| | |
|---|---|
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC211 (19-135-2) | XC211 |
| | Pre Works Site Photographs |
| | Client: Iarnród Éireann |
| | Engineer: Jacob's |
| | Date: 2020 |

| | |
|---|---|
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC211 (19-135-2) | XC211 |
| | Pre Works Site Photographs |
| | Client: Iarnród Éireann |
| | Engineer: Jacob's |
| | Date: 2020 |

| | |
|---|---|
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC211 (19-135-2) | XC211<br>Post Works Site Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: 2020 |

| | |
|---|---|
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC211 (19-135-2) | XC211<br>Post Works Site Photographs |
| Client: | Iarnród Éireann |
| Engineer: | Jacob's |
| Date: | 2020 |

| | |
|---|---|
| | XC211 |
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC211 (19-135-2) | Post Works Site Photographs |
| | Client: Iarnród Éireann |
| | Engineer: Jacob's |
| | Date: 2020 |

# Cork Line Level Crossings – XC212
# Ground Investigation

| | |
|---|---|
| Primary Author: | Ian Holley |
| Client: | Irish Rail |
| Client's Representative: | JACOBS |
| Report Date: | 25th November 2020 |
| Report No.: | OCB19-135-3 |
| File Location: | OCB19-135-3/Reporting/XC212 |

OCB Geotechnical
Unit 1 Carrigogna
Midleton
Co. Cork

admin@ocbgeotechnical.com
ocbgeotechnical.com

## CONTENTS



## APPENDICES

## Document Control Sheet

| | |
|---|---|
| Report No.: | OCB19-135-3 |
| Project title: | Cork Line Level Crossings – XC212 |
| Client: | Irish Rail |
| Client's Representative: | JACOBS |

| Revision | Status | Report prepared by: | Report reviewed by: | Report approved by: | Issue date |
|---|---|---|---|---|---|
| 001 | Draft Factual | Ian Holley | Glen Byrne | Michael O'Connell | 18th November 2020 |
| 002 | Final Factual | Ian Holley | Glen Byrne | Michael O'Connell | 25th November 2020 |

The works were conducted in accordance with:

*Specification And Related Documents For Ground Investigation In Ireland*. (2016) 2nd ed. Engineers Ireland.

BS EN 1997: *Eurocode 7 - Geotechnical Design – Parts 1 & 2* (2007)

UK Specification for Ground Investigation 2nd Edition (2012)

British Standards Institute (2010) BS 5930:1999 + A2: 2010, Code of practice for site investigations. Incorporating Amendment Nos. 1 and 2, as partially replaced by:

- BS EN ISO 22475-1:2006: Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution
- BS EN ISO 14688-1:2002/Amd 1:2013: Geotechnical investigation and testing. Identification and classification of soil. Identification and description
- BS EN ISO 14688-2:2004/Amd 1:2013: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification
- BS EN ISO 14689-1:2003: Geotechnical investigation and testing. Identification and classification of rock. Identification and description
- BS EN ISO 22476-2:2005/Amd 1:2011: Geotechnical investigation and testing. Field testing. Dynamic probing
- BS EN ISO 22476-3:2005/Amd 1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test

# METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in Section 6 of BS 5930: 1999 + A2: 2010, The Code of Practice for Site Investigation. The amendments revised the Standard to remove text superseded by BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and EN ISO 14689-1:2003 and refers to the relevant standard for each affected subclause. However, the following terms are used in the description of fine-grained soils, where applicable:

- Soft to Firm: fine-grained soil with consistency description close to the boundary between soft and firm soil (Table 13 of BS5930).
- Firm to Stiff: fine-grained soil with consistency description close to the boundary between firm and stiff soil (Table 13 of BS5930).

| **Abbreviations used on exploratory hole logs** | |
|---|---|
| U | Nominal 100mm diameter undisturbed open tube sample |
| P | Nominal 100mm diameter undisturbed piston sample |
| B | Bulk disturbed sample |
| D | Small disturbed sample |
| W | Water sample |
| ES / EW | Soil sample for environmental testing / Water sample for environmental testing |
| SPT | Standard penetration test using a split spoon sampler (small disturbed sample obtained) |
| SPT (C) | Standard penetration test using 60-degree solid cone |
| x,x/x,x,x,x | Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.<br>The length achieved is stated (mm) for any test increment less than 75mm |
| N=X | SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm) |
| N=X/Z | Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm) |
| V<br>VR | Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa<br>V: undisturbed vane shear strength VR: remoulded vane shear strength |
| dd/mm/yy: 1.0<br>dd/mm/yy: dry | Date & water level at the borehole depth at the end of shift<br>and the start of the following shift |
| **Abbreviations relating to rock core – reference Clause 44.4.4 of BS 5930: 1999** | |
| TCR (%) | Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run. |
| SCR (%) | Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures. |
| RQD (%) | Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run. |
| FI | Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing. |
| NI | Non-Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles. |
| AZCL | Assessed zone of core loss: The estimated depth range where core was not recovered. |
| DIF | Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring. |

# Cork Line Level Crossings – XC212

## 1 AUTHORITY

On the instructions of JACOBS on behalf of Iarnród Éireann / Irish Rail, a ground investigation was undertaken at multiple locations along the Cork to Dublin railway line, between Limerick Junction and Mallow stations, to provide geotechnical and environmental information for input to the design and construction of proposed overbridges, embankments, culverts, access roads and footpaths to enable the closure of five manned level crossings.

This report details the work carried out both on site at XC212 and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the in-situ and laboratory test results.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those measured during the investigation.

This report was prepared by OCB Geotechnical Ltd for the use of Iarnród Éireann / Irish Rail and JACOBS in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

## 2 SCOPE

The extent of the investigation, as instructed by the JACOBS, included a borehole, installation of a standpipe, water purging, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

## 3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, level crossing XC212 is located in Ballycoskery townland, Ballyhea, 0.25km east of the N20 road along L1533 local road, at grid reference ITM 554645.45, 617660.28. The level crossing is currently manned with a cabin located on the east side of the crossing and north of the L1533 road. An abandoned two-storey house, with an associated concrete-surfaced parking area and shed to the east, is located on the east side of the crossing along the south side of the L1533 road. Beechwood housing estate and Ballyhea Primary School are located north of the L1533 road on the west and east of the railway crossing, respectively.

The location of the proposed over-bridge is immediately to the south of the existing road, L1533, crossing agricultural fields. Access to the location of the proposed overbridge to the east of the railway is through a field gate opposite Ballyhea Primary School and the rear garden of the derelict house. Dense vegetation surrounds this marshy area. To the west of the railway, access is gained through a gate off the N20 road and crossing a number of fields and a stream to access the area south of the L1533 road. Dense hedgerows surround the fields in the vicinity of the proposed overbridge. A watercourse to the west of the rail line contains plant assemblage of conservation interest.

Ground surface in the site vicinity has an overall slope to the west from the lower slopes of the Ballyhoura Mountains towards a lake at Ballynadrideen townland to the west. However, the railroad runs along an embankment in this area and the L1533 local road rises from the west and east towards the railway crossing. Borehole XC212-CPRC01 was located on the south side of the derelict house, east of the railway crossing and south of L1533 road, where ground surface elevation is approximately 2m above that at the marshy agricultural land immediately to the south.

The existing site is presented on the site and exploratory hole location plans in Appendix A.

## 4 SITE OPERATIONS

Site operations, which were conducted between 2nd February 2020 and 28th June 2020, included:

- One (1) Cable Percussion with Rotary follow-on Borehole
- A Standpipe Installation in one (1) Borehole
- Water Purging in one (1) location

The exploratory holes and in situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

## 4.1 Borehole by Combined Cable Percussion and Rotary Follow-On Drilling

One borehole (CPRC01) was put down on the south side of the derelict house to the east of the railway crossing by a combination of cable percussion boring and rotary follow-on open hole drilling techniques. Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion upon reaching scheduled depth of 20.0m bgl.

Hand dug inspection pits were carried out between ground level and 1.2m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk bag and tub) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by Jacobs.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals throughout the overburden using the split spoon sampler (SPT). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

No rock core recovered.

Appendix B presents the borehole logs.

## 4.2 Standpipe Installations

A groundwater monitoring standpipe was installed in CPRC01 borehole.

Details of the installation, including the diameter of the pipe and depth range of the response zone, are provided in Appendix B on the individual borehole log.

Following the completion of the intrusive investigation work groundwater monitoring was undertaken at the site on six occasions. The results of the monitoring are presented in the report below in Section 6.3.

## 4.3 Water Purging

Prior to sampling from the standpipe water purging was carried out.

Appendix C presents the water purging data log.

### 4.4 Surveying

A broad survey of the site using a handheld CAT scanner to identify any existing buried services or old foundations/obstructions to excavation was carried out before commencement of excavation works. A GPR survey to PAS 128 specification was carried out at each location prior to excavation. The GPR survey report is presented in an addendum to follow issuance of this report.

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from OCB Geotechnical. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator, ITM) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

Pre-work site conditions were surveyed and upon completion of all site works at each site a post-work site condition survey was carried out. The pre and post site condition photographs are presented in Appendix F.

## 5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described and their descriptions incorporated into the borehole logs.

### 5.1 Geotechnical Laboratory Testing of Soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests, particle size distribution analysis and a 300m large shear box test.

- **soil chemistry:** pH, organic matter, Chloride content, Sulphur content and water-soluble and total sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute (1990) *BS 1377:1990, Methods of test for soils for civil engineering purposes. Parts 1 to 9.*

The test results are presented in Appendix D.

### 5.2 Environmental Laboratory Testing of Soils

In addition, environmental testing, as specified by Jacobs was conducted on selected environmental samples by Socotec at its laboratory in Burton-on-Trent, United Kingdom. Results of environmental testing are presented in Appendix E.

## 6 GROUND CONDITIONS

### 6.1 General Geology of the Area

Teagasc soil mapping indicates that the site area is underlain by Glacial Till derived chiefly from Devonian sandstones.

The Geological Survey of Ireland (GSI) bedrock mapping database indicates that soils in the site area are underlain at depth by the Carboniferous-age Ballysteen Formation, composed of Dark muddy Limestone and shale.

The site is underlain by a locally important aquifer, consisting of bedrock which is moderately productive only in local zones, and has a moderate groundwater vulnerability. No known karst features identified in the immediate site area but within the Ballysteen formation in the region a couple of karst features are noted. The closest of these is a spring approximately 1.75km to the North of the site.

### 6.2 Ground Types Encountered During Investigation of the Site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- Made Ground (fill / reworked material): Generally sandy gravelly Silt/Clay with angular cobbles and traces of inorganic material such as cloth, glass, stoneware and bricks. Extends to 3.50m bgl in CPRC01.
- Glacial Till: Sandy gravelly silty clay, frequently with cobble and boulder content, very soft to firm in upper horizons, becoming stiff with increasing depth.
- Fluvioglacial deposits: Typically medium dense to dense silty sandy Gravel with cobble content.
- Bedrock: Rockhead was not encountered to a maximum depth of 20.00m in CPRC01.

### 6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole log.

Groundwater monitoring to date in the standpipe installation, yielded the following results:

| Date | Depth to standing water level (m) |
|---|---|
| | CPRC01 |
| 13/08/20 | 3.65 |
| 17/08/20 | 3.70 |
| 21/08/20 | 3.13 |
| 29/09/20 | 3.67 |
| 07/10/20 | 3.40 |
| 22/10/20 | 3.76 |

Continued monitoring of the installed standpipe will give an indication of the seasonal variation in groundwater level.

# 7 DISCUSSION

## 7.1 Proposed Construction

It is proposed to construct overbridges, embankments, culverts, access roads and footpaths to enable the closure of five manned level crossings.

No further details were available to OCB Geotechnical at the time of preparing this report.

# 8 REFERENCES

*Specification And Related Documents For Ground Investigation In Ireland*. (2016) 2nd ed. Engineers Ireland.

BS EN 1997-1: 2007. *Eurocode 7 - Geotechnical design - Part 1 General Rules*. British Standards Institution, London.

BS EN 1997-2: 2007. *Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing*. British Standards Institution, London.

BS 1377: 1990. *Methods of test for soils for civil engineering purposes*. British Standards Institution, London.

BS 5930: 2015. *Code of practice for ground investigations*. British Standards Institution, London.

BS EN ISO 14688-1: 2002. *Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description*. British Standards Institution, London.

BS EN ISO 14689-1: 2003. *Geotechnical investigation and testing - Identification and classification of rock - Part 1 Identification and description*. British Standards Institution, London.

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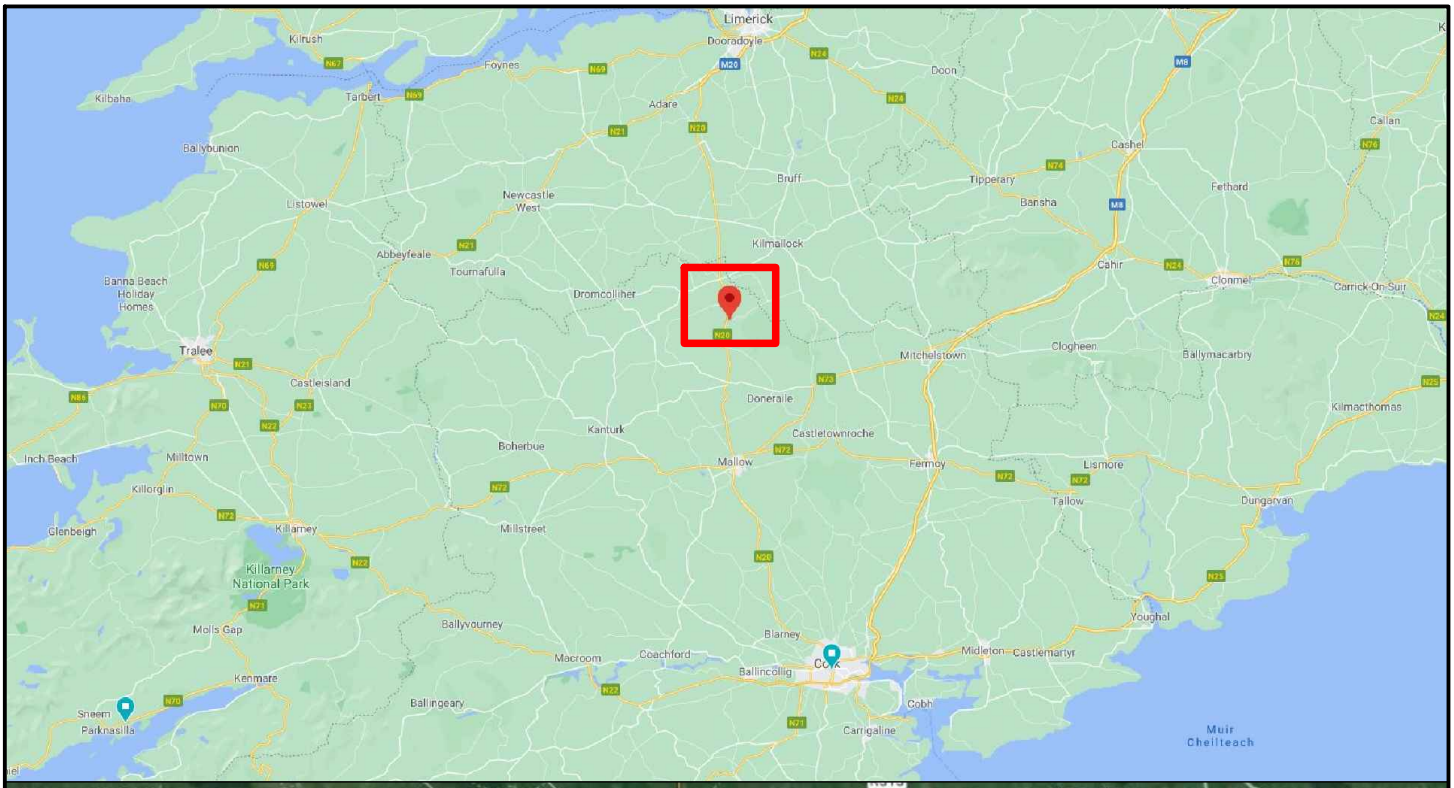
Environmental Protection Agency / Draft Guidance Note on Soil Recovery Waste Acceptance Criteria. December 2017.
http://www.epa.ie/pubs/consultation/soilrecoveryconsultation/

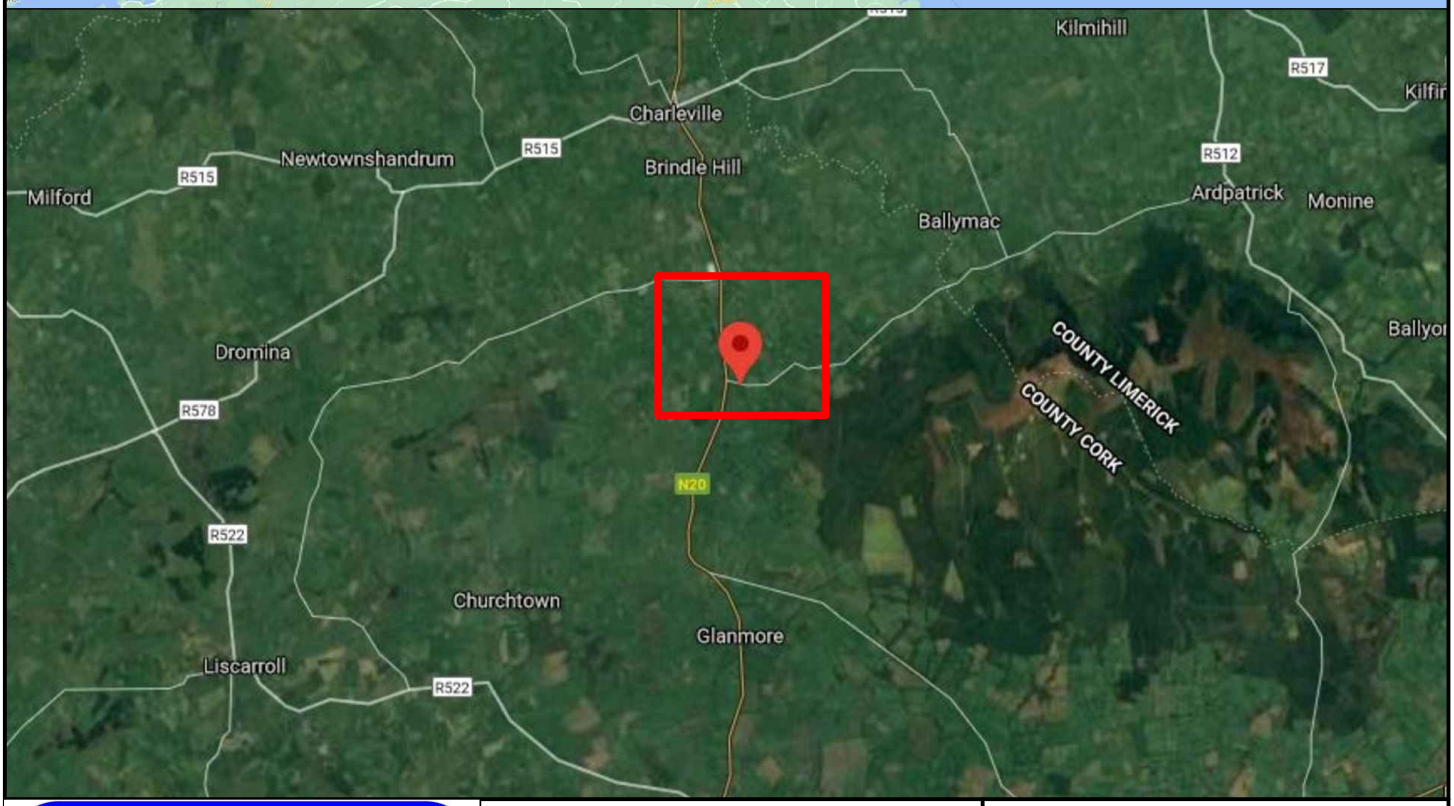
Environmental Protection Agency / Waste Classification List of Waste & Determining if Waste is Hazardous or Non-hazardous. 1st June 2015
https://www.epa.ie/pubs/reports/waste/stats/wasteclassification/EPA_Waste_Classification_2015_Web.pdf

Environment Agency UK (2009). Soil Guideline Values (SGVs).
https://www.gov.uk/government/collections/land-contamination-technical-guidance

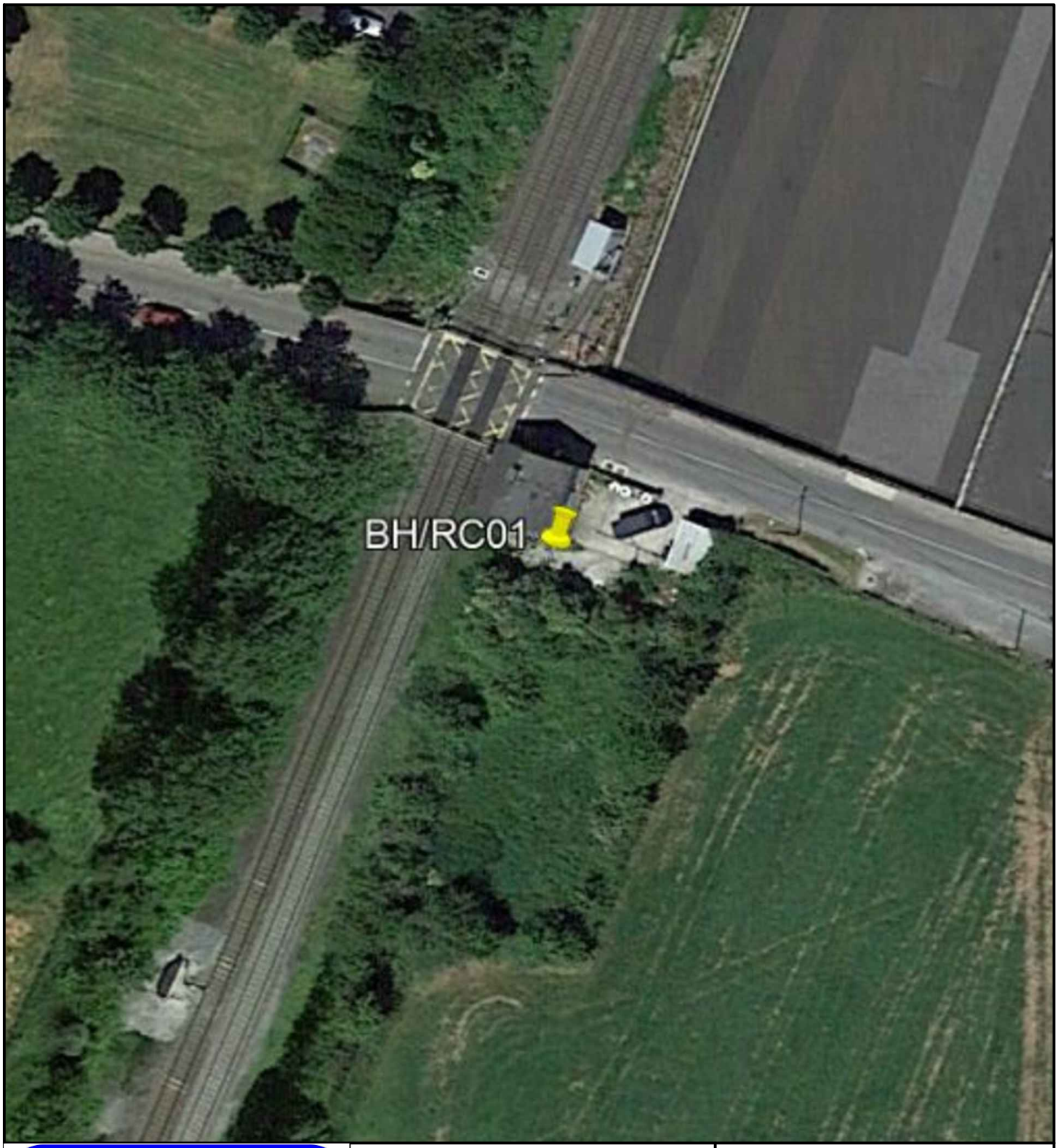
Soil Remediation Circular 2013, Ministry for Environment and Infrastructure, The Hague, Netherlands.
https://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/

# Appendix A Site and Exploratory Hole Location Plans




| | | |
|---|---|---|
| | Iarnród Éireann<br>Cork Line Level Crossings<br>XC212 (19-135-3) | SITE LOCATION MAPS |
| | | Client: Iarnród Éireann |
| | | Engineer: Jacob's |
| | | Date: June/July 2020 |




| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC212 (19-135-3) | Exploratory Hole Locations |
| | | Client: Iarnród Éireann |
| | | Engineer: Jacob's |
| | | Date: June/July 2020 |

