

# **Appendix A17.3 Site Investigation Borehole Locations and Report**



FINAL FOR ISSUE

# Greater Dublin Drainage Ground Investigation – Phase II Terrestrial Investigation

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|--------------------------|----------------------------|--------------|
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| Client's Representative: | Tobin Consulting Engineers |              |
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|                          |                            |              |

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|--------------------------|--|
| Project title:           | Greater Dublin Drainage Ground Investigation<br>Phase II Terrestrial Investigation |
| Client:                  | Irish Water  |
| Client's Representative: | Tobin Consulting Engineers   |

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#### The works were conducted in accordance with:

Site Investigation in Construction Part 3: Specification for Ground Investigation, Site Investigation Steering Group, published by Thomas Telford Ltd (1993)

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 1997-2:2007: Eurocode 7. Geotechnical design. Ground investigation and testing
- 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: Geotechnical investigation and testing. Identification and classification of soil. Identification and description
- BS EN ISO 14688-2:2004: 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: Geotechnical investigation and testing. Field testing. Dynamic probing
- BS EN ISO 22476-3:2005: 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 The amendments revised the Standard to remove text superseded by BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and EN ISO 14689-1:2003 and refers to the relevant standard for each affected subclause.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   |
| Р                                     | Nominal 100mm diameter undisturbed piston sample  |
| В                                     | 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. 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 kPaV: undisturbed vane shear strengthVR: remoulded vane shear strength   |
| <u>dd/mm/yy: 1.0</u><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                | g 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.  |





# **Greater Dublin Drainage Ground Investigation Phase II**

## **1** AUTHORITY

On the instructions of Consulting Engineers, Tobin Consulting Engineers ("the Client's Representative"), acting on the behalf of Irish Water ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a 17km long pipeline from Blanchardstown to Portmarnock.

This report details the work carried out both on site 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 Causeway Geotech Ltd for the use of the Client and the Client's Representative 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 Client's Representative, included boreholes, trial pits, soil and rock core sampling, in-situ and laboratory testing, geophysics survey, and the preparation of a factual report on the findings.

### **3 DESCRIPTION OF SITE**

The Greater Dublin Regional Drainage Scheme consists of a waste water treatment works (WWTW) plant and accompanying pipeline with a marine outfall in North County Dublin. This phase of works focussed on the inland section of the pipeline, covering an area some 17km in length.





The route commences at the M50-N3 junction in Blanchardstown and progresses in an north-easterly direction, parallel to the northern side of the M50. The route diverges slightly to the north of the M50. The route continues easterly towards the southern side of Silloge Golf Club and the M50-R108 junction at Ballymun cross. The pipeline then runs towards Collinstown Business Park and heads to Clonshaugh, the site of the proposed WWTW. This is located approximately 2.2km southeast of Dublin Airport and between the M1 and Malahide Road. The pipeline from Clonshaugh to the marine outfall progresses in a northerly direction before then turning east and running past Kinsealy. The pipeline then turns south briefly, then finally east, crossing under the Dublin-Belfast railway line to the south of Portmarnock and north of Mayne Bridge.

The site use is a mix of agricultural lands and residential areas. Primarily, site operations were carried out in agricultural lands.

### 4 SITE OPERATIONS

Site operations which were conducted between 24<sup>th</sup> November 2014 and 12<sup>th</sup> February 2015, included:

- six percussion boreholes
- thirteen percussion boreholes with rotary follow-on
- one percussion borehole with Geobor S wireline rotary coring follow-on
- twelve rotary only boreholes
- thirteen trial pits.

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 thirty-two boreholes were put down through soils and rock strata to their completion depths by a combination of methods, including light cable percussion boring by Dando 2000 and 3000 rigs, and rotary drilling by Comacchio 205, Comacchio 405 and Beretta T41 rotary drilling rigs.

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.

#### 4.1.1 Light cable percussion boreholes

Six boreholes (BH117, 120, 122, 134, 135 and 138) were put down to completion in minimum 200mm diameter using Dando 2000 and Dando 3000 light cable percussion soil boring rigs. All boreholes were



terminated either at their scheduled completion depths, or else on 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 and small bag) samples were taken within the encountered strata. Undisturbed (UT100 and U100) were taken where appropriate and as directed within cohesive soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals using the split spoon sampler (SPT) or solid cone attachment (SPTc). 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. The SPT hammer energy measurement report is provided in Appendix G. Details of the SPT hammer used are provided on the individual borehole logs.

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.

#### 4.1.2 Boreholes by combined percussion boring and rotary follow-on drilling

Fourteen boreholes (BH118, 121, 123-128, 130-133, 137 and 139) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques in bedrock. The boreholes were put down initially by Dando 2000 or Dando 3000 soil boring rigs until refusal was met, and they were then continued using a Comacchio 205, Comacchio 405 or Beretta T41 drilling rig.

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.

During percussion boring, disturbed (bulk and small bag) samples were taken within the encountered soil strata. Undisturbed (UT100 and U100) were taken where appropriate and as directed within cohesive soils.

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. The SPT hammer energy measurement report is provided in Appendix G. Details of the SPT hammer used are provided on the individual borehole logs.

Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used in some cases (if so, it will be detailed in the individual borehole log) with SPTs carried out at standard intervals as required.





Where coring was carried out within bedrock strata, conventional coring methods were used with a metric T2-101 core barrel, which produced core of nominal 84mm diameter, and was placed in triple channel wooden core boxes. One borehole (BH139) was taken to a depth of 78.4m using a Beretta T41 drilling rig. Core was recovered in a metric SK6L core barrel, producing core of nominal 102mm diameter.

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 off site by the Causeway Geotech Engineering Geologist.

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

#### 4.1.3 Rotary drilled boreholes

Twelve boreholes (BH106-116 and BH119) were put to their completion by rotary drilling techniques only. The boreholes were completed using a Comacchio 205, Comacchio 405 or a Beretta T41 drilling rig.

Symmetrix-cased full hole rotary percussive drilling techniques were employed to advance the boreholes to bedrock. SPTs were carried out at standard intervals throughout the overburden, with small disturbed samples obtained where possible through the soils strata. In selected boreholes, rotary coring was employed to recover core samples of the bedrock.

The core was extracted in up to 1.5m lengths using a metric T2-101 core barrel, which produced core of nominal 84mm diameter, and was placed in triple channel wooden core boxes. At borehole BH139, rotary coring was carried out by Geobor S triple-tube wireline coring techniques, with core of nominal 102mm diameter produced.

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 off site by the Causeway Geotech Engineering Geologist.

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

#### 4.2 Standpipe installations

Groundwater monitoring standpipes were installed in all the boreholes.

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.





#### 4.3 Trial Pits

Thirteen trial pits (TP100-TP106, TP108-110 and TP112-114) were excavated using a 7t tracked excavator fitted with a 600mm wide bucket, to maximum depth of 4.5m.

Disturbed (bulk bag) samples were taken at standard depth intervals and at change of strata. Environmental samples were also taken at regular depths in each trial pit.

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

#### 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.

Laboratory testing of soils comprised:

- soil classification tests: moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- rock strength testing: point load index and unconfined compressive strength tests
- soil chemistry tests (conducted by Chemtest): pH, water soluble sulphate and chloride content, and organic matter content
- environmental testing: carried out on selected environmental samples, this included metals, TPH and waste acceptance criteria (WAC) testing.

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 F.

#### 6 **GROUND CONDITIONS**

#### 6.1 General geology of the area

Superficial deposits of the area consist of glacial tills, with localised marine deposits in the Portmarnock area. The line of the site crosses several geological formations, all of Carboniferous age, and all dominated by limestones (typically argillaceous, sometimes carbonaceous) with occasional interbedded clastic sedimentary rocks.





#### 6.2 Ground types encountered during investigation of the site

The exploratory holes encountered the following ground types, listed in approximate stratigraphic order:

- Made Ground (concrete): found only in borehole BH06 in 100mm thickness.
- Topsoil: encountered in most exploratory holes, typically in 100-400mm thickness, up to 800mm in trial pit TP112.
- Made Ground (fill): reworked gravelly clay with fragments of brick, concrete, plastic, glass and/or timber. Found in at the surface or beneath topsoil in several trial pits and boreholes, to depths typically on the order of 0.5-1.2m, and to 2.2m in trial pit TP109.
- Glacial Till: brown to black sandy gravelly clay, frequently with low cobble content and rare boulders, typically firm or stiff. Present in all exploratory holes down to a maximum depth of 14.5m (borehole BH139).
- Bedrock: Rockhead was encountered at depths ranging from 0.95m in several trial pits, to 14.5m in borehole BH139. Bedrock typically consisted of weak to medium strong dark grey limestone (usually argillaceous, and often fossiliferous). Some boreholes also encountered very weak to weak black carbonaceous limestone and mudstone. Borehole BH139 went through a sequence of extremely weak mudstones, siltstones and sandstones between 39m and 47m, before returning to more competent grey limestone.

#### 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.

Standpipes were installed in every borehole, and continued monitoring of these will allow determination of the seasonal variation in groundwater level.





### 7 **REFERENCES**

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

BS 5930+A2: 2010: Code of practice for site investigations (Amendment 2). British Standards Institution.

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

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

Appendix A Site and exploratory hole location plans

















| Pageseen<br>Pageseen<br>Pageseen<br>Pageseen<br>PARDISTOWN<br>PARDISTOWN<br>TE:<br>19/02/2015<br>FRIES:<br>6 of 10<br>PWG ND:<br>14-645-EHL-006 |
|---|
|---|











Appendix B Borehole logs

| Caus                                | sew          | 'ay  | Geo         | otec | h Ltd      | Projec<br>14-645 | <b>:t no.</b>                  | Project<br>Name:            | Greater Du<br>Investigatio               | ıblin Drair<br>on            | nage Sche                     | me Ground                                   | Bore    | hole<br>H10     | ∍ No.<br>6           |
|-------------------------------------|--------------|--|-------------|------|------------|------------------|--------------------------------|-----------------------------|--|------------------------------|-------------------------------|---|---------|-----------------|----------------------|
| Method:                             |              |  |             |      |            | Co-ore           | ds:                            | Client:                     | Irish Water                              |                              |                               |   | She     | et 1            | of 1                 |
| 0.00 1.20<br>1.20 2.30<br>2.30 7.00 | In<br>R<br>R | spection Pi<br>otary Drillin<br>otary Coring | t<br>9<br>9 |      |            | 30884            | 2.77mE                         | Client's Re                 | oresentative                             | Tobin (                      | Consulting                    | Engineers                                   | Scale:  | 1:5             | 50                   |
| Plant:                              | (otor) (     | `omoo  | bia 20      | 5    |            | 23864<br>Groun   | 7.09mN                         |                             | presentative.                            |                              | Consulting                    | Engineero                                   | Crew:   | JC              | ;                    |
|                                     |              |  | 1           | Т    | 1          | 49.61N           | NOD                            | Dates:                      | 24/11/2014                               |                              |                               |   | Logged  | i By:           | +MFG                 |
| Depth (m)                           | TCR          | SCR  | RQD         | FI   | Field Reco | ords             | Level & Depth                  | 1                           | Str                                      | atum Deso                    | cription                      |   | Wate    | uox<br>∋r<br>es | Backfill<br>Installs |
|                                     |              |  |             |      |            |                  | (0.10)<br>49.51 0.10<br>(0.30) | CONCRE<br>MADE GR           | TE<br>OUND - Brown sa                    | andy angula                  | ar to subangu                 | lar fine to coarse                          |         |                 |                      |
|                                     |              |  |             |      |            |                  | 49.21 0.40                     | Firm brow                   | n slightly sandy gr                      | avelly sligh                 | tly silty CLAY                | . Sand is fine to                           |         |                 |                      |
|                                     |              |  |             |      |            |                  | (0.60)                         |                             | aven to cabarigat                        |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  | 48.61 1.00<br>(0.40)           | Stiff greyis<br>Sand is fin | h brown slightly s                       | andy slightly                | y gravelly slig               | ghtly silty CLAY.<br>ounded, fine to        |         | XXXX            |                      |
|                                     |              |  |             |      |            |                  | 48.21 1.40                     | coarse.<br>Weak dark        | grey LIMESTON                            | E. Probabl                   | y highly weat                 | hered (recovered                            |         |                 |                      |
|                                     |              |  |             |      |            |                  | (0.00)                         | as clayey                   | sandy angular to s                       | subangular                   | gravel and c                  | obbles)                                     |         | 2               |                      |
|                                     |              |  |             |      |            |                  | (0.90)                         |                             |  |                              |                               |   |         |                 |                      |
| 2.30 - 3.10                         |              |  |             |      |            |                  | 47.31 2.30                     | Medium st                   | rong thinly to thick                     | kly laminate                 | d dark grey                   | ARGILLACEOUS                                |         |                 |                      |
|                                     | 100          | 73   | 21          | 12   |            |                  |                                | of weak bl                  | ack CARBONACE                            | EOUS MUD                     | STONE with                    | occasional pyrite                           |         | 2               |                      |
| 2 10 1 15                           |              |  |             |      |            |                  |                                | Partially w                 | eathered with son                        | ne oxidation                 | n staining alo                | ng joint surfaces.                          |         | G               |                      |
| 5.10 - 4.45                         |              |  |             |      |            |                  |                                | Discontinu<br>medium s      | ity Set 1: Bedding<br>baced, planar, smo | g/laminatior<br>both, typica | n planes, 10 t                | to 20°, very close to<br>occasionally open, |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                | stained bro                 | own to 4.3m, clear                       | n below.                     | venu close to                 | closely spaced                              |         |                 |                      |
|                                     | 100          | 79   | 44          | 7    |            |                  |                                | randomly o<br>curved, typ   | prientated, typicall                     | y subparall                  | el to bedding<br>I <1-20mm th | , stepped to<br>iick.                       |         | q               |                      |
|                                     |              |  |             |      |            |                  |                                | 2.75-2.80m<br>2.80-3.10m    | n: Pyrite-rich.<br>n: Extremely weak     | <u>- poss</u> ible           | fault gouge.                  |   |         |                 |                      |
| 4.45 - 5.50                         |              |  |             |      |            |                  | (4.70)                         |                             |  |                              |                               |   |         |                 |                      |
|                                     | 100          | 52   | 0           | 20   |            |                  | (                              |                             |  |                              |                               |   |         | C               |                      |
|                                     | 100          | 55   | U           |      |            |                  |                                |                             |  |                              |                               |   |         | 5               |                      |
| 5.50 - 7.00                         |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         | 4               |                      |
|                                     | 100          | 77   | 63          | 6    |            |                  |                                |                             |  |                              |                               |   |         | 5               |                      |
|                                     | 100          |  | 05          |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         | С               |                      |
|                                     |              |  |             |      |            |                  | 42.61 7.00                     |                             | é  | nd of core at                | 7.00 m                        |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   |         |                 |                      |
| Remarks                             |              |  |             |      |            |                  |                                |                             | Core Barr                                | el:                          | Water Strike<br>Struck R      | s:<br>ose to Time                           | _       |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             | Flush Typ                                | e:                           | (m) (r                        | <u>iny (min)</u>                            |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             | Water Added                              |                              | Casing                        |   |         | u               | د                    |
|                                     |              |  |             |      |            |                  |                                |                             | From (m)                                 | To (m)                       | To (m)                        | Diameter (mm)                               |         |                 |                      |
|                                     |              |  |             |      |            |                  |                                |                             |  |                              |                               |   | © Cause | wayge<br>vay Ge | otech.com            |

| Caus                              | sew        | 'ay         | Geo     | oteo | ch Ltd          | <b>Projec</b><br>14-645 | <b>ct no.</b>                                | Project<br>Name:   | Greater Dub<br>Investigation   | olin Drain<br>n  | age Sche  | me Ground   | Bor               | ehole<br>BH10      | ∋ No.<br>7           |
|-----------------------------------|------------|-------------|---------|------|-----------------|-------------------------|--|--|--|--|---|---|-------------------|--------------------|----------------------|
| Method:<br>0.00 1.20<br>1.20 2.50 | ln<br>R    | spection Pi | t       |      |                 | <b>Co-ord</b>           | <b>ds:</b><br>8.92mE                         | Client:  | Irish Water  |  |   |   | Scale             | eet 1              | of 1                 |
| 2.50 7.00<br>Plant:               | R          | otary Corin | g       |      |                 | 23865                   | 5.10mN                                       | Client's Re  | presentative:  | Tobin C  | Consulting  | Engineers   | Crew:             | JC                 | ;                    |
| Hand Excav                        | /ator+C    | Comaco      | chio 20 | 5    |                 | <b>Groun</b><br>54.19N  | <b>id Level:</b><br>MOD                      | Dates:   | 26/11/2014   | Logge  | d By:   | DOM<br>+MFG   |                   |                    |                      |
| Depth (m)                         | TCR        | SCR         | RQD     | FI   | Field Rec       | ords                    | Level & Depth                                | ı  | Stra   | Stratum Description  |   |   |                   | nd &<br>ter<br>kes | Backfill<br>Installs |
|                                   |            |             |         |      |                 |                         | (0.10)<br>54.09 0.10<br>(0.60)<br>53.49 0.70 | TOPSOIL<br>Firm brown<br>fine to coar                      | slightly sandy slig<br>se. Gravel is suba  | htly gravel  | lly slightly sil<br>subrounded,                         | ty CLAY. Sand is fine to coarse.                    |                   |                    |                      |
| 1.20                              | SPT<br>(S) |             |         |      | N=33 (2,2/5,9,7 | r,12)                   | (0.50)<br>52.99 1.20<br>(0.30)<br>52.69 1.50 | Extremely v<br>recovered a                                 | ar to subrounded,<br>d.<br>weak dark grey LII<br>as angular to suba<br>edium strong dark | MESTONE<br>ngular fine<br>grey LIME                        | . (Probably<br>to coarse g                              | highly weathered ravel)                             | to                |                    |                      |
| 2.50 - 3.40                       |            |             |         |      |                 |                         | ( <i>1.00)</i><br>51.69 2.50                 | Medium str   | ong thinly to thickl<br>IE.  | y laminate   | d dark grey /   | ARGILLACEOUS  |                   |                    |                      |
| 3.40 - 4.70                       | 100        | 94          | 0       | 20   |                 |                         |  | Partially we<br>oxidation st<br>Discontinui<br>planar, smo | eathered to 3.9m w<br>taining along disco<br>ty Set 1: Bedding,<br>poth, typically close | vith some in<br>ontinuity su<br>, very close<br>ed to open | ncreased fac<br>rfaces.<br>e to medium<br>at close to r | cturing and<br>spaced, 20 to 40°<br>nedium spacing, |                   |                    |                      |
|                                   | 100        | 100         | 59      |      | -               |                         | (3.70)                                       | clean to sta   | lined orangey brov   | wn above 3   | 3.9m.   |   |                   |                    |                      |
| 4.70 - 6.20                       | 70         | 70          | 70      | 7    |                 |                         |  | 4.70-6.20m.  | Assumed zone o   | <u>f core</u> loss   |   |   |                   |                    |                      |
| 6.20 - 7.00                       |            |             |         |      | -               |                         | 47.99 6.20                                   | No recover   | y. Probably LIMES  | STONE.   |   |   |                   |                    |                      |
|                                   | 0          | 0           | 0       | NR   | -               |                         | <i>(0.80)</i><br>47.19 7.00                  |  | Ēr   | id of core at 7  | 7.00 m  |   |                   |                    |                      |
|                                   |            |             |         |      |                 |                         |  |  |  |  |   |   |                   |                    |                      |
| Remarks                           |            |             |         |      |                 |                         |  |  | Core Barre<br>+6<br>Flush Type<br>Water Added:<br>From (m)                               | èl:<br>è:<br>™ (m)   | Water Strike<br>Struck R<br>(m) (r<br>Casing:<br>To (m) | s:<br>ose to Time<br>(min)<br>Diameter (mm)         |                   | AG                 | S                    |
|                                   |            |             |         |      |                 |                         |  |  |  | - (m)  |   |   | www.cau<br>© Caus | sewayge<br>eway Ge | otech.com            |

| Caus                   | sew      | 'ay                           | Geo      | otec | ch Ltd            | <b>Projec</b><br>14-645 | <b>:t no.</b>            |       | Project<br>Name:   | Greater Dul<br>Investigatio                                  | blin Drair<br>n                             | age Sch                                   | eme Gro                      | ound                   | Boreh<br>BH             | iole No.<br>1108   |
|------------------------|----------|-------------------------------|----------|------|-------------------|-------------------------|--------------------------|-------|--|--|---|---|------------------------------|------------------------|-------------------------|--|
| Method:                | In       | anastian Di                   |          |      |                   | Co-ord                  | ds:                      |       | Client:  | Irish Water  |   |   |                              |                        | Shee                    | t 1 of 1   |
| 1.20 2.60<br>2.60 6.80 | R        | otary Drillin<br>otary Coring | g<br>g   |      |                   | 309256                  | 6.52mE                   |       | Client's Rep   | resentative:   | Tobin (                                     | Consultin                                 | g Engin                      | eers                   | Scale:                  | 1:50   |
| Plant:<br>Hand Excav   | /ator+C  | Comaco                        | chio 20  | 5    |                   | Groun                   | d Level                  | :     | Dates:   | 02/12/2014   |   |   |                              |                        | Crew:                   | JG   |
|                        |          |                               |          |      |                   | 59.37N                  | NOD                      |       |  |  |   |   |                              |                        | Legend                  | Backf  |
| Depth (m)              | TCR      | SCR                           | RQD      |      | Field Reco        | ords                    | Level &                  | Depth | TOPSOIL  | Stra   | itum Desc                                   | ription                                   |                              |                        | Water<br>Strike         | s Install  |
| 1 20                   | SPT      |                               |          |      | 86 (5 8/86 for 2  | 20mm)                   | ( <i>0.20</i> )<br>59.17 | 0.20  | Stiff to very s<br>CLAY with oc<br>Gravel is sub         | tiff dark grey sliq<br>ccasional cobble<br>langular to subre | ghtly sandy<br>is and bould<br>ounded, fin  | slightly gra<br>ders. Sanc<br>e to coarse | avelly sligi<br>I is fine to | ntly silty<br>coarse.  |                         | - 21 400-11 400-11 400-11 400-11 400-11 400-11 400-11 400-11 400-11 400- |
| 2.00                   | (S)      |                               |          |      | 50 (8,18/50 for 2 | 25mm)                   | (2.30)                   |       |  |  |   |   |                              |                        |                         | n na manana ang ang ang ang ang ang ang ang an                           |
| 2.60 - 3.60            | (3)      |                               |          |      | -                 |                         | 56.87                    | 2.50  | Medium stroi<br>fossiliferous                            | ng thinly to thick   | ly laminate<br>S LIMESTO                    | d dark grey<br>ONE interbe                | speckled                     | l white<br>h medium    |                         |  |
|                        | 100      | 64                            | 46       | 15   | -                 |                         |                          |       | to widely spa<br>LIMESTONE<br>Partially wea<br>surfaces. | ced very thin be<br>thered with som                          | eds of weak<br>e slight bro                 | t black CAF                               | RBONACE                      | EOUS                   |                         |  |
| 3.60 - 4.60            |          |                               |          |      |                   |                         |                          |       | Discontinuity<br>30°, planar to<br>close to med          | Set 1: bedding<br>o curved, smootl<br>ium spaced inte        | planes, clo<br>h, typically<br>rvals, clear | se to mediu<br>closed to o<br>1.          | um space<br>ccasional        | d, 15 to<br>ly open at |                         |  |
| 4 60 5 60              | 100      | 95                            | 92       | 5    |                   |                         |                          |       | Discontinuity<br>stepped, roug                           | Set 2: joints, wi<br>gh, open, locally                       | dely space<br>stained lig                   | d, subvertio<br>ht brown.                 | al to 70°,                   | planar to              |                         |  |
| 4.00 - 5.00            | 100      | 91                            | 66       |      |                   |                         | (4.30)                   |       |  |  |   |   |                              |                        |                         |  |
| 5.60 - 6.60            |          |                               |          | 15   | -                 |                         |                          |       |  |  |   |   |                              |                        |                         |  |
| 6.60 - 6.80            | 100      | 82                            | 40       | 5    |                   |                         |                          |       |  |  |   |   |                              |                        |                         |  |
|                        |          |                               |          |      |                   |                         | 52.57                    | 6.80  |  | Ē  | nd of core at 6                             | 5.80 m                                    |                              |                        |                         |  |
|                        |          |                               |          |      |                   |                         |                          |       |  |  |   |   |                              |                        |                         |  |
| Remarks                | <u> </u> | <u> </u>                      | <u> </u> |      | <u> </u>          |                         |                          |       |  | Core Barro<br>7<br>Flush Type                                | el:<br>e:                                   | Water Strik<br>Struck<br>(m)              | tes:<br>Rose to<br>(m)       | Time<br>(min)          | A                       | L<br>GS  |
|                        |          |                               |          |      |                   |                         |                          |       |  | Water Added:<br>From (m)                                     | Го (m)                                      | Casing:<br>To (m)                         | Diamet                       | er (mm)                | www.causew<br>© Causewa | /aygeotech.co<br>ay Geotech Ltc  |

| Caus                   | sew        | 'ay                          | Geo      | otec     | ch Ltd            | Projec<br>14-645 | s <b>t no.</b>   |       | Project<br>Name:                              | Greater Du<br>Investigatio                                 | blin Drair<br>on                          | nage Scl                           | heme                          | Groun                  | d                 | Borel<br>Bl             | iole No<br>1109           | •          |
|------------------------|------------|------------------------------|----------|----------|-------------------|------------------|------------------|-------|---|--|---|------------------------------------|-------------------------------|------------------------|-------------------|-------------------------|---------------------------|------------|
| Method:<br>2.50 6.20   | R          | otarty Corir                 | ng       |          |                   | Co-ore           | ds:              |       | Client:                                       | Irish Water  |   |                                    |                               |                        |                   | Shee                    | t 1 of 1                  |            |
| 1.20 2.50<br>0.00 1.20 | R<br>In    | otary Drillin<br>spection Pi | g<br>t   |          |                   | 23912            | 5.62mE<br>7.79mN |       | Client's Rep                                  | presentative   | Tobin (                                   | Consulti                           | ng En                         | gineers                | 3                 | Scale:                  | 1:50                      |            |
| Comacchio              | 205+H      | and Ex                       | kcavato  | r        |                   | Groun            |                  | l:    | Dates:  | 03/12/2014   |   |                                    |                               |                        |                   | Logged                  | By: MF(                   | 3          |
| Depth (m)              | TCR        | SCR                          | RQD      | FI       | Field Reco        | ords             | Level &          | Depth |   | Stratum Description  |   |                                    |                               |                        |                   | Legend &<br>Water       |                           | cfill      |
|                        |            |                              |          |          |                   |                  | (0.30)           |       | TOPSOIL                                       |  |   |                                    |                               |                        |                   |                         |                           |            |
| 1.20                   | SPT<br>(S) |                              |          |          | N=18 (3,4/5,4,4   | ,5)              | 71.64<br>(2.00)  | 0.30  | Stiff brownis<br>occasional o<br>angular to s | sh grey slightly s<br>cobbles and bou<br>ubangular fine to | andy slightly<br>Iders. Sanc<br>o coarse. | y gravelly<br>l is fine to         | slightly<br>coarse            | silty CL<br>e. Grave   | AY with<br>l is   |                         |                           |            |
| 2.00                   | SPT<br>(S) |                              |          |          | 55 (4,4/55 for 12 | 25mm)            | 60.64            | 2 20  |   |  |   |                                    |                               |                        |                   |                         |                           |            |
| 2.50 - 3.50            |            |                              |          | NI       | -                 |                  | ( <i>0.35</i> )  | 2.50  | Destructure<br>angular to s                   | d dark grey LIME<br>ubangular fine to                      | ESTONE - r<br>coarse cla                  | ecovered<br>yey grave              | as brov<br>el                 | wnish gro              | ey                |                         |                           |            |
|                        | 97         | 62                           | 26       | 7        |                   |                  | 69.29            | 2.65  | Medium stro<br>ARGILLACE<br>beds of wea       | ong thinly lamina<br>EOUS LIMESTO<br>ak black CARBO        | ted dark gre<br>NE with me<br>NACEOUS     | ey speckle<br>dium to w<br>LIMESTC | ed white<br>/iidely s<br>DNE. | e fossilife<br>paced v | erous<br>ery thin |                         |                           |            |
|                        |            |                              |          | 20       |                   |                  |                  |       | Partially we<br>surfaces, ty                  | athered to 3.5m<br>pically unweathe                        | with orange<br>red below.                 | y brown s                          | staining                      | on joint               |                   |                         |                           |            |
| 3.50 - 4.50            |            |                              |          |          | -                 |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
|                        | 100        | 100                          | 95       |          |                   |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
| 4.50 - 5.50            |            |                              |          | 7        |                   |                  | (3.55)           |       |   |  |   |                                    |                               |                        |                   |                         | ,°,=                      | • • •      |
|                        | 100        | 97                           | 31       |          | -                 |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
| 5.50 - 6.20            | 100        | 56                           | 27       |          | -                 |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
|                        |            |                              |          | 7        | -                 |                  | 65.74            | 6.20  |   | E  | ind of core at 6                          | 5.20 m                             |                               |                        |                   |                         |                           |            |
|                        |            |                              |          |          |                   |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
|                        |            |                              |          |          |                   |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
|                        |            |                              |          |          |                   |                  |                  |       |   |  |   |                                    |                               |                        |                   |                         |                           |            |
| Remarks                |            |                              | <u> </u> | <u> </u> |                   |                  |                  |       |   | Core Barr  | el:                                       | Water Str                          | rikes:                        | 0 Tim                  | e                 |                         |                           |            |
|                        |            |                              |          |          |                   |                  |                  |       |   | /<br>Flush Typ   | e:  | <u>(m)</u>                         | (m)                           | (mir                   | n)                | A                       | GS                        |            |
|                        |            |                              |          |          |                   |                  |                  |       |   | Water Added:<br>From (m)                                   | To (m)                                    | Casing:<br>To (m)                  | Dia                           | ameter (m              | m)                |                         |                           |            |
|                        |            |                              |          |          |                   |                  |                  |       |   |  |   |                                    |                               |                        |                   | www.causev<br>© Causewa | vaygeotech.<br>Iy Geotech | com<br>_td |

| Cau                                 | sew        | /ay   | Geo           | otec     | ch Ltd          | Projec<br>14-64 | <b>:t no.</b><br>5     |       | Project<br>Name:                              | Bore   | Borehole No.<br>BH110      |                            |                             |                     |                       |                       |                   |                        |
|-------------------------------------|------------|---|---------------|----------|-----------------|-----------------|------------------------|-------|---|--|----------------------------|----------------------------|-----------------------------|---------------------|-----------------------|-----------------------|-------------------|------------------------|
| Method:                             |            |   |               |          |                 | Co-ore          | ds:                    |       | Client:                                       | Irish Water  |                            |                            |                             |                     |                       | Shee                  | et 1 d            | of 1                   |
| 0.00 1.20<br>1.20 2.80<br>2.80 7.50 | R          | spection Fi<br>lotary Drillin<br>lotary Corin | t<br>ig<br>ig |          |                 | 310992          | 2.31mE                 |       | Client's Repr                                 | resentative:   | Tobin (                    | Consulti                   | ina E                       | naine               | ers                   | Scale:                | 1:5               | 0                      |
| Plant:<br>Hand Excav                | vator+(    | Comaci  | chio 20       | 15       |                 | Groun           | 1d Level:              |       | Detect  | lates: 04/12/2014                                    |                            |                            |                             |                     |                       | Crew:                 | JG                | ΠΟΜ                    |
|                                     | T          | T   | T             | т        | 1               | 76.98           |                        |       | Dates:  | ates: 04/12/2014                                     |                            |                            |                             |                     |                       | Logged<br>Legen       | By:               | +MFG                   |
| Depth (m)                           | TCR        | SCR   | RQD           | FI       | Field Rec       | ords            | Level & C              | Jepth | 1   | Stra   | tum Desc                   | ription                    |                             |                     |                       | Wate<br>Strike        | r<br>es           | Backfill               |
| Ĺ.                                  |            |   |               |          | T               |                 | <i>(0.30)</i><br>76.68 | 0.30  | MADE GROU                                     | IND  |                            |                            |                             |                     |                       |                       | 2000              |                        |
| 0.50                                | ES         |   |               |          |                 |                 | 10.00                  | 0.00  | Stiff brownish<br>occasional co               | grey slightly sa<br>bbles. Sand is<br>ine to coarse. | indy slightly fine to coa  | y gravelly<br>Irse. Grav   | slight<br>vel is            | tly silty subang    | CLAY with<br>gular to |                       | XIXIX             |                        |
|                                     |            |   |               |          |                 |                 |                        |       | 000.00  | 10 10 000.221  |                            |                            |                             |                     |                       |                       | (Nix)             |                        |
| 1.00<br>1.20                        | ES<br>SPT  |   |               |          | N=17 (3,3/3,4,5 | 5,5)            |                        |       |   |  |                            |                            |                             |                     |                       |                       | त <u>ाः</u> इ.स.  |                        |
|                                     | (S)        |   |               |          |                 |                 | (2.50)                 |       |   |  |                            |                            |                             |                     |                       |                       | ×                 |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       | <1%1%1>           | °."= .°                |
| 2.00                                | SPT<br>(S) |   |               |          | N=25 (5,5/6,6,6 | 3,7)            |                        |       |   |  |                            |                            |                             |                     |                       |                       | dix[x]            |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       | XIX:IX            |                        |
|                                     |            |   |               |          |                 |                 | 74.18                  | 2.80  | Week dark on                                  |  | Probabl                    | v destruct                 | tured.                      | racov               | fored as              |                       | ×#2               |                        |
| 2.20 4.20                           |            |   |               |          |                 |                 | (0.40)                 | o 00  | clayey angula                                 | ir gravel.   |                            | y ucon act                 | .uica                       | - 10000             | eicu as               |                       |                   |                        |
| 3.20 - 4.20                         |            |   |               |          |                 |                 | 13.10                  | 3.20  | Medium strong<br>LIMESTONE.                   | g thinly laminat<br>Partially weath                  | ed grey to<br>hered with   | dark grey<br>some clay     | <sup>7</sup> ARG<br>y linin | ILLACE<br>g alonç   | EOUS<br>g joint       |                       |                   |                        |
|                                     | 100        | 96  | 56            |          |                 |                 |                        |       | Discontinuity                                 | Set 1: Bedding                                       | planes, ext                | tremely cl                 | losely                      | space               | .d,                   |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       | subhorizontal<br>open at close<br><1mm thick. | to 20°, planar, s<br>to medium spa                   | smooth, typ<br>cings, unst | pically clo<br>tained to l | ised to                     | o occas<br>with gre | sionally<br>ey clay   |                       |                   |                        |
| 4.20 - 5.20                         |            |   |               | 1        |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     | 100        | 100   | 68            |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       | -                 |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
| 5.20 - 6.20                         |            | +   |               | 7        |                 |                 | (4.30)                 |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     | 100        | 98  | 54            |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       | -                 |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
| 6.20 - 7.20                         |            | ┼──   | ┼──           | -        |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     | 100        | 03  | 67            |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       | -                 |                        |
|                                     | 100        | రు  | 10            |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
| 7.20 - 7.50                         | 100        | - 100   | - 100         | -        |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     | 100        | 100   | 100           | <u> </u> | _               |                 | 69.48 <sup>·</sup>     | 7.50  |   | Ē  | nd of core at 7            | 7.50 m                     |                             |                     |                       |                       | _                 |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  |                            |                            |                             |                     |                       |                       |                   |                        |
| Domarke                             |            |   |               |          |                 |                 |                        |       |   | Core Barro   | el:                        | Water St                   | rikes:                      |                     |                       |                       |                   |                        |
| Kelliars                            |            |   |               |          |                 |                 |                        |       |   |  |                            | Struck<br>(m)              | Rose<br>(m)                 | e to                | Time<br>(min)         | _ ∎                   |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   | Flush Type   | Ð:                         |                            |                             |                     |                       | A                     | G                 | 3                      |
|                                     |            |   |               |          |                 |                 |                        |       |   | Water Added:   | To (m)                     | Casing:                    | <br>h                       | Diamete             | (mm)                  |                       |                   |                        |
|                                     |            |   |               |          |                 |                 |                        |       |   |  | 0 (m)                      | 10 (11.)                   |                             | James               | 1 (nin)               | www.cause<br>© Causew | wayger<br>/ay Ger | otech.com<br>otech Ltd |

| Causeway Geotech Ltd   |     |     |     |    | Projec<br>14-645 | ct no.          | Project<br>Name:            | Greater Du<br>Investigatio                          | Greater Dublin Drainage Scheme Ground<br>Investigation          |                          |                               |                          |                          |                          | No.<br>1     |                      |  |
|--|-----|-----|-----|----|------------------|-----------------|-----------------------------|---|---|--------------------------|-------------------------------|--------------------------|--------------------------|--------------------------|--------------|----------------------|--|
| Method:  |     |     |     |    |                  | Co-ore          | ds:                         | Client:   | Irish Water   |                          |                               |                          |                          | Shee                     | et 1 o       | of 1                 |  |
| 1.00         5.40         Rotary coring           0.00         1.00         Hand dug |     |     |     |    |                  | 31106           | 5.92mE                      | Client's Bonrocontative: Tabia Consulting Engineers |   |                          |                               |                          |                          | Scale: 1:50              |              |                      |  |
| Plant:   |     |     |     |    |                  | 23987:<br>Group | 3.57mN                      | Client's Re   | JIIent's Representative: Iobin Consulting Engineers             |                          |                               |                          |                          | Crew:                    | JC           |                      |  |
| Comacchio 205+Hand tools   |     |     |     |    |                  | 76.63N          |                             | Dates:  | 12/12/2014  |                          |                               |                          |                          | Logged                   | By:          | MFG<br>+DOM          |  |
| Depth (m)  | TCR | SCR | RQD | FI | Field Reco       | ords            | Level & Depth               | า   | Stra  | tum Des                  | cription                      |                          |                          | Legend<br>Wate<br>Strike | 1&<br>r<br>s | Backfill<br>Installs |  |
|  |     |     |     |    |                  |                 | <i>(0.10)</i><br>76.53 0.10 | TOPSOIL<br>Firm to stif                             | f brown slightly sa   | ndy slightly             | / gravelly sl                 | ghtly silty              | CLAY with                |                          | 00.13/2      |                      |  |
|  |     |     |     |    |                  |                 | (0.70)                      | subangula   | r to subrounded, fi   | ne to coars              | se.                           | oarse. G                 | lavens                   | 2023<br>2023             | と一〇月         |                      |  |
|  |     |     |     |    |                  |                 | 75.83 0.80                  | Dark grey   | LIMESTONE. Hig  | hly weathe               | ered (Driller'                | s descrip                | tion)                    |                          |              |                      |  |
| 1.00 - 1.40  | 88  | 63  | 48  | 6  |                  |                 | 75.63 1.00                  | Medium st<br>LIMESTO                                | rong thinly lamina  | ed dark gr               | ey ARGILLA                    | CEOUS                    |                          |                          |              |                      |  |
| 1.40 - 1.90  |     |     |     |    |                  |                 |                             | Partially w   | eathered to 2.4m  | with some                | increased fr                  | acturing                 | and clay                 |                          |              |                      |  |
|  | 70  | 0   | 0   | NI |                  |                 |                             | Discontinu  | ity Set 1: Bedding  | planes, ex               | tremely clos                  | sely spac                | ed,                      |                          |              |                      |  |
| 1.90 - 2.70  |     |     |     |    |                  |                 |                             | subhorizor<br>open at ve                            | ntal to 20°, planar,<br>ry close to close s<br>k above 2 4m dep | smooth, ty<br>pacings, u | pically close<br>nstained to  | ed to occa<br>lined with | asionally<br>I clay film |                          |              |                      |  |
|  | 91  | 90  | 70  | 8  |                  |                 |                             | Discontinu  | ity Set 2: joint, sub   | overtical, pl            | anar to curv                  | ved, infille             | ed with                  |                          |              |                      |  |
| 2.70 - 4.00  |     |     |     |    |                  |                 |                             | calcite, rur  | ning from 4.7m to   | 5.4m                     |                               | NE                       |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             | 2.20 2.101  | . Would, orginary in  |                          | ,                             |                          |                          |                          |              |                      |  |
|  | 100 | 100 | 93  | 6  |                  |                 | (4.40)                      |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
| 4.00 - 5.40  |     |     |     | -  |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  | 97  | 97  | 56  | 4  |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  | 01  |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 | 71.23 5.40                  |   | E   | nd of core at            | 5.40 m                        |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   |   |                          |                               |                          |                          |                          |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   | 0.000   |                          | M/sta - C1                    |                          |                          |                          |              |                      |  |
| Remarks  |     |     |     |    |                  |                 |                             |   | Core Barr   | eI:                      | vvater Strik<br>Struck<br>(m) | les:<br>Rose to<br>(m)   | Time<br>(min)            | -                        |              |                      |  |
|  |     |     |     |    |                  |                 |                             |   | Flush Typ   | e:                       |                               |                          |                          | Λ                        | 2            | 3                    |  |
|  |     |     |     |    |                  |                 |                             |   | Water Added:  |                          | Casing:                       |                          |                          |                          |              | -                    |  |
|  |     |     |     |    |                  |                 |                             |   | From (m)  | To (m)                   | To (m)                        | Diame                    | ter (mm)                 | www.cause                | wavger       | otech.com            |  |
| I  |     |     |     |    |                  |                 |                             |   |   |                          | 1                             |                          |                          | © Causew                 | ay Geo       | otech Ltd            |  |

| Causeway Geotech Ltd  |                 |          |          |          |                                    | Project no.<br>14-645 |  |                  | Project<br>Name:   | roject Greater Dublin Drainage Scheme Ground<br>lame: Investigation                |  |  |   |               |                         | iole No.<br>1112                 |  |  |
|-----------------------|-----------------|----------|----------|----------|------------------------------------|-----------------------|--|------------------|--|--|--|--|---|---------------|-------------------------|----------------------------------|--|--|
| Method:               |                 |          |          | Co-ords: |                                    |                       | Client:  | Irish Water      |  |  |  |  | Shee                                    | t 1 of 1      |                         |                                  |  |  |
| 0.00 7.00             | 0 г             | lotary i | Jrilling |          |                                    | 311792                | 2.60mE   |                  | Client's Rep   | resentative  | : Tobin (  | Consulti   | ng Engi                                 | neers         | Scale:                  | 1:50                             |  |  |
| Plant:<br>Beretta T41 |                 |          |          | Groun    | d Level:                           | :                     | Dates:   | Date: 03/02/2015 |  |  |  |  |   | GT            |                         |                                  |  |  |
|                       |                 | T        | T        |          | T                                  | 78.80N                |  |                  | Dutos.   | 00.0   |  |  |   |               | Legend & Back           |                                  |  |  |
| Depth (m)             | TCR             | SCR      | RQD      | FI       | Field Reco                         | ords                  | Level &  | Depth            | TOPSOIL  | Str  | atum Desc  | ription  |   |               | Water<br>Strike         | Installs                         |  |  |
| 1.50<br>1.50          | SPT<br>(S)<br>D |          |          |          | N=14 (2,2/3,4,3)                   |                       | ( <i>0.30</i> )<br>78.50<br>( <i>2.00</i> )<br>76.50 | 2.30             | TOPSOIL<br>Firm brown s<br>cobbles. Sar<br>fine to coars<br>Very stiff gre<br>Sand is fine<br>coarse | slightly sandy g<br>nd is fine to coa<br>e.<br>y black slightly<br>to coarse. Grav | avelly slight<br>rse. Gravel i<br>sandy slight<br>el is subang | ly silty CL<br>is subang<br>ly gravelly<br>jular to su | AY with a<br>ular to su<br>y slightly s | silty CLAY.   |                         |                                  |  |  |
| 3.00                  | (S)<br>D<br>SPT |          |          |          | (12,10/14,12,12<br>50 (25 for 40mn | ',14)<br>n/50 for     |  |                  |  |  |  |  |   |               |                         |                                  |  |  |
| 4.50                  | (S)<br>D        |          |          |          | 40mm)                              |                       | (4.70)   |                  |  |  |  |  |   |               |                         |                                  |  |  |
|                       |                 |          |          |          |                                    |                       | 71.80  | 7.00             |  |  | End of core at 7   | 7.00 m   |   |               |                         |                                  |  |  |
| Remarks               |                 |          |          |          |                                    |                       |  |                  |  | Core Barı<br>Flush Typ   | rel:<br>De:  | Water Str<br>Struck<br>(m)                             | rikes:<br>Rose to<br>(m)                | Time<br>(min) | A                       | L<br>GS                          |  |  |
|                       |                 |          |          |          |                                    |                       |  |                  |  | Water Added:<br>From (m)   | To (m)   | Casing:<br>To (m)<br>7.00                              | Diam                                    | eter (mm)     | www.causew<br>© Causewa | /aygeotech.com<br>ay Geotech Ltd |  |  |

| Caus         | Geo             | otec      | ch Ltd | Project no.<br>14-645 |                          |                  | Project<br>Name:       | Greater Du<br>Investigatio | ound  | Borehole No.<br>BH113                  |                               |                                  |                           |                            |   |                         |  |  |  |
|--------------|-----------------|-----------|--------|-----------------------|--------------------------|------------------|------------------------|----------------------------|---|--|-------------------------------|----------------------------------|---------------------------|----------------------------|---|-------------------------|--|--|--|
| Method: Co   |                 |           |        |                       |                          |                  | ds:                    |                            | Client:   | Irish Water                            |                               |                                  |                           |                            | Sheet ?   | 1 of 1                  |  |  |  |
| 0.00 o.u     |                 | KOLAT Y L | Junna  |                       |                          | 311888<br>241154 | 3.63m⊢<br>4.58mN       |                            | Client's Representative: Tobin Consulting Engineers |  |                               |                                  |                           |                            | Scale: 1:50                                     |                         |  |  |  |
| Beretta T41  |                 |           |        |                       |                          | Groun            | d Level                | :                          | Dates:  | 03/02/2015                             | 5                             |                                  |                           |                            | Logged By:                                      |                         |  |  |  |
| Donth (m)    | TCR             | ecB       | POD    |                       | Field Rec                | 78.7/Ⅳ           |                        | Donth                      |   | Str                                    | otum Dosc                     | rintion                          |                           |                            | Legend & Backfi                                 |                         |  |  |  |
| Deptil (m)   | IUN             | 301       | RQD    |                       |                          | oras             | Leverca                | Depui                      | MADE GRO  | OUND - brown sl                        | ightly sandy                  | gravelly slig                    | ahtly silty               | CLAY                       | Strikes   | Installs                |  |  |  |
| 1.50<br>1.50 | SPT<br>(S)<br>D |           |        |                       | N=12 (2,2/3,2,3          | 3,4)             | <i>(2.00)</i><br>76.77 | 2.00                       | Stiff dark gre<br>Sand is fine<br>coarse            | ey to black sligh<br>to coarse. Grav   | tly sandy slig                | ghtly gravell<br>jular to subr   | y slightly<br>ounded f    | silty CLAY.                | · 제품 문화     |                         |  |  |  |
| 3.00<br>3.00 | SPT<br>(S)<br>D |           |        |                       | N=18 (5,4/5,4,4          | .,5)             | (2.50)                 |                            |   |  |                               |                                  |                           |                            |   |                         |  |  |  |
| 4.50<br>4.50 | D<br>SPT<br>(S) |           |        |                       | 50 (25 for 50mm<br>60mm) | n/50 for         | 74.27                  | 4.50                       | Very stiff dai<br>CLAY. Sanc<br>to coarse.          | rk grey to black<br>d is fine to coars | slightly sanc<br>e. Gravel is | dy slightly gr<br>s subangular   | ravelly sli<br>r to subro | ghtly silty<br>ounded fine |   | * • • • • • • • • • • • |  |  |  |
| 6.00<br>6.00 | SPT<br>(S)<br>D |           |        |                       | 50 (25 for 35mn<br>50mm) | n/50 for         | (3.50)                 |                            |   |  |                               |                                  |                           |                            | 단체 지역 (1) 11 11 11 11 11 11 11 11 11 11 11 11 1 |                         |  |  |  |
| Remarks      |                 |           |        |                       |                          |                  | 70.77                  | 8.00                       |   | Core Bar                               | el:                           | Water Strik<br>Struck F<br>(m) ( | es:<br>Rose to<br>m)      | Time<br>(min)              |   |                         |  |  |  |
|              |                 |           |        |                       |                          |                  |                        |                            |   | Flush Typ<br>Water Added:<br>From (m)  | De:<br>To (m)                 | Casing:<br>To (m)<br>2.00        | Diamet                    | er (mm)                    | www.causeway                                    | geotech.com             |  |  |  |
|              |                 |           |        |                       |                          |                  |                        |                            |   |  |                               |                                  |                           |                            | © Causeway 0                                    | Seotech Ltd             |  |  |  |

| Causeway Geotech Ltd                                  |                 |     |     |    |                          | Projec<br>14-645 | t no.                       | Project         Greater Dublin Drainage Scheme Ground           Name:         Investigation |  |                       |   |                                  |                      |                         | Borehole No.<br>BH114                      |  |  |  |
|---|-----------------|-----|-----|----|--------------------------|------------------|-----------------------------|---|--|-----------------------|---|----------------------------------|----------------------|-------------------------|--|--|--|--|
| Method:   |                 |     |     |    |                          |                  | ls:                         | Client:   | Irish Wate   | r                     |   |                                  |                      | Shee                    | t 1 of 2                                   |  |  |  |
| 8.50 14.50 Rotary Coring<br>0.00 8.50 Rotary Drilling |                 |     |     |    |                          |                  | 5.60mE                      | Client's Rei  | neers  | Scale: 1:50           |   |                                  |                      |                         |  |  |  |  |
| Plant:<br>Beretta T41                                 |                 |     |     |    |                          | Groun            | d Level:                    | Detect  |  |                       |   |                                  |                      |                         |  |  |  |  |
|   |                 |     |     |    |                          |                  | IOD                         | Dates:  | 04/02/201  | 0                     |   |                                  |                      | Legend &                |  |  |  |  |
| Depth (m)   | TCR             | SCR | RQD | FI | Field Reco               | ords             | Level & Depth               |   | Sti  | atum Desc             | ription   |                                  |                      | Water<br>Strikes        | Backfill<br>Installs                       |  |  |  |
| 1.50  | SPT             |     |     |    | N=19 (2,2/3,4,5,         | ,7)              | <i>(1.50)</i><br>84.16 1.50 | Stiff becom   | ng very stiff are  | e nii with poo        | skets of brow   | ravelly                          | r.<br>sliahtly silty |                         |  |  |  |  |
| 1.50  | (S)<br>D        |     |     |    |                          |                  |                             | CLAY. Sand<br>to coarse   | is fine to coars   | e. Gravel is          | subangular te   | o subro                          | Sugnuy Sily          |                         |  |  |  |  |
| 3.00<br>3.00  | SPT<br>(S)<br>D |     |     |    | N=24 (3,4/5,6,7,         | ,6)              |                             |   |  |                       |   |                                  |                      |                         |  |  |  |  |
| 4.50  | SPT<br>(S)<br>D |     |     |    | 50 (25 for 60mm<br>50mm) | n/50 for         | (7.00)                      |   |  |                       |   |                                  |                      |                         | ىلى ئى |  |  |  |
| 8.50 - 9.50   | 0               | 0   | 0   |    |                          |                  | 77.16 8.50<br>(3.00)        | No recovery<br>LIMESTON   | Probably disti<br>E.                                     | nctly weathe          | ered to destru  | uctured                          |                      |                         |  |  |  |  |
| 9.50 - 10.50  | 0               | 0   | 0   |    |                          |                  |                             |   | с  | ontinued on ne        | xt sheet  |                                  |                      |                         |  |  |  |  |
| Remarks   |                 |     |     |    |                          |                  |                             |   | Core Bar<br>T210<br>Flush Tyj<br>Water Added<br>From (m) | rel:<br>pe:<br>To (m) | Water Strike       Struck     Rt       (m)     (n       8.50     8.5       Casing:     To (m) | s:<br>pse to<br>)<br>50<br>Diame | Time<br>(min)<br>10  | www.causew<br>© Causewa | aygeotech.com<br>y Geotech Ltd             |  |  |  |
| Caus                   | sew  | ay                   | Geo     | otec | h Ltd      | Projec<br>14-645 | t no.         | Project<br>Name:            | Greater Du<br>Investigatio              | ıblin Draiı<br>on     | nage Sche          | me Gro       | ound          | Boreho<br>BH1    | le No.<br>14 |
|------------------------|------|----------------------|---------|------|------------|------------------|---------------|-----------------------------|---|-----------------------|--------------------|--------------|---------------|------------------|--------------|
| Method:                |      |                      |         |      |            | Co-ord           | ls:           | Client:                     | Irish Water                             | •                     |                    |              |               | Sheet 2          | 2 of 2       |
| 8.50 14.3<br>0.00 8.50 | 50 F | totary C<br>totary D | rilling |      |            | 31237            | 5.60mE        | Client's Re                 | presentative                            | : Tobin               | Consulting         | Engine       | eers          | Scale: 1         | :50          |
| Plant:<br>Beretta T41  |      |                      |         |      |            | Groun            | d Level:      | Dates:                      | 04/02/2014                              | 5                     |                    |              |               | Crew: C          | GT           |
|                        |      |                      |         |      |            | 85.66N           | IOD           | Dutto.                      | 0 1102/2010                             |                       |                    |              |               | Legend &         | Backfill     |
| Depth (m)              | TCR  | SCR                  | RQD     | FI   | Field Reco | ords             | Level & Depth |                             | Str                                     | atum Des              | cription           |              |               | Water<br>Strikes | Installs     |
| 10.50 - 11.50          |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        | 0    | 0                    | 0       |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
| 11.50 - 12.50          |      |                      |         | 20   |            |                  | 74.16 11.50   | Medium str                  | rong grev white a                       | and vellow I          | arcely recrys      | tallised     |               |                  |              |
|                        |      |                      |         | 20   |            |                  |               | LIMESTON<br>sized vugs      | IE with very close                      | ely spaced            | coarse sand        | to mediu     | m gravel      |                  |              |
|                        | 100  | 95                   | 88      | 1    |            |                  |               | Distinctly w<br>11.65m.     | veathered: vugs t                       | hroughout,            | clay present       | on joints    | above         |                  | · ·          |
| 12.50 - 13.50          |      |                      |         |      |            |                  |               | DS1: Joints                 | s, close to mediu                       | m spaced, s           | subhorizonta       | to 30°, s    | stepped       |                  |              |
|                        |      |                      |         | 4    |            |                  |               | DS2: Joints                 | ar, rougn, open, o<br>s, widely spaced, | ciean.<br>60-70°, pla | inar to slightl    | y irregula   | ar, rough,    |                  |              |
|                        | 65   | 60                   | 60      |      |            |                  | (3.30)        | open, patcl<br>at 11.5-11.6 | hy yellow staining<br>65m.              | g, 1mm yelle          | owish grey cl      | ay prese     | ent on joint  |                  |              |
| 12.50 14.50            |      |                      |         |      |            |                  |               | 13.1-14.0m                  | : Assumed zone                          | of core los           | S.                 |              |               |                  |              |
| 13.30 - 14.30          |      |                      |         | NI   |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        | 54   | 37                   | 14      |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         | 8    |            |                  |               |                             |   |                       |                    |              |               |                  |              |
| 14.50 - 14.80          | 100  | 100                  | 100     | 3    |            |                  | 70.96 14.90   |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  | 70.00 14.00   |                             | E                                       | nd of core at         | 14.80 m            |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             |   |                       |                    |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             | Corre Di                                |                       | Water Ot-          |              |               |                  |              |
| Remarks                |      |                      |         |      |            |                  |               |                             | T210                                    | е.                    | Struck R<br>(m) (r | ose to<br>n) | Time<br>(min) |                  |              |
|                        |      |                      |         |      |            |                  |               |                             | Flush Typ                               | be:                   | 8.50 8.            | 50           | 10            | AC               | S            |
|                        |      |                      |         |      |            |                  |               |                             | Water Added:                            |                       | Casing:            |              |               |                  |              |
|                        |      |                      |         |      |            |                  |               |                             | From (m)                                | To (m)                | To (m)             | Diamet       | er (mm)       | www.causeway     | geotech.com  |
| 1                      |      |                      |         |      |            |                  |               |                             |   |                       |                    | 1            |               | ⊌ ⊂auseway (     | secrech Ltd  |

| Caus                   | sew             | 'ay                  | Geo      | oteo | ch Ltd          | Projec<br>14-645 | t no.                          | Project<br>Name:                      | Greater Du<br>Investigatio             | ıblin Drain<br>on              | age Sche                         | eme Gro                    | ound                         | Boreho<br>BH <sup>2</sup>  | ole No.<br>115              |
|------------------------|-----------------|----------------------|----------|------|-----------------|------------------|--------------------------------|---------------------------------------|--|--------------------------------|----------------------------------|----------------------------|------------------------------|----------------------------|-----------------------------|
| Method:                |                 |                      |          |      |                 | Co-ord           | ls:                            | Client:                               | Irish Water                            |                                |                                  |                            |                              | Sheet                      | 1 of 1                      |
| 0.00 3.00<br>3.00 8.80 | 0 F             | Rotary D<br>Rotary C | orilling |      |                 | 31283            | 6.67mE                         | Client's Rep                          | oresentative                           | : Tobin C                      | Consulting                       | g Engin                    | eers                         | Scale:                     | 1:50                        |
| Plant:<br>Beretta T41  |                 |                      |          |      |                 | Groun            | d Level:                       | Dates:                                | 31/01/2015                             | 5                              |                                  |                            |                              | Crew:                      |                             |
| Donth (m)              | TOD             | 60D                  | DOD      | -    | Field Dec       | 78.92N           |                                |                                       | <u> </u>                               |                                |                                  |                            |                              | Legend &                   | Backfill                    |
| Depth (m)              | ICR             | SCR                  | RQD      |      | Field Rec       | oras             | Level & Depth                  | TOPSOIL                               | Str                                    | atum Desc                      | ription                          |                            |                              | Strikes                    | Installs                    |
| 1.50<br>1.50           | SPT<br>(S)<br>D |                      |          |      | N=13 (2,3/2,3,4 | 4,4)             | (0.30)<br>78.62 0.30<br>(2.70) | Firm brown<br>fine to coars           | slightly sandy sl                      | ightly gravel<br>angular to su | ly slightly s                    | ilty CLAY                  | <sup>7</sup> . Sand is arse. |                            |                             |
| 3.00 - 4.00            |                 |                      |          |      | -               |                  | 75.92 3.00                     | Medium stro                           | ong thinly lamina                      | ited dark gre                  | y to black s                     | slightly                   |                              |                            |                             |
|                        | 0.5             |                      |          |      |                 |                  |                                | carbonaceo<br>Partially we            | us ARGILLACE                           | OUS LIMES                      | TONE.<br>n some joir             | nts, close                 | r fracture                   |                            |                             |
|                        | 95              | 70                   | 0        |      |                 |                  |                                | spacing, esp                          | pecially above 6                       | .3m.                           | par smooth                       |                            | closed to                    |                            |                             |
| 4.00 - 5.00            |                 |                      |          |      |                 |                  |                                | often open a                          | at very close spa                      | icing.                         |                                  | n, typicang                | avidiaad                     |                            | ******<br>***               |
|                        | 90              | 70                   | 0        |      |                 |                  |                                | brown.                                | , meaium space                         | a, 20-30°, st                  | eppea, rou                       | gn, open,                  | oxidised                     |                            |                             |
|                        | 90              | 70                   | 0        | 18   |                 |                  |                                | DS3: Thin c<br>rough, typic<br>brown. | alcite veins, wid<br>ally closed, occa | ely spaced,<br>isionally ope   | 70-80°, pla<br>n, 1mm ca         | nar, smoo<br>lcite fill, s | oth to<br>tained             |                            |                             |
| 5.00 - 6.00            |                 |                      |          |      |                 |                  |                                |                                       |  |                                |                                  |                            |                              |                            |                             |
| 6 00 - 7 00            | 90              | 60                   | 0        |      |                 |                  | (5.80)                         |                                       |  |                                |                                  |                            |                              |                            |                             |
|                        | 100             | 90                   | 22       |      | -               |                  |                                |                                       |  |                                |                                  |                            |                              |                            |                             |
| 7.00 - 8.00            | 100             | 100                  | 63       | 10   |                 |                  |                                |                                       |  |                                |                                  |                            |                              |                            |                             |
| 8.00 - 8.80            | 100             | 100                  | 20       |      |                 |                  | 70.12 8.80                     |                                       | ,                                      | and of once of 9               | 90 m                             |                            |                              |                            |                             |
|                        |                 |                      |          |      |                 |                  |                                |                                       |  | .nd oi core at a               | .co m                            |                            |                              |                            |                             |
| Remarks                | 1               | 1                    | 1        | 1    | 1               |                  | 1                              | 1                                     | Core Barr<br>T2101<br>Flush Typ        | rel:<br>oe:                    | Water Strik<br>Struck I<br>(m) ( | es:<br>Rose to<br>m)       | Time<br>(min)                | AC                         | J                           |
|                        |                 |                      |          |      |                 |                  |                                |                                       | Water Added:<br>From (m)               | To (m)                         | Casing:<br>To (m)<br>3.00        | Diamet<br>200              | er (mm)                      | www.causeway<br>© Causeway | /geotech.com<br>Geotech Ltd |

