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The Ted, Dun Laoghaire, Built to Rent

Stormwater Audit Stage 1

July 2021

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Report by:  Date: 2nd September 2021

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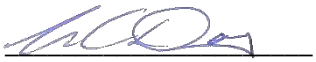
Checked by:  Date: 2nd September 2021

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1.0 Introduction

1.1 Purpose of Report

This report presents a Stage 1 Stormwater Audit carried out on a proposed development by Ted Living Ltd situated at the former Ted Castles site, Old Dun Leary Road, Dun Laoghaire/Monkstown, Co. Dublin. The proposed development comprises of:

i. The provision of 146 no. apartment units (Build to Rent) and all associated ancillary facilities (including residential amenities). The proposal provides for private and communal open spaces throughout.
ii. A retail unit addressing Old Dun Leary Road and Cumberland Street
iii. All associated ancillary car parking, cycle parking, a new vehicular entrance/cycle path (off the Old Dun Leary Road), ancillary plant areas, ESB substation and storage areas.
iv. Extensive hard and soft landscaping throughout, green roof, public lighting, signage, boundary treatments and public realm improvements.
v. The demolition of all existing buildings within the subject site (excluding the yellow brick building known as "Dunleary House" and the existing open fronted shed and the removal of existing boundary walls, piers, railings and gates.
vi. All associated ancillary site services and site development works.

DBFL Consulting Engineers were appointed to provide Engineering Services, which includes design of the surface water network and associated sustainable drainage systems (SuDS) proposed.

PUNCH Consulting Engineers have been appointed by DBFL to carry out an independent Stage 1 Stormwater Audit on the proposal in line with Dún Laoghaire-Rathdown County Council (DLRCC) requirements. The pre-planning reference number associated with this application is PAC/SHD/270/19.

1.2 Site Details

The proposed site is located in Monkstown, adjacent to the West Pier of Dun Laoghaire Harbour. The site is approximately 0.31Ha and is currently occupied by an existing dwelling, and associated maintenance buildings. The subject site comprises mostly hardstanding area.

The site is bound by streets on three sides, with Old Dunleary Road to the north, Dunleary Hill to the south and Cumberland Street to west, with an existing residential development bounding the site to the east.

The subject site is currently terraced, with retaining structures to the north of the site with the existing dwelling at a higher level, which is accessed from the south west. A yard and shed is terraced at a lower level to the north at approximately 4.5m AOD and accessed to the north off Old Dunleary Hill.

The subject site is relatively level, with a slight fall from south to north. There is also a steep embankment on the northern side of the site leading down to the site from Dunleary Road.

A vehicle entrance is currently located at the northern side of the site on Old Dunleary Road.

1.3 Report Details

This Stormwater Audit was carried out by Joshua Martin, Marie-Claire Daly and Leonard Brennan between the dates of June 22nd and 2nd September 2021.

This Stage 1 Audit has been carried out in accordance with the Dún Laoghaire-Rathdown County Council (DLRCC) Stormwater Audit Procedure Rev 0 January 2012. The auditor has examined only those issues within the design relating to surface water drainage implications of the scheme and has therefore not examined or verified the compliance of the design to any other criteria.

Appendix A contains copies of drawings and documents examined by the auditor. Appendix B contains the Surface Water Audit Feedback form.

All the findings outlined in Section 2.0 of this report are considered by the auditor to require action in order to improve the stormwater credentials of the scheme.

1.4 Drawings & Documents Examined as Part of Audit

TED-DBFL-CS-SP-DR-C-1201 - Site Services Layout
TED-DBFL-SW-SP-DR-C-1301 – Surface Water Strategy
TED-DBFL-SW-SP-DR-C-3311 – Surface Water Outfall & Attenuation Sections
TED-DBFL-XX-XX-RP-C-0001 Infrastructure Design Report

1.5 Drawings & Documents Examined as Part of Feedback Form

TED-DBFL-CS-SP-DR-C-1201 - Site Services Layout
TED-DBFL-SW-SP-DR-C-1301 – Surface Water Strategy
TED-DBFL-SW-SP-DR-C-3311 – Surface Water Outfall & Attenuation Sections
TED-DBFL-CS-SP-DR-C-5201 Drainage Details Sheet 1
TED-DBFL-CS-SP-DR-C-5202 Drainage Details Sheet 2
TED-DBFL-CS-SP-DR-C-5203 Drainage Details Sheet 3
TED-DBFL-XX-XX-RP-C-0001 Infrastructure Design Report
Ground Investigations Ireland Tedcastles Site - Report

2.0 Stage 1 Audit Findings

The following section should be read in tandem with the drawings included in Appendix B.

2.1 Roads and Carparks

2.1.1 Impermeable footpaths lining Old Dunleary Road and Cumberland Street

Problem: The footpaths lining Old Dunleary Road and Cumberland Street within the red line boundary are proposed to be upgraded. There is further potential for SuDS systems in these areas as their plan area is quite extensive.

Recommendation: Consider incorporation of bio-retention areas to reduce surface water runoff and add amenity to the area.

2.2 Buildings/Residential Units

2.2.1 Green roofs

Problem: Extensive/intensive green roofs are shown as one hatch on 'Surface Water Strategy' drawing no. 1301.

Recommendation: Consider updating drawing with distinctive hatches to differentiate between green roof types.

2.2.2 Green roofs

Problem: The CIRIA SuDs Manual 2015 states that there is limited surface water retention benefits from extensive roofs (CIRIA p.236).

Recommendation: Consider increasing the area of intensive green roof.

2.2.3 Green roofs

Problem: The green roof shown to the south of the site has conflicting layers with over lapping gravel strips shown.

Recommendation: Review the drawing.

2.2.4 Permeable Paving

Problem: Although permeable paving is located on part of the roof (Level 7 & Level 6), it should be considered in greater quantity.

Recommendation: Consider inclusion of permeable paving at Level 1 Courtyard and other areas where impermeable paving is proposed. The stone layer within the build-up would have a dual effect of cleaning the surface water run-off contaminants, and attenuating the flow reducing the rate at which surface water would flow from the surface areas.

2.2.5 Tree Pit Systems

Problem: There is potential to reduce the surface water runoff and to improve runoff quality from the development by providing a greater amount of SuDS measures.

Recommendation: Consider incorporating tree pit systems in areas in close proximity to the impermeable surfaces where trees are proposed.

2.2.6 Rainwater Harvesting

Problem: Has rainwater harvesting be considered? The large roof area at level 8 could be utilised for RWH and could provide irrigation for landscaping at the green podium level.

Recommendation: Consider use of a rainwater harvesting system (as per CIRIA Ch. 11) which could:

1. help meet some of the building's water demand, delivering sustainability and climate resilience benefits.
2. help reduce the volume of runoff from a site.
3. help reduce the volume of attenuation storage required on the site.

2.2.7 Typical Details

Problem: No details provided for proposed SuDS components example permeable paving, flow control devices, tree pits, etc.

Recommendation: The above details to be provided.

2.2.8 Maintenance

Problem: The report does not make reference to system maintenance relating to blockages.

Recommendation: Set out maintenance/inspection requirements for management of the storm water system. Maintenance management to include life-span of SuDS measures, inspection/monitoring details, grass and vegetation management, litter removal and excessive sediment removal. Ensure there are a sufficient amount of inspection chambers/manholes specified for the proposed SuDS measures in order to achieve access for maintenance including rodding, etc.

2.3 Calculations

2.3.1 Green roof run-off

Problem: The 'Infrastructure Design Report' (p.14) states that 'the soil build-up will primarily absorb some of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium'. However, CIRIA mentions that 'critical duration events for developments served by SuDS are commonly of the order of 12 to 36 hours, which tend to be representative of autumn and winter conditions, when reductions in runoff volumes from green roofs are likely to be small.' (CIRIA p.240).

Recommendation: Consider testing attenuation calculations for winter storms and where no reduction in runoff can be catered for by the greenroofs, i.e. 100% runoff from greenroof areas enter the drainage system.

2.3.2 Green roof area

Problem it is unclear if the green roof area provided meets the required 60% minimum coverage.

Recommendation: Show by way of calculation that the area provided meets the requirements

2.3.3 Site Investigations

Problem: Site investigation reports have not been provided.

Recommendation: If infiltration to ground is proposed for the permeable paving systems, please confirm soil investigation results and infiltration testing carried out on site have confirmed that existing ground conditions are suitable to allow for infiltration of surface water.

2.3.4 Attenuation Tank

Problem: The current surface water outflow from the attenuation tank is pumped to a discharge manhole which then outfalls to the existing public sewer. Pumped systems should be avoided if possible as they can be prone to failure.

Recommendation: Reconsider a gravity outfall option.

Appendix A Drawings & Documents Examined by the Auditor

Proposed Catchment Characteristics		
Description	Area (m²)	Reduction Factor
Roof - Hardstanding (draining to gullies)	105	5%
Roof - Green	1209	5%
Terraces - Hardstanding (draining to gullies)	90	5%
Terraces - Free draining aggregate build-up	720	15%
Podium - Draining through SuDS features	484	20%

ON ORIGINAL

0 5 10 15 20 30 40 50mm

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NOTES:

GENERAL NOTES:

1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE WORKS REQUIREMENTS.
2. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
3. ALL CO-ORDINATES ARE TO IRISH TRANSVERSE MERCATOR.
4. ALL LEVELS ARE TO ORDNANCE DATUM (MALIN HEAD).
5. ALL TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT SHALL COMPLY FULLY WITH THE WORKS REQUIREMENTS.
6. THE CONTRACTOR MUST LIAISE DIRECTLY WITH LOCAL AUTHORITY DEPARTMENTS AS DIRECTED IN THE WORKS REQUIREMENTS
7. ALL VEHICULAR & PEDESTRIAN, CYCLE & PRIVATE ACCESS ROUTES WITHIN AND SURROUNDING THE WORKS EXTENTS MUST BE MAINTAINED THROUGHOUT THE WORKS IN ACCORDANCE WITH THE CONTRACTORS APPROVED TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT PLAN.

DRAWING SPECIFIC NOTES

1. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES.
2. CONTRACTOR SHALL SATISFY HIMSELF AS TO THE ACCURACY OF EXISTING DRAINAGE LEVELS & SERVICES ON SITE PRIOR TO COMMENCEMENT OF WORKS ON SITE
3. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE NRA SPECIFICATION FOR ROAD WORKS UNLESS NOTED OTHERWISE
4. MANHOLE COVER LEVELS ARE TO CONFORM WITH FINISHED ROAD AND PATH LEVELS
5. ALL DRAINAGE TO BE AS PER THE LOCAL AUTHORITY CODE OF PRACTICE FOR DRAINAGE WORKS/LOCAL AUTHORITY & IRISH WATER REQUIREMENTS
6. ALL EXTERNAL COLLECTOR DRAINS TO BE MINIMUM 150 mm DIA.
7. ALL FOUL SEWERS TO BE uPVC TO EN1401
8. ALL SURFACE WATER SEWERS TO BE CLASS H CONCRETE TO EN1916 & IS 6 2004.
9. THIS DRAWING IS BASED ON TOPO SURVEY BY MURPHY SURVEY Ltd. DATED 13/04/2016
10. CONTRACTOR SHALL INSPECT THE ROUTE & CONFIRM LOCATIONS OF ALL TREES, FEATURES, ENTRANCES & ASPECTS IMPACTING CONSTRUCTION OF THE WORKS
11. GREEN ROOFS SHALL BE PROVIDED WITH A 1m WIDE GRAVEL FIRE BREAK EVERY 40m
12. GRAVEL STRIPS MUST BE PROVIDED AROUND ALL STRUCTURES PENETRATING THE ROOF.

LEGEND

- SITE BOUNDARY
- MIXTURE OF EXTENSIVE AND INTENSIVE GREEN ROOF
- LANDSCAPING AS PER LANDSCAPE ARCHITECT'S DETAILS
- IMPERMEABLE PAVED AREAS
- PERMEABLE PAVED AREAS
- DIRECTION OF FALL

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rev	date	description	by	chkd.
client approval		A - Approved		
		B - Approved with comments		
		C - Do not use		

suitability	issue purpose
S2 - INFORMATION	PLANNING

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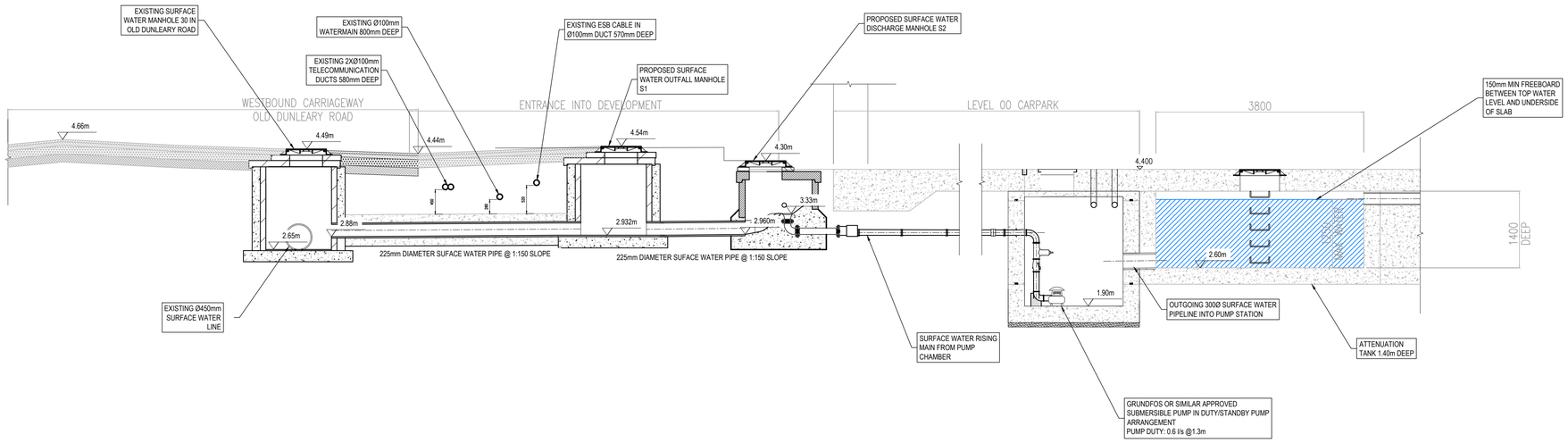
project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
SURFACE WATER STRATEGY

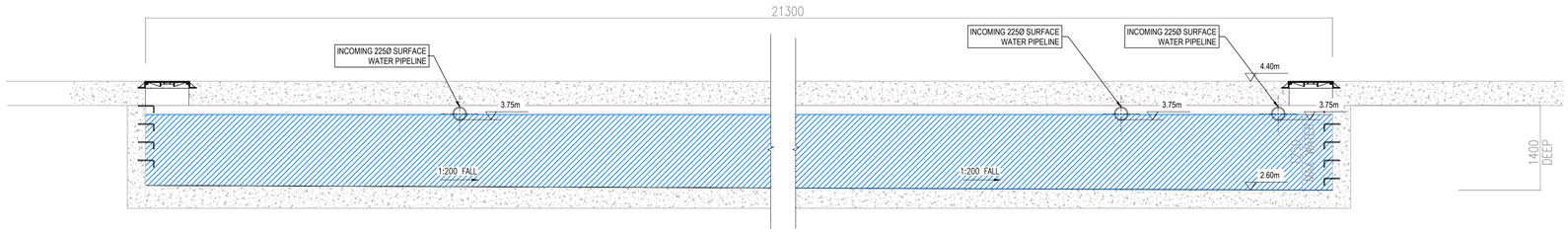
client
TED LIVING

designed by	author	scale	sheet size
PCC	BS	1:200	A1

drawing no.	revision
TED-DBFL-SW-SP-DR-C-1301	P01



LONGSECTION A THROUGH SURFACE WATER OUTFALL



SECTION B THROUGH ATTENUATION TANK

ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

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rev	date	description	by	chkd.
client approval		A - Approved		
		B - Approved with comments		
		C - Do not use		

suitability: S2 - INFORMATION
issue purpose: PLANNING

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project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
SURFACE WATER OUTFALL & ATTENUATION SECTIONS

client
TED LIVING

designed by	author	scale	sheet size
PCC	BS	1:50	A1

drawing no.: TED-DBFL-SW-SP-DR-C-3311
revision: P01

Project

The Ted, Dun Laoghaire, Built to Rent

Report Title

Infrastructure Design Report

Client

Ted Living Limited

INFRASTRUCTURE

DBFL CONSULTING ENGINEERS

JUNE 2021

Document Control

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Author: Prinavan Chetty

Reviewed by: Nick Fenner

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Design Team
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APPENDICES

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1.0 INTRODUCTION

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for the proposed mixed-use development at Tedcastles, Monkstown, Co. Dublin.

1.2 Location & Topography

The proposed site is located in Monkstown, adjacent to the West Pier of Dun Laoghaire Harbour (refer to Figure 1-1). The subject site is approximately 0.31Ha and is currently occupied by an existing dwelling, and associated maintenance buildings. The subject site comprises mostly hardstanding area.

The site is bound by streets on three sides, with Old Dunleary Road to the north, Dunleary Hill to the south and Cumberland Street to west, with an existing residential development bounding the site to the east.

As per Dun Laoghaire Rathdown County Council's development plan, the site has been zoned NC, to protect, provide for and-or improve mixed-use neighbourhood centre facilities.

The subject site is currently terraced, with retaining structures to the north of the site with the existing dwelling at a higher level, which is accessed from the south west. A yard and shed is terraced at a lower level to the north at approximately 4.5m AOD and accessed to the north off Old Dunleary Hill.

The subject site is relatively level, with a slight fall from south to north. There is also a steep embankment on the northern side of the site leading down to the site from Dunleary Road.

The topographical survey has been included in appendix C.

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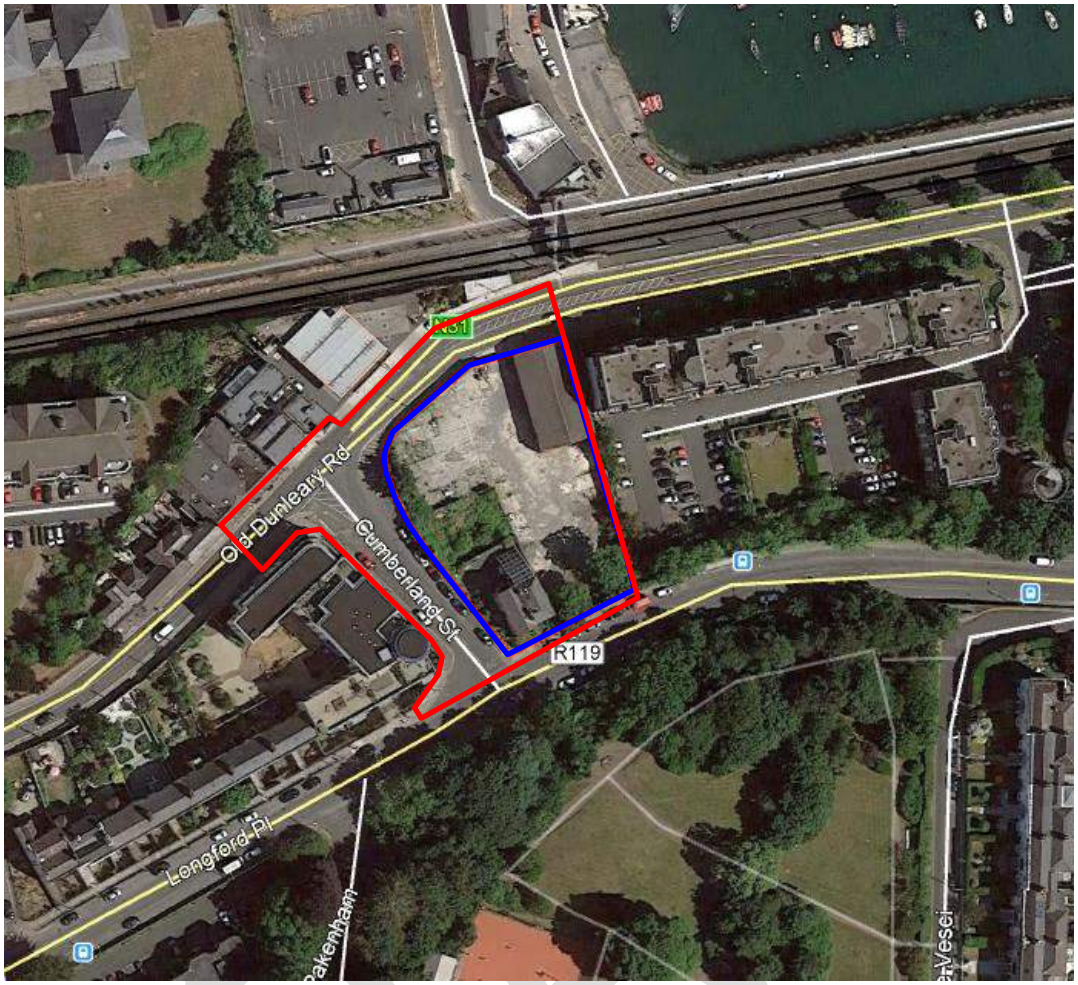

Site Boundary Proposed development boundary

Figure 1-1: *Site Location (Site Boundary Indicative Only)*

1.3 Existing Ground Conditions

A ground investigation was undertaken by Ground Investigations Ireland and this revealed that the strata encountered consisted mainly of Concrete Surfacing to approximately 0.2m BGL on Made Ground to 0.6m-2.7m BGL. The Made Ground was followed by Cohesive deposits slightly sandy slightly gravelly CLAY and Granular deposits of slightly clayey sandy sub angular to sub sub-rounded fine to coarse GRAVEL. Both Cohesive and Granular deposits contained the occasional cobbles and boulders. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix.

The rotary core boreholes recovered medium strong to very strong grey/white coarsely crystalline Granite. The depth to rock varies from a minimum of 4.80m BGL to a maximum of 11.10m BGL.

Ground water was encountered at 4.50m BGL in BH03 at the western part of the site and at 4.70m BGL in BH04 at the northern part of the side. The borehole locations are shown in Figure 1-2.

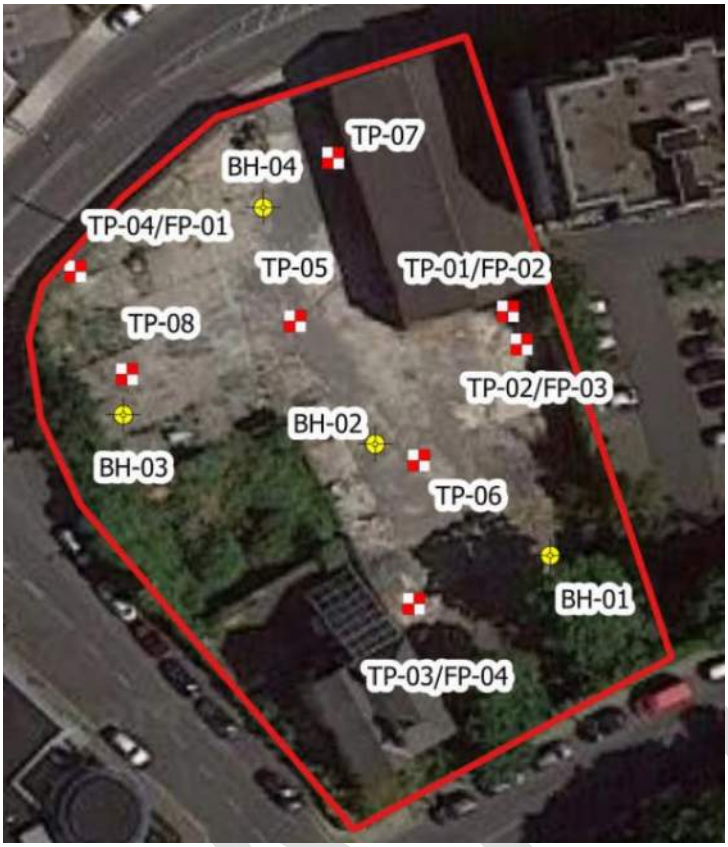

Figure 1-2: *Site investigation trial pit and borehole locations*

1.4 Proposed Development

The proposed development at the former Ted Castles site, Old Dun Leary Road, Cumberland Street and Dun Leary Hill, Dun Laoghaire will consist of:

- The provision of 146 no. apartment units (Build to Rent) and all associated ancillary facilities (including residential amenities) in a building with an overall height ranging from 6 storeys (with set backs from 4th storey) addressing Dun Leary Hill, to 5 and 8 storeys (with set backs from 7th storey) addressing Old Dun Leary Road. The proposal provides for private and communal open spaces throughout.
- A retail unit addressing Old Dun Leary Road and Cumberland Street
- All associated ancillary car parking, cycle parking, a new vehicular entrance/cycle path (off the Old Dun Leary Road), ancillary plant areas, ESB substation and storage areas.
- Extensive hard and soft landscaping throughout, green roof, public lighting, signage, boundary treatments and public realm improvements.
- The demolition of all existing buildings within the subject site excluding the yellow brick building known as “Dunleary House” and the existing open fronted shed and the removal of existing boundary walls, piers, railings and gates. The proposal includes the reuse and incorporation of part of the existing boundary wall material within the landscape proposals.
- All associated ancillary site services and site development works.

2.0 Flood Risk

Based on a review of the Eastern Catchment Flood Risk Assessment and Management (CFRAM) study, the Irish Coastal Protection Strategy Study (ICPSS) and Dún Laoghaire-Rathdown County Council's Strategic Flood Risk Assessment (SFRA), we note that the development lands are located within Flood Zone C.

The review concluded that the proposed development site is located within Flood Zone C and has a very low risk of fluvial flooding as there are no EPA water courses in close proximity to the site as shown in Figure 2-1. There is also no risk from tidal flooding as the lowest level on the site is 4.38m AOD and the 0.1% AEP water level reaches a maximum of 3.19m AOD, providing over 1m of freeboard.

A possible source of flood risk identified was from the surcharging or blockage of the development's drainage system. This risk will be mitigated by suitable design of the drainage network, regular maintenance and inspection of the network and establishment of exceedance overland flow routes.

Flood risk from all sources have been fully assessed in a Site Specific Flood Risk Assessment (SSFRA). Please refer to DBFL report 190057-Rep-003 – SSFRA.

Figure 2-1: *Extract from EPA online mapping*

3.0 SITE ACCESS AND ROAD LAYOUT

3.1 Existing Access

The proposed development site has a single entry-point for vehicles on Old Dunleary Road as shown on Figure 3-1. There is an existing pedestrian access on Cumberland Street at the north western side of the site, however it is overgrown and does not seem to be in use. Further pedestrian accesses to the south west giving access to the existing house are also present.

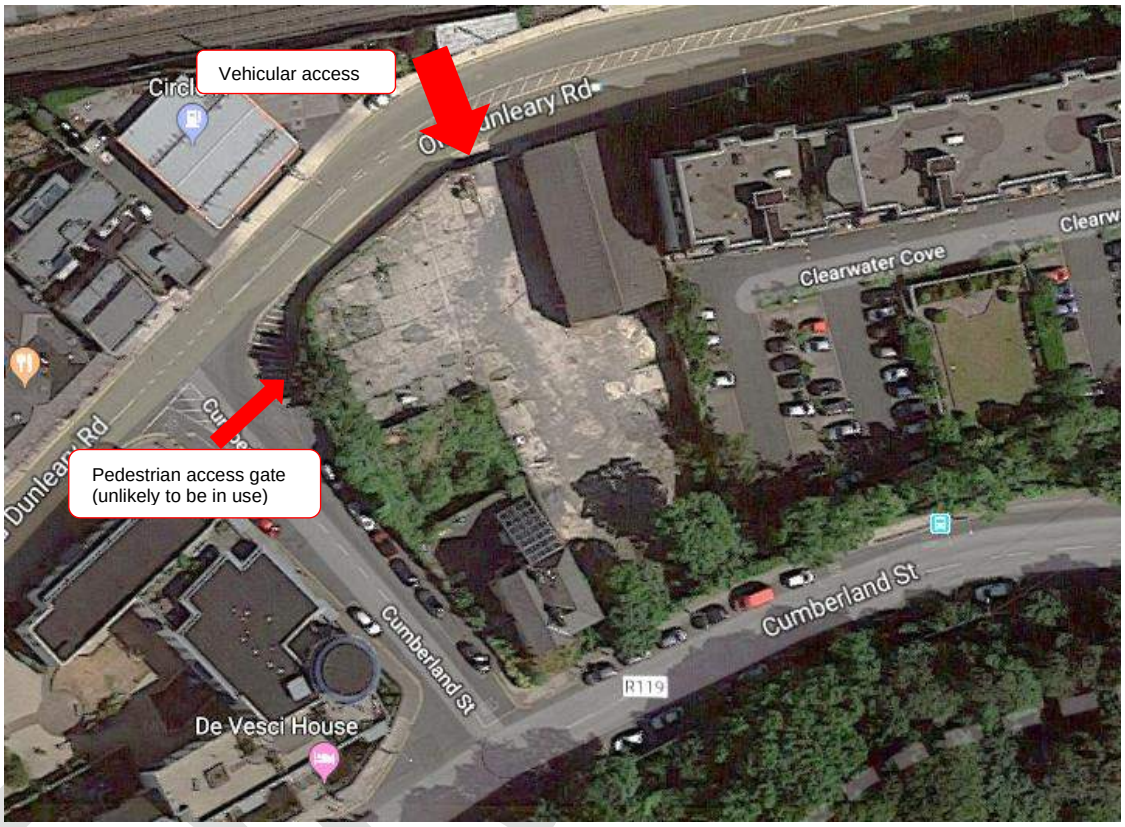

Figure 3-1: *Existing access into the site*

3.2 Proposed Access

The proposed development will have multiple accesses, shown in Figure 3-2, due to the existing topography of the surrounding street network which is 4.8m AOD on Old Dunleary Hill and 11mm AOD on Dunleary Hill.