# Appendix B Borehole Logs

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Borehole No.:** XC212-CPRC01 |
| **Coordinates:** 554653.01 E 617642.69 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 2 |
| **Method:** Cable Percussion+Rotary Open | **Client's Representative:** JACOBS | | **Scale:** 1:50 |
| **Plant:** Pilcon+T44 | **Ground Level:** 97.81 mOD | **Dates:** 02/03/2020 - 28/06/2020 | **Driller:** DS+AA +NOB |
| | | | **Logger:** MN |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description |
|---|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | | | (0.50) | | MADE GROUND: Dark brown fill material. |
| 0.50 | ES4 | | | | 97.31 | 0.50 | | |
| 0.50 - 1.50 | B2 | | | | | | | MADE GROUND: Brown, light brown and occasional grey slightly sandy to sandy gravelly silty CLAY with low to medium cobble content and occasional vegetation fragments, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. |
| 0.50 - 1.50 | D3 | | | | | | | |
| 1.00 | ES5 | | | | | (1.00) | | |
| 1.20 - 1.65 | SPT (C) N=7 | | | N=7 (1,1/1,2,2,2) | | | | |
| 1.50 - 2.50 | B6 | | | | 96.31 | 1.50 | | |
| 1.50 - 2.50 | D7 | | | | | | | MADE GROUND: Soft to firm light brown sandy gravelly silty CLAY with medium cobble content, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are predominantly subangular limestone. |
| 2.00 - 2.45 | SPT (C) N=12 | | | N=12 (1,2/2,3,4,3) | | (1.00) | | |
| 2.50 - 3.00 | B8 | | | | 95.31 | 2.50 | | |
| 2.50 - 3.00 | D9 | | | | | (0.30) | | MADE GROUND / DISTURBED NATIVE MATERIAL: Soft olive grey to brownish grey slightly sandy slightly gravelly silty CLAY with low cobble content including one concrete block and occasional black organic material, moist. One cloth fragment. Organic odour. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. |
| | | | | | 95.01 | 2.80 | | |
| | | | | | | (0.20) | | |
| 3.00 | ES12 | | | | 94.81 | 3.00 | | |
| 3.00 - 3.30 | B10 | | | | | | | |
| 3.00 - 3.30 | D11 | | | | | (0.50) | | As above, Dark olive grey with a trace of glass, slate and glazed stoneware fragments. |
| 3.30 - 3.50 | B13 | | | | 94.31 | 3.50 | | |
| 3.30 - 3.50 | D14 | 3.50 | 3.30 | 02-03-2020 | | (0.50) | | Possible MADE GROUND / DISTURBED NATIVE MATERIAL: Soft olive grey to brownish grey slightly sandy slightly gravelly silty CLAY, moist. Organic odour. Trace of possible red brick fragment, one possible mortar fragment. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. |
| 3.60 - 4.00 | B15 | | | | | | | |
| 3.60 - 4.00 | D16 | | | | 93.81 | 4.00 | | |
| 3.60 - 4.05 | SPT (C) | | | 0 (0 for 450mm/0 for 0mm) | | | | *U4 sample attempted at 3.0 to 3.5m. 0% recovery.* |
| | | 3.50 | 2.60 | 03-03-2020 | | (1.00) | | Very soft yellowish brown slightly sandy gravelly silty CLAY with low cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular including much limestone. |
| 4.00 - 5.00 | B17 | | | | | | | |
| 4.00 - 5.00 | D18 | | | | | | | Firm yellowish brown slightly sandy gravelly silty CLAY with medium cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are mostly subangular, predominantly limestone. |
| 4.00 - 4.45 | SPT (C) N=14 | | | N=14 (3,2/2,4,4,4) | 92.81 | 5.00 | | |
| 5.00 - 6.00 | B19 | | | | | | | Stiff yellowish brown slightly sandy gravelly silty CLAY with medium cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are mostly subangular, predominantly limestone. |
| 5.00 - 6.00 | D20 | | | | | | | |
| 5.00 - 5.45 | SPT (C) N=25 | | | N=25 (1,2/3,6,8,8) | | (1.00) | | |
| 6.00 - 7.00 | B21 | | | | 91.81 | 6.00 | | |
| 6.00 - 7.00 | D22 | | | | | | | Stiff greyish brown slightly sandy gravelly silty CLAY with medium cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are mostly subangular, predominantly limestone. |
| 6.00 - 6.45 | SPT (C) N=26 | | | N=26 (1,1/5,6,7,8) | | | | |
| | | | | | | (1.00) | | |
| 7.00 - 7.15 | B23 | | | | 90.81 | 7.00 | | |
| 7.00 - 7.15 | D24 | | | | | (0.30) | | Firm greyish brown slightly sandy gravelly silty CLAY with medium cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are mostly subangular, predominantly limestone. |
| 7.00 - 7.45 | SPT (C) N=12 | | | N=12 (0,1/2,2,4,4) | 90.51 | 7.30 | | |
| 7.30 - 8.00 | B25 | | | | | (0.70) | | Greyish brown slightly silty very sandy GRAVEL with low cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are angular to subrounded, sandstone, siltstone, limestone, conglomerate and occasional quartz. |
| 7.30 - 8.00 | D26 | | | (Water strike at 7.3m. Water rose to 3.5m in 2 mins. Gravel blowback to 6.4m.) | 89.81 | 8.00 | | |
| | | | | | | (0.80) | | Medium Dense greyish brown slightly silty very sandy GRAVEL with medium cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are mostly sandstone and limestone. |
| 8.00 - 8.80 | B27 | | | | | | | |
| 8.00 - 8.80 | D28 | | | | 89.01 | 8.80 | | |
| 8.00 - 8.45 | SPT (C) N=12 | | | N=12 (0,1/2,2,4,4) | | | | Dense greyish brown slightly silty very sandy GRAVEL with medium cobble content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are mostly sandstone and limestone. |
| | | 8.00 | 3.10 | 04-03-2020 | | (0.70) | | |
| | | 8.20 | 3.50 | 03-03-2020 | | | | |
| 8.80 - 9.00 | B29 | | | | 88.31 | 9.50 | | |
| 8.80 - 9.00 | D30 | | | | | | | Open Hole Boring - Driller Described: Sandy GRAVEL with boulders. |
| 9.00 - 9.40 | B31 | | | | | | | |
| 9.00 - 9.40 | D32 | | | | | | | |
| 9.00 - 9.45 | SPT (C) N=47 | | | N=47 (15,18/9,14,12,12) | | | | |

Continued on Next Page

Water | Backfill

**Remarks**

Cable Percussion terminated at 9.437m due to probable boulder obstruction. Rotary Open Hole techniques employed to 20.00m.

| Water Added | |
|---|---|
| From (m) | To (m) |
| | |

| Water Strike - General | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| 7.30 | 7.10 | 2 | 3.50 |
| 2.50 | 2.50 | 20 | 2.30 |
| 8.00 | 8.00 | 20 | 6.60 |

| Casing Details | |
|---|---|
| To (m) | Diam (mm) |
| 9.40 | 200 |
| 20.00 | 151 |

| Chiselling Details | | |
|---|---|---|
| From (m) | To (m) | Time (hh:mm) |
| 7.10 | 7.30 | 00:30 |
| 8.80 | 9.00 | 00:30 |
| 9.40 | 9.44 | 01:00 |

| | | | |
|---|---|---|---|
| | **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | **Borehole No.:** XC212-CPRC01 |
| | **Coordinates:** 554653.01 E | **Client:** Iarnród Éireann / Irish Rail | Sheet 2 of 2 |
| **Method:** Cable Percussion+Rotary Open | 617642.69 N | **Client's Representative:** JACOBS | **Scale:** 1:50 |
| **Plant:** Pilcon+T44 | **Ground Level:** 97.81 mOD | **Dates:** 02/03/2020 - 28/06/2020 | **Driller:** DS+AA +NOB<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description |
|---|---|---|---|---|---|---|---|---|
| 9.40 - 9.52 | SPT (C) | 9.40 | 2.90 | 50 (50 for 125mm/50 for 0mm)<br>04-03-2020 | | | | |
| 10.00 - 10.45 | SPT (C) N=41 | | | N=41 (3,7/12,12,8,9) | | (3.00) | | |
| | | | | | 85.31 | 12.50 | | Open Hole Boring - Driller Described: Boulder CLAY |
| 13.00 - 13.45 | SPT (C) N=47 | | | N=47 (3,7/13,14,9,11) | | (1.50) | | |
| | | | | | 83.81 | 14.00 | | Open Hole Boring - Driller Described: Sandy BOULDERS |
| | | | | | | (1.50) | | |
| | | | | | 82.31 | 15.50 | | Open Hole Boring - Driller Described: Clayey SAND with boulders |
| 16.00 - 16.45 | SPT (C) N=49 | | | N=49 (2,5/8,12,13,16) | | (3.00) | | |
| | | | | | 79.31 | 18.50 | | Open Hole Boring - Driller Described: Clayey SAND |
| 19.00 - 19.45 | SPT (C) N=56 | | | N=56 (3,4/9,13,15,19) | | (1.50) | | |
| 20.00 - 20.45 | SPT (C) N=52 | | | N=52 (6,8/9,10,15,18) | 77.81 | 20.00 | | End of borehole at 20.000m |

Water | Backfill

**Remarks**

Cable Percussion terminated at 9.437m due to probable boulder obstruction. Rotary Open Hole techniques employed to 20.00m.

| Water Added | |
|---|---|
| From (m) | To (m) |

| Water Strike - General | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| 7.30 | 7.10 | 2 | 3.50 |
| 2.50 | 2.50 | 20 | 2.30 |
| 8.00 | 8.00 | 20 | 6.60 |

| Casing Details | |
|---|---|
| To (m) | Diam (mm) |
| 9.40 | 200 |
| 20.00 | 151 |

| Chiselling Details | | |
|---|---|---|
| From (m) | To (m) | Time (hh:mm) |
| 7.10 | 7.30 | 00:30 |
| 8.80 | 9.00 | 00:30 |
| 9.40 | 9.44 | 01:00 |

# Appendix C Water Purging Data & Log

| | | | |
|---|---|---|---|
| Job Name: **I.E - Cork Line** | | h (m) | 5 |
| | | r (m) | 0.0505 |
| | | r2 | 0.00255025 |
| Job Nr: **19-135** | | TWV (m3) | 0.040059327 |

| | | | | |
|---|---|---|---|---|
| **BH ID:** XC212-CPRC01 | | | **Theoretical Well Volume** | 40.06 *ltrs* |
| **Depth to Response Zone:** | ***Top (mbgl)*** | ***Bottom (mbgl)*** | **TWV x3** | 120.18 *ltrs* |
| | 7.5 | 12.5 | | |

| | | | |
|---|---|---|---|
| **Purge Start Time:** | 09:30 | | **(mbgl)** |
| **Purge Finish Time:** | 12:01 | **Depth to Water** | 4.05 |
| | | **Total Depth** | 6.85 |
| **Depth to water after purging:** | mbgl | | |

| | Time Taken to fill 20ltr container(mins) | Flow Rate l/min | |
|---|---|---|---|
| Reading 1: | 11 | | (Pumping in well column) |
| Reading 2: | 20 | ~0.7 | |
| Reading 3: | 23 | ~0.9 | |

***Date*** 06/08/2020

| | | |
|---|---|---|
| Nr of Containers filled: | 5.5 | |
| **Total Volume Purged:** | 110 | ***litres*** |

| | **Temperature** | **pH** | **Electrical Conductivity** | **Dissolved Oxygen** | **Redox Potential** |
|---|---|---|---|---|---|
| Reading 1 | 16.37 | 6.28 | 12 | 0.6 | 28.6 |
| Reading 2 | 15.77 | 6.28 | 12 | 0.62 | 28 |
| Reading 3 | 15.75 | 6.63 | 10.71 | 0.62 | 26.5 |
| Reading 4 | 14.62 | 6.43 | 9.06 | 0.63 | 25.8 |
| Reading 5 | 13.93 | 6.55 | 11.53 | 0.64 | 24.5 |
| Reading 6 | 13.23 | 6.58 | 11.39 | 0.64 | 24.4 |
| Reading 7 | 13.41 | 6.65 | 10.13 | 0.63 | 24.7 |
| Reading 8 | 13.26 | 6.57 | 10.18 | 0.63 | 25.1 |
| Reading 9 | 13.3 | 6.54 | 11.16 | 0.63 | 26.1 |
| Reading 10 | 13.1 | 6.55 | 10.92 | 0.64 | 26.1 |

# Appendix D Geotechnical Soil Laboratory Test Results

**James Fisher Testing Services (Ireland) Ltd**
**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

James Fisher Testing Services

## LABORATORY TEST REPORT

**BRE Test Suite B - Greenfield Site**

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93839 |
| | Unit 1 Carrigogna | **Date Received:** | 09/03/2020 |
| | Midleton | **Date Reported:** | 09/04/2020 |
| | Co. Cork | **Material:** | Soil |
| **Order No.:** | 2003-104 | **Date Tested:** | 07/04/2020 |
| **Originator:** | Ian Holley | **Specification:** | Client |

**Sample Details** **XC212-CPRC01 Type D Sample 7**

| | | | |
|---|---|---|---|
| **Supplier:** | Client Info | **Date of Sampling:** | Client Info. |
| **Source:** | Client Info | **Sampled By:** | Client |
| **Sample Location:** | 1.5-2.5m | **Sampling Reason:** | Request |

| Parameter | RESULT |
|---|---|
| pH | 8.4 |
| Sulphate Aqueous Extract (SO4) (mg/l) | 2.9 |
| Sulphur as S, Total (%) | 0.03 |
| Sulphate as SO4, Total (%) | 0.03 |

**Comments:**
None



**Tested in accordance with the above specifications**
**Subcontracted to a laboratory UKAS accredited for this testing**

**Approved Signature**
**JAMES FISHER TESTING SERVICES (IRELAND) LTD.**

☐ **James Ward, Operations Manager**

James Fisher Testing Services

**James Fisher Testing Services (Ireland) Ltd**
**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co.Laois**
**Tel: 057 8664885**

James Fisher Testing Services

## LABORATORY TEST REPORT

### MOISTURE CONTENT BS 1377 : Part 2 : 1990 Oven Drying Method cl 3.2

| | | | |
|---|---|---|---|
| **Site:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93841 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Tested:** | 31/03/2020 |
| **Order No:** | 2003-104 | **Date Reported:** | 03/04/2020 |
| **Originator:** | **Ian Holley** | **Specification:** | Client |

***Sampled Ref:*** XC212-CPRC01 Type D Sample 9

| | | | |
|---|---|---|---|
| ***Sample Type:*** | Bulk | ***Location:*** | XC212-CPRC01 Type D Sample 9 |
| ***Date Sampled:*** | Client Info | ***Sample by:*** | Client |
| ***Depth:*** | 2.5-3.0m | ***Material Type:*** | Soil |

***Moisture Content (%):*** 19

Tested in accordance with BS 1377: Part 2: 1990
Sample preperation by cone and quarter



**Approved Signature**
**James Fisher Testing Services (Ireland) Ltd**
**James Ward, Operations Manager**

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**James Fisher Testing Services (Ireland) Ltd**
**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

James Fisher Testing Services

# LABORATORY TEST REPORT

**To determine the Organic Content of Soil**
**in accordance with BS 1377**

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93843 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Reported:** | 08/04/2020 |
| | Co. Cork | **Material:** | Soil |
| **Order No.:** | 2003-104 | **Date Tested:** | 07/04/2020 |
| **Originator:** | Ian Holley | **Specification:** | Client |

**Sample Details** **XC212-CPRC01 Type D Sample 9**

| | | | |
|---|---|---|---|
| **Supplier:** | Client Info | **Date of Sampling:** | Client Info |
| **Source:** | Client Info | **Sampled By:** | Client |
| **Sample Location:** | 2.5-3.0m | **Sampling Reason:** | Request |

## Result:

| | |
|---|---|
| **Organic Matter (%)** | **5.4** |

**Comments:**
None

**Tested in accordance with the above specifications**
**Subcontracted to a laboratory UKAS accredited for this testing**
**The stated result only relates to the item/location tested, this report shall not be reproduced except in full.**

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**James Ward, Operations Manager**

James Fisher Testing Services

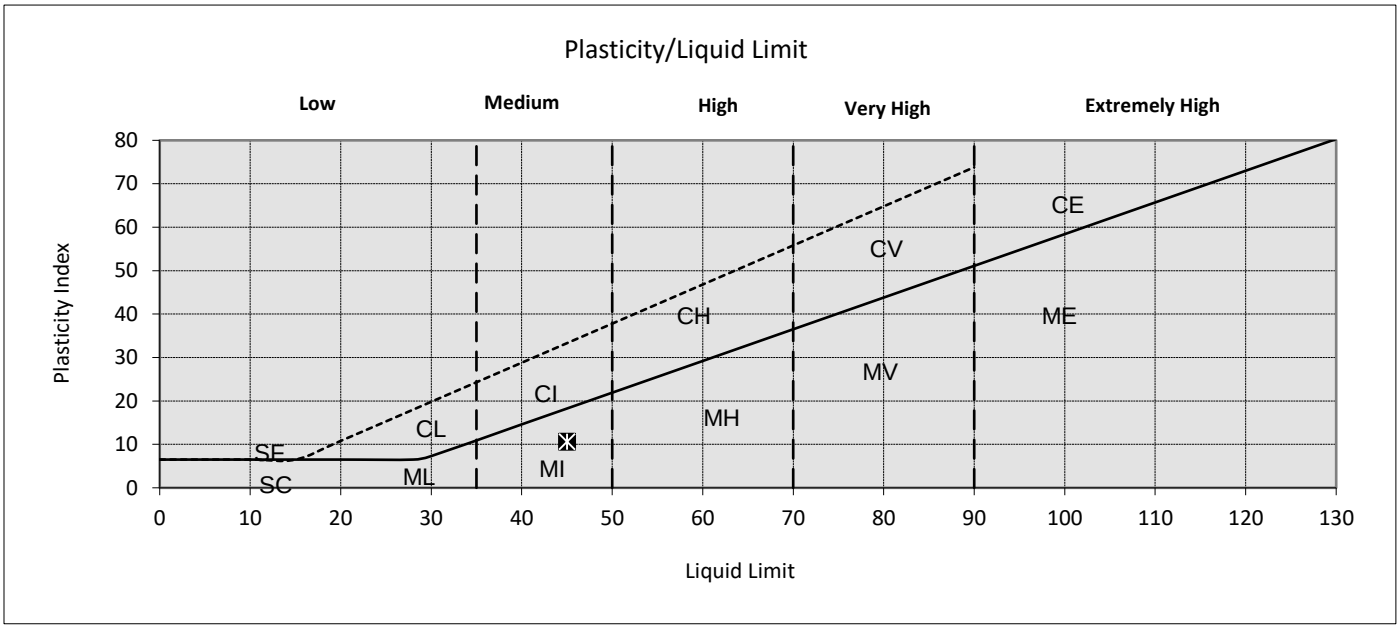
**James Fisher Testing Services Ltd**
**Ruby House, 40A Hardwick Grange**
**Warrington, WA1 4RF**
**Tel: 01925286880**

James Fisher Testing Services

# LABORATORY TEST REPORT
## LIQUID & PLASTIC LIMIT TESTS BS 1377: Part 2: 1990 Cl 4.4,5.3

| | | | |
|---|---|---|---|
| **Site Ref.:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93842 |
| | Unit 1 Carrigogna | **Sample Ref.:** | XC212-CPRC01 2.5-3.0m Type D S.9 |
| | Midleton | **Date Sampled:** | Client Info |
| | Co Cork | **Date Received:** | 26/03/2020 |
| **Order No:** | 2003-104 | **Date Tested:** | 03/04/2020 |
| **Originator:** | **Ian Holley** | **Date Reported:** | 03/04/2020 |

| | |
|---|---|
| Sampling Certificate | **No** |
| Sampled By | **Client** |
| Sample Type | **Bulk** |
| Sample Preparation Method | **Washed** |
| MATERIAL | **Soil** |
| Retained 425 micron (%) | **23** |
| Natural Moisture Content (%) | **38** |
| Liquid Limit (single point)(%) | **45** |
| Plastic Limit (%) | **34** |
| Plasticity Index | **11** |



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**James Fisher Testing Services Ltd**
**Phil Thorp, Laboratory Manager**

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**James Fisher Testing Services Ltd**
**Ruby House, 40A Hardwick Grange**
**Warrington, WA1 4RF**
**Tel: 01925286880**

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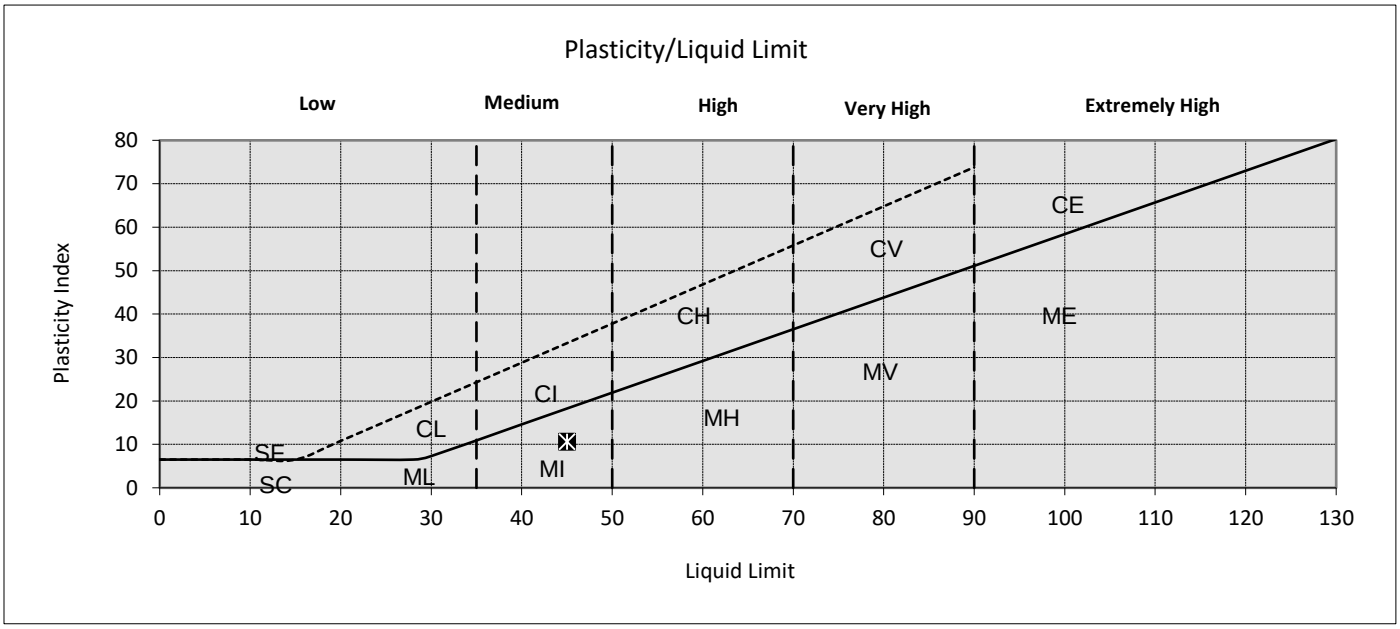
# LABORATORY TEST REPORT
## LIQUID & PLASTIC LIMIT TESTS BS 1377: Part 2: 1990 Cl 4.4,5.3

| | | | |
|---|---|---|---|
| **Site Ref.:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93842 |
| | Unit 1 Carrigogna | **Sample Ref.:** | XC212-CPRC01 2.5-3.0m Type D S.9 |
| | Midleton | **Date Sampled:** | Client Info |
| | Co Cork | **Date Received:** | 26/03/2020 |
| **Order No:** | 2003-104 | **Date Tested:** | 03/04/2020 |
| **Originator:** | **Ian Holley** | **Date Reported:** | 03/04/2020 |

| | |
|---|---|
| Sampling Certificate | **No** |
| Sampled By | **Client** |
| Sample Type | **Bulk** |
| Sample Preparation Method | **Washed** |
| MATERIAL | **Soil** |
| Retained 425 micron (%) | **23** |
| Natural Moisture Content (%) | **38** |
| Liquid Limit (single point)(%) | **45** |
| Plastic Limit (%) | **34** |
| Plasticity Index | **11** |

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**Portlaoise, Co. Laois**
**Tel: 057 8664885**

