169-177 Merrion Road Student Accommodation Basement Impact Assessment

29.08.2024

24042-X-XXX-RP-TNT-SE-0001

TENT ENGINEERING

Site Address:

Gowan Motors Compound Site,
169-177 Merrion Road,
Dublin 4

Client:

1 Merrion Compound Land Limited

TENT ENGINEERING

Revision and Review

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PURPOSE

P1	Information
P2	Coordination
P3	Planning
P4	Building Control
P5	Pre-tender
P6	Tender
P7	Construction

ACCEPTANCE (BY OTHERS)

S	Issued
A	Accepted
B	Accepted subject to comments
C	Rejected
D	Acceptance not required

Accepted by

REVISION(S)

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AUTHOR(S)

Name

Diarmuid Healy
Chartered Structural Engineer

Name

Orla Murphy
Chartered Geologist

REVIEWER(S)

Name

Edward Heukers
Co-founder, Director

Contents

NON-TECHNICAL SUMMARY

The proposed development at the former Gowan Motors Compound Site on Merrion Road, Dublin 4, involves the construction of 200 student bedrooms within two apartment blocks, with a shared single-story basement extending beneath both Block A and Block B. This modern structure is designed to replace the Gowan Motors Compound while carefully minimizing its impact on the surrounding area, particularly in terms of ground movement, groundwater management, and effects on neighboring properties.

Located in a historically developed area of Dublin, the site has been reviewed through historical assessments and site investigations, which have revealed no significant contamination. This suggests a low risk of environmental hazards. However, continuous monitoring during construction is recommended to address any unforeseen contamination issues that may arise.

The site's ground conditions primarily consist of made ground and natural stiff clay, which possesses low permeability, thereby reducing potential groundwater concerns. The basement will be constructed within this clay layer, ensuring structural stability and minimizing the risk of ground movement affecting nearby properties. A ground movement and structural assessment has confirmed that the impact on surrounding buildings and infrastructure will be minimal. The design includes specific measures to monitor and manage any ground movement throughout the construction process, with contingency plans in place to address any unexpected developments.

The project has been planned to ensure minimal impact on local groundwater levels. The natural clay layer acts as an effective barrier, preventing significant groundwater flow through the area. During construction, appropriate measures will be employed to control both groundwater and stormwater, ensuring that the excavation remains dry. Hydrogeological assessments have confirmed that the project will not affect the regional water table.

Environmental and hydrogeological assessments, conducted in accordance with the National Roads Authority (NRA), now Transport Infrastructure Ireland (TII) guidelines, indicate that the project's overall impact will be minimal. The hydrogeological importance of the site is rated as low to medium, with negligible effects expected on groundwater flow and levels.

1 Introduction

1.1 Project Background

Tent Engineering has been commissioned by 1 Merrion Land Limited to carry out a basement impact assessment at the Gowan Motors Compound Site, Merrion Road, Dublin 4.

1.2 Description of the proposed development

The subject site is currently occupied by a construction compound. The proposed development consists of a residential apartment block and includes the following:

Construction of 200 student bedrooms within a multi-story development.

All associated site development works and other ancillary works.

Fig 1.1 - Site Location in Relation to the Regional Road

Fig 1.2 - Site Location in Relation to the Local Road Network

The site has an area of approximately 0.28 hectares in total. The proposed works are outlined in a series of architectural drawings prepared by MDO and engineering drawings prepared by Tent Engineering, supplied as part of the planning documentation.

This report is specific to the proposed development, and the advice herein should be reviewed if the development proposals are amended.

1.3 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- To check the history of the site with respect to previous contaminative uses.
- To determine the ground conditions and their engineering properties.
- To provide advice and information regarding the design of suitable foundations and retaining walls.
- To assess the impact of the proposed basement on the local hydro-geology, hydrology, and stability of the surrounding natural and built environment.
- To provide an indication of the degree of soil contamination present.
- To assess the risk that any such contamination may pose to the proposed development, its users, or the wider environment.

1.4 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

A review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Geological Survey of Ireland (GIS) database (refer to appendix B).

A review of readily available geology maps from the Geological Survey of Ireland (GIS) database.

A walkover survey of the site carried out in conjunction with the fieldwork.

In light of this desk study, an intrusive ground investigation was carried out, which comprised, in summary, the following activities:

- 4 light cable percussion boreholes, one of which was completed using rotary drilling methods.
- Installation of groundwater monitoring standpipes in two boreholes.
- 4 machine-dug trial pits to depths of 3.0m.
- Geotechnical laboratory testing of soils comprising:
- Soil classification: moisture content measurement, Atterberg limit tests, and particle size distribution analysis.
- Shear strength (total stress): unconsolidated undrained triaxial tests, lab shear vane.
- Direct shear: shear box tests.
- Soil chemistry: pH, water-soluble sulphate content, acid-soluble sulphate content, and organic matter content.
- Environmental testing was conducted on selected soil and water samples by Chemtest at its laboratory in Newmarket, Suffolk.

Soil testing was carried out according to Engineer's Ireland Specification for Ground Investigation (2016) Suite I, which tested 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 on 8 samples.

Provision of a report presenting and interpreting the above data, together with advice and recommendations with respect to the proposed development.

The exploratory methods adopted in this investigation have been selected based on the constraints of the site, including but not limited to access and space limitations, as well as any budgetary or timing constraints.

1.4.1 Basement Assessment Impact

The work carried out includes a Hydrological and Hydrogeological Assessment and a Ground Movement Assessment. These assessments form part of the BIA procedure specified in the DCC Basement Impact Assessment Policy and associated Guidance Document. The aim of the work is to provide information on surface water, groundwater, and land stability, and in particular, to assess whether the development will affect neighbouring properties or groundwater movements and whether any identified impacts can be appropriately mitigated by the design of the development.

1.4.2 Qualifications

This report has been prepared by Diarmuid Healy, a Chartered Engineer with Engineers Ireland, and a Fellow of the Institution of Structural Engineers with over 17 years of experience. The report has been co-authored by Orla Murphy, a hydrogeologist, and Chartered Geologist with over 17 years of experience.

1.4.3 Limitations

The conclusions and recommendations made in this report are limited to those that can be made based on the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled, and the number of soil or groundwater samples tested. No liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing.
Any comments made based on information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by Tent Engineering.

2 The Site

2.1 Site Description

The site is located at Compound Site, 169-177 Merrion Road, Dublin 4. The subject site is currently occupied by a construction compound. The proposed development consists of two residential blocks and includes the following:

- Construction of 200 new student rooms.

All associated site development works and other ancillary works.

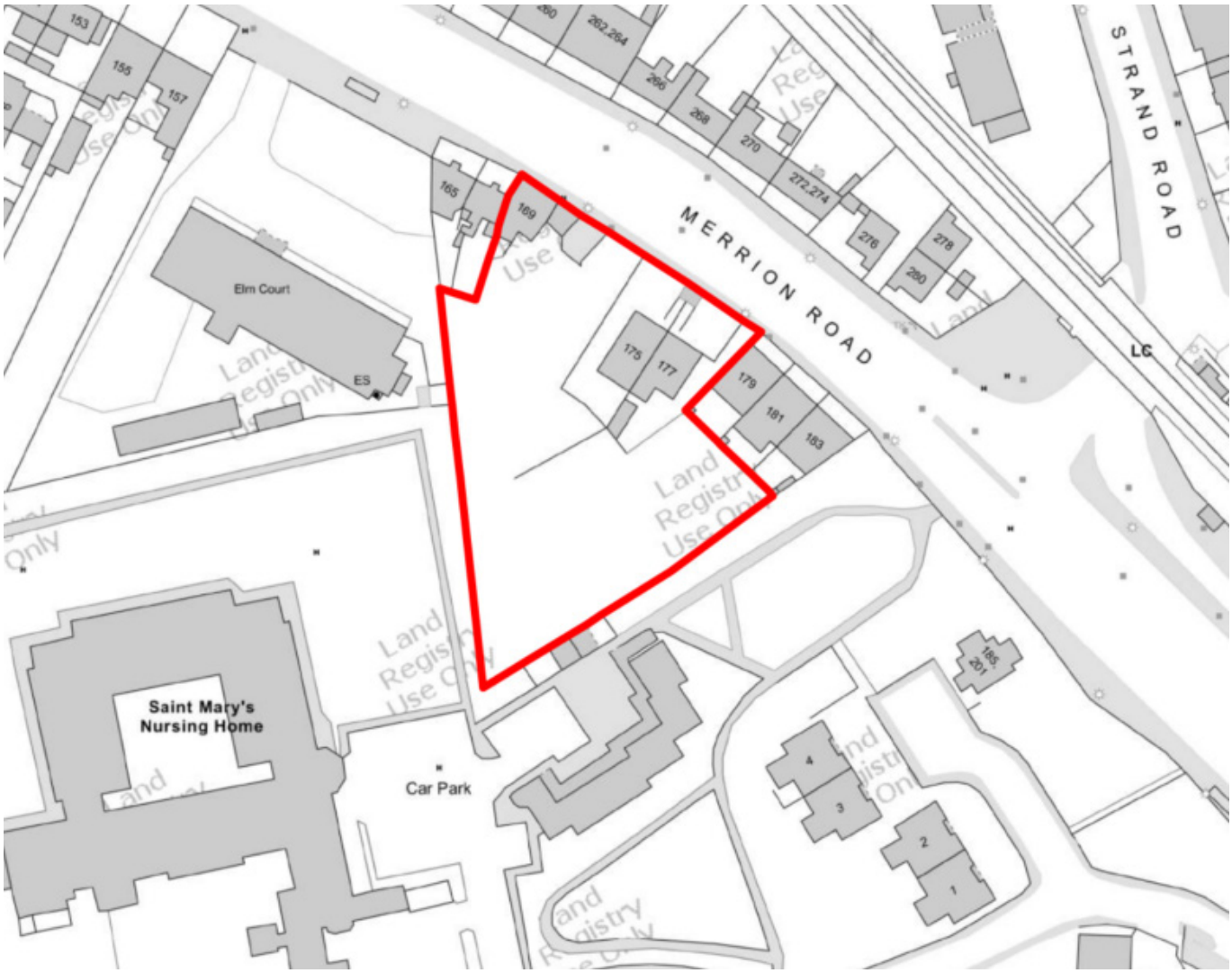
The development will also include a single level of basement access via a lift and stair core only. The site has an area of approximately 2823m^2 in total.

The site can be additionally located by National Grid Reference 319566(E), 231031(N) and is shown on the map extract below.

A walkover of the site was carried out by engineers from Tent Engineering at the time of the fieldwork. The site is roughly triangular in shape with road frontage on Merrion Road to the north.

The site slopes downwards from the southern corner (highest point at approximately 6.5m OD) down to Merrion Road (levels vary between 3.8-4.1m OD along the site frontage).

Fig 2.1 - Plan View of Site at 169-177 Compound Site, Merrion Road (landdirect.ie)



2.1.1 Neighbouring Structures

A search has been carried out on the DCC Planning Portal for planning applications that relate to the construction of basements. This has been supplemented by site walkovers of adjacent publicly accessible properties to verify the presence of basements. The search findings are highlighted on the map overleaf.

- Site 1: The existing houses along Merrion Road are not mentioned on the planning website, but during site walkovers, it was noted that they have a lower ground floor.
- Site 2: Former Lands of the Sisters of Charity, adjacent to St. Mary's Home and Caritas Convalescent Centre, Merrion Road, and Bellevue Avenue, Dublin 4 (Planning Application Ref: 1539/02) incorporates a proposed single-storey basement for parking and ancillary areas.
- Site 3: St. Vincent's University Hospital Campus, known as Saint Anthony's at the southern end of Herbert Avenue, Dublin 4 (Planning Application Ref: 5120/06) incorporates a double-storey basement for parking and M&E plant. (Constructed)
- Site 4: Site Merrion Hall, Strand Road, Dublin 4 (Planning Application Ref: 4542/02) incorporates a proposed single-storey basement for parking and ancillary areas. (Not constructed)
- Site 5: Elmpark Green, a large apartment and office complex located to the south of the site, incorporating extensive basements. Multiple planning applications have been made for this site.

Protected Structures

The National Monuments Service's historic environment viewer was accessed to identify nearby protected structures. The protected structures in the vicinity of the development site are as follows:

On the eastern side, the site is bordered by residential bungalow houses which are listed as protected structures. These are 179-181-183 Merrion Road.

Careful consideration has been given in the revised design to set the basement further back from the structures, compared to the previously granted permission. This approach is supported by the updated ground movement assessment prepared by Ayesa, as outlined in Appendix D, which indicates a negligible impact on ground movement.

Fig 2.2 - Nearby Structures Incorporating Basements

2.2 Site History

The history of the site and surrounding area has been researched by referencing archive historical maps and Ordnance Survey (OS) maps sourced from the GeoHive database. The historic mapping from 1837-1842 indicates a number of cottages/dwellings on the site with rear and front gardens. Subsequent historic mapping from 1888-1913 shows further development of the buildings on the site with additional structures present, and the lands to the southwest have been subdivided.

2.3 Other Information

As detailed in the Site-Specific Flood Risk Assessment has been prepared for this application. It notes the site falls within Flood Zone C and is not susceptible to flooding, including coastal, fluvial, or pluvial flooding. Records compiled by the Environmental Protection Agency (EPA) indicate that the site is situated in an area where between 1 and 5% of homes are estimated to exceed the Reference Level of 200 becquerels per cubic meter (Bq/m^3). Accordingly, radon protective measures will be integrated into the basement construction.

Refer to fig 2.2a for areal photography and appendix B for a site topographical survey.

2.4 Geology

Published geological mapping obtained from the Geological Survey of Ireland (GSI) database indicates that the superficial deposits underlying the site comprise marine sands and gravels. These deposits are underlain by limestones and shales of the Lucan Formation.

A search of the GSI records has identified records of a number of deep boreholes drilled approximately 315 m to the northeast of the site on Strand Road (GSI Report 554). The boreholes indicate that varying layers of clay were encountered to a depth of approximately 10.8-12.8m, below which bedrock was encountered.

2.5 Hydrology and Hydrogeology

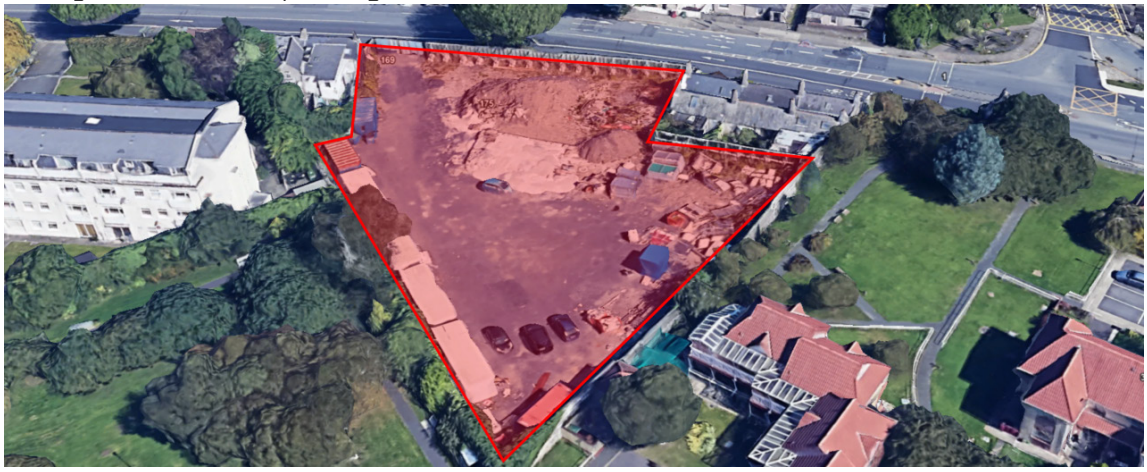
The site is not indicated as being at risk from flooding, as it is located in Flood Zone C. Please refer to the Site-Specific Flood Risk Assessment included in the original planning application documentation. Additionally, the site is not situated within a Groundwater Source Protection Zone.

The entirety of the site footprint is covered by external hardstanding. Consequently, infiltration of rainwater is generally restricted to surface water drains, leading the majority of surface runoff to drain into the combined sewer on Merrion Road.

The subsoils (Quaternary Sediments) at the site consist of marine beach sands under made ground. The subsoil permeability is identified as 'Low', with an Average Groundwater Recharge rate of 59 mm/year. There is a locally important bedrock aquifer, which is moderately productive only in local zones.

The site is not located within 100m of a watercourse, well, or potential spring line.

Fig 2.3 - Nearby Structures Incorporating Basements



2.6 Preliminary Risk Assessment

A Preliminary Risk Assessment has been undertaken to determine a “suitable for use” approach, which involves managing the risks posed by contaminated land through risk-based decisions. This risk assessment has been conducted based on a source-pathway-receptor approach.

2.6.1 Source

The desk study findings indicate that the site does not have a potentially contaminative history. As detailed in further depth in Section 6.2, the samples tested for Waste Acceptance Criteria (WAC) analysis as part of the site investigations indicated that material from the site may potentially be classified as inert/non-hazardous. Therefore, the risk of contaminants impacting the site is considered to be low.

2.6.2 Receptor

The future occupants of the site will represent relatively high sensitivity receptors. Buried services are likely to come into contact with any contaminants present within the soils through which they pass, and site workers are likely to come into contact with any contaminants present during construction works. Perched water may be present in the made ground or in the vicinity of existing foundations, although such pockets of water are likely to be localized.

2.6.3 Pathway

Within the site, end users will be isolated from direct contact with any contaminants present within the made ground by the extent of the proposed new buildings and surrounding hard surfacing. Therefore, no potential contaminant exposure pathways will exist for end users. However, there is potential for contaminants to move horizontally onto or off the site within the made ground, although these pathways already exist. During construction work, there will be a pathway for ground workers to come into contact with any contamination, and services may also come into contact with any contamination within the soils in which they are laid.

Overall, there is considered to be a low potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.6.4 Preliminary Risk Appraisal

Based on the above considerations, it is concluded that there is only a very low risk of a contaminant linkage at this site, which would necessitate any remediation work.

3 Scoping

The DCC Basement Development Guidance Document specifies that any development proposal incorporating a basement should undergo scoping to identify significant issues that must be addressed as part of the Basement Impact Assessment (BIA).

3.1 Scoping Assessment

The principal concerns related to the excavation of new basements are outlined in Section 3.0 of the DCC Basement Development Guidance Document. There is a potential for impacts during both the construction phase and the long-term/steady state phase of the project. Installation of temporary works may also result in temporary impacts. Each of these impacts should be addressed in the BIA submission. Basement construction impacts can be summarized under the following headings:

- Groundwater flow
- Land stability and ground movement
- Surface water flow and flooding
- Cumulative effects
- Construction stage impacts (including temporary works)

3.1.1 Groundwater Scoping Assessment

Below is a summary of key points regarding groundwater as it relates to the proposed development:

i. The site is directly above a locally important bedrock aquifer, which is only moderately productive and confined to local zones.

ii. The proposed basement will not extend beneath the water table surface.

iii. The site is not within 100 meters of a watercourse, well, or potential spring line.

iv. The proposed development, including basement construction, will not increase hard-surfaced or paved areas. Currently, the existing site consists entirely of hardstanding. As part of the development proposals, Sustainable Drainage Systems (SuDS) measures will be implemented, including extensive green roofs and intensively landscaped areas, as outlined in the Engineering Planning Report provided in the original planning application documentation

3.1.2 Stability Scoping Assessment

Below is a summary of key points regarding groundwater as it relates to the proposed development:

i. The existing site slopes from the southern corner (highest point at approximately 6.5m OD) down to Merrion Road (levels vary between 3.8-4.1m OD along the site frontage).

ii. There are no proposals as part of the development to introduce any significant re-profiling or introduction of slopes within the site.

iv. The site is located directly above an aquifer. However, this locally important bedrock aquifer is only moderately productive and restricted to local zones.

v. The proposed basement will not extend beneath the water table surface.

vi. Founding depth for the proposed development (basement) will be deeper relative to neighbors.

vii. The site is not located within 100 meters of a watercourse, well, or potential spring line.

viii. The site is bounded to the north by Merrion Road and the associated public footpath.

3.1.3 Surface Water Flow and Flooding Scoping Assessment

Below is a summary of key points related to groundwater concerning the proposed development:

i. The site is situated within Flood Zone C, as illustrated in DCC's Strategic Flood Risk Assessment. Please refer to the Site-Specific Flood Risk Assessment included in the original planning application documentation.

ii. The proposed development, including basement construction, will not lead to an increase in hard-surfaced or paved areas. Currently, the existing site consists entirely of hard-standing. As part of the development proposals, Sustainable Urban Drainage Systems (SUDS) measures will be implemented as outlined in the Engineering Planning Report – please refer to the original planning application documentation. SuDS measures include extensive green roofs and intensively landscaped areas.

iii. The discharge of surface water from the development will be enhanced through the application of SuDS measures, including attenuation of discharge from the site, as detailed in the Engineering Planning Report and Engineering Drawings.

3.1.4 Cumulative Effects Scoping Assessment

Below is a summary of key points regarding groundwater concerning the proposed development:

i. As outlined above in Section 2.1.1, there are limited adjacent or nearby basement structures that would introduce or trigger a cumulative impact. Therefore, an assessment of this single proposed basement is considered appropriate.

3.1.5 Construction Stage Impacts Scoping Assessment

Below is a summary of key points regarding groundwater in relation to the proposed development:

i. Temporary works, including the installation of a combination of contiguous and secant pile walls or sheet piling maybe required.

ii. Impacts of bulk excavations on adjacent structures will be assessed and included in this BIA document.

iii. An Outline Construction Management Plan has been prepared for this planning application.

4 Scoping and Site Investigations

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

4.1 Potential Impacts

The following potential impacts have been identified by the scoping process:

Table 4.1 - Potential Impacts

Potential Impact	Consequence
The site is located directly above an aquifer	The construction of basements may place the groundwater and surrounding enviro-ment at undue risk
Founding depth for the proposed development (basement) will be deeper relative to neighbours	If not designed and constructed appropriately, the excavation of a basement may result in structural damage to neighbouring buildings and structures
The site is bounded to the north by Merrion Road and the associated public footpath.	Excavation of a basement may result in structural damage to the road or footway

These potential impacts have been investigated through the site investigation and through further analysis/assessment informed by results of the site investigation.

5 Exploratory Work

Four boreholes (BH01 - BH04) were drilled using a combination of light cable percussion boring with a Dando 2000 rig and rotary follow-on drilling techniques using a Commachio 205. In cases where the cable percussion borehole had not reached the scheduled depth, rotary percussive methods were employed to complete the drilling. Symmetrix cased full-hole drilling was utilized.

All drilling locations were excavated using a JCB3CX, and a hand-dug inspection pit was conducted between ground level and a depth of 1.20m to ensure that boreholes were placed in clear areas, avoiding any services or subsurface obstructions.

Disturbed (bulk and small bag) samples were collected from the encountered strata, and undisturbed (U100) samples were taken where appropriate, particularly within fine soils. Environmental samples were collected at standard intervals.

Standard penetration tests were conducted 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 indicated for those tests where the full 150mm seating drive or 300mm test drive was not feasible. The N-values provided on the borehole logs are uncorrected, and no adjustments have been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix C.

Any encounters with water during drilling were documented, including any changes in their levels as drilling progressed.

Water used to aid boring is noted in the log. Groundwater monitoring standpipes were installed in BH01 and BH04, with details provided in Appendix C on the individual borehole log, including the depth range of the response zone.

Four trial pits (TP01–TP04) were excavated using a JCB3CX fitted with a 600mm wide bucket, reaching depths of 3.00m. Environmental samples were collected at standard intervals in each trial pit.

Disturbed (small jar and bulk bag) samples were taken at standard depth intervals and at changes in strata. Any water strikes encountered during excavation were recorded, along with changes in their levels as excavation progressed. The stability of the trial pit walls was noted upon completion.

All work was supervised by a geotechnical engineer from Causeway Geotech Limited. The Causeway Geotech SI Report, including all borehole and trial pit records, laboratory testing results, and a site plan indicating the SI test

locations, is included in Appendix C.

5.1 Sampling Strategy

The trial pit and borehole locations were determined prior to fieldwork. 94 soil samples (taken at standard depth intervals and at changes in strata) underwent analysis for various tests, including common industrial contaminants and contamination indicative parameters. The analytical suite for the soil and water included a range of metals, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide, and pH. The samples were also screened for the presence of asbestos.

The soil samples were chosen to provide a general understanding of the chemical conditions of the soils likely to be involved in human exposure or groundwater pathways and to offer guidance regarding reuse or waste disposal classification. The contamination analyses were conducted at an MCERTs and UKAS accredited laboratory, with the majority of the testing suite accredited to MCERTS and UKAS standards.

Several disturbed samples of natural soil were sent to a geotechnical testing laboratory for further analysis. Laboratory testing of soil included:

Soil classification: moisture content measurement, Atterberg Limit tests, and particle size distribution analysis.

Shear strength (total stress): unconsolidated undrained triaxial tests, lab shear vane.

Direct shear: shear box tests.

Soil chemistry: pH, water-soluble sulfate

content, acid-soluble sulfate content, and organic matter content.

Laboratory testing of soil samples was conducted 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).

6 Ground Conditions

The investigation has confirmed the anticipated ground conditions. Below a substantial layer of made ground, clay (glacial till) was consistently encountered, extending to the full depth of the investigation. A summary of the ground types encountered in the exploratory holes is provided below, in approximate stratigraphic order:

Paved surface: All boreholes and trial pits encountered 100 -150mm of macadam surfacing.

Made Ground (sub-base): Approximately 100 - 450mm of aggregate fill was found beneath the paved surface at all locations.

Made Ground (fill): Reworked sandy gravelly clay fill was encountered in BH03 and BH04, reaching a maximum depth of 1.00mbgl in BH03.

Glacial Till: Sandy gravelly clay, often with low cobble content, was consistently observed, typically firm or stiff in upper horizons and becoming very stiff with depth. Pockets of granular material were noted within this stratum, particularly in BH02 below 6.50m, where groundwater was present under artesian conditions. It's worth noting that this stratum was drilled using open hole symmetrix drilling with no recovery, so descriptions are based on the driller's interpretation of the flush returns.

6.1 Groundwater

Groundwater was encountered during the ground investigations as water strikes as shown in Table 6-1 below.

Table 6.1 - Groundwater strikes encountered during the ground investigation

GI Ref	Water Level (m bgl)	Route
BH03	8.00	Artesian conditions, GW rose to ground level
TP01	3.00	Seepage

Details of individual groundwater strikes, along with any relative changes in levels as works progressed, are provided on the exploratory hole logs for each location. Groundwater was not observed during drilling at the other borehole locations. However, it is worth noting that the casing utilized to support the borehole walls during drilling may have prevented or minimized additional groundwater strikes, and the potential for encountering groundwater during excavation works should not be disregarded.

No groundwater was encountered during the excavation of any of the other trial pits. Subsequent groundwater monitoring of the standpipe installations recorded water levels as depicted in Table 6.2.

Table 6.2 - Groundwater monitoring

Date	Water Level (m bgl)	
	BH01	BH04
26/02/2019	1.47	4.67
14/03/2019	1.10	1.00

6.2 Soil Contamination

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

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

Additionally, select soil samples underwent testing for a Waste Acceptance Criteria (WAC) suite to assess the potential categorization of waste from the site.

In the initial examination of the potential risk of site contamination, the laboratory results were compared to the LQM/CIEH S4UL's assessment criteria relevant to proposed residential land use without plant uptake.

The results from the tested samples do not indicate significantly elevated concentrations above the available S4UL's.

It's important to note that the above assessment is based on the results of the soil samples against available S4UL's, and this assessment has not been conducted following the CLR11 guidelines. No comments have been made where criteria are not available. Any potential contamination identified during site development by visual or olfactory means should be investigated, including further laboratory testing, and appropriate health & safety, waste disposal, and re-mediation measures adopted.

Regarding the assessment of the waste acceptance criteria (WAC) results, they 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. Any material excavated for off-site disposal would have to be classified under the guidance in the National

Hazardous Waste Management Plan (EPA, 2014).

6.2.1 Waste Disposal

In accordance with cradle-to-grave responsibilities, the Contractor will be accountable for all waste generated, from its generation until it reaches its final destination point, including its method of treatment/ disposal. The Waste Management Acts 1996 give effect to the polluter pays principle, effectively stating that the waste producer may be liable for any pollution incidents arising from the management of their waste. There is therefore an obligation on the Contractor to ensure that all contractors managing waste on their behalf are legally compliant and technically competent, and that the waste itself is contained, handled, treated, and disposed of in accordance with all relevant regulatory requirements.

Bio Diversity

The proposed basement has no negative impact on bio diversity.

7 Design Basis Report

This section of the report offers an interpretation of the findings outlined in Section 1, presenting them in the form of a ground model. Subsequently, it provides advice and recommendations regarding foundation options and contamination issues.

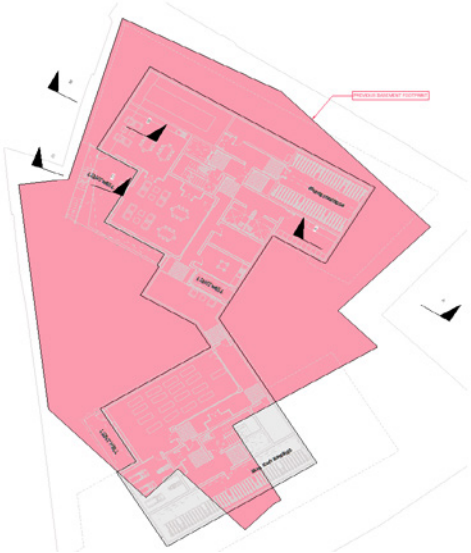
7.1 Introduction

The basement will accommodate a laundry area, bike storage, a plant room, flexible space, a co-working area, and a lounge. This basement is substantially smaller than the one previously approved for this site, as shown in Figure 7.2.

As part of the previously approved application, a Building Impact Assessment (BIA) was submitted, which included a detailed ground movement analysis. A revised detailed ground movement analysis has been completed for the revised basement footprint. This demonstrates significantly improved results. We have sought to demonstrate that, at all critical interfaces, the basement size has been reduced and set back considerably to provide additional reassurance

Fig 7.1 - Proposed Basement Plan

Fig 7.2 - Proposed Basement Plan relative to the previously granted and basement plan



7.2 Ground Model

On the basis of the fieldwork, as advised in Section 6, the ground conditions at this site can be characterized as follows:

Paved surface: all boreholes and trial pits encountered 100-150mm of macadam surfacing.

Made Ground (sub-base): approximately 100-450mm of aggregate fill beneath the paved surface at all locations.

Made Ground (fill): reworked sandy gravelly clay fill encountered in BH03 and BH04 to a maximum depth of 1.00mbgl in BH03.

Glacial Till: sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth. Pockets of granular material were encountered within this stratum most notably in BH02 below 6.50m, which contained groundwater under artesian conditions. Note this stratum was drilled using open hole symmetrix drilling with no recovery, therefore descriptions are based on driller's interpretation of the flush returns.

7.3 Advice and Recommendations

Excavations for the proposed basement structure will require temporary support to maintain stability and prevent any excessive ground movements in local areas where works are in close proximity to the adjacent buildings. Given the significantly reduced size of basement from the previously granted basement it is feasible to construct the basement using a combination of either open cut excavations, sheet piling, contiguous piled wall or indeed a king post solution. During construction, groundwater control by way of a sump and pump should be utilized throughout to keep any excavations dry. Permission from local authorities must be sought before discharging back into the sewer system any groundwater that is pumped from the site.

The formation level for the proposed development is likely to be within the stiff clay layer, which should provide a suitable bearing stratum for foundations excavated from basement level.

7.4 Basement Excavation

7.4.1 Basement Construction

It is understood that the proposed basement will extend to a depth of approximately 3.25m m below existing ground level, such that the formation level is likely to be within the stiff clay layer.

There are a number of methods by which the sides of the basement excavation could be supported in the temporary and permanent conditions. The choice of wall is governed, to a large extent, by whether it is to be incorporated into the permanent works and have a load-bearing function and also by the limited available access. The final choice will depend on a number of factors, including the need to protect nearby structures from movements, the required overall stiffness of the support system, and the potential need to control groundwater movement through the wall in the temporary condition. In this respect, the stability of the adjacent properties will be paramount. As noted above, the previously granted Basement Impact Assessment (BIA) detailed how structures in very close proximity to the basement could be carefully analyzed. In this revised proposal, we have worked diligently to set back the basement from all adjacent sensitive houses.

The ground movements associated with the basement excavation will depend on the method of excavation and support and the overall stiffness of the basement structure in the temporary condition. Thus, the design of the temporary earth retention system will need to ensure the necessary rigidity. In this respect, the timing of the provision of support to the excavations will have an important effect on movements. The stability of the adjacent party wall foundations will need to be ensured at all times.

7.4.2 Permanent RC Basement Walls

The permanent basement walls will consist of 200mm reinforced concrete elements, which will resist the horizontal surcharge from soil and groundwater. The basement will be further protected from water ingress by the installation of hydrophilic strips at all construction joints within the reinforced concrete wall and slabs.

7.4.3 Basement Heave

The 3-3.5m deep excavations to form the proposed basement will result in an unloading of approximately 60 kN/m² to 80 kN/m². This unloading will result in elastic heave and long-term swelling of the underlying clay soils, although these movements will to a certain extent be counteracted by the applied loads from the proposed development.

7.5 Pad Foundations

The load-bearing elements will be supported by an arrangement of reinforced concrete pad footings. These pad footings will be constructed integral with the basement slab. This form of construction will result in a fully monolithic basement structure.

7.6 Basement Floor Slabs

Following the excavation of the single-level basement, and to accommodate the anticipated heave, the slab will be suitably reinforced to cope with these movements. A reinforced concrete basement floor slab is proposed.

7.7 Shallow Investigations

Based on the findings from boreholes and trial pits, it is deemed that shallow excavations for foundations and services, extending through the made ground, should generally remain stable in the short term, although some instability may occur. Where personnel are required to enter excavations, a risk assessment should be conducted, and temporary lateral support or battering of the excavation sides should be considered to comply with standard safety requirements.

Significant inflows of groundwater into shallow excavations (<1.5m) are not generally expected, although seepages may be encountered from localized perched water tables within the made ground or underlying clay layers, particularly near existing foundations. However, such inflows should be adequately controlled by sump pumping.

7.8 Effect of Sulphates

An assessment of the Aggressive Chemical Environment for Concrete (ACEC) was conducted by referring to the Building Research Establishment (BRE) Special Digest 1 (2017).

As noted in BRE Special Digest 1, sulphates in the soil and groundwater are the primary chemical agents likely to attack concrete. The impact of sulphates on concrete depends on various factors such as their concentrations, the type of ground, the presence of groundwater, the type of concrete, and the construction form in which concrete is utilized.

- BRE Special Digest 1 outlines four distinct categories of sites requiring specific investigation procedures for aggressive ground conditions:
- Sites without prior industrial development and not perceived as containing pyrite.
- Sites without prior industrial development but 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 having undergone previous industrial development and not perceived as containing pyrite.

Chemical tests (pH and water-soluble sulphate contents) conducted on soil samples indicate Design Sulphate Class DS-1 and ACEC Class AC-1 – referring to Table C1 of BRE Special Digest 1 (Building Research Establishment, 2005). The Special Digest specifies no measures for protecting underground concrete elements thicker than 140mm. However, additional design measures are required to enhance protection against the elevated levels of sulphates and acidic soils found in certain parts of the site.

7.9 Specific Risk Assessment

The desk study findings suggest that the site lacks a potentially contaminative history. Consequently, the risk of contaminants affecting the site is deemed low.

Soil samples were selected for testing based on a Waste Acceptance Criteria (WAC) suite to evaluate waste categorization from the site. Initially, laboratory results were compared to the LQM/CIEH S4UL's assessment criteria applicable to proposed residential land use without plant uptake. The tested samples did not exhibit significantly elevated concentrations above the available S4UL's.

Furthermore, the WAC results were assessed against the European Union Directive limits for various landfill classifications, including Inert waste landfill, Stable, Non-reactive hazardous waste in non-hazardous landfill, and hazardous waste landfill criteria. Based on the WAC analysis, materials from the site may potentially be classified as inert/non-hazardous. Any excavated material destined for off-site disposal would need classification following the guidance outlined in the National Hazardous Waste Management Plan (EPA, 2014).

