-ACM-CE-0351 to 0358) have been shared with WP3, and it must be ensured that WP3's track layout and geometry can accommodate these station design concepts. Both stations propose a pedestrian footbridge, for which WP4 will be responsible. There are three existing stations on the line (Glounthaune, Carrigtwohill and Midleton). Upgrade designs and construction of existing stations to accommodate the twin tracking along the route shall be the responsibility of WP4.

There are five existing overbridges along the Glounthaune – Midleton line which have been discussed within this report. The rest of them within the CACR network shall be the responsibility of WP4.

11.4 Work Package 5 – Depot

Work Package 5 is a future work package and will consist of the design and construction of the Depot. Rail access to the depot has been proposed as part of the CACR Phase 2 alignment drawings. WP3 will ensure that a suitable track alignment is provided to facilitate the future connection.

11.5 Work Package 6 – Electrification

Work package 6 is future work and will consist of the design and construction of the electrification system within the whole CACR network. Although this work package has not yet commenced, the most significant interfaces that have been identified are:

- Electrification strategy
- Potential OHLE space provisions
- Midleton Sidings design
- Bridge clearance requirements.
- Location of substations and charging locations

- Cable routes
- EMC / EMI considerations

The expected option for the electrification is to use battery powered trains, and to provide a charging facility at Midleton Sidings. At this state, it is a working assumption that Midleton sidings shall follow a similar design to the Drogheda Charging Station.

A final decision needs to be made regarding any requirements to include electrification cables within the primary ducting, under track crossings and the under-road crossings, including any EMI / EMC considerations that need to be taken into account.

11.6 Work Package 7 – Rolling Stock

No significant interfaces have been identified between WP3 and WP7.

12 Sustainability

12.1 General

A Program Sustainability Plan (PSP) is being developed for CACR programme. A Sustainability Implementation Plan (SIP) is a key deliverable from the PSP. A review and update of the PSP & SIP will be undertaken during each phase of this project' life cycle.

13 Construction

13.1 Introduction

As part of the design development process, we have considered potential scenarios for the preliminary construction strategy, with the aim of both ensuring that the design is realistic and practical to construct, that the contract packages will be well defined and attractive to contractors, and that the construction interface with the public will be well understood.

There are two main potential construction scenarios: Scenario A, an incremental construction strategy, where the line is kept open as much as possible, and the works are done with as little impact on the train services as possible, and Scenario B, a large blockade where the line is closed for a longer period so that most of the work is done without interruption.

We have had initial discussions with Iarnród Éireann and the Signalling Contractors, and early indications are that Scenario A, the incremental construction method, is better suited to the linear shape of this project.

However, the construction strategy is not finalised or agreed at this stage. The following sections describe one potential construction strategy, based on scenario A, for the Twin Track project, and this will be subject to stakeholder input and ongoing interface discussions with other parties and projects including WP2.

13.2 Preliminary Construction Strategy

The proposed works embrace civil engineering, permanent way and signalling works to enable the installation of a second running line along the length of the existing railway between Glounthaune Junction and Midleton to allow the introduction of a significantly increased frequency of train operation.

To minimise disruption to the current railway operations it is proposed to undertake the construction works over an extended period of time utilising both day and night-time working. Night-time working is required to deliver works on or affecting the operational railway in a safe manner with regards to both the safety of the railway and the safety of those delivering the works. A disruptive blockade will be utilised to undertake the operational tie ins between the new and existing works and to test and commission the new signalling control systems.

As a consequence of the new signalling control works being part of a significantly wider scheme, the works and commissioning dates have been planned around that programme.

The works will take place in a long narrow corridor, 10km in length and of varying width (generally 15 to 30m).

13.3 Interface with train operations.

In order to construct the works in a safe and efficient manner and to minimise disruption to rail users we suggest that delivery will place over a period of approximately 36 months from mobilisation to demobilisation. To ensure safety, works on or within 3m of the existing operational track can only be undertaken when the railway is shut to normal operations and for some works beyond the 3m zone additional safeguards (such as rigid fencing or other appropriate barriers) will be required. Additionally, a track monitoring regime for excavation within the Track Support Zone (TSZ) and Critical Rail Temperature (CRT) monitoring for works affecting the CRT Management Zone will be implemented in accordance with CCE standards. These necessary

safety requirements result in the need to deliver many of the activities during the night when trains are not operating.

