For: Portal Asset Holdings Ltd. Port Road, Killarney

PROPOSED RESIDENTIAL DEVELOPMENT



Engineering Design Report

May **2024**



Consulting Engineers



Document Control Sheet

Client:	Portal Asset Holdings Ltd	
Project Title:	Proposed Residential Development at Port Road, Killarney, Co. Kerry	
Document Title:	Engineering Design Report	
Document No.:	18137HD-MHL-Doc04-EDR-Rev09_Engineering Design Report	
Job No.:	18137HD	

Rev.	Status	Author	Reviewed By	Approved By	Date
01	Internal Draft	D. Murphy	D. Murphy	B. Murphy	1 st - May - `19
02	External Draft	D. Murphy	D. Murphy	B. Murphy	3 rd - May - `19
03	Client Issue	D. Murphy	J Daly	B. Murphy	30 th - Oct - `20
04	Draft Issue	J. Daly	B. Murphy	B. Murphy	10 th - Nov - `21
05	Final Draft	J. Daly	B. Murphy	B. Murphy	17 th - Nov - `21
06	Final Issue	D. Murphy	B. Murphy	B. Murphy	24 th - Feb - `22
07	Final Issue	D. Murphy	B. Murphy	B. Murphy	28 th - Jun – `23
08	Final Issue	D. Murphy	B. Murphy	B. Murphy	15 th - April – `24
09	Final Issue	D. Murphy	B. Murphy	B. Murphy	08 th - May - `24

M.H.L. & Associates Ltd.

Consulting Engineers Unit 1b, The Atrium, Blackpool, Cork. Tel 021-4840214 Fax: 021-4840215 E-Mail: info@mhl.ie



CONTENTS

1 I	ntroduction	3
2 A	ccess Road and Entrance	5
2.1	Existing Access	5
2.2	Proposed Access	6
2.3	Shared Surface on Port Road	7
2.4	Existing Site Topography	8
3 I	nternal Road Design	10
3.1	Proposed Pedestrian Site Access	11
3.2	Fire Tender/ Refuse Truck Access	11
4 F	visting Services	12
5 0	ublic Lighting	12
51	Notos on Landscaping:	1/
5.I 6 E	Notes on Lanuscaphing.	14
		10
/ V	vater Design	18
8 5		20
8.1	Existing Surface water Drainage	20
8.2	Design Basis	20
8.3	Compliance with Surface Water Drainage Policy	21
8.4	Proposed Storm Network	23
8.5	SUDS Strategy for Development	25
8.6	Design Catchments	26
9 S	UDS	28
9.1	Proposals	28
9.2	Ground Investigation & Infiltration Tests	34
9.3	Interception Volume (Criterion 1)	35
9.4	Stream Protection (Criterion 2)	36
9.5	Level of Service Flooding (Criterion 3)	37
9.6	Storm Infiltration/ Storage (Criterion 4)	37
9.7	Surface Water Quality Impact	39
9.8	Climate Change	40
9.9	Pluvial Flooding Provision	40
9.1) Maintenance / Health & Safety (Drainage System)	40
0 1	1 Landscane / Biodiversity	/1
0 1	2 Surface Water Decign Information Summary	<u>⊣⊥</u> ∕/1
10		13
11	Cite Ecology	45
10		44 15
12	Annandia	45
13	A Cite Tenegraphical Current	40
14	A. Site Topographical Survey	47
15	B. Site Investigation Report	48
16	C. Irish Water / Statutory Bodies	49
17	D. Lighting Design Calculations	50
18	E. UKSUDS Site Evaluation Report	51
19	F. Greenfield Runoff Rate	52
20	G. Surface Water Infiltration/Storage	53
21	H. Mapping	54
22	I. Flood Risk Assessment	57
23	J. Product Specifications	58



Figures

Figure 1.1 Site Location	3
Figure 1.2 Site Layout	4
Figure 2.1 Site access	5
Figure 2.2 Existing Carriageway	5
Figure 2.3 Existing Carriageway X Section	6
Figure 2.4 Proposed visibility splay and entrance/ access road arrangement	6
Figure 2.5 Proposed Shared Surface along Port Road	7
Figure 2.6 Proposed Shared Surface Cross Section	8
Figure 2.7 Existing Topographical Layout	9
Figure 3.1 Proposed internal estate roads configuration.	10
Figure 3.2 Proposed internal estate spine road long section	10
Figure 3.3 Proposed pedestrian connection to Mill Wood Estate	11
Figure 4.1 Existing O/H ESB crossing through the site.	12
Figure 4.2 Proposed grounded measures for the onsite O/H ESB	12
Figure 5.1 Proposed Public Lighting Design	13
Figure 6.1 Proposed wastewater sewer layout for internal estate. (1 of 2)	15
Figure 6.2 Proposed wastewater sewer layout for internal estate. (2 of 2)	16
Figure 6.3 Proposed Storm sewer line	17
Figure 7.1 Existing public watermain connection location for the proposed estate	18
Figure 7.2 Proposed public watermain arrangement for the proposed estate	. 19
Figure 8.1 Proposed Treatment Train	20
Figure 8.2 Proposed Surface Water Network (1 or 2)	24
Figure 8.3 Proposed Surface Water Network (2 or 2)	24
Figure 8.4 Proposed Catchment Areas locations.	27
Figure 8.5 Proposed Catchment Areas	27
Figure 9.1 SuDs Water Train elements (1 or 2) (CIRIA)	29
Figure 9.2 SuDs Water Train elements (2 or 2) (CIRIA)	30
Figure 9.3 Green roof details (Zinco)	31
Figure 9.4 Infiltration /Storage details (Stormtech)	32
Figure 9.5 SuDs Water Train element locations.	33
Figure 9.6 Site Investigation locations.	34
Figure 9.7 Site Investigation findings	34
Figure 9.8 Interception storage (5mm)	35
Figure 9.9 Interception storage (15mm)	36
Figure 9.10 Proposed Infiltration/ storage (m3)	38
Figure 9.11 Proposed Surface Water Network outfall locations.	39
Figure 10.1 Proposed site's proximity to Folly Stream & River Deenagh	43
Figure 11.1 Site Ecology	44
Figure 21.1 Groundwater Resources (Aquifers) GSI	54
Figure 21.2 Groundwater Vulnerability GSI	54
Figure 21.3 Bedrock Geology GSI	55
Figure 21.4 Water Frame Work Directive (WFD SubCatchment- Deenagh)	55
Figure 21.5 Subsoils- EPA Maps	56





1 INTRODUCTION

M.H.L. & Associates Ltd. Consulting Engineers have been engaged by Portal Asset Holdings Ltd. to produce an Engineering Design Report to supplement a new planning application for a residential development at Coollegrean, Port Road, Killarney, Co. Kerry.



Figure 1.1 Site Location

Portal Asset Holdings Ltd. intend to apply for planning permission for a Large-Scale Residential Development (LRD) at Port Road and St Margaret's Road, Coollegrean, Inch, Knockreer, Ardnamweely, Derreen (townlands), Killarney, Co. Kerry.

The proposed development will consist of 224 no. units comprising 76 no. two storey houses (8 no. 2 bed units, 38 no. 3 bed units and 30 no 4 bed units), 52 no. duplexes over 3 no. storeys (14 no. 1 bed units, 26 no. 2 bed units and 12 no. 3 bed units) and 96 no. apartments in 3 no. 4 no. storey buildings (16 no. 1 bed units and 80 no. 2 bed units), and a 2 no. storey creche (334 sq. m). Ancillary site works include public and communal open spaces, hard and soft landscaping, the relocation/undergrounding of ESB powerlines, wastewater infrastructure including foul pumping station, surface water attenuation, water utility services, public lighting, bin stores, bicycle stores, ESB substation, and all associated site development works.

Vehicular access to the development will be via a new entrance from Port Road. The proposed development includes upgrade works to Port Road, a pedestrian connection to Millwood Estate, and improvements to the stormwater network on St. Margaret's Road, as part of enabling infrastructure for the project.





Figure 1.2 Site Layout

See drawing Proposed Site Layout accompanying the application produced by Deady Gahan Architects Co Ltd for the layout of the development. This report addresses the following Engineering design elements of this application:

TRANSPORT:

Access Road and Entrance Shared Surface proposals for Port Road Internal Road Design (Access Road) Fire Tender/Rubbish Truck Access

SERVICES: Existing Services Public Lighting Design for the internal site and nearby Port Road Foul Effluent Sewer Design Foul Effluent Disposal (tie-in) Potable Water Supply Surface Water Sewer Design and Infiltration SUDs Measures Flooding



2 ACCESS ROAD AND ENTRANCE

2.1 Existing Access

A temporary vehicular access is to the northwest of the applicant's site, connecting onto the R877 Port Road as noted in the following figures.



Figure 2.1 Site access.



Figure 2.2 Existing Carriageway



The existing Port Road is a wide single carriageway (c. 8-9.5m in width) with footways of varied widths both sides of its section along its length.



Typical Existing Road Cross Section

Figure 2.3 Existing Carriageway X Section

2.2 Proposed Access

The proposed entrance is located within a 60kph speed zone. The requirement under Design Manual for Urban Roads (for this design speed (km/h)) is to provide a Sight Stopping Distance (SSD) standard of 59m of clear line of sight in both directions from the entrance. The setback from the road edge is taken at 2.4m (X distance) as per the standard.

Please refer to Visibility Splay drawing for the entrance assessment and the Traffic and Transportation Assessment (TTA) which are supplied as part of this planning application.



Figure 2.4 Proposed visibility splay and entrance/ access road arrangement.



2.3 Shared Surface on Port Road

The site's proximity to both existing schools and the Killarney National Park, noted in Figure 2.1 means that it is a prime location to provide sustainable transport facilities. As part of this scheme and following consultation with both KCC and TII, it is proposed to install a 3.0m wide shared surface along Port Road. This 3.0m shared surface will replace the existing 1.1m footpath on the eastern side of Port Road.



Figure 2.5 Proposed Shared Surface along Port Road

To the north of the development entrance, it is proposed that the shared surface will terminate at a new uncontrolled pedestrian crossing to the Fossa Cycleway. To the south



of the development entrance the shared surface will extend as far as the junction of Port Road and New Road. This facility will provide pedestrian and cyclist linkage between Killarney Town and the Fossa Cycleway/National Park, providing excellent connectivity to the wider cycle network throughout the town and environs.



Figure 2.6 Proposed Shared Surface Cross Section

Please refer to N72 Port Road Shared Surface Proposal for the site in Planning Drawing Pack accompanying this report.

2.4 Existing Site Topography

The existing site is a greenfield site, located directly east of the nearby local Port Road, as shown in the figure below. Please refer to the topographical survey noted in the Appendix, carried out by Precise Control Surveyors.

The site is predominately grading north to south, with falls from the northern boundary towards its south and eastern boundary towards the nearby Folly Stream.





Figure 2.7 Existing Topographical Layout

Existing topographic survey information is shown in the background of the Proposed Roads Layout Plan and the following figures. The topography informed the design approach for the Engineering services as presented in the following chapters.



3 INTERNAL ROAD DESIGN

The proposed internal road and carpark design had been developed to DMURS. The road and footpath vertical profiles have been optimised to match the natural topography of the existing site, where it was applicable to do so. The road levels and proposed finished floor levels FFL of the units have been designed in parallel to ensure that accessible connectivity and connectivity of services can be achieved. The internal design speed is 50kph with a minimum internal roadway width is 5.5m.



Figure 3.1 Proposed internal estate roads configuration.



Figure 3.2 Proposed internal estate spine road long section.

Please refer to internal road layout and associated long sections for the site in Planning Drawing Pack accompanying this report.

The 3d design of the internal roads and streets have been carefully arrived at through modelling using applicable Cad and 3D software. The design ensures proposed development levels will result in a reasonable balance of materials on site. This balance of cut/fill ensures a minimal importation and exportation of materials to/from the site



and thereby minimising the environmental impact of the advance earthworks and site preparation phase of construction.

3.1 Proposed Pedestrian Site Access

Apart from the main site access to the site providing pedestrian access to Port Road, it is the intent of the design in provide pedestrian connection to the north of the site, connecting onto Millwood Estate.



Figure 3.3 Proposed pedestrian connection to Mill Wood Estate.

A new pedestrian crossing is proposed to be installed at this location as noted above.

