CAUSEWAY GEOTECH

Saggart Reservoir – Ground Investigation

Client: Irish Water

Client's Representative: RPS Consulting Engineers

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The works were conducted in accordance with:

UK Specification for Ground Investigation 2nd Edition, published by ICE Publishing (2012)

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

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

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	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 VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015	
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.

Saggart Reservoir Site Investigation

1 AUTHORITY

On the instructions of RPS Consulting Engineers 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 proposed construction of a new 150 Ml storage reservoir and associated works.

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. A discussion on the recommendations for construction is also provided.

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 recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to a particular set of 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, slit trenches, soil and rock core sampling, environmental sampling, groundwater monitoring, in-situ and laboratory testing, and the preparation of a report on the findings including recommendations for construction.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on the existing Saggart reservoir site complex near Saggart Village, Co. Dublin. The site is bordered to the west by Castle Road, to the south by agricultural lands, to the east by Pairc Mhuire Road and to the north by residential development. The site slopes gently westwards.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 20th February and 29th April 2018, comprised:

- twenty-seven light cable percussion boreholes most with rotary follow-on rotary drilling;
- a standpipe installation in eight boreholes;
- four machine dug trial pits;
- four slit trenches;
- in-situ testing including pump, variable head and soakaway tests;

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.

4.2 Boreholes

Twenty-seven (BH01-BH24, BH01A, BH04A and BH23A) were put down by a combination of light cable percussion boring using Dando 2000 and Dando 2500 soil boring rigs, and rotary drilling using a Hanjin 8D rotary drilling rig.

The boreholes were put down initially by light cable percussion to virtual refusal on obstructions such as boulders. Rotary follow-on drilling was subsequently carried out, with core recovery in bedrock and overburden where specified. Where the cable percussion borehole had not been advanced onto competent strata, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

Hand dug inspection pits were carried out between ground level and 1.20m 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. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Standard penetration tests were carried out in accordance with BS EN 22476-3: 2005 at standard depth intervals throughout the overburden using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). 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 K.

Where coring was carried out within bedrock strata, conventional coring methods were used with a metric T2-101 core barrel. Core was extracted in up to 1.5m lengths which produced core of nominal 84mm diameter and was placed in triple channel wooden core boxes.

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

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with *BS 5930: 2015: Code of practice for ground investigations*.

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

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

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

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in 8 boreholes (BH07, BH09, BH14, BH15, BH16, BH20, BH22 and BH23A).

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

4.4 Trial Pits

Four trial pits (TP01–TP04) were excavated using an 8t tracked excavator fitted with a 600mm wide bucket, to depths of 2.0m and 1.90m. All trial pits were excavated to allow completion of infiltration test.

Disturbed (small jar and bulk bag) samples were taken at standard depth intervals and at change of strata. Environmental samples were taken at 0.50m and 1.00m in trial pits TP02, TP03 and TP04.

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 F presents the trial pit logs along with soakaway test results.

4.5 Slit trenches

Four slit trenches (ST01-ST04) were excavated using a combination of hand digging and mechanical excavation using a compact 3t tracked excavator fitted with a 600mm wide toothless bucket, to locate and identify buried services at the site.

Drawing of the trenches and the locations of services encountered during excavation are shown on the slit trench logs in Appendix D, with photographs presented in Appendix E.

4.6 Soakaway tests

A soakaway test was carried out at four locations (TP01-TP04) in accordance with BRE Digest 365 - Soakaways (BRE, 2016). The tests were conducted in similarly numbered trial pits.

Appendix F presents the results and analysis of the infiltration test. The absence of the outflow from the pits precluded calculation of infiltration coefficients.

4.7 Variable head permeability testing

In-situ permeability tests were carried out in BH07, BH09, BH14, BH15, BH16 and BH20 by variable head permeability methods, following development of the wells. Testing was carried out in accordance with the guidance as set out in BS EN ISO 22282-2: 2012

The permeabilities were calculated using Hvorslev's formula k=A/FT as defined in BS 5930:1999 (pg 52).

The results are presented in Appendix H.

4.8 Pump tests

Pump and step tests were carried in borehole BH16 after the installation of a 100mm groundwater well.

Monitoring of nearby standpipes was carried out using manual dip-meters and digital data loggers to measure "drawdown" of the groundwater during tests. Results have been provided to the Client's Representative and are presented in Appendix G.

4.9 Surveying

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

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

5 LABORATORY WORK

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

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement (58 No.), Atterberg Limit tests (30 No.) and particle size distribution analysis (49 No. by wet sieve and 36 No. by sedimentation)
- **compaction related:** dry density/moisture content relationship (6 No.), Moisture Condition Value (MCV) at Natural Moisture Content (10 No.)
- **soil chemistry:** pH (20 No.) and water-soluble sulphate content (20 No.)

