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## 1 INTRODUCTION

### 1.1 SCOPE OF WORKS

In March 2009 RPS Consulting Engineers commissioned Priority Drilling PLC on behalf of their Client Bantry Bay Harbour Commissioners to carry out a marine ground investigation at Bantry Inner Harbour Co Cork. The purpose of the geotechnical ground investigation was to obtain sufficient geotechnical information in order to assess the suitability of the harbour for further development.

The investigation which was specified by RPS Consulting Engineers initially comprised of fifteen (15) number cable percussion boreholes thirteen (13) number rotary cored boreholes sixteen (16) number dynamic probes bathymetric surveying all associated sampling laboratory work marine sediment analysis and actual reporting as detailed in the contract specification and bill of quantities. The final scope of works as completed is detailed in Section 1.1. The field work was carried out between July and August 2009.

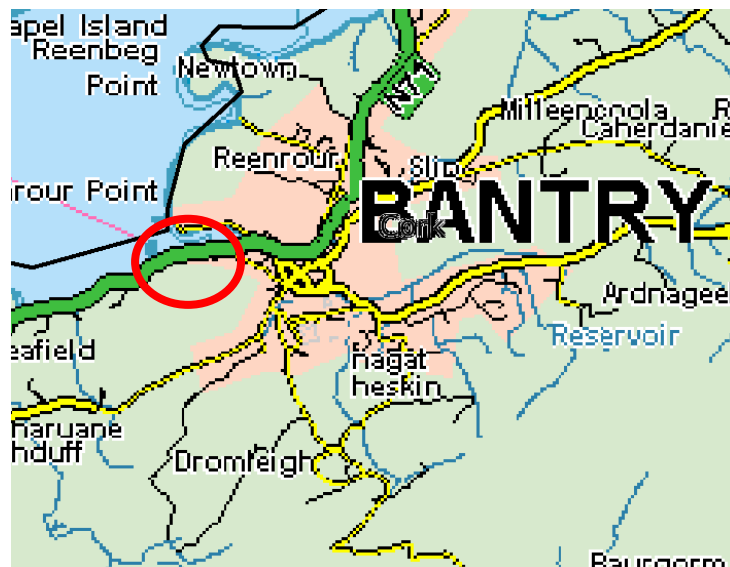
### 1.2 REPORTING

This report PC9030\_Rp000000 presents the actual records of the field work and laboratory testing with respect to the ground investigation contract undertaken for the Bantry Inner Harbour. A separate bathymetric survey and sub-bottom profiling of the bedrock was undertaken as outlined in report P000000 August 2009 presented in **APPENDIX B**.

## THE SITE

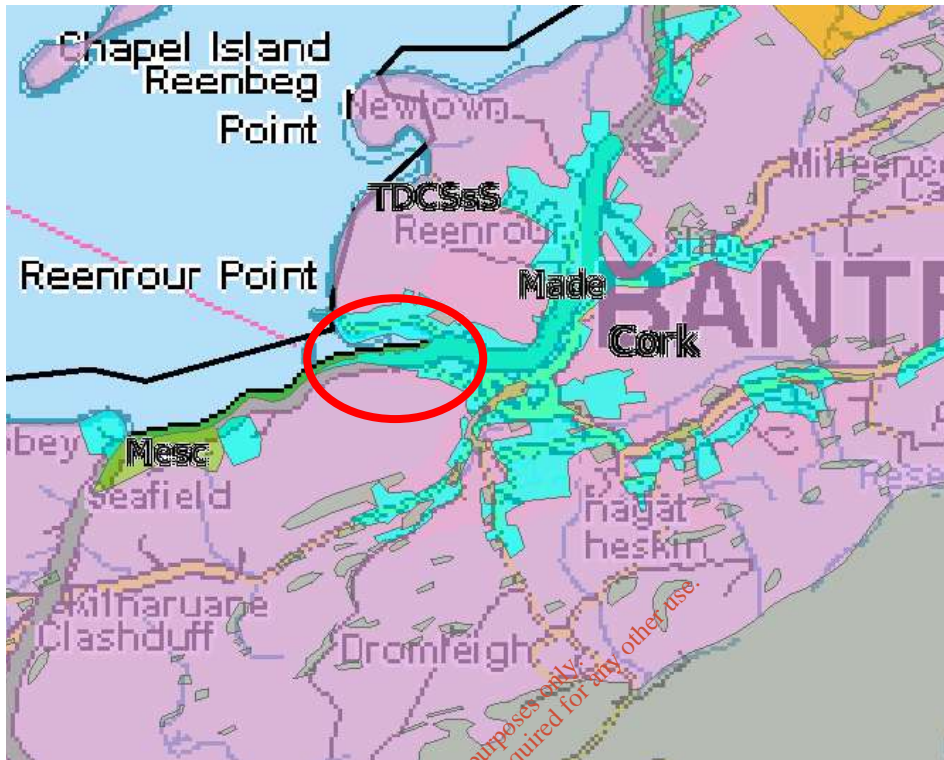
### SITE LOCATION DESCRIPTION

The site is within Bantry Inner Harbour, Co. Cork, located between the existing Pier on the N. Cork to Killarney Road and the Railway Pier on the Harbour Road. The site is tidal with water depths varying from 0.5m M.S. to -0.5m to Chart Datum. A significant portion of the site is subject to periodic wetting and drying governed by tidal levels.





Overburden deposits were expected to consist of made ground and marine estuarine silts and clays (Mesc) as indicated by subsoil mapping (Teagasc)



A S RBD T

**FIELD WORK**

**GENERAL**

The field work was carried out in general accordance with BS 5930 Code of Practice for Site Investigation and Part 4 of BS 5930 Method of Tests for Soil for Civil Engineering Purposes. Details of the equipment and plant used are presented below. The plant was operated from a jack up barge. A number of locations were accessible at low tide and were undertaken on land.

Operation	Equipment	Notes	Access	Comments
Cable percussion Boring	Hand	100mm	N/A	Standard Penetration Test values and bulk samples obtained
Rotary Boring	DeltaBase	Symmetrex 100mm open hole Double lined core barrel 100mm nominal core dia	Compressed air-mist	Standard Penetration Test values and core obtained
Dynamic Probes	Archday Competitor CPS	100mm	N/A	Super heavy 100kg drop weight

The exploration locations were selected by RPS and set out from existing features and the co-ordinates provided.