Although contamination on the site presents a theoretical risk during ground works, its likelihood and associated risk are deemed low, as elaborated below.

7.9.1 End Users

End users will be effectively shielded from any potential contamination within the proposed structures and hardstanding. Once the final configuration and levels of hard landscaping (outside the basement footprint) are established, it would be advisable to ascertain the thickness of the remaining made ground in these areas. At this juncture, for planning considerations, it is suggested that the made ground be excavated down to the sub-formation level of the hard landscaping.

7.9.2 Protection of Site Workers

Site workers should be informed about the potential contamination, and a work schedule should be established to safeguard workers handling any soil. The site working method should adhere to the guidelines outlined by the HSA and CIRIA12, as well as the stipulations of the Local Authority. A vigilant oversight should be upheld during the site operations, and if any dubious soil is encountered, it should be examined by a qualified engineer, with additional testing conducted if necessary.

7.10 Waste Disposal

Site workers should be informed about the potential contamination, and a work schedule should be established to safeguard workers handling any soil. The site working method should adhere to the guidelines outlined by the HSA and CIRIA12, as well as the stipulations of the Local Authority. A vigilant oversight should be upheld during the site operations, and if any dubious soil is encountered, it should be examined by a qualified engineer, with additional testing conducted if necessary.

8 Ground Movement Analysis

This section of the report entails an evaluation of the ground movements resulting from the proposed basement and foundation scheme discussed in Section 6. This analysis is based on the information gleaned from the investigations outlined in this report and a revised movement assessment completed by Byrne Looby in August 2024, which indicates an improvement over the previous Ground Movement Analysis completed by Byrne Looby in 2019 for the original approved basement.

8.1 Introduction

In the previous application the sides of an excavation would have inevitably experience some degree of movement, irrespective of the support provided. This movement typically comprises both horizontal and vertical components and is influenced by various factors such as the ground's engineering properties, groundwater levels and flow, the effectiveness of support systems employed, and the stiffness of any support structures. In this revised application, we have worked hard to set back the basement sufficiently far away from adjacent sensitive structures to ensure that ground movement is significantly reduced compared to the previous application. Byrne Looby's revised movement assessment further supports this, demonstrating a reduction in predicted ground movements relative to the earlier scheme.

The development will feature a single-level basement with various uses to support the student accommodation above. The finished floor level (FFL) of the basement will be at 1.07mOD, approximately 3.25 meters below the existing ground levels. Since the basement is set substantially further away from the adjacent sensitive houses, it is proposed to construct the basement using a combination of techniques. Open cut excavation will be the primary method, and where there is a risk of causing ground movement to adjacent structures, retaining wall solutions such as piled walls will be utilized. The basement slab will be constructed using reinforced concrete, with the walls initially designed as a cantilever system in the temporary condition. The detailed design of the walls will be entrusted to a specialist contractor.

For the permanent works, the basement structure will feature reinforced concrete walls cast against the embedded retaining wall. These permanent basement walls, made of reinforced concrete elements, will withstand horizontal pressures from groundwater and provide permanent waterproofing. The embedded retaining wall will be engineered to support all soil and surcharge pressures in the permanent condition. The revised assessment indicates that the predicted impacts on adjacent structures have been further minimized compared to the previous scheme.

The floor slabs will also be reinforced concrete, serving as load-bearing foundation elements. These slabs will be supported by reinforced concrete pad footings arranged integrally with the basement slab, resulting in a complete monolithic basement structure. Construction will likely commence with the basement slab level, followed by the installation of the subsequent transfer slab at ground floor level.

8.2 Construction Sequence

The following sequence of operations has been outlined to facilitate the analysis of ground movements around the basement, both during and after construction. This sequence is based on a suggested plan that the appointed main contractor may review at a later stage. Any alterations to this sequence will need to consider the contents and objectives of this study.

An open cut excavation is the preferred solution for temporary lateral retention in all areas where there is no risk of ground movement. In areas where this cannot be achieved, a piled wall solution will be utilized. In any event, such a piled wall will be set back further than the previously approved basement. Thus, the ground movement results remain valid and will likely be reduced. The revised movement assessment by Byrne Looby confirms that these measures will result in improved outcomes compared to the previous ground movement assessment.

The construction sequence is anticipated to follow a traditional pattern:

Excavation to the proposed formation level of the basement (approximately 3m to 4m below ground level).

Construction of the permanent works basement substructure, comprising:

a) Construction of basement floor slab.

b) Construction of reinforced concrete liner walls.

c) Construction of ground floor slab.

The specifics of the support provided to adjacent walls will be developed by Tent Engineering and an agreed methodology will be formulated with the selected contractor(s) upon appointment.

8.3 Temporary Works

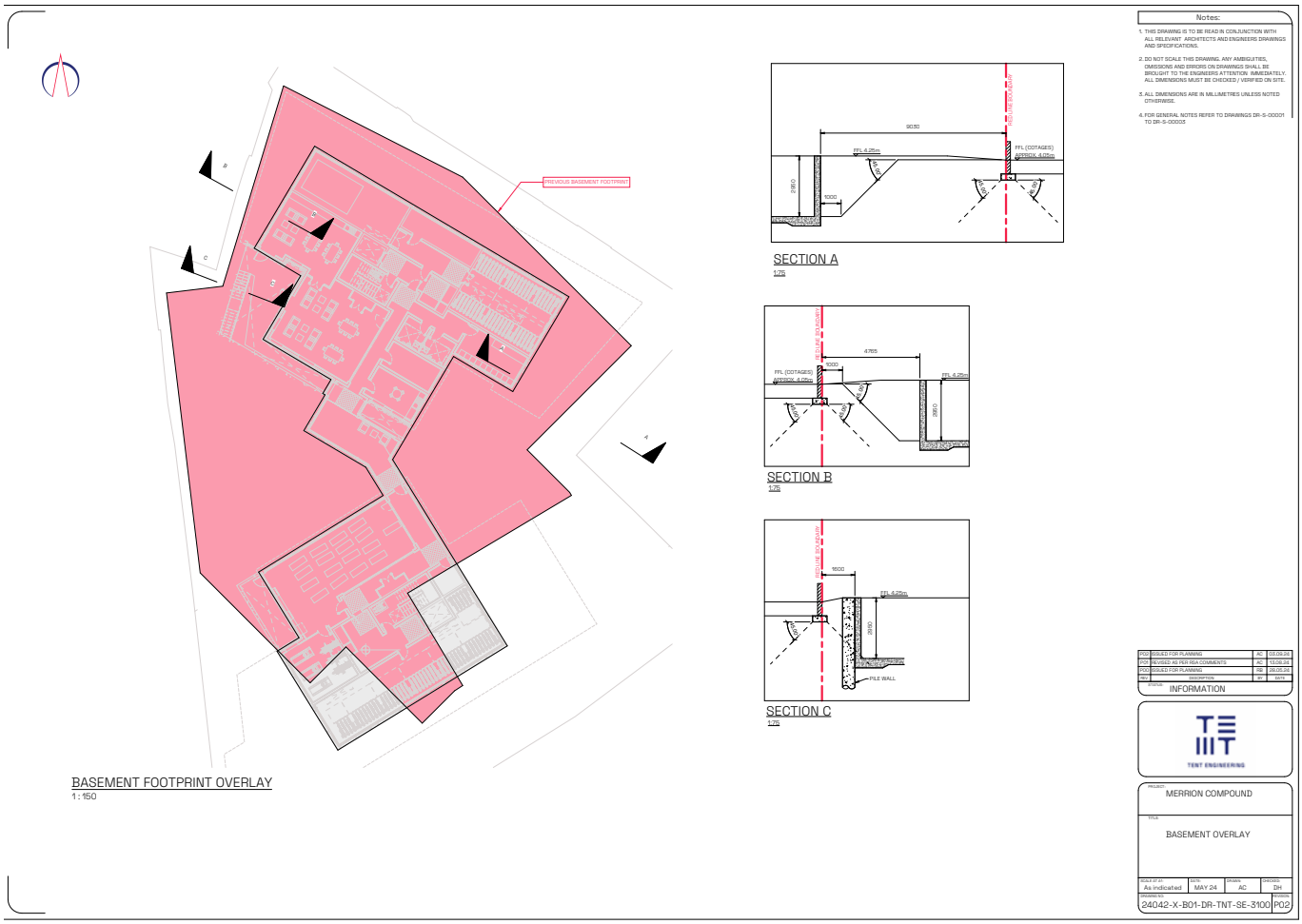
When the basement is in close proximity to an adjacent structure, a section can be constructed using a king post wall system. This method ensures safe excavation while minimizing excessive ground movement.

8.4 Permanent Works

Once the final excavation depth has been reached, the permanent works will be formed, consisting of reinforced concrete walls cast in situ. The proposed basement will be classified as Category 1 in accordance with the definitions of BS 8102:2009 'Code of practice for the protection of below-ground structures against water from the ground'.

Reinforced concrete will be employed for the basement floor slab. It is expected that the floor slabs, serving as permanent props, will be constructed at the basement slab level initially, followed by the subsequent installation of the transfer slab at the Ground Floor level.

Fig 8.1 - Proposed Basement Plan Sections



9 Ground Movement Assessment

Byrne Looby has completed a revised ground movement assessment, which demonstrates an improvement over the previous scheme. Refer to the appendix for this detailed ground movement assessment.

9.1 Results

The revised assessment by Byrne Looby confirms that the predicted ground movements and associated impacts have been further minimized compared to the previous scheme. Refer to the results in this report, which illustrate no negative impact. The revised basement layout is substantially smaller and has been moved further from the sensitive cottages, so the impacts are predicted to be no worse.

10 Damage Impact Assessment

In addition to the above assessment of the likely movements resulting from the proposed development, a Damage Impact Assessment of the neighbouring structures has been completed based on the classifications given in Table 10.1 of CIRIA report C760 (formerly C580). These classifications, which have been extracted and shown in the table below, are based on the method of damage assessment outlined by Burland et al. (1977), Boscardin and Cording (1989), and Burland (2001).

Given that the basement is substantially smaller and set further away from the sensitive houses compared to the approved application, this represents a significant improvement. The revised assessment by Byrne Looby further supports this by indicating reduced potential for damage compared to the previous application.

10.1 Movement Limits for Detailed Design

In order to meet the damage criteria outlined above, TENT will include a series of embedded retaining wall deflection limits in the engineering specification and piling drawings. This will ensure the detailed design will be completed in accordance with the requirements of this report.

10.2 Monitoring of Ground Movements

The predictions of ground movements given here are considered preliminary and are subject to the detailed design solutions implemented at the construction stage (i.e., rigidity of the wall, quality of construction and installation techniques, groundwater control measures, finalized bearing pressures from permanent works, etc.). The predictions given here are, however, considered appropriate estimations for the purposes of the BIA. The revised movement assessment has refined these predictions and suggests that the outcomes are likely to be more favorable compared to the previous scheme.

During construction, the predictions of ground movement based on the ground movement analysis should be checked by monitoring the retaining wall system and, if required, adjacent properties and structures. Piled walls can be monitored using inclinometer systems to ensure the lateral wall deflections are as per the design predictions.

Table 10-1 - Classification of visible damage to walls (after Burland et al, 1977, Boscardin and Cording, 1989, and Burland, 2001

Catagory of Damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting Tensile strain (%)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0 to 0.05
1 Very Slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	1	0.05 to 0.075
2 Slight	Cracks easily filled. Redecoration probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075 to 0.15
3 moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5 to 15 or a number of cracks >3	0.15 to 0.3
4 Severe	Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Services pipes disrupted.	15 to 25, but also depends on number of cracks	>0.3
5 Very Severe	This requires a major repair, involving partial or complete rebuilding. Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25, but depends on numbers of cracks	

It is recommended that condition surveys of adjacent existing structures be carried out before and after the proposed works. The precise monitoring strategy will be developed at a later stage and will be subject to discussions and agreements with the owners of the adjacent properties and structures.

Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels as noted above. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

11 Groundwater Assessment

Tent Engineering has completed a preliminary groundwater assessment associated with the proposed basement structure. Extracts of the Groundwater Assessment are included below.

11.1 Groundwater Flow

Groundwater flow is primarily influenced by permeability and topography. The groundwater within the Dublin City Centre area flows in a general eastward direction and either contributes to the various rivers flowing within the Dublin area or discharges directly to the sea at Dublin Bay. The figure below illustrates the ground elevation in Dublin via ground elevation contours, with respect to the location of the site. The ground elevation contours fall in an easterly direction towards the Irish Sea.

The closest available ground elevation head contour to the west of the site is approximately 200m from the site and is noted as +10m OD. To the east of the site, the groundwater contour at approximately 250m from the site, at the coast, is noted as 0.0m OD. The site is located between both contours.

Fig 11.1 - Groundwater Contours (GSI/EPA Online Database)

11.2 Cumulative Basement Effects on Hydrology

The cumulative effect of several underground developments in a given street could potentially differ from the impact of the initial single basement. It is therefore appropriate to consider the layout and proximity of existing basements in the vicinity with respect to the hydrogeology.

A search has been carried out of the DCC Planning Portal for planning applications that relate to the construction of basements. Tent Engineering has also completed a series of site walkovers of adjacent publicly accessible properties to verify the presence of basements. The search findings are highlighted in Section 2.1.1 of the BIA.

The figure below is a schematic of a homogeneous aquifer with isotropic hydrogeological properties, as provided in the DCC Basement Development Guidance Document Version 1.0 (September 2019). In relation to this project site, it is considered that Scenario B1 is most relevant and illustrates the principle of groundwater flow around a single basement structure.

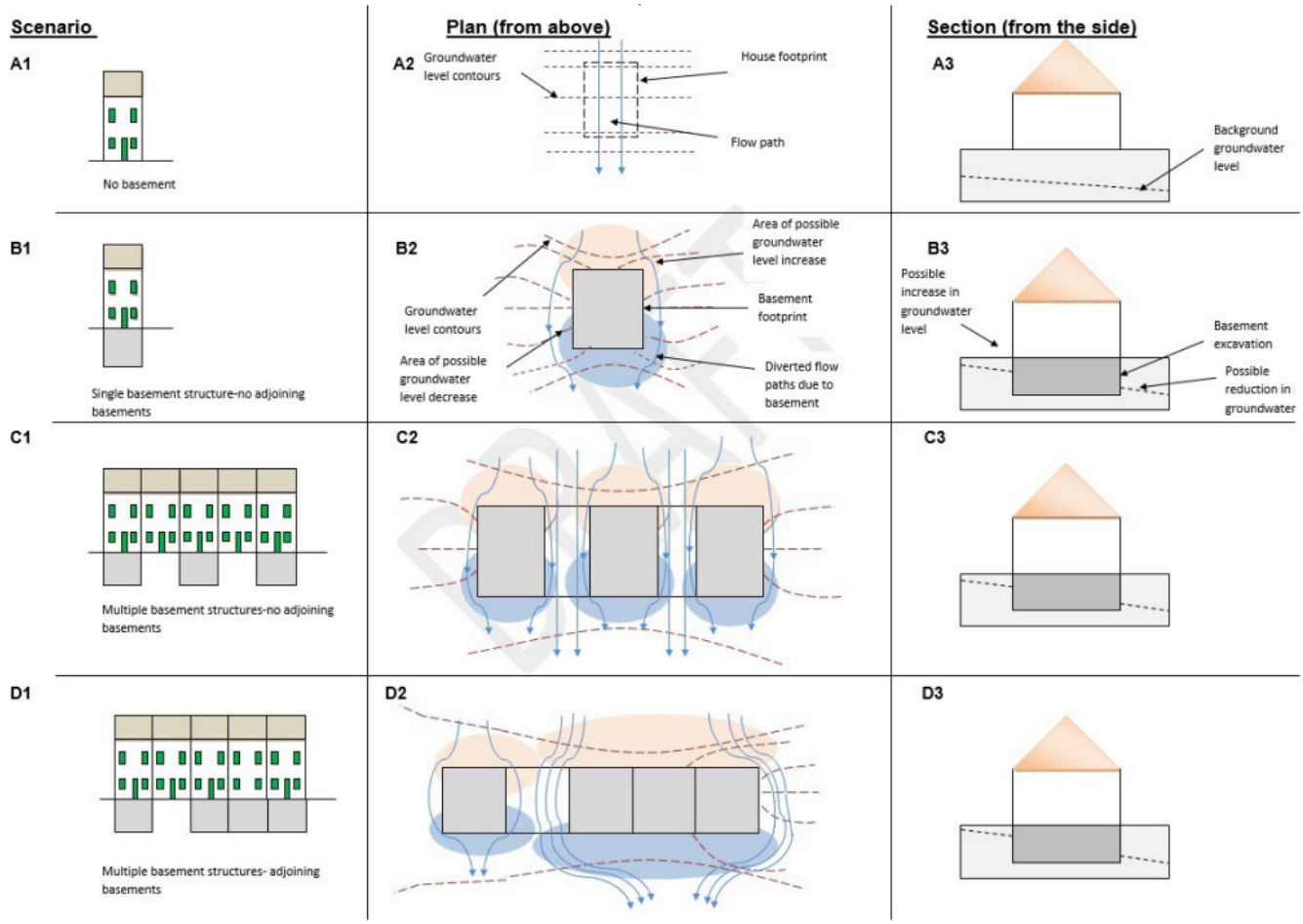
The diversion of flow paths around the basement structure would be expected to lead to a marginal increase in groundwater levels upstream and a similar reduction in groundwater levels downstream. The increase is a function of the width and depth of the basement and the permeability of the underlying soils.

The basement proposed for the Compound Student Accomadation will be entirely founded within the Sandy Gravelly Clay (Boulder Clay), which is a low permeability glacial till. It is widely published in the literature that the Dublin Boulder Clay does not transmit quantities of water significant enough to render it classified as an aquifer; it is widely classified as an aquitard/aquiclude. The basement will not be in contact with the gravel lenses encountered in BH03; the basement is expected to be at a depth of 3-4m BGL, while the gravel lenses were encountered at depths of 6.5-7.5 and 8.0-9.0m BGL. The gravel lenses were pockets and not known to be continuous.

The proposed development at the Compound Student Accommodation is considered remote from pre-existing or proposed basement structures. The nearest basement to the basement proposed in this project will be the 143 Merrion Road, Gowan Showroom Site, which is circa 120m to the west of the site. The Gowan Showroom basement will also be a single-storey basement of depth 3-4m BGL; it will also be founded within the Sandy Gravelly Clay (Boulder Clay). We have had a revised movement assessment completed by Byrne Looby, and the results indicate an improvement on the previous scheme, demonstrating minimal impact on the underlying aquifer. It is therefore considered that any significant damming effects from cumulative basement structures (i.e., Scenario C1 or D1) are not relevant. In addition, issues with increasing flow velocity and potential piping subsurface erosion of sandy material are not considered concerns.

A hydrogeological assessment has been completed to determine the extent of groundwater passing through the site.

Fig 11.2 - Cumulative effects of basement construction on hydrogeology (ref: DCC Guidance Documents)



11.3 Groundwater

As mentioned earlier, the underlying bedrock aquifer has a vulnerability rating of low to moderate. A significant depth of stiff, low-permeability clay will remain present between the aquifer and the bottom of the basement after construction, thus limiting the impact posed by the basement and its excavation on the aquifer.

It is expected that the embedded retaining wall for the basement perimeter will extend to approximately 8m BGL and be founded within the stiff to very stiff boulder clays. However, the retaining wall might penetrate any gravel lenses present beneath its footprint. Bedrock encounters are not anticipated since rock was not encountered at any investigation points and is expected to be at a depth of at least 11.5m BGL. Therefore, the aquifer and water levels on-site are likely to remain unaffected. Construction of the embedded retaining wall is expected to utilize CFA techniques, ensuring any artesian pressures potentially encountered are balanced by the CFA concreting method. Additionally, the revised movement assessment by Byrne Looby confirms that the regional water table primarily exists in the underlying limestone and is therefore not expected to be impacted.

11.4 Hydrogeology Impact Assessment

As noted in the groundwater modelling, the impact on groundwater levels is considered nominal concerning the overall hydrogeology and existing groundwater conditions and flow in the area.

A useful guide to assess the impact on hydrogeology due to construction is presented in the National Roads Authority (NRA), now TII, guidance document entitled Environmental Assessment for National Roads Schemes – Guidelines for Procedures for Assessment and Treatment of Geology, Hydrology, and Hydrogeology for National Roads schemes. The aim of the document is to provide guidance on the assessment of geological, hydrological, and hydrogeological impacts during the planning and design of national road schemes in Ireland. It specifically outlines the approach to be adopted in the consideration and treatment of geology, hydrology, and hydrogeology. Although developed specifically for road projects, this document can be applied to building sites, such that the likely impacts of the proposed basement construction are assessed, and potential mitigation measures recommended if required.

Significance ratings relating to the impact of construction on the hydrogeology in the vicinity of a development are outlined in this document. The importance of the site may be rated using the criteria outlined in Box 4.3 of the document (extracted and shown in the Table below).

Using this table and considering the geology and hydrogeology of the site presented earlier, it is considered that the importance of the project site is 'medium' to 'low'. Given the proximity of the site to the tidal River Liffey and Dublin Bay, it is unlikely that either the aquifers underlying the site will be used for potable supply, as the main supply of potable water in the Dublin area is taken from the nearby Wicklow Mountains.

Box 5.3 of the NRA document (extracted and shown in the Table below) may be used to rate the magnitude of the impact of the development on the hydrogeological condition of the site. The rise and fall in groundwater levels are considered nominal due to the basement construction, with groundwater flow paths not significantly affected. Additionally, the groundwater flow through the site is thought to be in an approximate northeast direction, and there are apparently no wells to the east of the site. As such, the magnitude of the impact of the development on the hydrogeological condition is considered to be 'Negligible' (i.e., results in an impact on the attribute but of insufficient magnitude to affect either use or integrity). The Byrne Looby assessment further supports this conclusion, confirming improved outcomes compared to the previous scheme.

Combining the two ratings for the site resulting using Box 5.4 of the NRA documents (see extract below), the significant environmental impact of the installation of the basement on the site is rated as 'Imperceptible'. The NRA describe this as 'an impact capable of measurement but without noticeable consequences'.

Table 11.1 - Criteria for Rating Site Attributes – Estimation of Importance of Hydrogeological Attributes

Importance	Criteria	Typical Exapmle
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation eg. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - eg. NHA status. Regionally important potable water source supplying >2500 homes inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying > 1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale	Locally important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

Table 11.2 - Criteria for Rating Site Importance – Estimation of Magnitude of Impact on Hydrogeology Attribute

Magnitude of Impact	Criteria	Typical Exapmles
Large Adverse	Results in loss of attribute and for quality and integrity of attribute	Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor Impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off Calculated risk of serious pollution incident >0.5% annually
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually

Table 11.3 - Rating of Significant Environmental Impact

		Magnitude of Impact			
		Negligible	Small Adverse	Moderate Adverse	Large Adverse
Importance of Attribute	Extremely High	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
	High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/ Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

11.5 Groundwater Detailed Design Considerations

11.5.1 Groundwater Control & Temporary Dewatering

During the bulk excavation of the basement, to ensure the excavation remains dry, groundwater and stormwater control via a sump and pump should be utilized. Permission from DCC will be required in the form of a discharge license before discharging any pumped groundwater/ stormwater into the sewer system.

With the combination of the low permeability clay present on-site and by providing a form of embedded wall, temporary lowering of the water table and piezometric surface outside the excavations will be prevented or at least limited to a nominal value. Dewatering will primarily be needed due to the collection of rainwater and surface water runoff. Minimizing the quantity of groundwater pumped from the excavation will limit any potential lowering of groundwater levels away from the construction site.

Due to the low permeability clay in which the basement is being founded, groundwater ingress into the excavation will be limited, and therefore groundwater extraction is considered nominal.

In the permanent condition, the basement substructure will provide permanent waterproofing to the development.

11.5.2 Design Groundwater Level

Based on the ground investigation information and monitoring, limited groundwater was detected in the Made Ground and low permeability clay, with additional findings pointing to the presence of localized perched water tables within the Made Ground. This presence can significantly impact seepage and groundwater behavior during construction phases. It is not envisaged that the embedded retaining wall will extend into the lower gravel and bedrock strata; rather, the wall is expected to terminate within the stiff clay strata.

Given these conditions, for the temporary works design, it would be prudent to not just assume dry conditions but also to implement contingency measures to manage any seepage, especially from the perched water tables identified. Such measures will help mitigate the impact of unexpected groundwater presence. For the permanent works design and considerations regarding permanent groundwater retention, assuming a groundwater level equivalent to the existing ground level is advisable. This assumption should take into account potential fluctuations in groundwater levels caused by factors such as dewatering and recharge, possible flooding, seasonal variations, and the potential failure of drainage systems (refer to IS EN1997-1 for further guidance). This proactive approach ensures that both the construction and long-term stability of the site are safeguarded against hydrological variabilities.

11.5.3 Temporary & Permanent Buoyancy (uplift)

The temporary and permanent buoyancy of the excavation shall be addressed at detailed design. For the temporary condition buoyancy will be controlled by groundwater pumping and the presence of the Clay stratum below the excavation.

Taking a preliminary assessment and assuming worst-case groundwater level 0m BGL, the maximum uplift pressure 13m deep acting at the base of the Clay layer would be approximately 130kPa. The 9m depth of Clay below the excavation level will be sufficient to resist such buoyancy. A detailed assessment should be completed prior to the construction stage taking into account variations in excavation levels and the bottom of the Clay. The Byrne Looby assessment suggests that in the permanent condition, the basement slab shall be structurally designed for all buoyancy pressures and the effects of heave as discussed in Section 9.3.

12 Basement Impact Assessment

This section of the report evaluates the direct and indirect implications of the revised project, based on the findings of the previous screening and scoping, site investigation and ground movement assessment.

12.1 Introduction

The screening/scoping, outlined in Section 3, identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation. Following these initial findings, a revised movement assessment was completed by Byrne Looby, which demonstrated improvements over the previous scheme.

12.2 Potential Impacts

The table above (Table 12-1) summarises the previously identified potential impacts and the additional information that is now available from the ground investigation in consideration of each impact. The revised movement assessment results have been considered in this table and show a reduction in potential impact magnitudes when compared to the previously granted scheme

Fig 12.1 - Potential Impacts

Potential Impact	Site Investigation Conclusions
The site is located directly above an aquifer	BH03 encountered artesian conditions at 8.0m bgl - refer to Table 6-1. Refer to Appendix C for further assessment of this locally important bedrock aquifer
Founding depth for the proposed development (basement) will be deeper relative to neighbours	Based on a review of available public records, substantial basements are not located within the immediate vicinity of the site - refer to Section 2.1.1. Assumptions informed by industry norms have been applied to the type and depth of foundations of neighbouring sensitive structures to inform the Damage Impact Assessment - refer to Section 10 and Appendix C.
The site is bounded to the north by Merrion Road and the associated public footpath, and to the east by Herbert Avenue and the associated public footpath	The investigation has not indicated any specific problems, such as weak of unstable ground that would make working in close proximity of public infrastructure problematic at this site.

The results of the site investigation have therefore been used below to review the remaining potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

12.2.1 Impact Assessment

Section 12 of this report summarizes whether, based on the findings of the investigation, the potential impacts still need to be given consideration and identifies ongoing risks that will require suitable engineering mitigation. The revised assessment by Byrne Looby confirms that the ground movement is negligible. Section 11 of this report also provides recommendations for the design of the proposed development.

Table 12.2 - Response to groundwater potential impacts

Ref	Potential Impact	Evidence
i	The site is located directly above an aquifer.	Limestone bedrock underlies the overburden on site and forms the main groundwater aquifer in the area. The GSI bedrock aquifer map of the area as shown in the figure below classifies the limestone bedrock as a Locally Important Aquifer- Bedrock which is Moderately Productive in Local Zones. To the south of the site, the aquifer is classified as a Poor Aquifer- Bedrock which is Unproductive Except for Local Zones. Refer to Section 5.1.1 of Appendix C.
ii	The proposed basement will not extend beneath the water table surface.	As outlined above in Section 2.1.1, there are no adjacent or nearby basement structures that would introduce or trigger a cumulative impact. Therefore, an assessment of this single proposed basement is appropriate. The groundwater flow modeling and resulting impact on hydrogeology are outlined in Section 10
iii	Is the site within 100m of a watercourse, well or potential spring line?	The site is not located within 100m of a watercourse, well or potential spring line.
iv	The proposed development will lead to an increase in impervious area throughout the site.	The proposed development (including basement construction) will not result in an increase of hard surfaced/ paved areas. The existing site consists of hardstanding throughout at present. As part of the development proposals, SuDS measures are to be implemented as outlined in the Engineering Planning Report - refer to original planning application documentation. SuDS measures include extensive green roofs and intensive landscaped areas.

Table 12.3 - Response to stability potential impacts

Ref	Potential Impact	Evidence
i	Does the site include steep slopes, natural or manmade?	The existing site slopes from the southern corner (highest point at approximately 6.5m OD) down to Merrion Road (levels vary between 3.8-4.1m OD along the site frontage). These levels are essentially maintained in the development, with the southern extents of the basement comprising a full basement, whereas the basement extents along the northern boundary are effectively a half basement.
ii	Does the development propose to introduce any significant reprofiling of the site?	There are no proposals as part of the development to introduce any re-profiling or introduction of slopes within the site.
iii	Will any tress be felled as part of the proposed development and/or are any works proposed within any tree protection zones where trees are to be retained.	A small number of low value trees located on the eastern boundary of the site are to be felled as a result of the proposed development as outlined in the Arborist Report submitted for Planning. New trees will be planted to offset this loss and result in a nett increase in planting as a result of the proposed landscaping details.
iv	The site is located directly above an aquifer.	Limestone bedrock underlies the overburden on site and forms the main groundwater aquifer in the area. The GSI bedrock aquifer map of the area as shown in the figure below classifies the limestone bedrock as a Locally Important Aquifer – Bedrock which is Moderately Productive in Local Zones. To the south of the site, the aquifer is classified as a Poor Aquifer – Bedrock which is Unproductive Except for Local Zones. Refer to Section 5.1.1 of Appendix C.
v	The proposed basement will extend beneath the water table surface.	As outlined above in Section 3.1.1, there are no adjacent or nearby basement structures that would introduce/trigger a cumulative impact. Therefore, an assessment of this single proposed basement is appropriate. The groundwater flow modelling and resulting impact on hydrogeology is outlined Section 12 and Appendix C.

Table 12.4 - Response to surface water flow and flooding potential impacts

Ref	Potential Impact	Evidence
i	Is the site located in flood prone lands	The site is located within Flood Zone C, as illustrated in DCC's Strategic Flood Risk Assessment. Refer to the Site Specific Flood Risk Assessment included in the original planning application documentation.
ii	Will the proposed development result in a change in the proportion of hard surface/paved area?	The proposed development (including basement construction) will not result in an increase of hard-surfaced/paved areas. The existing site consists of hardstanding throughout at present. As part of the development proposals, SuDS measures are to be implemented as outlined in the Engineering Planning Report—refer to the original planning application documentation. SuDS measures include extensive green roofs and intensive landscaped areas.
iii	Will the proposed development result in changes to the quantity of surface water being received by adjacent properties or downstream watercourses?	The discharge of surface water from the development will be improved through the application of SuDS measures, including attenuation of discharge from the site to a rate of 2 l/s, as detailed in the Engineering Planning Report and Engineering Drawings.

Table 12.5 - Response to cumulative potential impacts

Ref	Potential Impact	Evidence
i	Is there a cumulative risk associated with introducing a new basement structure in the locality?	As outlined above in Section 3.1.1, there are no adjacent or nearby basement structures that would introduce or trigger a cumulative impact. Therefore, an assessment of this single proposed basement is appropriate. The groundwater flow modeling and resulting impact on hydrogeology is outlined in Section 12 and Appendix C.

Table 12.6 - Response to construction stage potential impacts

Ref	Potential Impact	Evidence
i	Description of any required temporary works to be provided.	Temporary works consisting of installation of a piled contiguous wall are required. As outlined in Section 9.3 above, no additional support is required for the proposed embedded piled wall system, with the exception of the interface with the wall sections adjacent to ths Compound Student Accomadation site. As outlined in Section 11 above, these sections of the wall have been modeled using the 'excavations in front of a high stiffness wall in stiff clay'. Therefore, measures will be required to be implemented at the detailed design stage and on-site to increase the stiffness of the wall in this area and limit lateral deflections (i.e., locally propped wall or stiffer wall). No ground anchors outside of the site footprint are proposed.
ii	Impacts of bulk excavations on adjacent structures to be assessed.	The discharge of surface water from the development will be improved through the application of SuDS measures, including attenuation of discharge from the site to a rate of 2 l/s, as detailed in the Engineering Planning Report and Engineering Drawings.
iii	Appropriate method statements/management plans illustrating consideration of good management and mitigation of construction impacts associated with basement construction.	An 'Outline Construction Management Plan' has been prepared for this planning application Refer to this document. Refer to these documents for details of: • Provision for single phase of work • Provision for site management, safety, and supervision • A method statement detailing the proposed method of ensuring the safety and stability of neighboring properties and land throughout the construction phase • Provision to monitor movement of structures and land • Provision to monitor groundwater levels and alerts to be raised as required • Appropriate mitigation measures to be detailed if these limits are reached or exceeded, e.g., to prevent the occurrence of ground movement • Proposed site working hours • Management of noise, vibration, and dust

13 Outstanding Risks and Issues

This section of the report aims to highlight areas where further work is required, where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive but covers the main areas where additional work may be required.

The ground generally consists of made ground overlying heterogeneous natural material, and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

The desk study findings indicate that the site does not have a contaminative history. Therefore, the risk of contaminants impacting the site is considered to be low. Select soil samples were tested for a Waste Acceptance Criteria (WAC) suite to assess the potential categorization of waste from the site. The results from the tested samples do not identify significantly elevated concentrations above the available S4UL's. Notwithstanding these results, the appointed Contractor will be responsible for all waste arisings from the time the waste is generated until it reaches its final destination point. This includes its method of treatment/ disposal. The Contractor has the responsibility to ensure that all contractors managing waste on their behalf are legally compliant and technically competent and the waste itself is contained, handled, treated, and disposed of in accordance with all relevant regulatory requirements.

Based on the site history, and as with any site, there is a potential for further areas of contamination to be present within the made ground beneath parts of the site not covered by the investigation. It is recommended that a watching brief is maintained during any groundworks for the proposed new foundations and that if any suspicious soils are encountered, they are inspected by a waste contamination specialist, and further assessment may be required.

The findings of the revised ground movement analysis and damage assessment by Ayesa should be reviewed once the detailed design proposals have been finalized. The revised assessment indicates that the potential for movement and damage has been further reduced due to the design improvements. Measures will be required to be implemented at the detailed design stage and on-site to increase the stiffness of the walls in close proximity to neighboring structures (169 and 177 Merrion Road) and limit lateral deflections (i.e., locally propped wall or stiffer wall).

During construction, the predictions of ground movement based on the ground movement analysis should be checked by monitoring of the retaining wall system and if required, adjacent properties and structures. The revised movement assessment confirms that, given the reduction in the basement footprint and its repositioning further from sensitive structures, the ground movements associated with the proposed application are expected to be of a similar magnitude, if not lesser, compared to the previous scheme. Basement walls can be monitored using inclinometer systems to ensure the lateral wall deflections are as per the design predictions. It is recommended that condition surveys of adjacent existing structures should be carried out before and after the proposed works. The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels as noted above. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

These items should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

Monitoring Strategy Overview
The monitoring strategy for this project encompasses ground movement, groundwater level monitoring, and vibration monitoring to ensure the stability of the structure, neighboring properties, and environmental conditions. Monitoring will be carried out before, during, and after construction to assess any potential impacts.

Ground Movement Monitoring
Monitoring Systems:
Inclinometer Systems: Inclinometer tubes will be installed in the retaining wall to measure lateral ground movement.

Survey Markers:

Precise optical leveling and survey markers will be placed on adjacent properties to detect any vertical or horizontal displacement.

Trigger Limits:

Minor Movements (≤5mm): Acceptable; no immediate concern.
Moderate Movements (5mm–15mm): Initiate closer monitoring and increased observation.
Major Movements (≥15mm): Immediate action and contingency measures required.

Contingency Measures:

Minor Movements: Continue routine monitoring.
Moderate Movements: Investigate, increase monitoring, and implement temporary support measures.

Major Movements: Halt excavation or construction, implement stabilization measures, and assess neighboring structures.