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# LABORATORY TEST REPORT

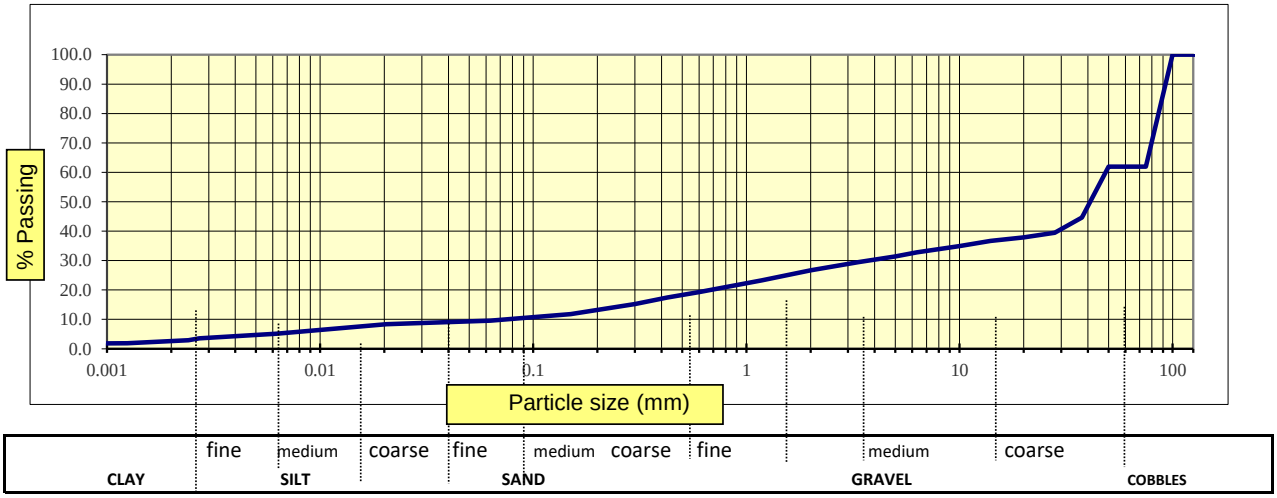
## Determination of Particle Size Distribution - BS 1377 : Part 2 : 1990

## Determination of Particle Size Distribution (Hydrometer Sedimentation) - BS 1377 : Part 2 : 1990 Cl. 9.5

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93840 |
| | Unit 1 Carrigogna | **Date Received:** | 11/03/2020 |
| | Midleton | **Date Reported:** | 02/04/2020 |
| | | **Date Tested:** | 01/04/2020 |
| **Order No:** | 2003-104 | **Material:** | Soil |
| **Originator:** | Ian Holley | **Visual Description** | Cobble, Dark Clay, Sandy |

| | |
|---|---|
| **Client Ref.** | **XC212-CPRC01 Type B Sample 8** |
| **Location:** | XC212-CPRC01 Type B Sample 8 |
| **Supplier:** | Bulk |
| **Source:** | Client Info. |
| **Depth (m):** | 2.5-3.0m |
| **Sampling Reason:** | Client Request |
| **Sampled By:** | Client |
| **Specification:** | Client |
| **Preparation Method:** | Without Organics Preparation |
| **Notes:** | Disturbed sample from cleanout |

| BS Sieve Size | % Passing | Specification |
|---|---|---|
| 300 mm | 100 | |
| 125 mm | 100 | |
| 100 mm | 100 | |
| 75 mm | 62 | |
| 63 mm | 62 | |
| 50 mm | 62 | |
| 37.5 mm | 45 | |
| 28 mm | 39 | |
| 20 mm | 38 | |
| 14 mm | 37 | |
| 10 mm | 35 | |
| 6.3 mm | 33 | |
| 5 mm | 31 | |
| 3.35 mm | 29 | |
| 2 mm | 27 | |
| 1.18 mm | 23 | |
| 0.6 mm | 19 | |
| 0.425 mm | 17 | |
| 0.3 mm | 15 | |
| 0.15 mm | 12 | |
| 0.063 mm | 10 | |
| 0.020 mm | 8 | |
| 0.006 mm | 5 | |
| 0.003 mm | 4 | |
| 0.002 mm | 3 | |
| 0.001 mm | 2 | |




Tested in accordance with BS 1377: Part 2 : 1990 Clause 9.2 and 9.5



Sedimentation by Hydrometer - Not UKAS

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**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

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# LABORATORY TEST REPORT

## BRE Test Suite B - Greenfield Site

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93844 |
| | Unit 1 Carrigogna | **Date Received:** | 09/03/2020 |
| | Midleton | **Date Reported:** | 09/04/2020 |
| | Co. Cork | **Material:** | Soil |
| **Order No.:** | 2003-104 | **Date Tested:** | 07/04/2020 |
| **Originator:** | Ian Holley | **Specification:** | Client |

**Sample Details** **XC212-CPRC01 Type D Sample 14**

| | | | |
|---|---|---|---|
| **Supplier:** | Client Info | **Date of Sampling:** | Client Info. |
| **Source:** | Client Info | **Sampled By:** | Client |
| **Sample Location:** | 3.3-3.5m | **Sampling Reason:** | Request |

| Parameter | RESULT |
|---|---|
| pH | 8 |
| Sulphate Aqueous Extract (SO4) (mg/l) | 46 |
| Sulphur as S, Total (%) | 0.03 |
| Sulphate as SO4, Total (%) | 0.03 |

**Comments:**
None



**Tested in accordance with the above specifications**
**Subcontracted to a laboratory UKAS accredited for this testing**

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**JAMES FISHER TESTING SERVICES (IRELAND) LTD.**

☐ **James Ward, Operations Manager**

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**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co.Laois**
**Tel: 057 8664885**

James Fisher Testing Services

## LABORATORY TEST REPORT

### MOISTURE CONTENT BS 1377 : Part 2 : 1990 Oven Drying Method cl 3.2

| | | | |
|---|---|---|---|
| **Site:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93845 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Tested:** | 31/03/2020 |
| **Order No:** | 2003-104 | **Date Reported:** | 03/04/2020 |
| **Originator:** | **Ian Holley** | **Specification:** | Client |

***Sampled Ref:*** XC212-CPRC01 Type D Sample 15

| | | | |
|---|---|---|---|
| ***Sample Type:*** | Bulk | ***Location:*** | XC212-CPRC01 Type D Sample 15 |
| ***Date Sampled:*** | Client Info | ***Sample by:*** | Client |
| ***Depth:*** | 3.6-4.0m | ***Material Type:*** | Soil |

***Moisture Content (%):*** 7.4

Tested in accordance with BS 1377: Part 2: 1990
Sample preperation by cone and quarter



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**James Ward, Operations Manager**

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**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

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## LABORATORY TEST REPORT

**To determine the Organic Content of Soil**
**in accordance with BS 1377**

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93847 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Reported:** | 08/04/2020 |
| | Co. Cork | **Material:** | Soil |
| **Order No.:** | 2003-104 | **Date Tested:** | 07/04/2020 |
| **Originator:** | Ian Holley | **Specification:** | Client |

**Sample Details** **XC212-CPRC01 Type D Sample 16**

| | | | |
|---|---|---|---|
| **Supplier:** | Client Info | **Date of Sampling:** | Client Info |
| **Source:** | Client Info | **Sampled By:** | Client |
| **Sample Location:** | 3.6-4.0m | **Sampling Reason:** | Request |

## Result:

| | |
|---|---|
| **Organic Matter (%)** | **0.9** |

**Comments:**
None

**Tested in accordance with the above specifications**
**Subcontracted to a laboratory UKAS accredited for this testing**
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**James Fisher Testing Services Ltd**
**Ruby House, 40A Hardwick Grange**
**Warrington, WA1 4RF**
**Tel: 01925286880**

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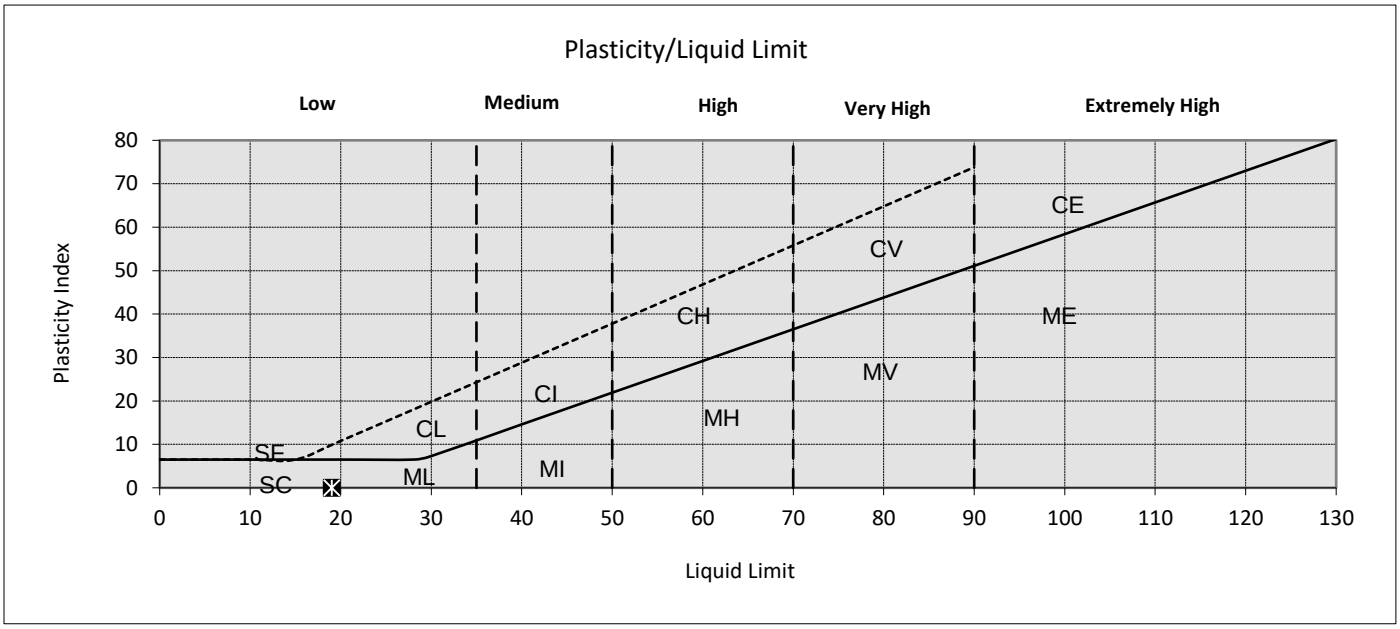
# LABORATORY TEST REPORT
## LIQUID & PLASTIC LIMIT TESTS BS 1377: Part 2: 1990 Cl 4.4,5.3

| | | | |
|---|---|---|---|
| **Site Ref.:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93846 |
| | Unit 1 Carrigogna | **Sample Ref.:** | XC212-CPRC01 3.6-4.0m Type B S.15 |
| | Midleton | **Date Sampled:** | Client Info |
| | Co Cork | **Date Received:** | 26/03/2020 |
| **Order No:** | 2003-104 | **Date Tested:** | 02/04/2020 |
| **Originator:** | **Ian Holley** | **Date Reported:** | 03/04/2020 |

| | |
|---|---|
| Sampling Certificate | **No** |
| Sampled By | **Client** |
| Sample Type | **Bulk** |
| Sample Preparation Method | **Washed** |
| MATERIAL | **Soil** |
| Retained 425 micron (%) | **66** |
| Natural Moisture Content (%) | **13** |
| Liquid Limit (single point)(%) | **19** |
| Plastic Limit (%) | **Non-Plastic** |
| Plasticity Index | **N/A** |



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**Phil Thorp, Laboratory Manager**

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**Tel: 057 8664885**

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## LABORATORY TEST REPORT

### MOISTURE CONTENT BS 1377 : Part 2 : 1990 Oven Drying Method cl 3.2

| | | | |
|---|---|---|---|
| **Site:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93849 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Tested:** | 31/03/2020 |
| **Order No:** | 2003-104 | **Date Reported:** | 03/04/2020 |
| **Originator:** | **Ian Holley** | **Specification:** | Client |

***Sampled Ref:*** XC212-CPRC01 Type D Sample 18

| | | | |
|---|---|---|---|
| ***Sample Type:*** | Bulk | ***Location:*** | XC212-CPRC01 Type D Sample 18 |
| ***Date Sampled:*** | Client Info | ***Sample by:*** | Client |
| ***Depth:*** | 4-5m | ***Material Type:*** | Soil |

***Moisture Content (%):*** 8

Tested in accordance with BS 1377: Part 2: 1990
Sample preperation by cone and quarter



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**James Ward, Operations Manager**

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**James Fisher Testing Services Ltd**
**Ruby House, 40A Hardwick Grange**
**Warrington, WA1 4RF**
**Tel: 01925286880**

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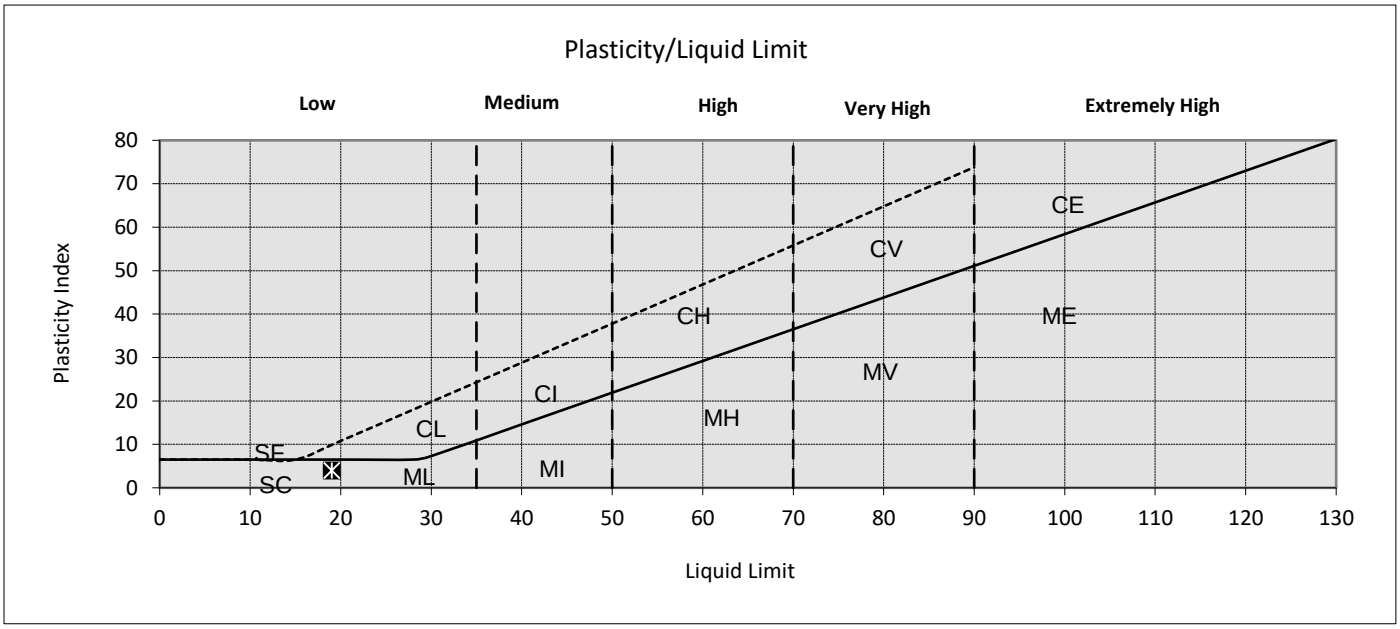
## LABORATORY TEST REPORT
## LIQUID & PLASTIC LIMIT TESTS BS 1377: Part 2: 1990 Cl 4.4,5.3

| | | | |
|---|---|---|---|
| **Site Ref.:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93850 |
| | Unit 1 Carrigogna | **Sample Ref.:** | XC212-CPRC01 4-5m Type D Sample 18 |
| | Midleton | **Date Sampled:** | Client Info |
| | Co Cork | **Date Received:** | 26/03/2020 |
| **Order No:** | 2003-104 | **Date Tested:** | 02/04/2020 |
| **Originator:** | **Ian Holley** | **Date Reported:** | 03/04/2020 |

| | |
|---|---|
| Sampling Certificate | **No** |
| Sampled By | **Client** |
| Sample Type | **Bulk** |
| Sample Preparation Method | **Washed** |
| MATERIAL | **Soil** |
| Retained 425 micron (%) | **19** |
| Natural Moisture Content (%) | **13** |
| Liquid Limit (single point)(%) | **19** |
| Plastic Limit (%) | **15** |
| Plasticity Index | **4** |






**Approved Signature**
**James Fisher Testing Services Ltd**
**Phil Thorp, Laboratory Manager**

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**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

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# LABORATORY TEST REPORT

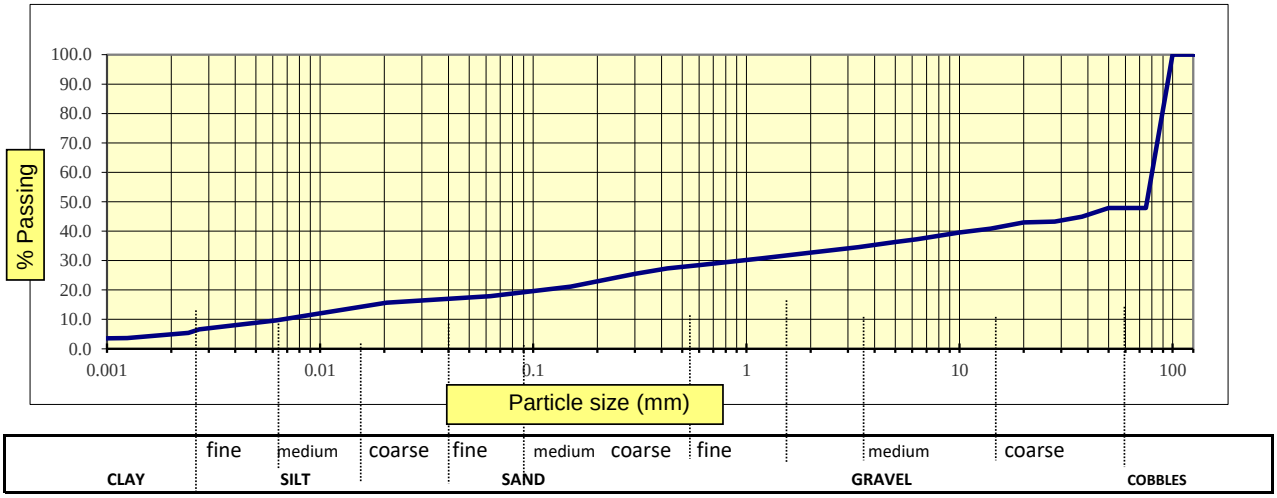
## Determination of Particle Size Distribution - BS 1377 : Part 2 : 1990

## Determination of Particle Size Distribution (Hydrometer Sedimentation) - BS 1377 : Part 2 : 1990 Cl. 9.5

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93848 |
| | Unit 1 Carrigogna | **Date Received:** | 11/03/2020 |
| | Midleton | **Date Reported:** | 02/04/2020 |
| | | **Date Tested:** | 01/04/2020 |
| **Order No:** | 2003-104 | **Material:** | Soil |
| **Originator:** | Ian Holley | **Visual Description** | Large Cobble, Light Clay, Sandy |

| | |
|---|---|
| **Client Ref.** | **XC212-CPRC01 Type B Sample 17** |
| **Location:** | XC212-CPRC01 Type B Sample 17 |
| **Supplier:** | Bulk |
| **Source:** | Client Info. |
| **Depth (m):** | 4.0-5.0m |
| **Sampling Reason:** | Client Request |
| **Sampled By:** | Client |
| **Specification:** | Client |
| **Preparation Method:** | Without Organics Preparation |
| **Notes:** | Disturbed sample from cleanout |

| BS Sieve Size | % Passing | Specification |
|---|---|---|
| 300 mm | 100 | |
| 125 mm | 100 | |
| 100 mm | 100 | |
| 75 mm | 48 | |
| 63 mm | 48 | |
| 50 mm | 48 | |
| 37.5 mm | 45 | |
| 28 mm | 43 | |
| 20 mm | 43 | |
| 14 mm | 41 | |
| 10 mm | 40 | |
| 6.3 mm | 37 | |
| 5 mm | 36 | |
| 3.35 mm | 35 | |
| 2 mm | 33 | |
| 1.18 mm | 31 | |
| 0.6 mm | 28 | |
| 0.425 mm | 27 | |
| 0.3 mm | 26 | |
| 0.15 mm | 21 | |
| 0.063 mm | 18 | |
| 0.020 mm | 16 | |
| 0.006 mm | 10 | |
| 0.003 mm | 7 | |
| 0.002 mm | 5 | |
| 0.001 mm | 4 | |




Tested in accordance with BS 1377: Part 2 : 1990 Clause 9.2 and 9.5



Sedimentation by Hydrometer - Not UKAS

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☐ **James Ward, Operations Manager**

**James Fisher Testing Services Limited**
**Unit D Zone 5**
**Clonminam Business Park**
**Tel: 057 86 64885**

James Fisher Testing Services

# Laboratory Test Report
## Determination of shear Strength by Direct Shear (Small Shearbox)
## in accordance with BS :1377: Part 7 : 1990 Clause 4

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossing | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93851 |
| | Unit 1 Carrigogna | **Date Received:** | 09/03/2020 |
| | Midleton | **Date Reported:** | 05/05/2020 |
| | | **Material:** | Earthworks |
| **Order No.:** | 2003-104 | **Visual Description:** | Brown very Gravelly Clay |
| **Originator:** | Ian Holley | **Specification:** | TII Series 600 |

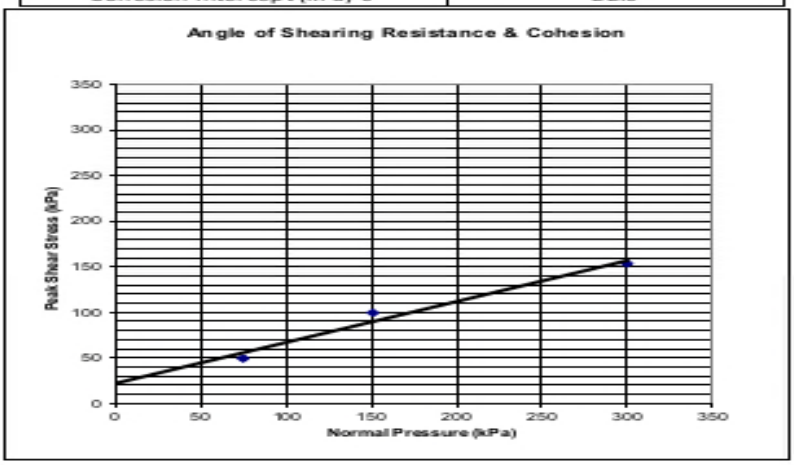
| | | | |
|---|---|---|---|
| **Client Ref:** | **ST 93851** | | |
| **Certificate of sampling** | Yes | **Date Of Sampling:** | Client info |
| **Lab Reference No.** | XC212-CPRC01 | **Sampled By:** | OCB |
| **Sample Source & Ticket No.** | Site Won | **Sample Preparation:** | Bulk sample sieved through 20mm sieve |
| **Sample Location / Orientation :** | Cork Line Level Crossings | **Tested Dry or Submerged:** | Dry |