3.3 Vehicular Access

The proposed vehicular access to the development will be via Old Dunleary Road at the north eastern part of the site which allows access to the ground floor car park of the development. The access will be 6m wide and will consist of a vehicle crossover and drop kerb due to the low volume of proposed traffic and to prioritise pedestrians.

3.4 Pedestrian Access

The development can be accessed by pedestrians via various entry points. The main access to the residential elements of the development will be via Cumberland Street at a level of 8.45m AOD which leads into the development's courtyard. The commercial and café units will be accessed via Old Dunleary Road at 5.95m AOD while a selection of own door units will be accessed from Dunleary Hill at a level of 11.9m AOD.

3.5 Cycle Access

A dedicated cycle access has been proposed as part of the vehicular access off Old Dunleary Road in accordance with DLRCC's Cycle parking standard. The cycle access will be 2.0m wide and will give cyclists a prioritised route to the proposed cycle store located within the car park.

3.6 Old Dunleary Road/Cumberland Street Signalised Junction and Cumberland Street Courtesy Crossing

The subject development proposals include the upgrading of the Old Dunleary Road/Cumberland Street junction to be signal controlled as well as the upgrading of Cumberland Street in line with the Design Manual for Road and Urban Streets (DMURS). The proposed road layout and hard landscaping areas have been tracked to demonstrate that the proposed corner radii will accommodate everyday vehicles such as normal delivery and cars. Other vehicles such as refuse trucks and fire tender have been tracked to ensure they can turn and manoeuvre around these roads (refer to DBFL Drawing TED-DBFL-RD-SP-DR-1101).

A courtesy crossing is proposed for the southern end of Cumberland Street in the form of a raised and paved crossing. This will allow pedestrians to assert a degree of priority over drivers, allowing a safer crossing point.

3.7 Proposed Parking

The parking area within the development will consist of 44 no. car parking spaces at the Level 00 with 2 no. accessible parking bays and a bike store area to accommodate 183 no. residential bikes with a further 82 no. short stay spaces available as Sheffield stands.

Provision for electric charging will be made for 4 no. spaces in accordance with Dun Laoghaire Rathdown County Council's Development Plan.

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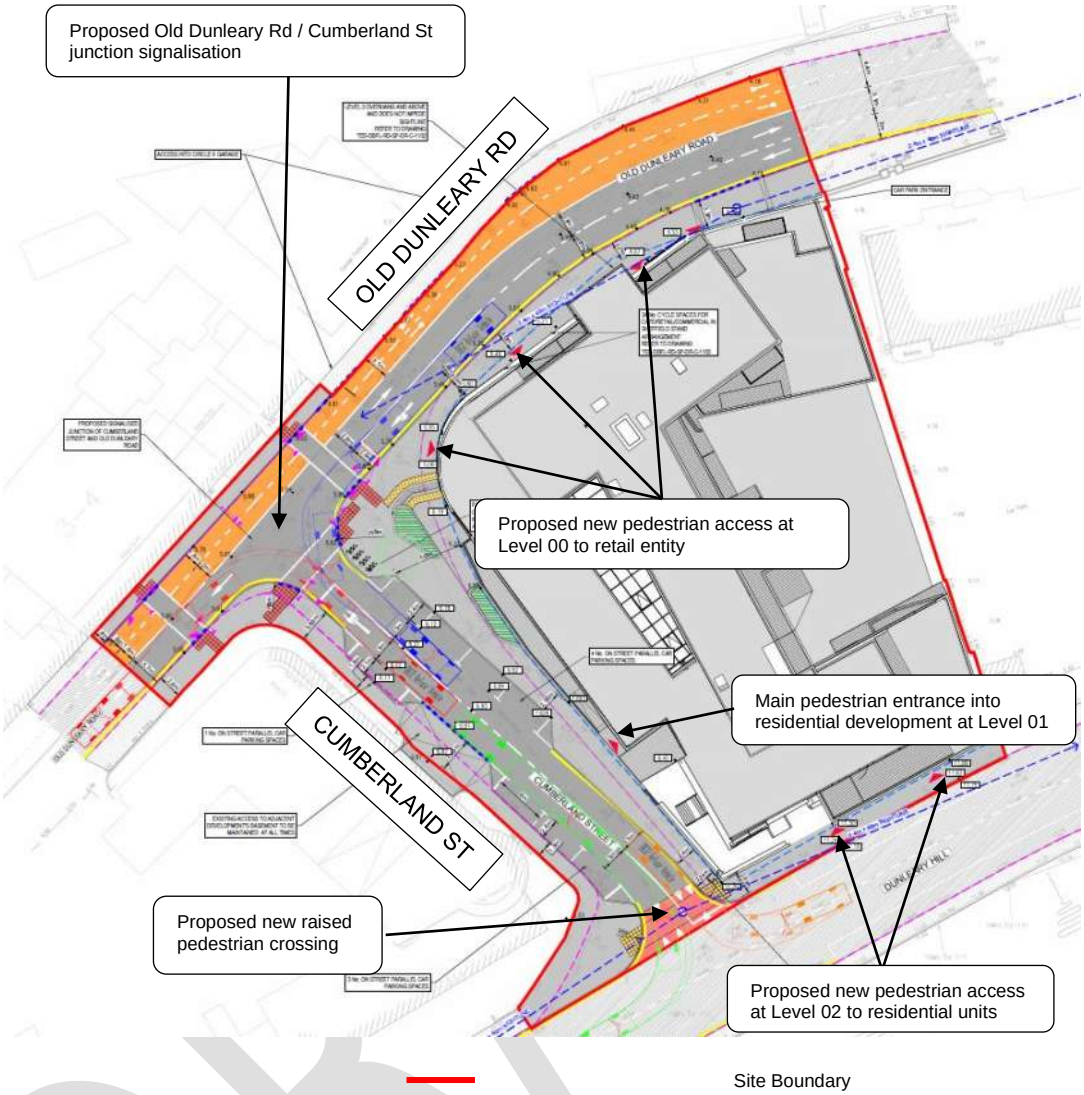

Figure 3-2: *Proposed Junction and Access for Development*

4.0 Public Realm Strategy

The development proposals include significant Public Realm improvements (shown in Figure 4-1) as mentioned under section 1.4. These works include footpath upgrades and alterations; resurfacing works; a signalised junction on Old Dun Leary Road and Cumberland Street including pedestrian crossings on all arms; provision of a seating area; landscaping; 32 no. bicycle parking spaces; and the inclusion street on car parking spaces on Cumberland Street. A layout of these proposals is shown on DBFL drawing TED-DBFL-RD-SP-DR-C-1101.

The proposed finished and materials for the works in the public realm will comply with the technical requirements of DLRCC and will be carried out by the Contractor appointed for the proposed development.

A preliminary construction traffic management plan, report no. TED-DBFL-XX-XX-C-0006, outlines the impacts of these works on affected properties and provisions to manage this.

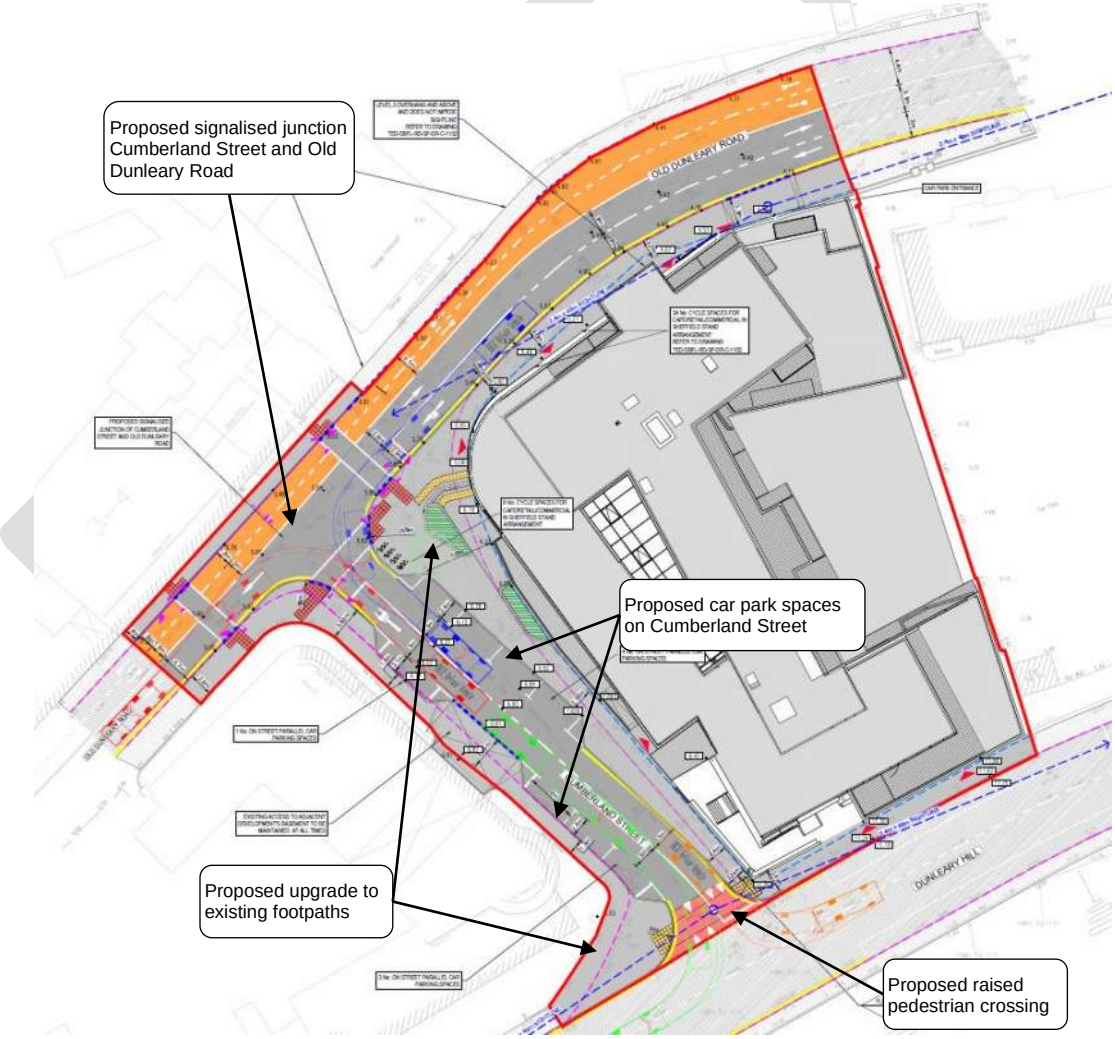

Figure 4-1: Proposed Public Realm Improvements

5.0 EXISTING SERVICES AND UTILITIES

5.1 General

A comprehensive topographical survey was carried out for the subject site and existing drainage and utility records in the vicinity of the site obtained and surveyed in detail. In addition to this, existing information was provided by DLRCC in relation to historical surveys that have been undertaken. A summary of the existing main services is provided below, and the Irish Water records can be found in appendix D.

5.2 Surface Water Drainage

The area is served by a complex network of surface water and combined sewers which surround the site shown in Figure 5-1. As part of the adjacent 'Top Hat' site development a new 450mm surface water outfall was constructed to the north of the development on Old Dunleary Road outfalling to the existing 900mm surface water in front of the Clearwater Cove Apartments to the east.

5.3 Foul Sewer

According to various site investigations, record drawings and discussions with DLRCC, there is an existing 1200mm diameter combined sewer on Old Dunleary Road. This outfalls north under the railway line into a 2100mm combined sewer.

It is also known that the old Monkstown Overflow Culvert passes through the northern part of the site. From discussions with DLRCC and Irish Water it is known that the culvert originates from Longford Street, which travels down Cumberland Street towards Old Dunleary Road where it turns within a manhole to the east and passes through the northern portion of the subject site. As part of the development, it is proposed to divert the Monkstown Overflow Sewer and the details can be found in section 7.1 of this report.

5.4 Water Supply

The site is well served by a series of watermains in Old Dunleary Road, Cumberland Street and Dunleary Hill as shown in Figure 5-1. The existing site looks to have two connections, one from Cumberland Street for the existing dwelling and another from Old Dun Leary Road which can be seen from the presence of water meters located on the Topographical survey.

There are existing fire hydrants along Old Dunleary Road north eastern corner of the site and along Cumberland Street on the south western corner of the site.

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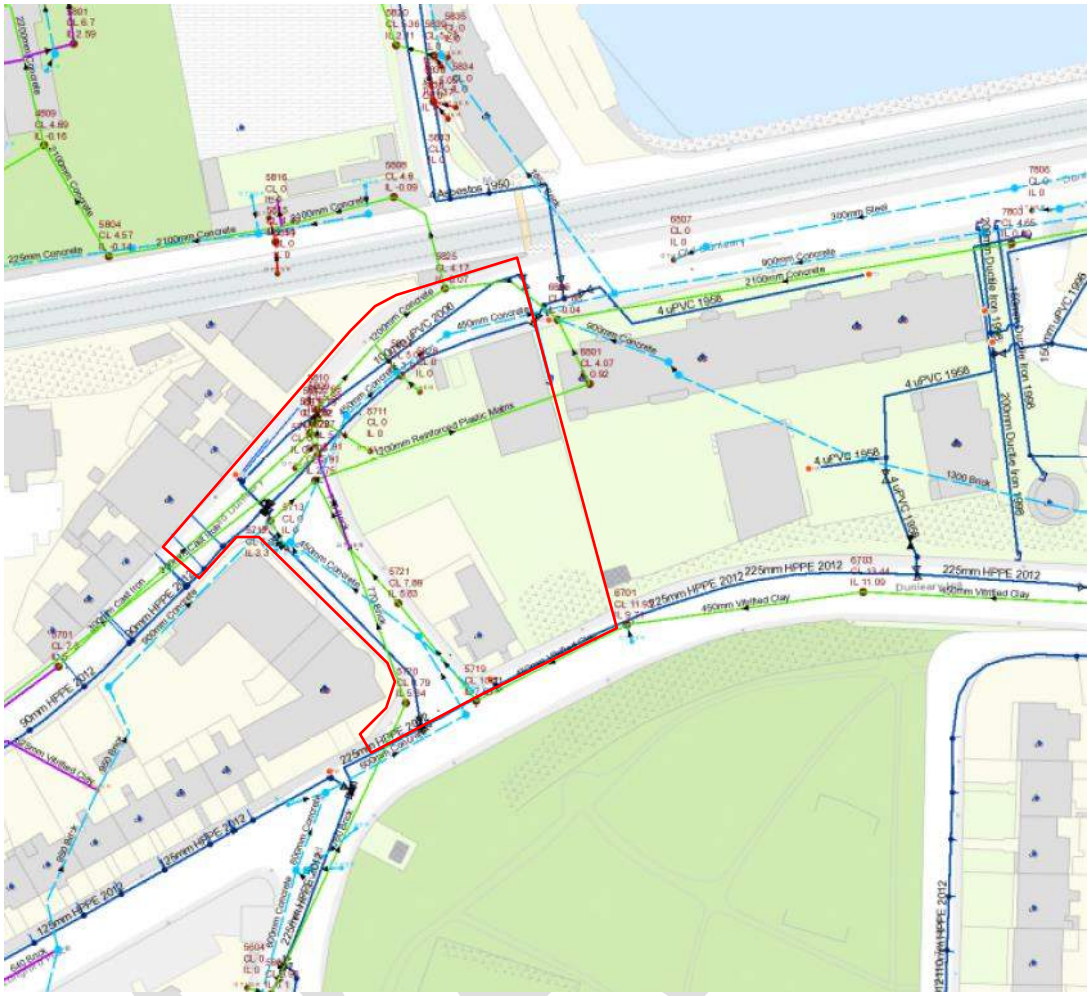

Figure 5-1: *Existing watermain and sewer records*

6.0 PROPOSED SURFACE WATER DRAINAGE

6.1 Surface Water Policy

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the Greater Dublin Strategic Drainage Study (GDSDS) and with the requirements of Dun Laoghaire Rathdown County Council. The guidelines require the following 4 main criteria to be provided by the design:

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment within the green roof, bio-retention/filter drains and green courtyard and garden.
- Criterion 2: River Regime Protection – satisfied by attenuating to greenfield run-off rates.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the development's surface water drainage design, planned flood routing, run-off contained within site, flood storage and building set greater than 0.5m above 100-year flood level.
- Criterion 4: River flood protection – attenuation volume and discharge limit designed to greenfield run-off rates (long term storage not provided).

6.2 Surface Water Strategy

To meet the requirements of the surface water policy above, the surface water strategy has been described in this section to give a clearer indication of how the design of the development has progressed to the submitted design. To give a clearer understanding of each SUDS element, the different stages of the treatment train has been explained in detail in the following section. An overview of the different SUDS features incorporated within the development proposals can be seen on DBFL Drawing TED-DBFL-CS-SP-DR-C-12001 and TED-DBFL-SW-SP-DR-C-1301.

Due to the coverage of structure over the subject site, infiltration techniques will not be suitable for the development. Therefore, SUDS features at roof/terrace and podium level such as green roofs/build-up, permeable paving and rain gardens shall be implemented into the development to convey surface run-off via the drainage system to the larger attenuation tank while also providing treatment and ecological value.

Roof Level:

As the first part of the treatment train, the SUDS features have been designed to prioritise, interception and reduction of flow rates. The features that will be incorporated into the design are:

Green roof - this will be a mixture of intensive and extensive type with 80mm minimum construction depth. All necessary safety requirements will be designed and constructed to ensure safe maintenance can occur. The green roof will provide interception and reduction of

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flow rates at the beginning of the treatment train, providing source control for a large area of the development. After surface water has passed through the Green Roof, this will discharge to the surface water network below.

- Once the rainwater has filtered through the various build-up mediums, run-off will drain to gullies located at the structural slab level and then conveyed to the below ground system via slung drainage.

Terrace Level:

- At terrace level the subject development will implement a free draining aggregate that will be placed on top of the terrace slabs allowing a reduction in flows within the drainage network.

Level 01:

- At podium level the subject development will implement a permeable paving in places and green landscaping.

  The green landscaped areas will constitute what is similar to an intensive Green Roof build-up, allowing surface water run-off to slowly percolate through the build-up medium, reducing the flows through the drainage network and also allowing vegetation to intercept run-off creating a reduction in run-off volumes.

- In areas of permeable paving a free draining aggregate sub-base will be used between the permeable paving and the podium slabs allowing a reduction in flows within the drainage network.

- Impermeable areas have been designed to drain through green podium to ensure that any surface water runoff has an element of interception and treatment.

- Once the rainwater has filtered through the various build-up mediums, run-off will drain to gullies located at the structural slab level and then conveyed to the below ground system via slung drainage.

- In addition to the above, smaller SUDS elements will also be located on podium such as Bio-swales, raised planters and rain gardens (refer to *Figure 6-1*). These will be specified in co-ordination with the landscape design to slow any areas of hardstanding that need to be drained and provide additional treatment and subsequent improvement of discharge quality.

Level 00:

- After rainwater has passed through the various SUDS features at the higher levels, this will drain to the below ground network. To ensure the development attenuates to greenfield run-off rates it is necessary to include an attenuation tank under the car park slab to provide the required volume for the 1% AEP event +10% Climate change

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allowance. A flow control (in this instance a pump due to the shallow depth of the surface water sewer) will limit discharge to 0.6l/s.

Figure 6-1: *Examples of Urban Swales/Bio-swales – Various Sources*

The incorporation of the above SUDS elements will provide a sustainable way to disperse surface water from the site and provide treatment of run-off and subsequent improvement of discharge quality.

6.3 Attenuation

Attenuation volumes have been calculated based on an allowable outflow / green field runoff rate of 0.6l/sec ($QBAR_{RURAL}$ calculated in accordance with Institute of Hydrology Report 124, see Appendix A). Refer to Appendix A for calculations sheets.

The drainage design uses SOIL type 2 for the site's QBar greenfield run-off calculations. To derive the soil type, table 4.5 of the Flood Studies Report was used as recommended by the GDSDS. Table 6-1 and Figure 6-2 is a summary of the site characteristics used in the selection of the pre-development soil value.

Table 6-1: Summary of Site Characteristics

Characteristic	Value	Description
Drainage Group	1 (Rarely Waterlogged within 60cm at any time)	Drainage group 1 was selected as the site is rarely waterlogged within 60cm at any time i.e. it is well drained.
Depth to impermeable layer	1 (>80cm)	Impermeable layers were encountered at depths of 4.80m BGL to 11.10m BGL during the site investigation.
Permeability group (above 'impermeable' layers or to 80cm)	Slow	The permeability group of the soil was set conservatively as "Slow" due to the clay deposits encountered during the site investigation.
Slope	2 - 8°	The fall across the site varies within the range of 2° to 8°.

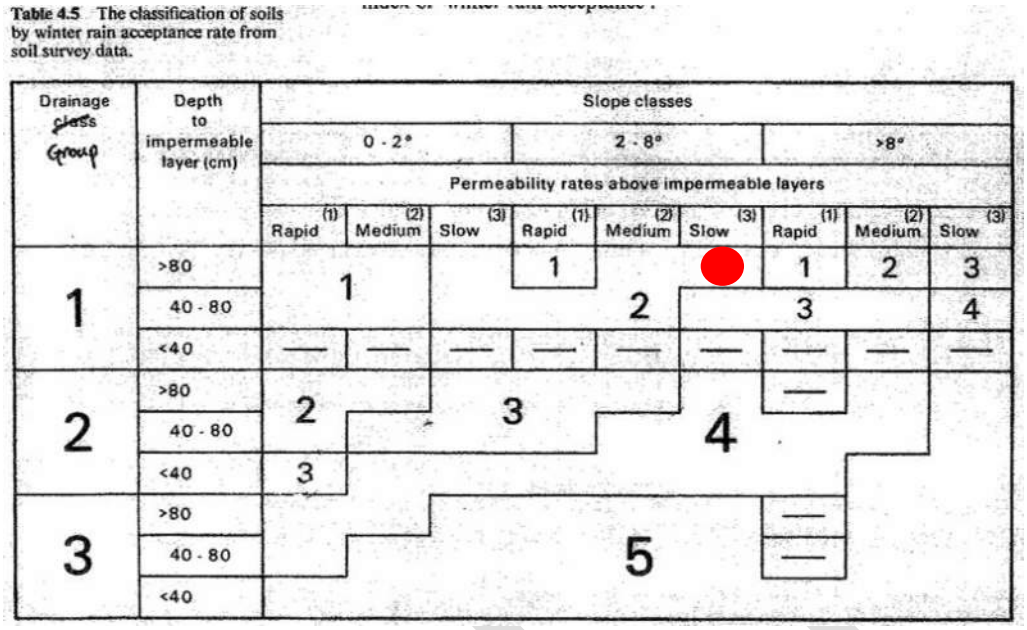

Table 4.5 The classification of soils by winter rain acceptance rate from soil survey data.

Drainage class Group	Depth to impermeable layer (cm)	Slope classes								
		0 - 2°			2 - 8°			>8°		
		Permeability rates above impermeable layers								
		Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)
1	>80	1			1			1	2	3
	40 - 80				2			3		4
	<40	—	—	—	—	—	—	—	—	—
2	>80	2		3			4	—		
	40 - 80									
	<40	3								
3	>80	5						—		
	40 - 80							—		
	<40									

Figure 6-2: *Extract of Table 4.5 for classification of SOIL type for the development*

The run-off from the new development will be treated at source using SUDS elements, shown in Figure 6-3 which include green roofs and green podiums, although the main volume will be based in a reinforced concrete tank that will be located beneath the ground floor parking, to ensure the design event of the 1% AEP plus 10% climate change is catered for.

The impermeable areas contributing to the attenuation volume have had the following reduction factors applied:

Roof Level:

- Green roofs, the proposed build-up will be a mix of intensive and extensive type with 80mm minimum construction depth. The soil build-up will primarily absorb some of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium. Therefore, a reduction of volume and flow rate will occur due to the presence of the green roof. Also, the green roof plant life will absorb a percentage of the run-off, further reducing volume that will drain to the surface water network. Therefore a 5% reduction factor has been applied.
- Impermeable rooflight and private terraces, a 5% reduction of the surface area is applied to take account of run-off not collected and stored within the micro and macro texture of the surfacing (various sources recommend different reduction coefficients e.g. IS EN752 recommends Runoff Coefficient (C for the Rational Method) of 0.9 to 1.0 for impermeable areas and steeply sloping roofs. For flat roofs it recommends 0.5 to 1.0 depending on area).

Podium Levels:

- Green areas over podium, a reduction factor of 20% has been applied. The deep soil build-up will primarily absorb a substantial amount of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium.
- Permeable Paving on podium and ground will have a free draining material within the build-up and will reduce the flow rate from these areas. Rainfall will 'wet' the initial surface of the paving allowing water to be stored in the micro and macrotexture of the surfacing and will be lost to evapotranspiration, as the run-off drains through the free draining aggregate, this build-up will also 'wet' giving another volume reduction due to evapotranspiration and natural storage within the SUDS feature. A reduction in velocity will also occur as the aggregate used will slow the run-off at source, changing the input hydrograph which will ultimately reduce the peak inflow for attenuation calculations. A reduction factor of 10% has been applied for these reasons.
- Areas draining to Green Podium filter drains and conveyance swales and/or treepits, a conservative reduction factor of 20% has been applied for these areas located over podium. Firstly, rainfall will 'wet' the initial surface of the paving, allowing water to be stored in the micro and macrotexture of the surfacing and will be lost to evapotranspiration, giving a reduction in volume. As run-off drains to these SUDS elements and through the build-up, the aggregate/soil surface area will also 'wet' giving another reduction of volume due to evapotranspiration and natural storage within the SUDS feature. The vegetation within these areas will provided a level of treatment and interception at the source. There will also be a reduction of velocity as the aggregate/filter material used in the SUDS feature slows the run-off at source, changing the input hydrograph which will ultimately reduce the peak inflow for attenuation calculations. The SUDS Manual outlines that they "can help reduce flow rates from a site by providing some attenuation storage and can reduce storage volume requirements where infiltration occurs".

A reinforced concrete attenuation tank will be constructed under the ground floor slab, as the building footprint takes the majority of the site. Due to topography levels and the existing infrastructure in the vicinity of the site, the proposed attenuation tank will also need to be pumped as a gravity connection is not feasible in this location, due to the shallow nature of the 450mm diameter surface water sewer located in Old Dunleary Road. The attenuation tank has been designed to provide the required volume for the 100-year storm event (+10% climate change) using Micro Drainage source control software. Refer to Appendix B for the summary of results for various storm-water duration. Calculations indicate that 187m^3 of storage volume for the 100-year event (+10% climate change) is needed; and the attenuation tank will be provided with a total available volume of 252m^3 to allow for 360mm of freeboard.

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Surface water attenuation calculation can be found in Appendix B. A section of the attenuation tank and outfall details DBFL drawing TED-DBFL-CS-SP-DR-C-5204. A summary of the surface water runoff reduction factors is shown under Table 6-2.

Table 6-2: Summary of surface water runoff reduction factors

Description	Area (m^2)	Reduction Factor
Roof – Hardstanding (draining to gullies)	105	5%
Roof – Green	1209	5%
Terraces – Hardstanding (draining to gullies)	90	5%
Terraces – Free draining aggregate build-up	720	15%
Courtyard – Draining through SUDS features	484	20%

Figure 6-3: *Proposed Landscape showing green roof and green podium*

6.4 Design Standards

Storm-water drainage has been designed in accordance with the Greater Dublin Code of Practice for Drainage Works. The following design parameters are applicable to the design:

- Time of entry: 4 minutes
- Pipe Friction (Ks): 0.6 mm

- Minimum Velocity: 1.0 m/s
- Standard Average Annual Rainfall: 757mm
- M5-60: 15.9mm
- Ratio r (M5-60/M5-2D): 0.27
- Attenuation Tank Storm Return Event GDSDS Volume 2, p61, Criterion 3

  30 year no flooding on site.

  100 year check no internal property flooding. Flood routing plan. FFL freeboard above 100-year flood level. No flooding to adjacent areas.
- Climate Change 10% for rainfall intensities, as GDSDS

Surface water sewers have been designed in accordance with IS EN 752 and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

The minimum pipe diameter for public surface water sewers is 225mm. Private drains comprise of diameters from 100mm.

6.5 Climate Change

Surface water calculations for the development made use of rainfall values for the Monkstown area as provided by Met Eireann. Rainfall intensities were increased by a factor of 10% to take account of climate change, as required by the DLRCC for attenuation storage design.

6.6 Surface Water Quality Impact

The type of development is low risk i.e. it does not present a high risk of run-off contamination. The development's design and layout further reduce the risk of contaminants entering the surface water network as most of the site coverage will be roof/terrace/podium area with the all of vehicle parking provided at ground level. Run-off from green areas of the roof will have a first stage of treatment by draining through green-roof medium which in turn drain to the on-line attenuation storage systems. The podium areas will drain via their build-ups to a slung system which in turn also drain via the attenuation storage system.

The highest risk of contaminated surface water run-off from the site would be from the access road and entrance to the car park which are relatively small areas.

All incidental drainage from the car park is discharged via a Class 1 oil separator to the attenuation tank before eventually being discharged into to the foul sewer as per DLRCC requirements. Furthermore, the volume of surface water from the carpark is expected to be small as it is undercroft and will have a negligible impact on the water quality. In this way it is considered that the development provides treatment of collected run-off, provides a SUDS treatment train approach and is low risk of pollutants.

The proposed surface water system has therefore been designed to incorporate SUDS techniques which naturally reduce pollutants and improve water quality.

