# Chapter 9
# Land and Soils

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# 9. Land and Soils

## 9.1. Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) has been prepared in accordance inter alia with the Transport (Railway Infrastructure) Act 2001 as amended. The European Union (Railway Orders) (Environmental Impact Assessment) (Amendment) Regulations 2021 (S.I. No. 743 of 2021) gives further effect to the transposition of the EIA Directive (EU Directive 2011/92/EU as amended by Directive 2014/52/EU) on the assessment of the effects of certain public private projects on the environment by amending the Transport (Railway Infrastructure) Act 2001 ('the 2001 Act'). Section 39 of the 2001 Act provides for the contents of an EIAR.

An examination, analysis and evaluation is carried out by An Bord Pleanála in order to identify, describe and assess, in the light of each individual case, the direct and indirect significant effects of the proposed railway works, including significant effects derived from the vulnerability of the activity to risks of major accidents and disasters relevant to it, on: population and human health; biodiversity, with particular attention to species and habitats protected under the Habitats and Birds Directives; land, soil, water, air and climate; material assets, cultural heritage and the landscape, and the interaction between the above factors.

This Chapter of the EIAR identifies, describes and presents an assessment of the likely significant effects of the proposed Project on Land and Soils. The assessment will examine the potential impacts during the construction and operational phases of the proposed Project.

## 9.2. Legislation, Policy and Guidance

The key legislation and guidance referenced in the preparation of the EIAR is outlined in Chapter 1 (Sections 1.5, 1.6 and 1.7). Specific to Land and Soils, the following legislation, guidance and planning framework relevant to the consideration of land and soils has informed the assessment as outlined below.

### 9.2.1. Legislation

Specifically in relation to Land & Soils, the following principal legislation relevant to the assessment is set out in the following primary European legislation:

- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration (daughter to 2000/60/EC) (Groundwater Daughter Directive).

A brief summary of the relevant legislation is provided in this section.

#### 9.2.1.1. Groundwater Directives (80/68/EEC) and (2006/118/EC)

Directive (80/68/EEC) on the protection of groundwater against pollution caused by certain dangerous substances provided a groundwater protection framework before the Groundwater Directive 2006/118/EC (commonly referred to as the 'Groundwater Daughter Directive').

The Groundwater Directive (80/68/EC) aimed to protect groundwater from pollution by controlling discharges and disposal of certain dangerous substances to groundwater. The Directive was transposed into Irish Law by the Protection of Groundwater Regulations, 1999 (SI No. 41 of 1999). It was repealed by the Water Framework Directive 2006/60/EC (WFD) in 2013.

In Ireland the original Groundwater Directive (80/68/EEC) was primarily transposed into National legislation through:

- The Local Government (Water Pollution) Act, 1977 to 1990;
- The Local Government (Water Pollution) Regulations, 1978 (SI No 108 of 1978);
- The Protection of Groundwater Regulations, 1999 (SI No 41 of 1999). This was repealed and replaced by the Wastewater Discharge (Authorisation) Regulations, 2007 (SI 684 of 2007) in 2013; and
- The Local Government (Water Pollution) (Amendment) Regulations, 1999 (SI No 42 of 1999). This was repealed and replaced by the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No 9 of 2010) in 2013.

#### 9.2.1.2. European Communities Environmental Objectives (Groundwater) Regulations 2009 (S.I. No. 9 of 2010)

The purpose of the European Communities Environmental Objectives (Groundwater) Regulations is to transpose the requirements of the Water Framework Directive and the Groundwater Daughter Directive into national legislation and provide for transitional arrangements from the old Groundwater Directive (80/68/EEC). These regulations have been transposed into National legislation through the Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010) and Environmental Objectives (Groundwater) Amendment) Regulations 2016 (S.I. No. 366 of 2016). These Regulations aim to:

- Establish a new strengthened regime for the protection of groundwater in line with the requirements of the Water Framework Directive (2000/60/EC) and by the Groundwater Directive (2006/118/EC);
- Establish clear Environmental Objectives, Groundwater Quality Standards and Threshold Values for the classification of groundwater and the protection against pollution and deterioration; and
- The Regulations also introduce the legal basis for a more flexible, proportionate and risk-based approach to implementing the legal obligation to prevent or limit inputs of pollutants into groundwater which already exist under the old Groundwater Directive (80/69/EEC).

### 9.2.2. Policy

The assessment has had due regard to relevant policy that includes the following:

- Project Ireland 2040 (National Planning Framework and National Development Plan 2021 – 2030);
- Dublin City Development Plan 2022-2028

- Park West - Cherry Orchard Local Area Plan 2019;
- South Dublin County Development Plan 2022 – 2028;
- Adamstown Strategic Development Zone Planning Scheme 2014;
- Clonburris Strategic Development Zone Planning Scheme 2019;
- Kildare County Development Plan 2017 – 2023 (and draft plan 2023-2029 as available);
- Celbridge Local Area Plan 2017-2023; and
- EU Soil Strategy for 2030 – Reaping the benefits of health soils for people, food, nature and climate (European Commission, 2021).

### 9.2.3. Guidance

The assessment has had due regard to relevant guidelines that include the following:

- Guidance on Land Contamination Risk Management (LCRM), (Environment Agency (EA) UK 2020);
- Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (EPA, 2013);
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2009);
- The Model Procedures for the Management of Land Contamination (CLR 11) (EA, 2004); and,
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (Institute of Geologists of Ireland (IGI) (2013).

## 9.3. Methodology

The general approach adopted within this impact assessment is as follows:

- Define the appropriate study area required to allow consideration of potential effects;
- Characterise baseline conditions within the study area relevant to the consideration of land and soils;
- Scoping and Consultation; and
- Assessment of likely significant effects.

### 9.3.1. Study Area

The potential effect that the proposed Project may have on the land and soil regime of the site represents the principal consideration for this assessment. To understand the nature of the land and soil regime relevant to the site, the spatial scope of the study area must be sufficiently large to enable the general land and soil setting and associated Conceptual Site Model (CSM) to be defined. As such, the study area relevant to consideration of land and soils extends outside of the proposed Project boundaries, to include a 1-kilometre (km) buffer zone to examine the potential impacts on adjacent soils and land.

In addition to the 1km buffer zone, the proposed Project has been divided into four distinct geographic zones along the length of the rail corridor (Zones A to D) as outlined in Chapter 4 Project Description.

The Zone of Influence (ZoI) for this assessment will be extended to include potential receptors of the proposed Project. The ZoI will also cover the Locally Important Bedrock Aquifer within the Lucan Formation as the groundwater within the aquifer has value in the local area for abstraction purposes.

## 9.3.2. Survey Methodology

### 9.3.2.1. Desk Surveys

The following publicly available data sources [Accessed: April 2022] were used to classify the regional and site setting, which will be used to support the characterisation of the study area and the surrounding area:

- Environmental Protection Agency (EPA) - http://gis.epa.ie/Envision;
- EPA Catchments - https://www.catchments.ie/;
- EPA online resources that include Hydronet (EPA Hydronet) and HydroTool (EPA HydroTool);
- GeoHive Historic Ordnance Survey Ireland (OSi) geospatial data – https://www.map.geohive.ie;
- Geological Survey of Ireland (GSI) including Tellus Data Viewer - https://www.gsi.ie/;
- National Parks & Wildlife Service (NPWS) - http://www.npws.ie/;
- Office of Public Works (OPW) - http://www.floodinfo.ie/map/floodmaps; and
- Open source mapping including Google Earth.

### 9.3.2.2. Field Surveys

The following site-specific investigation work and associated data and reporting as outlined in Table 9.1 has informed the conceptualisation and baseline characterisation of the study area.

**Table 9.1: Summary of Site-Specific Survey Data**

| Report | Extent of Survey |
|---|---|
| DART+ South West Trackside Ground Investigation Factual Report, Causeway Geotech Ltd., March 2022 (Draft) | The Trackside Ground Investigation (GI) Factual Report was prepared by Causeway Geotech Ltd. (Causeway) as the Main Contractor with responsibility for the GI between the 20km corridor from Hazelhatch Station to Glasnevin Junction. The site investigation works were completed between 28th June 2021 and 6th February 2022.<br>This report provides full details of the investigative methods employed during the works including borehole drilling techniques, dynamic probes, standpipe installation (for groundwater monitoring) and track bed vacuum inspection pits. Summary details and results of geotechnical and environmental laboratory testing carried out is presented in full. The Causeway report also includes details of Archaeological monitoring at certain locations, conducted by Shanarc Archaeology. |
| DART+ South West Ground Investigation Report, TTA JV, December 2021 | The Ground Investigation Report (GIR) completed on behalf of Iarnród Éireann which addresses the geotechnical aspects of the design and construction of the DART+ South West. This report is based upon a comprehensive ground investigation completed along the project corridor.<br>The Ground Investigation (GI) works were carried out by Causeway and staged in three defined areas within the rail corridor; Area 1, 2 and 3. Area 1 is between Glasnevin Junction to Heuston Station, Area 2 is between Heuston Station and Inchicore Railway |

| Report | Extent of Survey |
|---|---|
| | Works, and Area 3 is between Inchicore Railway Works and Hazelhatch Station. GI works included a variety of investigative methods such as cable percussive boreholes with rotary follow-on, windowless sampling, dynamic probing, vacuum excavated trial pits with associated geotechnical and geochemical laboratory testing.<br>A geophysical survey and utility survey were also carried out in selected project areas as part of the GI works. The geophysical survey was carried out via Electrical Resistivity Tomography (ERT) and the utility survey was conducted via Ground Penetrating Radar (GPR).<br>A summary of the ground conditions encountered is provided (including groundwater) followed by the geotechnical properties (e.g. liquid limit, plastic limit, standard penetration test (SPT) 'N' values) of subsurface materials. An assessment of earthworks material to be excavated as part of the project is included, with the majority of excavated material expected to be classified as inert Class 2C Glacial Till.<br>The GIR contains detailed drawings identifying all ground investigation locations. |
| DART+ South West Geotechnical Design Report, TTA JV, September 2022 | This report focuses on the preliminary geotechnical design details relating to key project elements including bridges (6 no.), retaining wall structures, trackbed design and building design. This design report incorporates the findings of the GIR. A general design overview is presented for each element with further consideration given to ground and groundwater conditions, impacts on construction methods, geotechnical parameters, foundations, settlement and earthworks/ground movements. |

A comprehensive project specific site investigation was undertaken along the full route of the proposed Project. The Trackside Ground Investigation (GI) was conducted by Causeway along the 20km corridor from Hazelhatch & Celbridge Station to Glasnevin Junction. These site investigation works were completed between June 2021 and February 2022.