The locations were subsequently surveyed using Trimble GPS equipment to the National Grid system of co-ordinates with elevations recorded to Chart datum. These locations are shown on the Exploration Location Plan drawing ref PC-SI- presented in

**APPENDIX E**

**EXPLORATOR HOLES**

The exploratory holes as completed during the ground investigation are listed in the following table

**SUMMARY OF EXPLORATOR HOLES**

Type	Quantity	Depth Range	Remarks
Cable Tool Boreholes	1 No	0m to 10m	B1 and B2
Cable Tool and Rotary Cored Boreholes	1 No	0m to 10m	B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15, B16, B17, B18, B19, B20, B21, B22, B23, B24, B25, B26, B27, B28, B29, B30, B31, B32, B33, B34, B35, B36, B37, B38, B39, B40, B41, B42, B43, B44, B45, B46, B47, B48, B49, B50, B51, B52, B53, B54, B55, B56, B57, B58, B59, B60, B61, B62, B63, B64, B65, B66, B67, B68, B69, B70, B71, B72, B73, B74, B75, B76, B77, B78, B79, B80, B81, B82, B83, B84, B85, B86, B87, B88, B89, B90, B91, B92, B93, B94, B95, B96, B97, B98, B99, B100
Dynamic Probes	1 No	0m to 10m	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32, P33, P34, P35, P36, P37, P38, P39, P40, P41, P42, P43, P44, P45, P46, P47, P48, P49, P50, P51, P52, P53, P54, P55, P56, P57, P58, P59, P60, P61, P62, P63, P64, P65, P66, P67, P68, P69, P70, P71, P72, P73, P74, P75, P76, P77, P78, P79, P80, P81, P82, P83, P84, P85, P86, P87, P88, P89, P90, P91, P92, P93, P94, P95, P96, P97, P98, P99, P100

The exploration records are presented in **APPENDIX A** and **APPENDIX D** and should be read in conjunction with the included key sheet. The records provide descriptions based on engineer's/geologist's descriptions of the material encountered in accordance with BS 5930 together with any observations made during the investigation.

**GROUNDWATER MONITORING**

Groundwater was recorded when encountered during boring. Groundwater levels were monitored over a period of 10 minutes noting any changes that have may occurred.

**IN SITU TESTING**

Standard Penetration Test (N) values were carried out in boreholes at 1m to 2m spacing. The results are presented in the exploration records **APPENDIX A** and summarised below.

Dynamic probing was undertaken recording the blows per 100mm penetration. A CP (S) super heavy rig was used.

Grab samples were taken of the harbour marine sediment for environmental assessment and analysis.

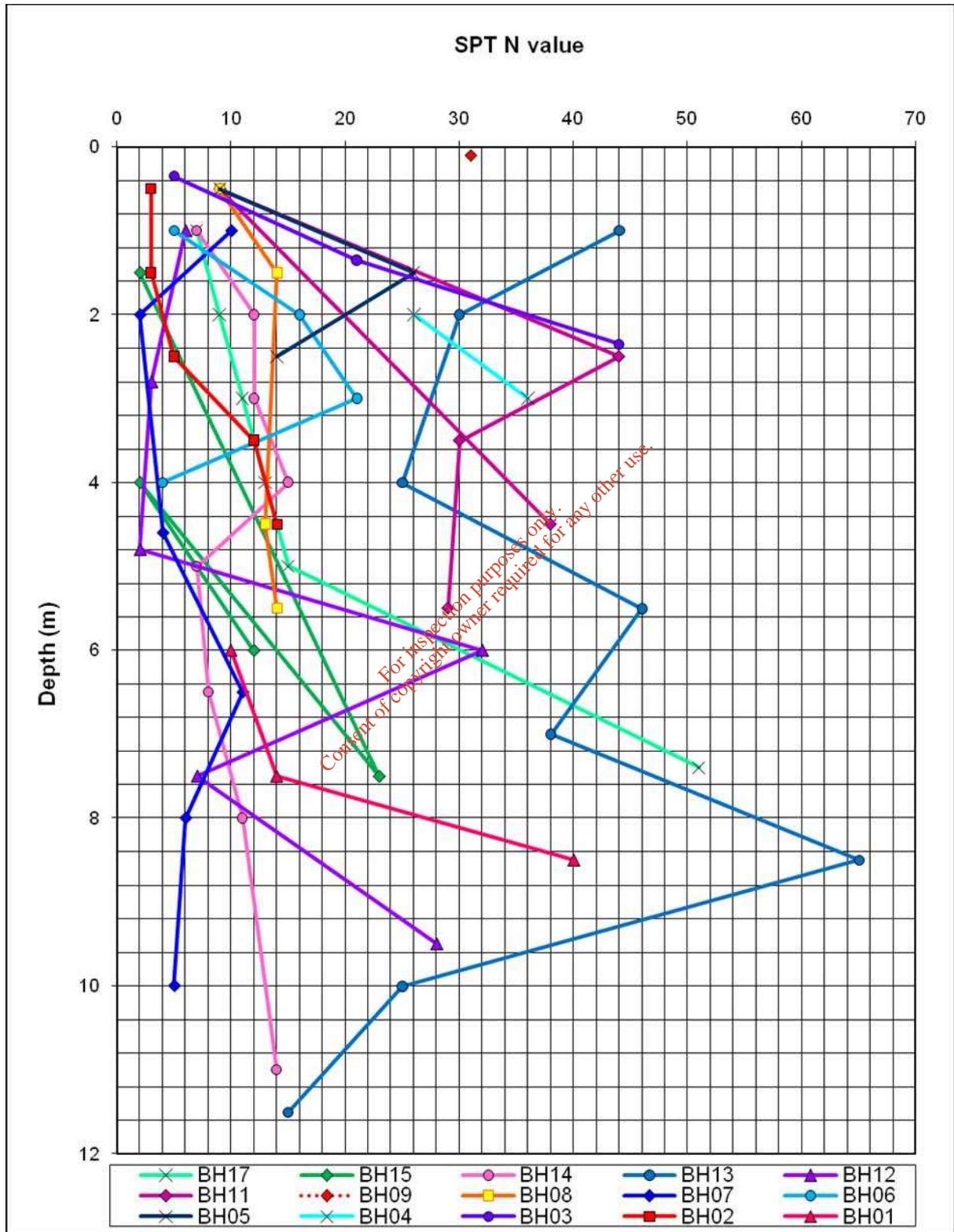
**SUMMARY OF IN SITU TESTING**

TEST	STATUS	REMARKS
Standard Penetration Test (N) values	No	N ranging from 0 to 10 0 No SPT (C) and 0 No SPT (S)
Bathymetric & Sub-bottom Profile Survey	-	Report re: P
Grab Samples	No	Taken at 1m depth below bed level
Dynamic Probing	No	0m to 0m bsl Blow range from 0000mm to 0000mm

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The distribution of SPT N values with depth below sea bed is presented below



## LABORATOR TESTING

All samples and core were transported to Priority Geotechnical's laboratory in Middleton Co. Cork examined and logged in accordance with BS 5930 Geotechnical Testing as scheduled by Priority Geotechnical and approved by the Engineer. Testing as carried out by PGL in accordance with BS 5930 Methods of test for soils for civil engineering purposes and the ISRM suggested methods for rock characterisation testing and monitoring. Triaxial testing and oedometer consolidation testing as undertaken by GEO Laboratory Testing Services (UK) Ltd in accordance with the relevant BS 5930 Geotechnical

Specialist environmental analysis as undertaken on the marine sediment at UK Environmental Agency National Laboratory Service. The data is presented in **APPENDIX C**

A summary of tests are detailed below and presented in **APPENDIX C**

## SOIL TESTING

### SUMMARY OF LABORATOR TESTING UNDERTAKEN ON OVERBURDEN SOILS

SOIL		
TEST	NO.	REMARKS
Natural Moisture Content	1	Range 10% to 15%
Atterberg Limit	1	Liquid Limit 15% to 20% Plastic Limit 5% to 10% including NP non plastic soils Plasticity Index 10% to 15%
Grading analysis	1	No hydrometer analysis was undertaken
Loss on Ignition	1	10% to 15%
Organic Content	1	10% to 15%
Undrained Triaxial Compression	1	C 10 kPa to 15 kPa every soil to firm
Shear Box	1	C 10 kPa to 15 kPa $\Phi$ 10 to 15
Triaxial Compression - CU	1	C 10 kPa to 15 kPa $\Phi$ 10 to 15
Oedometer consolidation	1	-
Marine Sediment Analysis	-	classification Specification outlines scope of analysis