6.7 Interception of First Flush of Rainfall

The GDSDS recommends that no run-off should pass directly to a river for rainfall depths of 5mm and up to 10mm if possible, i.e. interception. The development's drainage design allows for collection of most of the site's run-off via SUDS features e.g. green roofs and filter drains, providing interception at source. In turn resulting runoff is conveyed to attenuation storage system provide a level of further interception. Calculations in accordance with the GDSDS recommendations can be found in appendix A and indicate a minimum of 12.2m^3 of interception volume should be provided. This interception will occur within elements such as the green roof, green podium and planters.

6.8 Surface Water Pumping

As discussed under Section 6.3, the outflow from the proposed attenuation tank will need to be pumped as a gravity connection is not viable due to the shallow nature of the 450mm diameter surface water sewer located in Old Dunleary Road. The pump shall limit the discharge to 0.6l/s as per the allowable outflow discussed under Section 6.3. The outflow will be discharged into a discharge manhole before draining under gravity via a proposed new 225mm diameter surface water line to the public sewer.

The pumps within the pump station will be installed in a duty stand-by arrangement with two stand-by pumps to allow for redundancy in the system. Maintenance and operating procedures will be provided by the Contractor to management of the property. The type of pumps proposed are submersible pumps suited for drainage applications which can be used as a stationary installation. The anticipated system curve and duty point are shown on Figure 6-4 and calculations included under Appendix G.

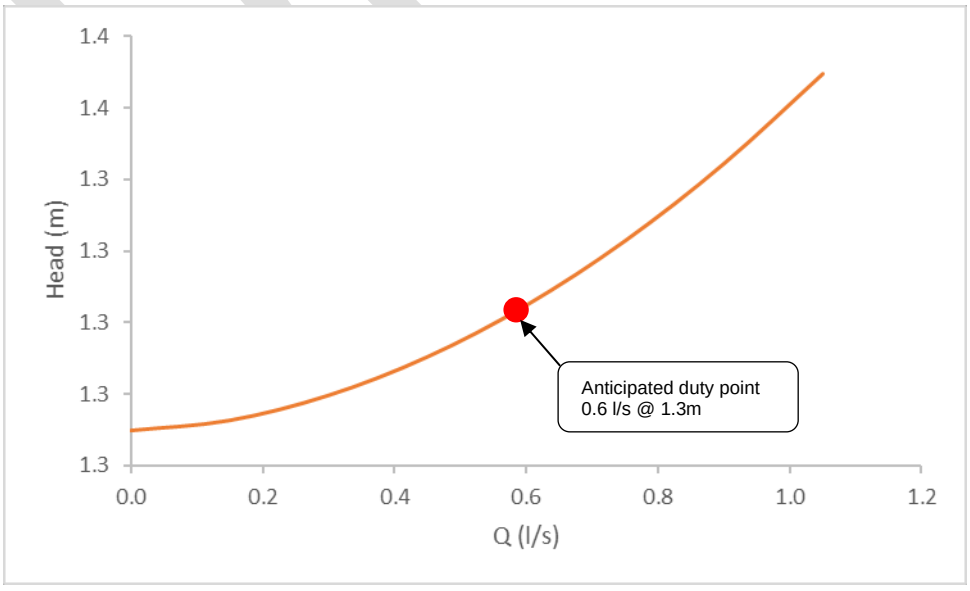

Figure 6-4: Anticipated surface water rising main system curve and duty

In the case that the external public sewer is surcharged and hence the discharge manhole is at capacity, the pump will discontinue pumping and the overflow will be contained within the car park area as the entrance level has been manipulated to allow 100mm to be stored over the car park area providing approximately 165m^3 of storage. This carpark storage excludes the volume available within the attenuation tank and internal surface water sewer network.

All doors at car park level will be fitted with water-tight seals to prevent the flooding of any facilities.

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7.0 PROPOSED FOUL DRAINAGE

7.1 Proposed External Foul Sewer Diversion

Correspondence with Irish Water was undertaken on the proposed diversion of the existing Monkstown Culvert. A feasibility studies report, outlining the possible diversion options, was submitted to Irish Water along with the hydraulic modelling for each option based on the East and West Pier Drainage Area Plan. The preferred option is shown in Figure 7-1 and the confirmation of feasibility issued by Irish Water is included under Appendix E.

Referring to Figure 7-1, it is proposed to construct a new manhole (*MH-A*) to replace the existing manhole on Cumberland Street (*Ex MH-1*) immediately upstream of the existing Monkstown Culvert. The construction of this manhole (*MH-A*) will make it possible to collect the existing flows from the upstream brick culvert and intercept the 300mm diameter overflow sewer at this location. The proposed sewer diversion will begin at this proposed manhole (*MH-A*) and run directly to the existing manhole on Old Dun Leary Road (*Ex MH-2*) where this will tie back into the existing network.

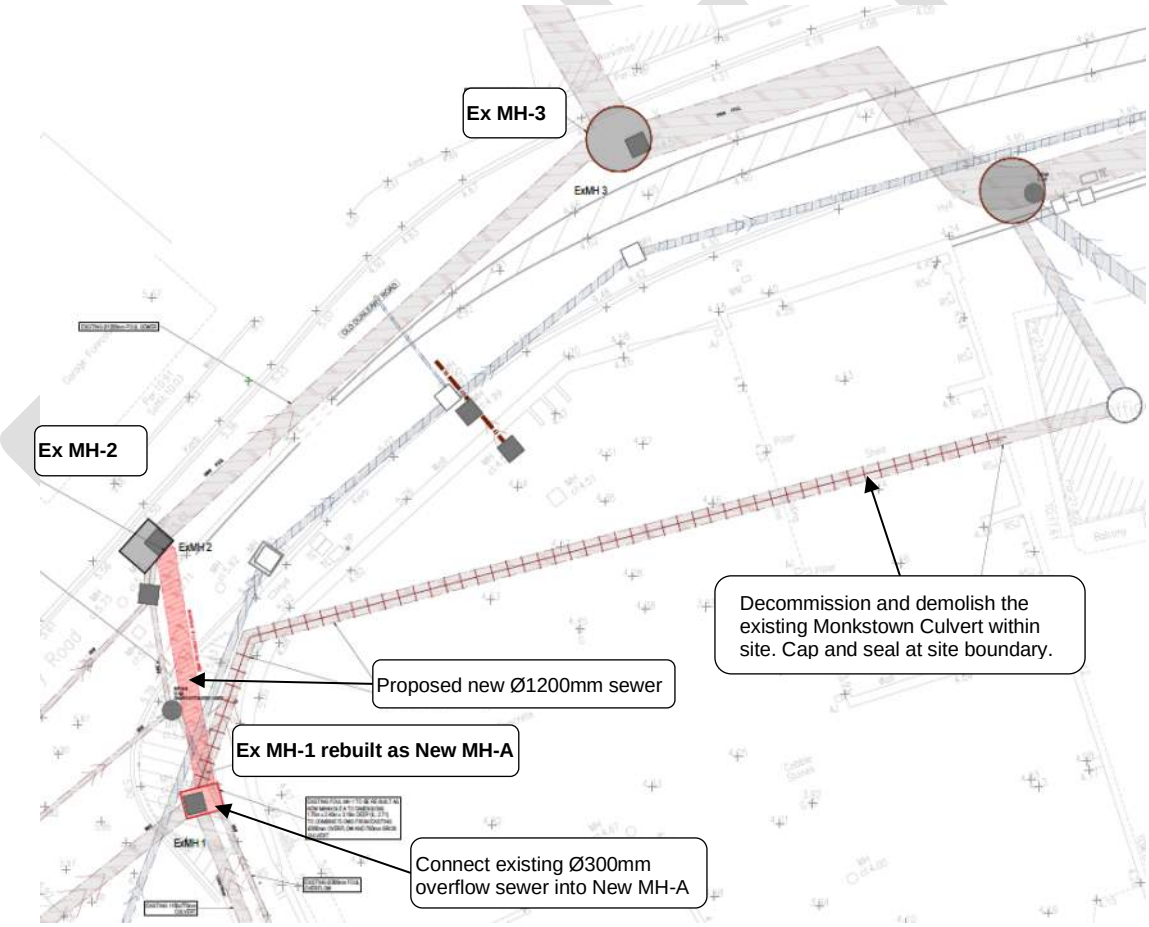

Figure 7-1: Overview of Proposed Diversion

7.2 Proposed Foul Layout

The proposed foul drainage layout for the development is largely reliant on slung drainage in the basement. As the basement extents cover most of the site, slung drainage will be located

by foul stacks which will be drained at high level under the podium slab. DBFL drawing TED-DBFL-CS-SP-DR-C-1201 shows an indicative layout of slung drainage which is designed based on a maximum 500mm service void to reach the furthest points of the basement at the required gradients.

The slung foul along with all basement level foul will ultimately drain via one outfall to the existing 1200mm diameter Irish Water foul sewer on Old Dunleary Road to the North of the development. Irish Water has confirmed the feasibility of this connection based on a pre-connection enquiry that was submitted to Irish Water to assess the capacity available in the network. The Irish Water confirmation of feasibility has been included under Appendix E.

7.3 Design Calculations

All new main foul sewers are designed to discharge by gravity. Minimum gradients and pipe diameters for gravity collector and main sewers are designed in accordance with the Building Regulations and Irish Water's Code of Practice for wastewater infrastructure and Standard Details for wastewater infrastructure.

The sewer network is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Wastewater Infrastructure, IS EN 752 (2008), IS EN12056: Part 2 and Building Regulations Part H.

Foul sewer design criteria are as follows:

Pipe Roughness Coefficient	1.5 mm
Minimum Velocity	0.75 m/s (self-cleansing)
Maximum Velocity	3.0 m/s

Estimated peak foul loading generated by the proposed development is provided in Table 7-1 and Table 7-2.

Table 7-1: *Estimated Foul Loading for residential development*

RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Use Type	**No. of Units**	**Occupancy Rate**	**Population (P)**	**Loading (G) (l/day/person)***	**Daily Loading (PG) (l/day)**	**Daily Loading (l/s)**
Residential	146	2.7 people/dwelling	394	150	59,130	0.68
					Daily Loading	**0.68**
					Growth factor	1.00
					Infiltration @ 10% (as CoP Appendix C - 2.2.4)	0.07
					Dry Weather Flow (l/s)	**0.75**
					Residential Peaking Factor (as CoP Appendix C - 2.2.5)	6.00
					Design Foul Flow (l/s)	**4.52**
					Surface Water allowance SW @ 3% (as CoP Appendix C - 2.2.10)	0.14

Design Flow (l/s)	**4.66**
***Flow rates extracted from IW CoP for Wastewater Infrastructure - Appendix D**	

Table 7-2: *Estimated Foul Loading for commercial development*

COMMERCIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Use Type	**Floor Space (m^2)**	**Occupancy Rate**	**Population (P)**	**Loading (G) (l/day/person)***	**Daily Loading (PG) (l/day)**	**Daily Loading (l/s)****
Retail	290	1 per 50 m^2 (staff)	6	50	290	0.003
Residential Amenities	458	1 per 20 m^2	23	50	1,145	0.013
					Daily Loading	**0.016**
					Growth factor	1.00
					Infiltration @ 10% (as CoP Appendix C - 1.2.4)	0.0016
					Dry Weather Flow (l/s)	**0.0176**
					Commercial Peaking Factor (as CoP Appendix C - 2.2.7)	4.50
					Design Foul Flow (l/s)	**0.08**
					Surface Water allowance SW_E @ 1.5 (as CoP Appendix C - 2.2.11)	0.0012
					Design Flow (l/s)	**0.0812**
***Flow rates extracted from IW CoP for Wastewater Infrastructure - Appendix D** ****For commercial premises, a working day is assumed to be over 12 hours**						

Overall design flows from the development are calculated using IW CoP for Wastewater Infrastructure Appendix C, as outlined below.

Dry Weather Flow = PG + I + E

Design Foul Flow = [Pf_{Dom} x PG] + [$Pf_{Dom,\ Ind}$ x $P_E G_E$] + I +[Pf_{Trade} x E] (Eqn1)

Design Flow = Eqn 1 + [SW + SW_E]

The type of proposed use is mixed-use comprising residential and commercial; therefore, no industrial flow has been assumed.

For commercial premises a working day is assumed to be over 12 hours when flows will be contributing to the public sewer network.

Growth rates are not assumed as the proposed application is for a fixed quantum of development (G = 1).

Total Dry Weather Flow = 0.75 l/s (residential) + 0.0176 l/s (commercial) = 0**.77 l/s**

Total Foul Flow = 4.52 l/s (residential) + 0.08 l/s (commercial) = **4.60 l/s**

Total Flow = 4.66 l/s (residential) + 0.0812 l/s (commercial) = **4.74 l/s**

8.0 WATER SUPPLY AND DISTRIBUTION

8.1 Proposed Water main and Supply

As part of the development proposals the existing connection to the 100mm diameter uPVC water main on Old Dun Leary Road will be utilised. Irish Water has confirmed the feasibility of this connection, based on a pre-connection enquiry that was submitted to Irish Water to assess the capacity available in the network, subject to a valid connection agreement.

The Irish Water confirmation of feasibility has been included under Appendix E.

8.2 Water main Standards and Details

The water main layout and details including valves, hydrants, metering etc. will be in accordance with Irish Water's Code of Practice and Standard Details for water infrastructure.

8.3 Hydrants

As stated previously, there are existing fire hydrants along Old Dunleary Road at the north eastern corner of the site and along Cumberland Street on the south western corner of the site. These will be maintained to cater for any fire at the proposed development.

Hydrants shall comply with the requirements of BS 750:2012 and shall be installed in accordance with Irish Water's Code of Practice and Standard Details.

8.4 Design Calculations

The water demand is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Water Infrastructure Connections and Developer Services Design & Construction Requirements for Self-Lay Developments December 2017:

Overall water demand is calculated using IW CoP for Water Infrastructure section 3.7.2, as outlined below:

Per-capita consumption	150l/person/day
Average day/week demand factor	1.25
Peak demand factor	5.0

Average daily domestic demand = Total occupancy * Per-capita consumption

Average day/peak week demand = Average daily domestic demand * Average day/week demand factor.

Peak hour water demand = Average day/peak week demand * Peak demand factor

Estimated water demand for the proposed development is provided in Table 8-1 and Table 8-2. The total peak hour water demand for the combined commercial and residential use will be 4.59 l/s.

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Table 8-1: *Estimated Water Demand for Residential Development*

RESIDENTIAL WATER DEMAND							
Use Type	**No. of Units**	**Occupancy Rate**	**Population (P)**	**Average daily domestic demand (l/day)**	**Average daily domestic demand (l/s)**	**Average day/peak week demand (l/s)**	**Peak hour water demand (l/s)**
Residential	146	2.7 persons/dwelling	394	59,130	0.68	0.86	4.28
						Peak hour water demand (l/s)	**4.28**

Table 8-2: *Estimated Water Demand for Commercial Development*

COMMERCIAL WATER DEMAND							
Use Type	**Floor Space (m^2)**	**Occupancy Rate**	**Population (P)**	**Average daily domestic demand (l/day)**	**Average daily domestic demand (l/s)***	**Average day/peak week demand (l/s)**	**Peak hour water demand (l/s)**
Retail	290	1 per 50 m^2 (staff)	6	870	0.01	0.0125	0.0625
Residential Amenities	458	1 per 20 m^2	23	3,435	0.04	0.05	0.25
						Peak hour water demand (l/s)	**0.3125**
For commercial premises, a working day is assumed to be over 12 hours							

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Appendix A

PERMISSIBLE OUTFLOW CALCULATIONS

PROJECT			JOB REF.
Mxed Use Development at Ted Castles, Monkstown, Co. Dublin			p190057
SUBJECT			**Calc. Sheet No.**
Surface Water Calculations - Permissible Site Discharge (Impermeable Area draining to Attenuation Tank)			1
Drawing ref.	**Calculations by**	**Checked by**	**Date**
	PCC	NJF	22-Jun-21

PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the overall site area? **0.30** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? No

How many different soil types are present on the pre-developed site? 1

Catchment	This refers to the entire site area	0.30	
Area		0.30	Hectares (ha)
Drainage Group		2	Class
Depth to Impermeable Layers		2	Class
Permeability Group above Impermeable Layers		2	Class
Slope [o]		2	Class
SOIL Type		**2**	
[1]**SOIL Index**		0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? No

What is the overall site area for catchment? 0.30 Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff.	Effective Area (m^2)
Roof - Hardstanding (Draining to gullies)	105.000	0.95	99.750
Roof - Green	1140.000	0.95	1083.000
Terraces - Hardstanding (Draining to gullies)	90.000	0.95	85.500
Terraces - Free draining aggregate build up	570.000	0.90	513.000
Podium - Hardstanding (Draining to gullies)	0.000	0.95	0.000
Podium - Draining to SUDs features	1020.000	0.80	816.000

Include Public Open Space in Effective Catchment Area? No

Effective Catchment Area **2597.250** m^2

Effective Catchment Runoff Coefficient **0.89**

Long-Term Storage

Is long-term Storage provided? No

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? 757.0 mm From Met Eireann, Co-ordinates N320000, E226000

Is the overall site area less than 50 hectares? Yes

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site 0.60 Litres/sec

[7]Site Discharge = **2.00** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7.
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change.
4. Long-term storage Vol_{os} (m^3) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(1-PIMP/100)(β.SPR)-SPR]. (GDSDS Section 6.7.3).
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas samller than 50hectares.
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible.
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

Appendix B

ATTENUATION CALCULATIONS

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	2.799	0.199	0.0	35.7	O K
30 min Summer	2.878	0.278	0.6	50.0	O K
60 min Summer	2.973	0.373	0.6	67.1	O K
120 min Summer	3.084	0.484	0.6	87.0	O K
180 min Summer	3.153	0.553	0.6	99.6	O K
240 min Summer	3.203	0.603	0.6	108.6	O K
360 min Summer	3.270	0.670	0.6	120.5	O K
480 min Summer	3.319	0.719	0.6	129.4	O K
600 min Summer	3.356	0.756	0.6	136.1	O K
720 min Summer	3.385	0.785	0.6	141.4	O K
960 min Summer	3.429	0.829	0.6	149.2	O K
1440 min Summer	3.478	0.878	0.6	158.0	O K
2160 min Summer	3.504	0.904	0.6	162.7	O K
2880 min Summer	3.512	0.912	0.6	164.2	O K
4320 min Summer	3.502	0.902	0.6	162.4	O K
5760 min Summer	3.471	0.871	0.6	156.8	O K
7200 min Summer	3.431	0.831	0.6	149.5	O K
8640 min Summer	3.389	0.789	0.6	141.9	O K
10080 min Summer	3.346	0.746	0.6	134.3	O K
15 min Winter	2.821	0.221	0.6	39.8	O K
30 min Winter	2.911	0.311	0.6	56.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	73.311	0.0	0.0	19
30 min Summer	51.777	0.0	32.4	34
60 min Summer	34.973	0.0	50.1	64
120 min Summer	22.919	0.0	71.3	124
180 min Summer	17.646	0.0	85.1	184
240 min Summer	14.547	0.0	94.1	244
360 min Summer	10.944	0.0	97.6	362
480 min Summer	8.943	0.0	96.5	482
600 min Summer	7.638	0.0	94.9	602
720 min Summer	6.710	0.0	93.3	722
960 min Summer	5.462	0.0	90.3	962
1440 min Summer	4.076	0.0	84.5	1440
2160 min Summer	3.032	0.0	180.0	1968
2880 min Summer	2.453	0.0	172.5	2308
4320 min Summer	1.815	0.0	158.1	3072
5760 min Summer	1.465	0.0	256.1	3920
7200 min Summer	1.242	0.0	272.5	4752
8640 min Summer	1.085	0.0	286.7	5536
10080 min Summer	0.969	0.0	299.3	6360
15 min Winter	73.311	0.0	22.0	19
30 min Winter	51.777	0.0	38.5	33

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Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	3.018	0.418	0.6	75.2	O K
120 min Winter	3.143	0.543	0.6	97.7	O K
180 min Winter	3.221	0.621	0.6	111.8	O K
240 min Winter	3.277	0.677	0.6	121.9	O K
360 min Winter	3.353	0.753	0.6	135.5	O K
480 min Winter	3.408	0.808	0.6	145.5	O K
600 min Winter	3.451	0.851	0.6	153.3	O K
720 min Winter	3.486	0.886	0.6	159.4	O K
960 min Winter	3.537	0.937	0.6	168.6	O K
1440 min Winter	3.597	0.997	0.6	179.5	O K
2160 min Winter	3.636	1.036	0.6	186.4	O K
2880 min Winter	3.641	1.041	0.6	187.4	O K
4320 min Winter	3.622	1.022	0.6	183.9	O K
5760 min Winter	3.582	0.982	0.6	176.8	O K
7200 min Winter	3.527	0.927	0.6	166.9	O K
8640 min Winter	3.466	0.866	0.6	155.9	O K
10080 min Winter	3.404	0.804	0.6	144.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	34.973	0.0	58.3	64
120 min Winter	22.919	0.0	82.0	122
180 min Winter	17.646	0.0	95.7	182
240 min Winter	14.547	0.0	99.1	240
360 min Winter	10.944	0.0	98.6	358
480 min Winter	8.943	0.0	97.2	476
600 min Winter	7.638	0.0	95.8	592
720 min Winter	6.710	0.0	94.4	708
960 min Winter	5.462	0.0	91.7	942
1440 min Winter	4.076	0.0	86.7	1398
2160 min Winter	3.032	0.0	183.2	2056
2880 min Winter	2.453	0.0	176.3	2680
4320 min Winter	1.815	0.0	163.3	3332
5760 min Winter	1.465	0.0	289.1	4264
7200 min Winter	1.242	0.0	307.5	5184
8640 min Winter	1.085	0.0	323.2	6056
10080 min Winter	0.969	0.0	321.9	6952

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	15.900	Shortest Storm (mins)	15
Ratio R	0.272	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.260

Time (mins) From:	To:	Area (ha)
0	4	0.260

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Model Details

Storage is Online Cover Level (m) 4.400

Tank or Pond Structure

Invert Level (m) 2.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	1.400	180.0	2.800	0.0	4.200	0.0
0.200	180.0	1.600	0.0	3.000	0.0	4.400	0.0
0.400	180.0	1.800	0.0	3.200	0.0	4.600	0.0
0.600	180.0	2.000	0.0	3.400	0.0	4.800	0.0
0.800	180.0	2.200	0.0	3.600	0.0	5.000	0.0
1.000	180.0	2.400	0.0	3.800	0.0		
1.200	180.0	2.600	0.0	4.000	0.0		

Level Controlled Pump Outflow Control

Invert Level (m) 2.600 Cut In Height (m) 0.200 Cut Out Height (m) 0.100

Depth (m)	Outflow (l/s)	Depth (m)	Outflow (l/s)	Depth (m)	Outflow (l/s)
0.200	0.6000	2.200	0.6000	4.200	0.6000
0.400	0.6000	2.400	0.6000	4.400	0.6000
0.600	0.6000	2.600	0.6000	4.600	0.6000
0.800	0.6000	2.800	0.6000	4.800	0.6000
1.000	0.6000	3.000	0.6000	5.000	0.6000
1.200	0.6000	3.200	0.6000	5.200	0.6000
1.400	0.6000	3.400	0.6000	5.400	0.6000
1.600	0.6000	3.600	0.6000	5.600	0.6000
1.800	0.6000	3.800	0.6000	5.800	0.6000
2.000	0.6000	4.000	0.6000	6.000	0.6000

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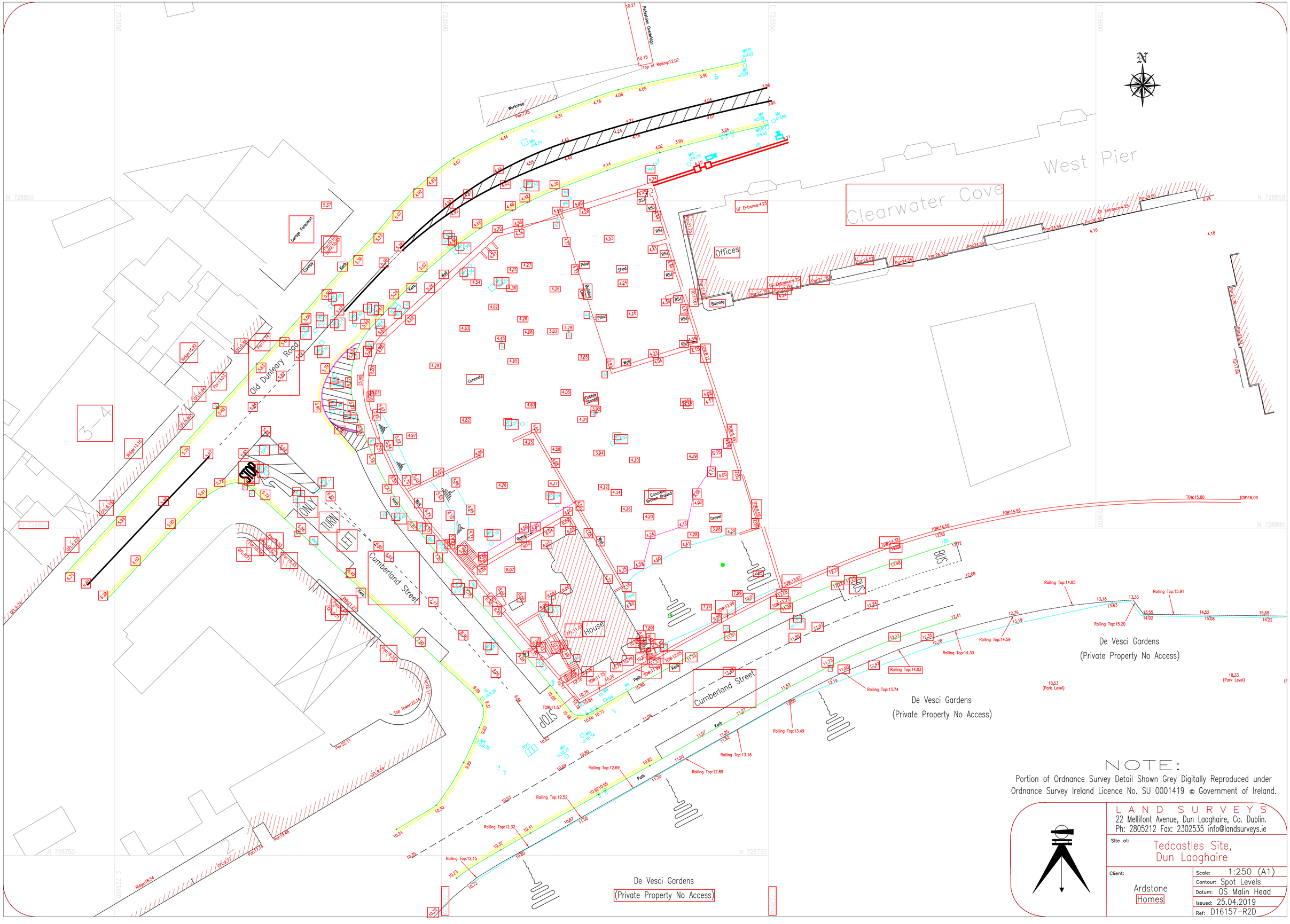
Appendix C

TOPOGRAPHICAL SURVEY



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LAND SURVEYS
22 Mellifont Avenue, Dun Laoghaire, Co. Dublin.
Ph: 2805212 Fax: 2302535 info@landsurveys.ie

Site at: Tedcastles Site, Dun Laoghaire

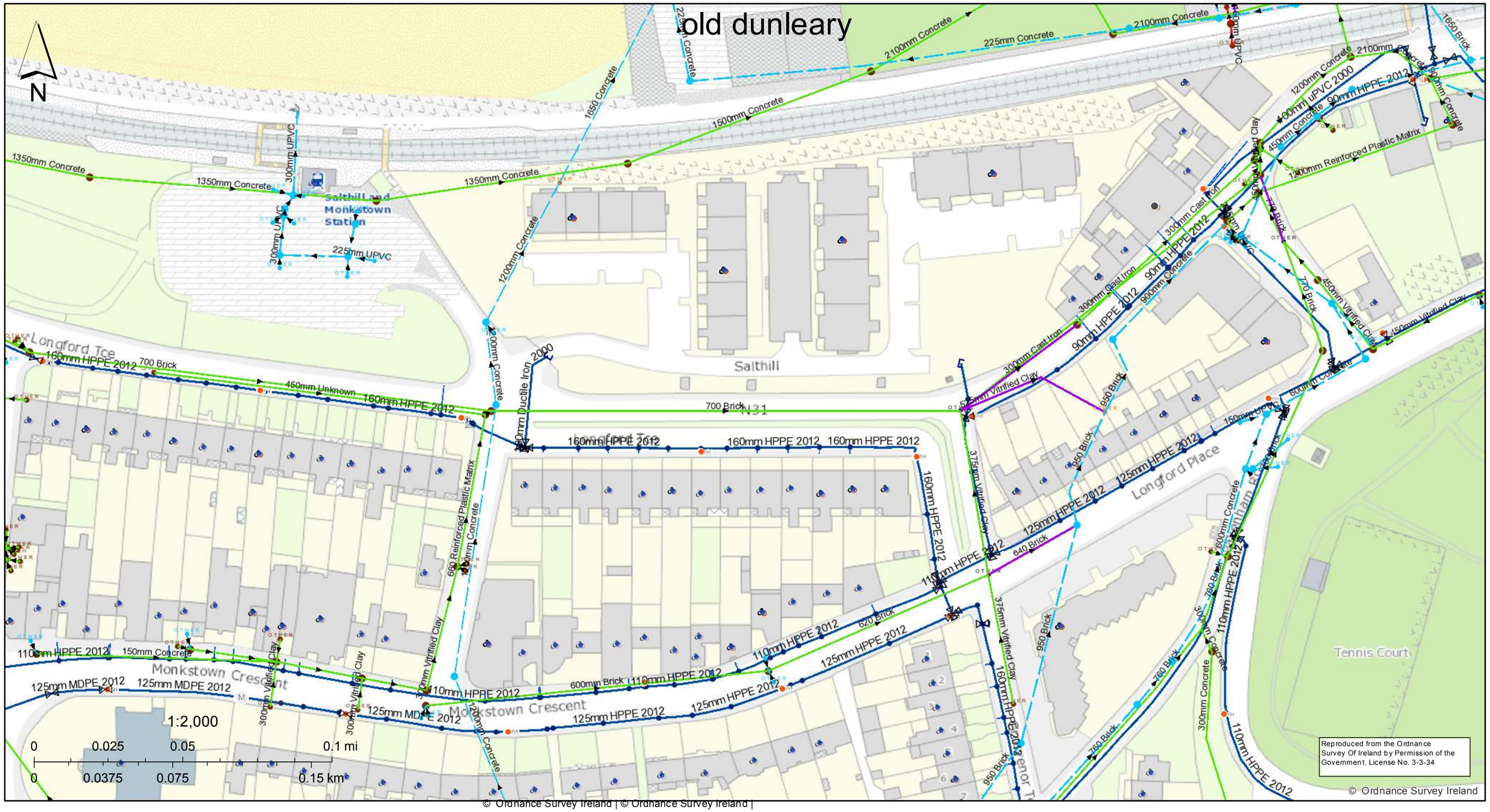
Client: Ardstone Homes

Scale:	1:250 (A1)
Contour:	Spot Levels
Datum:	OS Malin Head
Issued:	25.04.2019
Ref:	D16157-R2D

Appendix D

IRISH WATER RECORDS

old dunleary



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5/3/2019 10:31:57 AM

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown

- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated. © Irish Water

UISCE ÉIREANN : IRISH WATER

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old dunleary monkstown

5/3/2019 10:39:13 AM

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Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

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Appendix E

IRISH WATER CONFIRMATION OF FEASBILITY AND DESIGN STATEMENT

Appendix F

GROUND PENETRATING RADAR SURVEY

N

Footpath

Old Dunleary Rd

Survey extension wall to kerb

Road Centre Line

SIGN

LP

BOLLARD

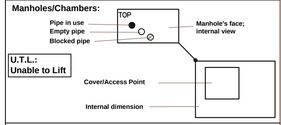
KEYMAP

Service	Color / Line type
Drainage/Sewerage	
Eircom	
ESB	
Gas	
Unidentified Pipe/Service	
Water:	
UPC/NTL:	
Public Lighting:	
Traffic:	
Survey Area:	
Subsurface Anomaly Area:	
Probable Pipe:	By layer
Assumed Pipe:	By layer

Description	Color	Type
No. of pipes of the same duct:	By layer	**n x ∅**
Cover Depht (to the top of the pipe or duct):	By layer	**(0.00)**
Hatched area^:	By Layer	
Valve:	By Layer	**V**
Water Meter:	By Layer	**WM**
Fire Hydrant:	By Layer	**FH**
Pole:	By Layer	Pole/PL

Hatched Area^: It represents several cables OR a reinforced layer as protection on top of the utilities.