The Ground Investigation Report (GIR) was completed by TTA JV in March 2022, on behalf of Iarnród Éireann. This report provides the geotechnical interpretation of the findings from the GI, including aspects of the proposed design and construction of the DART+ South West Project.

In combination these two reports act as the most reliable baseline to inform the geotechnical aspects of the design and construction of the DART+ South West Project.

The ground investigation carried out by Causeway included the following works (both on-track and off-track) undertaken throughout the full project length:

- Two hundred and twelve (212) investigative boreholes including -
  - Twelve (12) light cable percussive boreholes
  - Fifteen (15) boreholes by light cable percussive extended by rotary follow-on drilling
  - Twenty (20) boreholes by rotary drilling methods
  - One hundred and sixty-five (165) boreholes by dynamic (windowless) sampling methods
- Eighteen (18) groundwater monitoring standpipe installations
- Ninety-seven (97) dynamic probes
- Seventy-four (74) foundation pits
- Three hundred and ten (310) track bed inspection pits
- Four (4) slit trenches

- Two hundred and thirteen (213) indirect California Bearing Ratio (CBR) tests
- Electrical Resistivity Tomography (ERT) geophysical surveys

### 9.3.3. Models / Tools Used in Assessment

No modelling software / tools were used in the land and soils assessment included in this EIAR.

### 9.3.4. Assessment Methodology

#### 9.3.4.1. Key Parameters for Assessment

The key activities that have potential to result in likely significant effects on land and soils (soils and geology) are outlined below:

**Construction Phase**

- Loss of soil reserves through the construction of hardstanding, piling and structures;
- Land use change / reduction of available lands due to proposed works e.g., track widening, road bridge construction;
- Localised ground subsidence or settlement from excavations and induced ground vibrations from drilling / piling works;
- Accidental emission / release of potentially hazardous substances (principally hydrocarbons), resulting in a short-term localised effect on soil;
- Accidental emissions and release of potentially hazardous substances during construction that may affect the quality of soils, most notably associated with cement, concrete materials (high alkalinity run-off), temporary oils and fuel particularly where below ground excavations are required;
- Potential to encounter contaminated soil which could be disturbed during the construction works;
- Potential excavation of contaminated soil and proposed remediation strategy;
- Short-term effects upon groundwater recharge through the infiltration of surface run-off within or adjacent to construction areas;
- Impacts on surface waters as a result of stormwater run-off causing soil erosion and sedimentation to surface waterbodies; and,
- Potential impacts to geological heritage areas.

**Operation Phase**

- Accidental emission / release of potentially hazardous substances (principally hydrocarbons), resulting in a short-term localised effect on soil; and
- Spills of fuel oils, solvents, lubricating oils or herbicides may occur through ongoing railway maintenance activity and operation of electrical substations.

### 9.3.4.2. Assessment Criteria and Significance

The significance of an impact is defined by first considering the importance of the attribute impacted and secondly the magnitude of the impact. In accordance with the Institute of Geologists of Ireland (IGI) Guidelines, the importance of geological attributes (rating criteria) is defined in accordance with the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (hereafter referred to as the 'NRA Guidelines') (2009). This guidance uses the same significance terminology as the EPA and includes intermediate steps for rating site importance (Table 9.2), magnitude of impact (Table 9.3), and then significance of impacts (Table 9.4).

**Table 9.2: Rating Criteria for Site Importance of Geological Attributes (NRA, 2009)**

| Importance | Criteria | Typical Examples: Geology |
|---|---|---|
| **Extremely High** | Attribute has a high quality or value on an international scale | |
| **Very High** | Attribute has a high quality or value on a national or regional scale<br>Degree or extent of soil contamination is significant on a national or regional scale<br>Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale* | Geological feature rare on a national or regional scale (NHA)<br>Large existing quarry or pit<br>Proven economically extractable mineral resource |
| **High** | Attribute has a high quality, significance or value on a local scale<br>Degree or extent of soil contamination is significant on a local scale.<br>Volume of peat and/or soft organic soil underlying route is significant on a local scale* | Contaminated soil on site with previous heavy industrial usage<br>Moderately sized existing quarry or pit<br>Large recent landfill site for mixed wastes<br>Geological feature of high value on a local scale (County Geological Site)<br>Well drained and/or high fertility soils<br>Marginally economic extractable mineral resource |
| **Medium** | Attribute has a medium quality or value on a local scale<br>Degree or extent of soil contamination is moderate on a local scale<br>Volume of peat and/or soft organic soil underlying route is moderate on a local scale* | Contaminated soil on site with previous light industrial usage<br>Small recent landfill site for mixed wastes<br>Moderately drained and/or moderate fertility soils<br>Small existing quarry or pit<br>Sub-economic extractable mineral resource |
| **Low** | Attribute has a low quality, significance, or value on a local scale<br>Degree or extent of soil contamination is minor on a local scale | Large historical and/or recent site for construction and demolition wastes<br>Small historical and/or recent landfill site for construction and demolition wastes<br>Poorly drained and/or low fertility soils<br>Uneconomically extractable mineral resource |

| Importance | Criteria | Typical Examples: Geology |
|---|---|---|
| | Volume of peat and/or soft organic soil underlying route is small on a local scale* | |

Table 9.2 Notes: * Relative to the total volume of inert soil disposed of and/or recovered.

**Table 9.3: Rating Criteria for Magnitude of Impact on Geological Attributes (NRA, 2009)**

| Importance | Criteria | Typical Examples: Geology |
|---|---|---|
| **Large Adverse** | Results in loss of attribute. | Loss of high proportion of future quarry or pit reserves.<br>Irreversible loss of high proportion of local high fertility soils.<br>Removal of entirety of geological heritage features.<br>Requirement to excavate / remediate entire waste site. |
| **Moderate Adverse** | Results in impact on integrity of attribute or loss of part of attribute. | Loss of moderate proportion of future quarry or pit reserves.<br>Removal of part of geological heritage feature.<br>Irreversible loss of moderate proportion of local high fertility soils.<br>Requirement to excavate / remediate significant proportion of waste site.<br>Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils. |
| **Small Adverse** | Results in minor impact on integrity of attribute or loss of small part of attribute. | Loss of small proportion of future quarry or pit reserves.<br>Removal of small part of geological heritage feature.<br>Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils.<br>Requirement to excavate / remediate small proportion of waste site.<br>Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils. |
| **Negligible** | Results in an impact on attribute but not of sufficient magnitude to affect either use or integrity. | No measurable changes in attributes. |
| **Minor Beneficial** | Results in minor improvement of attribute quality. | Minor enhancement of geological heritage feature. |
| **Moderate Beneficial** | Results in moderate improvement of attribute quality. | Moderate enhancement of geological heritage feature. |
| **Major Beneficial** | Results in major improvement of attribute quality. | Major enhancement of geological heritage feature. |

**Table 9.4: Rating of Significant Environmental Impacts (NRA, 2009)**

| Importance | Magnitude of Potential Impact | | | |
|---|---|---|---|---|
| | Negligible | Small Adverse | Moderate Adverse | Large Adverse |
| **Extremely High** | Imperceptible | Significant | Profound | Profound |
| **Very High** | Imperceptible | Significant/Moderate | Profound/Significant | Profound |
| **High** | Imperceptible | Moderate/Slight | Significant/Moderate | Profound/Significant |
| **Medium** | Imperceptible | Slight | Moderate | Significant |
| **Low** | Imperceptible | Imperceptible | Slight | Slight/Moderate |

### 9.3.5. Consultation

The overall project stakeholder and public consultation undertaken in respect of the Project is set out in the Public Consultation No. 1 Findings Report (for PC1) and Public Consultation No. 2 Findings Report (for PC2) which are included in Volume 4, Appendix 1.3 and 1.4. All feedback was collated, including feedback specific to the EIAR topic 'Land and Soils'. This feedback has informed this chapter including the baseline and impact assessment presented.

Specific consultation was also undertaken with key stakeholders in relation to EIA Scoping. A summary of the issues raised in relation to the scope of the EIA is included in Volume 4, Appendix 1.2. Feedback on the scope and level of detail of the assessment, data sources and methodologies as they pertain to the EIAR topic 'Land and Soils' have been reviewed and have influenced this chapter of the EIAR.

Specific consultation was also undertaken with representatives of various Departments in Kildare, South Dublin and Dublin City Councils. This included a combination of presentations, workshops and meetings to discuss the project, technical design issues and environment and planning matters.

Nine pre-application meetings were held with ABP to explain the project and present technical and environmental information. A summary of the information presented, and the environmental issues discussed at the nine meetings is provided in Volume 4, Appendix 1.6. Feedback relevant to the topic 'Land and Soils' has been reviewed and has influenced this chapter of the EIAR.

### 9.3.6. Difficulties Encountered / Limitations

This Chapter of the EIAR has been prepared based upon the best available information and in accordance with current best practice and relevant guidelines.

There were no technical difficulties or otherwise encountered in the preparation of this chapter of the EIAR. Site-specific ground investigation and geotechnical reports prepared by the TTA JV Geotechnical Team, as referenced in Section 9.3.2.2 were reviewed as part of this assessment, and relevant details included as appropriate throughout.

## 9.4. Receiving Environment

### 9.4.1. Current Baseline

The proposed Project has been divided into four distinct geographic zones along the length of the corridor (Zones A to D) as outlined in Chapter 4 Project Description and summarised below. The proposed Project is described from west to east along the railway corridor.

- **Zone A -** Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station (refer to Section 4.6);
- **Zone B -** Park West & Cherry Orchard Station to Heuston Station (incorporating Inchicore Works) (refer to Section 4.7);
- **Zone C -** Heuston Yard & Station (incorporating New Heuston West Station) (refer to Section 4.8);
- **Zone D -** Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line) (refer to Section 4.9).

Descriptions of the relevant elements for land and soils have also been provided by geographic zone, although due to the nature of the subsurface environment there is significant interaction between zones. Sections 9.4.1.1 to 9.4.1.4 describes the topography, soils and geology baseline of the proposed Project. These sections utilise the Geological Survey Ireland (GSI) online public data viewer (https://www.gsi.ie/) to assess the underlying ground conditions, in combination with site specific data from the recently completed DART+ South West Ground Investigations. The environmental receptors are discussed in Section 9.4.1.7.