| Caus                  | sew             | ay                  | Geo      | otec | ch Ltd          | <b>Projec</b><br>14-645 | t no.                     |        | Project<br>Name:  | Greater Du<br>Investigati   | ublin Drain<br>on               | age Sche                                   | me Gro                           | ound                          | Boreh<br>BH               | ole No.<br>116                                  |
|-----------------------|-----------------|---------------------|----------|------|-----------------|-------------------------|---------------------------|--------|---|---|---------------------------------|--|----------------------------------|-------------------------------|---------------------------|---|
| Method:               | 0 5             | latar / D           | rillin a |      |                 | Co-ord                  | ds:                       |        | Client:   | Irish Wate  | r                               |  |                                  |                               | Sheet                     | 1 of 1  |
| 2.00 2.00<br>2.00 9.7 | 0 R             | otary D<br>totary C | oring    |      |                 | 313163                  | 3.53mE                    |        | Client's Re   | oresentative  | : Tobin C                       | Consulting                                 | Engine                           | eers                          | Scale:                    | 1:50  |
| Plant:<br>Beretta T41 |                 |                     |          |      |                 | Groun                   | d Level                   | :      | Dates:  | 02/02/201   | 5                               |  | -                                |                               | Crew:                     | GT<br>av <sup>. DOM</sup>                       |
| Denth (m)             | TCR             | SCR                 | ROD      | FI   | Field Reco      | 75.64N                  |                           | Denth  |   | Sti   | ratum Desc                      | rintion                                    |                                  |                               | Legend                    | Backfill  |
|                       |                 | 300                 | RQD      |      |                 |                         | Levera                    | Deptil | TOPSOIL   | 50  | atum Desc                       | nption                                     |                                  |                               | Strikes                   | Installs  |
|                       |                 |                     |          |      |                 |                         | (0.30)<br>75.34<br>(1.70) | 0.30   | Firm brown<br>fine to coars                                 | slightly sandy s<br>se. Gravel is sut                             | lightly gravel<br>bangular to s | lly slightly sil<br>ubrounded f            | ty CLAY.<br>fine to co           | Sand is<br>barse              |                           | * 0<br>0<br>* 0<br>0<br>* 0<br>0<br>0<br>0<br>0 |
| 1.50<br>1.50          | SPT<br>(S)<br>D |                     |          |      | N=14 (2,2/4,3,4 | ,3)                     |                           |        |   |   |                                 |  |                                  |                               |                           |   |
| 2.00 - 3.00           | 45              | 0                   | 0        |      |                 |                         | 73.64                     | 2.00   | Weak thinly<br>Distinctly we<br>fracture spa<br>DS1: Joints | laminated black<br>eathered: brown<br>icing.<br>, very closely sp | CARBONA<br>oxidised joir        | CEOUS LIN<br>nts, weaken<br>gles but typio | IESTON<br>ed, mucł<br>cally 60-ł | E.<br>n closer<br>80°, planar |                           |   |
| 3.00 - 4.00           |                 |                     |          |      |                 |                         |                           |        | and stepped<br>DS1: Beddi                                   | d, rough, open, l<br>ng, 20-40°, plan                             | brown oxidat<br>ar, smooth, t   | ion staining.<br>typically clos            | ed to oc                         | casionally                    |                           |   |
|                       | 40              | 0                   | 0        | NI   |                 |                         |                           |        | open at ver   | y close to close  | spacing.                        |  |                                  |                               |                           |   |
| 4.00 - 5.00           |                 |                     |          |      |                 |                         |                           |        |   |   |                                 |  |                                  |                               |                           |   |
| 5.00 6.00             | 45              | 5                   | 0        |      |                 |                         |                           |        |   |   |                                 |  |                                  |                               |                           |   |
| 6.00 7.00             | 45              | 25                  | 0        | 20   |                 |                         | (6.80)                    |        |   |   |                                 |  |                                  |                               |                           |   |
| 0.00 - 7.00           | 40              | 5                   | 0        |      | -               |                         |                           |        |   |   |                                 |  |                                  |                               |                           |   |
| 7.00 - 8.80           |                 |                     |          | NI   |                 |                         |                           |        |   |   |                                 |  |                                  |                               |                           |   |
|                       | 25              | 2                   | 0        |      |                 |                         |                           |        |   |   |                                 |  |                                  |                               |                           |   |
| 8.80 - 9.70           |                 |                     |          | 20   | -               |                         | 66.84                     | 8.80   | Medium stro   | ong thinly lamina<br>E.   | ated dark gre                   | ey ARGILLA                                 | CEOUS                            | · "                           |                           |   |
|                       | 100             | 61                  | 49       | 6    |                 |                         | <i>(0.90)</i><br>65.94    | 9.70   | closed to of<br>staining.                                   | ten open betwe  | en 8.8 and 9.                   | .25m at very                               | ooth, typ<br>close sj            | pacing no                     |                           |   |
|                       |                 |                     |          |      |                 |                         |                           |        |   |   |                                 |  |                                  |                               |                           |   |
| Remarks               |                 |                     |          |      |                 |                         |                           |        |   | Core Bar<br>T2101<br>Flush Tyj                                    | rel:<br>pe:                     | Water Strike<br>Struck R<br>(m) (r         | es:<br>ose to<br>n)              | Time<br>(min)                 | A                         | L<br>GS   |
|                       |                 |                     |          |      |                 |                         |                           |        |   | Water Added<br>From (m)   | To (m)                          | Casing:<br>To (m)                          | Diamet                           | er (mm)                       | www.causewa<br>© Causeway | aygeotech.com<br>Geotech Ltd                    |

| Caus                                   | seway            | Geo          | otec         | h Ltd                 | <b>Projec</b><br>14-645 | t no.            |       | Project<br>Name:                        | Greate<br>Investi                                | er Du<br>gatio             | blin Drain<br>n                                | age Sche                                      | eme Gro                           | ound                                 | Boreh<br>BH              | ole No.<br>117                 |
|--|------------------|--------------|--------------|-----------------------|-------------------------|------------------|-------|---|--|----------------------------|--|---|-----------------------------------|--------------------------------------|--------------------------|--------------------------------|
| Method:                                |                  | orouss       | ion          |                       | Co-ord                  | ls:              |       | Client:                                 | Irish W  | /ater                      |  |   |                                   |                                      | Sheet                    | : 1 of 1                       |
| 0.00 0.0                               |                  | ercuss       |              |                       | 314059<br>241569        | 9.18mE<br>9.93mN |       | Client's Re                             | epresenta  | tive:                      | Tobin C  | Consulting                                    | I Engine                          | ers                                  | Scale:                   | 1:50                           |
| Dando 3000                             | )                |              |              |                       | Groun                   | d Level          | :     | Dates:                                  | 12/01/2  | 2015                       |  |   |                                   |                                      | Crew:                    |                                |
| Donth (m)                              | Sample / Teat    | Casing       | Water        | Field Beer            | 72.59N                  |                  | Donth |   |  | Ctur                       |  | rintion                                       |                                   |                                      | Legend                   | & Backfill                     |
| Depth (m)                              | Sample / Test    | Ueptn<br>(m) | Uepth<br>(m) | Field Reco            | oras                    | Level &          | Deptn | TOPSOIL                                 |  | Stra                       | itum Desc                                      | ription                                       |                                   |                                      | Strikes                  | Installs                       |
| 0.35 - 1.20                            | В                |              |              |                       |                         | (0.35)<br>72.24  | 0.35  | Stiff browr<br>Sand is fin<br>coarse.   | n slightly san<br>ne to coarse.                  | dy slig<br>Grav            | htly gravell<br>el is subang                   | y silty CLAY<br>gular to sub                  | with rare rounded,                | e cobbles.<br>fine to                |                          |                                |
| 1.20<br>1.20 - 1.65                    | D<br>U           |              |              |                       |                         | (1.45)           |       |   |  |                            |  |   |                                   |                                      |                          |                                |
| 1.80 - 3.00<br>2.00<br>2.00            | B<br>SPT(S)<br>D |              |              | N=43 (4,6/10,10       | ),11,12)                | 70.79            | 1.80  | Firm to stii<br>CLAY with<br>to coarse. | ff dark grey to<br>noccasional o<br>Gravel is su | o blac<br>cobble<br>ibangi | k slightly sa<br>es and lense<br>ular to subro | ndy slightly<br>es of gravell<br>bunded, fine | gravelly<br>y sand. 3<br>to coars | slightly silty<br>Sand is fine<br>e. |                          |                                |
| 3.00 - 3.45                            | U                |              |              |                       |                         |                  |       |   |  |                            |  |   |                                   |                                      |                          |                                |
| 3.50<br>3.50 - 4.00                    | D<br>B           |              |              |                       |                         | (4.20)           |       |   |  |                            |  |   |                                   |                                      |                          |                                |
| 4.00<br>4.00                           | SPT(S)<br>D      |              |              | N=44 (5,7/9,11,1      | 12,12)                  | (4.20)           |       |   |  |                            |  |   |                                   |                                      |                          |                                |
| 4.50 - 5.00                            | В                |              |              |                       |                         |                  |       |   |  |                            |  |   |                                   |                                      |                          |                                |
| 5.00<br>5.00                           | SPT(S)<br>D      |              |              | N=41 (6,6/8,10,7      | 10,13)                  |                  |       |   |  |                            |  |   |                                   |                                      |                          |                                |
| 6.00                                   | SPT(S)<br>D      |              |              | N=38 (4,8/9,9,10      | 0,10)                   | 66.59            | 6.00  |   |  | End                        | of borehole a                                  |   |                                   |                                      |                          |                                |
| Remarks<br>SPTs carrier<br>Borehole te | d out using SF   | PT ham       | nmer C       | C04.<br>pletion depth |                         |                  |       |   | Chisellin<br>From<br>(m)<br>0.00                 | ng:<br>To<br>(m)<br>1.20   | <b>Time</b><br>(hh:mm)<br>01:00                | Water Strike<br>Struck F<br>(m) (             | es:<br>tose to<br>m)              | Time<br>(min)                        | ,                        | Ţ                              |
|  |                  |              |              | , <b>vopu</b> li      |                         |                  |       |   | Water A<br>From (m                               | dded:<br>1)                | <br>Го (m)                                     | Casing:<br>To (m)<br>6.00                     | Diamete<br>200                    | er (mm)                              | www.causewa<br>© Causewa | aygeotech.com<br>y Geotech Ltd |

| Caus                               | sew             | ay       | Geo                  | oteo | ch Ltd          | Projec<br>14-645 | <b>:t no.</b><br>5 | Project<br>Name:            | Greater D<br>Investigati               | ublin Drai<br>on              | nage Sc                    | heme (                      | Ground                       | Boreh<br>Bł     | nole<br>1118    | No.<br>3 | •          |
|------------------------------------|-----------------|----------|----------------------|------|-----------------|------------------|--------------------|-----------------------------|--|-------------------------------|----------------------------|-----------------------------|------------------------------|-----------------|-----------------|----------|------------|
| Method:                            |                 |          |                      |      |                 | Co-ore           | ds:                | Client:                     | Irish Wate                             | r                             |                            |                             |                              | Shee            | et 1 c          | of 2     |            |
| 0.00 8.50<br>8.50 13.6             | 50 R            | lotary D | ercussio<br>Prilling | n    |                 | 31480            | 9.73mE<br>1.19mN   | Client's Re                 | presentative                           | : Tobin                       | Consulti                   | ng Eng                      | ineers                       | Scale:          | 1:50            | 0        |            |
| Plant:<br>Dando 2000               | )+Bere          | tta T41  |                      |      |                 | Groun            | id Level:          | Dates:                      | 22/01/201                              | 5                             |                            |                             |                              | Crew:           | MM              | lc+G     | эт<br>—    |
|                                    |                 |          |                      |      | I               | 70.22            | NOD                | Duttoo.                     | 22/01/201                              |                               |                            |                             |                              | Legend          | ву:<br>8. р     | Back     | fill       |
| Depth (m)                          |                 | SCR      | RQD                  | FI   | Field Reco      | ords             | Level & Depth      | TOPSOIL                     | St<br>Brown slightly s                 | ratum Des                     | cription                   | <u> </u>                    |                              | Water<br>Strike | s<br>I          | Insta    | ills       |
| 0.00 - 0.50                        | В               |          |                      |      |                 |                  | (0.40)             | TOFSOL                      | - BIOWIT Slightly s                    | alluy clay w                  | nin rooilei                | 5.                          |                              |                 |                 |          |            |
| 0.50                               | D               |          |                      |      |                 |                  | 69.82 0.40         | Stiff brown<br>fine to coa  | slightly sandy sl<br>rse. Gravel is su | ightly grave<br>brounded to   | lly slightly<br>angular fi | silty CLA                   | Y. Sand is<br>arse of        |                 |                 |          |            |
|                                    |                 |          |                      |      |                 |                  |                    | sandstone                   |  |                               |                            |                             |                              |                 |                 |          |            |
| 1.20<br>1.20 - 1.65                | SPT<br>(S)      |          |                      |      | N=16 (2,3/4,3,4 | ,5)              | (1.60)             |                             |  |                               |                            |                             |                              |                 |                 |          | Ì          |
| 1.20 - 1.65                        | D<br>B          |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | S          |
| 2.00                               | <b>SDT</b>      |          |                      |      | N-20 (4 5/6 4 5 | 5)               | 68.22 2.00         |                             |  |                               |                            |                             |                              |                 |                 | ×        | Ĭ          |
| 2.00<br>2.00 - 2.45<br>2.00 - 2.45 | (S)<br>D        |          |                      |      | N=20 (4,5/6,4,5 | ,5)              | 66.22 2.00         | Stiff, become slightly silt | ming very stiff do<br>y CLAY. Sand is  | wnhole, dar<br>fine to coars  | k grey slig<br>se. Gravel  | htly sand<br>is subrou      | ly gravelly<br>unded to      |                 |                 | <u></u>  | Ì          |
|                                    | В               |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 | 9        | S          |
|                                    |                 |          |                      |      |                 | _                |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ĭ          |
| 3.00<br>3.00 - 3.45<br>3.00 - 3.45 | (S)<br>B        |          |                      |      | N=20 (5,4/6,4,5 | ,5)              |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ï          |
|                                    | D               |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 | 8        | ÿ          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ì          |
| 4.00<br>4.00 - 4.45<br>4.00 - 4.45 | SPT<br>(S)<br>B |          |                      |      | N=22 (6,6/5,5,5 | ,7)              |                    |                             |  |                               |                            |                             |                              |                 |                 |          | ÿ          |
| 4.00 - 4.40                        | D               |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 | 8        | Y          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ì          |
| 5.00<br>5.00 - 5.45                | SPT<br>(S)      |          |                      |      | N=23 (6,5/6,5,6 | ,6)              |                    |                             |  |                               |                            |                             |                              |                 |                 |          | ÿ          |
| 5.00 - 5.45                        | D               |          |                      |      |                 |                  | (6.50)             |                             |  |                               |                            |                             |                              |                 |                 | 8        | ÿ          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ì          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | ÿ          |
| 6 50                               | SPT             |          |                      |      | N=31 (7 8/7 8 8 | 8)               |                    |                             |  |                               |                            |                             |                              |                 |                 | 8        | Ì          |
| 6.50 - 6.95<br>6.50 - 6.95         | (S)<br>B        |          |                      |      | N-31 (7,077,0,0 | ,0)              |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ì          |
|                                    | D               |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | S          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 | ÿ.       | Ï          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 | <u></u>  | Ì          |
| 8.00                               | SPT             |          |                      |      | N=32 (8,7/9,8,8 | ,7)              |                    |                             |  |                               |                            |                             |                              |                 |                 | <u></u>  | S          |
| 8.00 - 8.45<br>8.00 - 8.45         | D<br>B          |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ĭ          |
|                                    |                 |          |                      |      |                 |                  | 61.72 8.50         | Very stiff d<br>Sand is fin | ark grey slightly<br>e to coarse. Gra  | sandy slight<br>ivel is angul | ly gravelly<br>ar to suba  | v slightly s<br>ingular, fi | silty CLAY.<br>ne to coarse. |                 |                 |          | Ì          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 | 8        | S          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Ĭ          |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              |                 |                 |          | Y          |
| 10.00                              | SPT             |          |                      |      | 50 (25 for 20mn | n/50 for         |                    |                             |  |                               |                            |                             |                              |                 |                 | 9        | Y          |
|                                    | (S)             |          |                      |      | 30mm)           |                  |                    |                             | (                                      | Continued on ne               | ext sheet                  |                             |                              | <u> </u>        | 1               | X        | ý          |
| Remarks                            |                 |          |                      |      |                 |                  |                    |                             | Core Bar                               | rel:                          | Water St<br>Struck         | rikes:<br>Rose to           | Time                         |                 |                 | _        |            |
|                                    |                 |          |                      |      |                 |                  |                    |                             | Flush Ty                               | pe:                           | ( <b>m)</b><br>11.50       | ( <b>m</b> )<br>11.50       | (min)<br>10                  |                 |                 |          |            |
|                                    |                 |          |                      |      |                 |                  |                    |                             | Water Added                            | :                             | Casing                     |                             |                              |                 | uù              | Ş        |            |
|                                    |                 |          |                      |      |                 |                  |                    |                             | From (m)                               | To (m)                        | To (m)<br>13.60            | Dian<br>150                 | neter (mm)                   |                 |                 |          |            |
|                                    |                 |          |                      |      |                 |                  |                    |                             |  |                               |                            |                             |                              | © Causewa       | aygeo<br>ay Geo | itech L  | .um<br>_td |

| Method:         Code #S0   | Caus                  | sew                      | ay                  | Geo                 | otec        | ch Ltd  | Projec<br>14-645    | t no.                        | Project<br>Name: | Greater Du<br>Investigatio | ublin Drair      | nage Sche  | me Gro                | ound                | Boreh       | ole No.<br>118       |
|--|-----------------------|--------------------------|---------------------|---------------------|-------------|---|---------------------|------------------------------|------------------|----------------------------|------------------|--|-----------------------|---------------------|-------------|----------------------|
| 10.00             10.00  | Method:               |                          |                     |                     |             |   | Co-orc              | ls:                          | Client:          | Irish Water                |                  |  |                       |                     | Sheet       | 2 of 2               |
| Plant:         United 2000-1000-1000-1000-1000-1000-1000-1000  | 0.00 8.5<br>8.50 13.0 | 0 C<br>60 F              | able Pe<br>totary D | ercussio<br>rilling | 'n          |   | 314809              | 9.73mE                       | Client's R       | opresentative              | · Tobin (        | Consulting   | Engine                | oore                | Scale:      | 1:50                 |
| Beach Lob         Logent Pit         Logent Pit         Logent Pit           Depth (m)         To         So         Ro         P         Feld Record         Logent Pit         Logent Pit         Logent Pit           11.50         Sp         Y         Y         Y         Sp  | Plant:                | ∩+Rere                   | +ta T41             | I                   |             | I   | 24159<br>Groun      | 1.19mN<br>d Level:           | -                | CO/01/004/                 | -                | 00110an  | Lug                   |                     | Crew:       | MMc+GT               |
| Depth       TCR       SCR       RO       PI       Field Record       Lowed A Daph       Stratum Description       Topological  |                       |                          | ιια · - ·<br>Τ      | 1                   | <del></del> | T   | 70.22N              | 10D                          | Dates:           | 22/01/201                  | 5                |  |                       |                     | Logged E    | 3y:<br>e             |
| 11:50       SPT<br>(P)       SD (25 for forwist) for<br>(SD (25 for forwist) f | Depth (m)             | TCR                      | SCR                 | RQD                 | FI          | Field Reco  | ords                | Level & Depth                |                  | Str                        | atum Deso        | cription   | _                     |                     | Water       | Backfill<br>Installs |
| Remarks       Remarks     Core Barrel:     Water Strikes:       Flush Type:     Table       Water Addet:     Casing:       Trent ()     To ()  | 11.50                 | SPT<br>(S)<br>SPT<br>(S) |                     |                     |             | 50 (25 for 0mm/<br>0mm)<br>50 (25 for 30mn<br>25mm) | '50 for<br>n/50 for | <i>(5.10)</i><br>56.62 13.60 |                  | E                          | īnī of core at 1 | 13.60 m  |                       |                     |             |                      |
| Remarks     Struck (m)     Rose to (min)       Flush Type:     11.50     10       Water Added:     Casing:       From (m)     To (m)       I     13.60   |                       |                          |                     |                     |             |   |                     |                              |                  | Core Bar                   | 2011             | Water Strik  | <b>96</b> :           |                     |             |                      |
| From (m)     To (m)     To (m)     Diameter (mm)       13.60     150     www.causewaygeotech.cd  | Remarks               |                          |                     |                     |             |   |                     |                              |                  | Flush Typ                  | be:              | Struck         R           (m)         (I)           11.50         1           Casing:         1 | tose to<br>m)<br>1.50 | Time<br>(min)<br>10 | A           | L<br>GS              |
| Courseway Costoob /  |                       |                          |                     |                     |             |   |                     |                              |                  | From (m)                   | To (m)           | To (m)<br>13.60  | Diamet<br>150         | er (mm)             | www.causewa | iygeotech.com        |

| NameSecore1111 </th <th>Caus</th> <th>sew</th> <th>ay</th> <th>Geo</th> <th>otec</th> <th>ch Ltd</th> <th><b>Projec</b><br/>14-645</th> <th>t no.</th> <th></th> <th>Project<br/>Name:</th> <th>Greater D<br/>Investigati</th> <th>ublin Drair<br/>on</th> <th>nage Sch</th> <th>eme Gr</th> <th>ound</th> <th>Boreho<br/>BH1</th> <th>le No.<br/>19</th>  | Caus         | sew             | ay       | Geo      | otec | ch Ltd                   | <b>Projec</b><br>14-645 | t no.                  |       | Project<br>Name:                                 | Greater D<br>Investigati                  | ublin Drair<br>on             | nage Sch                      | eme Gr                   | ound                        | Boreho<br>BH1              | le No.<br>19                          |
|--|--------------|-----------------|----------|----------|------|--------------------------|-------------------------|------------------------|-------|--|---|-------------------------------|-------------------------------|--------------------------|-----------------------------|----------------------------|---------------------------------------|
| No.         No. <td>Method:</td> <td>00 5</td> <td>Potary [</td> <td>Drilling</td> <td></td> <td></td> <td>Co-ord</td> <td>ls:</td> <td></td> <td>Client:</td> <td>Irish Wate</td> <td>r</td> <td></td> <td></td> <td></td> <td>Sheet</td> <td>1 of 2</td>   | Method:      | 00 5            | Potary [ | Drilling |      |                          | Co-ord                  | ls:                    |       | Client:  | Irish Wate                                | r                             |                               |                          |                             | Sheet                      | 1 of 2                                |
| Print         Constraint 1/2         Constraint 2/2         Constraint 2/2 </td <td>0.00 13.</td> <td>00 1</td> <td>totary I</td> <td>Jinnig</td> <td></td> <td></td> <td>241535</td> <td>5.92mE</td> <td></td> <td>Client's Rep</td> <td>resentative</td> <td>: Tobin (</td> <td>Consulting</td> <td>g Engin</td> <td>eers</td> <td>Scale: 1</td> <td>1:50</td>   | 0.00 13.     | 00 1            | totary I | Jinnig   |      |                          | 241535                  | 5.92mE                 |       | Client's Rep                                     | resentative                               | : Tobin (                     | Consulting                    | g Engin                  | eers                        | Scale: 1                   | 1:50                                  |
| 100       101       100       101  | Beretta T41  |                 |          |          |      |                          | Groun                   | d Level                | :     | Dates:   | 05/02/201                                 | 5                             |                               |                          |                             | Crew: C                    |                                       |
| upper       Up   |              |                 |          |          |      |                          | 68.26N                  | 10D                    |       |  |   |                               |                               |                          |                             | Legend &                   | Backfill                              |
| 130       131       141       141       143       143       143       143       143       143       143       143       143       143       143       143       143       143       143       143       143       143       143       144       1  | Depth (m)    | ICR             | SCR      | RQD      | FI   | Field Reco               | ords                    | Level &                | Depth | TOPSOIL - F                                      | Stown CLAY                                | ratum Desc                    | cription                      |                          |                             | Water<br>Strikes           | Installs                              |
| 3.00       SPT<br>(P)       N=27 (5.05,7.0.7)  | 1.50<br>1.50 | SPT<br>(S)<br>D |          |          |      | N=18 (4,3/4,5,4          | .5)                     | <i>(2.00)</i><br>66.26 | 2.00  | Stiff becomin<br>silty CLAY. S<br>fine to coarse | g very stiff doo<br>and is fine to c<br>e | vnhole slight<br>oarse. Grave | ily sandy sli<br>el is subanç | ghtly gra<br>gular to si | velly slightly<br>ubrounded |                            |                                       |
| 4.50       0, 10, 10, 10, 10, 10, 10, 10, 10, 10, 1  | 3.00<br>3.00 | SPT<br>(S)<br>D |          |          |      | N=27 (5,6/5,7,8          | ,7)                     |                        |       |  |   |                               |                               |                          |                             |                            |                                       |
| 6.00       SPT<br>(S)       S0 (25 for 10mm/50 for<br>(mm)       (11.00)         7.50       SPT<br>(S)       S0 (25 for 50mm/50 for<br>60mm)       S0 (25 for 50mm/50 for<br>60mm)         9.00       SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)         8.00       SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)         8.00       SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)         File       SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)         File       SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)         SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)       S0 (25 for 70mm/50 for<br>80mm)         SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)         SPT<br>(S)       S0 (25 for 70mm/50 for<br>80mm)  | 4.50<br>4.50 | D<br>SPT<br>(S) |          |          |      | N=34 (7,8/9,8,9          | ,8)                     |                        |       |  |   |                               |                               |                          |                             |                            |                                       |
| 7.50       SPT<br>(S)       SO (25 for 50mm/50 for<br>60mm)       SO (25 for 50mm/50 for<br>60mm)       SO (25 for 50mm/50 for<br>80mm)       SO (25 for 70mm/50 for<br>80mm)  | 6.00         | SPT<br>(S)      |          |          |      | 50 (25 for 10mn<br>0mm)  | n/50 for                | (11.00)                |       |  |   |                               |                               |                          |                             |                            |                                       |
| 9.00 SPT (S) 0 (25 for 70mm/50 for 80mm) Continued on next sheet  Remarks  Kernarks  K | 7.50<br>7.50 | SPT<br>(S)<br>D |          |          |      | 50 (25 for 50mn<br>60mm) | n/50 for                |                        |       |  |   |                               |                               |                          |                             |                            | · · · · · · · · · · · · · · · · · · · |
| Continued on next sheet         Remarks       Core Barrel:       Water Strikes:       Struck       Rose to       Time         Flush Type:       Image: Construct on the struct   | 9.00         | SPT<br>(S)      |          |          |      | 50 (25 for 70mn<br>80mm) | n/50 for                |                        |       |  |   |                               |                               |                          |                             |                            |                                       |
| Remarks     Core barrer.     Struck Rose to (min)       Flush Type:     Image: Core barrer.       Water Added:     Casing:       From (m)     To (m)       Image: Core barrer.     Image: Core barrer.       Water Added:     Casing:       From (m)     To (m)       Image: Core barrer.     Image: Core barrer.  |              |                 |          |          |      |                          |                         |                        |       |  | Coro Por                                  | continued on ne               | xt sheet                      | (AS'                     |                             |                            |                                       |
| Flush Type:     Casing:       Water Added:     Casing:       From (m)     To (m)     Diameter (mm)       © Causeway Geotech. Ld  | Remarks      |                 |          |          |      |                          |                         |                        |       |  | Core Bar                                  | rei:                          | Struck<br>(m)                 | Rose to<br>(m)           | Time<br>(min)               |                            |                                       |
| Water Added:     Casing:       From (m)     To (m)     Diameter (mm)       Image: Caseway Geotech Ltd     Image: Caseway Geotech Ltd   |              |                 |          |          |      |                          |                         |                        |       |  | Flush Ty                                  | pe:                           |                               |                          |                             | Aſ                         | S                                     |
| www.causewaygeotech.com<br>© Causeway Geotech Ltd  |              |                 |          |          |      |                          |                         |                        |       |  | Water Added                               | :<br> To (m)                  | Casing:<br>To (m)             | Diame                    | ter (mm)                    |                            |                                       |
|  |              |                 |          |          |      |                          |                         |                        |       |  |   |                               |                               | 2.4116                   |                             | www.causeway<br>© Causeway | geotech.com<br>Geotech Ltd            |

| Caus                  | sew  | ay       | Geo      | otec | h Ltd     | <b>Projec</b><br>14-64! | <b>:t no.</b> | Project<br>Name: | Greater Du<br>Investigatio | blin Drair      | nage Sche          | me Gr          | ound          | Boreho<br>BH1                 | le No.<br>19               |
|-----------------------|------|----------|----------|------|-----------|-------------------------|---------------|------------------|----------------------------|-----------------|--------------------|----------------|---------------|-------------------------------|----------------------------|
| Method:               |      |          |          |      |           | Co-ore                  | ds:           | Client:          | Irish Water                |                 |                    |                |               | Sheet 2                       | 2 of 2                     |
| 0.00 13.              | 00 R | lotary [ | Drilling |      |           | 314889                  | 9.92mE        | Client's Re      | presentative:              | Tobin (         | Consulting         | Fnain          | eers          | Scale: 1                      | :50                        |
| Plant:<br>Beretta T41 |      |          |          |      |           | Groun                   | id Level:     | Deteci           | 05/02/2015                 |                 |                    |                |               | Crew: G                       | эТ                         |
|                       |      |          | <u> </u> |      | T         | 68.26N                  | NOD           | Dates:           | 05/02/2015                 |                 |                    |                |               | Logged By                     | r: DOM                     |
| Depth (m)             | TCR  | SCR      | RQD      | FI   | Field Rec | ords                    | Level & Depth | ı                | Stra                       | atum Desc       | ription            |                |               | Water<br>Strikes              | Backfill<br>Installs       |
| Remarks               |      |          |          |      |           |                         | 55.26 13.00   |                  | Core Barr                  | nd of core at 1 | 3.00 m             | es:<br>Rose to | Time          |                               |                            |
|                       |      |          |          |      |           |                         |               |                  |                            |                 | Struck R<br>(m) (I | lose to<br>m)  | Time<br>(min) |                               | a                          |
|                       |      |          |          |      |           |                         |               |                  | Flush Typ                  | e:              |                    |                |               | AC                            | S                          |
|                       |      |          |          |      |           |                         |               |                  | Water Added:<br>From (m)   | To (m)          | Casing:<br>To (m)  | Diame          | ter (mm)      |                               |                            |
|                       |      |          |          |      |           |                         |               |                  |                            |                 |                    |                | _             | www.causewayo<br>© Causeway G | geotech.com<br>Geotech Ltd |

| Cau                                 | seway                          | Ge                | otec             | h Ltd             | Projec<br>14-645            | t no.     |      | Project<br>Name:                          | Greate<br>Investi            | er Du<br>gatio             | blin Drair<br>n                   | age Scl                    | neme G                 | Ground                       | Boreh  | ole No.<br>120                 |
|-------------------------------------|--------------------------------|-------------------|------------------|-------------------|-----------------------------|-----------|------|---|------------------------------|----------------------------|-----------------------------------|----------------------------|------------------------|------------------------------|--|--------------------------------|
| Method:                             |                                |                   |                  |                   | Co-orc                      | ls:       |      | Client:                                   | Irish W                      | /ater                      |                                   |                            |                        |                              | Sheet  | 1 of 2                         |
| 0.00 11.                            | .50 Cable F                    | Percuss           | sion             |                   | 314972                      | 2.58mE    |      | Client's Bon                              | roconto                      | tivo:                      | Tobin (                           | Conculti                   | na Engi                | incore                       | Scale:   | 1:50                           |
| Plant:                              | 0                              |                   |                  |                   | 24147 <sup>2</sup><br>Groun | 1.58mN    |      | Chefft S Kep                              | resenta                      |                            |                                   | Jonsulli                   |                        |                              | Crew:  | СС                             |
| Dando 2000                          | 0                              |                   |                  | 1                 | 65.99N                      |           |      | Dates:                                    | 13/01/                       | 2015                       |                                   |                            |                        |                              | Logged I   | By: DOM                        |
| Depth (m)                           | Sample / Test                  | Casing<br>t Depth | Depth            | Field Rec         | ords                        | Level & D | epth |   |                              | Stra                       | tum Desc                          | ription                    |                        |                              | Legend<br>Water  | & Backfil<br>Installs          |
| 0.00 - 1.70                         | В                              | (11)              | (11)             |                   |                             |           |      | MADE GRO                                  | UND - Firr                   | n brov                     | vn grey CL                        | AY with gl                 | ass share              | ds.                          | Strikes  |                                |
| 0.50<br>1.00                        | es<br>es                       |                   |                  |                   |                             | (1.70)    |      |   |                              |                            |                                   |                            |                        |                              |  |                                |
| 1.20<br>1.20<br>1.50<br>1 70 - 2 00 | D<br>SPT(S)<br>ES<br>B         |                   |                  | N=10 (2,2/2,3,2   | .,3)                        | 64 29 1   | 1 70 |   |                              |                            |                                   |                            |                        |                              |  |                                |
| 2.00<br>2.00<br>2.00<br>2.00        | D<br>ES<br>SPT(S)              |                   |                  | N=39 (4,6/9,9,1   | 0,11)                       | (1.40)    | 1.70 | Stiff to very s<br>Sand is fine<br>coarse | stiff brown<br>to coarse.    | slightl<br>Grave           | y sandy slig<br>el is subang      | ghtly grav<br>jular to su  | elly slight<br>brounde | tly silty CLAY.<br>d fine to | <pre>xi xi xi xi xi xi xi<br/>xi xi xi xi xi xi<br/>xi xi xi xi xi xi xi<br/>xi xi xi xi xi xi xi<br/>xi xi xi xi xi xi xi xi xi</pre> |                                |
| 3.00                                | D<br>SPT(S)                    |                   |                  | N=45 (5,9/11,10   | ),12,12)                    | 62.89 3   | 3.10 |   | ak alisabilu                 | and                        |                                   | abth ailt                  |                        | Cond is find to              |  |                                |
| 3.10 - 4.00                         | В                              |                   |                  |                   |                             |           |      | coarse. Grav                              | vel is suba                  | sandy<br>ngulai            | to subrour                        | ided fine t                | o coarse               | sand is fine to              | <pre>xi xi x</pre>  |                                |
| 4.00<br>4.00                        | D<br>SPT(S)                    |                   |                  | 50 (7,10/50 for ) | 225mm)                      | (2.40)    |      |   |                              |                            |                                   |                            |                        |                              | (() () () () () () () () () () () () ()  |                                |
| 5.00<br>5.00                        | SPT(S)<br>D                    |                   |                  | N=35 (4,6/7,8,1   | 0,10)                       |           |      |   |                              |                            |                                   |                            |                        |                              |  |                                |
| 5.50 - 6.50                         | В                              |                   |                  |                   |                             | 60.49 5   | 5.50 | Stiff black sli<br>to coarse. G           | ightly sand<br>ravel is su   | ly sligl<br>bangu          | ntly gravelly<br>lar to subro     | v slightly s<br>ounded fin | ilty CLAY<br>e to coar | 7. Sand is fine<br>rse       |  |                                |
| 6.50<br>6.50                        | D<br>SPT(S)                    |                   |                  | N=23 (2,3/5,5,6   | 5,7)                        |           |      |   |                              |                            |                                   |                            |                        |                              |  |                                |
| 8.00<br>8.00<br>8.00 - 9.00         | D<br>SPT(S)<br>B               |                   |                  | N=19 (3,3/4,5,5   | ,5)                         | (5.00)    |      |   |                              |                            |                                   |                            |                        |                              |  |                                |
| 9.50<br>9.50                        | SPT(S)<br>D                    |                   |                  | N=29 (3,5/7,7,7   | ,8)                         |           |      |   |                              |                            | ntinued on pe                     | vt shoot                   |                        |                              | (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)  |                                |
| Remarks                             | 1                              | _                 | 1                | 1                 |                             | I         |      | <u> </u>                                  | Chiselli                     | ng:                        |                                   | Water Str                  | ikes:                  |                              | 1  |                                |
| SPTs carrie<br>Refusal me           | d out using S<br>t on possible | PT han<br>large b | nmer C<br>oulder | C04.<br>at 11.50m |                             |           |      |   | From<br>(m)<br>0.00<br>11.40 | To<br>(m)<br>1.20<br>11.50 | Time<br>(hh:mm)<br>00:30<br>01:00 | Struck<br>(m)              | Rose to<br>(m)         | Time<br>(min)                | A  | L<br>GS                        |
|                                     |                                |                   |                  |                   |                             |           |      |   | Water A<br>From (m           | ldded:<br>1)               | <br>To (m)                        | Casing:<br>To (m)<br>11.40 | Diam<br>200            | neter (mm)                   | www.causewa<br>© Causeway  | aygeotech.com<br>/ Geotech Ltd |

| Cau           | Causeway Geotech Ltd |                        |                         |            |                 | t no.                        |         | Project<br>Name:            | Greate                          | r Dublii<br>pation     | n Draina            | age Sch       | neme Gi                | round         | Boreh                      | ole No.               |
|---------------|----------------------|------------------------|-------------------------|------------|-----------------|------------------------------|---------|-----------------------------|---------------------------------|------------------------|---------------------|---------------|------------------------|---------------|----------------------------|-----------------------|
| Method:       |                      |                        |                         |            | Co-or           | ds:                          |         | Client:                     | Irish W                         | ater                   |                     |               |                        |               | Shee                       | t 2 of 2              |
| 0.00 11.      | .50 Cable F          | Percuss                | sion                    |            | 31497           | 2.58mE                       |         |                             |                                 |                        |                     |               |                        |               | Scale:                     | 1:50                  |
| Plant:        |                      |                        |                         |            | 24147           | 1.58mN                       | I       | Client's Re                 | presentat                       | tive:                  | Tobin C             | onsultir      | ng Engir               | neers         | Crew:                      | СС                    |
| Dando 200     | 0                    |                        |                         |            | Groun<br>65.99N | I <mark>d Leve</mark><br>AOD | 1:      | Dates:                      | 13/01/2                         | 2015                   |                     |               |                        |               | Logged                     | By: DOM               |
| Depth (m)     | Sample / Test        | Casing<br>Depth<br>(m) | y Water<br>Depth<br>(m) | Field Reco | ords            | Level &                      | & Depth |                             |                                 | Stratu                 | m Descr             | ription       |                        |               | Legend<br>Water<br>Strikes | & Backfil<br>Installs |
|               | _                    |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
| 10.50 - 11.00 | В                    |                        |                         |            |                 | 55.49                        | 10.50   | Stiff black s<br>coarse. Gr | slightly sandy<br>avel is subar | y gravell<br>ngular to | y slightly subround | silty CLA     | Y. Sand is<br>o coarse | fine to       |                            |                       |
| 11.00         | D                    |                        |                         |            |                 | (1.00)                       |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 | 54.49                        | 11.50   |                             |                                 | End of b               | orehole at          | 11.50 m       |                        |               | XXXXX                      |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
|               |                      |                        |                         |            |                 |                              |         |                             |                                 |                        |                     |               |                        |               |                            |                       |
| Remarks       | 1                    | 1                      | 1                       | I          |                 | 1                            |         | 1                           | Chisellin                       | ıg:                    |                     | Water Str     | ikes:                  | 1             |                            | I                     |
| SPTs carrie   | d out using S        | PT han                 | nmer C                  | C04.       |                 |                              |         |                             | From<br>(m)<br>0.00             | To Ti<br>(m) (h        | me<br>h:mm)<br>0:30 | Struck<br>(m) | Rose to<br>(m)         | Time<br>(min) | ┤∎                         |                       |
| Refusal me    | t on possible        | large b                | ouldera                 | at 11.50m  |                 |                              |         |                             | 11.40                           | 11.50 01               | :00                 |               |                        |               |                            | 20                    |

|         |       |        |         |         |        | AGS                     |
|---------|-------|--------|---------|---------|--------|-------------------------|
| Water A | dded: |        | Casing: |         |        |                         |
| From (m | )     | To (m) | To (m)  | Diamete | r (mm) |                         |
|         |       |        | 11.40   | 200     |        | www.coucoucoucotoob.com |
|         |       |        |         |         |        | © Causeway Geotech Ltd  |

| Caus   | sew                                     | ay       | Geo     | oteo   | ch Ltd                   | Projec<br>14-645 | <b>:t no.</b>    | Project<br>Name:            | Greater Du<br>Investigation                | ublin Drai<br>on             | nage Sche  | me Gr                           | ound                       | Boreh<br>BH   | ole No.<br>121 |
|--|---|----------|---------|--------|--------------------------|------------------|------------------|-----------------------------|--|------------------------------|--|---------------------------------|----------------------------|---|----------------|
| Method:  |   |          |         |        |                          | Co-oro           | ds:              | Client:                     | Irish Water                                | r                            |  |                                 |                            | Sheet   | : 1 of 2       |
| 4.30 11.9  | 90 F                                    | lotary D | rilling | n      |                          | 31519            | 0.35mE<br>8 11mN | Client's R                  | epresentative                              | : Tobin                      | Consulting   | Engin                           | eers                       | Scale:  | 1:50           |
| Plant:<br>Dando 2000                               | )+Com                                   | acchio   | 405     |        |                          | Groun            | d Level:         | Dates:                      | 13/01/201                                  | 5                            |  |                                 |                            | Crew:   | CC+GI          |
| Donth (m)  | тср                                     | SCP      | POD     | FI     | Field Pace               | 66.66N           |                  |                             | St.  | atum Dos                     | cription   |                                 |                            | Legend  | & Backfill     |
| Deptil (III)                                       |   | 301      | NGD     |        |                          |                  | (0.20)           | MADE GF                     | ROUND - Hardcor                            | e Fill                       | cription   |                                 |                            | Strikes   | Installs       |
| 0.20 - 1.20<br>0.50<br>1.00<br>1.20                | B<br>ES<br>ES<br>SPT                    |          | 1.20    |        | N=10 (2,3/3,3,2          | .2)              | 66.46 0.20       | MADE GF<br>boulders.        | ROUND - Firm ver                           | y sandy gra                  | avelly CLAY v  | vith occa                       | asional                    |   | <b>A</b>       |
| 1.20<br>1.50                                       | (S)<br>1.20<br>D<br>ES                  |          |         |        |                          |                  | (2.50)           |                             |  |                              |  |                                 |                            |   |                |
| 2.00<br>2.00<br>2.00<br>2.00 - 2.50                | SPT<br>(S)<br>2.00<br>ES<br>D<br>B      |          | 2.00    |        | N=17 (2,2/6,6,3          | .2)              |                  |                             |  |                              |  |                                 |                            |   |                |
| 2.70<br>2.70 - 3.00<br>3.00<br>3.00<br>3.50 - 4.00 | ES<br>B<br>3.00<br>SPT<br>(S)<br>D<br>B |          | 3.00    |        | 50 (7,10/50 for 2        | 225mm)           | 63.96 2.70       | Very stiff t<br>fine to coa | black slightly sand<br>arse. Gravel is sut | y slightly gi<br>bangular to | ravelly slightl<br>subrounded  | v silty CL<br>ine to co         | LAY. Sand is<br>oarse.     |   |                |
| 4.00<br>4.00                                       | D<br>SPT                                |          | 4.00    |        | 50 (8,12/50 for 1        | 150mm)           | (1.80)           |                             |  |                              |  |                                 |                            | (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)   |                |
|  | 4.00                                    |          |         |        |                          |                  | 62.16 4.50       | Very stiff t                | to hard grey slight                        | ly sandy sli                 | ghtly gravelly   | slightly                        | silty CLAY                 | 지, 11, 11, 11, 11, 11, 11, 11, 11, 11, 1  |                |
| 6.00   | SPT<br>(S)                              |          |         |        | 50 (25 for 0mm/<br>0mm)  | 50 for           |                  |                             |  |                              |  |                                 |                            | [[1] [[1] [[1] [[1] [[1] [[1] [[1] [[1]   |                |
| 7.50   | SPT<br>(S)                              |          |         |        | 50 (25 for 25mn<br>35mm) | n/50 for         | (7.40)           |                             |  |                              |  |                                 |                            | 관점 사람이 있는 것은 것을 다 있는 것을 다 있다.<br>2015년 1월 2015년 1월 2015년 2월 2015년<br>1월 2015년 2월 2015년 2월 2015년 2월 2015년<br>1월 2015년 2월 2015년 2015년 2015년 2015년 |                |
| 9.00   | SPT<br>(S)                              |          |         |        | 50 (25 for 45mm<br>35mm) | n/50 for         |                  |                             |  |                              | aut aboat  |                                 |                            |   |                |
| Remarks  |   |          |         |        | I                        |                  |                  |                             | Core Bar                                   | rel:                         | Water Strike   | s:                              | 1                          |   |                |
| SPTs carried                                       | d out u                                 | sing SI  | PT ham  | imer C | C04.                     |                  |                  |                             | Flush Tv                                   | oe:                          | struck         R           (m)         (I           2.70         0           10.50         0 | <b>ose to</b><br>n)<br>70<br>70 | 1 ime<br>(min)<br>20<br>20 | ╎┎  |                |
|  |   |          |         |        |                          |                  |                  |                             | Water Added                                |                              | Casing:  |                                 |                            | A   | 5              |
|  |   |          |         |        |                          |                  |                  |                             | From (m)                                   | To (m)                       | <b>To (m)</b><br>4.30  | Diamet<br>200                   | ter (mm)                   | www.causewa   | aygeotech.com  |
|  |   |          |         |        |                          |                  |                  |                             |  |                              |  |                                 |                            | © Causeway  | / Geotech Ltd  |

| Caus                    | sew        | ay                 | Geo     | otec   | h Ltd                   | Projec<br>14-645 | t no.         | Project<br>Name: | Greater Du<br>Investigati                        | ublin Drain<br>on     | age Sche  | me Gr                                   | round  | Borehol<br>BH1                | le No.<br>21               |
|-------------------------|------------|--------------------|---------|--------|-------------------------|------------------|---------------|------------------|--|-----------------------|---|---|--|-------------------------------|----------------------------|
| Method:                 |            |                    |         |        |                         | Co-orc           | ls:           | Client:          | Irish Wate                                       | r                     |   |   |  | Sheet 2                       | 2 of 2                     |
| 0.00 4.30<br>4.30 11.9  | 90 R       | able Pe<br>otary D | rilling | n      |                         | 315190           | ).35mE        | Client's Rep     | resentative                                      | : Tobin C             | Consulting  | Engin                                   | ieers  | Scale: 1                      | :50                        |
| Plant:<br>Dando 2000    | )+Coma     | acchio             | 405     |        |                         | Groun            | d Level:      | Dates:           | 13/01/201  | 5                     |   |   |  | Crew: C                       | C+GT                       |
|                         |            |                    |         |        |                         | 66.66N           | 10D           | Dates.           | 10/01/2015                                       | 5                     |   |   |  | Logged By                     | Rackfill                   |
| Depth (m)               | TCR        | SCR                | RQD     | FI     | Field Reco              | ords             | Level & Depth |                  | Sti  | atum Desc             | ription   |   |  | Water<br>Strikes              | Installs                   |
| 10.50                   | SPT<br>(S) |                    |         |        | 50 (25 for 0mm/<br>0mm) | 50 for           | 54.76 11.90   |                  | Core Bar   | End of core at 11     | 1.90 m  | 5:                                      |  |                               |                            |
| Remarks<br>SPTs carried | d out u    | sing SI            | PT ham  | imer C | C04.                    |                  |               |                  | Core Bar<br>Flush Tyj<br>Water Added<br>From (m) | rel:<br>De:<br>To (m) | Water Strike           Struck         Ri           (m)         (n           2.70         0.           10.50         0.           Casing:         To (m)           4.30         30 | s:<br>pse to<br>1)<br>70<br>70<br>Diame | Time<br>(min)           20           20           ter (mm) | AG                            | S                          |
|                         |            |                    |         |        |                         |                  |               |                  |  |                       | 4.50  | 200                                     |  | www.causewayg<br>© Causeway G | geotech.com<br>Geotech Ltd |

| Cau          | seway          | Geo      | otec   | h Ltd                     | <b>Projec</b><br>14-645 | s <b>t no</b> .        |       | Project<br>Name:                                       | Greate<br>Investi                            | er Du<br>gatio              | blin Drain<br>n                             | age Scl                                  | hem                        | e Gr                         | ound                             | Boreho<br>BH1                  | le No.<br>22               |
|--------------|----------------|----------|--------|---------------------------|-------------------------|------------------------|-------|--|--|-----------------------------|---|--|----------------------------|------------------------------|----------------------------------|--------------------------------|----------------------------|
| Method:      |                |          |        |                           | Co-ore                  | ds:                    |       | Client:  | Irish W                                      | /ater                       |   |  |                            |                              |                                  | Sheet                          | 1 of 2                     |
| 0.00 10      | .50 Cable F    | ercuss   | ion    |                           | 31551 <sup>-</sup>      | 1.95mE                 |       |  |  | 41                          | Tabia (                                     | Como ulti-                               |                            |                              |                                  | Scale: 1                       | 1:50                       |
| Plant:       | <u>_</u>       |          |        |                           | 24135                   | 6.89mN                 | l•    | Cilent's Re  | presenta                                     | uve.                        |   | Jonsulu                                  |                            | ngin                         |                                  | Crew: (                        | cc                         |
| Dando 3000   | U<br>          |          |        | 1                         | 64.22N                  | NOD                    |       | Dates:   | 07/01/2                                      | 2015                        |   |  |                            |                              |                                  | Logged B                       | y: DOM                     |
| Depth (m)    | Sample / Test  | Depth    | Depth  | Field Rec                 | ords                    | Level &                | Depth |  |  | Stra                        | itum Desc                                   | ription                                  |                            |                              |                                  | Legend &<br>Water<br>Strikes   | Backfil                    |
| 0.20 - 1.20  | В              |          | (,     |                           |                         | <i>(0.20)</i><br>64.02 | 0.20  | TOPSOIL<br>Firm to stiff<br>occasional<br>fine to coar | f brown sligh<br>cobbles and<br>rse. Sand is | ntly sa<br>d boul<br>s fine | ndy gravelly<br>ders. Grave<br>to medium.   | y slightly s<br>el is subar              | silty (<br>ngula           | CLAY<br>r to si              | with<br>Ibrounded                |                                |                            |
| 1.20<br>1.20 | SPT(S)<br>D    |          |        | N=16 (3,3/4,3,4           | -,5)                    | (1.50)                 |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 1.70 - 2.00  | В              |          |        |                           |                         | 62.52                  | 1.70  | Very stiff bl<br>occasional<br>fine to coar            | lack slightly<br>cobbles and<br>rse. Cobbles | sandy<br>d boul<br>s and l  | slightly gra<br>ders. Grave<br>coulders are | avelly sligl<br>el is subar<br>e subangi | htly s<br>ngula<br>ular te | ilty CL<br>r to sı<br>o subi | AY with<br>ibrounded<br>rounded. | 20270<br>20270<br>20270        |                            |
| 2.50 - 3.00  | В              |          |        |                           |                         |                        |       |  |  |                             |   |  |                            |                              |                                  | <u>6</u> 200                   | ~                          |
| 3.00<br>3.00 | D<br>SPT(S)    |          |        | 50 (6,7/50 for 2          | 25mm)                   |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 4.00<br>4.00 | D<br>SPT(S)    |          |        | 50 (4,7/50 for 2          | 15mm)                   |                        |       |  |  |                             |   |  |                            |                              |                                  |                                | ×                          |
| 4.50 - 5.00  | В              |          |        |                           |                         |                        |       |  |  |                             |   |  |                            |                              |                                  | *0~?Q<br>*0~?Q<br>*2~?Q        |                            |
| 5.00<br>5.00 | SPT(S)<br>D    |          |        | 50 (7,13/50 for )         | 200mm)                  |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 6.00 - 6.50  | В              |          |        |                           |                         | (8.80)                 |       |  |  |                             |   |  |                            |                              |                                  | <u>*0~*0</u><br>*0**0<br>*6**0 |                            |
| 6.50<br>6.50 | SPT(S)<br>D    |          |        | 50 (25 for 125m<br>150mm) | nm/50 for               |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 7.00 - 7.50  | В              |          |        |                           |                         |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 7.50         | D              |          |        | 50 (9,12/50 TOF           | 229mm)                  |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 9.00<br>9.00 | D<br>SPT(S)    |          |        | 50 (11,14/50 for          | r 150mm)                |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| 9.50 - 10.00 | В              |          |        |                           |                         |                        |       |  |  |                             |   |  |                            |                              |                                  |                                |                            |
| Remarks      |                | <u> </u> |        |                           |                         |                        |       |  | Chisellin                                    | Co<br>ng:                   | ntinued on ne>                              | tt sheet<br>Water Str                    | rikes:                     |                              |                                  |                                |                            |
| SPT's carrie | ed out using S | SPT Ha   | mmer ( | CC04                      |                         |                        |       |  | From<br>(m)<br>0.00                          | To<br>(m)<br>1.20           | Time<br>(hh:mm)<br>01:00                    | Struck<br>(m)<br>3.90                    | Ros<br>(m)<br>2.6          | e to                         | Time<br>(min)<br>20              | AC                             | L<br>IS                    |
|              |                |          |        |                           |                         |                        |       |  | Water A<br>From (m                           | dded:<br>1)                 | Го (m)                                      | Casing:<br>To (m)<br>10.50               | 2                          | Diamet<br>200                | er (mm)                          | www.causeway<br>© Causeway (   | geotech.con<br>Geotech Ltd |

| Caus                 | seway          | Geo          | otec         | ch Ltd           | <b>Projec</b><br>14-645 | ; <b>t no.</b> | Project<br>Name: | Greater D<br>Investigat | Jublin Drain                  | nage Sche         | eme Gr        | ound                | Borehole<br>BH12       | e No.<br>22 |
|----------------------|----------------|--------------|--------------|------------------|-------------------------|----------------|------------------|-------------------------|-------------------------------|-------------------|---------------|---------------------|------------------------|-------------|
| Method:              |                |              |              |                  | Co-ord                  | ds:            | Client:          | Irish Wate              | er                            |                   |               |                     | Sheet 2                | of 2        |
| 0.00 10.             | 50 Cable P     | ercuss       | ion          |                  | 315511                  | 1.95mE         | Client's Rep     | resentativ              | e: Tobin (                    | Consulting        | n Engin       | ieers               | Scale: 1:              | 50          |
| Plant:<br>Dando 3000 | )              |              |              |                  | Groun                   | d Level:       | Datas            | 07/01/20/               | 15                            |                   |               |                     | Crew: CO               |             |
|                      | [              | Casing       | Water        | ,                | 64.22N                  | /OD            | Dates.           | 07/01/20                |                               |                   |               |                     | Logged By:<br>Legend & | DOM         |
| Depth (m)            | Sample / Test  | Depth<br>(m) | Depth<br>(m) | Field Reco       | ords                    | Level & Depth  |                  | S                       | tratum Desc                   | ription           |               |                     | Water<br>Strikes       | Backfin     |
| 10.40<br>10.50       | SPT(S)         |              |              | 50 (10,13/50 for | <sup>.</sup> 200mm)     | 53.72 10.50    |                  | F                       | and of borehole a             | + 10 50 m         |               |                     |                        |             |
| 10.00                |                |              |              |                  |                         |                |                  |                         |                               | 10.00             |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
|                      |                |              |              |                  |                         |                |                  |                         |                               |                   |               |                     |                        |             |
| Remarks              |                |              |              |                  |                         |                |                  | Chiselling:             |                               | Water Strik       | es:           |                     |                        |             |
| SPT's carrie         | ed out using S | PT Ha        | mmer (       | CC04             |                         |                |                  | From To<br>(m) (m       | Time<br>) (hh:mm)<br>20 01:00 | Struck (<br>(m) ( | Rose to<br>m) | Time<br>(min)<br>20 |                        |             |
|                      |                |              |              |                  |                         |                |                  | 0.00                    | 01.00                         |                   |               |                     | AG                     | S           |
|                      |                |              |              |                  |                         |                |                  | Water Adde              | d:                            | Casing:           | Diamo         | tor (mm)            |                        |             |
|                      |                |              |              |                  |                         |                |                  | From (m)                | 10 (m)                        | 10.50             | 200           | ter (mm)            | ł                      |             |