Laboratory testing of soils samples was carried out in accordance with British Standards Institute: *BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (2016), and Parts 2-9 (1990).*

The test results are presented in Appendix I.

5.2 Environmental laboratory testing of soils

57 No. of environmental samples were taken at a range of depths and testing was conducted, as indicated by the employer's representative, on selected environmental soil and water samples by Chemtest at its laboratory in Newmarket, Suffolk.

Testing was carried out on 24 No. of samples for a range of determinants, including:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cyanides
- Asbestos screen
- pH.

Waste acceptance criteria (WAC) testing was carried out 15 No. of borehole and trial pit samples.

Results of environmental laboratory testing are presented in Appendix J.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping from the Geological Society of Ireland (GSI) indicate the superficial deposits underlying the site comprise Glacial Till. These deposits are underlain by coarse greywacke and shales of the Pollaphuca Formation.

6.2 Ground types encountered during investigation of the site

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

- **Topsoil:** encountered typically in 200-400mm thickness
- **Made Ground (fill):** reworked sandy gravelly clay extending to a depth of 2.2m in BH20.
- **Fluvioglacial deposits:** typically, medium to very dense sands and gravels encountered as lenses within Glacial Till
- **Glacial Till:** sandy gravelly clay, frequently with low to medium cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.
- **Bedrock (Sandstone/Mudstone/Shale/Phyllite):** Rockhead was encountered at its shallowest depth of 10.50m in BH14 and at its greatest depth of 13.3m in BH20.

6.3 Groundwater

Groundwater was encountered during percussion boring through soil as water strikes. Table 1 below shows groundwater strikes struck during the ground investigation.

GI Location ID	Groundwater Strike (mbgl)
BH02	6.0
BH02	26.0
BH03	1.6
BH05	11.0

BH08	1.5
BH10	3.8
BH10	16.0
BH11	0.3
BH13	3.1
BH15	10.0
BH16	7.5
BH16	24.5
BH17	10.0
BH17	15.0
BH19	8.0
BH22	7.0
BH22	10.5
BH24	11.5
BH24	14.0

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 the casing used in supporting the borehole walls during drilling may have sealed out additional groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out. In addition, any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Seasonal variation in groundwater levels should also be factored into design considerations.

7 DISCUSSION

7.1 Proposed construction

It is proposed to construct a new 150Ml storage reservoir along with associated infrastructure.

No further details were available to Causeway Geotech at the time of preparing this report and any designs based on the recommendations or conclusions within this report should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory holes. Causeway Geotech were commissioned to provide a geotechnical report, and it is outwith our remit to advise on structure design.

7.2 Recommendations for construction

7.2.1 Summary

Due to the loads anticipated at the base of the reservoir, the implementation of spread/raft foundations bearing on stiff glacial till or dense fluvioglacial sand/gravel at relatively shallow depths across the footprint of the proposed reservoir are considered most suitable foundation solution. The construction plans also show details of several buildings across the site, for which traditional foundations (strip/pad) are also considered suitable.

7.2.2 Soil strength parameters

When estimating the shear strength of fine soils (silt/clay), reference is made to the results of Standard Penetration Tests (SPT's) carried out within the boreholes. The undrained shear strength of fine soils can be estimated using the correlation developed by Stroud & Butler:

$$C_u = f_1 \times N$$

where f_1 is typically in the range 4 to 6. A median f_1 value of 5 is adopted for this report.

For granular soils (sand/gravel), a graphical relationship between SPT "N" value and angle of shearing resistance, φ, has been developed by Peck, Hanson and Thorburn. This is published in *Foundation Design and Construction* (Tomlinson, 2001) and is referenced in this report when deriving angles of shearing resistance for the gravel soils.

7.2.3 Foundations and reservoir tank construction

Foundations for any proposed structure and the reservoir base should transfer loading to below any Made Ground, firm glacial till or subsoil present. The recommended foundation construction and allowable bearing pressure (ABP) at the borehole locations are presented in Table 2.

Table 2: Construction recommendations

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Proposed Foundation type	Groundwater
BH01a	2	300	Stiff Glacial Till	Spread/Raft	Water strike at 9.7m
BH02	1.2	225	Stiff Glacial Till	Spread/Raft	Water strike at 6.0m