ROC TESTING

SUMMARY OF LABORATORY TESTING UNDERTAKEN ON ROC

ROC		
T	N	R
Point Load Index		MPa to MPa
Unconfined Uniaxial Compressive Strength UCS		MPa to MPa

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## □ □ ROUND CONDITIONS

The site □as characterised by marine□estuarine deposits o□slightly sandy CLAY□SILT□ slightly sandy slightly gra□elly organic SILT□silty gra□elly SAND□clayey sandy GRA□□L□silty sandy GRA□□L and sandy GRA□□L to depths o□□□□m belo□ sea bed level (bsl)□

P□AT □as encountered at B□□□ at a depth o□□□□m bsl to □□□m bsl□

Based on the Standard Penetration Test (SPT)□N □alues□the cohesive soils □ere o□variable strength and described as □ery soft to □ery sti□□ha□ing N □alues ranging □om □ to □□□The granular deposits □ere described as □ery loose to dense□□ith N □alues □□ to □□□

MU□STON□ □as encountered at depths o□□□□m bsl to □□□□m bsl□and □as described as being □eak to moderately strong□ha□ing an Unconfined Compressive Strength o□□□□MPa and Point Load Indices o□□□□MPa to □□□□MPa□

Interbedded MU□STON□ and SAND□STON□ □as encountered at depths o□□□□m bsl to □□□□m bsl□and □as described as being moderately □eak to strong□ ha□ing an Unconfined Compressive Strength o□□□□MPa and Point Load Indices o□□□□MPa to □□□□MPa□

Interbedded MU□STON□ and LIM□STON□ □as encountered at depths o□□□□□m bsl to □□□□□m bsl□and □as described as being moderately □eak to □ery strong□ Unconfined Compressive Strengths o□□□□□MPa to □□□□□MPa and Point Load Indices o□□□□□MPa to □□□□□MPa□

SILTSTON□ □as encountered at depths o□□□□□m bsl to □□□□□m bsl□and □as described as being □eak to strong□ha□ing an Unconfined Compressive Strength o□□□□□MPa and Point Load Indices o□□□□□MPa to □□□□□MPa□

Interbedded SILTSTON□ AN□ SAND□STON□ □as encountered at depths o□□□□□m bsl to □□□□□m bsl□and □as described as being moderately □eak to □ery strong□ha□ing Unconfined Compressive Strengths o□□□□□MPa to □□□□□MPa and Point Load Indices o□□□□□MPa to □□□□□MPa□

LIM□STON□ □as encountered at depths o□□□□□m bsl to □□□□□m bsl□and □as described as being moderately strong to strong□ha□ing Unconfined Compressive Strengths o□□□□□MPa to □□□□□MPa and Point Load Indices o□□□□□MPa to □□□□□MPa□

At B... the MU...STON... was non-intact and highly weathered in the upper... the interbedded MU...STON... and SAN...STON... had a R... to ... At B... the interbedded MU...STON... and LIM...STON... had a R... to ... At B... the SILTSTON... was non-intact and highly weathered in the upper... the interbedded SILTSTON... and SAN...STON... had a R... to ... At B... the interbedded SILTSTON... SAN...STON... and Mudstone had a R... to ...

**SUMMARY OF ROUND CONDITIONS**

Soil Description	Rooting Depth (m)	Lithology
Slightly sandy slightly gravelly CLAY	0.1m to 0.3m	B... B... B... B... B... B... B... B... and B...
Slightly sandy slightly gravelly SILT	0.1m to 0.3m	B... B... B... B... B... B... B... and B...
Slightly sandy slightly gravelly organic SILT	0.1m to 0.3m	B... B... B... B... B... B... and B...
Silty very gravelly SAND	0.1m to 0.3m	B... B... B... B... and B...
Clayey sandy GRAVEL	0.1m to 0.3m	B... and B...
Slightly silty SAND AN GRAVEL	0.1m	B...
Silty very sandy GRAVEL	0.1m to 0.3m	B... B... B... B... B... B... B... B... B... and B...
Sandy GRAVEL	0.1m to 0.3m	B... B... B... and B...
PEAT	0.1m	B...
COBBLES	0.1m to 0.3m	B... B... and B...
MU...STON...	0.1m to 0.3m	B... B... B... B... B... and B...
MU...STON... and SAN...STON...	0.1m to 0.3m	B... and B...
MU...STON... and LIM...STON...	0.1m	B...

Stratum Encountered	Range of Depths (m)	Locations
SILTSTON	0.00m to 0.00m	B0000 B0000 B0000 B0000 B0000 and B0000
SILTSTON and SANDSTON	0.00m to 0.00m	B0000 B0000 B0000 B0000 and B0000
SILTSTON SANDSTON and MUDSTON	0.00m	B0000
LIMESTON	0.00m to 0.00m	B0000 B0000 B0000 and B0000

Geological longitudinal sections (drawing reference PC0000-LS-A and PC0000-LS-00 to PC0000-LS-000) have been produced and are presented in **APPENDIX E** to further describe the ground conditions and should be reviewed in conjunction with the sub-bottom profiling drawings presented in **APPENDIX B**

## 5.1 GROUNDWATER

Groundwater was encountered during rotary coring at B0000. Groundwater details are provided and presented graphically on the logs presented in **APPENDIX A** and summarised as follows:

Location	Groundwater level, m bgl	Groundwater details
B0000	0.00	-

**TECHNICAL REPORT**

Under the scope of reporting it was required to determine the magnitude of settlements expected. It is proposed to place 1.5m of rockfill at an imposed loading of 100kPa. Based on the oedometer consolidation test data the following settlements have been calculated.

$$\Delta h = h \times \frac{\Delta e}{e_0}$$

where h is the thickness of the strata

e is the initial voids ratio and

$\Delta e$  is the change in voids ratio

Location		Point A	Point B	Point C	Point D	Point E
$e_0$		1.00	1.00	1.00	1.00	1.00
$h_s$	m	1.5	1.5	1.5	1.5	1.5
$h_{dr}$	m	1.5	1.5	1.5	1.5	1.5
$e_{100}$	at 100kPa	0.95	0.95	0.95	0.95	0.95
$\Delta e$	%	5.0	5.0	5.0	5.0	5.0
t	m	1.5	1.5	1.5	1.5	1.5
$\Delta t$	mm	75	75	75	75	75
TOTAL $\Delta t$ mm						75
$C_\alpha$	m <sup>2</sup> /yr	0.001	0.001	0.001	0.001	0.001
$t_{dr}$	m	1.5	1.5	1.5	1.5	1.5
$t_{90}$	yr	0.1	0.1	0.1	0.1	0.1

$t_{dr}$  is the drainage height. Here GRAVEL layer underlies the strata the strata thickness and drainage height has been halved.