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| Caus                        | sew                          | /ay      | Geo      | oteo | ch Ltd                   | <b>Projec</b><br>14-645 | <b>:t no</b> .<br>5  |       | Project<br>Name:                              | Greater Du<br>Investigatio                                | ublin Draiı<br>on                            | nage Sch                                  | eme Gr                      | round                    | Boreh<br>BH               | ole No.<br>123                 |
|-----------------------------|------------------------------|----------|----------|------|--------------------------|-------------------------|----------------------|-------|---|---|--|---|-----------------------------|--------------------------|---------------------------|--------------------------------|
| Method:<br>0.00 4.00        | 0 C                          | Cable Pe | ercussio | n    |                          | <b>Co-or</b>            | <b>ds:</b><br>0 88mF |       | Client:                                       | Irish Water   | r  |   |                             |                          | Sheet                     | 1 of 1                         |
| 4.00 8.00<br>Plant:         | 0 F                          | Rotary D | rilling  |      |                          | 24173                   | 2.26mN               |       | Client's Re                                   | oresentative  | : Tobin                                      | Consultin                                 | g Engin                     | ieers                    | Scale:<br>Crew:           | CC+SJ                          |
| Dando 3000                  | )+Bere                       | tta T41  |          |      |                          | <b>Groun</b><br>56.88M  | <b>d Leve</b><br>AOD | l:    | Dates:  | 08/12/2014  | 4  |   |                             |                          | Logged E                  | By: DOM                        |
| Depth (m)                   | TCR                          | SCR      | RQD      | FI   | Field Reco               | ords                    | Level 8              | Depth |   | Str   | atum Des                                     | cription                                  |                             |                          | Legend<br>Water           | & Backfil                      |
|                             |                              |          |          |      |                          |                         | (0.25)               |       | MADE GRO                                      | UND: Grey GR  | AVEL (hard                                   | core fill).                               |                             |                          | Strikes                   |                                |
| 1.00<br>1.00                | В<br>1.00<br>SPT             |          | 1.00     |      | N=15 (3,3/3,4,4          | ,4)                     | 56.63<br>(1.05)      | 0.25  | Firm to stiff<br>occasional<br>is subangul    | dark brown sligt<br>cobbles and rare<br>ar to subrounde   | ntly sandy g<br>e boulders.<br>d, fine to co | ravelly silty<br>Sand is fin<br>arse.     | CLAY wi<br>e to coars       | th<br>se. Gravel         |                           |                                |
| 1.30 - 2.00                 | (S)<br>D<br>B                |          | 0.00     |      |                          |                         | 55.58<br>(1.20)      | 1.30  | Stiff dark br<br>with occasio<br>Gravel is su | own slightly sligl<br>onal cobbles and<br>bangular to sub | htly sandy s<br>d rare bould<br>rounded, fir | lightly grav<br>ers. Sand<br>le to coarse | elly slight<br>is fine to e | ly silty CLAY<br>coarse. |                           |                                |
| 2.00<br>2.00<br>2.50 - 3.00 | 2.00<br>SPT<br>(S)<br>D<br>B |          | 2.00     |      | N=19 (3,4/4,4,5          | ,0)                     | 54.38                | 2.50  | Verv stiff da                                 | rk arev to black  | slightly san                                 | dv slightly (                             | aravelly s                  | lightly silty            |                           |                                |
| 3.00<br>3.00                | 3.00<br>D<br>SPT<br>(S)      |          | 3.00     |      | 50 (25 for 50mn<br>75mm) | n/50 for                | (1.50)               |       | CLAY with c<br>coarse. Gra                    | occasional cobbl<br>avel is subangul                      | les and rare<br>ar to subrou                 | boulders.<br>Inded, fine                  | Sand is f<br>to coarse      | ine to                   |                           |                                |
| 4.00<br>4.00                | 4.00<br>D<br>SPT<br>(S)      |          | 4.00     |      | 50 (25 for 65mn<br>50mm) | n/50 for                | 52.88                | 4.00  | Dark grey s<br>to coarse. C                   | lightly sandy slig<br>Gravel is subang                    | htly gravell<br>ular to subr                 | y slightly si<br>ounded fine              | ty CLAY.                    | Sand is fine<br>e.       |                           |                                |
| 5.50                        | SPT<br>(S)                   |          |          |      | 50 (8,30/50 for 7        | 75mm)                   | (4.00)               |       |   |   |  |   |                             |                          |                           |                                |
| 7.00                        | SPT<br>(S)                   |          |          |      | 50 (25 for 50mn<br>75mm) | n/50 for                |                      |       |   |   |  |   |                             |                          |                           |                                |
| 8.00                        | SPT<br>(S)                   |          |          |      | 50 (7,28/50 for 7        | 75mm)                   | 48.88                | 8.00  |   |   | End of core at                               | ē   |                             |                          |                           |                                |
|                             |                              |          |          |      |                          |                         |                      |       |   |   |  |   |                             |                          |                           |                                |
| Remarks                     | 1                            | 1        | 1        | 1    | 1                        |                         | 1                    |       |   | Core Bar  | rel:   | Water Stri<br>Struck                      | kes:<br>Rose to             | Time                     |                           |                                |
|                             |                              |          |          |      |                          |                         |                      |       |   | Flush Typ   | De:  |   | <u>(III)</u>                |                          | A                         | GS                             |
|                             |                              |          |          |      |                          |                         |                      |       |   | Water Added:<br>From (m)                                  | To (m)                                       | Casing:<br>To (m)<br>4.00                 | Diame<br>200                | ter (mm)                 | www.causewa<br>© Causeway | aygeotech.com<br>/ Geotech Ltd |

| Caus                                | sew                                   | /ay                  | Geo                 | oted   | ch Ltd                             | Projec       | t no.         | Project<br>Name:                | Greater Du<br>Investigatio             | ıblin Draiı<br>on            | nage Sch                      | ieme Gi                    | round             | Boreho<br>BH1  | ole No.<br>I24              |
|-------------------------------------|---------------------------------------|----------------------|---------------------|--------|------------------------------------|--------------|---------------|---------------------------------|--|------------------------------|-------------------------------|----------------------------|-------------------|--|-----------------------------|
| Method:                             |                                       |                      |                     |        |                                    | Co-ord       | ds:           | Client:                         | Irish Water                            |                              |                               |                            |                   | Sheet  | 1 of 1                      |
| 0.00 4.6<br>4.60 10.                | 0 C<br>00 F                           | Cable Pe<br>Rotary D | ercussio<br>rilling | n      |                                    | 317070       | 0.14mE        | Client's Boy                    | recentative                            | Tohin                        | Conquitin                     | a Engin                    | 0.010             | Scale: 1   | 1:50                        |
| Plant:                              |                                       |                      |                     |        |                                    | 242222       | 2.29mN        | Client's Rep                    | Siesemative                            |                              | Consulti                      | iy Engii                   | leers             | Crew: (  | CC+GT                       |
| Dando 2000                          | )+Bere                                | tta 141              |                     |        |                                    | 57.53N       | NOD           | Dates:                          | 14/01/2018                             | 5                            |                               |                            |                   | Logged B   | y: DOM                      |
| Depth (m)                           | TCR                                   | SCR                  | RQD                 | FI     | Field Rec                          | ords         | Level & Depth |                                 | Str                                    | atum Des                     | cription                      |                            |                   | Legend 8<br>Water  | Backfil Installs            |
| 0.00 - 1.20                         | В                                     |                      |                     |        |                                    |              |               | Firm brown<br>coarse. Gra       | slightly sandy sl<br>avel is subangul  | ightly grave<br>ar to subrou | elly silty CL.<br>unded, fine | AY. Sand<br>to coarse      | is fine to        |  |                             |
| 1.20<br>1.20<br>1.50<br>1.50 - 2.00 | D<br>SPT<br>(S)<br>1.20<br>SPT<br>(S) |                      | 1.20                |        | N=11 (2,2/3,2,3<br>N=14 (2,2/3,3,4 | 3,3)<br>1,4) | (2.10)        |                                 |  |                              |                               |                            |                   |  |                             |
| 2.00<br>2.00<br>2.10 - 3.00         | B<br>SPT<br>(S)<br>D<br>2.00<br>B     |                      | 2.00                |        | N=31 (2,4/7,7,8                    | 3,9)         | 55.43 2.10    | Very stiff gre<br>fine to coars | ey slightly sandy<br>se. Gravel is sub | slightly gra                 | avelly slight<br>subrounde    | ly silty CL<br>d fine to c | AY. Sand is oarse |  | <b>-</b>                    |
| 3.00<br>3.00<br>3.50 - 4.00         | 3.00<br>SPT<br>(S)<br>D<br>B          |                      | 3.00                | 2.9    | N=45 (6,9/10,1 <sup>-</sup>        | 1,11,13)     |               |                                 |  |                              |                               |                            |                   |  |                             |
| 4.00<br>4.00                        | D<br>4.00<br>SPT<br>(S)               |                      | 4.00                | 3.8    | 50 (9,12/50 for                    | 150mm)       |               |                                 |  |                              |                               |                            |                   |  |                             |
| 6.00                                | SPT<br>(S)                            |                      |                     |        | 50 (25 for 10mr<br>10mm)           | n/50 for     | (7.90)        |                                 |  |                              |                               |                            |                   |  |                             |
| 7.50<br>7.50                        | SPT<br>(S)<br>D                       |                      |                     |        | 50 (25 for 80mr<br>100mm)          | m/50 for     |               |                                 |  |                              |                               |                            |                   | 선정하는 정수는 정수는 정수는 정수는 정수는 것을 수 있다.<br>18월 19일 년 19일 |                             |
| 9.00<br>9.00                        | SPT<br>(S)<br>D                       |                      |                     |        | 50 (25 for 15mr<br>25mm)           | m/50 for     |               |                                 |  |                              |                               |                            |                   |  |                             |
|                                     |                                       |                      |                     |        |                                    |              | 47.53 10.00   |                                 | E                                      | nd of core at 1              | 10.00 m                       |                            |                   |  |                             |
| Remarks                             | 1                                     | 1                    | 1                   | 1      | 1                                  |              | 1             | 1                               | Core Bar                               | rel:                         | Water Stri<br>Struck          | kes:<br>Rose to            | Time              |  |                             |
| SPTs carrie                         | d out u                               | sing SI              | PT harr             | nmer C | C04.                               |              |               |                                 | Flush Typ                              | be:                          | <b>(m)</b><br>2.90            | (m)<br>2.60                | (min)<br>20       |  |                             |
|                                     |                                       |                      |                     |        |                                    |              |               |                                 | Water Added:                           |                              | Casina:                       |                            |                   | AU   | <b>D</b>                    |
|                                     |                                       |                      |                     |        |                                    |              |               |                                 | From (m)                               | To (m)                       | <b>To (m)</b><br>4.60         | <b>Diame</b><br>200        | ter (mm)          | _  |                             |
|                                     |                                       |                      |                     |        |                                    |              |               |                                 |  |                              |                               |                            |                   | © Causeway   | /geotech.com<br>Geotech Ltd |

| Caus                         | sew                  | 'ay      | Geo     | otec   | ch Ltd                        | Projec<br>14-645 | t no.                  |       | Project<br>Name:                            | Greater D<br>Investigati                                   | ublin Drair<br>on                              | lage Schei   | me Grou                               | und                    | Borel<br>Bl  | nole<br>H125       | No.                                   |
|------------------------------|----------------------|----------|---------|--------|-------------------------------|------------------|------------------------|-------|---|--|--|--|---------------------------------------|------------------------|--|--------------------|---------------------------------------|
| Method:                      |                      | able D   |         |        |                               | Co-orc           | ds:                    |       | Client:                                     | Irish Wate   | r  |  |                                       |                        | Shee   | et 1 o             | ıf 2                                  |
| 4.00 4.00                    | 20 F                 | Rotary D | rilling | in .   |                               | 317260           | 0.55mE                 |       | Client's Re                                 | presentative   | : Tobin (                                      | Consulting   | Enginee                               | ers                    | Scale:   | 1:50               | )                                     |
| Plant:<br>Dando 2000         | )+Bere               | tta T41  |         |        |                               | Groun            | d Level                | :     | Dates:                                      | 15/01/201  | 5  |  |                                       |                        | Crew:  | BV: [              | SJ                                    |
| Donth (m)                    | тер                  | SCR      | BOD     | -      | Field Beer                    | 55.75N           |                        | Donth |   | 64   | rotum Door                                     | vintion  |                                       |                        | Legend   | Бу. с<br>1 & в     | Backfill                              |
| Depth (m)                    | ICR                  | SCR      | RQD     |        | Field Reco                    | oras             |                        | Deptr | TOPSOIL                                     | 50   | ratum Desc                                     | ription  |                                       |                        | Strike   | r lı<br>s          | nstalls                               |
| 0.35                         | В                    |          |         |        |                               |                  | <i>(0.35)</i><br>55.40 | 0.35  | Stiff brown<br>fine to coars                | slightly sandy sl<br>se. Gravel is sul                     | ightly gravell<br>bangular to s                | y slightly silt<br>ubrounded fi                      | / CLAY. Sanne to coar                 | and is<br>rse          |  |                    |                                       |
| 1.20<br>1.20<br>1.20         | D<br>SPT<br>(S)<br>D |          |         |        | N=19 (2,3/4,4,5               | ,6)              | (1.45)                 |       |   |  |  |  |                                       |                        |  |                    |                                       |
| 1.80<br>2.00<br>2.00         | B<br>SPT<br>(S)<br>D |          |         |        | N=50 (17 for<br>90mm/10,11,15 | ,14)             | 53.95                  | 1.80  | Very stiff bla<br>fine to coars             | ack slightly sand<br>se. Gravel is sul                     | ly slightly gra<br>bangular to s               | avelly slightly<br>subrounded fi                     | silty CLA<br>ne to coar               | Y. Sand is<br>rse      |  |                    | *******                               |
| 3.00<br>3.00<br>3.00<br>3.50 | SPT<br>(S)<br>D<br>B |          |         |        | 50 (6,9/50 for 20             | 00mm)            | (2.20)                 |       |   |  |  |  |                                       |                        | 2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012<br>2012 |                    | · · · · · · · · · · · · · · · · · · · |
| 4.00<br>4.00<br>4.00         | D<br>D<br>SPT<br>(S) |          |         |        | 50 (10,15/50 for              | r 150mm)         | 51.75                  | 4.00  | Very stiff da<br>with large b<br>subrounded | ark gray slightly<br>oulders. Sand is<br>I fine to coarse. | sandy slightl<br>s fine to coar<br>Boulders ar | y gravelly slig<br>se. Gravel is<br>e subangula      | htly silty (<br>subangul<br>to subrou | CLAY<br>ar to<br>unded |  |                    |                                       |
| 6.20                         | SPT<br>(S)           |          |         |        | 50 (10,29/50 for              | r 75mm)          | (7.20)                 |       |   |  |  |  |                                       |                        |  |                    | ۰                                     |
| 7.70                         | SPT<br>(S)           |          |         |        | 50 (12,13/50 for              | r 10mm)          | (7.20)                 |       |   |  |  |  |                                       |                        |  |                    | · · · · · · · · · · · · · · · · · · · |
| 9.20                         | SPT<br>(S)           |          |         |        | 80 (8,32/80 for <sup>-</sup>  | 150mm)           |                        |       |   |  |  |  |                                       |                        |  |                    |                                       |
| Remarke                      |                      |          |         |        |                               |                  |                        |       |   | Core Bar   | continued on ne                                | xt sheet<br>Water Strike                             | s:                                    |                        |  |                    |                                       |
| SPTs carried                 | d out u              | sing SI  | PT ham  | nmer C | C04.                          |                  |                        |       |   | Flush Ty   | pe:  | Struck (m)         Rd (m)           2.80         2.6 | ose to T<br>) (r<br>5 20              | 'ime<br>min)<br>0      | A  | L<br>GS            |                                       |
|                              |                      |          |         |        |                               |                  |                        |       |   | Water Added<br>From (m)                                    | :<br>To (m)                                    | Casing:<br>To (m)<br>4.00                            | Diameter<br>200                       | (mm)                   | www.causev<br>© Causewa  | vaygeot<br>ay Geot | tech.com                              |

| Caus                    | sew      | ay                 | Geo                 | otec   | h Ltd    | <b>Projec</b><br>14-645 | st no.        | Project<br>Name: | Greater Di<br>Investigati                        | ublin Drain<br>on     | age Sche  | me Gi                                    | round                            | Borehol<br>BH12                     | e No.<br>25                   |
|-------------------------|----------|--------------------|---------------------|--------|----------|-------------------------|---------------|------------------|--|-----------------------|---|--|----------------------------------|-------------------------------------|-------------------------------|
| Method:                 |          |                    | -                   |        |          | Co-ord                  | ds:           | Client:          | Irish Wate                                       | r                     |   |  |                                  | Sheet 2                             | of 2                          |
| 0.00 4.00<br>4.00 11.2  | 0 R      | able Pe<br>otary D | ercussio<br>rilling | n      |          | 31726                   | 0.55mE        | Client's Ren     | resentative                                      | : Tobin C             | Consulting                                      | Engir                                    | neers                            | Scale: 1:                           | 50                            |
| Plant:<br>Dando 2000    | +Rorot   | ta T41             |                     |        |          | Groun                   | d Level:      | Det              | 45/04/00   | -                     | Julia   |  |                                  | Crew: C                             | C+SJ                          |
|                         | Deret    | la 141             |                     |        |          | 55.75N                  | NOD           | Dates:           | 15/01/201  | 5                     |   |  |                                  | Logged By                           | : DOM                         |
| Depth (m)               | TCR      | SCR                | RQD                 | FI     | Field Re | cords                   | Level & Depth |                  | St   | ratum Desc            | ription   |  |                                  | Water<br>Strikes                    | Backfill<br>Installs          |
|                         |          |                    |                     |        |          |                         | 44.55 11.20   |                  |  | End of core at 11     | 1.20 m  |  |                                  | Strikes                             |                               |
| Remarks<br>SPTs carried | l out us | sing SF            | │<br>⊃T harr        | nmer C | <br>C04. |                         |               |                  | Core Bar<br>Flush Typ<br>Water Added<br>From (m) | rel:<br>De:<br>To (m) | Water StrikeStruckR(m)(n2.802.Casing:To (m)4.00 | es:<br>ose to<br>n)<br>6<br>Diame<br>200 | Time<br>(min)<br>20<br>eter (mm) | AG<br>www.causewayg<br>© Causeway G | S<br>eotech.com<br>eotech Ltd |

| Caus                         | sew                       | ay      | Geo      | otec | h Ltd                     | Projec<br>14-645 | t no.                    |       | Project<br>Name:                | Greater Du<br>Investigatio              | ıblin Drain<br>on              | age Sche                     | eme Gr                 | round                 | Boreh<br>BH              | ole No.<br>126                        |
|------------------------------|---------------------------|---------|----------|------|---------------------------|------------------|--------------------------|-------|---------------------------------|---|--------------------------------|------------------------------|------------------------|-----------------------|--------------------------|---------------------------------------|
| Method:                      |                           | able De | arcussio | n    |                           | Co-orc           | ls:                      |       | Client:                         | Irish Water                             |                                |                              |                        |                       | Sheet                    | : 1 of 2                              |
| 4.70 11.7                    | 0 R                       | otary D | rilling  |      |                           | 242037           | 5.46mE<br>7.20mN         |       | Client's Re                     | presentative                            | : Tobin C                      | Consulting                   | Engin                  | ieers                 | Scale:                   | 1:50                                  |
| Dando 2000                   | +Beret                    | tta T41 |          |      |                           | Groun            | d Leve                   | l:    | Dates:                          | 16/01/201                               | 5                              |                              |                        |                       | Logged I                 | Bv: DOM                               |
| Depth (m)                    | TCR                       | SCR     | RQD      | FI   | Field Reco                | 51.32M           | Level &                  | Depth |                                 | Str                                     | atum Desc                      | ription                      |                        |                       | Legend<br>Water          | & Backfill                            |
|                              |                           | _       |          |      |                           |                  | (0.20)                   |       | TOPSOIL                         |   |                                | •                            |                        |                       | Strikes                  |                                       |
| 0.20                         | В                         |         |          |      |                           |                  | 51.12<br>( <i>1.00</i> ) | 0.20  | Stiff brown s<br>fine to coars  | slightly sandy sli<br>se. Gravel is sub | ghtly gravell<br>angular to s  | y slightly sili<br>ubrounded | ty CLAY.<br>fine to c  | . Sand is<br>oarse    |                          |                                       |
| 1.20<br>1.20<br>1.20<br>1.70 | D<br>SPT<br>(S)<br>D<br>B |         |          |      | N=23 (3,3/4,5,7,          | .7)              | 50.12                    | 1.20  | Very stiff bla<br>fine to coars | ack slightly sand<br>se. Gravel is sub  | y slightly gra<br>angular to s | avelly slightly<br>ubrounded | y silty C<br>fine to c | LAY. Sand is<br>oarse |                          |                                       |
| 2.00<br>2.00                 | D<br>SPT<br>(S)           |         |          |      | N=49 (7,10/10,1           | 1,13,15)         |                          |       |                                 |   |                                |                              |                        |                       |                          |                                       |
| 2.50<br>2.50                 | D<br>B                    |         |          |      |                           |                  |                          |       |                                 |   |                                |                              |                        |                       |                          |                                       |
| 3.00<br>3.00                 | SPT<br>(S)<br>D           |         |          |      | 50 (6,9/50 for 15         | 50mm)            | (3.50)                   |       |                                 |   |                                |                              |                        |                       |                          | , , , , , , , , , , , , , , , , , , , |
| 3.50<br>3.50                 | B<br>D                    |         |          |      |                           |                  |                          |       |                                 |   |                                |                              |                        |                       |                          |                                       |
| 4.00<br>4.00                 | D<br>SPT<br>(S)           |         |          |      | 50 (25 for 130m<br>130mm) | m/50 for         |                          |       |                                 |   |                                |                              |                        |                       |                          |                                       |
| 4.50                         | D                         |         |          |      |                           |                  | 46.62                    | 4.70  | Very stiff to                   | hard black sligh                        | tly sandy slir                 | nhtly gravell                | v sliahtly             | v silty CLAY          |                          |                                       |
| 5.50                         | SPT<br>(S)                |         |          |      | 50 (25 for 20mm<br>0mm)   | n/50 for         |                          |       | Sand is fine<br>coarse          | to coarse. Grav                         | el is subang                   | ular to subr                 | ounded                 | fine to               |                          |                                       |
| 7.00                         | SPT<br>(S)                |         |          |      | 50 (25 for 3mm/<br>0mm)   | 50 for           | (7.00)                   |       |                                 |   |                                |                              |                        |                       |                          |                                       |
| 8.50                         | SPT<br>(S)                |         |          |      | 50 (25 for 20mm<br>0mm)   | n/50 for         |                          |       |                                 |   |                                |                              |                        |                       |                          |                                       |
| 10.00                        | SPT<br>(S)                |         |          |      | 50 (25 for 0mm/<br>0mm)   | 50 for           |                          |       |                                 | c                                       | ontinued on new                | kt sheet                     |                        |                       |                          |                                       |
| Remarks                      |                           |         |          |      |                           |                  |                          |       |                                 | Core Bar                                | rel:                           | Water Strike<br>Struck       | es:<br>lose to         | Time                  |                          |                                       |
|                              |                           |         |          |      |                           |                  |                          |       |                                 | Flush Typ                               | be:                            | ( <b>m</b> ) (1<br>7.00 7    | <b>m)</b><br>.0        | (min)<br>10           | A                        | GS                                    |
|                              |                           |         |          |      |                           |                  |                          |       |                                 | Water Added:<br>From (m)                | To (m)                         | Casing:<br>To (m)<br>4.70    | Diame<br>200           | ter (mm)              | www.causewa<br>© Causewa | aygeotech.com<br>/ Geotech Ltd        |

| Caus                   | sew         | ay                  | Geo                 | otec        | ch Ltd                    | Projec<br>14-64{ | ;t no.              | Project<br>Name: | Greater Du<br>Investigatio | blin Drair      | nage Sch            | ieme G     | Fround      | Borehol<br>BH1:               | e No.<br>26                |
|------------------------|-------------|---------------------|---------------------|-------------|---------------------------|------------------|---------------------|------------------|----------------------------|-----------------|---------------------|------------|-------------|-------------------------------|----------------------------|
| Method:                |             |                     |                     |             |                           | Co-ore           | ds:                 | Client:          | Irish Water                |                 |                     |            |             | Sheet 2                       | 2 of 2                     |
| 0.00 4.70<br>4.70 11.7 | ) C<br>70 F | able Pe<br>totary D | ercussio<br>Filling | n           |                           | 318086           | 6.46mE              | Client's Re      | presentative               | Tobin (         | Consultir           |            | ineers      | Scale: 1:                     | :50                        |
| Plant:                 | ∿+Rere      | #a T41              | i                   |             |                           | Groun            | 7.20mN<br>id Level: |                  | 10/04/0045                 |                 |                     |            |             | Crew: C                       | C+GT                       |
|                        |             | 110 1               | <del></del>         | <del></del> | <del></del>               | 51.32N           | /OD                 | Dates:           | 16/01/2015                 | ·               |                     |            |             | Logged By                     | ': DOM                     |
| Depth (m)              | TCR         | SCR                 | RQD                 | FI          | Field Rec                 | ords             | Level & Depth       |                  | Stra                       | atum Desc       | cription            |            |             | Water<br>Strikes              | Backfill<br>Installs       |
| 11.50<br>Remarks       | SPT<br>(S)  |                     |                     |             | 50 (25 for 20mr<br>225mm) | m/50 for         | 39.62 11.70         |                  | Core Barr                  | nī of core at 1 | Water Str<br>Struck | ikes:      |             |                               |                            |
|                        |             |                     |                     |             |                           |                  |                     |                  | Elush Tvn                  |                 | (m)<br>7.00         | (m)<br>7.0 | (min)<br>10 |                               | D                          |
|                        |             |                     |                     |             |                           |                  |                     |                  |                            | e.              |                     |            |             | AG                            | S                          |
|                        |             |                     |                     |             |                           |                  |                     |                  | Water Added:<br>From (m)   | To (m)          | Casing:<br>To (m)   | Diam       | neter (mm)  |                               |                            |
|                        |             |                     |                     |             |                           |                  |                     |                  |                            |                 | 4.70                | 200        |             | www.causewayg<br>© Causeway G | jeotech.com<br>Jeotech Ltd |

| Caus                                       | sew                               | ay i     | Geo     | otec   | ch Ltd                       | <b>Projec</b><br>14-645 | <b>t no.</b>           |       | Project<br>Name:                              | Greater Du<br>Investigatio                       | ıblin Drair<br>on              | nage Sch                     | eme Gr                      | ound                       | Boreh<br>BH              | ole No.<br>127                 |
|--|-----------------------------------|----------|---------|--------|------------------------------|-------------------------|------------------------|-------|---|--|--------------------------------|------------------------------|-----------------------------|----------------------------|--------------------------|--------------------------------|
| Method:                                    |                                   | able De  |         | -      |                              | Co-oro                  | ds:                    |       | Client:                                       | Irish Water                                      |                                |                              |                             |                            | Sheet                    | t 1 of 1                       |
| 4.50 9.50                                  | ) R                               | lotary D | rilling | 11     |                              | 318292<br>24199         | 2.95mE                 |       | Client's Re                                   | oresentative                                     | : Tobin (                      | Consultin                    | g Engin                     | eers                       | Scale:                   | 1:50                           |
| Plant:<br>Dando 2000                       | +Bere                             | tta T41  |         |        |                              | Groun                   | d Level                | :     | Dates:  | 14/01/201  | 5                              |                              |                             |                            | Crew:                    | BV: DOM+                       |
| Donth (m)                                  | TOP                               | SCR      | BOD     | E1     | Field Beer                   | 49.17N                  |                        | Donth |   | C4-  | atum Door                      | vintion                      |                             |                            | Legend                   | & Backfill                     |
| Depth (m)                                  | ICR                               | SUR      | RQD     | F1     | Field Reco                   | oras                    | Level &                | Depth | TOPSOIL                                       | 50   | atum Desc                      | ription                      |                             |                            | Strikes                  | Installs                       |
| 0.30 - 1.20                                | В                                 |          |         |        |                              |                         | <i>(0.30)</i><br>48.87 | 0.30  | Stiff to very<br>clayey SILT<br>fine to coars | stiff brown grey<br>Sand is fine to<br>se.       | slightly sand<br>coarse. Gra   | dy slightly (<br>vel is suba | gravelly si<br>ngular to    | ightly<br>subrounded       |                          |                                |
| 1.20<br>1.20                               | 1.20<br>SPT<br>(S)<br>D           |          | 1.20    |        | N=31 (4,6/6,7,9              | ,9)                     | (1.50)                 |       |   |  |                                |                              |                             |                            |                          |                                |
| 1.80 - 2.00<br>2.00<br>2.00<br>2.50 - 3.00 | B<br>2.45<br>SPT<br>(S)<br>D<br>B |          | 2.45    |        | N=49 (6,8/10,11              | ,13,15)                 | 47.37                  | 1.80  | Very stiff bla<br>is fine to co               | ack slightly sand<br>arse. Gravel is s           | y slightly gra<br>ubangular to | avelly sligh<br>o subround   | tly silty Cl<br>led fine to | LAY. Sand<br>coarse.       |                          |                                |
| 3.00<br>3.00                               | D<br>SPT<br>(S)                   |          |         |        | 50 (9,15/50 for <sup>-</sup> | 150mm)                  | (2.70)                 |       |   |  |                                |                              |                             |                            |                          |                                |
| 4.00<br>4.00                               | 4.00<br>D<br>SPT<br>(S)           |          | 4.00    |        | 50 (11,14/50 for             | 150mm)                  | 44.67                  | 4.50  | Dark grey s<br>boulder. Sa<br>to coarse.      | lightly sandy sli <u>c</u><br>nd is fine to coar | htly gravelly<br>se. Gravel i  | ∕ slightly si<br>s subangu   | ity CLAY i                  | with large<br>rounded fine |                          |                                |
| 6.00                                       | SPT<br>(S)                        |          |         |        | 86 (11,34/86 for             | 150mm)                  |                        |       |   |  |                                |                              |                             |                            |                          |                                |
| 7.50                                       | SPT<br>(S)                        |          |         |        | 50 (25 for 60mm<br>10mm)     | n/50 for                | (5.00)                 |       |   |  |                                |                              |                             |                            |                          |                                |
| 9.50                                       | SPT<br>(S)                        |          |         |        | 50 (7,35/50 for 7            | 75mm)                   | 39.67                  | 9.50  |   |  | End of core at §               | 9.50 m <sup></sup>           |                             |                            |                          |                                |
| Remarks                                    |                                   | 1        | 1       | I      | 1                            |                         | 1                      |       | 1   | Core Bar   | el:                            | Water Stri                   | kes:                        | Time                       |                          |                                |
| SPTs carried                               | d out u                           | sing SF  | PT ham  | imer C | C04.                         |                         |                        |       |   | Eluch Tre  |                                | Struck<br>(m)                | Rose to<br>(m)              | (min)                      |                          |                                |
|  |                                   |          |         |        |                              |                         |                        |       |   |  |                                |                              |                             |                            | A                        | GS                             |
|  |                                   |          |         |        |                              |                         |                        |       |   | Water Added:<br>From (m)                         | To (m)                         | Casing:<br>To (m)<br>4.50    | Diame<br>200                | ter (mm)                   | www.causewa<br>© Causewa | aygeotech.com<br>y Geotech Ltd |

| Caus                   | sew         | 'ay                  | Geo                  | otec | ch Ltd          | <b>Projec</b><br>14-645 | <b>:t no.</b>                     |       | Project<br>Name:  | Greater Du<br>Investigatio                                | ıblin Drain<br>on   | age Sch                              | neme G                                    | round                                  | Boreho<br>BH1              | ole No.<br>28               |
|------------------------|-------------|----------------------|----------------------|------|-----------------|-------------------------|-----------------------------------|-------|---|---|---|--------------------------------------|---|--|----------------------------|-----------------------------|
| Method:                |             |                      |                      |      |                 | Co-ore                  | ds:                               |       | Client:   | Irish Water   |   |                                      |   |  | Sheet                      | 1 of 1                      |
| 0.00 3.60<br>3.60 8.00 | ) ()<br>) F | Cable Pe<br>Rotary D | ercussio<br>Prilling | n    |                 | 31881                   | 4.73mE                            |       |   |   |   |                                      |   |  | Scale: 1                   | 1:50                        |
| Plant:                 |             |                      |                      |      |                 | 24184                   | 4.11mN                            |       | Client's Re   | presentative  |   | Consultir                            | ng Engi                                   | neers                                  | Crew: (                    | CC+SJ                       |
| Dando 2000             | )+Bere      | tta T41              |                      |      |                 | 45.95N                  | I <b>d Leve</b> i:<br>10D         |       | Dates:  | 06/01/2015  | 5   |                                      |   |  | Logged B                   | y: DOM                      |
| Depth (m)              | TCR         | SCR                  | RQD                  | FI   | Field Rec       | ords                    | Level & I                         | Depth |   | Str   | atum Desc   | ription                              |   |  | Legend 8<br>Water          | Backfil<br>Installs         |
| 0.00 - 0.30            | В           |                      |                      |      |                 |                         | (0.30)                            |       | TOPSOIL   |   |   |                                      |   |  |                            |                             |
| 0.30 - 1.10            | В           |                      |                      |      |                 |                         | 45.65<br>( <i>0.80</i> )<br>44.85 | 0.30  | Firm to stiff<br>SILT with o<br>Gravel is su<br>Very stiff bl | light brown sligh<br>ccasional cobble<br>ibrounded to sub | tly sandy sli<br>s and bould<br>bangular fine<br>y gravelly sli | ghtly grav<br>ers. Sand<br>to coarse | elly sligh<br>is fine to<br>e.<br>CLAY wi | tly clayey<br>coarse.<br>th occasional |                            |                             |
| 1.20<br>1.20           | U           |                      |                      |      |                 |                         |                                   |       | cobbles and<br>coarse.  | d boulders. Grav  | el is subrour   | nded to su                           | ıbangular                                 | fine to                                |                            |                             |
| 2.00<br>2.00           | SPT<br>(S)  |                      |                      |      | N=41 (4,8/10,1) | 0,11,10)                |                                   |       |   |   |   |                                      |   |  | <u>862-97</u><br>67-97     |                             |
| 2.50 - 3.00            | В           |                      |                      |      |                 |                         | (2.50)                            |       |   |   |   |                                      |   |  |                            |                             |
| 3.00                   | U           |                      |                      |      |                 |                         |                                   |       |   |   |   |                                      |   |  | 4 <u>0</u> 400<br>400      | *                           |
| 3.50                   | D           |                      |                      |      | 50 (25 for 25mr | m/50 for                | 42.35                             | 3.60  |   |   | 1   |                                      |   | 1                                      | <u> </u>                   | ×                           |
| 5.50                   | (S)         |                      |                      |      | Sommy           |                         |                                   |       | Very stiff to<br>CLAY. Sand<br>to coarse                      | hard dark grey s  | e. Gravel is s  | y siigntiy g                         | gravelly s<br>Ir to subr                  | lightly slity<br>ounded fine           |                            |                             |
| 5.00                   | SPT<br>(S)  |                      |                      |      | 50 (9,26/50 for | 75mm)                   | (4.40)                            |       |   |   |   |                                      |   |  |                            |                             |
| 6.50                   | SPT<br>(S)  |                      |                      |      | 50 (7,32/50 for | 75mm)                   |                                   |       |   |   |   |                                      |   |  |                            |                             |
| 8.00                   | SPT<br>(S)  |                      |                      |      | 50 (6,28/50 for | 75mm)                   | 37.95                             | 8.00  |   | ı   | End of core at £  | .00 m                                |   |  |                            |                             |
| Remarks                |             |                      |                      |      |                 |                         |                                   |       |   | Core Bar  | rel:  | Water Str<br>Struck                  | ikes:<br>Rose to                          | Time                                   |                            |                             |
| SPT's carrie           | ed out i    | using S              | PT Ha                | mmer | CC04            |                         |                                   |       |   | Flush Typ   | be:   | (m)<br>3.60                          | (m)<br>3.10                               | (min)<br>20                            | AC                         | L<br>IS                     |
|                        |             |                      |                      |      |                 |                         |                                   |       |   | Water Added:<br>From (m)                                  | To (m)  | Casing:<br>To (m)<br>3.60            | Diam                                      | eter (mm)                              | www.causeway<br>© Causeway | /geotech.com<br>Geotech Ltd |

| Cau                                | sew                  | /ay                  | Geo                  | oted | ch Ltd                  | Projec          | s <b>t no</b> .          |       | Project<br>Name:            | Greater Du<br>Investigatio                 | ıblin Draiı<br>on               | nage Sche                        | eme Ground                                | Boreho                                       | ole No.<br>130              |
|------------------------------------|----------------------|----------------------|----------------------|------|-------------------------|-----------------|--------------------------|-------|-----------------------------|--|---------------------------------|----------------------------------|---|--|-----------------------------|
| Method:                            |                      |                      |                      |      |                         | Co-ore          | ds:                      |       | Client:                     | Irish Water                                |                                 |                                  |   | Sheet  | 1 of 1                      |
| 0.00 4.0<br>4.00 7.6               | 0 C                  | Cable Pe<br>Rotary D | ercussic<br>Drilling | n    |                         | 32078           | 4.92mE                   |       |                             |  |                                 |                                  |   | Scale:                                       | 1:50                        |
| Plant:                             |                      |                      |                      |      |                         | 24281           | 5.26mN                   |       | Client's Re                 | epresentative                              | : Tobin                         | Consulting                       | Engineers                                 | Crew:  | MMc+GT                      |
| Dando 200                          | 0+Bere               | tta T41              | l                    |      |                         | Groun<br>28.54N | I <b>d Leve</b> l<br>NOD | l:    | Dates:                      | 22/01/2015                                 | 5                               |                                  |   | Logged E                                     | By:                         |
| Depth (m)                          | TCR                  | SCR                  | RQD                  | FI   | Field Rec               | ords            | Level &                  | Depth |                             | Str  | atum Des                        | cription                         |   | Legend &<br>Water                            | & Backfil<br>Installs       |
|                                    |                      |                      |                      |      |                         |                 | (0.40)                   |       | TOPSOIL                     | - Light brown slig                         | htly sandy o                    | lay with root                    | lets                                      | Strikes                                      |                             |
| 0.50 - 1.00<br>0.50 - 1.00         | D<br>B               |                      |                      |      |                         |                 | 28.14<br>( <i>1.10</i> ) | 0.40  | Firm brow<br>CLAY. Gra      | n mottled grey slig<br>avel is subrounded  | ghtly sandy<br>I to angular     | slightly grave<br>fine to coars  | elly slightly silty<br>se of sandstone    |  |                             |
| 1.20<br>1.20 - 1.65<br>1.20 - 1.65 | SPT<br>(S)<br>B<br>D |                      |                      |      | N=14 (3,3/4,3,3         | ,4)             | 27.04                    | 1.50  | Stiff grey r<br>subrounde   | mottled brown slig                         | htly gravelly<br>to coarse of   | / slightly silty<br>f sandstone  | CLAY. Gravel is                           |  |                             |
| 2.00<br>2.00 - 2.45<br>2.00 - 2.45 | SPT<br>(S)<br>B<br>D |                      |                      |      | N=21 (5,4/5,6,5         | ,5)             | (1.00)                   | 2 50  |                             |  |                                 |                                  |   |  |                             |
| 3.00<br>3.00 - 3.45                | SPT<br>(S)           |                      |                      |      | N=25 (6,5/6,6,7         | ,6)             | 26.04                    | 2.50  | Stiff dark of fine to coa   | grey slightly sandy<br>arse. Gravel is sub | v slightly gra<br>pangular to i | avelly slightly<br>rounded fine  | silty CLAY. Sand is to coarse.            | <u>*************************************</u> |                             |
| 4.00                               | B                    |                      |                      |      | N-20 (7 6/7 9 9         | 7)              | 24.54                    | 4.00  |                             |  |                                 |                                  |   |  |                             |
| 4.00<br>4.00 - 4.45<br>4.00 - 4.50 | (S)<br>B<br>D        |                      |                      |      | N=30 (7,6/7,8,8         | ,7)             | 24.54                    | 4.00  | Very stiff o<br>Sand is fir | lark grey slightly s<br>ne to coarse. Grav | andy slight<br>el is suban      | ly gravelly sli<br>gular to roun | ightly silty CLAY.<br>ded fine to coarse. |  |                             |
| 5.00<br>5.00 - 5.45<br>5.00 - 5.45 | SPT<br>(S)<br>B<br>D |                      |                      |      | N=30 (7,7/6,7,8         | ,9)             |                          |       |                             |  |                                 |                                  |   |  |                             |
|                                    |                      |                      |                      |      |                         |                 | (3.60)                   |       |                             |  |                                 |                                  |   |  |                             |
| 7.00                               | SPT<br>(S)           |                      |                      |      | 50 (25 for 2mm/<br>3mm) | /50 for         |                          |       |                             |  |                                 |                                  |   |  |                             |
|                                    |                      |                      |                      |      |                         |                 | 20.94                    | 7.60  |                             |  | End of core at                  | 7.60 m                           |   |  |                             |
|                                    |                      |                      |                      |      |                         |                 |                          |       |                             |  |                                 |                                  |   |  |                             |
|                                    |                      |                      |                      |      |                         |                 |                          |       |                             |  |                                 | 1                                |   |  |                             |
| Remarks                            |                      |                      |                      |      |                         |                 |                          |       |                             | Core Bar                                   | rel:                            | Water Strike<br>Struck (m) (1    | es:<br>Rose to Time<br>m) (min)           |  | <b></b>                     |
|                                    |                      |                      |                      |      |                         |                 |                          |       |                             | Flush Typ                                  | be:                             | 7.00                             | UT] U.                                    | A  | S                           |
|                                    |                      |                      |                      |      |                         |                 |                          |       |                             | Water Added:<br>From (m)                   | To (m)                          | Casing:<br>To (m)                | Diameter (mm)                             |  |                             |
|                                    |                      |                      |                      |      |                         |                 |                          |       |                             |  |                                 | 7.60                             | 150                                       | www.causewa<br>© Causeway                    | ygeotech.com<br>Geotech Ltd |

| Caus   | sew                            | /ay  | Geo               | otec | ch Ltd                   | Projec<br>14-64! | ct no.                   |              | Project<br>Name:                                      | Greater Du<br>Investigatic  | blin Drair<br>n                             | nage Sche  | eme Gro                                | ound                         | Boreh                   | iole No.<br>1131                 |
|--|--------------------------------|--|-------------------|------|--------------------------|------------------|--------------------------|--------------|---|---|---|--|--|------------------------------|-------------------------|----------------------------------|
| Method:  |                                |  |                   |      |                          | Co-or            | ds:                      |              | Client:   | Irish Water   |   |  |  |                              | Shee                    | t 1 of 1                         |
| 0.00 3.00<br>3.00 5.60<br>5.60 7.60                              | R<br>R                         | able Percu<br>totary Drillin<br>totary Corin | ssion<br>1g<br>1g |      |                          | 32126            | 1.16mE                   |              | Client's Re   | presentative:   | Tobin (                                     | Consulting                                       | n Engina                               | eers                         | Scale:                  | 1:50                             |
| Plant:<br>Dando 2000   | 0+Bere                         | etta T4′                                     | 1                 |      |                          | Grour            | nd Leve                  | l:           | Datas   | 21/01/2015  |   |  |  |                              | Crew:                   | MMc+GT                           |
|  | , <u></u>                      | T  | <del></del>       | T    | T                        | 22.70            |                          |              | Dates.  | 21/01/2013  |   |  |  |                              | Logged<br>Legend        | By: +MFG                         |
| Depth (m)  | TCR                            | SCR  | RQD               | FI   | Field Rece               | ords             | Level 8                  | Depth        |   | Stra  | itum Desc                                   | cription   |  |                              | Water<br>Strike         | Backfin<br>Installs<br>s         |
| 0.50 - 1.00<br>0.50 - 1.00                                       | DB                             |  |                   |      |                          |                  | (0.10)<br>(226)<br>22.40 | 0.10<br>0.30 | TOPSOIL<br>White mott<br>Stiff brown<br>is fine to co | led grey slightly cl<br>mottled grey sligh<br>parse. Gravel is su | ayey slight<br>itly sandy g<br>ibangular to | ly silty fine t<br>gravelly sligh<br>o subrounde | o coarse<br>itly silty C<br>ed fine to | SAND<br>XLAY. Sand<br>coarse |                         |                                  |
| 1.20<br>1.20 - 1.65<br>1.20 - 1.65                               | SPI<br>(S)<br>D<br>B           |  |                   |      | N=17 (4,4/3,4,5          | i,5)             | (1.90)                   |              |   |   |   |  |  |                              |                         |                                  |
| 2.00<br>2.00 - 2.45<br>2.00 - 2.45<br>2.50 - 3.00<br>2.50 - 3.00 | SPT<br>(S)<br>B<br>D<br>B<br>D |  |                   |      | N=19 (4,5/6,5,4          | .,4)             | 20.50<br>( <i>0.80)</i>  | 2.20         | Stiff to very<br>CLAY. San<br>to coarse.              | / stiff dark grey slig<br>d is fine to coarse                     | ghtly sandy<br>. Gravel is :                | v slightly gra<br>subangular                     | velly sligh<br>to subrou               | ntly silty<br>unded fine     |                         |                                  |
| 3.00   | SPT<br>(S)                     |  |                   |      | 50 (25 for 30mn<br>20mm) | n/50 for         | 19.70                    | 3.00         | Stiff dark g  | rey CLAY with free  | quent bould                                 | Jers.  |  |                              |                         |                                  |
| 5.00   | SPT                            |  |                   |      | 50 (25 for 5mm           | n/50 for         | (2.60)                   |              |   |   |   |  |  |                              |                         |                                  |
| 5.60 - 6.60  | (S)                            |  | <br>              |      | 5mm)                     |                  | 17.10                    | 5.60         | Medium sti<br>ARGILLAC                                | rong, thinly lamina<br>CEOUS LIMESTO                              | ated to very<br>NE.                         | , thinly bedd                                    | ed, dark (                             | grey                         |                         |                                  |
| 6.60 - 7.60  | 90                             | 84   | 84                | - 4  |                          |                  | (2.00)                   |              | Partially we<br>DS1: Joint<br>to rough, o             | eathered.<br>s, close to mediun<br>pen, occasional o              | n spaced, h<br>xidised bro                  | orizontal to<br>wn, rare slic                    | 20° plana<br>kensides                  | ar, smooth<br>s.             |                         |                                  |
|  | 90                             | 85   | 76                |      |                          |                  |                          |              |   |   |   |  |  |                              |                         |                                  |
|  |                                |  |                   |      |                          |                  | 15.10                    | 7.60         |   | E   | nd of core at                               | 7.60 m   |  |                              |                         |                                  |
| Remarks  |                                |  |                   |      |                          |                  |                          |              |   | Core Barr<br>+Impreg<br>Flush Typ                                 | el:<br>e:                                   | Water StrikStruckF(m)(5.00F                      | es:<br>Rose to<br><u>m)</u>            | <b>Time</b><br>(min)<br>10   | <br>  <b>Б</b>          |                                  |
|  |                                |  |                   |      |                          |                  |                          |              |   | Water Added:<br>From (m)  | е.<br><br>То (m)                            | Casing:<br>To (m)<br>5.50                        | <b>Diamet</b>                          | er (mm)                      | www.causew<br>© Causewa | /aygeotech.com<br>ay Geotech Ltd |

| Caus                                      | sew            | ay                 | Geo              | otec                                       | h Ltd      | Projec<br>14-645 | t no.  |       | Project<br>Name:  | Greater Du<br>Investigatio   | blin Drair   | nage Sch   | eme Gr                 | ound  | Boreh<br>BH             | ole No.<br>I132                |
|---|----------------|--------------------|------------------|--|------------|------------------|--|-------|---|--|--|--|------------------------|---|-------------------------|--------------------------------|
| Method:                                   |                |                    |                  |  |            | Co-orc           | ds:  |       | Client:   | Irish Water  |  |  |                        |   | Shee                    | t 1 of 1                       |
| 0.00 4.50<br>4.50 7.60                    | ) R<br>) R     | otary D<br>otary C | rilling<br>oring |  |            | 321296           | 6.46mE   |       |   |  |  |  |                        |   | Scale:                  | 1:50                           |
| Plant:                                    |                |                    |                  |  |            | 242799           | 9.15mN   |       | Client's Re   | presentative   | Tobin (  | Consultin  | g Engin                | eers  | Crew:                   | GT                             |
| Beretta T41                               |                |                    |                  |  |            | Groun<br>22.49M  | d Level:<br>10D  |       | Dates:  | 11/02/2015   | i  |  |                        |   | Logged I                | By: MFG                        |
| Depth (m)                                 | TCR            | SCR                | RQD              | FI   | Field Reco | ords             | Level &  | Depth |   | Str  | atum Desc  | ription  |                        |   | Legend<br>Water         | & Backfill                     |
|   |                |                    |                  |  |            |                  | (0.20)   |       | TOPSOIL   |  |  |  |                        |   | Strikes                 | s instans                      |
| 4.50 - 5.50<br>5.50 - 6.50<br>6.50 - 7.60 | 95<br>75<br>77 | 91 48 27           | 49               | NI<br>5<br>20<br>5<br>15<br>20<br>12<br>20 |            |                  | (0.20)<br>22.29<br>(1.80)<br>20.49<br>(2.50)<br>17.99<br>(3.10)<br>14.89 | 0.20  | TOPSOIL<br>Brown mark<br>Grey slightl<br>occasional<br>subangular<br>Medium str<br>LIMESTON<br>throughout.<br>Partially we<br>brownish gr<br>DS1: Beddi<br>often open<br>DS2: Joints<br>light browni<br>DS3: Calcit<br>unstained. | y CLAY<br>y Slightly sandy s<br>cobbles and bou<br>to subrounded, f<br>mighting lamina<br>E with fine to coa<br>athered: Slightly<br>ey staining on so<br>ng, thinly lamina<br>at very close or c<br>, medium space<br>sh grey staining.<br>e vein at 4.95m, | ted dark grav<br>ine to coars<br>ine to coars<br>closer fract<br>ome joints.<br>ted 40 to 50<br>close spacir<br>d, 70 to 90°<br>45°, planar, | elly slightly<br>i is fine to o<br>se.<br>ey to black<br>ized pyrite<br>ure spacing<br>o, smooth,<br>g, unstaine<br>, planar, sm<br>rough, ope | silty CLA<br>coarse. G | Y with<br>iravel is<br>ACEOUS<br>cattered<br>chy<br>closed to<br>en, patchy<br>5mm calcite, |                         |                                |
| Remarks                                   |                |                    |                  |  | L          |                  |  |       |   | Core Barr  | el:  | Water Stri   | kes:<br>Rose to        | Time  |                         |                                |
|   |                |                    |                  |  |            |                  |  |       |   | T2101<br>Flush Typ   | e:   | (m)  | (m)                    | (min)   | Δ                       |                                |
|   |                |                    |                  |  |            |                  |  |       |   | Water Added  |  | Casino:  |                        |   |                         | au                             |
|   |                |                    |                  |  |            |                  |  |       |   | From (m)   | To (m)   | <b>To (m)</b>  | Diamet                 | ter (mm)  |                         |                                |
|   |                |                    |                  |  |            |                  |  |       |   |  |  |  |                        |   | www.causew<br>© Causewa | aygeotech.com<br>y Geotech Ltd |

| Caus                               | sew                | /ay                  | Geo                 | otec | ch Ltd          | <b>Projec</b><br>14-64{ | <b>:t no.</b><br>5 |       | Project<br>Name:                | Greater D<br>Investigati              | ublin Drair<br>on              | nage Sche                      | me Gro                      | ound                    | Boreh<br>BH     | iole No.<br>1133  |
|------------------------------------|--------------------|----------------------|---------------------|------|-----------------|-------------------------|--------------------|-------|---------------------------------|---------------------------------------|--------------------------------|--------------------------------|-----------------------------|-------------------------|-----------------|-------------------|
| Method:                            |                    |                      |                     |      |                 | Co-ore                  | ds:                |       | Client:                         | Irish Wate                            | -                              |                                |                             |                         | Shee            | t 1 of 1          |
| 0.00 5.50<br>5.50 7.6              | 0 C                | Cable Pe<br>Rotary D | ercussio<br>Filling | n    |                 | 321944                  | 4.99mE<br>3.04mN   |       | Client's Rep                    | presentative                          | : Tobin (                      | Consulting                     | Engine                      | ers                     | Scale:          | 1:50              |
| Plant:<br>Dando 2000               | )+Bere             | etta T41             | ]                   |      |                 | Groun                   |                    | 1:    | Dates:                          | 23/01/201                             | 5                              |                                |                             |                         | Crew:           | MMc+GI<br>By: DOM |
| Depth (m)                          | TCR                | SCR                  | RQD                 | FI   | Field Rec       | ords                    | Level &            | Depth | 1                               | St                                    | atum Deso                      | cription                       |                             |                         | Legend<br>Water | & Backfi          |
| -                                  | <del> </del>       | <u> </u>             | +                   | -    | <u> </u>        |                         | (0.40)             |       | TOPSOIL -                       | Brown slightly s                      | andy firm cl                   | ay with rootle                 | ets                         |                         | Strikes         | 3                 |
| 0.50 - 1.00                        | D                  |                      |                     |      |                 |                         | 18.36<br>(0.20)    | 0.40  | Brown claye                     | ey silty fine to m                    | edium SANI                     | D                              |                             |                         |                 |                   |
| 0.50 - 1.00                        | В                  |                      |                     |      |                 |                         | 18.16              | 0.60  | Stiff to very<br>Sand is fine   | stiff brown sligh<br>to coarse. Grav  | tly sandy sli<br>vel is subrou | ghtly gravelly<br>inded to ang | y slightly s<br>ular fine t | silty CLAY.<br>o coarse |                 |                   |
| 1.20                               | SPT                |                      |                     |      | N=19 (4,5/5,4,5 | .5)                     |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 1.20 - 1.65<br>1.20 - 1.65         | (S)<br>B           |                      |                     |      |                 | -,                      |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 2.00<br>2.00 - 2.35<br>2.00 - 2.45 | 2.00<br>SPT<br>(S) |                      | 2.00                |      | N=19 (5,5/4,5,5 | ,5)                     | (2.70)             |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 2.00 - 2.40                        | B<br>D             |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 3.00<br>3.00 - 3.45                | SPT<br>(S)         |                      | 3.00                |      | N=31 (9,8/7,8,9 | ,7)                     |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 3.00 - 3.40                        | B<br>D             |                      |                     |      |                 |                         | 15.46              | 3.30  | Very stiff bla<br>fine to coars | ick slightly sand<br>e. Gravel is sul | y slightly gra                 | avelly slightly angular fine   | y silty CL/<br>to coarse    | AY. Sand is             |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 4.00<br>4.00 - 4.45                | SPT<br>(S)         |                      | 4.00                |      | N=31 (7,8/7,9,7 | ,8)                     |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 4.00 - 4.45                        | 4.00<br>B<br>D     |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 5.00<br>5.00 - 5.45                | SPT<br>(S)         |                      | 5.00                |      | N=37 (9,10/8,10 | ),9,10)                 | (3.70)             |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 5.00 - 5.45<br>5.50                | 5.00<br>B<br>D     |                      | 5.50                |      | 50 (25 for 81mr | n/50 for                |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 0.00                               | 5.50<br>SPT        |                      | 0.01                |      | 125mm)          | 100 10.                 |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    | (5)                |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 6.50                               | QPT                |                      |                     |      | 50 (25 for 50mr | ~/50 for                |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
| 0.00                               | (S)                |                      |                     |      | 40mm)           | 1/30 101                |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         | 11.76              | 7.00  | Coarse GR/                      | AVEL (possible                        | ooulder)                       |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         | (0.60)             |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         | 11.16              | 7.60  |                                 |                                       | End of core at                 | 7.60 m                         |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 | Coro Bar                              |                                | Motor Strike                   | · • •                       |                         | +               |                   |
| Remarks                            |                    |                      |                     |      |                 |                         |                    |       |                                 | CUIE Dai                              | rei:                           | Struck R<br>(m) (r             | es:<br>tose to<br>n)        | Time<br>(min)           |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 | Flush Ty                              | be:                            | 7.00 7.                        | .0                          | 10                      | A               | 25                |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 | Water Added                           |                                | Casing:                        |                             |                         |                 |                   |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 | From (m)<br>0.00                      | <b>To (m)</b><br>5.50          | To (m)<br>5.50                 | Diamete<br>200              | er (mm)                 | www.causew      | aygeotech.cor     |
|                                    |                    |                      |                     |      |                 |                         |                    |       |                                 |                                       |                                |                                |                             |                         | Causewa         | y Geotech Ltd     |

| Cau                         | seway                             | Ge                | otec             | ch Ltd                     | Projec    | <b>:t no.</b>   |         | Project<br>Name:                              | Greater Du<br>Investigatic                               | blin Drain                                    | age Scher                             | me Gro                    | ound                  | Borehol<br>BH1   | ie No.<br>34               |
|-----------------------------|-----------------------------------|-------------------|------------------|----------------------------|-----------|-----------------|---------|---|--|---|---------------------------------------|---------------------------|-----------------------|--|----------------------------|
| Method:                     |                                   |                   |                  |                            | Co-ore    | ds:             |         | Client:                                       | Irish Water  |   |                                       |                           |                       | Sheet 1  | 1 of 1                     |
| 0.00 7.5                    | 50 Cable P                        | 'ercuss           | ion              |                            | 322387    | 7.05mE          | -       | Client's Ren                                  |  | Tobin C                                       | <u>`onsulting</u>                     | Engine                    | Are                   | Scale: 1   | :50                        |
| Plant:                      |                                   |                   |                  |                            | 24183     | 7.46mN          | <br> :  | Cilencercop                                   | lesentative.   |   |                                       |                           |                       | Crew: C  | ;C                         |
|                             |                                   | Casin             | Mator            |                            | 11.63N    | NOD             |         | Dates:  | 08/01/2015   | - 09/01/2                                     | .015                                  |                           |                       | Logged By  | r: DOM                     |
| Depth (m)                   | Sample / Test                     | t Depth<br>(m)    | Depth<br>(m)     | Field Reco                 | ords      | Level 8         | & Depth | า   | Stra   | atum Desc                                     | ription                               |                           |                       | Legend &<br>Water<br>Strikes   | Backfill<br>Installs       |
|                             |                                   |                   |                  |                            |           | (0.30)          | 2.20    | TOPSOIL                                       |  |   |                                       |                           |                       |  |                            |
| 0.30 - 1.20<br>1.20         | B                                 |                   |                  |                            |           | 11.33<br>(1.50) | 0.30    | Firm to stiff t<br>Sand is fine<br>coarse.    | orown slightly sa<br>to coarse. Grav                     | ndy slightly<br>rel is subang                 | gravelly sligi<br>jular to subro      | htly silty ounded, t      | CLAY.<br>fine to      | $\begin{array}{c} \begin{array}{c} & & & \\ & & & \\ & & \\ & & \\ \end{array} \\ \end{array} \\ \begin{array}{c} & & \\ & & \\ \end{array} \\ \end{array} \\ \begin{array}{c} & & \\ & & \\ \end{array} \\ \begin{array}{c} & & \\ & & \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} & & \\ & & \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} & & \\ & & \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} & & \\ \end{array} \\ \end{array}$ |                            |
| 1.20                        | U                                 |                   |                  |                            |           |                 |         |   |  |   |                                       |                           |                       |  |                            |
| 1.80 - 2.50<br>2.00<br>2.00 | B<br>SPT(S)<br>D                  |                   |                  | N=50 (6,9/50 for<br>240mm) | ſ         | 9.83            | 1.80    | Very stiff dar<br>CLAY with o<br>subangular t | k grey to black s<br>ccasional cobble<br>o subrounded, f | slightly sand<br>es. Sand is<br>ine to coarse | y slightly gra<br>fine to coars<br>e. | avelly slig<br>æ. Grave   | jhtly silty<br>el is  |  |                            |
| 3.00<br>3.00                | SPT(S)<br>D                       |                   |                  | 50 (8,13/50 for 2          | 200mm)    | (2.70)          |         |   |  |   |                                       |                           |                       |  |                            |
| 3.50 - 4.00                 | В                                 |                   |                  |                            |           |                 |         |   |  |   |                                       |                           |                       |  |                            |
| 4.00<br>4.00                | SPT(S)<br>D                       |                   |                  | 50 (25 for 140m<br>130mm)  | ım/50 for |                 |         |   |  |   |                                       |                           |                       |  |                            |
| 4.50 - 6.00                 | В                                 |                   |                  |                            |           | 7.13            | 4.50    | Very stiff dar<br>CLAY with o                 | k greyish brown  | slightly san                                  | dy slightly gr<br>boulders. Sa        | ravelly sli<br>and is fin | ightly silty<br>ie to |  |                            |
| 5.00<br>5.00                | SPT(S)<br>D                       |                   |                  | N=50 (7,9/50 for<br>235mm) | r         |                 |         | coarse. Gra                                   | vel is angular to  | subangular                                    | , fine to coar                        | 'se.                      |                       |  |                            |
|                             |                                   |                   |                  |                            |           | (3.00)          |         |   |  |   |                                       |                           |                       |  |                            |
| 6.50<br>6.50                | SPT(S)<br>D                       |                   |                  | N=50 (9,11/12,1            | 12,13,13) |                 |         |   |  |   |                                       |                           |                       |  | ×                          |
|                             |                                   |                   |                  |                            |           | 4.13            | 7.50    |   | Enc  | j of borehole at                              | i 7.50 m                              |                           |                       |  |                            |
|                             |                                   |                   |                  |                            |           |                 |         |   |  |   |                                       |                           |                       |  |                            |
| Remarks                     |                                   |                   | <u> </u>         |                            |           |                 |         |   | Chiselling:  | Time  | Water Strikes                         | s:                        | Timo                  |  |                            |
| SPT's carrie<br>Refusal me  | ed out using S<br>t on possible ! | SPT Ha<br>large b | mmer (<br>oulder | CC04                       |           |                 |         |   | (m) (m)<br>0.00 1.30<br>7.20 7.80                        | (hh:mm)<br>01:00<br>01:30                     | (m) (m<br>7.00 6.5                    | 1)<br>50 :                | (min)<br>20           | AG   | I<br>S                     |
|                             |                                   |                   |                  |                            |           |                 |         |   | Water Added:<br>From (m)                                 | To (m)  | Casing:<br>To (m)<br>7.50             | Diamete<br>200            | ər (mm)               | www.causewayg<br>© Causeway G  | geotech.con<br>Geotech Ltd |