3.2 Fire Tender/ Refuse Truck Access

The proposed site's internal roads have been assessed for vehicular movements (ingress/egress) within the site using Auto Turn vehicle tracking software. The assessment considered two vehicle types: a 3-axle refuse truck and a fire tender. The assessment identifies swept paths for these vehicle types and identifies the functioning of the proposed alignments and turning hammerhead locations. Please refer to proposed autotracking layout for further details.

Please refer to the Road Safety Audit and Internal Road Safety Audit submitted as part of this application.



4 EXISTING SERVICES

The site is well serviced for in terms of service providers with main utility services located to the west of the site, along Port Road.

• IW Services

Both potable water and wastewater service are available, and capacity has been confirmed.

• Surface Water

Surface water is to be cater for by on-site infiltration, out falling to Folly Stream. • ESB

An existing 10Kv overhead ESB power line cross diagonally across the proposed development site as shown in Figure 4.1.



Figure 4.1 Existing O/H ESB crossing through the site.

These powerlines are to be rerouted and buried underground, diverted to match the proposed road alignments of the site.



Figure 4.2 Proposed grounded measures for the onsite O/H ESB



Please refer to Existing & Proposed Services- ESB for the site in Planning Drawing Pack accompanying this report.

5 PUBLIC LIGHTING

The proposed public lighting for the new development has been designed using Lighting Reality Public Lighting Reality. This lighting design software provides lighting compliant designs to EN13201:2015. The design is a residential estate comprising of housing units and apartments.

All internal estate roads have been designed to lighting Class P3.

Isolated footpaths and Plaza Areas have been designed to lighting Class P4.

All internal lighting is to Philips Luma luminaires on 6.0m columns. Isolated footpath columns are to be hinged type.

As part of this application, it is proposed to replace the existing public lighting heads along Port Road for the length of the proposed shared surface works along Port Road, please refer to the accompanying lighting design report for Port Road.



Figure 5.1 Proposed Public Lighting Design

Please refer to Proposed Services- Public Lighting layouts for the site in Planning Drawing Pack accompanying this report:

Lighting Specification:

• Lanterns should comply with IS EN 60598-2-3



- Columns are to have a double locked framed door and should be multisided galvanised to Kerry County Council specification.
- Columns shall be manufactured to BS 5649.
- Public lighting to be fed from new power supply connections.
- Minimum lux level on public roads, paths, and playgrounds within the housing estate to be 1.5 lux.
- The S/P ratio can be applied to the internal estate lux levels depending on lantern type.
- The proposed internal estate public lights are to be dimmable from 12.00 midnight to 06.00 as per dimming class 2A in housing estates.

5.1 Notes on Landscaping:

No trees to be located within 1.5 times the height of the lighting columns.

i.e. Not within 10m of all estate lighting including pathways and playground areas.

Notes on Ecology:

All ecological constraints as raised in the Ecology Report as produced by Malachy Walsh & Partners have been accounted for by optimising the revised design to cater for the protection of wildlife (EC Habitats Directive and the Wildlife Act), ensuring the impact of artificial light is minimised. Light spillage is to be kept to a minimum by:

- Lighting with suitably chosen lantern heads where optics selected stop indirect lighting.
- Inclusion of lighting hoods/shields to direct light only where it is needed.
- Luminaires design to be mounted on the horizontal with zero degrees vertical tilt, reducing spill light and preventing backlighting.
- All luminaires to lack UV elements.
- The proposed lighting design has been designed using warm white spectrum (3000k) lanterns to reduce the blue light component.
- Lanterns to be flat glass type to minimise the amount of upward light and spill light onto the surrounding area.
- The LEDs proposed have sharp cut offs, lower intensity, good colour rendition and dimming capability.
- An option for dimming and part-night lighting, controlled diurnally, seasonally, and according to human activity can be employed

Design Drawings:

Drawings have been compiled showing the lantern types, column locations and lux contours for 1.5, 3.0, 5.0, 10, 15 and 20, as appropriate. The drawings are scaled at 1:500 @ A1.



6 FOUL EFFLUENT SEWER DESIGN

The following is the proposed strategy for the disposal of foul effluent generated by the development. All foul from the proposed development will be collected by a 150 mmØ / 225mmØ foul sewer laid to falls not less than 1:150. The proposed foul sewer design is to be routed to the west of the site and discharge into an existing foul sewer manhole, as shown in Figures 6.1 and 6.2. Due to the topography of the site and the proposed estate levels, a portion of the wastewater network has been routed south to collect in a foul pumping station as shown. All wastewater collected at this location is to be pumped to the receiving header MH and outfall to Foul line 1, where it will gravity flow out to the tie-in main foul manhole on Port Road.

Each person is assumed to consume 150 litres of water per day.

Dry Weather Flow (DWF) = 600 l/dwelling/day

Design for 6 X DWF = 3,600 litres/dwelling/day (to account for surges in the consumption at peak times leading to surcharges in the pipe network.

For each pipe run the accumulative number of households contributing to that section of pipework is used to calculate the design flow.

230No. Residential Units and 1creche: Average DWF= 9.636l/sec Peak DWF=25.302/sec



Figure 6.1 Proposed wastewater sewer layout for internal estate. (1 of 2)





Figure 6.2 Proposed wastewater sewer layout for internal estate. (2 of 2)

150mm dia. & 225mm dia. Polyethylene (PE) pipe have adequate capacity for all the development.

The receiving foul tie IL is 29.110m O. D with the proposed foul line tie in level 29.110m O.D.

Please refer to the wastewater detail layouts and associated long sections for the site in Planning Drawing Pack accompanying this report.

The proposed foul sewer as shown in will connect into the existing foul sewer network at the proposed estate entrance location on Port Road. The existing wastewater sewer drains by gravity and flows to the Killarney WWTP.

The construction of the foul sewer pipe network shall be in accordance with Irish Water's Code of Practice for Wastewater Infrastructure and Section 3 of the Department of Environment and Local Government publication "Recommendations for Site Development Works for Housing Areas" and Irish Water's COP and Standard Details.

Irish Water has issued a Statement of Design Acceptance confirming acceptance of the proposed water and wastewater design networks for the site. Please refer to the Appendix. Included also is the original IW Confirmation of Feasibility.

Due to limited capacity in the existing foul/ combined network in the local area, a solution has been arrived at with Irish Water. To offset the limited capacity, it has been



agreed remove sections of surface water loading from the combined sewer along St. Margaret's Road., This section of road will be removed from the combined system and assigned to a separate existing storm sewer network. The outcome of these works will alleviate current loading in the existing foul network, thereby providing capacity for the site's generated foul flows.



Figure 6.3 Proposed Storm sewer line.

Following issuance of this proposal to Kerry County Council, the Killarney Municipal District Office advised that a Larger (Area Wide) storm network re-design was being developed for the St Margaret's Road area and costing of same are being prepared. This proposal has been agreed with Irish Water.



7 WATER DESIGN

An existing 150mm \emptyset uPVC watermain is located along the western boundary of the site along Port Road as shown in Figure 7.1. The entrance of the estate is to be the connection point between the new proposed watermain and the existing in situ watermain.



Figure 7.1 Existing public watermain connection location for the proposed estate.

A 150mm Ø Polyethylene (PE) watermain is proposed to supply water to all the fire hydrants in the development as shown in Figure 7.2. The proposed pipe network loops through the site. The domestic water will be taken off the 150mm mains for the development and supplied to each of the individual residential units as shown in proposed watermain drawings within the accompanying planning drawing pack. –

Hydrant locations will comply with Building Regulations 2006 Technical Guidance Document B- Fire Safety.

Post development peak hour water demand: 2.866 l/s. Post development average hour water demand: 1.36/s.







Figure 7.2 Proposed public watermain arrangement for the proposed estate.

The construction of the water supply pipe network shall be in accordance with Section 4 of the Department of Environment and Local Government publication "Recommendations for Site Development Works for Housing Areas" and Irish Water's COP and Standard Details.

Please refer to Proposed Watermain layouts showing the network layout for the site in Planning Drawing Pack accompanying this report.

Irish Water has issued a Statement of Design Acceptance confirming acceptance of the proposed water and wastewater design networks for the site. Please refer to the Appendix. Included also is the original IW Confirmation of Feasibility.



8 SURFACE WATER NETWORK

8.1 Existing Surface Water Drainage

Examination of the drainage infrastructure for the surrounding areas, indicated that existing developed sites adjacent to the subject's site as noted in Section 1 of this report, the existing site is greenfield and generally the existing topography falls in a southeastern direction towards the Folly Stream.

8.2 Design Basis

An overall surface water drainage strategy has been developed by MHL Consulting Engineers for the subject site. This strategy has been outlined in a number of drawings and reference should be made to Storm / Surface Water Layouts. This strategy has been discussed with Kerry County Council Water Services Department. The drawings make reference to the proposed outfall locations and outlines SUDS features including tree pits, bio retention, swales and other features discussed further in this section. The proposed surface water outfalls are expected to provide suitable surface water discharge point for the proposed development. The figure below outlines the proposed treatment train for this proposed development.



Figure 8.1 Proposed Treatment Train

Surface water discharged from the proposed surface water drainage network will be controlled by a vortex flow control device and associated underground infiltration tanks (Stormtech Chambers). Surface water discharge will also pass via combination of nature-



based infiltration infrastructure and a full retention fuel / oil separator (sized in accordance with permitted discharge from the site).

The surface water drainage network will collect surface water runoff from the site via a piped network prior to discharging off site via the site water storage features, flow control device and separator arrangement as noted above. Prior to reaching the piped network surface water shall be collated via a range of at source SUDS features including catchpits, tree pits, permeable paving and bioswales. These features shall primarily act as bio-retention and storage. Surface water runoff from the site's road network will be directed to the proposed pipe network via conventional road gullies where there are no adjacent open green areas. Green roofs shall be provided within Management controlled areas which shall be fitted with an overflow to main stormwater network. Surface water runoff from roofs will be routed to the proposed surface water pipe network via the porous aggregates beneath permeable paved driveways to the front and porous paving and raingardens to the rear of the housing units.

Where there are open green adjacent areas surface water shall overflow into open green areas via strategically placed dropped kerbs where there will be bio-swales installed to collect the surface water while surface water runoff from driveways will be captured by permeable paving. Both of these features will be fitted with an overflow to drain into the main pipe network.

Suds design focuses on

- Reduction of run-off rates.
- Provision of volume storage.
- Volume treatment provided.
- Reduction in volume run-off.
- Water quality improvement.
- Biodiversity.

8.3 Compliance with Surface Water Drainage Policy

The site's surface water management infrastructure has been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) policies and guidelines and the requirements of Kerry County Council. The GDSDS requires that the following design criteria be applied to all sites:

Criterion 1 (River Water Quality Protection):

Interception provided by way of:

- Permeable paving in public open spaces around the creche area.
- Permeable paving provided to create 'home-zones' and traffic calming elements in parts of the development.
- Surface water runoff to 'Stormtech' infiltration chambers in parts of the development. These will be equipped with silt chambers and hydrocarbon interceptors.
- Green Roofs for Apartment Blocks
- Water Butts and soak pits to rear gardens taken roof and patio drainage.



• Bioretention Systems along the road edge

Bioretention Systems are one of the most common Sustainable Drainage Systems (SUDS) in use today. Bioretention areas are shallow landscaped depressions with enhanced vegetation and filtration to remove pollution and reduce runoff downstream. These recessed landscape beds serve as natural areas for absorbing rain. The purpose of a Bioretention System is to slow the flow and filter pollutants from runoff before it reaches our groundwater or discharges into our waterways. Sometimes referred to as Bioswales, Vegetative Swales or Rain Gardens, these landscape features are specifically designed to enhance the appearance of an area while acting as an integral element of stormwater management. Bioretention systems are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. Runoff from the impervious surfaces is directed into the bioretention area, where it ponds and slowly infiltrates. Flows from large rainfall events, bypass the bio-retention area and are conveyed directly to the sewer system.

During storms periods, runoff puddles above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. All the remaining runoff filters through the mulch and prepared soil mix and will be collected in a perforated underdrain and returned to the storm drain system. This bioretention systems will allow for infiltration of stormwater into native soils below where applicable and will allow for groundwater recharge.

Criterion 2 (Stream Regime Protection):

Discharge rate restricted to QBAR for all storm events up to and including the 1 in 100year storm event.

Criterion 3 (Level of service (flooding) for the site):

A review of the Office of Public Works (OPW) Flood Hazard Mapping website indicates that there are no records of flooding incidents at the site of the proposed development. See the associated Flood Risk Assessment which forms part of this submission.