I		B	B	B	B	B	B
e <sub>o</sub>							
	m						
	m						
e <sub>max</sub>	at kPa						
Δe	%						
t	m						
Δt	mm						
TOTAL Δt <sub>mm</sub>							
C <sub>α</sub>	m <sup>2</sup> /yr						
t <sub>dr</sub>	m						
t <sub>90</sub>	yr						

I		B	B	B	B
e <sub>o</sub>					
	m				
	m				
e <sub>max</sub>	at kPa				
Δe	%				
t	m				
Δt	mm				
TOTAL Δt <sub>mm</sub>					
C <sub>α</sub>	m <sup>2</sup> /yr				
t <sub>dr</sub>	m				
t <sub>90</sub>	yr				

It can be seen that primary settlement can be expected to range from mm to mm. This does not include or settlement of the loose GRA deposits or settlement associated with these layers is expected to be minimal. Settlement of the loose silty SAN is expected to be of the order mm.

The time for consolidation is expected to be varied.

Settlement of silty SAN mm B



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Representative geological long sections (PC0000LS00A, PC0000LS0000, PC0000LS0000 and PC0000LS0000) through the site have been produced based on the information at the exploratory holes. The exploratory locations constitute points of known ground conditions. The ground conditions between these known points have been interpreted and may be subject to variation. The long-sections are presented in **APPENDIX E** and represent an interpretation of the data obtained. These geological cross sections should be read in conjunction with the sub-bottom survey **APPENDIX B** and the borehole logs **APPENDIX A**.

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## SUMMARY

- The site was characterised by very soft to very stiff slightly sandy slightly CLAY SILT very loose to dense silty very gravelly SAND and clayey silty very sandy GRAVEL to depths of 0.0000m below existing sea bed level bsl
- Weak to moderately strong MUDSTONE moderately weak to strong interbedded MUDSTONE and SANDSTONE moderately weak to very strong interbedded MUDSTONE and LIMESTONE weak to strong SILTSTONE moderately weak to very strong interbedded SILTSTONE and SANDSTONE and moderately strong to strong LIMESTONE were encountered from depths of 0.0000m to 0.0000m bsl
- Groundwater was encountered at a level of 0.0000m bsl
- A bathymetric and sub-bottom profiling survey was undertaken. The interpretation of the data is presented in **APPENDIX B**
- Laboratory testing was undertaken to characterise the soil and rock encountered
- Settlement under the proposed 0.00m of fill is expected to be between 000mm and 0000mm and varied across the site. The time for 000 consolidation was highly variable with significant time associated with some of the organic sediment up to 00 years
- Marine sediment analysis was undertaken. The data is presented in **APPENDIX C**
- A bathymetric survey was completed as part of the works and outlines the rock profile. Geological longitudinal sections have been produced from the borehole data to further characterise the site

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**APPENDIX A**

**EXPLORATOR BORE RECORDS**

Key to Exploration Bore Records

Key

Cable Tool Boreholes

B[ ] and B[ ]

Cable Tool and Rotary Cored Boreholes

B[ ] B[ ] B[ ] B[ ]  
B[ ] B[ ] B[ ] B[ ]  
B[ ] B[ ] B[ ] B[ ]  
B[ ] B[ ] and B[ ]

Dynamic Probes CP IS

P[ ] P[ ] P[ ] P[ ]  
P[ ] P[ ] P[ ] P[ ]  
P[ ] P[ ] P[ ] P[ ]  
P[ ] P[ ] P[ ] and  
P[ ]

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# 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, F - not recovered, P - partially recovered  
B Bulk sample - disturbed  
D Jar Sample - disturbed  
W Water Sample  
CBR California Bearing Ratio mould sample  
CS 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 insufficient 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

## GROUNDWATER

 Groundwater strike  
 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  
C Standard Penetration Test - solid 60° cone  
SW Self Weight Penetration  
IVp, HVp (R) In Situ Vane Test - Hand Vane Test (R) demonstrates remoulded strength  
K(F), (C), (R), (P) Permeability Test  
HP Hand Penetrometer Test

## MEASURED PROPERTIES

N 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  
Cu Undrained Shear Strength (kN/m<sup>2</sup>)  
CBR California Bearing Ratio

## ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)	
	Borehole	Core
N	75	54
H	99	76
P	120	92
S	146	113



Symbols used on Exploratory Hole Records

Key





<b>Project Name:</b> Bantry Bay Inner [ ] Harbour	<b>Project No.:</b> PC [ ] [ ] [ ] [ ]	<b>Co-ords:</b> [ ] [ ] [ ] [ ] - [ ] [ ] [ ] [ ] N	<b>Hole Type:</b> Cable [ ] Rotary [ ]
<b>Client:</b> Bantry Bay [ ] Harbour Commissioners	<b>Dates:</b> [ ] [ ] [ ] [ ] - [ ] [ ] [ ] [ ]	<b>Level:</b> - [ ] [ ] [ ] m AO [ ]	<b>Scale:</b> [ ] [ ] [ ]

Well Backfill	Water Strikes	Samples		In Situ Testing		Casing Flush	Level m AO	Depth m	Stratum Description	Legend
		Depth m	Type	Results	Results					
		[ ] [ ] - [ ] [ ]	B						Very loose dark blue/black silty grey gravelly SAND with many shell fragments	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	SPT	N [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	S							
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	B						Very loose slightly silty very sandy GRAVEL with many shell fragments Sand is fine to coarse Gravel is fine to medium subrounded	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	U							
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	SPT	N [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]								
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	B						Loose sandy GRAVEL with lenses of grey clay and many shell fragments Sand is fine to coarse Gravel is fine to medium subrounded	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	CPT	N [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]								
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	B						Medium dense slightly silty very sandy GRAVEL with many shell fragments Sand is fine to coarse Gravel is fine to medium subrounded	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	CPT	N [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]								
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	B						Medium dense sandy GRAVEL with some shell fragments Sand is fine to coarse Gravel is fine to coarse subangular to subrounded	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	CPT	N [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]								
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	B						Sandy GRAVEL with lenses of grey clay and many shell fragments Sand is fine to coarse Gravel is fine to medium subrounded	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	CPT	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] or [ ] mm						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]								
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	B						Very dense slightly silty very sandy GRAVEL with some shell fragments Sand is fine to coarse Gravel is fine to medium subangular	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	CPT	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] or [ ] mm						
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]								
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	CPT	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] or [ ] mm					Chiselled from [ ] m to [ ] m for [ ] hours	
		[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]							Very strong dark grey thinly laminated SILTSTONE fine-grained SANDSTONE and carbonate MUDSTONE with occasional fossils and calcite veins weathering Slightly weathered Localised oxide staining on fracture surfaces Clay in filling of fractures up to [ ] mm thick Fractures extremely closely spaced predominantly non-intact Fractures dip [ ] to [ ] degrees with planar smooth surfaces [ ] m - [ ] m No recovery [ ] m - [ ] m Fracture index - NI	

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<b>Groundwater:</b> Struck [ ] Rose to [ ] Water [ ] Sealed [ ] Comment [ ]	<b>Hole Information:</b> Diameter [ ] m Depth [ ] m Casing Diameter [ ] m Casing Depth [ ] m	<b>Chiselling:</b> Depths [ ] m Time [ ] h [ ] m [ ] s Tool Chisel
--	---	---