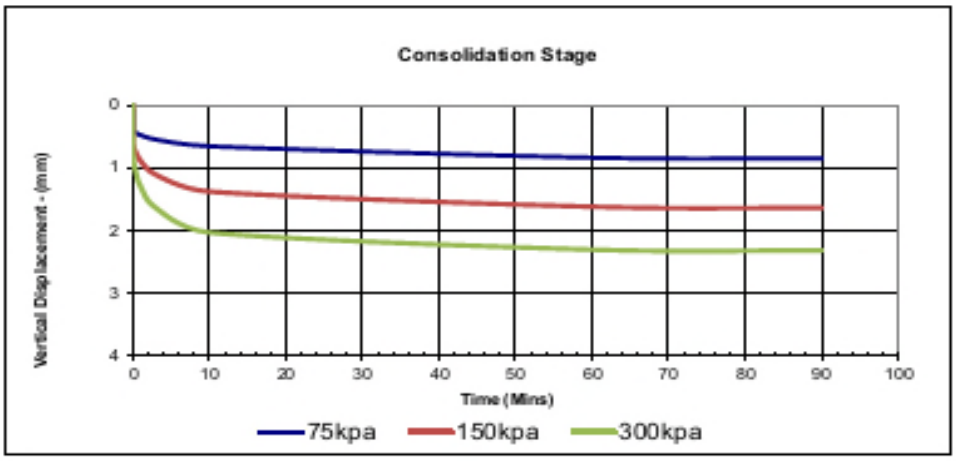
## Results

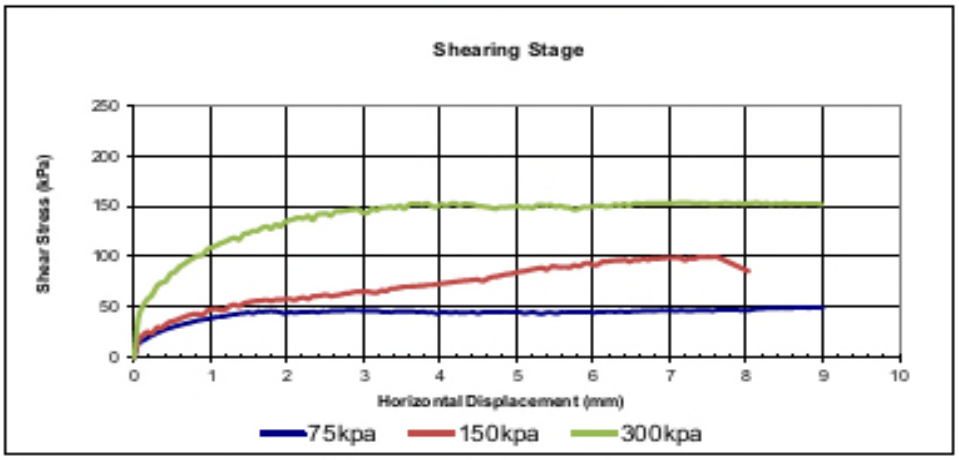
| SUMMARY OF TEST RESULTS: | |
|---|---|
| Angle of Shearing Resistance (°) φ' | 24.0 |
| Cohesion Intercept (kPa) c' | 22.0 |

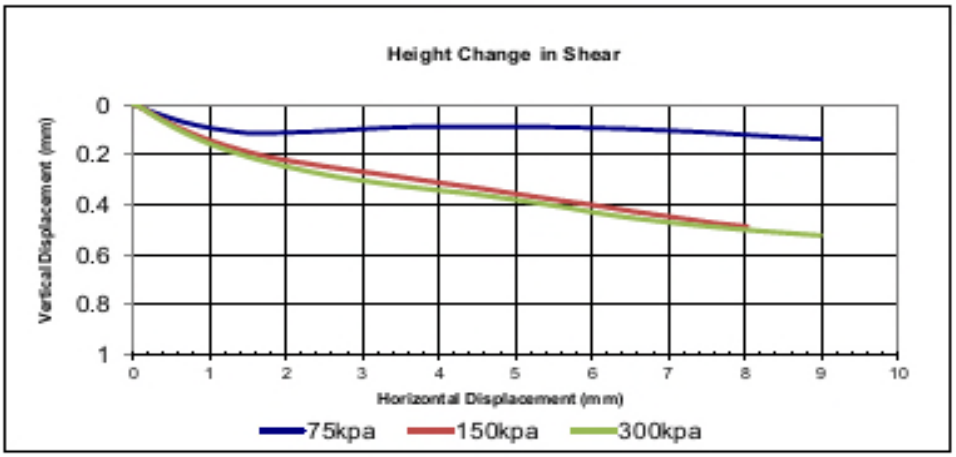
Sample Condition: Submerged
Particle Density: 2.65(Mg/m3) Assumed
Sample Preparation: Remoulded (Hand Tamped)
Material tested passing 2mm sieve

| **Initial Condition** | | | |
|---|---|---|---|
| | Stage | | |
| | 1 | 2 | 3 |
| Normal Pressure (kPa) | 75 | 150 | 300 |
| Height (mm) | 20.39 | 20.20 | 20.37 |
| Width (mm) | 59.9 | 59.9 | 59.9 |
| Bulk Density (Mg/m$^3$) | 2.07 | 2.09 | 2.07 |
| Dry Density (Mg/m$^3$) | 1.80 | 1.82 | 1.80 |
| Moisture Content (%) | 15 | 15 | 15 |
| Voids Ratio | 0.469 | 0.457 | 0.475 |
| Degree of Saturation | 84.8 | 87.0 | 83.7 |
| **Shearing Stage** | | | |
| Rate of Displacement (mm/min) | 0.03 | 0.03 | 0.03 |
| Peak Shear Stress (kPa) | 49.4 | 99.6 | 153.5 |
| Displacement at Peak Stress (mm) | 8.9 | 7.6 | 8.1 |
| **Final Condition** | | | |
| Bulk Density (Mg/m$^3$) | 2.28 | 2.40 | 2.42 |
| Dry Density (Mg/m$^3$) | 1.90 | 2.03 | 2.09 |
| Moisture Content (%) | 20 | 18 | 16 |
| Angle of Shearing Resistance (°) φ' | 24.0 | | |
| Cohesion Intercept (kPa) c' | 22.0 | | |



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**Approved Signature**
**James Fisher Testing Services Limited**
**James Ward, Operations Manager**

**James Fisher Testing Services (Ireland) Ltd**
**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

James Fisher Testing Services

## LABORATORY TEST REPORT

**BRE Test Suite B - Greenfield Site**

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93852 |
| | Unit 1 Carrigogna | **Date Received:** | 09/03/2020 |
| | Midleton | **Date Reported:** | 09/04/2020 |
| | Co. Cork | **Material:** | Soil |
| **Order No.:** | 2003-104 | **Date Tested:** | 07/04/2020 |
| **Originator:** | Ian Holley | **Specification:** | Client |

**Sample Details** **XC212-CPRC01 Type D Sample 20**

| | | | |
|---|---|---|---|
| **Supplier:** | Client Info | **Date of Sampling:** | Client Info. |
| **Source:** | Client Info | **Sampled By:** | Client |
| **Sample Location:** | 5-6m | **Sampling Reason:** | Request |

| Parameter | RESULT |
|---|---|
| pH | 8.3 |
| Sulphate Aqueous Extract (SO4) (mg/l) | 15 |
| Sulphur as S, Total (%) | 0.01 |
| Sulphate as SO4, Total (%) | 0.01 |

**Comments:**
None

**The stated result only relates to the item/location tested, this report shall not be reproduced except in full.**
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**Subcontracted to a laboratory UKAS accredited for this testing**

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**Clonminam Business Park**
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# Laboratory Test Report
## Determination of shear Strength by Direct Shear (Small Shearbox)
## in accordance with BS :1377: Part 7 : 1990 Clause 4

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossing | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93853 |
| | Unit 1 Carrigogna | **Date Received:** | 09/03/2020 |
| | Midleton | **Date Reported:** | 05/05/2020 |
| | | **Material:** | Earthworks |
| **Order No.:** | 2003-104 | **Visual Description:** | Brown very Gravelly, very Clayey SAND |
| **Originator:** | Ian Holley | **Specification:** | TII Series 600 |

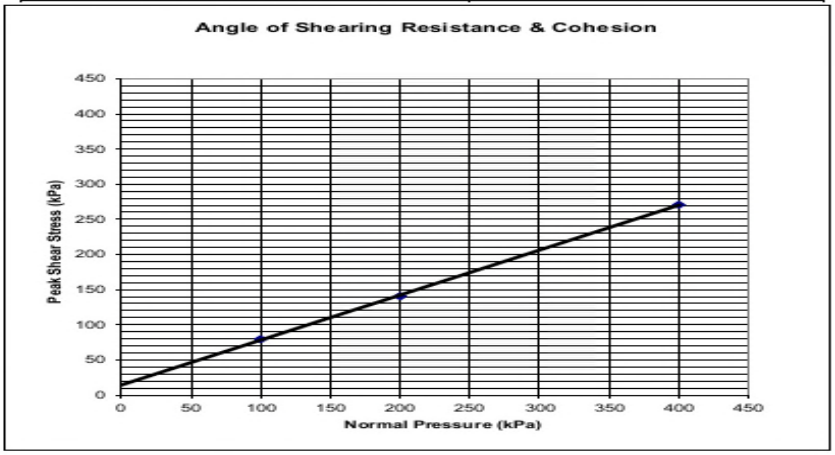
| | | | |
|---|---|---|---|
| **Client Ref:** | **ST 93853** | | |
| **Certificate of sampling** | Yes | **Date Of Sampling:** | Client info |
| **Lab Reference No.** | XC212-CPRC01 6-7m Type B Ref 21 | **Sampled By:** | OCB |
| **Sample Source & Ticket No.** | Site Won | **Sample Preparation:** | Bulk sample sieved through 20mm sieve |
| **Sample Location / Orientation :** | Cork Line Level Crossings | **Tested Dry or Submerged:** | Dry |

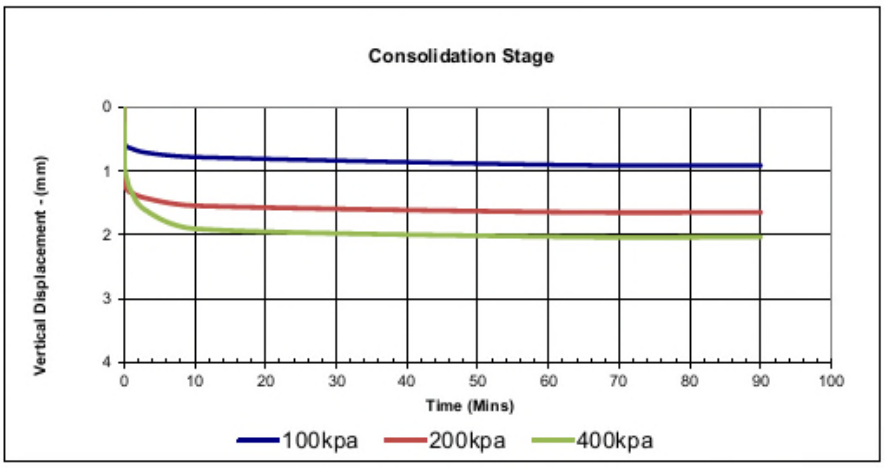
## Results

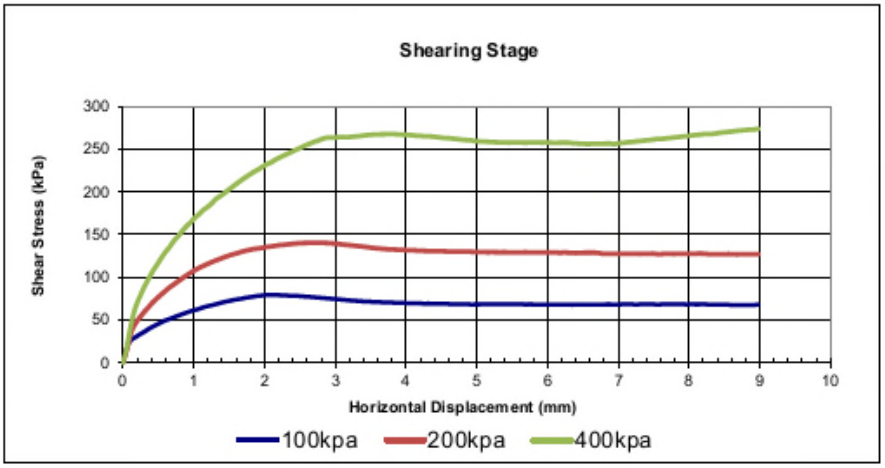
| SUMMARY OF TEST RESULTS: | |
|---|---|
| Angle of Shearing Resistance (°) φ' | 32.5 |
| Cohesion Intercept (kPa) c' | 14.0 |

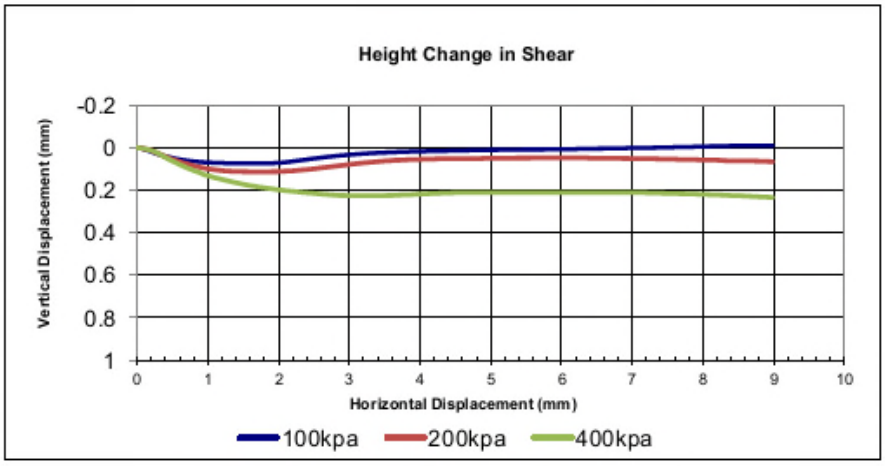
Sample Condition: Submerged
Particle Density: 2.65(Mg/m3) Assumed
Sample Preparation: Remoulded (Hand Tamped)
Material tested passing 2mm sieve

| **Initial Condition** | | | |
|---|---|---|---|
| | Stage | | |
| | 1 | 2 | 3 |
| Normal Pressure (kPa) | 100 | 200 | 400 |
| Height (mm) | 20.60 | 20.23 | 20.77 |
| Width (mm) | 59.9 | 59.9 | 59.9 |
| Bulk Density ($Mg/m^3$) | 2.24 | 2.26 | 2.21 |
| Dry Density ($Mg/m^3$) | 2.03 | 2.04 | 1.99 |
| Moisture Content (%) | 10 | 11 | 11 |
| Voids Ratio | 0.303 | 0.301 | 0.329 |
| Degree of Saturation | 87.3 | 96.8 | 88.5 |
| **Shearing Stage** | | | |
| Rate of Displacement (mm/min) | 0.03 | 0.03 | 0.03 |
| Peak Shear Stress (kPa) | 79.4 | 140.4 | 270.7 |
| Displacement at Peak Stress (mm) | 2.0 | 2.7 | 9.0 |
| **Final Condition** | | | |
| Bulk Density ($Mg/m^3$) | 2.40 | 2.49 | 2.44 |
| Dry Density ($Mg/m^3$) | 2.13 | 2.23 | 2.24 |
| Moisture Content (%) | 13 | 12 | 9 |
| Angle of Shearing Resistance (°) φ' | 32.5 | | |
| Cohesion Intercept (kPa) c' | 14.0 | | |



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**James Fisher Testing Services Limited**
**James Ward, Operations Manager**

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**Portlaoise, Co.Laois**
**Tel: 057 8664885**

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## LABORATORY TEST REPORT

### MOISTURE CONTENT BS 1377 : Part 2 : 1990 Oven Drying Method cl 3.2

| | | | |
|---|---|---|---|
| **Site:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93854 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Tested:** | 31/03/2020 |
| **Order No:** | 2003-104 | **Date Reported:** | 03/04/2020 |
| **Originator:** | **Ian Holley** | **Specification:** | Client |

***Sampled Ref:*** XC212-CPRC01 Type D Sample 22

| | | | |
|---|---|---|---|
| ***Sample Type:*** | Bulk | ***Location:*** | XC212-CPRC01 Type D Sample 22 |
| ***Date Sampled:*** | Client Info | ***Sample by:*** | Client |
| ***Depth:*** | 6-7m | ***Material Type:*** | Soil |

***Moisture Content (%):*** 6.2

Tested in accordance with BS 1377: Part 2: 1990
Sample preperation by cone and quarter



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**James Ward, Operations Manager**

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**James Fisher Testing Services Ltd**
**Ruby House, 40A Hardwick Grange**
**Warrington, WA1 4RF**
**Tel: 01925286880**

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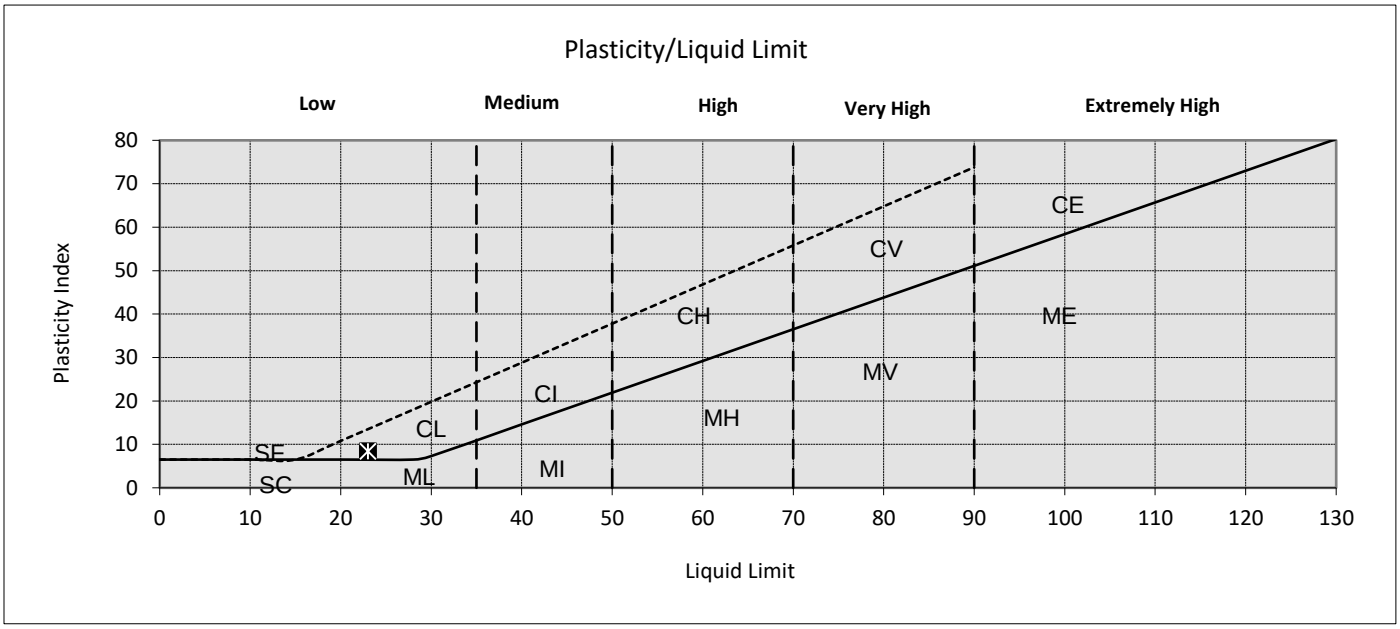
# LABORATORY TEST REPORT
## LIQUID & PLASTIC LIMIT TESTS BS 1377: Part 2: 1990 Cl 4.4,5.3

| | | | |
|---|---|---|---|
| **Site Ref.:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93855 |
| | Unit 1 Carrigogna | **Sample Ref.:** | XC212-CPRC01 6-7m Type D Sample 22 |
| | Midleton | **Date Sampled:** | Client Info |
| | Co Cork | **Date Received:** | 26/03/2020 |
| **Order No:** | 2003-104 | **Date Tested:** | 02/04/2020 |
| **Originator:** | **Ian Holley** | **Date Reported:** | 03/04/2020 |

| | |
|---|---|
| Sampling Certificate | **No** |
| Sampled By | **Client** |
| Sample Type | **Bulk** |
| Sample Preparation Method | **Washed** |
| MATERIAL | **Soil** |
| Retained 425 micron (%) | **20** |
| Natural Moisture Content (%) | **13** |
| Liquid Limit (single point)(%) | **23** |
| Plastic Limit (%) | **14** |
| Plasticity Index | **8** |

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**Phil Thorp, Laboratory Manager**

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# LABORATORY TEST REPORT

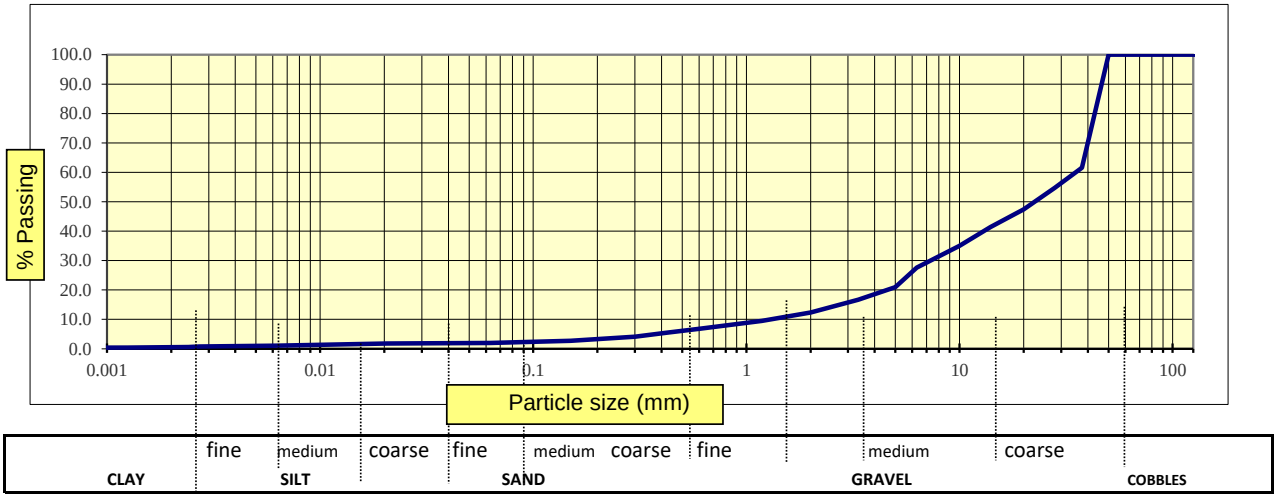
## Determination of Particle Size Distribution - BS 1377 : Part 2 : 1990

## Determination of Particle Size Distribution (Hydrometer Sedimentation) - BS 1377 : Part 2 : 1990 Cl. 9.5

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93857 |
| | Unit 1 Carrigogna | **Date Received:** | 11/03/2020 |
| | Midleton | **Date Reported:** | 02/04/2020 |
| | | **Date Tested:** | 01/04/2020 |
| **Order No:** | 2003-104 | **Material:** | Soil |
| **Originator:** | Ian Holley | **Visual Description** | Cobble, Sandy |

| | |
|---|---|
| **Client Ref.** | **XC212-CPRC01 Type B Sample 25** |
| **Location:** | XC212-CPRC01 Type B Sample 25 |
| **Supplier:** | Bulk |
| **Source:** | Client Info. |
| **Depth (m):** | 7.3-8.0m |
| **Sampling Reason:** | Client Request |
| **Sampled By:** | Client |
| **Specification:** | Client |
| **Preparation Method:** | Without Organics Preparation |
| **Notes:** | Disturbed sample from cleanout |

| BS Sieve Size | % Passing | Specification |
|---|---|---|
| 300 mm | 100 | |
| 125 mm | 100 | |
| 100 mm | 100 | |
| 75 mm | 100 | |
| 63 mm | 100 | |
| 50 mm | 100 | |
| 37.5 mm | 62 | |
| 28 mm | 55 | |
| 20 mm | 47 | |
| 14 mm | 41 | |
| 10 mm | 35 | |
| 6.3 mm | 28 | |
| 5 mm | 21 | |
| 3.35 mm | 17 | |
| 2 mm | 12 | |
| 1.18 mm | 9 | |
| 0.6 mm | 7 | |
| 0.425 mm | 5 | |
| 0.3 mm | 4 | |
| 0.15 mm | 3 | |
| 0.063 mm | 2 | |
| 0.020 mm | 2 | |
| 0.006 mm | 1 | |
| 0.003 mm | 1 | |
| 0.002 mm | 1 | |
| 0.001 mm | 0 | |




Tested in accordance with BS 1377: Part 2 : 1990 Clause 9.2 and 9.5



Sedimentation by Hydrometer - Not UKAS

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# LABORATORY TEST REPORT

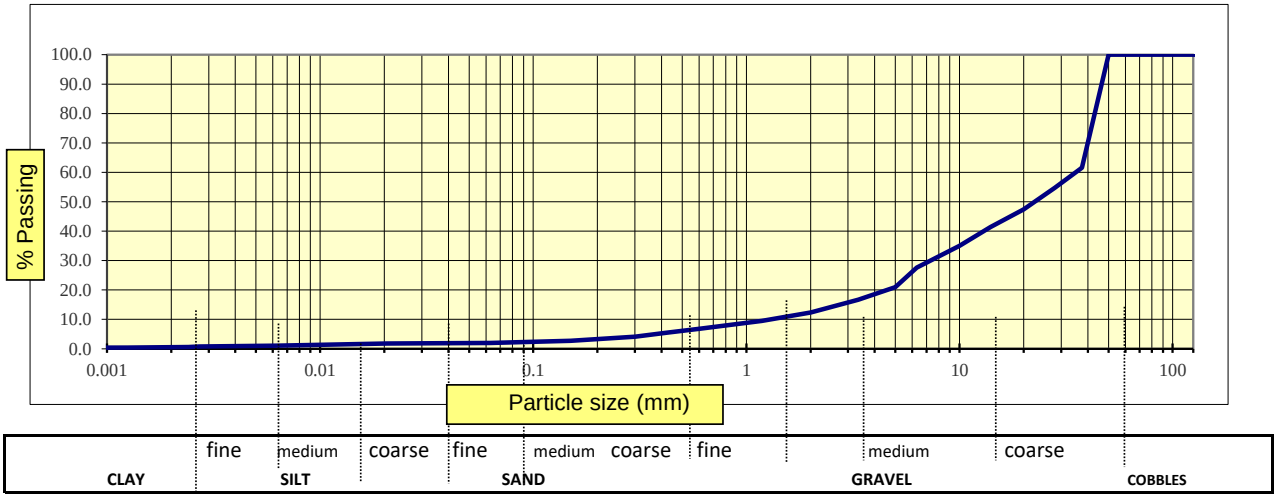
## Determination of Particle Size Distribution - BS 1377 : Part 2 : 1990