#### 9.4.1.1. Zone A: Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station

##### 9.4.1.1.1. Land Use and Topography

Hazelhatch & Celbridge Station, on the border between County Kildare and South Dublin, marks the western extent of the DART+ South West Project. The rail corridor is predominantly at grade (i.e. the rail level is at the surrounding ground level) – though there are several existing retaining wall structures in the vicinity of Park West & Cherry Orchard Station. The existing rail corridor comprises four tracks. Current surrounding land use within Zone A is primarily a mix of rural agricultural and low density suburban residential development in the eastern portion from Hazelhatch & Celbridge Station to Adamstown Station, with medium density suburban residential, commercial and light industrial development from Adamstown Station, east to Park West & Cherry Orchard Station. Topography along this section is relatively flat, ranging from approximately 59m to 66m above ordnance datum (AOD) with no significant changes in elevation.

##### 9.4.1.1.2. Soils (Teagasc Soils)

The national Teagasc Soils map classifies surface soils in Ireland into 25 classes. Soils within the full linear project site from Hazelhatch & Celbridge to Glasnevin Junction and the surrounding area are presented in Figure 9-1.

The soils (Teagasc soils) underlying much of the greater Dublin region are largely classified as Made Ground (Made) associated with urbanisation leading to an increased volume of hardstanding and impermeable surfaces, particularly within the M50 motorway. Made Ground are typically urban soils extensively influenced by human activities, found mostly but not only in urban areas. Within Zone A Made Ground is present surrounding Clondalkin Industrial Estate and east to Park West. At its southwestern extent the route (south of Celbridge) transverses across a region of shallow poorly drained mainly basic soils (BminSP) derived from mainly calcareous parent materials.

West of Clondalkin, the route transverses across extensive regions of deep well drained mainly basic mineral soil (BminDW), poorly drained mainly basic mineral soils (BminPD) and shallow well drained mainly basic mineral soils (BminSW).

#### 9.4.1.1.3. Quaternary Sediments (Subsoils)

The Quaternary Sediments (Subsoils) underlying the site and the surrounding area are presented in Figure 9-2. Quaternary Sediments refers to the deposits formed during this geologic period in which Ireland was subject to the actions of several ice ages.

According to the GSI, the regional Quaternary sediment underlying Dublin City include Urban ground, alluvium sediment, till derived from limestones (TLs) and gravels derived from limestones (GLs). Within Zone A specifically, the Quaternary sediments are predominately mapped as till derived from limestones (TLs) with isolated regions where bedrock or subcrop is at or close to the surface (Rck). These bedrock or subcrop regions (Rck) are mapped within the rail corridor approx. 1.5km east and west of Adamstown station. An area underlain by gravels derived from limestones (GLs) occurs to the northeast of Adamstown station, with a smaller pocket also located to the east of Clondalkin / Fonthill station within the rail corridor.

#### 9.4.1.1.4. Bedrock Geology

The regional bedrock geology for the proposed Project (covering all four geographic zones) is presented in Figure 9-3.

A large proportion of Dublin City and County is underlain by the Lucan Formation (CDLUCN). The Lucan Formation was formed during the Dinantian Series of the Carboniferous Period and comprises of dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are rare dark coarser grained calcarenitic limestones, sometimes graded and interbedded dark-grey calcar within the formation. The formation ranges from 300m to 800m in thickness.

There are no karst features within the proposed Project boundary. Karst features are not common in the vicinity of the rail corridor. Based on GSI mapping the closest karst feature is a spring (St. Columbs Well) located approx. 4km northwest of Adamstown Station.

The rail corridor and surrounding land within Zone A is entirely underlain by the Lucan Formation. Within Zone A the bedrock is mapped by the GSI to be at or close to the surface east of Hazelhatch, at Adamstown and at Ronanstown. The linear route traverses across a GSI mapped fault (striking northeast-southwest) approximately 2.5km northeast of Hazelhatch & Celbridge Station. The bedrock bedding in the vicinity of the site is predominantly shallowly dipping to the southeast (between 20° and 30°) and occasionally shallowly dipping to the north (10° dip around Lucan).

#### 9.4.1.1.5. Geological Protected Sites

Available online geological heritage data from the GSI's records of County Geological Sites (CGS) was used to prepare this section. There are three audited Geological Heritage Sites in the vicinity of the linear route in Dublin City, Phoenix Park (Site Code: DC009), Glasnevin Cemetery County Geological Site (CGS) (Site Code: DC004 – The variety of rock types here, and the variety of ways in which they have been worked, are unique) and Guinness Wells CGS (recommended for Geological Natural Heritage Area) (Site Code: DC005 – comprising of two borehole wells dug within the Guinness brewery complex for historical, technical and cultural importance).

There are no audited Geological Heritage Sites within the vicinity of Zone A. The closest Heritage Site to Zone A is the Newcastle Buried Chanel (Site Code: SD010) located approx. 2.5km south-southeast of Hazelhatch & Celbridge Station.

#### 9.4.1.1.6. Geo-Hazards

According to the GSI online database, there are two recorded geo-hazards within a 5km radius of the study area. The Diswellstown event (ID: GSI_LS05-0006) occurred in December 1999 and was a translational slide, occurring approximately 3.4km north of Park West & Cherry Orchard Station (Zone A/B), north of Palmerston on the north side of the River Liffey, where Carboniferous sand and gravel failed resulting in a sliding surface.

The Strawberry Beds Landslide (ID: GSI_LS16-0025) occurred in 2016. The event was a minor landslide at the rear of a cement factory resulting in a 40m landslide. The site is located approximately 4.0km northeast of Adamstown Station (Zone A), north of Lucan Town and west of Lower Lucan Road.

GSI landslide susceptibility classification within Zone A is Low.

#### 9.4.1.1.7. Site Specific Geology

Topsoil was generally encountered to a depth of 0.1m below ground level (mbgl) within Zone A. Limited areas of topsoil were recorded within the rail corridor due to the existing nature of the railway. Made Ground was encountered along much of the route within Zone A and was classified as either engineered or non-engineered fill. Typically Made Ground described as sandy gravel of limestone was encountered from 0.1 to 1.0mbgl. This was generally underlain by Dublin Boulder Clay in the following sequences:

- Upper Brown Boulder Clay: approx. 2.0 to 3.0mbgl (typically described as firm to very stiff brown sandy gravelly clay with occasional cobbles and boulders)
- Upper Black Boulder Clay: approx. 3.0 to 10.0mbgl (typically described as a very stiff grey-black sandy gravelly clay with occasional cobbles)
- Lower Brown Boulder Clay: approx. 10.0 to 20.0mbgl (typically a stiff to hard grey-brown sandy gravelly clay, becoming silty locally, with occasional cobbles and boulders)
- Lower Black Boulder Clay: depths greater than 20.0mbgl (typically a very stiff dark grey-black slightly sandy gravelly clay)

The GI confirmed that bedrock consisting of the Lucan Formation (limestone) underlies the full length of the proposed Project. This formation is described as dark-grey to black, medium strong, fine grained,

occasionally cherty, micritic limestones. Depths to bedrock were generally found to be between 15 to 20mbgl, often shallower within Zone A (west of Park West & Cherry Orchard Station). The minimum depth to rock in Zone A was reported to occur at 0.5mbgl, approx. 400m east of Adamstown Station.

#### 9.4.1.2. Zone B: Park West and Cherry Orchard Station to Heuston Yard

##### 9.4.1.2.1. Land Use and Topography

The western end of this section begins at Park West & Cherry Orchard Station and continues in a general east-northeast direction to the South Circular Road Bridge (OBC1A) in Kilmainham. Current surrounding land use in Zone B is primarily medium density residential development (mainly along north side of track) and light industrial / commercial (along south side of track). The Inchicore Railway Works facility lies within this section, east of Kylemore Road Bridge (OBC5A), occupying approx. 26 hectares on the south side of the track. Topography in Zone B falls gradually east from a high point of approx. 55mAOD in Park West to a low point of approx. 10mAOD at South Circular Road Bridge (OBC1A) where the track follows a section of deep cut. The gradient of incline is greatest between Islandbridge and Inchicore, increasing from approximately 26mAOD to 58mAOD.

##### 9.4.1.2.2. Soils (Teagasc Soils)

The area surrounding Park West & Cherry Orchard Station (east of the M50) is underlain by pockets of deep well drained mainly basic mineral soil (BminDW) and poorly drained mainly basic mineral soil (BminPD). Further to the east and surrounding the Inchicore Works / Depot soils consist predominantly of made ground (Made). Made ground refers to soil which has been significantly altered or placed by human activity. Made ground is typically encountered in urban environments. At Islandbridge alluvial mineral soils (AlluvMIN) and shallow well drained mainly basic mineral soils (BminSW) are present, typical of soils found along rivers i.e. the River Liffey. Alluvium is typically made up of a variety of materials, including fine particles of silt and clay and larger particles of sand and gravel.

##### 9.4.1.2.3. Quaternary Sediments (Subsoils)

According to the GSI, the subsoils underlying Zone B, east from Park West & Cherry Orchard consist primarily of till derived from limestones (TLs) north of the track from M50 east to Kylemore Road, and also underlying most of route east from Kylemore Road to the east of Inchicore Works. Urban ground is mapped along the south side of the track from the M50 to Kylemore Road and along Con Colbert Road to the South Circular Road.

##### 9.4.1.2.4. Bedrock Geology

Zone B is underlain by the Lucan Formation (CDLUCN) as detailed in Section 9.4.1.1.4. There are no bedrock outcrops or GSI mapped faults within the immediate vicinity of Zone B. The closest mapped outcrop to the rail corridor lies approx. 0.4km northeast of Inchicore Works, adjacent to Ballyfermot Road.

##### 9.4.1.2.5. Geological Protected Sites

Within Zone B, the rail corridor does not traverse any audited Geological Heritage Sites. Within the surrounding area the Phoenix Park (Site Code: DC009) lies approx. 0.5km north of the rail corridor at

Islandbridge, and the Guinness Wells CGS (Site Code: DC005) is located approx. 1.2km east of the South Circular Road Bridge (OBC1A).

#### 9.4.1.2.6. Geo-Hazards

The nearest mapped landslide events to the proposed Project are detailed in Section 9.4.1.1.6. Landslide susceptibility classification within Zone B is Low.

#### 9.4.1.2.7. Site Specific Geology

The lithology of Zone B is generally similar to that described in Section 9.4.1.1.7 for Zone A. A maximum depth of Made Ground to 1.90mbgl was reported on the east side of South Circular Road Bridge (OBC1A). A maximum depth to bedrock of 21.30mbgl was reported on the east side of South Circular Road Bridge (OBC1A), and a minimum depth of 5.30mbgl reported approx. 200m west of Le Fanu Road Bridge (OBC7).