| Cau                                | seway            | Geo          | otec         | h Ltd                     | Projec   | st no.              |      | Project<br>Name:                                 | Greater Dub<br>Investigation  | olin Drair                             | nage Sch                            | ieme Gr                       | ound                       | Boreho                     | ole No.<br>135              |
|------------------------------------|------------------|--------------|--------------|---------------------------|----------|---------------------|------|--|---|--|-------------------------------------|-------------------------------|----------------------------|----------------------------|-----------------------------|
| Method:                            |                  |              |              |                           | Co-ore   | ds:                 |      | Client:  | Irish Water   |  |                                     |                               |                            | Sheet                      | 1 of 1                      |
| 0.00 8.4                           | 40 Cable F       | Percuss      | ion          |                           | 32240    | 8.09mE              |      | Client's Bo                                      | orocontativo:   | Tobin (                                | Concultin                           | a Engin                       | oore                       | Scale:                     | 1:50                        |
| Plant:                             | 0                |              |              |                           | 24183    | 8.13mN<br>Id Level: |      |  |   |  | Consultin                           |                               |                            | Crew: N                    | MMc                         |
|                                    |                  | Casing       | Wator        | 1                         | 11.18N   | NOD                 |      | Dates:   | 27/01/2015  |  |                                     |                               |                            | Logged B                   | y: MMc                      |
| Depth (m)                          | Sample / Test    | Depth<br>(m) | Depth<br>(m) | Field Reco                | ords     | Level & De          | epth |  | Stra  | tum Dese                               | cription                            |                               |                            | Water                      | Backfil Installs            |
|                                    |                  |              |              |                           |          | (0.30)              |      | TOPSOIL  |   |  |                                     |                               |                            |                            |                             |
| 0.50 - 1.00<br>0.50 - 1.00         | D<br>B           |              |              |                           |          | 10.88 0             | .30  | Stiff to very<br>CLAY. Sand<br>to coarse, o      | stiff brown mottle<br>I is fine to coarse.<br>If various lithologie                         | d grey slig<br>Gravel is<br>es.        | htly sandy<br>subangula             | slightly gr<br>r to subrou    | avelly silty<br>unded fine |                            |                             |
| 1.20<br>1.20 - 1.65<br>1.20 - 1.65 | SPT(S)<br>D<br>B |              |              | N=20 (3,3/4,5,6           | ,5)      | (2.40)              |      |  |   |  |                                     |                               |                            |                            |                             |
| 2.00<br>2.00 - 2.45<br>2.00 - 2.45 | SPT(S)<br>D<br>B |              |              | N=36 (3,5/7,10,           | 10,9)    |                     |      |  |   |  |                                     |                               |                            |                            |                             |
| 3.00<br>3.00 - 3.45<br>3.00 - 3.45 | SPT(S)<br>D<br>B |              |              | N=33 (4,5/6,8,1)          | 0,9)     | 8.48 2              | 70   | Very stiff da<br>Sand is fine<br>coarse of va    | rk grey slightly sa<br>to coarse. Grave<br>arious lithologies.                              | ndy slightl<br>I is subang             | ly gravelly s<br>gular to sub       | slightly silt<br>prounded f   | y CLAY.<br>fine to         |                            |                             |
| 4.00<br>4.00 - 4.45<br>4.00 - 4.45 | SPT(S)<br>B<br>D |              |              | N=36 (6,8/7,9,1           | 0,10)    | (3.80)              |      |  |   |  |                                     |                               |                            |                            |                             |
| 5.00<br>5.00 - 5.45<br>5.00 - 5.45 | SPT(S)<br>B<br>D |              |              | N=43 (8,9/10,11           | 1,10,12) |                     |      |  |   |  |                                     |                               |                            |                            |                             |
| 6.50<br>6.50 - 6.95<br>6.50 - 6.95 | SPT(S)<br>D<br>B |              |              | N=50 (7,9/50 fo<br>275mm) | r        | 4.68 6.<br>(0.90)   | .50  | Very stiff bri<br>is fine to co<br>various lithe | own slightly sandy<br>arse. Gravel is su<br>logies, gravelly b                              | / slightly g<br>bangular t<br>elow 7m. | ravelly sligi<br>o subround         | htly silty C<br>led fine to   | LAY. Sand coarse of        |                            | ×<br>                       |
|                                    |                  |              |              |                           |          | 3.78 7              | .40  | Very stiff bro<br>is fine to co<br>various litho | own slightly sandy<br>arse. Gravel is su<br>blogies.  | / slightly g<br>bangular t             | ravelly slig<br>o subround          | htly silty C<br>led fine to   | LAY. Sand coarse of        |                            |                             |
| 8.00<br>8.00 - 8.40                | SPT(C)<br>B      |              |              | 50 (9,10/50 for 7         | 160mm)   | (1.00)              |      |  |   |  |                                     |                               |                            |                            | **.                         |
| 0.00 - 0.40                        |                  |              |              |                           |          | 2.78 8              | .40  |  | Ēnd   | of borehole a                          | at 8.40 m                           |                               |                            |                            |                             |
|                                    |                  |              |              |                           |          |                     |      |  |   |  |                                     |                               |                            |                            |                             |
| Remarks                            |                  | <u> </u>     | <u> </u>     | <u> </u>                  |          | 1                   |      |  | Chiselling:           From         To           (m)         (m)           7.40         8.40 | <b>Time</b><br>(hh:mm)<br>02:00        | Water Stri<br>Struck<br>(m)<br>7.40 | kes:<br>Rose to<br>(m)<br>6.5 | Time<br>(min)<br>20        |                            |                             |
|                                    |                  |              |              |                           |          |                     |      |  | Water Added:From (m)T0.007  | <b>`o (m)</b><br>.40                   | Casing:<br>To (m)<br>8.40           | Diamet<br>200                 | er (mm)                    | www.causeway<br>© Causeway | ygeotech.com<br>Geotech Ltd |

| Caus                               | sew             | 'ay     | Geo     | otec   | ch Ltd            | Projec<br>14-645 | s <b>t no.</b> |       | Project<br>Name:            | Greater D<br>Investigati            | ublin Dra<br>on              | inage Sc                      | heme                | 9 Gro    | und                        | Bore                  | nole<br>H13 <sup>.</sup>   | • No<br>7      | ).           |
|------------------------------------|-----------------|---------|---------|--------|-------------------|------------------|----------------|-------|-----------------------------|-------------------------------------|------------------------------|-------------------------------|---------------------|----------|----------------------------|-----------------------|--|----------------|--------------|
| Method:                            |                 |         |         |        |                   | Co-ord           | ds:            |       | Client:                     | Irish Wate                          | r                            |                               |                     |          |                            | Shee                  | et 1 (   | of 2           | 2            |
| 0.00 7.60<br>7.60 10.9             | 90 S            | ymmet   | rix     | n      |                   | 323078           | 8.15mE         |       | Client's Re                 | oresentative                        | : Tobin                      | Consulti                      | ng Er               | ngine    | ers                        | Scale:                | 1:5  | i0             |              |
| Plant:<br>Dando 2000               | )+Bere          | tta T41 |         |        |                   | Groun            | d Leve         | l:    | Dates:                      | 27/01/201                           | 5                            |                               | -                   |          |                            | Crew:                 | MM<br>Bwi  |                |              |
|                                    |                 |         |         |        |                   | 8.68M            |                |       |                             | 211011201                           |                              |                               |                     |          |                            | Logged                | ву:<br>1&  | Bac            | ₩            |
| Depth (m)                          | TCR             | SCR     | RQD     | FI     | Field Rec         | ords             | Level 8        | Depth | TOPSOIL                     | St                                  | ratum Des                    | scription                     | tlate               |          |                            | Wate<br>Strike        | r<br>s<br>অ  | Inst           | alls         |
|                                    |                 |         |         |        |                   |                  | (0.50)         |       |                             |                                     | in buildy of                 | ay warroo                     |                     |          |                            |                       | 11/2/17  |                |              |
| 0.50 - 1.00<br>0.50 - 1.00         | D<br>B          |         |         |        |                   |                  | 8.18           | 0.50  | Stiff brown<br>coarse. Gra  | slightly sandy sl                   | ightly grave<br>ar to rounde | elly silty CL<br>ed fine to c | AY. Sa<br>oarse.    | ind is   | fine to                    |                       | ×1×1×  |                |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | X IX IV  | 88             | 8            |
| 1.20<br>1.20 - 1.65                | SPT<br>(S)      |         |         |        | N=23 (5,6/5,7,6   | ,5)              |                |       |                             |                                     |                              |                               |                     |          |                            |                       | XIXIX  | S              |              |
| 1.20 - 1.05                        | D               |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       |  | Ĭ              |              |
| 2.00                               | SPT<br>(S)      |         |         |        | N=24 (5,7/6,5,6   | ,7)              | (3.20)         |       |                             |                                     |                              |                               |                     |          |                            |                       |  |                |              |
| 2.00 - 2.45                        | D<br>B          |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | 100045   | Ĭ              |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       |  |                |              |
| 3.00<br>3.00 - 3.45                | SPT<br>(S)      |         |         |        | N=29 (6,7/8,7,7   | ,7)              |                |       |                             |                                     |                              |                               |                     |          |                            |                       | avba   | ÿ              |              |
| 3.00 - 3.45                        | B<br>D          |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       |  |                |              |
|                                    |                 |         |         |        |                   |                  | 4.98           | 3.70  | Very stiff da               | rk grey slightly                    | sandy sligh                  | tly gravelly                  | slight              | ly silty | CLAY                       |                       | 1014120  | ÿ              |              |
| 4.00<br>4.00 - 4.45                | SPT<br>(S)      |         |         |        | N=40 (7,8/8,9,1   | 0,13)            |                |       | subrounded                  | fine to coarse                      | of various li                | thologies.                    | Siaver              | 10 000   | ungular to                 |                       | <u> ক</u> র্মা সংগ্রহ  |                |              |
| 4.00 - 4.45                        | D               |         |         |        |                   |                  | (1.30)         |       |                             |                                     |                              |                               |                     |          |                            |                       | NIMBY.   | ÿ              |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | \$200 \$V  |                |              |
| 5.00<br>5.00 - 5.45<br>5.00 - 5.45 | SPT<br>(S)<br>D |         |         |        | N=48 (7,8/10,14   | 1,12,12)         | 3.68           | 5.00  | Very stiff da<br>occasional | rk grey slightly<br>cobbles. Sand i | sandy grav                   | elly slightly<br>arse. Grave  | silty C<br>el is su | LAY bang | with<br>ular to            |                       | N Sarki  | S              |              |
|                                    | В               |         |         |        |                   |                  |                |       | subrounded                  | fine to coarse                      | of various li                | thologies.                    |                     |          |                            |                       | õärx:lea   |                |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | N: 45 W.   | S              |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | MIX1Au   | Ĭ              |              |
| 6.50<br>6.50                       | D<br>B          |         |         |        | N=46 (9,10/11,1   | 2,12,11)         |                |       |                             |                                     |                              |                               |                     |          |                            |                       | NI&WX  | S              |              |
| 6.50                               | SPT<br>(S)      |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | 541×164  |                |              |
| 7.40                               | ODT             |         |         |        | 50 (10 11/50 for  | 125mm)           |                |       |                             |                                     |                              |                               |                     |          |                            |                       | XIQIX  |                |              |
| 7.40<br>7.40 - 7.80<br>7.40 - 7.80 | (C)<br>B        |         |         |        | 50 (10, 11/50 10) | 12511111)        | (5.90)         |       |                             |                                     |                              |                               |                     |          |                            |                       | te e l'Aller   | Ĭ              |              |
|                                    | D               |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | (lēā ×14   |                |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | 100 M  |                |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | ( ইউটেং ( )  |                |              |
| 9.00                               | SPT<br>(S)      |         |         |        | 50 (25 for 0mm    | /50 for          |                |       | Coarse GRA                  | VEL (possibly                       | a broken u                   | o boulder)                    |                     |          |                            |                       | 1.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2. |                | •            |
|                                    | (-)             |         |         |        | ,                 |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | let the  |                |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | ×≣@l×t   | •••            |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            |                       | <u> </u>   | ° .            | ŀ            |
| Remarks                            |                 |         |         |        |                   |                  |                |       |                             | Core Bar                            | continued on r               | Water St                      | rikes:              |          |                            |                       |  |                | _            |
|                                    |                 |         |         |        | -+ 7 0            |                  |                |       |                             | · -                                 |                              | Struck<br>(m)<br>9.50         | Rose<br>(m)<br>9.50 | to       | <b>Time</b><br>(min)<br>10 |                       |  |                |              |
| Refusal met                        | on po           | ssible  | arge bo | buider | at 7.6m           |                  |                |       |                             | Flush Ty                            | pe:                          |                               |                     |          |                            | A                     | G  | S              |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             | Water Added<br>From (m)             | To (m)                       | Casing:<br>To (m)             | D                   | iamete   | er (mm)                    |                       |  |                |              |
|                                    |                 |         |         |        |                   |                  |                |       |                             |                                     |                              |                               |                     |          |                            | www.cause<br>© Causew | waygeo<br>ay Geo   | otech<br>otech | com<br>. Ltd |

| Caus                   | sew         | ay                | Geo             | otec   | h Ltd    | Projec<br>14-645 | <b>:t no.</b> | Project<br>Name: | Greater Du<br>Investigatio | ıblin Drain<br>on | age Sch                   | eme             | Gro       | ound        | Borehol<br>BH1               | e No.<br>37               |
|------------------------|-------------|-------------------|-----------------|--------|----------|------------------|---------------|------------------|----------------------------|-------------------|---------------------------|-----------------|-----------|-------------|------------------------------|---------------------------|
| Method:                |             |                   |                 |        |          | Co-ord           | ds:           | Client:          | Irish Water                |                   |                           |                 |           |             | Sheet 2                      | of 2                      |
| 0.00 7.60<br>7.60 10.9 | ) C<br>90 S | able Pe<br>ymmetr | ercussio<br>rix | n      |          | 323078           | 8.15mE        | Client's R       | nrocontotivo               | Tohin (           | Conquitin                 | a               | ain       |             | Scale: 1                     | :50                       |
| Plant:                 |             |                   |                 |        |          | 241730<br>Group  | 0.65mN        | Clients Re       | epresentative              |                   | Jonsulting                | y En            | igine     | 2015        | Crew: N                      | Mc                        |
| Dando 2000             | +Berei      | ta 141            |                 |        | 1        | 8.68M            | OD            | Dates:           | 27/01/2015                 | 5                 |                           |                 |           |             | Logged By                    | : DOM                     |
| Depth (m)              | TCR         | SCR               | RQD             | FI     | Field Re | cords            | Level & Depth |                  | Str                        | atum Desc         | ription                   |                 |           |             | Legend &<br>Water<br>Strikes | Backfill<br>Installs      |
| Depth (m)              | TCR         | SCR               | RQD             | FI     | Field Re | cords            | -2.22 10.90   |                  | Str                        | nd of core at 1   |                           |                 |           |             | Vater<br>Strikes             |                           |
| Remarks                |             |                   |                 |        |          |                  |               |                  | Core Bar                   | el:               | Water Strik<br>Struck     | kes:<br>Rose    | to        | Time        |                              |                           |
| Refusal met            | on pos      | ssible l          | arge bo         | oulder | at 7.6m  |                  |               |                  | Flush Typ                  | e:                | (m)<br>9.50               | (m)<br>9.50     |           | (min)<br>10 | AG                           | s<br>S                    |
|                        |             |                   |                 |        |          |                  |               |                  | Water Added:<br>From (m)   | To (m)            | Casing:<br>To (m)<br>7.60 | <b>Di</b><br>20 | amet<br>0 | er (mm)     | www.causeway<br>© Causeway G | jeotech.com<br>eotech Ltd |

| Cau          | seway         | Geo    | otec     | ch Ltd                    | Projec<br>14-645 | <b>t no.</b>           |          | Project<br>Name:         | Greater [<br>Investiga            | Dublin Dra<br>tion         | iinage Scl                    | neme Gro                    | ound          | Boreho<br>BH1                                  | ole No.<br>138              |
|--------------|---------------|--------|----------|---------------------------|------------------|------------------------|----------|--------------------------|-----------------------------------|----------------------------|-------------------------------|-----------------------------|---------------|--|-----------------------------|
| Method:      | O Cabla D     |        |          |                           | Co-orc           | ds:                    |          | Client:                  | Irish Wat                         | ər                         |                               |                             |               | Sheet  | 1 of 1                      |
| 0.00 7.5     | SU Cable P    | ercuss |          |                           | 323173           | 3.16mE<br>3.17mN       |          | Client's Re              | presentativ                       | e: Tobin                   | ı Consultir                   | ng Engine                   | eers          | Scale: 1                                       | 1:50                        |
| Dando3000    | )             |        |          |                           | Groun            | d Leve                 | l:       | Dates:                   | 10/12/20                          | 14                         |                               |                             |               | Logged B                                       |                             |
| Denth (m)    | Sample / Test | Casing | Water    | Field Rec                 | 4.22M            |                        | Denth    |                          | s                                 | tratum De                  | scription                     |                             |               | Legend &                                       | Backfil                     |
| 0.00 - 0.90  | B             | (m)    | (m)      |                           |                  | Levero                 | - Deptil | Firm to stif             | f brown sandy                     | gravelly CLA               | Y with occa                   | sional cobb                 | bles and      | Strikes  | Installs                    |
| 0.90 - 1.50  | В             | 1.00   | 0.7      | N=16 (3 3/4 3 4           | 5)               | ( <i>0.90)</i><br>3.32 | 0.90     | boulders. to coarse.     | Sand is fine to                   | coarse. Gra                | avel is angul<br>tly sandy su | ar to subroo<br>bangular to | unded, fine   |  |                             |
| 1.00         | SPT(C)        | 1.00   | 0.1      | 11 10 (0,01,0,1           | ,0)              |                        |          | fine to coar             | rse GRAVEL w                      | th occasion                | al cobbles.                   | Sand is fine                | e to coarse.  |  |                             |
| 2.00<br>2.00 | SPT(C)<br>D   | 2.00   | 1.2      | N=12 (2,3/3,3,3           | ,3)              | (2.70)                 |          |                          |                                   |                            |                               |                             |               | a X a X a                                      |                             |
| 2.50 - 3.00  | В             |        |          |                           |                  | (2.70)                 |          |                          |                                   |                            |                               |                             |               |  | 0 0 0<br>0 0<br>0 0         |
| 3.00<br>3.00 | SPT(C)<br>D   | 3.00   | 2.6      | N=17 (1,1/2,3,5           | ,7)              |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
| 3.60 - 4.00  | в             |        |          |                           |                  | 0.62                   | 3.60     | Very stiff da            | ark grey to blac                  | k slightly sa              | indy slightly                 | gravelly slig               | ghtly silty   | <u> 2000 000 000 000 000 000 000 000 000 0</u> |                             |
| 4.00         | U             |        |          |                           |                  |                        |          | CLAY with<br>Gravel is a | occasional cob<br>ngular to subro | bles and bo<br>unded, fine | ulders. Sar<br>to coarse.     | id is fine to               | coarse.       |  |                             |
| 4.50         | D             |        |          |                           |                  |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
| 5.00<br>5.00 | D<br>SPT(S)   | 5.00   | 4.8      | 50 (8,12/50 for 2         | 200mm)           |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
| 5.50 - 6.00  | В             |        |          |                           |                  | (3.90)                 |          |                          |                                   |                            |                               |                             |               |  |                             |
| 6.00<br>6.00 | SPT(S)<br>D   | 6.00   |          | 50 (3,11/50 for 1         | 150mm)           |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
| 6.50 - 7.00  | В             |        |          |                           |                  |                        |          |                          |                                   |                            |                               |                             |               | <u> 67670</u><br>67677                         |                             |
| 7.00<br>7.00 | SPT(S)<br>D   | 7.00   |          | 50 (25 for 75mn<br>125mm) | n/50 for         |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
|              |               |        |          |                           |                  | -3.28                  | 7.50     |                          |                                   | End of borehold            | e at 7.50 m                   |                             |               | <u>æzer</u> ri                                 |                             |
|              |               |        |          |                           |                  |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
|              |               |        |          |                           |                  |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
|              |               |        |          |                           |                  |                        |          |                          |                                   |                            |                               |                             |               |  |                             |
| Remarks      | 1             |        | <u> </u> | <u> </u>                  |                  |                        |          |                          | Chiselling:<br>From To<br>(m) (m  | Time<br>) (hh:mm)          | Water Str<br>Struck<br>(m)    | ikes:<br>Rose to<br>(m)     | Time<br>(min) |  |                             |
|              |               |        |          |                           |                  |                        |          |                          | 0.00 1.0                          | d:                         | 0.90                          | 0.50                        | 20            | AC   | iS                          |
|              |               |        |          |                           |                  |                        |          |                          | From (m)<br>0.90                  | <b>To (m)</b><br>3.60      | To (m)<br>7.50                | Diamete<br>200              | er (mm)       | www.causeway<br>© Causeway                     | /geotech.con<br>Geotech Ltd |

| Cau                                | sew          | 'ay                | Geo                | oted | ch Ltd           | Projec<br>14-645 | <b>ct no.</b><br>5 | Project<br>Name:           | Greater D<br>Investigati             | ublin Drai<br>on               | nage Scl                    | neme Gi                    | round            | Boreh<br>BH                | ole No.<br>139                 |
|------------------------------------|--------------|--------------------|--------------------|------|------------------|------------------|--------------------|----------------------------|--------------------------------------|--------------------------------|-----------------------------|----------------------------|------------------|----------------------------|--------------------------------|
| Method:                            |              |                    |                    |      |                  | Co-or            | ds:                | Client:                    | Irish Wate                           | r                              |                             |                            |                  | Sheet                      | 1 of 8                         |
| 0.00 14.<br>14.50 78.              | 50 C<br>40 F | able P<br>Rotary ( | ercussic<br>Coring | on   |                  | 32382            | 4.04mE             | Client's Bo                | procontative                         | . Tobin                        | Conculti                    | na Engir                   | oore             | Scale:                     | 1:50                           |
| Plant:                             | 0 · D        | ц. <b>т</b> а      |                    |      |                  | 24166<br>Groun   | 3.70mN             | Cilent's Re                | presentative                         | . 100111                       | Consulti                    | iy Engi                    | 10015            | Crew:                      | MMcC                           |
| Dando 2000                         | л+веге       |                    | I<br>1             | 1    | 1                | 9.07M            | OD                 | Dates:                     | 04/02/201                            | 5 - 12/02                      | 2015                        |                            |                  | Logged E                   | By: DOM<br>+MFG                |
| Depth (m)                          | TCR          | SCR                | RQD                | FI   | Field Rec        | ords             | Level & Depth      |                            | St                                   | ratum Des                      | cription                    |                            |                  | Legend<br>Water<br>Strikes | Backfil                        |
|                                    |              |                    |                    |      |                  |                  | (0.40)             | TOPSOIL                    |                                      |                                |                             |                            |                  |                            |                                |
| 0.50 - 1.00                        | D            |                    |                    |      |                  |                  | 8.67 0.40          | Stiff brown                | slightly sandy s                     | lightly grave                  | lly slightly                | silty CLAY                 | Sand is          |                            |                                |
| 0.50 - 1.00                        | В            |                    |                    |      |                  |                  |                    | various lith               | ologies.                             | Darigular to                   | Subrounde                   |                            | uarse,           |                            |                                |
| 1 20                               | SDT          |                    |                    |      | N-10 (5 6/5 5 4  | 5)               |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 1.20<br>1.20 - 1.65<br>1.20 - 1.65 | (S)<br>B     |                    |                    |      | 14-19 (3,0/3,3,4 | .,J)             |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    | D            |                    |                    |      |                  |                  | (2.30)             |                            |                                      |                                |                             |                            |                  |                            |                                |
| 2.00                               | SPT          |                    |                    |      | N=26 (7,6/7,7,6  | i,6)             |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 2.00 - 2.45                        | D<br>B       |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  | 6.37 2.70          | Vory stiff b               | ook olightly opp                     | ty clightly a                  |                             | athy ailty C               | AV with          |                            |                                |
| 3.00                               | SPT          |                    |                    |      | N=42 (7,9/10,11  | 1,10,11)         |                    | occasional                 | cobbles. Sand i<br>d fine to coarse. | s fine to coa                  | arse. Grave                 | l is suban                 | gular to         |                            |                                |
| 3.00 - 3.45<br>3.00 - 3.45         | (S)<br>D     |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 4.00                               | SDT          |                    |                    |      | N-36 (7 8/8 10   | 0.0)             |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 4.00 - 4.45<br>4.00 - 4.45         | (S)<br>D     |                    |                    |      | 14-50 (7,0/0,10, | 3,3)             |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    | В            |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 5.00<br>5.00 - 5.45<br>5.00 - 5.45 | SPT<br>(S)   |                    |                    |      | N=41 (8,9/9,10,  | 12,10)           | (4.80)             |                            |                                      |                                |                             |                            |                  |                            |                                |
| 0.00 - 0.40                        | D            |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 6.00 - 6.45                        | В            |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 6 50                               |              |                    |                    |      | N-37 (7 9/10 8   | 0 10)            |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
| 6.50                               | SPT<br>(S)   |                    |                    |      | 14-37 (7,8/10,0, | 3,10)            |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  | 1.57 7.50          | Stiff dark g<br>occasional | rey slightly sand cobbles. Sand i    | y slightly gr<br>s fine to coa | avelly sligh<br>arse. Grave | tly silty CL<br>I is suban | AY with gular to |                            |                                |
| 8.00                               | SPT          |                    |                    |      | N=25 (6,7/6,7,6  | i,6)             |                    | subrounde                  | d fine to coarse.                    |                                |                             |                            |                  |                            |                                |
| 8.00 - 8.45<br>8.00 - 8.45         | (S)<br>D     |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    | Б            |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                |                             |                            |                  |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      | ontinued                       | avt choot                   |                            |                  |                            |                                |
| Remarks                            | 1            | I                  | 1                  | 1    |                  |                  |                    |                            | Core Ba                              | rel:                           | Water Str                   | ikes:                      | 1                |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            | <b></b>                              |                                | Struck<br>(m)               | Rose to<br>(m)             | Time<br>(min)    |                            | I                              |
|                                    |              |                    |                    |      |                  |                  |                    |                            | Flush Ty                             | pe:                            |                             |                            |                  | A                          | GS                             |
|                                    |              |                    |                    |      |                  |                  |                    |                            | Water Added<br>From (m)              | :<br>To (m)                    | Casing:<br>To (m)           | Diame                      | ter (mm)         |                            |                                |
|                                    |              |                    |                    |      |                  |                  |                    |                            |                                      |                                | 74.50                       | 200                        | _                | www.causewa<br>© Causeway  | aygeotech.com<br>/ Geotech Ltd |

| Cau                     | sew          | ay                   | Geo                | otec | h Ltd     | Projec | st no.                | Project<br>Name:  | Greater  | Dublination                            | in Drain   | age Sch  | heme G                              | round                      | Boreho<br>BH1                | le No.<br>39               |
|-------------------------|--------------|----------------------|--------------------|------|-----------|--------|-----------------------|---|--|--|--|--|-------------------------------------|----------------------------|------------------------------|----------------------------|
| Method:                 |              |                      |                    |      |           | Co-or  | ds:                   | Client:   | Irish Wa   | ter                                    |  |  |                                     |                            | Sheet 2                      | 2 of 8                     |
| 0.00 14.5<br>14.50 78.4 | 50 C<br>40 F | ;able P∈<br>≀otary C | ercussio<br>Coring | 'n   |           | 323824 | 4.04mE                |   |  |  |  |  |                                     |                            | Scale: 1                     | :50                        |
| Plant:                  |              |                      |                    |      |           | 241663 | 3.70mN                | Client's Ke   | presentativ  | ve:                                    |  | Consultir  | ng Engir                            | ieers                      | Crew: N                      | IMcC                       |
| Dando 2000              | I+Bere       | tta T41              |                    |      |           | 9.07M  |                       | Dates:  | 04/02/20   | )15 - 1                                | 12/02/2  | 2015   |                                     |                            | Logged By                    | /: DOM<br>+MFG             |
| Depth (m)               | TCR          | SCR                  | RQD                | FI   | Field Rec | ords   | Level & Depth         | 1   |  | Stratu                                 | um Desc  | ription  |                                     |                            | Legend &<br>Water            | Backfill<br>Installs       |
|                         |              |                      |                    |      |           |        | (7.00)                |   |  |  |  |  |                                     |                            |                              |                            |
| 14.50 - 15.60           | 100          | 0                    | 0                  | NA   |           |        | -5.43 14.50<br>(1.50) | Dark brown<br>boulders. \$<br>coarse. Cc<br>14.6m to 1. | n clayey very c<br>Sand is fine to<br>obbles are sub-<br>4.90m: Limest | gravelly<br>coarse<br>angula<br>one bc | y SAND v<br>e. Gravel<br><u>ar to s</u> ubro<br><u>oulde</u> r | with occas<br>is angula<br>ounded.                       | sional cob<br>r to subar            | bles and<br>Igular fine to |                              |                            |
| 15.00 - 10.90           | 100          | 0                    | 0                  | NI   |           |        | -6.93 16.00           | Extremely<br>Distinctly v<br>fracture sp<br>lithorelics | weak to weak<br>weathered to d<br>acing and freq<br>in light brown s   | grey a<br>estruct<br>juently<br>andy c | and light b<br>tured: gre<br>recovere<br>clay matri            | orown LIM<br>eatly weał<br>ed as orde<br>ix.             | IESTONE<br>kened, mu<br>ered to dis | ich closer<br>iordered     |                              |                            |
|                         | 100          | 22                   | 0                  | 20   |           |        | (4.10)                |   |  |  |  |  |                                     |                            |                              |                            |
| 18.40 - 19.90           | 100          | 4                    | 0                  | NI   |           |        |                       |   |  |  |  |  |                                     |                            |                              |                            |
| 19.90 - 21.40           |              |                      |                    |      |           |        | -11.03 20.10          | Weak to m<br>patches                                    | iedium strong,   | locally<br>Contin                      | / very wea   | ak, grey v   | vith light b                        | rown                       |                              |                            |
| Remarks                 |              |                      |                    |      |           |        |                       |   | Core Ba<br>Flush T<br>Water Add<br>From (m)                            | arrel:<br>[ype:<br>led:                | (m)  | Water Str<br>Struck<br>(m)<br>Casing:<br>To (m)<br>74.50 | ikes:<br>Rose to<br>(m)<br>Diame    | ter (mm)                   | www.causeway<br>© Causeway C | geotech.com<br>Geotech Ltd |

| Caus          | sew    | /ay      | Geo  | otec             | h Ltd     | <b>Projec</b><br>14-645 | t no.            | Project<br>Name:             | Greater Du<br>Investigatic                 | blin Drair<br>on             | nage So                        | cheme                   | Gro                | ound                  | Boreh<br>BH             | iole<br>1139    | No.<br>9               |
|---------------|--------|----------|--|------------------|-----------|-------------------------|------------------|------------------------------|--|------------------------------|--------------------------------|-------------------------|--------------------|-----------------------|-------------------------|-----------------|------------------------|
| Method:       |        | <u>-</u> |  |                  |           | Co-orc                  | ds:              | Client:                      | Irish Water                                |                              |                                |                         |                    |                       | Shee                    | t 3 c           | of 8                   |
| 14.50 78.4    | 40 R   | totary C | oring  |                  |           | 24166                   | 1.04m⊨<br>3.70mN | Client's Re                  | presentative:                              | Tobin                        | Consult                        | ting Er                 | ngine              | ers                   | Scale:                  | 1:50            | 0                      |
| Dando 2000    | )+Bere | tta T41  | 1  |                  |           | Groun                   | id Level:        | Dates:                       | 04/02/2015                                 | - 12/02/                     | 2015                           |                         |                    |                       | Logged                  | By:             |                        |
| Depth (m)     | TCR    | SCR      | RQD  | FI               | Field Rec | ords                    | Level & Depth    | 1                            | Stra                                       | atum Des                     | cription                       |                         |                    |                       | Legend<br>Water         | &               | Backfil                |
|               |        |          |  |                  |           |                         | +                | LIMESTON                     | NE.  |                              | ·                              |                         |                    |                       | Strike                  | s               |                        |
|               | 100    | 76       | 40   | 5                |           |                         |                  | Distinctly w<br>closer fract | veathered, occasic ture spacing. Yellc     | onally parti;<br>owish light | ally destru<br>brown ox        | uctured                 | l: wea<br>staini   | ıkened,<br>ng         |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  | DS1: Joint                   | j in.<br>s. close to mediur                | n spaced, :                  | subhorizc                      | ontal to                | 50°, r             | blanar to             |                         | 1               |                        |
| 21.40 - 22.90 |        |          | ┼──  |                  |           |                         |                  | irregular, sr<br>brown san   | mooth to rough, or<br>dy clay, oxidation   | pen, typica<br>staining off  | Ily filled w<br>en penet       | vith 1 to<br>trating in | o 10m<br>n.        | m soft light          |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  | DS2: Jointe<br>rough, ope    | s, medium spaced<br>an, typically filled v | i, 70° to ve<br>vith 1 to 10 | rtical, und<br>mm soft l       | dulating<br>light brc   | j, smo<br>own sa   | ooth to<br>andy clay. |                         |                 |                        |
|               | 100    | 37       | 9  | 15               |           |                         |                  | _                            |  |                              |                                | C                       |                    | •                     |                         | 1               |                        |
|               |        |          |  |                  |           |                         | (4 50)           |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               |        |          |  |                  | 1         |                         | (4.50)           |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
| 22.90 - 24.40 |        |          | <del>                                     </del> |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
|               |        |          |  | 10               |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               | 100    | 60       | 9  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              |  | ,                            |                                |                         |                    |                       |                         | i I             |                        |
|               |        |          |  | NI               |           |                         |                  | 24.0m to 24                  | I.6m: Very weaк,                           | partially de                 | structure                      | ∍d.                     |                    |                       |                         | 1               |                        |
| 24.40 - 25.80 |        |          |  |                  | 4         |                         | -15.53 24.60     | Madium at                    | The area LIMES                             |                              |                                |                         |                    |                       |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  | Partially w                  | rong, grey Liivi⊨ə<br>eathered.            | IONE.                        |                                |                         |                    |                       |                         | 1               |                        |
|               | 100    | 67       | 33   |                  |           |                         |                  | DS1: Joint                   | s, medium spacec                           | l, horizonta                 | il to 40°, j                   | planar,                 | smoo               | th to                 |                         | 1               |                        |
|               |        |          |  |                  |           |                         |                  | rough, oper<br>brown soft    | n, occasionally cle<br>sandy clay.         | an, typical                  | ly filled w                    | /ith 10 t               | .o 20n             | nm light              |                         | 1               |                        |
| 25.80 - 27.40 |        | <u> </u> | <u> </u>   | !                |           |                         |                  | DS2: Joints<br>undulating    | s, medium to wide<br>, smooth to rough     | ly spaced,<br>, open, thir   | 70° to su<br>1 light bro       | ubvertica<br>own clay   | al, pla<br>/ film. | anar to               |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              | -                              |                         |                    |                       |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
|               | 100    | 90       | 30   |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               |        |          |  | 8                |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
| 27.40 - 28.90 |        |          |  |                  |           |                         | (6.05)           |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               | 100    | 80       | 26   |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
| 29.00 30.40   |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
| 20.90 - 30.40 |        |          |  | $\left  \right $ | 1         |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
|               | 100    | 90       | 73   | 5                |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
|               |        |          |  | Ŭ                |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         |                 |                        |
| 30 40 - 31,90 |        |          |  |                  |           |                         |                  |                              |  |                              |                                |                         |                    |                       |                         | 1               |                        |
|               |        |          |  |                  |           |                         |                  | <u> </u>                     | Co   | ntinued on ne                | ext sheet                      |                         |                    |                       |                         |                 |                        |
| Remarks       |        |          |  |                  |           |                         |                  |                              | Core Barr                                  | el:                          | Water S <sup>4</sup><br>Struck | trikes:                 | to                 | Time                  |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              | Flush Typ                                  | e:                           | <u>(m)</u>                     | (m)                     |                    | <u>(min)</u>          |                         | Ļ               |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              | <u> </u>                       |                         |                    | L                     | A                       | հ               | 5                      |
|               |        |          |  |                  |           |                         |                  |                              | Water Added:<br>From (m)                   | To (m)                       | Casing:<br>To (m)              | D                       | iamete             | ər (mm)               |                         |                 |                        |
|               |        |          |  |                  |           |                         |                  |                              |  |                              | 74.50                          | 20                      | 10                 |                       | www.causew<br>© Causewa | aygeo<br>iy Geo | stech.com<br>stech Ltd |

| Caus                    | sew          | 'ay      | Geo      | otec       | h Ltd     | Projec<br>14-645 | t no.         | Project<br>Name:               | Greater Dul<br>Investigatio             | blin Drair<br>n         | nage Sch                    | eme Gr          | ound                  | Boreho<br>BH1              | ole No.<br>139                 |
|-------------------------|--------------|----------|----------|------------|-----------|------------------|---------------|--------------------------------|---|-------------------------|-----------------------------|-----------------|-----------------------|----------------------------|--------------------------------|
| Method:                 |              |          |          |            |           | Co-ord           | ls:           | Client:                        | Irish Water                             |                         |                             |                 |                       | Sheet                      | 4 of 8                         |
| 0.00 14.3<br>14.50 78.4 | 50 C<br>40 F | Rotary C | oring    | <i>.</i> n |           | 323824           | 4.04mE        | Client's Rep                   | presentative:                           | Tobin (                 | Consultin                   | a Engin         | eers                  | Scale:                     | 1:50                           |
| Plant:<br>Dando 2000    | )+Bere       | tta T41  | l        |            |           | Groun            | d Level:      | Dates:                         | 04/02/2015                              | - 12/02/2               | 2015                        |                 |                       | Crew:                      | MMcC                           |
|                         |              |          |          |            |           | 9.07M            |               |                                |   |                         |                             |                 |                       | Legend &                   | <sup>y.</sup> +MFG<br>Backfill |
| Depth (m)               | TCR          | SCR      | RQD      | FI         | Field Rec | ords             | Level & Depth |                                | Stra                                    | itum Desc               | cription                    |                 |                       | Water<br>Strikes           | Installs                       |
|                         |              |          |          |            |           |                  | -21.58 30.65  | horizons.                      | ong, grey to dark                       | grey LIMES              | STONE wit                   | h soft clay     | / joint               |                            |                                |
|                         | 100          | 87       | 57       | NI         |           |                  |               | Partially wea                  | athered: oxidation                      | n staining p            | enetrating                  | in from so      | ome joints.           |                            |                                |
|                         |              |          |          |            |           |                  |               | planar to slig<br>orangey or y | phtly undulating,<br>ellowish light bro | smooth, op<br>own clay. | spaced, su<br>ben, filled w | vith 10 to \$   | 50mm soft             |                            |                                |
| 31.90 - 33.40           |              |          |          | _          |           |                  |               | DS2: Joints,                   | widely spaced, a                        | 70° to subv             | ertical, pla                | nar to uno      | lulating,<br>ed brown |                            |                                |
|                         |              |          |          |            |           |                  |               |                                | ugn, open, ood                          |                         | spient, typi                |                 |                       |                            |                                |
|                         |              |          |          | 8          |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         | 100          | 75       | 43       |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
| 33.40 - 34.90           |              |          | <u> </u> |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         | 100          | 65       | 17       | 15         |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          | 15         |           |                  | (7.55)        |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
| 34.90 - 36.40           |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         | 100          | 91       | 86       |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
| 36 40 - 37 90           |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
| 50.40 - 57.50           |              |          |          | 4          |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         | 96           | 80       | 72       |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
| 37.90 - 39.40           |              |          | <u> </u> | -          |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  | -29.13 38.20  | Extremely w                    | eak to weak, gre                        | y LIMESTO               | ONE.                        |                 |                       |                            |                                |
|                         | 100          | 20       | 12       |            |           |                  |               | Distinctly we                  | eathered to destruction                 | uctured: gre            | eatly weak                  | ened, mu        | ch closer             |                            |                                |
|                         | 100          | 20       | 12       | NI         |           |                  | (1.20)        | yellowish gr                   | ey clay matrix.                         |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
| 39.40 - 40.90           |              |          | <u> </u> |            |           |                  | -30.33 39.40  | Extremely w<br>extremely w     | eak light grey fin<br>eak yellowish lia | e grained S             | SANDSTON<br>TSTONE.         | NE interbe      | edded with            |                            |                                |
|                         |              |          |          |            |           |                  |               | Destructure                    | d: greatly weaker                       | ned, mottle             | d oxidation                 | staining f      | hroughout.            |                            |                                |
|                         | 80           | 0        | 0        |            |           |                  |               | Largely reco                   | overed as firm to                       | stiff sandy             | ciay.                       |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       |                            |                                |
|                         |              |          |          |            |           |                  |               |                                | Co                                      | ntinued on ne:          | xt sheet                    |                 |                       | • • • • • •                |                                |
| Remarks                 | 1            | 1        |          | <u> </u>   | 1         |                  |               | 1                              | Core Barr                               | el:                     | Water Stri                  | kes:<br>Rose to | Time                  |                            |                                |
|                         |              |          |          |            |           |                  |               |                                | Flush Tvo                               | e:                      | (m)                         | (m)             | (min)                 |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         |                             |                 |                       | AC                         | 15                             |
|                         |              |          |          |            |           |                  |               |                                | Water Added:<br>From (m)                | Го (m)                  | Casing:<br>To (m)           | Diamet          | er (mm)               |                            |                                |
|                         |              |          |          |            |           |                  |               |                                |   |                         | /4.50                       | 200             |                       | www.causeway<br>© Causeway | ygeotech.com<br>Geotech Ltd    |

| Caus   | sew | ay  | Geo | otec  | h Ltd     | <b>Projec</b><br>14-645 | t no.                           | P    | roject Greater Dublin Drainage Scheme Ground<br>ame: Investigation            |  |   |  |   | ound                          | Borehole No.<br>BH139         |                            |
|--|-----|-----|-----|-------|-----------|-------------------------|---------------------------------|------|---|--|---|--|---|-------------------------------|-------------------------------|----------------------------|
| Method: Co-ords:   |     |     |     |       |           |                         |                                 |      | lient:  | Irish Water  |   |  |   |                               | Sheet 5                       | 5 of 8                     |
| 0.00 14.50 Cable Percussion 323824.04mE<br>14.50 78.40 Rotary Coring |     |     |     |       |           |                         |                                 |      | lient's Rec   | resentative  | : Tobin C   | Consultin  | a Enain   | eers                          | Scale: 1                      | :50                        |
| Plant: 241663./0mN<br>Dando 2000+Beretta T41 Ground Level:           |     |     |     |       |           |                         |                                 |      |   |  | - 40/00/0   | 045  | .99   |                               | Crew: N                       |                            |
|  | 1   |     |     | 9.07M | MOD       |                         | Dates. 04/02/2010 - 12/02/2015  |      |   |  |   |  | Logged By   | +MFG                          |                               |                            |
| Depth (m)  | TCR | SCR | RQD | FI    | Field Rec | ords                    | Level & Dep                     | oth  |   | Str  | atum Desc   | ription  |   |                               | Water<br>Strikes              | Backfill<br>Installs       |
| 40.90 - 42.40<br>42.40 - 43.90                                       | 94  | 0   | 0   | NI    |           |                         | (3.75)<br>-34.08 43.1<br>(0.70) | 15 — | Extremely w<br>Destructure  | eak light grey n<br>1: greatly weak  | nottled yellov  | v MUDST  | DNE.  | aining                        |                               |                            |
|  |     |     |     |       |           |                         | 24 70 42 0                      | 05   | throughout. Recovered as stiff clay.  |  |   |  |   |                               |                               |                            |
| 43.90 - 45.40  | 100 | 13  | 0   | NI    |           |                         | -34.78 43.8<br>(1.75)           | 35   | Extremely w<br>with coarse<br>increasing fr<br>Distinctly we<br>oxidation sta | eak to very wea<br>sand-sized clea<br>equency from 4<br>eathered to dest<br>aining, largely re | ik, light grey<br>r to brown c:<br>4.9m to 45.6<br>ructured: gr<br>covered as | fine grain<br>alcite crys<br>Sm.<br>eatly weal<br>clayey sar | ed SAND<br>tals occur<br>kened, mo<br>nd.           | STONE,<br>ring with<br>ottled |                               |                            |
| 45.40 - 46.90  |     |     |     |       |           |                         | -36.53 45.6                     | 60 - |   |  |   |  |   |                               | · · · · · · ·                 |                            |
|  | 88  | 67  | 67  | 2     |           |                         | (1.00)                          |      | Weak to me<br>Distinctly we<br>gravel-sized                                   | dium strong gre<br>athered slightly<br>vugs created b  | y and yellow<br>weakened,<br>y dissolution                                    | nottled ox   | ONE.<br>kidation st                                 | aining,                       |                               |                            |
| 46.90 - 48.40  |     |     |     |       |           |                         | -37.53 46.6                     | 30 - | Extremely w   | eak, light grey t<br>arse sand-sized   | o yellow fine<br>clear to brow  | grained S  | SANDSTC<br>crvstals.                                | NE, with                      |                               |                            |
|  |     |     |     |       |           |                         | -38.03 47.1                     | 10   | Destructured: greatly weakened, mottled oxidation staining, recovered         |  |   |  |   |                               |                               |                            |
|  | 94  | 38  | 13  | 10    |           |                         |                                 |      | Very weak to<br>SANDSTON<br>Distinctly we<br>fracture spar<br>sandy clay r    | b weak grey LIM<br>E horizons.<br>Eathered to dest<br>cing, locally rec<br>natrix. Occasior    | IESTONE w<br>ructured: gr<br>overed as or<br>nal red staini                   | ith extrem<br>eatly weal<br>dered litho<br>ng on som         | ely weak<br>kened, mu<br>prelics in l<br>ne joints. | ich closer<br>ight brown,     |                               |                            |
| 48.40 - 49.90  |     |     |     |       |           |                         |                                 |      |   |  |   |  |   |                               |                               |                            |
| 49.90 - 51.40  | 93  | 31  | 0   | NI    |           |                         | (4.95)                          |      | 49.70m to 49  | 9.90m: Extreme   | ly weak des<br>erial lost in s  | tructured<br>subsequer                                       | sandstone<br>ht two con                             | e: possibly<br>e runs.        |                               |                            |
| 40.00-01.40  | 63  | 10  | 0   |       |           |                         |                                 |      | 49.90m to 51  | .40m: AZCL   | ontinued on nex   | t sheet  |   |                               |                               |                            |
| Remarks  |     |     |     |       |           |                         |                                 |      |   | Core Barr<br>Flush Typ   | rel:<br>be:   | Water Stri<br>Struck<br>(m)                                  | kes:<br>Rose to<br>(m)                              | Time<br>(min)                 | AG                            | S                          |
|  |     |     |     |       |           |                         |                                 |      |   | Water Added:<br>From (m)   | To (m)  | Casing:<br>To (m)<br>74.50                                   | Diame<br>200  | ter (mm)                      | www.causewayg<br>© Causeway G | geotech.com<br>Seotech Ltd |
| Caus                    | sew          | ay                 | Geo   | otec     | h Ltd     | <b>Projec</b><br>14-645 | t no.            |       | Project<br>Name:   | Greater Du<br>Investigatio   | blin Drain<br>m   | age Sch  | ieme Gi   | round  | Boreho<br>BH1                | le No.<br>39               |
|-------------------------|--------------|--------------------|-------|----------|-----------|-------------------------|------------------|-------|--|--|---|--|---|--|------------------------------|----------------------------|
| Method:                 |              |                    |       |          |           | Co-ord                  | ls:              |       | Client:  | Irish Water  |   |  |   |  | Sheet 6                      | 6 of 8                     |
| 0.00 14.5<br>14.50 78.4 | 50 C<br>40 R | able Pe<br>otary C | oring | n        |           | 323824                  | 4.04mE           |       | Client's Ret   | presentative:  | Tobin C   | Consultin  | a Enair   | eers   | Scale: 1                     | :50                        |
| Plant:<br>Dando 2000    | )+Rere       | Ita T41            |       |          |           | Groun                   | d Level          | l:    |  | 0.4/00/00.45   | 10/00/0   |  | <u> </u>  |  | Crew: N                      |                            |
|                         |              |                    |       |          |           | 9.07M                   |                  |       | Dates:   | 04/02/2015   |   |  |   |  | Logged By                    | /: +MFG                    |
| Depth (m)               | TCR          | SCR                | RQD   | FI       | Field Rec | ords                    | Level &          | Depth |  | Stra   | atum Desc   | ription  |   |  | Water<br>Strikes             | Backfill                   |
| 51.40 - 52.90           | 37           | 2                  | 0     |          |           |                         | -42.98           | 52.05 | NO RECOV   | ERY  |   |  |   |  |                              |                            |
| 52.90 - 54.40           |              |                    |       | NR       |           |                         | (0.85)<br>-43.83 | 52.90 | Week to me   | dium atrang loa  |   | ak alaaa t   |   | into grov  |                              |                            |
|                         | 100          | 77                 | 57    |          |           |                         |                  |       | DS1: Joints<br>undulating,<br>yellow soft<br>zone and of | v mottled yellow<br>v mottled yellow<br>tistinctly weather<br>t some joints wit<br>close to mediur<br>smooth to rough<br>o stiff sandy clay<br>n penetrating in<br>ccasionally very of | red: Closer 1<br>h yellow oxi<br>n spaced, 3<br>, open, fillec<br>2. Red stain<br>up to 50mm<br>closely space | ar close it<br>racture sp<br>dation sta<br>0°to 50°, p<br>with <1 to<br>ing on son<br>with corr<br>ed anasto | pacing, gr<br>ining pen<br>planar to s<br>o 30mm li<br>ne joints.<br>respondir<br>mosing ir | eatly<br>etrating in.<br>stepped or<br>ght brown or<br>Yellow<br>g very weak<br>icipient |                              |                            |
| 54.40 - 55.90           | 100          | 40                 | 26    | 11       |           |                         |                  |       | joints.<br>DS2: Joints<br>smooth to ro<br>yellow firm s  | widely spaced,<br>bugh, open, to in<br>sandy clay.   | subvertical,<br>cipient, filleo   | undulating<br>1 with 1 to  | g and ver<br>20mm lig   | y irregular,<br>ht brown or  |                              |                            |
| 55.90 - 57.40           | 100          | 100                | 95    | 3        |           |                         | (8.80)           |       |  |  |   |  |   |  |                              |                            |
| 57.40 - 58.90           | 100          | 73                 | 15    | 14       |           |                         |                  |       |  |  |   |  |   |  |                              |                            |
|                         | 100          | 53                 | 23    |          |           |                         |                  |       |  |  |   |  |   |  |                              |                            |
| 60.40 - 61.90           | 100          | 100                | 76    | 5        |           |                         |                  |       |  |  | untinued on an  | t sheet  |   |  |                              |                            |
| Remarks                 | 1            | 1                  | 1     | <u> </u> | I         |                         | 1                |       | 1  | Core Barr<br>Flush Typ<br>Water Added:<br>From (m)   | rel:<br>Ie:<br>To (m)   | Water Stri<br>Struck<br>(m)<br>Casing:<br>To (m)<br>74.50  | kes:<br>Rose to<br>(m)<br>Diame   | Time<br>(min)<br>ter (mm)  | AG                           | S                          |
|                         |              |                    |       |          |           |                         |                  |       |  |  |   | 14.00  | 200   |  | www.causeway<br>© Causeway C | geotech.com<br>Geotech Ltd |

| Causeway Geotech Ltd Project no. |          |          | Project<br>Name:                                 | Project         Greater Dublin Drainage Scheme Ground           Name:         Investigation |           |                |                          |  | Boreh<br>Bł   | No.<br>9                                  |  |                                 |                            |                           |                 |                      |
|----------------------------------|----------|----------|--|---|-----------|----------------|--------------------------|--|---|---|--|---------------------------------|----------------------------|---------------------------|-----------------|----------------------|
| <b>Method:</b>                   | 50 (     | able Pt  | ercussic   |   |           | Co-or(         | ds:                      | Client:                                  | Irish Water   |   |  |                                 |                            | Shee                      | t 7 c           | of 8                 |
| 14.50 78.4<br>Plant:             | 40 R     | totary C | oring  |   |           | 24166          | 1.04m⊨<br>3.70mN         | Client's Re                              | presentative:   | Tobin (                                   | Consulting                                   | j Engin                         | eers                       | Scale:                    | 1:50<br>MN      | 0<br>AcC             |
| Dando 2000                       | )+Bere   | tta T41  |  |   |           | Groun<br>9.07M | i <b>d Level:</b><br>IOD | Dates:                                   | 04/02/2015  | - 12/02/2                                 | 2015   |                                 |                            | Logged                    | By:             | DOM<br>+MFG          |
| Depth (m)                        | TCR      | SCR      | RQD  | FI  | Field Rec | ords           | Level & Depth            | n  | Stra  | itum Desc                                 | ription                                      |                                 |                            | Legend<br>Water<br>Strike | &<br>•          | Backfill<br>Installs |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           | Í               |                      |
|                                  |          |          |  | <b> </b>  | -         |                | -52.63 61.70             | Medium st                                | arong to strong thin  | ly to thickly                             | / laminated (                                | dark grey                       | y                          |                           |                 |                      |
| 61.90 - ชีวิ.4บ                  |          |          |  |   |           |                |                          | Mostly unv                               | weathered.  | JE.                                       |  |                                 |                            |                           | 1               |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          | DS1: Bedd<br>rough, typi<br>typically ur | ling, thinly to thickly<br>ically closed to occ<br>nstained. One at 6 | y laminated<br>asionally o<br>3.75m stair | d, 30 to 50°,<br>pen at medi<br>ned blood re | ् planar, इ<br>ium to wi<br>ed. | smooth to<br>ide spacing,  |                           |                 |                      |
|                                  |          |          |  | 3   |           |                |                          | DS2: Calci<br>stepped, c                 | ite veins at 72.4-73<br>slosed with up to 30                          | 3.3m, close<br>0mm calcite                | ly spaced, 5                                 | 50 to 80°.<br>2.4m to7          | , planar and<br>72.5m with |                           |                 |                      |
| 22.40 64.00                      |          |          |  |   |           |                |                          | brown sand                               | dy clay film and bro  | own stainin                               | ig.  |                                 |                            |                           | 1               |                      |
| 63.40 - 64.90                    |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   | 1         |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          |  |   |   |  |                                 |                            |                           | 1               |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
| 64.90 - 66.40                    | <b> </b> |          | <u> </u>   | -   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
| 66.40 - 67.90                    |          |          | ├──  | 2   |           |                | (16 70)                  |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                | (10.70)                  |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 102      | 100      | 102  |   |           |                |                          |  |   |   |  |                                 |                            |                           | 1               |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
| 67.90 - 69.40                    |          |          | <del>                                     </del> | -   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   | -         |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
| 69.40 - 70.90                    |          |          | $\vdash$   | 1   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  | 100      | 100      | 100  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  | 1   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
| 70.90 - 72.40                    |          |          |  |   |           |                |                          |  |   |   |  |                                 |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  | Co  | intinued on ne                            | ext sheet                                    |                                 |                            |                           |                 |                      |
| Remarks                          | L        |          |  | L   | <u> </u>  |                |                          | <u> </u>                                 | Core Barre  | el:                                       | Water Strik                                  | es:                             |                            |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  | Flush Typ   | ·~·                                       | (m) (i                                       | (Ose io<br>m)                   | (min)                      |                           | J               |                      |
|                                  |          |          |  |   |           |                |                          |  |   | <i>.</i>                                  |  |                                 |                            | A                         | Gť              | 5                    |
|                                  |          |          |  |   |           |                |                          |  | Water Added:<br>From (m)  | To (m)                                    | Casing:<br>To (m)                            | Diame                           | ter (mm)                   |                           |                 |                      |
|                                  |          |          |  |   |           |                |                          |  |   | _   | 74.50  | 200                             | _                          | www.causew<br>© Causewa   | aygeo<br>ay Gec | stech.com            |

| Caus  | sew   | ay                    | Geo  | otec        | h Ltd        | <b>Projec</b>   | st no.        | Project<br>Name: | Greater Duł<br>Investigatio | olin Drair<br>n | nage Sch                              | neme Gr                  | ound          | Borehol<br>BH1:               | e No.<br>39          |
|---|---|-----------------------|--|-------------|--------------|-----------------|---------------|------------------|-----------------------------|-----------------|---------------------------------------|--------------------------|---------------|-------------------------------|----------------------|
| Method:   |   |                       |  |             |              | Co-ore          | ds:           | Client:          | Irish Water                 |                 |                                       |                          |               | Sheet 8                       | of 8                 |
| 0.00 14.5<br>14.50 78.4   | 50 C<br>40 R  | able Pe<br>totary C   | ercussio<br>Coring   | 'n          |              | 323824          | 4.04mE        | Client's Re      |                             | Tobin (         | Concultir                             |                          |               | Scale: 1:                     | :50                  |
| Plant:  |   |                       |  |             |              | 241663<br>Groun | 3.70mN        |                  |                             |                 |                                       |                          |               | Crew: M                       | McC                  |
| Danuo 2000  | )+Beie  |                       |  | <del></del> | <del> </del> | 9.07M           | OD            | Dates:           | 04/02/2015                  | - 12/02/2       | 2015                                  |                          |               | Logged By                     | : DOM<br>+MFG        |
| Depth (m)   | TCR   | SCR                   | RQD  | FI          | Field Rec    | ords            | Level & Depth |                  | Stra                        | tum Desc        | cription                              |                          |               | Water<br>Strikes              | Backfill<br>Installs |
| Depth (m)<br>72.40 - 73.90<br>73.90 - 75.40<br>75.40 - 76.90<br>76.90 - 78.40 | TCR         100         100         100         100         100         100 | SCR 100 83 100 100 95 | RQD         100         70         100         92         60 | FI          | Field Reco   | DINGS           | Level & Depth | 76.8m to 73      | 3.3m: Calcite veins         | tum Desc        | , subvertic<br>h calcite a<br>n clay. | al, planar,<br>nd quartz | . slightly    |                               | Backfill             |
| Remarks   |   |                       |  |             |              |                 |               |                  | Core Barro                  | əl:             | Water Str                             | ikes:                    |               |                               |                      |
|   |   |                       |  |             |              |                 |               |                  |                             |                 | Struck<br>(m)                         | Rose to<br>(m)           | Time<br>(min) | ┤┏┲                           | a                    |
|   |   |                       |  |             |              |                 |               |                  | Flush Type                  | Ð:              |                                       |                          |               | AG                            | S                    |
|   |   |                       |  |             |              |                 |               |                  | Water Added:<br>From (m)    | Го (m)          | Casing:<br>To (m)                     | Diame                    | ter (mm)      | ]                             |                      |
|   |   |                       |  |             |              |                 |               |                  |                             |                 | 74.50                                 | 200                      |               | www.causewayg<br>© Causeway G | eotech.com           |