During normal train operations the no trains periods outlined in Table 13-1 below are available.

Table 13-1: Glounthaune Junction to Midleton - Rules of the Route

Days	Start	Finish	Working Time	Comments
Midweek	23:00 Mon	05:30 Tue	6:30	
	23:00 Tue	05:30 Wed	6:30	
	23:00 Wed	05:30 Thu	6:30	
	23:00 Thu	05:30 Fri	6:30	
Saturday	23:00 Sat	08:00 Sun	9:00	
Sunday	21:00 Sun	05:30 Mon	8:30	

Enhanced working times as outlined in Table 13-2 can be made available through curtailment of the evening train services and their replacement by a road coach.

Table 13-2: Glounthaune Junction to Midleton - Enhanced Rules of the Route

Days	Start	Finish	Working Time	Comments
Midweek	19:00 Mon	05:30 Tue	10:30	Road transport substituted for 4 trains
	19:00 Tue	05:30 Wed	10:30	Road transport substituted for 4 trains
	19:00 Wed	05:30 Thu	10:30	Road transport substituted for 4 trains
	19:00 Thu	05:30 Fri	10:30	Road transport substituted for 4 trains
Saturday	20:00 Sat	08:00 Sun	12:00	Road transport substituted for 3 trains
Sunday	19:00 Sun	05:30 Mon	10:30	Road transport substituted for 1 train

It is proposed that for the first 20 months that normal “Rules of the Route” working times are utilised followed by a period of 8 months with “Enhanced Rules of the Route” working.

There are a number of operations that will require a longer period of track access and it is proposed to close the railway to facilitate these works as outlined in Table 13-3. Specific closure requirements are subject to agreement with the IÉ internal stakeholders.

Table 13-3: Glounthaune Junction to Midleton - Enhanced Rules of the Route with Weekend Disruptive

Days	Start	Finish	Working Time	Comments
Midweek	19:00 Mon	05:30 Tue	10:30	Road transport substituted for 4 trains
	19:00 Tue	05:30 Wed	10:30	Road transport substituted for 4 trains
	19:00 Wed	05:30 Thu	10:30	Road transport substituted for 4 trains
	19:00 Thu	05:30 Fri	10:30	Road transport substituted for 4 trains
Weekend	23:00 Fri	05:30 Mon	54:30	Road transport substituted for 30 trains

To undertake the final construction activities and to install, test and commission the signalling control system a disruptive blockade will be required subject to detailed design.

13.4 Delivery of the works

It is anticipated that the delivery of the works will be through a mixture of contract works and IE direct / specialist contract provision. The activities are detailed below:

Civil Contract:

- Vegetation clearance
- Earthworks: slope regrading
- Earthworks: retaining structures
- Culvert upgrading
- Bridge removal – OBY8
- Bridge modification – UBY11
- Preparation of track formation
- Track drainage
- Bottom ballast supply and installation
- Cable ducting
- Ancillary civils works
- Fencing

IE direct / specialist contract

- Supply and delivery of sleepers and rail
- Installation of sleepers and rail
- Supply and installation of S&C
- Supply and installation of top ballast
- Track welding
- Tamping and track finishing
- Stressing
- PWay recoveries

Signalling works: separate contract.

- Lift and shift
- New works
- System commissioning
- Recoveries

13.5 Site Compounds

It is proposed to establish site compounds, stockpiles and access points at the following locations:

- Chainage 1200m - Glounthaune Junction downside.
- Chainage 2400m - Carrigtwohill upside.
- Chainage 6650m - Ballyadam upside.
- Chainage 9800m - Owenacurra River Midleton downside.