Groundwater Level Monitoring

Monitoring Systems:
Piezometers: Install piezometers around the site to monitor groundwater levels.
Flow Meters: Measure water extraction rates during dewatering.

Trigger Limits:

Normal Groundwater Levels: Variations of ≤300mm from baseline levels are acceptable.
Elevated Groundwater Levels (300mm–500mm): Investigate potential water ingress and mitigation measures.
Critical Groundwater Levels (>500mm): Immediate action required.

Contingency Measures:

Normal Levels: Routine monitoring.
Elevated Levels: Investigate sources and apply dewatering or drainage systems.
Critical Levels: Halt construction, implement additional dewatering, and review drainage strategy.

Vibration Monitoring

Monitoring Systems:

Vibration Monitoring System: Install a vibration monitoring system to detect vibrations caused by construction activities. This system will raise an alarm if set vibration limits are exceeded, ensuring timely adjustments to reduce vibrations.

Trigger Limits:

The Peak Particle Velocity (PPV) trigger levels are defined in Table 1 below:

Trigger Level	50Hz and Below (PPV)	Above 50 Hz (PPV)
1	10mm/s	10mm/s
2	10mm/s	12mm/s
3	10mm/s	15mm/s

Contingency Measures:

Background Monitoring:

Establish background vibration levels before starting construction to set the baseline.

Trigger Response:

If vibration exceeds the defined trigger levels:
Adjust construction methods to reduce vibrations.
Increase vibration monitoring frequency.
Reassess and modify machinery or techniques to stay within safe limits.

Monitoring Frequency

Phase	Monitoring Type	Frequency
Pre-construction	Ground movement, groundwater, vibration	Weekly
During construction	Ground movement, groundwater, vibration	Daily
Post-construction (6 months)	Ground movement, groundwater, vibration	Monthly
Post-construction (12 months)	Ground movement, groundwater, vibration	Quarterly

Reporting and Review
Regular Reporting:

All data will be regularly compiled and reported to stakeholders. Reports will include comparisons with baseline data and any exceeded trigger levels.

Review Meetings:

Regular review meetings with geotechnical and construction teams will assess data trends and adapt strategies as needed.

Long-term Monitoring and Maintenance
Post-construction monitoring:

Will continue for a minimum of 12 months after construction.

System Maintenance

Monitoring equipment will undergo maintenance every six months to ensure accurate data collection.

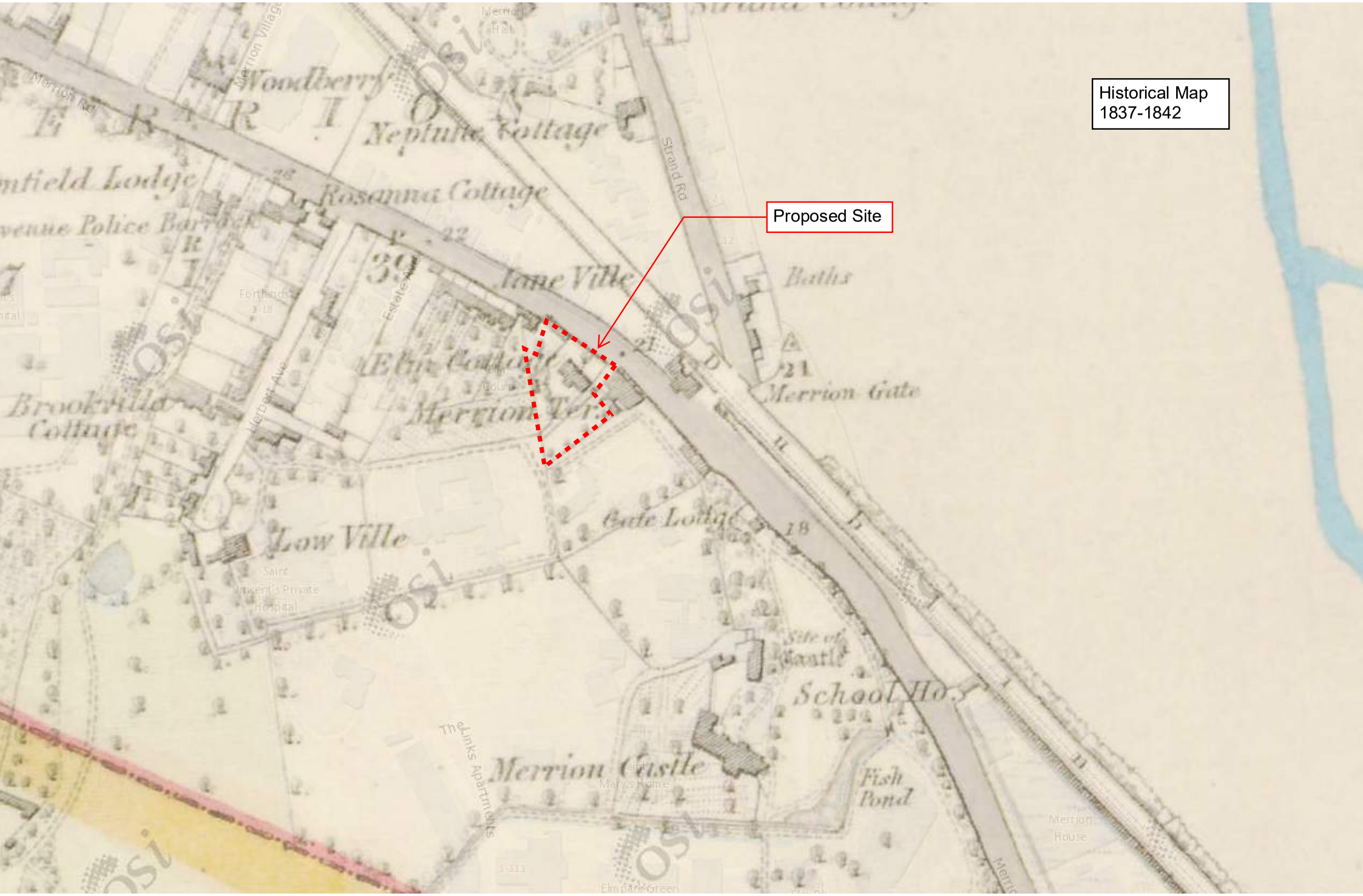
Emergency Action Plan
In case of exceeded Major Movement, Critical Groundwater Levels, or High Vibration Levels, an emergency action plan will be initiated:

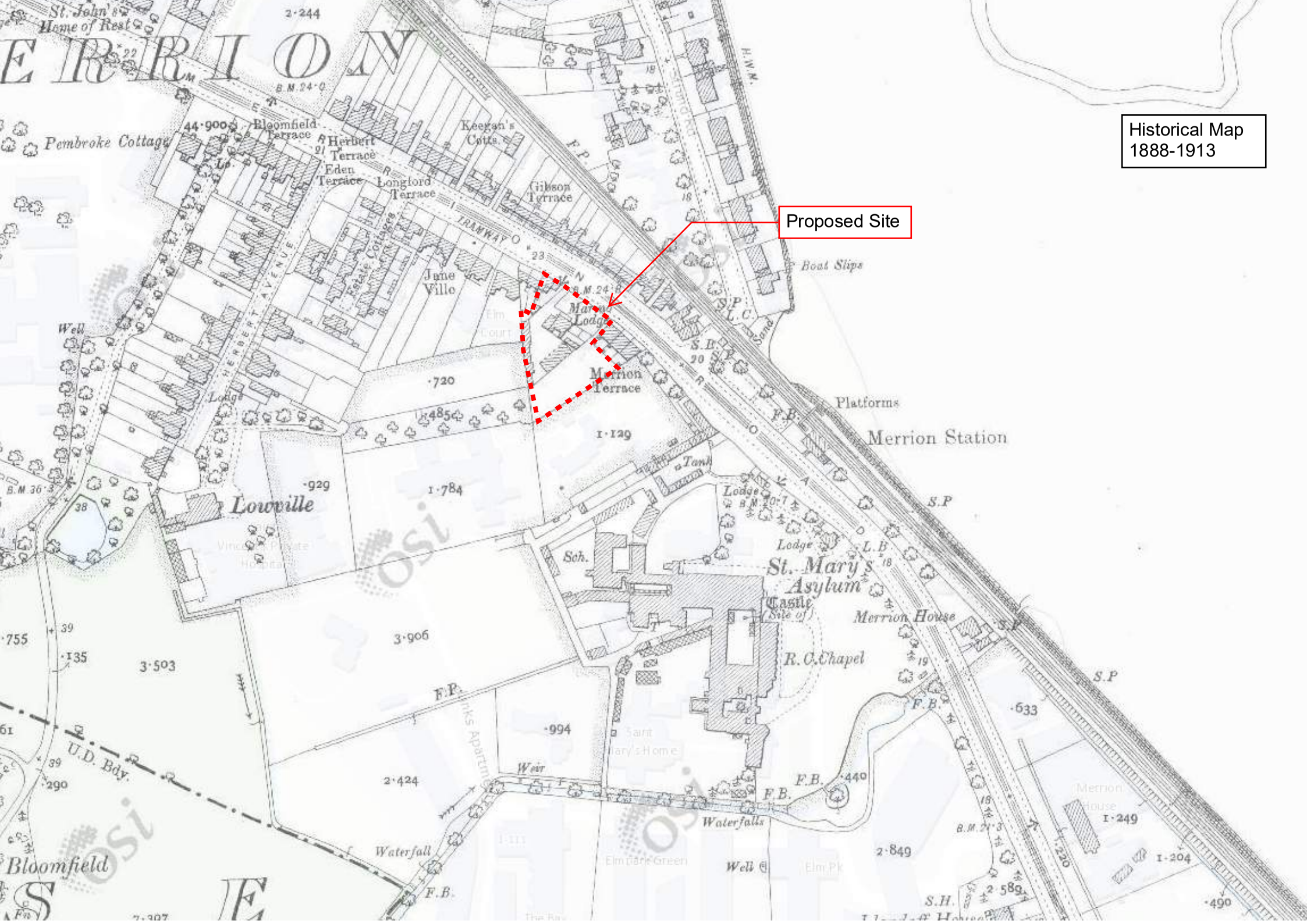
- Immediate halt of construction activities.
- Rapid deployment of stabilization measures (e.g., reinforced wall supports).
- Adjustments to vibration-causing equipment or activities.
- Engage local authorities and stakeholders for rapid response.

14 Appendix A - Drawings

Refer to 24042-X-L00-DR-TNT-CE-3203: KING POST WALL LAYOUT
Refer to 24042-X-B01-DR-TNT-SE-3100: BASEMENT OVERLAY

15 Appendix B - Historic Maps


Historical Map
1837-1842
Proposed Site
Neptune Cottage
Rosanna Cottage
Merrion Gate
Baths
Merrion Castle
School Ho's
Fish Pond
Low Ville
Gate Lodge
Brookville Cottage
Merrion Rd
Strand Rd
Herbert Ave
The Links Apartments
Merrion House


Historical Map
1888-1913
Proposed Site
Merrion Station
Platforms
Boat Slips
St. Mary's Asylum
Castle (Site of)
R.C. Chapel
Merrion House
Merrion Terrace
Jane Ville
Lowville
Pembroke Cottage
Bloomfield Terrace
Herbert Terrace
Eden Terrace
Longford Terrace
Gibson Terrace
Keegan's Cotts.
Herbert Avenue
Tramway
Waterfall
Weir
Waterfalls
Well
Tank
Lodge
Sch.
U.D. Bdy.
F.P.
F.B.
S.P.
S.H.
B.M. 24·0
B.M. 24·1
B.M. 20·7
B.M. 21·3
B.M. 36·3
2·244
44·900
·720
·485
1·129
·929
1·784
3·906
3·503
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·135
·290
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·633
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1·204
2·849
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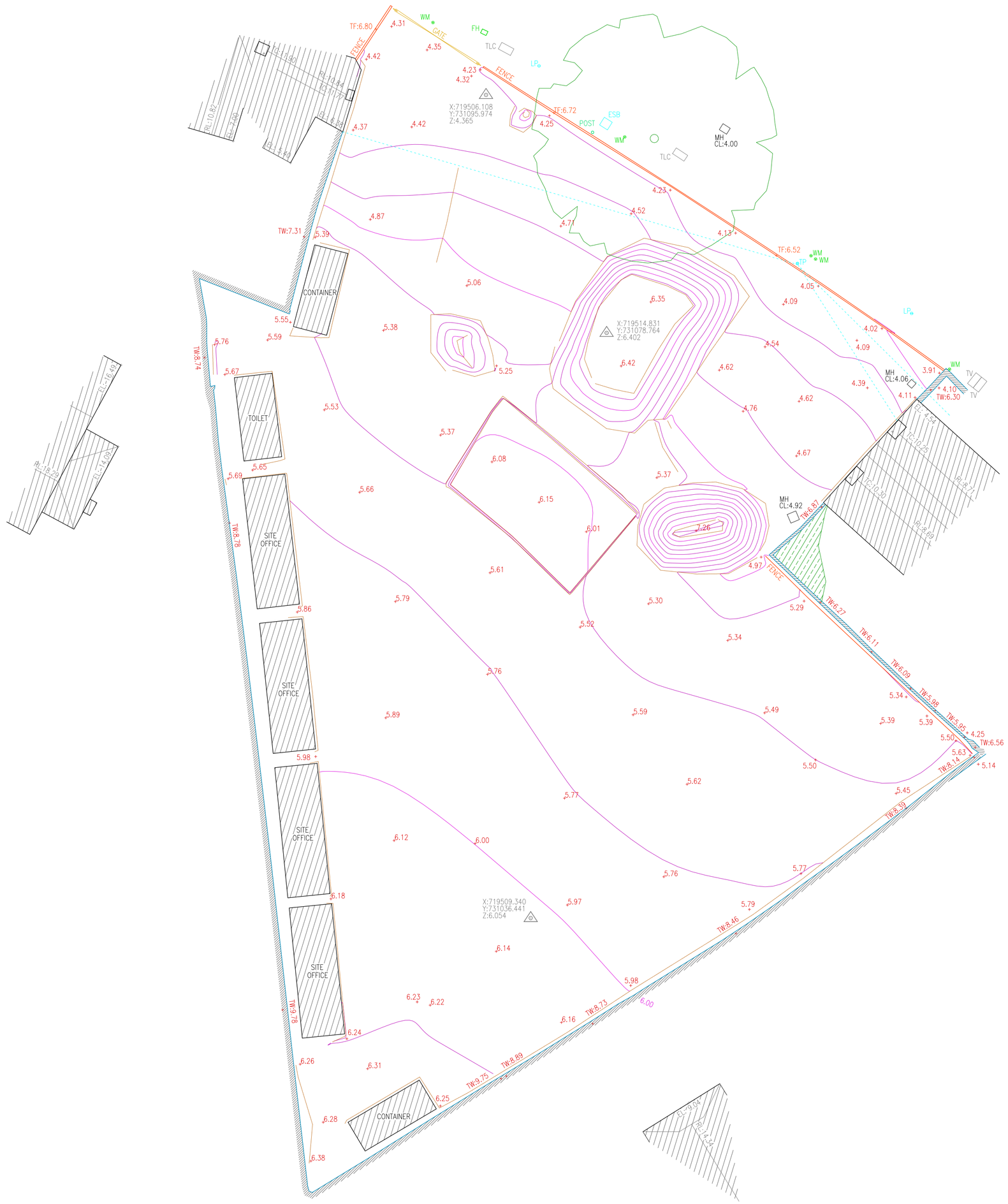
·490
·220



N

NOTES:

Units are in metres.
Survey data is referenced to the ITM Grid.
Levels are referenced to OSGM15.
(Ordnance Datum Malin Head)

LEGEND:

AC	Access Chamber
AJ	Armstrong Junction
AV	Air Valve
BA	Safety Barrier
BB	Bottom of Bank
BO	Bollard
BS	Bus Stop
CL	Cover Level
CCTV	CCTV Pole
EL	Eaves Level
EM	Electricity Meter
ESB	ESB Access Chamber
EP	Electricity Pole
FE	Fence
FFL	Finished Floor Level
FH	Fire Hydrant
FM	Foul Manhole
FRL	Flat Roof Level
GV	Gas Valve
IL	Invert Level
KB	Kerb Bottom
KT	Kerb Top
LP	Lamp Post
MC	Motorway Comms
MH	Manhole
PB	Pillar Box
PL	Parapet Level
PRL	Pitched Roof Level
RE	Road Edge
RFG	Roof Gully
RG	Road Gully
RL	Ridge Level
RS	Road Sign
SM	Storm Manhole
SV	Sluice Valve
SVP	Soil Vent Pipe
TB	Top of Bank
TC	Top of Chimney
TEL	Telecom Access Chamber
TF	Top of Fence
TH	Top of Hedge
TL	Traffic Lights
TLC	Traffic Light Comms
TP	Telegraph Pole
TT	Top of Tree
TV	Cable TV Chamber
TW	Top of Wall
WM	Water Meter

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techsol technical solutions ltd.

TECHSOL Technical Solutions Ltd.
Civil Engineering Surveyors
E2 Calmount Business Park
Ballymount, Dublin 12
Tel: 01 4242227

PROJECT: Topographical Survey at
167 Merrion Road
Dublin
D04 V4H7

CLIENT: Lioncor

sales@techsol.ie

Surveyed by	Drawn by	Checked by
IG	IG	RM
File ref.	Date	Scale
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Job ID	Revision No.	Sheet No.
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Drawing No.
LIO8806-MERRIONRD-2D

16 Appendix C - Site Investigations

Refer to The Gowan Compound Site - Site Investigation

175 Merrion Road – Ground Investigation

Client:	Lincor Developments
Client's Representative:	Punch Consulting
Report No.:	18-1169B
Date:	March 2019
Status:	Final for Issue

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

+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

Registered in Northern Ireland. Company Number: NI610766
Approved: ISO 9001 • ISO 14001 • OHSAS 18001

CONTENTS

APPENDICES

Document Control Sheet

Report No.:		18-1169B			
Project Title:		175 Merrion Road			
Client:		Lincor Developments			
Client's Representative:		Punch Consulting			
Revision:	A00	**Status:**	Final for Issue	**Issue Date:**	29 March 2019
Prepared by:		**Reviewed by:**		**Approved by:**	
 Sean Ross BSc MSc		 Stephen Franey BSc (Hons) MSc MIEnvSc		 Darren O'Mahony BSc MSc MIEI	

The works were conducted in accordance with:

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
▽	Water strike: initial depth of strike
▼	Water strike: depth water rose to
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.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum).

175 Merrion Road

1 AUTHORITY

On the instructions of Punch Consulting Engineers, ("the Client's Representative"), acting on the behalf of Dun Laoghaire - Rathdown County Council ("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 residential development.

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, soil 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 site of a disused car valeting company. The site is relatively flat and is bordered by residential dwellings on the east and west and by a rehabilitation centre to the south.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 4th and 20th February 2019, comprised:

- four light cable percussion boreholes; one of which was put down to completion by rotary drilling methods;
- a standpipe installation in two boreholes; and
- four machine dug 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.

4.2 Boreholes

Four boreholes (BH01 - BH04) were put down by a combination of light cable percussion boring using a Dando 2000 rig and rotary follow-on drilling techniques using a Commachio 205. Where the cable percussion borehole had not been advanced to the scheduled depth, rotary percussive methods were employed to advance the borehole to completion. Symmetrix cased full-hole drilling was used.

All locations were broken out using a JCB3CX and a hand dug inspection pit 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. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils. 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 G.

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 BH01 and BH04.

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 a JCB3CX fitted with a 600mm wide bucket, to depths of 3.00m.

Environmental samples were taken at standard intervals in each trial pit.

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

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

4.5 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) 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.

4.6 Groundwater monitoring

Following completion of site works, groundwater monitoring was conducted on two rounds. Ground water monitoring was carried out using a water interface probe.

Details of groundwater monitoring are presented in Table 2 of Section 6.3.

5 LABORATORY WORK

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

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **shear strength** (total stress): unconsolidated undrained triaxial tests, lab shear vane
- **direct shear:** shear box tests
- **soil chemistry:** pH, water soluble sulphate content, acid soluble sulphate content and organic matter content

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 E.

5.2 Environmental laboratory testing of soils

Environmental testing was conducted on selected environmental soil and water samples by Chemtest at its laboratory in Newmarket, Suffolk.

Soil testing was carried according to Engineer's Ireland specification for Ground Investigation (2016) Suite I which tested 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 on eight samples.

It is noted that TP01A and TP01B in the lab report were mis-labelled on site. The reported TP01A should be TP01B and vice versa.

Results of environmental laboratory testing are presented in Appendix F.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise marine sands and gravels. These deposits are underlain by limestones and shales of the Lucan 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:

- **Paved surface:** all boreholes and trial pits encountered 100 -150mm of macadam surfacing.
- **Made Ground (sub-base):** approximately 100 - 450mm of aggregate fill beneath the paved surface at all locations.
- **Made Ground (fill):** reworked sandy gravelly clay fill encountered in BH03 and BH04 to a maximum depth of 1.00mbgl in BH03.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth. Pockets of granular material were encountered within this stratum most notably in BH02 below6.50m, which contained groundwater under artesian conditions. Note this stratum was drilled using open hole symmetrix drilling with no recovery, therefore descriptions are based on driller's interpretation of the flush returns.

6.3 Groundwater

Groundwater was encountered during rotary drilling and trial pit excavation as water strikes as shown in Table 1 below.

Table 1: Groundwater strikes encountered during the ground investigation

GI Ref	Water level (mbgl)	Comments
BH03	8.00	Artesian conditions, GW rose to ground level
TP01	3.00	Seepage

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.

Groundwater was not noted during drilling of the other borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any/additional groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

Groundwater was not encountered during excavation of any of the other trial pits.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 2: Groundwater monitoring

Date	Water level (mbgl)	
	BH01	BH04
26/02/2019	1.47	4.67
14/03/2019	1.10	1.00

Seasonal variation in groundwater levels should also be factored into design considerations, and continued monitoring of the two installed standpipes will give an indication of the seasonal variation in groundwater level.

7 DISCUSSION

7.1 Proposed construction

It is proposed to construct a new residential development on the site.

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

The ground conditions across the site (highly variable glacial deposits and marine sands and gravels), coupled with the relatively shallow groundwater table will render the implementation of any shallow (spread) foundations problematic, and in most areas of the site not suitable. It follows that the most practicable solution for installing safe working foundations across the site will be by a "deep" foundation method, such as piling to transfer loadings to depth.

Should piling be adopted as the preferred foundation type, it is highly recommended that further ground investigation works involving rotary drilling be carried out to prove the depth to bedrock across the site.

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 ground floor construction

Foundations should transfer loading to below any Made Ground or subsoil. The recommended foundation construction and allowable bearing pressure (ABP) at the borehole locations are presented in Table 3.

Table 3: Construction recommendations

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Foundation type	Groundwater
BH01	>4.00	Unable to be determined	Unable to be determined	Piled	None encountered

Borehole	Depth below EGL* to suitable bearing stratum	Estimated ABP (kPa)	Strata description	Foundation type	Groundwater
BH02	6.50m	>250	Stiff Glacial Till	Piled	None encountered
BH03	6.50m	>250	Stiff Glacial Till	Piled	Artesian groundwater table encountered at 8.00m.
BH04	6.50m	>250	Stiff Glacial Till	Piled	None encountered

*Existing Ground Level

It is noted that the rig was driving a cobble in BH01 and the SPT readings at this location were affected by the presence of this cobble. It is also noted that, the above recommendations are based on the assumption that the piles will terminate in glacial till and achieve enough shaft friction to support the structural loadings. If the structural loadings are anticipated are higher, it is recommended to prove bedrock across to site to allow piles to be end bearing on bedrock.

It is therefore critical to the design of the development that rotary drilling is undertaken in future to prove bedrock across the footprint of the proposed apartment block.

Given the generally fine grained/cohesive nature of the soils throughout the proposed formation levels, excavations for foundations are likely to be relatively stable. However, any instability can be minimised by battering the side slopes at 2 vertical to 1 horizontal and by limiting the duration that the excavation is open. Groundwater control, where required, will be possible by pumping from sumps formed in the base of excavations.

7.2.4 Piling recommendations

Piling to transfer loadings to depth is suggested to be the most practicable and applicable option given the variation in depth to a consistent bearing stratum across the site, coupled with the relatively shallow water table and artesian groundwater conditions.

Driven piles are the preferred pile type – of precast concrete or steel/ductile iron. The piles should be driven to a predetermined set – each pile will, therefore, be effectively proof tested by the installation method.

If the surrounding land use precludes the use of hard drive piles, due to environmental restrictions with respect to noise and vibration, low vibration driven piles, continuous flight auger (CFA) or continuous helical displacement (CHD) piles will be required.

Piles will acquire capacity from shaft friction through glacial deposits, and end bearing on bedrock.

Where site levels are to be raised, piles should be designed to resist additional loading that will arise due to negative skin friction along the pile length passing through Made Ground and soft soils.

The detailed design of piles should be undertaken in conjunction with specialist piling contractors. Their proposals should include the means to verify that the required load capacity has been achieved: for example, dynamic pile tests and/or static load tests.

Where pile foundation solution is adopted, floor slabs should be supported by ground beams spanning between piles caps supported by piles.

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, will be required to maintain trench stability and safe working conditions. Groundwater control at these locations should be possible by means of sump pumping.

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 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. The Special Digest requires additional design measures to be applied to increase protection from the elevated levels of sulphates and acidic soils present in parts of the site.

7.3 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
- Asbestos screen
- pH.

Select 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 LQM/CIEH S4UL's assessment criteria relevant to a proposed residential without plant uptake land use:

The results from the tested samples do not identify significantly elevated concentrations above the available S4UL's.

It should be noted that the above assessment is based on the results of the soil samples against available S4UL's and this assessment has not been undertaken following the CLR11 guidelines. No comment has been made where criteria are not available. Any potential contamination identified during site development by visual or olfactory means should be investigated, including further laboratory testing, and appropriate health & safety, waste disposal and remediation measures adopted.

In assessment of the waste acceptance criteria (WAC) results, the test results 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. 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

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.

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

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

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

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

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

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

CAUSEWAY GEOTECH

Project No.:	18-1169B	**Client:**	Lincor Developments
Project Name:	175 Merrion Road, Dublin	**Client's Representative:**	Punch Consulting

Legend Key

Title:
Site Location Plan

Last Revised:	**Scale:**
25/03/2019	1:5000

Motors Compound - Basement Impact Assessment Report

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Tent Engineering

CAUSEWAY GEOTECH

Project No.:	18-1169B	**Client:**	Lincor Developments
Project Name:	175 Merrion Road, Dublin	**Client's Representative:**	Punch Consulting

Tent Engineering

Lotts Compound - Basement Impact Assessment Report

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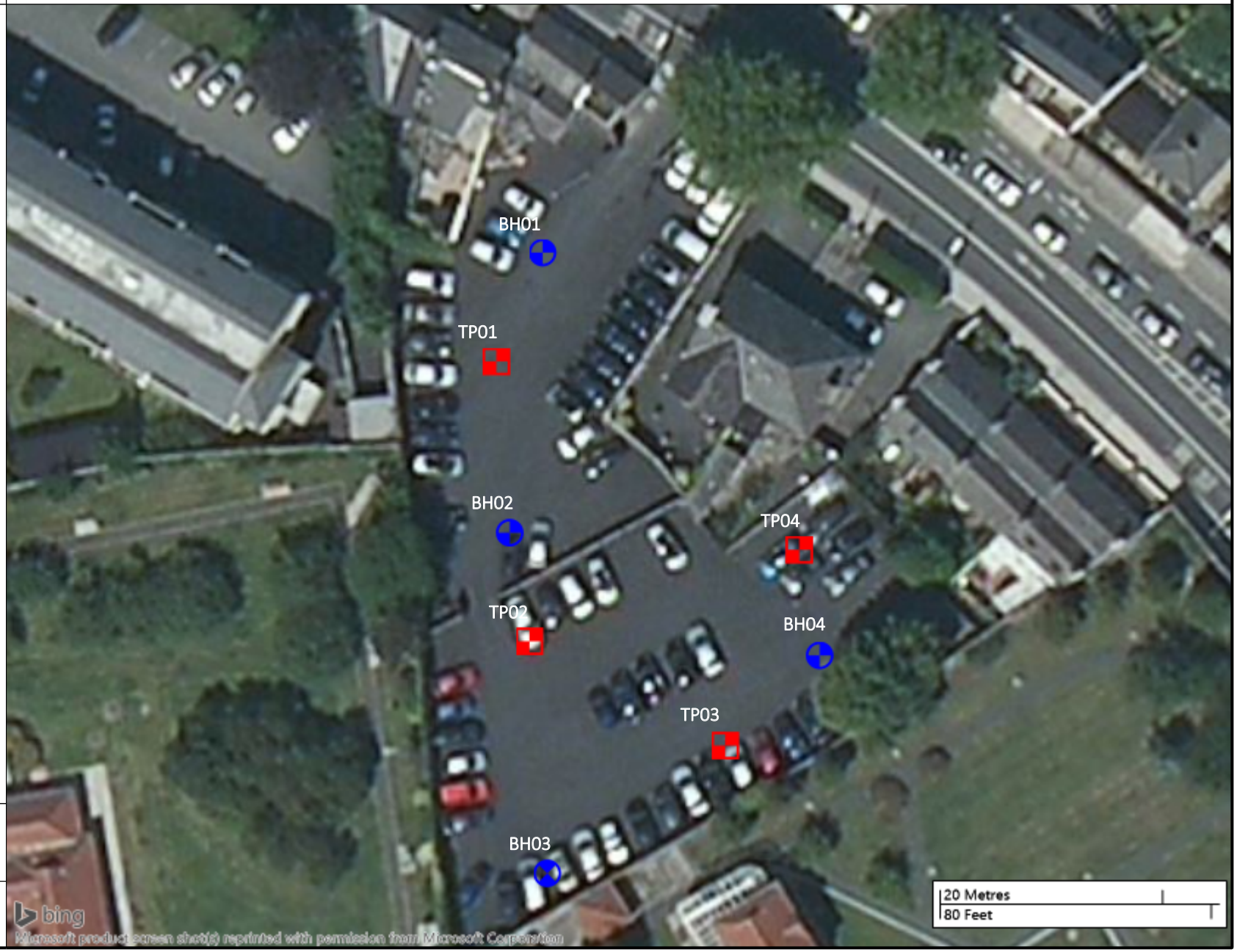
Legend Key

- Locations By Type - CP
- Locations By Type - CP+RC
- Locations By Type - TP



Title:
Exploratory Hole Location Plan

Last Revised:	**Scale:**
25/03/2019	1:500

APPENDIX B
BOREHOLE LOGS

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	4.00

Project No.: 18-1169B

Project Name: 175 Merrion Road, Dublin

Borehole No.: BH01

Coordinates: 319574.92 E, 231054.51 N

Client: Lincor Developments

Sheet 1 of 1

Client's Representative: Punch Consulting

Scale: 1:50

Driller: MK

Ground Level: 5.42 mOD

Dates: 20/02/2019 - 20/02/2019

Logger: SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					5.32	(0.10)		MADE GROUND: Bitmac		
						(0.20)		MADE GROUND: Grey sandy subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
					5.12	0.30		Firm becoming stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
0.50	B3 D6 ES1									
1.00	B4 D7 ES2									
1.20 - 1.65	SPT (S) N=14			N=14 (3,3/4,4,3,3)		(2.30)				
2.00	B5 D8									
2.00 - 2.45	SPT (S) N=27			N=27 (3,4/5,7,7,8)						
					2.82	2.60		Stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
3.00	B9 D11									
3.00 - 3.45	SPT (S) N=23			N=23 (2,4/3,5,7,8)		(1.40)				
4.00	B10 D12 U13			Ublow=80 70%	1.42	4.00		End of Borehole at 4.00m		

Remarks

Hand dug inspection pit excavated to 1.20m.

No groundwater encountered.

Terminated on obstruction - possible boulder.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Water Added

From (m)	To (m)

Casing Details

To (m)	Diam (mm)
4.00	200

Chiselling Details

From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	7.00

Project No.: 18-1169B

Project Name: 175 Merrion Road, Dublin

Borehole No.: BH02

Coordinates: 319572.42 E, 231029.19 N

Client: Lincor Developments

Sheet 1 of 1

Client's Representative: Punch Consulting

Scale: 1:50

Ground Level: 5.99 mOD

Dates: 20/02/2019 - 20/02/2019

Driller: MK

Logger: SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					5.89	(0.10)		MADE GROUND: Bitmac		
					5.79	(0.20)		MADE GORUND: Grey sandy subangular fine to coarse GRAVEL of mixed lithologies.		
						(0.40)				
0.50	B3 D5 ES1				5.39	0.60		MADE GROUND: Grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.		
1.00	B4 D6 ES2							Stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
1.20 - 1.65	SPT (S) N=18			N=18 (3,3/4,5,5,4)						
						(2.10)				
2.00	B7 D12									
2.00 - 2.45	U18			Ublow=70 100%						
					3.29	2.70		Very stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
3.00	B8 D13 D14									
3.00 - 3.44	SPT (S)			N=50 (4,5/50 for 290mm)						
4.00	B9 D15									
4.00 - 4.45	U19			Ublow=80 100%						
						(4.30)				
5.00	B10 D16									
5.00 - 5.44	SPT (S)			N=50 (5,6/50 for 295mm)						
6.00	D11 D17									
6.00 - 6.45	U20			Ublow=100 100%						
6.50 - 6.80	SPT (S)			N=50 (11,16/50 for 155mm)						
					-1.01	7.00		End of Borehole at 7.00m		

Remarks

Hand dug inspection pit excavated to 1.20m.

No groundwater encountered.

Terminated on obstruction - possible boulder.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Water Added

From (m)	To (m)
1.20	1.50

Casing Details

To (m)	Diam (mm)

Chiselling Details

From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion Rotary Drilling	Dando 2000 Comacchio 205	0.00 6.50	6.50 11.50

Project No.: 18-1169B

Project Name: 175 Merrion Road, Dublin

Borehole No.: BH03

Coordinates: 319576.70 E 230998.58 N

Client: Lincor Developments

Sheet 1 of 2

Client's Representative: Punch Consulting

Scale: 1:50

Driller: MK+KW

Ground Level: 6.43 mOD

Dates: 18/02/2019 - 20/02/2019

Logger: SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
					6.33	(0.10)		MADE GROUND: Bitmac		
					6.23	(0.20)		MADE GROUND: Grey sandy subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
0.50	B6 D11 ES4					(0.80)		MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	B7 D12 ES5				5.43	1.00		Stiff brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.20 - 1.65	SPT (S) N=15	1.20	Dry	N=15 (2,3/3,4,4,4)						
2.00	B8 D13					(1.80)				
2.00 - 2.45	U1			Ublow=80 0%						
					3.63	2.80		Stiff grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
3.00	B9 D14									
3.00 - 3.45	SPT (S) N=30	3.00	Dry	N=30 (4,5/6,6,8,10)		(1.20)				
4.00	B10 D15				2.43	4.00		Soft grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.		
4.00 - 4.45	U2			Ublow=70 100%						
						(1.00)				
5.00	B16 D18				1.43	5.00		Very stiff grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
5.00 - 5.45	SPT (S) N=36	5.00	Dry	N=36 (3,4/6,8,10,12)						
						(1.50)				
6.00	B17 D19									
6.00 - 6.45	U3			Ublow=100 60%						
6.50 - 6.58	SPT (S)	6.50	Dry	N=50 (26 for 50mm/50 for 25mm)	-0.07	6.50		Grey sandy clayey fine to coarse GRAVEL. (Driller's description)		
						(1.00)				
					-1.07	7.50		Dark grey sandy gravelly CLAY with high cobble content. (Driller's description)		
						(0.50)				
				Water strike at 8.00m	-1.57	8.00		Grey clayey fine to coarse GRAVEL with high cobble and boulder content. (Driller's description)	▼	
						(1.00)				
					-2.57	9.00		Dark grey sandy gravelly CLAY with high cobble and boulder content. (Driller's description)		
						(2.50)				

Remarks
Hand dug inspection pit excavated to 1.20m.
Terminated due to artesian groundwater.