### 9.4.1.3. Zone C: Heuston Yard and Heuston Station

#### 9.4.1.3.1. Land Use and Topography

This Zone includes Heuston Station and Heuston Yard including the site for the future Heuston West Station. The area extends west to east from St John's Road Bridge (OBC0A) eastwards to include the existing Heuston Station and from the CIÉ boundary along the Chapelizod Bypass northwards to the CIÉ boundary on the banks of the River Liffey, an area of approximately 15.5 hectares. Surrounding land use is mainly composed of high-density residential development with an area of parkland on the south of Heuston Station (Bully's Acre and the Royal Hospital Kilmainham Gardens). The topography of the site is generally flat, ranging from approx. 10mAOD to 4mAOD, sloping gently to the east towards Heuston Station and north towards the River Liffey. St Johns Road immediately south is at an elevated level sloping east towards Heuston Station. The western approach of the railway into Heuston Yard is in cutting and this cutting reduces on entry into the yard.

#### 9.4.1.3.2. Soils (Teagasc Soils)

Soils within the area of Heuston Station, Heuston Yard and the proposed Heuston West Station consist primarily of made ground (Made) with alluvial mineral soils (AlluvMIN) along the banks of the River Liffey.

#### 9.4.1.3.3. Quaternary Sediments (Subsoils)

The GSI subsoils underlying Heuston Station within Zone C are classified as urban ground. Alluvium (A) underlies the River Liffey along the northern boundary of Zone C with a relatively small area of gravels derived from limestones (GLs) mapped along the west side of the rail corridor at the location of the proposed Heuston West Station.

#### 9.4.1.3.4. Bedrock Geology

Zone C is underlain by the Lucan Formation (CDLUCN) as detailed in Section 9.4.1.1.4. There are no bedrock outcrops or GSI mapped faults within the immediate vicinity of Zone C or within the surrounding areas of Islandbridge and Kilmainham. The closest mapped outcrop to the rail corridor lies

approx. 1.5km southwest of Heuston Station, south of the Grand Canal at the Davitt Road / Dolphin Road junction.

#### 9.4.1.3.5. Geological Protected Sites

Within Zone C, the rail corridor does not traverse any audited Geological Heritage Sites. The Phoenix Park (Site Code: DC009) lies adjacent, on the north side of the Liffey Bridge (UBO1). The Guinness Wells CGS (Site Code: DC005) is located approx. 0.3km southeast of Heuston Station.

#### 9.4.1.3.6. Geo-Hazards

The nearest mapped landslide events to the proposed Project are detailed in Section 9.4.1.1.6. Landslide susceptibility classification within Zone C is Low.

#### 9.4.1.3.7. Site Specific Geology

The lithology of Zone C is generally similar to that described in Section 9.4.1.1.7 for Zone A. Granular material was more frequently encountered around Heuston Station, consisting of medium dense gravelly sand, and medium dense to dense silty sandy gravel. Further evidence of this was recorded at borehole BH02-HP (approx. 50m southeast of the Liffey Bridge) where Made Ground (loose clayey gravel) was found to a depth of 5.90mbgl, with a clay layer from 6.0 to 9.5mbgl, overlying granular material (coarse sands, silt and gravel) to a depth of 20.0mbgl. Depth to bedrock in the vicinity of Heuston Station was reported at depths between 17.5mbgl and 22.65mbgl. According to the GIR, previous site investigations also encountered peat approx. 70m east of the Liffey Bridge (UBO1) near Heuston Station.

### 9.4.1.4. Zone D: Liffey Bridge to Glasnevin Junction (Phoenix Park Tunnel Branch Line)

#### 9.4.1.4.1. Land Use and Topography

Zone D commences on the south bank of the River Liffey (adjacent to the northern boundary of the Heuston Yard) and extends northeast terminating at Glasnevin Junction. The route extends northwards over the River Liffey via the Liffey Bridge (UBO1) and under Conyngham Road Overbridge (OBO2) after which, it enters the existing Phoenix Park Tunnel (PPT). The PPT is approx. 700m in length.

Apart from the River Liffey crossing, the rail corridor is located within an existing tunnel under the Phoenix Park and a deep cutting thereafter to Glasnevin Junction where the DART+ South West Project ties into the existing track at Glasnevin Junction and interfaces with the proposed DART+ West Project. Primary surrounding land use within Zone D is medium density residential and commercial development, parkland (the Phoenix Park and Royal Canal) and the southern extent of Glasnevin Cemetery to the northwest of Glasnevin Junction. A new high-density residential and commercial development, Hamilton Gardens, is under construction on former CIÉ lands at Carnlough Road, adjacent to the west of the track. The aboveground section of Zone D lies primarily within a deep cut with the elevation ranging from approx. 18mAOD to 28mAOD, increasing gradually to the northeast.

#### 9.4.1.4.2. Soils (Teagasc Soils)

Within Zone D the primary soil type is made ground (Made) in the developed urban areas. Within the Phoenix Park the soil types along the route consist of deep well drained mainly basic mineral soil

(BminDW) and poorly drained mainly basic mineral soil (BminPD). These two soils are also present along the Royal Canal in Glasnevin.

#### 9.4.1.4.3. Quaternary Sediments (Subsoils)

The GSI subsoils underlying Zone D north and northeast from Heuston Station to Glasnevin Junction consist primarily of till derived from limestones (TLs). At the southern extent of the PPT the subsoils are composed of a mix of urban ground and alluvium (A), with urban ground also underlying the Royal Canal south of the rail line.

#### 9.4.1.4.4. Bedrock Geology

Zone D is underlain by the Lucan Formation (CDLUCN) as detailed in Section 9.4.1.1.4. There are no bedrock outcrops or GSI mapped faults within the immediate vicinity of Zone D or within the surrounding areas of Islandbridge, Stoneybatter and Cabra. The closest mapped bedrock outcrop to the rail corridor lies approx. 0.6km to the north at the northeast corner of Glasnevin Cemetery.

#### 9.4.1.4.5. Geological Protected Sites

The approx. 700m long PPT within Zone D traverses the Phoenix Park CGS (Site Code: DC009). This CGS forms a 707 hectare (ha) natural landscape within the confines of Dublin City. The Park represents a Quaternary (Ice Age) geological landscape, albeit very heavily altered. The complexity of the site in terms of its glacial form and the manipulation of this is unusual and has been recommended for Geological Natural Heritage Area (NHA) status.

To the north of Zone D, Glasnevin Cemetery CGS (Site Code: DC004) is located approx. 0.2km northeast of the rail corridor, along the north of Finglas Road. This 120-acre site is important for cultural, educational and historic reasons and provides a unique range of worked rock types from the 1830's to present day.

#### 9.4.1.4.6. Geo-Hazards

The nearest mapped landslide events to the proposed Project are detailed in Section 9.4.1.1.6. Landslide susceptibility classification within Zone D is Low.

#### 9.4.1.4.7. Site Specific Geology

The lithology of Zone D is generally similar to that described in Section 9.4.1.1.7 for Zone A. Within the PPT track bed inspection (TBI) pits only were advanced to an approx. depth of 0.9mbgl with Made Ground reported at all locations. Cohesive material was generally found within Zone D consisting of soft to very stiff brown sandy gravelly clay from 0.5 to 4.0mbgl, overlying very stiff dark grey sandy gravelly clay (Upper Black Boulder Clay). A localised area of soft clay was encountered approx. 75m south of Faussagh Avenue Road Bridge (OBO7). At rotary core borehole locations bedrock (medium strong dark grey to black Limestone) was encountered at significantly varying depths within Zone D, from 3.70mbgl south of Faussagh Avenue to 19.50mbgl southwest of Blackhorse Avenue Bridge (OBO4).

### 9.4.1.5. Contaminated Soils

Previous historic ground investigations in combination with environmental sampling and testing have identified a number of areas where ground contamination is likely present within the proposed Project

boundary. A variety of contaminants are often found in soils and ballast associated with historic railway operations, including hydrocarbons, solvents, asbestos containing materials (ACM) and pesticides. Significant volumes of Made Ground, typically with residual hydrocarbon contamination (e.g., ground adjacent to roads), will be encountered during the proposed works.

Environmental soil sampling and analysis was undertaken during the site-specific trackside GI along the full length of the project. This data will be used to identify areas of contamination likely to require the implementation of appropriate mitigation measures or additional controls. Historic reports have previously referenced contaminated soils at Inchicore Works (Zone B) and Heuston Station (Zone C).

The trackside GI works completed between June 2021 and February 2022 included environmental testing (to Engineers Ireland Suite E and I specification) of shallow soil samples at regular intervals along the 20km project corridor. Environmental testing was performed by an approved laboratory (Eurofins Chemtest, Newmarket, UK) for a range of parameters including the following:

- Metals
- Total petroleum hydrocarbons (TPH)
- Polycyclic aromatic hydrocarbons (PAH)
- Polychlorinated biphenyls (PCBs)
- Cyanide
- Asbestos
- Waste acceptance criteria (WAC) testing also performed (to determine whether soil classified as inert, non-hazardous or hazardous material)

Soil samples were typically collected from Made Ground between 0.8 and 1.2mbgl within the project rail corridor. The GIR presented a limited summary of findings related to potential locations of contaminated land which include:

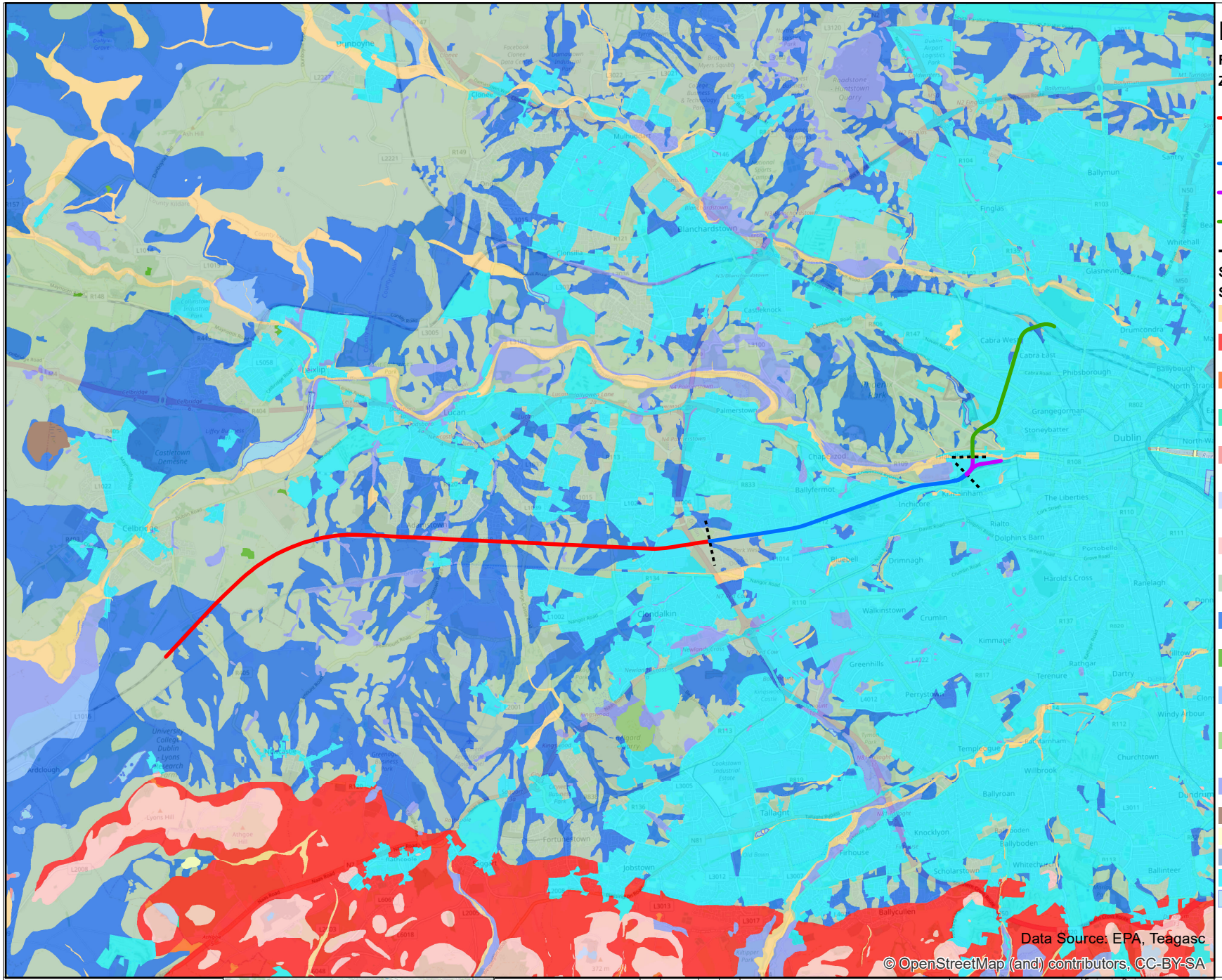
- **Heuston Station (Zone C)** – Elevated levels of heavy metals (e.g. arsenic, lead) and total petroleum hydrocarbons (TPH) were reported at locations in the vicinity of Heuston Station. Laboratory reports indicate that samples taken within 0.0-1.2mbgl on the northwest side of Heuston Station (BH02-HP) contain elevated levels of TPH (2,400 milligrams per kilogram [mg/kg]), and metals including lead (530mg/kg) and zinc (370mg/kg). This location is adjacent to an access road also used as bus parking (and potentially historic maintenance activities). Elevated levels of TPH within this range are typically attributable to small scale releases of hydrocarbons e.g., diesel fuel. Samples from additional TBI pits at Heuston did not report similar elevated levels of contaminants, indicating localised impacts.

  The GIR also indicated the presence of an historic gravel pit near Heuston Station which may have been backfilled with potentially hazardous material. Elevated levels of total organic carbon (TOC) was reported at several locations in the centre and west of Heuston Station, at values ranging from 5% to 27%. These levels of TOC are indicative of highly disturbed fill material and may result in some material from this area being classified as hazardous waste.

- **Inchicore Works (Zone B)** - The Inchicore Railway Depot is located approximately 3km east of the M50. Ground Investigation works and an Environmental Impact Statement (EIS) completed as part of the original Kildare Route Project at the Inchicore Depot indicated exceedances for polycyclic aromatic hydrocarbons (total PAHs) in three (3) locations located at the eastern extent of the Inchicore Works. Based on reported soil analysis as part of the recent GI works, elevated levels of TPH (3,300mg/kg) were recorded in one location along the rail corridor at the centre of Inchicore Depot (TBI-251+900). Low levels of heavy metals and PAHs were also reported (below generic assessment criteria) in the vicinity of Inchicore Works. These results suggest localised impacts from hydrocarbon sources.

Elevated levels of metals e.g., arsenic, lead, and zinc were also found throughout the rail corridor, although in most instances these values were significantly below applicable human health risk-based screening criteria. The GSI's Dublin SURGE soil geochemistry study (Glennon et al., 2012) provides an indication of background levels for inorganic (metals) and organic (PAHs and PCBs) pollutants in the city's topsoil (a depth of 0-10cm below ground level). It is worth noting that the SURGE study reported elevated (background) levels for several heavy metals in soils associated with human activity (e.g. arsenic, cadmium, lead) particularly in former industrial areas of the city, e.g. surrounding Heuston Station. The SURGE study also identified creosote treated railway sleepers as a known source of PAHs.

Potential contamination of soil from asbestos containing materials (ACM) such as asbestos dust associated with train braking systems was identified in the GIR. Asbestos identification testing was performed by an accredited laboratory on each soil sample. Results from ACM testing will be used to identify areas of significant contamination and for waste classification.




# Legend

**Rail Network Line**

**Zone**

- Zone A: from Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station
- Zone B: Park Wet & Cherry Orchard Station to Heuston
- Zone C: Heuston Station and Yard
- Zone D: From Liffey Bridge to Glasnevin Junction
- Zone Boundaries

**Soils**

**Soil Description**

- AlluvMIN - Alluvial (Mineral)
- AminDW - Deep well drained mineral (Mainly acidic)
- AminPD - Mineral poorly drained (Mainly acidic)
- AminPDPT - Peaty poorly drained mineral (Mainly acidic)
- AminSP - Shallow well drained mineral (Mainly acidic)
- AminSRPT - Shallow, rocky, peaty/non-peaty mineral complexes (Mainly acidic)
- AminSW - Shallow well drained mineral (Mainly acidic)
- BminDW - Deep well drained mineral (Mainly basic)
- BminPD - Mineral poorly drained (Mainly basic)
- BminPDPT - Peaty poorly drained mineral (Mainly basic)
- BminSP - Shallow poorly drained mineral (Mainly basic)
- BminSRPT - Shallow, rocky, peaty/non-peaty mineral complexes (Mainly basic)
- BminSW - Shallow well drained mineral (Mainly basic)
- Cut - Cutover/cutaway peat
- Lacustrine type soils
- Marine Sediment
- Made Ground
- Water

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DART+ South West

NTA Údarás Náisiúnta Iompair National Transport Authority

Tionscadal Éireann Project Ireland 2040

| Rev | Date | Drn | Chk'd | App'd | Description |
|---|---|---|---|---|---|
| v02 | 26/10/2022 | NR | EH | CR | Soil Distribution |
| v01 | 25/03/2022 | NR | EH | CR | Soil Distribution |

Client: Iarnród Éireann Irish Rail

Engineering Designer: TYPSA, ATKINS, TUC RAIL

Supported by: rps

| Date | Scale | Drawn | Checked | Approved |
|---|---|---|---|---|
| 18/01/2023 | 1:100,000 @ A4 | NR | EH | CR |

| Project Code | Issuer | QMS Code |
|---|---|---|
| 5195886 | TTA | |

Project Title: DART + SOUTH WEST

Drawing Title: **Figure 9.1: Soils (Teagasc)**

| Drawing File Name | Version | Status |
|---|---|---|
| DP-04-23-DWG-EV-TTA-23738 | v02 | S3 |

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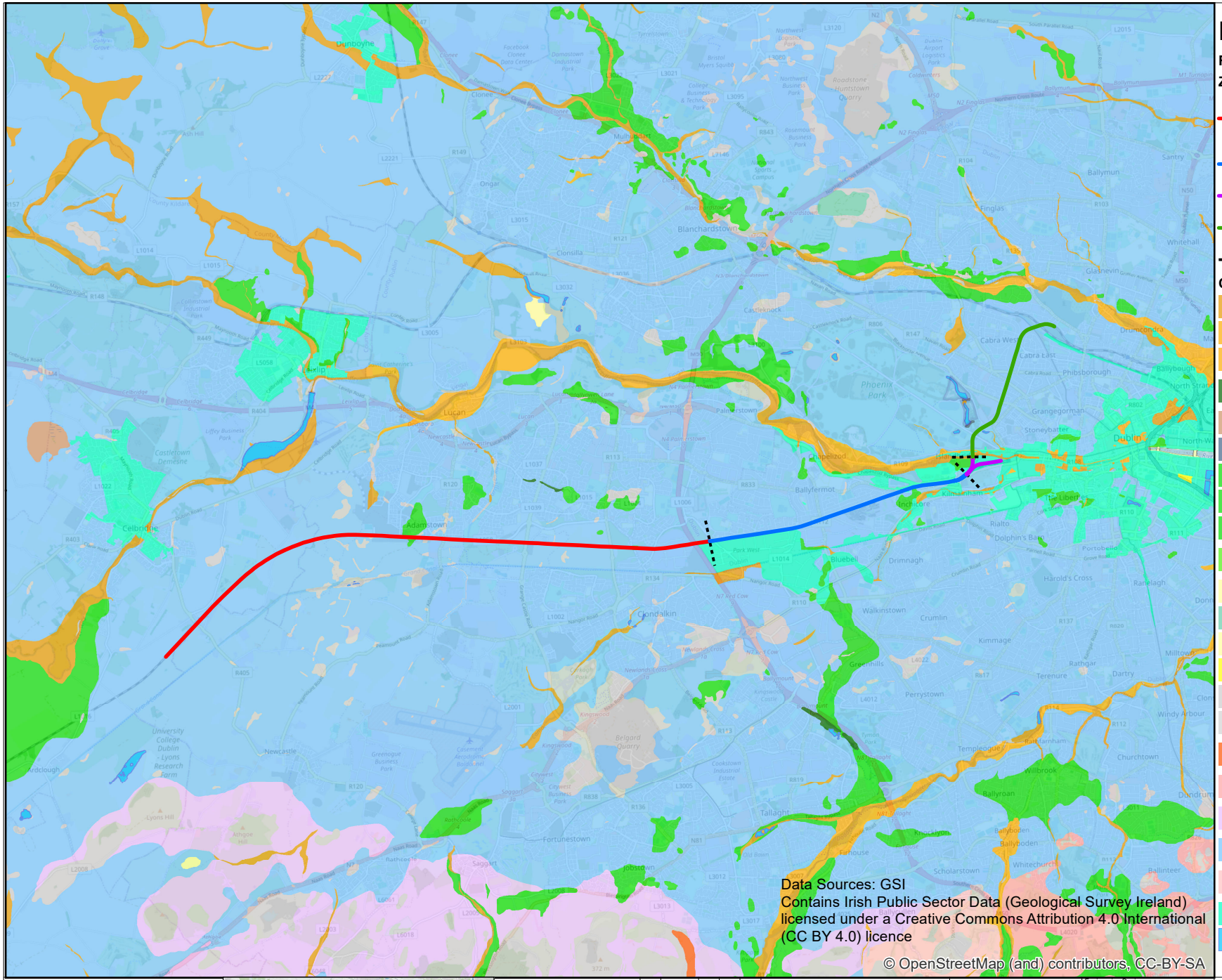