Manholes/Chambers:



Subsurface Utility Engineering
Utility Services Mapping with No-Dig technologies
TST Engineering Ltd Disclaimer

TST Engineering surveyed the required area in order to provide information about the existing utility services located within the area and its immediate parts.
While the best precision and accuracy were performed during site activities, TST extremely recommends attention prior to excavation, as there is still uncertainty related with no dig surveys. There is no guarantee that all buried services were identified with the survey and shown in the layout.
The quality of the acquired data depends by the soil water percentage and the ground conditions; TST Engineering bore any possible effort in order to provide the most reliable results.
Technical Specification:
GPR scans starting from physical elements (e.g. walls, kerbs) can bear an offset of approx 0.45m due to the GPR trolley's configuration; this is a small section of the area that remains not covered by the GPR scans and consequently does not show GPR information.
The greatest survey depth achievable with GPR is about 3 - 2.5 meters from the ground surface and it can vary according to the penetrating parameters of the soil. Deeper pipes were located, where possible, with electronic detection devices and through the inspection of chambers and manholes.
Accuracy margins, depending upon problems encountered while surveying or systematic device errors, will be within 10% of actual depths. Infrastructures' position on layouts can vary from actual surface by 0.10 meters, axial distance.
Buried utilities are shown through polylines and tags identifying, where possible, the typology, characteristics, state of use and any other useful information. A single polyline may represent a pipeline, a duct, a cable, a group of cables or ducts; the relative tags describe the elements represented.
Manholes, chambers, boxes, valves and any other surface element related with the buried utilities were surveyed and represented in the layout with their real dimensions (2D or 3D).
All distances are shown in metres unless otherwise stated.
Information such as operating pressure and relining (for gas pipes), voltage (for electric cables) is obtained from records of the assets owners and is not verified by TST Engineering Ltd.
Layers Description:
Probable Pipe represents elements that were identified with the survey but the typology was assigned on logical interpretation and not proved by visual evidence.
Assumed Pipe represents elements that were not found on site but that match record information data.
Unidentified Pipe represents elements that were identified on site but cannot be classified as part of any utility network.
Survey Area represents the area surveyed with the complete range of instruments and procedures as per Method Statement.
Not Surveyed with GPR represents areas that were not suitable for survey with GPR due to fixed obstables (e.g. shrubs, bushes, fencing etc).
Subsurface Anomaly Area represents particular areas that were not suitable for survey due to subsurface anomalies (e.g. soil conditions, previous excavations, etc). In these circumstances surveying depth usually will not be greater than 1.2 meters.

This drawing represents a 2D model of the result of the surveys.
The background cartographical information was surveyed by TST Engineering Ltd in ING and Datum Malin Head based on OSI map provided by the Client.

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www.tstengineering.com

CLIENT:

Drainage Design Section
DUN LAOGHAIRE RATHDOWN COUNTY COUNCIL

Project: DUNLEARY HILL - GROUND INVESTIGATIONS

Description: Underground no-dig survey of existing utilities

Drawing No.: 251D-10-004-08

Scale: 1:100 (on A1)

Enclosed with: - - - -

Surveyed by: EM-APa-JB-CP	Date:	Jun/10
Drawn by: EM-VM-MB		Jun-Jul/10
Checked by: CP		07/08/10
Approved by: CP		12/08/10

REVISIONS

No.	Date	Description
1.0	12/08/10	First Layout

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N

Old Dunleary Rd

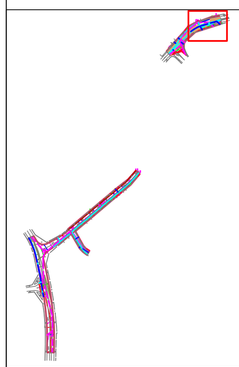
Footpath

Survey extents up to wall

Footpath

GATE

KEYMAP



Service	Color / Line type
Drainage/Sewerage	
Eircom	
ESB	
Gas	
Unidentified Pipe/Service	
Water:	
UPC/NTL:	
Public Lighting:	
Traffic:	
Survey Area:	
Subsurface Anomaly Area:	
Probable Pipe:	By layer
Assumed Pipe:	By layer

Description	Color	Type
No. of pipes of the same duct:	By layer	**n x ∅**
Cover Depht (to the top of the pipe or duct):	By layer	**(0.00)**
Hatched area^:	By Layer	
Valve:	By Layer	**V**
Water Meter:	By Layer	**WM**
Fire Hydrant:	By Layer	**FH**
Pole:	By Layer	Pole/PL

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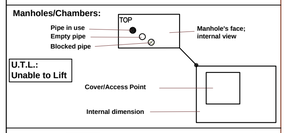

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CLIENT:

Drainage Design Section
DUN LAOGHAIRE RATHDOWN COUNTY COUNCIL

Project: DUNLEARY HILL - GROUND INVESTIGATIONS

Description: Underground no-dig survey of existing utilities

Drawing No.: 251D-10-004-09

Scale: 1:100 (on A1)

Enclosed with: - - - -

Surveyed by: EM-APa-JB-CP	**Date:**	Jun/10
Drawn by: EM-VM-MB		Jun-Jul/10
Checked by: CP		07/08/10
Approved by: CP		12/08/10

REVISIONS

No.	Date	Description
1.0	**12/08/10**	**First Layout**

Subsurface Utility Engineering
Utility Services Mapping with No-Dig technologies
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The background cartographical information was surveyed by TST Engineering Ltd in ING and Datum Malin Head based on OSI map provided by the Client.

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Appendix G

SURFACE WATER RISING MAIN CALCULATIONS

PROJECT
Mxed Use Development at Ted Castles, Monkstown, Co. Dublin

Job Ref:
190057

SUBJECT
Surface Water Rising Main Duty

Drawing Ref.	**Calculation by:**	**Checked by:**	**Date:**
190057-3002	PCC	NJF	01-Jan-2020

PIPELINE DATA

	Max	Min	Design
Suction wet well level (mAOD)	2.20	2.20	2.20
Discharge level (mAOD)	2.91	2.91	2.91
Static head (m)	0.71	0.71	0.71

NPSH Reference Plane (mAOD) 2.7

Section*	1	2	3	4	5	6
Pump Branch or Rising Main ?	Rising Main					
Diameter (mm)	96.8					
Length (m)	25.2					
Roughness (mm)	0.1					
Temperature (°C)	20	20	20	20	20	20
Duty flow velocity (m/s)	0.89	-	-	-	-	-

Minor Losses — Insert number of each type of fitting in each section

		1	2	3	4	5	6
Entry							
- Sharp edged	0.50						
- Bellmouth	0.05						
Bends							
- Sharp 90°	0.90	3					
- Sharp 45°	0.40						
- Sharp 22.5°	0.15						
- Long radius 90°	0.40						
- Long radius 45°	0.20						
- Long radius 22.5°	0.10						
Tees							
- Flow in line	0.30						
- Line to branch	1.00						
Sudden Enlargement							
- 4:5	0.15						
- 3:4	0.20						
- 1:2	0.60						
Sudden Contraction							
- 5:4	0.20						
- 4:3	0.30						
- 2:1	0.40						
Tapers							
- 4:5	0.10						
- 3:4	0.15						
Valves							
- Gate fully open	0.20	1					
- Butterfly fully open	0.15						
- Swing check	2.50	1					
Exit							
- Sharp edged	1.00						
- Bellmouth	0.20	1					
User Inputs							
Total Minor Losses		5.6	0	0	0	0	0

***Description of sections**	1	
	2	
	3	
	4	
	5	
	6	

PUMP DUTY INFORMATION

Duty Flow 0.6 l/s Nr of duty pumps 1 Pump Duty Head: 0.7 m Pump Duty Flow 0.6 l/s

PUMPED MEDIA

Pumped media: Clean Water / Sewage

FLOW / HEAD DATA

Flow (l/s)	Headloss in each section 1 (m)	2 (m)	3 (m)	4 (m)	5 (m)	6 (m)	Total Headloss (m)	Maximum Head (m)	Minimum Head (m)	Design Head (m)
0.0							0.0	0.7	0.7	0.7
0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7

Please note that only headlosses on sections marked as rising main are included in calculation of the system curve
Headlosses on sections marked as pump suction or pump discharge are included in the pump curves

Appendix B Storm Water Audit Feedback Form

STORM WATER AUDIT FEEDBACK FORM

Scheme: The Ted, Dun Laoghaire, Built to Rent

Area:

Audit Stage: 1 **Date Audit Completed:** 02/09/2021 **Our Ref :** 202119

Paragraph No. in Audit Report	Issue Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.1.1	Y	N	The benefits of including SUDS systems in the public realm are noted. However, this will reduce space on the footpaths which may impact adversely on pedestrian mobility and adjacent properties. There is also a significant amount of shallow services in the area and minimising excavation works were key to the design of the public realm improvements	Yes
2.2.1	Y	Y	DBFL drawing no. TED-DBFL-SW-SP-DR-C-1301 has been updated to indicate the green roof types.	
2.2.2	Y	Y	Increasing the amount of intensive green roof coverage would be given further consideration during detailed designs.	
2.2.3	Y	Y	DBFL drawing no. TED-DBFL-SW-SP-DR-C-1301 has been updated to correct the conflicting layers.	
2.2.4	Y	N	The benefits of including additional permeable paving as part of the development proposals are noted. Areas that have been proposed as impermeable paving will drain to green areas, where possible, to provide similar benefits to permeable paving.	Yes
2.2.5	Y	N	The benefits of including tree pit systems as part of the development proposals are noted. However, most tree planting is either proposed on slabs or in the public realm. Due to the volume of existing services within the footpaths in the public realm, tree pit systems have not been considered to mitigate against adverse impacts to these services.	Yes

STORM WATER AUDIT FEEDBACK FORM

Paragraph No. in Audit Report	Issue Accepted (Yes/No)	Recommended Measure Accepted (Yes/No)	Alternative Measures (described) [or reason problem not accepted]	Alternative Measures Accepted by Auditors (Yes/No)
2.2.6	Y	N	The benefits of rainwater harvesting were considered at an early stage in the design process, however rainwater harvested can only be used for limited purposes. Therefore, due to the introduction of additional plant, increased maintenance due to the system and additional pipework for each unit, the option of rainwater harvesting was discounted for the development.	Yes
2.2.7	Y	Y	DBFL drawing no. TED-DBFL-SW-SP-DR-C-5203 has been updated to provide details for the proposed SUDS components.	
2.2.8	Y	Y	Section 6.9 has been added to DBFL report no. TED-DBFL-XX-XX-RP-C-0001 - Infrastructure Design Report to reference the surface water system maintenance requirements.	
2.3.1	N	N	A conservative reduction factor of 5% has been applied to the green roofs as part of the attenuation calculations for the proposed development. This accounts for the texture of the greenroof.	Yes
2.3.2	Y	Y	DBFL drawing no. TED-DBFL-SW-SP-DR-C-1301 has been updated to include a table that indicates the green roof coverage area, which meets the required 60% minimum coverage requirement.	
2.3.3	Y	Y	Infiltration options were not considered as part of the surface water management strategy as the level 00 slab covers most of the proposed development's footprint. A ground investigation report, compiled by Ground Investigations Ireland based on site investigations undertaken, has been included for information.	
2.3.4	Y	N	Since the invert level of the existing public sewer is at a higher level than the proposed attenuation tank, the option of pumping to a discharge manhole is preferred. Increasing the tank footprint to decrease the depth would be unachievable due to the space available for other services and structural elements.	Yes

STORM WATER AUDIT FEEDBACK FORM

Signed:		**Design Team Project Manager**	**Date:**	23-AUG-2021

Please complete and return to the auditor

Auditor Signed Off:		Joshua Martin	**Date:**	02-09-2021

Appendix C Drawings & Documents Examined with Feedback Form

GROUND INVESTIGATIONS IRELAND

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Ground Investigations Ireland

Tedcastles Site

Ground Investigation Report

DOCUMENT CONTROL SHEET

Project Title	Tedcastles Site Investigations
Engineer	DBFL Consulting Engineers
Project No	8674-04-19
Document Title	Geotechnical Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Final	N Morgan	B Sexton	C Finnerty	Dublin	18 July 2019

GROUND INVESTIGATIONS IRELAND

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CONTENTS

APPENDICES

1.0 Preamble

On the instructions of DBFL Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between April and June 2019 at the site of the proposed residential development located on Cumberland Street off Old Dunleary Road, Monkstown, Co. Dublin.

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently occupied by a three-storey detached dwelling located in the south-western part of the site with a corrugated iron shed to the north east and the remainder of the site being a paved concrete yard. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 8 No. Trial Pits to a maximum depth of 2.8m BGL
- Carry out 4 No. Foundation Inspection Pits to determine existing foundation details
- Carry out 4 No. Cable Percussion boreholes to a maximum depth of 5.3m BGL
- Carry out 4 No. Rotary Core follow on Boreholes to a maximum depth of 15.1m BGL
- Installation of 2 No. Groundwater monitoring wells
- Geotechnical & Environmental Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Trial Pits

The trial pits were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by a Geotechnical Engineer/Engineering Geologist prior to backfilling with arisings. Notes were made of any services, inclusions, pit stability, groundwater encountered and the characteristics of the strata encountered and are presented on the trial pit logs which are provided in Appendix 2 of this Report.

3.3. Foundation Pits

The foundation inspection pits were excavated at the locations shown in the exploratory hole location plan in Appendix 3. The exposed foundations were logged and sketched prior to backfilling and reinstatement. The logs and sketches are provided in Appendix 3 of this Report.

3.4. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.
The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata.
Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60º cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 4 of this Report.

3.5. Rotary Boreholes

The rotary coring was carried out by a track mounted T44 Beretta rig at the locations shown on the location plan in Appendix 1. The rotary boreholes were completed from the ground surface or alternatively, where noted on the individual borehole log, from the base of the cable percussion borehole where a temporary liner was installed to facilitate follow-on rotary coring.

The T44 Beretta is equipped with rubber tracks which allow for short travel on pavement surfaces avoiding any damage to the surface. The T44 Beretta utilises a triple tube core barrel system operated using a wireline drilling process. The outer barrel is rotated by the drill rods and at its lower end, carries the coring bit. The inner barrel is mounted on a swivel so that it does not rotate during the process. The third barrel or liner is placed within the second one to retain the core intact and to preserve as much as possible the fabric of the drilling stratum. The core is cut by the coring bit and passes to the inner liner. The core is brought up to the surface within the inner barrel on a small diameter wire rope or line attached to the "overshoot" recovery tool which is then placed into a core box in order of recovery. A drilling fluid, typically air mist or water flush is passed from the surface through hollow drill rods to the drill bit, and is used to cool the drill bit. Temporary casing is used in some situations to support unstable ground or to seal off fissures or voids. It should be noted that the rotary coring can only achieve limited recovery in overburden, particularly granular or weakly cemented strata due to the flushing medium washing away the cohesive fraction during coring. The recovery achieved, where required is noted on the borehole logs and core photographs are provided to allow assessment of the core recovered. The rotary borehole logs are provided in Appendix 4 of this Report.

3.6. Surveying

The exploratory hole locations have been recorded using a Trimble R10 GNSS System which records the coordinates and elevation of the locations to ITM or Irish National Grid as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.7. Groundwater Monitoring Installations

Groundwater Monitoring Installation were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. The installation details are provided on the exploratory hole logs in the appendices of this Report.

3.8. Laboratory Testing

Samples were selected from the exploratory holes for a range of geotechnical and environmental testing to assist in the classification of soils and to provide information for the proposed design.

Environmental testing consisting of pH & sulphate and groundwater analysis was carried out by Exova Jones Environmental Laboratory in the UK. Further environmental testing was carried out and reported under the cover of a separate report by O'Callaghan Moran.
Geotechnical testing consisting of moisture content, Atterberg limits, Particle Size Distribution (PSD), were carried out in NMTL's Geotechnical Laboratory in Carlow.
The results of the laboratory testing are included in Appendix 5 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were variable across the site and are generally comprised;

- Surfacing
- Made Ground
- Granular Deposits
- Cohesive Deposits
- Bedrock

SURFACING: Concrete was encountered in the majority of the exploratory holes and was present to a maximum depth of 0.2m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Surfacing and was present to a relatively consistent depth of between 0.6m and 2.7m BGL. These deposits were described generally as *light brown to dark brown slightly sandy slightly gravelly CLAY with occasional sub-angular to sub-rounded cobbles and boulders and contained occasional fragments of concrete, metal, ceramics red brick, glass and plastic.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground and Granular Deposits and were described typically as *Firm to stiff light brown slightly sandy slightly gravelly CLAY with occasional cobbles and boulders.* The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

GRANULAR DEPOSITS: The granular deposits were encountered both within and at the base of the cohesive deposits and were typically described as G*rey to brown slightly clayey sandy sub angular to sub sub-rounded fine to coarse GRAVEL with occasional cobbles and rare boulders.* The secondary

sand/gravel and silt/clay constituents varied across the site and with depth while occasional or frequent cobble and boulder content also present where noted on the exploratory hole logs.
Based on the SPT N values the deposits are typically medium dense and become dense with depth. It should be noted that many of the trial pits where granular deposits or groundwater were encountered, experienced instability. This was described either as side wall spalling or as side wall collapse in the remarks section at the base of the trial pit logs.

BEDROCK: The rotary core boreholes recovered *medium strong to very strong grey/white coarsely crystalline Granite*. Visible calcite veins were noted during logging which are typically present within the Granite.
The depth to rock varies from 4.80m BGL in BH04 to a maximum of 11.10m BGL in BH03. Rock was encountered at a depth of 9m BGL in BH01 and at a depth of 7.30m BGL in BH02. The total core recovery is good, typically 100%. The SCR and RQD both are relatively poor in the upper weathered zone, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes.

4.2. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded.
We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed in BH01 and BH04 to allow the equilibrium groundwater level to be determined.

4.3. Laboratory Testing

The geotechnical testing carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution tests were completed on one cohesive sample and two granular samples and give the range of particle sizes passing standard size sizes.
The pH and sulphate testing carried out indicate that pH results are slightly elevated however the water soluble sulphate results are low when compared to the guideline values from BRE Special Digest 1:2005. The samples tested classify the soil as a Design Sulphate Level DS-1.
The results from the completed laboratory testing is included in Appendix 5 of this report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.2. Foundations

Due to the depth of Made Ground and the presence of both cohesive and granular deposits beneath the footprint of the proposed structure, piled foundations are recommended for the proposed building. The type, size and depth of the pile foundations should be confirmed by a specialist piling contractor based on the loading from the proposed building. The floor slab is recommended be suspended and also supported on the building piles.

The pH and sulphate testing completed on samples recovered from the trial pits indicates the pH results are near neutral and the sulphate results are low, when compared to the guideline values from BRE Special Digest 1:2005. No special precautions are required for concrete foundations to prevent sulphate attack.

5.3. Excavations

Short term temporary excavations in the cohesive deposits will remain stable for a limited time only and will require to be appropriately battered or the sides supported if the excavation is below 1.25m BGL or is required to permit man entry.

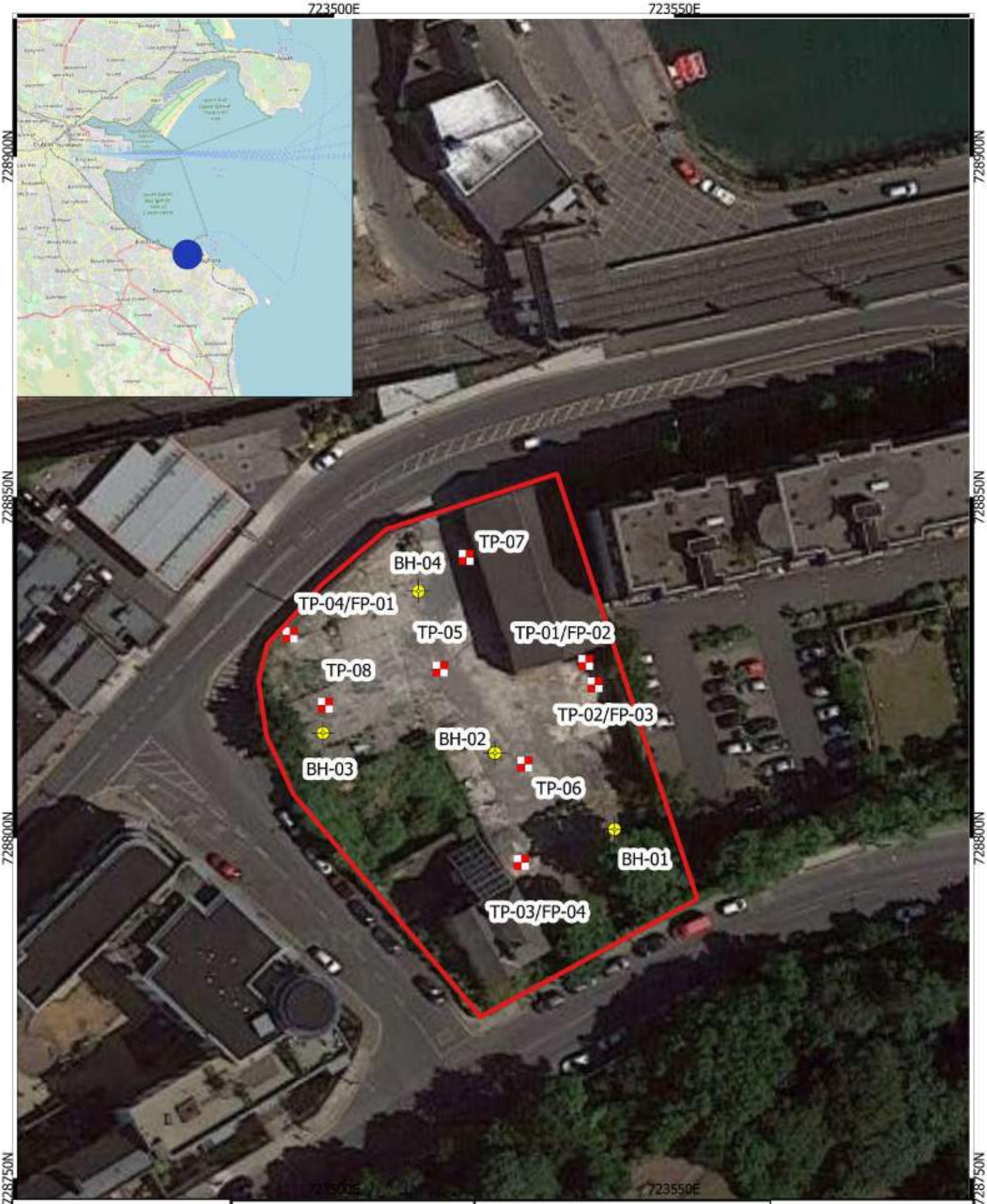
Excavations in the Made Ground or soft Cohesive Deposits will require to be appropriately battered or the sides supported due to the low strength of these deposits.

Any excavations which penetrate the granular deposits will require to be appropriately battered or the sides supported and are likely to require dewatering due to the groundwater seepages noted in the exploratory hole logs in the Appendices of this Report.

The groundwater and stability noted on the trial pit logs should be consulted when determining the most appropriate construction methods for excavations. Generally, where significant excavations are required in water bearing granular deposits a cut-off wall may be more cost effective than extensive dewatering. An assessment by a specialist dewatering contractor is recommended to determine the most cost effective approach to the proposed excavation.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan



GROUND INVESTIGATIONS IRELAND

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Hazelhatch Road,
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Client:

Project Title:
Tedcastles Site

Drawing Title:
Figure 1: SI Points

GII Project Reference:
8674-04-19

0 10 20 30 m

Drawn By:
NM

Date:
28/06/2019

Site Boundary
Site Location

SI Points
CP/RC Boreholes
Trial Pits

APPENDIX 2 – Trial Pit Records

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Tedcastles Site	TP-01

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	1.00mW x 2.80mL	4.02	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723537 E 728825.6 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.20)	CONCRETE		
				3.82	0.20	MADE GROUND: Dark brown sandy gravelly CLAY with occasional sub-angular to subrounded cobbles and boulders. Occasional fragments of shells red brick ceramics clay pipe glass and white pvc water pipe with occasional concrete blocks and rare rebar.		
1.00-2.00	EN				(2.30)			
				1.52	2.50	Complete at 2.50m		

Plan

Remarks

No groundwater encountered
Sidewalls spalling at 1.50m
Trial pit terminated and backfilled at 2.50m due to collapsing sidewalls

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-01

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Site	Trial Pit Number
Tedcastles Site	TP-02

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	1.00mW x 3.10mL	4.63	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723538.4 E 728822.3 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.20)	CONCRETE		
				4.43	0.20	MADE GROUND: Light brown sandy clayey GRAVEL with occasional sub-angular to subrounded cobbles and boulders. Occasional red brick cobbles with occasional fragments of slate roof tile and steel. Frequent rootlets from 0.40m - 1.20m.		
1.00-2.00	EN				(2.20)			
				2.23	2.40	Complete at 2.40m		

Plan

Remarks

No groundwater encountered
Sidewalls spalling at 2.00m
Trial pit backfilled at 2.40m

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-02

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Site	Trial Pit Number
Tedcastles Site	TP-03

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	1.00m x 2.80m	5.60	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723527.6 E 728796.3 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.20)	CONCRETE		
				5.40	0.20	MADE GROUND: Light brown sandy gravelly CLAY with occasional sub-angular to subrounded cobbles and boulders of granite. Occasional red brick cobbles with occasional fragments of ceramics.		
					(0.50)			
				4.90	0.70	Light brown sandy gravelly CLAY with occasional subangular to subrounded cobble and boulders. Fine to coarse sand and fine to coarse subangular to subrounded gravel.		
1.00-2.00	EN				(1.00)			
				3.90	1.70	Light brown sandy clayey fine to coarse subangular to subrounded GRAVEL with occasional subangular to subrounded cobbles and boulders.		
					(0.30)			
				3.60	2.00	Complete at 2.00m		

Plan

Remarks

No groundwater encountered
Sidewalls spalling at 1.80m
Trial pit backfilled at 2.00m

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-03

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Site	Trial Pit Number
Tedcastles Site	TP-04

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	1.10mW x 2.80mL	4.97	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723493.6 E 728829.6 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.20)	CONCRETE		
				4.77	0.20	MADE GROUND: Brown sandy clayey fine to coarse sub-angular to subrounded GRAVEL with occasional sub-angular to subrounded cobbles and boulders of granite and concrete. Occasional cobbles of red brick and occasional fragments of plastic shells and ceramics. Concrete slab at 1.70m.		
1.00-2.00	EN				(2.50)			
				2.27	2.70	Complete at 2.70m		

Plan

Remarks

No groundwater encountered
Sidewalls spalling at 0.50m
Trial pit terminated and backfilled at 2.70m due to collapsing sidewalls

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-04

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www.gii.ie

Site	Trial Pit Number
Tedcastles Site	TP-05

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.60mW x 3.10mL	4.17	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723515.6 E 728824.6 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.30)	Dark grey sandy fine to coarse sub-angular to subrounded GRAVEL with occasional sub-angular to subrounded cobbles.		
				3.87	0.30	MADE GROUND: Brown sandy clayey fine to coarse sub-angular GRAVEL with occasional sub-angular to subrounded cobbles and boulders. Occasional fragments of red brick granite plastic and metal wiring.		
1.00-2.00	EN				(2.10)			
				1.77	2.40	Complete at 2.40m		

Plan

Remarks

No groundwater encountered
Sidewalls collapsing at 2.20m
Trial pit terminated and backfilled at 2.40m due to collapsing sidewalls.