Appendix C Core photographs



BH106 2.30-5.15m



BH106 5.15-7.00m





BH107 2.5-5.5m



BH107 5.5-6.2m





BH108 2.6-5.6m



BH108 5.6-6.8m





BH109 2.5-5.5m



BH109 5.5-6.2m





BH110 3.2-6.2m



BH110 6.2-7.5m





BH111 1.0-4.0m



BH111 4.0-5.4m





BH114 11.5-14.8m





BH115 3.0-6.0m



BH115 6.0-8.8m





BH116 2.0-5.0m





BH116 5.0-8.8m



BH116 8.8-9.7m





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BH131 5.6-7.6m
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BH132 4.5-7.6m





BH139 14.5-15.6m



# BH139 15.6-16.9m



BH139 16.9-18.4m





## BH139 18.4-19.9m



# BH139 19.9-21.4m



BH139 21.4-22.9m





BH139 22.9-24.4m



## BH139 24.4-25.9m



BH139 25.9-27.4m





# BH139 27.4-28.9m



## BH139 28.9-30.4m



BH139 30.4-31.9m





### BH139 31.9-33.4m



## BH139 33.4-34.9m



BH139 34.9-36.4m





BH139 36.4-37.9m



BH139 37.9-39.4m



BH139 39.4-40.9m



#### Greater Dublin Drainage Phase 2



BH139 40.9-42.4m



## BH139 42.4-43.9m



BH139 43.9-45.4m





BH139 45.4-46.9m



BH139 46.9-48.4m



BH139 48.4-49.9m





BH139 49.9-51.4m



BH139 51.4-52.9m



BH139 52.9-54.4m





### BH139 54.4-55.9m



### BH139 55.9-57.4m



BH139 57.4-58.9m





BH139 58.9-60.4m



## BH139 60.4-61.9m



BH139 61.9-63.4m





# BH139 63.4-64.9m



### BH139 64.9-66.4m



BH139 66.4-67.9m





BH139 67.9-69.4m



## BH139 69.4-70.9m



BH139 70.9-72.4m





BH139 72.4-73.9m



BH139 73.9-75.4m



BH139 75.4-76.9m





BH139 76.9-78.4m



Appendix D Trial pit logs

| Cau           | Causeway Geotech Ltd |                      | td Proj                  | Project no. |       | Project<br>Name:                             | Greater Dub<br>Investigatior | olin Drainage Scheme Ground<br>า | Ground Trialpit No<br>TP101 |          |  |
|---------------|----------------------|----------------------|--------------------------|-------------|-------|--|------------------------------|----------------------------------|-----------------------------|----------|--|
| Method:       |                      | Plant:               | Co-                      | ords:       |       | Client:                                      | Irish Water                  |                                  | Sheet 1                     | 1 of 1   |  |
| Trial Pitting |                      | 7t tracked excavator | 308                      | 841.24mE    |       |  |                              |                                  | Scale: 1                    | :25      |  |
| Width: 0.     | 50m Be               | earing: D            | 238                      | 648.55mN    |       | Client's R                                   | epresentative:               | Tobin Consulting Engineers       | Crew:                       |          |  |
| Length: 2.    | 00m (d               |                      | A Gro                    |             | :     | Dates:                                       | 11/12/2014                   |                                  | Logged By                   | : DOM    |  |
| Dought (m)    |                      |                      | 49.0                     |             | Denth |  | 01                           | ture Basarda film                | Legend &                    | Backfil  |  |
| Deptn (m)     | Sample / Test        |                      | oras                     | Level &     | Depth | TOPOOU                                       | Stra                         | tum Description                  | Strikes                     | Installs |  |
| Depth (m)     | ES<br>ES<br>ES       | E Field Reco         | brds                     | Level &     | 0.10  | TOPSOIL<br>MADE G<br>gravelly s<br>is subrou | Strat                        | tum Description                  | Water<br>Strikes            |          |  |
| Remarks       |                      |                      | Water Stri<br>Struck (m) | ikes:       | ails  | Sta<br>Sta                                   | <b>bility:</b><br>ble        |                                  |                             |          |  |
| Refusal me    | t on possible        | limestone bedrock    | 1.40                     |             |       | Dif  | ficulty:                     |                                  | AG                          | S        |  |

| Cau           | seway           | Geotech L           | td Project        | ct no.<br>5                   |              | Project<br>Name:         | Greater Dub<br>Investigatior               | olin Drainage Scheme Ground<br>า  | Trialpi<br>TP1    | t No.<br>02 |
|---------------|-----------------|---------------------|-------------------|-------------------------------|--------------|--------------------------|--|---|-------------------|-------------|
| Method:       |                 | Plant:              | Co-or             | ds:                           |              | Client:                  | Irish Water                                |   | Sheet             | 1 of 1      |
| Trial Pitting |                 | 7t tracked excavato | r 30896           | 8.37mE                        |              |                          |  |   | Scale: 1          | :25         |
| Width: 0.     | 50m Be          | aring: D            | 23866             | 7.25mN                        | 1.           | Client's Re              | presentative:                              | Tobin Consulting Engineers  | Crew:             |             |
| Length: 2.    | 20m (d          | еg. N) в            | A Groun<br>54.591 | MOD                           | •            | Dates:                   | 11/12/2014                                 |   | Logged By         | : DOM       |
| Depth (m)     | Sample / Test   | Field Reco          | ords              | Level &                       | Depth        | 1                        | Strat                                      | tum Description   | Legend 8<br>Water | Backfill    |
|               |                 |                     |                   | (0.00)                        |              | TOPSOIL                  |  |   | Strikes           |             |
|               |                 |                     |                   | ( <i>0.20)</i><br>54.39       | 0.20         | Firm brown               | slightly sandy gra                         | velly slightly silty CLAY. Sand is fine to                                    |                   |             |
|               |                 |                     |                   |                               |              | coarse. Gra              | avel is subrounded                         | to subangular fine to medium.   |                   |             |
| 0.50          | В               |                     |                   | (0.50)                        |              |                          |  |   |                   |             |
|               |                 |                     |                   | 50.00                         | 0.70         |                          |  |   |                   |             |
|               |                 |                     |                   | 53.89                         | 0.70         | Firm grey s<br>weathered | lightly sandy grave<br>roots. Sand is fine | elly slightly silty CLAY with fragments of to coarse. Gravel is subrounded to |                   |             |
|               |                 |                     |                   |                               |              | subangular               | fine to medium.                            |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   | (0.90)                        |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
| 1.50          | в               |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   | ( <del>52,9</del> 9<br>(52.94 | 1.60<br>1.65 | <u>Possible lir</u>      | nestone BEDROC                             | K<br>I of trial pit at 1.60 m   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |
| Romarke       |                 |                     | Water Strike      | es:                           |              | Stab                     | ility:                                     |   |                   |             |
| A cinarks     |                 |                     | Struck (m)        | Flow Det                      | ails         | Stab                     | le   |   |                   |             |
| Refusal me    | t on possible l | imestone bedrock    |                   |                               |              |                          |  |   |                   |             |
|               |                 |                     |                   |                               |              | Diffi                    | culty:                                     |   | AU                | 0           |
|               |                 |                     |                   |                               |              |                          |  |   |                   |             |

| Caus          | seway           | Geotech L            | td Project        | s <b>t no.</b>         |       | Projec<br>Name | t Greater Dub<br>Investigation                        | lin Drainage Scheme Ground  | Trialpit<br>TP10         | No.<br>)3 |
|---------------|-----------------|----------------------|-------------------|------------------------|-------|----------------|---|---|--------------------------|-----------|
| Method:       |                 | Plant:               | Co-or             | ds:                    |       | Client         | : Irish Water   |   | Sheet 1                  | of 1      |
| Trial Pitting |                 | 7t tracked excavator | 30924             | 8.62mE                 |       |                |   |   | Scale: 1:                | 25        |
| Width: 0.     | 50m Be          | aring: D             | 23875             | 3.21mN                 |       | Client         | 's Representative:                                    | Tobin Consulting Engineers  | Crew:                    |           |
| Length: 1.    | 80m (d          | с<br>eq.N) в         | A Groun<br>59.12N | I <b>d Leve</b><br>MOD | l:    | Dates          | : 11/12/2014  |   | Logged By                | : DOM     |
| Depth (m)     | Sample / Test   | Field Reco           | ords              | Level &                | Depth |                | Strat   | um Description  | Legend &<br>Water        | Backfill  |
|               |                 |                      |                   |                        |       | TOP            | SOIL  | ·····   | Strikes                  | Installs  |
|               |                 |                      |                   | (0,40)                 |       |                |   |   |                          |           |
|               |                 |                      |                   | (0.40)                 |       |                |   |   |                          |           |
| 0.50          |                 |                      |                   | 58.72                  | 0.40  | Firm           | brown slightly sandy slig                             | htly gravelly slightly clayey SILT. Gravel is                                   |                          |           |
| 0.50          | в               |                      |                   | (0.40)                 |       | Subi           |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
| 0.90          | в               |                      |                   | 58.32<br><i>(0.15)</i> | 0.80  | Firm<br>fragr  | brown slightly sandy slig<br>nents of weathered roots | htly gravelly slightly clayey SILT with and occasional cobbles. Sand is fine to |                          |           |
|               |                 |                      |                   | 58.17                  | 0.95  | coar           | seGravel is subrounded<br>End                         | to subangular fine to medium  | ् <u>र्वेण अक्त</u> े आज |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |
| Remarks       |                 |                      | Water Strike      | es:                    |       |                | Stability:  |   |                          | 1         |
|               |                 |                      | Struck (m)        | Flow De                | tails |                | Stable  |   |                          |           |
| Refusal me    | t on possible l | limestone bedrock    |                   |                        |       |                |   |   |                          | 6         |
|               |                 |                      |                   |                        |       |                | Difficulty:   |   | AG                       | 6         |
|               |                 |                      |                   |                        |       |                |   |   |                          |           |

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| Cau           | seway         | Geotech L           | td Pro     | o <b>ject no.</b><br>645 |         | Project<br>Name:           | Greater Dub<br>Investigation                            | lin Drainage Scheme Ground<br>า               | Trialpit<br>TP1   | t No.<br>04 |
|---------------|---------------|---------------------|------------|--------------------------|---------|----------------------------|---|---|-------------------|-------------|
| Method:       |               | Plant:              | Co         | -ords:                   |         | Client:                    | Irish Water   |   | Sheet 1           | of 1        |
| Trial Pitting |               | 7t tracked excavato | or 309     | 9762.45m                 | E       |                            |   |   | Scale: 1          | :25         |
| Width: 0.     | 50m Be        | earing: D           | 239        | 9136.59m                 | N       | Client's Rep               | presentative:   | Tobin Consulting Engineers                    | Crew:             |             |
| Length: 3.    | 00m (d        | eq.N) B             | A Gro      | ound Lev<br>56MOD        | el:     | Dates:                     | 11/12/2014  |   | Logged By         | : DOM       |
| Depth (m)     | Sample / Test | Field Rec           | ords       | Level                    | & Denth |                            | Strat   | tum Description                               | Legend &<br>Water | Backfill    |
|               |               |                     |            |                          |         | TOPSOIL                    |   |   | Strikes           | Installs    |
|               |               |                     |            | (0.30)                   |         |                            |   |   |                   |             |
|               |               |                     |            | 71.26                    | 0.30    |                            | - 11 - 14   |   |                   |             |
|               |               |                     |            |                          |         | occasional o               | slightly sandy slig<br>obbles. Sand is fifine to medium | ine to coarse. Gravel is subrounded to        |                   |             |
| 0.50          | В             |                     |            | (0.40)                   |         | g                          |   |   |                   |             |
|               |               |                     |            | 70.86                    | 0.70    | Firm grey br               | own slightly sand                                       | y slightly gravelly slightly clayey SILT with |                   |             |
|               |               |                     |            |                          |         | occasional o<br>subangular | obbles. Sand is fine to medium.                         | ine to coarse. Gravel is subrounded to        |                   |             |
| 1.00          | В             |                     |            | (0.50)                   |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            | 70.36<br>(0.15)          | 1.20    | Firm grey br               | own slightly sand                                       | y gravelly slightly silty CLAY with           |                   |             |
|               |               |                     |            | 70.21                    | 1.35    | to medium.                 |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
|               |               |                     |            |                          |         |                            |   |   |                   |             |
| Remarks       |               |                     | Water St   | rikes:                   | otoile  | Stabi                      | lity:   |   |                   |             |
| Refusal me    | t on possible | limestone bedrock   | Struck (m) | Flow D                   | etalls  | Stable                     | e   |   |                   |             |
|               |               |                     |            |                          |         | <b>B</b> 100               |   |   | AG                | S           |
|               |               |                     |            |                          |         |                            | uity.   |   |                   |             |
| I             |               |                     | 1          | 1                        |         | 1                          |   |   | 1                 |             |

| Caus                   | seway           | Geotech L            | td Projection    | <b>ct no.</b><br>5 |       | Project<br>Name: | t Greater Dub<br>Investigation | in Drainage Scheme Ground              | Trialpit<br>TP10  | No.<br>)5 |
|------------------------|-----------------|----------------------|------------------|--------------------|-------|------------------|--------------------------------|--|-------------------|-----------|
| Method:                |                 | Plant:               | Co-or            | ds:                |       | Client:          | Irish Water                    |  | Sheet 1           | of 1      |
| Trial Pitting          |                 | 7t tracked excavator | 31106            | 8.44mE             |       |                  |                                |  | Scale: 1:         | 25        |
| Width: 0.              | 50m Be          | aring: D             | 23987            | 2.32mN             |       | Client's         | s Representative:              | Tobin Consulting Engineers             | Crew:             |           |
| Length: 1.             | 80m (d          | с<br>eq.N) в         | A Groui<br>76.51 | nd Leve<br>MOD     | l:    | Dates:           | 11/12/2014                     |  | Logged By:        | : DOM     |
| Depth (m)              | Sample / Test   | Field Reco           | ords             | Level 8            | Depth |                  | Strat                          | um Description                         | Legend &<br>Water | Backfill  |
|                        |                 |                      |                  | (0.10)             |       | TOPS             | SOIL                           | · · · · · · · · · · · · · · · · · · ·  | Strikes           | Installs  |
|                        |                 |                      |                  | 76.41              | 0.10  | MADE             | E GROUND - Firm brown          | grey slightly sandy slightly gravelly  |                   |           |
| 0.30                   | ES              |                      |                  |                    |       | coars            | e. Gravel is subrounded        | to subangular fine to coarse.          |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
| 0.50                   | В               |                      |                  | (1.00)             |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
| 1.00                   | ES              |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  | 75.41              | 1.10  | Firm b           | brown slightly sandy sligh     | ntly gravelly slightly silty CLAY with |                   |           |
|                        |                 |                      |                  |                    |       | mediu            | um.                            |  |                   |           |
|                        |                 |                      |                  | (0.50)             |       |                  |                                |  |                   |           |
| 1.50<br>1.50           | ES<br>B         |                      |                  | 74.91              | 1.60  |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  | Enu                            | or that pit at 1.00 m                  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
|                        |                 |                      |                  |                    |       |                  |                                |  |                   |           |
| Remarks                | 1               | 1                    | Water Strik      | es:                |       | :                | Stability:                     |  |                   |           |
|                        |                 |                      | Struck (m)       | Flow De            | tails |                  | Stable                         |  |                   |           |
| Retusal met<br>bedrock | t on possible l | large boulder or     |                  |                    |       | ļ                |                                |  | AG                | S         |
|                        |                 |                      |                  |                    |       |                  | Difficulty:                    |  |                   | Ŭ         |
| 1                      |                 |                      | 1                | 1                  |       |                  |                                |  |                   |           |

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| Caus          | Causeway Geotech Ltd |                     | td Proje   | Project no.               |              |                 | roject Greater Dublin Drainage Scheme Ground<br>Iame: Investigation |  |                  | Trialpit No.<br>TP106 |  |
|---------------|----------------------|---------------------|------------|---------------------------|--------------|-----------------|---|--|------------------|-----------------------|--|
| Method:       |                      | Plant:              | Co-c       | Co-ords:                  |              |                 | Irish Water   |  | Sheet            | 1 of 1                |  |
| Trial Pitting |                      | 7t tracked excavato | 3109       | 89.18mE                   |              |                 |   |  | Scale:           | 1:25                  |  |
| Width: 0      | 50m Be               | aring:              | 2398       | 35.24mN                   | 1            | Client's        | s Representative:   | Tobin Consulting Engineers                           | Crew:            |                       |  |
| Length: 2.    | 10m (d               |                     |            | INOD                      | el:          | Dates:          | 11/12/2014  | Logged B   | y: DOM           |                       |  |
|               | (u                   |                     |            |                           |              |                 |   |  | Legend &         | *<br>Backfil          |  |
| Depth (m)     | Sample / Test        | Field Reco          | ords       | Level                     | & Depth      |                 | Strat   | um Description                                       | Water<br>Strikes | Installs              |  |
|               |                      |                     |            | ( <i>0.76</i> )1<br>76.91 | 0.00<br>0.10 | MADE            | SOIL<br>E GROUND - Firm browi                                       | n sandy slightly gravelly silty CLAY with            |                  |                       |  |
| 0.20          | ES                   |                     |            | (0 35)                    |              | fragm<br>subro  | ents of brick, glass and founded to subangular fine                 | timber. Sand is fine to coarse. Gravel is to coarse. |                  |                       |  |
| 0.30          | В                    |                     |            | (0.00)                    |              |                 | -   |  |                  |                       |  |
|               |                      |                     |            | 76.56                     | 0.45         | Firm I<br>subro | brown slightly sandy grav   | velly slightly silty CLAY. Gravel is                 | 543.5324         |                       |  |
| 0.60          | ES                   |                     |            |                           |              |                 | g   |  |                  |                       |  |
| 0.80          | в                    |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 | End   | of trial pit at 0.95 m                               |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |
| Remarks       | 1                    | 1                   | Water Stri | kes:                      |              | · ;             | Stability:  |  |                  |                       |  |
| _             |                      |                     | Struck (m) | Flow De                   | tails        |                 | Stable  |  |                  | -                     |  |
| Refusal me    | t on possible l      | imestone bedrock    |            |                           |              |                 |   |  |                  |                       |  |
|               |                      |                     |            |                           | ŀ            | Difficulty:     |   | AU   | 0                |                       |  |
|               |                      |                     |            |                           |              |                 |   |  |                  |                       |  |

| www.causewaygeotecn.com |
|-------------------------|
| © Causeway Geotech Ltd  |

| Cau                          | Causeway Geotech Ltd  |                     |                      | oject no.   |         | Project<br>Name:   | Greater Dub<br>Investigation   | Trial  | Trialpit No.     |            |
|------------------------------|---|---------------------|----------------------|---|---------|--------------------|--|--|------------------|------------|
| Method:                      |   | Plant:              | Co                   | o-ords:   |         | Client:            | Irish Water  |  | Shee             | t 1 of 1   |
| Trial Pitting                |   | 7t tracked excavato | ۲<br>31 <sup>.</sup> | 1795.47mE   |         |                    |  |  | Scale:           | 1:25       |
| Width: 0                     | 50m Be  | l<br>aring:         | 24                   | 0613.08ml   | 1       | Client's           | Representative:  | Tobin Consulting Engineers   | Crew:            |            |
| Length: 2                    | 00m (a  |                     | A Gr                 |   | el:     | Dates:             | 11/12/2015   |  | Logged           | By: MG     |
|                              | (u  |                     |                      |   |         |                    |  |  | Legend           | & Backfill |
| Depth (m)                    | Sample / Test   | Field Reco          | ords                 | Level   | & Depth |                    | Stra   | tum Description  | Water<br>Strikes | Installs   |
| 0.50                         | В   |                     |                      | (0.15)<br>78.74<br>(1.20)<br>77.54<br>(0.15)<br>77.39 | 0.15    | Firm bro<br>subang | IL<br>wn gravelly CLAY. G<br>Jar.<br>wn gravelly CLAY with<br>the bedrock. Gravel is<br><u>Jar.</u><br>End | ravel is fine to medium, subrounded to<br>h occasional cobbles of weathered<br>fine to medium, subrounded to<br>of trial pit at 1.50 m |                  |            |
| <b>Remarks</b><br>Refusal me | Remarks     Wate       Refusal met on possible limestone bedrock. |                     |                      | trikes:<br>) Flow De                                  | etails  | St<br>Di           | ability:<br>able<br>fficulty:  |  | A                | GS         |
| 1                            |   |                     |                      | 1   |         |                    |  |  |                  |            |

| Cau           | seway         | Geot   | ech Lto      | d Projec     | t no.              | Projec<br>Name       | t Greater Dub<br>Investigation  | lin Drainage Scheme Ground  | Trial   | pit No.<br>2108   |
|---------------|---------------|--------|--------------|--------------|--------------------|----------------------|---|---|---|---|
| Method:       |               | Plant: |              | Co-ord       | ls:                | Client               | : Irish Water   |   | Shee  | et 1 of 1   |
| Trial Pitting |               | CX130  |              | 311897       | .22mE              |                      |   |   | Scale:  | 1:25  |
| Width: 0.     | 60m Be        | aring: | D            | 241152       | 2.78mN             | Client               | 's Representative:  | Tobin Consulting Engineers  | Crew:   |   |
| Length: 2     | 50m (d        |        | c            | A Groun      | d Level:           | Dates                | : 03/02/2015  |   | Logged  | By: DOM   |
| Double (m)    |               |        | B            | /0.01N       |                    |                      | 01  | Description   | Legend  | 1 & Backfill  |
| Deptn (m)     | Sample / Test |        | Field Record | 15           | Level & Depth      |                      | Strat   |   | Strike  | s Installs  |
| 1.00          | В             |        |              |              | (2.00)             | suba                 | angular to subrounded fine  | to coarse.  | 해소한 성수가 해소한 해소한 것은 것을 하는 것을 수 있는 것을 수 있는 것을 하는 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있는 것을 수 있는 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있다. 것을 수 있는 것을 수 있는 것을 수 있다. 것을 수 있다. 것을 수 있는 것을 수 있다. 않다. 것을 수 있다. 것을 수 있다 | and                                 |
| 2.00          | В             |        |              |              | 76.81 2.00         | Firm<br>occa<br>suba | to stiff dark grey slightly sisional cobbles and bould angular to subrounded fine | sandy gravelly slightly silty CLAY with<br>ers. Sand is fine to coarse. Gravel is<br>e to coarse. |   | (19년1년) 1월 20년 2월 20년 2월 20년 2월 20년 |
| 3.00          | В             |        |              |              | (2.50)             |                      |   |   |   | · · · · · · · · · · · · · · · · · · ·                                   |
| 4.00          | В             |        |              |              | 74.31 4.50         |                      | End   | of trial pit at 4.50 m  |   | 「大田人」(「南人」(「南人」(「南人」「「南人」「「南人」」「南人」(「                                   |
| Remarks       |               |        | V            | Vater Strike | s:<br>Flow Details |                      | <b>Stability:</b><br>Stable   |   |   |   |
|               |               |        |              |              |                    |                      | Difficulty:   |   | www.causev<br>© Causew  | Waygeotech.com  |

| Caus                  | Causeway Geotech Lto |                        | td Project         | ct no.<br>5      | Projec<br>Name: | t Greater Dub   | lin Drainage Scheme Ground  | Trialpit No.<br>TP109 |                          |  |
|-----------------------|----------------------|------------------------|--------------------|------------------|-----------------|---|---|-----------------------|--------------------------|--|
| Method:               |                      | Plant:                 | Co-or              | ds:              | Client:         | Irish Water   |   | Sheet                 | 1 of 1                   |  |
| Trial Pitting         |                      | CX130                  | 31237              | 1.79mE           |                 |   |   | Scale: 1              | 1:25                     |  |
| Width: 0.             | 60m Be               | aring: D               | 24140              | 7.09mN           | Client'         | s Representative:                                       | Tobin Consulting Engineers  | Crew:                 |                          |  |
| Length: 5.            | 00m (d               | eq.N) B                | A Grour<br>85.831  | nd Level:<br>MOD | Dates:          | 03/02/2015  |   | Logged By: DOM        |                          |  |
| Depth (m)             | Sample / Test        | Field Reco             | ords               | Level & Depth    |                 | Strat   | tum Description   | Legend 8<br>Water     | Backfil                  |  |
|                       |                      |                        |                    |                  | MAD<br>subro    | E GROUND - Soft grey g<br>ounded fine to medium. H      | ravelly CLAY. Gravel is subangular to<br>ligh content of fill material. | Strikes               |                          |  |
| 0.50                  | ES                   |                        |                    |                  |                 |   |   |                       | x                        |  |
| 1.00<br>1.00          | BES                  |                        |                    | (2.20)           |                 |   |   |                       |                          |  |
| 2.00                  | ES                   |                        |                    | 83.63 2.20       | Soft suba       | grey slightly sandy slightl<br>ngular to subrounded fin | y gravelly slightly silty CLAY. Gravel is<br>e to medium                |                       |                          |  |
| 3.00<br>3.00          | B<br>ES              |                        |                    | (1.20)           |                 |   |   |                       |                          |  |
|                       |                      |                        |                    | 82.43 3.40       |                 | Ēīd   | of trial pit at 3.40 m  |                       |                          |  |
| Remarks               |                      |                        | Water Strike       | es:              |                 | Stability:  |   |                       |                          |  |
| Trial pit tern<br>in. | ninated at site      | of trench wall falling | Struck (m)<br>0.50 | Flow Details     |                 | Unstable - sides fall Difficulty:                       | ing in.   |                       | <b>P</b><br>yaeotech.com |  |

| Caus   | seway                                   | Geotech I        | _td                    | Projec          | t no.  |                              | Project<br>Name:               | Greater Dul<br>Investigatio   | blin Drainage Scheme Ground  | Trialpi<br>TP1    | it No.<br>110 |
|--|---|------------------|------------------------|-----------------|--|------------------------------|--------------------------------|---|--|-------------------|---------------|
| Method:                                      |   | Plant:           |                        | Co-ord          | ds:  |                              | Client:                        | Irish Water   |  | Sheet             | 1 of 1        |
| Trial Pitting                                |   | CX130            |                        | 312439          | 9.57mE   |                              |                                |   |  | Scale:            | 1:25          |
| Width: 0.                                    | 60m Be                                  | aring: D         |                        | 241496          | 6.47mN   |                              | Client's I                     | Representative:   | Tobin Consulting Engineers   | Crew:             |               |
| Length: 3.                                   | 50m (d                                  | c<br>ea.N) B     | A                      | Groun<br>83.87N | <b>d Leve</b> l<br>10D   | :                            | Dates:                         | 03/02/2015  |  | Logged B          | y: DOM        |
| Depth (m)                                    | Sample / Test                           | Field Re         | cords                  |                 | Level &  | Depth                        |                                | Stra  | tum Description  | Legend &<br>Water | Backfil       |
|  |   |                  |                        |                 |  |                              | TOPSO                          | L   |  | Strikes           | Installs      |
| Depth (m) 0.50 0.50 1.00 1.50 2.00 2.00 2.00 | B<br>ES<br>B<br>B<br>ES<br>B<br>B<br>ES | Field Re         | cords                  |                 | (0.30)<br>83.57<br>(1.60)<br>81.97<br>(0.30)<br>81.67<br>(0.20)<br>81.47 | 0.30<br>1.90<br>2.20<br>2.40 | Firm bro<br>cobbles<br>subroun | stiff dark grey slightly<br>and boulders. Sand<br>ded fine to medium. | tum Description  the provide the second seco | Water<br>Strikes  |               |
| <b>Remarks</b><br>Refusal me                 | t on possible                           | imestone bedrock | Wate<br>Struck<br>2.40 | r Strike<br>(m) | PS:<br>Flow Det  | ails                         | St<br>St                       | ability:<br>able  |  | AG                |               |
|  |   |                  |                        |                 |  |                              |                                | incuity:  |  |                   |               |

| Causeway                              | Causeway Geotech Ltd      |                     | t no.   | Projec<br>Name:        | t Greater Dub<br>Investigation      | Trialpi<br>TP1             | Trialpit No.<br>TP112  |                               |  |  |
|---------------------------------------|---------------------------|---------------------|---|------------------------|-------------------------------------|----------------------------|------------------------|-------------------------------|--|--|
| Method:                               | Plant:                    | Co-orc              | ls:   | Client:                | : Irish Water                       |                            | Sheet                  | 1 of 1                        |  |  |
| Trial Pitting                         | CX130                     | 313162              | 2.95mE  |                        |                                     |                            | Scale: 1               | 1:25                          |  |  |
| Width: 0.60m Be                       | aring: D                  | 241596              | 6.95mN  | Client                 | 's Representative:                  | Tobin Consulting Engineers | Crew:                  |                               |  |  |
| Length: 3.00m (de                     | сА<br>eq. N) в            | Groun<br>75.80N     | d Level:<br>10D   | Dates:                 | 03/02/2015                          |                            | Logged B               | Logged By: DOM                |  |  |
| Depth (m) Sample / Test               | Field Records             |                     | Level & Depth   |                        | Strat                               | um Description             | Legend &<br>Water      | Backfill                      |  |  |
| Depth (m) Sample / Test 0.50 B 1.50 B | eg. N) B<br>Field Records | 75.80M              | Level & Depth<br>(0.80)<br>75.00 0.80<br>(0.90)<br>74.10 1.70<br>(0.20)<br>73.90 1.90 | Firm<br>cobbi<br>media | Strat                               | sum Description            | Legend & Water Strikes | s bow<br>Backfill<br>Installs |  |  |
| Remarks<br>Refusal met on possible I  | imestone bedrock          | er Strike<br>:k (m) | S:<br>Flow Details  |                        | Stability:<br>Stable<br>Difficulty: |                            | AC                     | I<br>S                        |  |  |

| Cau           | Causeway Geotech Lto |             | d Projec                   | Project no.                  |                      | t Greater Dub  | lin Drainage Scheme Ground  | Trialpit No.<br>TP113           |                          |
|---------------|----------------------|-------------|----------------------------|------------------------------|----------------------|--|---|---------------------------------|--------------------------|
| Method:       |                      | Plant:      | Co-ore                     | ds:                          | Client               | : Irish Water  |   | Sheet 1                         | of 1                     |
| Trial Pitting |                      | CX130       | 32339                      | 3.78mE                       |                      |  |   | Scale: 1:2                      | 25                       |
| Width: 0.     | 60m Be               | earing: D   | 24148                      | 7.97mN                       | Client               | 's Representative:   | Tobin Consulting Engineers  | Crew:                           |                          |
| Length: 3.    | .00m (d              | c           | A Groun                    | on<br>OD                     | Dates                | 03/02/2015   |   | Logged By:                      | DOM                      |
| Depth (m)     | Sample / Test        | Eield Pacor |                            | Lovel & Depth                |                      | Strat  | um Description  | Legend &                        | Backfil                  |
|               |                      |             |                            |                              | TOP                  | SOIL   |   | Strikes                         | Installs                 |
|               |                      |             |                            | (0.30)                       |                      |  |   |                                 |                          |
| 1.00          | В                    |             |                            | ( <i>3.70</i> )              | Firm<br>cobb<br>medi | brown slightly sandy grav<br>les and boulders. Gravel<br>ium. Cobbles and boulder        | relly slightly silty CLAY with occasional<br>is subangular to subrounded fine to<br>is are subangular to subrounded |                                 |                          |
| 3.00          | В                    |             |                            |                              |                      |  |   |                                 |                          |
| 4.00          | В                    |             |                            | 0.84 4.00<br>( <i>0.50</i> ) | Firm<br>with<br>Grav | to stiff dark grey slightly s<br>occasional cobbles and ra<br>rel is subangular to subro | sandy slightly gravelly slightly silty CLAY<br>are boulders. Sand is fine to coarse.<br>unded fine to medium.       |                                 |                          |
| Remarks       |                      |             | Nater Strike<br>Struck (m) | PS:<br>Flow Details          |                      | End<br>Stability:<br>Stable<br>Difficulty:   | or trial pit at 4.50 m  | AG                              | S                        |
|               |                      |             |                            |                              |                      |  |   | www.causewayge<br>© Causeway Ge | eotech.com<br>eotech Ltd |

| Cau           | Causeway Geotech Ltd |        |               | Project no.<br>14-645 |                          |       | Projec<br>Name:           | t Greater Dub<br>Investigation  | Trialpit No.<br>TP114  |                   |             |
|---------------|----------------------|--------|---------------|-----------------------|--------------------------|-------|---------------------------|---|--|-------------------|-------------|
| Method:       |                      | Plant: |               | Co-ord                | ds:                      |       | Client:                   | Irish Water   |  | Sheet 2           | 1 of 1      |
| Trial Pitting |                      | CX130  |               | 323399                | 9.33mE                   |       |                           |   |  | Scale: 1          | :25         |
| Width: 0.     | 60m Be               | aring: | D             | 241458                | 3.33mN                   |       | Client'                   | s Representative:   | Tobin Consulting Engineers   | Crew:             |             |
| Length: 3.    | 50m (d               | eg. N) | B             | 3.98M                 | <b>d Levei:</b><br>DD    |       | Dates:                    | 03/02/2015  |  | Logged By         | : DOM       |
| Depth (m)     | Sample / Test        | F      | Field Records |                       | Level &                  | Depth |                           | Strat   | um Description   | Legend &<br>Water | Backfil     |
| 1.00<br>2.00  | B                    |        |               |                       | (0.25)<br>3.73<br>(1.85) | 0.25  | Firm                      | SOIL<br>brown slightly sandy gra<br>es and boulders. Gravel<br>um. Cobbles and boulde | velly slightly silty CLAY with occasional<br>is subangular to subrounded fine to<br>rs are subangular to subrounded. |                   | Installs    |
| 3.00          | В                    |        |               |                       | 1.88<br>(2.40)           | 2.10  | Firm t<br>with c<br>subar | to stiff dark grey slightly<br>occasional cobbles and t<br>ngular to subrounded fin   | sandy slightly gravelly slightly silty CLAY<br>oulders. Sand is fine to coarse. Gravel is<br>e to medium.            |                   |             |
| 4.00          | В                    |        |               |                       | -0.52                    | 4.50  |                           | Ēīd   | of trial pit at 4.50 m   |                   |             |
|               |                      |        |               |                       |                          |       |                           |   |  |                   |             |
| Remarks       |                      |        | Wate          | er Strike             | s:                       |       |                           | Stability:  |  |                   |             |
|               |                      |        | Struc         | k (m)                 | Flow Deta                | ails  |                           | Stable  |  |                   |             |
|               |                      |        |               |                       |                          |       | ŀ                         | D.(() //  |  | - AC              | S           |
|               |                      |        |               |                       |                          |       |                           | Difficulty:   |  |                   | -           |
|               |                      |        |               |                       |                          |       |                           |   |  | www.caueewow      | neotech.com |
|               |                      |        |               |                       |                          |       |                           |   |  | © Causeway 0      | Seotech Ltd |

Appendix E Trial pit photographs





















































































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Appendix F Laboratory test results


# SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

| То:     | Bord Gais                          |
|---------|------------------------------------|
| Copy:   | Orla Smyth (kkidd@bge.ie)          |
| From:   | Stephen Watson                     |
|         | Laboratory Manager                 |
|         | Causeway Geotech Ltd               |
| Tel:    | +44(0)2827666640                   |
| E-mail: | stephen.watson@causewaygeotech.com |
| Date:   | 25/02/15                           |
| Ref:    | 14-645                             |

#### **Greater Dublin Drainage Scheme Ground Investigation**

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the *Contents page(s)*.

The samples were delivered to our laboratory in Ballymoney, Co. Antrim on 18/01/2015 and tested in accordance with the electronic schedule received on 20/01/2015. Further testing instructions were received on 16/02/2015 All testing was performed 26/01/2015 to 25/02/2015.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of one month from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Approved Signatory

Stephen Watson Laboratory Manager

### Causeway Geotech Ltd

8 Drumahiskey Road, Ballymoney Co. Antrim, N. Ireland, BT53 7QL



## Project Name Greater Dublin Drainage Scheme Ground Investigation

### Report Reference. 14-645

The table below details the tests carried out, the specifications used and the number of tests included in this report:

| Material<br>tested | Type of test/Properties<br>measured/Range of measurement          | Standard<br>specifications | Number of test<br>results included in<br>the report | Comments   |
|--------------------|---|----------------------------|---|--|
| SOIL               | Moisture content<br>- oven drying method                          | BS 1377-2:1990             | 64  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Liquid limit<br>- cone penetrometer                               | BS 1377-2:1990             | 44  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Liquid limit<br>- cone penetrometer<br>- one point                | BS 1377-2:1990             | 44  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Plastic limit   | BS 1377-2:1990             | 44  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Plasticity index and liquidity index                              | BS 1377-2:1990             | 44  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Particle size distribution<br>- wet sieving                       | BS 1377-2:1990             | 42  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Particle size distribution<br>- dry sieving                       | BS 1377-2:1990             | 0   | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Particle size distribution<br>-sedimentation<br>hydrometer method | BS 1377-2:1990             | 40  | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Density - linear  | BS 1377-2:1990             | 0   | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Particle density – gas jar  | BS 1377-2:1990             | 0   | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | Dry density/moisture content<br>relationship (2.5 kg rammer)      | BS 1377-4:1990             | 0   | Currently working<br>towards UKAS<br>accreditation |
|                    | Dry density/moisture content<br>relationship (4.5 kg rammer)      | BS 1377-4:1990             | 0   | Currently working<br>towards UKAS<br>accreditation |
| SOIL               | MCV   | BS 1377-4:1990             | 0   | Currently working<br>towards UKAS<br>accreditation |

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8 Drumahiskey Road, Ballymoney Co. Antrim, N. Ireland, BT53 7QL



| SOIL | MCV relationship  | BS 1377-4:1990  | 0  | Currently working<br>towards UKAS<br>accreditation |
|------|---|---|----|--|
| SOIL | California Bearing Ratio (CBR)  | BS 1377-4:1990  | 0  | Currently working<br>towards UKAS<br>accreditation |
| SOIL | One-dimensional consolidation properties  | BS 1377- 5:1990   | 0  | Currently working<br>towards UKAS<br>accreditation |
| SOIL | Laboratory vane   | BS 1377- 7:1990   | 0  | Currently working<br>towards UKAS<br>accreditation |
| SOIL | Undrained shear strength – triaxial<br>compression without measurement<br>of pore pressure<br>(loads from 0.12 to 24 kN)                                | BS 1377- 7:1990   | 0  | Currently working<br>towards UKAS<br>accreditation |
| SOIL | Undrained shear strength – triaxial<br>compression with multistage<br>loading and without measurement<br>of pore pressure<br>(loads from 0.12 to 24 kN) | BS 1377- 7:1990   | 0  | Currently working<br>towards UKAS<br>accreditation |
| ROCK | Point load index  | ISRM Commission<br>on Testing<br>Methods.<br>Suggested<br>Method for<br>Determining<br>Point Load<br>Strength<br>1985 | 10 | Currently working<br>towards UKAS<br>accreditation |
| ROCK | UCS   | ISRM Suggested<br>Methods -<br>Rock<br>Characterization<br>Testing<br>and Monitoring,<br>Ed. E T Brown -<br>1981      | 6  | Currently working<br>towards UKAS<br>accreditation |

| CA   | Project No.           14-645           Hole No.         Ref         Top           BH117         B03         3.50           BH117         B04         4.50           BH117         D05         5.00           BH117         B02         1.80           BH117         B01         0.35           BH117         B01         0.35           BH117         B01         0.35           BH117         B01         0.35           BH118         8         8.00           BH120         14         9.50           BH120         14         5.00           BH120         12         6.50           BH120         12         6.50           BH120         13         8.00           BH120         13         8.00           BH120         13         3.10           BH120         3         3.10           BH121         4         3.50           BH121         6         2.00           BH122         B07         9.50           BH122         B04         4.50 |          |         |   | Summar   | y of (       | Clas       | sific   | ation            | Test     | Re     | suli | ts                  |       |      |
|--|---|----------|---------|---|--|--------------|------------|---------|------------------|----------|--------|------|---------------------|-------|------|
| Project No.                                |   |          | Project | Name  | )  |              |            |         |                  |          |        |      |                     |       |      |
| 14   | -645  |          |         |   | Greater I  | Dublin D     | rainag     | ge Sche | eme Gro          | und Inve | estiga | ion  |                     |       |      |
| Hole No.                                   |   | Sa       | mple    |   | Soil Description   | Dens<br>bulk | ity<br>dry | W       | Passing<br>425µm | LL       | PL     | ΡI   | Particle<br>density | Rema  | arks |
|  | Ref   | Тор      | Base    | Туре  |  | Mg/n         | l<br>n3    | %       | %                | %        | %      | %    | Mg/m3               |       |      |
| BH117                                      | B03   | 3.50     | 4.00    | в   | Very stiff dark grey to black sandy<br>gravelly CLAY with occasional<br>cobbles. |              |            | 14.0    | 62               | 28 -1pt  | NP     |      |                     |       |      |
| BH117                                      | B04   | 4.50     | 5.00    | в   | Very stiff dark grey to black sandy<br>gravelly CLAY with occasional<br>cobbles. |              |            | 13.0    |                  |          |        |      |                     |       |      |
| BH117                                      | D05   | 5.00     |         | D   | Very stiff dark grey to black sandy<br>gravelly CLAY with occasional<br>cobbles. |              |            | 15.0    |                  |          |        |      |                     |       |      |
| BH117                                      | B02   | 1.80     | 3.00    | в   | Very stiff dark grey to black sandy<br>gravelly CLAY with occasional<br>cobbles. |              |            | 11.0    | 44               | 27 -1pt  | 15     | 12   |                     |       |      |
| BH117                                      | B01   | 0.35     | 1.20    | в   | Stiff brown sandy gravelly CLAY with rare cobbles.                               |              |            | 12.0    | 57               | 29 -1pt  | 17     | 12   |                     |       |      |
| BH118                                      | 8   | 8.00     | 8.45    | В   | Stiff dark grey slightly sandy<br>slightly<br>gravelly CLAY.                     |              |            | 20.0    | 50               | 31 -1pt  | 18     | 13   |                     |       |      |
| BH120                                      | 14  | 9.50     |         | D   | Firm to stiff black sandy gravelly CLAY.   |              |            | 22.0    |                  |          |        |      |                     |       |      |
| BH120                                      | 11  | 5.00     |         | D   | Stiff black sandy gravelly CLAY.   |              |            | 18.0    |                  |          |        |      |                     |       |      |
| BH120                                      | 4   | 5.50     | 6.50    | в   | B Firm to stiff black sandy gravelly CLAY.                                       |              |            | 19.0    | 68               | 31 -1pt  | 16     | 15   |                     |       |      |
| BH120                                      | 12  | 6.50     |         | D   | Firm to stiff black sandy gravelly CLAY.   |              |            | 12.0    |                  |          |        |      |                     |       |      |
| BH120                                      | 13  | 8.00     |         | D   | Firm to stiff black sandy gravelly CLAY.   |              |            | 17.0    | 50               | 28 -1pt  | 16     | 12   |                     |       |      |
| BH120                                      | 2   | 1.70     | 2.00    | в   | Stiff brown sandy gravelly CLAY.   |              |            | 13.0    | 60               | 30 -1pt  | 17     | 13   |                     |       |      |
| BH120                                      | 3   | 3.10     | 4.00    | В   | Stiff black sandy gravelly CLAY.   |              |            | 16.0    | 52               | 29 -1pt  | 15     | 14   |                     |       |      |
| BH121                                      | 4   | 3.50     | 4.00    | в   | Stiff black sandy gravelly CLAY.   |              |            | 8.9     | 53               | 28 -1pt  | 16     | 12   |                     |       |      |
| BH121                                      | 6   | 2.00     |         | D   | MADE GROUND - Firm very<br>sandy gravelly CLAY with<br>occasional boulders.      |              |            | 13.0    | 45               | 25 -1pt  | 16     | 9    |                     |       |      |
| BH122                                      | B07   | 9.50     | 10.00   | в   | Black very stiff gravelly CLAY with occasional cobbles and boulders.             |              |            | 27.0    | 56               | 31 -1pt  | 17     | 14   |                     |       |      |
| BH122                                      | B04   | 4.50     | 5.00    | В   | Black very stiff gravelly CLAY with occasional cobbles and boulders.             |              |            | 13.0    |                  |          |        |      |                     |       |      |
| BH122                                      | B05   | 6.00     | 6.50    | В   | Black very stiff gravelly CLAY with occasional cobbles and boulders.             |              |            | 13.0    | 39               | 28 -1pt  | 15     | 13   |                     |       |      |
| BH122                                      | B06   | 7.00     | 7.50    | 0 B Black very stiff gravelly CLAY with occasional cobbles and boulders.    |  |              |            | 16.0    |                  |          |        |      |                     |       |      |
| BH122                                      | B03   | 2.50     | 3.00    | 3.00 B Black very stiff gravelly CLAY with occasional cobbles and boulders. |  |              |            |         | 54               | 29 -1pt  | 15     | 14   |                     |       |      |
| All tests perf                             | All tests performed in accordance with BS1377:1990 unless specified otherwise   |          |         |   |  |              | ise        | -       |                  |          |        |      |                     |       |      |
| Key  | Key   |          |         |   |  |              |            |         | Printed          |          | Appr   | oved | Ву                  | Table |      |
| Density test Liquid Limit Particle density |   |          |         |   |  |              | ate-       | 0.4     | 0/0045           | 00.00    |        |      |                     |       | 1    |
| Linear r<br>wd - wa                        | Linear measurement unless : 4pt cone unless : sp - small pyknome<br>wd - water displacement cas - Casagrande method gi - gas iar  |          |         |   |  |              |            | 04/0    | 19/2015          | 00:00    |        |      |                     | sheet |      |
| wi - imr                                   | nersion   | in water |         | 1pt - si  | ngle point test  | •            |            |         |                  |          | Step   | hen. | Watson              |       | 1    |

|                      | USEV   | <b>VAY</b><br>TECH    |         |   | Summar   | y of (              | Clas       | sific   | ation            | Test     | Re      | sult | ts               |       |      |
|----------------------|--|-----------------------|---------|---|--|---------------------|------------|---------|------------------|----------|---------|------|------------------|-------|------|
| Project No.          |  |                       | Project | Name  | •  |                     |            |         |                  |          |         |      |                  |       |      |
| 14-                  | -645   |                       |         |   | Greater I  | Dublin D            | rainag     | ge Sche | eme Gro          | und Inve | estigat | ion  |                  |       |      |
| Hole No.             |  | Sa                    | mple    |   | Soil Description   | Dens<br>bulk        | ity<br>dry | W       | Passing<br>425µm | LL       | PL      | ΡI   | Particle density | Rem   | arks |
|                      | Ref  | Гор                   | Base    | Туре  |  | Mg/n                | n3         | %       | %                | %        | %       | %    | Mg/m3            |       |      |
| BH122                | B01  | 0.20                  | 1.20    | в   | Brown firm to stiff gravelly CLAY with occasional cobbles and boulders.                      |                     |            | 12.0    | 48               | 29 -1pt  | 16      | 13   |                  |       |      |
| BH123                | D04  | 4.00                  |         | D   | Very stiff dark grey to black sandy gravelly CLAY with occasional cobbles and rare boulders. |                     |            | 9.1     |                  |          |         |      |                  |       |      |
| BH123                | B02  | 1.30                  | 2.00    | в   | Stiff dark brown sandy gravelly<br>CLAY with occasional cobbles and<br>boulders.             |                     |            | 13.0    | 49               | 28 -1pt  | 15      | 13   |                  |       |      |
| BH123                | B03  | 2.50                  | 3.00    | В   | Very stiff dark grey to black sandy gravelly CLAY with occasional cobbles and boulders.      |                     |            | 11.0    | 48               | 31 -1pt  | 18      | 13   |                  |       |      |
| BH123                | B01  | 0.25                  | 1.00    | в   | Firm to stiff dark brown sandy<br>gravelly CLAY with occasional<br>cobbles<br>and boulders.  |                     |            | 13.0    | 52               | 31 -1pt  | 17      | 14   |                  |       |      |
| BH124                | 2  | 1.50                  | 2.00    | В   | Firm brown gravelly CLAY   |                     |            | 14.0    | 46               | 30 -1pt  | 17      | 13   |                  |       |      |
| BH124                | 3  | 2.10                  | 3.00    | В   | Very stiff black sandy gravelly<br>CLAY.   |                     |            | 16.0    | 51               | 30 -1pt  | 16      | 14   |                  |       |      |
| BH124                | 1  | 0.00                  | 1.20    | в   | Firm brown gravelly CLAY   |                     |            | 16.0    | 64               | 35 -1pt  | 17      | 18   |                  |       |      |
| BH125                | 3  | 3.50                  |         | в   | Very stiff black sandy gravelly<br>CLAY.   |                     |            | 16.0    | 45               | 29 -1pt  | 15      | 14   |                  |       |      |
| BH127                | 7  | 4.00                  |         | D   | Very stiff black sandy gravelly<br>CLAY.   |                     |            | 12.0    | 57               | 29 -1pt  | 15      | 14   |                  |       |      |
| BH127                | 2  | 1.80                  | 2.00    | в   | Very stiff black sandy gravelly<br>CLAY.   |                     |            | 14.0    |                  |          |         |      |                  |       |      |
| BH127                | 3  | 2.50                  | 3.00    | в   | Very stiff black sandy gravelly<br>CLAY.   |                     |            | 12.0    | 49               | 29 -1pt  | 16      | 13   |                  |       |      |
| BH127                | 1  | 0.30                  | 1.20    | в   | Stiff brown grey sandy gravelly<br>CLAY  |                     |            | 34.0    | 67               | 44 -1pt  | 32      | 12   |                  |       |      |
| BH128                | D03  | 3.50                  |         | D   | Very stiff black gravelly CLAY with occasional cobbles and boulders.                         |                     |            | 9.7     | 35               | 29 -1pt  | 16      | 13   |                  |       |      |
| BH128                | B04  | 2.50                  | 3.00    | в   | Very stiff black gravelly CLAY with occasional cobbles and boulders.                         |                     |            | 8.2     | 41               | 29 -1pt  | 16      | 13   |                  |       |      |
| BH128                | B02  | 0.30                  | 1.10    | в   | Firm to stiff light brown gravelly<br>CLAY with occasional cobbles and<br>boulders.          |                     |            | 30.0    | 78               | 45 -1pt  | 28      | 17   |                  |       |      |
| BH128                | B03  | 1.10                  | 2.00    | в   | Very stiff black gravelly CLAY with occasional cobbles and boulders.                         |                     |            | 15.0    | 42               | 25 -1pt  | 14      | 11   |                  |       |      |
| BH130                | 6  | 5.00                  | 5.45    | в   | Very stiff dark grey slightly sandy slightly gravelly CLAY.                                  |                     |            | 20.0    | 62               | 32 -1pt  | 18      | 14   |                  |       |      |
| BH130                | 2  | 1.20                  | 1.65    | в   | Firm brown mottled grey slightly gravelly CLAY.  |                     |            | 16.0    | 53               | 32 -1pt  | 17      | 15   |                  |       |      |
| BH135                | 6  | 5.00                  | 5.45    | 5.45 B Stiff dark grey sandy gravelly CLAY. |  |                     |            | 16.0    | 71               | 29 -1pt  | 16      | 13   |                  |       |      |
| All tests perf       | formed in accordance with BS1377:1990 unless specified otherwise |                       |         |   |  |                     |            |         |                  |          |         |      |                  |       |      |
| Key                  | Key  |                       |         |   |  |                     |            |         | Printed          |          | Appr    | oved | Ву               | Table |      |
| Density              | Density test Liquid Limit Particle density                       |                       |         |   |  |                     |            | 0.4"    | 00/004 F         | 00.00    |         |      |                  |       | 2    |
| Linear n<br>wd - wai | neasure<br>ter displa  | ment unles<br>acement | s:      | 4pt con<br>cas - C                          | e uniess : sp - sr<br>asagrande method di - da   | nan pyknon<br>s jar | ieter      | 04/0    | J9/2015          | 00:00    |         |      |                  | sheet |      |
| wi - imr             | nersion  | in water              |         | 1pt - si                                    | ngle point test  | <b>,</b>            |            |         |                  |          | Step    | hen. | Watson           | 5     | 2    |

| CA                   | USEV   | <b>VAY</b><br>TECH  |         |   | Summar  | y of (   | Clas   | sific   | ation   | Test     | Re      | sul  | ts       |       |      |
|----------------------|--|---------------------|---------|---|---|----------|--------|---------|---------|----------|---------|------|----------|-------|------|
| Project No.<br>14-   | 645  |                     | Project | Name                                    | Greater I   | Dublin D | rainac | ie Sche | eme Gro | und Inve | estigat | tion |          |       |      |
|                      |  | Sa                  | mple    |   |   | Dens     | itv    | w       | Passing | LL       | PL      | PI   | Particle |       |      |
| Hole No.             | Ref  | Тор                 | Base    | Туре                                    | Soil Description  | bulk     | dry    |         | 425µm   |          |         |      | density  | Rem   | arks |
|                      |  | - 1                 |         | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |   | Mg/n     | n3     | %       | %       | %        | %       | %    | Mg/m3    |       |      |
| BH135                | 2  | 1.20                | 1.65    | В                                       | Brown mottled grey sandy gravelly<br>CLAY   |          |        | 20.0    | 60      | 35 -1pt  | 20      | 15   |          |       |      |
| BH137                | 2  | 1.20                | 1.65    | В                                       | Firm to soft brown sandy gravelly CLAY.   |          |        | 19.0    | 63      | 35 -1pt  | 17      | 18   |          |       |      |
| BH138                | B03  | 2.50                | 3.00    | в                                       | Medium dense grey slightly sandy<br>subangular to rounded fine to<br>medium GRAVEL.             |          |        | 6.0     |         |          |         |      |          |       |      |
| BH138                | B02  | 0.90                | 1.50    | в                                       | Medium dense grey slightly sandy<br>subangular to rounded fine to<br>medium GRAVEL.             |          |        | 5.4     | 10      | 27 -1pt  | 19      | 8    |          |       |      |
| BH139                | 8  | 8.00                | 8.45    | в                                       | Firm to stiff dark grey slightly<br>sandy gravelly CLAY with<br>occasional                      |          |        | 14.0    | 54      | 28 -1pt  | 15      | 13   |          |       |      |
| BH139                | 7  | 6.00                | 6.45    | в                                       | Stiff black slightly sandy slightly<br>gravelly CLAY with occasional<br>cobbles.                |          |        | 13.0    | 58      | 28 -1pt  | 15      | 13   |          |       |      |
| BH139                | 3  | 2.00                | 2.45    | в                                       | Firm to stiff brown slightly sandy slightly gravelly CLAY                                       |          |        | 16.0    | 67      | 30 -1pt  | 17      | 13   |          |       |      |
| TP100                | B02  | 1.50                |         | В                                       | Firm brown gravelly CLAY. MADE GROUND - Firm brown grey gravelly CLAY with fragments            |          |        | 8.3     | 33      | 29 -1pt  | 18      | 11   |          |       |      |
| TP100                | B01  | 0.50                |         | в                                       | MADE GROUND - Firm brown<br>grey gravelly CLAY with fragments<br>of plastic timber and gravel.  |          |        | 14.0    | 55      | 29 -1pt  | 18      | 11   |          |       |      |
| TP101                | B01  | 0.50                |         | в                                       | MADE GROUND - Soft to firm light<br>brown gravelly CLAY with<br>fragments of plastic and glass. |          |        | 20.0    | 59      | 41 -1pt  | 27      | 14   |          |       |      |
| TP102                | 2  | 1.50                |         | в                                       | Firm grey gravelly CLAY with<br>fragments of weathered roots.                                   |          |        | 13.0    | 37      | 30 -1pt  | 22      | 8    |          |       |      |
| TP102                | B01  | 0.50                |         | в                                       | Firm brown gravelly CLAY.   |          |        | 14.0    | 35      | 37 -1pt  | 25      | 12   |          |       |      |
| TP103                | B01  | 0.50                |         | В                                       | Firm brown gravelly CLAY  |          |        | 15.0    | 33      | 34 -1pt  | 24      | 10   |          |       |      |
| TP103                | B02  | 0.90                |         | в                                       | Firm brown gravelly CLAY with<br>fragments of weathered roots.                                  |          |        | 8.5     | 25      | 33 -1pt  | 24      | 9    |          |       |      |
| TP104                | B01  | 0.50                |         | В                                       | Firm brown gravelly CLAY with occasional cobbles.   |          |        | 32.0    | 92      | 51 -1pt  | 29      | 22   |          |       |      |
| TP104                | B02  | 1.00                |         | в                                       | Firm grey brown gravelly CLAY with occasional cobbles.  |          |        | 15.0    | 58      | 46 -1pt  | 28      | 18   |          |       |      |
| TP105                | B02  | 0.80                |         | в                                       | Firm brown gravelly CLAY.   |          |        | 18.0    | 55      | 41 -1pt  | 25      | 16   |          |       |      |
| TP106                | B01  | 0.30                |         | В                                       | MADE GROUND - Firm brown<br>gravelly CLAY with fragments of<br>brick,glass and timbers.         |          |        | 24.0    | 55      | 42 -1pt  | 25      | 17   |          |       |      |
| TP108                | 2  | 2.00                |         | в                                       | Firm to stiff dark grey gravelly<br>CLAY with occasional cobbles                                |          |        | 9.5     | 40      | 29 -1pt  | 17      | 12   |          |       |      |
| TP109                | 7  | 3.00                |         | B Soft grey gravelly CLAY.              |   |          |        |         | 59      | 39 -1pt  | 21      | 18   |          |       |      |
| All tests perfo      | performed in accordance with BS1377:1990 unless specified otherwise  |                     |         |   |   |          | ise    |         |         |          | -       |      |          |       |      |
| Key                  |  |                     |         |   |   |          |        | Date F  | Printed |          | Appr    | oved | Ву       | Table |      |
| Density<br>Linear m  | Density test         Liquid Limit         Particle density           Linear measurement unless :         4pt cone unless :         sp - small pyknometer |                     |         |   |   |          | neter  | 04/0    | 09/2015 | 00:00    |         |      |          |       | 3    |
| wd - wat<br>wi - imn | er displation  | acement<br>in water |         | cas - C<br>1pt - si                     | asagrande method gj - ga<br>ngle point test   | s jar    |        |         |         |          | Step    | hen. | Watson   | sheet | 3    |