- No Site Flooding.
- No internal property flooding.
- All FFLs are a minimum of 500mm above adjacent on-site drainage /infiltration tanks.
- Flood routes have been mapped from each attenuated storage area showing overland routes away from dwellings.
- Run-off from green areas during high intensity storm events can be catered for in on-site infiltration/storage tanks.

Criterion 4 (River Flood Protection):

Maximum discharge rate of QBAR for all attenuated storage is proposed which is considerably less than the 30-year and 100-year greenfield run-off rates. No reduction in terms of run-off has been allowed for in the sizing of infiltration tanks as a result of proposed SuDs measures.



For the operational phase of the scheme the provision of SuDs interception measures will ensure that the first 5mm of rainfall is prevented from discharging from the site. It is often the case that the initial run-off from roads and hard pavement areas has a concentration of pollutants. This first-flush is being addressed on site thus ensuring the quality of the receiving waters is not impacted.

The storm water management proposals for the site have been informed by the relevant standards and comply with best practice in terms of SuDs (Sustainable Urban Drainage Design). In advance of submitting to the Board, agreement has been reached with Kerry County Council in terms of discharge location, discharge rate and SuDs measures proposed. By providing the measures as outlined, the impact of the proposed development on the hydrological area has been minimised and results in a reduction in the existing greenfield runoff rate for the site.

8.4 Proposed Storm Network

The surface water network is designed and arranged in accordance with the requirement of the GDSDS and the GDRC in conjunction with the "Recommendations for Site Development Works for Housing Areas" (DOEHLG), and also takes account of the recommendations contained within the Building Regulations Part H- Drainage and Wastewater Disposal.

The following assumptions have been made as part of the design criteria:

- No pipe surcharge for up to the 1 in 5-year rainfall evening including 10% for climate uplift.
- No folding above ground for up to the 1 in 100-year rainfall event including 10% for climate uplift.
- The proposed stormwater network has been designed using Causeway Flow drainage design software and the tanks have been designed with MicroDrainage. Please refer to the Appendix for design details.

The following criteria have been specified in the design:

- Pipe hydraulic roughness 0.6
- Pipe velocities range between 0.75m/s and 3m/s.
- Pipe minimum cover 1.2m inf trafficked areas including footpaths. Trafficked areas where cover is less that 1.2m shall include concrete surrounds.

All surface water generated on the site will be routed through a new site storm network as shown in Figure 8.2. This proposed network will infiltrate at the tank locations / bioswales shown and overflow if required to the Folly Stream, as indicated.

- The proposed storm network has been designed for a 1in30year storm event, the infiltration/storage tanks are designed for a 1 in 100year storm event, with a rainfall intensity of 50mm/hr.
- 225mm Ø to 375mm Ø pipes provide adequate capacity for the development for all the pipe runs.
- The minimum gradient in the development storm sewer network is 1/200.





Figure 8.2 Proposed Surface Water Network (1 or 2)



Figure 8.3 Proposed Surface Water Network (2 or 2)





Please refer to Proposed Storm Sewer Lines showing the network layout and long sections for the site in Planning Drawing Pack accompanying this report.

Design Standards

Proposed surface water drains have been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), the Department of the Environment's Recommendations for Site Development Works for Housing Areas, the Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Wastewater Disposal" and BS EN 752: 2008 Drain and Sewer Systems Outside Buildings.

As part of the design process the "Interim Code of Practice for Sustainable Drainage System" published in July 2004 by the National SUDS Working Group was consulted.

The construction of the storm sewer pipe network shall be in accordance with Section 3 of the Department of Environment and Local Government publication "Recommendations for Site Development Works for Housing Areas".

The storm water from the development has been broken into several hardstanding zones/ Development Catchments that are to be controlled to existing greenfield runoff rates. Each hardstanding area identified will be collected by the proposed storm sewer network. From its collection point it will be directed to pass through slit traps, Class 2 Bypass Interceptors before entering infiltration tanks (Stormtech tank or similar approved). Flow control manholes downstream of each tank will be installed and are designed to ensure that the proposed development's runoff rate matches the existing site's greenfield runoff rate I/s/ha, as shown in greenfield calculation in the Appendix.

The storm system proposed will incorporate:

- Bypass Oil Separator: Premier Tech Aqua CNSB 4.5S/21 or similar approved.
- Hydrobrake flow control to be installed to control outflow rate l/s or similar approved.
- Stormtech SC-740 storage tanks or similar approved

The proposed basement carpark areas located under the apartment blocks and central plaza, to the southeast of the site, will have a series of gullies and drainage channels cast into the floor slab which will cater for limited amounts of run off that enters the proposed car park through ramps, service ventilation opes, etc. The gravity pipe will connect into the nearby infiltration stormtech tank located directly east of the car park entrance.

8.5 SUDS Strategy for Development

This section demonstrates how the proposed development has been designed using best practice in relation to flood risk and stormwater management including compliance with the following:

- Greater Dublin Regional Code of Practice for Drainage Works (GDRCoP)
- Greater Dublin Strategic Drainage Study (GDSDS)
- 'The SuDS Manual (CIRIA C753,2015)



- IS EN752, 'Drain and Sewer Systems Outside Buildings'
- The incorporation of SuDS features to reduce run-off.

The site-specific proposals for storm water management including SuDS strategy and implementation are dealt with below in this report. In addition to this, site specific information was attained through a site investigation undertaken by Priority Geotechnical Limited in July 2021.

Trial pits around the site indicated varying depth of topsoil of between 100mm and 350mm over a brown, sandy Gravel. The findings were used by MHL in determining the actual soil classification and confirming that it was as indicated within the flood studies report. Such clarification is important as it directly relates to the calculation of QBAR as regards the allowable discharge from the subject development.

Various interception measures such as **permeable paving**, **storm water storage butts** for each unit, roof drainage to **soakaways** in rear gardens in parts of the development and **green roofs** for apartment will ensure that the initial 5mm of rainfall is prevented from discharging from the site. This will ensure that the water quality of the receiving watercourse is preserved, one of the primary objectives of SuDs.

The SuDS strategy for the site includes the following:

- Discharge Rate to be limited to QBAR for all rainfall events up to and including the 100-year storm event.
- Infiltration storage to be provided up to the 100-year storm event allowing for 10% climate change.
- Hydrocarbon interceptor and silt chambers to be used upstream of each tank.
- Provision of infiltration soak pits in rear gardens of all residential units.
- Provision of permeable paving in public areas, driveways.
- Provision of Bioretention Systems along the edge of roadways where applicable.
- Provision of tree-pits at suitable locations along roads and within the park Area.
- Green roofs for apartment blocks.

8.6 Design Catchments

Due to the topography of the site, the drainage design has been broken into three catchment areas, as noted in below.





Figure 8.4 Proposed Catchment Areas locations.

Design Catchment	Area m2	Area Ha	Qbar l/s
1	5700	0.57	2.44
2	32000	3.2	13.67
3	15200	1.5	6.41
For the full site		c.5.29	26.59

Figure 8.5 Proposed Catchment Areas

Design Catchment 1

This is the smallest of the site's proposed design catchments, comprising of a portion of the access road, creche and surrounding units. It is proposed to utilise NBS and SUDS as noted in Figure 9.5. These include permeable paving, bioswale and infiltration/soakaway storage.

Design Catchment 2

As the largest of the site's proposed design catchments, comprising of the majority of the site developable area, it is proposed to utilise NBS and SUDS as noted. These include permeable paving, bioswale and 2no. infiltration/soakaway storage.

Design Catchment 3

The lower catchment area is proposed to cater of the all the designated apartment structures of the development. This development area lends itself to green roof infrastructure application. SUDs measures are to include permeable paving, bioswale, green roofs on all 3no apartments blocks and 1no. infiltration/soakaway storage.



9 SUDS

9.1 Proposals

In accordance with the GDSDS it is proposed to use Sustainable Urban Drainage Systems (SUDS) and Nature Based Systems (NBS) for managing stormwater for the proposed development.

The SuDS measure employed are to develop surface water control measures to mitigate the impact of the proposed development, by means of storage, infiltration, conveyance, and source control.

The aim of the SUDS and NBS strategy for the site will be to:

- Replicate the natural characteristics of rainfall runoff for the site
- Recharge the groundwater profile
- Biodiversity and ecology benefits
- Attenuate Stormwater run-off at source and site control areas
- Reduce stormwater run-off
- Reduce pollution impact and improve water quality

The following SUDS methodologies are to form part of the SuDS treatment train approach:

- Permeable paving in driveway / in curtilage areas (areas not to be taken in charge).
- Infiltration trenches to also act as storage in high rainfall events provided along parking bays and local streets.

• Catchpits within tree pits to overflow into the main convenance storm network in high rainfall periods.

• Road bioswales with dropped kerbs along edge of roadways

The management train provides potential for 'interception losses' along its whole length, as well as through soakage into the ground, evaporation, and transpiration through the leaves of vegetation. It also reduces the rate at which runoff flows through the site and provides treatment of runoff as it passes through each SuDS component.





Figure 9.1 SuDs Water Train elements (1 or 2) (CIRIA)

The proposed use of green roof construction for the roof areas of the apartment's blocks will hold on to rainwater in the short term and when the water begins to be slowly released, a large proportion will be retained with the plants and soil layers. The additional surface water run off for these roof areas will discharge initially into rain gardens/ overflows to infiltration trench.

Conveyance swales will be used, where practical, to collect and convey the runoff from the rainwater outlets. The parking spaces of the proposed development is to be constructed using permeable paving. Kilsaran Climapave or similar approved. The permeable pavements will allow the rainwater to infiltrate through the surface into the underlying ground by infiltration or evaporation to the environment.



BIORETENTION SYSTEMS and RAIN GARDENS

allows rainwater to infiltrate down through vegetation and subsoil which cleanses and slows the water run off. They are also attractive spaces and can have flora and fauna benefits

TREE PITS capture

rainwater and lower street and building temperatures by providing shade. They also add value to bio diversity and public amenity in development areas.









SOAKAWAYS and INFILTRATION SYSTEMS encourage infiltration as

an effective means of managing water runoff and aiding groundwater recharge. Infiltration can be implemented via overground shallow basins or underground infiltration systems.

PERVIOUS PAVEMENTS

such as pourous asphalt, grasscrete and permeable pavers provide a hard surface that can be used for pedestrians or vehicles. Pervious Pavements allow rainwater to infiltrate through the soil or can be used as storage systems.



Figure 9.2 SuDs Water Train elements (2 or 2) (CIRIA)

Run-off from the proposed development will be controlled using vortex type flow control devices (Hydrobrake or equivalent). Due to the topography and site layout, it is proposed that the site be divided into 3no. catchments each containing an infiltration storage system. Surface water run-off is designed to match greenfield runoff rates (Qbar). This is calculated as 25.13l/s using the Institute of Hydrology equation as



recommended in the Greater Dublin Strategic Drainage Study (GDSDS) based on an area of 5.00Ha. The overall catchment and a catchment plan strategy is shown in the drawing pack submitted. Soil Type 2 has been used to calculate Qbar and the infiltration storage.

Permeable Pavements

The treatment processes that occur within permeable pavements include:

I. Filtration of silt and the attached pollutants – the majority of silt is trapped within the top 30mm of the jointing material between the blocks.

II. Biodegradation of organic pollutants, such as petrol and diesel within the pavement construction

III. Adsorption of pollutants (pollutants attach or bind to surfaces within the construction) which depends on factors such as texture, aggregate structure, and moisture content.

IV. Settlement and retention of solids.

Green roofs

The use of green roofs on the apartment blocks comprises of areas of living vegetation, installed on the top of building, for a range of reasons including visual benefit, ecological value, enhanced building performance, and the reduction of surface water run-off. Green Roofs comprise a multi-layered system which covers the roof of a building with vegetation and landscaping over a drainage layer. This system is designed to intercept and retain precipitation which reduces the volume and rate of surface water runoff. They are particularly suited to flat/gently sloping roofs. The advantages of a green roof are:

- No additional land take.
- Ecological, aesthetic and amenity benefits
- Good removal of atmospherically deposited pollutants
- Provides further insulation to buildings.
- Runoff storage provided at source.

Urban, construction and ecological advantages:

New Habitat



Protects the roof

membrane from

UV exposure, heat

cold and hail and

mechanical damage

Extended Roof Life

 Encourages wildlife to remain within build-up areas.