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-05

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Site	Trial Pit Number
Tedcastles Site	TP-06

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.70mW x 3.00mL	4.04	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723528.1 E 728810.6 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.30)	MADE GROUND: Grey sandy fine to coarse sub-angular to subrounded GRAVEL with occasional fragments of red brick.		
				3.74	0.30	Firm light brown slightly sandy slightly gravelly CLAY with occasional sub-angular to subrounded cobbles and boulders. Fine to coarse sand and fine to coarse sub-angular to subrounded gravel.		
1.00-2.00	EN				(1.90)			
				1.84	2.20	Complete at 2.20m		

Plan

Remarks

Groundwater encountered at 0.50m
Sidewalls spalling at 0.50m
Tial pit backfilled at 2.20m

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-06

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Site	Trial Pit Number
Tedcastles Site	TP-07

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	0.80mW x 3.00mL	4.31	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723519.4 E 728841 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.20)	CONCRETE		
				4.11	0.20	MADE GROUND: Dark brown sandy clayey fine to coarse sub-angular GRAVEL with occasional sub-angular to subrounded cobbles and boulders. Occasional fragments of red brick and granite with occasional concrete blocks.		
1.00-2.00	EN				(1.40)			
				2.71	1.60	MADE GROUND: Light brown sandy gravelly CLAY with occasional sub-angular to subrounded cobbles and boulders. Occasional cobbles of red brick and occasional concrete blocks with rare fragments of ceramics.		
					(0.90)			
				1.81	2.50			
					(0.10)	MADE GROUND: Light brown sandy gravelly CLAY with occasional sub-angular to subrounded cobbles and boulders. Occasional fragments of red brick and charcoal.		
				1.71	2.60	Complete at 2.60m		

Plan

Remarks

No groundwater encountered
Sidewalls collapsing at 2.30m
Trial pit terminated and backfilled at 2.60m due to collapsing sidewalls.

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-07

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Site	Trial Pit Number
Tedcastles Site	TP-08

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	1.00mW x 3.10mL	4.30	DBFL Consulting Engineers	8674-04-19
	Location	**Dates**	**Engineer**	**Sheet**
	723498.8 E 728819.3 N	25/04/2019		1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-1.00	EN				(0.15)	CONCRETE		
				4.15	0.15	MADE GROUND: Dark grey sandy clayey fine to coarse sub-angular GRAVEL with occasional sub-angular to subrounded cobbles and boulders and occasional cobbles of red brick.		
					(0.45)			
				3.70	0.60	MADE GROUND: Light brown sandy clayey GRAVEL with occasional sub-angular to subrounded cobbles and boulders. Occasional fragments of red brick and charcoal.		
1.00-2.00	EN				(1.10)			
				2.60	1.70	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with occasional sub-angular to subrounded cobbles and boulders. Occasional fragments of red brick charcoal and shells. Fine to coarse sand and fine to coarse sub-angular to subrounded gravel of mixed lithologies with sub-angular to subrounded quartz and granite.		
					(1.10)			
				1.50	2.80	Complete at 2.80m		

Plan

Remarks

No groundwater encountered
Sidewalls stable at 2.80m
Trial pit backfilled at 2.80m

Scale (approx)	Logged By	Figure No.
1:25	PM	8674-04-19.TP-08

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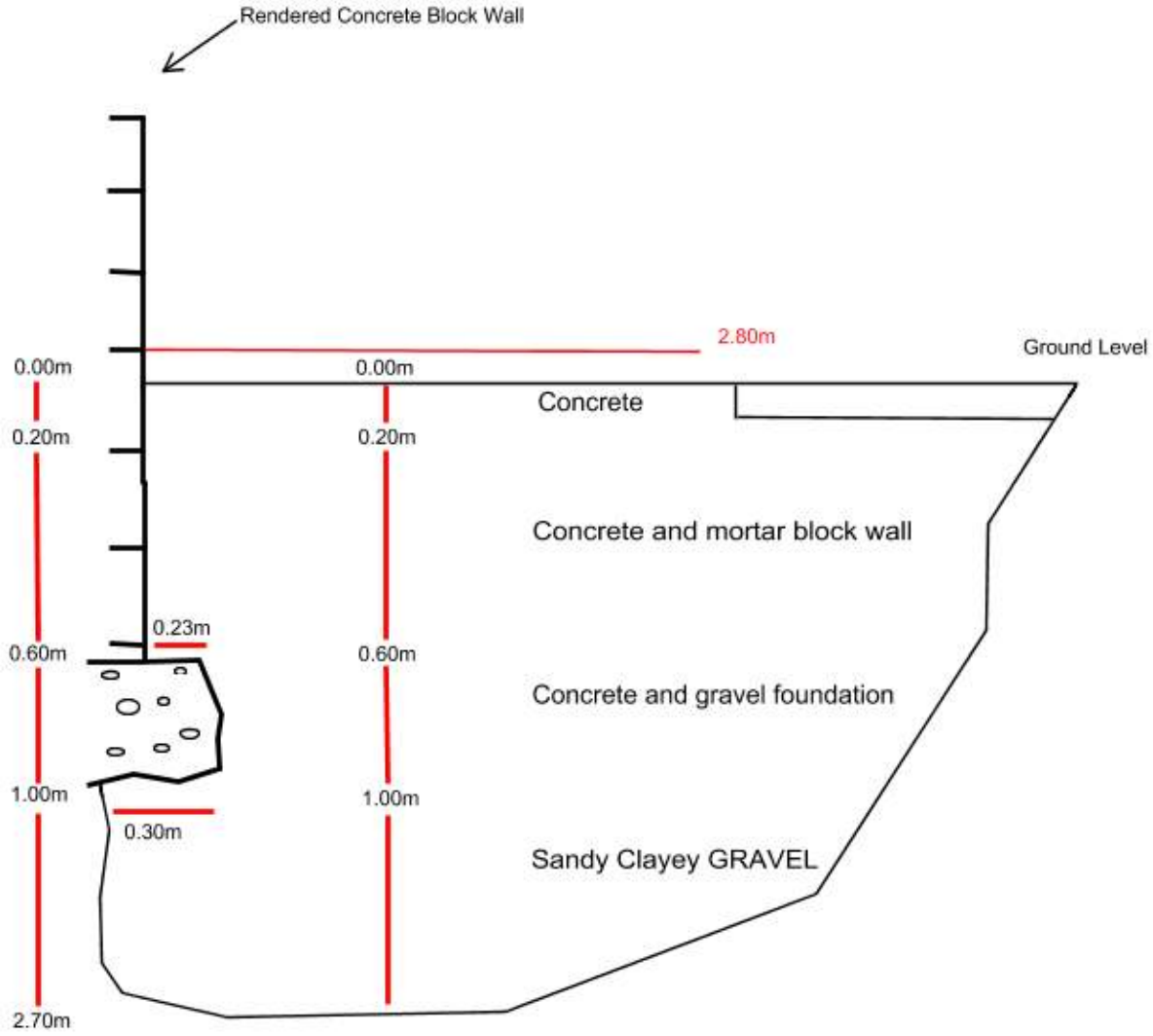
APPENDIX 3 – Foundation Pit Records

GROUND INVESTIGATIONS IRELAND

Ground Investigations Ireland Ltd.,
Catherineslawn House,
Hazelhatch Road,
Newcastle, Co Dublin.
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
Email: info@gii.ie | Web: gii.ie

Foundation Pit



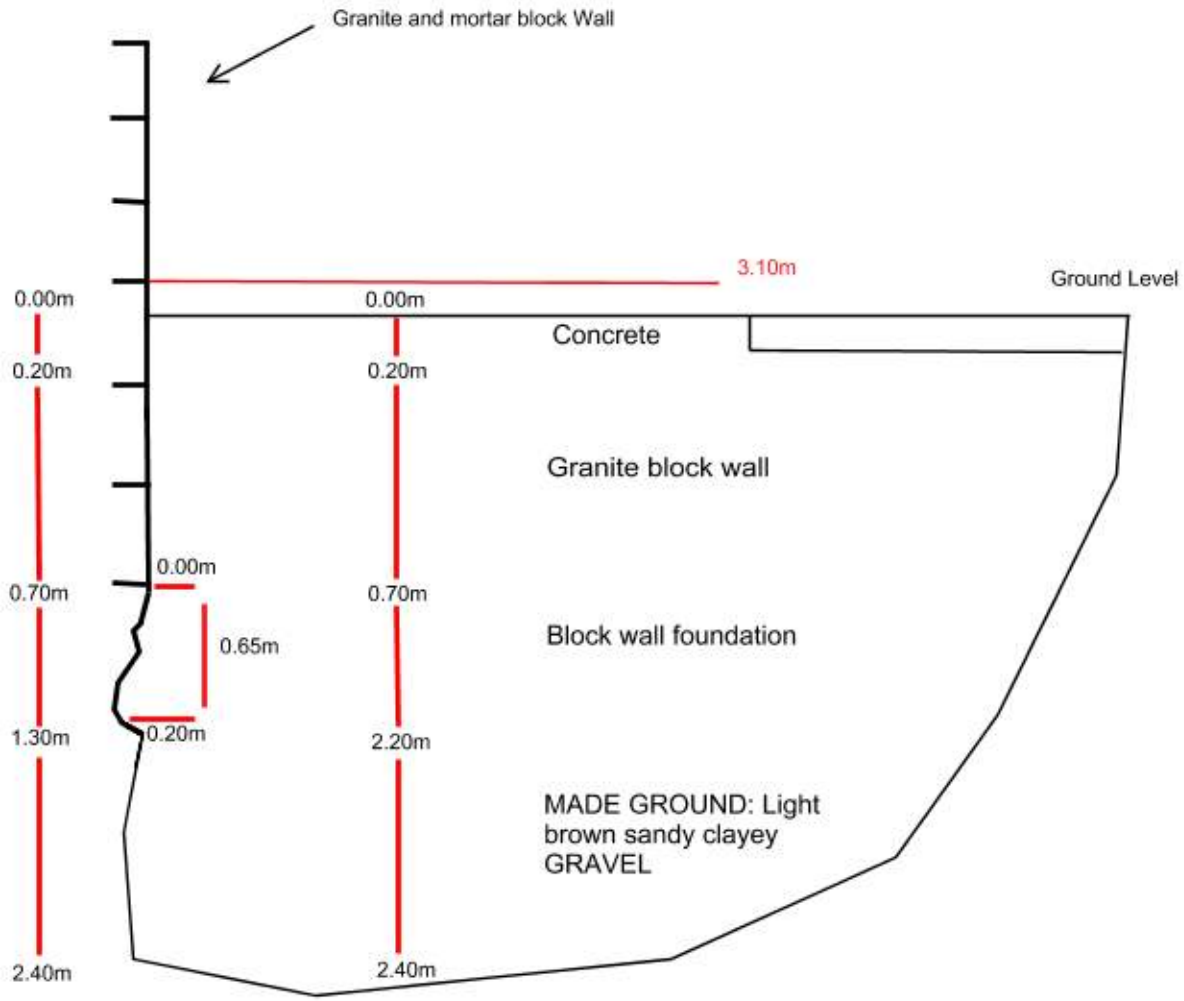
0.00-0.20	Concrete
0.20-2.70	MADE GROUND: Brown sandy clayey fine to coarse GRAVEL with occasional subangular to subrounded cobbles and boulders. Occasional cobbles of red brick and granite with occasional fragments of plastic ceramics and shells.

Project	Tedcastles Site 8674-04-19	Foundation Pit 01	
Client	DBFL Consulting Engineers		
Contractor	Ground Investigations Ireland Ltd	Date	25-04-19

GROUND INVESTIGATIONS IRELAND

Ground Investigations Ireland Ltd.,
Catherineslawn House,
Hazelhatch Road,
Newcastle, Co Dublin.
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
Email: info@gii.ie | Web: gii.ie

Foundation Pit



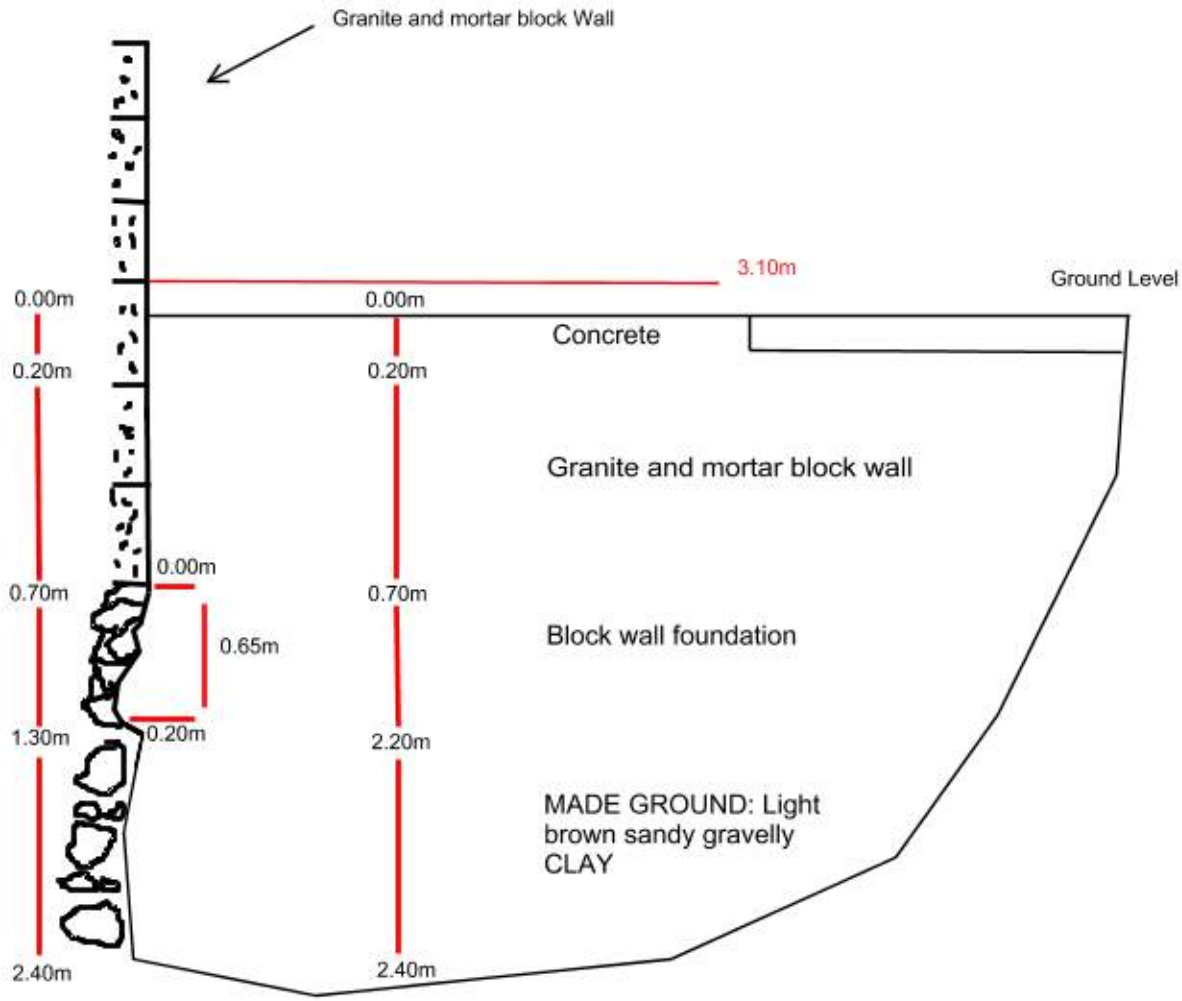
(m)	
0.00-0.20	Concrete
0.20-2.40	MADE GROUND: Light brown sandy gravelly CLAY with occasional subangular to subrounded cobbles and boulders with occasional red brick cobbles and occasional fragments of roof and oxidise iron.

Project	Tedcastles Site 8674-04-19	Foundation Pit 02	
Client	DBFL Consulting Engineers		
Contractor	Ground Investigations Ireland Ltd	Date	25-04-19

GROUND INVESTIGATIONS IRELAND

Ground Investigations Ireland Ltd.,
Catherineslawn House,
Hazelhatch Road,
Newcastle, Co Dublin.
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
Email: info@gii.ie | Web: gii.ie

Foundation Pit



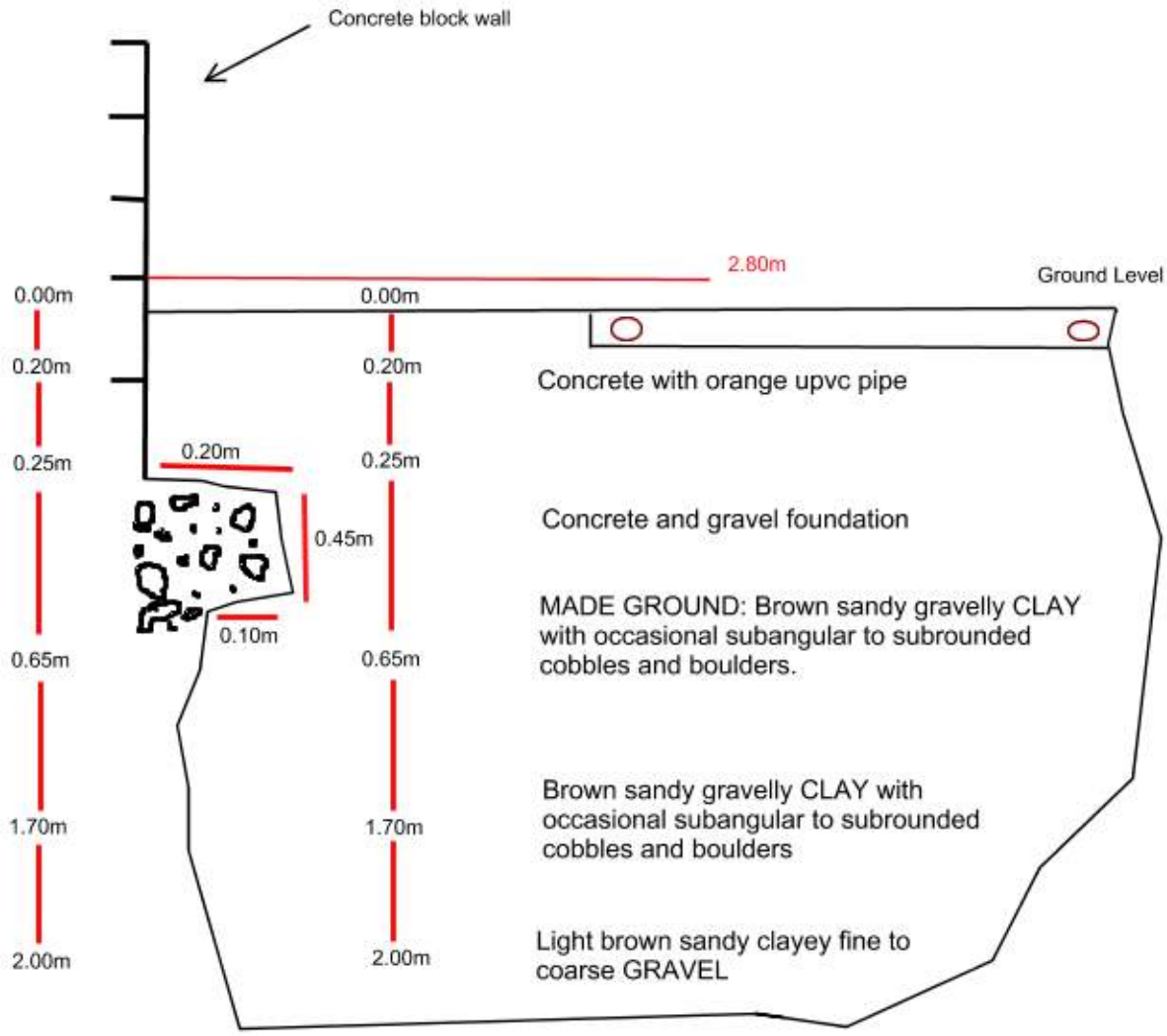
(m)	
0.00-0.20	Concrete
0.20-2.40	MADE GROUND: Light brown sandy gravelly CLAY with occasional subangular to subrounded cobbles and boulders with occasional red brick cobbles and occasional fragments of roof slate and oxidise iron. Frequent rootlets from0.40m - 1.20m

Project	Tedcastles Site 8674-04-19	Foundation Pit 03	
Client	DBFL Consulting Engineers		
Contractor	Ground Investigations Ireland Ltd	Date	25-04-19

GROUND INVESTIGATIONS IRELAND

Ground Investigations Ireland Ltd.,
Catherineslawn House,
Hazelhatch Road,
Newcastle, Co Dublin.
Tel: 01 601 5175 / 5176 | Fax: 01 601 5173
Email: info@gii.ie | Web: gii.ie

Foundation Pit



(m)	
0.00-0.20	Concrete
0.20-0.70	MADE GROUND: Brown sandy gravelly CLAY with occasional subangular to subrounded cobbles and boulders of granite. Occasional red brick cobbles with occasional fragments of ceramics
0.70-1.70	Brown sandy gravelly CLAY with occasional subangular to subrounded cobbles and boulders
1.70-2.00	Light brown sandy clayey fine to coarse GRAVEL with occasional subangular to subrounded cobbles and boulders

Project	Tedcastles Site 8674-04-19	Foundation Pit 04	
Client	DBFL Consulting Engineers		
Contractor	Ground Investigations Ireland Ltd	Date	25-04-19

APPENDIX 4 – Cable Percussion and Rotary Borehole Records

Ground Investigations Ireland Ltd
www.gii.ie

Site Tedcastles Site			**Borehole Number** BH-01
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 1.70m 100mm to 14.30m **Location** 723493.6 E 728829.6 N	**Ground Level (mOD)** 4.92 **Dates** 21/05/2019-11/06/2019	**Client** DBFL Consulting Engineers **Engineer**	**Job Number** 8674-04-19 **Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00											
							(0.60)	MADE GROUND: Light brown slightly sandy slightly gravelly CLAY with occasional sub-angular to sub-rounded cobbles and boulders. Occasional fragments of concrete and ceramics with occasional red brick cobbles.			
0.50					B	4.32	0.60				
1.00-1.45					2,3/7,9,34 SPT(C) N=50			Very stiff light brown sandy gravelly CLAY with occasional sub-angular to sub-rounded cobbles and boulders. Fine to coarse sand and fine to coarse sub-angular to sub-rounded gravel.			
1.00					B		(1.10)				
1.50					B 25/50						
1.70-2.15					SPT(C) N=50	3.22	1.70	OVERBURDEN. Recovery consists of Gravel and Cobble fragments. Driller notes boulder clay. Recovery typically 16-50%.			
1.70	16										
							(5.30)				
4.70	50										
5.30	22										
7.00	48					-2.08	7.00	OVERBURDEN. Recovery consists of stiff dark grey slightly sandygravelly Clay with gravel and cobble fragments. Driller notes boulder clay. Recovery typically 48%.			
							(2.00)				
8.30											
9.00	100	21	18	5		-4.08	9.00	Medium strong to strong greenish white coarsely crystalline GRANITE. Distinctly weathered.			
							(0.70)	9.00-9.79m. Two fracture sets. F1: closely spaced, 10-30 degrees, stepped rough, tight to open, clay staining. F2: closely spaced, 70-85 degrees, stepped rough, tight to open,			
9.70											

Remarks
Cable Percussion to 1.70m BGL with Rotary Core follow on to 14.30m BGL.
50mm slotted standpipe installed from 11.00m to 3.00m with pea gravel surround, plain pipe installed from 3.00m to ground level with bentonite seal and flush cover.
Chiselling from 1.50m to 1.70m for 1 hour.

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-01

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Site Tedcastles Site			**Borehole Number** BH-01
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 1.70m 100mm to 14.30m	**Ground Level (mOD)** 4.92	**Client** DBFL Consulting Engineers	**Job Number** 8674-04-19
	Location 723493.6 E 728829.6 N	**Dates** 21/05/2019-11/06/2019	**Engineer**	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						-4.78	9.70	clay staining. Strong to very strong whitish grey coarsely crystalline GRANITE. Partially weathered.			
	100	100	100	2				9.70-12.40m. Two fracture sets. F1: medium to widely spaced, 0-20 degrees, stepped rough, tight to open, clean. F2: widely spaced, 60-70 degrees, stepped rough, tight to open, clay staining.			
11.30											
	100	93	88				(4.60)				
12.40											
12.90				4							
	100	100	100					12.40-14.30m. Two fracture sets. F1: closely spaced, 10-30 degrees, stepped rough, tight to open, clean. F2: closely spaced, 55-65 degrees, stepped rough, tight to open, clay staining.			
14.30						-9.38	14.30	Complete at 14.30m			

Remarks

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-01

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Site Tedcastles Site			**Borehole Number** BH-02
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 0.10m 100mm to 13.00m **Location** 723498.8 E 728819.3 N	**Ground Level (mOD)** 4.89 **Dates** 21/05/2019-11/06/2019	**Client** DBFL Consulting Engineers **Engineer**	**Job Number** 8674-04-19 **Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00								MADE GROUND: Light brown slightly sandy slightly gravelly CLAY with occasional sub-angular to sub-rounded cobbles and boulders. Occasional concrete blocks and fragments of ceramics with occasional red brick cobbles.		
0.50					B					
							(1.50)			
1.00-1.45					7,19/50 SPT(C) N=50					
1.00					B					
1.50					B	3.39	1.50	Stiff light brown slightly sandy gravelly CLAY with occasional sub-angular to sub-rounded cobbles and boulders. Fine to coarse sand and fine to coarse sub-angular to sub-rounded gravel.		
2.00-2.45					2,4/4,5,3,7 SPT(C) N=19					
2.00					B					
							(1.50)			
3.00-3.45					3,5/6,6,5,7 SPT(C) N=24	1.89	3.00			
3.00					B			Light brown grey slightly sandy very clayey fine to coarse sub-angular to sub-rounded GRAVEL with occasional sub-angular to sub-rounded cobbles and boulders.		
							(0.80)			
3.80						1.09	3.80	OVERBURDEN. Recovery consists of grey black sub-angular to sub-rounded COBBLES and BOULDERS with frequent sub-angular to sub-rounded gravels. Driller notes: Boulder Clay. Revovery typically 45-48%.		
	45									
4.50							(1.50)			
	48									
5.30						-0.41	5.30	OVERBURDEN. Recovery consists of dark grey sub-rounded to rounded GRAVELS with occasional sub-rounded cobbles. Driller notes: Boulder Clay. Recovery typically 55%.		
	57									
6.00										
							(2.00)			
	55									
7.30						-2.41	7.30	Weak whitish brown coarsely crystalline GRANITE. Distinctly weathered. 7.30-7.70m. Non Intact		
7.40				NI			(0.40)			
7.70	100	64	55			-2.81	7.70	Very strong whitish grey medium to coarsely crystalline GRANITE. Partially weathered		
8.30										
	100	100	90					7.70-10.70m. One fracture set. F1: Medium spaced, 10-30 degrees, stepped rough, tight to open, clean.		
9.10				2						
	100	100	94							

Remarks
Cable Percussion to 3.8m BGL with Rotary Core follow on to 13.00m BGL.
Borehole backfilled on completion.
Chiselling from 1.20m to 1.50m for 1 hour. Chiselling from 3.70m to 3.80m for 1 hour.

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-02

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Site Tedcastles Site			**Borehole Number** BH-02
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 0.10m 100mm to 13.00m	**Ground Level (mOD)** 4.89	**Client** DBFL Consulting Engineers	**Job Number** 8674-04-19
	Location 723498.8 E 728819.3 N	**Dates** 21/05/2019-11/06/2019	**Engineer**	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							(5.30)			
10.70	100	81	81					10.70-13.00m. Two fracture sets. F1: Medium spaced, 60-80 degrees, stepped rough, tight to open, clean. F2: Closely spaced, 30-45 degrees, stepped rough, tight to open, clay staining.		
11.50	100	100	93	3						
12.20	100	90	75							
13.00						-8.11	13.00	Complete at 13.00m		

Remarks

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-02

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Site Tedcastles Site			**Borehole Number** BH-03
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 4.50m 100mm to 15.10m **Location** 723515.6 E 728824.6 N	**Ground Level (mOD)** 4.15 **Dates** 23/05/2019	**Client** DBFL Consulting Engineers **Engineer**	**Job Number** 8674-04-19 **Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00						3.90	(0.25) 0.25	CONCRETE		
0.50					B			MADE GROUND: Firm light brown slightly sandy slightly gravelly CLAY with mortar and redbrick fragments. Occasional sub-angular to sub-rounded cobbles and boulders. Fine to coarse sand and fine to coarse sub-angular to sub-rounded gravel.		
1.00-1.45 1.00					1,3/3,3,4,3 SPT(C) N=13 B		(1.75)			
1.50					B					
2.00-2.45 2.00					2,5/9,13,28 SPT(C) N=50 B	2.15	2.00	Very stiff light brown slightly sandy gravelly CLAY with occasional sub-angular to sub-rounded cobbles and boulders. Fine to coarse sand and fine to coarse sub-angular to sub-rounded gravel.		
3.00-3.45 3.00					8,25/50 SPT(C) N=50 B		(2.40)			
4.00-4.45 4.00					25/50 SPT(C) N=50 B					
4.50					Water strike(1) at 4.50m, rose to 4.30m in 20 mins.	-0.25 -0.35	4.40 4.50	Grey slightly clayey fine to coarse sub-angular to sub-rounded GRAVEL with occasional sub-angular to sub-rounded cobbles and boulders.		▼1 ▽1
	10							OVERBURDEN. Recovery consists of grey sub-rounded to rounded GRAVEL with occasional cobbles and boulders. Driller notes: Boulder Clay. Recovery typically 10%.		
6.00							(3.70)			
	9									
8.20						-4.05	8.20	OVERBURDEN. Recovery consists of stiff black slightly sandy gravelly CLAY with occasional sub-rounded cobbles. Driller notes: Boulder Clay. recovery typically 20-100%.		
	19									
10.00							(2.90)			

Remarks
Cable Percussion to 4.5m BGL with Rotary Core follow on to 15.10m BGL.
Groundwater encountered at 4.50m BGL.
Borehole backfilled on completion.
Chiselling from 0.00m to 0.25m for .50 hours. Chiselling from 4.20m to 4.40m for 1 hour.