<b>Remarks:</b> Depth of water [ ] m Cable percussion terminated at [ ] m due to obstruction Borehole terminated at required depth [ ]	<b>Shift Data:</b>																				
<b>Equipment Methods:</b> [ ] and [ ] [ ] [ ] [ ] [ ] Base [ ] [ ] Compressed air-mist flush [ ]	<table border="1"> <tr> <th>Groundwater</th> <th>Shift</th> <th>Depth</th> <th>Remarks</th> </tr> <tr> <td>-</td> <td>[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]</td> <td>[ ] m</td> <td>Start of Borehole</td> </tr> <tr> <td>-</td> <td>[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]</td> <td>[ ] m</td> <td>End of shift</td> </tr> <tr> <td>-</td> <td>[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]</td> <td>[ ] m</td> <td>Start of shift</td> </tr> <tr> <td>-</td> <td>[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]</td> <td>[ ] m</td> <td>End of Borehole</td> </tr> </table>	Groundwater	Shift	Depth	Remarks	-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	Start of Borehole	-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	End of shift	-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	Start of shift	-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	End of Borehole
Groundwater	Shift	Depth	Remarks																		
-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	Start of Borehole																		
-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	End of shift																		
-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	Start of shift																		
-	[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]	[ ] m	End of Borehole																		













Priority Geotechnical  
 Tel: 0000 000000  
 Fax: 0000 000000  
 www.prioritygeotechnical.ie

Drilled By  
 G: AK  
 Logged By  
 AM SC

Borehole No  
**BH04**  
 Sheet 00

Project Name:  
 Bantry Bay Inner Harbour

Project No.  
 PC0000

Co-ords: 000000 - 000000N

Hole Type  
 Cable Rotary

Client: Bantry Bay Harbour Commissioners

Dates:  
 00000000

Level: -0000 m AO

Scale  
 0000

Well Backfill	Water Strikes	Rotary Coring					Casing Flush	Level m AO	Depth m	Stratum Description	Legend
		Depth m	TCR	SCR	R	Fractures					
									Remaining detail 0000m - 0000m 0000m - 0000m fracture index -NI		
									0000m - 0000m fracture index -NI		
									End of Borehole at 0000m		

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**Groundwater:**  
 Struck:  Rose to:  Water:  Sealed:  Comment:

**Hole Information:**  
 Hole depth: 0000m / 0000m  
 Casing diameter: 0000mm / 0000mm  
 Casing depth: 0000m / 0000m

**Chiselling:**  
 Depths: 0000m to 0000m  
 Time: 00:00 to 00:00  
 Tool: Chisel

**Remarks:** Depth of water 0000m. Cable percussion terminated at 0000m due to obstruction. Borehole terminated at required depth.

**Shift Data:** Groundwater: - / -  
 Shift: 00/00/0000  
 Casing depth: 0000m / 0000m  
 Remarks: Start of Borehole: 0000m / 0000m  
 End of Borehole: 0000m / 0000m

**Equipment Methods:**  ando   eltaBase   
 Compressed air-mist flush









































Priority Geotechnical  
 Tel: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]  
 Fax: [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]  
 [ ] [ ] [ ] prioritygeotechnical.ie

Drilled By  
 C  G  
 Logged By  
 AM

Borehole No  
**BH14**  
 Sheet [ ] of [ ]

<b>Project Name:</b> Bantry Bay Inner <input type="checkbox"/> Harbour	<b>Project No.:</b> PC [ ] [ ] [ ] [ ]	<b>Co-ords:</b> [ ] [ ] [ ] [ ] - [ ] [ ] [ ] [ ] N	<b>Hole Type:</b> Cable <input type="checkbox"/> Rotary
<b>Client:</b> Bantry Bay <input type="checkbox"/> Harbour Commissioners	<b>Dates:</b> [ ] [ ] [ ] [ ] [ ] [ ]	<b>Level:</b> - [ ] [ ] [ ] m AO [ ]	<b>Scale:</b> [ ] [ ]

Well Backfill	Water Strikes	Samples			In Situ Testing		Casing Flush	Level m AO	Depth m	Stratum Description	Legend
		Depth m	Type	Results							
		[ ] [ ] - [ ] [ ]	B	[ ] [ ] recovery					[ ] m dark grey slightly gravelly slightly sandy CLAY Sand is fine to medium Gravel is fine to medium sub-rounded		
		[ ] [ ] - [ ] [ ]	B						Medium dense cobbles of SILTSTONE		
		[ ] [ ] - [ ] [ ]	B CPT	N [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]					Chiselled from [ ] m to [ ] m		
		[ ] [ ] - [ ] [ ]	B CPT	[ ] [ ] [ ] [ ] [ ] or [ ] mm					Open hole boring - miller described Rock		
		[ ] [ ] - [ ] [ ]	CPT	[ ] [ ] [ ] [ ] [ ] or [ ] mm or [ ] mm					Weak to moderately weak grey thinly laminated MUDSTONE weathering slightly weathered frequent clay smearing along fracture surfaces fractures closely spaced dipping approximately [ ] degrees with planar smooth surfaces [ ] m [ ] m fracture index - [ ]		
		[ ] [ ] - [ ] [ ]	CPT	[ ] [ ] [ ] [ ] [ ] or [ ] mm					[ ] m - [ ] m fracture index - [ ]		
		[ ] [ ] - [ ] [ ]							End of Borehole at [ ] m		

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<b>Groundwater:</b> Struck <input type="checkbox"/> Rose to <input type="checkbox"/> Water <input type="checkbox"/> Sealed <input type="checkbox"/> Comment: No water encountered	<b>Hole Information:</b> Diameter [ ] m Casing depth [ ] m Casing diameter [ ] mm Casing depth [ ] mm	<b>Chiselling:</b> Depths [ ] m Time [ ] h [ ] m Tool [ ]
--	---	--

<b>Remarks:</b> Cable percussion terminated at [ ] m due to obstruction Borehole terminated due to obstruction	<b>Shift Data:</b> Groundwater [ ] Shift [ ] dd/mm/yyyy Casing depth [ ] m Start of Borehole [ ] m End of Borehole [ ] m
---	---