# Legend

**Rail Network Line**

**Zone**

- Zone A: from Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station
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- Zone Boundaries

**Quaternary Sediments (Subsoil)**

- A, Alluvium
- Ag, Alluvium (gravelly)
- Asi, Alluvium (silty)
- BasEsk, Eskers comprised of gravels of basic reaction
- Cut, Cut over raised peat
- Embankment
- GCh, Gravels derived from chert
- GGr, Gravels derived from granite
- GLs, Gravels derived from Limestones
- GMp, Gravels derived from Metamorphic rocks
- L, Lacustrine sediments
- Landfill
- Lsi, Lacustrine silts
- Mbs, Marine beach sands
- Rck, Bedrock outcrop or subcrop
- Scree, Scree
- TBi, Till derived from basic igneous rocks
- TGr, Till derived from granites
- TLPSsS, Till derived from Lower Palaeozoic sandstones and shales
- TLs, Till derived from limestones
- TMp, Till derived from Metamorphic rocks
- Urban
- Water

N W E S

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DART+ South West

NTA Údarás Náisiúnta Iompair National Transport Authority

Tionscadal Éireann Project Ireland 2040

| Rev | Date | Drn | Chk'd | App'd | Description |
|---|---|---|---|---|---|
| v02 | 25/03/2022 | NR | EH | CR | Quaternary Sediments (Subsoil) |
| v01 | 25/03/2022 | NR | EH | CR | Quaternary Sediments (Subsoil) |

Client: Iarnród Éireann Irish Rail

Engineering Designer: TYPSA, ATKINS, TUC RAIL

Supported by: rps

| Date | Scale | Drawn | Checked | Approved |
|---|---|---|---|---|
| 18/01/2023 | 1:100,000 @ A4 | NR | EH | CR |

| Project Code | Issuer | QMS Code |
|---|---|---|
| 5195886 | TTA | |

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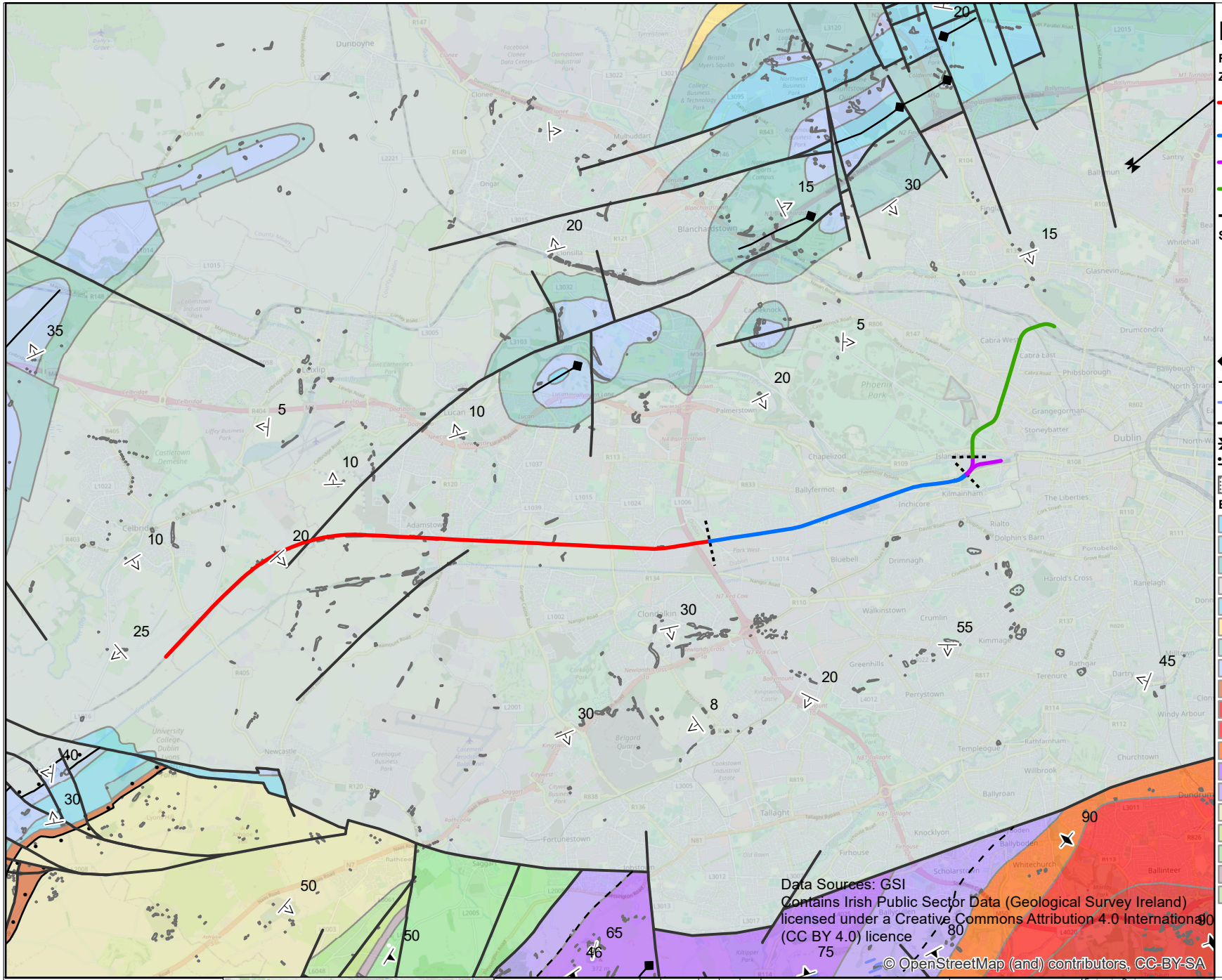
Project Title: **DART + SOUTH WEST**

Drawing Title: **Figure 9.2: Quaternary Sediments**

| Drawing File Name | Version | Status |
|---|---|---|
| DP-04-23-DWG-EV-TTA-23739 | v02 | S3 |




# Legend

**Rail Network Line**

**Zone**

- Zone A: from Hazelhatch & Celbridge Station to Park West & Cherry Orchard Station
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- Zone Boundaries

**Structural Symbols (1:100k)**

- Strike and dip of bedding, right way up
- Strike and dip of first foliation
- Strike and dip of overturned bedding
- Strike of vertical first foliation
- Anticlinal Axis
- Area
- Dyke
- Fault
- Synclinal Axis
- Unconformity, dots on younger side
- Bedrock Outcrops

**Bedrock Geology (Bedrock Units 1:100k)**

- Ballysteen Formation
- Boston Hill Formation
- Feighcullen Formation
- Lucan Formation
- Malahide Formation
- Rush Conglomerate Formation
- Tober Colleen Formation
- Waulsortian Limestones
- Old Red Sandstone (undifferentiated
- Type 3 muscovite porphyritic
- Type 2e equigranular
- Type 2p microcline porphyritic
- Aghfarrell Formation
- Butter Mountain Formation
- Carrighill Formation
- Glen Ding Formation
- Pollaphuca Formation
- Slate Quarries Formation
- Tipperkevin Formation

W E S

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DART+ South West

NTA | Tionscadal Éireann Project Ireland 2040

| Rev | Date | Drn | Chk'd | App'd | Description |
|---|---|---|---|---|---|
| v02 | 28/10/2022 | NR | EH | CR | Bedrock Geology (Bedrock Units 1:100k) |
| v01 | 25/03/2022 | NR | EH | CR | Bedrock Geology (Bedrock Units 1:100k) |

Client: Iarnród Éireann Irish Rail

Engineering Designer: TYPSA, ATKINS, TUC RAIL. Supported by: rps

| Date | Scale | Drawn | Checked | Approved |
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| 18/01/2023 | 1:100,000 @ A4 | NR | EH | CR |

| Project Code | Issuer | QMS Code |
|---|---|---|
| 5195886 | TTA | |

Project Title: DART + SOUTH WEST

Drawing Title: **Figure 9.3: Bedrock Geology**

| Drawing File Name | Version | Status |
|---|---|---|
| DP-04-23-DWG-EV-TTA-23740 | v02 | S3 |

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#### 9.4.1.6. Designated Sites

The proposed Project is not located within or adjoining any nationally or internationally designated sites for nature conservation. The closest European site (i.e. Special Area of Conservation (SAC), candidate Special Area of Conservation (cSAC), Special Protection Area (SPA), proposed Special Protection Area (pSPA)) to the proposed Project is the Rye Water Valley / Carton SAC (site code 001398), located approx. 2.9km north of proposed Project.

More information on the surrounding designated sites can be found in Chapter 8 Biodiversity.

#### 9.4.1.7. Environmental Receptors

The environmental receptors considered relevant to the assessment presented in this chapter and their respective sensitivity is summarised in Table 9.5.

**Table 9.5: Environmental Receptors**

| Receptor | Key Receptor Attributes | Distance from the proposed Project | Receptor Importance |
|---|---|---|---|
| Phoenix Park Geological Heritage Site | County Geological Site – High value on a local scale | Underlying the proposed Project– Traversed by the Phoenix Park Tunnel in Zone D (the existing tunnel runs through the subsurface of the heritage site) | High |
| Soils and Subsoils | Moderately drained and/or moderate fertility soils, medium quality, or value on a local scale<br>Contaminated soil on site with previous light industrial usage | Underlying the proposed Project | Medium |

### 9.4.2. Evolution of the Environment in the absence of the Project (Do Nothing)

Annex IV of the EIA Directive sets out the information required to be included in an EIAR. This includes:

> "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*".