Stormwater

 Reduces immediate water run-off. The sewer pipes can be reduced in capacity.

Reduction of Dust and Smog Levels



Enhances the microclimate by cooling, filtering out dust and smog particles.

Improve Building Operations



 Thermal protection in both summer and winter and reduction of heating and cooling costs.

Noise Reduction



 Improves sound insulation.

Figure 9.3 Green roof details (Zinco)

Infiltration systems

• Surface water runoff from roofs will be routed to the proposed surface water pipe network via the stone reservoir beneath permeable paved driveways

• Storage of the 100-year return period storms within Stormtech Tank Chambers.



• Installation of a vortex flow control device (Hydrobrake or equivalent), limiting surface water discharge from the site to 2.0 l/sec/ha.

• Surface water discharge will also pass via a Class 1 full retention fuel / oil separator (sized in accordance with permitted discharge from the site).



Figure 9.4 Infiltration /Storage details (Stormtech)





Figure 9.5 SuDs Water Train element locations.

33



9.2 Ground Investigation & Infiltration Tests

To establish suitable site specific Sustainable Urban Drainage Systems for the overall development, a geotechnical investigation was carried out by Priority Geotechnical Limited to undertake soil infiltration testing in 8no. separate locations throughout the site, as noted in the figure below.



Figure 9.6 Site Investigation locations.

The results of the tests are as indicated in below
--

Location	Depth Strike (m bgl)	Remarks
SA01	-	None encountered.
SA02	-	None encountered.
SA03	-	None encountered.
SA04	-	None encountered.
SA05	-	None encountered.
SA06	-	None encountered.
SA07	1.6	Slow flow rate.
SA08	0.5	Slow flow rate.
TP01	-	None encountered.
TP02	-	None encountered.

Location	Infiltration coefficient		
SA_TP01	7.42E-05 ms^-1		
SA01	1.41E-04 ms^-1		
SA02	1.02E-04 ms^-1		
SA03	2.08E-04 ms^-1		
SA04	1.88E-04 ms^-1		
SA05_1	9.37E-05 ms^-1		
SA05_2	7.29E-05 ms^-1		
SA06	2.14E-05 ms^-1		

Figure 9.7 Site Investigation findings.

The results of the infiltration testing confirm that infiltration of storm flows can be expected throughout the site and that source control/interception type SuDS measures are viable throughout the scheme such that initial runoff to the receiving watercourses


can be prevented, thus providing enhanced water quality protection for the receiving watercourses. For further details on the SI reporting, please refer to the Appendix.

9.3 Interception Volume (Criterion 1)

The GDSDS (Vol. 2, Table 6.3) requires interception storage to be incorporated into surface water drainage design in order to limit discharge of sediment and pollutants into the downstream surface water drainage network and receiving water courses. This interception storage is designed to capture surface water run-off from rainfall depths of 5mm (and up to 10mm if possible). The proposed development SuDS features will provide the necessary interception volume required (within stone reservoirs beneath permeable paved driveways and within the Stormtech Tank Chambers).

Interception storage is proposed by way of soakaways in rear gardens, green roofs, permeable paving fronting houses, tree pits along roadways, sump manholes and petrol interceptors.

Total site area =5.29ha Hardstanding area=8500m2 Permeable area paving=3970m2 Additional Permeable area in landscape areas

Proposed Suds plan areas:

- Bioswale BP1 (500m2)
 Bioswale BP 2 (860m2)
- Green roof Apartment J, K, L (2450m2)
- Permeable Paving Driveways
 (3970m2)
- Bioretention areas (located throughout site)

Interception storage for the first 5mm of rainfall over 80% of the impervious area.

	Roof	Hardstanding	Paved Area			Total
	(m3)	(m3)	(m3)			(m3)
Volume	32.5	34	15.88			82.38
required						
	Green roof	Bioswale	Permeable	Raingarden	Stormtech	
	Green roof (m3)	Bioswale (m3)	Permeable Paving	Raingarden (m3)	Stormtech tank	
	Green roof (m3)	Bioswale (m3)	Permeable Paving (m3)	Raingarden (m3)	Stormtech tank (m3)	
Volume	Green roof (m3) 13.45	Bioswale (m3) 8	Permeable Paving (m3) 486	Raingarden (m3) 6	Stormtech tank (m3) Not used in	514.57

Figure 9.8 Interception storage (5mm)

Interception Volume provided sufficient.



	Roof	Hardstanding	Paved Area			Total
	(m3)	(m3)	(m3)			(m3)
Volume required	97.5	102	47.64			247.14
	Green roof (m3)	Bioswale (m3)	Permeable Paving (m3)	Raingarden (m3)	Stormtech tank (m3)	
Volume provided	14.57	8	486	6	Not used in calc	514.57

Treatment storage for the first 15mm of rainfall over 80% of the impervious area.

Figure 9.9 Interception storage (15mm)

Interception Treatment Volume provided sufficient.

9.4 Stream Protection (Criterion 2)

Criterion 2 (Stream Regime Protection):

Design Catchment 1 (.57ha)

The allowable outflow for this catchment has been calculated for the 1 in 30-year return period and the 1 in 100-year return period using GDSDS and is 4.73 l/s and 5.59l/s. The Qbar calculation is based on a Soil factor of 0.3.

Design Catchment 2 (3.2ha)

The allowable outflow for this catchment has been calculated for the 1 in 30-year return period and the 1 in 100-year return period using GDSDS and is 26.54l/s and 31.36l/s. The Qbar calculation is based on a Soil factor of 0.3.

Design Catchment 3 (1.5ha)

The allowable outflow for this catchment has been calculated for the 1 in 30-year return period and the 1 in 100-year return period using GDSDS and is 12.44 l/s and 14.7l/s. The Qbar calculation is based on a Soil factor of 0.3.

A review of the Office of Public Works (OPW) Flood Hazard Mapping website indicates that there are no records of flooding incidents at the site of the proposed development. See the associated Flood Risk Assessment which forms part of this submission.

- No Site Flooding.
- No internal property flooding.
- All FFLs are a minimum of 500mm above adjacent on-site infiltration tanks.
- Flood routes have been mapped from each attenuated storage area showing overland routes away from dwellings.
- Run-off from green areas during high intensity storm events can be catered for in on-site infiltration tanks.

The use of infiltration/soakaways and flow control manholes will ensure the development flows will be prevented from exceeding the site's existing greenfield runoff rates.



The drainage system proposed the use of Hydro-Brake® flow controls or similar approved. These are self-activating devices, relying on upstream hydraulic head to generate an air-filled vortex within the centre of the casing. The flow control moves through three distinct phases of operation:

- Low Flow- Under low flow conditions the flow control behaves like an oversized orifice. The flow is gentle, with minimal turbulence inside the volute of the flow control or the outlet pipe. As the water level starts to increase above the soffit of the outlet, air becomes trapped in the volute. This exerts a back pressure against the water and begins to restrict the cross-sectional area available for water flow. As the water depth continues to increase, a vortex begins to form within the unit and the entrapped air forms the central core. At first there is not enough energy in the water flow to sustain a stable vortex, so the vortex will continually start to build and collapse. The head at the end of this phase is the point at which there is sufficient energy within the flow to sustain a stable vortex.
- High Flow- A stable vortex is maintained within the flow control. High peripheral velocities around an aerated core create a back pressure, which effectively chokes the flow through the outlet aperture. Following initiation of the vortex, the flow control restricts the flow in a similar fashion to an orifice, but with clear openings up to 600% larger, significantly reducing the risk of blockage.
- Drain Down- As the water level subsides, the energy within the flow reduces and the vortex collapses. Air is drawn into the volute and the flow control returns to operating in a similar manner to an oversized orifice. This drains the system quickly and more effectively, so that the flood storage reservoir is ready for the next event.

9.5 Level of Service Flooding (Criterion 3)

Please refer to Chapter 10 of this report and the Flood Reporting submitted.

9.6 Storm Infiltration/ Storage (Criterion 4)

The SUDs principle of attenuating storm water flows generated by the development has been employed in this design. SUDs or Sustainable Urban Drainage Systems recommends methods of controlling runoff from a development site. These methods are based on preventing heavy rainfall that falls on the development during a storm diurnal event from entering the receiving watercourse at a higher flow rate than the natural undeveloped greenfield runoff rate of the site. Without infiltration/storage, the outfall storm flows from the site would enter receiving watercourses at a faster rate, causing potential downstream engorgement, and associated riparian flooding.

The proposed storm water drainage system and associated infiltration/storage system has been designed in accordance with SUDs guidelines. The SUDs principle of attenuating the site's generated storm water flows has been employed in this design.

The site's impervious hardstanding areas to be control through SUDs measures are all the proposed roof tops, footpaths, and internal estate roads.

37



To determine the allowable volume of storm water discharge from the site, the following formula was employed:

$Q_{bar} = 0.00108 \times (Area)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$

Discussions with the Local Area Engineer dictated that the proposed development should incorporate a suitably sized filtration system to minimise the impact of the development.

Storage volumes have been calculated using MicroDrainage WinDes analysis software taking account of the depth and type of storage/infiltration system.

Catchment	SuDs element	Volume (m3)	Design Type	Infiltration Rate
1	Tank 1	44.7	Soakaway	0.50760m/hr
2	Tank 2	108.4	Infiltration Tank	0.36700m/hr
2	Tank 3	155	Infiltration Tank	0.74880m/hr
3	Tank 4	79.9	Infiltration Tank	0.07704m/hr
3	Green roof	14.57	Green Roof	
Total		402.57		

Figure 9.10 Proposed Infiltration/ storage (m3)

In total 402.57m3 of surface water storage is provided which includes a 10% factor for Climate Change. Detailed drainage drawings have also been provided and reference should be made to drawing planning drawings submitted.

- Tank 1 is proposed to be positioned near the entrance into the development (to the west) and infiltrating 100% into the ground.
- Tank 2 will be in the Green Area in the middle of the site.
- Tank 3 located to the south of the site will outfall to the folly stream.
- Tank 4 located to the east of the site will outfall to the folly stream.
- Allowable flow rate into the Folly stream (Tank 2, 3 & 4) will be a as per the Appendix.

Proposed Tank type

It is proposed to use turnkey tanking solution by Stormtech or similar approved. This will ensure ease of installation, performance, and maintenance objects of the drainage structure. Catch/ Slit trap pits are to be installed as part of the tank structure with appropriate isolator row for jetting.

Proposed Outfall locations

The infiltration storage tanks locations and outfalls have been designed as part of the overall SuDs strategy /drainage network to reflect the natural drainage characteristics of the site and the proposed road /FFL design levels. The 2no. outfall locations are located as noted in the figure below, out falling Catchments 2 and 3 into the Folly Stream. An emergency overflow is also proposed to cater for extreme events in Catchment 1.





Figure 9.11 Proposed Surface Water Network outfall locations.

Headwalls are proposed at the two locations that the surface water drainage system outfalls with Folly Stream, to prevent possible scouring/ sediment wash out. Please refer to the Drainage drawing layouts for details.

9.7 Surface Water Quality Impact

Run-off rates from the site are controlled by flow control devices. Surface water management proposals for the development also incorporate the following impact reduction measures:

• Surface water network designed in accordance with GDSDS requirement

• Incorporates SUDS features e.g., permeable paving in the higher risk parking areas at the front of houses (i.e. treatment / filtration provided within the stone reservoir beneath permeable paved driveways)

• Surface water storage (i.e., treatment / filtration provided within the granular surround of the Stormtech Chambers) in conjunction with a final Class 1 fuel / oil separator prior to discharge to the downstream surface water network.

- Swales provided adjacent to streets where possible.
- · Bio-retention areas are provided adjacent to streets
- Tree pits provided

• On-line storage / infiltration facilities with a petrol interceptor to discharge to a public surface water sewer. The calculations provided in the Appendix do not assume a benefit from the proposed swales, bio-retention areas, and tree pits in terms of reduction factors or infiltration to ensure a conservative design.



For a 1in100 year event, the required m3 volume for the site SuDs elements are split between the proposed nature-based systems and the proposed infiltration storage/ sewer network.

9.8 Climate Change

Rainfall values for the proposed development are sourced from Met Eireann to calculate the input hydrograph for the drainage design. The design rainfall intensities were increased by a factor of 10% to take account of climate change, as required by the Kerry County Council for surface water storage design. The Micro drainage and Flow simulation results are included within the Appendix.