Core Barrel

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
8.00	8.00		

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Flush Type

Water Added

From (m)	To (m)
1.20	6.50

Casing Details

To (m)	Diam (mm)

CAUSEWAY GEOTECH

Project No.:	Project Name:	Borehole No.:
18-1169B	175 Merrion Road, Dublin	BH03
Coordinates: 319576.70 E 230998.58 N	**Client:** Lincor Developments	Sheet 2 of 2
	Client's Representative: Punch Consulting	**Scale:** 1:50
Ground Level: 6.43 mOD	**Dates:** 18/02/2019 - 20/02/2019	**Driller:** MK+KW
		Logger: SR

Method	Plant Used	Top	Base
Cable Percussion Rotary Drilling	Dando 2000 Comacchio 205	0.00 6.50	6.50 11.50

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
								Dark grey sandy gravelly CLAY with high cobble and boulder content. (Driller's description)		
					-5.07	11.50		End of Borehole at 11.50m		

Remarks
Hand dug inspection pit excavated to 1.20m.

Core Barrel

Flush Type

Water Strikes			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
8.00	8.00		

Water Added		Casing Details	
From (m)	To (m)	To (m)	Diam (mm)
1.20	6.50		

Chiselling Details		
From (m)	To (m)	Time (hh:mm)

Terminated due to artesian groundwater.

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2000	0.00	6.50

Project No.: 18-1169B

Project Name: 175 Merrion Road, Dublin

Borehole No.: BH04

Coordinates: 319600.70 E, 231018.83 N

Client: Lincor Developments

Sheet 1 of 1

Client's Representative: Punch Consulting

Scale: 1:50

Driller: MK

Ground Level: 5.75 mOD

Dates: 14/02/2019 - 14/02/2019

Logger: SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
					5.65	(0.10)		MADE GROUND: Bitmac
					5.55	0.20		MADE GROUND: Grey sandy subangular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.
						(0.40)		
0.50	B3 D10 ES1				5.15	0.60		MADE GROUND: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
1.00	B4 D11 ES2							Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
1.20 - 1.65	SPT (S) N=13	1.20	Dry	N=13 (2,3/3,3,4,3)		(1.60)		
2.00	B5 D12							
2.00 - 2.45	U17	2.00	Dry	Ublow=80 100%	3.55	2.20		Very stiff grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.
3.00	B6 D13					(1.80)		
3.00 - 3.45	SPT (S) N=31	3.00	0.50	N=31 (4,4/5,7,9,10)				
4.00	B7 D14				1.75	4.00		Soft grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
4.00 - 4.45	U18	4.00	1.0	Ublow=70 100%		(1.00)		
5.00	B8 D15				0.75	5.00		Very stiff grey silty slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.
5.00 - 5.45	SPT (S) N=34	5.00	3.00	N=34 (4,5/6,8,9,11)		(1.50)		
6.00	B9 D16							
6.00 - 6.45	U19	6.00	1.0	Ublow=80 100%				
6.50 - 6.70	SPT (S)	6.50	1.00	N=50 (12,25/50 for 45mm)	-0.75	6.50		End of Borehole at 6.50m

Water: Backfill

Remarks

Hand dug inspection pit excavated to 1.20m.

No groundwater encountered.

Terminated on obstruction - possible boulder.

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Water Added

From (m)	To (m)
1.20	6.00

Casing Details

To (m)	Diam (mm)
6.00	200

Chiselling Details

From (m)	To (m)	Time (hh:mm)

APPENDIX C
TRIAL PIT LOGS

CAUSEWAY GEOTECH

Project No.: 18-1169B	**Project Name:** 175 Merrion Road, Dublin		**Trial Pit No.:** TP01
Co-ordinates: 319570.85 E	**Client:** Lincor Developments		Sheet 1 of 1
Method: Trial Pitting	231044.60 N	**Client's Representative:** Punch Consulting	**Scale:** 1:25
Plant: JCB Excavator	**Ground Level:** 5.65 mOD	**Date:** 04/02/2019	**Logger:** GH

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
				(0.15)		MADE GROUND: Bitmac	
			5.50	0.15			
				(0.15)		MADE GROUND: Black angular fine to coarse GRAVEL of mixed lithologies.	
			5.35	0.30			
				(0.30)		MADE GROUND: Brown slightly sandy angular fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse	
0.50	B1						
0.50	ES2		5.05	0.60			
						Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies.	
1.00	B3						
1.00	ES4						
				(1.80)			
			3.25	2.40			
						Stiff blackish grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are angular of mixed lithologies.	
				(0.60)			
3.00	B5	Seepage at 3.00m	2.65	3.00		End of trial pit at 3.00m	▼

Remarks

Terminated on maximum strength of excavator.

Water Strikes:

Struck at (m):	Remarks:
3.00	Seepage at 3.00m

Stability: Stable

Width: 0.80

Length: 2.60

	Project No.:	Project Name:	Trial Pit No.:
CAUSEWAY GEOTECH	18-1169B	175 Merrion Road, Dublin	TP02
	Co-ordinates: 319574.60 E	Client: Lincor Developments	Sheet 1 of 1
Method: Trial Pitting	231019.45 N	Client's Representative: Punch Consulting	Scale: 1:25
Plant: JCB Excavator	Ground Level: 6.13 mOD	Date: 04/02/2019	Logger: GH

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
			6.03	(0.10) 0.10		MADE GROUND: Bitmac	
				(0.20)		MADE GROUND: Black angular fine to coarse GRAVEL of mixed lithologies.	
			5.83	0.30		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.	
0.50	B1						
0.50	ES2						
				(0.90)			
1.00	B4						
1.00	ES3						
			4.93	1.20		Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to medium of mixed lithologies.	
				(1.40)			
2.00	B5						
			3.53	2.60		Stiff blackish grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.	
				(0.40)			
3.00	B6		3.13	3.00		End of trial pit at 3.00m	

Remarks
No groundwater encountered.

Terminated on maximum strength of excavator.

Water Strikes:	
Struck at (m):	Remarks:

Stability: Stable

Width: 0.80

Length: 2.60

CAUSEWAY GEOTECH	Project No.: 18-1169B	Project Name: 175 Merrion Road, Dublin	Trial Pit No.: TP03
	Co-ordinates: 319592.45 E	Client: Lincor Developments	Sheet 1 of 1
Method: Trial Pitting	231010.49 N	Client's Representative: Punch Consulting	Scale: 1:25
Plant: JCB Excavator	Ground Level: 6.01 mOD	Date: 04/02/2019	Logger: GH

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
			5.90	(0.10) 0.10		MADE GROUND: Bitmac	
			5.86	(0.15) 0.25		MADE GROUND: Whitish grey angular fine to coarse GRAVEL of mixed lithologies.	
			5.70	(0.15) 0.40		MADE GROUND: Blackish grey angular fine to coarse GRAVEL of mixed lithologies.	
0.50	B1					Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse, predominantly of limestone	
0.50	ES2						
1.00	B3						
1.00	ES4						
				(2.30)			
2.00	B5						
			3.40	2.60		Stiff greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse, predominantly limestone. Cobbles are subrounded and of mixed lithologies.	
				(0.40)			
3.00	B6		3.00	3.00		End of trial pit at 3.00m	

Remarks
No groundwater encountered.

Terminated on maximum strength of excavator.

Water Strikes:	
Struck at (m):	Remarks:

Stability: Stable

Width: 0.80

Length: 2.60

CAUSEWAY GEOTECH

Project No.: 18-1169B	**Project Name:** 175 Merrion Road, Dublin		**Trial Pit No.:** TP04
Co-ordinates: 319598.58 E	**Client:** Lincor Developments		Sheet 1 of 1
Method: Trial Pitting	231028.31 N	**Client's Representative:** Punch Consulting	**Scale:** 1:25
Plant: JCB Excavator	**Ground Level:** 5.54 mOD	**Date:** 04/02/2019	**Logger:** GH

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
			5.44	(0.10) 0.10		MADE GROUND: Bitmac	
				(0.20)		MADE GROUND: Black angular fine to coarse GRAVEL of mixed lithologies.	
			5.24	0.30		MADE GROUND: Pinkish grey angular fine to coarse GRAVEL of mixed lithologies.	
				(0.20)			
0.50	B1		5.04	0.50		Firm grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.	
0.50	ES2						
				(0.80)			
1.00	B3						
1.00	ES4						
			4.24	1.30		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.	
2.00	B5			(1.40)			
			2.84	2.70		Stiff blackish grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies.	
				(0.30)			
3.00	B6		2.54	3.00		End of trial pit at 3.00m	

Remarks
No groundwater encountered.

Terminated on maximum strength of excavator.

Water Strikes:	
Struck at (m):	Remarks:

Stability: Stable

Width: 0.80

Length: 2.60

APPENDIX D
TRIAL PIT PHOTOGRAPHS

TP01B

TP01B

TP01B

TP01B

TP01B

TP01B

TP01B

TP02B

TP02B

TP02B

TP02B

TP02B

TP02B

TP02B

TP03B

TP03B

TP03B

TP03B

TP03B

TP03B

TP03B

TP04B

TP04B

TP04B

TP04B

TP04B

TP04B

APPENDIX E
GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

10122

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Project Name:	143 and 175 Merrion Road, Dublin
Project No.:	18-1169B
Client:	Lincor Developments
Engineer:	Punch Consulting
Date:	25/02/19

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 attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days 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

Signed for and on behalf of Causeway Geotech Ltd

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

Registered in Northern Ireland. Company Number: NI610766

CAUSEWAY GEOTECH

+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

10122

Project Name: 143 and 175 Merrion Road, Dublin

Report Reference: Schedule 1

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

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	4
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	4
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	4
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	4

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Pro Soils Limited *(UKAS 2183)*	pH Value of Soil		4
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		4
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content Acid extract		4
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Organic Matter Content		4

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.	Project Name
18-1169B	143 and 175 Merrion Road, Dublin

Hole No.	Sample Ref	Top	Base	Type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
TP01	3	1.00		B	Greyish brown sandy gravelly CLAY.			20.0	70	42 -1pt	23	19		CI
TP02	5	2.00		B	Brown sandy slightly gravelly CLAY.			14.0	70	31 -1pt	17	14		CL
TP03	3	1.00		B	Grey brown sandy gravelly CLAY.			14.0	58	32 -1pt	18	14		CL
TP04	3	1.00		B	Brown sandy slightly gravelly CLAY.			15.0	65	28 -1pt	15	13		CL

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 4

Key

Density test | Liquid Limit | Particle density

Linear measurement unless : | 4pt cone unless : | sp - small pyknometer

wd - water displacement | cas - Casagrande method | gj - gas jar

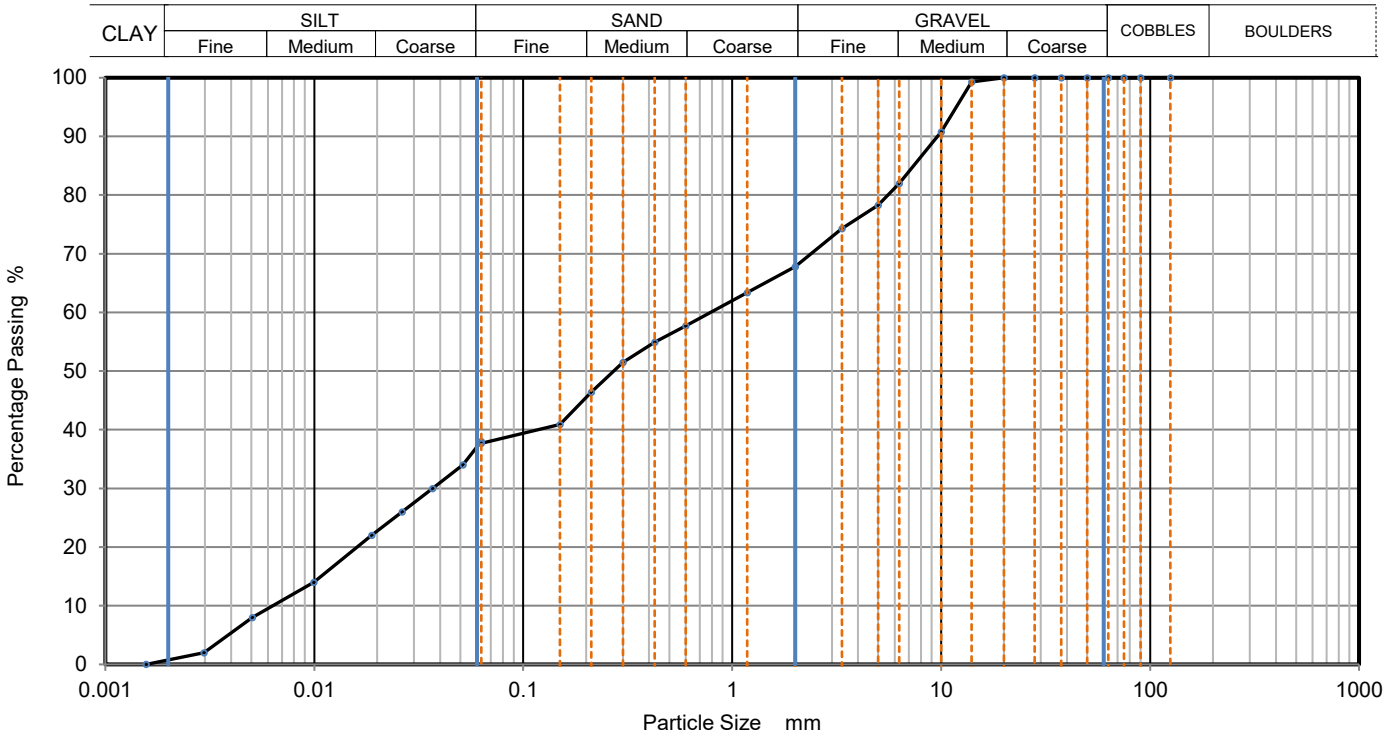
wi - immersion in water | 1pt - single point test

Date Printed: 25/02/2019

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	TP01
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	3
Soil Description	Greyish brown sandy gravelly CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201902073



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	38
90	100	0.0514	34
75	100	0.0368	30
63	100	0.0263	26
50	100	0.0188	22
37.5	100	0.0099	14
28	100	0.0051	8
20	100	0.0030	2
14	99	0.0016	0
10	91		
6.3	82		
5	78		
3.35	74		
2	68		
1.18	63		
0.6	58	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	52		
0.212	46		
0.15	41		
0.063	38		

Dry Mass of sample, g	617

Sample Proportions	% dry mass
Cobbles	0
Gravel	32
Sand	30
Silt	37
Clay	1

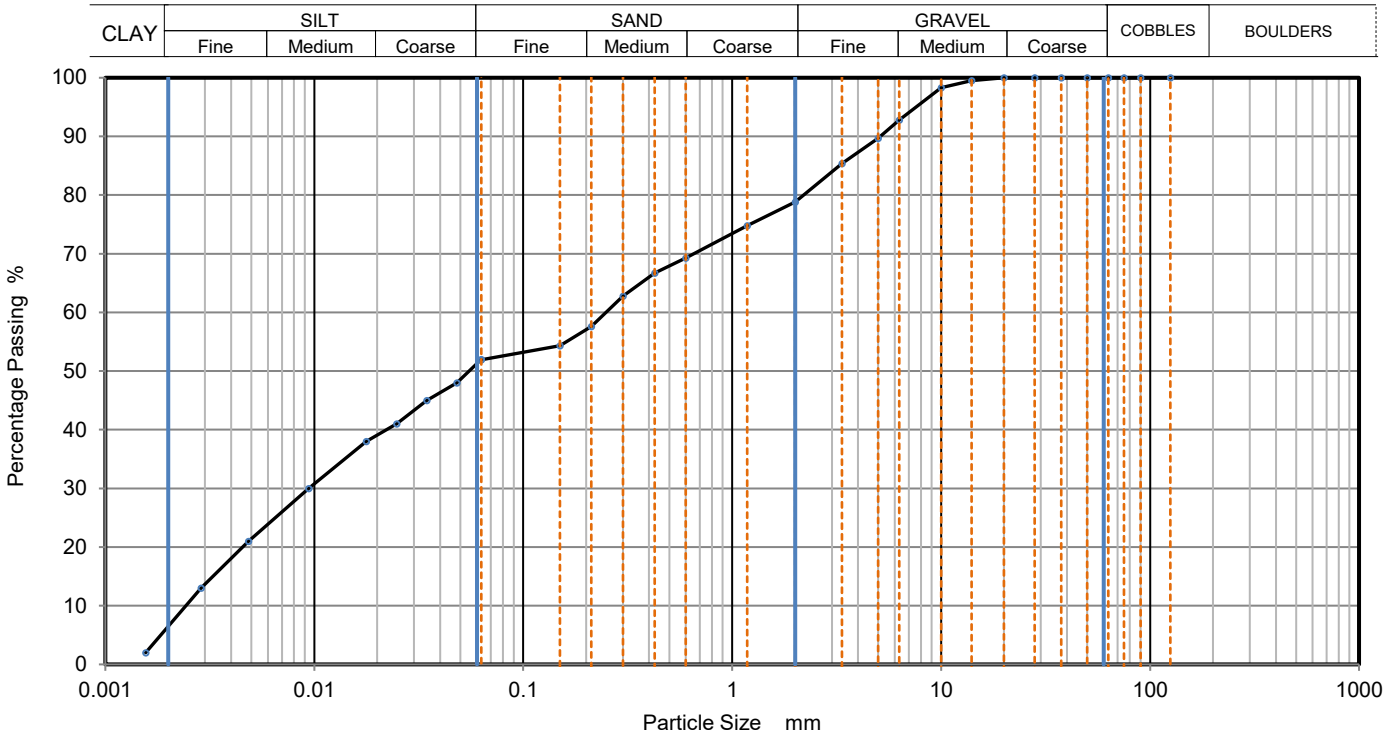
Grading Analysis		
D100	mm	
D60	mm	0.789
D30	mm	0.0376
D10	mm	0.00639
Uniformity Coefficient		120
Curvature Coefficient		0.28

Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	TP02
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	5
Soil Description	Brown sandy slightly gravelly CLAY.			Depth, m	2.00
Specimen Reference	6	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201902074



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	52
90	100	0.0482	48
75	100	0.0346	45
63	100	0.0248	41
50	100	0.0177	38
37.5	100	0.0094	30
28	100	0.0048	21
20	100	0.0029	13
14	100	0.0016	2
10	98		
6.3	93		
5	90		
3.35	85		
2	79		
1.18	75		
0.6	69	Particle density	(assumed)
0.425	67	2.65	Mg/m3
0.3	63		
0.212	58		
0.15	54		
0.063	52		

Dry Mass of sample, g: 431

Sample Proportions	% dry mass
Cobbles	0
Gravel	21
Sand	27
Silt	46
Clay	6

Grading Analysis		
D100	mm	
D60	mm	0.249
D30	mm	0.0091
D10	mm	0.00249
Uniformity Coefficient		100
Curvature Coefficient		0.13

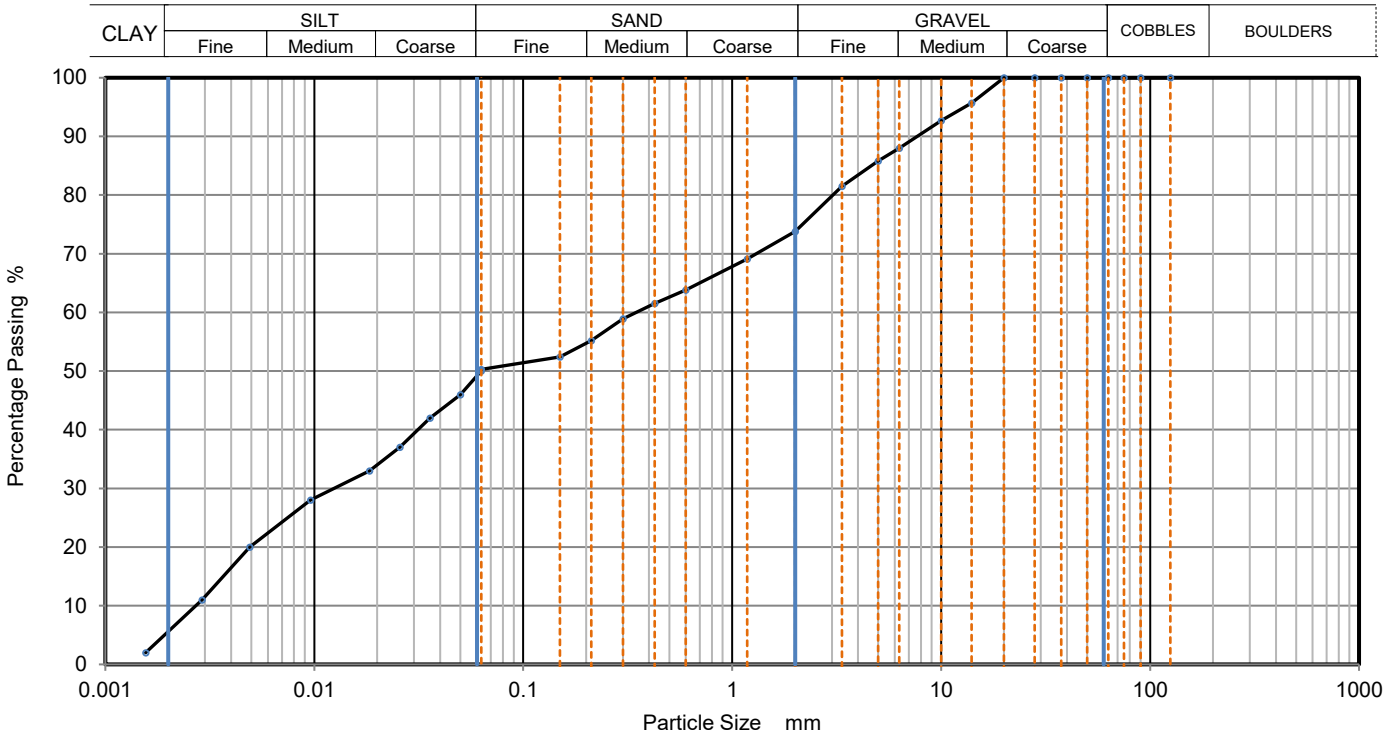
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	TP03
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	3
Soil Description	Grey brown sandy gravelly CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201902075



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	50
90	100	0.0500	46
75	100	0.0358	42
63	100	0.0256	37
50	100	0.0184	33
37.5	100	0.0096	28
28	100	0.0049	20
20	100	0.0029	11
14	96	0.0016	2
10	93		
6.3	88		
5	86		
3.35	82		
2	74		
1.18	69		
0.6	64	Particle density	(assumed)
0.425	62	2.65	Mg/m3
0.3	59		
0.212	55		
0.15	52		
0.063	50		

Dry Mass of sample, g	640

Sample Proportions	% dry mass
Cobbles	0
Gravel	26
Sand	24
Silt	45
Clay	6

Grading Analysis		
D100	mm	
D60	mm	0.348
D30	mm	0.0121
D10	mm	0.00271
Uniformity Coefficient		130
Curvature Coefficient		0.16

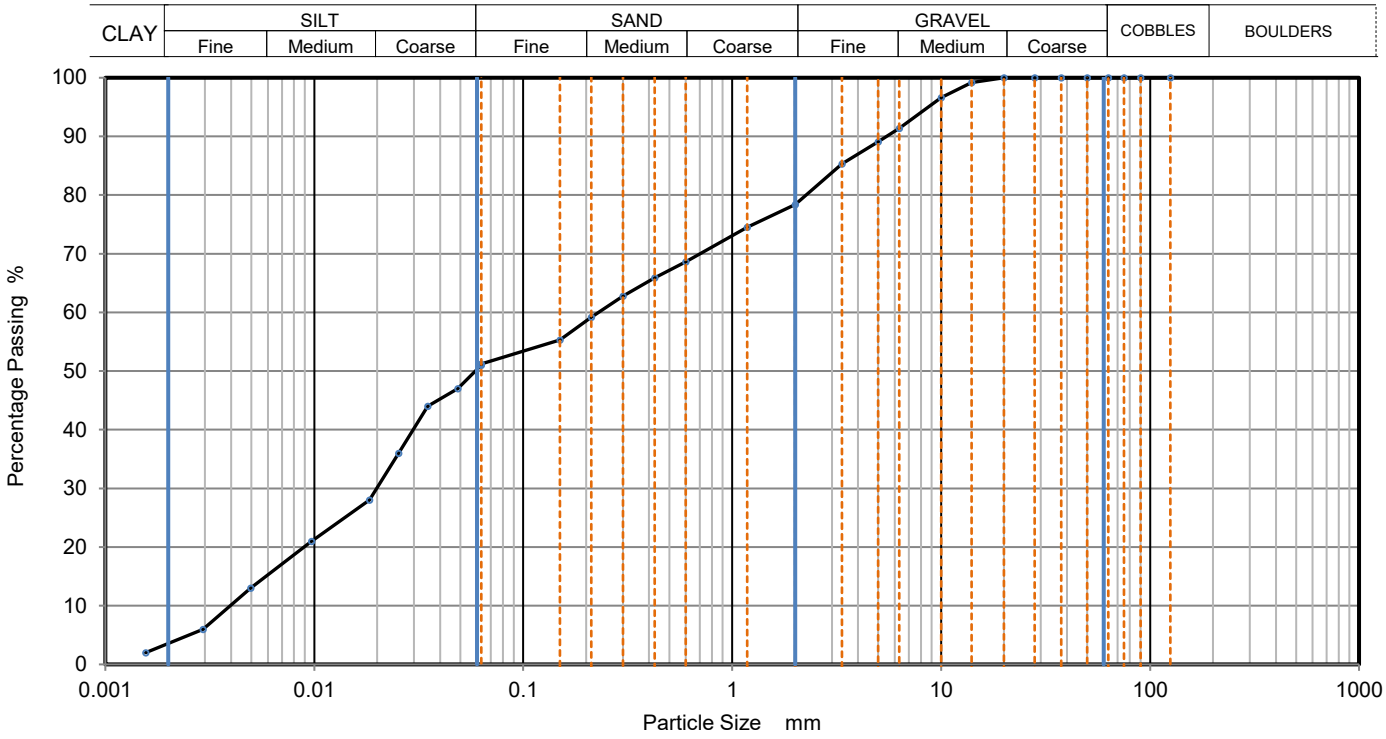
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	TP04
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	3
Soil Description	Brown sandy slightly gravelly CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201902076



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	51
90	100	0.0486	47
75	100	0.0349	44
63	100	0.0253	36
50	100	0.0184	28
37.5	100	0.0097	21
28	100	0.0050	13
20	100	0.0029	6
14	99	0.0016	2
10	97		
6.3	91		
5	89		
3.35	85		
2	78		
1.18	75		
0.6	69	Particle density	(assumed)
0.425	66	2.65	Mg/m3
0.3	63		
0.212	59		
0.15	55		
0.063	51		

Dry Mass of sample, g	532

Sample Proportions	% dry mass
Cobbles	0
Gravel	22
Sand	27
Silt	48
Clay	3

Grading Analysis		
D100	mm	
D60	mm	0.23
D30	mm	0.0196
D10	mm	0.00396
Uniformity Coefficient		58
Curvature Coefficient		0.42

Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.: 19-05449-1

Initial Date of Issue: 21-Feb-2019

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

Contact(s): Carin Cornwall
Colm Hurley
Darren O'Mahony
Gabriella Horan
John Cameron
Lucy Newland
Matthew Gilbert
Neil Haggan
Paul Dunlop
Paul McNamara
Sean Ross
Stephen Franey
Stephen Watson
Stuart Abraham

Project 18-1169B 143 and 176 Merrion Road

Quotation No.:		**Date Received:**	14-Feb-2019
Order No.:		**Date Instructed:**	14-Feb-2019
No. of Samples:	4		
Turnaround (Wkdays):	5	**Results Due:**	20-Feb-2019
Date Approved:	21-Feb-2019		

Approved By:

Details: Glynn Harvey, Laboratory Manager

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

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 18-1169B 143 and 176 Merrion Road

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		19-05449	19-05449	19-05449	19-05449
Quotation No.:			**Chemtest Sample ID.:**		774616	774617	774618	774619
Order No.:			Client Sample Ref.:		1	4	1	1
			Sample Location:		TP01	TP02	TP03	TP04
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.5	1.0	0.5	0.5
			Date Sampled:		13-Feb-2019	13-Feb-2019	13-Feb-2019	13-Feb-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Moisture	N	2030	%	0.020	5.4	16	16	13
pH	U	2010		N/A	8.7	7.9	7.9	8.2
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.029	0.057	0.028	0.030
Sulphate (Acid Soluble)	U	2430	%	0.010	0.032	0.070	0.064	0.044
Organic Matter	U	2625	%	0.40	4.0	7.8	19	4.5

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

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+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

10122

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Project Name:	143 and 175 Merrion Road, Dublin
Project No.:	18-1169B
Client:	Lincor Developments
Engineer:	Punch Consulting
Date:	26/03/19

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 attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days 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

Signed for and on behalf of Causeway Geotech Ltd

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+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

10122

Project Name: 143 and 175 Merrion Road, Dublin

Report Reference: Schedule 2 - FINAL

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

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	5
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	5
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	5
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	5
SOIL	Laboratory Vane Shear Strength (3 determinations)*	BS 1377-7: 1990: Cl 3	2
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	2

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+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

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SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Pro Soils Limited *(UKAS 2183)*	pH Value of Soil		1
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		1
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content Acid extract		1
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Organic Matter Content		1
SOIL – subcontracted to Pro Soils Limited *(UKAS 4043)*	Direct Shear Strength using 60mm Small shearbox	BS 1377-7: 1990: Cl 4	1
	Extra over for sample preparation Note: The sample preparation charge covers screening and remoulding.		1
	Extra over days		3

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.	Project Name
18-1169B	143 and 175 Merrion Road, Dublin

Hole No.	Sample Ref	Top	Base	Type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
BH01	4	1.00		B	Brown sandy gravelly CLAY.			31.0	73	34 -1pt	13	21		CL
BH02	4	1.00		B	Brown sandy gravelly CLAY.			20.0	68	38 -1pt	20	18		CI
BH03	7	1.00		B	Brown sandy slightly gravelly CLAY.			32.0	86	41 -1pt	24	17		CI
BH03	9	3.00		B	Brown sandy gravelly CLAY.			16.0	59	25 -1pt	14	11		CL
BH04	6	3.00		B	Brown sandy gravelly CLAY.			9.7	57	21 -1pt	13	8		CL

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 4

Key

Density test | Liquid Limit | Particle density

Linear measurement unless : | 4pt cone unless : | sp - small pyknometer

wd - water displacement | cas - Casagrande method | gj - gas jar

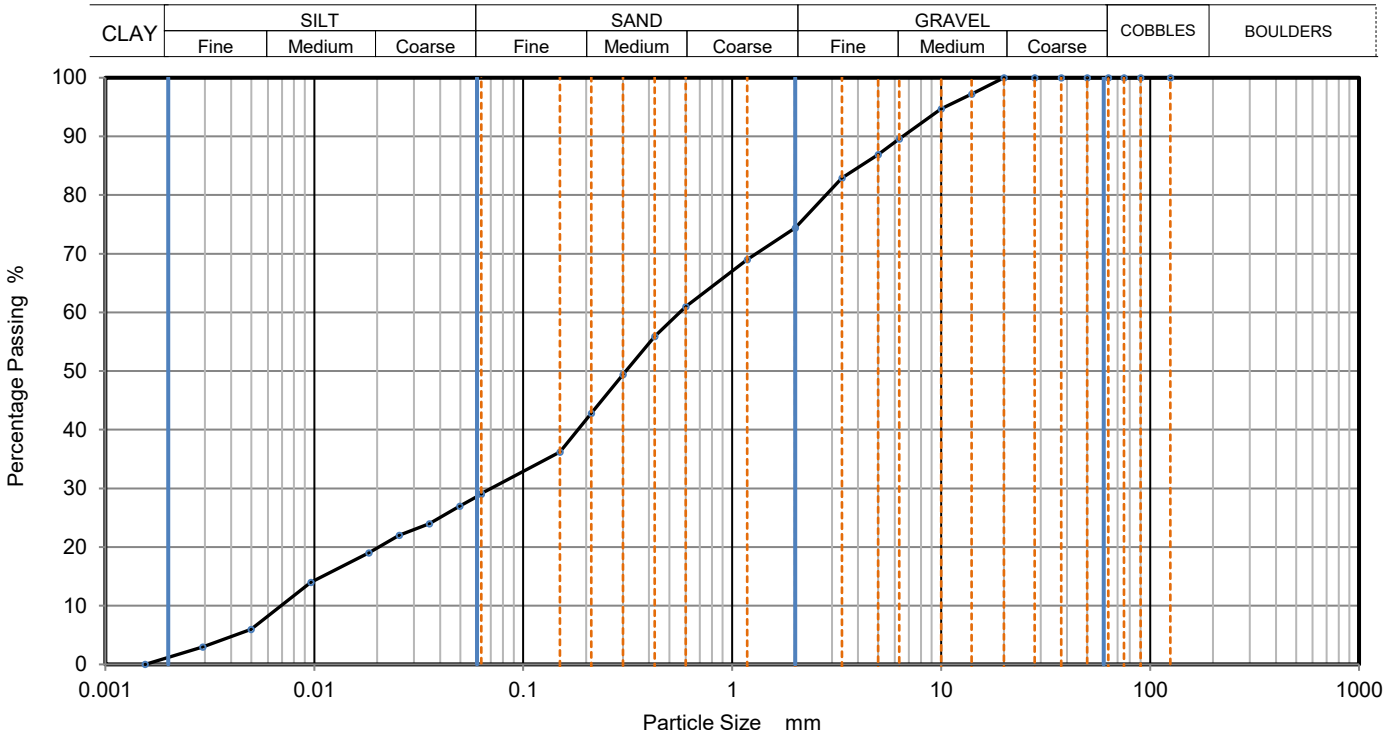
wi - immersion in water | 1pt - single point test

Date Printed: 20/03/2019

Approved By: Stephen.Watson

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	BH01
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	4
Soil Description	Brown sandy gravelly CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201902288



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	29
90	100	0.0497	27
75	100	0.0356	24
63	100	0.0255	22
50	100	0.0182	19
37.5	100	0.0096	14
28	100	0.0050	6
20	100	0.0029	3
14	97	0.0016	0
10	95		
6.3	90		
5	87		
3.35	83		
2	74		
1.18	69		
0.6	61	Particle density	(assumed)
0.425	56	2.65	Mg/m3
0.3	49		
0.212	43		
0.15	36		
0.063	29		

Dry Mass of sample, g	526

Sample Proportions	% dry mass
Cobbles	0
Gravel	26
Sand	45
Silt	28
Clay	1

Grading Analysis		
D100	mm	
D60	mm	0.56
D30	mm	0.0702
D10	mm	0.00685
Uniformity Coefficient		82
Curvature Coefficient		1.3

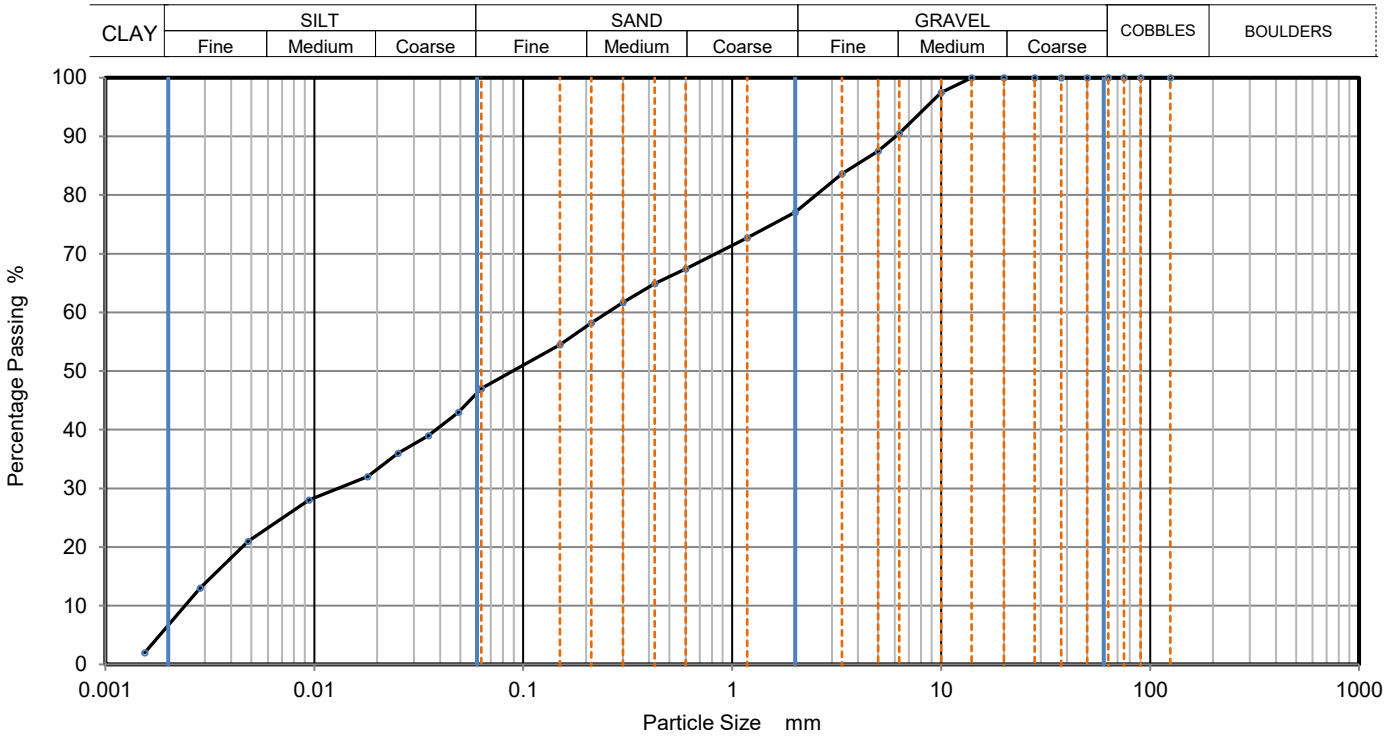
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen.Watson