## Determination of Particle Size Distribution (Hydrometer Sedimentation) - BS 1377 : Part 2 : 1990 Cl. 9.5

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93857 |
| | Unit 1 Carrigogna | **Date Received:** | 11/03/2020 |
| | Midleton | **Date Reported:** | 02/04/2020 |
| | | **Date Tested:** | 01/04/2020 |
| **Order No:** | 2003-104 | **Material:** | Soil |
| **Originator:** | Ian Holley | **Visual Description** | Cobble, Sandy |

| | |
|---|---|
| **Client Ref.** | **XC212-CPRC01 Type B Sample 25** |
| **Location:** | XC212-CPRC01 Type B Sample 25 |
| **Supplier:** | Bulk |
| **Source:** | Client Info. |
| **Depth (m):** | 7.3-8.0m |
| **Sampling Reason:** | Client Request |
| **Sampled By:** | Client |
| **Specification:** | Client |
| **Preparation Method:** | Without Organics Preparation |
| **Notes:** | Disturbed sample from cleanout |

| BS Sieve Size | % Passing | Specification |
|---|---|---|
| 300 mm | 100 | |
| 125 mm | 100 | |
| 100 mm | 100 | |
| 75 mm | 100 | |
| 63 mm | 100 | |
| 50 mm | 100 | |
| 37.5 mm | 62 | |
| 28 mm | 55 | |
| 20 mm | 47 | |
| 14 mm | 41 | |
| 10 mm | 35 | |
| 6.3 mm | 28 | |
| 5 mm | 21 | |
| 3.35 mm | 17 | |
| 2 mm | 12 | |
| 1.18 mm | 9 | |
| 0.6 mm | 7 | |
| 0.425 mm | 5 | |
| 0.3 mm | 4 | |
| 0.15 mm | 3 | |
| 0.063 mm | 2 | |
| 0.020 mm | 2 | |
| 0.006 mm | 1 | |
| 0.003 mm | 1 | |
| 0.002 mm | 1 | |
| 0.001 mm | 0 | |




Tested in accordance with BS 1377: Part 2 : 1990 Clause 9.2 and 9.5



Sedimentation by Hydrometer - Not UKAS

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**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

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# LABORATORY TEST REPORT

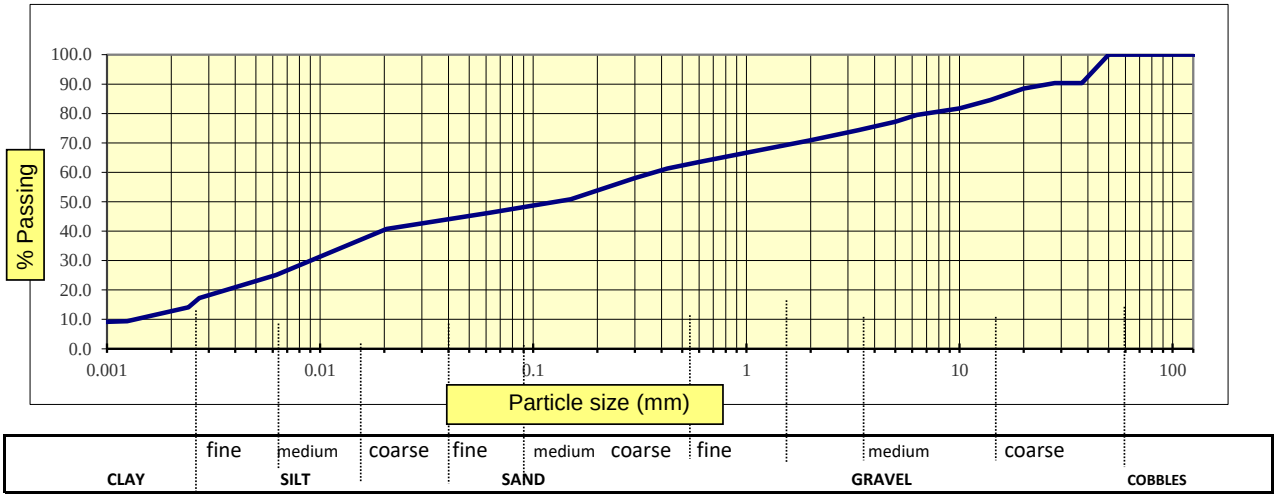
## Determination of Particle Size Distribution - BS 1377 : Part 2 : 1990

## Determination of Particle Size Distribution (Hydrometer Sedimentation) - BS 1377 : Part 2 : 1990 Cl. 9.5

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93856 |
| | Unit 1 Carrigogna | **Date Received:** | 11/03/2020 |
| | Midleton | **Date Reported:** | 02/04/2020 |
| | | **Date Tested:** | 01/04/2020 |
| **Order No:** | 2003-104 | **Material:** | Soil |
| **Originator:** | Ian Holley | **Visual Description** | Light Clay, Sandy |

| | |
|---|---|
| **Client Ref.** | **XC212-CPRC01 Type B Sample 23** |
| **Location:** | XC212-CPRC01 Type B Sample 23 |
| **Supplier:** | Bulk |
| **Source:** | Client Info. |
| **Depth (m):** | 7.0-7.15m |
| **Sampling Reason:** | Client Request |
| **Sampled By:** | Client |
| **Specification:** | Client |
| **Preparation Method:** | Without Organics Preparation |
| **Notes:** | Disturbed sample from cleanout |

| BS Sieve Size | % Passing | Specification |
|---|---|---|
| 300 mm | 100 | |
| 125 mm | 100 | |
| 100 mm | 100 | |
| 75 mm | 100 | |
| 63 mm | 100 | |
| 50 mm | 100 | |
| 37.5 mm | 90 | |
| 28 mm | 90 | |
| 20 mm | 89 | |
| 14 mm | 85 | |
| 10 mm | 82 | |
| 6.3 mm | 79 | |
| 5 mm | 77 | |
| 3.35 mm | 74 | |
| 2 mm | 71 | |
| 1.18 mm | 68 | |
| 0.6 mm | 64 | |
| 0.425 mm | 61 | |
| 0.3 mm | 58 | |
| 0.15 mm | 51 | |
| 0.063 mm | 46 | |
| 0.020 mm | 41 | |
| 0.006 mm | 25 | |
| 0.003 mm | 17 | |
| 0.002 mm | 14 | |
| 0.001 mm | 9 | |




Tested in accordance with BS 1377: Part 2 : 1990 Clause 9.2 and 9.5



Sedimentation by Hydrometer - Not UKAS

UKAS TESTING 0955

**Approved Signature**
**JAMES FISHER TESTING SERVICES (IRELAND) LTD.**
☐ **James Ward, Operations Manager**

**James Fisher Testing Services (Ireland) Ltd**
**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

# LABORATORY TEST REPORT

## BRE Test Suite B - Greenfield Site

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93860 |
| | Unit 1 Carrigogna | **Date Received:** | 09/03/2020 |
| | Midleton | **Date Reported:** | 09/04/2020 |
| | Co. Cork | **Material:** | Soil |
| **Order No.:** | 2003-104 | **Date Tested:** | 07/04/2020 |
| **Originator:** | Ian Holley | **Specification:** | Client |

**Sample Details** **XC212-CPRC01 Type D Sample 30**

| | | | |
|---|---|---|---|
| **Supplier:** | Client Info | **Date of Sampling:** | Client Info. |
| **Source:** | Client Info | **Sampled By:** | Client |
| **Sample Location:** | 8.8-9.0m | **Sampling Reason:** | Request |

| Parameter | RESULT |
|---|---|
| pH | 8.3 |
| Sulphate Aqueous Extract (SO4) (mg/l) | 20 |
| Sulphur as S, Total (%) | 0.02 |
| Sulphate as SO4, Total (%) | 0.03 |

**Comments:**
None



**Tested in accordance with the above specifications**
**Subcontracted to a laboratory UKAS accredited for this testing**

**Approved Signature**
**JAMES FISHER TESTING SERVICES (IRELAND) LTD.**

☐ **James Ward, Operations Manager**

James Fisher Testing Services Limited
Ruby House, 40A Hardwick Grange
Warrington,WA1 4RF
Tel: 01925 286 880

James Fisher Testing Services

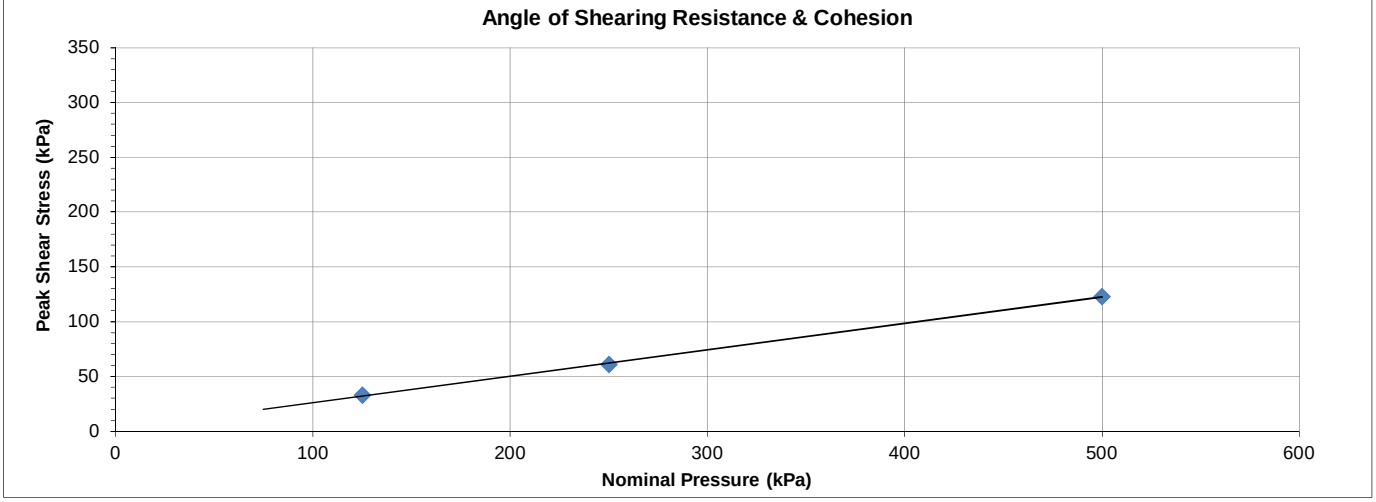
# Laboratory Test Report

## To determine the Effective Angle of Internal Friction & Effective Cohesion by Dry Direct Shear of a sample, according to SHW Clause 636 March 2000 & BS :1377: Part 7 : 1990 Clause 5

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No.:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref. No.:** | ST 93859 |
| | Unit 1 Carrigogna | **Date Received:** | 26/03/2020 |
| | Midleton | **Date Reported:** | 09/04/2020 |
| | Co Cork | **Material:** | Earthworks |
| **Order No.:** | 2003-104 | **Visual Description:** | Sand & Coarse Gravel |
| **Originator:** | Ian Holley | **Specification:** | TII Series 600 |

| | | | |
|---|---|---|---|
| **Client Ref:** | **ST 93859** | | |
| **Certificate of sampling** | No | **Date Of Sampling:** | Client Info |
| **Lab Reference No.** | XC212-CRPC01 8-8.8m Type D Sample 28 | **Sampled By:** | Client |
| **Sample Source & Ticket No.** | Client Info | **Sample Preparation:** | Bulk sample sieved through 20mm sieve |
| **Sample Location / Orientation :** | Cork Line Level Crossings | **Tested Dry or Submerged:** | Dry |

## Results




| | | | |
|---|---|---|---|
| Test Specimen Size (mm) | 305x305x150 | | |
| Maximum Dry Density (Mg/m$^3$) | 1.990 | | |
| Optimum Moisture Content (%) | 11.0 | | |
| Particle Density Used (Mg/m$^3$) | 2.60 | | |
| PD indicating measured or assumed | Assumed | | |
| Initial Bulk Density (Mg/m$^3$) | 2.142 | 2.143 | 2.146 |
| Moisture Content (%) | 14.0 | 14.2 | 14.2 |
| Initial Dry Density (Mg/m$^{3)}$ | 1.879 | 1.877 | 1.879 |
| Indicating which direct shear procedure was used, 5.5.4 single stage or 5.5.5 multi-reversal test | Single Stage Test | | |
| Normal Pressure (kPa) | 125 | 250 | 500 |
| Peak Shear Strength (kPa) | 33 | 61 | 123 |
| **Cohesion (kPa) to 0.1** | **2.0** | | |
| **Angle of friction ($^0$) to nearest (0.5$^0$)** | **13.5** | | |
| Rate of Displacement (mm/min) | 2.5 | 2.5 | 2.5 |

**Comments/Departure from specified procedure:** None

**Approved Signature**
**James Fisher Testing Services Limited**
**Phil Thorp, Laboratory Manager**



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**James Fisher Testing Services (Ireland) Ltd**
**Unit D, Zone 5, Clonminam Business Park**
**Portlaoise, Co. Laois**
**Tel: 057 8664885**

James Fisher Testing Services

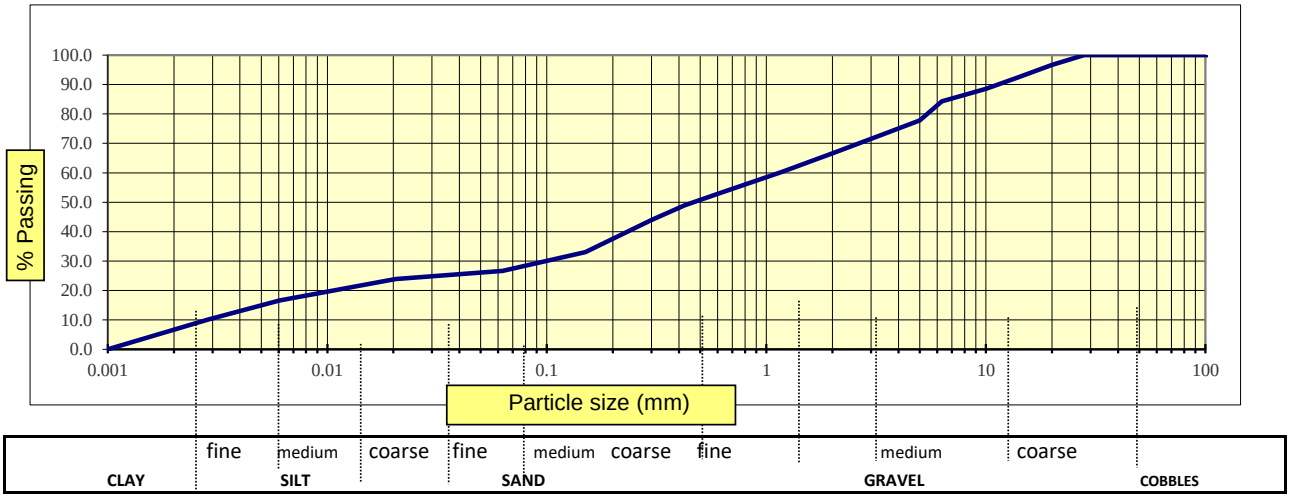
# LABORATORY TEST REPORT

## Determination of Particle Size Distribution - BS 1377 : Part 2 : 1990
## Determination of Particle Size Distribution (Hydrometer Sedimentation) - BS 1377 : Part 2 : 1990 Cl. 9.5
## Moisture content to BS 1377: Part 2 : 1990 Oven Drying Method Cl 3.2

| | | | |
|---|---|---|---|
| **Project:** | Cork Line Level Crossings | **Job No:** | 19-135 |
| **Client:** | OCB Geotechnical | **Lab Ref No.:** | ST 93858 |
| | Unit 1 Carrigogna | **Date Received:** | 11/03/2020 |
| | Midleton | **Date Reported:** | 02/04/2020 |
| | Co Cork | **Date Tested:** | 01/04/2020 |
| **Order No:** | 2003-104 | **Material:** | Soil |
| **Originator:** | Ian Holley | **Visual Description** | Dark Clay, Sandy |

| | |
|---|---|
| **Client Ref.** | **XC212-CRPC01 Type B Sample 27** |
| **Location:** | XC212-CRPC01 Type B Sample 27 |
| **Supplier:** | Client Info. |
| **Source:** | Client Info. |
| **Depth (m):** | 8.0-8.8m |
| **Sampling Reason:** | Client Request |
| **Sampled By:** | Client |
| **Specification:** | Client |
| **Preparation Method:** | Without Organics Preparation |
| **Notes:** | Disturbed sample from cleanout |
| **Moisture Content%:** | 27 |

| BS Sieve Size | % Passing | Specification |
|---|---|---|
| 125 mm | 100 | |
| 100 mm | 100 | |
| 90 mm | 100 | |
| 75 mm | 100 | |
| 63 mm | 100 | |
| 50 mm | 100 | |
| 37.5 mm | 100 | |
| 28 mm | 100 | |
| 20 mm | 97 | |
| 14 mm | 92 | |
| 10 mm | 89 | |
| 6.3 mm | 84 | |
| 5 mm | 78 | |
| 3.35 mm | 73 | |
| 2 mm | 67 | |
| 1.18 mm | 60 | |
| 0.6 mm | 53 | |
| 0.425 mm | 49 | |
| 0.3 mm | 44 | |
| 0.15 mm | 33 | |
| 0.063 mm | 27 | |
| 0.0205 mm | 24 | |
| 0.0060 mm | 17 | |
| 0.0029 mm | 10 | |




Tested in accordance with BS 1377: Part 2 : 1990 Clause 3.2, 9.2 and 9.5
Sedimentation by Hydrometer - Not UKAS



**Approved Signature**
**JAMES FISHER TESTING SERVICES (IRELAND) LTD.**
☐ **James Ward, Operations Manager**

UKAS TESTING 0955

# Appendix E Environmental Laboratory Test Results

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

# Final Report

| | | | |
|---|---|---|---|
| **Report No.:** | 20-08714-1 | | |
| **Initial Date of Issue:** | 25-Mar-2020 | | |
| **Client** | Environmental Laboratory Services Ltd | | |
| **Client Address:** | Acorn Business Campus<br>Mahon Industrial Park<br>Blackrock<br>Cork<br>Ireland | | |
| **Contact(s):** | Emer Kearney<br>Results | | |
| **Project** | Water Analysis | | |
| **Quotation No.:** | Q20-19728 | **Date Received:** | 19-Mar-2020 |
| **Order No.:** | 6997 | **Date Instructed:** | 19-Mar-2020 |
| **No. of Samples:** | 2 | | |
| **Turnaround (Wkdays):** | 5 | **Results Due:** | 25-Mar-2020 |
| **Date Approved:** | 25-Mar-2020 | | |
| **Approved By:** | | | |
| **Details:** | Glynn Harvey, Technical Manager | | |

Chemtest
The right chemistry to deliver results

# Results - Leachate

**Project: Water Analysis**

| **Client: Environmental Laboratory Services Ltd** | | | | **Chemtest Job No.:** | | 20-08714 | 20-08714 |
|---|---|---|---|---|---|---|---|
| Quotation No.: Q20-19728 | | | | **Chemtest Sample ID.:** | | 988286 | 988287 |
| Order No.: 6997 | | | | Client Sample Ref.: | | 177724/001 | 177724/002 |
| | | | | Client Sample ID.: | | 1 | 2 |
| | | | | Sample Type: | | SOIL | SOIL |
| | | | | Top Depth (m): | | 1.00 | 3.00 |
| | | | | Date Sampled: | | 02-Mar-2020 | 04-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Type** | **Units** | **LOD** | | |
| pH | U | 1010 | 10:1 | | N/A | 8.9 | 8.1 |
| Cyanide (Free) | U | 1300 | 10:1 | mg/l | 0.050 | < 0.050 | < 0.050 |
| Arsenic (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | 13 | 1.5 |
| Boron (Dissolved) | U | 1450 | 10:1 | µg/l | 20 | < 20 | 62 |
| Barium (Dissolved) | U | 1450 | 10:1 | µg/l | 5.0 | 6.2 | 35 |
| Beryllium (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | < 1.0 | < 1.0 |
| Cadmium (Dissolved) | U | 1450 | 10:1 | µg/l | 0.080 | < 0.080 | < 0.080 |
| Chromium (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | < 1.0 | < 1.0 |
| Copper (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | 3.4 | 2.4 |
| Mercury (Dissolved) | U | 1450 | 10:1 | µg/l | 0.50 | < 0.50 | < 0.50 |
| Nickel (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | < 1.0 | < 1.0 |
| Lead (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | 1.4 | < 1.0 |
| Selenium (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | 1.1 | < 1.0 |
| Vanadium (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | 3.4 | < 1.0 |
| Zinc (Dissolved) | U | 1450 | 10:1 | µg/l | 1.0 | 1.8 | 3.0 |
| Aliphatic TPH >C5-C6 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C6-C8 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C8-C10 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C10-C12 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C12-C16 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C16-C21 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C21-C35 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aliphatic TPH >C35-C44 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Total Aliphatic Hydrocarbons | N | 1675 | 10:1 | µg/l | 5.0 | [B] < 5.0 | [B] < 5.0 |
| Aromatic TPH >C5-C7 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C7-C8 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C8-C10 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C10-C12 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C12-C16 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C16-C21 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C21-C35 | N | 1675 | 10:1 | µg/l | 0.10 | [B] < 0.10 | [B] < 0.10 |
| Aromatic TPH >C35-C44 | N | 1680 | 10:1 | µg/l | 50.00 | [B] < 50 | [B] < 50 |
| Total Aromatic Hydrocarbons | N | 1675 | 10:1 | µg/l | 5.0 | [B] < 5.0 | [B] < 5.0 |
| Total Petroleum Hydrocarbons | N | 1675 | 10:1 | µg/l | 10 | [B] < 10 | [B] < 10 |
| Benzene | U | 1760 | 10:1 | µg/l | 1.0 | [B] < 1.0 | [B] < 1.0 |
| Toluene | U | 1760 | 10:1 | µg/l | 1.0 | [B] < 1.0 | [B] < 1.0 |
| Ethylbenzene | U | 1760 | 10:1 | µg/l | 1.0 | [B] < 1.0 | [B] < 1.0 |
| m & p-Xylene | U | 1760 | 10:1 | µg/l | 1.0 | [B] < 1.0 | [B] < 1.0 |

Chemtest
The right chemistry to deliver results

# Results - Leachate

**Project: Water Analysis**

| **Client: Environmental Laboratory Services Ltd** | | | | **Chemtest Job No.:** | | 20-08714 | 20-08714 |
|---|---|---|---|---|---|---|---|
| Quotation No.: Q20-19728 | | | | **Chemtest Sample ID.:** | | 988286 | 988287 |
| Order No.: 6997 | | | | Client Sample Ref.: | | 177724/001 | 177724/002 |
| | | | | Client Sample ID.: | | 1 | 2 |
| | | | | Sample Type: | | SOIL | SOIL |
| | | | | Top Depth (m): | | 1.00 | 3.00 |
| | | | | Date Sampled: | | 02-Mar-2020 | 04-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Type** | **Units** | **LOD** | | |
| o-Xylene | U | 1760 | 10:1 | µg/l | 1.0 | [B] 2.0 | [B] < 1.0 |
| Methyl Tert-Butyl Ether | N | 1760 | 10:1 | µg/l | 1.0 | [B] < 1.0 | [B] < 1.0 |
| Naphthalene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Acenaphthylene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Acenaphthene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Fluorene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Phenanthrene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Anthracene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Fluoranthene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Pyrene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Benzo[a]anthracene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Chrysene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Benzo[b]fluoranthene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Benzo[k]fluoranthene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Benzo[a]pyrene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Indeno(1,2,3-c,d)Pyrene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Dibenz(a,h)Anthracene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Benzo[g,h,i]perylene | U | 1800 | 10:1 | µg/l | 0.10 | < 0.10 | < 0.10 |
| Total Of 16 PAH's | U | 1800 | 10:1 | µg/l | 2.0 | < 2.0 | < 2.0 |