9.9 Pluvial Flooding Provision

The proposed site levels, FFLs, road vertical alignments, surface water network and storage are designed to accommodate a 100-year storm event and includes for 10% climate change provision. Floor levels of houses are set above the 100-year flood levels by a minimum of 0.5m for protection. For storms more than 100 years, the development has been designed to provide overland flood routes along the various development roads towards the surface water drainage outfall and Folly Stream. Please refer to the site's Flood Risk Assessment for further details.

9.10 Maintenance / Health & Safety (Drainage System)

Integrating SuDS into the fabric of development using the available landscape spaces as well as the construction profile of buildings. This approach provides more interesting surroundings, cost benefits, and simplified future maintenance. The general approach to 'Principles of Prevention' for SuDS is that all parts of a SuDS design should be fully accessible to people, with each element of the design considered from the health and safety perspective.

Surface collection in channels, gutters, and permeable pavements, or as sheet flow onto grass surfaces, keeps runoff at or near the surface, enabling cost- effective construction and maximising the opportunities for nature-based SuDS. Checking inlets, outlets and control structures must be easily accessible and able to be maintained by landscape care personnel.

It is noted that some SuDS components may need some degree of rehabilitation / dedicated SuDS maintenance, for example, re-gritting of the joints in a permeable pavement.

Collection of runoffs at or near the surface also reduces maintenance costs and allows for simple removal of blockages.

Providing Source control SuDS structures also ensures that SuDS components are less susceptible to erosion further down the management train, as runoff is not conveyed at peak flow rates along the system.



Site Controls: these features will normally be preceded by source controls and meet remaining storage requirements. Where the is insufficient storage at source, additional open conveyance, and storage structures, such as basins and wetlands or ponds, will manage remaining runoff volumes on most sites.

All parts of the SuDS are to be easily reached and safe for recreation and maintenance, meeting KCC taking in charge requirements for accessible maintenance.

9.11 Landscape / Biodiversity

Landscape character – the nature of the development and how SuDS is integrated into site design.

Biodiversity – opportunities for wildlife, clean water, connectivity, and habitat design face Water Quality Impact.

Please refer to the landscape architects design pack for further details.

9.12 Surface Water Design Information Summary

MHL calculations for infiltration/storage in the four stormwater networks are cognisant of the proposed SuDS measures and existing ground infiltration characteristics.

It is noted that at present Kerry County Council do not have a SuDS strategy that is to be followed in the development and design of residential schemes, however the best practice guideline as details in the documents above have been implemented in the submitted design.

Included below are details of pre and post development flow characteristics, storm Infiltration capacities, pipe sizing and discharge rates. SuDS specific proposals and their implementation on site including maintenance considerations are discussed.

The SuDS strategy for the subject site is as summarised hereunder and reflected in MHL Drawings and further detailed in proposed Landscape Plan.

The proposed drainage system as described comprises SuDS devices, traditional road gullies, storage systems and underground pipes. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction, and operation. Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. Regular maintenance of the flow control device will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods. It is recommended that the petrol interceptors be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance are recommended for the petrol interceptors.

As outlined above, the discharge from the individual storage devices will be controlled to QBAR via a Hydrobrake flow control device and as noted on MHL drainage plan layouts. These measures will control the stormwater outflows. Exact details of the Hydrobrake



are normally developed at detailed design stage and submitted to the relevant Local Authority prior to construction.

The infiltration/storage as proposed will be via Stormtech tank units (or similar approved) as shown on MHL drainage plan layout. To ensure compliance with best practice, discharge from the site will be limited to QBAR which is typically the discharge rate adopted for the majority of site developments.



10 FLOODING

The site's proximity to existing watercourses has been examined in a Site-Specific Flood Risk Assessment (SSFRA) prepared by Donal Moynihan, B.E., C.Eng., M.I.E.I. The site's southern boundary lies adjacent to the Folly Stream, with the Deenagh River located to the west of the site in Figure 10.1 below.



Figure 10.1 Proposed site's proximity to Folly Stream & River Deenagh

The SSFRA has be submitted as part of this planning application and states that the nature, area, and extent of the development has minimal impact, with low flood risk impact in this area. The flood risk impact can be minimised by flood mitigation measures such as:

- Raising the site to provide finished floor levels at a higher elevation relative to the river level (existing/ 1%AEP floodwater level).
- Risk can be minimised by ensuring that during construction and operation of the development, the existing watercourses are maintained.
- Proposed surface water management in the form of site infiltration/storage, (inclusive of tank spill areas) as discussed previously in this report.

Please refer to the submitted Site Specific Flood Risk Assessment (SSFRA) for further details.



11 SITE ECOLOGY

The design team has been very conscious of the on-site ecology through concept and preliminary planning. MHL has designed the proposed services for the site in such a way as noted, to reduce the ecological impact of the development as far as possible. The existing Folly Stream and nearby ecological habitat to the west of the proposed apartment blocks is to remain as insitu.



Figure 11.1 Site Ecology

Please refer to the Ecological Impact Assessment, Natura Impact Statement Report and the Appropriate Assessment Screening Report carried out as part of this submission.



12 REFERENCE

BS5489-1: Code of practice for the Design Of Road Lighting- Part 1: Lighting roads and public amenity areas

EN13201:2015 Road Lighting

Lighting Reality software

Irish Water- Water Infrastructure Standard Details

Irish Water- Water Code of Practice for Water Infrastructure

Irish Water-Wastewater Infrastructure Standard Details

Irish Water- Wastewater Code of Practice for Water Infrastructure

Interim Code of Practice for Sustainable Drainage System" published in July 2004 by the National SUDS Working Group

Google Aerial Photography

Recommendations for site development works for housing areas. Dept. of Environment

DMURS: Design Manual for Urban Roads and Streets

Kerry County Council Development Plan 2022-2028

National Guidance Document on the Provision of Water for Fire Fighting (Jan 2007, 3rd Ed, section 5.2)

Interim Code of Practice for Sustainable Drainage System" published in July 2004 by the National SUDS Working Group

Code of Practice for Avoiding Danger from Overhead Electricity Lines, May 2019, ESB Networks.

Avoidance of Electrical Hazards When Working Near Overhead Electric Lines, ESB Networks



13 APPENDIX

(Page left intentionally blank)



14 A. SITE TOPOGRAPHICAL SURVEY

(Page left intentionally blank)



	Survey Notes:
	GRID: THIS SURVEY IS RELATED TO ORDNANCE SURVEY GRID. IRISH TRANSVERSE MERCATOR (OSGM15).
	DATUM: LEVELS ARE RELATED TO ORDNANCE SURVEY DATUM. (MALIN HEAD, OSGM15 ADJUSTMENT).
	SURVEY ABBREVIATION LIST. AV: WATER MAIN AIR VALVE BH: BONCH BS: BOLARD BS: BUS STOP CL: COVER LEVEL CV: CENTRE LINE DP: DOWN PIPE EC: ESB INSPECTION COVER EM: ESB MARKER EP: ESB POLE EN: ESB INSPECTION COVER EM: ESB ELECTRICITY SUPPLY BOARD FF: FINISHED FLOOR LEVEL FH: FIRE HYDRANT RISER FP: FLAG POLE GM: GAS MARKER GMY: GUY WIRE TO POLE GM: GAS MARKER GMY: GUY WIRE TO POLE GM: GAS MARKER GMY: GUY WIRE TO POLE GM: GAS MARKER MUY: GUY WIRE TO POLE GM: GAS MARKER GMY: GUY WIRE TO POLE CL: INSPECTION COVER LF: INUSPECTION COVER LF: INUSPECTION COVER LF: SIGM STANDARD LT: LIGHT STANDARD LT: LIGHT STANDARD LT: LIGHT STANDARD LT: LIGHT STANDARD CM: OVERHEAD OSBM: O.S. BENCH MARK PB: POST BOX RG: ROAD GULLY SAP: TREE SAPLING SC: WATER MAIN STOP COCK SH: SHORE SN: SIGN STN: SURVEY STATION SY: WATER MAIN SLUICE VALVE TBM: TEMPORARY BENCH MARK TF: LEVEL AT DOOR THRESHOLD TC: TELECOM INSPECTION COVER TK: TELEPHONE KIOSK TL: TRAFFIC LIGHT TM: TELECOM MARKER TOF: TOP OF TREE LEVEL TOW: TOP OF VALL EVEL TY: TELECOM PLLAR TRIC: TRAFFIC INSPECTION COVER TK: TELECOM MARKER TOF: TOP OF TREE LEVEL TOW: TOP OF TREE LEVEL TOW: TOP OF VALL LEVEL TP: TELECOM PLLAR TRIC: TRAFFIC INSPECTION COVER W: WATER MAIN SLUICE VALVE TP: TELECOM PLLAR TRIC: TRAFFIC INSPECTION COVER W: WATER MAIN SLUICE VALVE TP: TELECOM PLLAR TRIC: TRAFFIC INSPECTION COVER W: WATER MAIN METER W: WATER MAIN VALVE SVENY FFORT HAS BEEN MADE TO OBTAIN ALL DETAIL. HOWEVER SOME DETAIL MAY HAVE BEEN HDDEN AT THE IME OF THE SURVEY DUE TO PARKED CARS OR OTHER OBSTRUCTIONS.
CT CF HERCE	
SL OF TRETTLE SL OF K K K SL OF K K K K K K K K K K K K K K K K K K K	
St. OF HEREE 34.69 ****** ***** *****	Rev. Drn. Date. Description.
The free free free free free free free fr	Rev. Drn. Date. Description. Rev. Drn. Date. Description. Description. Description. Unit 11, Eastgate Way, Eastgate, Little Island, T45 TD77, Co. Cork. Unit 11, Eastgate Way, Eastgate, Little Island, T45 TD77, Co. Cork. t. 021 4351050 - e: info@precisecontrol.com - w: www.precisecontrol.com
TO THEME ALL ALL ALL ALL ALL ALL ALL AL	Rev Drn. Date. Description. Rev Drn. Date. Description. Description. Description. Description. Job Title: Port Road, Killarney, Co. Kerry. Description. Survey: Description. Description.
	Rev. Drn. Date. Description. Rev. Drn. Date. Description. Description. Rev. Drn. Date. Description. Description. <
	Rev. Drn. Date. Description. Rev. Drn. Date. Description. Rev. Drn. Date. Description. Rev. Drn. Date. Description. Rev. Drn. Date. Description. Rev. Drawn Date. Description. Description. Rev. Drawn Dy Material Action Actio



15 B. SITE INVESTIGATION REPORT

(Page left intentionally blank)





Our Ref: JMS/Rp/P21154 24th February, 2022. **M.H.L & Associates Ltd.** 10 High Street, Douglas Road,

Cork.

Re: Residential Development Port Road Killarney, Geotechnical report

In June, 2021 Priority were requested by M.H.L & Associates Ltd., acting on behalf of their Client, Portal Asset Holdings Ltd. to undertake a ground investigation as part of Residential Development at Port Road, Killarney, Co. Kerry. The purpose of the investigation is to assist in determining the ground conditions for proposed development.

The scope of works as determined by M.H.L & Associates Ltd. Comprised of;

- Excavations;
- Infiltration tests;
- All associated sampling;
- Associated reporting.

Fieldworks

The intrusive works were carried out on the 05th and 06th July 2021 under the supervision of PGL, Engineering Geologist(s); in accordance with the contract specification: The site investigation was carried out in accordance with the specification for ground investigation, ground investigation and testing (BS EN 1997-2: 2007) and the relevant British Standards (BS 5930 (2015) Code of Practice for Site Investigation and BS 1377, Method of Tests for Soil for Civil Engineering Purposes, *in situ* Tests Parts 1 to 9). Details of the plant and equipment used are detailed on the relevant exploratory records.

Excavations

Eight (08) pits were excavated to depths 1.0m below existing ground level (bgl) to 3.3m bgl for the purpose of infiltration testing. Two (02) trial pits were excavated to depths of 3.0m bgl using a 13t tracked excavator. The exploratory records accompany this report.

Location	Depth, m bgl	Groundwater strike m bgl	Stability remarks
TP01	3.0	-	Moderate
TP02	3.0	-	Moderate

Location	Depth, m bgl	Groundwater strike m bgl	Stability remarks
SA01	3.1	-	Very poor
SA02	3.3	-	Very poor
SA03	3.5	-	Very poor
SA04	3.8	-	Very poor
SA05	2.1	-	Moderate
SA06	2.0	-	Good
SA07	2.0	1.6	Moderate
SA08	1.0	0.5	Moderate

In situ testing

Eight (08) infiltration/ soakaway tests were undertaken at excavation pit locations and completed in general accordance with BRE Digest 365, Soakaway Design (2003/2007). Water level was monitored over a period of 20 to 366 minutes of observation. No tests were carried out at SA07 & SA08 due to high volume of groundwater encountered. The findings are attached herein.