UKAS TESTING

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	BH02
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	4
Soil Description	Brown sandy gravelly CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201902289



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	47
90	100	0.0491	43
75	100	0.0351	39
63	100	0.0252	36
50	100	0.0180	32
37.5	100	0.0094	28
28	100	0.0048	21
20	100	0.0028	13
14	100	0.0015	2
10	98		
6.3	91		
5	88		
3.35	84		
2	77		
1.18	73		
0.6	67	Particle density	(assumed)
0.425	65	2.65	Mg/m3
0.3	62		
0.212	58		
0.15	55		
0.063	47		

Dry Mass of sample, g	525

Sample Proportions	% dry mass
Cobbles	0
Gravel	23
Sand	30
Silt	40
Clay	7

Grading Analysis		
D100	mm	
D60	mm	0.253
D30	mm	0.0128
D10	mm	0.0024
Uniformity Coefficient		110
Curvature Coefficient		0.27

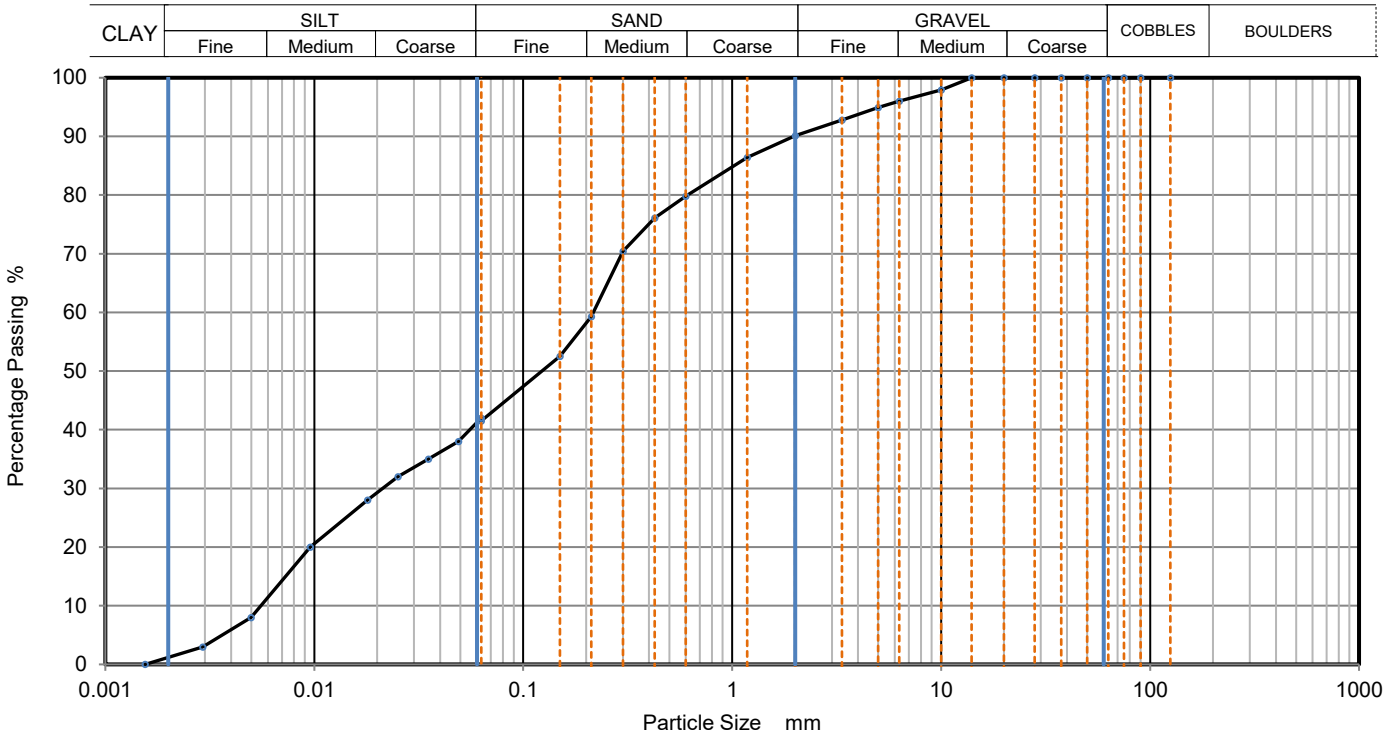
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	BH03
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	7
Soil Description	Brown sandy slightly gravelly CLAY.			Depth, m	1.00
Specimen Reference	6	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2019022811



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	42
90	100	0.0491	38
75	100	0.0351	35
63	100	0.0252	32
50	100	0.0180	28
37.5	100	0.0096	20
28	100	0.0050	8
20	100	0.0029	3
14	100	0.0016	0
10	98		
6.3	96		
5	95		
3.35	93		
2	90		
1.18	86		
0.6	80	Particle density	(assumed)
0.425	76	2.65	Mg/m3
0.3	70		
0.212	59		
0.15	53		
0.063	42		

Dry Mass of sample, g	504

Sample Proportions	% dry mass
Cobbles	0
Gravel	10
Sand	49
Silt	40
Clay	1

Grading Analysis		
D100	mm	
D60	mm	0.217
D30	mm	0.0215
D10	mm	0.00548
Uniformity Coefficient		40
Curvature Coefficient		0.39

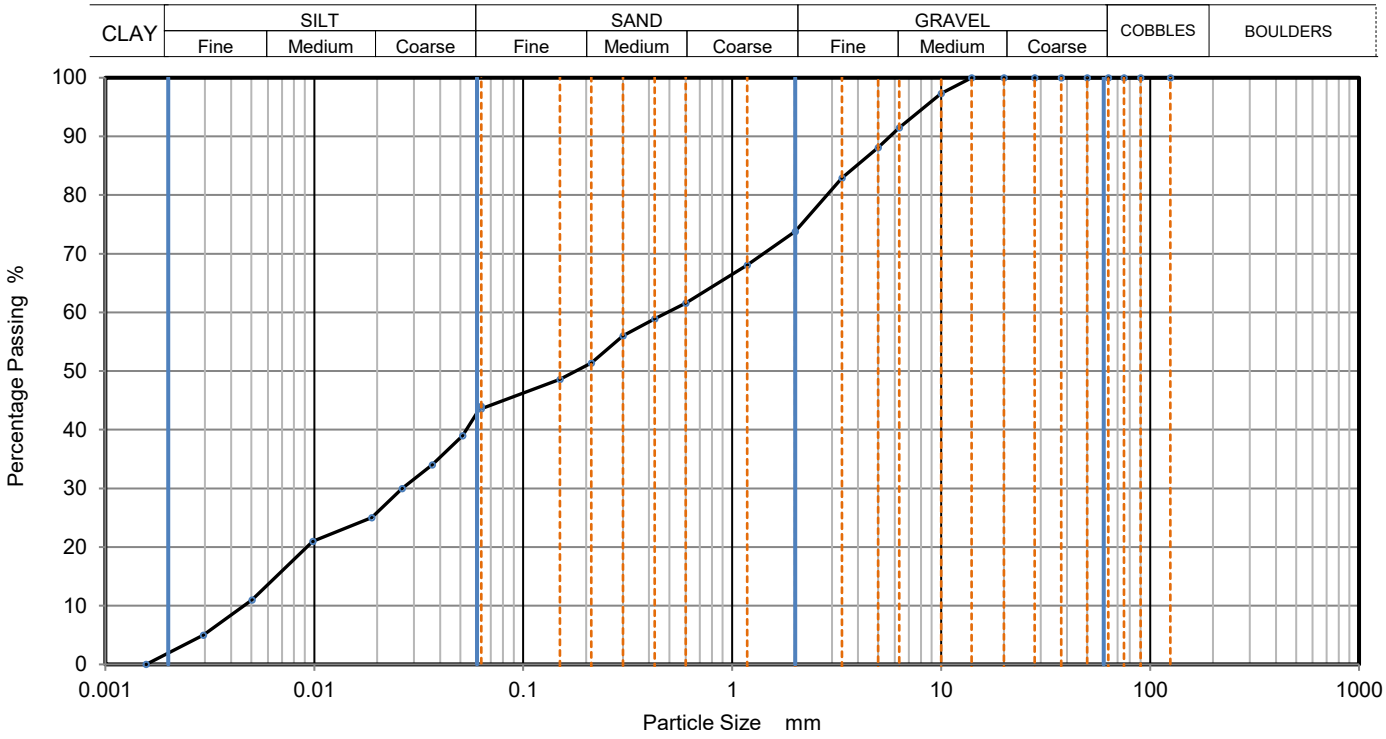
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	BH03
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	9
Soil Description	Brown sandy gravelly CLAY.			Depth, m	3.00
Specimen Reference	6	Specimen Depth	3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2019022812



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	44
90	100	0.0513	39
75	100	0.0367	34
63	100	0.0263	30
50	100	0.0188	25
37.5	100	0.0098	21
28	100	0.0050	11
20	100	0.0029	5
14	100	0.0016	0
10	97		
6.3	92		
5	88		
3.35	83		
2	74		
1.18	68		
0.6	62	Particle density	(assumed)
0.425	59	2.65	Mg/m3
0.3	56		
0.212	51		
0.15	49		
0.063	44		

Dry Mass of sample, g	522

Sample Proportions	% dry mass
Cobbles	0
Gravel	26
Sand	30
Silt	42
Clay	2

Grading Analysis		
D100	mm	
D60	mm	0.49
D30	mm	0.0266
D10	mm	0.00448
Uniformity Coefficient		110
Curvature Coefficient		0.32

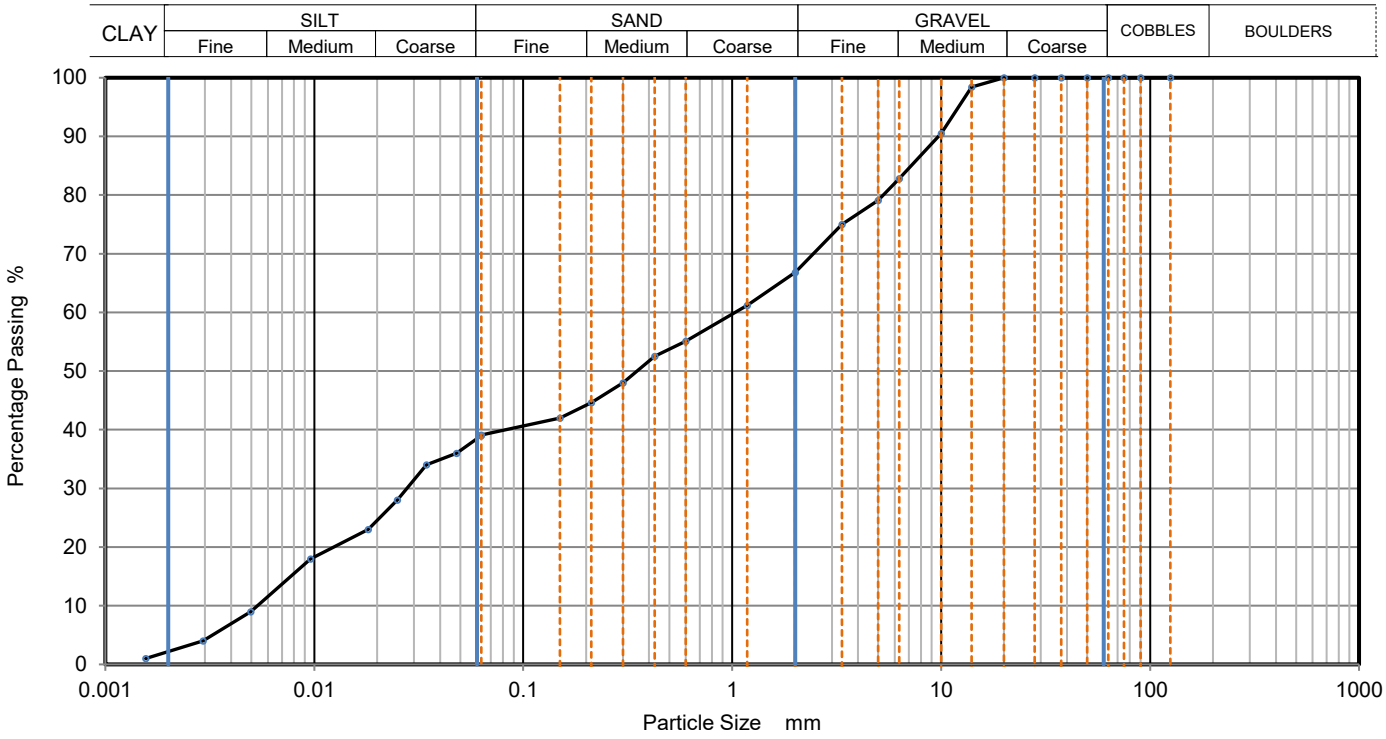
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-1169B**
				Borehole/Pit No.	BH04
Site Name	143 and 175 Merrion Road, Dublin			Sample No.	6
Soil Description	Brown sandy gravelly CLAY.			Depth, m	3.00
Specimen Reference	6	Specimen Depth	3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2019022814



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	39
90	100	0.0480	36
75	100	0.0344	34
63	100	0.0250	28
50	100	0.0181	23
37.5	100	0.0096	18
28	100	0.0050	9
20	100	0.0029	4
14	98	0.0016	1
10	91		
6.3	83		
5	79		
3.35	75		
2	67		
1.18	61		
0.6	55	Particle density	(assumed)
0.425	53	2.65	Mg/m3
0.3	48		
0.212	45		
0.15	42		
0.063	39		

Dry Mass of sample, g: 542

Sample Proportions	% dry mass
Cobbles	0
Gravel	33
Sand	28
Silt	37
Clay	2

Grading Analysis		
D100	mm	
D60	mm	1.03
D30	mm	0.0276
D10	mm	0.0052
Uniformity Coefficient		200
Curvature Coefficient		0.14

Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

UKAS TESTING

Approved
Stephen.Watson

Summary of Laboratory Vane Test Results

Project No.	Project Name
18-1169B	143 and 175 Merrion Road, Dublin

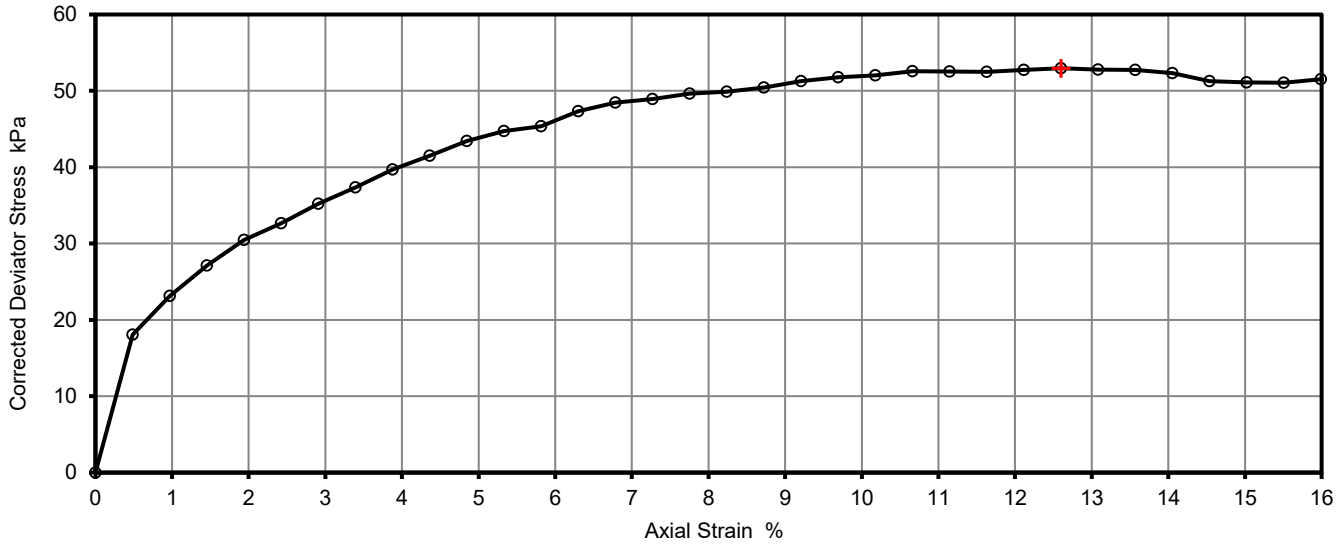
Hole No.	Sample				Soil Description at test horizon	Moisture Content %	Vane shear strength		Sensitivity	Remarks
	Ref	Top	Base	Type			Undisturbed kPa	Remoulded kPa		
BH03	2	4.00		U	Brown sandy slightly gravelly CLAY.	12	33			
BH04	18	4.00		U	Brown sandy gravelly CLAY.	15	45			

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377:Part 7:clause 3 using 19mm x 30mm vane Tests carried out in nominally 100mm diameter tube unless noted otherwise Shear strengths are average of at least 3 tests unless noted otherwise	20/03/2019		1 sheet

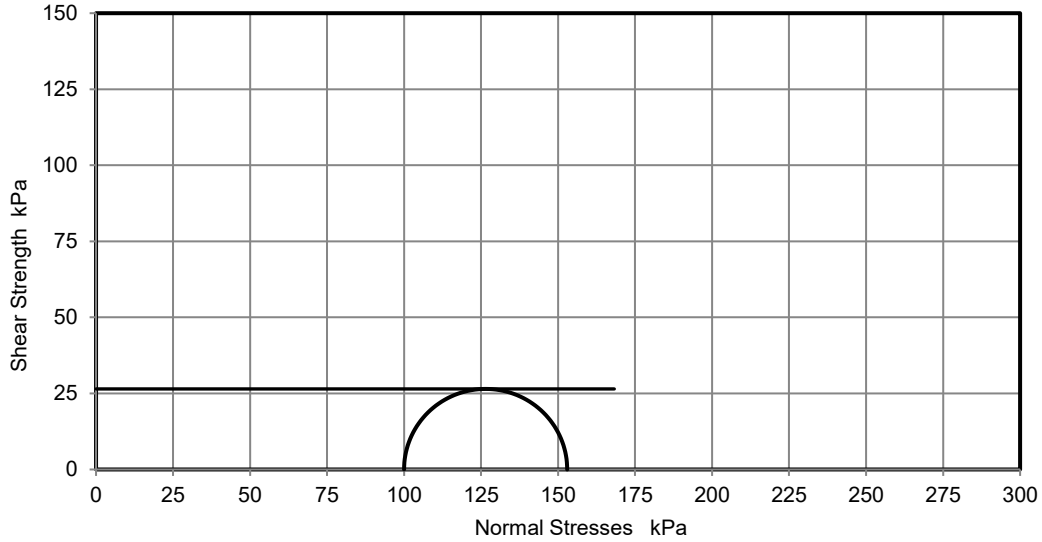
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	18-1169B
					Borehole/Pit No.	BH03
Site Name	143 and 175 Merrion Road, Dublin				Sample No.	2
Soil Description	Brown sandy slightly gravelly CLAY.				Depth	4.00
Specimen Reference	3	Specimen Depth	4.05	m	Sample Type	U
Specimen Description	Soft brown sandy slightly gravelly CLAY.				KeyLAB ID	Caus2019022813
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	19/03/2019

Test Number		1	
Length		206.4	mm
Diameter		105.7	mm
Bulk Density		2.46	Mg/m3
Moisture Content		11.6	%
Dry Density		2.21	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		100	kPa
At failure	Axial Strain	12.6	%
	Deviator Stress, (σ1 - σ3)f	53	kPa
	Undrained Shear Strength, cu	26	kPa ½(σ1 - σ3)f
	Mode of Failure	Plastic	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7.
This is provided for information only.

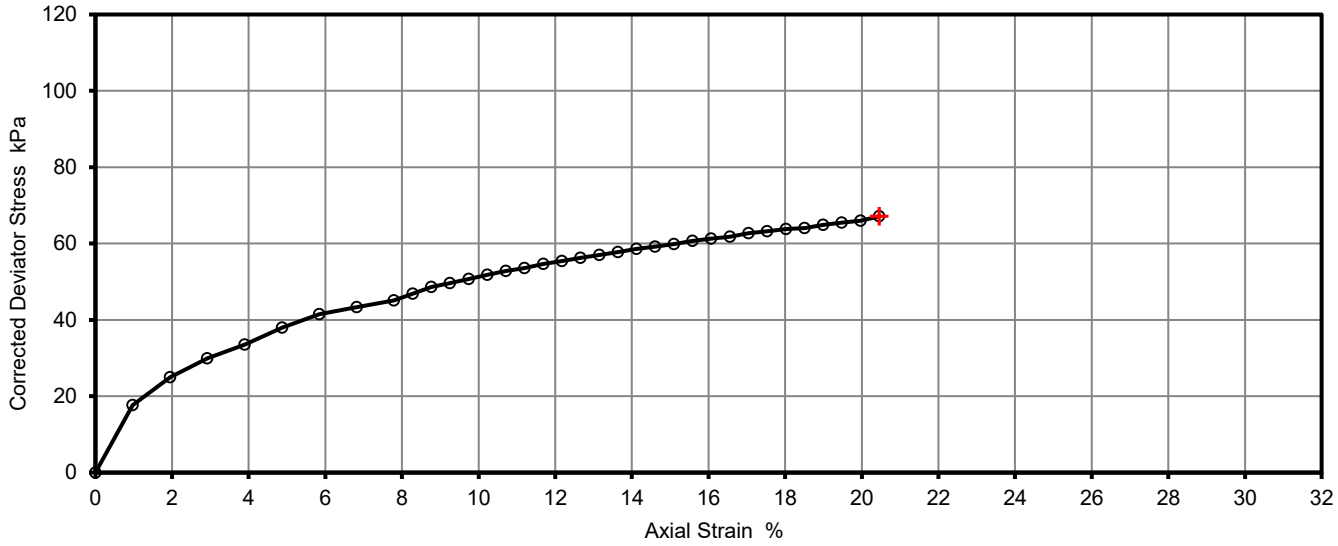
Remarks

Approved	Printed
Stephen.Watson	20/03/2019 13:08

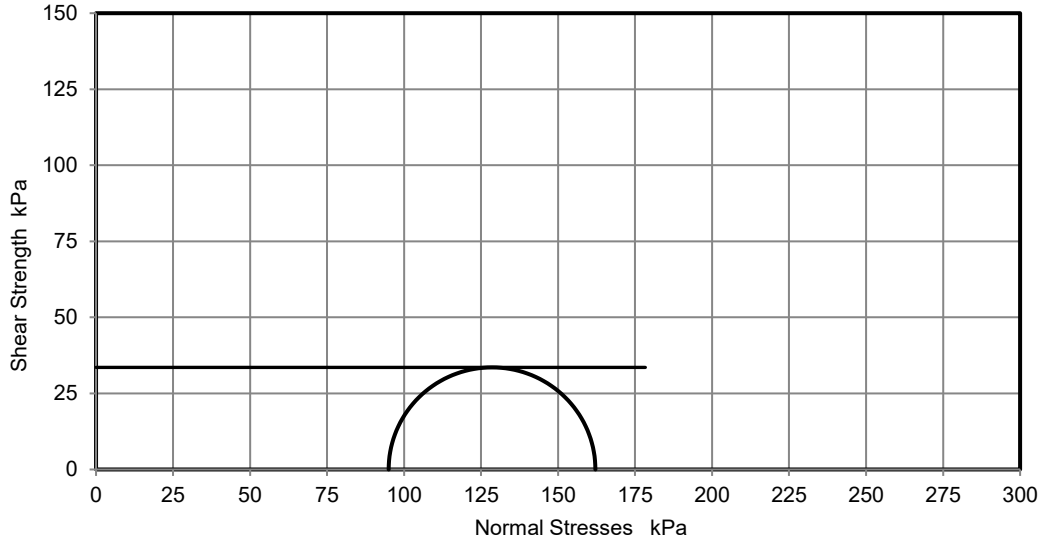
CAUSEWAY GEOTECH	**Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen**				Job Ref	18-1169B
					Borehole/Pit No.	BH04
Site Name	143 and 175 Merrion Road, Dublin				Sample No.	18
Soil Description	Brown sandy gravelly CLAY.				Depth	4.00
Specimen Reference	3	Specimen Depth	4.00	m	Sample Type	U
Specimen Description	Soft brown sandy gravelly CLAY.				KeyLAB ID	Caus2019022815
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	15/03/2019

Test Number		1	
Length		205.3	mm
Diameter		104.3	mm
Bulk Density		2.36	Mg/m3
Moisture Content		14.8	%
Dry Density		2.05	Mg/m3
Rate of Strain		2.0	%/min
Cell Pressure		95	kPa
At failure	Axial Strain	20.5	%
	Deviator Stress, (σ1 - σ3)f	67	kPa
	Undrained Shear Strength, cu	34	kPa ½(σ1 - σ3)f
	Mode of Failure		

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7.
This is provided for information only.

Remarks

Testing terminated at 20% strain

Approved: Stephen.Watson

Printed: 20/03/2019 13:08

LABORATORY REPORT

4043

Contract Number: PSL19/1567

Report Date: 18 March 2019

Client's Reference: 18-1169B

Client Name: Causeway Geotech
8 Drumahiskey Road
Ballymoney
Co.Antrim
BT53 7QL

For the attention of: Stephen Watson

Contract Title: 143 and 175 Merrion Road, Dublin

Date Received: 8/3/2019
Date Commenced: 8/3/2019
Date Completed: 18/3/2019

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)	A Watkins (Director)	R Berriman (Quality Manager)
S Royle (Laboratory Manager)	S Eyre (Senior Technician)	L Knight (Senior Technician)

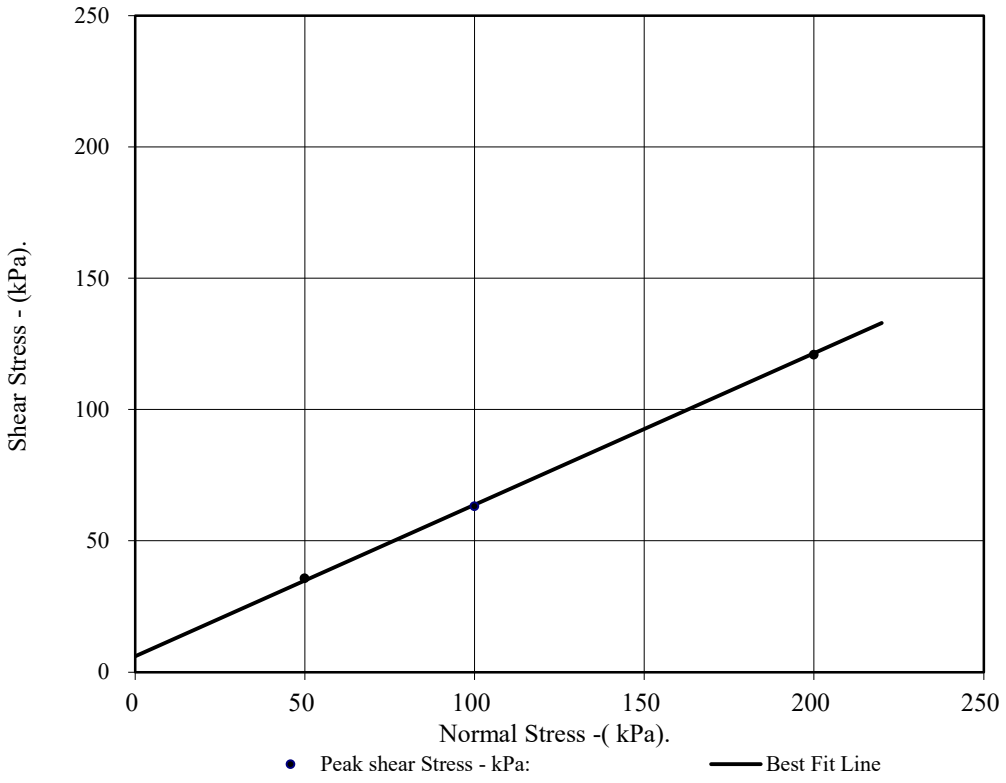
5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	**BH02**		Top Depth:	**2.00**
Sample Number:	**7**		Base Depth:	
Sample Conditions:	Submerged		Sample Type	**B**
Particle Density - Mg/m3:	2.65	Assumed	**Remarks:**	
Sample Preparation:	Material tested passing 2mm sieve Remoulded using 2.5kg effort			
Sample Description:	**Grey gravelly very sandy CLAY**			

STAGE	**1**	**2**	**3**
Initial Conditions			
Height - mm:	20.01	20.01	20.01
Length - mm:	59.95	59.95	59.95
Moisture Content - %:	11	11	11
Bulk Density - Mg/m3:	2.14	2.13	2.12
Dry Density - Mg/m3:	1.93	1.91	1.90
Voids Ratio:	0.372	0.384	0.392
Normal Pressure- kPa	50	100	200
Consolidation Stage			
Consolidated Height - mm:	19.02	18.53	18.07
Shearing Stage			
Rate of Strain (mm/min)	0.050	0.050	0.050
Displacement at peak shear stress (mm)	3.46	4.66	4.46
Peak shear Stress - kPa:	36	63	121
Final Consolidated Conditions			
Moisture Content - %:	15	15	14
Bulk Density - Mg/m3:	2.26	2.30	2.35
Dry Density - Mg/m3:	1.96	2.00	2.06
Peak			
Angle of Shearing Resistance:(~~θ~~)	**30**		
Effective Cohesion - kPa:	**6**		

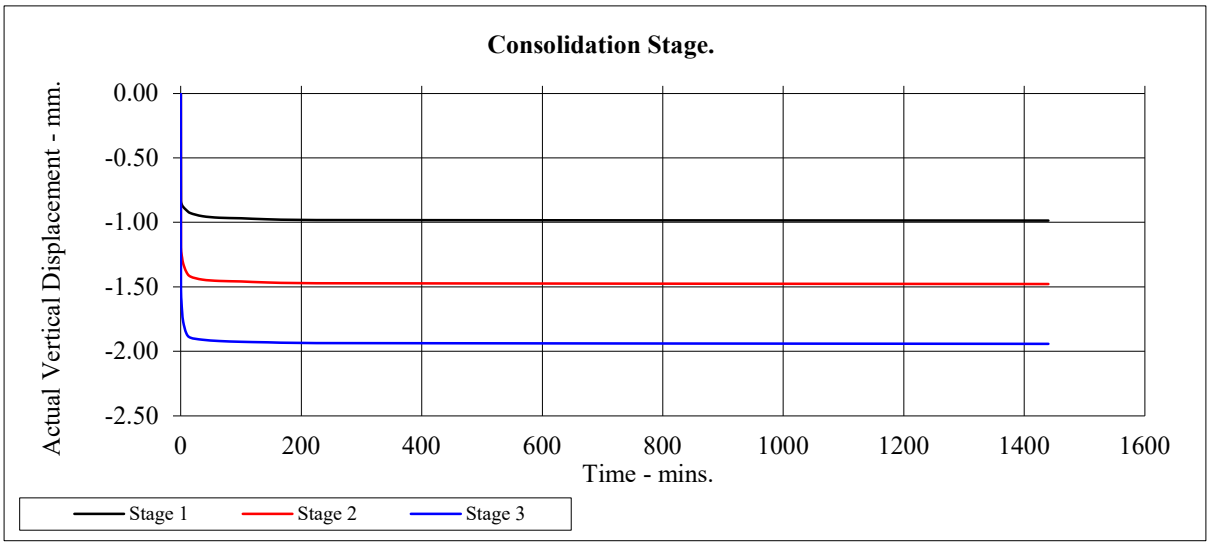


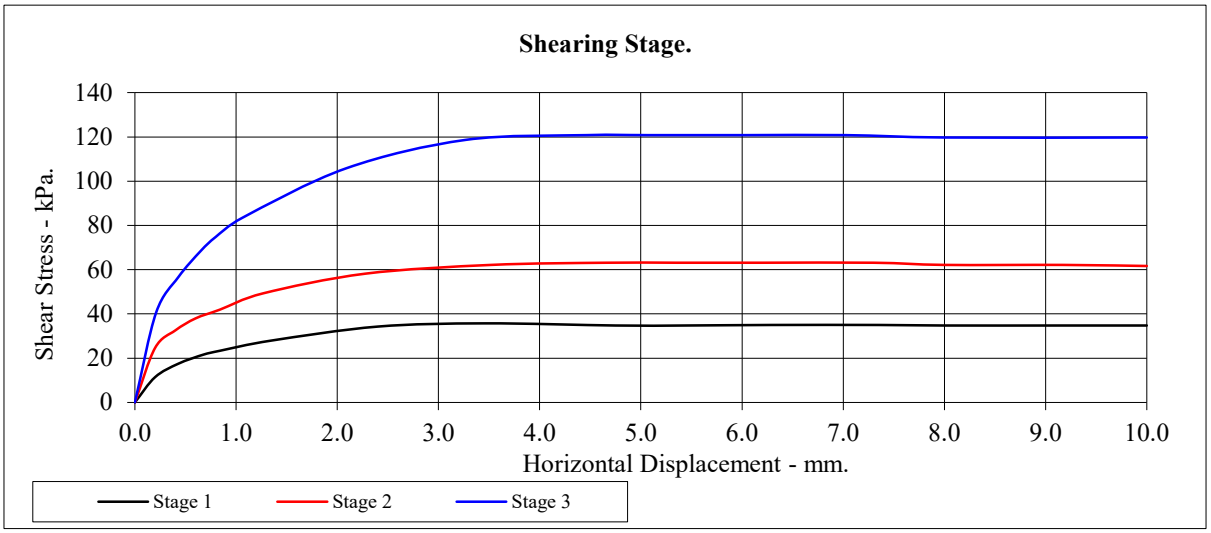
UKAS TESTING 4043	PSL Professional Soils Laboratory	**143 and 175 Merrion Road, Dublin**	**Contract No:** PSL19/1567 **Client Ref:** 18-1169B

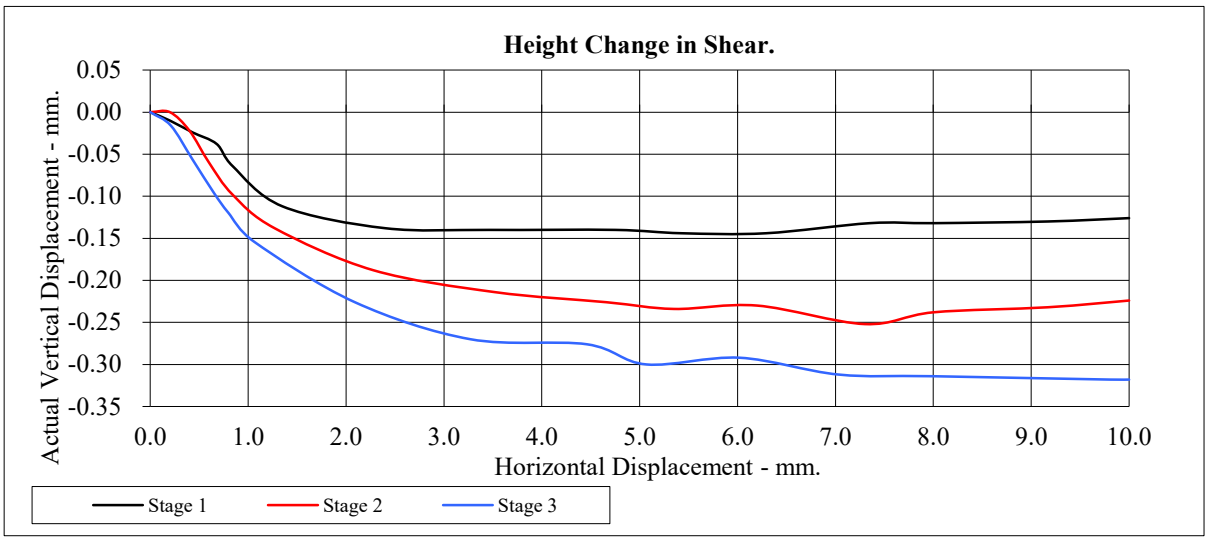
CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4