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Proposed Foundation type	Groundwater
BH03	2.6	300	Stiff Glacial Till	Spread/Raft	Water strike at 1.6m
BH04a	2	300	Stiff Glacial Till	Spread/Raft	Not Encountered
BH05	1.2	175	Stiff Glacial Till	Spread/Raft	Water strike at 11m
BH06	1.6	300	Stiff Glacial Till	Spread/Raft	Not Encountered
BH07	2.2	225	Stiff Glacial Till	Spread/Raft	Monitored at 6.69m
BH08	2	220	Stiff Glacial Till	Spread/Raft	Water strike at 12m
BH09	2	250	Stiff Glacial Till	Spread/Raft	Monitored at 0.97
BH10	3	175	Stiff Glacial Till	Spread/Raft	Water strike at 3.8m
BH11	2	250	Stiff Glacial Till	Spread/Raft	Water strike at 0.3m
BH12	2	300	Stiff Glacial Till	Spread/Raft	Not Encountered
BH13	2	150	Stiff Glacial Till	Spread/Raft	Water strike at 3.0m
BH14	1.2	300	Stiff Glacial Till	Spread/Raft	Monitored at 3.69m
BH15	2	300	Stiff Glacial Till	Spread/Raft	Monitored at 6.96m
BH16	1.2	300	Dense Sand	Spread/Raft	Monitored at 3.67m
BH17	1.2	300	Stiff Glacial Till	Spread/Raft	Water strike at 10.0m
BH18	1.2	300	Very Dense Gravel	Spread/Raft	Not Encountered
BH19	1.2	175	Stiff Glacial Till	Spread/Raft	Water strike at 8.0m
BH20	2.2	300	Very Dense Gravel	Spread/Raft	Monitored at 3.7m

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Proposed Foundation type	Groundwater
BH21	1.2	200	Stiff Glacial Till	Spread/Raft	Not Encountered
BH22	1.2	200	Stiff Glacial Till	Spread/Raft	Water strike at 7.0m
BH23a	2.6	300	Stiff Glacial Till	Spread/Raft	Not Encountered
BH24	1.2	175	Stiff Glacial Till	Spread/Raft	Water strike at 11.5m

*Existing Ground Level

The base of foundation excavations should be thoroughly inspected; any soft soils should be removed with the resultant void backfilled with well graded well compacted granular fill material. A consistent bearing stratum should be provided for any building unit to limit the development of differential settlements.

Excavations for foundation slabs are likely to be relatively stable. However, any instability can be minimised by battering the side slopes at 2 vertical to 1 horizontal or in the case where cut is in gravels, 3/4:1.

Groundwater control, where required, will be possible by pumping from sumps formed in the base of excavation. Given the presence of shallow groundwater in some boreholes the site (possibly coincident with perched water sitting on top of the low permeability glacial tills), some groundwater control will be required.

7.2.4 Floor slabs/reservoir tank base

Floor slabs or reservoir base slabs should not bear directly onto Made Ground, firm glacial till or other soft soils that may be encountered at the time of construction. Therefore, the use of ground bearing floor slabs is only appropriate following the removal of any of the soils mentioned above. Any soft or unsuitable soils should be removed and replaced using well-graded well-compacted granular fill.

However, for buildings, a suspended floor slab should be adopted where the difference in levels of the proposed floor and the base of Made Ground/soft soils is greater than 600mm.

7.2.5 Excavations for services

For the installation of services ducts/trenches, it is suggested that open trenching will be the most practicable construction method. Generally speaking, the ground conditions should render the use of open trenching by backhoe excavator possible.

Where working in open trenches, it is thought that trench support systems, by way of a trench box (or possibly sheet piles), will be required to maintain trench stability and safe working conditions. Groundwater control at these locations should be possible by means of sump pumping.

To preclude the eventuality of differential settlements in pipes, they should be laid on a consistent stratum of appropriate allowable bearing capacity and protected with appropriate fill cover.

Where ducts and chambers must be installed in areas where localised soft spots are encountered, the use of geogrid reinforcement along the base of the very soft/soft soil (e.g. peat) below the trench base is recommended. This will stiffen the base of the trench and help control longitudinal differential settlement.

Backfilling of trenches may be completed by using compacted Cl 804 granular fill and reinstated as appropriate.

7.2.6 Soil aggressivity

An assessment of the Aggressive Chemical Environment for Concrete (ACEC) was undertaken through reference to the Building Research Establishment (BRE) Special Digest 1 (2017).

As noted by BRE Special Digest 1, sulphates in the soil and groundwater are the chemical agents most likely to attack concrete. The extent to which sulphates affect concrete is linked to their concentrations, the type of ground, the presence of groundwater, the type of concrete and the form of construction in which concrete is used.

BRE Special Digest 1 identifies four different categories of site which require specific procedures for investigation for aggressive ground conditions:

- Sites not subjected to previous industrial development and not perceived as containing pyrite;
- Sites not subjected to previous industrial development and perceived as containing pyrite;
- Brownfield sites not perceived as containing pyrite;
- Brownfield sites perceived as containing pyrite.

For the purposes of this report the site was classified as not having been subject to previous industrial development and not perceived as containing pyrite.