Location	Infiltration coefficient
SA_TP01	7.42E-05 ms^-1
SA01	1.41E-04 ms^-1
SA02	1.02E-04 ms^-1
SA03	2.08E-04 ms^-1
SA04	1.88E-04 ms^-1
SA05_1	9.37E-05 ms^-1
SA05_2	7.29E-05 ms^-1
SA06	2.14E-05 ms^-1

Sampling

A total of twenty two (22) bulk disturbed samples (B) and four (04) small disturbed samples (D) were recovered from the exploratory holes in accordance with Geotechnical Investigation and Sampling – Sampling Methods and Groundwater Measurements (EN ISO 22475-1:2006).

Please note that all samples shall be retained for a period no longer than 28 days from the date of this report. Thereafter all remaining samples shall be appropriately disposed of unless a written instruction to the contrary is received by PGL prior to the date of this reporting and within the 28 day period outlined above.

Location plan

The 'as built' exploration locations were surveyed to the Ordinance Survey Irish Transverse Mercator system of co-ordinates (ITM) and elevations to Malin Head datum and shown on the relevant exploratory logs and the Exploratory Location Plan (P21154-SI-A, P21154-SI-01) accompanying this report.

Location	Easting	Northing	Ground Level (mOD)	Final Depth (m bgl)	Date Start (dd/mm/yyyy)
SA01	495811.08	591485.74	36.27	3.10	05/07/2021
SA02	495833.79	591482.51	36.60	3.30	05/07/2021
SA03	495866.68	591439.67	36.66	3.50	05/07/2021
SA04	495871.71	591423.14	36.09	3.80	05/07/2021
SA05	495796.04	591366.91	31.21	2.10	05/07/2021
SA06	495821.57	591349.60	31.91	2.00	05/07/2021
SA07	496042.92	591226.80	28.74	2.00	05/07/2021
SA08	496045.47	591211.52	27.43	1.00	05/07/2021
TP01	496012.12	591307.95	34.05	3.00	06/07/2021
TP02	496035.71	591278.22	33.03	3.00	06/07/2021

Ground and groundwater conditions

The full details of the ground conditions encountered are provided for on the exploratory records accompanying this report. The records provide descriptions, in accordance with BS 5930 (2015) and Eurocode 7, Geotechnical Investigation and Testing, Identification and classification of soils, Part 1, Identification and description (EN ISO 14688-1: 2002),– Identification and Classification of Soil, Part 2: Classification Principles (EN ISO 14688-2:2004) and Identification and Classification of Rock, Part 1: Identification & Description (EN ISO 14689-1:2004) of the materials encountered, *in situ* testing and details of the samples taken, together with any observations made during the site investigation.

Groundwater levels may be subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions etc. Low volume groundwater flow may be cutoff in stiff glacial deposits. The duration trial pit excavations remain open may not be sufficient to allow for low volume flow to present. The groundwater regime should be assessed from standpipe well installations, where available. The groundwater encountered was summarized as follows:

Location	Depth Strike (m bgl)	Remarks
SA01	-	None encountered.
SA02	-	None encountered.
SA03	-	None encountered.
SA04	-	None encountered.
SA05	-	None encountered.
SA06	-	None encountered.
SA07	1.6	Slow flow rate.
SA08	0.5	Slow flow rate.
TP01	-	None encountered.
TP02	-	None encountered.

Published Geology

A review of the Geological Survey of Ireland Mapping tool (sheet 21) showed the area to be underlain by two (02) geological formations. The northern section of the site is characterised by the Dirtoge Limestone Formation (DI) described as bioclastic cherty grey Limestone. The Cloonagh Limestone Formation (CL) is mapped to the south and made up of bedded bioclastic Limestone. Teagasc mapping of quaternary soils showed the area to be underlain by Made Ground deposits and Gravels derived from Devonian Sandstones. The national groundwater vulnerability mapping indicated a high vulnerability across the site.

The exploratory locations were backfilled with their arisings.



Should you have any queries in relation to the data collected and presented herein, please do not hesitate to contact our office.

Yours sincerely, For **Priority Geotechnical**,

Yours sincerely, For **Priority Geotechnical,**

James McSweeney BSc Engineering Geologist

No responsibility can be held by PGL for ground conditions between exploratory locations. The exploratory logs provide for ground profiles and configuration of strata relevant to the investigation depths achieved during the fieldworks. Caution shall be taken when extrapolating between such exploratory locations. No liability is accepted for ground conditions extraneous to the exploratory locations.

No account has been taken of potential subsidence or ground movement due to mineral extraction, mining works or karstification below or in proximity to the site, unless specifically addressed.

This report has been prepared for the Employer and their Representative as outline, herein. The information should not be used without their prior written permission. PGL accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.





KEY TO SYMBOLS ON EXPLORATORY HOLE RECORDS

All linear dimensions are in metres or millimetres

DESCRIPTIONS

**	Drillers Description
Friable	Easily crumbled
SAMPLES	
U()	Undisturbed 102mm diameter sample, () denotes number of blows to drive sampler
U()F, U()P	F- not recovered, P-partially recovered
U38	Undisturbed 38mm diameter sample
P(F), (P)	Piston sample - disturbed
В	Bulk sample - disturbed
D	Jar Sample - disturbed
W	Water Sample
CBR	California Bearing Ratio mould sample
ES	Chemical Sample for Contamination Analysis
SPTLS	Standard Penetration Test S lump sample from split sampler
CORE RECOVERY AND	ROCK QUALITY
TCR	Total Core Recovery (% of Core Run)
SCR	Solid Core Recovery (length of core having at least one full diameter as % of core run)
RQD	Rock Quality Designation (length of solid core greater than 100mm as % of core run)
Where there is insuffi	cient space for the TCR, SCR and RQD, the results may be found in the remarks column
lf	Fracture Spacing in mm (Minimum/Average/Maximum) NI - non intact, NR - no recovery
AZCL	Assumed Zone of Core Loss
NI	Non intact
GROUNDWATER	
\bigtriangledown	Groundwater strike
V	Groundwater level after standing period
Date/Water	Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date
INSITU TESTING	
S	Standard Penetration Test - split barrel sampler
С	Standard Penetration Test - solid 60° cone
SW	Self Weight Penetration
lvp, HVp (R)	In Situ Vane Test, Hand Vane Test (R) demonstrates remoulded strength
K(F), (C), (R), (P)	Permeability Test
НР	Hand Penetrometer Test
MEASURED PROPERT	IES
Ν	Standard Penetration Test - blows required to drive 300mm after seating drive
x/y	Denotes x blows for y mm within the Standard Penetration Test
x*/y	Denotes x blows for y mm within the seating drive

c_u Undrained Shear Strength (kN/m²)

CBR California Bearing Ratio

ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)			
	Borehole	Core		
Ν	75	54		
н	99	76		
Р	120	92		
S	146	113		



Key Sheet

nal					Priority (Geotechr	iical Ltd.	Trial Pit No	
Pgip	riority Potechnical			,	Fax:	021 4638	3690 chnical ie	SA01	
Design				Proje		1.9900.0	Co-orde://05811F - 501486N	Sheet 1 of 1	
Name:	Port Road R	tesidential I	Development	P211	54		Level: 36.27m OD	05/07/2021	
Locatior	1: Killarney, C	Co. Kerry		<u> </u>			Dimensions (m):	Scale	
Client	Dortol Asso	- at ∐olding					Depth:	1:25 Logged	
. «õ≘	Pullai Asso		5 Llu		1	J	3.10m BGL EK		
Wateı štrike Backfi	Depth (m)	Type	Results	Depth (m)	Level (m OD)	Legend	Stratum Description		
	• • •						(TOPSOIL) Soft to firm, organic, slightly sandy	gravelly	
	0.30 - 0.90 0.30 - 0.90	B D		0.30	35.97	× × × ×	Soft to firm, light brown, slightly sandy gravelly	SILT.	
						(* * * * * * * * *	rounded to rounded.	Sub-	
						× × × × × × × ×			
	1.00 - 2.00	в		0.90	35.37	× × × ×	Loose, very gravelly SAND. Sand is fine to coa	rse. ad High 1 -	
	1.00 2.01						cobble content, sub-rounded, 63-150mm dia.		
						0.000			
						0.000			
						0 0 0 0			
	2.00 - 2.70	в						2 -	
						0.00			
						0.000			
								3 -	
				3.10	33.17	<u> </u>	End of Pit at 3.100m		
								4 -	
								5 -	
Stability: Plant:	Very poor. 13t tracked exc	cavator.			ľ	Groundwa	iter: None encountered.		
Backfill: Remarks:	Arisings. Pit terminated	at 3.10m bg	Jl. Soakaway test c	arried out in	pit.				
1									

P21154 Port road, Killarney Test 1 **SA01** 07/07/2021 l, m 4.70 3.20 d, m 3.10 b, m d_eff, m l_base, m 4.70 1.95 l_eff, m 4.70 Measure, m Depth Time, min Fall, m Volume Time, sec hal water, m

	bgi		water, m		
0	1.15	0	1.95	0.00	0.00
1	1.19	60	1.91	0.04	0.60
2	1.22	120	1.88	0.07	1.05
3	1.23	180	1.87	0.08	1.20
4	1.24	240	1.86	0.09	1.35
5	1.26	300	1.84	0.11	1.65
6	1.29	360	1.81	0.14	2.11
7	1.31	420	1.79	0.16	2.41
8	1.34	480	1.76	0.19	2.86
9	1.36	540	1.74	0.21	3.16
10	1.38	600	1.72	0.23	3.46
15	1.41	900	1.69	0.26	3.91
20	1.5	1200	1.60	0.35	5.26
25	1.58	1500	1.52	0.43	6.47
30	1.64	1800	1.46	0.49	7.37
45	1.82	2700	1.28	0.67	10.08
60	1.96	3600	1.14	0.81	12.18
70	2.06	4200	1.04	0.91	13.69

Area	15.04 m^2	$V_{p75-25 \text{ theory}}$	volume	14.664 m^3
50% Area_eff, a _{p50}	30.445 m^2	V _{p 75} - 25 actual	volume	6.8432 m^3
50% Area_act, a _{p50}	22.229 m^2	t _{p 75-25 actual}	time	2181.00 s

Infiltration Coefficient

f

1.41E-04 ms^-1



NOTES:

See SA01 for detailed soil description. No groundwater encountered.

Photographic Record





Priority							iical Ltd.	Trial Pit No
pgi					Tel: Fax:	021 4631 021 4638	600 3690	SA02
				v	vww.prio	ritygeote	chnical.ie S	Sheet 1 of 1
Project	Port Road R	esidential I	Development	Proje	ect No.		Co-ords:495834E - 591483N	Date
Name:	P21154				54		Level: 36.60m OD	05/07/2021 Scale
Locatior	Location: Killarney, Co. Kerry						Dimensions (m):	1:25
Client:	Portal Asse	t Holding	s Ltd				Depth:	Logged EK
ater ke& ckfill	Samp	les & In Situ	u Testing	Depth	Level	Legend	Stratum Description	
Stri K	Depth (m)	Туре	Results	(m)	(m OD)		(TOPSOIL) Soft to firm slightly sandy gravely SILT	r I
							with medium cobble content, rounded, 63-200mm of Sand is fine to coarse. Gravel is fine to coarse, rounded.	dia.
	0.35 - 0.70 0.35 - 0.70	D		0.35	36.25	× × × × × × × × × × × ×	Soft to firm, light brown, slightly sandy gravelly SIL with high cobble content, rounded, 63-200mm dia. Sand is fine to coarse. Gravel is fine to coarse, rounded.	T
	1.00 - 2.00	в		0.70	35.90		Loose, light brown, very gravelly SAND with mediu cobble and boulder content, 63-300mm dia. Sand i fine to coarse. Gravel is fine to coarse, sub-rounde rounded.	im
	2.00 - 3.00	в						2 —
								3 —
				3.30	33.30		End of Pit at 3.300m	4
								5 —
Stability: Plant:	Very poor. 13t tracked exc	avator.		·		Groundwa	ater: None encountered.	
Backfill: Remarks:	Arisings. Pit terminated	at 3.30m bg	I due to pit walls co	llapsing. So	akaway tes	st carried o	ut in pit.	