In the event that the proposed Project does not proceed, an assessment of the future baseline conditions has been carried out and is described within this section.

In the "do-nothing" scenario the interventions for the modernisation of the railway corridor and areas outside of CIÉ lands for the Project would not be undertaken and includes the continued use of the existing railway line. The baseline condition of land and soils (soils and geology) will remain unaltered under such a scenario other than natural variation in these parameters with time.

Under the "do-nothing" scenario the opportunity to reduce the volume of potentially contaminated surface soils and ballast from the rail corridor and identified areas of historic maintenance works will be lost however. It is likely that track maintenance activity would increase in the medium to long term.

The magnitude of the impact is considered small adverse, the sensitivity of the receptor is considered to be medium and therefore the effect will be of slight significance.

## 9.5. Description of Potential Impacts

### 9.5.1. Potential Construction Impacts

Potential construction phase impacts on the receiving environment are described in the following section. The primary civil engineering works which will have potential temporary impact on the soils and geology during construction are summarised below.

- Ground investigation works for detailed design, further intrusive investigation required to advance the design for construction is likely to include additional boreholes and inspection pits / trial pits.
- Site enabling and preparation works including clearance works (removal of vegetation, trees etc.).
- The undertaking of earthworks including excavations at top or base of cut slopes, new (replacement) overbridges, construction of new retaining walls, topsoil stripping, the stockpiling of material and further processing and haulage by road and rail. Estimated earthworks volumes include approx. 15,000 cubic metres ($m^3$) of topsoil, approx. 50,000$m^3$ of imported track ballast, and approx. 400,000$m^3$ of soil to be removed from site.
- Earthworks, drainage works, and other construction activity associated with the proposed development of the new Heuston West Station including associated platforms and bridges.
- The installation of a temporary works compounds and associated infrastructure. The compounds vary in size and are located as close as possible to the rail corridor and areas where significant works are to be undertaken i.e. bridge replacement / upgrades.
- Bridge construction including significant works (replacement) of six bridges along the rail corridor to facilitate the installation of the overhead line equipment (OHLE) system, track widening, or upgraded road tie-ins. The major bridge replacement / upgrades occur primarily in the four-tracking area, where the existing bridges crossing the rail corridor have insufficient horizontal spans or vertical clearance.
- Retaining structures including significant sections of bored piled walls with continuous flight auger (CFA) piling rigs, soil nailing and cantilever retaining walls.
- Permanent way construction, primarily excavations required for track lowering and widening through the four-tracking section of the scheme, installation of slab track through the PPT and for new turnback siding at Hazelhatch & Celbridge Station.
- New track drainage works between Park West & Cherry Orchard Station and Heuston Station, including construction of 3 no. underground stormwater attenuation tanks, and upgrades to the existing drainage system along the Phoenix Park Tunnel (PPT) Branch Line.
- Road reconstruction works generally include for reinstatement of the carriageway and footway surfaces as a result of the reconstruction works at overbridges.

- Electrification works including OHLE infrastructure (foundations, masts, wires etc.), six (6) new substations (fenced compound surrounding building to house electrical switch gear) and ancillary equipment rooms along the project route for signalling, telecoms and electrification infrastructure and controls.

A detailed description of the project design elements is provided in Chapter 4 Project Description, Section 4.5. Details concerning the construction programme, phasing and methodologies are provided in Chapter 5 Construction Strategy. Details concerning specific geotechnical design of project elements are provided in the Geotechnical Design Report (TTA JV, September 2022).

The construction phase does have the potential to affect soils and geology and therefore effects considered for this chapter include:

- Excavation and Removal of Soils, Subsoils and Bedrock
- Erosion of Exposed Subsoils during Earthworks and Construction Activity
- Accidental Emissions and Release of Potentially Hazardous Substances

#### 9.5.1.1. Excavation and Removal of Soils, Subsoils and Bedrock

Large-scale and widespread excavation and removal of topsoil, subsoil and bedrock throughout the proposed Project will result in a permanent loss of soil resource within the study area. Excavations include at top or base of cut slopes, around bridge abutments, and significant volumes of material are removed via the CFA piling rigs during installation of bored piled walls. The estimated volumes of material to be removed from the site are detailed in Section 5.2.3 of Chapter 5 Construction Strategy.

**Magnitude of Impact**

Soils and Subsoils

The majority of material to be removed will be from within the pre-existing rail corridor i.e., there is no significant land-take required. The loss of a significant volume of medium quality soil, an essential resource, at a local scale within the proposed rail corridor is considered to be a permanent moderate negative impact.

**Sensitivity of the Receptor**

Soils and Subsoils

The soils and subsoils underlying the site vary, a full description of soil and subsoil types in each zone are provided in Sections 9.4.1.1 to 9.4.1.4. Soils and subsoil have significance on a local scale, however the majority of soils to be removed originate from brownfield, highly developed areas; and is therefore of Medium importance.

**Significance of the Effect**

Soils and Subsoils

The magnitude of the impact is deemed to be moderate and the sensitivity of the receptor is considered to be medium and therefore the effect will be of moderate adverse significance without mitigation, which

causes noticeable changes in the character of the environment without affecting its sensitivities on soil quality.

#### 9.5.1.2. Erosion of Exposed Subsoils during Earthworks and Construction Activity

Due to the linear nature of the project, the extensive areas being excavated (particularly cut sections) and the nature of the works which will involve significant stockpiling of material, the potential exists for erosion of soils. In addition prolonged haulage and tracked machinery movements are planned within, or adjacent to, the various worksites or compounds.

**Magnitude of Impact**

Soils and Subsoils

Significant areas along the rail corridor are likely to be exposed to the open environment (potential for wind, rain, ice effects) during construction works phasing and it is not possible nor feasible to cover or protect areas of exposed ground.

As the site is relatively low-lying and topography is generally flat the expected volumes of material lost through erosion will be low. This impact upon medium quality soil, at a local scale within the proposed rail corridor is considered to be a permanent small adverse impact.

**Sensitivity of the Receptor**

Soils and Subsoils

The soils and subsoils underlying the site vary throughout the proposed Project's length as discussed in Section 9.4.1 above. Soils and subsoil have significance on a local scale, however the majority of soils likely to be impacted by erosion effects are within brownfield, highly developed areas, and therefore of Medium importance.

**Significance of the Effect**

Soils and Subsoils

The magnitude of the impact is deemed to be small adverse and the sensitivity of the receptor is considered to be medium, therefore the effect will be of slight adverse significance without mitigation, which is not considered significant in EIA terms.

#### 9.5.1.3. Accidental Emissions and Release of Potentially Hazardous Substances

Accidental spillages of fuels, chemicals or other contaminants during construction works may result in localised contamination of soils / subsoils underlying the site, if materials are not stored and used in an environmentally safe manner. This includes the disturbance of areas of potential soil contamination (detailed in Section 9.4.1.5) leading to the contamination of soil during the construction phase. There is also a risk of release of potentially hazardous substances from imported material which has not been appropriately screened.

The majority of traffic / haulage movements associated with the proposed Project will be via existing track access points to the existing local road network, with designated haul routes to be confirmed for each works zone. During the construction phase, vehicles will move across, over or excavate into a limited number of greenfield areas, for example between Islandbridge and Heuston Station. There is

potential for accidental spillage of diesel fuel and / or hydraulic oil from on-site machinery during the construction phase. Construction phase storage of fuels and hazardous materials has the potential to impact soil quality if not stored correctly. The proposed construction of the primary site compounds e.g., at Kylemore Road Bridge (OBC5A), will require the removal of wastewater from welfare facilities which will require treatment and safe disposal to a suitable location.

**Magnitude of Impact**

Soils and Subsoils

The potential for potentially hazardous substances contaminating the soil as a result of an accidental spill within the proposed Project boundary during the construction phase can contribute to reduced soil quality. Potential impacts are predicted to be localised due to the controlled nature of the scheme and planned phasing of works. In the absence of mitigation measures the impact to soils is considered to be a moderate adverse impact of temporary duration.

**Sensitivity of the Receptor**

Soils and Subsoils

The soils and subsoils underlying the site vary throughout the proposed Project's length as discussed in Section 9.4.1. Soils and subsoil have significance on a local scale, however the majority of soils likely to be impacted by erosion effects are within brownfield, highly developed areas, and therefore of Medium importance.

**Significance of the Effect**

Soils and Subsoils

The magnitude of the impact is deemed to be moderate and the sensitivity of the receptor is considered to be medium and therefore the effect will be of moderate adverse significance without mitigation.

## 9.5.2. Potential Operational Impacts

The operational phase (which includes railway maintenance operations and maintenance of permanent structures) has the potential to affect soils and geology. Effects considered for this phase include:

- Accidental emissions and release of potentially hazardous substances during operation or maintenance that may affect the quality of soils, most notably associated with release of hydrocarbons (fuels and oils).

### 9.5.2.1. Accidental Emissions and Release of Potentially Hazardous Substances

Accidental spillages of fuels, chemicals or other contaminants during operation and maintenance (O&M) activities may result in localised contamination of soils underlying the site, if materials are not stored and used in an environmentally safe manner. This includes the disturbance of unknown contamination (via ballast replacement maintenance activity for example) leading to the contamination of soils during the operation phase. The impact arising from any contamination event is likely to be moderate on a local scale due to the use of the new railway during the operational stage and the temporary duration of any maintenance activities.

The soil receptor will be impacted by a source of contamination migrating through into the urban and natural ground.

**Magnitude of Impact**

Soils and Subsoils

The potential for hazardous substances contaminating the soil as a result of an accidental spill within the proposed Project boundary during the operational phase can contribute to reduced soil quality.

Potential impacts are predicted to be localised due to the highly specialised and structured nature of the railway O&M works. In the absence of mitigation measures the magnitude of impact to soils is considered to be small adverse impact of temporary duration.

**Sensitivity of the Receptor**

Soils and Subsoils

The soils and subsoils underlying the site vary throughout the proposed Project's length as discussed in Section 9.4.1. Soils and subsoil have significance on a local scale, however the majority of soils likely to be impacted by accidental spills or releases of hydrocarbons or other potentially hazardous materials are within brownfield, highly developed areas, and therefore of Medium importance.

**Significance of the Effect**

Soils and Subsoils

The magnitude of the impact is deemed to be small and the sensitivity of the receptor is considered to be medium, therefore the effect will be of slight adverse significance without mitigation.