Hole Number:	**BH02**	Top Depth:	**2.00**
Sample Number:	**7**	Base Depth:	







UKAS TESTING 4043	PSL Professional Soils Laboratory	**143 and 175 Merrion Road, Dublin**	**Contract No: PSL19/1567** **Client Ref: 18-1169B**

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.: 19-09821-1

Initial Date of Issue: 26-Mar-2019

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

Contact(s): Carin Cornwall
Colm Hurley
Darren O'Mahony
Gabriella Horan
John Cameron
Lucy Newland
Matthew Gilbert
Neil Haggan
Paul Dunlop
Paul McNamara
Sean Ross
Stephen Franey
Stephen McCracken
Stephen Watson
Stuart Abraham

Project 18-1169B - 143 and 175 Merrion Road

Quotation No.:		**Date Received:**	20-Mar-2019
Order No.:		**Date Instructed:**	20-Mar-2019
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	28-Mar-2019
Date Approved:	26-Mar-2019		

Approved By:

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

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 18-1169B - 143 and 175 Merrion Road

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		19-09821
Quotation No.:			**Chemtest Sample ID.:**		796671
Order No.:			Client Sample Ref.:		8
			Sample Location:		BH03
			Sample Type:		SOIL
			Top Depth (m):		2.00
			Date Sampled:		19-Mar-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.020	21
pH	U	2010		N/A	8.4
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Sulphate (Acid Soluble)	U	2430	%	0.010	0.087
Organic Matter	U	2625	%	0.40	4.5

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

LABORATORY RESTRICTION REPORT

Project Reference	18-1169B	To	Sean Ross
Project Name	Merrion Road	Position	Project Manager
TR reference	18-1169B / 1	From	Stephen Watson
		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 Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
BH02	17	4	U	UU Triaxial Lab Vane	Unable to obtain test specimen. Material had high gravel content. Sample too broken & disturbed on extrusion	Cancel

For electronic reporting a form of electronic signature or printed name is acceptable

Laboratory Signature Stephen Watson	Project Manager Signature Sean Ross
Date 18 March 2019	Date 18 March 2019

APPENDIX F

ENVIRONMENTAL LABORATORY TEST RESULTS

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

UKAS TESTING
2183

Final Report

Report No.: 19-04477-1

Initial Date of Issue: 18-Feb-2019

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

Contact(s): Carin Cornwall
Colm Hurley
Darren O'Mahony
Gabriella Horan
John Cameron
Lucy Newland
Lucy Peaker
Matthew Gilbert
Neil Haggan
Paul Dunlop
Paul McNamara
Sean Ross
Stephen Franey
Stephen Watson
Stuart Abraham

Project 18-1169 Merrion Road

Quotation No.: Q18-13245 **Date Received:** 07-Feb-2019

Order No.: **Date Instructed:** 07-Feb-2019

No. of Samples: 17

Turnaround (Wkdays): 4 **Results Due:** 12-Feb-2019

Date Approved: 18-Feb-2019

Approved By:

Details: Glynn Harvey, Laboratory Manager

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

Results - Soil

Project: 18-1169 Merrion Road

Client: Causeway Geotech Ltd				Chemtest Job No.:	19-04477	19-04477	19-04477	19-04477	19-04477	19-
Quotation No.: Q18-13245				Chemtest Sample ID.:	769447	769448	769450	769451	769452	76
				Sample Location:	TP01A	TP01A	TP01A	TP02A	TP02A	TP
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	S
				Top Depth (m):	0.5	1.0	3.0	0.5	1.0	
				Date Sampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Fe
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COV
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-	-	-	
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No A Det
ACM Detection Stage	U	2192		N/A	-	-	-	-	-	
Moisture	N	2030	%	0.020	15	18	7.9	16	16	
pH	U	2010		N/A	8.0	7.9	8.4	8.5	8.5	
Arsenic	U	2450	mg/kg	1.0	15	11	16	23	18	
Barium	U	2450	mg/kg	10	70	72	69	170	120	
Cadmium	U	2450	mg/kg	0.10	1.4	1.2	2.2	1.2	2.6	
Chromium	U	2450	mg/kg	1.0	18	17	13	16	13	
Molybdenum	U	2450	mg/kg	2.0	3.5	3.5	4.3	3.1	4.8	
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0	2.1	2.5	2.4	
Copper	U	2450	mg/kg	0.50	21	22	27	31	25	
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.54	< 0.10	<
Nickel	U	2450	mg/kg	0.50	36	32	42	33	50	
Lead	U	2450	mg/kg	0.50	24	18	17	330	23	
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	1.3	< 0.20	< 0.20	
Zinc	U	2450	mg/kg	0.50	82	86	79	120	81	
Chromium (Trivalent)	N	2490	mg/kg	1.0	18	17	13	16	13	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<
Total Organic Carbon	U	2625	%	0.20	0.81	0.74	0.63	1.9	0.35	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	23	< 1.0	<
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	23	< 5.0	<
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	22	< 1.0	<
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	22	< 5.0	<

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Neil Burrows
Southern Testing Laboratories
Unit 11
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref:	0209
Test Date:	23/02/2019
Report Date:	26/02/2019
File Name:	0209.spt
Test Operator:	NPB

Instrumented Rod Data

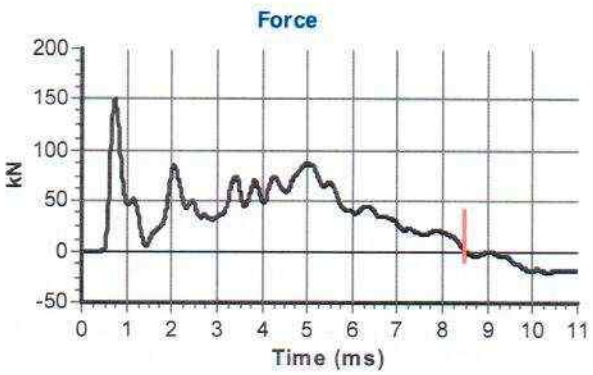
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

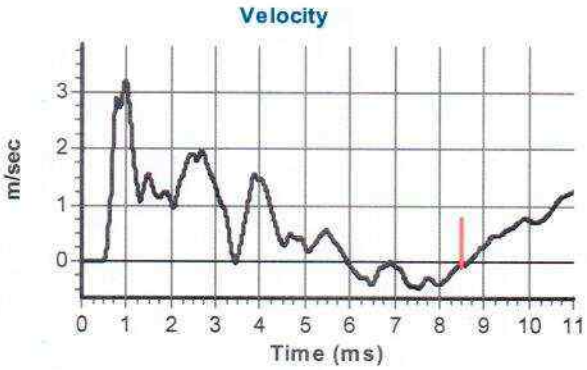
SPT Hammer Information

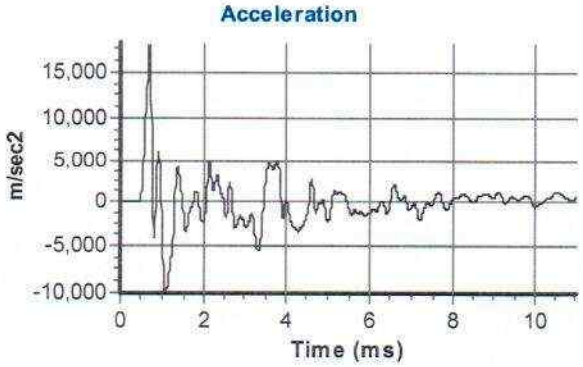
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

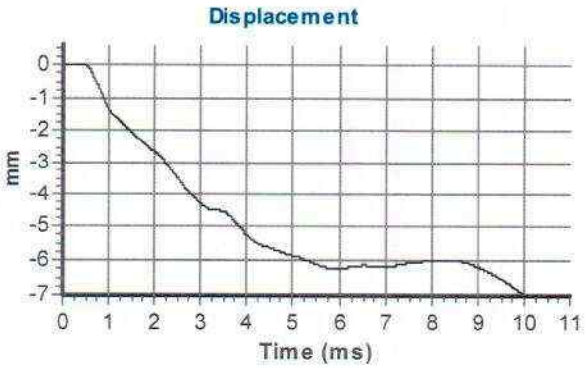
Comments / Location

CAUSEWAY









Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	330

Energy Ratio E_r (%): **70**

N P Burrows

Signed: N P Burrows

Title: Field Operations Manager

The recommended calibration interval is 12 months

Results - Soil

Project: 18-1169 Merrion Road

Client: Causeway Geotech Ltd				Chemtest Job No.:	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477
Quotation No.: Q18-13245				Chemtest Sample ID.:	769447	769448	769450	769451	769452	769454	769455	769456	769458
				Sample Location:	TP01A	TP01A	TP01A	TP02A	TP02A	TP02A	TP03A	TP03A	TP03A
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.0	3.0	0.5	1.0	3.0	0.5	1.0	3.0
				Date Sampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-	-	-	-	-	-	-
Moisture	N	2030	%	0.020	15	18	7.9	16	16	9.9	17	18	7.7
pH	U	2010		N/A	8.0	7.9	8.4	8.5	8.5	8.7	8.5	8.5	8.5
Arsenic	U	2450	mg/kg	1.0	15	11	16	23	18	18	17	17	17
Barium	U	2450	mg/kg	10	70	72	69	170	120	61	110	50	53
Cadmium	U	2450	mg/kg	0.10	1.4	1.2	2.2	1.2	2.6	2.2	1.2	1.9	1.7
Chromium	U	2450	mg/kg	1.0	18	17	13	16	13	13	17	17	14
Molybdenum	U	2450	mg/kg	2.0	3.5	3.5	4.3	3.1	4.8	5.3	3.4	5.0	3.9
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0	2.1	2.5	2.4	2.2	2.0	2.3	< 2.0
Copper	U	2450	mg/kg	0.50	21	22	27	31	25	29	25	25	24
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.54	< 0.10	< 0.10	0.65	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	36	32	42	33	50	47	32	49	39
Lead	U	2450	mg/kg	0.50	24	18	17	330	23	19	140	21	24
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	1.3	< 0.20	< 0.20	1.9	0.20	< 0.20	1.6
Zinc	U	2450	mg/kg	0.50	82	86	79	120	81	79	98	83	68
Chromium (Trivalent)	N	2490	mg/kg	1.0	18	17	13	16	13	13	17	17	14
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Organic Carbon	U	2625	%	0.20	0.81	0.74	0.63	1.9	0.35	1.0	1.6	0.27	0.73
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	23	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	23	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	22	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	22	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 18-1169 Merrion Road

Client: Causeway Geotech Ltd				**Chemtest Job No.:**	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477
Quotation No.: Q18-13245				**Chemtest Sample ID.:**	769447	769448	769450	769451	769452	769454	769455	769456	769458
				Sample Location:	TP01A	TP01A	TP01A	TP02A	TP02A	TP02A	TP03A	TP03A	TP03A
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.0	3.0	0.5	1.0	3.0	0.5	1.0	3.0
				Date Sampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	45	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	29	34	26	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	22	120	100	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	22	67	40	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	25	160	57	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	45	210	53	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	8.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.61	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.18	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.16	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 18-1169 Merrion Road

Client: Causeway Geotech Ltd				**Chemtest Job No.:**	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477
Quotation No.: Q18-13245				**Chemtest Sample ID.:**	769459	769460	769461	769462	769463	769464	769465	769466
				Sample Location:	TP01B	TP01B	TP02B	TP02B	TP03B	TP03B	TP04B	TP04B
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
				Date Sampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-	-	-	-	-	-
Moisture	N	2030	%	0.020	8.0	12	19	17	22	12	17	12
pH	U	2010		N/A	8.8	8.4	8.1	8.1	7.8	8.6	8.2	8.5
Arsenic	U	2450	mg/kg	1.0	22	28	75	47	42	26	32	22
Barium	U	2450	mg/kg	10	81	79	67	140	220	75	100	62
Cadmium	U	2450	mg/kg	0.10	0.99	1.5	0.92	2.8	1.9	2.4	2.1	2.4
Chromium	U	2450	mg/kg	1.0	12	19	13	28	24	17	22	15
Molybdenum	U	2450	mg/kg	2.0	2.5	4.0	3.3	5.3	5.7	5.3	4.0	4.7
Antimony	N	2450	mg/kg	2.0	< 2.0	2.6	3.0	5.0	4.7	2.9	3.9	2.6
Copper	U	2450	mg/kg	0.50	19	35	40	65	83	38	120	35
Mercury	U	2450	mg/kg	0.10	0.25	0.60	0.67	1.2	1.7	0.13	0.57	0.11
Nickel	U	2450	mg/kg	0.50	25	47	33	100	72	61	59	57
Lead	U	2450	mg/kg	0.50	69	110	140	180	350	35	130	20
Selenium	U	2450	mg/kg	0.20	< 0.20	0.68	0.69	0.89	1.2	0.57	0.81	0.39
Zinc	U	2450	mg/kg	0.50	58	110	94	270	300	87	160	84
Chromium (Trivalent)	N	2490	mg/kg	1.0	12	19	13	28	24	17	22	15
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Organic Carbon	U	2625	%	0.20	2.2	3.0	3.0	3.6	5.9	0.41	3.4	0.50
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	5.4	5.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	66	38	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	71	43	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	1.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	29	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	180	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	880	62	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	30	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	1100	72	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

Results - Soil

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Client: Causeway Geotech Ltd					Chemtest Job No.:	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477	19-04477
Quotation No.: Q18-13245					Chemtest Sample ID.:	769459	769460	769461	769462	769463	769464	769465	769466
					Sample Location:	TP01B	TP01B	TP02B	TP02B	TP03B	TP03B	TP04B	TP04B
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
					Date Sampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019
					Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		1200	110	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0		< 1.0	< 1.0	3.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10		0.11	0.43	< 0.10	0.13	0.54	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10		< 0.10	< 0.10	< 0.10	0.10	0.23	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10		0.40	1.1	< 0.10	1.6	0.91	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10		0.45	1.1	< 0.10	0.95	0.56	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10		5.6	10	2.2	18	7.4	< 0.10	0.24	< 0.10
Anthracene	U	2800	mg/kg	0.10		0.90	1.6	0.39	2.2	1.7	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10		7.1	12	3.7	17	13	< 0.10	0.16	< 0.10
Pyrene	U	2800	mg/kg	0.10		6.3	11	3.0	15	13	< 0.10	0.13	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10		2.7	4.3	0.95	4.0	6.5	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10		3.6	5.7	1.4	5.6	8.0	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10		3.0	5.3	0.93	4.2	8.4	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10		0.86	1.5	0.21	1.0	2.9	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10		2.0	3.9	0.51	2.5	7.1	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10		0.74	1.9	0.13	1.0	3.6	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	0.16	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10		0.75	1.9	0.13	1.0	3.7	< 0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0		35	62	14	74	78	< 2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010		< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	N	2815	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

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					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769447						
Sample Ref:							
Sample ID:							
Sample Location:	TP01A						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.81	3	5	6
Loss On Ignition	2610	U	%	2.7	--	--	10
Total BTEX	2760	U	mg/kg	0.14	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.14	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.10	1.0	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	27	270	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	9.4	94	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	15

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769448						
Sample Ref:							
Sample ID:							
Sample Location:	TP01A						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.74	3	5	6
Loss On Ignition	2610	U	%	2.8	--	--	10
Total BTEX	2760	U	mg/kg	0.59	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		7.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.027	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.10	1.0	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	14	140	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	9.6	96	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	18

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769450						
Sample Ref:							
Sample ID:							
Sample Location:	TP01A						
Top Depth(m):	3.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.63	3	5	6
Loss On Ignition	2610	U	%	2.0	--	--	10
Total BTEX	2760	U	mg/kg	0.28	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.16	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0036	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0026	0.026	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.11	1.1	10	150	500
Sulphate	1220	U	3.7	37	1000	20000	50000
Total Dissolved Solids	1020	N	33	330	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.8	58	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	7.9

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

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					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769451						
Sample Ref:							
Sample ID:							
Sample Location:	TP02A						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	1.9	3	5	6
Loss On Ignition	2610	U	%	4.3	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	42	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.37	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	0.0015	< 0.050	0.5	2	25
Barium	1450	U	0.0033	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0025	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	0.0013	0.013	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0011	0.011	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	3.2	32	1000	20000	50000
Total Dissolved Solids	1020	N	42	420	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.9	89	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	16

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769452						
Sample Ref:							
Sample ID:							
Sample Location:	TP02A						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.35	3	5	6
Loss On Ignition	2610	U	%	1.8	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.12	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0027	< 0.50	20	100	300
Cadmium	1450	U	0.00012	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0011	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	7.4	74	800	15000	25000
Fluoride	1220	U	0.11	1.1	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	27	270	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.3	53	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	16

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769454						
Sample Ref:							
Sample ID:							
Sample Location:	TP02A						
Top Depth(m):	3.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	1.0	3	5	6
Loss On Ignition	2610	U	%	2.2	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.15	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0012	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0015	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.13	1.3	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	31	310	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.9	59	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	9.9

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769455						
Sample Ref:							
Sample ID:							
Sample Location:	TP03A						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	1.6	3	5	6
Loss On Ignition	2610	U	%	3.0	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.35	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0013	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0037	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.13	1.3	10	150	500
Sulphate	1220	U	3.3	33	1000	20000	50000
Total Dissolved Solids	1020	N	38	380	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.9	69	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	17

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769456						
Sample Ref:							
Sample ID:							
Sample Location:	TP03A						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	0.27	3	5	6
Loss On Ignition	2610	U	%	1.3	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.087	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0014	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.11	1.1	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	27	270	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.2	82	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	18

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769458						
Sample Ref:							
Sample ID:							
Sample Location:	TP03A						
Top Depth(m):	3.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.73	3	5	6
Loss On Ignition	2610	U	%	1.5	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.40	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0013	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0031	0.031	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.14	1.4	10	150	500
Sulphate	1220	U	5.5	55	1000	20000	50000
Total Dissolved Solids	1020	N	36	360	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.9	59	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	7.7

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769459						
Sample Ref:							
Sample ID:							
Sample Location:	TP01B						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	2.2	3	5	6
Loss On Ignition	2610	U	%	3.3	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	1200	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	35	100	--	--
pH	2010	U		8.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.29	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0028	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	1.3	13	1000	20000	50000
Total Dissolved Solids	1020	N	44	440	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.6	86	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	8.0

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769460						
Sample Ref:							
Sample ID:							
Sample Location:	TP01B						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.0	3	5	6
Loss On Ignition	2610	U	%	4.9	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	120	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	62	100	--	--
pH	2010	U		8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.12	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	3.1	31	1000	20000	50000
Total Dissolved Solids	1020	N	40	400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	9.0	90	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	12

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769461						
Sample Ref:							
Sample ID:							
Sample Location:	TP02B						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.0	3	5	6
Loss On Ignition	2610	U	%	4.7	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	14	100	--	--
pH	2010	U		8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.43	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 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	2.0	20	1000	20000	50000
Total Dissolved Solids	1020	N	25	250	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.3	83	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	19

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769458						
Sample Ref:							
Sample ID:							
Sample Location:	TP03A						
Top Depth(m):	3.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.73	3	5	6
Loss On Ignition	2610	U	%	1.5	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.40	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0013	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	0.0031	0.031	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.14	1.4	10	150	500
Sulphate	1220	U	5.5	55	1000	20000	50000
Total Dissolved Solids	1020	N	36	360	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.9	59	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	7.7

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769462						
Sample Ref:							
Sample ID:							
Sample Location:	TP02B						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.6	3	5	6
Loss On Ignition	2610	U	%	6.8	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	74	100	--	--
pH	2010	U		8.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.19	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.21	2.1	10	150	500
Sulphate	1220	U	2.0	20	1000	20000	50000
Total Dissolved Solids	1020	N	30	300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	8.0	80	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	17

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769463						
Sample Ref:							
Sample ID:							
Sample Location:	TP03B						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	5.9	3	5	6
Loss On Ignition	2610	U	%	9.6	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	78	100	--	--
pH	2010	U		7.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.049	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.15	1.5	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	23	230	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	10	100	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	22

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769464						
Sample Ref:							
Sample ID:							
Sample Location:	TP03B						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.41	3	5	6
Loss On Ignition	2610	U	%	1.8	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.62	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	33	330	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	10	100	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	12

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769465						
Sample Ref:							
Sample ID:							
Sample Location:	TP04B						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.4	3	5	6
Loss On Ignition	2610	U	%	6.2	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.052	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.097	< 1.0	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	27	270	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	15	150	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	17

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Project: 18-1169 Merrion Road

					Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	19-04477						
Chemtest Sample ID:	769466						
Sample Ref:							
Sample ID:							
Sample Location:	TP04B						
Top Depth(m):	1.0						
Bottom Depth(m):							
Sampling Date:	04-Feb-2019				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	0.50	3	5	6
Loss On Ignition	2610	U	%	2.1	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.56	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	< 0.0010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.14	1.4	10	150	500
Sulphate	1220	U	< 1.0	< 10	1000	20000	50000
Total Dissolved Solids	1020	N	35	350	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	14	140	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	12

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

17 Appendix D - Ayesa Ground Movement and Hydrological Assessment

Refer to Ayesa Ground Movement Hydrological Assessment

Basement Impact Assessment (BIA)

Lioncor Merrion Compound

Report No. B2167-AYE-GEO-RP001

04 September 2024

Revision 00

Lioncor

Document Control

Project

Lioncor Merrion Compound

Client

Lioncor

Document

Basement Impact Assessment (BIA)

Report Number:

B2167-AYE-GEO-RP001

Document Checking:

Date	Rev	Details of Issue	Prepared by	Checked by	Approved by
04 Sep 2024	00	Information	Oindrila Das	Keith Jennings	Nick Peters

Disclaimer: Please note that this report is based on specific information, instructions, and information from our Client and should not be relied upon by third parties.

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Contents

[1] Introduction

[1.1] Scope

Ayesa has been requested by Lioncor to complete the Basement Impact Assessment (BIA) for 169-177 Merrion Road, Dublin 4, the Gowan car compound site.

In accordance with the requirements of Appendix 9 of the Dublin City Development Plan (2022-2028), a BIA shall accompany all planning applications that include a basement. This report complies with the requirements of Dublin City Council's (DCC) Basement Impact Requirements. It provides information on the ground and groundwater conditions at the site to assess the impact of the basement on the groundwater regime and neighbouring structures.

The current development includes construction of a residential apartment which will accommodate 200 student bedrooms within a multi-story development and a basement car parking.

The purpose of this BIA is to identify potential short- and long-term impacts, inform as to whether the development incorporating a basement is acceptable and identify appropriate mitigating measures where required.

[1.2] Site Location

The site is located at 169-177 Merrion road in Dublin 4, Dublin. The location is shown in Figure 1-1.

Figure 1-1 Site Location

[1.3] Proposed Development

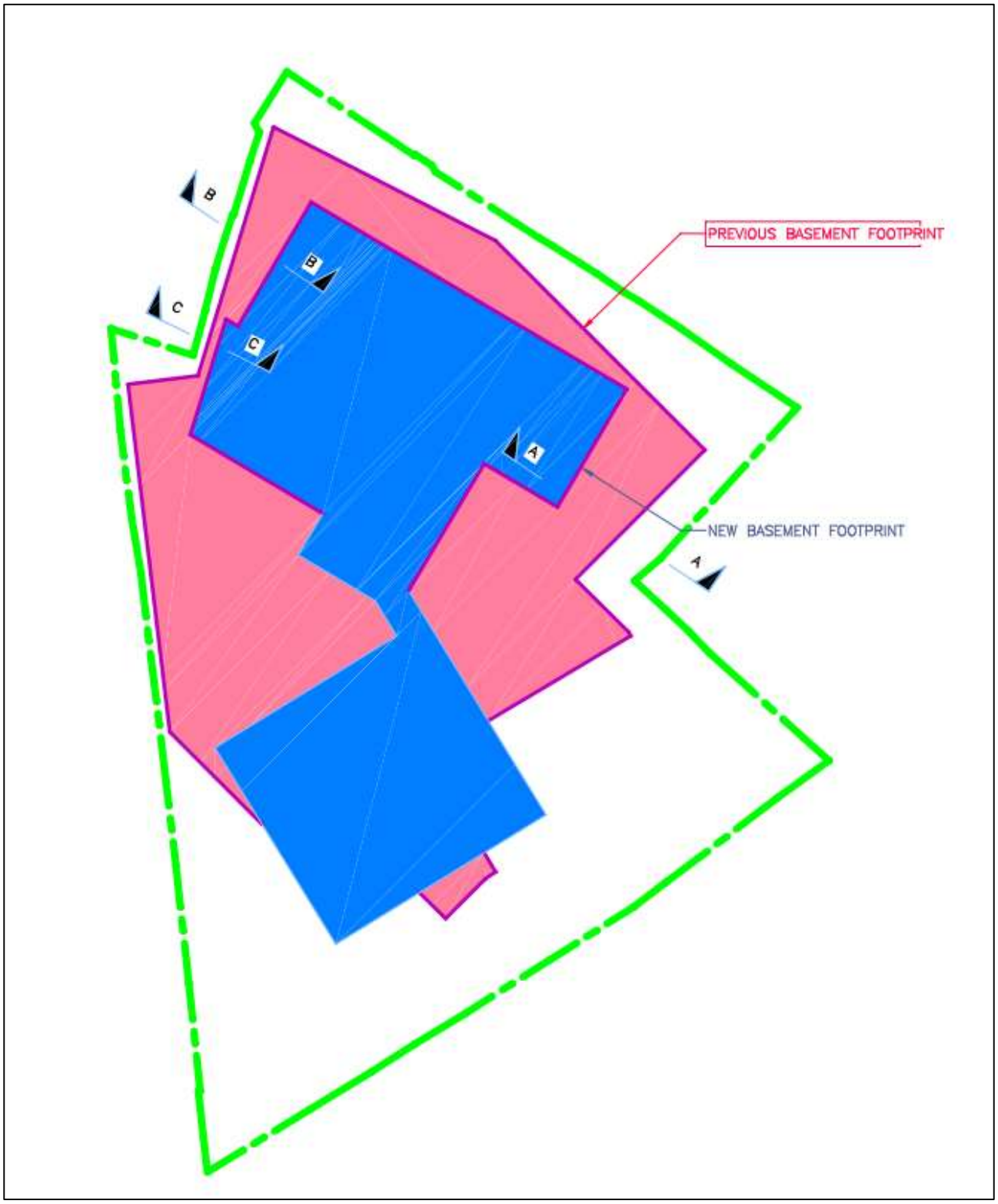


Figure 1-2 Revised Basement (Ref: 24042-X-B01-DR-TNT-SE-3100)

[1.4] Report Limitations

Previously, Ayesa carried out a BIA for the basement with complete desk study and hydrology assessment (Ayesa Report Ref: B1653-GEO-R002_Rev04_169-177 Merrion Road, _Ground Movement & Hydrogeology Assessment). The basement plan has been revised recently. This report complies with the revised basement plan.

The conclusions and recommendations made in this report are limited to those that can be made based on the ground investigations and surveys completed. The results of this work should be viewed in the context of the range of data sources consulted and the number of ground test and sampling locations. No liability can be accepted for information from other data sources or conditions not revealed by the sampling or testing.

The monitoring should be completed over an extended period to record any seasonal variations in groundwater level. Should variations in groundwater level be encountered to assumptions made in this report, a revision to this report will be required. Additionally, where possible, the foundation details of adjacent properties should be investigated and confirmed during the site-specific ground investigation.

[2] Ground Condition

[2.1] General Information

Causeway Geotech Limited completed a ground investigation for the site in February 2019 which has been reviewed with respect to developing a suitable ground model for the assessment. The ground investigation included the following works:

- 4 No. cable percussion boreholes (BH01-BH04)
- 1 No. rotary core boreholes (BH03) (follow-on from cable percussion)
- 4 No. trial pits (TP01-TP04)
- 2 No. standpipe installations to facilitate groundwater monitoring (BH01 & BH04)
- Geotechnical laboratory testing

The findings of above were summarized in Causeway Geotech report 18-1169B. The locations of the ground investigation holes are shown in Figure 2-1.

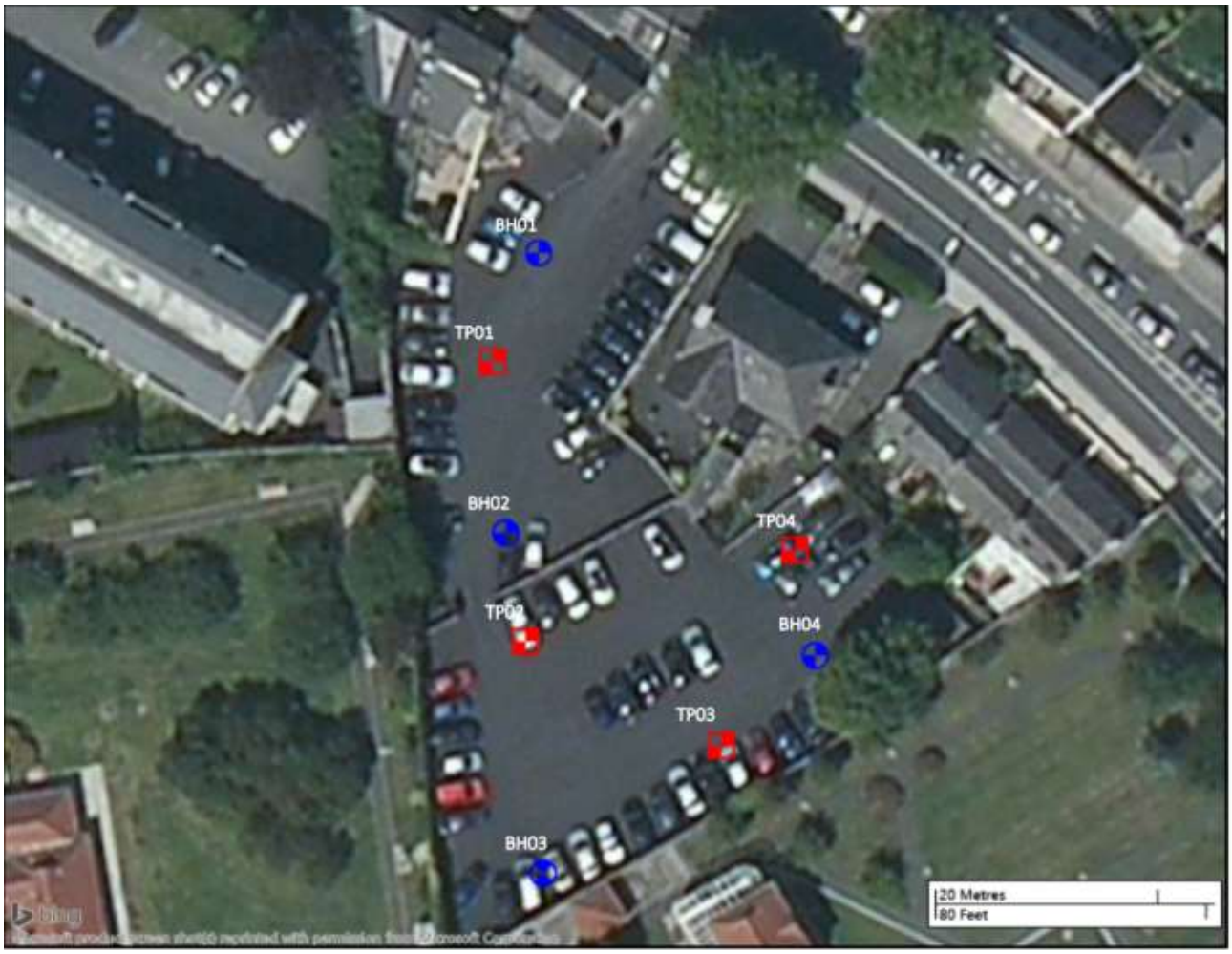


Figure 2-1 Borehole Location

[2.2] Ground Profile

All the boreholes have been considered to prepare the ground profile: -

- **Paved Road**: - The layer is 0.1 m thick and it is described containing paving brick and Bitmac.
- **Made Ground**: - The average thickness of this layer is found to be 2m. The layer is classified as firm slightly sandy slightly gravelly silty CLAY. The layer is described as brownish grey in colour. On the top of firm CLAY layer, a 0.3 m thick layer of greyish brown slightly sandy slightly clayey GRAVEL is noticed.
- **Glacial Till**: - The average thickness of the layer is found to be 4.5 m. The layer is classified as stiff to very stiff slightly sandy slightly gravelly CLAY with low cobble content. The layer is described as grey to blackish grey in colour.
- **Marine Deposit**: - This layer is underlaying the glacial till deposit. The layer is classified as sandy gravelly CLAY with high cobble and boulder content. The layer is described as dark grey to brownish grey in colour.

**Average 1m thick grey sandy clayey silty fine to coarse GRAVEL was noticed sandwiched in between Glacial till in BH01 and BH02.*

Table 2-1 General Ground Profile

Stratum	Depth to Top (mBGL)	Thickness (m)	Elevation (mOD)
Made Ground	0	2	4.0
Glacial Till	2.0	4.5	1.9
Marine Deposit	6.5	~	-2.6

[2.3] Soil Parameter Determination

[2.3.1] SPT Testing

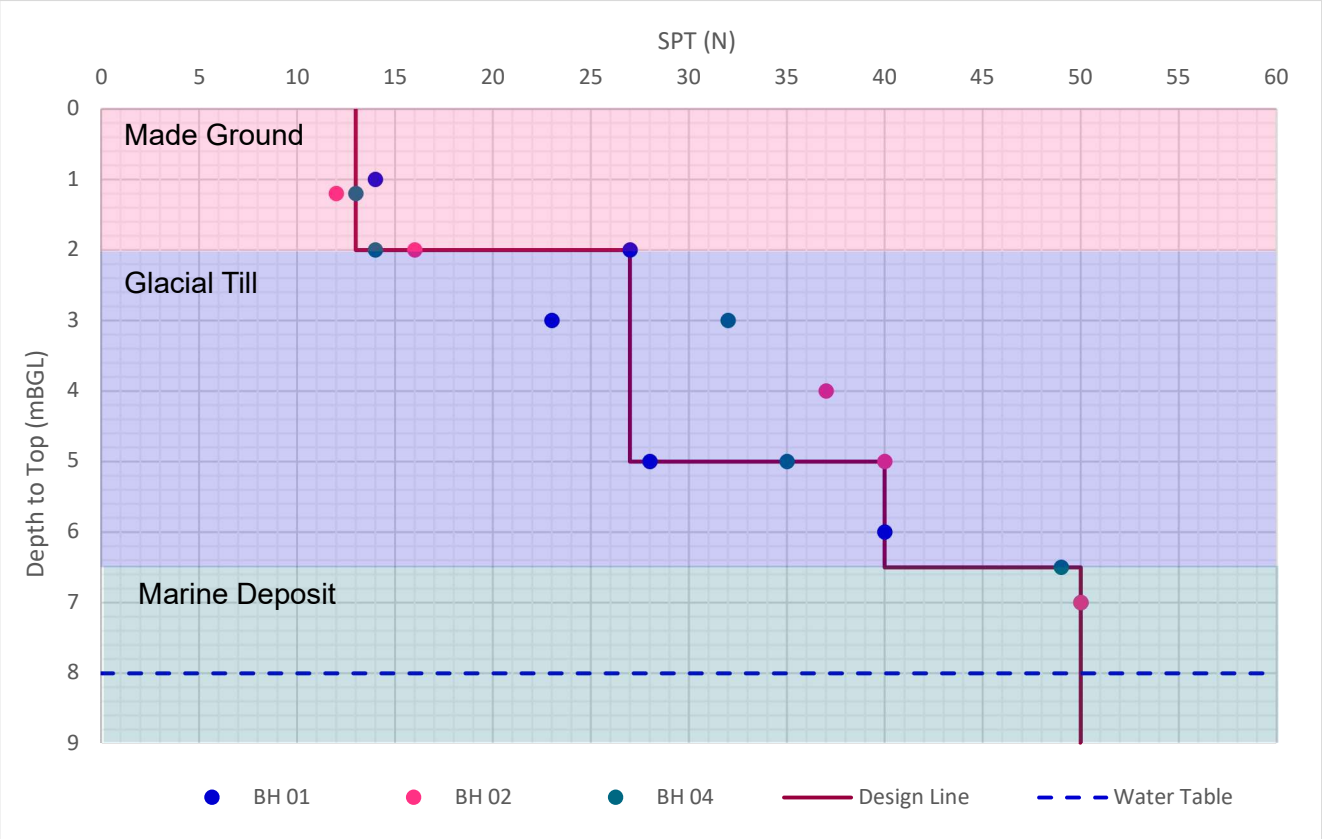


Figure 2-2 SPT (N) vs Depth (mBGL)

[2.3.2] Undrained Shear Strength

As per CIRIA 760, the undrained shear strength of cohesive soil can be calculated based on Stroud (1989) correlation,

$$C_u = f_1 \times N_{60}$$

Where,

C_u = Undrained shear strength of soil (kPa)

f_1 = Depends upon plasticity of the clay (kPa)

N_{60} = Standard Penetration blow count

As shown in Figure 2-3 the value of f_1 can vary from 4kPa to 6 kPa.