**Equipment Methods:**  ando  DeltaBase   
Compressed air-mist flush

















**Project Name:** Bantry Bay Inner Harbour

**E:** [ ] [ ] [ ] [ ]

**Date:**  
[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

**Location:** Bantry Co Cork

**N:** [ ] [ ] [ ] [ ]

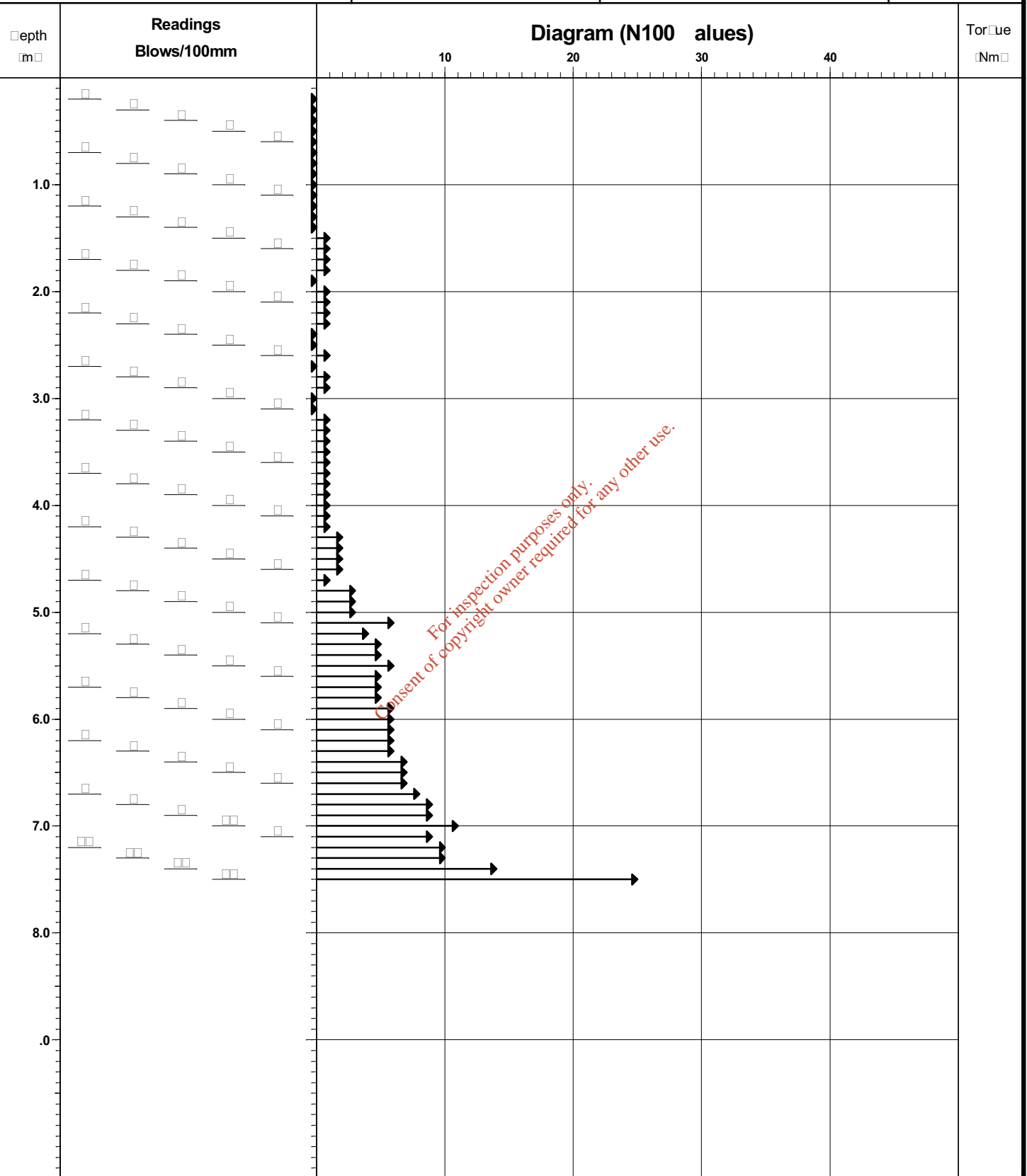
**Operated by:**

**Client:** Bantry Bay Harbour Commissioners

**Project No:** PC [ ] [ ] [ ] [ ]

**Level:** - [ ] [ ] [ ] m AO

L [ ]



**Remarks:** -

**Fall Height:** [ ] [ ]

**Cone Base Diameter:** [ ] [ ]

**Hammer Wt:** [ ] [ ] [ ] [ ]

**Final Depth:** [ ] [ ] [ ] [ ]

**Probe Type:** [ ] PS [ ]

**Log Scale:** [ ] [ ] [ ] [ ]

**Project Name:** Bantry Bay Inner Harbour

**E:** [ ] [ ] [ ] [ ]

**Date:**  
[ ] [ ] [ ] [ ] [ ] [ ]

**Location:** Bantry Co. Cork

**N:** [ ] [ ] [ ] [ ]

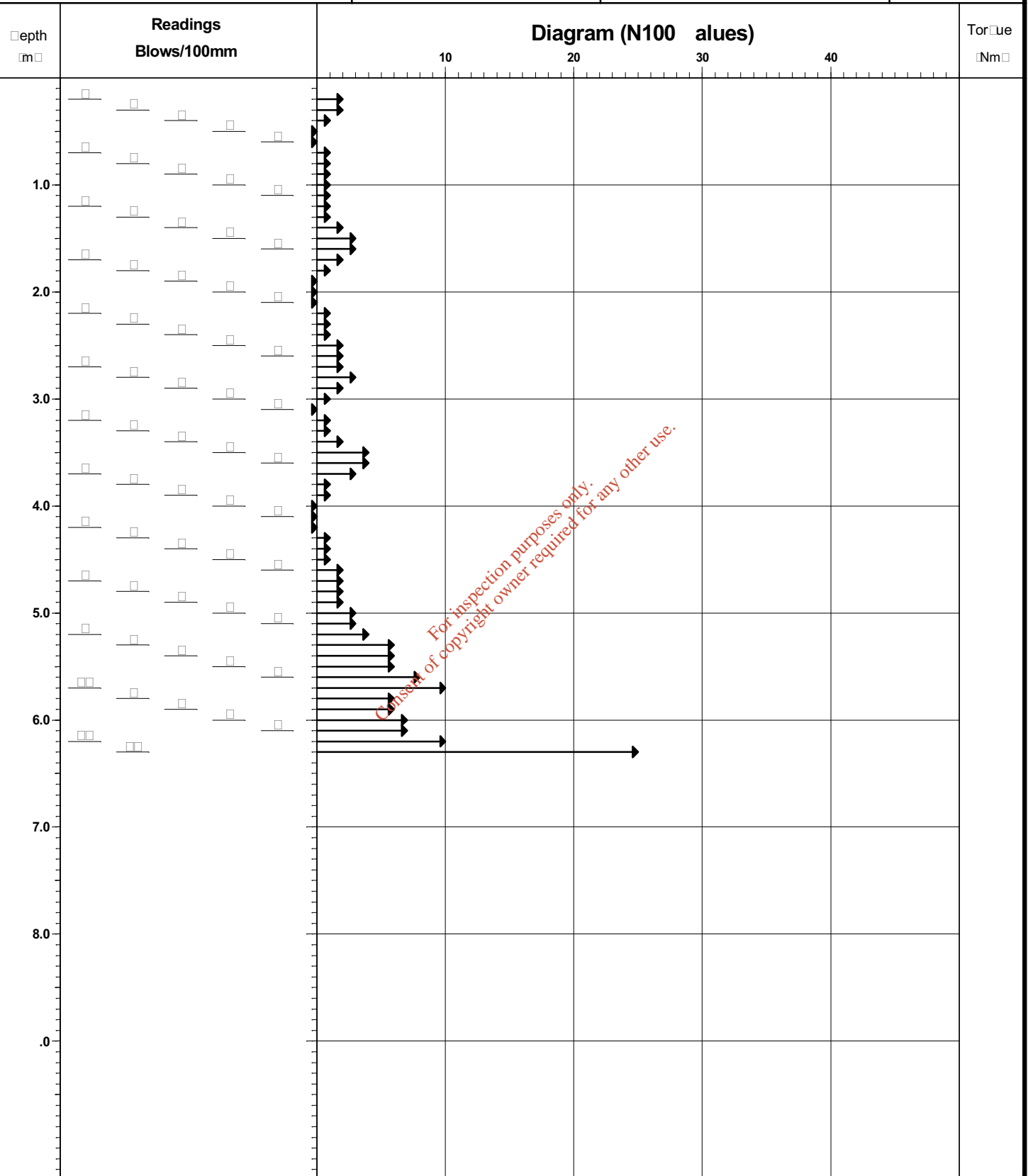
**Operated by:**

**Client:** Bantry Bay Harbour Commissioners

**Project No:** PC [ ] [ ] [ ] [ ]

**Level:** - [ ] [ ] [ ] m AO

L [ ]