13.6 Construction Traffic

To minimise construction traffic utilising the public road network it is proposed to utilise the existing rail line to deliver and distribute materials where practicable:

Delivery by heavy haul trains

- Concrete sleepers
- Long Welded Rail (LWR) strings

Site movement of spoil / stone / materials: Unimog tug and box trailers

- Excavated material from track bed
- Drainage materials
- Bottom ballast
- Top ballast

13.7 Works staging

It is proposed that the works will be delivered in several stages and that the delivery of the works will progress in a linear manner.

13.7.1 Stage 1a: Earthworks, Temporary Enabling Works and Preparation of the Track Formation

This stage of the delivery work will take place along the line of route in a progressive manner. A proportion of the works will be undertaken during normal daytime working with train operations continuing undisturbed. To enable these works to take place in a safe manner rigid fencing, rigid barriers will be set up to separate people and machinery from the operating railway. Where any works encroach upon the track support zone appropriate track monitoring measures will be put in place. It is anticipated that the following works will be undertaken in this manner:

- Preliminary enabling works,
- Route vegetation clearance,
- Lift and shift affected cable routes (temporary split duct on sleeper ends),
- Embankment / cutting slope regrading,
- Slope retention works,
- Route works.

Works may also take place close to or utilising the rail line to access plant and deliver materials. These works could be undertaken with the railway blocked to normal traffic during night-time “Rules of the Route” possessions. It is anticipated that the following works could potentially be undertaken in this manner:

- Temporary relocation of signals, location cases and BOPs from new formation,
- Piped cess drainage,
- Track formation: Install, grade and compact capping layer, geotextiles and bottom ballast (typical example Figure 13-1 and Figure 13-2),
- Install bases for new location cases and signals,
- Install new UTXs,
- Owenacurra River bridge preparation of piers and abutments.

Figure 13-1: New track formation being created alongside operational line

Figure 13-2: New formation and drainage formed alongside existing single track

13.7.2 Stage 1b: Midleton Sidings

The construction of new sidings at Midleton, involving limited earthworks, drainage and ancillary support can be undertaken as a standalone brown field construction site. The site will be protected from the operational railway by shortening the existing track arrangement, installing temporary stop blocks and fencing the interface between site and operational railway. This work can be delivered during normal daytime working.

13.7.3 Stage 2a: Track Construction

The construction of sections of new track parallel to the existing track will be predominantly undertaken utilising the rail line to access plant and deliver materials. These works could potentially be undertaken with the railway blocked to normal traffic during night-time “Enhanced Rules of the Route” possessions. It is suggested that to efficiently progress the works that working times are extended by the curtailment of evening train service and substitute bussing of passengers. It is envisaged that new concrete sleepers could be delivered by rail and laid on the

new formation using excavators fitted with 7 sleeper hydraulic bails then LWR threaded in. Typical examples of the installation of sleepers are shown in Figure 13-3and Figure 13-4.

With the erection of a rigid barrier fence between the running and new lines (typical example shown in Figure 13-5) activities such as clipping up and welding could take place during normal daytime working.

Figure 13-3: Installation of sleepers on widened track bed

Figure 13-4: Sleepers and rails installed on widened track bed

Figure 13-5: Rigid barrier fencing in place between operational and new track

As part of this stage, it is envisaged that other enabling works could potentially be undertaken, including;

- Watterrock Level Crossing preparatory civils works,
- Ford LC closure and recoveries,
- Signalling civil enabling works,
- Fencing to new works.

13.7.4 Stage 2b Track Construction

A number of track and related construction activities could require a continuous time longer than that afforded by “Enhanced Rules of the Route” track access. These works include:

- OB 8 (Ballyadam House) Removal,
- Midleton sidings tie in,
- Owenacurra River bridge new deck and parapet beams installation,
- Proposed Ballyadam Depot crossover installation.

Figure 13-6: New line, route works and cess support

13.7.5 Stage 3: Track Completion and Signalling Works

The track completion and signalling works are of such a scale and nature involving systems interfaces that a blockade of the railway could be required to enable safe implementation. To complete the planned works, it is anticipated that a complete line closure will be required for a minimum of 16 weeks.

Track completion works require the recovery of existing P&C and alterations to current track alignment at major slew points together with tamping throughout and stressing. This work impacts upon and requires the shutdown of the existing signalling control system.