# Results - Soil

**Project: Water Analysis**

| **Client: Environmental Laboratory Services Ltd** | | | | | **Chemtest Job No.:** | 20-08714 | 20-08714 |
|---|---|---|---|---|---|---|---|
| Quotation No.: Q20-19728 | | | | | **Chemtest Sample ID.:** | 988286 | 988287 |
| Order No.: 6997 | | | | | Client Sample Ref.: | 177724/001 | 177724/002 |
| | | | | | Client Sample ID.: | 1 | 2 |
| | | | | | Sample Type: | SOIL | SOIL |
| | | | | | Top Depth (m): | 1.00 | 3.00 |
| | | | | | Date Sampled: | 02-Mar-2020 | 04-Mar-2020 |
| **Determinand** | **Accred.** | **SOP** | **Units** | **LOD** | | | |
| Moisture | N | 2030 | % | 0.020 | | 13 | 26 |
| pH | U | 2010 | | 4.0 | | 9.4 | 7.8 |

# Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

| Sample: | Sample Ref: | Sample ID: | Sample Location: | Sampled Date: | Deviation Code(s): | Containers Received: |
|---|---|---|---|---|---|---|
| 988286 | 177724/001 | 1 | | 02-Mar-2020 | B | Amber Glass 250ml |
| 988286 | 177724/001 | 1 | | 02-Mar-2020 | B | Plastic Tub 500g |
| 988287 | 177724/002 | 2 | | 04-Mar-2020 | B | Amber Glass 250ml |
| 988287 | 177724/002 | 2 | | 04-Mar-2020 | B | Plastic Tub 500g |

Chemtest
The right chemistry to deliver results

# Test Methods

| SOP | Title | Parameters included | Method summary |
|---|---|---|---|
| 1010 | pH Value of Waters | pH | pH Meter |
| 1300 | Cyanides & Thiocyanate in Waters | Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate | Continuous Flow Analysis. |
| 1450 | Metals in Waters by ICP-MS | Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc | Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS). |
| 1675 | TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG) | Aliphatics: >C5–C6, >C6–C8, >C8– C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44 | Pentane extraction / GCxGC FID detection |
| 1680 | Extractable Petroleum Hydrocarbons | Aliphatics: >C5–C6, >C6–C8, >C8– C10*, >C10–C12*, >C12–C16*, >C16–C21*, >C21–C35*, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10*, >C10–C12*, >C12–C16*, >C16–C21*, >C21– C35*, >C35– C44 | Dichloromethane extraction / GCxGC FID detection |
| 1760 | Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS | Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260) | Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds. |
| 1800 | Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS | Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene | Pentane extraction / GCMS detection |
| 2010 | pH Value of Soils | pH | pH Meter |
| 2030 | Moisture and Stone Content of Soils(Requirement of MCERTS) | Moisture content | Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C. |
| 640 | Characterisation of Waste (Leaching C10) | Waste material including soil, sludges and granular waste | ComplianceTest for Leaching of Granular Waste Material and Sludge |

## Report Information

### Key

| | |
|---|---|
| U | UKAS accredited |
| M | MCERTS and UKAS accredited |
| N | Unaccredited |
| S | This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis |
| SN | This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis |
| T | This analysis has been subcontracted to an unaccredited laboratory |
| I/S | Insufficient Sample |
| U/S | Unsuitable Sample |
| N/E | not evaluated |
| < | "less than" |
| > | "greater than" |

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

### Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

### Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

# Appendix F Pre & Post Site Condition Photographs

| | |
|---|---|
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC212 (19-135-3) | XC212 |
| | Pre Works Site Photographs |
| | Client: Iarnród Éireann |
| | Engineer: Jacob's |
| | Date: 2020 |

| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC212 (19-135-3) | XC212<br>Post Works Site Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: 2020 |

| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC212 (19-135-3) | XC212<br>Post Works Site Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: 2020 |

# Cork Line Level Crossings – XC215
# Ground Investigation

| | |
|---|---|
| Primary Author: | Ian Holley |
| Client: | Irish Rail |
| Client's Representative: | JACOBS |
| Report Date: | 25th November 2020 |
| Report No.: | OCB19-135-4 |
| File Location: | OCB19-135-4/Reporting/XC215 |

OCB Geotechnical
Unit 1 Carrigogna
Midleton
Co. Cork

admin@ocbgeotechnical.com
ocbgeotechnical.com

**CONTENTS**

**APPENDICES**

## Document Control Sheet

| | |
|---|---|
| Report No.: | OCB19-135-4 |
| Project title: | Cork Line Level Crossings – XC215 |
| Client: | Irish Rail |
| Client's Representative: | JACOBS |

| Revision | Status | Report prepared by: | Report reviewed by: | Report approved by: | Issue date |
|---|---|---|---|---|---|
| 001 | Draft | Ian Holley | Glen Byrne | Michael O'Connell | 1st October 2020 |

The works were conducted in accordance with:

*Specification And Related Documents For Ground Investigation In Ireland*. (2016) 2nd ed. Engineers Ireland.

BS EN 1997: *Eurocode 7 - Geotechnical Design – Parts 1 & 2* (2007)

UK Specification for Ground Investigation 2nd Edition (2012)

British Standards Institute (2010) BS 5930:1999 + A2: 2010, Code of practice for site investigations. Incorporating Amendment Nos. 1 and 2, as partially replaced by:

- BS EN ISO 22475-1:2006: Geotechnical investigation and testing. Sampling methods and groundwater measurements. Technical principles for execution
- BS EN ISO 14688-1:2002/Amd 1:2013: Geotechnical investigation and testing. Identification and classification of soil. Identification and description
- BS EN ISO 14688-2:2004/Amd 1:2013: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification
- BS EN ISO 14689-1:2003: Geotechnical investigation and testing. Identification and classification of rock. Identification and description
- BS EN ISO 22476-2:2005/Amd 1:2011: Geotechnical investigation and testing. Field testing. Dynamic probing
- BS EN ISO 22476-3:2005/Amd 1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test

# METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in Section 6 of BS 5930: 1999 + A2: 2010, The Code of Practice for Site Investigation. The amendments revised the Standard to remove text superseded by BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and EN ISO 14689-1:2003 and refers to the relevant standard for each affected subclause. However, the following terms are used in the description of fine-grained soils, where applicable:

- Soft to Firm: fine-grained soil with consistency description close to the boundary between soft and firm soil (Table 13 of BS5930).
- Firm to Stiff: fine-grained soil with consistency description close to the boundary between firm and stiff soil (Table 13 of BS5930).

| **Abbreviations used on exploratory hole logs** | |
|---|---|
| U | Nominal 100mm diameter undisturbed open tube sample |
| P | Nominal 100mm diameter undisturbed piston sample |
| B | Bulk disturbed sample |
| D | Small disturbed sample |
| W | Water sample |
| ES / EW | Soil sample for environmental testing / Water sample for environmental testing |
| SPT | Standard penetration test using a split spoon sampler (small disturbed sample obtained) |
| SPT (C) | Standard penetration test using 60-degree solid cone |
| x,x/x,x,x,x | Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.<br>The length achieved is stated (mm) for any test increment less than 75mm |
| N=X | SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm) |
| N=X/Z | Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm) |
| V<br>VR | Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa<br>V: undisturbed vane shear strength VR: remoulded vane shear strength |
| dd/mm/yy: 1.0<br>dd/mm/yy: dry | Date & water level at the borehole depth at the end of shift<br>and the start of the following shift |
| **Abbreviations relating to rock core – reference Clause 44.4.4 of BS 5930: 1999** | |
| TCR (%) | Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run. |
| SCR (%) | Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures. |
| RQD (%) | Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run. |
| FI | Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing. |
| NI | Non-Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles. |
| AZCL | Assessed zone of core loss: The estimated depth range where core was not recovered. |
| DIF | Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring. |

# Cork Line Level Crossings – XC215

## 1 AUTHORITY

On the instructions of Iarnród Éireann / Irish Rail, a ground investigation was undertaken at multiple locations along the Cork to Dublin railway line, between Limerick Junction and Mallow stations, to provide geotechnical and environmental information for input to the design and construction of proposed overbridges, embankments, culverts, access roads and footpaths to enable the closure of five manned level crossings

This report details the work carried out both on site at XC215 and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results.

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those measured during the investigation.

This report was prepared by OCB Geotechnical Ltd for the use of Iarnród Éireann / Irish Rail in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

## 2 SCOPE

The extent of the investigation, as instructed by the JACOBS, included boreholes, trial pits, indirect CBR testing, installation of standpipes, water purging, soil and rock core sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

## 3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, level crossing XC215 is located in the Imphrick townland approximately 4.5km south of Charleville and immediately west of the N20. The crossing is currently manned with a house and small cabin to the west. The site is surrounded by agricultural land with a number of houses and farms in the wider area.

The site is generally flat within the site area.

The existing site is presented on the site and exploratory hole location plans in Appendix A.

# 4 SITE OPERATIONS

Site operations, which were conducted between 18th February 2020 and 14th August 2020, included:

- One (1) Cable Percussion Borehole
- Two (2) Cable Percussion with Rotary follow-on Boreholes
- A Standpipe Installation in two (2) Boreholes
- Nine (9) Trial Pits
- Indirect CBR tests at eighteen (18) locations
- Water Purging in two (2) locations

The exploratory holes and in situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

## 4.1 Boreholes

A total of three boreholes were put down in a minimum diameter of 101mm through soils and rock strata to their completion depths by a combination of methods, including cable percussion boring by Pilcon rigs, and rotary drilling by a T44 rig.

The borehole logs state the methodology and plant used for each location, as well as the appropriate depth ranges.

A summary of the boreholes, subdivided by category in accordance with the methods employed for their completion, is presented in the following sub-sections.

Appendix B presents the borehole logs.

### 4.1.1 Cable Percussion Boreholes

One borehole (CP01) was put down to completion in minimum 200mm diameter using a Pilcon cable percussion soil boring rig. The borehole was terminated upon encountering virtual refusal on obstructions, including large boulders and weathered bedrock.

Hand dug inspection pits were carried out between ground level and 1.2m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk bag and tub) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by Jacobs.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals using the split spoon sampler (SPT). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Appendix B presents the borehole logs.

### 4.1.2 Boreholes by Combined Percussion Boring and Rotary Follow-On Drilling

Two boreholes (CPRC01 & CPRC02) were put down by a combination of cable percussion boring and rotary follow-on open hole and coring drilling techniques. Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/obstruction.

Hand dug inspection pits were carried out between ground level and 1.2m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Disturbed (bulk bag and tub) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by Jacobs.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals throughout the overburden using the split spoon sampler (SPT). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Where coring was carried out within bedrock strata, Geobor S Coring was used. The core was extracted in up to 1.5m lengths using a SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with *BS 5930:1999 + A2: 2010, Code of practice for site investigations* (Incorporating Amendment Nos. 1 and 2).

Core logging was carried out both on and off site by the OCB Geotechnical Engineering Geologist.

Appendix B presents the borehole logs, with core photographs presented in Appendix C.

## 4.2 Standpipe Installations

A groundwater monitoring standpipe was installed in boreholes CP01 and CPRC01.

Details of the installations, including the diameter of the pipe and depth range of the response zone, are provided in Appendix B on the individual borehole logs.

Following the completion of the intrusive investigation work groundwater monitoring was undertaken at the site on four occasions. The results of the monitoring are presented in the report below in Section 6.3.

## 4.3 Trial Pits

Nine trial pits (TP01–TP09) were excavated using a 15t tracked excavator fitted with a 600mm wide bucket, to depths between 0.80m and 2.40m. Most trial pits were terminated due to the pit walls collapsing while TP02 was terminated at 0.80m due to a possible archaeological feature and TP08 and TP09 were terminated early to prevent damage to the property owners' field.

Environmental samples were taken at depths of 0.05m, 0.50m and 1.0m in each trial pit.

Disturbed (small tub and bulk bag) samples were taken at standard depth intervals and at change of strata.

Hand Vane testing was completed successfully where appropriate and where specified by Jacobs.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix D presents the trial pit logs with photographs of the pits and arising provided in Appendix E.

## 4.4 Indirect CBR Tests

An indirect CBR test was conducted at eighteen locations (TRL01 to TRL18) using a Dynamic Cone Penetrometer (DCP). The equipment was developed in conjunction with the UK Transport Research Laboratory, is used widely throughout the world, and is referred to in the UK Highway Agency Interim Advice Note 73/06.

The test results are presented in Appendix F in the form of plots of the variation with depth of the cumulative blow count. Straight lines have been fitted to the plots and the CBR for each depth range estimated using the following relationship, as proposed by DTP Interim Advice Note 73/06 (Design Guidance for Road Pavement Foundations):

Log CBR = 2.48-1.057 Log (mm/blow)

The occasionally elevated CBR values could be a consequence of the coarse-grained content of the penetrated soils and are often not representative of the soil matrix.

## 4.5 Water Purging

Prior to sampling from each standpipe (in CP01 and CPRC01) water purging was carried out.

Appendix G presents the water purging data logs.

## 4.6 Surveying

A broad survey of the site using a handheld CAT scanner to identify any existing buried services or old foundations/obstructions to excavation was carried out before commencement of excavation works. A GPR survey to PAS 128 specification was carried out at each location prior to excavation. The GPR survey report is presented in an addendum to follow issuance of this report.

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from OCB Geotechnical. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator, ITM) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

Pre-work site conditions were surveyed and upon completion of all site works at each site a post-work site condition survey was carried out. The pre and post site condition photographs are presented in Appendix K.

# 5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described and their descriptions incorporated into the borehole logs.

## 5.1 Geotechnical Laboratory Testing of Soils

Laboratory testing of soils comprised:

- **soil classification:** Moisture Content measurement, Atterberg Limit tests and particle size distribution analysis.
- **shear strength**: 60mm Shear Box test
- **soil chemistry:** pH, Sulphur content, Organic Matter content and water-soluble and total Sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute (1990) *BS 1377:1990, Methods of test for soils for civil engineering purposes. Parts 1 to 9.*

The test results are presented in Appendix H.

## 5.2 Geotechnical Laboratory Testing of Rock

Laboratory testing of rock sub-samples comprised:

- Point Load index

| Test | Test carried out in accordance with |
|---|---|
| Point Load Index | ISRM Suggested Methods (1985) Suggested method for determining point-load strength. Int. J. Rock Mech. Min. Sci. Geomech. Abstr. 22, pp. 53–60 |

The test results are presented in Appendix I.

## 5.3 Environmental Laboratory Testing of Soils

In addition, environmental testing, as specified by Jacobs was conducted on selected environmental samples by Socotec at its laboratory in Burton-on-Trent, United Kingdom. Results of environmental testing are presented in Appendix J.

# 6 GROUND CONDITIONS

## 6.1 General Geology of the Area

Teagasc soil mapping indicates that the site vicinity is underlain by Glacial Till derived chiefly from Devonian sandstones.

The Geological Survey of Ireland (GSI) bedrock mapping database indicates that soils in the site area are underlain at depth by the Upper Devonian-age Kiltorcan Formation, which consists of thick coarse-grained white-yellow sandstone (commonly in channel form), intraformational mudflake conglomerate, red-yellow flaggy sandstone, and red and green silty mudstone and mudstone.

The Upper Devonian strata were subjected to compressional deformation (tectonic shortening) during the Variscan Orogeny in Late Carboniferous and Early Permian times, resulting in the formation of an east-northeast west-southwest trending fold-thrust belt. The site is located on the west side of the Ballyhoura Mountains on either side of a west-southwest to east-northeast orientated anticline (upfold). Bedrock in the site vicinity dips at variable angles to the north, west and south, having undergone buckle folding and contractional thrust faulting.

The site is underlain by a regionally important fissured bedrock aquifer and has a moderate to high groundwater vulnerability.

## 6.2 Ground Types Encountered During Investigation of the Site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- Topsoil: Encountered typically between 200mm and 350mm thickness.
- Glacial Till: Sandy gravelly clay/silt, frequently with low cobble content. Observed directly below the topsoil and at greater depths below the range of 3.60m and 4.70m bgl.
- Fluvioglacial deposits: Observed predominantly between the upper strata and lower strata (glacial till). Typically loose to medium dense sands and gravels.
- Bedrock (Sandstone, Mudstone and Siltstone): Rockhead was encountered at 6.60m in CPRC02 and 9.60m in CPRC01. Predominantly Medium Strong Sandstone with some weaker layers of Mudstone and Siltstone interbedded.

## 6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

It should be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Groundwater monitoring to date in standpipe installations, yielded the following results:

| Date | Depth to standing water level (m) | |
|---|---|---|
| | CP01 | CPRC01 |
| 13/08/20 | Dry | 9.51 |
| 17/08/20 | Dry | 9.57 |
| 21/08/20 | Dry | 4.64 |
| 29/09/20 | Dry | 7.16 |

Continued monitoring of the two installed standpipes will give an indication of the seasonal variation in groundwater level.

# 7 DISCUSSION

## 7.1 Proposed Construction

It is proposed to construct overbridges, embankments, culverts, access roads and footpaths to enable the closure of five manned level crossings.

No further details were available to OCB Geotechnical at the time of preparing this report.

# 8 REFERENCES

*Specification And Related Documents For Ground Investigation In Ireland*. (2016) 2nd ed. Engineers Ireland.

BS EN 1997-1: 2007. *Eurocode 7 - Geotechnical design - Part 1 General Rules*. British Standards Institution, London.

BS EN 1997-2: 2007. *Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing*. British Standards Institution, London.

BS 1377: 1990. *Methods of test for soils for civil engineering purposes*. British Standards Institution, London.

BS 5930: 2015. *Code of practice for ground investigations*. British Standards Institution, London.

BS EN ISO 14688-1: 2002. *Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description*. British Standards Institution, London.

BS EN ISO 14689-1: 2003. *Geotechnical investigation and testing - Identification and classification of rock - Part 1 Identification and description*. British Standards Institution, London.

Building Research Establishment, 2005. BRE Special Digest 1, Concrete in aggressive ground.

Building Research Establishment, 2007. BRE Digest 365: Soakaways.

BS EN 12457-2: 2002 Characterisation of waste. Leaching. Compliance test for leaching of granular waste materials and sludges. One stage batch test at a liquid to solid ratio of 10 l/kg for materials with particle size below 4 mm (without or with size reduction).

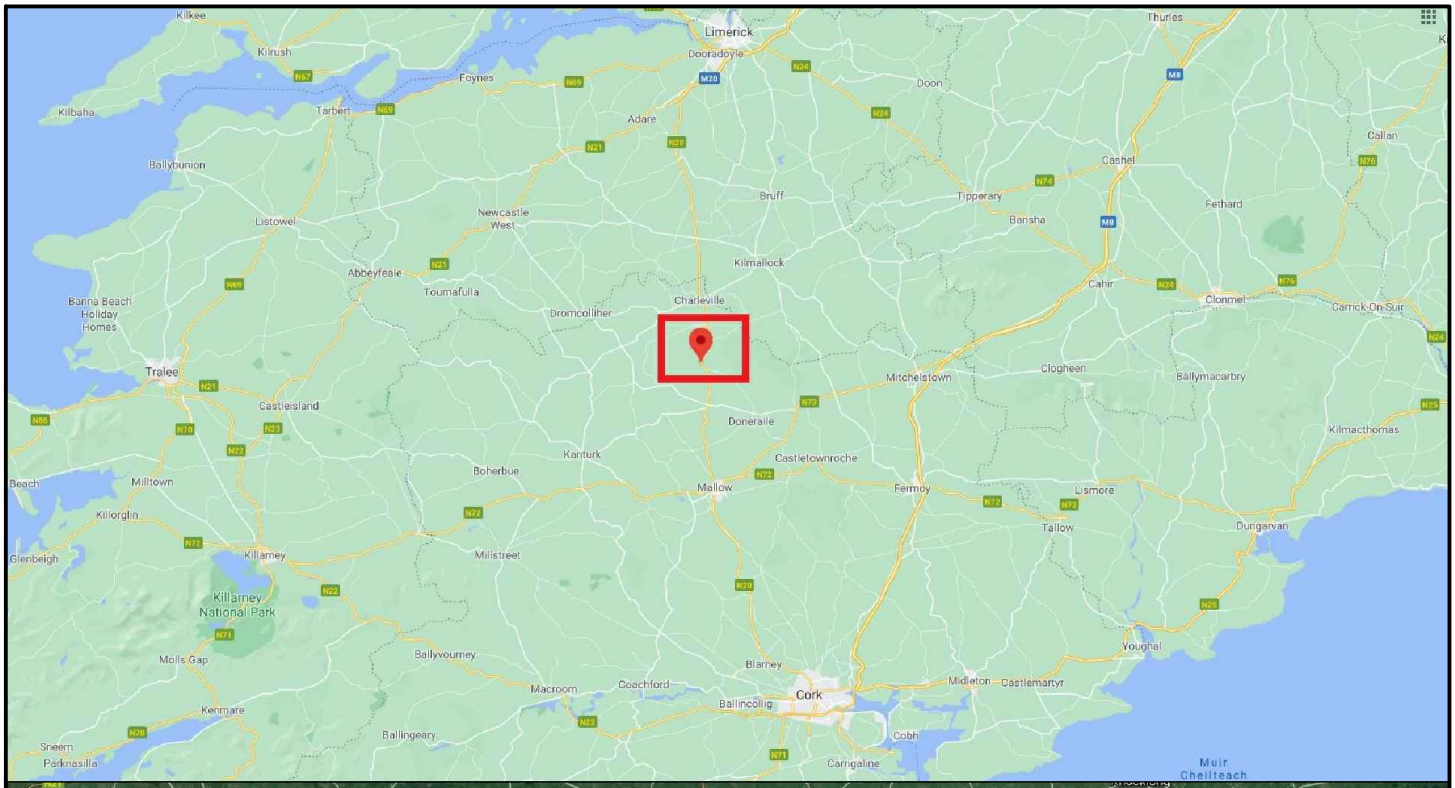
Environmental Protection Agency / Draft Guidance Note on Soil Recovery Waste Acceptance Criteria. December 2017.
http://www.epa.ie/pubs/consultation/soilrecoveryconsultation/

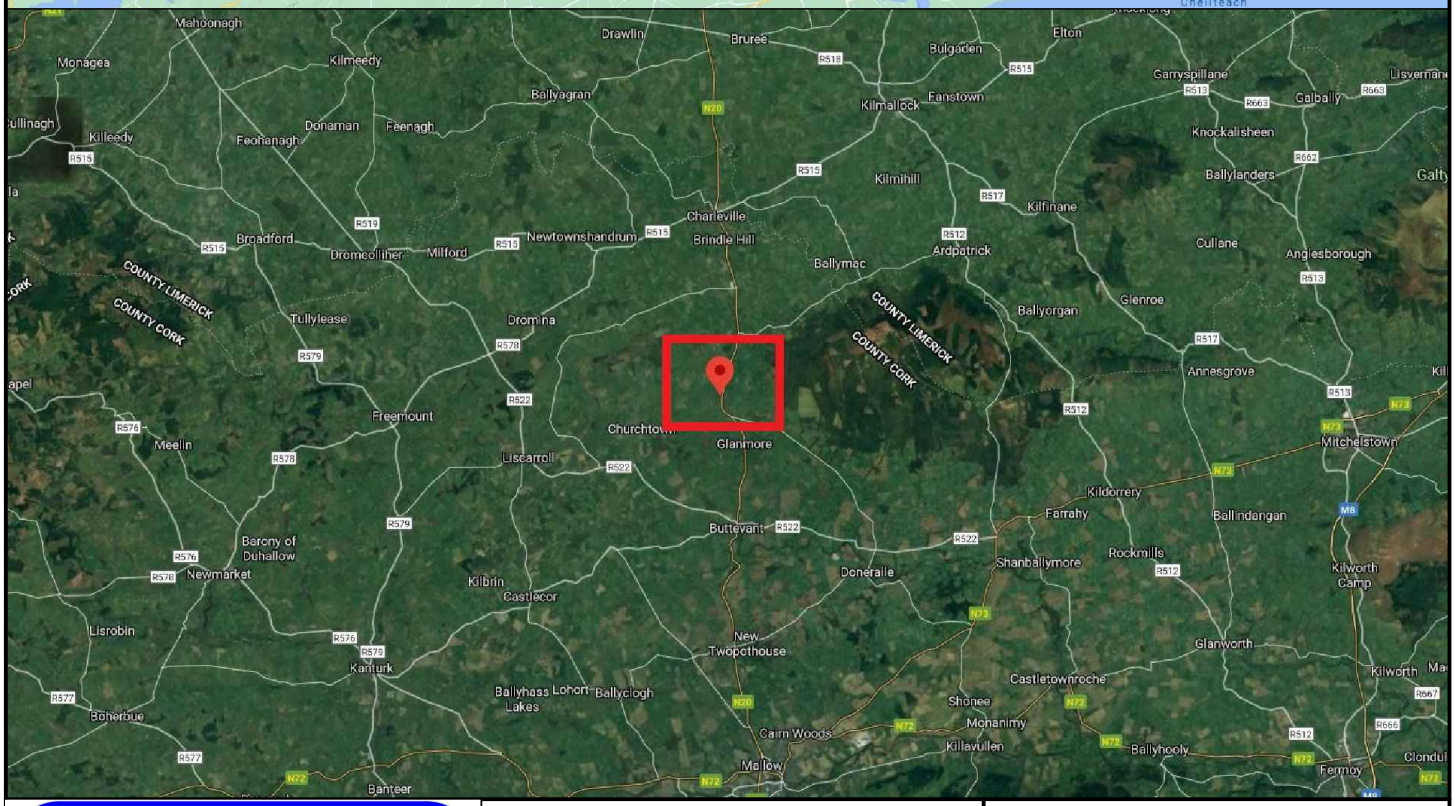
Environmental Protection Agency / Waste Classification List of Waste & Determining if Waste is Hazardous or Non-hazardous. 1st June 2015
https://www.epa.ie/pubs/reports/waste/stats/wasteclassification/EPA_Waste_Classification_2015_Web.pdf