**Remarks:** -

**Fall Height:** [ ] [ ]

**Cone Base Diameter:** [ ] [ ]

**Hammer Wt:** [ ] [ ] [ ] [ ]

**Final Depth:** [ ] [ ] [ ] [ ]

**Probe Type:** [ ] PS [ ]

**Log Scale:** [ ] [ ] [ ] [ ]









**Project Name:** Bantry Bay Inner Harbour

**E:** [ ] [ ] [ ] [ ]

**Date:**  
[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

**Location:** Bantry Co. Cork

**N:** [ ] [ ] [ ] [ ]

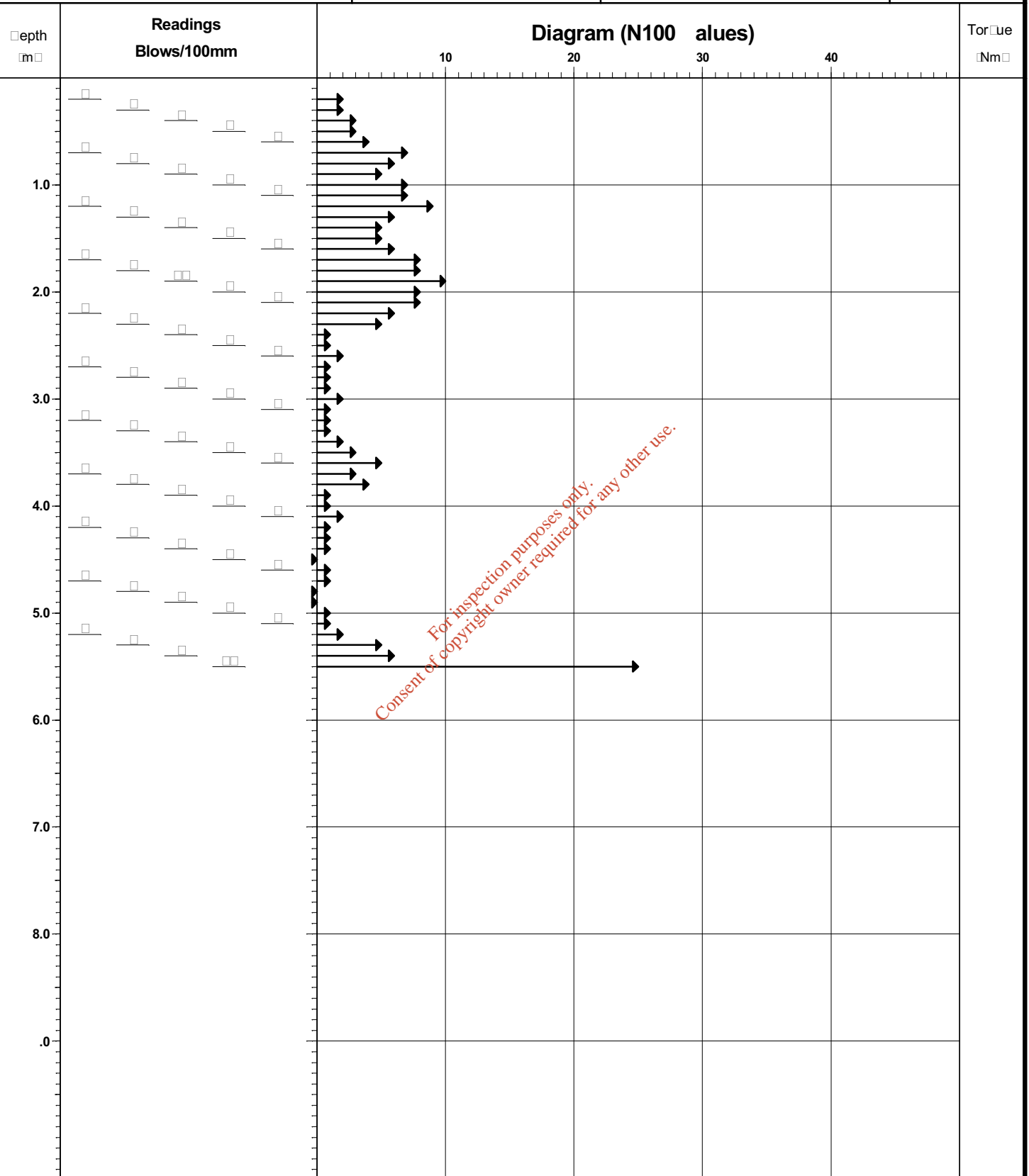
**Operated by:**

**Client:** Bantry Bay Harbour Commissioners

**Project No:** PC [ ] [ ] [ ] [ ]

**Level:** - [ ] [ ] [ ] m AO

L [ ]



**Remarks:** -

<b>Fall Height:</b> [ ] [ ]	<b>Cone Base Diameter:</b> [ ] [ ]
<b>Hammer Wt:</b> [ ] [ ] [ ] [ ]	<b>Final Depth:</b> [ ] [ ] [ ] [ ]
<b>Probe Type:</b> [ ] PS [ ]	<b>Log Scale:</b> [ ] [ ] [ ] [ ]