| •         | CA  | USE | WAY   |                                 |   | Summa   | ry of (     | Clas   | sific   | ation   | Test     | Re      | sult   | ts        |       |      |
|-----------|---|-----|-------|---------------------------------|---|---|-------------|--------|---------|---------|----------|---------|--------|-----------|-------|------|
| Project   | No.   |     |       | Project                         | Name  | 1   |             |        |         |         |          |         |        |           |       |      |
|           | 14-0  | 645 |       |                                 |   | Greater   | Dublin D    | rainag | ge Sche | eme Gro | und Inve | estigat | tion   |           |       |      |
|           |   |     | Sa    | mple                            |   |   | Dens        | sity   | w       | Passing | LL       | PL      | ΡI     | Particle  |       |      |
| Hole I    | No.   | Pof | Top   | Page                            | Turne   | Soil Description  | bulk        | dry    |         | 425µm   |          |         |        | density   | Rem   | arks |
|           |   | Rei | тор   | Dase                            | Type  |   | Mg/n        | n3     | %       | %       | %        | %       | %      | Mg/m3     |       |      |
| TP11      | 10  | 5   | 1.50  |                                 | в   | Firm brown gravelly CLAY with occasional cobbles and boulders.      |             |        | 13.0    | 49      | 32 -1pt  | 18      | 14     |           |       |      |
| TP11      | 12  | 2   | 1.50  |                                 | в   | Firm to stiff dark grey gravelly<br>CLAY with cobbles and boulders. |             |        | 10.0    | 26      | 33 -1pt  | 18      | 15     |           |       |      |
| TP11      | 13  | 4   | 4.00  |                                 | в   | Firm to stiff dark grey gravelly<br>CLAY with cobbles and boulders. |             |        | 10.0    | 62      | 25 -1pt  | 15      | 10     |           |       |      |
| TP11      | 14  | 4   | 4.00  |                                 | в   | Firm to stiff dark grey gravelly<br>CLAY with occasional cobbles    |             |        | 9.1     | 65      | 26 -1pt  | 15      | 11     |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
|           |   |     |       |                                 |   |   |             |        |         |         |          |         |        |           |       |      |
| All tests | s performed in accordance with  |     |       | ordance                         | with B  | S1377:1990 unless specif  | ied otherv  | vise   |         |         |          |         | -      |           |       |      |
| Кеу       |   |     |       |                                 |   |   |             |        | Date F  | Printed |          | Appr    | oved   | Ву        | Table |      |
| [         | Density test Liqu   |     |       |                                 | Liquid I  | Limit Parti   | cle density |        |         | 0/00/-  | 00.00    |         |        |           |       | 4    |
| L<br>v    | Density test Liqui<br>Linear measurement unless : 4pt c<br>wd - water displacement cas -<br>wi - immersion in water 1pt - |     |       | 4pt con<br>cas - C<br>1pt - sir | e unless : sp - s<br>asagrande method gj - g<br>ngle point test | small pyknon<br>as jar  | neter       | 04/0   | 9/2015  | 00:00   | Sten     | hen     | Watson | sheet     | 4     |      |
| v         | •• ••••   |     | water |                                 | 1917-31   | ngio point toot   |             |        | L       |         |          |         |        | ** 413011 |       |      |



|       | CAUSEV  | Р  | ARTIC               | .E SIZE      | DISTR             | RIBL      | JTI      | DN    |           |       |           | Jot      | Ref    |          |       |         |          |       | 1       | 4-64   | 5     | _     |      |
|-------|---|--|---------------------|--------------|-------------------|-----------|----------|-------|-----------|-------|-----------|----------|--------|----------|-------|---------|----------|-------|---------|--------|-------|-------|------|
|       | - GLOI  | KACTI.   |                     |              |                   |           |          |       |           |       |           |          | Во     | rehole   | e/Pit | No.     |          |       |         | В      | H11   | 7     |      |
| Si    | te Name   |  | Greater Dublin      | Drainage     | Scheme            | Ground    | Inve     | stiga | tion      |       |           |          | Sar    | mple I   | NO.   |         |          |       |         |        | B03   |       |      |
| Sc    | CAUSEWAY       Greater Du         ite Name       Greater Du         poil Description       Very stiff dai         pecimen Reference       1         est Method       BS1377:Part         CLAY       Fine         Mediu       Mediu         100       90         80       60         70       60         60       60         50       60         40       60         30       70         60       60         50       60         60       60         50       60         40       60         30       70         60       60         50       60         10       0.001         0.001       0.01   |  | Very stiff dark gre | y to black : | sandy grav        | velly CLA | Y wit    | n occ | asiona    | al co | bbles.    |          | De     | pth, n   | ר     |         |          |       |         |        | 3.50  | 1     |      |
| Sp    | ecimen Refer  | ence   | 12                  |              | Specimen<br>Depth |           |          |       |           |       |           | m        | Sai    | mple 1   | Гуре  |         |          |       |         |        | В     |       |      |
| Te    | est Method  |  | BS1377:Part 2:19    | 90, clauses  | 9.2 and 9         | 9.5       |          |       |           |       |           |          | Ke     | yLAB I   | D     |         |          |       | 1       | 4645   | BH1:  | 17B03 | 3    |
|       | CLAY  |  | SILT                | -            |                   | SA        | ND       | 1     |           |       |           | _        | GR/    | AVEL     |       |         |          | СОВІ  | BLES    |        | BOUL  | DERS  | -    |
|       | 100   | Fir  | ie Medium           | Coarse       | Fine              | Med       | muit     |       | Coarse    | e     | Fine      | 11       | Me     | dium     |       | oarse   |          | TT    | -       | 1      | 1 1   | 111   |      |
|       | 90  |  |                     |              |                   |           |          |       |           |       |           |          |        | 1        | 1     |         |          |       |         |        |       |       |      |
|       | 80  |  |                     |              |                   |           |          |       |           |       |           |          | 4      |          |       |         |          |       |         |        |       |       |      |
|       |   |  |                     |              |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
| %     | 70  |  |                     |              |                   |           |          |       | T         |       |           |          |        |          |       |         |          |       | 1       |        |       |       |      |
| ssing | 60  |  |                     |              |                   | 1         |          |       | +         |       |           |          | -      |          |       |         |          | -     | -       | +      | +++   |       |      |
| e Pas | 100<br>90<br>80<br>70<br>60<br>50<br>40<br>30<br>20<br>10<br>0<br>0.001<br>0.001<br>0.01<br>Sieving<br>Particle Size mm<br>% Passing  |  |                     |              |                   |           | 1        |       |           |       |           |          |        |          |       |         |          |       | -       | -      |       |       |      |
| entag | CLAY         SILT<br>Fine         Mediur           90         40         60 |  |                     | /            |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
| Perce | 60<br>50<br>40<br>30<br>20<br>10<br>0.001<br>0.01   |  |                     |              |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       | 60<br>50<br>40<br>30<br>20<br>10<br>0.001<br>0.01   |  |                     |              |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       | 10  | 60<br>50<br>40<br>30<br>20<br>10<br>0<br>0.001<br>0.01<br>Sieving<br>Sieving |                     |              |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       |   | 20   |                     |              |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       | 0.001   | fie  | 0.01                | 1            | 0.1               |           | Par      | licle | 1<br>Size | m     | m         |          | 10     | )        |       |         |          | 10    | 0       |        |       |       | 1000 |
|       | Particle Size   | e mm   | % Passing           | Particle     | Size mm           | % P       | accin    | a     | 1         |       | D         | ry M     | lass   | of sai   | nple  | , g     |          |       |         |        | 3458  | 3     |      |
|       | 125   |  | 100                 |              | 575               | 70 F      | 45       | Б     | -         | S     | amole I   | Pron     | ortio  | ns       |       |         | _        |       |         | %      | dov o | 1255  |      |
|       | 90  |  | 100                 | 0.0          | 315               |           | 37       | _     |           | V     | егу соа   | rse      | ortio  | 113      | _     |         |          | _     |         | 70 1   | 0     | 1035  |      |
|       | 75  | _  | 100                 | 0.0          | 168               |           | 30       |       | -         | G     | ravel     |          |        |          | _     |         | _        |       |         | _      | 25    | _     |      |
|       | 50  |  | 100                 | 0.0          | 056               | 1         | 24<br>18 |       | 1         | 130   | anu       |          |        |          |       |         | _        |       |         |        | 30    |       |      |
|       | 37.5  |  | 100                 | 0.0          | 028               |           | 12       |       | ]         | Fi    | nes <0.   | .063r    | nm     |          |       |         |          |       |         |        | 45    |       |      |
|       | 28  |  | 96                  | -            |                   |           |          |       | -         | G     | rading    | Anal     | ysis   |          |       |         | _        |       |         |        |       |       |      |
|       | 14  |  | 91                  |              |                   |           |          |       | 1         | D     | 100       |          | _      |          |       | m       | nm       |       |         |        |       |       |      |
|       | 10  |  | 85                  |              |                   |           | _        | _     |           | D     | 60        | _        | _      |          | _     | n       | ım       | _     | _       |        | 0.35  | 6     | _    |
|       | 5   |  | 82                  |              |                   |           |          | -     | -         | 6     | 10        |          |        |          | _     | n<br>n  | nm<br>nm |       | _       |        | 0.016 | 6     |      |
|       | 3.35  | 5 81<br>3.35 78  |                     |              |                   | 1         |          |       | 1         | U     | niformi   | ity Co   | peffic | cient    |       |         |          |       |         |        | _     |       |      |
|       | 2 75  |  |                     |              |                   | 1         |          |       | 1         | С     | urvatur   | e Co     | effici | ent      |       |         |          |       |         |        |       |       |      |
|       | 1.18 71   |  |                     |              | 2                 |           |          |       |           | 11    |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       | 0.6   | 0.6 65   |                     |              | density           | (assume   | ed)      |       |           | R     | emarks    | 5        |        |          |       |         |          |       |         |        |       |       |      |
|       | 0.425   | 0.425 02<br>0.3 59   |                     |              | 50                | Mg/m3     | _        | _     | -         | Pr    | eparation | n and to | esting | in accoi | dance | with BS | 51377    | unles | s noted | a belo | w     |       |      |
|       | 0.3   |  | 59                  |              |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       | 0.15  | _  | 55                  | 1            |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       | 0.063   |  | 45                  | 1            |                   |           |          |       |           |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
| _     |   |  |                     | EU.          |                   |           |          |       | - 1       |       |           |          |        |          |       |         |          |       |         |        |       |       |      |
|       |   |  | Approved            |              |                   |           |          |       |           |       |           | S        | heet   | print    | ed    |         |          |       |         |        |       |       |      |
| -     |   |  |                     |              |                   |           | _        |       |           |       |           | 25/      | 02/7   | 015 1    | 0:12  |         |          |       |         |        | 1     | ⊦ıg   | 34   |
|       |   |  | Stephen.Wate        | son          |                   |           |          |       |           |       |           | 104      | 5412   |          | 5.14  |         |          |       |         |        | S     | neet  |      |



|       | CAUSEW   |                                 | PARTI            | CLE SIZE   | DISTRI            | BUTI       | ON      |        | Job Ref             |                   |                | 14-645                |            |                  |
|-------|--|---------------------------------|------------------|------------|-------------------|------------|---------|--------|---------------------|-------------------|----------------|-----------------------|------------|------------------|
| -     |  | 2                               |                  |            |                   |            |         |        |                     | Borehole          | /Pit No.       |                       | BH120      |                  |
| Sit   | e Name   |                                 | Greater Dublin   | Drainag    | e Scheme          | Ground Inv | /estiga | tion   |                     | Sample N          | 10.            |                       | 2          |                  |
| So    | ecimen Reference 1<br>st Method BS1377:Part<br>CLAY SILT<br>Fine Mediu<br>100<br>90<br>80<br>70<br>60<br>50<br>40<br>30<br>20<br>10<br>0.001 0.01  |                                 |                  | y gravelly | CLAY,             |            |         |        |                     | Depth, m          | 1 😤            |                       | 1.70       |                  |
| Sp    | ecimen Refere  | ence                            | 12               |            | Specimer<br>Depth |            |         |        | m                   | Sample T          | уре            |                       | В          |                  |
| Те    | st Method  |                                 | BS1377:Part 2:19 | 990, claus | es 9.2 and 9      | ).5        |         |        |                     | KeyLAB 1          | D              | 146                   | 545BH120B2 |                  |
|       | CLAY   |                                 | SILT             |            |                   | SANE       | )       |        |                     | GRAVEL            |                | COPPLES               |            |                  |
|       | 100  | Fin                             | e Medium         | Coarse     | Fine              | Mediu      | m       | Coarse | Fine                | Medium            | Coarse         | COBBLES               | BOULDERS   |                  |
|       | 00   |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | 90   |                                 |                  |            |                   |            |         |        |                     | 1                 |                |                       |            |                  |
|       | 80   |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
| %     | 70   |                                 |                  |            |                   | _          |         | 1      |                     |                   |                |                       |            |                  |
| ssing | 100<br>90<br>80<br>70<br>60<br>50<br>40<br>30<br>20<br>10<br>0.001<br>0.01   |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
| e Pas | Ecimen Reference         1           St Method         BS1377:Part           CLAY         SILT           Fine         Mediu           100         90           90         80           70         60           50         60           50         60           30         90           20         90           10         0           0         0           0         0           0         0           0         0           10         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0           0         0 </td <td></td>  |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
| entag | ecimen Reference         1           it Method         BS1377:Part           CLAY         Fine           90         Image: Siling test in the |                                 |                  | ,          |                   |            |         |        |                     |                   |                |                       |            |                  |
| Perc  | 100       90         90       80         70       60         50       60         50       60         50       60         40       60         30       20         10       0         0       0.001         0.001       0.01         Sieving         Particle Size mm       % Passing         125       100         90       100         75       100  |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | CLAY         SIL1           Fine         Mediu           90         80           80         70           60         60           50         60           50         60           30         70           20         70           10         0           0         0.001           0.001         0.01   |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | CLAY       SILT         Fine       Mediur         90       90         80       90         80       90         80       90         80       90         90       90         80       90         90       90         80       90         90       90         80       90         90       90         60       90         10       90         10       90         10       90         125       100         90       100         75       100         63       100         50       100         37.5       100         10       85         6.3       81         5       79         3.35       76   |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | 10   | 30<br>20<br>10<br>0.001<br>0.01 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | 30<br>20<br>10<br>0.001<br>0.01  |                                 |                  |            | 0.1               |            | الليل   | 1      |                     | 10                |                | 100                   |            | <b>山</b><br>1000 |
|       |  |                                 |                  |            |                   | P          | article | Size   | mm                  |                   |                |                       |            |                  |
|       |  |                                 |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       |  | Siev                            | ving             |            | Sedim             | entation   |         | 7      | Dry N               | Mass of san       | nple, g        |                       | 2869       |                  |
|       | Particle Size  | mm                              | % Passing        | Partic     | le Size mm        | % Pass     | sing    |        |                     |                   |                |                       |            |                  |
|       | 125<br>90  | -                               | 100              |            | .0571             | 42         |         |        | Sample Prop         | portions          |                | 9                     | 6 dry mass |                  |
|       | 75   |                                 | 100              |            | .0168             | 28         |         |        | Gravel              |                   |                |                       | 27         |                  |
|       | 63<br>50   |                                 | 100              |            | .0095             | 22         |         | -      | Sand                |                   |                |                       | 30         |                  |
|       | 37.5   |                                 | 100              |            | .0028             | 17         |         |        | Fines < 0.063       | mm                |                |                       | 42         | _                |
|       | 28   | _                               | 98               |            |                   | -          |         |        | 1 <u></u>           |                   |                |                       |            | ۵.               |
|       | 14   |                                 | 95               | -          |                   |            |         | 1      | Grading Ana<br>D100 | ilysis            | mm             |                       |            |                  |
|       | 10   |                                 | 85               |            |                   |            |         | 1      | D60                 |                   | mm             |                       | 0.416      |                  |
|       | 6.3  |                                 | 81               |            |                   |            |         |        | D30                 |                   | mm             |                       | 0.021      |                  |
|       | 3.35   |                                 | 79               |            |                   |            |         | -      | D10                 | oefficient        | mm             |                       |            |                  |
|       | 3.35         76           2         73   |                                 |                  |            |                   |            |         |        | Curvature Co        | pefficient        |                |                       |            |                  |
|       | 1.18 69  |                                 |                  |            |                   |            |         | 1      |                     |                   |                |                       |            |                  |
|       | 0.6 63<br>0.425 60   |                                 |                  | Partic     | le densitγ        | (assumed)  |         |        | Remarks             | testing in access | ance with DE12 | 77 uplate act-d+      | low        |                  |
|       | 0.425  | 0.3 57                          |                  |            | 1.30              | wig/1113   |         |        | reparation and      | searing in accord | ance with 0313 | י , שווובסא ווטנפט De |            |                  |
|       | 0.212  | 0.212 53                        |                  |            |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | 0.15   |                                 | 50               | -          |                   |            |         |        |                     |                   |                |                       |            |                  |
|       | 0.063  |                                 | 42               | 11         |                   |            |         | 1      |                     |                   |                |                       |            |                  |
|       |  |                                 | A                | -          |                   |            | 1       |        |                     | Sheet printe      | d              |                       | 1          |                  |
| -     |  |                                 | Approved         |            |                   |            |         |        |                     | 10015             |                |                       | Fig        | 24               |
|       |  |                                 | Stephen.Wat      | son        |                   |            |         |        | 25                  | /02/2015 10       | ):11           |                       | Sheet      |                  |

| -          | CAUSEWAY         | PA                     | RTICLE SIZE           | DISTRIB    | UTION      |                     | Job Ref                         | :                   | L4-645      |    |
|------------|------------------|------------------------|-----------------------|------------|------------|---------------------|---------------------------------|---------------------|-------------|----|
|            | Great Carry      |                        |                       |            |            |                     | Borehole/Pit No.                |                     | BH120       |    |
| Sit        | e Name           | Greater Dublin Dr      | ainage Scheme G       | round inve | stigation  |                     | Sample No.                      |                     | 4           |    |
| So         | il Description   | Firm to stiff black sa | ndy gravelly CLAY.    |            |            |                     | Depth, m                        |                     | 5.50        |    |
| Sp         | ecimen Reference | 12                     | Specimen<br>Depth     |            |            | m                   | Sample Type                     |                     | В           |    |
| Те         | st Method        | BS1377:Part 2:1990     | , clauses 9.2 and 9.9 | 5          |            |                     | KeyLAB ID                       | 1464                | 15BH120B4   |    |
|            | CLAY             | SILT                   |                       | SAND       |            |                     | GRAVEL                          | COBBLES             | BOULDERS    |    |
|            | 100 Fin          | e Medium C             | Coarse Fine           | Medium     | Coarse     | Fine                | Medium Coarse                   |                     | BOOLDENG    |    |
|            | 00               |                        |                       |            |            |                     |                                 |                     |             |    |
|            | 90               |                        |                       |            |            |                     |                                 |                     |             |    |
|            | 80               |                        |                       |            |            |                     |                                 |                     |             |    |
| <b>\</b> 0 | 70               |                        |                       | -          |            |                     |                                 |                     |             |    |
| ∿ gn       | 60               |                        |                       |            |            |                     |                                 |                     |             |    |
| assi       |                  |                        |                       |            |            |                     |                                 |                     |             |    |
| age F      | 50               |                        |                       |            |            |                     |                                 |                     |             | †  |
| cent       | 40               |                        |                       |            |            |                     |                                 |                     | 1-1-1-1-1-0 |    |
| Per        | 30               |                        |                       |            |            | _                   |                                 |                     |             |    |
|            | 20               |                        |                       |            |            |                     |                                 |                     |             |    |
|            | 20               |                        |                       |            |            |                     |                                 |                     |             |    |
|            | 10               |                        |                       |            |            |                     |                                 |                     |             |    |
|            | 0                |                        |                       |            | ļ          |                     |                                 |                     |             | Ц  |
|            |                  |                        |                       | Par        | ticle Size | mm                  | -                               |                     |             |    |
|            | Siev             | /ing                   | Sedimer               | ntation    |            | Dry N               | Aass of sample, g               |                     | 2868        |    |
|            | Particle Size mm | % Passing              | Particle Size mm      | % Passir   | ng         |                     |                                 |                     |             |    |
|            | 90               | 100                    | 0.0575                | 53         | _          | Sample Prop         | portions                        | %                   | dry mass    |    |
|            | 75               | 100                    | 0.0167                | 37         |            | Gravel              |                                 |                     | 24          |    |
|            | 63<br>50         | 100                    | 0.0095                | 28         |            | Sand                |                                 | -                   | 24          |    |
|            | 37.5             | 100                    | 0.0038                | 14         |            | Fines < 0.063       | mm                              |                     | 52          |    |
|            | 28               | 96                     |                       |            |            |                     |                                 |                     |             |    |
|            | 14               | 87                     |                       |            | _          | Grading Ana<br>D100 | ilysis<br>mm                    |                     |             |    |
|            | 10               | 82                     |                       |            |            | D60                 | mm                              |                     | 0.168       |    |
|            | 6.3              | 80                     |                       |            |            | D30                 | mm                              |                     | 0.0109      | _  |
|            | 3.35             | 78                     |                       |            |            | Uniformity C        | Coefficient                     |                     |             |    |
|            | 2                | 76                     |                       |            |            | Curvature Co        | pefficient                      |                     |             |    |
|            | 0.6              | 74 70                  | Particle density (    | (assumed)  | -          | Remarks             |                                 |                     |             |    |
|            | 0.425            | 68                     | 1.50                  | Mg/m3      |            | Preparation and     | testing in accordance with BS13 | 77 unless noted bek | w           |    |
|            | 0.3              | 65                     |                       |            |            |                     |                                 |                     |             |    |
|            | 0.15             | 59                     |                       |            |            |                     |                                 |                     |             |    |
|            | 0.063            | 53                     |                       |            |            |                     |                                 |                     |             |    |
| <b></b>    |                  | Annroved               |                       |            |            |                     | Sheet printed                   |                     |             |    |
|            |                  | Abbioven               |                       |            |            |                     | 102/2015 40:42                  |                     | Fig         | 39 |
|            |                  | Stephen.Watsor         | 1                     |            |            | 25                  | /02/2015 10:12                  |                     | Sheet       |    |

| -     | CAU             | JSEWAY      | Р                   | ARTICLE SIZE        | DISTRIB     | UTION            |                       | Job Ref                          | 1                  | 14-645     |     |
|-------|-----------------|-------------|---------------------|---------------------|-------------|------------------|-----------------------|----------------------------------|--------------------|------------|-----|
| ~     |                 | GEOTECH     |                     |                     |             |                  |                       | Borehole/Pit No.                 | 6                  | 3H121      |     |
| Sit   | te Name         | 2           | Greater Dublin (    | Drainage Scheme     | Ground Inve | estigation       |                       | Sample No.                       |                    | 4          |     |
| Sc    | il Descri       | ption       | Stiff black sandy g | ravelly CLAY.       |             |                  |                       | Depth, m                         |                    | 3.50       |     |
| Sp    | ecimen          | Reference   | 11                  | Specime<br>Depth    | n           |                  | m                     | Sample Type                      |                    | В          |     |
| Te    | st Meth         | od          | BS1377:Part 2:199   | 90, clauses 9.2 and | 9.5         |                  |                       | KeyLAB ID                        | 1464               | I5BH121B4  |     |
|       |                 |             | SILT                |                     | SAND        |                  | 1                     | GRAVEL                           | COBBLES            | BOULDERS   |     |
|       | 100 r           | Fin         | e Medium            | Coarse Fine         | Medium      | Coarse           | Fine                  | Medium Coarse                    |                    | -1-1-1-1-1 |     |
|       | 90              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
|       | 00              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
|       | 00 T            |             |                     |                     |             |                  |                       |                                  |                    |            |     |
| %     | 70              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
| ssing | 60              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
| je Pa | 50              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
| entaç | 40              |             |                     |                     | -           |                  |                       |                                  |                    |            |     |
| Pero  | 30              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
|       | 20              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
|       | 20              |             |                     |                     |             |                  |                       |                                  |                    |            |     |
|       |                 |             |                     |                     |             |                  |                       |                                  |                    |            |     |
|       | 0.00            | )1          | 0.01                | 0.1                 | Pa          | 1<br>rticle Size | mm                    | 10                               | 100                | 1          | 000 |
|       |                 | Sie         | ving                | Sedim               | entation    |                  |                       |                                  |                    | 0740       | _   |
|       | Partic          | cle Size mm | % Passing           | Particle Size mm    | % Passi     | ng               | Dry I                 | vlass of sample, g               |                    | 3/18       |     |
|       |                 | 125         | 100                 | 0.0584              | 39          |                  | Sample Pro            | portions                         | %                  | dry mass   |     |
|       |                 | 90<br>75    | 100                 | 0.0317              | 32          |                  | Very coarse<br>Gravel |                                  |                    | 0          |     |
|       |                 | 63          | 100                 | 0.0096              | 19          |                  | Sand                  |                                  |                    | 27         |     |
|       |                 | 50<br>37.5  | 100                 | 0.0056              | 16          |                  | Fines < 0.063         | 3mm                              |                    | 39         | -   |
|       |                 | 28          | 93                  | -                   |             |                  |                       |                                  | 1                  |            |     |
|       |                 | 14          | 90<br>81            |                     |             |                  | Grading Ana<br>D100   | alysis<br>mm                     |                    |            | -   |
|       |                 | 10          | 78                  |                     |             |                  | D60                   | mm                               |                    | 1.03       |     |
|       | -               | 6.3<br>5    | 75                  |                     |             |                  | D30<br>D10            | mm                               |                    | 0.0256     |     |
|       | 5 73<br>3.35 70 |             |                     |                     |             |                  | Uniformity (          | Coefficient                      |                    | 360        |     |
|       | 2 66<br>1.18 61 |             |                     |                     |             |                  | Curvature C           | oefficient                       |                    | 0.22       |     |
|       | -               | 0.6         | 55                  | Particle density    | (assumed)   |                  | Remarks               |                                  |                    |            |     |
|       |                 | 0.425       | 53                  | 1.50                | Mg/m3       |                  | Preparation and       | testing in accordance with BS137 | 7 unless noted bel | ow         |     |
|       | -               | 0.3         | 49                  | -                   |             |                  |                       |                                  |                    |            |     |
|       |                 | 0.15        | 44                  | -                   |             |                  |                       |                                  |                    |            |     |
|       |                 | 0.063       | 39                  |                     |             |                  |                       |                                  |                    |            | 12  |
|       |                 |             |                     |                     |             | r                |                       | Sheet printed                    |                    | · · · · ·  |     |
|       |                 | 8           | Approved            |                     |             |                  |                       | oncer printeu                    |                    | Fig        | 33  |
|       |                 |             | Stephen.Wats        | son                 |             |                  | 25                    | 6/02/2015 10:12                  |                    | Sheet      |     |

|       | CAUS   | EWAY       | P                 |                        |                    |                 | Job Ref                         | t                   | 4-645     |   |
|-------|--|------------|-------------------|------------------------|--------------------|-----------------|---------------------------------|---------------------|-----------|---|
|       | G  | EDTECH     | r                 |                        | DISTRIBUTR         |                 | Borehole/Pit No.                | l                   | 3H122     |   |
| Si    | te Name  |            | Greater Dublin [  | Orainage Scheme G      | Fround Investiga   | tion            | Sample No.                      |                     | B01       |   |
| So    | CAUSEWAY       Greater Dul         bil Description       Brown firm t         bil Description       Brown firm t         becimen Reference       11         est Method       BS1377:Part         CLAY       SILT         Fine       Mediur         100       90         90       60         50       60         50       60         50       60         30       20         10       0.001         0.001       0.01         Sieving       Particle Size mm         % Passin       125         125       100         90       100         75       100         63       100         50       90 |            |                   | f gravelly CLAY with o | occasional cobbles | and boulders.   | Depth, m                        |                     | 0.20      |   |
| S     | oecimen Re   | ference    | 12                | Specimen<br>Depth      |                    | m               | Sample Type                     |                     | В         |   |
| Т     | est Method   |            | BS1377:Part 2:199 | 90, clauses 9.2 and 9. | .5                 |                 | KeyLAB ID                       | 1494                | 5BH122B01 |   |
|       | CLA  | AY Fin     | SILT<br>Nedium    | Coarse Fine            | SAND<br>Medium C   | Coarse Fine     | GRAVEL<br>Medium Coarse         | COBBLES             | BOULDERS  |   |
|       | 100  |            |                   |                        |                    |                 |                                 |                     |           |   |
|       | 90   | -          |                   |                        |                    |                 |                                 |                     |           |   |
|       | 80   | _          |                   |                        |                    |                 |                                 |                     |           |   |
| -     | 70   | _          |                   |                        |                    |                 |                                 |                     |           |   |
| % ɓu  | 60   |            |                   |                        |                    |                 |                                 |                     |           |   |
| Passi |  |            |                   |                        |                    |                 |                                 |                     |           |   |
| age   | 50   |            |                   |                        | 1                  |                 |                                 |                     |           |   |
| rcent | 40   |            |                   |                        |                    |                 |                                 |                     |           |   |
| Pe    | 30   | _          |                   |                        |                    |                 |                                 |                     |           |   |
|       | 20   | _          |                   |                        |                    |                 |                                 |                     |           |   |
|       | 10   |            |                   |                        |                    |                 |                                 |                     |           |   |
|       |  |            |                   |                        |                    |                 |                                 |                     |           |   |
|       |  | Sio        | ving              | II Sodimo              | Particle           | Size mm         |                                 | r                   |           |   |
|       | Particle   | Size mm    | % Passing         | Particle Size mm       | % Passing          | - Dry I         | Mass of sample, g               |                     | 6324      |   |
|       | 1  | 25         | 100               | 0.0575                 | 35                 | Sample Pro      | portions                        | %                   | drv mass  |   |
|       | 9  | 90         | 100               | 0.0313                 | 30                 | Very coarse     |                                 |                     | 0         |   |
|       |  | 75<br>53   | 100               | 0.0168                 | 24                 | Gravel          |                                 |                     | 43        | _ |
|       | 5  | 50         | 90                | 0.0056                 | 14                 |                 |                                 |                     |           |   |
|       | 37   | 7.5<br>28  | 86                | 0.0028                 | 9                  | Fines < 0.06    | 3mm                             |                     | 35        |   |
|       | 2  | 20         | 77                |                        |                    | Grading An      | alysis                          |                     |           |   |
|       | 1  | 14         | 69                |                        |                    | D100            | mm                              |                     | 3 26      | _ |
|       | 6  | i.3        | 64                |                        |                    | D30             |                                 |                     | 0.0319    | _ |
|       |  | 5          | 63                |                        |                    | D10             | mm                              |                     | 0.00306   |   |
|       | 3.   | .35        | 60                |                        |                    | Uniformity      | Coefficient                     |                     | 1100      |   |
|       |  | 19         | 57                |                        |                    | Curvature C     | oefficient                      |                     | 0.1       |   |
|       |  | 0.6        | 50                | Particle density       | (assumed)          | Remarks         |                                 |                     |           |   |
|       | 0.4  | 425        | 48                | 1.50                   | Mg/m3              | Preparation and | testing in accordance with BS13 | 77 unless noted bel | DW        |   |
|       | 0  | .3         | 45                |                        |                    |                 |                                 |                     |           |   |
|       | 0.2  | 212        | 43                | 4                      |                    |                 |                                 |                     |           |   |
|       | 0.   | .15<br>063 | 40                | -                      |                    |                 |                                 |                     |           |   |
|       | L0.0   |            |                   | л                      |                    | -               |                                 |                     |           |   |
|       |  |            | Approved          |                        |                    |                 | Sheet printed                   |                     |           |   |
| -     |  |            |                   |                        |                    |                 | 02/2015 10-11                   |                     | Fig       | 2 |
|       |  |            | Stephen.Wats      | son                    |                    | 25              | 5/02/2015 10:11                 |                     | Sheet     |   |







|        | CAUSEWAY         | P/                 |                        | STRIBUTI      | ON                     | Job Ref                         | 1                   | 14-645                                  |  |
|--------|------------------|--------------------|------------------------|---------------|------------------------|---------------------------------|---------------------|---|--|
|        | GLOTICH          |                    |                        |               | on                     | Borehole/Pit No.                | I                   | 3H124                                   |  |
| Sit    | e Name           | Greater Dublin D   | rainage Scheme Grou    | und Investiga | tion                   | Sample No.                      |                     | 1                                       |  |
| So     | il Description   | Firm brown gravell | y CLAY                 |               |                        | Depth, m                        |                     | 0.00                                    |  |
| Sp     | ecimen Reference | 12                 | Specimen<br>Depth      |               | m                      | Sample Type                     |                     | В                                       |  |
| Те     | st Method        | BS1377:Part 2:1990 | D, clauses 9.2 and 9.5 |               |                        | KeyLAB ID                       | 1464                | 5BH124B1                                |  |
|        | CLAY             | SILT               |                        | SAND          |                        | GRAVEL                          | CORPLES             | BOUILDERS                               |  |
|        | 100 Fin          | e Medium           | Coarse Fine            | Medium (      | Coarse Fine            | Medium Coarse                   |                     | BOULDERS                                |  |
|        | 90               |                    |                        |               |                        |                                 |                     |   |  |
|        |                  |                    |                        |               |                        | -                               |                     |   |  |
|        | 80               |                    |                        |               |                        |                                 |                     |   |  |
| %      | 70               |                    |                        |               |                        |                                 |                     | 1 · · · · · · · · · · · · · · · · · · · |  |
| ssing  | 60               |                    |                        |               |                        |                                 |                     |   |  |
| le Pa: | 50               |                    |                        |               |                        |                                 |                     |   |  |
| entag  | 40               |                    |                        |               |                        |                                 |                     |   |  |
| Perc   | 30               |                    |                        |               |                        |                                 |                     |   |  |
|        | 20               |                    |                        |               |                        |                                 |                     |   |  |
|        | 20               |                    |                        |               |                        |                                 |                     |   |  |
|        | 10               |                    |                        |               |                        |                                 |                     |   |  |
|        | 0                | 0.01               | 0.1                    | <u></u>       | 4 <b>;</b> 1           | 10                              | 100                 | 1000                                    |  |
|        |                  |                    |                        | Particle      | Size mm                |                                 |                     |   |  |
|        |                  |                    |                        |               |                        |                                 |                     |   |  |
|        | Siev             | /ing               | Sedimentat             | ion           | Dry N                  | lass of sample, g               |                     | 2706                                    |  |
|        | Particle Size mm | % Passing          | Particle Size mm       | % Passing     |                        |                                 |                     |   |  |
|        | 125<br>90        | 100                | 0.0567                 | 46            | Sample Prop            | ortions                         | %                   | dry mass                                |  |
|        | 75               | 100                | 0.0167                 | 31            | Gravel                 |                                 |                     | 23                                      |  |
|        | 63               | 100                | 0.0094                 | 24            | Sand                   |                                 |                     | 30                                      |  |
|        | 37.5             | 100                | 0.0028                 | 19            | Fines < 0.063          | mm                              |                     | 46                                      |  |
|        | 28               | 99                 |                        |               |                        |                                 |                     |   |  |
|        | 20               | 96                 |                        |               | Grading Ana            | lysis                           |                     |   |  |
|        | 10               | 90                 |                        |               | D100                   | mm<br>mm                        |                     | 0.283                                   |  |
|        | 6.3              | 86                 |                        |               | D30                    | mm                              |                     | 0.0154                                  |  |
|        | 5                | 84                 |                        |               | D10                    | mm                              |                     |   |  |
|        | 3.35             | 81                 |                        |               | Uniformity C           | oefficient                      |                     |   |  |
|        | 1.18             | 73                 |                        |               |                        | encient                         | 1                   |   |  |
|        | 0.6              | 67                 | Particle density (ass  | umed)         | Remarks                |                                 |                     |   |  |
|        | 0.425            | 64                 | 1.50 Mg/               | m3            | Preparation and        | esting in accordance with BS137 | 7 unless noted belo | w                                       |  |
|        | 0.3              | 61                 |                        |               |                        |                                 |                     |   |  |
|        | 0.212            | 57                 |                        |               |                        |                                 |                     |   |  |
|        | 0.063            | 46                 |                        |               |                        |                                 |                     |   |  |
|        | 0.000            |                    |                        |               | 1                      |                                 |                     |   |  |
|        |                  | Approved           |                        |               | 9                      | Sheet printed                   |                     |   |  |
| -      |                  | Αρριονεά           |                        |               | Fig                    |                                 |                     |   |  |
|        |                  | Stephen.Watsor     | n                      |               | 25/02/2015 10:11 Sheet |                                 |                     |   |  |

|       | CAU        | SEWAY      |                     |                       |             |                 |                | Job Ref                            | 14-645              |          |  |  |
|-------|------------|------------|---------------------|-----------------------|-------------|-----------------|----------------|------------------------------------|---------------------|----------|--|--|
|       |            | GEOTECH    |                     |                       | יפוא ונוש   |                 |                | Borehole/Pit No.                   | E                   | H125     |  |  |
| Si    | te Name    |            | Greater Dublin      | Drainage Scheme       | Ground Inve | stigation       |                | Sample No.                         |                     | 3        |  |  |
| Sc    | il Descrip | otion      | Very stiff black sa | ndy gravelly CLAY.    |             |                 |                | Depth, m                           |                     | 3.50     |  |  |
| Sp    | ecimen F   | Reference  | 6                   | Specime<br>Depth      | n           |                 | m              | Sample Type                        | В                   |          |  |  |
| Te    | est Metho  | bd         | BS1377:Part 2:19    | 90, clauses 9.2 and 9 | 9.5         |                 |                | KeyLAB ID                          | 14645BH125B3        |          |  |  |
|       | CI         | AY         | SILT                |                       | SAND        |                 |                | GRAVEL                             | COBBLES             | BOULDERS |  |  |
|       | 100        | Fin        | e Medium            | Coarse Fine           | Medium      | Coarse          | Fine           | Medium Coarse                      |                     |          |  |  |
|       | 90 -       |            |                     |                       |             |                 | _              |                                    |                     |          |  |  |
|       | 80         |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
|       | 70         |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
| % D   |            |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
| assin | 60         |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
| age P | 50         |            |                     |                       | _           |                 |                |                                    |                     |          |  |  |
| rcent | 40 -       | -          |                     |                       |             |                 | _              |                                    |                     |          |  |  |
| Ре    | 30 -       | _          |                     |                       |             |                 | _              |                                    |                     |          |  |  |
|       | 20         |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
|       | 10         |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
|       | 10         |            |                     |                       |             |                 |                |                                    |                     |          |  |  |
|       | 0.00       | 1          | 0.01                | 0.1                   | Da          | 1<br>ticle Size | mm             | 10                                 | 100                 | 1000     |  |  |
|       |            |            |                     |                       | r di        |                 |                |                                    |                     |          |  |  |
|       |            | Sio        | ving                | Codim                 | ontation    |                 |                |                                    | · · · · · ·         |          |  |  |
|       | Partic     | le Size mm | % Passing           | Particle Size mm      | % Passi     | ng              | Dry I          | Mass of sample, g                  | 4469                |          |  |  |
|       | -          | 125        | 100                 | 0.0580                | 33          |                 | Sample Pro     | portions                           | %                   | dry mass |  |  |
|       |            | 90         | 100                 | 0.0315                | 28          |                 | Very coarse    |                                    |                     | 0        |  |  |
|       |            | 75<br>63   | 100                 | 0.0168                | 23          |                 | Gravel<br>Sand | 2                                  |                     | 21       |  |  |
|       |            | 50         | 100                 | 0.0056                | 14          |                 |                |                                    |                     |          |  |  |
|       | _          | 37.5       | 97                  | 0.0028                | 8           |                 | Fines < 0.063  | 3mm                                | P                   | 33       |  |  |
|       | -          | 20         | 89                  |                       | 1           |                 | Grading An     | alysis                             | 1                   |          |  |  |
|       |            | 14         | 82                  |                       |             |                 | D100           | mm                                 |                     |          |  |  |
|       |            | 10         | 71                  |                       |             |                 | D60            | mm                                 |                     | 4.06     |  |  |
|       |            | 5          | 62                  | -                     |             |                 | D30            | mm                                 |                     | 0.0389   |  |  |
|       |            | 3.35       | 59                  |                       |             |                 | Uniformity     | Coefficient                        |                     | 1200     |  |  |
|       |            | 2          | 55                  |                       |             |                 | Curvature C    | oefficient                         |                     | 0.11     |  |  |
|       |            | 1.18       | 51                  |                       |             |                 |                |                                    |                     |          |  |  |
|       | 0.6 47     |            |                     | Particle density      | (assumed)   |                 | Remarks        | testing in accordance with BS197   | 7 unless noted hale | 1W       |  |  |
|       | <u> </u>   | 0.3        | 45                  | 1.50                  | ivig/m3     |                 | reparation and | r rescand in accordance with 05121 | . ameas noted beit  |          |  |  |
|       | 0          | 0.212      | 41                  | 1                     |             |                 |                |                                    |                     |          |  |  |
|       |            | 0.15       | 38                  |                       |             |                 |                |                                    |                     |          |  |  |
|       | 0          | 0.063      | 33                  |                       |             |                 |                |                                    |                     |          |  |  |
|       | Approved   |            |                     |                       |             |                 |                | Sheet printed                      |                     |          |  |  |
|       |            |            | Approved            |                       |             |                 |                | -                                  |                     | Fig 32   |  |  |
|       |            |            | Stephen.Wat         | son                   |             |                 | 25             | 5/02/2015 10:12                    |                     | Shoot    |  |  |

| -       | CAUSEWAY         | PAR                    | TICLE SIZE D       | ISTRIB    | UTION            |                 | Job Ref                         |                     | 14-645   |  |
|---------|------------------|------------------------|--------------------|-----------|------------------|-----------------|---------------------------------|---------------------|----------|--|
|         | utoritar         |                        |                    |           |                  |                 | Borehole/Pit No.                |                     | BH127    |  |
| Sit     | te Name          | Greater Dublin Drai    | nage Scheme Gro    | ound Inve | estigation       |                 | Sample No.                      |                     | 1        |  |
| So      | il Description   | Stiff brown grey sandy | gravelly CLAY      | 20        |                  |                 | Depth, m                        |                     | 0.30     |  |
| Sp      | ecimen Reference | 12                     | Specimen<br>Depth  |           |                  | m               | Sample Type                     |                     | В        |  |
| Те      | st Method        | BS1377:Part 2:1990, c  | auses 9.2 and 9.5  |           |                  |                 | KeyLAB ID                       | 14645BH127B1        |          |  |
|         | CLAY             | SILT                   |                    | SAND      |                  |                 | GRAVEL                          | COBBLES             | BOULDERS |  |
|         | 100 Fin          | e Medium Coa           | arse Fine          | Medium    | Coarse           | e Fine          | Medium Coarse                   |                     |          |  |
|         | 90               |                        |                    |           |                  |                 |                                 |                     |          |  |
|         |                  |                        |                    |           |                  |                 | -                               |                     |          |  |
|         | 80               |                        |                    | 1         |                  |                 |                                 |                     |          |  |
| %       | 70               |                        |                    |           |                  |                 |                                 |                     |          |  |
| sing    | 60               |                        |                    |           |                  |                 |                                 |                     |          |  |
| Pas     | 50               |                        |                    |           |                  |                 |                                 |                     |          |  |
| ntage   | 10               |                        |                    |           |                  |                 |                                 |                     |          |  |
| erce    | 40               |                        |                    |           |                  |                 |                                 |                     |          |  |
| щ       | 30               |                        |                    |           |                  |                 |                                 |                     |          |  |
|         | 20               |                        |                    |           |                  |                 |                                 |                     |          |  |
|         | 10               |                        |                    |           |                  |                 |                                 |                     |          |  |
|         | 0                |                        |                    |           |                  |                 |                                 |                     |          |  |
|         | 0.001            | 0.01                   | 0.1                | Pa        | 1<br>rticle Size | mm              | 10                              | 100                 | 1000     |  |
|         | Sie              | ving                   | Sediment           | ation     |                  | Dry N           | lass of sample, g               | 2277                |          |  |
|         | Particle Size mm | % Passing Pa           | rticle Size mm     | % Passir  | ng               |                 | 1.10                            |                     |          |  |
|         | 125              | 100                    | 0.0584             | 60        |                  | Sample Prop     | ortions                         | %                   | dry mass |  |
|         | 75               | 100                    | 0.0319             | 37        |                  | Gravel          |                                 |                     | 16       |  |
|         | 63               | 100                    | 0.0097             | 27        |                  | Sand            |                                 |                     | 24       |  |
|         | 37.5             | 100                    | 0.0058             | 18        |                  | Fines < 0.063   | mm                              |                     | 60       |  |
|         | 28               | 99                     |                    |           |                  | Candina         | husia                           |                     |          |  |
|         | 14               | 98                     |                    |           |                  | D100            | 1ys15 mm                        | -                   |          |  |
|         | 10               | 90                     |                    |           |                  | D60             | mm                              |                     | 0.0571   |  |
|         | 5                | 87                     |                    |           |                  | D30<br>D10      | mm                              |                     | 0.0116   |  |
|         | 3.35             | 85                     |                    |           |                  | Uniformity C    | oefficient                      |                     |          |  |
|         | 2                | 84                     |                    |           |                  | Curvature Co    | pefficient                      |                     |          |  |
|         | 0.6              | 79 Pi                  | article density (a | ssumed)   |                  | Remarks         |                                 |                     |          |  |
|         | 0.425            | 77                     | 1.50 M             | Ig/m3     |                  | Preparation and | testing in accordance with BS13 | 77 unless noted bel | w        |  |
|         | 0.3              | 75                     |                    |           |                  |                 |                                 |                     |          |  |
|         | 0.15             | 69                     |                    |           |                  |                 |                                 |                     |          |  |
|         | 0.063            | 60                     |                    | _         |                  |                 |                                 |                     |          |  |
| <b></b> |                  |                        |                    |           |                  |                 | Sheet printed                   | (                   |          |  |
|         |                  | Approved               |                    |           | Fig              |                 |                                 |                     | Fig 4    |  |
|         |                  | Stephen.Watson         |                    |           |                  | Sheet           |                                 |                     |          |  |

|         | CA       | LISEW     | AY   |                  | DADTI      |                   |            |                  |                 | Job Ref                          | 14-645              |               |                  |
|---------|----------|-----------|------|------------------|------------|-------------------|------------|------------------|-----------------|----------------------------------|---------------------|---------------|------------------|
| -       |          | Gtore     | СН   |                  | FANIT      |                   |            | SOTION           |                 | Borehole/Pit No.                 |                     | BH127         |                  |
| Sit     | te Nam   | e         |      | Greater Dubl     | in Drainag | e Scheme G        | Ground Inv | estigation       |                 | Sample No.                       |                     | 3             |                  |
| Sc      | il Desc  | ription   |      | Very stiff black | sandy grav | velly CLAY.       |            |                  |                 | Depth, m                         |                     | 2.50          |                  |
| Sp      | ecimer   | n Referei | nce  | 12               |            | Specimen<br>Depth |            |                  | m               | Sample Type                      | В                   |               |                  |
| Te      | st Met   | hod       |      | BS1377:Part 2:   | 1990, clau | ses 9.2 and 9     | .5         |                  |                 | KeyLAB ID                        | 1464                | 15BH127B3     |                  |
|         | -        |           |      | SILT             |            |                   | SAND       |                  |                 | GRAVEL                           |                     |               | 1                |
|         | 100 1    |           | Fin  | e Medium         | Coarse     | Fine              | Mediur     | n Coarse         | Fine            | Medium Coarse                    |                     | BOOLDERS      | -                |
|         | 90 -     |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | 80 -     |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | 70 -     |           |      |                  |            |                   |            |                  | -               |                                  |                     |               |                  |
| % DL    | 60       |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
| Passir  | 50       |           |      |                  |            |                   |            |                  | 1               |                                  |                     |               |                  |
| itage I | 50 -     |           |      |                  |            |                   | 1          |                  |                 |                                  |                     |               |                  |
| ercer   |          |           |      |                  |            | 1                 |            |                  |                 |                                  |                     |               | Ï                |
|         |          |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | 20       |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | 10       | 10        |      |                  |            |                   |            |                  |                 |                                  |                     |               | <u></u>          |
|         | 0<br>0.0 | 01        |      | 0.01             |            | 0.1               |            | 1                |                 | 10                               | 100                 | 1             | <b>4</b><br>1000 |
|         |          |           |      |                  |            |                   | Pa         | article Size     | mm              |                                  |                     |               |                  |
|         |          |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | -        |           | Siev | /ing             |            | Sedime            | ntation    |                  | Dry N           | Mass of sample, g                |                     | 6617          |                  |
|         | Part     | icle Size | mm   | % Passing        | Partio     | cle Size mm       | % Pass     | ing              |                 |                                  | L                   |               |                  |
|         |          | 90        |      | 100              |            | 0.0571<br>0.0313  | 36         |                  | Sample Prop     | portions                         | %                   | dry mass<br>0 |                  |
|         |          | 75        |      | 100              |            | 0.0169            | 23         |                  | Gravel          |                                  |                     | 40            |                  |
|         |          | 63        |      | 100              |            | 0.0095            | 19         |                  | Sand            |                                  |                     | 23            |                  |
|         |          | 37.5      | _    | 91               |            | 0.0056            | 15         |                  | Fines <0.063    | mm                               |                     | 36            |                  |
|         |          | 28        |      | 88               |            | 5.0020            | 5          |                  | 1 mes <0.005    |                                  |                     | 50            |                  |
|         |          | 20        |      | 84               |            |                   |            |                  | Grading Ana     | alysis                           |                     |               |                  |
|         |          | 14        |      | 76               |            |                   |            |                  | D100            | mm                               |                     |               |                  |
|         |          | 10        | _    | 72               | _          |                   |            |                  | D60             | mm                               |                     | 2.08          |                  |
|         | -        | 5         | _    | 66               | _          |                   |            |                  | 030             | mm                               |                     | 0.0309        |                  |
|         | -        | 3.35      | -    | 64               |            |                   |            |                  | Uniformity (    | Coefficient                      |                     | 690           |                  |
|         |          | 2         |      | 60               |            |                   |            | -                | Curvature Co    | oefficient                       |                     | 0.15          |                  |
|         |          | 1.18      |      | 56               |            |                   |            |                  |                 |                                  |                     |               |                  |
|         |          | 0.6       |      | 51               | Parti      | cle density       | (assumed)  |                  | Remarks         |                                  |                     |               |                  |
|         | 0.425 49 |           |      |                  |            | 1.50              | Mg/m3      |                  | Preparation and | testing in accordance with BS137 | 7 unless noted belo | w             |                  |
|         | 0.3 47   |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | 0.212 45 |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | 0.15 42  |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         |          |           |      |                  |            |                   |            |                  |                 |                                  |                     |               |                  |
|         | Approved |           |      |                  |            |                   |            |                  |                 | Sheet printed                    |                     |               |                  |
|         | Approved |           |      |                  | ed         |                   |            | Fig              |                 |                                  | 27                  |               |                  |
|         |          |           |      | Stephen W        | atson      |                   |            | 25/02/2015 10:11 |                 |                                  |                     |               |                  |
|         |          |           |      |                  |            |                   |            | 1                |                 |                                  |                     | Sheet         |                  |