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-03

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Site Tedcastles Site			**Borehole Number** BH-03
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 4.50m 100mm to 15.10m	**Ground Level (mOD)** 4.15	**Client** DBFL Consulting Engineers	**Job Number** 8674-04-19
	Location 723515.6 E 728824.6 N	**Dates** 23/05/2019	**Engineer**	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
	100	9	9							
11.10						-6.95	11.10			
11.20	100	77	67	6			(0.40)	Medium strong whitish grey coarsely crystalline GRANITE. Distinctly to partially weathered.		
						-7.35	11.50	Medium strong whitish grey medium to coarsely crystalline GRANITE. Partially weathered.		
12.80	100	96	79	5			(3.60)	11.10-12.80m. Two fracture sets. F1: closely spaced, 10-30 degrees, stepped rough, tight to open, clay staining. F2: medium to widely spaced, 50-70 degrees, stepped rough, tight to open, clay staining.		
14.20	100	60	54					12.80-15.10m. Two fracture sets. F1: closely spaced, 0-20 degrees, stepped rough, tight to open, clean. F2: close to medium spaced, 45-65 degrees, stepped rough, tight to open, clean.		
15.10						-10.95	15.10	Complete at 15.10m		

Remarks

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-03

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Site Tedcastles Site			**Borehole Number** BH-04
Machine : Dando 2000, Beretta T44 **Flush :** **Core Dia :** mm **Method :** Cable Percussion, Rotary Cored	**Casing Diameter** 200mm to 4.80m 100mm to 10.00m **Location** 723538.4 E 728822.3 N	**Ground Level (mOD)** 4.16 **Dates** 22/05/2019-11/06/2019	**Client** DBFL Consulting Engineers **Engineer**	**Job Number** 8674-04-19 **Sheet** 1/1

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00						4.04	0.12 (0.18)	CONCRETE			
						3.86	0.30	MADE GROUND: Dark grey fine to coarse angular to sub-angular GRAVEL.			
0.50					B			MADE GROUND: Grey brown slightly sandy very clayey fine to coarse sub-angular to sub-rounded Gravel with redbrick concrete and plastic fragments. Occasional sub-angular to sub-rounded cobbles and boulders.			
1.00-1.45					2,2/1,2,2,3 SPT(C) N=8						
1.00					B		(1.70)				
1.50					B						
2.00-2.45					1,0/1,2,2,3 SPT(C) N=8						
2.00					B	2.16	2.00	MADE GROUND: Firm brown slightly sandy very gravelly Clay with small redbrick fragments. Occasional sub-angular to sub-rounded cobbles.			
							(1.00)				
3.00-3.45					3,2/3,3,2,4 SPT(C) N=12						
3.00					B	1.16	3.00	Firm to stiff brown slightly sandy very gravelly CLAY with occasional sub-angular to sub-rounded cobbles.			
							(1.10)				
4.00-4.45					3,4/3,3,5,6 SPT(C) N=17						
4.00					B	0.06	4.10	Brown sandy clayey fine to coarse sub-angular GRAVEL with occasional sub-angular to sub-rounded cobbles and boulders.		▼1	
							(0.70)			V1	
4.80					25/50 SPT(C) N=50 Water strike(1) at 4.70m, rose to 4.50m in 20 mins.	-0.64	4.80				
4.80-5.25				5				Weak to medium strong whitish grey medium to coarsely crystalline GRANITE. Distinctly weathered.			
	94	29	29					4.80-7.40m. Two fracture sets. F1: closely spaced, 10-30 degrees, stepped rough, tight to open, clay staining. F2: closely spaced, 75-85 degrees, stepped rough, tight to open, clay staining.			
5.95				NI			(2.60)	5.95-6.50m. Non Intact.			
6.50				4							
	100	17	11								
7.00				NI				7.00-7.40m. Non Intact.			
7.40						-3.24	7.40	Weak to medium strong whitish grey medium to coarsely crystalline GRANITE. Distinctly to partially weathered.			
	100	67	55								
				5			(2.60)				
8.90								7.40-10.00m. Two fracture sets. F1: closely spaced, 10-35 degrees, stepped rough, tight to open, clay staining. F2: medium spaced, 60-80 degrees, stepped rough, tight to open, clay staining.			
	100	23	23								
10.00						-5.84	10.00				

Remarks
Cable Percussion to 4.80m BGL with Rotary Core follow on to 10.00m BGL.
50mm slotted standpipe installed from 7.00m to 3.00m with pea gravel surround, plain pipe installed from 3.00m to ground level with bentonite seal and flush cover.
Groundwater encounted at 4.70m BGL.
Chiselling from 0.00m to 0.12m for .33 hours. Chiselling from 4.80m to 4.80m for 1 hour.

Scale (approx)	Logged By
1:50	PM

Figure No. 8674-04-19.BH-04

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APPENDIX 5 – Laboratory Testing

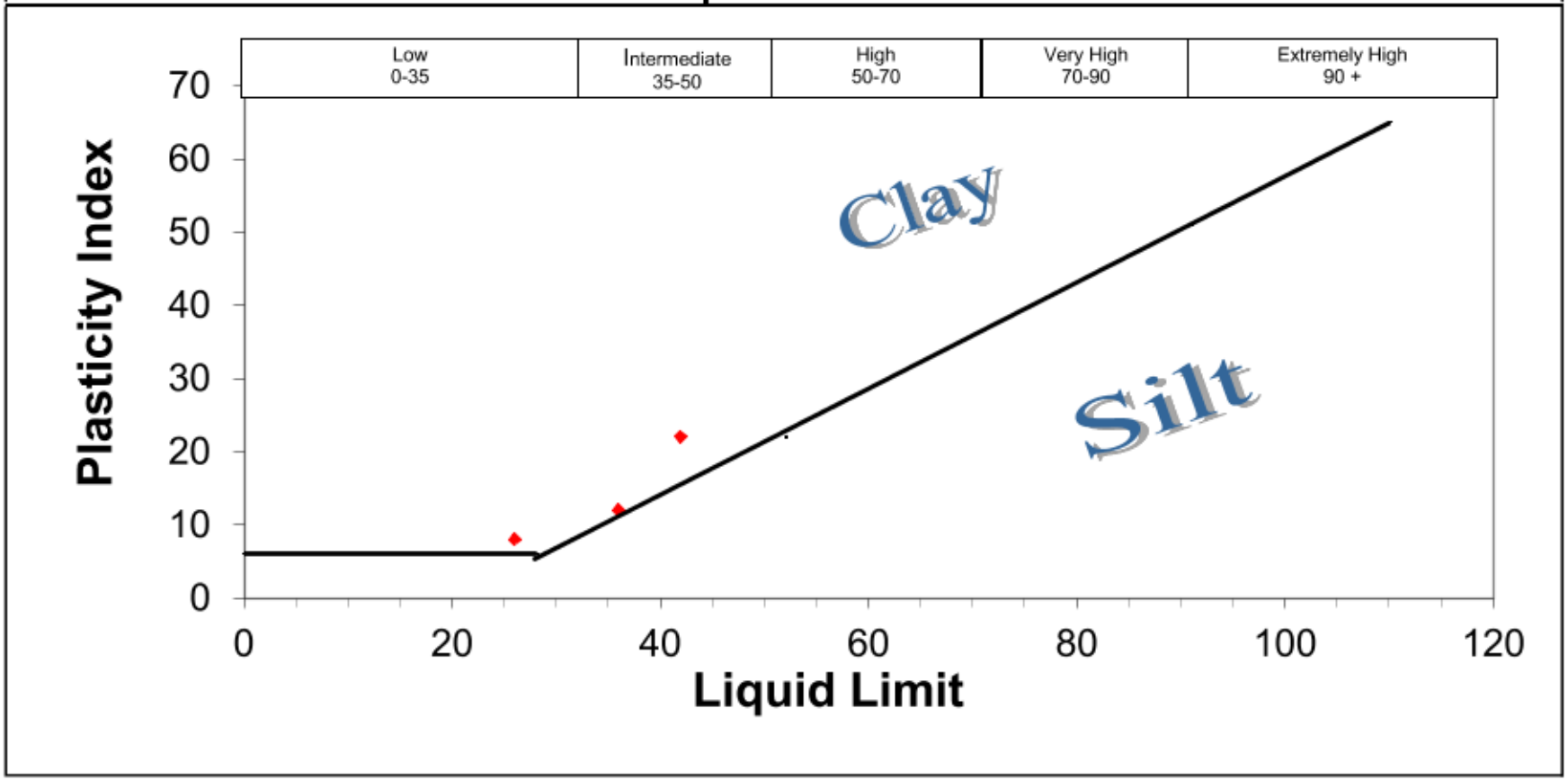
National Materials Testing Laboratory Ltd.

SUMMARY OF TEST RESULTS

				Particle			Index Properties		Bulk	Cell	Undrained Triaxial Tests		Lab	
BH/TP	Depth	sample	Moisture	Density	<425um	LL	PL	PI	Density	Presssure	Compressive	Strain at	Vane	Remarks
No	m	No.	%	Mg/m3	%	%	%	%	Mg/m3	kPa	Stress kPa	Failure %	kPa	
BH01	1.00	B	18.1		72.6	42	20	22						
BH02	2.00	B	8.4		18.5	26	18	8						
BH04	1.50	B	14.8		18.9	36	24	12						

NMTL	Notes :	Job ref No.	NMTL	GII Project ID:	8674-04-19
	1. All BS tests carried out using preferred (definitive) method unless otherwise stated.	Location	Tedcastles Site		

NMTL LTD	**Contract:** Tedcastles Site
Unit 18c, Tullow Industrial Estate	**Client:** Ground Investigations Ireland Ltd
Tullow	**Engineer:** Conor Finnerty
County Carlow	**GII Project ID** 8674-04-19
Tel: 00353 59 9180822	**Date:** 03/07/2019
Mob: 00353 872575508	**Tested By:** Sb **Checked:** Bc
billa@nmtl.ie	**Job ref No.** NMTL

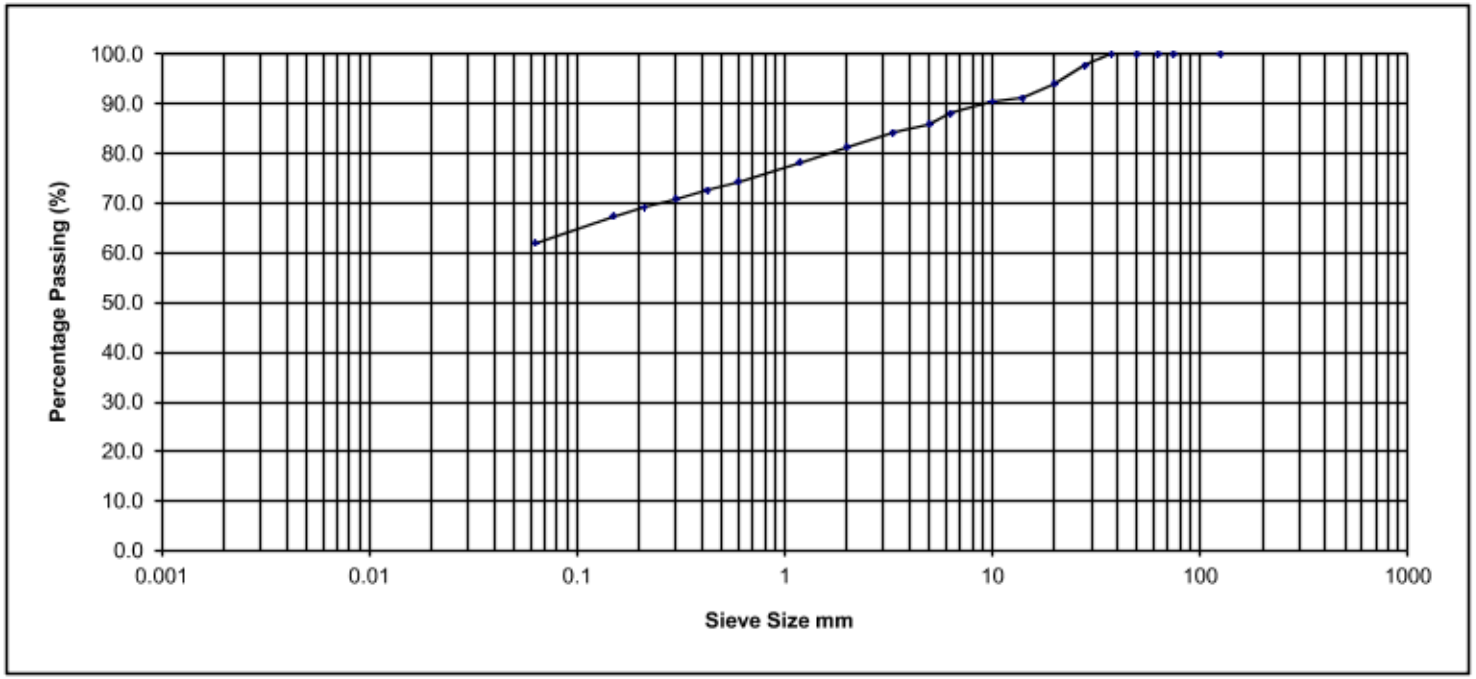


NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	97.8
20.000	94.1
14.000	91.2
10.000	90.5
6.300	88.1
5.000	86.0
3.350	84.2
2.000	81.3
1.180	78.3
0.600	74.4
0.425	72.6
0.300	70.9
0.212	69.2
0.150	67.4
0.063	62.0



Percentage Particle Size

Clay	Fine Silt	Medium Silt	Coarse Silt	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Medium Gravel	Coarse Gravel	Cobbles	Boulder
		62.0			19.4			18.7		0.0	0.0

Sample Description: Light brown/oragne slightly gravelly slightly sandy silty CLAY.

Project: Tedcastles Site

GII PROJECT ID: 8674-04-19

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	21/06/2019

Project No.	NMTL 2935
BH/TP No.	BH01
Sample No.	B
Depth	1.0m

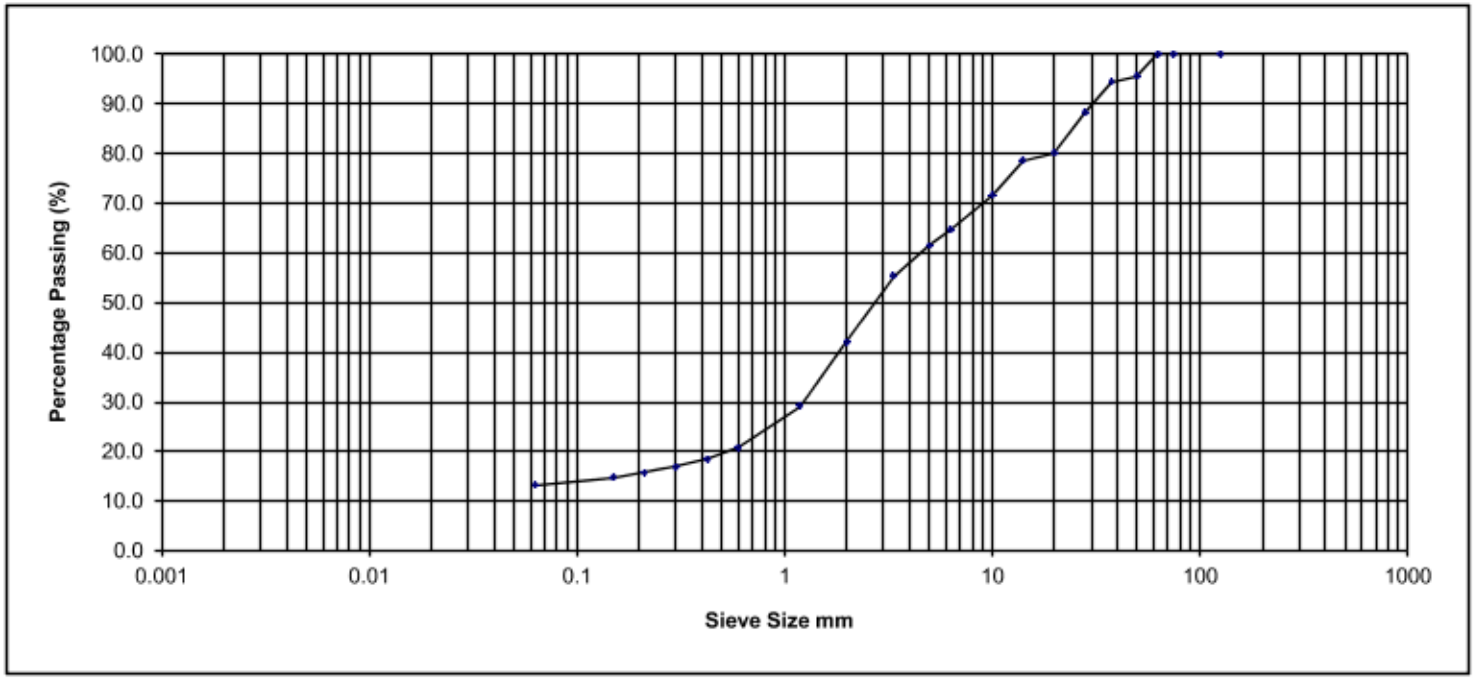
NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	95.7
37.500	94.5
28.000	88.3
20.000	80.2
14.000	78.7
10.000	71.6
6.300	64.7
5.000	61.5
3.350	55.5
2.000	42.1
1.180	29.3
0.600	20.7
0.425	18.5
0.300	16.9
0.212	15.8
0.150	14.9
0.063	13.2



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		13.2			28.8			57.9		0.0	0.0

Sample Description	Brown silty very sandy fine to coarse GRAVEL						Project No.	NMTL 2935
							BH/TP No.	BH02
Project	Tedcastles Site				GII PROJECT ID: 8674-04-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	21/06/2019	Depth	2.00m

NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	92.4
50.000	86.3
37.500	77.9
28.000	67.0
20.000	54.3
14.000	48.8
10.000	43.8
6.300	39.0
5.000	37.5
3.350	35.7
2.000	31.8
1.180	27.4
0.600	21.5
0.425	18.9
0.300	16.7
0.212	14.7
0.150	12.7
0.063	9.5

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		9.5			22.3			60.6		7.6	0.0

Sample Description: Dark brown silty very sandy fine to coarse GRAVEL, with some cobbles.

Project: Tedcastles Site

GII PROJECT ID: 8674-04-19

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	21/06/2019

Project No.	NMTL 2935
BH/TP No.	BH04
Sample No.	B
Depth	1.50m

NM TL Ltd

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Ground Investigations Ireland
Catherinestown House
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Ireland

Attention :	Barry Sexton
Date :	24th June, 2019
Your reference :	8674-04-19
Our reference :	Test Report 19/9527 Batch 1
Location :	Tedcastles Site
Date samples received :	13th June, 2019
Status :	Final report
Issue :	1

Four samples were received for analysis on 13th June, 2019 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton BSc
Senior Project Manager

Please include all sections of this report if it is reproduced

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Tedcastles Site
Contact: Barry Sexton
EMT Job No: 19/9527

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1-3	4-6	7-9	10-12							LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-02	BH-03	BH-04									
Depth	1.0	2.0	1.0	1.5									
COC No / misc													
Containers	V J T	V J T	V J T	V J T									
Sample Date	12/06/2019	12/06/2019	12/06/2019	12/06/2019									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	13/06/2019	13/06/2019	13/06/2019	13/06/2019									
Sulphate as SO4 (2:1 Ext) #	0.0356	0.0083	0.0387	0.0245							<0.0015	g/l	TM38/PM20
pH #	8.86	9.16	9.34	9.13							<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Tedcastles Site
Contact: Barry Sexton

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 19/9527						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No: 19/9527

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/9527

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

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Ground Investigations Ireland
Catherinestown House
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Newcastle
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Ireland

Attention :	Barry Sexton
Date :	1st July, 2019
Your reference :	8674-04-19
Our reference :	Test Report 19/9813 Batch 1
Location :	Ted Castles
Date samples received :	18th June, 2019
Status :	Final report
Issue :	1

Two samples were received for analysis on 18th June, 2019 of which two were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Where Waste Acceptance Criteria Suite (EC Decision of 19 December 2002 (2003/33/EC)) has been requested, all analyses have been performed using the relevant EN methods where they exist.

Compiled By:

Lucas Halliwell
Project Co-ordinator

Please include all sections of this report if it is reproduced

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton
EMT Job No: 19/9813

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-10	11-20									LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-04											
Depth													
COC No / misc													
Containers	V H HN HCL Z P G	V H HN HCL Z P G											
Sample Date	17/06/2019	17/06/2019											
Sample Type	Ground Water	Ground Water											
Batch Number	1	1											
Date of Receipt	18/06/2019	18/06/2019											
Dissolved Arsenic #	<2.5	3.0									<2.5	ug/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5									<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7									<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5									<5	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2									<2	ug/l	TM30/PM14
Dissolved Zinc #	<3	<3									<3	ug/l	TM30/PM14
Methyl Tertiary Butyl Ether #	<0.1	<0.1									<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5									<0.5	ug/l	TM15/PM10
Toluene #	<5	<5									<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1									<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2									<2	ug/l	TM15/PM10
o-Xylene #	<1	<1									<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	105	104									<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	106	99									<0	%	TM15/PM10
Pesticides													
Organochlorine Pesticides													
Aldrin	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Alpha-HCH (BHC)	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Beta-HCH (BHC)	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Delta-HCH (BHC)	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Dieldrin	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Endosulphan I	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Endosulphan II	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Endosulphan sulphate	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Endrin	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Gamma-HCH (BHC)	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Heptachlor	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Heptachlor Epoxide	<0.01	<0.01									<0.01	ug/l	TM149/PM30
o,p'-Methoxychlor	<0.01	<0.01									<0.01	ug/l	TM149/PM30
p,p'-DDE	<0.01	<0.01									<0.01	ug/l	TM149/PM30
p,p'-DDT	<0.01	<0.01									<0.01	ug/l	TM149/PM30
p,p'-Methoxychlor	<0.01	<0.01									<0.01	ug/l	TM149/PM30
p,p'-TDE	<0.01	<0.01									<0.01	ug/l	TM149/PM30

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton
EMT Job No: 19/9813

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-10	11-20									LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-04											
Depth													
COC No / misc													
Containers	V H HN HCL Z P G	V H HN HCL Z P G											
Sample Date	17/06/2019	17/06/2019											
Sample Type	Ground Water	Ground Water											
Batch Number	1	1											
Date of Receipt	18/06/2019	18/06/2019											
Pesticides													
Organophosphorus Pesticides													
Azinphos methyl	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Diazinon	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Dichlorvos	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Disulfoton	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Ethion	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Ethyl Parathion (Parathion)	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Fenitrothion	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Malathion	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Methyl Parathion	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Mevinphos	<0.01	<0.01									<0.01	ug/l	TM149/PM30
Fats Oils and Grease	<10	<10									<10	ug/l	TM5/PM16/PM30
TPH CWG													
Aliphatics													
>C5-C6 #	<10	<10									<10	ug/l	TM36/PM12
>C6-C8 #	<10	<10									<10	ug/l	TM36/PM12
>C8-C10 #	<10	<10									<10	ug/l	TM36/PM12
>C10-C12 #	<5	<5									<5	ug/l	TM5/PM16/PM30
>C12-C16 #	<10	<10									<10	ug/l	TM5/PM16/PM30
>C16-C21 #	<10	<10									<10	ug/l	TM5/PM16/PM30
>C21-C35 #	<10	<10									<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-35 #	<10	<10									<10	ug/l	TM36/PM12/PM30
Aromatics													
>C5-EC7 #	<10	<10									<10	ug/l	TM36/PM12
>EC7-EC8 #	<10	<10									<10	ug/l	TM36/PM12
>EC8-EC10 #	<10	<10									<10	ug/l	TM36/PM12
>EC10-EC12 #	<5	<5									<5	ug/l	TM5/PM16/PM30
>EC12-EC16 #	<10	<10									<10	ug/l	TM5/PM16/PM30
>EC16-EC21 #	<10	<10									<10	ug/l	TM5/PM16/PM30
>EC21-EC35 #	<10	<10									<10	ug/l	TM5/PM16/PM30
Total aromatics C5-35 #	<10	<10									<10	ug/l	TM36/PM12/PM30
Total aliphatics and aromatics(C5-35) #	<10	<10									<10	ug/l	TM36/PM12/PM30
Total Phenols HPLC	<0.15	<0.15									<0.15	mg/l	TM26/PM0
Fluoride	0.4	<0.3									<0.3	mg/l	TM173/PM0
Sulphate as SO4 #	65.0	241.5									<0.5	mg/l	TM38/PM0
Chloride #	210.8	1330.9									<0.3	mg/l	TM38/PM0
Nitrate as N #	2.28	5.79									<0.05	mg/l	TM38/PM0
MRP Ortho Phosphate as P	0.05	0.23									<0.03	mg/l	TM38/PM0

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton
EMT Job No: 19/9813

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

EMT Sample No.	1-10	11-20									LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-04											
Depth													
COC No / misc													
Containers	V H HN HCL Z P G	V H HN HCL Z P G											
Sample Date	17/06/2019	17/06/2019											
Sample Type	Ground Water	Ground Water											
Batch Number	1	1											
Date of Receipt	18/06/2019	18/06/2019											
Total Cyanide #	<0.01	<0.01									<0.01	mg/l	TM89/PM0
Ammoniacal Nitrogen as NH3 #	<0.03	0.11									<0.03	mg/l	TM38/PM0
Anionic Surfactants	<0.2	0.4									<0.2	mg/l	TM33/PM0
BOD (Settled) #	<1	<1									<1	mg/l	TM58/PM0
COD (Settled) #	9	25									<7	mg/l	TM57/PM0
Electrical Conductivity @25C #	1179	4773									<2	uS/cm	TM76/PM0
pH #	8.00	7.99									<0.01	pH units	TM73/PM0
Total Suspended Solids #	<10	11									<10	mg/l	TM37/PM0

Please see attached notes for all abbreviations and acronyms

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton
EMT Job No: 19/9813

SVOC Report : Liquid

EMT Sample No.	1-10	11-20									LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-04											
Depth													
COC No / misc													
Containers	V H HN HCL Z P G	V H HN HCL Z P G											
Sample Date	17/06/2019	17/06/2019											
Sample Type	Ground Water	Ground Water											
Batch Number	1	1											
Date of Receipt	18/06/2019	18/06/2019											
SVOC MS													
Phenols													
2-Chlorophenol #	<1	<1									<1	ug/l	TM16/PM30
2-Methylphenol #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5	<0.5									<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1	<1									<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1	<1									<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
4-Methylphenol	<1	<1									<1	ug/l	TM16/PM30
4-Nitrophenol	<10	<10									<10	ug/l	TM16/PM30
Pentachlorophenol	<1	<1									<1	ug/l	TM16/PM30
Phenol	<1	<1									<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene #	<1	<1									<1	ug/l	TM16/PM30
2-Methylnaphthalene #	<1	<1									<1	ug/l	TM16/PM30
Naphthalene #	<1	<1									<1	ug/l	TM16/PM30
Acenaphthylene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Acenaphthene #	<1	<1									<1	ug/l	TM16/PM30
Fluorene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Phenanthrene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Anthracene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Fluoranthene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Pyrene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Benzo(a)anthracene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Chrysene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Benzo(bk)fluoranthene #	<1	<1									<1	ug/l	TM16/PM30
Benzo(a)pyrene	<1	<1									<1	ug/l	TM16/PM30
Indeno(123cd)pyrene	<1	<1									<1	ug/l	TM16/PM30
Dibenzo(ah)anthracene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Benzo(ghi)perylene #	<0.5	<0.5									<0.5	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5	<5									<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1	<1									<1	ug/l	TM16/PM30
Di-n-butyl phthalate #	<1.5	<1.5									<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1	<1									<1	ug/l	TM16/PM30
Diethyl phthalate #	<1	<1									<1	ug/l	TM16/PM30
Dimethyl phthalate	<1	<1									<1	ug/l	TM16/PM30