On completion of the track work the new signalling system will be completed involving installation of new hardware and interfacing with the control centre. As the system is safety critical significant hardware and extensive systems testing is required, much of which requires wheels free conditions.

13.7.6 Stage 4: Demobilisation and Finishing Works.

This, the final stage of the delivery work, will take place along the line of route. A proportion of the works will be undertaken during normal daytime working with train operations continuing undisturbed. Those activities requiring interface with the track or operating systems will take place with the railway blocked to normal traffic during night-time “Rules of the Route” possessions.

The works planned for this phase are:

- Close out test logs / defects correction,
- Third party accommodation and mitigation works,
- Follow up / design tamping (T+6),
- Decommission site compounds.

14 Drawings & Documents

14.1 Lists of Documents Accompanying the Submission

Drawing Number	Drawing Title
C745-WP3_03-XX-XX-XXX-DR-MMD-CE-3001	Proposed Track Schematic
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0050	Typical Scheme Cross-section
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0001	Permanent Way Preferred Option Sheet 1 of 28
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0002	Permanent Way Preferred Option Sheet 2 of 28
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0003	Permanent Way Preferred Option Sheet 3 of 28
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0004	Permanent Way Preferred Option Sheet 4 of 28
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0005	Permanent Way Preferred Option Sheet 5 of 28
C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0006	Permanent Way Preferred Option Sheet 6 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-PW-0025	Permanent Way Preferred Option Sheet 25 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0002	Drainage Design Sheet 2 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0004	Drainage Design Sheet 4 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0014	Drainage Design Sheet 14 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0017	Drainage Design Sheet 17 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0020	Drainage Design Sheet 20 of 28
C745-WP3_03-XX-XX-XXX-DR-MMD-DE-0021	Drainage Design Sheet 21 of 28
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C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0110	OBY1 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0100	OBY1A - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0120	OBY2 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0130	OBY3A - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0140	OBY4 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0150	OBY5D - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0160	OBY6 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0170	OBY7 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0180	OBY8 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0190	OBY8A - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0200	OBY8B - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0210	OBY9B - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0220	OBY13 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0230	UBY11 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0240	UBY2A & IDA Culvert - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0250	Structures Typical Details
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0260	UBY1B. CH1346 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0270	UBY1C. CH1700 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0280	UBY5. CH3600 - Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0290	UBY5A. CH3700- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0300	UBY5B. CH3965- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0310	UBY5C. CH4024- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0320	UBY6A. CH4418- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0330	UBY6B. CH5317- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0340	UBY6C. CH5460- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-SE-0350	UBY12. CH10000- Plans, Sections & Elevations
C745-WP3_03-XX-XX-XXX-DR-MMD-EE-0001	Cable Ways Design Sheet 1 of 28

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C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0001	Site Location Map
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0002	Site Location Plan. Sheet 1
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0003	Site Location Plan. Sheet 2
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0004	Site Location Plan. Sheet 3
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0005	Site Location Plan. Sheet 4
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0006	Site Location Plan. Sheet 5
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0007	Site Location Plan. Sheet 6
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-0008	Site Location Plan. Sheet 7
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-2301	Closure of Ford Level Crossing at Ch. 8980
C745-WP3_03-XX-XX-XXX-DR-MMD-PR-2302	Water Rock Level Crossing at Ch. 8590
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1101	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1102	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1103	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1104	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1105	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1106	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1107	Existing Utilities. Irish Water
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1108	Existing Utilities. Irish Water

Drawing Number	Drawing Title
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1201	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1202	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1203	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1204	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1205	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1206	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1207	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1208	Existing Utilities. ESB
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1301	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1302	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1303	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1304	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1305	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1306	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1307	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1308	Existing Utilities. EIR
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1401	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1402	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1403	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1404	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1405	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1406	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1407	Existing Utilities. Gas Networks Ireland
C745-WP3_03-XX-XX-XXX-DR-MMD-UE-1408	Existing Utilities. Gas Networks Ireland

A. Drawings

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