|        | CAUSEV         | VAY  |                     |                       |              |                    |                            | Job Ref                         |                                       | 14-645        |  |  |
|--------|----------------|------|---------------------|-----------------------|--------------|--------------------|----------------------------|---------------------------------|---------------------------------------|---------------|--|--|
| -      | GEON           | ECH. |                     | PARTICLE SIZE         | DISTRID      |                    |                            | Borehole/Pit No.                |                                       | 3H128         |  |  |
| Sit    | e Name         |      | Greater Dublin      | Drainage Scheme       | Ground Inve  | stigation          |                            | Sample No.                      |                                       | B02           |  |  |
| So     | il Description |      | Firm to stiff light | brown gravelly CLAY   | with occasio | nal cobbles ar     | nd boulders.               | Depth, m                        |                                       | 0.30          |  |  |
| Sp     | ecimen Refer   | ence | 12                  | Specimen<br>Depth     |              |                    | m                          | Sample Type                     |                                       | В             |  |  |
| Те     | st Method      |      | BS1377:Part 2:19    | 90, clauses 9.2 and 9 | .5           |                    |                            | KeyLAB ID                       | 1464                                  | 5BH128B02     |  |  |
|        | CLAY           |      | SILT                |                       | SAND         | г                  |                            | GRAVEL                          | COBBLES                               | BOUILDERS     |  |  |
|        | 100            | Fin  | e Medium            | Coarse Fine           | Medium       | Coarse             | Fine                       | Medium Coarse                   |                                       |               |  |  |
|        | 90             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
|        | 80             |      |                     |                       |              |                    | -                          |                                 |                                       |               |  |  |
|        | 70             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
| % ըլ   | 60             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
| Passir | 50             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
| itage  | 50             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
| ercer  | 40             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
| Ľ.     | 30             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
|        | 20             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
|        | 10             |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
|        | 0              |      | 0.01                | 0.1                   |              | <u>      </u><br>1 |                            | 10                              | 100                                   | 1000          |  |  |
|        |                |      |                     |                       | Pa           | ticle Size         | mm                         |                                 |                                       |               |  |  |
|        |                |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
|        |                | Sie  | ving                | Sedime                | entation     |                    | Dry N                      | /lass of sample, g              | 2304                                  |               |  |  |
|        | Particle Siz   | e mm | % Passing           | Particle Size mm      | % Passii     | ng                 |                            |                                 | · · · · · · · · · · · · · · · · · · · |               |  |  |
|        | 90             | _    | 100                 | 0.0571                | 55           |                    | Sample Prop<br>Very coarse | oortions                        | %                                     | dry mass<br>0 |  |  |
|        | 75             |      | 100                 | 0.0166                | 40           |                    | Gravel                     |                                 |                                       | 14            |  |  |
|        | 63             |      | 100                 | 0.0094                | 30           |                    | Sand                       |                                 |                                       | 30            |  |  |
|        | 37.5           |      | 100                 | 0.0038                | 14           |                    | Fines < 0.063              | mm                              |                                       | 55            |  |  |
|        | 28             |      | 93                  |                       |              |                    |                            |                                 |                                       |               |  |  |
|        | 20             |      | 92                  |                       |              |                    | Grading Ana                | lysis                           |                                       |               |  |  |
|        | 14             |      | 92                  | -                     |              |                    | D100                       | mm                              |                                       | 0.0943        |  |  |
|        | 6.3            |      | 89                  | 1                     |              |                    | D30                        | mm                              |                                       | 0.00943       |  |  |
|        | 5              |      | 88                  |                       |              |                    | D10                        | mm                              |                                       |               |  |  |
|        | 3.35           | _    | 87                  |                       |              |                    | Uniformity C               | Coefficient                     |                                       |               |  |  |
|        | 1 18           |      | 86                  | -                     |              | _                  | Curvature Co               | pefficient                      |                                       |               |  |  |
|        | 0.6            | _    | 80                  | Particle density      | (assumed)    |                    | Remarks                    |                                 |                                       |               |  |  |
|        | 0.425 78       |      |                     | 1.50                  | Mg/m3        |                    | Preparation and            | testing in accordance with BS13 | 77 unless noted bela                  | w             |  |  |
|        | 0.3            |      | 75                  |                       |              |                    |                            |                                 |                                       |               |  |  |
|        | 0.212          |      | 71                  | -1                    |              |                    |                            |                                 |                                       |               |  |  |
|        | 0.063          |      | 55                  | -                     |              |                    |                            |                                 |                                       |               |  |  |
|        | L              |      |                     |                       |              |                    |                            |                                 |                                       |               |  |  |
|        |                |      | Approved            |                       |              |                    |                            | Sheet printed                   |                                       |               |  |  |
|        |                |      |                     |                       |              | 25/02/2015 10:11   |                            |                                 | Fig 6                                 |               |  |  |
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|          | CAUSEW          |      |  |              |                   |             |                 |                                  | Job Ref             | 14-645    |               |     |
|----------|-----------------|------|--|--------------|-------------------|-------------|-----------------|----------------------------------|---------------------|-----------|---------------|-----|
| -        | GFOY            | сен  |  | ANTIC        |                   | DISTRIB     |                 |                                  | Borehole/Pit No.    |           | 3H130         |     |
| Sit      | e Name          |      | Greater Dublin                                 | Drainage     | Scheme G          | Ground Inve | estigation      |                                  | Sample No.          |           | 2             |     |
| So       | il Description  |      | Firm brown mott                                | led grey sli | ghtly grave       | elly CLAY:  |                 |                                  | Depth, m            |           | 1.20          |     |
| Sp       | ecimen Refere   | ence | 6  |              | Specimen<br>Depth |             |                 | m                                | Sample Type         | В         |               |     |
| Te       | st Method       |      | BS1377:Part 2:19                               | 90, clause:  | s 9.2 and 9.      | .5          |                 |                                  | KeyLAB ID           | 45BH130B2 |               |     |
|          | CLAY            |      | SILT   |              |                   | SAND        |                 | 1                                | GRAVEL              |           | _             |     |
|          | 100             | Fin  | e Medium                                       | Coarse       | Fine              | Medium      | Coarse          | Fine                             | Medium Coarse       |           | BOOLDERS      | -   |
|          | 00              |      |  |              |                   |             |                 |                                  |                     |           |               |     |
|          | 90              |      |  |              |                   |             |                 |                                  |                     |           |               |     |
|          | 80              |      |  |              |                   |             |                 |                                  |                     |           |               |     |
| %        | 70              |      | <u>1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -</u> |              |                   |             |                 |                                  |                     |           |               | -   |
| sing     | ខ្លី 60 <b></b> |      |  |              |                   |             |                 | 1                                |                     |           |               |     |
| Pas      | ξ<br>50         |      |  |              |                   |             |                 |                                  |                     |           |               | _   |
| ntage    | 40              |      |  |              |                   |             |                 |                                  |                     |           |               |     |
| ercei    |                 |      |  |              | T III I           |             |                 |                                  |                     |           |               |     |
| <u>م</u> | 30              |      |  |              |                   |             |                 |                                  |                     |           |               |     |
|          | 20              |      |  |              |                   |             |                 | -                                |                     |           |               | E-1 |
|          |                 |      |  |              |                   |             |                 |                                  |                     |           |               |     |
|          | 0               |      |  |              |                   |             |                 |                                  |                     |           |               |     |
|          | 0.001           |      | 0.01   |              | 0.1               | Pa          | rticle Size     | mm                               | 10                  | 100       |               |     |
|          |                 | Sie  | ving   | _            | Sedime            | ntation     |                 | Dry N                            | Mass of sample, g   | 5961      |               |     |
|          | Particle Size   | e mm | % Passing                                      | Particle     | Size mm           | % Passi     | ng              |                                  |                     |           |               |     |
|          | 125<br>90       | _    | 100  | 0.0          | 0575<br>0313      | 40          |                 | Sample Proj<br>Verv coarse       | portions            | %         | dry mass<br>4 |     |
|          | 75              |      | 100  | 0.0          | 0167              | 28          |                 | Gravel                           |                     |           | 32            |     |
|          | 63<br>50        |      | 96<br>93                                       | 0.0          | 0094<br>0056      | 23          |                 | Sand                             |                     |           | 24            |     |
|          | 37.5            |      | 93   | 0.0          | 0028              | 8           |                 | Fines <0.063                     | 3mm                 |           | 40            |     |
|          | 28              |      | 92<br>89                                       | -            |                   |             |                 | Grading Ana                      | alysis              |           |               |     |
|          | 14              | _    | 80   |              |                   |             |                 | D100                             | mm                  |           | 4.22          |     |
|          | 6.3             |      | 78   |              |                   |             |                 | D60<br>D30                       | mm                  |           | 1.22          |     |
|          | 5               |      | 72   |              |                   |             |                 | D10                              | mm                  |           | 0.00317       |     |
|          | 3.35            |      | 69   |              |                   |             |                 | Uniformity (                     | Coefficient         |           | 390           |     |
|          | 1 10            |      | 64   |              |                   |             |                 | Curvature Co                     | oefficient          |           | 0.1           |     |
|          | 0.6             |      | 55   | Particle     | e density         | (assumed)   |                 | Remarks                          |                     |           |               |     |
|          | 0.425           | 53   | 1  | .50          | Mg/m3             |             | Preparation and | testing in accordance with BS137 | 7 unless noted belo | w         |               |     |
|          | 0.3             |      | 51   |              |                   |             |                 |                                  |                     |           |               |     |
|          | 0.212           |      | 48   | _            |                   |             |                 |                                  |                     |           |               |     |
|          | 0.15            |      | 46   | -            |                   |             |                 |                                  |                     |           |               |     |
|          | L0.005          |      |  | .0           |                   |             |                 |                                  |                     | .2.1      |               |     |
|          |                 |      | A  |              |                   |             |                 |                                  | Sheet printed       |           |               |     |
| _        |                 |      | Approved                                       |              |                   |             |                 |                                  |                     |           | Fig           | 19  |
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|        | CAUSEWAY         | P/                   | ARTICLE SIZE DI           | ISTRIBL       | JTION          |                       | Job Ref                         | 1                    | 14-645   |     |  |  |
|--------|------------------|----------------------|---------------------------|---------------|----------------|-----------------------|---------------------------------|----------------------|----------|-----|--|--|
| -      | GEOTECH          |                      |                           |               |                |                       | Borehole/Pit No.                | E                    | BH130    |     |  |  |
| Sit    | e Name           | Greater Dublin D     | orainage Scheme Gro       | ound Inves    | tigation       |                       | Sample No.                      |                      | 6        |     |  |  |
| Sc     | il Description   | Very stiff dark grey | slightly sandy slightly g | gravelly CL   | AY.            |                       | Depth, m                        |                      | 5.00     |     |  |  |
| Sp     | ecimen Reference | 6                    | Specimen<br>Depth         |               |                | m                     | Sample Type                     |                      | В        |     |  |  |
| Те     | st Method        | B\$1377:Part 2:1990  | 0, clauses 9.2 and 9.5    |               |                |                       | KeyLAB ID                       | 1464                 |          |     |  |  |
|        | CLAX             | SILT                 |                           | SAND          |                |                       | GRAVEL                          | COBBLES              |          |     |  |  |
|        |                  | ne Medium            | Coarse Fine               | Medium        | Coarse         | Fine                  | Medium Coarse                   |                      | DOGEDENS | -   |  |  |
|        | 90               |                      |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 00               |                      |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 80               |                      |                           |               |                |                       |                                 |                      |          |     |  |  |
| % f    | 70               |                      |                           |               | H              |                       |                                 |                      |          | 1   |  |  |
| assing | 60               |                      |                           |               |                |                       |                                 |                      |          | 1   |  |  |
| ge Pa  | 50               |                      |                           |               |                |                       |                                 |                      |          |     |  |  |
| centa  | 40               |                      |                           |               |                |                       |                                 |                      |          |     |  |  |
| Per    | 30               |                      |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 20               |                      |                           |               |                |                       |                                 |                      | -        |     |  |  |
|        | 10               | 10                   |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 0                |                      |                           |               |                |                       |                                 |                      |          | ]   |  |  |
|        | 0.001            | 0.01                 | 0.1                       | Parl          | 1<br>icle Size | mm                    | 10                              | 100                  | 10       | 900 |  |  |
|        | Sie              | eving                | Sedimenta                 | ation         |                | Dry N                 | Ass of sample a                 |                      | 2508     |     |  |  |
|        | Particle Size mm | % Passing            | Particle Size mm          | % Passin      | g              | Diyi                  | lass of sample, B               |                      | 2500     |     |  |  |
|        | 125              | 100                  | 0.0580                    | 47            |                | Sample Prop           | ortions                         | %                    | dry mass |     |  |  |
|        | 90<br>75         | 100                  | 0.0320                    | 37            |                | Very coarse<br>Gravel |                                 |                      | 27       |     |  |  |
|        | 63               | 100                  | 0.0095                    | 24            |                | Sand                  |                                 |                      | 26       |     |  |  |
|        | 37.5             | 100                  | 0.0028                    | 19            |                | Fines < 0.063         | mm                              |                      | 47       |     |  |  |
|        | 28               | 96                   |                           |               |                |                       | lucia                           | 1                    |          |     |  |  |
|        | 20               | 93                   |                           |               | _              | Grading Ana<br>D100   | ilysis                          | <u> </u>             |          | _   |  |  |
|        | 10               | 85                   |                           |               |                | D60                   | mm                              | n                    | 0.347    |     |  |  |
|        | 6.3              | 81                   |                           |               |                | D30                   | mm                              | n                    | 0.017    |     |  |  |
|        | 5                | 80                   |                           |               |                | D10                   | mm                              | <u>ا</u>             |          |     |  |  |
|        | 3.35             | 72                   |                           |               |                | Curvature C           | oefficient                      | -                    |          |     |  |  |
|        | 1.18             | 68                   |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 0.6              | 63                   | Particle density (as      | ssumed)       |                | Remarks               |                                 |                      |          |     |  |  |
|        | 0.425            | 62                   | 1.50 M                    | g/m3          |                | Preparation and       | testing in accordance with BS13 | 377 unless noted bel | w        |     |  |  |
|        | 0.3              | 59                   |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 0.212            | 57                   |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 0.15             | 53                   |                           |               |                |                       |                                 |                      |          |     |  |  |
|        | 0.063            | 47                   |                           |               |                |                       |                                 |                      |          |     |  |  |
|        |                  |                      |                           |               |                | Characteristic d      |                                 |                      |          |     |  |  |
|        |                  | Approved             |                           | Sheet printed |                |                       |                                 |                      | Fig      | 37  |  |  |
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|       | CAUSEWA         | Y        |                | DARTIC      |                  | דצוח :   | RIRI     |                  |                 |                           | Ι           | Job Ref          |             |          |           | 1         | 4-645       |     |     |
|-------|-----------------|----------|----------------|-------------|------------------|----------|----------|------------------|-----------------|---------------------------|-------------|------------------|-------------|----------|-----------|-----------|-------------|-----|-----|
| -     | GFOTIC          | й)<br>   |                | ANTIC       |                  | . 0131   | NIDC     |                  |                 |                           |             | Borehole/        | Pit No.     |          |           | В         | H135        |     |     |
| Si    | te Name         | Great    | er Dublin      | Drainage    | Scheme           | Ground   | Inve     | stigat           | ion             |                           |             | Sample No        | <b>b</b> .  |          |           |           | 2           |     |     |
| Sc    | il Description  | Brown    | mottled g      | rey sandy   | gravelly Cl      | LAY      |          |                  |                 |                           |             | Depth, m         |             |          |           |           | 1.20        |     |     |
| Sp    | ecimen Referen  | æ        | 3              |             | Specime<br>Depth | n        |          |                  |                 | m                         | Sample Type |                  |             |          | В         |           |             |     |     |
| Te    | est Method      | B\$137   | 7:Part 2:19    | 990, clause | es 9.2 and       | 9.5      |          |                  |                 |                           |             | KeyLAB ID        | 1           |          |           | 1464      | 5BH135      | 582 |     |
|       | CLAY            | Fine     | SILT<br>Medium | Coarse      | Fine             | S/<br>Me | AND      | С                | oarse           | Fine                      |             | GRAVEL<br>Medium | Coarse      | c        | OBBLE     | s         | BOULDI      | ERS |     |
|       | 100             |          |                |             |                  |          | 1        |                  | Π               |                           |             |                  |             | 1        |           |           |             |     | ]   |
|       | 90              |          |                |             |                  |          |          |                  |                 |                           |             |                  | 1           | /        |           |           |             |     |     |
|       | 80              |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           | _         | +++         |     |     |
|       | 70              |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     |     |
| % DL  | 60              |          |                |             |                  |          |          |                  | 1               |                           |             |                  |             |          |           |           |             |     |     |
| assir | 00              |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     |     |
| age P | 50              |          |                |             | 11               |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     | 1   |
| rcent | 40              |          |                | P           | 1                |          |          |                  |                 |                           |             |                  |             |          |           | _         |             |     |     |
| Pe    | 30              |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           |           | -           |     |     |
|       | 20              |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           | _         |             |     |     |
|       | 10              |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     |     |
|       |                 |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     |     |
|       | 0.001           |          | 0.01           |             | 0.1              |          | Part     | ticle S          | 1<br>Size       | mm                        |             | 10               |             |          | 100       |           |             | 1(  | 000 |
|       |                 |          |                |             |                  |          |          |                  | ł               |                           |             |                  |             |          |           |           |             |     |     |
|       |                 | Sieving  |                |             | Sedim            | entation | 1        | _                | Dry Mass of san |                           |             |                  | f sample, g |          |           |           | 3168        |     |     |
|       | Particle Size n | ım %     | Passing        | Particl     | e Size mm        | %        | Passin   | g                |                 |                           |             |                  |             |          |           |           |             |     |     |
|       | 90              |          | 100            | 0.          | .0584<br>.0315   | -        | 43<br>38 |                  | ł               | Sample Provide Very coars | opo<br>se   | rtions           |             | -        |           | %         | dry ma<br>0 | \$5 |     |
|       | 75              |          | 100            | 0.          | 0170             |          | 28       |                  |                 | Gravel                    |             |                  |             |          |           |           | 30          |     |     |
|       | 63<br>50        |          | 100<br>91      | 0.          | .0096            |          | 22<br>16 |                  |                 | Sand                      |             |                  |             | -        |           |           | 27          |     |     |
|       | 37.5            |          | 91             | 0.          | 0028             |          | 9        |                  | 1               | Fines < 0.08              | 63m         | ım               |             |          |           |           | 43          |     |     |
|       | 28              | _        | 88             |             |                  |          |          |                  |                 | Grading A                 | naly        | /sis             |             |          |           |           |             |     |     |
|       | 14              |          | 82             |             |                  |          |          |                  | 1               | D100                      |             |                  | m           | nm       |           |           | o           |     | _   |
|       | 6.3             | _        | 80<br>77       | -           |                  | -        |          | _                |                 | D60<br>D30                | _           |                  | m           | nm<br>nm |           | (         | 0.415       |     |     |
|       | 5               |          | 75             |             |                  |          |          |                  | 1               | D10                       |             |                  | m           | nm       |           | 0         | .00298      | 3   |     |
|       | 3.35            |          | 72             |             |                  |          |          | _                |                 | Uniformity                | / Co        | efficient        |             |          |           |           | 140         |     |     |
|       | 1.18            | _        | 67             |             |                  |          |          |                  | 1               | Curvature                 | Coe         | fficient         |             |          |           |           | 0.3         |     |     |
|       | 0.6             |          | 62             | Partic      | le density       | (assum   | ned)     |                  | 1               | Remarks                   |             |                  |             |          |           |           |             |     |     |
|       | 0.425 60        |          |                |             | 1.50             | Mg/m3    | 3        |                  |                 | Preparation ar            | nd te:      | sting in accord  | ance with B | 51377 ı  | unless no | oted belo | w           |     |     |
|       | 0.3 57          |          |                | -           |                  |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     |     |
|       | 0.212 54        |          |                |             |                  |          |          |                  |                 |                           |             |                  |             |          |           |           |             |     |     |
|       | 0.063 43        |          |                |             |                  |          |          |                  | I               |                           |             |                  |             |          |           |           |             |     |     |
|       |                 |          |                |             |                  |          |          |                  |                 | Sheet printed             |             |                  |             |          |           |           |             |     |     |
|       |                 | <u>ا</u> |                |             |                  |          | Fig      |                  |                 |                           | g           | 17               |             |          |           |           |             |     |     |
|       |                 | son      | on             |             |                  |          |          | 25/02/2015 10:11 |                 |                           |             | Sho              | et          |          |           |           |             |     |     |

| -        | CAUSEWAY         | P/                   | ARTICLE SIZE DIS       | TRIBU     | TION      |                 | Job Ref                           | 1                  | 4-645            |       |
|----------|------------------|----------------------|------------------------|-----------|-----------|-----------------|-----------------------------------|--------------------|------------------|-------|
|          |                  |                      |                        |           |           |                 | Borehole/Pit No.                  | E                  | 3H135            |       |
| Sit      | e Name           | Greater Dublin D     | rainage Scheme Grou    | nd Invest | tigation  |                 | Sample No.                        |                    | 6                |       |
| So       | il Description   | Stiff dark grey sand | ly gravelly CLAY.      |           |           |                 | Depth, m                          |                    | 5.00             |       |
| Sp       | ecimen Reference | 3                    | Specimen<br>Depth      |           |           | m               | Sample Type                       | В                  |                  |       |
| Te       | st Method        | BS1377:Part 2:199    | 0, clauses 9.2 and 9.5 |           |           |                 | KeyLAB ID                         | 1464               |                  |       |
|          | CLAY             | SILT                 |                        | SAND      |           |                 | GRAVEL                            | COBBLES            | COBBLES BOULDERS |       |
|          | 100 Fin          | e Medium             | Coarse Fine            | Medium    | Coarse    | Fine            | Medium Coarse                     |                    | 1   1   1   1    | <br>1 |
|          | 90               |                      |                        |           |           |                 |                                   |                    |                  |       |
|          | 00               |                      |                        |           |           |                 |                                   |                    |                  |       |
|          | 80 .             |                      |                        |           | 1         |                 |                                   |                    |                  | 1     |
| %        | 70               |                      |                        | X         |           |                 |                                   |                    |                  | 1     |
| sing     | 60               |                      |                        |           |           |                 |                                   |                    |                  |       |
| Pas      | 50               |                      |                        |           |           |                 |                                   |                    |                  |       |
| ntage    | 10               |                      |                        |           |           |                 |                                   |                    |                  |       |
| ercei    | 40               |                      |                        |           |           |                 |                                   |                    |                  | ]     |
| ш.       | 30               |                      |                        |           |           |                 |                                   |                    |                  |       |
|          | 20               |                      |                        |           |           |                 |                                   |                    |                  |       |
|          | 10               |                      |                        |           |           |                 |                                   |                    |                  |       |
|          | 0                |                      |                        |           |           |                 |                                   |                    |                  | ļ     |
|          | Sie              | ving                 | Sedimentati            | Parti     | icle Size | mm              |                                   |                    |                  |       |
|          | Particle Size mm | % Passing            | Particle Size mm       | % Passing |           | Đry N           | Aass of sample, g                 |                    | 3067             |       |
|          | 125              | 100                  | 0.0584                 | 50        | <b>`</b>  | Sample Prop     | portions                          | 1 %                | drv mass         | 1     |
|          | 90               | 100                  | 0.0320                 | 41        |           | Very coarse     |                                   |                    | 0                |       |
|          | 63               | 100                  | 0.0171                 | 31<br>25  |           | Gravel          |                                   |                    | 33               |       |
|          | 50               | 100                  | 0.0057                 | 19        |           |                 |                                   |                    |                  |       |
|          | 37.5             | 100<br>98            | 0.0028                 | 12        |           | Fines < 0.063   | mm                                |                    | 50               |       |
|          | 20               | 98                   |                        |           |           | Grading Ana     | lysis                             |                    |                  |       |
|          | 14               | 96                   |                        |           | _         | D100<br>D60     | mm                                |                    | 0.159            | _     |
|          | 6.3              | 89                   |                        |           |           | D30             | mm                                |                    | 0.0153           |       |
|          | 5                | 88                   |                        |           |           | D10             | mm                                |                    |                  |       |
|          | 3.35             | 86                   |                        |           | _         | Uniformity C    | oefficient                        | -                  |                  | _     |
|          | 1.18             | 80                   |                        |           |           | Curvature et    | Jennelent                         |                    |                  |       |
|          | 0.6              | 74                   | Particle density (assu | umed)     |           | Remarks         |                                   |                    |                  |       |
|          | 0.425            | 71<br>67             | 1.50 Mg/               | m3        |           | Preparation and | testing in accordance with B\$137 | 7 unless noted bek | w                |       |
|          | 0.212            | 64                   |                        |           |           |                 |                                   |                    |                  |       |
|          | 0.15             | 59                   |                        |           |           |                 |                                   |                    |                  |       |
|          | 0.063            | 50                   |                        |           |           |                 |                                   |                    |                  |       |
| <b>—</b> |                  |                      |                        | r         |           | Shoot aristod   |                                   |                    |                  |       |
|          |                  | Approved             |                        |           |           |                 | Sheet printed                     |                    |                  | 38    |
|          |                  | Stephen.Watso        | on                     |           |           | 25              | /02/2015 10:12                    |                    | Sheet            |       |





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|       | CA      | USEW       | YAY  |                 | PARTI      |                 |          |          |                        |       |                 | Jot       | o Ref     |              |          |            | 1         | .4-645          |     |     |
|-------|---------|------------|------|-----------------|------------|-----------------|----------|----------|------------------------|-------|-----------------|-----------|-----------|--------------|----------|------------|-----------|-----------------|-----|-----|
| -     |         | GEOT       | ECH: |                 |            |                 |          |          |                        |       |                 | Во        | rehole    | /Pit No.     |          |            | 1         | FP102           |     |     |
| Sit   | e Nan   | ne         |      | Greater Dubli   | n Drainag  | e Schem         | e Groun  | d Inve   | stiga                  | tion  |                 | Sai       | mple N    | 0.           |          |            |           | B01             |     |     |
| Sc    | il Desc | cription   |      | Firm brown gra  | velly CLAY | •3)             |          |          |                        |       |                 | De        | pth, m    |              |          |            |           | 0.50            |     |     |
| Sp    | ecime   | en Refere  | ence | 12              |            | Specim<br>Depth | ien      |          |                        |       | m               | Sai       | mple T    | уре          |          |            |           | В               |     |     |
| Те    | st Me   | thod       |      | BS1377:Part 2:1 | 990, claus | es 9.2 and      | d 9.5    |          |                        |       |                 | Ke        | ylab II   | )            |          |            | 1464      | 5TP102          | 301 |     |
| L     | -       |            | 1    | SILT            |            | //              |          | SAND     |                        |       |                 | GR        |           |              | 1        |            |           |                 |     |     |
|       | 100     | CLAY       | Fin  | e Medium        | Coarse     | Fin             | ne N     | ledium   | c                      | oarse | Fine            | Me        | dium      | Coars        | e        | COBBLE     | S         | BOULDE          | ERS |     |
|       | 100     |            |      |                 |            |                 |          |          |                        |       |                 |           |           |              |          | /          |           |                 |     | 1   |
|       | 90      |            |      |                 |            |                 |          |          |                        |       |                 |           |           |              | A        |            |           |                 |     |     |
|       | 80      |            | 1    |                 | +          |                 |          |          |                        |       | _               |           |           |              |          |            | _         |                 |     |     |
|       | 70      | <u> </u>   |      |                 |            |                 |          |          | _                      |       |                 |           | -         | 1            |          |            | _         |                 |     |     |
| % DL  | 60 -    |            |      |                 |            |                 |          |          |                        |       |                 |           | 1         |              |          |            |           |                 |     |     |
| assir | 00      |            |      |                 |            |                 |          |          |                        |       |                 |           | 1         |              |          |            |           |                 |     |     |
| age F | 50      |            |      |                 |            |                 |          |          |                        |       | 1               |           |           |              |          |            |           |                 |     |     |
| cent  | 40      |            |      |                 |            |                 | _        |          |                        | +     |                 |           |           |              |          |            | _         |                 |     |     |
| Per   | 30      | <u> </u>   |      |                 |            |                 |          |          | 1                      | 4     |                 |           | _         |              |          |            | _         | +++             |     |     |
|       | 20      |            |      |                 |            | 1               |          |          |                        |       |                 |           |           |              |          |            |           |                 |     |     |
|       | 10      |            |      |                 |            |                 |          |          |                        |       |                 |           |           |              |          |            |           |                 |     |     |
|       | 10      |            | -    |                 |            |                 |          |          |                        |       |                 |           |           |              |          |            |           |                 |     |     |
|       | 0.0     | 001        |      | 0.01            | -          | 0.1             |          | * *      |                        | 1     |                 | 10        | )         | <u> </u>     | **       | 100        |           | مل <u>المار</u> | 10  | 000 |
|       |         |            |      |                 |            |                 |          | Par      | ticle                  | Size  | mm              |           |           |              |          |            |           |                 |     |     |
|       |         |            |      |                 |            |                 |          |          |                        | -     |                 |           |           |              |          |            |           |                 |     |     |
|       | -       |            | Sie  | ving            |            | Sedi            | mentatio | n        |                        | -     | Dry I           | Mass      | of san    | nple, g      |          |            |           | 6955            |     |     |
|       | Par     | ticle Size | e mm | % Passing       | Partic     | le Size mr      | m %      | 6 Passir | ng                     |       | ·               |           |           |              |          | L          |           |                 |     |     |
|       | -       | 125        | _    | 100             |            | 0.0567          |          | 27       |                        | ]     | Sample Pro      | portio    | ns        |              |          |            | %         | dry mas         | 55  |     |
|       |         | 75         |      | 91              |            | ).0170          |          | 16       |                        |       | Gravel          |           | -         |              |          |            |           | 49              |     |     |
|       |         | 63<br>50   | _    | 91              |            | 0.0097          | _        | 11       |                        | ]     | Sand            |           | _         |              |          |            |           | 16              |     |     |
|       |         | 37.5       |      | 78              |            | 0.0037          |          | 6        |                        | 1     | Fines < 0.063   | 3mm       |           |              |          |            |           | 27              |     |     |
|       |         | 28         | 1    | 74              |            |                 | _        |          |                        | -     | Grading And     | alveie    |           |              |          | 1          |           |                 |     | _   |
|       |         | 14         |      | 60              |            |                 |          |          |                        | 1     | D100            | a1¥212    |           |              | mm       |            |           |                 |     |     |
|       |         | 10         |      | 54              |            |                 |          |          | _                      | -     | D60             |           |           |              | mm       |            | _         | 13.9            |     |     |
|       | -       | 5          |      | 48              |            |                 | -        |          |                        | 1     | D30<br>D10      |           |           |              | mm<br>mm |            |           | 0.146           |     |     |
|       |         | 3.35       |      | 46              |            |                 |          |          |                        | 1     | Uniformity (    | Coeffic   | ient      |              | _        |            |           | 1900            |     |     |
|       | -       | 2          |      | 43              | _          |                 |          |          |                        | 4     | Curvature C     | oeffici   | ent       |              |          |            |           | 0.21            |     |     |
|       |         | 0.6        | 15   | 39              | Parti      | cle densit      | v (assur | med)     |                        | 1     | Remarks         |           |           |              |          |            |           |                 |     |     |
|       |         | 0.425      |      | 35              |            | 1.50            | Mg/m     | 13       |                        |       | Preparation and | l testing | in accord | lance with I | BS137    | 7 unless n | oted belo | w               |     |     |
|       |         | 0.3        |      | 33              | _          |                 |          |          |                        | 1     |                 |           |           |              |          |            |           |                 |     |     |
|       | -       | 0.212      |      | 32              | _          |                 |          |          |                        |       |                 |           |           |              |          |            |           |                 |     |     |
|       |         | 0.15       |      | 27              | -          |                 |          |          |                        |       |                 |           |           |              |          |            |           |                 |     |     |
|       |         |            |      |                 |            |                 |          |          |                        | 1     |                 |           |           |              |          |            |           |                 |     |     |
|       |         |            |      | Approve         | d          |                 |          |          |                        |       |                 | Sheet     | printe    | d            |          |            |           | -               |     | 40  |
| -     |         |            |      |                 |            |                 |          | _        |                        |       | 25              | 5/02/2    | 015 10    | ):11         |          |            |           | FIE             | 5   | 10  |
|       |         |            |      | Stephen.Wa      | tson       |                 |          |          | 25/02/2015 10:11 Sheet |       |                 |           |           |              |          |            |           |                 |     |     |





| -    | CAUSEWAY         | PA                  | ARTICLE SIZE          | DISTRIB            | JTION      |                            | Job Ref                         | 1                   | 4-645                                   |    |
|------|------------------|---------------------|-----------------------|--------------------|------------|----------------------------|---------------------------------|---------------------|---|----|
|      | GEOTECH          |                     |                       |                    |            |                            | Borehole/Pit No.                | -                   | ГР104                                   |    |
| Sit  | e Name           | Greater Dublin D    | rainage Scheme G      | iround Inve        | stigation  |                            | Sample No.                      |                     | B01                                     |    |
| So   | il Description   | Firm brown gravelly | y CLAY with occasion  | nal cobbles.       |            |                            | Depth, m                        |                     | 0.50                                    |    |
| Sp   | ecimen Reference | 12                  | Specimen<br>Depth     |                    |            | m                          | Sample Type                     |                     | В                                       |    |
| Те   | st Method        | BS1377:Part 2:1990  | 0, clauses 9.2 and 9. | 5                  |            |                            | KeyLAB ID                       | 1464                | 5TP104B01                               |    |
|      | CLAY             | SILT                |                       | SAND               | T          |                            | GRAVEL                          | COBBLES             | BOULDERS                                |    |
|      | 100 Fin          | e Medium (          | Coarse Fine           | Medium             | Coarse     | Fine                       | Medium Coarse                   |                     | 1 1 1 1 1 1                             |    |
|      | 90               |                     |                       |                    |            |                            |                                 |                     |   |    |
|      | 00               |                     |                       |                    |            |                            |                                 |                     |   |    |
|      | 80               |                     |                       |                    |            |                            |                                 |                     |   |    |
| %    | 70               |                     |                       |                    |            |                            |                                 |                     |   |    |
| ing  | 60               |                     |                       |                    |            |                            |                                 |                     |   |    |
| Pass | 50               |                     |                       |                    |            |                            |                                 |                     |   |    |
| age  | 50               |                     |                       |                    |            |                            |                                 |                     |   | 1  |
| cent | 40               |                     |                       |                    |            |                            |                                 |                     |   |    |
| Per  | 30               |                     |                       |                    |            |                            |                                 |                     | + |    |
|      | 20               |                     |                       |                    |            |                            |                                 |                     |   |    |
|      | 20               |                     |                       |                    |            |                            |                                 |                     |   |    |
|      | 10               |                     |                       |                    |            |                            |                                 |                     |   |    |
|      | 0                | 0.01                |                       |                    |            |                            |                                 |                     |   | 4  |
|      | Sig              | ving                | Sedime                | Pai                | ticle Size | mm                         | 21                              |                     |   |    |
|      | Particle Size mm | % Passing           | Particle Size mm      | % Passir           | ng         | Dry N                      | Aass of sample, g               |                     | 1935                                    |    |
|      | 125              | 100                 | 0.0567                | 91                 |            | Sample Brou                | ortions                         | T %                 | dry mass                                |    |
|      | 90               | 100                 | 0.0311                | 67                 |            | Very coarse                |                                 | 70                  | 0                                       |    |
|      | 75               | 100                 | 0.0166                | 56                 |            | Gravel                     |                                 |                     | 4                                       |    |
|      | 50               | 100                 | 0.0094                | 43                 |            | Sand                       |                                 |                     | 16                                      |    |
|      | 37.5             | 100                 | 0.0028                | 22                 |            | Fines < 0.063              | Imm                             | 1                   | 81                                      |    |
|      | 28               | 98                  |                       |                    |            | Grading Ana                | heie                            | Т                   |   |    |
|      | 14               | 97                  |                       |                    |            | D100                       | mysis<br>mm                     |                     |   |    |
|      | 10               | 97                  |                       |                    |            | D60                        | mm                              |                     | 0.0208                                  |    |
|      | 6.3              | 97                  |                       |                    |            | D30                        | mm                              |                     | 0.00504                                 |    |
|      | 3.35             | 97                  |                       |                    |            | Uniformity (               | Coefficient                     | -                   |   |    |
|      | 2                | 96                  |                       |                    |            | Curvature C                | oefficient                      |                     |   |    |
|      | 1.18             | 96                  |                       |                    |            |                            |                                 |                     |   |    |
|      | 0.425            | 93                  | Particle density      | (assumed)<br>Mg/m3 |            | Remarks<br>Preparation and | testing in accordance with BS13 | 77 unless noted bek | w                                       |    |
|      | 0.3              | 89                  | 1.50                  |                    |            |                            |                                 |                     |   |    |
|      | 0.212            | 87                  |                       |                    |            |                            |                                 |                     |   |    |
|      | 0.15             | 85                  |                       |                    |            |                            |                                 |                     |   |    |
|      | 0.063            | 81                  |                       |                    |            |                            |                                 |                     |   |    |
|      |                  |                     |                       |                    |            |                            | Sheet printed                   |                     |   |    |
|      |                  | Approved            |                       |                    |            |                            |                                 |                     | Fig                                     | 11 |
|      |                  | Stephen.Watso       | n                     |                    |            | 25                         | /02/2015 10:11                  |                     | Sheet                                   |    |



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|        | CA       | USEW       | YAY  |                   | PARTI       | CLE SIZI         |          | RIB      | υτιο         | N        |                            | Job Ref            |                |                   | 14-645     |      |
|--------|----------|------------|------|-------------------|-------------|------------------|----------|----------|--------------|----------|----------------------------|--------------------|----------------|-------------------|------------|------|
|        |          |            |      |                   |             |                  |          |          |              |          |                            | Borehole/          | Pit No.        |                   | TP112      |      |
| Si     | te Nan   | ne         |      | Greater Dublin    | n Drainag   | e Scheme         | Groun    | d Inve   | stigati      | on       |                            | Sample No          | ).             |                   | 2          |      |
| So     | oil Desc | cription   |      | Firm to stiff dar | k grey grav | velly CLAY v     | with cob | bles an  | nd boul      | ders.    |                            | Depth, m           |                |                   | 1.50       |      |
| Sp     | ecime    | n Refer    | ence | 3                 |             | Specime<br>Depth | 'n       |          |              |          | m                          | Sample Ty          | pe             |                   | В          |      |
| Те     | est Me   | thod       |      | BS1377:Part 2:1   | 990, claus  | es 9.2 and       | 9.5      |          |              |          |                            | KeyLAB ID          |                | 146               | 545TP112B2 |      |
|        | -        | CLAY       |      | SILT              | -           |                  | 5        | SAND     | 1            |          |                            | GRAVEL             |                | COBBLES           | BOULDERS   |      |
|        | 100      |            | Fin  | e Medium          | Coarse      | Fine             | M        | edium    | Co           | arse     | Fine                       | Medium             | Coarse         |                   |            |      |
|        | 90       |            |      |                   |             |                  |          |          |              | ļ        |                            |                    |                |                   |            |      |
|        |          |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        | 80       |            |      |                   |             |                  |          |          |              |          |                            |                    | 1              |                   |            |      |
| %      | 70       |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
| sing   | 60       |            |      |                   |             | -                |          |          |              |          |                            |                    |                |                   |            |      |
| e Pas  | 50       |            |      |                   |             |                  |          |          |              | -        |                            |                    |                |                   |            | 21   |
| entage | 40       |            |      |                   |             |                  |          |          |              |          |                            | H                  |                |                   |            |      |
| Perce  | 30       |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        | 20       |            |      |                   |             |                  |          | -+-      |              |          |                            |                    |                |                   |            |      |
|        | 20       |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        | 10       |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        | 0.(      | 001        |      | 0.01              |             | 0.1              | A        | Par      | 1<br>ticle S | i<br>ize | mm                         | 10                 |                | 100               |            | 1000 |
|        |          |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        |          |            | Sie  | ving              |             | Sedin            | nentatio | n        |              |          | Dry N                      | Mass of sam        | ple, g         |                   | 8832       |      |
|        | Par      | ticle Size | e mm | % Passing         | Partic      | le Size mm       | %        | Passin   | ng           |          |                            |                    |                |                   |            |      |
|        | -        | 90         |      | 100               |             | ).0584<br>).0320 | -        | 20<br>16 |              |          | Sample Prop<br>Very coarse | portions           |                | %                 | 6 dry mass |      |
|        |          | 75         |      | 96                | 0           | 0.0172           |          | 12       |              |          | Gravel                     |                    |                |                   | 56         |      |
|        | -        | 63<br>50   |      | 89                |             | 0.0097           | -        | 10       |              |          | Sand                       |                    |                | -                 | 13         |      |
|        |          | 37.5       |      | 70                |             | ).0028           |          | 4        |              |          | Fines < 0.063              | Imm                |                |                   | 20         |      |
|        |          | 28         |      | 61                |             |                  |          |          |              |          |                            |                    |                | T                 |            |      |
|        |          | 14         |      | 50                |             |                  |          |          |              |          | D100                       | aiysis             | mm             |                   |            |      |
|        |          | 10         |      | 46                |             |                  |          |          |              |          | D60                        |                    | mm             | •                 | 26.4       |      |
|        |          | 6.3        | _    | 41                | _           |                  |          |          |              |          | D30                        |                    | mm             |                   | 1.23       |      |
|        | -        | 3 35       |      | 39                | -           |                  | -        |          |              |          | D10                        | oefficient         | mm             | -                 | 2700       |      |
|        |          | 2          |      | 32                | -           |                  | 1        |          |              |          | Curvature Co               | pefficient         |                |                   | 5.8        |      |
|        |          | 1.18       |      | 30                |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        |          | 0.6        |      | 27                | Parti       | cle density      | (assun   | ned)     |              |          | Remarks                    |                    |                |                   |            |      |
|        | _        | 0.425      |      | 26                | _           | 1.50             | Mg/m     | 3        |              |          | Preparation and            | testing in accorda | nce with BS137 | / unless noted be | elow       |      |
|        |          | 0.3        |      | 23                |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        |          | 0.15       |      | 23                | -           |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        |          | 0.063      |      | 20                |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
| _      |          |            |      |                   |             |                  |          |          |              |          |                            |                    |                |                   |            |      |
|        |          |            |      | Approve           | d           |                  |          |          |              |          | :                          | sneet printed      | I              |                   | Fie        | 20   |
|        |          |            |      | Stephen.Wa        | tson        |                  |          | v.       |              |          | 25                         | /02/2015 10:       | 11             |                   | Choot      |      |





Contract: Greater Dublin Drainage Scheme

#### Job No.: 14-645

#### UNIAXIAL COMPRESSIVE STRENGTH TEST RESULTS

- D = core diameter
- L = specimen length
- M = specimen mass
- P = applied load for failure

 $\mathbf{g}_{b}$  = Bulk Density (4M x10<sup>6</sup>/p x D<sup>2</sup> x L)

MCS = Uncorrected compressive strength (4P  $\times 10^3$ /p  $\times D^2$ )

UCS = Size corrected uniaxial compression strength (MCS x F)

F = Size correction factor for core L/D<2 (0.89 + 0.11x(L/D - 1))

| Borehole | Specimen<br>Depth<br>(m bgl) | Specimen<br>Diameter<br>D<br>(mm) | Specimen<br>Length<br>L<br>(mm) | Specimen<br>Mass<br>M<br>(kg) | Failure<br>Load<br>P<br>(tonf) | Failure<br>Load<br>P<br>(kN) | Bulk<br>Density<br>γ <sub>b</sub><br>(Mg/m³) | Measured<br>Compressive<br>Strength (MCS)<br>(MPa) | Correction<br>Factor<br>F | Uniaxial<br>Compressive<br>Strength (UCS)<br>(MPa) | Remarks   |
|----------|------------------------------|-----------------------------------|---------------------------------|-------------------------------|--------------------------------|------------------------------|--|--|---------------------------|--|---|
| BH106    | 4.45-5.50                    |                                   |                                 |                               |                                |                              |  |  |                           |  | Testing not possible. Sample broke while attempting trimming. No suitable replacement |
| BH107    | 5.50                         | 83                                | 206                             | 3.017                         | 40.0                           | 398.6                        | 2.71   | 73.66  | 1.00                      | 73.7   | -   |
| BH107    | 4.30                         | 83                                | 193                             | 2.817                         | 7.0                            | 69.7                         | 2.70   | 12.89  | 1.00                      | 12.9   | -   |
| BH108    | 3.60                         | 70                                | 171                             | 1.826                         | 7.5                            | 74.7                         | 2.77   | 19.42  | 1.00                      | 19.4   | -   |
| BH109    | 3.70                         | 70                                | 197                             | 2.142                         | 14.5                           | 144.5                        | 2.83   | 37.54  | 1.00                      | 37.5   | -   |
| BH110    | 4.00                         | 70                                | 173                             | 1.885                         | 24.5                           | 244.1                        | 2.83   | 63.43  | 1.00                      | 63.4   | -   |
| BH111    | 2.50                         | 83                                | 205                             | 3.014                         | 2.5                            | 24.9                         | 2.72   | 4.60   | 1.00                      | 4.6  | -   |

Sheet 1 of 1

Contract: Greater Dublin Drainage Scheme

- W = core diameter (Axial test) or specimen width (Irregular lump test)
- $D_e^2 = D \times D'$  (Diametral test)

Job No.: 14-645

#### POINT LOAD STRENGTH TEST RESULTS

- D = core diameter (Diametral test) or specimen length (Axial test/Irregular lump test) L = measured applied load for failure
- P = actual applied load for failure (L x calibration factor)
- D' = distance between platens at point of failure

- $D_e^2 = 4/p$  (W x D') (Axial test / Irregular lump test) Sheet 1 of 1
- $I_s$  = Uncorrected point load strength (P/D<sub>e</sub><sup>2</sup>)
- $I_{s(50)}$  = Size corrected point load strength ( $I_s \times F$ )
- $F = (D_e/50)^{0.45}$  Size correction factor for core other than 50mm diameter

| Borehole | Specimen<br>Depth<br>(m bgl) | <b>Test Type</b><br>A = Axial<br>D = Diametral<br>I = Irregular | W<br>(mm) | D<br>(mm) | D'<br>(mm) | L<br>(kN) | P<br>(kN) | De <sup>2</sup><br>(mm <sup>2</sup> ) | De<br>(mm) | ls<br>(MPa) | F    | <b>ls(50)</b><br>(MPa) | Remarks |
|----------|------------------------------|---|-----------|-----------|------------|-----------|-----------|---------------------------------------|------------|-------------|------|------------------------|---------|
| BH106    | 4.50                         | D   |           | 83        | 78         | 12.0      | 12.0      | 6474                                  | 80.46      | 1.85        | 1.24 | 2.29                   | Invalid |
| BH106    | 5.60                         | D   |           | 83        | 80         | 8.3       | 8.3       | 6640                                  | 81.49      | 1.25        | 1.25 | 1.56                   | Valid   |
| BH107    | 3.50                         | А   | 83        | 50        | 42         | 13.2      | 13.2      | 4439                                  | 66.62      | 2.97        | 1.14 | 3.38                   | Invalid |
| BH107    | 5.20                         | D   |           | 83        | 79         | 4.1       | 4.1       | 6557                                  | 80.98      | 0.62        | 1.24 | 0.78                   | Invalid |
| BH108    | 3.30                         | D   |           | 70        | 66         | 5.8       | 5.8       | 4620                                  | 67.97      | 1.25        | 1.15 | 1.44                   | Invalid |
| BH108    | 5.10                         | D   |           | 71        | 68         | 4.6       | 4.6       | 4828                                  | 69.48      | 0.95        | 1.16 | 1.10                   | Invalid |
| BH109    | 4.80                         | D   |           | 70        | 67         | 3.2       | 3.2       | 4690                                  | 68.48      | 0.68        | 1.15 | 0.79                   | Valid   |
| BH110    | 5.00                         | D   |           | 70        | 67         | 17.4      | 17.4      | 4690                                  | 68.48      | 3.71        | 1.15 | 4.27                   | Valid   |
| BH111    | 3.50                         | D   |           | 83        | 80         | 3.2       | 3.2       | 6640                                  | 81.49      | 0.48        | 1.25 | 0.60                   | Valid   |
| BH111    | 4.50                         | D   |           | 83        | 79         | 6.9       | 6.9       | 6557                                  | 80.98      | 1.05        | 1.24 | 1.31                   | Valid   |

### LABORATORY RESTRICTION REPORT

| Project Reference | 14-645                    |               | То       | Darren O'Mahony    |
|-------------------|---------------------------|---------------|----------|--------------------|
| Project Name      | Greater Dublin Drainage S | Scheme Ground | Position | Project Manager    |
|                   | Investigatio              | n             | From     | Stephen Watson     |
| TR reference      | 14-645                    | / 1           |          |                    |
|                   | 11010                     | , .           | Position | Laboratory Manager |

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

| Hole                                 | Ś                                | Sample       |                | Test                                    |  |                      |   |
|--------------------------------------|----------------------------------|--------------|----------------|---|--|----------------------|---|
| Number                               | Number                           | Depth<br>(m) | Туре           | Туре                                    | Reason for Restriction   | Re                   | quired Action   |
| BH113                                |                                  | 4.5          | D              | Natural<br>mositure<br>Atterberg<br>PSD | No sample received   | Tes                  | sting cancelled   |
| BH124                                |                                  | 1.5          | D              | Natural<br>mositure<br>Atterberg<br>PSD | No sample received   | Tes                  | ting Cancelled  |
| For electr<br>electronic<br>acceptab | ronic repor<br>c signature<br>le | ting a forr  | n of<br>d name | e is                                    | Laboratory Signature<br>Stephen Watson<br>Date<br>25 February 2015 | Project<br>Dar<br>25 | Manager Signature<br>rren O'Mahony<br>Date<br>February 2015 |
| •                                    | C                                | AU           | SE             | WAY                                     | TEST RESTRICTIO  | IN FORM              | lssue No. 1<br>Page 1 of<br>Date 25/02/20                   |





| Report Number:            | 15-01364 Issue-1   |                  |           |
|---------------------------|--|------------------|-----------|
| Initial Date of Issue:    | 29-Jan-15  |                  |           |
| Client:                   | Causeway Geotech Ltd   |                  |           |
| Client Address:           | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |                  |           |
| Contact(s):               | Darren O'Mahony<br>Paul Dunlop<br>Stephen Franey                           |                  |           |
| Project:                  | 14-645 Greater Dublin Drainage GI - Phase 2                                |                  |           |
| Quotation No.:            |  | Date Received:   | 23-Jan-15 |
| Order No.:                | 47-645   | Date Instructed: | 23-Jan-15 |
| No. of Samples:           | 8  | Results Due:     | 29-Jan-15 |
| Turnaround:<br>(Weekdays) | 5  |                  |           |
| Date Approved:            | 29-Jan-15  |                  |           |
| Approved By:              |  |                  |           |
| Details:                  | Darrell Hall, Laboratory Director  |                  |           |



| Client: Causeway Geotech Ltd        |         | Chem   | test Job | o No.: | 15-01364  | 15-01364  | 15-01364  | 15-01364  | 15-01364  | 15-01364  | 15-01364  |
|-------------------------------------|---------|--------|----------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Quotation No.:                      | Che     | emtes  | t Sampl  | e ID.: | 92555     | 92556     | 92557     | 92558     | 92559     | 92560     | 92561     |
| Order No.: 47-645                   |         | Client | Sample   | Ref.:  |           |           |           |           |           |           |           |
|                                     |         | Clien  | t Sampl  | e ID.: | BH120     | BH121     | BH121     | TP100     | TP101     | BH122     | BH138     |
|                                     |         | ;      | Sample   | Type:  | SOIL      |
|                                     |         | T      | op Dept  | h (m): | 0.50      | 0.50      | 1.00      | 0.30      | 0.20      | 7.50      | 0.90      |
|                                     |         | Botte  | om Dep   | th(m): |           |           |           |           |           |           |           |
|                                     |         | D      | ate San  | npled: | 22-Jan-15 |
| Determinand                         | Accred. | SOP    | Units    | LOD    |           |           |           |           |           |           |           |
| Moisture                            | Ν       | 2030   | %        | 0.02   | 21        | 10        | 9.5       | 17        | 19        | 12        | 6.4       |
| рН                                  | U       | 2010   |          |        |           |           |           |           |           | 8.6       | 8.5       |
| Sulphate (2:1 Water Soluble) as SO4 | U       | 2120   | g/l      | 0.01   |           |           |           |           |           | 0.029     | 0.030     |
| Arsenic                             | U       | 2450   | mg/kg    | 1      | 25        | 26        | 30        | 38        | 34        |           |           |
| Barium                              | U       | 2450   | mg/kg    | 10     | 200       | 140       | 160       | 130       | 60        |           |           |
| Cadmium                             | U       | 2450   | mg/kg    | 0.1    | 2.1       | 2.7       | 2.5       | 0.55      | 0.35      |           |           |
| Chromium                            | U       | 2450   | mg/kg    | 1      | 21        | 21        | 15        | 21        | 21        |           |           |
| Copper                              | U       | 2450   | mg/kg    | 0.5    | 61        | 31        | 27        | 27        | 27        |           |           |
| Mercury                             | U       | 2450   | mg/kg    | 0.1    | 0.39      | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Molybdenum                          | U       | 2450   | mg/kg    | 2      | 5.7       | 7.5       | 8.9       | 2.4       | < 2.0     |           |           |
| Nickel                              | U       | 2450   | mg/kg    | 0.5    | 44        | 64        | 51        | 72        | 60        |           |           |
| Lead                                | U       | 2450   | mg/kg    | 0.5    | 94        | 24        | 21        | 48        | 43        |           |           |
| Antimony                            | N       | 2450   | mg/kg    | 2      | 2.6       | 2.1       | < 2.0     | < 2.0     | < 2.0     |           |           |
| Selenium                            | U       | 2450   | mg/kg    | 0.2    | 0.35      | < 0.20    | < 0.20    | < 0.20    | < 0.20    |           |           |
| Zinc                                | U       | 2450   | mg/kg    | 0.5    | 100       | 84        | 73        | 74        | 75        |           |           |
| LOI                                 | U       | 2610   | %        | 0.1    | 15        | 1.7       | 1.6       | 2.7       | 2.7       |           |           |
| Total Organic Carbon                | U       | 2625   | %        | 0.2    | 7.0       | 0.46      | 0.58      | 0.63      | 0.55      |           |           |
| TPH >C6-C10                         | N       | 2670   | mg/kg    | 1      | < 1.0     | < 1.0     | < 1.0     | < 1.0     | < 1.0     |           |           |
| TPH >C10-C21                        | N       | 2670   | mg/kg    | 1      | < 1.0     | < 1.0     | < 1.0     | < 1.0     | < 1.0     |           |           |
| TPH >C21-C40                        | N       | 2670   | mg/kg    | 1      | < 1.0     | < 1.0     | < 1.0     | < 1.0     | < 1.0     |           |           |
| Total TPH >C6-C40                   | U       | 2670   | mg/kg    | 10     | < 10      | < 10      | < 10      | < 10      | < 10      |           |           |
| Naphthalene                         | U       | 2800   | mg/kg    | 0.1    | 0.38      | 0.32      | 0.55      | 0.97      | 1.2       |           |           |
| Acenaphthylene                      | N       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Acenaphthene                        | U       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Fluorene                            | U       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | 0.12      | 0.26      |           |           |
| Phenanthrene                        | U       | 2800   | mg/kg    | 0.1    | 0.42      | 0.12      | 0.21      | 0.30      | 0.55      |           |           |
| Anthracene                          | U       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Fluoranthene                        | U       | 2800   | mg/kg    | 0.1    | 0.22      | 0.50      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Pyrene                              | U       | 2800   | mg/kg    | 0.1    | 0.21      | 0.45      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Benzo[a]anthracene                  | U       | 2800   | mg/kg    | 0.1    | < 0.10    | 0.22      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Chrysene                            | U       | 2800   | mg/kg    | 0.1    | < 0.10    | 0.22      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Benzo[b]fluoranthene                | N       | 2800   | mg/kg    | 0.1    | < 0.10    | 0.18      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Benzo[k]fluoranthene                | U       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Benzo[a]pyrene                      | U       | 2800   | mg/kg    | 0.1    | < 0.10    | 0.12      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Indeno(1,2,3-c,d)Pyrene             | U       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Dibenz(a,h)Anthracene               | N       | 2800   | mg/kg    | 0.1    | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |



| Client: Causeway Geotech Ltd |         | Chem   | test Joł | o No.:  | 15-01364  | 15-01364  | 15-01364  | 15-01364  | 15-01364  | 15-01364  | 15-01364  |
|------------------------------|---------|--------|----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Quotation No.:               | Che     | emtest | t Samp   | le ID.: | 92555     | 92556     | 92557     | 92558     | 92559     | 92560     | 92561     |
| Order No.: 47-645            |         | Client | Sample   | e Ref.: |           |           |           |           |           |           |           |
|                              |         | Client | t Sampl  | le ID.: | BH120     | BH121     | BH121     | TP100     | TP101     | BH122     | BH138     |
|                              |         | 9,     | Sample   | Type:   | SOIL      |
|                              |         | Т      | op Dept  | h (m):  | 0.50      | 0.50      | 1.00      | 0.30      | 0.20      | 7.50      | 0.90      |
|                              |         | Botto  | om Dep   | th(m):  |           |           |           |           |           |           |           |
|                              |         | D      | ate San  | npled:  | 22-Jan-15 |
| Determinand                  | Accred. | SOP    | Units    | LOD     |           |           |           |           |           |           |           |
| Benzo[g,h,i]perylene         | U       | 2800   | mg/kg    | 0.1     | < 0.10    | 0.11      | < 0.10    | < 0.10    | < 0.10    |           |           |
| Coronene                     | N       | 2800   | mg/kg    | 0.1     | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |
| Total Of 17 PAH's            | N       | 2800   | mg/kg    | 2       | < 2.0     | 2.2       | < 2.0     | < 2.0     | 2.0       |           |           |
| PCB 28                       | U       | 2810   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| PCB 52                       | U       | 2815   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| PCB 101                      | U       | 2815   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| PCB 118                      | U       | 2815   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| PCB 153                      | U       | 2815   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| PCB 138                      | U       | 2815   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| PCB 180                      | U       | 2810   | mg/kg    | 0.01    | < 0.010   | < 0.010   | < 0.010   | < 0.010   | < 0.010   |           |           |
| Total PCBs (7 Congeners)     | N       | 2815   | mg/kg    | 0.1     | < 0.10    | < 0.10    | < 0.10    | < 0.10    | < 0.10    |           |           |



| Chemtest Job No: 15-01364    |      |         |          |         | Landfill Wa   | aste Acceptar  | ce Criteria    |
|------------------------------|------|---------|----------|---------|---------------|----------------|----------------|
| Chemtest Sample ID: 92555    |      |         |          |         |               | Limits         |                |
| Sample Ref:                  |      |         |          |         |               | Stable, Non-   |                |
| Sample ID: BH120             |      |         |          |         |               | reactive       |                |
| Top Depth(m): 0.50           |      |         |          |         | Inert Waste   | hazardous      | Hazardous      |
| Bottom Depth(m):             |      |         |          |         | Landfill      | waste in non   | Waste          |
| Sampling Date: 22-Jan-2015   |      |         |          |         |               | hazardous      | Landfill       |
| Determinand                  | SOP  | Accred. | Units    |         |               | Landfill       |                |
| Total Organic Carbon         | 2625 | U       | %        |         | 3             | 5              | 6              |
| Loss on Ignition             | 2610 | U       | %        |         |               |                | 10             |
| Total BTEX                   | 2760 | U       | mg/kg    |         | 6             |                |                |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg    |         | 1             |                |                |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg    |         | 500           |                |                |
| Total (of 17) PAHs           | 2700 | N       | mg/kg    |         | 100           |                |                |
| рН                           | 2010 | U       |          |         |               | >6             |                |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg   |         |               | To evaluate    | To evaluate    |
|                              |      |         | 10:1     | 10:1    |               | for complian   | aa laaahing    |
| Eluate Analysis              |      |         | Eluate   | Eluate  | Limit values  | S for complian | the leacning   |
| -                            |      |         | mg/l     | mg/kg   | test using ba | 5 EN 12457-3   | at L/S 10 I/kg |
| Arsenic                      | 1450 | U       | 0.003    | < 0.050 | 0.5           | 2              | 25             |
| Barium                       | 1450 | U       | 0.014    | < 0.50  | 20            | 100            | 300            |
| Cadmium                      | 1450 | U       | < 0.0001 | < 0.010 | 0.04          | 1              | 5              |
| Chromium                     | 1450 | U       | 0.002    | < 0.050 | 0.5           | 10             | 70             |
| Copper                       | 1450 | U       | 0.005    | 0.054   | 2             | 50             | 100            |
| Mercury                      | 1450 | U       | < 0.0005 | < 0.005 | 0.01          | 0.2            | 2              |
| Molybdenum                   | 1450 | U       | 0.007    | 0.068   | 0.5           | 10             | 30             |
| Nickel                       | 1450 | U       | 0.003    | < 0.050 | 0.4           | 10             | 40             |
| Lead                         | 1450 | U       | 0.002    | 0.023   | 0.5           | 10             | 50             |
| Antimony                     | 1450 | U       | 0.001    | 0.012   | 0.06          | 0.7            | 5              |
| Selenium                     | 1450 | U       | < 0.001  | < 0.010 | 0.1           | 0.5            | 7              |
| Zinc                         | 1450 | U       | 0.006    | < 0.50  | 4             | 50             | 200            |
| Chloride                     | 1220 | U       | < 1.0    | < 10    | 800           | 15000          | 25000          |
| Fluoride                     | 1220 | U       | 0.19     | 1.9     | 10            | 150            | 500            |
| Sulphate                     | 1220 | U       | 10       | 100     | 1000          | 20000          | 50000          |
| Total Dissolved Solids       | 1020 | N       | 110      | 1100    | 4000          | 60000          | 100000         |
| Phenol Index                 | 1920 | U       | < 0.030  | < 0.30  | 1             | -              | -              |
| Dissolved Organic Carbon     | 1610 | N       | 14       | 140     | 500           | 800            | 1000           |

| Soild Information           |      |
|-----------------------------|------|
| Dry mass of test portion/kg | 0.09 |
| Moisture (%)                | 21   |



| Chemtest Job No: 15-01364    |      |         |          |         | Landfill Wa                              | aste Acceptar | ce Criteria    |  |
|------------------------------|------|---------|----------|---------|--|---------------|----------------|--|
| Chemtest Sample ID: 92556    |      |         |          |         |  | Limits        |                |  |
| Sample Ref:                  |      |         |          |         |  | Stable, Non-  |                |  |
| Sample ID: BH121             |      |         |          |         |  | reactive      |                |  |
| Top Depth(m): 0.50           |      |         |          |         | Inert Waste                              | hazardous     | Hazardous      |  |
| Bottom Depth(m):             |      |         |          |         | Landfill                                 | waste in non  | Waste          |  |
| Sampling Date: 22-Jan-2015   |      |         |          |         |  | hazardous     | Landfill       |  |
| Determinand                  | SOP  | Accred. | Units    |         |  | Landfill      |                |  |
| Total Organic Carbon         | 2625 | U       | %        |         | 3  | 5             | 6              |  |
| Loss on Ignition             | 2610 | U       | %        |         |  |               | 10             |  |
| Total BTEX                   | 2760 | U       | mg/kg    |         | 6  |               |                |  |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg    |         | 1  |               |                |  |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg    |         | 500                                      |               |                |  |
| Total (of 17) PAHs           | 2700 | N       | mg/kg    |         | 100                                      |               |                |  |
| рН                           | 2010 | U       |          |         |  | >6            |                |  |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg   |         |  | To evaluate   | To evaluate    |  |
|                              |      |         | 10:1     | 10:1    |  | for complian  | aa laaahing    |  |
| Eluate Analysis              |      |         | Eluate   | Eluate  | test using BS EN 12457-3 at 1 /S 10 1/kg |               |                |  |
| -                            |      |         | mg/l     | mg/kg   | test using ba                            | 5 EN 12457-3  | at L/S 10 1/kg |  |
| Arsenic                      | 1450 | U       | < 0.001  | < 0.050 | 0.5                                      | 2             | 25             |  |
| Barium                       | 1450 | U       | 0.008    | < 0.50  | 20                                       | 100           | 300            |  |
| Cadmium                      | 1450 | U       | < 0.0001 | < 0.010 | 0.04                                     | 1             | 5              |  |
| Chromium                     | 1450 | U       | 0.003    | < 0.050 | 0.5                                      | 10            | 70             |  |
| Copper                       | 1450 | U       | 0.001    | < 0.050 | 2  | 50            | 100            |  |
| Mercury                      | 1450 | U       | < 0.0005 | < 0.005 | 0.01                                     | 0.2           | 2              |  |
| Molybdenum                   | 1450 | U       | 0.013    | 0.13    | 0.5                                      | 10            | 30             |  |
| Nickel                       | 1450 | U       | < 0.001  | < 0.050 | 0.4                                      | 10            | 40             |  |
| Lead                         | 1450 | U       | < 0.001  | < 0.010 | 0.5                                      | 10            | 50             |  |
| Antimony                     | 1450 | U       | < 0.001  | < 0.010 | 0.06                                     | 0.7           | 5              |  |
| Selenium                     | 1450 | U       | < 0.001  | < 0.010 | 0.1                                      | 0.5           | 7              |  |
| Zinc                         | 1450 | U       | 0.002    | < 0.50  | 4  | 50            | 200            |  |
| Chloride                     | 1220 | U       | < 1.0    | < 10    | 800                                      | 15000         | 25000          |  |
| Fluoride                     | 1220 | U       | 0.2      | 2       | 10                                       | 150           | 500            |  |
| Sulphate                     | 1220 | U       | < 1.0    | < 10    | 1000                                     | 20000         | 50000          |  |
| Total Dissolved Solids       | 1020 | N       | 56       | 560     | 4000                                     | 60000         | 100000         |  |
| Phenol Index                 | 1920 | U       | < 0.030  | < 0.30  | 1  | -             | -              |  |
| Dissolved Organic Carbon     | 1610 | N       | 25       | 250     | 500                                      | 800           | 1000           |  |

| Soild Information           |      |
|-----------------------------|------|
| Dry mass of test portion/kg | 0.09 |
| Moisture (%)                | 10   |