P21154 Port road, Killarney Test 1 SA02

Test 1	SA02					05/07/2021
l, m I_base, m I_eff, m	3.50 3.50 3.50	b, m	2.90	d, m d_eff, m	3.30 2.25	
	Time, min	Measure, m bgl	Time, sec	Depth water, m	Fall, m	Volume
	0	1.05	0	2.25	0.00	0.000
	1	1.1	30	2.20	0.05	0.508
	1	1.13	60	2.17	0.08	0.812
	2	1.14	120	2.16	0.09	0.913
	3	1.15	180	2.15	0.10	1.015
	5	1.21	300	2.09	0.16	1.624
	6	1.23	360	2.07	0.18	1.827
	7	1.24	420	2.06	0.19	1.929
	8	1.27	480	2.03	0.22	2.233
	9	1.28	540	2.02	0.23	2.335
	10	1.3	600	2.00	0.25	2.538
	15	1.46	900	1.84	0.41	4.162
	20	1.53	1200	1.77	0.48	4.872
	25	1.59	1500	1.71	0.54	5.481
	30	1.65	1800	1.65	0.60	6.090
	45	1.79	2700	1.51	0.74	7.511
	60	1.95	3600	1.35	0.90	9.135
	70	3.3	4200	0.00	2.25	22.838

Area	10.15 m^2	V p75-25 theory	volume	11.41875 m^3
50% Area_eff, a _{p50}	24.55 m^2	V _{p 75} - 25 actual	volume	4.5675 m^3
50% Area_act, a _{p50}	24.55 m^2	t _{p 75-25 actual}	time	1818.00 s

Infiltration Coefficient

f

1.02E-04 ms^-1



NOTES:

See SA02 for detailed soil description. No groundwater encountered. Final reading disregarded due to side wall collsapse.

Photographic Record





pglp	Priority Ge Tel: 02 geotechnical Fax: 0						ical Ltd. T 600 3690	Trial Pit No SA03			
Broject			Project No.			itygeote	Co-ords:495867E - 591440N	heet 1 of 1			
Name:	Port Road R	esidential I	Development	P211	54		Level: 36.66m OD	05/07/2021			
Locatior	-ocation: Killarney, Co. Kerry						Dimensions (m):	Scale			
Client:	Portal Asse	t Holding	s Ltd				Depth: m 3.50m BGL	Logged EK			
/ater rike & ıckfill	Samp	les & In Situ	u Testing	Depth	Level	Legend	and Stratum Description				
≥ <u>ŝ</u>	Depth (m)	Туре	Results		(1100)		(TOPSOIL) Soft to firm, dark brown, organic SILT.				
	0.50 - 1.50 0.50 - 1.50 1.80 - 2.80 2.80 - 3.50	B		0.30	36.36 34.86 33.16		Soft to firm, light brown, slightly sandy gravelly SILT with medium cobble content, sub-rounded to rounde 63-150mm dia. Sand is fine to coarse. Gravel is fine coarse, rounded. Loose, brown, very sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse, sub-rounded to rounded. Loose, brown, very sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Gravel is fine to coarse, sub-rounded to rounded. End of Pit at 3.500m	2			
								4			
Stability:	Very poor.				 	 Groundwa	ater: None encountered	5 -			
Plant: Backfill: Remarks:	13t tracked exc Arisings. Pit terminated	avator. at 3.50m bg	I due to pit walls co	llapsing. So	akaway tes	t carried c	ut in pit.				

Test 1 **SA03** 05/07/2021 I, m 4.60 3.80 d, m 3.50 b, m I base, m 4.60 d_eff, m 1.96 l eff, m 4.60 Measure, m Depth Time, min Volume Time, sec Fall, m water, m bgl 0.00 0.00 0 1.54 0 1.96 1.92 1.58 30 0.04 0.70 1 1.60 60 1.90 0.06 1.05 1 2 1.63 120 1.87 0.09 1.57 3 1.60 180 1.90 0.06 1.05 4 1.63 240 1.87 0.09 1.57 5 1.64 300 1.86 0.10 1.75 6 1.67 360 1.83 0.13 2.27 1.70 420 1.80 0.16 2.80 7 8 1.72 480 1.78 0.18 3.15 9 1.74 540 1.76 0.20 3.50 10 1.77 600 1.73 0.23 4.02 15 1.84 900 1.66 0.30 5.24 20 1200 0.00 3.50 1.96 34.26 Area 17.48 m^2 V p75-25 theory volume 17.1304 m^3 50% Area_eff, ap50 2.622 m^3 33.944 m^2 V p 75 - 25 actual volume 50% Area_act, ap50 33.944 m^2 time 371.00 s tp 75-25 actual f Infiltration Coefficient 2.08E-04 ms^-1



NOTES: See SA03 for detailed soil description. No groundwater encountered. Final reading disregardded due to side wall collapse.

P21154 Port road, Killarney

Photographic Record





Pri Pglpriority					Priority (Tel:	Geotechi 021 4631	Trial Pit No SA04		
g	eotechnical			v	vww.prio	ritygeote	chnical.ie	Sheet 1 of 1	
Project	D. A.D. A.D.		Development	Project No.			Co-ords: 495872E - 591423N	Date)
Name:	Name: Port Road Residential Development P2			P211	54		Level: 36.09m OD	05/07/20	021
Location	Location: Killarney, Co. Kerry						Dimensions (m):	Scale	•
Client	Portal Asso		a l td				Depth: 4	Logge	d
. ø =	Portal ASSC		- Teeting				3.80m BGL	EK	
Nater trike ackfi	Denth (m)		Posulte	Depth (m)	Level (m OD)	Legend	Stratum Description		
- <u>2</u> 0	0.00 - 0.30	В	Results				(TOPSOIL) Soft firm, organic SILT.		- 1
	0.00 - 0.30	D							
				0.30	35.79		Soft to firm, light brown, slightly sandy gravelly	SILT	-
						× × × × × × × ×	with high cobble content and low boulder content is fine to coarse. Gravel is fine to coarse round	ent. Sand	-
						× × × ×	Cobbles are rounded, 63-150mm dia.	100.	-
				0.70	35.39		Loose, grey brown, very sandy GRAVEL with h	nigh	-
						e e e	cobble content, Sand is fine to coarse. Gravel coarse, sub-rounded to rounded. Cobbles are	is fine to rounded,	
	1.00 - 2.00	в					63- 200mm dia.		1 -
						a ° ° 0	ब - -		-
						a • ° 0	a - -		-
						a a 9 0 a 9 0	े अ		-
									-
						°°°°°			
						е ° ° ° ° °			-
	2 00 - 3 00	в				a • a 0	स - -		2
	2.00 - 0.00					a ° ° 0 9 0	· · ·		
							त 		-
						e e e			-
						°°°°°			
							4 • •		-
						ە • • • • •	a 		
						a • a 0			_
						a a 9 0 a 9 0	े अ		
						a 9 0			-
						°°°°°			-
						е ° ° ° ° °			
						a 96 0	ब - 		-
				3.80	32.29		5 - 1 - 5 D to 4 0, 000		-
					-		End of Pit at 3.800m		-
									4 -
									5 -
Stability: Plant	Very poor. 13t tracked exc	avator		I		Groundw	ater: None encountered.		
Backfill:	Arisings.	at 2 00 L	l duo to <u>mit</u> !!-	lancing 0	akovert	t oc	sut in hit		
I Condi KS	Pit terminated	at 3.80m bg	i uue to pit walls co	mapsing. So	akaway tes	a carried o	out in pit		

P21154	Port road, k	Cillarney				
Test 1	SA04					05/07/2021
l, m l_base, m l_eff, m	3.80 3.80 3.80	b, m	4.70	d, m d_eff, m	4.50 2.85	
	Time, min	Measure, m bgl	Time, sec	Depth water, m	Fall, m	Volume
	0	1.65	0	2.85	0.00	0.00
	1	1.70	30	2.80	0.05	0.89
	1	1.75	60	2.75	0.10	1.79
	2	4.00	100	0.70	0.45	0.00
	Z	1.80	120	2.70	0.15	2.68
	3	1.80	120	2.70	0.15	3.21
	2 3 4	1.80 1.83 1.85	120 180 240	2.70 2.67 2.65	0.15 0.18 0.20	3.21 3.57

360

420

480

540

600

900

1200

1500

1800

2700

1.92

1.95

1.97

2.00

2.05

2.12

2.20

2.26

2.34

3.80

Area	17.86 m^2	V p75-25 theory	volume	25.4505 m^3
50% Area_eff, a _{p50}	42.085 m^2	V _{p 75} - 25 actual	volume	6.1617 m^3
50% Area_act, a _{p50}	36.135 m^2	t _{p 75-25 actual}	time	909.00 s

Infiltration Coefficient

2.58

2.55

2.53

2.50

2.45

2.38

2.30

2.24

2.16

0.70

0.27

0.30

0.32

0.35

0.40

0.47

0.55

0.61

0.69

2.15

4.82 5.36

5.72

6.25

7.14

8.39

9.82

10.89

12.32

38.40





Final reading disregarded due to side wall collapse.

6

7

8

9

10

15

20

25

30

45

Photographic Record





					Priority (Geotechi	nical Ltd.	Trial Pit N	0
Pylp	riority				Fax:	021 463 021 463	1600 8690	SA05	
		www.prioritygeo				ritygeote	chnical.ie	Sheet 1 of	1
Project Name:	Port Road R	lesidential	Development	Proje P211	Ct NO.		Co-ords:495796E - 591367N	Date 05/07/202	1
Location	ecotion: Killerney, Co. Kerny				<u> </u>		Dimensions (m): 2.20	Scale	-
20000.00		<u> </u>					Depth:	1:25 Logged	
Client:	Portal Asse	t Holding	s Ltd			1	2.10m BGL	OD	
Nater trike { ackfil	Samples & In Situ Testing Depth Level Legen (m) Type Results (m) (m OD)		Legend	d Stratum Description					
≥ <u>∞</u> ⊓		INhe					(TOPSOIL)		
				0.05	20.06				-
				0.25	30.90		Soft to firm, light brown, slightly sandy gravelly with high cobble content and low boulder content	SILT ent. Sand	-
	0.50 - 1.50	в					is fine to coarse. Gravel is fine to coarse, round Cobbles are rounded, 63-150mm.	led.	_
									4
						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
						× × × × ×			_
						$\times \times \times \times$			-
	1 60 2 10			1 60	20.61		<		_
	1.00 - 2.10			1.00	29.01	م×. مح و محمد مح	Loose, grey brown, very sandy GRAVEL with h cobble content. Sand is fine to coarse. Gravel	igh is fine to	-
						a X 0 a X 0 a X 0	coarse, sub-rounded to rounded. Cobbles are 63-200mm dia.	rounded,	-
						م × ۵ م م × ۵ م م × ۵	ि २ २		2 —
				2.10	29.11	+9"X:	End of Pit at 2.100m		-
									-
									-
									-
									-
									-
								:	3 —
									-
									-
									-
									-
									-
									-
								· · · · · · · · · · · · · · · · · · ·	4
									-
									-
									_
									-
									-
									5 —
Stability:	Moderate.	<u> </u>			<u> </u>	Groundw	ater: None encountered.		
Plant: Backfill:	13t tracked exc Arisings.	avator.					· · ·		
Kemarka.	Pit terminated	at 2.10m bç	JI due to required a	epth reached	d. Soakawa	ay test cari	ried out in pit.		
P21154	Port road, k	Cillarney							
----------------------------------------------------------	----------------------	-------------------	------------------------------------------------------------	-------------------	---------------------------	------------			
Test 1	SA05_01					05/07/2021			
l, m l_base, m l_eff, m	2.10 2.10 2.10	b, m	2.20	d, m d_eff, m	1.20 0.80				
	Time, min	Measure, m bgl	Time, sec	Depth water, m	Fall, m	Volume			
	0	0.40	0	0.80	0.00	0.000			
	1	0.42	60	0.78	0.02	0.092			
	2	0.44	120	0.76	0.04	0.185			
	3	0.45	180	0.75	0.05	0.231			
	4	0.48	240	0.72	0.08	0.370			
	5	0.50	300	0.70	0.10	0.462			
	22	0.77	1320	0.43	0.37	1.709			
	32	0.88	1920	0.32	0.48	2.218			
	50	0.99	3000	0.21	0.59	2.726			
	76	1.12	4560	0.08	0.72	3.326			
	136	1.20	8160	0.00	0.80	3.696			
Area 50% Area_eff, a _{p50} 50% Area_act_a	4.62 8.06	m^2 m^2	V _{p75-25} theory V _{p75} - 25 actual	volume volume	1.848 1.848 2448.00	m^3 m^3			
$50\%$ Alea_aci, $a_{p50}$	8.00	nr 2	^c p 75- 25 actual	ume	2440.00	5			
		Infiltration Co	efficient	f	9.37E-05	ms^-1			
			Volume v	Time					
	0.000	0 200	0 4000	6000	8000	10000			
	0.500								
	Ę ^{1.500}								
	2.000								
	<b>7</b> 2.500	<b>*</b> ,							
	3.000								

-

Time, s

NOTES:

See SA05 for detailed soil description.