Environment Agency UK (2009). Soil Guideline Values (SGVs).
https://www.gov.uk/government/collections/land-contamination-technical-guidance

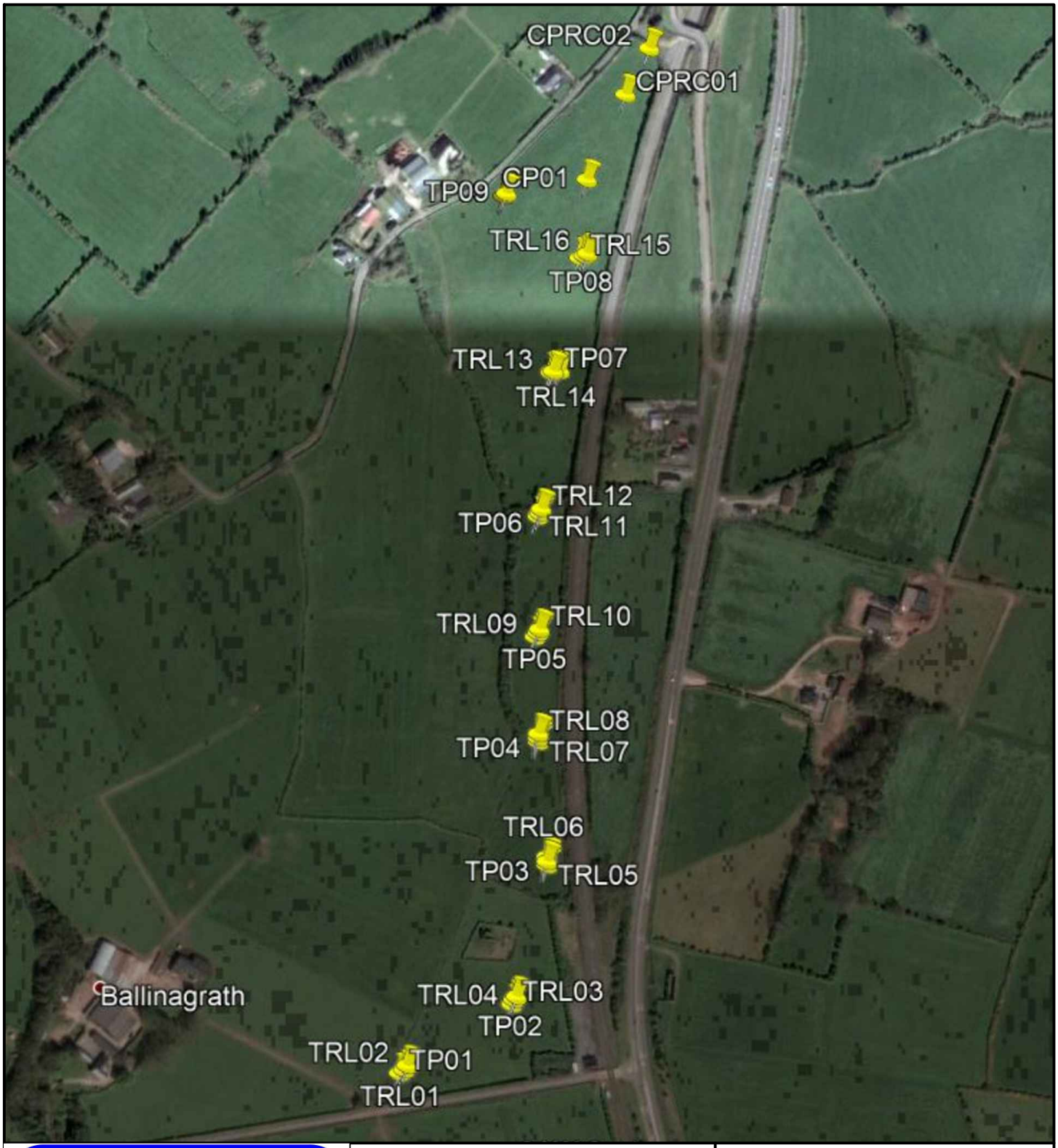
Soil Remediation Circular 2013, Ministry for Environment and Infrastructure, The Hague, Netherlands.
https://rwsenvironment.eu/subjects/soil/legislation-and/soil-remediation/

# Appendix A Site and Exploratory Hole Location Plans




| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC215 (19-135-4) | SITE LOCATION MAPS<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: February/May-July 2020 |




Iarnród Éireann

Cork Line Level Crossings

XC215 (19-135-4)

Exploratory Hole Locations

Client: Iarnród Éireann

Engineer: Jacob's

Date: February/May-July 2020

# Appendix B Borehole Logs

| | | | |
|---|---|---|---|
| | **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | **Borehole No.:** XC215-CP01 |
| | **Coordinates:** 553546.75 E 615237.48 N | **Client:** Iarnród Éireann / Irish Rail | Sheet 1 of 1 |
| **Method:** Cable Percussion | | **Client's Representative:** JACOBS | **Scale:** 1:50 |
| **Plant:** Pilcon | **Ground Level:** 98.42 mOD | **Dates:** 29/05/2020 - 03/06/2020 | **Driller:** AA |
| | | | **Logger:** IH |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description |
|---|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | | 98.22 | (0.20) 0.20 | | TOPSOIL |
| 0.20 - 1.20 | B2 | | | | | | | Reddish brown slightly silty slightly gravelly very sandy CLAY. Gravel is fine to medium, subrounded. Sand is fine to coarse. |
| 0.20 - 1.20 | D3 | | | | | | | |
| 0.50 | ES4 | | | | | (1.00) | | |
| 1.20 - 2.00 | B5 | | | | 97.22 | 1.20 | | Loose reddish brown slightly silty gravelly clayey SAND with low cobble content. Gravel is fine to coarse, angular to subrounded. Sand is fine to coarse. Cobbles are subrounded. |
| 1.20 - 2.00 | D6 | | | | | | | |
| 1.20 - 1.65 | SPT (C) N=6 | | | N=6 (1,1/2,1,2,1) | | (0.80) | | |
| 1.50 | ES7 | | | | | | | |
| 2.00 - 3.00 | B8 | | | | 96.42 | 2.00 | | Medium Dense reddish brown slightly silty sandy GRAVEL with medium cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are subangular to subrounded. |
| 2.00 - 3.00 | D9 | | | | | | | |
| 2.00 - 2.45 | SPT (C) N=17 | | | N=17 (3,6/4,5,4,4) | | (1.00) | | |
| 3.00 | ES10 | | | | 95.42 | 3.00 | | Medium Dense reddish brown slightly silty clayey very sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. |
| 3.00 - 3.60 | B11 | | | | | | | |
| 3.00 - 3.60 | D12 | | | | | (0.60) | | |
| 3.00 - 3.45 | SPT (C) N=20 | | | N=20 (2,4/4,6,5,5) | 94.82 | 3.60 | | Stiff brown mottled grey slightly gravelly slightly sandy silty CLAY with medium cobble content and low boulder content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles and boulders are subrounded. |
| 3.60 - 4.50 | B13 | | | | | | | |
| 3.60 - 4.50 | D14 | | | | | | | |
| 4.00 - 4.45 | SPT (C) N=17 | | | N=17 (3,3/2,4,4,7) | | (0.90) | | |
| 4.50 - 5.50 | B15 | | | | 93.92 | 4.50 | | Soft to Firm brown slightly silty slightly sandy slightly gravelly CLAY with low to medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subrounded. |
| 4.50 - 5.50 | D16 | | | | | | | |
| 5.00 - 5.45 | SPT (C) N=8 | | | N=8 (1,1/1,3,2,2) | | (1.50) | | |
| 5.50 - 6.00 | B17 | | | | | | | |
| 5.50 - 6.50 | D18 | | | | | | | |
| 6.00 - 6.80 | B19 | | | | 92.42 | 6.00 | | Loose to Medium Dense reddish brown sandy clayey GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. |
| 6.00 - 6.80 | D20 | | | | | | | |
| 6.00 - 6.45 | SPT (C) N=12 | | | N=12 (1,1/2,3,3,4) | | (1.60) | | |
| 6.80 - 7.60 | B21 | | | | | | | |
| 6.80 - 7.60 | D22 | | | | | | | |
| 6.80 - 6.80 | SPT (C) | | | 50 (25 for 0mm/50 for 0mm) | | | | |
| 7.00 - 7.45 | SPT (C) N=22 | | | N=22 (2,4/3,5,7,7) | | | | |
| 7.60 - 7.60 | SPT (C) | | | 50 (25 for 0mm/50 for 0mm) | 90.82 | 7.60 | | End of borehole at 7.600m |

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5

**Remarks**

| Water Added | |
|---|---|
| From (m) | To (m) |
| 1.20 | 3.00 |
| 3.00 | 3.60 |

| Water Strike - General | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| 3.70 | 3.70 | 20 | 3.50 |

| Casing Details | |
|---|---|
| To (m) | Diam (mm) |
| 7.60 | 200 |

| Chiselling Details | | |
|---|---|---|
| From (m) | To (m) | Time (hh:mm) |
| 6.80 | 7.00 | 00:30 |
| 7.60 | 7.60 | 01:00 |

| | | | |
|---|---|---|---|
| | **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | **Borehole No.:** XC215-CPRC01 |
| | **Coordinates:** 553581.51 E | **Client:** Iarnród Éireann / Irish Rail | Sheet 1 of 2 |
| **Method:** Cable Percussion+Rotary Open+Rotary Coring | 615311.63 N | **Client's Representative:** JACOBS | **Scale:** 1:50 |
| **Plant:** Pilcon+T44 | **Ground Level:** 99.59 mOD | **Dates:** 28/05/2020 - 31/07/2020 | **Driller:** AA +NOB |
| | | | **Logger:** IH |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | | | (0.30) | | TOPSOIL | | |
| 0.30 - 1.20 | B2 | | | | 99.28 | 0.30 | | Dark brown sandy gravelly SILT. Gravel is fine to medium, subangular to subrounded. sand is fine to coarse. | | |
| 0.30 - 1.20 | D3 | | | | | | | | | |
| 0.50 | ES4 | | | | | (0.90) | | | | |
| 1.20 - 2.00 | B5 | | | | 98.38 | 1.20 | | Loose dark grey / brown slightly silty clayey very sandy GRAVEL with high cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded. | | |
| 1.20 - 2.00 | D6 | | | | | | | | | |
| 1.20 - 1.65 | SPT (C) N=8 | | | N=8 (2,1/2,3,1,2) | | (0.80) | | | | |
| 1.50 | ES7 | | | | | | | | | |
| 2.00 - 3.00 | B8 | | | | 97.58 | 2.00 | | Medium Dense dark grey / brown slightly silty clayey very sandy GRAVEL with high cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are angular to subangular | | |
| 2.00 - 3.00 | D9 | | | | | | | | | |
| 2.00 - 2.45 | SPT (C) N=11 | | | N=11 (3,2/2,3,4,2) | | (1.00) | | | | |
| 3.00 | ES10 | | | | 96.58 | 3.00 | | Medium Dense reddish brown clayey very sandy GRAVEL with medium cobble content. Gravel is fine to coarse, subangular to subrounded. Cobbles are angular to subangular. | | |
| 3.00 - 4.00 | B11 | | | | | | | | | |
| 3.00 - 4.00 | D12 | | | | | | | | | |
| 3.00 - 3.45 | SPT (C) N=16 | | | N=16 (1,1/4,4,4,4) | | (1.00) | | | | |
| 4.00 - 4.70 | B13 | | | | 95.58 | 4.00 | | Medium Dense grey angular to subrounded COBBLES with a matrix of reddish brown slightly silty slightly clayey gravelly SAND. | | |
| 4.00 - 4.70 | D14 | | | | | | | | | |
| 4.00 - 4.45 | SPT (C) N=14 | | | N=14 (1,2/2,3,3,6) | | (0.70) | | | | |
| 4.70 - 6.00 | B15 | | | | 94.88 | 4.70 | | Firm brown slightly gravelly slightly sandy silty CLAY with low cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 4.70 - 6.00 | D16 | | | | | | | | | |
| 5.00 - 5.45 | SPT (C) N=9 | | | N=9 (4,1/1,2,3,3) | | (1.30) | | | | |
| 6.00 - 6.50 | B17 | | | | 93.58 | 6.00 | | Firm brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. | | |
| 6.00 - 6.50 | D18 | | | | | | | | | |
| 6.00 - 6.45 | SPT (C) N=13 | | | N=13 (2,2/3,3,2,5) | | (0.50) | | | | |
| 6.50 - 6.50 | SPT (C) | | | 50 (25 for 0mm/50 for 0mm) | 93.08 | 6.50 | | Rotary Open Hole Drilling.<br>Drillers Description: Boulders with sand | | |
| 7.50 - 7.95 | SPT (C) N=38 | | | N=38 (6,6/8,8,8,14) | | (3.10) | | | | |
| 8.50 - 8.95 | SPT (C) N=49 | | | N=49 (9,9/9,12,12,16) | | | | | | |
| 9.60 - 9.60 | SPT (C) | | | 50 (25 for 0mm/50 for 0mm) | | 9.60 | | | | |
| 9.60 - 9.60 | | | 14 | 50 (25 for 0mm/50 for 0mm) | 89.98 | (1.08) | | Medium Strong light greyish brown fine to medium grained SANDSTONE.<br><br>Distinctly weathered with brown, black and orange brown discolouration (iron oxide staining) penetrating up to 5mmfrom discontinuities and | | |
| | TCR | SCR | RQD | FI | | | | Continued on Next Page | | |

**Remarks**

Cable percussion terminated at 6.50m due to probable boulder obstruction. Rotary techniques employed thereafter.

| Water Added | |
|---|---|
| From (m) | To (m) |
| 1.20 | 4.70 |

| Water Strike - General | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| | | | |

| Casing Details | |
|---|---|
| To (m) | Diam (mm) |
| 6.50 | 200 |
| 9.60 | 151 |

| Chiselling Details | | |
|---|---|---|
| From (m) | To (m) | Time (hh:mm) |
| 6.50 | 6.50 | 01:00 |

| | | | |
|---|---|---|---|
| | **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | **Borehole No.:** XC215-CPRC01 |
| | **Coordinates:** 553581.51 E | **Client:** Iarnród Éireann / Irish Rail | Sheet 2 of 2 |
| **Method:** Cable Percussion+Rotary Open+Rotary Coring | 615311.63 N | **Client's Representative:** JACOBS | **Scale:** 1:50 |
| **Plant:** Pilcon+T44 | **Ground Level:** 99.59 mOD | **Dates:** 28/05/2020 - 31/07/2020 | **Driller:** AA +NOB |
| | | | **Logger:** IH |

| Depth (m) | TCR | SCR | RQD | FI | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | occasional orange brown speckling. | | |
| | 100 | 55 | 8 | | | 88.90 | (0.98) | | Discontinuities: Very closely to closely spaced.<br>1.) Subhorizontal, planar, rough.<br>2.) Step to subvertical, planar, rough | | |
| 11.10 | | | | NI | | 88.88 | (1.06) | | Very weak light olive green MUDSTONE with black and orange iron oxide staining on extremely closely spaced fractures. | | |
| | | | | | | | | | Very weak to weak maroon MUDSTONE / SILTSTONE, distinctly weathered to destructured locally broken dow to purple gravelly silty Clay. | | |
| | 84 | 38 | 8 | | | 87.82 | 11.77 | | Discontinuities:<br>Extremely closely to very closely spaced, undulating and planar, slightly rough with some black and orange brown iron oxide staining on surfaces.<br>1.) Shallow to subhorizontal planar to slightly undulating slightly rough.<br>2.) Steep to subvertical, planar to slightly undulating, slightly rough. | | |
| 12.60 | | | | | | | | | Weak to medium strong maroon fine sandy SILTSTONE, locally thinly laminated with occasional thin laminae of pale red (pink) fine grained SANDSTONE. Occasional grey (locally weathered to yellowish brown) possible calcrete nodules, locally weathered out to voids. | | |
| | 54 | 42 | 17 | 15 | | | (2.33) | | Distinctly weathered with a little reddish brown slightly sandy slightly gravelly silty Clay infilling of discontinuities. | | |
| | | | | | | | | | Discontinuities:<br>Very closely to closely spaced with black iron oxide staining on surfaces. | | |
| 14.10 | | | | | | 85.48 | 14.10 | | End of borehole at 14.100m | | |
| | TCR | SCR | RQD | FI | | | | | | | |

**Remarks**

Cable percussion terminated at 6.50m due to probable boulder obstruction. Rotary techniques employed thereafter.

| Water Added | |
|---|---|
| From (m) | To (m) |
| 1.20 | 4.70 |

| Water Strike - General | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| | | | |

| Casing Details | |
|---|---|
| To (m) | Diam (mm) |
| 6.50 | 200 |
| 9.60 | 151 |

| Chiselling Details | | |
|---|---|---|
| From (m) | To (m) | Time (hh:mm) |
| 6.50 | 6.50 | 01:00 |

| | | | |
|---|---|---|---|
| | **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | **Borehole No.:** XC215-CPRC02 |
| | **Coordinates:** 553601.76 E | **Client:** Iarnród Éireann / Irish Rail | Sheet 1 of 1 |
| **Method:** Cable Percussion+Rotary Open+Rotary Coring | 615349.74 N | **Client's Representative:** JACOBS | **Scale:** 1:50 |
| **Plant:** Pilcon+T44 | **Ground Level:** 100.21 mOD | **Dates:** 27/05/2020 - 30/07/2020 | **Driller:** AA +NOB<br>**Logger:** IH |

| Depth (m) | Sample / Tests | Casing Depth (m) | Water Depth (m) | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water | Backfill |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.05 | ES17 | | | | | (0.30) | | TOPSOIL | | |
| 0.30 - 1.20 | B1 | | | | 99.91 | 0.30 | | Dark brown slightly clayey slightly sandy slightly gravelly SILT with low cobble content and frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subrounded. | | |
| 0.30 - 1.20 | D2 | | | | | | | | | |
| 0.50 | ES18 | | | | | (0.90) | | | | |
| 1.20 - 2.00 | B3 | | | | 99.01 | 1.20 | | Loose dark grey / brown slightly sandy slightly silty GRAVEL with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subangular to subrounded | | |
| 1.20 - 2.00 | D4 | | | | | | | | | |
| 1.20 - 1.65 | SPT (C) N=7 | | | N=7 (2,1/2,1,2,2) | | (0.80) | | | | |
| 1.50 | ES19 | | | | | | | | | |
| 2.00 - 3.00 | B5 | | | | 98.21 | 2.00 | | Dense reddish brown clayey very sandy GRAVEL with low cobble content. Gravel is fine to coarse, subangular to subrounded. Sand is fine to coarse. Cobbles are subangular to subrounded. | | |
| 2.00 - 3.00 | D6 | | | | | | | | | |
| 2.00 - 2.45 | SPT (C) N=46 | | | N=46 (10,13/11,11,13,11) | | (1.00) | | | | |
| 3.00 | ES20 | | | | 97.21 | 3.00 | | Medium Dense subrounded grey COBBLES with a matrix of grey slightly silty very gravelly SAND. | | |
| 3.00 - 3.50 | B7 | | | | | | | | | |
| 3.00 - 3.50 | D8 | | | | | (0.50) | | | | |
| 3.00 - 3.45 | SPT (C) N=16 | | | N=16 (4,7/6,4,3,3) | 96.71 | 3.50 | | Firm to stiff reddish brown slightly silty sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subrounded. | | |
| 3.50 - 4.20 | B9 | | | | | | | | | |
| 3.50 - 4.20 | D10 | | | | | (0.70) | | | | |
| 4.00 - 4.45 | SPT (C) N=15 | | | N=15 (1,1/2,1,3,9) | | | | | | |
| 4.20 - 5.00 | B11 | | | | 96.01 | 4.20 | | Stiff reddish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded. Cobbles are subrounded. | | |
| 4.20 - 5.00 | D12 | | | | | | | | | |
| 5.00 - 6.00 | B13 | | | | | | | | | |
| 5.00 - 6.00 | D14 | | | | | | | | | |
| 5.00 - 5.45 | SPT (C) N=19 | | | N=19 (3,4/4,4,6,5) | | (2.40) | | | | |
| 6.00 - 6.20 | B15 | | | | | | | | | |
| 6.00 - 6.20 | D16 | | | | | | | | | |
| 6.00 - 6.20 | SPT (C) | | | 75 (5,8/75 for 50mm) | | | | | | |
| ~~6.20 - 6.20~~ | ~~SPT (C)~~ | | | ~~50 (25 for 0mm/50 for 0mm)~~ | 93.61 | 6.60 | | Medium Strong to Strong, pale yellow / grey, medium grained SANDSTONE. | | |
| | 60 30 | 17 | NI | | | (1.50) | | Distinctly weathered with pervasive light brown clay staining and infill of discontinuities. Much black and orange / brown oxide staining on discontinuity surfaces. | | |
| | | | | | | | | Discontinuities: Subhorizontal to 20°. Planar, rough, very closely spaced. | | |
| 8.10 | | | | | 92.11 | 8.10 | | Borehole collapsed. Likely entered a void or soft clay band at this depth. | | |
| | | | | | | (1.50) | | | | |
| | | | | | 90.61 | 9.60 | | End of borehole at 9.600m | | |
| | TCR SCR | RQD | FI | | | | | | | |

**Remarks**

Borehole collapsed from 8.10m with 0% core recovery. Had to move off location due to safety concerns.

Cable Percussion terminated at 6.20m due to probable boulder obstruction. Rotary Techniques employed thereafter.