For the design purpose, the value of f_1 has been considered as 5 kPa.

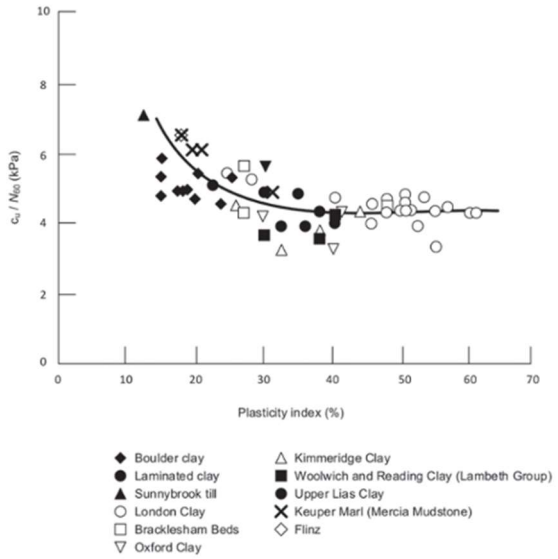


Figure 2-3 Correlation between N60 value and undrained shear strength and plasticity index for insensitive clays (After Stroud and Butler, 1975)

[2.3.3] Soil Stiffness Modulus (E'$_s$, E$_u$)

The soil stiffness modulus (E', E$_u$) was assessed using relationships as set out in CIRIA C760 and based on research conducted by Stroud & Butler (1975), Duncan (1976) and Jamiolkowski (1979).

- For cohesive soils, the undrained stiffness modulus can be taken between $E_u = 250.C_u$ (for normally consolidated soils) to $E_u = 600.C_u$ (for over consolidated soils) as per Figure 2-4 below.
- The drained stiffness modulus for normally consolidated cohesive soils is calculated assuming 80% of the undrained stiffness modulus of Eu (E' = 80% E$_u$).
- The drained stiffness modulus for over consolidated cohesive soils is calculated assuming 66% of the undrained stiffness modulus of Eu (E' = 66% E$_u$).
- For granular soils, the stiffness modulus (E') is calculated as 1000xN for normally consolidated soils (loose) and 2000xN for over consolidated soils (dense).

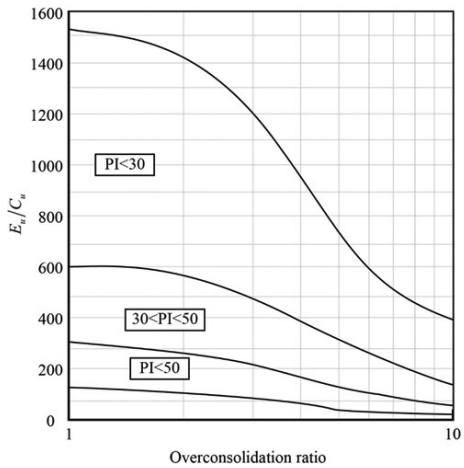


Figure 2-4 Relationship between Eu/Cu versus OCR

[2.3.4] Angle of Internal Friction

- The internal angle of friction of the granular materials can be calculated after the relationship published by Peck, with Figure 2-5 below detailing Peck's relationship between SPT 'N' values and the angle of shearing resistance.

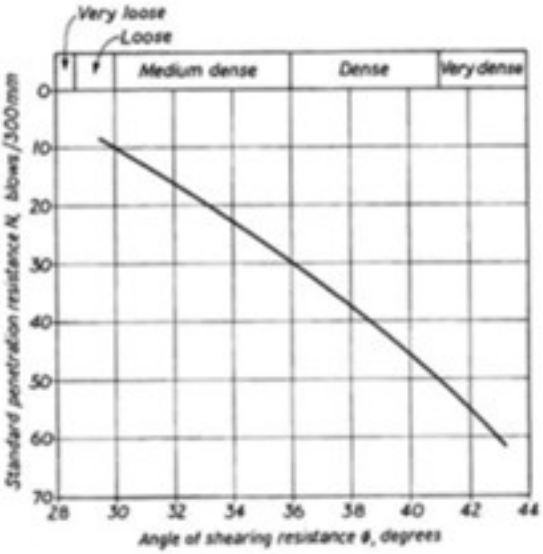


Figure 2-5 Peck's (1974) Relationship between SPT 'N' angle of shearing resistance

- For cohesive soils, an estimation of the angle of shearing resistance (ϕ') was developed using the relationship proposed by Terzaghi, Peck and Mesri (1996) as shown in Figure 2-6 below.

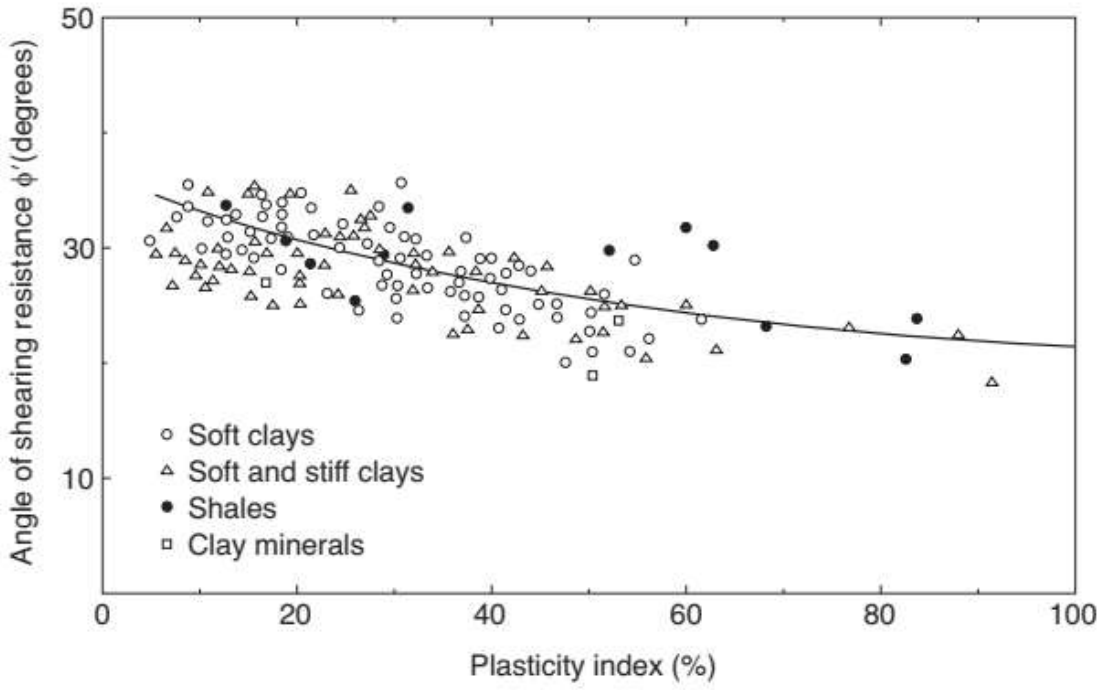


Figure 2-6 Angle of shearing resistance (φ') and plasticity index (%)

[2.4] Soil Parameters of the Site

[2.4.1] Made Ground

As per the Figure 2-2, the adapted SPT of the layer is 13.

This layer has been considered as a normally consolidated layer.

The undrained shear strength, $C_u = 5 \times 13\ kPa = 65\ kPa$

The undrained stiffness modulus, $E_u = 250 \times 65\ kPa = 16.25\ MPa$

The drained stiffness modulus, $E' = 80\% \times E_u = 0.8 \times 16250\ kPa = 13000\ kPa = 13\ MPa$

The angle of shearing resistance as per Figure 2-6 is considered to be 30˚.

[2.4.2] Glacial Till

As per the Figure 2-2, the adapted SPT of the layer is 27.

This layer has been considered as an over consolidated layer.

The undrained shear strength, $C_u = 5 \times 27\ kPa = 135\ kPa$

The undrained stiffness modulus, $E_u = 600 \times 135\ kPa = 81\ MPa$

The drained stiffness modulus, $E' = 66\% \times E_u = 0.66 \times 16250\ kPa = 53460\ kPa = 53.46\ MPa$

The angle of shearing resistance as per Figure 2-6 is considered to be 32˚.

[2.4.3] Marine Deposit

As per the Figure 2-2, the adapted SPT of the layer is 50.

This layer has been considered as an over consolidated layer.

The undrained shear strength, $C_u = 5 \times 50\ kPa = 250\ kPa$

The undrained stiffness modulus, $E_u = 600 \times 250\ kPa = 150\ MPa$

The drained stiffness modulus, $E' = 66\% \times E_u = 0.66 \times 150000\ kPa = 99000\ kPa = 99\ MPa$

The angle of shearing resistance as per Figure 2-6 is considered to be 34˚.

Table 2-2 Characteristic Soil Parameters

Stratum	SPT (N)	Density	Angle of Friction	Undrained		Drained	
		γ (kN/m³)	φ' (˚)	C_u (kPa)	E_u (MPa)	C' (kPa)	E' (MPa)
Made Ground	13	18	28	65	16	-	13
Glacial Till	27	19	30	135	81	-	53
Marine Deposit	50	19	32	250	150	-	99

[2.5] Groundwater

Groundwater was encountered in TP01 at the termination depth of 3m BGL within the boulder CLAY and in BH03 at depth of 8m BGL within the GRAVEL layer. No groundwater was encountered in the other trial pits and boreholes.

Groundwater monitoring was completed on 2No. standpipes installed in BH01 and BH04. Groundwater levels were recorded on two separate occasions in February and March of 2019. The results of the groundwater monitoring are summarised below which indicate shallow water levels. The water levels within these standpipes are perched water within the Sandy Gravelly Clay (boulder clay) or they could be surface water infiltration.

[3] Ground Movement Assessment

[3.1] General

Ayesa has completed a preliminary ground movement assessment of the proposed basement substructure. This substructure will be founded within the Glacial Till strata. The excavation depth is approximately 3.25m BGL.

[3.2] Construction Sequence

An open cut excavation is preferred to be adopted for the construction. The places where the risk of ground movement is higher, a retaining structure option can be adopted to keep the ground movement minimal.

Construction of the permanent works basement substructure, comprising:

1. Construction of basement floor slab
2. Construction of reinforced concrete liner walls
3. Construction of ground floor slab

Essentially, the sequence can be categorized into three groups of activities:

- Initial installation of the pile walls (locally where there is not adequate clearance to the boundary walls, elsewhere the excavations will be carried out with open cut techniques)
- Subsequent bulk excavations down to basement construction level
- Construction of the permanent works

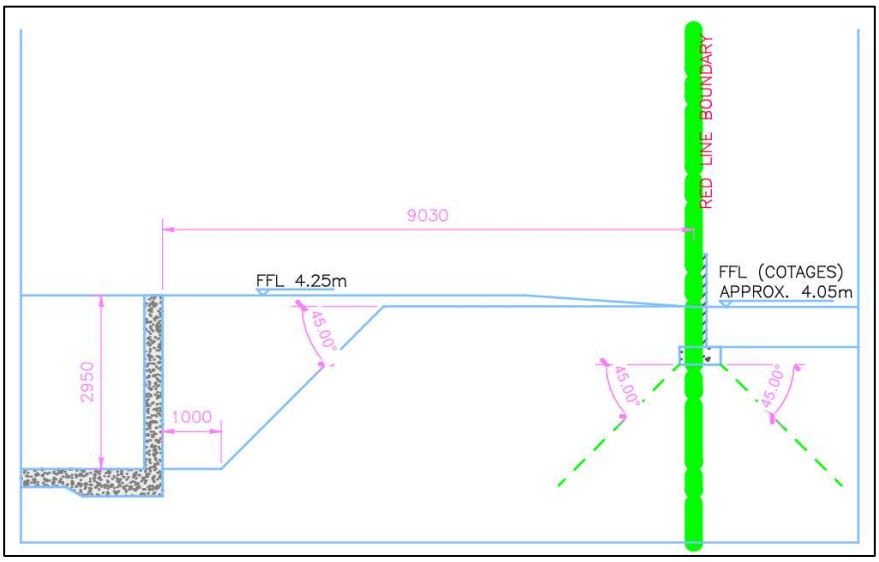


Figure 3-1 Cross section of Excavation

[3.3] Ground Movement Surrounding Existing Basement

The following ground movement mechanisms have been assessed:

- *Ground movements within the basement (heave & settlement):*

  The ground movements within the basement are a result of the unloading of the formation soils, which will generate ground movement. This could affect adjacent foundations. Stress relief will initially cause short-term heave following which the soils will be subject to structural loading from the substructure.

  This mechanism considers the existing stress conditions, stress and weight of soil removed and design loads from the new structural slab and pad / strip foundations. Short-term movements in the form of heave are associated with undrained conditions. The long-term movements are associated with drained conditions.

  Based on the over-consolidated nature of the Glacial Till (Boulder Clay), the ground movements associated with heave and settlement are considered nominal and have not been included within this assessment.

- *Ground movements surrounding the basement:*

  It is recommended to install an embedded pile wall where the open cut excavation can not be achieved to facilitate the construction of the basement and mitigate the ground movement risk to acceptable levels.

  Elsewhere, the excavation down to formation level will likely be feasible by adopting open cut excavation techniques with the side sloped at 45 degrees in the temporary case during construction.

  Ayesa has completed an assessment of the ground movements based on that of the excavation in front of a low stiffness wall (CIRIA C760 Fig. 6.15 (b). These were derived from several historic case studies.

[3.4] Software

The assessment of ground movements within and surrounding the excavation area has been completed by means of the geotechnical modelling software application OASYS XDisp. This software suite is commonly used within the ground engineering industry and considered to be an appropriate tool for this analysis. The XDisp software has been used to predict ground movements likely to arise from the construction of the proposed basement. This includes the settlement of the ground in the form of vertical movement and the lateral or horizontal movement of the soil caused by the excavation.

[3.5] Adjacent Structure

The proposed site is located in a lightly dense residential area. The location of the adjacent structures relative to the development site are displayed in Figure 3-2.

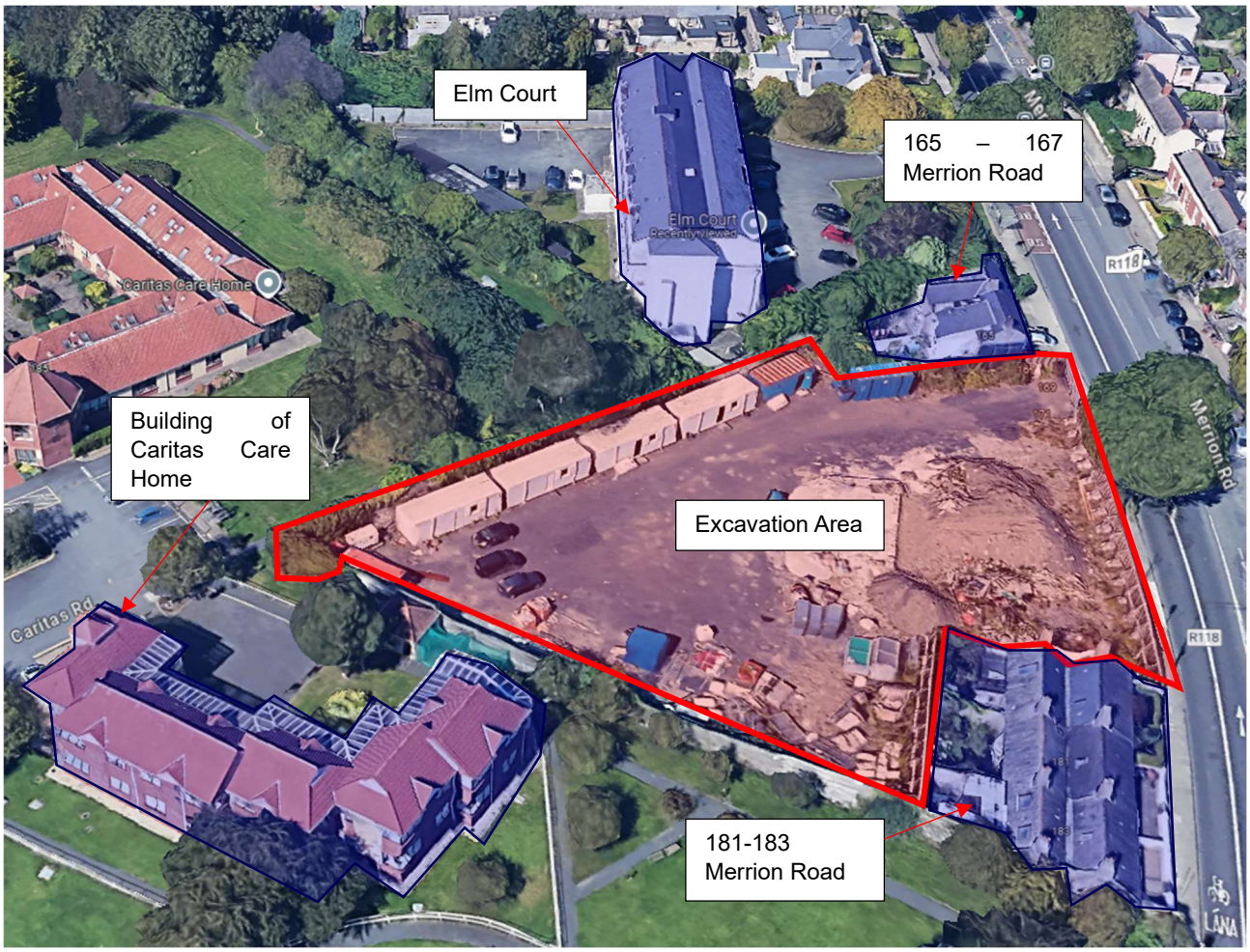


Figure 3-2 Location of Adjacent Structure

The nearest adjacent structures to the proposed basement are: -

- Elm Court:

  It is a 4-storey tall apartment building. No definitive information has been provided on the foundations for this cluster of buildings. There is no evidence available to suggest that these building have a basement, and the foundation is likely to consist of foundation pads and a ground floor slab with the slab cast approximately at ground level. However, the XDisp model has conservatively been modelled as strip foundations, so ground movements have been assessed at existing ground level.

- 165 – 167 Merrion Road:

  This is 1 storey terraced building. No definitive information has been provided on the foundations for this cluster of buildings. There is no evidence available to suggest that these building have a basement, and the foundation is likely to consist of foundation pads and a ground floor slab with the slab cast approximately at ground level. However, the XDisp model has conservatively been modelled as strip foundations, so ground movements have been assessed at existing ground level.

- 181-183 Merrion Road:

  This is 1 storey terraced building. No definitive information has been provided on the foundations for this cluster of buildings. There is no evidence available to suggest that these building have a basement, and the foundation is likely to consist of foundation pads and a ground floor slab with the slab cast approximately at ground level. However, the XDisp model has conservatively been modelled as strip foundations, so ground movements have been assessed at existing ground level.

- Building of Caritus Care Home:

  It is a 2-storey tall cottage. No definitive information has been provided on the foundations for this cluster of buildings. There is no evidence available to suggest that these building have a basement, and the foundation is likely to consist of foundation pads and a ground floor slab with the slab cast approximately at ground level. However, the XDisp model has conservatively been modelled as strip foundations, so ground movements have been assessed at existing ground level.

Pre-existing ground movement curves in accordance with CIRIA 760 were used to model the proposed development and the adjacent buildings in the XDisp model. This facilitated the assessment of the ground movement and impact on neighbouring buildings. The movement curves utilised for the analysis were those of “excavation in front of high stiffness wall in stiff clay” for the initial stage of the basement construction, which is considered conservative for the site conditions and excavation proposals. The plan view of the adjacent structures is shown in Figure 3-3.

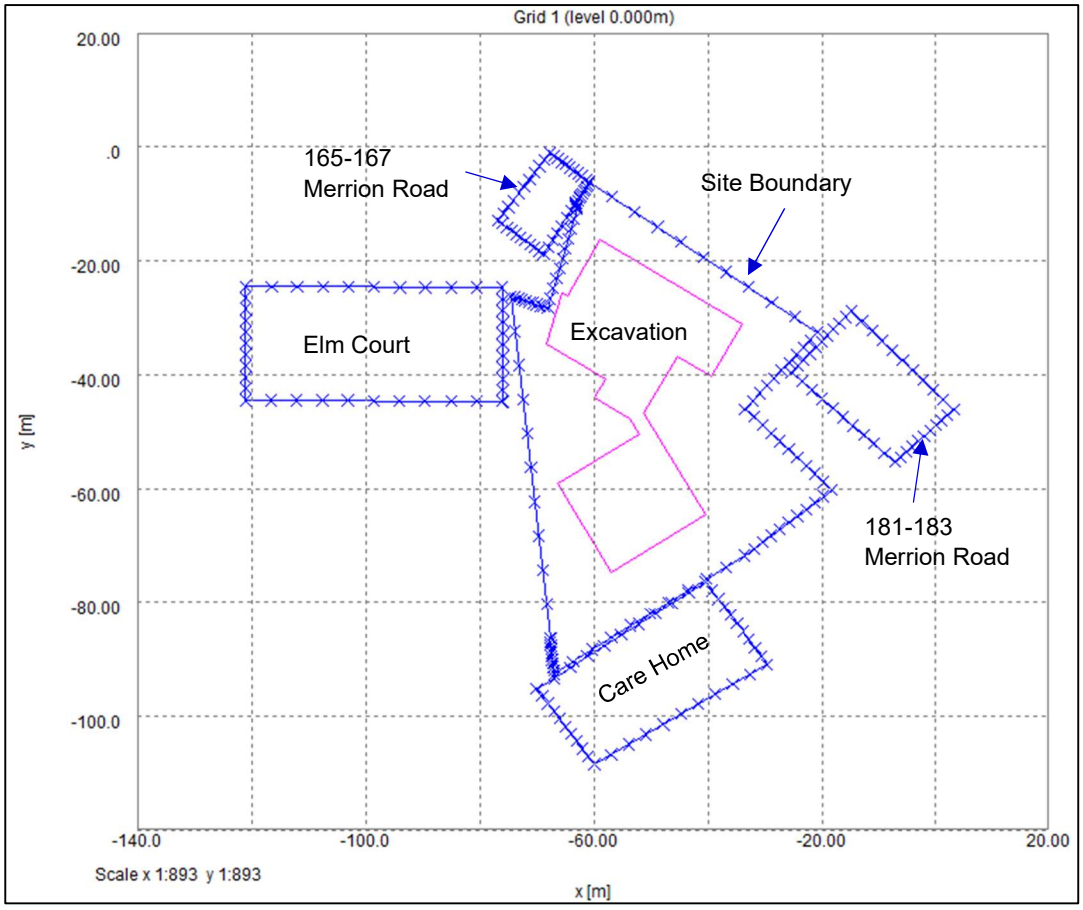


Figure 3-3 Adjacent Buildings

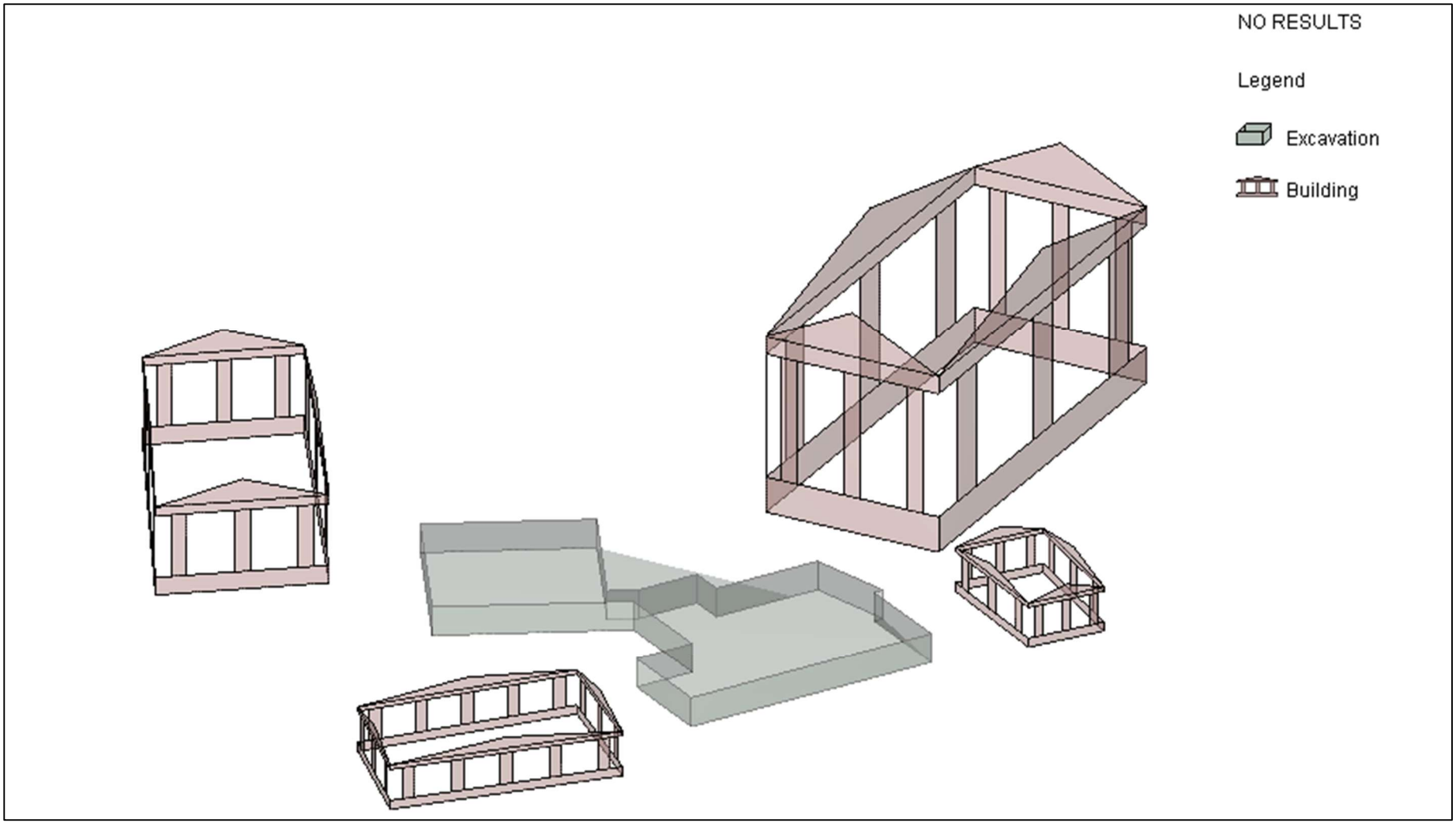


Figure 3-4 XDisp Input Model

[3.6] X Disp Output

The Maximum settlement was found to be between 7mm to 8mm at the junction of the north and south division the excavation. The general settlement was found to be in between 2 mm to 4mm. The building damage category is shown in Figure 3-5.

Table 3-1 Building Damage

Building Name	Damage Category
Elm Court	Cat 0
Caritus Care Home Cottage	Cat 0
181 – 183 Merrion Road	No Damage
165 -167 Merrion Road	Cat 0 to Cat 1

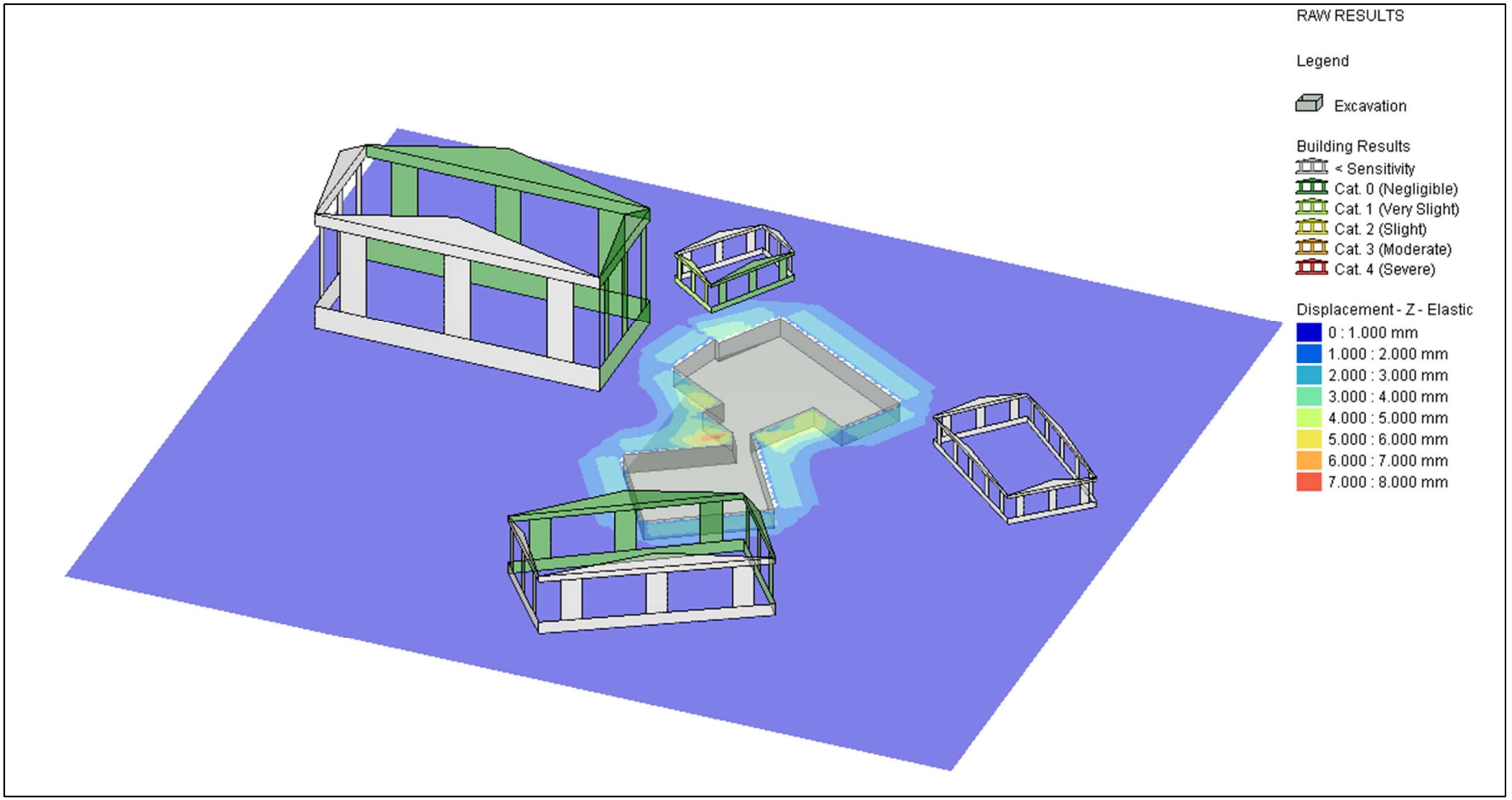


Figure 3-5 Building Damage Category

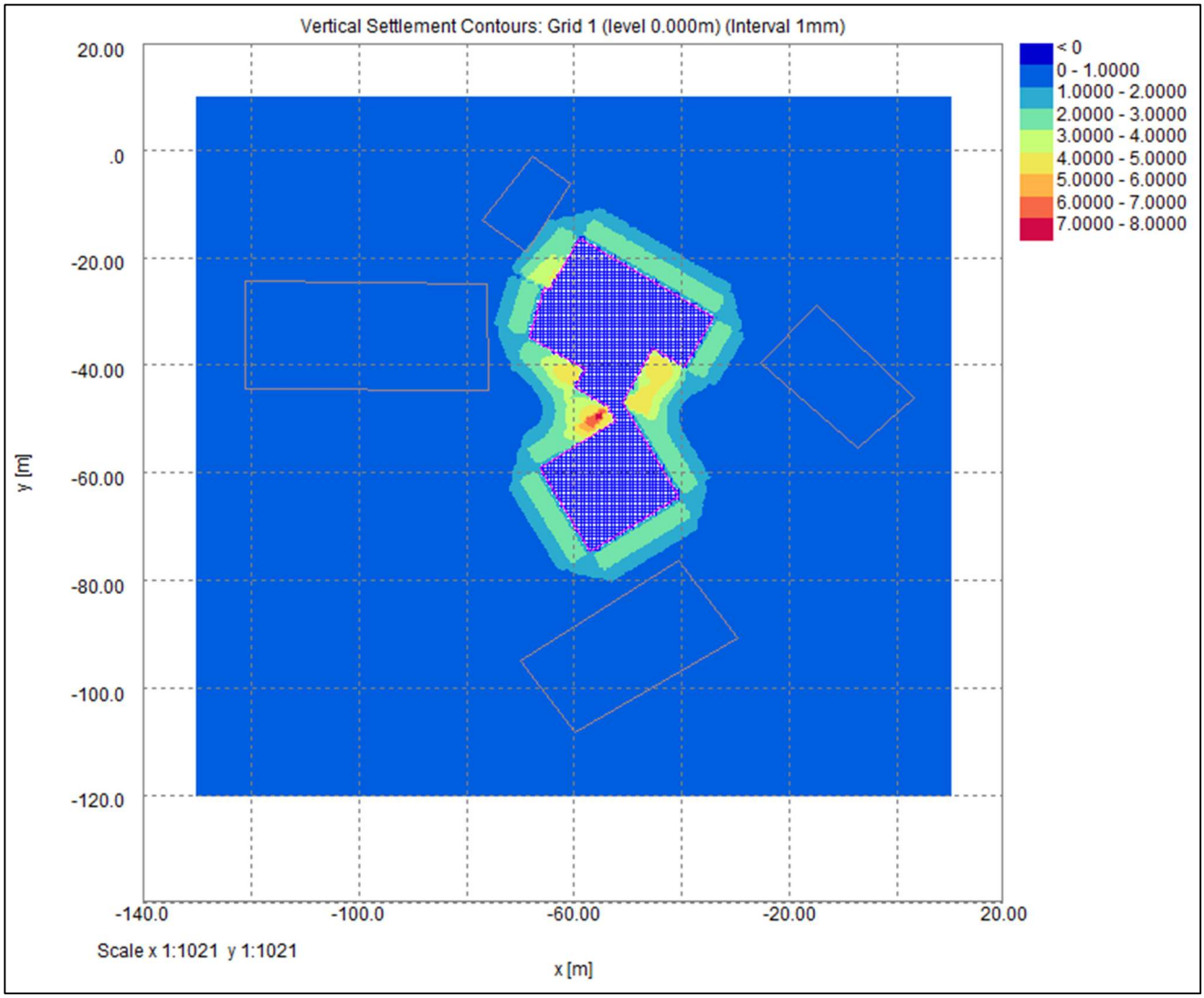


Figure 3-6 Vertical Settlement of the soil

[3.7] Damage Impact Assessment

A damage impact assessment of the neighbouring structures has been completed based on the classifications stated in Table 6.4 of CIRIA report C760 (formally C580). These classifications have been extracted and shown in Table 5.1 below. They are based on the method of damage assessment outlined by Burland et al. (1977), Boscardin and Cording (1989) and Burland (2001).