## 9.6. Mitigation Measures

The Contractor will ensure "good housekeeping" at all times. A Construction & Environmental Management Plan (CEMP) as outlined in Volume 4, Appendix 5.1 of this EIAR will be updated by the successful Main Contractor. The CEMP will set out the Contractor's overall management and administration of the construction project. It will be prepared by the Contractor during the pre-construction phase to ensure commitments included in the statutory approvals are adhered to and that it integrates the requirements of the CEMP including management of Construction & Demolition Waste. The mitigation measures will be implemented by the appointed Main Contractor(s). These include the best practice measures and the site-specific mitigation measures outlined below.

### 9.6.1. Construction Phase

#### 9.6.1.1. Excavation and Removal of Soils, Subsoils and Bedrock

The following mitigation measures are proposed during the construction phase to manage impacts from excavation and removal of soils:

**Mitigation by Design**

Construction works will be carried out with the smallest feasible footprint, reducing / limiting disturbance of soils, and minimising volumes of excavated material. It is a core strategy of the proposed Project to

limit the volume of material that will be removed from the site, as detailed below and in Chapter 5, Section 5.2.3. The hierarchy of preference in terms of dealing with excess material is:

1) Retain on site and recycle within the works
2) Use strategic excess areas of land to deposit material
3) Use elsewhere on the Iarnród Éireann network or programme of works
4) Enable contractor to use on another site
5) Dispose to appropriate off site facility

The CEMP will address the Main Contractor's plans to manage excavation, stockpiling and movement of soils in accordance with the requirements of this EIAR. A preliminary geotechnical risk register has been prepared by TTA JV and will be developed during the detailed design phase to identify potential hazards (e.g. unforeseen soft ground, potential for settlement and induced vibration) and reduce via suitable mitigation (additional site investigation) significant risks (inadequate foundation design) posed by ground conditions.

**Mitigation During Active Works**

Once works have started in an area, the Main Contractor will be responsible for ensuring there is no excess removal of material beyond that deemed necessary to complete the works, in accordance with the approved design. Due to the limited space of many proposed work zones, and locations adjacent to other critical infrastructure (e.g. major roads, utilities) this is of primary concern. The layout of site work zones and compounds shall be optimised to reduce the need for subgrade works. Buried temporary works infrastructure will only be utilised where absolutely necessary. Designated material stockpile and sorting areas will be utilised to encourage on-site reuse.

Old ballast will be removed to a dedicated site in the Inchicore Depot for re-use / recycling / disposal as appropriate. In areas where corridor widening is required the new tracks will be laid first and then old tracks will be removed and recycled / disposed of in line with the requirements of this EIAR including management of Construction and Demolition Waste.

Should unknown contamination be encountered during construction, material will be considered as potentially hazardous and further testing will be required to confirm waste classification of suitability for re-use / retention on-site or disposal off site.

Site water management is required at all earthworks sites to prevent waterlogging of freshly excavated soil, to prevent silty runoff from entering watercourses and drainage systems, and to alleviate rutting of haul routes. It requires ongoing design and management to reflect the changing operational sequences on the site. Measures will comprise slopes across haul routes and drainage channels leading to outfall positions. At outfall positions, measures will be required to de-silt the runoff using silt traps, settling ponds, pumping to settlement areas or other mechanical means.

There is known flooding on the line within Zone D, between the Royal Canal and Luas Twin Arch Bridge (OBO8) and the Maynooth Line Twin Arch Bridge (OBO9). The infrastructure currently in place to overcome this is a pump station, pumping water to an adjacent filtration area. With track lowering required in this area it is proposed that the pump station will be enlarged to account for a higher volume of water.

Where track lowering is required, as excavations are complete, a new drainage system is required to drain the lower foundation level of the railway.

All plant, equipment, materials, temporary infrastructure and vehicles will be removed at the earliest opportunity and the surface of the ground restored as near as practicable to its original condition.

#### 9.6.1.2. Erosion of Exposed Subsoils during Earthworks and Construction Activity

The following mitigation measures are proposed during the construction phase to manage impacts from erosion of exposed subsoils during earthworks and construction activity:

**Mitigation during Active Works**

Erosion control measures to be taken during the construction works will be outlined within a Sediment and Erosion Control Plan (SECP) which will be prepared by the successful Main Contractor. Mitigation contained within the SECP will be to current industry best practice and principles (e.g. CIRIA C648) and will typically include:

- Installation of drainage and runoff controls prior to start of site clearance / earthworks;
- Sequence works in order to minimise areas of exposed ground;
- Prevention of runoff from entering active works zones via interceptor drains, bunds etc;
- Dedicated areas for stockpiling and storage of excavated materials;
- Covering of stockpiles to reduce wind / rain effects;
- Monitoring and maintenance of erosion and sediment controls; and
- Establishment of vegetation / landscaping as soon as practicable following reinstatement.

#### 9.6.1.3. Accidental Emissions and Release of Potentially Hazardous Substances

**Mitigation During Active Works**

The following mitigation measures are proposed during the construction phase to manage accidental emissions and release of potential hazardous substances:

- The storage and handling of oils, fuel, chemicals and hydraulic fluids will be in secure areas within the site compounds and will not occur within a minimum of 50m from watercourses.
- Fuel and oil containers shall be stored within a secondary containment system e.g. bund to 110% of volume for static tanks or a drip tray for mobile stores. All ancillary equipment such as hoses, pipes are contained within the bund;
- Fuel and oil stores including tanks and drums shall be regularly inspected for leaks and signs of damage;
- Only designated trained operators are authorised to refuel plant on site;
- Storage of fuels, chemicals and lubricants at the Contractor's compound must be fenced off and have a lockable gate to prevent unauthorised access or vandalism.
- Precautions will be installed on all fuel delivery pipes to ensure no leakages or spillages e.g. taps / valves fitted with a lock.

- Interceptor drip trays will be used during all refuelling operations and for stationary mobile plant.
- The principal control measures are as follows:
  - A Fuel Management Protocol will be prepared by the Contractor;
  - Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with the TII / NRA document "*Guidelines for the crossing of watercourses during the construction of National Road Schemes*". All chemical and fuel filling locations will be protected from potential spillages through the provision of appropriate protection measures including bunded areas and double skinned bowser units with spill kits;
  - Storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage. Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with *Best Practice Guide BPGCS005 – Oil Storage Guidelines* (Enterprise Ireland);
  - Where required, the pouring of concrete, sealing of joints, application of water-proofing paint or protective systems and curing agents will be completed in the dry and allowed to cure for 48 hours in order to avoid pollution of watercourses;
  - The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage, and dedicated concrete washout areas / boxes will be utilized;
  - An Emergency Response Plan will be prepared by the successful Main Contractor detailing the procedures to be undertaken in the event of a spillage of chemical, fuel or other hazardous wastes (e.g. concrete) to be in place prior to commencement of project. This will include identification of clean-up specialist emergency contractor. This Plan will contain at a minimum the following mitigation measures:
    - Carry out an investigation to identify the nature, source and cause of the incident and any emission arising therefrom;
    - Isolate the source of any such emission;
    - Evaluate the environmental pollution, if any, caused by the incident;
    - Identify and execute the measures to minimise the emissions / malfunction and the effects thereof;
    - Identify the date, time and place of the incident;
    - Notify the Agency and other relevant authorities; and,
    - The licensee shall provide a proposal to the Agency for its agreement within one month of the incident occurring or as otherwise agreed by the Agency to identify and put in place measures to avoid reoccurrence of the incident and identify and put in place any other appropriate remedial action.
  - Relevant staff, including cover staff shall be trained in the implementation of the Emergency Response Plan and the use of any spill kit / control equipment as necessary; and,

- Plant and equipment shall be maintained in place and in working order for the duration of the works.

- Site compounds / storage facilities will be located at least 50m away from surface waters, where practicable. In addition, measures will be implemented to ensure that silt laden or contaminated surface water run-off from the compound does not discharge directly to surface waters. Appropriate mitigation measures should be adopted where compounds are constructed in lands at risk of flooding;
- All soiled construction run-off water will be passed through settlement ponds / silt traps and/or bunds prior to outfall to the receiving surface water where appropriate;
- Management of material deposition areas to prevent siltation of watercourse systems through run-off during rainstorms. It is recommended to construct collector ditches surrounding material stockpiles to contain run-off and direct it to the settlement ponds / silt traps before discharge to an adjacent watercourse; and,
- Wheel wash facilities to be appropriately located to ensure wash waters are intercepted, contained and directed to settlement ponds / silt traps prior to discharge to surface waters.

### 9.6.2. Operational Phase

No operational phase mitigation measures are proposed beyond those contained within the existing Iarnród Éireann Environmental Management Policies and Process document (CCE-IMS-008).

## 9.7. Monitoring

This section outlines the monitoring measures associated with the impacts identified in Section 9.5 for both the construction and operational and maintenance phases of the Project.

### 9.7.1. Construction Phase

Additional environmental testing of soils is not considered necessary unless further areas (currently unknown) of contamination are identified during the construction phase. The following procedures will form part of the CEMP/ SECP to visually monitor all sources and pathways.

It will be the responsibility of the Main Contractor to appoint a Project Ecologist (an Environmental Clerk of Works (ECoW)) to ensure that the mitigation measures outlined in this document (including any updates to this document following consent) are implemented in full and to supervise works in sensitive locations.

- An emergency response plan will be put in place in the event of an incident (i.e. a spill or leak);
- Environmental audits;
- Environmental awareness; and,
- Pollution / spill prevention measures.

Monitoring of dust generation will be part of the management of construction activities. Dust monitoring locations will be established on site. A baseline dust measurement will be made in advance of works

and an ongoing system of monitoring will be implemented during the construction. Particular mitigation measures will be implemented when significant increases in deposition above baseline are measured.

### 9.7.2. Operational Phase

With the implementation of the proposed design, no additional mitigation measures for land and soils, are considered necessary for the operation of the Project.

In the operational phase the proposed infrastructure will be maintained by Iarnród Éireann's Civil Engineering (CCE) and Signal, Electrical and Telecoms (SET) Departments and will be subject to their management procedures to ensure that the correct measures are taken in the event of any accidental spillages and this will reduce the potential for any impact.

## 9.8. Residual Effects

During the construction phase, the magnitude of impact from excavation and removal of soils, subsoils and bedrock is considered to be moderate (soil of medium sensitivity) and therefore the effect will be of moderate adverse significance. Through the implementation of mitigation measures outlined in Section 9.7.1 the magnitude of impact will be reduced to small, reducing the significance to slight adverse, which is not considered significant in EIA terms.

## 9.9. Cumulative Effects

The cumulative assessment of relevant plans and projects is undertaken separately in Chapter 26 of this EIAR.

## 9.10. References

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