| Chemtest Job No: 15-01364    |      |         |          |         | LandfIII Waste Acceptance Criteria   |               |                |  |
|------------------------------|------|---------|----------|---------|--------------------------------------|---------------|----------------|--|
| Chemtest Sample ID: 92557    |      |         |          |         |                                      | Limits        |                |  |
| Sample Ref:                  |      |         |          |         |                                      | Stable, Non-  |                |  |
| Sample ID: BH121             |      |         |          |         |                                      | reactive      |                |  |
| Top Depth(m): 1.00           |      |         |          |         | Inert Waste                          | hazardous     | Hazardous      |  |
| Bottom Depth(m):             |      |         |          |         | Landfill                             | waste in non  | Waste          |  |
| Sampling Date: 22-Jan-2015   |      |         |          |         |                                      | hazardous     | Landfill       |  |
| Determinand                  | SOP  | Accred. | Units    |         |                                      | Landfill      |                |  |
| Total Organic Carbon         | 2625 | U       | %        |         | 3                                    | 5             | 6              |  |
| Loss on Ignition             | 2610 | U       | %        |         |                                      |               | 10             |  |
| Total BTEX                   | 2760 | U       | mg/kg    |         | 6                                    |               |                |  |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg    |         | 1                                    |               |                |  |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg    |         | 500                                  |               |                |  |
| Total (of 17) PAHs           | 2700 | N       | mg/kg    |         | 100                                  |               |                |  |
| рН                           | 2010 | U       |          |         |                                      | >6            |                |  |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg   |         |                                      | To evaluate   | To evaluate    |  |
|                              |      |         | 10:1     | 10:1    |                                      | for compliant | aa laaahina    |  |
| Eluate Analysis              |      |         | Eluate   | Eluate  | Limit values for compliance leaching |               |                |  |
| -                            |      |         | mg/l     | mg/kg   | test using B                         | 5 EN 12457-3  | at L/S 10 l/kg |  |
| Arsenic                      | 1450 | U       | < 0.001  | < 0.050 | 0.5                                  | 2             | 25             |  |
| Barium                       | 1450 | U       | 0.006    | < 0.50  | 20                                   | 100           | 300            |  |
| Cadmium                      | 1450 | U       | < 0.0001 | < 0.010 | 0.04                                 | 1             | 5              |  |
| Chromium                     | 1450 | U       | 0.002    | < 0.050 | 0.5                                  | 10            | 70             |  |
| Copper                       | 1450 | U       | 0.002    | < 0.050 | 2                                    | 50            | 100            |  |
| Mercury                      | 1450 | U       | < 0.0005 | < 0.005 | 0.01                                 | 0.2           | 2              |  |
| Molybdenum                   | 1450 | U       | 0.005    | 0.053   | 0.5                                  | 10            | 30             |  |
| Nickel                       | 1450 | U       | < 0.001  | < 0.050 | 0.4                                  | 10            | 40             |  |
| Lead                         | 1450 | U       | < 0.001  | < 0.010 | 0.5                                  | 10            | 50             |  |
| Antimony                     | 1450 | U       | < 0.001  | < 0.010 | 0.06                                 | 0.7           | 5              |  |
| Selenium                     | 1450 | U       | < 0.001  | < 0.010 | 0.1                                  | 0.5           | 7              |  |
| Zinc                         | 1450 | U       | < 0.001  | < 0.50  | 4                                    | 50            | 200            |  |
| Chloride                     | 1220 | U       | 1.1      | 11      | 800                                  | 15000         | 25000          |  |
| Fluoride                     | 1220 | U       | 0.29     | 2.9     | 10                                   | 150           | 500            |  |
| Sulphate                     | 1220 | U       | 4.6      | 46      | 1000                                 | 20000         | 50000          |  |
| Total Dissolved Solids       | 1020 | N       | 75       | 750     | 4000                                 | 60000         | 100000         |  |
| Phenol Index                 | 1920 | U       | < 0.030  | < 0.30  | 1                                    | -             | -              |  |
| Dissolved Organic Carbon     | 1610 | N       | 6.7      | 67      | 500                                  | 800           | 1000           |  |

| Soild Information           |      |
|-----------------------------|------|
| Dry mass of test portion/kg | 0.09 |
| Moisture (%)                | 9.5  |



| Chemtest Job No: 15-01364    |      |         |          |         | LandfIII Waste Acceptance Criteri |                          |                |
|------------------------------|------|---------|----------|---------|-----------------------------------|--------------------------|----------------|
| Chemtest Sample ID: 92558    |      |         |          |         |                                   | Limits                   |                |
| Sample Ref:                  |      |         |          |         |                                   | Stable, Non-             |                |
| Sample ID: TP100             |      |         |          |         |                                   | reactive                 |                |
| Top Depth(m): 0.30           |      |         |          |         | Inert Waste                       | hazardous                | Hazardous      |
| Bottom Depth(m):             |      |         |          |         | Landfill                          | waste in non             | Waste          |
| Sampling Date: 22-Jan-2015   |      |         |          |         |                                   | hazardous                | Landfill       |
| Determinand                  | SOP  | Accred. | Units    |         |                                   | Landfill                 |                |
| Total Organic Carbon         | 2625 | U       | %        |         | 3                                 | 5                        | 6              |
| Loss on Ignition             | 2610 | U       | %        |         |                                   |                          | 10             |
| Total BTEX                   | 2760 | U       | mg/kg    |         | 6                                 |                          |                |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg    |         | 1                                 |                          |                |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg    |         | 500                               |                          |                |
| Total (of 17) PAHs           | 2700 | N       | mg/kg    |         | 100                               |                          |                |
| рН                           | 2010 | U       |          |         |                                   | >6                       |                |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg   |         |                                   | To evaluate              | To evaluate    |
|                              |      |         | 10:1     | 10:1    |                                   |                          | aa laaabin n   |
| Eluate Analysis              |      |         | Eluate   | Eluate  |                                   | test using DS EN 12457.2 |                |
| -                            |      |         | mg/l     | mg/kg   | test using B                      | 5 EN 12457-3             | at L/S 10 l/kg |
| Arsenic                      | 1450 | U       | < 0.001  | < 0.050 | 0.5                               | 2                        | 25             |
| Barium                       | 1450 | U       | 0.004    | < 0.50  | 20                                | 100                      | 300            |
| Cadmium                      | 1450 | U       | < 0.0001 | < 0.010 | 0.04                              | 1                        | 5              |
| Chromium                     | 1450 | U       | 0.003    | < 0.050 | 0.5                               | 10                       | 70             |
| Copper                       | 1450 | U       | < 0.001  | < 0.050 | 2                                 | 50                       | 100            |
| Mercury                      | 1450 | U       | < 0.0005 | < 0.005 | 0.01                              | 0.2                      | 2              |
| Molybdenum                   | 1450 | U       | 0.004    | < 0.050 | 0.5                               | 10                       | 30             |
| Nickel                       | 1450 | U       | < 0.001  | < 0.050 | 0.4                               | 10                       | 40             |
| Lead                         | 1450 | U       | < 0.001  | < 0.010 | 0.5                               | 10                       | 50             |
| Antimony                     | 1450 | U       | < 0.001  | < 0.010 | 0.06                              | 0.7                      | 5              |
| Selenium                     | 1450 | U       | < 0.001  | < 0.010 | 0.1                               | 0.5                      | 7              |
| Zinc                         | 1450 | U       | < 0.001  | < 0.50  | 4                                 | 50                       | 200            |
| Chloride                     | 1220 | U       | < 1.0    | < 10    | 800                               | 15000                    | 25000          |
| Fluoride                     | 1220 | U       | 0.25     | 2.5     | 10                                | 150                      | 500            |
| Sulphate                     | 1220 | U       | 3.7      | 37      | 1000                              | 20000                    | 50000          |
| Total Dissolved Solids       | 1020 | N       | 57       | 570     | 4000                              | 60000                    | 100000         |
| Phenol Index                 | 1920 | U       | < 0.030  | < 0.30  | 1                                 | -                        | -              |
| Dissolved Organic Carbon     | 1610 | Ν       | 3.8      | < 50    | 500                               | 800                      | 1000           |

| Soild Information           |      |
|-----------------------------|------|
| Dry mass of test portion/kg | 0.09 |
| Moisture (%)                | 17   |



| Chemtest Job No: 15-01364    |      |         |          |         | Landfill Wa                             | aste Acceptar | ce Criteria    |  |
|------------------------------|------|---------|----------|---------|---|---------------|----------------|--|
| Chemtest Sample ID: 92559    |      |         |          |         |   | Limits        |                |  |
| Sample Ref:                  |      |         |          |         |   | Stable, Non-  |                |  |
| Sample ID: TP101             |      |         |          |         |   | reactive      |                |  |
| Top Depth(m): 0.20           |      |         |          |         | Inert Waste                             | hazardous     | Hazardous      |  |
| Bottom Depth(m):             |      |         |          |         | Landfill                                | waste in non  | Waste          |  |
| Sampling Date: 22-Jan-2015   |      |         |          |         |   | hazardous     | Landfill       |  |
| Determinand                  | SOP  | Accred. | Units    |         |   | Landfill      |                |  |
| Total Organic Carbon         | 2625 | U       | %        |         | 3                                       | 5             | 6              |  |
| Loss on Ignition             | 2610 | U       | %        |         |   |               | 10             |  |
| Total BTEX                   | 2760 | U       | mg/kg    |         | 6                                       |               |                |  |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg    |         | 1                                       |               |                |  |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg    |         | 500                                     |               |                |  |
| Total (of 17) PAHs           | 2700 | N       | mg/kg    |         | 100                                     |               |                |  |
| рН                           | 2010 | U       |          |         |   | >6            |                |  |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg   |         |   | To evaluate   | To evaluate    |  |
|                              |      |         | 10:1     | 10:1    |   | for complian  | aa laaahing    |  |
| Eluate Analysis              |      |         | Eluate   | Eluate  | test using BS EN 12457-3 at 1/S 10 1/kg |               |                |  |
| -                            |      |         | mg/l     | mg/kg   | test using ba                           | 5 EN 12457-3  | at L/S 10 1/kg |  |
| Arsenic                      | 1450 | U       | < 0.001  | < 0.050 | 0.5                                     | 2             | 25             |  |
| Barium                       | 1450 | U       | 0.004    | < 0.50  | 20                                      | 100           | 300            |  |
| Cadmium                      | 1450 | U       | < 0.0001 | < 0.010 | 0.04                                    | 1             | 5              |  |
| Chromium                     | 1450 | U       | 0.004    | < 0.050 | 0.5                                     | 10            | 70             |  |
| Copper                       | 1450 | U       | 0.002    | < 0.050 | 2                                       | 50            | 100            |  |
| Mercury                      | 1450 | U       | < 0.0005 | < 0.005 | 0.01                                    | 0.2           | 2              |  |
| Molybdenum                   | 1450 | U       | 0.003    | < 0.050 | 0.5                                     | 10            | 30             |  |
| Nickel                       | 1450 | U       | 0.001    | < 0.050 | 0.4                                     | 10            | 40             |  |
| Lead                         | 1450 | U       | < 0.001  | < 0.010 | 0.5                                     | 10            | 50             |  |
| Antimony                     | 1450 | U       | < 0.001  | < 0.010 | 0.06                                    | 0.7           | 5              |  |
| Selenium                     | 1450 | U       | < 0.001  | < 0.010 | 0.1                                     | 0.5           | 7              |  |
| Zinc                         | 1450 | U       | 0.002    | < 0.50  | 4                                       | 50            | 200            |  |
| Chloride                     | 1220 | U       | < 1.0    | < 10    | 800                                     | 15000         | 25000          |  |
| Fluoride                     | 1220 | U       | 0.24     | 2.4     | 10                                      | 150           | 500            |  |
| Sulphate                     | 1220 | U       | 2.5      | 25      | 1000                                    | 20000         | 50000          |  |
| Total Dissolved Solids       | 1020 | N       | 59       | 590     | 4000                                    | 60000         | 100000         |  |
| Phenol Index                 | 1920 | U       | < 0.030  | < 0.30  | 1                                       | -             | -              |  |
| Dissolved Organic Carbon     | 1610 | N       | 3.9      | < 50    | 500                                     | 800           | 1000           |  |

| Soild Information           |      |
|-----------------------------|------|
| Dry mass of test portion/kg | 0.09 |
| Moisture (%)                | 19   |

#### 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, SVCOs, PCBs, Phenols For all other tests the samples were dried at < 37°C prior to analysis All Asbestos testing is performed at our Coventry 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

#### Sample Retention and Disposal

All soil samples will be retained for a period of 60 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: <u>customerservices@chemtest.co.uk</u>





| Report Number:         | 15-03477 Issue-1   |                   |             |
|------------------------|--|-------------------|-------------|
| Initial Date of Issue: | 25-Feb-2015  |                   |             |
| Client:                | Causeway Geotech Ltd   |                   |             |
| Client Address:        | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |                   |             |
| Contact(s):            | Darren O'Mahony<br>Paul Dunlop<br>Stephen Franey                           |                   |             |
| Project:               | 14-645 Greater Dublin Drainage GI: Phase 2                                 |                   |             |
| Quotation No.:         |  | Date Received:    | 16-Feb-2015 |
| Order No.:             | 14-645   | Date Instructed:  | 16-Feb-2015 |
| No. of Samples:        | 7  |                   |             |
| Turnaround: (Wkdays)   | 5  | Results Due Date: | 20-Feb-2015 |
| Date Approved:         | 19-Feb-2015  |                   |             |
| Approved By:           |  |                   |             |
| Details:               | Darrell Hall, Laboratory Director  |                   |             |



| Client: Causeway Geotech Ltd        | C                    | hemte | est Job | o No.: | 15-03477 | 15-03477 | 15-03477 | 15-03477 | 15-03477 | 15-03477 | 15-03477 |
|-------------------------------------|----------------------|-------|---------|--------|----------|----------|----------|----------|----------|----------|----------|
| Quotation No.:                      | Chemtest Sample ID.: |       |         | 103328 | 103329   | 103330   | 103331   | 103332   | 103333   | 103334   |          |
| Order No.: 14-645                   | Client Sample Ref.:  |       |         |        |          |          |          |          |          |          |          |
|                                     | Client Sample ID.:   |       |         |        | BH138    | BH139    | TP108    | TP109    | TP110    | TP113    | TP114    |
|                                     | Sample Type:         |       |         |        | SOIL     |
|                                     | Top Depth (m):       |       |         |        | 0.00     | 6.00     | 2.00     | 1.00     | 0.50     | 1.00     | 2.00     |
|                                     | Bottom Depth(m):     |       |         |        |          |          |          |          |          |          |          |
|                                     |                      | Da    | ate San | npled: |          |          |          |          |          |          |          |
| Determinand                         | Accred.              | SOP   | Units   | LOD    |          |          |          |          |          |          |          |
| рН                                  | U                    | 2010  |         |        |          | 8.3      | 8.2      | 8.1      | 8.2      | 8.4      |          |
| Sulphate (2:1 Water Soluble) as SO4 | U                    | 2120  | g/l     | 0.01   |          | 0.12     | 0.064    | 0.93     | < 0.010  | < 0.010  |          |
| Chloride (Extractable)              | U                    | 2220  | g/l     | 0.01   | < 0.010  |          |          | < 0.010  | < 0.010  |          |          |
| Organic Matter                      | U                    | 2625  | %       | 0.4    | 5.5      |          |          | 1.9      | 0.95     | 0.66     | 0.81     |

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- 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, SVCOs, PCBs, Phenols For all other tests the samples were dried at < 37°C prior to analysis All Asbestos testing is performed at our Coventry 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

#### Sample Retention and Disposal

All soil samples will be retained for a period of 60 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: <u>customerservices@chemtest.co.uk</u>





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

| Report Number:  | 15-03479 Issue-1   |   |   |
|---|--|---|---|
| Initial Date of Issue:  | 25-Feb-2015  |   |   |
| Client:   | Causeway Geotech Ltd   |   |   |
| Client Address:   | 8 Drumahiskey Road<br>Balnamore<br>Ballymoney<br>County Antrim<br>BT53 7QL |   |   |
| Contact(s):   | Darren O'Mahony<br>Paul Dunlop<br>Stephen Franey                           |   |   |
| Project:  | 14-645 Greater Dublin Drainage GI: Phase 2                                 |   |   |
| Quotation No.:  |  |   | 16 Eab 2015                               |
|   |  | Date Received:  | 10-Feb-2015                               |
| Order No.:  | 14-645   | Date Received:<br>Date Instructed:                      | 16-Feb-2015                               |
| Order No.:<br>No. of Samples:   | 14-645<br>5  | Date Received:<br>Date Instructed:                      | 16-Feb-2015                               |
| Order No.:<br>No. of Samples:<br>Turnaround: (Wkdays)                                   | 14-645<br>5<br>7   | Date Received:<br>Date Instructed:<br>Results Due Date: | 16-Feb-2015<br>16-Feb-2015<br>24-Feb-2015 |
| Order No.:<br>No. of Samples:<br>Turnaround: (Wkdays)<br>Date Approved:                 | 14-645<br>5<br>7<br>24-Feb-2015  | Date Received:<br>Date Instructed:<br>Results Due Date: | 16-Feb-2015<br>16-Feb-2015<br>24-Feb-2015 |
| Order No.:<br>No. of Samples:<br>Turnaround: (Wkdays)<br>Date Approved:<br>Approved By: | 14-645<br>5<br>7<br>24-Feb-2015  | Date Received:<br>Date Instructed:<br>Results Due Date: | 16-Feb-2015<br>16-Feb-2015<br>24-Feb-2015 |

Details:

Keith Jones, Technical Manager



| Chemtest Job No: 15-03479    |                            |         |             |             |              |                             | LandfIII Waste Acceptance Criteria |                                |                               |  |
|------------------------------|----------------------------|---------|-------------|-------------|--------------|-----------------------------|------------------------------------|--------------------------------|-------------------------------|--|
| Chemtest Sample ID: 103338   | Chemtest Sample ID: 103338 |         |             |             |              |                             |                                    | Limits                         |                               |  |
| Sample Ref:                  |                            |         |             |             |              |                             |                                    | Stable Non-                    |                               |  |
| Sample ID: BH138             |                            |         |             |             |              |                             |                                    | reactive                       |                               |  |
| Top Depth(m): 0.00           |                            |         |             |             |              |                             | Inert Waste                        | Hazardous                      | Hazardous                     |  |
| Bottom Depth(m):             |                            |         |             |             |              |                             | Landfill                           | waste in                       | Waste                         |  |
| Sampling Date:               |                            |         |             |             |              |                             |                                    | non-                           | Landfill                      |  |
| Determinand                  | SOP                        | Accred. | Units       |             |              |                             |                                    | hazardous                      |                               |  |
| Total Organic Carbon         | 2625                       | U       | %           |             |              | 3.4                         | 3                                  | 5                              | 6                             |  |
| Loss on Ignition             | 2610                       | U       | %           |             |              | 6.9                         |                                    |                                | 10                            |  |
| Total BTEX                   | 2760                       | U       | mg/kg       |             |              | A < 0.01                    | 6                                  |                                |                               |  |
| Total PCBs (7 congeners)     | 2815                       | U       | mg/kg       |             |              | < 0.10                      | 1                                  |                                |                               |  |
| TPH Total WAC (Mineral Oil)  | 2670                       | U       | mg/kg       |             |              | A < 10                      | 500                                |                                |                               |  |
| Total (of 17) PAHs           | 2700                       | N       | mg/kg       |             |              | 6                           | 100                                |                                |                               |  |
| рН                           | 2010                       | U       |             |             |              | 8                           |                                    | >6                             |                               |  |
| Acid Neutralisation Capacity | 2015                       | N       | mol/kg      |             |              | 0.16                        |                                    | To evaluate                    | To evaluate                   |  |
| Eluate Analysis              |                            |         | 2:1<br>mg/l | 8:1<br>mg/l | 2:1<br>mg/kg | Cumulative<br>10:1<br>mg/kg | Limit values<br>test using B       | s for complian<br>S EN 12457-3 | ce leaching<br>at L/S 10 l/kg |  |
| Arsenic                      | 1450                       | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                                | 2                              | 25                            |  |
| Barium                       | 1450                       | U       | 0.015       | 0.004       | < 0.50       | < 0.50                      | 20                                 | 100                            | 300                           |  |
| Cadmium                      | 1450                       | U       | < 0.0001    | < 0.0001    | < 0.010      | < 0.010                     | 0.04                               | 1                              | 5                             |  |
| Chromium                     | 1450                       | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                                | 10                             | 70                            |  |
| Copper                       | 1450                       | U       | 0.002       | < 0.001     | < 0.050      | < 0.050                     | 2                                  | 50                             | 100                           |  |
| Mercury                      | 1450                       | U       | < 0.0005    | < 0.0005    | < 0.001      | < 0.005                     | 0.01                               | 0.2                            | 2                             |  |
| Molybdenum                   | 1450                       | U       | 0.004       | 0.001       | < 0.050      | < 0.050                     | 0.5                                | 10                             | 30                            |  |
| Nickel                       | 1450                       | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.4                                | 10                             | 40                            |  |
| Lead                         | 1450                       | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.5                                | 10                             | 50                            |  |
| Antimony                     | 1450                       | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.06                               | 0.7                            | 5                             |  |
| Selenium                     | 1450                       | U       | 0.003       | 0.001       | < 0.010      | 0.016                       | 0.1                                | 0.5                            | 7                             |  |
| Zinc                         | 1450                       | U       | < 0.001     | < 0.001     | < 0.50       | < 0.50                      | 4                                  | 50                             | 200                           |  |
| Chloride                     | 1220                       | U       | 3.3         | 2.7         | < 10         | 27                          | 800                                | 15000                          | 25000                         |  |
| Fluoride                     | 1220                       | U       | 0.36        | 0.11        | < 1.0        | 1.3                         | 10                                 | 150                            | 500                           |  |
| Sulphate                     | 1220                       | U       | 18          | < 1.0       | 35           | 18                          | 1000                               | 20000                          | 50000                         |  |
| Total Dissolved Solids       | 1020                       | N       | 180         | 48          | 350          | 610                         | 4000                               | 60000                          | 100000                        |  |
| Phenol Index                 | 1920                       | U       | < 0.030     | < 0.030     | < 0.30       | < 0.50                      | 1                                  | -                              | -                             |  |
| Dissolved Organic Carbon     | 1610                       | N       | 7.4         | 6.5         | < 50         | 65                          | 500                                | 800                            | 1000                          |  |

| Soild Information           |       |
|-----------------------------|-------|
| Dry mass of test portion/kg | 0.175 |
| Moisture (%)                | 23    |

| Leachate Test Information           |       |  |  |  |  |  |  |
|-------------------------------------|-------|--|--|--|--|--|--|
| Leachant volume 1st extract/l       | 0.298 |  |  |  |  |  |  |
| Leachant volume 2nd extract/l       | 1.4   |  |  |  |  |  |  |
| Eluant recovered from 1st extract/l | 0.173 |  |  |  |  |  |  |



| Chemtest Job No: 15-03479    |      |         |             |             |              |                             | Landfill Wa                  | aste Acceptar                  | ce Criteria |
|------------------------------|------|---------|-------------|-------------|--------------|-----------------------------|------------------------------|--------------------------------|-------------|
| Chemtest Sample ID: 103339   |      |         |             |             |              |                             |                              | Limits                         |             |
| Sample Ref:                  |      |         |             |             |              |                             |                              | Stable Non-                    |             |
| Sample ID: TP108             |      |         |             |             |              |                             |                              | reactive                       |             |
| Top Depth(m): 1.00           |      |         |             |             |              |                             | Inert Waste                  | Hazardous                      | Hazardous   |
| Bottom Depth(m):             |      |         |             |             |              |                             | Landfill                     | waste in                       | Waste       |
| Sampling Date:               |      |         |             |             |              |                             |                              | non-                           | Landfill    |
| Determinand                  | SOP  | Accred. | Units       |             |              |                             |                              | hazardous                      |             |
| Total Organic Carbon         | 2625 | U       | %           |             |              | 2.9                         | 3                            | 5                              | 6           |
| Loss on Ignition             | 2610 | U       | %           |             |              | 6.7                         |                              |                                | 10          |
| Total BTEX                   | 2760 | U       | mg/kg       |             |              | A < 0.01                    | 6                            |                                |             |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg       |             |              | < 0.10                      | 1                            |                                |             |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg       |             |              | A 29                        | 500                          |                                |             |
| Total (of 17) PAHs           | 2700 | N       | mg/kg       |             |              | < 2.0                       | 100                          |                                |             |
| рН                           | 2010 | U       |             |             |              | 8                           |                              | >6                             |             |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg      |             |              | 0.19                        |                              | To evaluate                    | To evaluate |
| Eluate Analysis              |      |         | 2:1<br>mg/l | 8:1<br>mg/l | 2:1<br>mg/kg | Cumulative<br>10:1<br>mg/kg | Limit values<br>test using B | ice leaching<br>at L/S 10 l/kg |             |
| Arsenic                      | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 2                              | 25          |
| Barium                       | 1450 | U       | 0.012       | 0.003       | < 0.50       | < 0.50                      | 20                           | 100                            | 300         |
| Cadmium                      | 1450 | U       | < 0.0001    | < 0.0001    | < 0.010      | < 0.010                     | 0.04                         | 1                              | 5           |
| Chromium                     | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 10                             | 70          |
| Copper                       | 1450 | U       | 0.002       | < 0.001     | < 0.050      | < 0.050                     | 2                            | 50                             | 100         |
| Mercury                      | 1450 | U       | < 0.0005    | < 0.0005    | < 0.001      | < 0.005                     | 0.01                         | 0.2                            | 2           |
| Molybdenum                   | 1450 | U       | 0.003       | 0.001       | < 0.050      | < 0.050                     | 0.5                          | 10                             | 30          |
| Nickel                       | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.4                          | 10                             | 40          |
| Lead                         | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.5                          | 10                             | 50          |
| Antimony                     | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.06                         | 0.7                            | 5           |
| Selenium                     | 1450 | U       | 0.003       | < 0.001     | < 0.010      | < 0.010                     | 0.1                          | 0.5                            | 7           |
| Zinc                         | 1450 | U       | < 0.001     | < 0.001     | < 0.50       | < 0.50                      | 4                            | 50                             | 200         |
| Chloride                     | 1220 | U       | 3.3         | < 1.0       | < 10         | < 10                        | 800                          | 15000                          | 25000       |
| Fluoride                     | 1220 | U       | 0.4         | 0.14        | < 1.0        | 1.7                         | 10                           | 150                            | 500         |
| Sulphate                     | 1220 | U       | 14          | < 1.0       | 27           | 15                          | 1000                         | 20000                          | 50000       |
| Total Dissolved Solids       | 1020 | N       | 150         | 43          | 290          | 540                         | 4000                         | 60000                          | 100000      |
| Phenol Index                 | 1920 | U       | < 0.030     | < 0.030     | < 0.30       | < 0.50                      | 1                            | -                              | -           |
| Dissolved Organic Carbon     | 1610 | N       | 56          | 7.5         | 110          | 130                         | 500                          | 800                            | 1000        |

| Soild Information           |       |
|-----------------------------|-------|
| Dry mass of test portion/kg | 0.175 |
| Moisture (%)                | 21    |

| Leachate Test Information           |       |  |  |  |  |  |  |  |
|-------------------------------------|-------|--|--|--|--|--|--|--|
| Leachant volume 1st extract/l       | 0.303 |  |  |  |  |  |  |  |
| Leachant volume 2nd extract/l       | 1.4   |  |  |  |  |  |  |  |
| Eluant recovered from 1st extract/l | 0.182 |  |  |  |  |  |  |  |



| Chemtest Job No: 15-03479    |      |         |             |             |              |                             | Landfill W                   | aste Acceptar                  | ce Criteria |
|------------------------------|------|---------|-------------|-------------|--------------|-----------------------------|------------------------------|--------------------------------|-------------|
| Chemtest Sample ID: 103340   |      |         |             |             |              |                             |                              | Limits                         |             |
| Sample Ref:                  |      |         |             |             |              |                             |                              | Stable Non-                    |             |
| Sample ID: TP109             |      |         |             |             |              |                             |                              | reactive                       |             |
| Top Depth(m): 0.50           |      |         |             |             |              |                             | Inert Waste                  | Hazardous                      | Hazardous   |
| Bottom Depth(m):             |      |         |             |             |              |                             | Landfill                     | waste in                       | Waste       |
| Sampling Date:               |      |         |             |             |              |                             |                              | non-                           | Landfill    |
| Determinand                  | SOP  | Accred. | Units       |             |              |                             |                              | hazardous                      |             |
| Total Organic Carbon         | 2625 | U       | %           |             |              | 1.1                         | 3                            | 5                              | 6           |
| Loss on Ignition             | 2610 | U       | %           |             |              | 2.9                         |                              |                                | 10          |
| Total BTEX                   | 2760 | U       | mg/kg       |             |              | A < 0.01                    | 6                            |                                |             |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg       |             |              | < 0.10                      | 1                            |                                |             |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg       |             |              | A < 10                      | 500                          |                                |             |
| Total (of 17) PAHs           | 2700 | N       | mg/kg       |             |              | 12                          | 100                          |                                |             |
| рН                           | 2010 | U       |             |             |              | 7.9                         |                              | >6                             |             |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg      |             |              | 0.58                        |                              | To evaluate                    | To evaluate |
| Eluate Analysis              |      |         | 2:1<br>mg/l | 8:1<br>mg/l | 2:1<br>mg/kg | Cumulative<br>10:1<br>mg/kg | Limit values<br>test using B | ice leaching<br>at L/S 10 l/kg |             |
| Arsenic                      | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 2                              | 25          |
| Barium                       | 1450 | U       | 0.023       | 0.022       | < 0.50       | < 0.50                      | 20                           | 100                            | 300         |
| Cadmium                      | 1450 | U       | 0.0001      | < 0.0001    | < 0.010      | < 0.010                     | 0.04                         | 1                              | 5           |
| Chromium                     | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 10                             | 70          |
| Copper                       | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 2                            | 50                             | 100         |
| Mercury                      | 1450 | U       | < 0.0005    | < 0.0005    | < 0.001      | < 0.005                     | 0.01                         | 0.2                            | 2           |
| Molybdenum                   | 1450 | U       | 0.004       | 0.006       | < 0.050      | 0.055                       | 0.5                          | 10                             | 30          |
| Nickel                       | 1450 | U       | 0.003       | < 0.001     | < 0.050      | < 0.050                     | 0.4                          | 10                             | 40          |
| Lead                         | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.5                          | 10                             | 50          |
| Antimony                     | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.06                         | 0.7                            | 5           |
| Selenium                     | 1450 | U       | 0.006       | 0.002       | 0.012        | 0.02                        | 0.1                          | 0.5                            | 7           |
| Zinc                         | 1450 | U       | 0.017       | < 0.001     | < 0.50       | < 0.50                      | 4                            | 50                             | 200         |
| Chloride                     | 1220 | U       | 2.2         | < 1.0       | < 10         | < 10                        | 800                          | 15000                          | 25000       |
| Fluoride                     | 1220 | U       | 0.14        | 0.24        | < 1.0        | 2.3                         | 10                           | 150                            | 500         |
| Sulphate                     | 1220 | U       | 1500        | 150         | 3000         | 3000                        | 1000                         | 20000                          | 50000       |
| Total Dissolved Solids       | 1020 | N       | 1300        | 300         | 2600         | 4100                        | 4000                         | 60000                          | 100000      |
| Phenol Index                 | 1920 | U       | < 0.030     | < 0.030     | < 0.30       | < 0.50                      | 1                            | -                              | -           |
| Dissolved Organic Carbon     | 1610 | N       | 14          | 5           | < 50         | 60                          | 500                          | 800                            | 1000        |

| Soild Information           |       |
|-----------------------------|-------|
| Dry mass of test portion/kg | 0.175 |
| Moisture (%)                | 13    |

| Leachate Test Information           |       |  |  |  |  |  |  |  |
|-------------------------------------|-------|--|--|--|--|--|--|--|
| Leachant volume 1st extract/l       | 0.325 |  |  |  |  |  |  |  |
| Leachant volume 2nd extract/l       | 1.4   |  |  |  |  |  |  |  |
| Eluant recovered from 1st extract/l | 0.196 |  |  |  |  |  |  |  |



| Chemtest Job No: 15-03479    |      |         |             |             |              |                             | Landfill Wa                  | aste Acceptar                  | ce Criteria |
|------------------------------|------|---------|-------------|-------------|--------------|-----------------------------|------------------------------|--------------------------------|-------------|
| Chemtest Sample ID: 103341   |      |         |             |             |              |                             |                              | Limits                         |             |
| Sample Ref:                  |      |         |             |             |              |                             |                              | Stable Non-                    |             |
| Sample ID: TP110             |      |         |             |             |              |                             |                              | reactive                       |             |
| Top Depth(m): 1.00           |      |         |             |             |              |                             | Inert Waste                  | Hazardous                      | Hazardous   |
| Bottom Depth(m):             |      |         |             |             |              |                             | Landfill                     | waste in                       | Waste       |
| Sampling Date:               |      |         |             |             |              |                             |                              | non-                           | Landfill    |
| Determinand                  | SOP  | Accred. | Units       |             |              |                             |                              | hazardous                      |             |
| Total Organic Carbon         | 2625 | U       | %           |             |              | 0.63                        | 3                            | 5                              | 6           |
| Loss on Ignition             | 2610 | U       | %           |             |              | 2.4                         |                              |                                | 10          |
| Total BTEX                   | 2760 | U       | mg/kg       |             |              | A < 0.01                    | 6                            |                                |             |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg       |             |              | < 0.10                      | 1                            |                                |             |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg       |             |              | A < 10                      | 500                          |                                |             |
| Total (of 17) PAHs           | 2700 | N       | mg/kg       |             |              | 3                           | 100                          |                                |             |
| рН                           | 2010 | U       |             |             |              | 8.1                         |                              | >6                             |             |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg      |             |              | 0.34                        |                              | To evaluate                    | To evaluate |
| Eluate Analysis              |      |         | 2:1<br>mg/l | 8:1<br>mg/l | 2:1<br>mg/kg | Cumulative<br>10:1<br>mg/kg | Limit values<br>test using B | ice leaching<br>at L/S 10 l/kg |             |
| Arsenic                      | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 2                              | 25          |
| Barium                       | 1450 | U       | 0.006       | 0.003       | < 0.50       | < 0.50                      | 20                           | 100                            | 300         |
| Cadmium                      | 1450 | U       | < 0.0001    | < 0.0001    | < 0.010      | < 0.010                     | 0.04                         | 1                              | 5           |
| Chromium                     | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 10                             | 70          |
| Copper                       | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 2                            | 50                             | 100         |
| Mercury                      | 1450 | U       | < 0.0005    | < 0.0005    | < 0.001      | < 0.005                     | 0.01                         | 0.2                            | 2           |
| Molybdenum                   | 1450 | U       | 0.001       | 0.001       | < 0.050      | < 0.050                     | 0.5                          | 10                             | 30          |
| Nickel                       | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.4                          | 10                             | 40          |
| Lead                         | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.5                          | 10                             | 50          |
| Antimony                     | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.06                         | 0.7                            | 5           |
| Selenium                     | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.1                          | 0.5                            | 7           |
| Zinc                         | 1450 | U       | < 0.001     | < 0.001     | < 0.50       | < 0.50                      | 4                            | 50                             | 200         |
| Chloride                     | 1220 | U       | 9.4         | < 1.0       | 19           | 11                          | 800                          | 15000                          | 25000       |
| Fluoride                     | 1220 | U       | 0.23        | 0.11        | < 1.0        | 1.2                         | 10                           | 150                            | 500         |
| Sulphate                     | 1220 | U       | 9.1         | < 1.0       | 18           | 10                          | 1000                         | 20000                          | 50000       |
| Total Dissolved Solids       | 1020 | N       | 130         | 43          | 260          | 530                         | 4000                         | 60000                          | 100000      |
| Phenol Index                 | 1920 | U       | < 0.030     | < 0.030     | < 0.30       | < 0.50                      | 1                            | -                              | -           |
| Dissolved Organic Carbon     | 1610 | N       | 12          | 12          | < 50         | 120                         | 500                          | 800                            | 1000        |

| Soild Information           |       |
|-----------------------------|-------|
| Dry mass of test portion/kg | 0.175 |
| Moisture (%)                | 13    |

| Leachate Test Information           |       |  |  |  |  |  |  |  |
|-------------------------------------|-------|--|--|--|--|--|--|--|
| Leachant volume 1st extract/l       | 0.324 |  |  |  |  |  |  |  |
| Leachant volume 2nd extract/l       | 1.4   |  |  |  |  |  |  |  |
| Eluant recovered from 1st extract/l | 0.202 |  |  |  |  |  |  |  |



Project: 14-645 Greater Dublin Drainage GI: Phase 2

| Chemtest Job No: 15-03479    |      |         |             |             |              |                             | Landfill Wa                  | aste Acceptar                  | ce Criteria |
|------------------------------|------|---------|-------------|-------------|--------------|-----------------------------|------------------------------|--------------------------------|-------------|
| Chemtest Sample ID: 103342   |      |         |             |             |              |                             |                              | Limits                         |             |
| Sample Ref:                  |      |         |             |             |              |                             |                              | Stable Non-                    |             |
| Sample ID: TP114             |      |         |             |             |              |                             |                              | reactive                       |             |
| Top Depth(m): 1.00           |      |         |             |             |              |                             | Inert Waste                  | Hazardous                      | Hazardous   |
| Bottom Depth(m):             |      |         |             |             |              |                             | Landfill                     | waste in                       | Waste       |
| Sampling Date:               |      |         |             |             |              |                             |                              | non-                           | Landfill    |
| Determinand                  | SOP  | Accred. | Units       |             |              |                             |                              | nazardous                      |             |
| Total Organic Carbon         | 2625 | U       | %           |             |              | 0.53                        | 3                            | 5                              | 6           |
| Loss on Ignition             | 2610 | U       | %           |             |              | 1.8                         |                              |                                | 10          |
| Total BTEX                   | 2760 | U       | mg/kg       |             |              | A < 0.01                    | 6                            |                                |             |
| Total PCBs (7 congeners)     | 2815 | U       | mg/kg       |             |              | < 0.10                      | 1                            |                                |             |
| TPH Total WAC (Mineral Oil)  | 2670 | U       | mg/kg       |             |              | A < 10                      | 500                          |                                |             |
| Total (of 17) PAHs           | 2700 | N       | mg/kg       |             |              | 3.1                         | 100                          |                                |             |
| рН                           | 2010 | U       |             |             |              | 8.3                         |                              | >6                             |             |
| Acid Neutralisation Capacity | 2015 | N       | mol/kg      |             |              | 0.32                        |                              | To evaluate                    | To evaluate |
| Eluate Analysis              |      |         | 2:1<br>mg/l | 8:1<br>mg/l | 2:1<br>mg/kg | Cumulative<br>10:1<br>mg/kg | Limit values<br>test using B | ice leaching<br>at L/S 10 l/kg |             |
| Arsenic                      | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 2                              | 25          |
| Barium                       | 1450 | U       | 0.014       | 0.003       | < 0.50       | < 0.50                      | 20                           | 100                            | 300         |
| Cadmium                      | 1450 | U       | < 0.0001    | < 0.0001    | < 0.010      | < 0.010                     | 0.04                         | 1                              | 5           |
| Chromium                     | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.5                          | 10                             | 70          |
| Copper                       | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 2                            | 50                             | 100         |
| Mercury                      | 1450 | U       | < 0.0005    | < 0.0005    | < 0.001      | < 0.005                     | 0.01                         | 0.2                            | 2           |
| Molybdenum                   | 1450 | U       | 0.008       | 0.002       | < 0.050      | < 0.050                     | 0.5                          | 10                             | 30          |
| Nickel                       | 1450 | U       | < 0.001     | < 0.001     | < 0.050      | < 0.050                     | 0.4                          | 10                             | 40          |
| Lead                         | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.5                          | 10                             | 50          |
| Antimony                     | 1450 | U       | < 0.001     | < 0.001     | < 0.010      | < 0.010                     | 0.06                         | 0.7                            | 5           |
| Selenium                     | 1450 | U       | 0.005       | 0.001       | 0.011        | 0.017                       | 0.1                          | 0.5                            | 7           |
| Zinc                         | 1450 | U       | < 0.001     | < 0.001     | < 0.50       | < 0.50                      | 4                            | 50                             | 200         |
| Chloride                     | 1220 | U       | 22          | < 1.0       | 43           | 29                          | 800                          | 15000                          | 25000       |
| Fluoride                     | 1220 | U       | 0.39        | 0.091       | < 1.0        | 1.3                         | 10                           | 150                            | 500         |
| Sulphate                     | 1220 | U       | 17          | < 1.0       | 33           | 22                          | 1000                         | 20000                          | 50000       |
| Total Dissolved Solids       | 1020 | N       | 160         | 41          | 310          | 560                         | 4000                         | 60000                          | 100000      |
| Phenol Index                 | 1920 | U       | < 0.030     | < 0.030     | < 0.30       | < 0.50                      | 1                            | -                              | -           |
| Dissolved Organic Carbon     | 1610 | N       | 2.9         | 2.9         | < 50         | < 50                        | 500                          | 800                            | 1000        |

| Soild Information           |       |  |  |  |  |  |
|-----------------------------|-------|--|--|--|--|--|
| Dry mass of test portion/kg | 0.175 |  |  |  |  |  |
| Moisture (%)                | 19    |  |  |  |  |  |

| Leachate Test Information           |       |
|-------------------------------------|-------|
| Leachant volume 1st extract/l       | 0.31  |
| Leachant volume 2nd extract/l       | 1.4   |
| Eluant recovered from 1st extract/l | 0.229 |

Page 6 of 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.

| Chemtest Sample ID: | Sample Ref: | Sample ID: | Sampled Date: | Containers Received: | Deviation Code(s): |
|---------------------|-------------|------------|---------------|----------------------|--------------------|
| 103338              |             | BH138      | None Supplied | Amber Glass 250ml    | А                  |
| 103338              |             | BH138      | None Supplied | Amber Glass 60ml     | А                  |
| 103338              |             | BH138      | None Supplied | Plastic Tub 500g     | А                  |
| 103339              |             | TP108      | None Supplied | Amber Glass 250ml    | А                  |
| 103339              |             | TP108      | None Supplied | Amber Glass 60ml     | А                  |
| 103339              |             | TP108      | None Supplied | Plastic Tub 500g     | А                  |
| 103340              |             | TP109      | None Supplied | Amber Glass 250ml    | А                  |
| 103340              |             | TP109      | None Supplied | Amber Glass 60ml     | А                  |
| 103340              |             | TP109      | None Supplied | Plastic Tub 500g     | А                  |
| 103341              |             | TP110      | None Supplied | Amber Glass 250ml    | А                  |
| 103341              |             | TP110      | None Supplied | Amber Glass 60ml     | А                  |
| 103341              |             | TP110      | None Supplied | Plastic Tub 500g     | А                  |
| 103342              |             | TP114      | None Supplied | Amber Glass 250ml    | А                  |
| 103342              |             | TP114      | None Supplied | Amber Glass 60ml     | А                  |
| 103342              |             | TP114      | None Supplied | Plastic Tub 500g     | А                  |

#### 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, SVCOs, PCBs, Phenols For all other tests the samples were dried at < 37°C prior to analysis All Asbestos testing is performed at our Coventry 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

#### Sample Retention and Disposal

All soil samples will be retained for a period of 60 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: <u>customerservices@chemtest.co.uk</u>
Appendix G SPT hammer energy measurement report



## SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

| SPT Hammer Ref: | CG G205                         |
|-----------------|---------------------------------|
| Test Date:      | 03/01/2013                      |
| Report Date:    |                                 |
| File Name:      | CG G205. report spt_checked.spt |
| Test Operator:  | MR                              |

#### Instrumented Rod Data

Co Antrim, Northern Ireland.

Mr. David Cameron Causeway Geotech Ltd. 8 Drumahiskey Road, balnamore, Ballymoney,

**BT 53 7QL** 

| Diameter d <sub>r</sub> (mm):         | 54   |
|---------------------------------------|------|
| Wall Thickness t <sub>r</sub> (mm):   | 6.6  |
| Assumed Modulus E <sub>a</sub> (GPa): | 208  |
| Accelerometer No.1:                   | 5677 |
| Accelerometer No.2:                   | 5833 |

#### **SPT Hammer Information**

Hammer Mass m (kg): 63.5 Falling Height h (mm): 770 SPT String Length L (m): 14.0

#### **Comments / Location**

T G205



The recommended calibration interval is 12 months





Signed: Michael Robinson Title: Test Engineer



# **SPT Hammer Energy Test Report**

in accordance with BSEN ISO 22476-3:2005

| Mr. David Cameron          |   |
|----------------------------|---|
| Causeway Geotech Ltd.      |   |
| 8 Drumahiskey Road,        |   |
| Balnamore, Ballymoney,     |   |
| Co Antrim, Northern Irelan | d |
| BT 53 7QL                  |   |

### Instrumented Rod Data

| Diameter d <sub>r</sub> (mm):         | 54   |
|---------------------------------------|------|
| Wall Thickness t <sub>r</sub> (mm):   | 6.6  |
| Assumed Modulus E <sub>a</sub> (GPa): | 208  |
| Accelerometer No.1:                   | 5677 |
| Accelerometer No.2:                   | 5833 |

| SPT Hammer Ref: | CG CC4                     |                        |
|-----------------|----------------------------|------------------------|
| Test Date:      | 03/01/2013                 | (≱≮)                   |
| Report Date:    | 07/01/2013                 | UKAS<br>IESUNG<br>0955 |
| File Name:      | CG CC4. report spt_checked | d.spt                  |
| Test Operator:  | MR                         |                        |

#### **SPT Hammer Information**

| Hammer Mass    | m (kg):    | 63.5 |
|----------------|------------|------|
| Falling Height | h (mm):    | 760  |
| SPT String Len | gth L (m): | 13.0 |

**Comments / Location** 

TRIP CC4



The recommended calibration interval is 12 months

2.5

2.5

3

з

Appendix H Geophysics report (Apex Geoservices)

### AGL15015\_01

**REPORT ON THE** 

**GEOPHYSICAL SURVEY** 

FOR

**GREATER DUBLIN REGIONAL DRAINAGE** 

FOR

CAUSEWAY GEOTECH LTD.

26TH FEBRUARY 2015



APEX Geoservices Limited Unit 6 Knockmullen Business Pk., Gorey, Co. Wexford, Ireland

T: 0402 21842 F: 0402 21843 E: info@apexgeoservices.ie W: www.apexgeoservices.com

# PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

| PROJECT NUMBER                                      | AGL15015                          |               |                                |
|---|-----------------------------------|---------------|--------------------------------|
| Author  | CHECKED                           | REPORT STATUS | Date                           |
| EURGEOL SHANE O`ROURKE<br>P.GEO., M.SC (GEOPHYSICS) | TONY LOMBARD M.SC<br>(GEOPHYSICS) | V.01          | 26 <sup>th</sup> February 2015 |



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#### 1. EXECUTIVE SUMMARY

APEX Geoservices Limited was requested by Causeway Geotech Ltd. to carry out a geophysical investigation as part of the site investigation at three locations along the proposed pipeline route for the Greater Dublin Regional Drainage Scheme.

The objectives of the survey were to produce depth to bedrock sections for the sites, to provide information on the type and quality of the bedrock, to provide information on the thickness and stiffness of the superficial deposits and to provide locations for targeted intrusive investigation.

The investigation consisted of 2D Electrical Resistivity Tomography (ERT) and Seismic Refraction Profiling at three locations; GEO-1, GEO-2 and GEO-3.

GEO-1 is in the area of Dubber Cross and c.3km to the west of GEO-2 and GEO-3 which are both in Ballymun. Each area is just to the north of the M50 motorway.

The results for GEO-1 generally indicate made ground followed by firm-very stiff sandy gravelly clay to 1.6-8.2m bgl followed by thin discontinuous highly-moderately weathered bedrock followed by slightly weathered-fresh bedrock.

The results for GEO-2 generally indicate made ground followed by firm-very stiff sandy gravelly clay to 4.9-10.1m bgl followed by thin discontinuous highly-moderately weathered bedrock followed by slightly weathered-fresh bedrock.

The results for GEO-3 generally indicate made ground followed by firm-very stiff sandy gravelly clay to 7.2-8.2m bgl followed by slightly weathered-fresh bedrock.

The invert level for all three areas is within slightly weathered-fresh muddy limestone and shale.



### 2. INTRODUCTION

APEX Geoservices Limited was requested by Causeway Geotech Ltd. to carry out a geophysical investigation as part of the site investigation at three locations along the proposed invert for the Greater Dublin Regional Drainage Scheme.

#### 2.1 Survey Objectives

The objectives of the survey were to:

1. Produce depth to bedrock sections for the sites.

2. Provide information on the type and quality of the bedrock.

3. Provide information on the thickness and stiffness of the superficial deposits.

4. Provide locations for targeted intrusive investigation.

#### 2.2 Site Background

ERT and Seismic Refraction Profiling has been carried out at three locations along the Greater Dublin Regional Drainage Scheme, namely GEO-1, GEO-2 and GEO-3. The three areas are located immediately north of the M50 motorway in north county Dublin.

GEO-1 is 200m east of the N2 roadway and comprises 200m of continuous ERT and Seismic Refraction Profiling in a generally flat area of grass/made ground.

GEO-2 is 2.6km east of GEO-1 and 200m west of the R108 roadway and comprises 200m of continuous ERT and Seismic Refraction Profiling in a generally flat area of grass/made ground

GEO-3 is 140m east of GEO-2 and comprises two cross-profiles within a confined area of made ground immediately west of the R108.





#### 2.3 Geology

The GSI 1:100k Bedrock Geology map for GEO-1 (Fig.2.1) indicates that the site is located at the boundary of calcareous shale & limestone conglomerate of the Tober Colleen Formation and massive unbedded lime-mudstone of the Waulsortian Limestones.



Fig.2.1. Geological map for the GEO-1 site.

Fig.2.2 indicates that the GEO-2 and GEO-3 sites are located within calcareous shale & limestone conglomerate of the Tober Colleen Formation.



Fig.2.2. Geological map for the GEO-2 and GEO-3 sites.





Fig.2.3. Soils map for the GEO-1 site.



Fig.2.4. Soils map for the GEO-2 and GEO-3 sites.

The Teagasc soils map for GEO-1 (Fig.2.3) indicates made ground to the west, followed by till derived from limestone, with outcrop for the eastern 100m of the section. The map shows made ground (Fig.2.4) for GEO-2 and GEO-3.







Fig.2.5. Vulnerability map for the GEO-1 site.



Fig.2.6. Vulnerability map for the GEO-2 and GEO-3 sites.

The vulnerability map for GEO-1 (Fig.2.5) indicates extreme vulnerability to the west and rock at or near surface or karst to the east. The map shows low vulnerability (Fig.2.6) for GEO-2 and GEO-3.

Geophysical Investigation Greater Dublin Regional Drainage for Causeway Geotech Ltd.



#### 2.6 Historical Data



Fig.2.7. 6" Sheet for the GEO-1 site.



Fig.2.8. 6" Sheet for the GEO-2 and GEO-3 sites.

The 6" Sheet for GEO-1 (Fig.2.7) shows outcrop at the location of the survey comprising dark grey earthy limestones dipping by  $40^{\circ}$  to the west.



#### 2.7 Site Investigation

BH114 has been drilled at GEO-1 and records made ground followed by stiff clay to 8.5m followed by weathered bedrock to 11.5, and then bedrock.

TP109 at GEO-1 records made ground to 2.2m followed by soft clay to 3.4m. TP110 at GEO-1 records firm to stiff clay to 1.9m followed by weathered bedrock.

BH120-BH121 were both drilled 47-58m to the north of GEO-2 and record firm-hard clay to 11.5-11.9m bgl.

#### 2.8 Survey Rationale

Electrical Resistivity Tomography (ERT) soundings will image the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity to 25m bgl, depending on the length of the profile. Each pseudo-section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials.

Seismic Refraction Profiling measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph. This method should allow us to profile the depth to the top of the bedrock, along profiles across the sites.



#### 3. RESULTS & INTERPRETATION

#### 3.1 2D Electrical Resistivity Tomography (ERT)

ERT Profiles R1-R7 have been acquired across the sites (Drawings AGL15015\_02, AGL15015\_03 and AGL15015\_04). The profiles have been interpreted on the following basis:

| Resistivity (Ohm.m) | Interpretation                    |  |
|---------------------|-----------------------------------|--|
| 30-50               | SILT / CLAY                       |  |
| 50-245              | Sandy Gravelly Clay               |  |
| 110-145             | Weathered Muddy LIMESTONE & SHALE |  |
| 145-1181            | Muddy LIMESTONE & SHALE           |  |

#### 3.2 Seismic Refraction Profiling

Ten seismic refraction spreads were recorded throughout the sites, with four at spreads at each of GEO-1 and GEO-2 and two cross-profiles at GEO-3.

The seismic data has outlined four velocity layers and has been generally interpreted on the following basis:

| Layer | Seismic Velocity<br>(m/s) | Average Seismic<br>Velocity (m/s) | Thickness (m) | Interpretation                         | Stiffness/Rock<br>Quality | Excavatability           |
|-------|---------------------------|-----------------------------------|---------------|--|---------------------------|--------------------------|
| 1     | 118-753                   | 376                               | 0.3-1.9       | Overburden/<br>Made Ground             | Soft-Firm                 | Diggable                 |
| 2     | 533-1296                  | 879                               | 0.1-5.9       | Overburden/<br>Made Ground             | Firm-Stiff                | Diggable                 |
| 2     | 1046-2398                 | 046-2398 1739                     | 0.1-8.7       | Overburden                             | Stiff-very Stiff          | Diggable                 |
| 3     |                           |                                   |               | Highly-Moderately<br>Weathered Bedrock | Poor-Fair                 | Rippable-<br>Break/Blast |
| 4     | 2455-5030                 | 3283                              |               | Slightly Weathered-Fresh<br>Bedrock    | Good                      | Break/Blast              |

#### 3.3 Discussion

Material with a resistivity of 30-50 and 50-245 ohm.m has been interpreted as silt/clay and sandy gravelly clay respectively. Bedrock with a resistivity of 110-245 and 145-1181 ohm.m has been interpreted as weathered muddy limestone & shale and muddy limestone & shale respectively.

<u>Layer 1.</u> Material with a velocity of 118-753 m/s has been interpreted as soft-firm overburden and made ground which will be diggable.

<u>Layer 2.</u> Material with a velocity of 533-879 m/s has been interpreted as firm-stiff overburden and made ground which will be diggable.



<u>Layer 3.</u> Material with a velocity of 1046-2398 m/s has mainly been interpreted as stiffvery stiff overburden. Some parts of Layer 3 for GEO-1 and GEO-2 have been interpreted as highly-moderately weathered bedrock, which will be rippable to requiring breaking/blasting.

<u>Layer 4.</u> Material with a velocity of 2455-5030 m/s has mainly been interpreted as slightly-weathered to fresh bedrock which will require breaking/blasting upon excavation.

#### 3.3.1 GEO-1

#### Drawing AGL15015 02

The western half of GEO-1 from 0-90m (local distance along section) has been interpreted as made ground followed by firm-very stiff mainly sandy gravelly clay to 4.0-8.2m bgl. This is followed by thin discontinuous highly-moderately weathered bedrock with a maximum thickness of 3.0m and then slightly weathered-fresh bedrock.

The eastern half of GEO-1 from 90-180m has been interpreted as by soft-very stiff mainly sandy gravelly clay to 1.6-4.0m bgl. This is followed by thin highly-moderately weathered bedrock with a maximum thickness of 3.0m and then slightly weathered-fresh bedrock.

The seismic velocity of Layer 3 will provide an indication as to the excavatibility of the weathered bedrock. All of the Layer 3 velocities for GEO-1 are generally 1200-1500 m/s which is indicative of rippable-marginally rippable bedrock.

The invert level for GEO-1 is 9.5-13.6m below the current ground level (based on survey elevations which should be checked against the project datum), which is within interpreted slightly weathered-fresh bedrock.

#### 3.3.2 GEO-2

#### Drawing AGL15015 03

GEO-2 has been interpreted as made ground followed by firm-very stiff sandy gravelly clay to 4.9-10.1m bgl. A zone of thin highly-moderately weathered bedrock has been interpreted from 93-130m with a maximum thickness of 1.8m. The Layer 3 velocities for this zone range from 2204-2385 m/s which is indicative of bedrock requiring breaking/blasting.

This is then followed by slightly weathered-fresh bedrock.

The invert level for GEO-2 is 8.9-10.3m below the current ground level (based on survey elevations which should be checked against the project datum) which is within interpreted slightly weathered-fresh bedrock.



#### 3.3.3 GEO-3

#### Drawing AGL15015 04

GEO-3 has been interpreted as made ground followed by firm-very stiff mainly sandy gravelly clay to 6.0-9.5m bgl (7.2-8.2m bgl at the locations of the pipeline on R6 and R7 respectively). This is then followed by slightly weathered-fresh bedrock.

The invert level for GEO-3 is 10.0m below the current ground level (based on survey elevations which should be checked against the project datum) which is within interpreted as slightly weathered-fresh bedrock.

Profile R7 is characterised by resistivities which are generally very low for the interpreted material types. These low resistivities are also present to a lesser extent on Profile R6 where it crosses Profile R7. These resistivities are anomalous and may be due to a contaminant material and further investigation is recommended below to determine their cause as low soil resistivities can be indicative of potentially corrosive material.



#### 4. **RECOMMENDATIONS**

A trial pit and a borehole are recommended at GEO-3 at ITM 715265E, 741468N to investigate the cause of the low resistivities returned at this location.

The geophysical results should be reviewed upon the completion of any further site investigation.



#### 5. REFERENCES

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#### 6. APPENDIX A: DETAILED METHODOLOGY

#### 6.1 Electrical Resistivity Tomography (ERT)

#### 6.1.1 Principles

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of 1-32 electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

#### 6.1.2 Data Collection

Profiles R1-R7 were recorded using a ABEM resistivity meter, imaging software, one 32 takeout multicore cables and up to 32 stainless steel electrodes. Saline solution was used at the electrode\ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after the survey. The data was acquired on 3-4<sup>th</sup> January 2015.

#### 6.1.3 Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on the accompanying drawings. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

#### 6.1.4 Relocation

All data were referenced using a Pro-XR Differential GPS system with c.20mm accuracy.

#### 6.2 Seismic Refraction Profiling

#### 6.2.1 Principles

The seismic refraction profiling method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

#### 6.2.2 Data Collection

Ten seismic spreads were recorded on the 3-4<sup>th</sup> February 2015 using a Geode highresolution 24 channel digital seismograph with geophone spacings of 2m (with the



exception of Profile S9 which had a 1.5m spacing). The source of the seismic waves was a sledgehammer.

#### 6.2.3 Data Processing

The recorded data was interpreted using the ray-tracing and intercept time methods, to acquire depths to layer boundaries and the P-wave velocities of these layers, using the FIRSTPIX and GREMIX programs.

GREMIX interprets seismic refraction data as a laterally varying layered earth structure. It incorporates the slope-intercept method, parts of the Plus-Minus Method of Hagedoorn (1959), Time-Delay Method, and features the Generalized Reciprocal Method (GRM) of Palmer (1980). Up to four layers can be mapped, one deduced from direct arrivals and three deduced from refractions. Phantoming of all possible travel time pairs can be carried out by adjusting reciprocal times of off shots.

#### 6.2.4 Relocation

All data were referenced using a Pro-XS Differential GPS system with c.20mm accuracy.



#### 7. APPENDIX B: SEISMIC REFRACTION PLATES























#### 8. APPENDIX C: DRAWINGS

The information derived from the geophysical investigation is presented in the following drawings:

| AGL15015_01 | Geophysical Location | 1:4000 | @ A3 |
|-------------|----------------------|--------|------|
| AGL15015_02 | GEO-1 Results        | 1:750  | @ A3 |
| AGL15015_03 | GEO-2 Results        | 1:750  | @ A3 |
| AGL15015_04 | GEO-3 Results        | 1:750  | @ A3 |








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