Table 3-2 Table 6.4 of CIRIA C760: Classification of visible damage to walls (after Burland et al. (1977), Boscardin and Cording (1989) & Burland (2001)

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain, ε_{lim} (%)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible	<0.1	0.0 to 0.05
1 Very slight	**Fine cracks that can easily be treated during normal decoration.** Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection	<1	0.05 to 0.075
2 Slight	**Cracks easily filled. Redecoration probably required.** Several slight fractures showing inside of building. Cracks are visible externally and **some repointing may be required externally** to ensure weathertightness. Doors and windows may stick slightly.	<5	0.075 to 0.15
3 Moderate	**The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable lining. Repointing of external brickwork and possibly a small amount of brickwork to be replaced.** Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5 to 15 or a number of cracks >3	0.15 to 0.3
4 Severe	**Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows.** Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Services pipes disrupted.	15 to 25, but also depends on number of cracks	>0.3
5 Very severe	**This requires a major repair, involving partial or complete rebuilding.** Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	Usually >25, but depends on numbers of cracks	

[3.8] Monitoring Ground Movement

The predictions of the ground movements given here are considered preliminary and are subject to the detailed design solutions implemented at the construction stage (i.e. rigidity of wall, quality of construction and installation techniques, groundwater control measures, finalized bearing pressures from permanent works etc.). The predictions given here are however considered appropriate estimations for the preliminary BIA.

During construction, the predictions of ground movement based on the ground movement analysis should be checked by monitoring the retaining wall system and if required, adjacent properties and

structures. Traditional pile walls can be monitored using inclinometer systems to ensure the lateral wall deflections are as per the design predictions.

It is recommended that a condition and foundation-level surveys of adjacent existing structures should be carried out before and after the proposed works. The precise monitoring strategy will be developed at a later stage, and it will be subject to discussions and agreements with the owners of the adjacent properties and structures.

[4] Summary and Recommendations

Ayesa has completed the Basement Impact Assessment (BIA) for a proposed residential scheme at 169 -177 Merrion Road, Dublin 4 in county Dublin.

The assessment was completed by analysing the ground conditions and hydrogeology of the site and subsequently modelling the basement using the software package XDisp. The assessment included a damage impact assessment on the nearby buildings based on empirical ground movement curves from CIRIA C760 6.15 A & B guidance, assumed ground conditions and adjacent foundation details.

It is expected that most of the proposed basement will be excavated using open cut excavation techniques (battered slope) where there is adequate clearance between the basement edge and the property boundary line. At some local areas, where the basement is close to the boundary line, a pile wall will likely be required to facilitate the basement excavations. These have been accounted for in the ground movement and damage assessment carried out as part of the BIA.

The ground movement analysis has concluded that the predicted damage to the neighbouring properties would be deemed negligible to very slight.

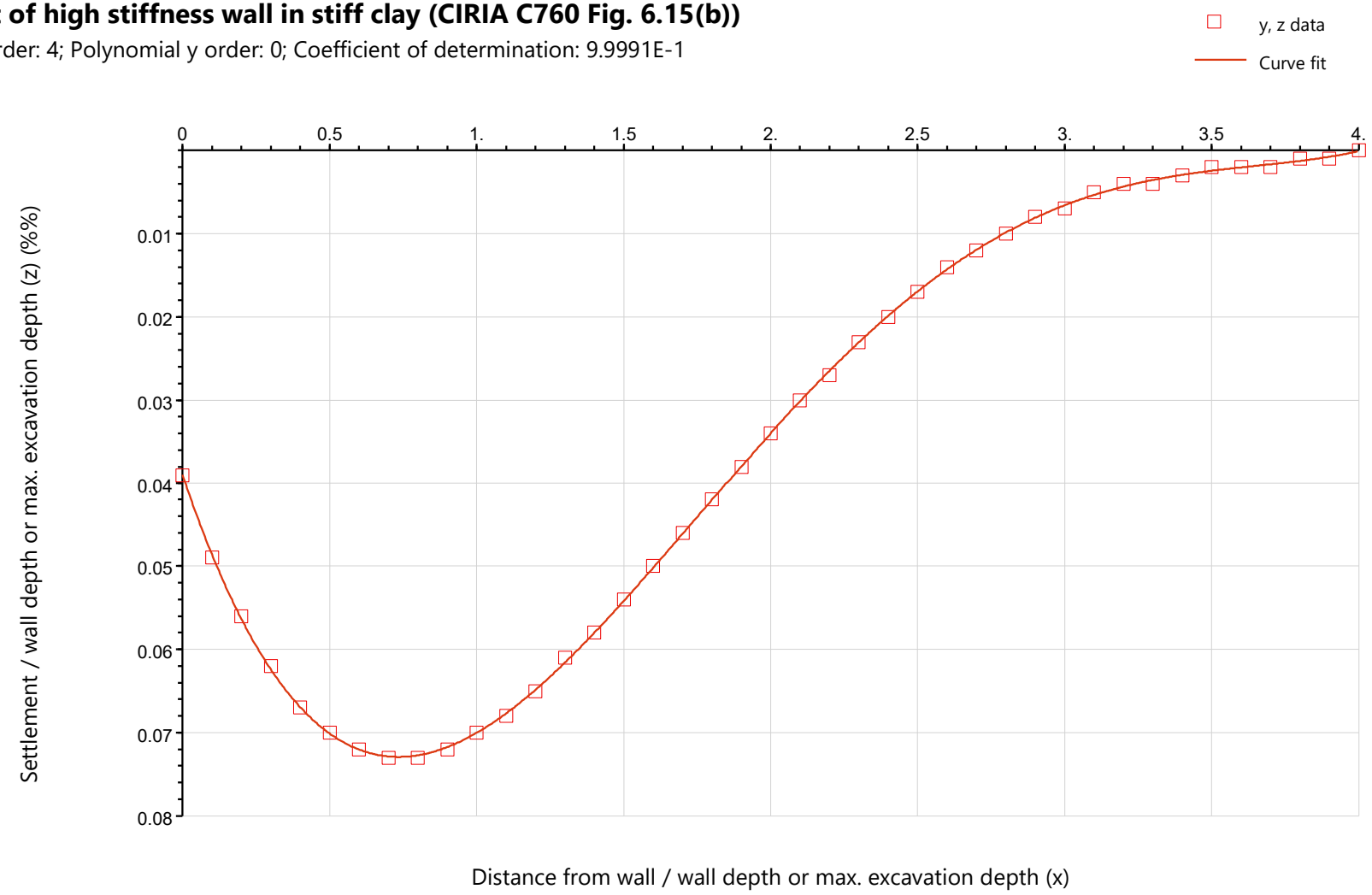
The predictions of ground movements given are considered preliminary based on the information provided. Based on the clearances outlined, an open-cut excavation should be feasible with adequate clearance to the adjacent existing structures. Should the clearance be less than indicated and to avoid excessive damage to the existing structures, an embedded retaining wall may be required in localised areas. This requirement shall be reviewed during the construction stage by the design team.

Additionally, the BIA is based on assumed adjacent foundation details. This is to be investigated and confirmed during a site-specific ground investigation.

Appendix A: X Disp Results

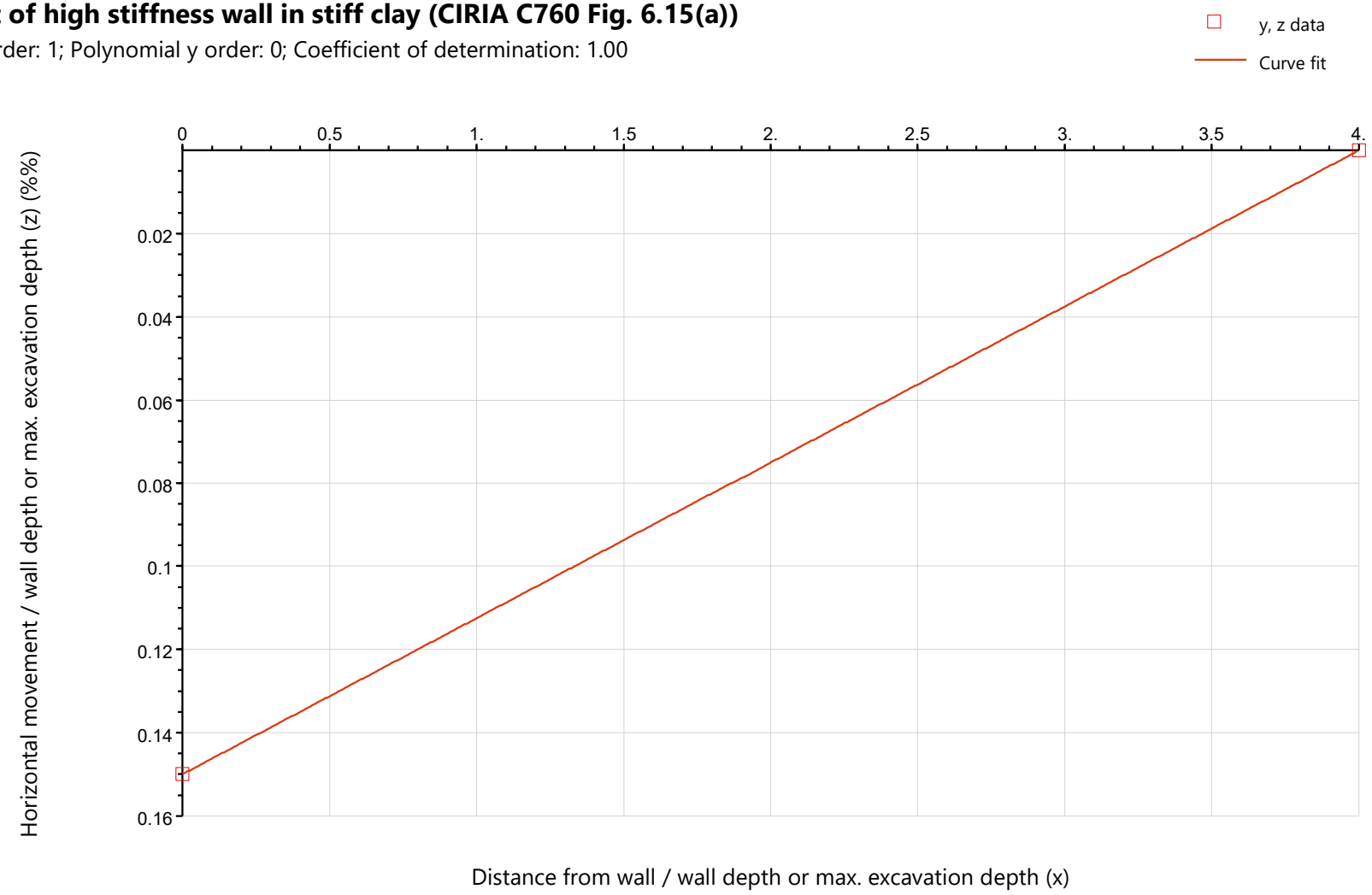
Exc. in front of high stiffness wall in stiff clay (CIRIA C760 Fig. 6.15(b))

Polynomial x order: 4; Polynomial y order: 0; Coefficient of determination: 9.9991E-1



Exc. in front of high stiffness wall in stiff clay (CIRIA C760 Fig. 6.15(a))

Polynomial x order: 1; Polynomial y order: 0; Coefficient of determination: 1.00



Specific Building Damage Results - Vertical Displacements

Stage: Ref.	Stage: Name	Specific Building: Ref.	Specific Building: Name	Sub-building Name	Vertical Offset [m]	Dist. [m]	x [m]	y [m]	z [m]	δz [mm]
0	Base Model	1	Elm Court	Sub 1	0.0	0.0	-76.02595	-44.67307	0.00000	0.018559
						0.0045000	-76.02145	-44.67310	0.00000	0.018665
						0.0090000	-76.01695	-44.67312	0.00000	0.018771
						0.013500	-76.01245	-44.67315	0.00000	0.018877
						0.018000	-76.00795	-44.67317	0.00000	0.018982
						0.022500	-76.00345	-44.67320	0.00000	0.019087
						0.027000	-75.99895	-44.67322	0.00000	0.019192
						0.031500	-75.99445	-44.67324	0.00000	0.019297
						0.036000	-75.98995	-44.67327	0.00000	0.019401
						0.040500	-75.98546	-44.67329	0.00000	0.019505
						0.045000	-75.98096	-44.67332	0.00000	0.019609
		2	Elm Court	Sub 1	0.0	0.0	-121.02554	-44.48083	0.00000	0.0
						4.5000	-116.52558	-44.50005	0.00000	0.0
						9.0000	-112.02563	-44.51928	0.00000	0.0
						13.500	-107.52567	-44.53850	0.00000	0.0
						18.000	-103.02571	-44.55773	0.00000	0.0
						22.500	-98.52575	-44.57695	0.00000	0.0
						27.000	-94.02579	-44.59618	0.00000	0.0
						31.500	-89.52583	-44.61540	0.00000	0.0
						36.000	-85.02587	-44.63462	0.00000	0.0
						40.500	-80.52591	-44.65385	0.00000	0.0
						45.000	-76.02595	-44.67307	0.00000	0.018559
		3	Elm Court	Sub 1	0.0	0.0	-121.02902	-24.48083	0.00000	0.0
						2.0000	-121.02867	-26.48083	0.00000	0.0
						4.0000	-121.02832	-28.48083	0.00000	0.0
						6.0000	-121.02798	-30.48083	0.00000	0.0
						8.0000	-121.02763	-32.48083	0.00000	0.0
						10.000	-121.02728	-34.48083	0.00000	0.0
						12.000	-121.02693	-36.48083	0.00000	0.0
						14.000	-121.02659	-38.48083	0.00000	0.0
						16.000	-121.02624	-40.48083	0.00000	0.0
						18.000	-121.02589	-42.48083	0.00000	0.0
						20.000	-121.02554	-44.48083	0.00000	0.0
		4	Elm Court	Sub 1	0.0	0.0	-76.02954	-24.69819	0.00000	0.15264
						4.5000	-80.52949	-24.67646	0.00000	0.0
						9.0000	-85.02944	-24.65472	0.00000	0.0
						13.500	-89.52939	-24.63298	0.00000	0.0
						18.000	-94.02933	-24.61125	0.00000	0.0
						22.500	-98.52928	-24.58951	0.00000	0.0
						27.000	-103.02923	-24.56777	0.00000	0.0

Stage: Stage: Name Ref.	Specific Building: Ref.	Specific Building: Name	Sub-building Name	Vertical Offset [m]	Dist. [m]	x [m]	y [m]	z [m]	δz [mm]
					31.500	-107.52918	-24.54604	0.00000	0.0
					36.000	-112.02912	-24.52430	0.00000	0.0
					40.500	-116.52907	-24.50256	0.00000	0.0
					45.000	-121.02902	-24.48083	0.00000	0.0
	5	Elm Court	Sub 1	0.0	0.0	-75.98096	-44.67332	0.00000	0.019609
					1.9975	-75.98581	-42.67580	0.00000	0.062326
					3.9950	-75.99067	-40.67829	0.00000	0.13743
					5.9926	-75.99553	-38.68078	0.00000	0.24940
					7.9901	-76.00039	-36.68327	0.00000	0.36379
					9.9876	-76.00525	-34.68576	0.00000	0.45012
					11.985	-76.01011	-32.68824	0.00000	0.43401
					13.983	-76.01497	-30.69073	0.00000	0.45369
					15.980	-76.01983	-28.69322	0.00000	0.32305
					17.978	-76.02469	-26.69571	0.00000	0.22352
					19.975	-76.02954	-24.69819	0.00000	0.15264
	6	Caritus Care Home	Sub 2	0.0	0.0	-40.43665	-76.38297	0.00000	0.16233
					3.5000	-43.39853	-78.24772	0.00000	0.15855
					7.0000	-46.36041	-80.11247	0.00000	0.15488
					10.500	-49.32229	-81.97721	0.00000	0.15129
					14.000	-52.28416	-83.84196	0.00000	0.093758
					17.500	-55.24604	-85.70671	0.00000	0.049136
					21.000	-58.20792	-87.57145	0.00000	0.0
					24.500	-61.16980	-89.43620	0.00000	0.0
					28.000	-64.13167	-91.30095	0.00000	0.0
					31.500	-67.09355	-93.16570	0.00000	0.0
					35.000	-70.05543	-95.03044	0.00000	0.0
	7	Caritus Care Home	Sub 2	0.0	0.0	-29.57490	-90.73644	0.00000	0.0
					1.8000	-30.66107	-89.30110	0.00000	0.0
					3.6000	-31.74725	-87.86575	0.00000	0.0
					5.4000	-32.83342	-86.43040	0.00000	0.0
					7.2000	-33.91960	-84.99506	0.00000	0.0
					9.0000	-35.00578	-83.55971	0.00000	0.0
					10.800	-36.09195	-82.12436	0.00000	0.0
					12.600	-37.17813	-80.68901	0.00000	0.0
					14.400	-38.26430	-79.25367	0.00000	0.0
					16.200	-39.35048	-77.81832	0.00000	0.056078
					18.000	-40.43665	-76.38297	0.00000	0.16233
	8	Caritus Care Home	Sub 2	0.0	0.0	-59.85188	-108.29505	0.00000	0.0
					3.5000	-56.82418	-106.53919	0.00000	0.0
					7.0000	-53.79648	-104.78333	0.00000	0.0
					10.500	-50.76878	-103.02747	0.00000	0.0
					14.000	-47.74108	-101.27161	0.00000	0.0
					17.500	-44.71339	-99.51575	0.00000	0.0
					21.000	-41.68569	-97.75989	0.00000	0.0
					24.500	-38.65799	-96.00403	0.00000	0.0
					28.000	-35.63029	-94.24817	0.00000	0.0
					31.500	-32.60259	-92.49231	0.00000	0.0
					35.000	-29.57490	-90.73644	0.00000	0.0
	9	Caritus Care Home	Sub 2	0.0	0.0	-70.05543	-95.03044	0.00000	0.0

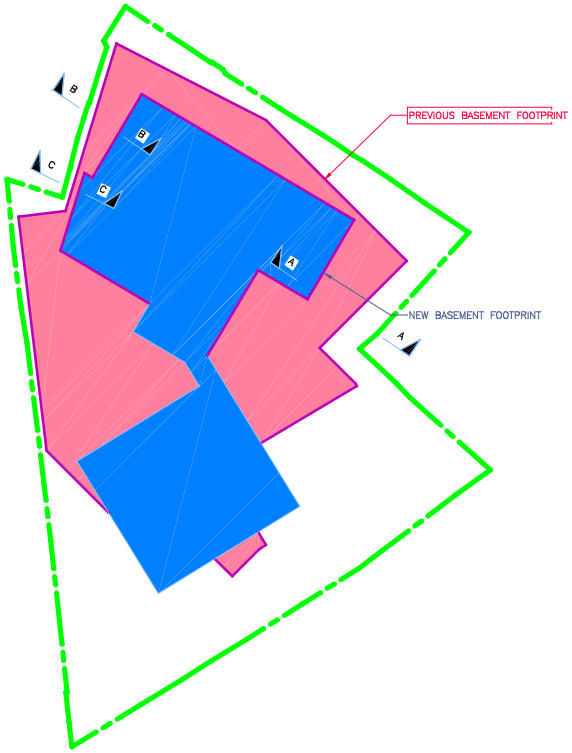
Stage: Stage: Name Ref.	Specific Building: Ref.	Specific Building: Name	Sub-building Name	Vertical Offset	Dist.	x	y	z	δz
				[m]	[m]	[m]	[m]	[m]	[mm]
					1.6735	-69.03507	-96.35690	0.00000	0.0
					3.3470	-68.01472	-97.68336	0.00000	0.0
					5.0205	-66.99436	-99.00982	0.00000	0.0
					6.6940	-65.97401	-100.33628	0.00000	0.0
					8.3675	-64.95365	-101.66275	0.00000	0.0
					10.041	-63.93330	-102.98921	0.00000	0.0
					11.715	-62.91294	-104.31567	0.00000	0.0
					13.388	-61.89259	-105.64213	0.00000	0.0
					15.062	-60.87223	-106.96859	0.00000	0.0
					16.735	-59.85188	-108.29505	0.00000	0.0
	10	181-183 Merrion Road	Sub 3	0.0	0.0	-25.28012	-39.61444	0.00000	0.057467
					2.4000	-23.46761	-41.18760	0.00000	0.0
					4.8000	-21.65511	-42.76075	0.00000	0.0
					7.2000	-19.84260	-44.33391	0.00000	0.0
					9.6000	-18.03009	-45.90706	0.00000	0.0
					12.000	-16.21758	-47.48022	0.00000	0.0
					14.400	-14.40508	-49.05337	0.00000	0.0
					16.800	-12.59257	-50.62653	0.00000	0.0
					19.200	-10.78006	-52.19968	0.00000	0.0
					21.600	-8.96755	-53.77284	0.00000	0.0
					24.000	-7.15505	-55.34599	0.00000	0.0
	11	181-183 Merrion Road	Sub 3	0.0	0.0	-14.87517	-28.80996	0.00000	0.0
					1.5000	-15.91566	-29.89040	0.00000	0.0
					3.0000	-16.95616	-30.97085	0.00000	0.0
					4.5000	-17.99665	-32.05130	0.00000	0.0
					6.0000	-19.03715	-33.13175	0.00000	0.0
					7.5000	-20.07764	-34.21220	0.00000	0.0
					9.0000	-21.11814	-35.29265	0.00000	0.0
					10.500	-22.15863	-36.37310	0.00000	0.0
					12.000	-23.19913	-37.45355	0.00000	0.018407
					13.500	-24.23962	-38.53399	0.00000	0.044000
					15.000	-25.28012	-39.61444	0.00000	0.057467
	12	181-183 Merrion Road	Sub 3	0.0	0.0	3.16892	-46.11345	0.00000	0.0
					2.5000	1.36452	-44.38310	0.00000	0.0
					5.0000	-0.43989	-42.65275	0.00000	0.0
					7.5000	-2.24430	-40.92240	0.00000	0.0
					10.000	-4.04871	-39.19205	0.00000	0.0
					12.500	-5.85312	-37.46170	0.00000	0.0
					15.000	-7.65753	-35.73135	0.00000	0.0
					17.500	-9.46194	-34.00100	0.00000	0.0
					20.000	-11.26635	-32.27065	0.00000	0.0
					22.500	-13.07076	-30.54030	0.00000	0.0
					25.000	-14.87517	-28.80996	0.00000	0.0
	13	181-183 Merrion Road	Sub 3	0.0	0.0	-7.15505	-55.34599	0.00000	0.0
					1.3850	-6.12265	-54.42274	0.00000	0.0
					2.7700	-5.09025	-53.49948	0.00000	0.0
					4.1550	-4.05785	-52.57623	0.00000	0.0
					5.5400	-3.02546	-51.65297	0.00000	0.0
					6.9250	-1.99306	-50.72972	0.00000	0.0

Stage: Stage: Name Ref.	Specific Building: Ref.	Specific Building: Name	Sub-building Name	Vertical Offset	Dist.	x	y	z	δz
				[m]	[m]	[m]	[m]	[m]	[mm]
					8.3100	-0.96066	-49.80646	0.00000	0.0
					9.6950	0.07173	-48.88321	0.00000	0.0
					11.080	1.10413	-47.95996	0.00000	0.0
					12.465	2.13653	-47.03670	0.00000	0.0
					13.850	3.16892	-46.11345	0.00000	0.0
	14	165-167 Merrion Road	Sub 4	0.0	0.0	-68.75680	-18.87118	0.00000	1.1589
					1.5000	-67.95702	-17.60218	0.00000	1.0550
					3.0000	-67.15724	-16.33319	0.00000	0.97567
					4.5000	-66.35745	-15.06419	0.00000	0.92705
					6.0000	-65.55767	-13.79520	0.00000	0.91112
					7.5000	-64.75789	-12.52620	0.00000	0.58963
					9.0000	-63.95811	-11.25721	0.00000	0.50995
					10.500	-63.15832	-9.98821	0.00000	0.38573
					12.000	-62.35854	-8.71922	0.00000	0.25259
					13.500	-61.55876	-7.45023	0.00000	0.14136
					15.000	-60.75897	-6.18123	0.00000	0.073347
	15	165-167 Merrion Road	Sub 4	0.0	0.0	-76.87443	-13.03130	0.00000	0.0
					1.0000	-76.06266	-13.61528	0.00000	0.0
					2.0000	-75.25090	-14.19927	0.00000	0.0
					3.0000	-74.43914	-14.78326	0.00000	0.0
					4.0000	-73.62738	-15.36725	0.00000	0.0
					5.0000	-72.81562	-15.95124	0.00000	0.070546
					6.0000	-72.00385	-16.53522	0.00000	0.12831
					7.0000	-71.19209	-17.11921	0.00000	0.23129
					8.0000	-70.38033	-17.70320	0.00000	0.42759
					9.0000	-69.56857	-18.28719	0.00000	0.73849
					10.000	-68.75680	-18.87118	0.00000	1.1589
	16	165-167 Merrion Road	Sub 4	0.0	0.0	-67.74552	-1.12907	0.00000	0.0
					1.5000	-68.65841	-2.31929	0.00000	0.0
					3.0000	-69.57130	-3.50952	0.00000	0.0
					4.5000	-70.48419	-4.69974	0.00000	0.0
					6.0000	-71.39708	-5.88996	0.00000	0.0
					7.5000	-72.30997	-7.08018	0.00000	0.0
					9.0000	-73.22286	-8.27041	0.00000	0.0
					10.500	-74.13575	-9.46063	0.00000	0.0
					12.000	-75.04864	-10.65085	0.00000	0.0
					13.500	-75.96154	-11.84107	0.00000	0.0
					15.000	-76.87443	-13.03130	0.00000	0.0
	17	165-167 Merrion Road	Sub 4	0.0	0.0	-60.75897	-6.18123	0.00000	0.073347
					0.86218	-61.45763	-5.67602	0.00000	0.048528
					1.7244	-62.15628	-5.17080	0.00000	0.033746
					2.5866	-62.85494	-4.66558	0.00000	0.020317
					3.4487	-63.55359	-4.16037	0.00000	0.0
					4.3109	-64.25225	-3.65515	0.00000	0.0
					5.1731	-64.95090	-3.14993	0.00000	0.0
					6.0353	-65.64955	-2.64472	0.00000	0.0
					6.8975	-66.34821	-2.13950	0.00000	0.0
					7.7597	-67.04686	-1.63429	0.00000	0.0
					8.6218	-67.74552	-1.12907	0.00000	0.0

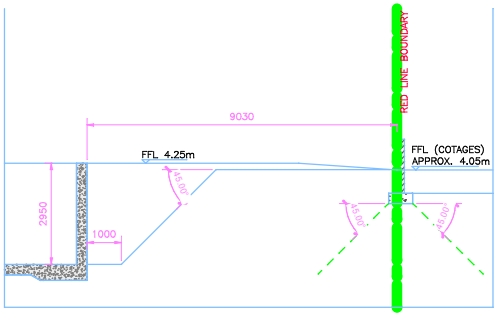
Specific Building Damage Results - Critical Segments within Each Building

Stage: Ref.	Stage: Name	Specific Building: Ref.	Specific Building: Name	Parameter	Critical Sub-Building	Critical Segment	Start [m]	End [m]	Curvature	Max Slope	Max Settlement [mm]	Max Tensile Strain [%]	Min Radius of Curvature (Hogging) [m]	Min Radius of Curvature (Sagging) [m]	Damage Category
0	Base Model	0	Elm Court	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	Caritus Care Home	Max Slope	Sub 2	2	3.5242	10.500	None	**16.438E-6**	0.15853	4.7565E-6	-	-	0 (Negligible)
				Max Settlement	Sub 2	1	0.0	3.5242	None	1.0777E-6	**0.16233**	4.1127E-6	-	-	0 (Negligible)
				Max Tensile Strain	Sub 2	2	3.5242	10.500	None	16.438E-6	0.15853	**4.7565E-6**	-	-	0 (Negligible)
				Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
				Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	-
		0	181-183 Merrion Road	All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
				All vertical displacements are less than the limit sensitivity.											
		0	165-167 Merrion Road	Max Slope	Sub 4	2	3.5426	7.0740	None	**214.31E-6**	0.95808	0.010544	-	-	0 (Negligible)
				Max Settlement	Sub 4	1	0.0	3.5426	None	69.306E-6	**1.1589**	372.11E-6	-	-	0 (Negligible)
				Max Tensile Strain	Sub 4	2	3.5426	7.0740	None	214.31E-6	0.95808	**0.010544**	-	-	0 (Negligible)
				Min Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
				Min Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	-

Appendix B : Sections and Plan



BASEMENT FOOTPRINT OVERLAY
1 :
300



SECTION A
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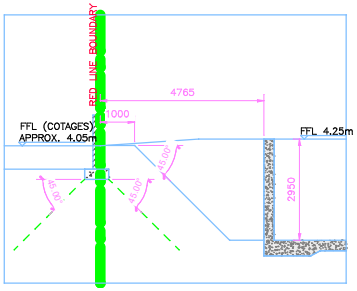
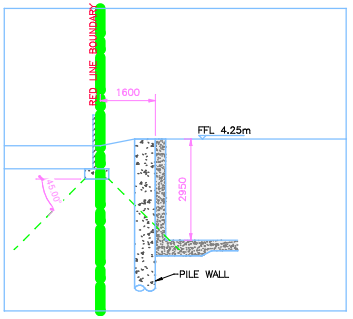


SECTION B
1:75



SECTION C
1:75

Notes:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWINGS DR-S-00001 TO DR-S-00003

REV	DESCRIPTION	BY	DATE
P01	REVISED AS PER RSA COMMENTS	AC	13.08.24
P00	ISSUED FOR PLANNING	RB	28.05.24

STATUS: INFORMATION

PROJECT: MERRION COMPOUND

TITLE: BASEMENT OVERLAY

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
As indicated	MAY 24	RB	DH

DRAWING NO: 24042-X-B01-DR-TNT-SE-P0100

REVISION: P01

18 Appendix E - Applicant and BIA Author Details

Comhairle Cathrach Bhaile Átha Cliath
Dublin City Council

SECTION 1 – Basement Impact Assessment (BIA)
Applicant and BIA Author Details – completed by Applicant

Before completing this form, please read the accompanying documents, "DCC Basement Development Policy document" and the "DCC Basement Development Guidance document".

This form is to be completed in BLOCK LETTERS:

Planning Ref. for Development:	
Development Address:	169-177 Merrion Road, Dublin 4
Development Description:	200 Unit Student Bed Scheme
Applicant Name:	1 Merrion Land Limited
Applicant Address:	Earlscourt Terrace
Applicant Contact Name:	Brenda Butterly - Mcgill Planning
Applicant Contact Phone Number:	0858229829
	012846464
Applicant Contact E-Mail:	Brenda@mcgplanning.ie
BIA Author Company:	Tent Engineering
BIA Author Contact Name:	Diarmuid Healy
BIA Author Contact Ph. No:	0838304308
	01 539 2977
BIA Author E-Mail:	Diarmuid.Healy@tentengineering.com

Note: Basement Impact Assessments are required to adhere to the *"DCC Basement Development Policy document"* and are to be undertaken in accordance with the *"DCC Basement Development Guidance document ''.*

19 Appendix F Submission Check Sheet

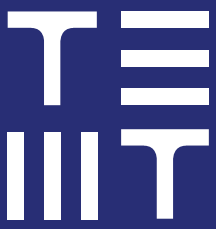
BIA Submission Check Sheet

Items Provided fro Basement Impact Assessment (BIA)[1]			
	Items Provided	Yes, No or N/A[2]	Name of BIA document/ appendix which information is contained and/or comment
1	Description of proposed development.	Yes	Site Investigation and Basement Impact Assessment Report – Section 1.2
2	Plan showing boundary of development including any land required temporarily during construction.	Yes	Site Investigation and Basement Impact Assessment Report – Section 2.1 and Appendix A
3	Plans, maps and/or photographs to show location of basement relative to surrounding structures.	Yes	Site Investigation and Basement Impact Assessment Report – Section 2.1.1
4	Plans, maps and/or photographs to show topography of surrounding area with any nearby watercourses/waterbodies including consideration of the relevant maps in the FRA.	Yes	Site Investigation and Basement Impact Assessment Report – Appendix A, Appendix C: Ground Movement & Hydrogeology Assessment Report – Figures 5.1, 5.2, 5.3 and 5.4
5	Plans and sections to show foundation details of adjacent structures.	Yes	Site Investigation and Basement Impact Assessment Report – Figures 6 and 9. Ground Movement & Hydrogeology Assessment Report – Figures 4.1 and 4.3.
6	Plans and sections to show layout and dimensions of proposed basement.	Yes	Site Investigation and Basement Impact Assessment Report – Figures 4 and 5, Appendix A: Proposed Plans
7	Programme for enabling works, construction and restoration. No	No	The detailed programme is subject to the appointment of a Contractor and will be outlined in their Construction Management Plan to be submitted for approval by DCC
8	Identification of potential risks to land stability (including surrounding structures and infrastructure), and surface and groundwater flooding.	Yes	Site Investigation and Basement Impact Assessment Report – Sections 3, 4 & 12

9	Assessment of impact of potential risks on neighbouring properties and surface and groundwater.	Yes	Site Investigation and Basement Impact Assessment Report – Section 3, 4 & 12 Ground Movement & Hydrogeology Assessment Report – Sections 4.4 and 5.4
10	Identification of significant adverse impacts.	Yes	Site Investigation and Basement Impact Assessment Report – Sections 4 and 12
11	Evidence of consultation with neighbours.	Yes	Planning process has included the erection and advertisement of site notices and the opportunity for neighbours to input into the planning process through third party observation
12	Ground Investigation Report and Conceptual Site Model including: Desktop study Exploratory hole records Results from monitoring the local groundwater regime Confirmation of baseline conditions Factual site investigation report	Yes	Site Investigation and Basement Impact Assessment Report: Appendix B Sections 2, 5, 6, and 7.2 Ground Movement & Hydrogeology Assessment Report – Sections 2 and 3
13	Ground Movement Assessment (GMA).	Yes	Site Investigation and Basement Impact Assessment Report – Appendix C
14	Plans, drawings, reports to show extent of affected area.	Yes	Site Investigation and Basement Impact Assessment Report
15	Specific mitigation measures to reduce, avoid or offset significant adverse impacts.	Yes	Site Investigation and Basement Impact Assessment Report – Sections 12 and 13
16	Construction Sequence Methodology (CSM) referring to site investigation and containing basement, floor and roof plans, sections (all views), sequence of construction and temporary works.	Yes	Site Investigation and Basement Impact Assessment Report – Sections 7 and 8 Outline Basement Construction Method Statement
17	Proposals for monitoring during construction.	Yes	Site Investigation and Basement Impact Assessment Report – Section 10.2 Ground Movement & Hydrogeology Assessment Report – Sections 4.6 Outline Basement Construction Method Statement

18	Confirmatory and reasoned statement identifying likely damage to nearby properties according to Burland Scale.	Yes	Site Investigation and Basement Impact Assessment Report – Section 10
19	Confirmatory and reasoned statement with supporting evidence that the structural stability of the building and neighbouring properties will be maintained (by reference to BIA, Ground Movement Assessment and Construction Sequence Methodology), including consideration of cumulative effects.	Yes	Site Investigation and Basement Impact Assessment Report – Section 12 Ground Movement & Hydrogeology Assessment Report – Sections 6
20	Confirmatory and reasoned statement with supporting evidence that there will be no adverse effects on drainage or run-off and no damage to the water environment (by reference to ground investigation, BIA and CSM), including consideration of cumulative effects.	Yes	Site Investigation and Basement Impact Assessment Report – Section 12 Ground Movement & Hydrogeology Assessment Report – Section 6 Site Specific Flood Risk Assessment Engineering Planning Report
21	Identification of areas that require further investigation	Yes	Site Investigation and Basement Impact Assessment Report – Section 13
22	Non-technical summary for each stage of BIA.	Yes	Site Investigation and Basement Impact Assessment Report – Included in the main text throughout each stage of the BIA.

1. It is assumed that consideration of architectural character, impacts on archaeology, amenity and other matters which are not covered by this checklist shall be incorporated elsewhere within the applicant's submission.
2. Where response is 'no' or 'N/A', an explanation is required in the Comment section.



TENT ENGINEERING