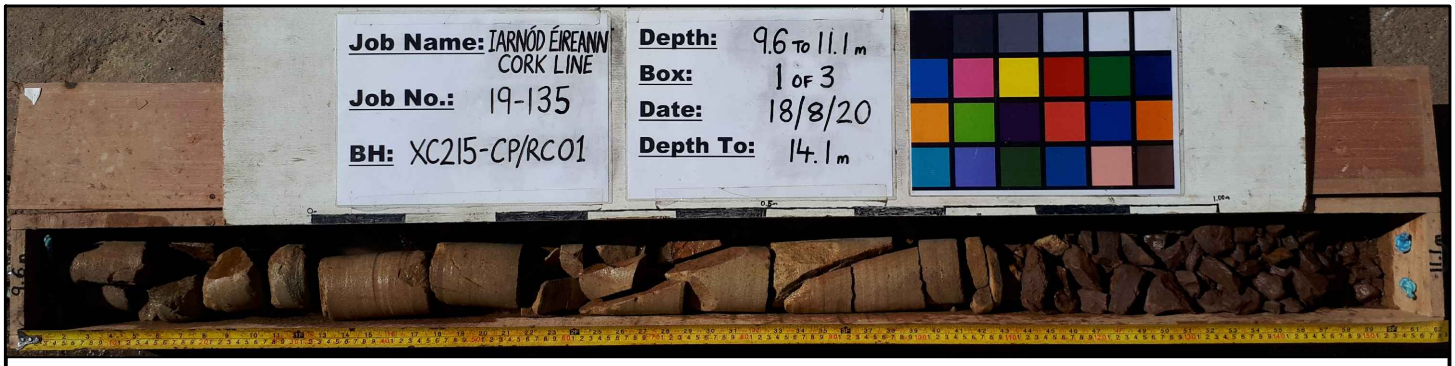
| Water Added | |
|---|---|
| From (m) | To (m) |
| 1.20 | 4.20 |

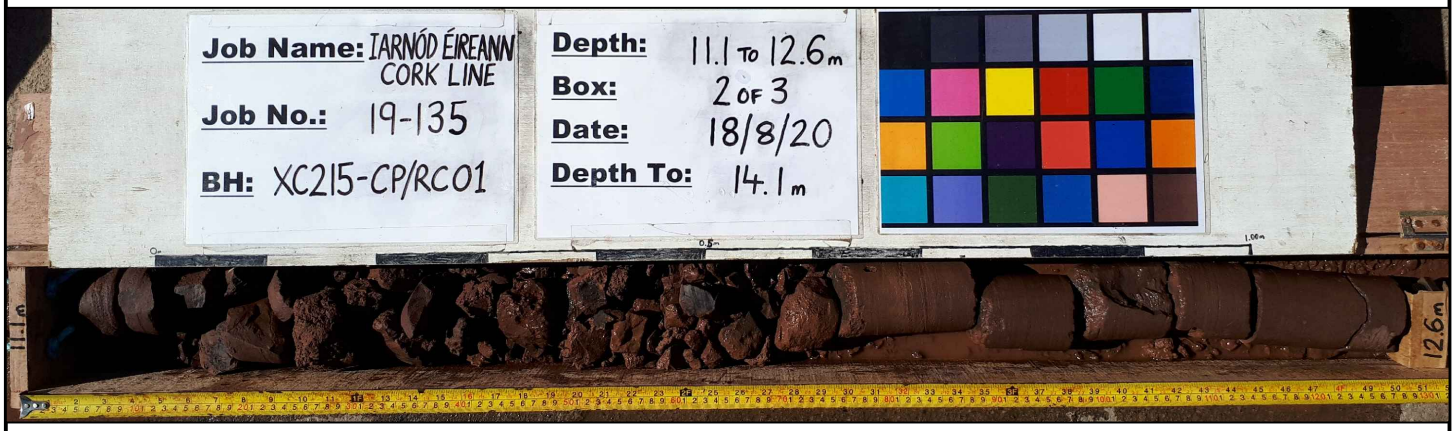
| Water Strike - General | | | |
|---|---|---|---|
| Struck at (m) | Casing to (m) | Time (min) | Rose to (m) |
| | | | |

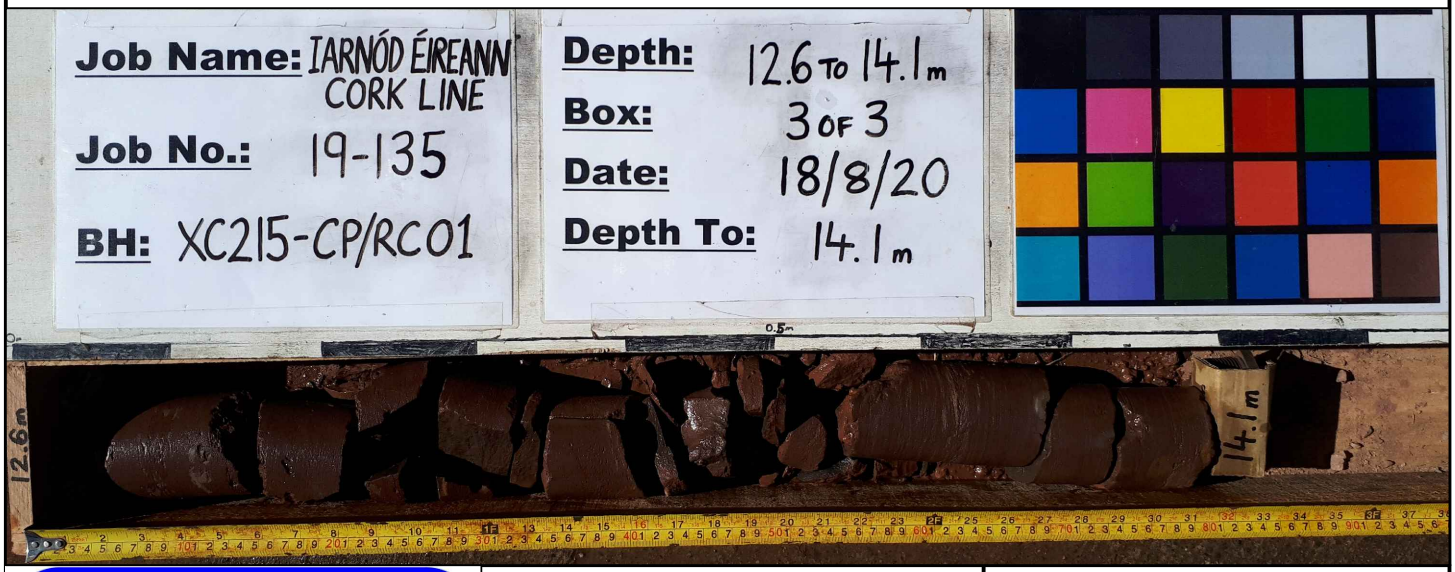
| Casing Details | |
|---|---|
| To (m) | Diam (mm) |
| 6.20 | 200 |
| 6.60 | 151 |

| Chiselling Details | | |
|---|---|---|
| From (m) | To (m) | Time (hh:mm) |
| 6.20 | 6.20 | 01:30 |

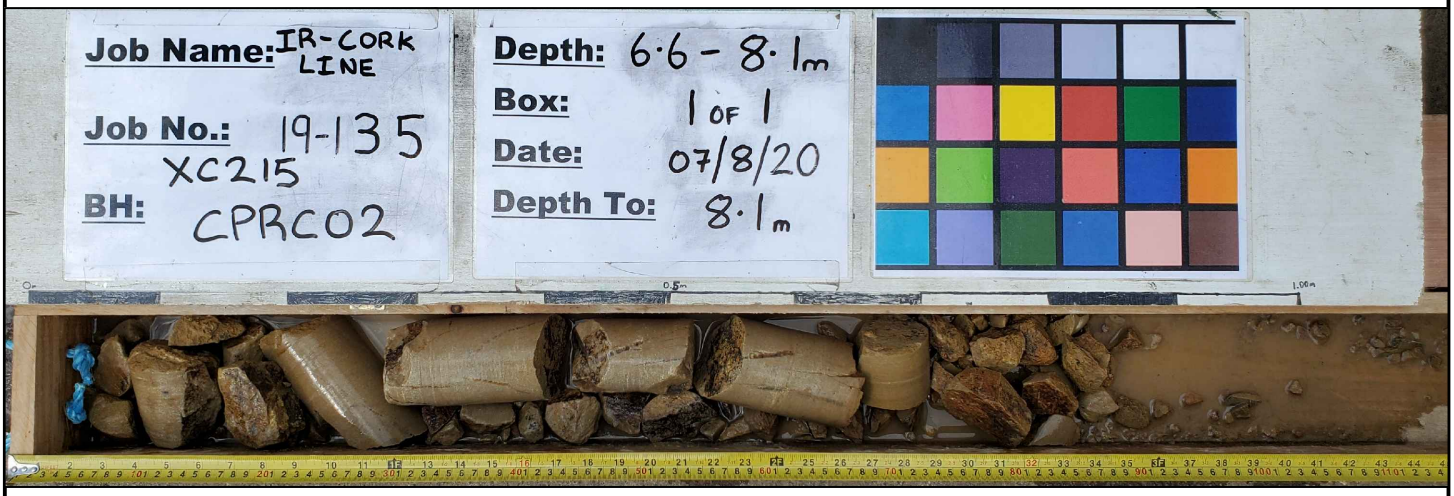
# Appendix C Rock Core Photographs




| | |
|---|---|
| Iarnród Éireann<br>Cork Line Level Crossings<br>XC215 (19-135-4) | C.P/R.C01<br>Rock Core Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: May - July 2020 |




| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC215 (19-135-4) | C.P/R.C02<br>Rock Core Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: May - July 2020 |

# Appendix D Trial Pit Logs

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP01 |
| **Co-ordinates:** 553382.20 E | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | 614488.00 N | **Client's Representative:** JACOBS | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 90.51 mOD | **Date:** 18/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description |
|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.35) | | TOPSOIL: Soft greyish brown slightly gravelly sandy silty CLAY with frequent rootlets, moist. |
| 0.35 - 0.80 | B2 | | 90.16 | 0.35 | | Soft to firm light brown slightly gravelly becoming gravelly sandy silty CLAY with low cobble content and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are angular to subrounded, sandstone and siltstone. |
| 0.35 - 0.80 | B3 | | | | | |
| 0.35 - 0.80 | D4 | | | | | |
| 0.50 | ES5 | | | | | |
| 0.50 | | HVP=38, HVR=16 | | (0.45) | | |
| 1.00 | ES6 | | 89.71 | 0.80 | | Light brown mottled orange and reddish brown slightly clayey slightly silty very sandy GRAVEL with medium cobble and low small boulder content, moist becoming wet by 1.55m. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are angular to subangular, sandstone and siltstone. |
| 1.10 - 1.60 | B7 | | | | | |
| 1.10 - 1.60 | D8 | | | | | |
| | | Rapid Inflow - Rose to 1.35m | | (1.40) | | |
| | | | 88.31 | 2.20 | | End of trial pit at 2.200m |

Water

0.5 1.0 1.5 2.0 2.5 3.0 3.5

**Remarks**

Trial Pit terminated at 2.20m due to pit walls collapsing.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 1.55 | Rapid Inflow - Rose to 1.35m |

**Stability:** Sides collapsing

**Width:** 1.90

**Length:** 4.80

| | | | |
|---|---|---|---|
| | **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | **Trial Pit No.:** XC215-TP02 |
| | **Co-ordinates:** 554817.30 E | **Client:** Iarnród Éireann / Irish Rail | Sheet 1 of 1 |
| **Method:** Excavation | 617963.85 N | **Client's Representative:** JACOBS | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 97.95 mOD | **Date:** 18/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.00 | ES1 | | | (0.25) | | TOPSOIL: Soft greyish brown slightly gravelly sandy silty CLAY with frequent rootlets, moist. | |
| | | | 97.70 | 0.25 | | | |
| 0.30 - 0.80 | B3 | | | | | Firm (locally soft) light brown with a little orange brown mottling slightly gravelly sandy silty CLAY with low cobble content, and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| 0.30 - 0.80 | D4 | | | | | *From 0.25m - 0.80m: WNW - ESE orientated, approx 2m wide with linear boundary. Firm grey slightly gravelly sandy silty CLAY with low cobble content and occasional rootlets, moist.* | |
| 0.50 | ES2 | | | (0.55) | | | |
| 0.50 | | HVP=48, HVR=65 | | | | | |
| | | | 97.15 | 0.80 | | End of trial pit at 0.800m | |

**Remarks**
Permission to excavate further / alternate trial pit in the area was refused.

Terminated due to possible archaeological feature.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| | None Encountered |

**Stability:** Good

**Width:** 3.60

**Length:** 7.40

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP03 |
| **Co-ordinates:** 553507.73 E 614663.96 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 92.40 mOD | **Date:** 19/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.25) | | TOPSOIL: Soft dark brown slightly sandy silty CLAY with occasional gravel and frequent rootlets, moist. | |
| 0.25 - 0.50 | B2 | | 92.14 | 0.25 | | Soft orange and black slightly sandy SILT / CLAY with high content of gravel to boulder sized cemented vesicular iron pan (composed of silty sand and gravel) and occasional rootlets. | |
| 0.25 - 0.50 | D3 | | | (0.25) | | *STONE FIELD DRAIN (0.3 - 0.6m): N - S orientation, 0.20m wide.* *STONE FIELD DRAIN (0.3 - 0.9m): NE - SW orientation, 0.30m wide.* | |
| 0.50 | ES4 | | 91.90 | 0.50 | | Soft to firm becoming stiff light brown and orange mottled slightly sandy slightly gravelly silty CLAY with low cobble and boulder content and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles and boulders are angular to subangular, sandstone and siltstone. | |
| 0.50 - 1.00 | B5 | | | | | | |
| 0.50 - 1.00 | D6 | Water inflow from field drain. - No rise | | | | | |
| 0.70 | | HVP=57, HVR=20 | | (0.60) | | | |
| 1.00 | ES7 | | | | | | |
| | | | 91.30 | 1.10 | | Soft reddish brown sandy gravelly silty CLAY with medium cobble and low boulder content, wet. | |
| | | | | (0.20) | | | |
| 1.30 - 1.80 | B8 | | 91.10 | 1.30 | | Brown slightly silty very sandy GRAVEL with medium cobble content and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are subangular, sandstone, siltstone and quartz. | |
| 1.30 - 1.80 | D9 | Rapid Inflow - No rise | | | | | |
| | | | | (0.70) | | | |
| | | | 90.40 | 2.00 | | End of trial pit at 2.000m | |

**Remarks**

Trial Pit terminated at 2.00m due to pit walls collapsing.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 0.60 | Water inflow from field drain. - No rise |
| 1.30 | Rapid Inflow - No rise |

**Stability:** Sides collapsing

**Width:** 1.80

**Length:** 3.70

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP04 |
| **Co-ordinates:** 553501.42 E 614767.21 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 93.90 mOD | **Date:** 19/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.30) | | TOPSOIL: Soft greyish brown slightly sandy to sandy silty CLAY with frequent rootlets, moist. | |
| 0.30 - 0.70 | B2 | | 93.60 | 0.30 | | | |
| 0.30 - 0.70 | D3 | | | | | Firm light brown and orange brown mottled slightly sandy slightly gravelly silty CLAY with low cobble content and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| 0.50 | ES4 | | | (0.40) | | | |
| 0.50 | | HVP=68, HVR=24 | | | | | |
| 0.70 - 1.00 | B5 | | 93.20 | 0.70 | | | |
| 0.70 - 1.00 | D6 | | | | | Firm becoming soft reddish brown slightly gravelly slightly sandy becoming sandy silty CLAY with low cobble content and occasional rootlets, moist becoming wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| | | | | (0.30) | | | |
| 1.00 | ES7 | | 92.90 | 1.00 | | | |
| 1.00 - 1.50 | B8 | | | | | Greyish brown silty SAND and GRAVEL with medium cobble content and occasional rootlets, wet with thin bed of slightly silty very gravelly sand with occasional blackened partially decayed wood fragments. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are angular to subrounded, sandstone and siltstone. | |
| 1.00 - 1.50 | D9 | Rapid inflow - Rose to 0.90m. | | (1.00) | | | |
| | | | 91.90 | 2.00 | | End of trial pit at 2.000m | |

**Remarks**

Trial Pit terminated at 2.00m due to pit walls collapsing.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 1.00 | Rapid inflow - Rose to 0.90m. |

**Stability:** Sides collapsing

**Width:** 1.70

**Length:** 3.90

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP05 |
| **Co-ordinates:** 553501.82 E 614855.46 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 95.04 mOD | **Date:** 19/02/2020 | **Driver:** TS / **Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.30) | | TOPSOIL: Soft greyish brown slightly sandy silty CLAY with frequent rootlets, moist. | |
| | | | 94.74 | 0.30 | | | |
| 0.40 | | HVP=73, HVR=25 | | | | Firm light brown and orange brown slightly sandy slightly gravelly silty CLAY with low cobble content, and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to rounded. Cobbles are angular to rounded. | |
| 0.50 | ES2 | | | | | | |
| 0.50 - 1.00 | B3 | | | | | | |
| 0.50 - 1.00 | D4 | | | (0.80) | | | |
| 1.00 | ES5 | | | | | | |
| 1.10 - 1.60 | B6 | | 93.94 | 1.10 | | | |
| 1.10 - 1.60 | D7 | | | | | Soft reddish brown sandy gravelly silty CLAY with low cobble content, moist becoming wet by 1.3m. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| 1.10 | | HVP=25, HVR=12 | | (0.60) | | | |
| 1.70 - 2.20 | B8 | | 93.34 | 1.70 | | | ▼ |
| 1.70 - 2.20 | D9 | Rapid inflow - Rose to 1.7m. | | | | Brown clayey silty becoming slightly silty very sandy GRAVEL with low to medium cobble content and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are mostly subangular, sandstone and siltstone. | ▽ |
| | | | | (0.50) | | | |
| | | | 92.84 | 2.20 | | End of trial pit at 2.200m | |

**Remarks**

Trial Pit terminated at 2.20m due to pit walls collapsing.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 1.80 | Rapid inflow - Rose to 1.7m. |

**Stability:** Sides collapsing below 1.7m

**Width:** 0.80

**Length:** 3.60

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP06 |
| **Co-ordinates:** 553504.67 E 614955.90 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 95.74 mOD | **Date:** 19/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.30) | | TOPSOIL: Soft greyish brown slightly sandy silty CLAY with frequent rootlets, moist. | |
| | | | 95.44 | 0.30 | | | |
| 0.40 | | HVP=60, HVR=24 | | | | Firm light brown and orange brown slightly sandy slightly gravelly silty CLAY with low cobble content and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| 0.50 | ES2 | | | | | | |
| 0.50 - 1.00 | B3 | | | | | | |
| 0.50 - 1.00 | D4 | | | (1.10) | | | |
| 1.00 | ES5 | | | | | | |
| | | | 94.34 | 1.40 | | | |
| 1.50 - 2.00 | B6 | | | | | Brown clayey silty very sandy GRAVEL with medium cobble content and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles are angular to subrounded. | |
| 1.50 - 2.00 | D7 | | | (0.30) | | | |
| | | Rapid inflow - Rose to 1.4m | 94.04 | 1.70 | | Brown slightly silty very sandy GRAVEL with medium cobble content and low boulder content, wet. Sand is fine to coarse. Gravel is angular to subrounded. Cobbles and boulders are angular to subangular, sandstone and siltstone. | |
| | | | | (0.40) | | | |
| | | | 93.64 | 2.10 | | End of trial pit at 2.100m | |

**Remarks**

Trial Pit terminated at 2.10m due to pit walls collapsing.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 1.70 | Rapid inflow - Rose to 1.4m |

**Stability:** Sides collapsing below 1.4m

**Width:** 0.90

**Length:** 3.30

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP07 |
| **Co-ordinates:** 553516.77 E 615075.58 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 96.29 mOD | **Date:** 19/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.25) | | TOPSOIL: Soft greyish brown slightly sandy silty CLAY with frequent rootlets, moist. | |
| | | | 96.04 | 0.25 | | | |
| | | | | (0.15) | | Firm light brown mottled orange brown slightly sandy silty CLAY with occasional rootlets, moist. | |
| 0.40 - 0.80 | B2 | | 95.89 | 0.40 | | | |
| 0.40 - 0.80 | D3 | | | | | Stiff light grey with a little orange brown mottling slightly gravelly slightly sandy silty CLAY with low cobble content, occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| 0.50 | ES4 | | | | | | |
| 0.50 | | HVP=53, HVR=21 | | (0.40) | | | |
| | | | 95.49 | 0.80 | | | |
| 0.90 - 1.40 | B5 | | | | | Stiff orange brown slightly sandy becoming sandy gravelly silty CLAY with low cobble content, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular, sandstone and siltstone. | |
| 0.90 - 1.40 | D6 | | | | | | |
| 1.00 | ES7 | | | | | | |
| | | | | (0.80) | | | |
| | | Rapid inflow - No rise | | | | | ▼ |
| 1.60 - 2.10 | B8 | | 94.69 | 1.60 | | | |
| 1.60 - 2.10 | D9 | | | | | Soft greyish brown and orange brown mottled clayey silty very sandy GRAVEL with medium cobble and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are angular to subangular, sandstone and siltstone. | |
| | | | | (0.50) | | | |
| 2.10 - 2.40 | B10 | | 94.19 | 2.10 | | | |
| 2.10 - 2.40 | D11 | | | | | Brown slightly silty very sandy GRAVEL with medium cobble and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are angular to subangular, sandstone and siltstone. | |
| | | | | (0.30) | | | |
| | | | 93.89 | 2.40 | | End of trial pit at 2.400m | |

**Remarks**

Trial Pit terminated at 2.40m due to pit walls collapsing.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 1.30 | Rapid inflow - No rise |

**Stability:** Sides collapsing

**Width:** 1.10

**Length:** 2.80

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP08 |
| **Co-ordinates:** 553543.87 E 615173.05 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 97.83 mOD | **Date:** 18/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.35) | | TOPSOIL: Soft dark brown sandy silty CLAY with frequent rootlets, moist. | |
| | | | 97.48 | 0.35 | | Firm light brown with a little orange brown mottling slightly gravelly sandy silty CLAY with low cobble content and occasional rootlets, moist. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular. Cobbles are angular to subangular. | |
| 0.50 | ES2 | | | | | | |
| 0.50 - 1.00 | B3 | | | | | | |
| 0.50 - 1.00 | D4 | | | | | | |
| 0.60 | | HVP=41, HVR=18 | | | | | |
| 0.75 | | | | (1.00) | | | |
| 1.00 | ES5 | | | | | | |
| | | Rapid inflow - No rise | 96.48 | 1.35 | | Brown slightly silty very sandy GRAVEL with medium cobble and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are subangular, sandstone and siltstone. | ▼ |
| 1.40 - 1.80 | B6 | | | | | | |
| 1.40 - 1.80 | D7 | | | (0.45) | | | |
| | | | 96.03 | 1.80 | | End of trial pit at 1.800m | |

**Remarks**
Instructed by clients engineer to terminate TP at 1.80m to minimise impact to farmer.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 1.35 | Rapid inflow - No rise |

**Stability:** Sides collapsing

**Width:** 1.90

**Length:** 4.90

| | | | |
|---|---|---|---|
| **Project No.:** 19-135 | **Project Name:** Cork Line Level Crossings | | **Trial Pit No.:** XC215-TP09 |
| **Co-ordinates:** 553478.44 E 615226.62 N | **Client:** Iarnród Éireann / Irish Rail | | Sheet 1 of 1 |
| **Method:** Excavation | **Client's Representative:** JACOBS | | **Scale:** 1:20 |
| **Plant:** Kobelco SK140SRu | **Ground Level:** 96.75 mOD | **Date:** 18/02/2020 | **Driver:** TS<br>**Logger:** MN |

| Depth (m) | Sample / Tests | Field Records | Level (mOD) | Depth (m) (Thickness) | Legend | Description | Water |
|---|---|---|---|---|---|---|---|
| 0.05 | ES1 | | | (0.35) | | TOPSOIL: Soft dark brown slightly gravelly sandy silty CLAY with frequent rootlets, moist. | |
| 0.35 - 0.60 | B2 | | 96.40 | 0.35 | | | |
| 0.35 - 0.60 | D3 | | | | | Soft dark brown sandy gravelly silty CLAY with low cobble content and occasional rootlets. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. | |
| 0.50 | ES4 | | | (0.25) | | | |
| 0.60 - 1.10 | B5 | | 96.15 | 0.60 | | | |
| 0.60 - 1.10 | D6 | Rapid inflow - Rose to 0.5m | | | | Brown slightly clayey silty very sandy GRAVEL with medium cobble content and low boulder content, wet. Sand is fine to coarse. Gravel is fine to coarse, angular to subrounded. Cobbles and boulders are subangular, sandstone and siltstone. | |
| | | | | (0.50) | | | |
| 1.00 | ES7 | | | | | | |
| | | | 95.65 | 1.10 | | End of trial pit at 1.100m | |

0.5
1.0
1.5
2.0
2.5
3.0
3.5

**Remarks**
Instructed by clients engineer to terminate TP at 1.10m to minimise impact to farmer.

**Water Strikes:**

| Struck at (m): | Remarks: |
|---|---|
| 0.75 | Rapid inflow - Rose to 0.5m |

**Stability:** Sides collapsing

**Width:** 1.80

**Length:** 4.60

# Appendix E Trial Pit Photographs

| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC215 (19-135-4) | T.PIT1<br>Trial Pit Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: February 2020 |


| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC215 (19-135-4) | T.PIT1<br>Trial Pit Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: February 2020 |

| | | |
|---|---|---|
| ocbgeo | Iarnród Éireann<br>Cork Line Level Crossings<br>XC215 (19-135-4) | T.PIT1<br>Trial Pit Photographs<br>Client: Iarnród Éireann<br>Engineer: Jacob's<br>Date: February 2020 |

Iarnród Éireann

Cork Line Level Crossings

XC215 (19-135-4)

| | |
|---|---|
| T.PIT1 | |
| Trial Pit Photographs | |
| Client: | Iarnród Éireann |
| Engineer: | Jacob's |
| Date: | February 2020 |