The results of chemical tests (pH and water soluble sulphate contents) on soil samples indicate Design Sulphate Class DS-1 and ACEC Class AC-1 – reference Table C1 of BRE Special Digest 1 (Building Research Establishment, 2005). The Special Digest does not require any measures to protect underground concrete elements greater that 140mm thick.

7.3 Infiltration drainage

Infiltration tests were carried out in trial pits TP01-TP04, however the absence of outflow from the pits precluded calculation of infiltration coefficients. The low-permeability fine-grained soils are considered as such poor infiltration media, and would be deemed unsuitable for the implementation of infiltration drainage systems.

7.4 Material re-use

In assessing the reusability of soil several approaches may be considered. Most commonly, the following parameters are used:

a) moisture content and the plastic limit / moisture content ratio of potential Cohesive Fill: an upper bound ratio of 1.2 is often adopted.

b) undrained shear strength (undisturbed and remoulded) of potential Cohesive Fill: a lower bound strength of 50kPa is often adopted.

c) Moisture Condition Value (MCV) of potential Cohesive Fill: a lower bound MCV of 8 is often adopted.

d) California Bearing Ratio (CBR) of potential Cohesive Fill: a lower bound CBR of 2% is often adopted.

e) measured SPT *N* value of potential Cohesive Fill: a lower bound value of 12 is often adopted, using the published relationships between *N* value and c_u, Clayton (1995). However, the individual blow counts need to be examined to allow assessment of whether *N* values have been elevated by the presence of coarse gravel or cobbles.

f) particle size distribution, in particular the fines content, of potential Granular Fill.

g) moisture content of potential Granular Fill as reflected by laboratory test results and the records of groundwater strikes in coarse grained soils

h) coefficient of uniformity, C_u, of granular material.

Allowance will also have to be made of construction expedients and their impact on the proportion of reusable soil, including:

- the effects of weathering of the near surface soils
- the presence of moisture susceptible soils
- the difficulties of separating layers and lenses of potential Granular and Cohesive Fill

- the presence of groundwater in lenses and layers of coarse grained soils.

Note that not all the aforementioned parameters are applicable in each case, more so a combination of those most applicable.

In assessing its suitability for use as fill, reference is made to the in-situ test results and the laboratory testing conducted on representative disturbed samples obtained from the trial pits and boreholes during the ground investigation.

It is likely given the low strength, high natural moisture content and occasional organic nature of the upper 1-2m of soils, that these soils will not be suitable for re-use as fill.

From assessment of the Dry Density/moisture content relationships and Moisture Condition Value Single Point tests, Glacial Till (brown sandy gravelly CLAY) may be suitable for re-use as cohesive general fill once the moisture content has been reduced to Optimum Moisture Content (OMC) - measured as between 7.7 to 9.5%. Seasonal variations in the groundwater table will affect the natural moisture content of these soils and as such will affect their suitability for re-use, therefore any earthworks should ideally be undertaken during the summer months.

The lower stiff glacial till soils will be suitable for re-use as general fill. It should be noted that the field logs make note of low cobble content across the area in concern; these would have tended not to have been included in the samples taken for testing and as such have not been considered in the above assessment. Certain pockets of coarse soils encountered may fall under classification of starter layers.

Dense sands and gravels encountered as lenses within the glacial till will also be suitable for re-use as general granular fill once the fines content has been reduced on site prior to placing.

The above assessment is based on the information gleaned from the investigation points. When carrying out excavation works, further on-site testing should be conducted to verify the type/classification and suitability of fill material.

7.5 Site contamination and waste disposal

Selected soil samples were analysed for a range of potential contaminants including:

- Metals;
- Speciated total petroleum hydrocarbons (TPH);
- Speciated polycyclic aromatic hydrocarbons (PAH);
- Cyanides;
- Sulphates and sulphide;
- Phenols; and

- Asbestos screening

Selected samples were also tested for a Waste Acceptance Criteria (WAC) suite to assess the potential categorisation of waste from the site.

In the initial examination of the potential risk of site contamination, the laboratory results have been compared to the following available assessment criteria relevant to the proposed land use:

- the Environment Agency Soil Guideline Values (SGVs) published, in 2009. These relate to arsenic, mercury, selenium, cadmium, benzene, toluene, ethylbenzene, xylenes, and phenol.

The results from the samples tested do not identify significantly elevated concentrations above the SGVs where criteria are available for commercial land use criteria.

The results of the waste acceptance criteria (WAC) testing have been compared with the European Union Directive limits for Inert waste landfill, Stable, Non-reactive hazardous waste in non-hazardous landfill and hazardous waste landfill criteria.

From the samples tested for WAC analysis material from the site may potentially be classified as inert/non-hazardous. It is noted however that any material excavated for off-site disposal would have to be classified under the guidance in the National Hazardous Waste Management Plan (EPA, 2014).

8 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

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

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

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BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description. British Standards Institution.

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BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

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