No groundwater encountered. Pit assumed unsaturated on first fill

3.500

4.000

P21154	Port road, M	Cillarney				
Test 1	SA05_02					05/07/2021
l, m I_base, m I_eff, m	2.10 2.10 2.10	b, m	2.20	d, m d_eff, m	1.20 1.20	m bgl
	Time, min	Measure, m bgl	Time, sec	Depth water, m	Fall, m	Volume
	0	0	0	1.20	0.00	0.000
	1	0	60	1.20	0.00	0.000
	4	0.09	240	1.11	0.09	0.416
	62	0.79	3720	0.41	0.79	3.650
	150	1.19	9000	0.01	1.19	5.498
	235	1.2	14100	0.00	1.20	5.544
Area 50% Area_eff, a _{p50} 50% Area_act, a _{p50}	4.62 9.78 9.78	m^2 m^2 m^2	$V_{p75-25 theory}$ $V_{p75-25 actual}$ $t_{p75-25 actual}$	volume volume time	2.772 2.772 3888.00	m^3 m^3 s

Infiltration Coefficient

7.29E-





f

#### NOTES:

See SA05 for detailed soil description.

No groundwater encountered. Pit assumed saturated on second fill





					Priority (	Geotech	nical Ltd.	Trial Pit	No
pgip	eotechnical				Tel: Fax:	021 4631 021 463	1600 8690	SA06	6
				۷ ـــــــ	www.prior	ritygeote	chnical.ie	Sheet 1 o	of 1
Project Name:	Port Road F	Residential	Development	Proje P211	<b>∋ct No.</b>	ļ	Co-ords:495822E - 591350N	Date	101
	- Killarnev (	- Karry			04		2.40	Scale	)
LUCAUL	Client: Portal Asset Holdings Ltd					!	Danth	1:25	4
Client:	Portal Asse	et Holding	s Ltd	<del></del>		!	2.00m BGL	EK	u
Vater rike 8 ackfil	Samp	les & In Siti	u Testing	Depth (m)	Level (m OD)	Legend	Stratum Description		
> 2 0 0	Deptn (m)	Туре	Kesuns	· · ·	· · · ·		(TOPSOIL)		
				0.20	31.71		CDAVEL with t		-
				-	-	a X: • a X • 0	Loose, grey brown, very sandy GKAVEL with cobble content, Sand is fine to coarse. Gravel	igh is fine to	
	0.50 - 1.50	в				a ×: • • • •	63-200mm dia.	rounaea,	
	0.0 -					• × • • × •	X. The second		
						a X 0			
						a × , , a × , a			
						a×: • a× 0			1 -
						• × • • • • •			
						.a.X: , aX 9			-
	1.70 - 2.00	в		1.70	30.21	9 X 9 9 X 9	Croom SAND Sand is fine		
							Uream, SAND. Sand is inte.		
				2.00	29.91		End of Pit at 2.000m		2 —
									-
									-
									-
									3 —
									-
									-
									-
									-
									-
									4 —
									-
									-
									-
									-
									5 —
Stability: Plant:	Good. 13t tracked exc	cavator.			/	Groundw	ater: None encountered.	<u> </u>	
Backfill: Remarks:	Arisings.	1 at 2 00m br	al due to required d	tenth reache	soakawa	ov test car	ried out in nit		
		u	1 440 12 1-1	000000		,			

P21154	Port road, Killarney								
Test 1	SA06					05/07/2021			
l, m l_base, m l_eff, m	2.00 2.00 2.00	b, m	2.40	d, m d_eff, m	1.30 0.92				
	Time, min	Measure, m bgl	Time, sec	Depth water, m	Fall, m	Volume			
	0	0.38	0	0.92	0.00	0.000			
	1	0.4	60	0.90	0.02	0.096			
	2	0.41	120	0.89	0.03	0.144			
	3	0.43	180	0.87	0.05	0.240			
	4	0.45	240	0.85	0.07	0.336			
	5	0.46	300	0.84	0.08	0.384			
	24	0.57	1440	0.73	0.19	0.912			
	39	0.63	2340	0.67	0.25	1.200			
	64	0.71	3840	0.59	0.33	1.584			
	141	0.88	8460	0.42	0.50	2.400			
	236	1.02	14160	0.28	0.64	3.072			
	328	1.13	19680	0.17	0.75	3.600			
	366	1.16	21960	0.14	0.78	3.744			
Area	4.8	m^2	V p75-25 theory	volume	2.208	m^3			
50% Area_eff, a _{p50}	8.848	m^2	V _{p 75 - 25 actual}	volume	1.872	m^3			
50% Area_act, a _{p50}	8.232	m^2	t _{p 75-25 actual}	time	10617.00 s				

#### Infiltration Coefficient

f

2.14E-05 ms^-1



#### NOTES: See SA06 for detailed soil description. No groundwater encountered.





nal					Seotechi	nical Ltd.	Trial Pit No		
	riority otechnical			v	Fax:	021 463	8690	SAU/	
Draiget				Proie	ect No.	11990010	Co-ords:496043F - 591227N	Sheet 1 of	4
Name:	Port Road R	tesidential	l Development	Development P21154			Level: 28.74m OD	05/07/2021	
Location	1: Killarney, C	Co. Kerry	,				Dimensions (m):	Scale	
Client:	Portal Asse	-t Holding	as I td				Depth:	Logged	_
L ∞ ≣	Samp	les & In Si	itu Testina		<u> </u>	1	2.00m BGL	EK	_
Wate Strike Backf	Depth (m)	Туре	Results	Deptn (m)	Levei (m OD)	Legend	Stratum Description		
Stability: Plant:	Moderate. 13t tracked exc	cavator.		2.00	26.74	Groundw	MADE GROUND) Brown, slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is fine coarse.  End of Pit at 2.000m  End of Pit at 2.000m  ater: 1.60m: Slow flow rate.	<ul> <li>&gt;to</li> <li>1</li> <li>1</li> <li>2</li> <li>3</li> <li>4</li> <li>4</li> <li>5</li> </ul>	
Backfill: Remarks:	Arisings.	at 2 00m h	ad due to required d	onth reacher	d Soakawa	w tost car	riad aut in hit		—
Kemars.	Pit terminated	at 2.00m b	gl due to required a	epth reached	I. Soakawa	y test cari	ried out in pit.		









pgl _p	)riority eotechnical				Priority C Tel: Fax:	Geotechr 021 4631 021 463 021 463	nical Ltd. 600 8690 chaical in	Trial Pit No SA08			
- i oot				Proje	ww.p.re.	llygeen	Contratile	Sheet 1 Date	of 1		
Name:	Port Road Re	esidentia	al Development	P211	54		Level: 27.42m OD	05/07/20	021		
Locatior	n: Killarney, C	o. Kerry	/				Dimensions (m):	Scale	•		
Client:	Portal Asse	t Holdin	uas I ta				Depth: 7	1:25 Logge	d		
_ જ <u>≡</u>	Samp	les & In S	situ Testina		<u></u>	<b>/</b>					
Wate Strike Backf	Depth (m)	Туре	Results	_ Depth (m)	Level (m OD)	Legend	Stratum Description				
				1.00	26.42		Soft to firm, brown, slightly sandy, slightly grave CLAY. Sand is fine to coarse. Gravel is fine to c 0.00m-1.00m: Small amount of waste timber found.	illy oarse.			
Stability: Plant:	Moderate. 13t tracked exca	avator.			ľ	Groundwa	ater: 0.50m: Slow flow rate.				
Backfill: Remarks:	Arisings. Pit terminated a	at 1.00m t	bgl due to required de	əpth reachec	1. Soakawa	ıy test carr	ied out in pit				





pgl _p	<b>riority</b>				Priority ( Tel: Fax:	Geotechr 021 4631 021 463 021 463	nical Ltd. 1600 8690 schnical ie	Trial Pit No <b>TP01</b>	
Project	Dest Dood D		Duriterment	Proje	ect No.	liygeoio	Co-ords:496012E - 591308N	Sheet 1 of 1 Date	
Name:	Роп коао к	esidentiai i	Development	P211	54		Level: 34.05m OD	06/07/2021	
Location	1: Killarney, C	o. Kerry					Dimensions (m):	1:25	
Client:	Portal Asse	et Holding:	s Ltd				Depth:            3.00m BGL	Logged OD	
<i>l</i> ater rike & ackfill	Samp	les & In Situ	u Testing	Depth (m)	Level (m OD)	Legend	Stratum Description		
2 <u>2</u> 2	Depuir (iii)	Туре		0.10	33.95		(TOPSOIL) Brown grey, slightly gravelly SAND. Sand is fine medium. Gravel is fine to coarse, sub-rounded to rounded.	to	
	0.50 - 1.50	в						1-	
	1.50 - 2.50	в							
	2.50 - 3.00	в							
				3.00	31.05		End of Pit at 3.000m	3 -	
								4 -	
								5 -	
Stability: Plant:	Moderate. 13t tracked exc	avator.				Groundwa	ater: None encountered.	I	
Backfill: Remarks:	Arisings. Pit terminated	at 3.00m b <u>c</u>	JI due to required d	epth reache [,]	d.				

P21154	Port road, k	Killarney				
Test 1	SA_TP01					06/07/2021
I, m I_base, m I_eff, m	3.20 3.20 3.20	b, m	1.20	d, m d_eff, m	3.00 2.23	
	Time, min	Measure, m bgl	Time, sec	Depth water, m	Fall, m	Volume
	0	0.77	0	2.23	0.00	0.000
	2	0.78	120	2.22	0.01	0.038
	89	1.60	5340	1.40	0.83	3.187
	119	1.73	7140	1.27	0.96	3.686
Area 50% Area_eff, a _{p50} 50% Area_act, a _{p50}	3.84 13.652 8.064	m^2 m^2 m^2	V _p 75-25 theory V _p 75 - 25 actual t _p 75- 25 actual	volume volume time	4.2816 1.8432 3079.00	m^3 m^3 s

Infiltration Coefficient f 7.42E-05 ms^-1



#### NOTES: See TP01 for detailed soil description.

No groundwater encountered.





pgl	priority eotechnical			Y	Priority ( Tel: Fax:	Geotechr 021 4631 021 463	nical Ltd. 1600 8690 schpical in	Trial Pit No <b>TP02</b>			
Proiect				Proje	ect No.	nygeole	Co-ords:496036E - 591278N	eet 1 of 1 Date			
Name:	Port Road R	esidential	Development	P211	54		Level: 33.03m OD 06/07/20				
Locatio	n: Killarney, C	o. Kerry					Dimensions (m):	<b>Scale</b> 1:25			
Client:	Portal Asse	et Holding	s Ltd				Depth:         ↔         L           _3.00m BGL	<b>.ogged</b> OD			
Vater rike & ackfill	Samp	les & In Situ	u Testing	Depth (m)	Level (m OD)	Legend	Stratum Description				
- <u>2</u> 0	Deptii (iii)	Type	Nesulta	0.10	32.93		(TOPSOIL) Beige, slightly gravelly SAND. Sand is fine to medium				
	0.50 - 1.50	в					Gravel is fine to coarse, sub-rounded to rounded.				
	1.50 - 2.50	в									
	2.50 - 3.00	в		2.50	30.53		Firm, beige SAND. Sand is fine.	2			
				3 00	30.03						
							End of Pit at 3.000m				
								4			
								5 —			
Stability: Plant:	Moderate.				·	Groundwa	l ater: None encountered.				
Backfill: Remarks	Arisings.	at 3.00m bg	I due to required d	epth reached	d.						