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton
EMT Job No: 19/9813

SVOC Report : Liquid

EMT Sample No.	1-10	11-20											
Sample ID	BH-01	BH-04											
Depth													
COC No / misc													
Containers	V H HN HCL Z P G	V H HN HCL Z P G											
Sample Date	17/06/2019	17/06/2019											
Sample Type	Ground Water	Ground Water											
Batch Number	1	1											
Date of Receipt	18/06/2019	18/06/2019											
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene #	<1	<1											
1,2,4-Trichlorobenzene #	<1	<1											
1,3-Dichlorobenzene #	<1	<1											
1,4-Dichlorobenzene #	<1	<1											
2-Nitroaniline	<1	<1											
2,4-Dinitrotoluene #	<0.5	<0.5											
2,6-Dinitrotoluene	<1	<1											
3-Nitroaniline	<1	<1											
4-Bromophenylphenylether #	<1	<1											
4-Chloroaniline	<1	<1											
4-Chlorophenylphenylether #	<1	<1											
4-Nitroaniline	<0.5	<0.5											
Azobenzene #	<0.5	<0.5											
Bis(2-chloroethoxy)methane #	<0.5	<0.5											
Bis(2-chloroethyl)ether #	<1	<1											
Carbazole #	<0.5	<0.5											
Dibenzofuran #	<0.5	<0.5											
Hexachlorobenzene #	<1	<1											
Hexachlorobutadiene #	<1	<1											
Hexachlorocyclopentadiene	<1	<1											
Hexachloroethane #	<1	<1											
Isophorone #	<0.5	<0.5											
N-nitrosodi-n-propylamine #	<0.5	<0.5											
Nitrobenzene #	<1	<1											
Surrogate Recovery 2-Fluorobiphenyl	127	118											
Surrogate Recovery p-Terphenyl-d14	126	128											

Please see attached notes for all abbreviations and acronyms

LOD/LOR	Units	Method No.
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<0.5	ug/l	TM16/PM30
<1	ug/l	TM16/PM30
<0	%	TM16/PM30
<0	%	TM16/PM30

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton
EMT Job No: 19/9813

VOC Report : Liquid

EMT Sample No.	1-10	11-20									LOD/LOR	Units	Method No.
Sample ID	BH-01	BH-04											
Depth													
COC No / misc													
Containers	V H HN HCL Z P G	V H HN HCL Z P G											
Sample Date	17/06/2019	17/06/2019											
Sample Type	Ground Water	Ground Water											
Batch Number	1	1											
Date of Receipt	18/06/2019	18/06/2019											
VOC MS													
Dichlorodifluoromethane	<2	<2									<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.1	<0.1									<0.1	ug/l	TM15/PM10
Chloromethane #	<3	<3									<3	ug/l	TM15/PM10
Vinyl Chloride #	<0.1	<0.1									<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1									<1	ug/l	TM15/PM10
Chloroethane #	<3	<3									<3	ug/l	TM15/PM10
Trichlorofluoromethane #	<3	<3									<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<3	<3									<3	ug/l	TM15/PM10
Dichloromethane (DCM) #	<5	<5									<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3									<3	ug/l	TM15/PM10
1,1-Dichloroethane #	<3	<3									<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3									<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1									<1	ug/l	TM15/PM10
Bromochloromethane #	<2	<2									<2	ug/l	TM15/PM10
Chloroform #	13	2									<2	ug/l	TM15/PM10
1,1,1-Trichloroethane #	<2	<2									<2	ug/l	TM15/PM10
1,1-Dichloropropene #	<3	<3									<3	ug/l	TM15/PM10
Carbon tetrachloride #	<2	<2									<2	ug/l	TM15/PM10
1,2-Dichloroethane #	<2	<2									<2	ug/l	TM15/PM10
Benzene #	<0.5	<0.5									<0.5	ug/l	TM15/PM10
Trichloroethene (TCE) #	<3	<3									<3	ug/l	TM15/PM10
1,2-Dichloropropane #	<2	<2									<2	ug/l	TM15/PM10
Dibromomethane #	<3	<3									<3	ug/l	TM15/PM10
Bromodichloromethane #	<2	<2									<2	ug/l	TM15/PM10
cis-1-3-Dichloropropene	<2	<2									<2	ug/l	TM15/PM10
Toluene #	<5	<5									<5	ug/l	TM15/PM10
trans-1-3-Dichloropropene	<2	<2									<2	ug/l	TM15/PM10
1,1,2-Trichloroethane #	<2	<2									<2	ug/l	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3									<3	ug/l	TM15/PM10
1,3-Dichloropropane #	<2	<2									<2	ug/l	TM15/PM10
Dibromochloromethane #	<2	<2									<2	ug/l	TM15/PM10
1,2-Dibromoethane #	<2	<2									<2	ug/l	TM15/PM10
Chlorobenzene #	<2	<2									<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane #	<2	<2									<2	ug/l	TM15/PM10
Ethylbenzene #	<1	<1									<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2									<2	ug/l	TM15/PM10
o-Xylene #	<1	<1									<1	ug/l	TM15/PM10
Styrene	<2	<2									<2	ug/l	TM15/PM10
Bromoform #	<2	<2									<2	ug/l	TM15/PM10
Isopropylbenzene #	<3	<3									<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4									<4	ug/l	TM15/PM10
Bromobenzene #	<2	<2									<2	ug/l	TM15/PM10
1,2,3-Trichloropropane #	<3	<3									<3	ug/l	TM15/PM10
Propylbenzene #	<3	<3									<3	ug/l	TM15/PM10
2-Chlorotoluene #	<3	<3									<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene #	<3	<3									<3	ug/l	TM15/PM10
4-Chlorotoluene #	<3	<3									<3	ug/l	TM15/PM10
tert-Butylbenzene #	<3	<3									<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene #	<3	<3									<3	ug/l	TM15/PM10
sec-Butylbenzene #	<3	<3									<3	ug/l	TM15/PM10
4-Isopropyltoluene #	<3	<3									<3	ug/l	TM15/PM10
1,3-Dichlorobenzene #	<3	<3									<3	ug/l	TM15/PM10
1,4-Dichlorobenzene #	<3	<3									<3	ug/l	TM15/PM10
n-Butylbenzene #	<3	<3									<3	ug/l	TM15/PM10
1,2-Dichlorobenzene #	<3	<3									<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2									<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3									<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3									<3	ug/l	TM15/PM10
Naphthalene	<2	<2									<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3									<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	105	104									<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	106	99									<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 8674-04-19
Location: Ted Castles
Contact: Barry Sexton

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 19/9813						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No: 19/9813

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/9813

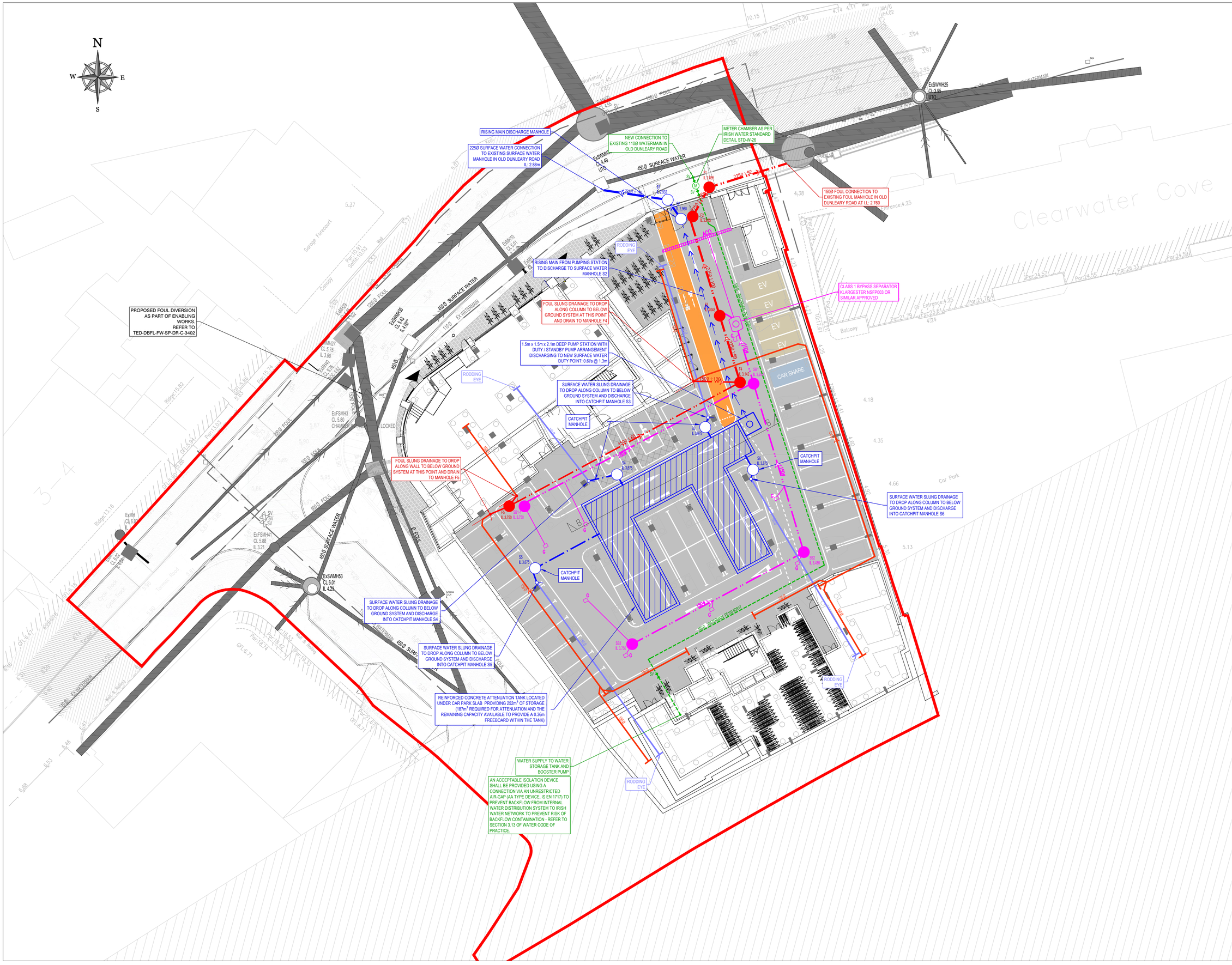
Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details	Yes			
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM16	Modified USEPA 8270. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM33	Determination of Anionic surfactants by reaction with Methylene Blue to form complexes which are analysed spectrophotometrically. (MBAS)	PM0	No preparation is required.				

EMT Job No: 19/9813

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results can be confirmed using GCMS.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods USEPA 160.2, EN872:2005 and SMWW 2540D. Gravimetric determination of Total Suspended Solids. Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed.	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods 325.2 (Chloride), 375.4 (Sulphate), 365.2 (o-Phosphate), 353.1 (TON), 354.1 (Nitrite), 350.1 (NH4+) comparable to BS ISO 15923-1, 7196A (Hex Cr)	PM0	No preparation is required.	Yes			
TM57	Modified US EPA Method 410.4. Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM58	APHA Standard Methods for the Examination of Water and Waste Water (SMEWW) 5210B. Comparible with ISO 5815:1989. Measurement of Biochemical Oxygen Demand. When cBOD (Carbonaceous BOD) is requested a nitrification inhibitor is added which prevents the oxidation of reduced forms of nitrogen, such as ammonia, nitrite and organic nitrogen which exert a nitrogenous demand. Determination of Dissolved Oxygen using the Hach	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM89	Modified USEPA method OIA-1667. Determination of cyanide by Flow Injection Analyser. Where WAD cyanides are required a Ligand displacement step is carried out before analysis.	PM0	No preparation is required.	Yes			
TM149	Determination of Pesticides by Large Volume Injection on GC Triple Quad MS, based upon USEPA method 8270	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				

EMT Job No: 19/9813

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.				



ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

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NOTES:

1. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES
2. ALL LEVELS ARE IN METRES AND ARE RELATED TO ORDNANCE DATUM
3. CONTRACTOR SHALL SATISFY HIMSELF AS TO THE ACCURACY OF PAVEMENT LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORKS ON SITE
4. ALL NEW FOUL SEWER INFRASTRUCTURE SHALL BE LAID IN ACCORDANCE WITH IRISH WATER WASTEWATER INFRASTRUCTURE STANDARD DETAILS CONSTRUCTION REQUIREMENTS FOR SELF-LAY DEVELOPMENTS DECEMBER 2017 (REVISION 03) DOCUMENT IW-CDS-5030-01
4. ALL FOUL SEWERS TO BE uPVC TO COMPLY WITH IS EN 1401 2009/2012 UNLESS INDICATED OTHERWISE.
5. THIS DRAWING IS FOR PLANNING PURPOSES ONLY
6. MANHOLE COVER LEVELS ARE TO CONFORM WITH FINISHED ROAD AND PATH LEVELS
7. WHERE COVER TO PIPE IS LESS THAN 1200mm (ROAD/PATH/VERGE) OR 900mm (OPEN SPACE) SURROUND PIPE IN MINIMUM 150mm CONCRETE AS STD-WW- 08
8. WHERE INDICATED, ALL DISTANCES FROM DIVERTED SEWER TO ADJACENT STRUCTURES ARE TO CENTRELINE OF NEW SEWER.
9. ALL NEW MANHOLES TO BE TO STD-WW-10 UNO

LEGEND

- SITE BOUNDARY
- COURTYARD OUTLINE
- EXISTING KERB

SERVICES LEGEND

- PROPOSED FOUL SEWER
- PROPOSED SURFACE WATER SEWER
- EXISTING FOUL SEWER
- EXISTING SURFACE WATER SEWER
- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- GULLY
- ACO DRAIN
- FILTER DRAIN
- ATTENUATION STORAGE
- PROPOSED FOUL WATER SLUNG DRAIN
- PROPOSED CAR PARK DRAINAGE
- PROPOSED SURFACE WATER SLUNG DRAIN
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED CARPARK DRAINAGE RISING MAIN

rev	date	description	by	chkd.
P01	19-08-21	ISSUED FOR PLANNING	BS	PCC

client approval
- A - Approved
- B - Approved with comments
- C - Do not use

suitability: S2 - INFORMATION
issue purpose: PLANNING

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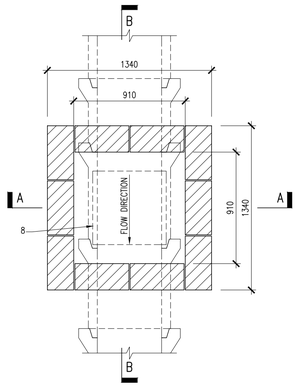
project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
SITE SERVICES LAYOUT

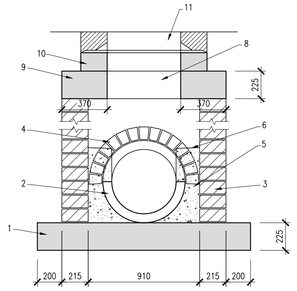
client
TED LIVING

designed by	author	scale	sheet size
NJF	BS	VALUE	A1

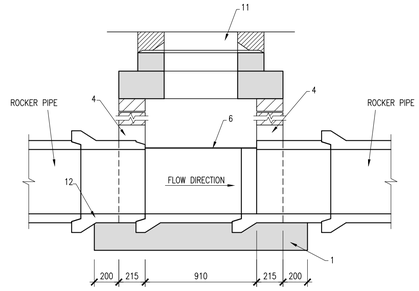
drawing no.: TED-DBFL-CS-SP-DR-C-1201
revision: P01



PLAN BELOW ROOF SLAB



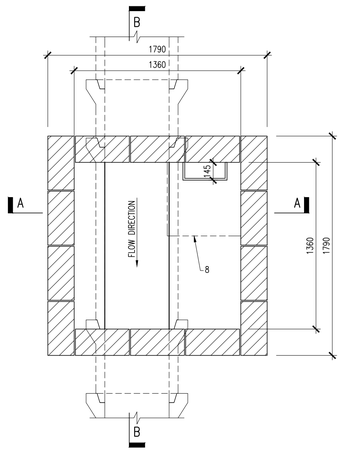
SECTION A–A



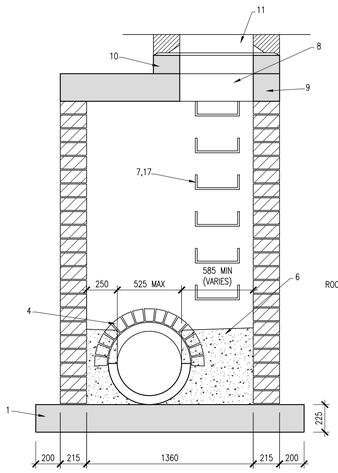
SECTION B–B

TYPE A MANHOLE
MANHOLE DETAILS FOR PIPE DIA's 150,225,300,375 & 450
DEPTH TO INVERT LESS THAN 1.0m

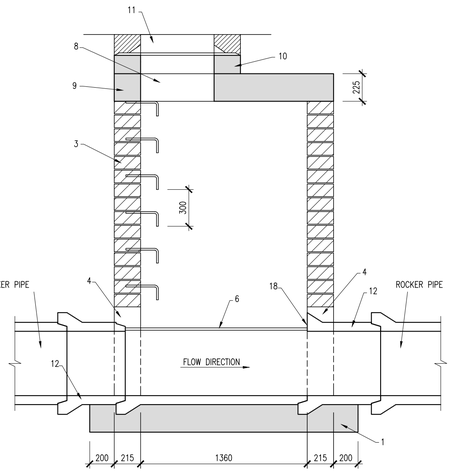
DETAIL 1A



PLAN BELOW ROOF SLAB



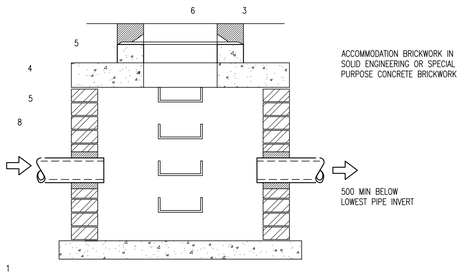
SECTION A–A



SECTION B–B

TYPE B MANHOLE
MANHOLE DETAILS FOR PIPE DIA's 225,300,375 & 450
DEPTH TO INVERT GREATER THAN 1.0m & LESS THAN 3.0m

DETAIL 1B



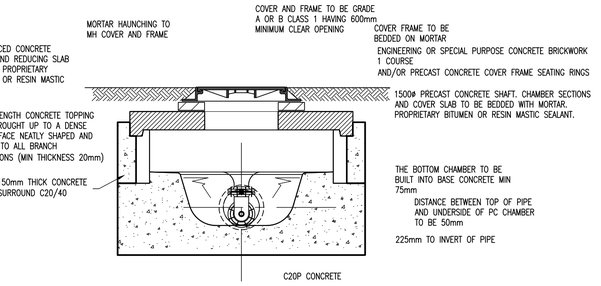
CATCHPIT MANHOLE SECTION (FILTER DRAINS ONLY)

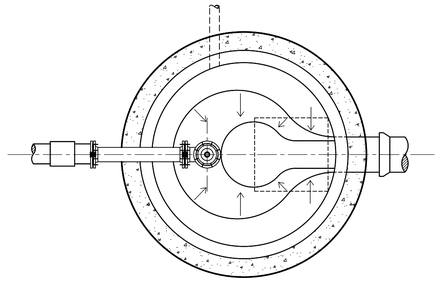
NOTES.

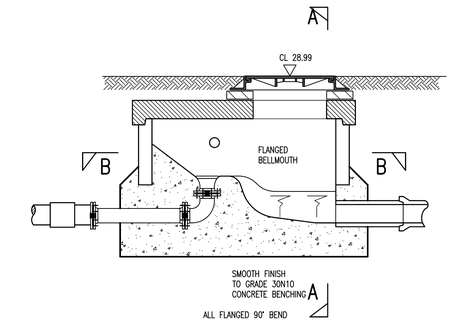
1. 225mm THK C20 MASS CONCRETE FOUNDATIONS
2. BENCHING AND PIPE CHANNEL PIPE SURROUND – C20 CONCRETE.
3. 600mm SQUARE OPENING IN ROOF SLAB.
4. 200mm THK PRECAST R.C. ROOF SLAB IN C20 CONCRETE.
   COVER TO STEEL SHALL BE 40mm. SLAB SHALL BE CONTRACTOR DESIGNED TO BS5911
5. ENGINEERING BRICK H53 TO I.S.91:1983 SET IN TYPE (ii)
6. AN APPROVED DEEP SEAL PATERN GALVANISED IRON AIR TIGHT
   COVER AND FRAME WEIGHING MIN. 4.3 kg, 600 x 600 MM CLEAR OPENING
   SIZE. FRAME TO BE BEDDED IN MASTIC AND 25 x 25 mm SEAL TO BE FILLED
   WITH MANHOLE GREASE.
7. DRAWING TO BE READ IN CONJUNCTION WITH DBFL DRAWINGS
   042097–3201, 042097–3202 & 042097–3203
8. DOUBLE STEP RUNGS TO BE FIXED IN LINE VERTICAL AND SPACED AT 300 mm CENTRES.

MANHOLE TYPE	X	Y
BROADS TRAP/OUTFALL	1200 mm	1200 mm
> 1.5 m	600 mm	900 mm
< 1.5 m	600 mm	750 mm

DETAIL 1C



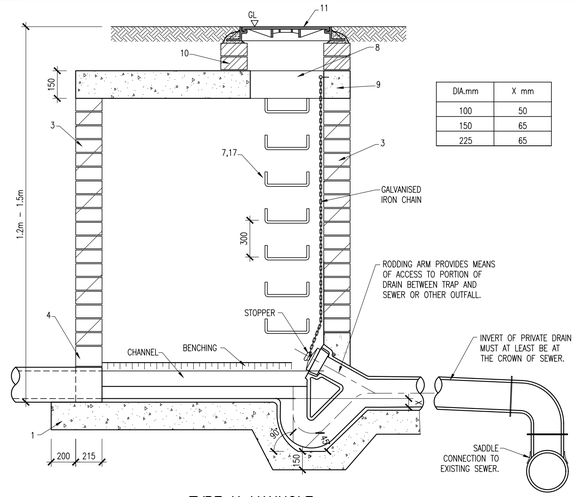




DETAIL 1D

EXTRACTED FROM THE GREATER DLRCOCO REGIONAL CODE OF PRACTICE FOR DRAINAGE WORKS

1. 225MM THICK CL. 20N/20MM MASS CONCRETE FOUNDATIONS.
2. PREFORMED HALF CIRCLE CHANNEL PIPES. THE PIPELINE MAY, WHERE PRACTICABLE, BE LAID THROUGH THE MANHOLE AND THE CROWN CUT OUT TO HALF DIAMETER, PROVIDED FLEXIBLE JOINTS ARE SITUATED ON EACH SIDE NO FURTHER THAN 600MM FROM THE INNER FACE OF MANHOLE WALL.
3. MANHOLE CONSTRUCTION.
   FOR SURFACE WATER MANHOLES HIGH–DENSITY BLOCKS TO CLS10 OF IS.20 PART 1:1987 OR CL. 30N/20MM IN–SITU CONCRETE.
   BLOCK WORK SHALL BE BEDDED AND JOINTED USING MORTAR TO IS406. BEDS AND VERTICAL JOINTS SHALL BE COMPLETELY FILLED WITH MORTAR AS THE BLOCKS ARE LAID.
   JOINTS SHALL BE FLUSH POINTED AS THE WORK PROCEEDS.
   ALL FOUL MANHOLES MUST BE FACED IN SOLID ENGINEERING BRICK (MIN. CLASS A OR B), OR IN–SITU CONCRETE FOR 1 METRE ABOVE BENCHING LEVEL.
   BRICK TO BE BONDED TO BLOCK WORK USING ENGLISH GARDEN WALL BOND.
4. RELIEVING ARCH FORMED BY 215X103X65 SOLID ENGINEERING BRICK CLASS A OR B AS PER DRAWING. RELIEVING ARCHES USED IN BRICK OR BLOCK WORK MANHOLES EXTEND OVER FULL THICKNESS OF WALL. A DOUBLE ARCH IS TO BE FORMED FOR PIPE DIAMETERS GREATER THAN 600MM.
5. BENCHING AND PIPE CHANNEL PIPE SURROUND – CL. 20/20 CONCRETE.
6. BENCHING FINISHED IN 2:1 SAND–CEMENT MORTAR WITH A SMOOTH TROWEL FINISH, AT 1 IN 30 SLOPE TOWARDS CHANNEL.
7. STANDARD RUNGS AT 300C/C VERTICALLY AND GALVANIZED TO THE LATEST VERSION OFB.S. 729 OR EQUIVALENT. NOTE: STEPS IRONS ARE NOT ACCEPTABLE.
8. 600MM SQUARE OPENING IN ROOF SLAB.
9. PRECAST R.C. ROOF SLAB SHALL BE 200MM THICK IN CLASS 30N/20MM, WITH 40MM COVER TO STEEL.
10. 1 TO 2 COURSES OF SOLID ENGINEERING BRICKS C.L.B TO I.S.91:1983 SET IN 1:3 (CEMENT AND MORTAR).
11. CLASS D400 OR E600 MANHOLE COVER AND FRAME TO IS/EN 124. 150MM DEEP FRAME FOR ROADS AND 100MM DEEP FOR FOOTPATHS AND GREEN AREAS. NON–ROCK DESIGN, CLOSED KEYWAYS, MANUFACTURED FROM SPHEROIDAL GRAPHITE CAST IRON (DUCTILE CAST IRON), 600 X 600 (600 DIAM.) CLEAR OPENING, COVER AND FRAME COATED IN BITUMEN OR OTHER APPROVED MATERIAL, COVER TO HAVE A MINIMUM MASS OF 140KG/M2, FRAME BEARING AREA SHALL BE 80,000MM2 MIN, FRAMES SHALL BE DESIGNED TO PREVENT COVERS FALLING INTO MANHOLE. FRAMES SHALL BE BEDDED ON APPROVED MORTAR TO MANUFACTURES INSTRUCTIONS.
12. SHORT LENGTH PIPE AND PIPE JOINT EXTERNAL TO MANHOLE SHALL NOT EXCEED 600MM FROM THE INNER FACE OF MANHOLE WALL.
13. TOE HOLES OF 230MM MINIMUM DEPTH AND GALVANIZED STEEL SAFETY RAILINGS TO BE PROVIDED IN BENCHING OF SEWERS GREATER THAN 525MM DIAMETER AND DEPTH TO INVERT >3M FOR ACCESS TO INVERT.
14. A SAFETY CHAIN IS TO BE PROVIDED ON PIPES THAT EXCEED 450MM IN DIAMETER. MILD SAFETY CHAIN SHALL BE 10MM NOMINAL SIZE GRADE M(H) NON–CALIBRATED CHAIN, TYPE 1, COMPLYING WITH B.S.4942 PART 2 OR EQUIVALENT.
15. WHEN DEPTH OF MANHOLES TO INVERT IS GREATER THAN 3.0M LADDERS SHALL BE USED INSTEAD OF RUNGS TO B.S.4211 OR EQUIVALENT EXCEPT THAT STRINGERS SHOULD BE NOT LESS THAN 65 X 12MM IN SECTION AND RUNGS 25MM IN DIAMETER. FIXED LADDERS SHOULD MEET THE DIMENSIONAL REQUIREMENTS OF B.S.4211 OR EQUIVALENT.
16. LADDER STRINGERS SHOULD BE ADEQUATELY SUPPORTED FROM THE MANHOLE WALL AT INTERVALS OF NOT MORE THAN 2.0M STRINGERS SHOULD BE BOLTED TO CLEATS TO FACILITATE RENEWAL.
17. ALL LADDERS, RUNGS, HANDRAILS, SAFETY CHAINS ETC SHALL BE HOT DIP GALVANIZED TO B.S.729 OR EQUIVALENT.
18. PIPE SHOULD BE CUT FLUSH WITH THE INSIDE SURFACE OF THE MANHOLE WALL SO THAT THE CHANNEL EXTENDS THE FULL LENGTH OF THE MANHOLE (EXCEPT FOR PRECAST MANHOLES).
19. POSITION OF 910 SQUARE OPENING IN INTERMEDIATE ROOF SLAB.
    ALL MANHOLES SHALL BE WATERTIGHT TO THE SATISFACTION OF THE ENGINEER.
    FORMWORK TO REINFORCED CONCRETE AND MASS CONCRETE SHALL COMPLY WITH CLASS 2, SECTION 6.2.7, B.S.8110: PART 1: 1997.
    FINISH TO THE TOP OF SLABS SHALL COMPLY WITH TYPE A, SECTION 6.2.7, B.S.8110: PART 1:1997.
    PLAN DIMENSIONS OF MANHOLES ARE BASED ON BLOCK WORK HAVING A COORDINATING SIZE OF 450 X 225 X 100.
    MANHOLES ARE DESIGNED TO B.S.8005 AND WALL THICKNESS TO LS.325 BLOCK WORK DESIGN CODE TAKING GRANULAR FILL PRESSURE AND H.B. SURCHARGE.
    REINFORCEMENT TO SLABS TO ENGINEERS DETAILS.
20. FOR MANHOLES >3M DEPTH TO INVERT USE 30N/20MM IN–SITU CONCRETE. REINFORCING MESH REF. A393 @ 6.16KG/M TO BE FIXED AT MIDPOINT OF WALL. ADDITIONAL REINFORCEMENT TO BE SUPPLIED OVER PIPE CROWN.
21. FOR PRECAST MANHOLES, CHAMBER WALLS AND COVER SLAB TO BE CONSTRUCTED TO IS EN 1917 AND IS 420 2004
22. MANHOLE OPENINGS TO BE SITUATED FURTHEST FROM THE NEAREST CARRIAGEWAY. MANHOLE STEPS / ACCESS TO BE POSITIONED TO ALLOW VIEWING OF ONCOMING TRAFFIC.
23. FOR BEDDING AND SEALING OF CHAMBER RINGS, THE TOP RING (TO PRECAST COVER SLAB) AND BOTTOM RING TO BE BEDDED WITH CEMENT MORTAR. FOR INTERMEDIATE RINGS, JOINTS TO BE SEALED WITH APPROVED PRE–FORMED JOINTING STRIP.
24. PRECAST MANHOLES TO BE SURROUNDED WITH A MINIMUM OF 150MM THICK GRADE C20/40 CONCRETE.



DIA.mm	X mm
100	50
150	65
225	65

TYPE H MANHOLE
DETAIL OF MANHOLE WITH BROADS TRAP INTERCEPTOR
SCALE 1:25

DETAIL 1E

ON ORIGINAL
0 5 10 15 20 30 40 50mm

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NOTES:

1. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH NRA SPECIFICATION FOR ROADWORKS UNLESS OVERRIDDEN BY GREATER DLRCOCO REGIONAL CODES OF PRACTICE FOR DRAINAGE WORKS AS AMENDED BY DLRCOCO CITY COUNCIL
2. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES.
3. ALL LEVELS ARE IN METRES AND ARE RELATED TO THE ORDANANCE DATUM.
4. CONTRACTOR SHALL SATISFY HIMSELF AS TO THE ACCURACY OF PAVEMENT LEVELS ON SITE PRIOR TO COMMENCEMENT OF WORKS.
5. ALL SURFACE WATER MANHOLES TO BE TAKEN IN CHARGE BY DCC TO BE BLOCKWORK OR IN SITU CONCRETE AS PER THE GREATER DLRCOCO REGIONAL CODES OF PRACTICE FRO DRAINAGE WORKS AS AMENDED BY DLRCOCO CITY COUNCIL.
6. ALL FOUL MANHOLES TO BE CONSTRUCTED IN ACCORDANCE WITH IRISH WATER'S CODE OF PRACTICE FOR WASTEWATER INFRASTRUCTURE.
7. ALL MANHOLES TO BE RETAINED IN PRIVATE OWNERSHIP TO BE PRE-CAST CONCRETE MANHOLES AS PER DRAINAGE DESIGN DETAILS.

rev	date	description	by	chkd.
P01	19-08-21	ISSUED FOR PLANNING	BS	PCC

client approval
- A - Approved
- B - Approved with comments
- C - Do not use

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issue purpose: PLANNING

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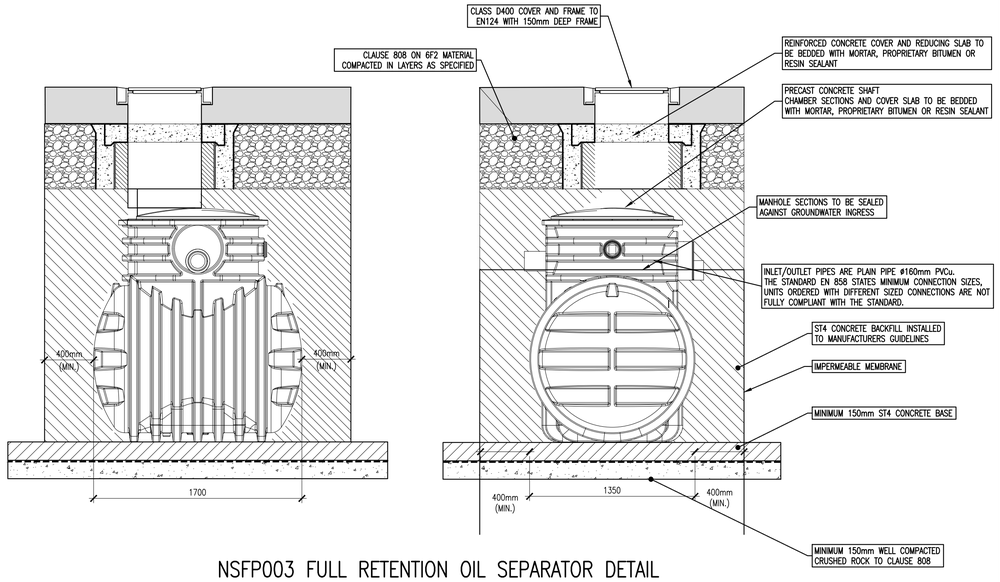
project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
DRAINAGE DETAILS SHEET 1

client
TED LIVING

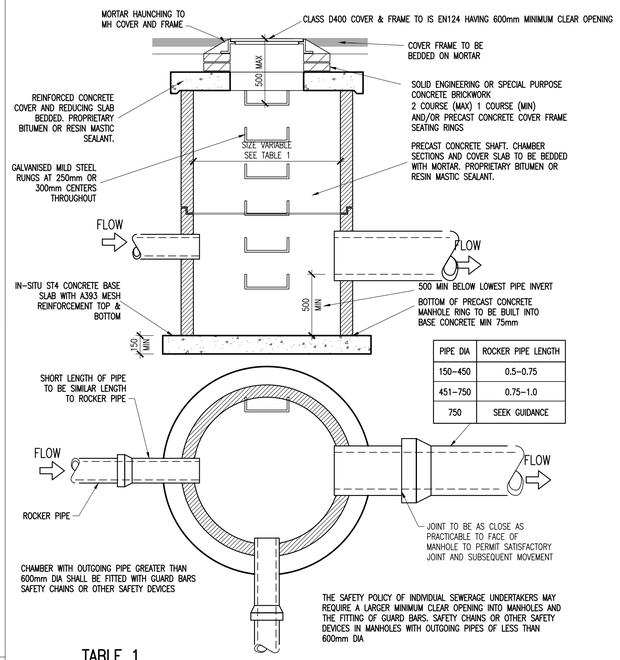
designed by	author	scale	sheet size
PCC	BS	AS SHOWN	A1

drawing no.: TED-DBFL-CS-SP-DR-C-5201
revision: P01



NSFP003 FULL RETENTION OIL SEPARATOR DETAIL

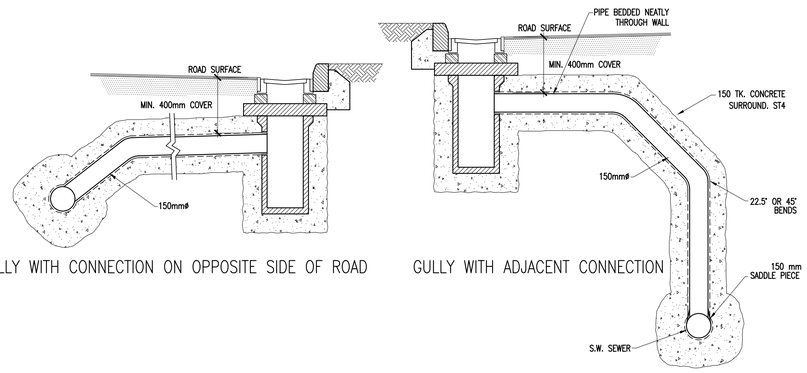
SCALE 1:25



PIPE DIA	ROCKER PIPE LENGTH
150–450	0.5–0.75
451–750	0.75–1.0
750	SEEK GUIDANCE

TABLE 1

DIAMETER OF LARGEST PIPE IN MANHOLE (mm)	CHAMBER SECTION DIAMETER (mm)
LESS THAN 375	1200 (1050 WHERE DEPTH TO SOFFIT IS 1.35m – 1.5m)
375 – 450	1350
500 – 700	1500
750 – 900	1800

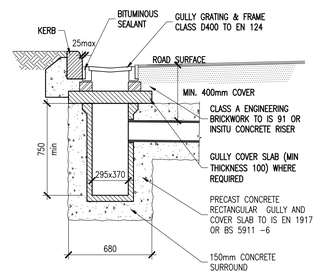


GULLY WITH CONNECTION ON OPPOSITE SIDE OF ROAD

GULLY WITH ADJACENT CONNECTION

ROAD GULLY DETAILS

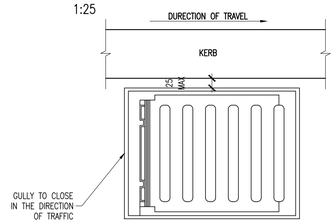
SCALE 1:25

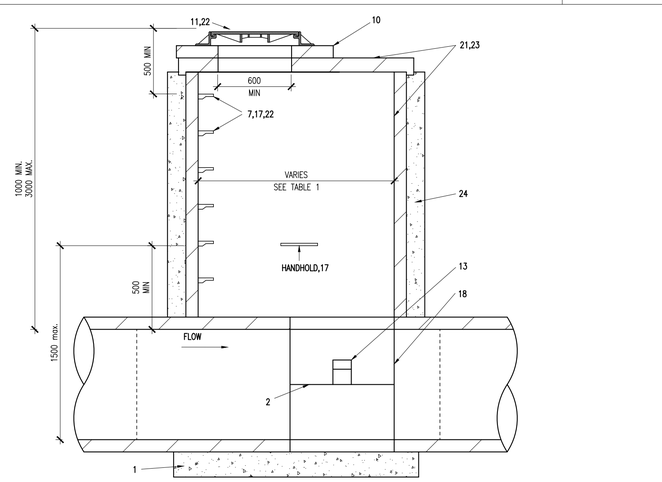


ROAD GULLY DETAILS SECTION

CATCHPIT MANHOLE DETAIL

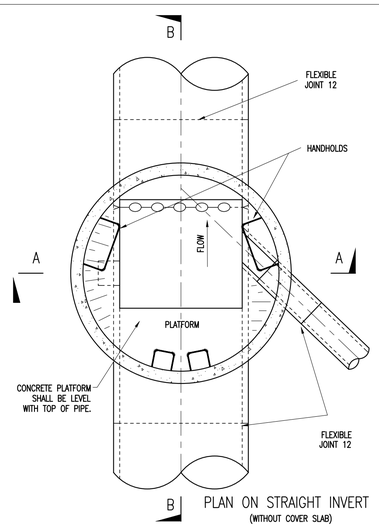
1:25



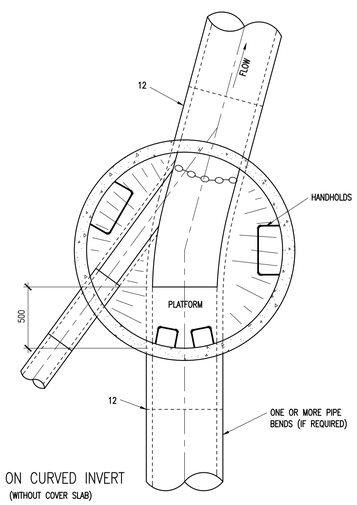


SECTION B–B

INTEGRAL IN–SITU 20N/20mm CONCRETE BASE WALLS, BENCHING AND BASE SLAB WITH PRECAST CHANNEL AS SHOWN OR IN–SITU FORMED INVERT AS ALTERNATIVE. WALLS TO EXTEND 150mm BEYOND OUTER FACES OF CHAMBER RING. ALTERNATIVELY PRECAST CONCRETE CHAMBER RINGS MAY BE BEDDED IN MORTAR OR IN SITU 20N/20mm CONCRETE BASE SLAB 300mm GREATER IN DIAMETER THAN CHAMBER RINGS.



PLAN ON STRAIGHT INVERT (WITHOUT COVER SLAB)



PLAN ON CURVED INVERT (WITHOUT COVER SLAB)

GREATER DLRCOCO CODE OF PRACTICE FOR DRAINAGE WORKS TYPICAL MANHOLE DETAIL – TYPE J DEPTH TO SOFFIT 1 TO 3m

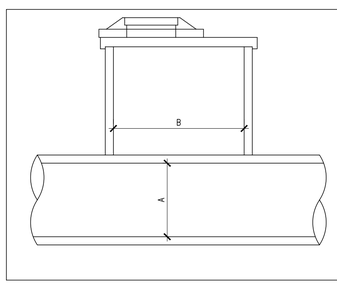
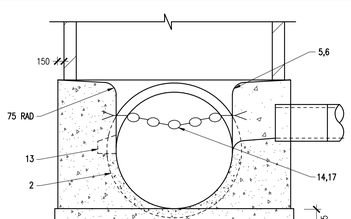


TABLE 1:

MAXIMUM PIPE DIAMETER A	CHAMBER INTERNAL DIAMETER B
225	1200
300	1200
375	1200
450	1200
525	1200
600	1200
675	1350
750	1350
900	1500
1050	2100
1200	2100



SECTION A–A

ON ORIGINAL

0 5 10 15 20 30 40 50mm

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NOTES:

1. WHERE ROCKS OR OTHER HARD THE FIGURE DENOTED BY * IS TO TRENCH BOTTOM IS ENCOUNTERED BE DOUBLED.
2. TYPE 1 GRANULAR MATERIAL: BROKEN STONE OR GRAVEL TO PASS 10mm SIEVE AND BE RETAINED ON 5mm SIEVE.
3. TYPE 2 GRANULAR MATERIAL: BROKEN STONE OR GRAVEL TO PASS 10mm - 25mm SIEVE, ACCORDING TO PIPE SIZE, (SEE TABLE) AND BE RETAINED ON 5mm SIEVE.
4. TYPE 3 SELECTED FILL: UNIFORM READILY COMPACTED MATERIAL FREE FROM TREE ROOTS, VEGETABLE MATTER, BUILDING DEBRIS, AND FROZEN SOIL AND EXCLUDING CLAY LUMPS RETAINED ON A 75mm SIEVE AND STONES RETAINED ON A 37.5mm SIEVE.
5. RIGID PIPES SHALL MEAN CAST OR SPUN IRON, CONCRETE OR CLAY.
6. FLEXIBLE PIPES SHALL MEAN PIPES OF STEEL, PVC, OTHER PLASTIC OR DUCTILE IRON.
7. ROAD GULLY GRATINGS AND FRAMES SHALL COMPLY WITH THE REQUIRE MENTS OF I.S./EN 124: 1994. EACH GULLY AND FRAME SHALL HAVE MARKED CLEARLY THEREON:

(A) I.S./EN 124:1994 - CLASS C250 OR CLASS D400 AS APPROPRIATE (B) THE NAME AND/OR IDENTIFICATION MARK OF THE MANUFACTURER AND THE PLACE OF MANUFACTURE.
(C) THE YEAR OF MANUFACTURE.
(D) MARK OF THE CERTIFICATION BODY

8. ROAD GULLY PITS TO BE IN-SITU CONCRETE OR RECTANGULAR AS SPECIFIED.
9. SEPARATORS TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS/INSTRUCTIONS.

rev	date	description	by	chkd.
P01	19-08-21	ISSUED FOR PLANNING	BS	PCC

client approval
A - Approved
B - Approved with comments
C - Do not use

suitability: S2 - INFORMATION
issue purpose: PLANNING

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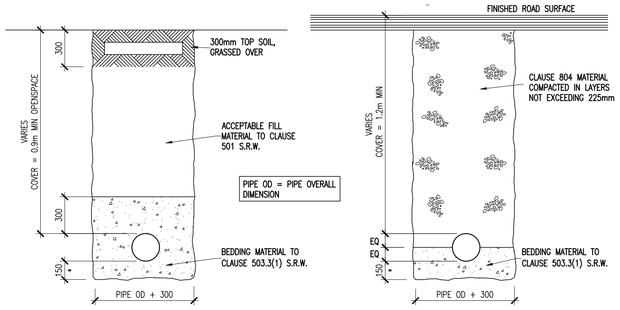
project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
DRAINAGE DETAILS SHEET 2

client
TED LIVING

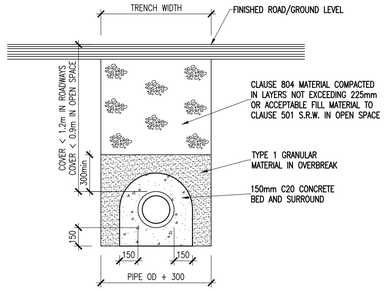
designed by	author	scale	sheet size
PCC	BS	AS SHOWN	A1

drawing no.: TED-DBFL-CS-SP-DR-C-5202
revision: P01



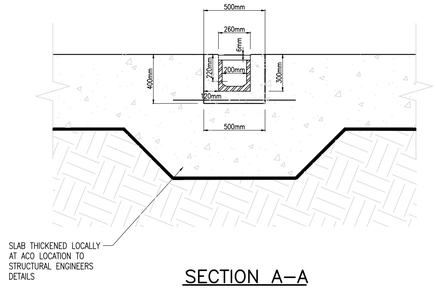
(A) BEDDING ACROSS OPEN SPACE (SIMILAR)

(B) BEDDING DETAILS IN ROADWAYS/VERGES/PATHS

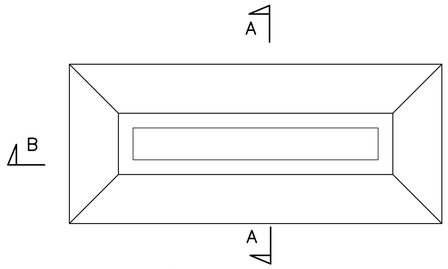


(C) BEDDING DETAIL WITH CONCRETE SURROUND

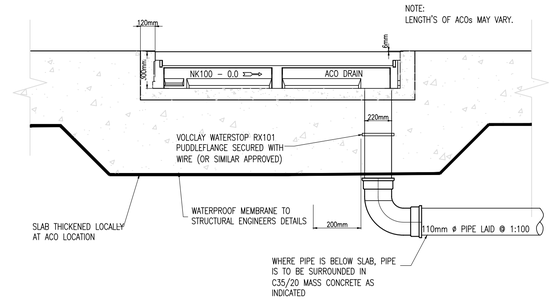
TYPICAL BEDDING DETAILS
SCALE 1:25



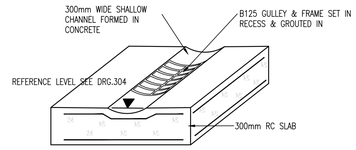
SECTION A–A
SCALE 1:25



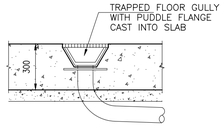
ACO DRAIN (NK100 0.0) IN 300mm SLAB
SCALE 1:25



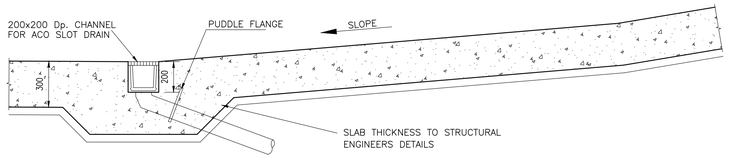
SECTION B–B
SCALE 1:10



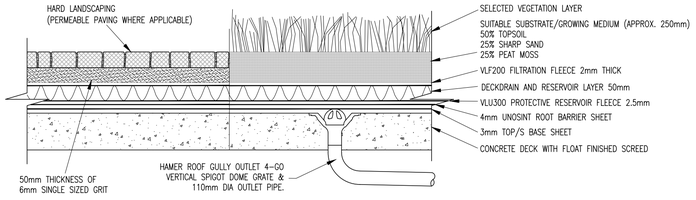
SLAB CHANNEL
NTS



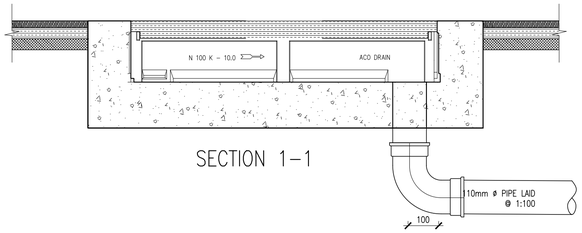
TYPICAL FLOOR GULLY DETAIL TO BASEMENT
SCALE 1:20



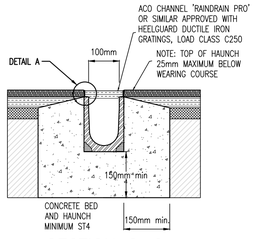
TYPICAL ACO DRAIN
SCALE 1:20



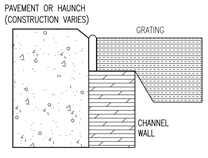
PODIUM DECK DETAIL
SCALE NTS



SECTION 1–1

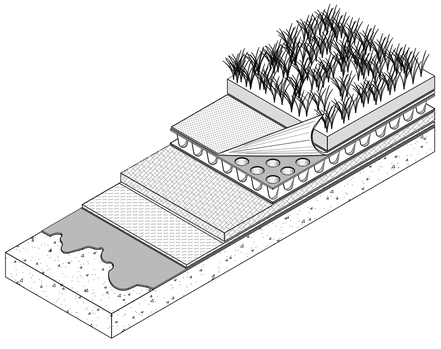


SECTION 2–2

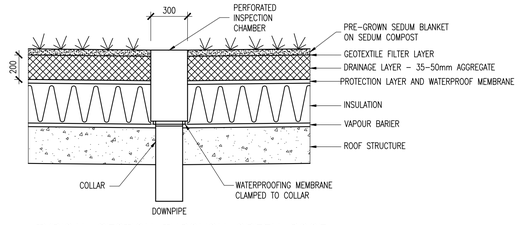


DETAIL A

ACO CHANNELS IN ASPHALT
SCALE 1:10



GREEN ROOF SCHEMATIC
SCALE NTS



TYPICAL SECTION THROUGH GREEN ROOF
SCALE 1:25

ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

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NOTES:

1. ALL WORKS TO COMPLY WITH THE CURRENT BUILDING REGULATIONS, WATER BYELAWS AND LOCAL AUTHORITY REQUIREMENTS.
2. SLUNG SURFACE WATER PIPEWORK SHALL BE uPVC.
3. SLUNG NETWORKS TO BE COORDINATED WITH M&E SERVICES AND ARCHITECTURAL SERVICES/DROPS.
4. MIN. FALLS IN SLUNG DRAINAGE TO COMPLY WITH BUILDING REGS

rev	date	description	by	chkd.
P01	19-08-21	ISSUED FOR PLANNING	BS	PCC

client approval: A - Approved; B - Approved with comments; C - Do not use

suitability: S2 - INFORMATION

issue purpose: PLANNING

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project ref.: TEDCASTLES SITE, DUN LAOGHAIRE

drawing title: DRAINAGE DETAILS SHEET 3

client: TED LIVING

designed by	author	scale	sheet size
PCC	BS	AS SHOWN	A1

drawing no.: TED-DBFL-CS-SP-DR-C-5203

revision: P01

Proposed Catchment Characteristics		
Description	Area (m²)	Reduction Factor
Roof - Hardstanding (draining to gullies)	105	5%
Roof - Green	1209	5%
Terraces - Hardstanding (draining to gullies)	90	5%
Terraces - Free draining aggregate build-up	720	15%
Podium - Draining through SuDS features	484	20%

Green Roof Coverage		
Description	Area (m²)	Coverage
Hardstanding Roof Area	105	8%
Green Roof Area	1209	92%
Total Roof Area	1314	100%

ON ORIGINAL

0 5 10 15 20 30 40 50mm

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NOTES:

GENERAL NOTES:

1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE WORKS REQUIREMENTS.
2. ALL DIMENSIONS IN METRES UNLESS SPECIFIED OTHERWISE.
3. ALL CO-ORDINATES ARE TO IRISH TRANSVERSE MERCATOR.
4. ALL LEVELS ARE TO ORDNANCE DATUM (MALIN HEAD).
5. ALL TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT SHALL COMPLY FULLY WITH THE WORKS REQUIREMENTS
6. THE CONTRACTOR MUST LIAISE DIRECTLY WITH LOCAL AUTHORITY DEPARTMENTS AS DIRECTED IN THE WORKS REQUIREMENTS
7. ALL VEHICULAR & PEDESTRIAN, CYCLE & PRIVATE ACCESS ROUTES WITHIN AND SURROUNDING THE WORKS EXTENTS MUST BE MAINTAINED THROUGHOUT THE WORKS IN ACCORDANCE WITH THE CONTRACTORS APPROVED TEMPORARY TRAFFIC & OPERATIONS MANAGEMENT PLAN.

DRAWING SPECIFIC NOTES

1. ALL DRAWINGS TO BE CHECKED BY CONTRACTOR ON SITE AND ENGINEER INFORMED OF DISCREPANCIES BEFORE WORK COMMENCES.
2. CONTRACTOR SHALL SATISFY HIMSELF AS TO THE ACCURACY OF EXISTING DRAINAGE LEVELS & SERVICES ON SITE PRIOR TO COMMENCEMENT OF WORKS ON SITE
3. ALL WORKS TO BE CONSTRUCTED IN ACCORDANCE WITH THE NRA SPECIFICATION FOR ROAD WORKS UNLESS NOTED OTHERWISE
4. MANHOLE COVER LEVELS ARE TO CONFORM WITH FINISHED ROAD AND PATH LEVELS
5. ALL DRAINAGE TO BE AS PER THE LOCAL AUTHORITY CODE OF PRACTICE FOR DRAINAGE WORKS/LOCAL AUTHORITY & IRISH WATER REQUIREMENTS
6. ALL EXTERNAL COLLECTOR DRAINS TO BE MINIMUM 150 mm DIA.
7. ALL FOUL SEWERS TO BE uPVC TO EN1401
8. ALL SURFACE WATER SEWERS TO BE CLASS H CONCRETE TO EN1916 & IS 6 2004.
9. THIS DRAWING IS BASED ON TOPO SURVEY BY MURPHY SURVEY Ltd. DATED 13/04/2016
10. CONTRACTOR SHALL INSPECT THE ROUTE & CONFIRM LOCATIONS OF ALL TREES, FEATURES, ENTRANCES & ASPECTS IMPACTING CONSTRUCTION OF THE WORKS
11. GREEN ROOFS SHALL BE PROVIDED WITH A 1m WIDE GRAVEL FIRE BREAK EVERY 40m
12. GRAVEL STRIPS MUST BE PROVIDED AROUND ALL STRUCTURES PENETRATING THE ROOF.

LEGEND

- SITE BOUNDARY
- EXTENSIVE GREEN ROOF
- LANDSCAPING AS PER LANDSCAPE ARCHITECT'S DETAILS
- IMPERMEABLE PAVED AREAS
- PERMEABLE PAVED AREAS
- DIRECTION OF FALL

rev	date	description	by	chkd.
P01	19-08-21	ISSUED FOR PLANNING	BS	PCC

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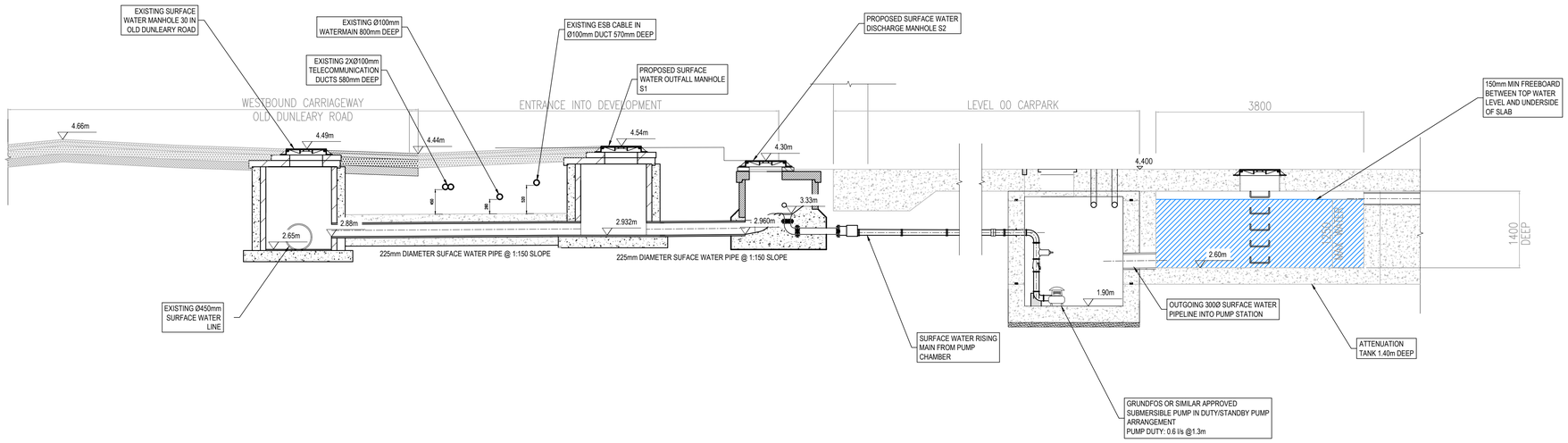
project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
SURFACE WATER STRATEGY

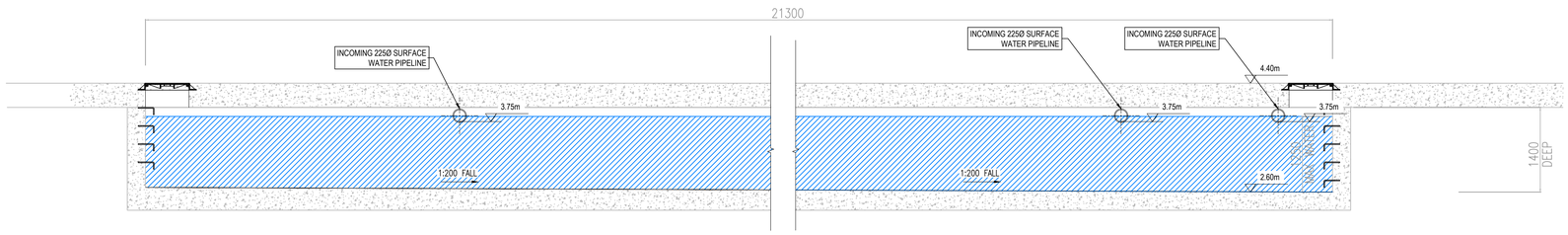
client
TED LIVING

designed by	author	scale	sheet size
PCC	BS	1:200	A1

drawing no.: TED-DBFL-SW-SP-DR-C-1301
revision: P01



LONGSECTION A THROUGH SURFACE WATER OUTFALL



SECTION B THROUGH ATTENUATION TANK

ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

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project ref.
TEDCASTLES SITE, DUN LAOGHAIRE

drawing title
SURFACE WATER OUTFALL & ATTENUATION SECTIONS

client
TED LIVING

designed by	author	scale	sheet size
PCC	BS	1:50	A1

drawing no.: TED-DBFL-SW-SP-DR-C-3311
revision: P01