**Project Name:** Bantry Bay Inner Harbour

**E:** [ ] [ ] [ ] [ ]

**Location:** Bantry Co. Cork

**N:** [ ] [ ] [ ] [ ]

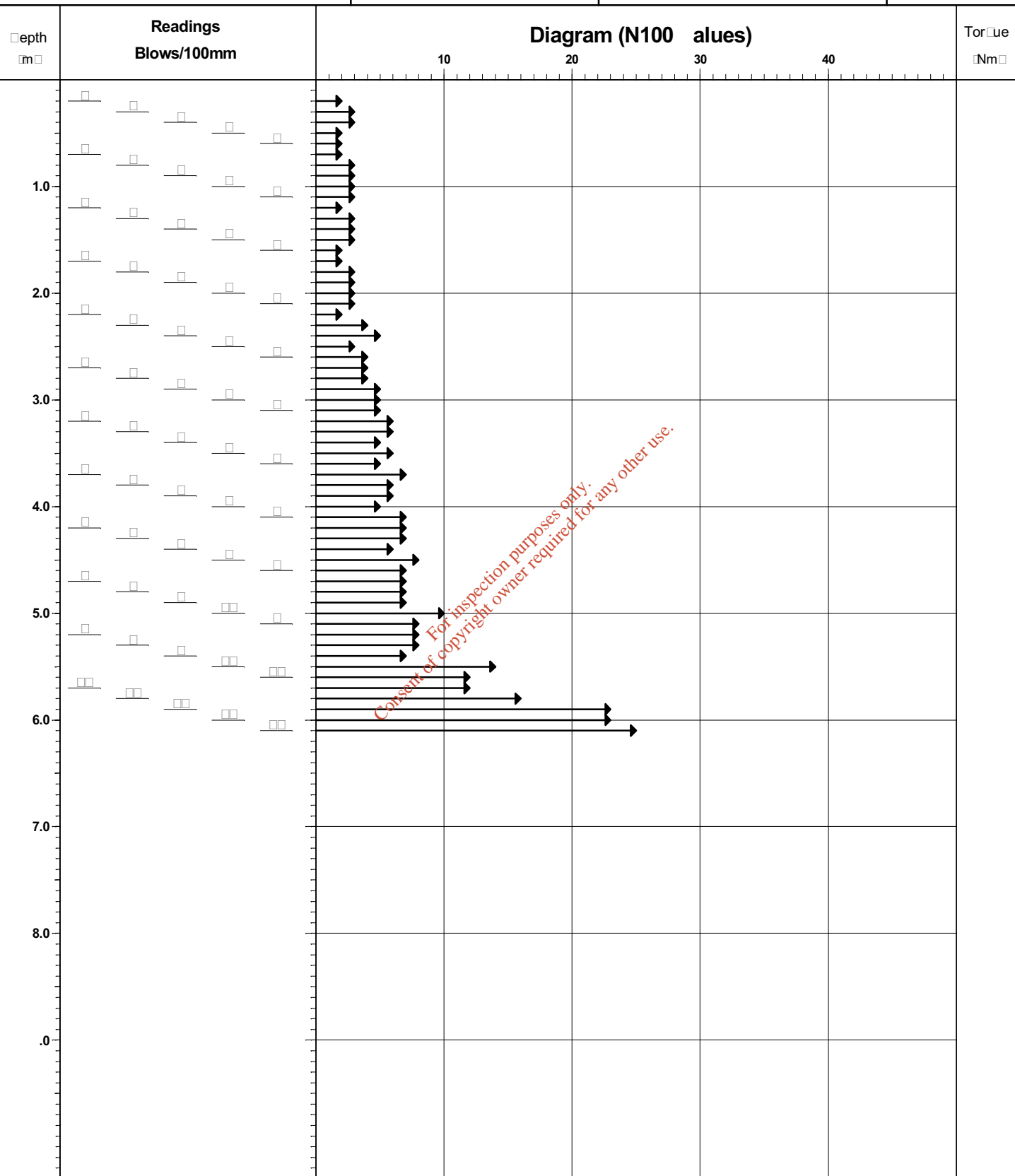
**Operated by:**

**Client:** Bantry Bay Harbour Commissioners

**Project No:** PC [ ] [ ] [ ] [ ]

**Level:** - [ ] [ ] [ ] m AO

L [ ]



**Remarks:** -

**Fall Height:** [ ] [ ]

**Cone Base Diameter:** [ ] [ ]

**Hammer Wt:** [ ] [ ] [ ] [ ]

**Final Depth:** [ ] [ ] [ ] [ ]

**Probe Type:** [ ] PS [ ]

**Log Scale:** [ ] [ ] [ ] [ ]





**Project Name:** Bantry Bay Inner Harbour

**E:** [ ] [ ] [ ] [ ]

**Date:**

[ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

**Location:** Bantry Co. Cork

**N:** [ ] [ ] [ ] [ ]

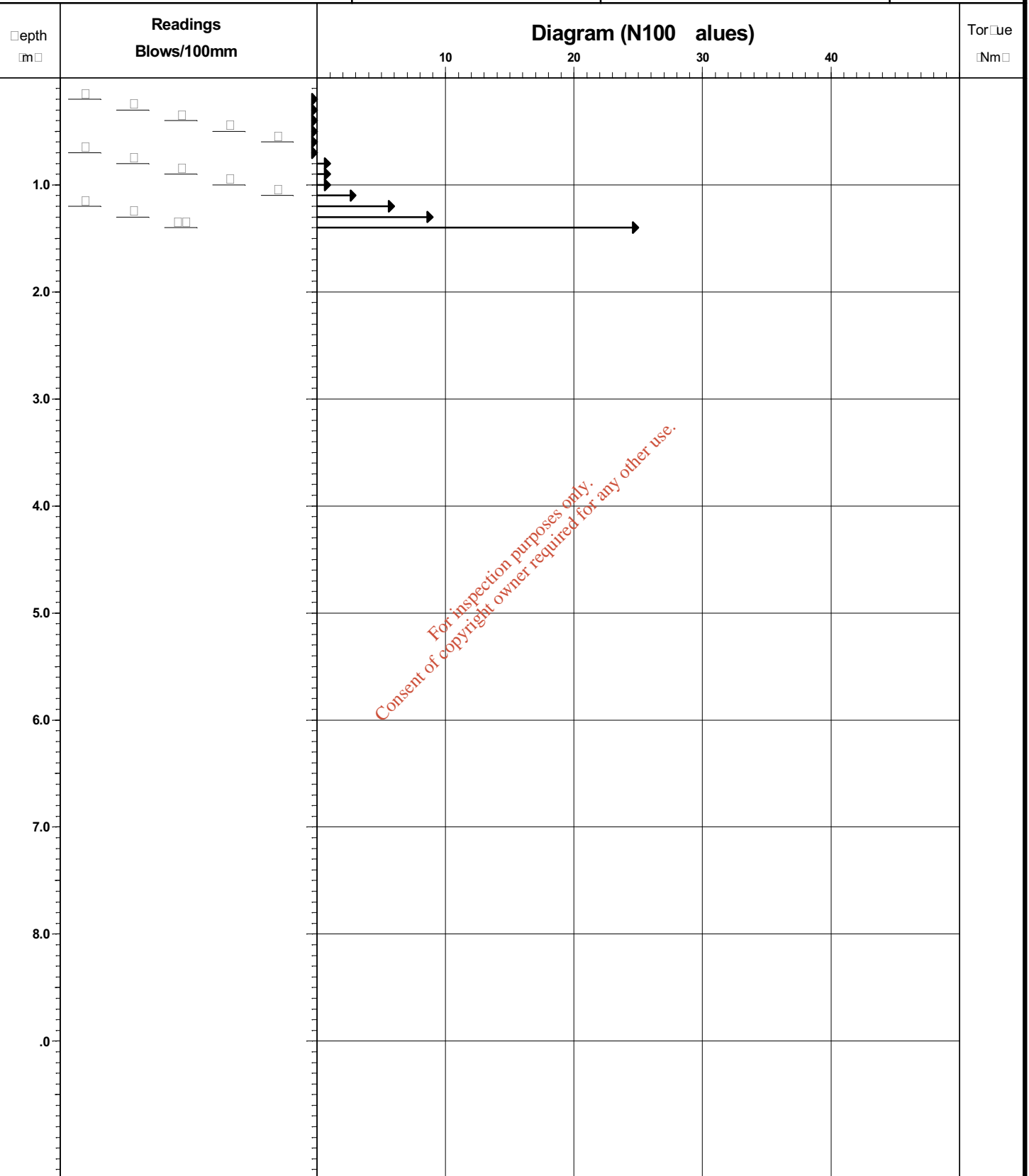
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**Client:** Bantry Bay Harbour Commissioners

**Project No:** PC [ ] [ ] [ ] [ ]

**Level:** - [ ] [ ] [ ] m AO

L [ ]



**Remarks:** -

**Fall Height:** [ ] [ ]

**Cone Base Diameter:** [ ] [ ]

**Hammer Wt:** [ ] [ ] [ ] [ ]

**Final Depth:** [ ] [ ] [ ] [ ]

**Probe Type:** [ ] PS [ ]

**Log Scale:** [ ] [ ] [ ] [ ]







Project Name: Bantry Bay Inner Harbour

E: [ ] [ ] [ ] [ ]

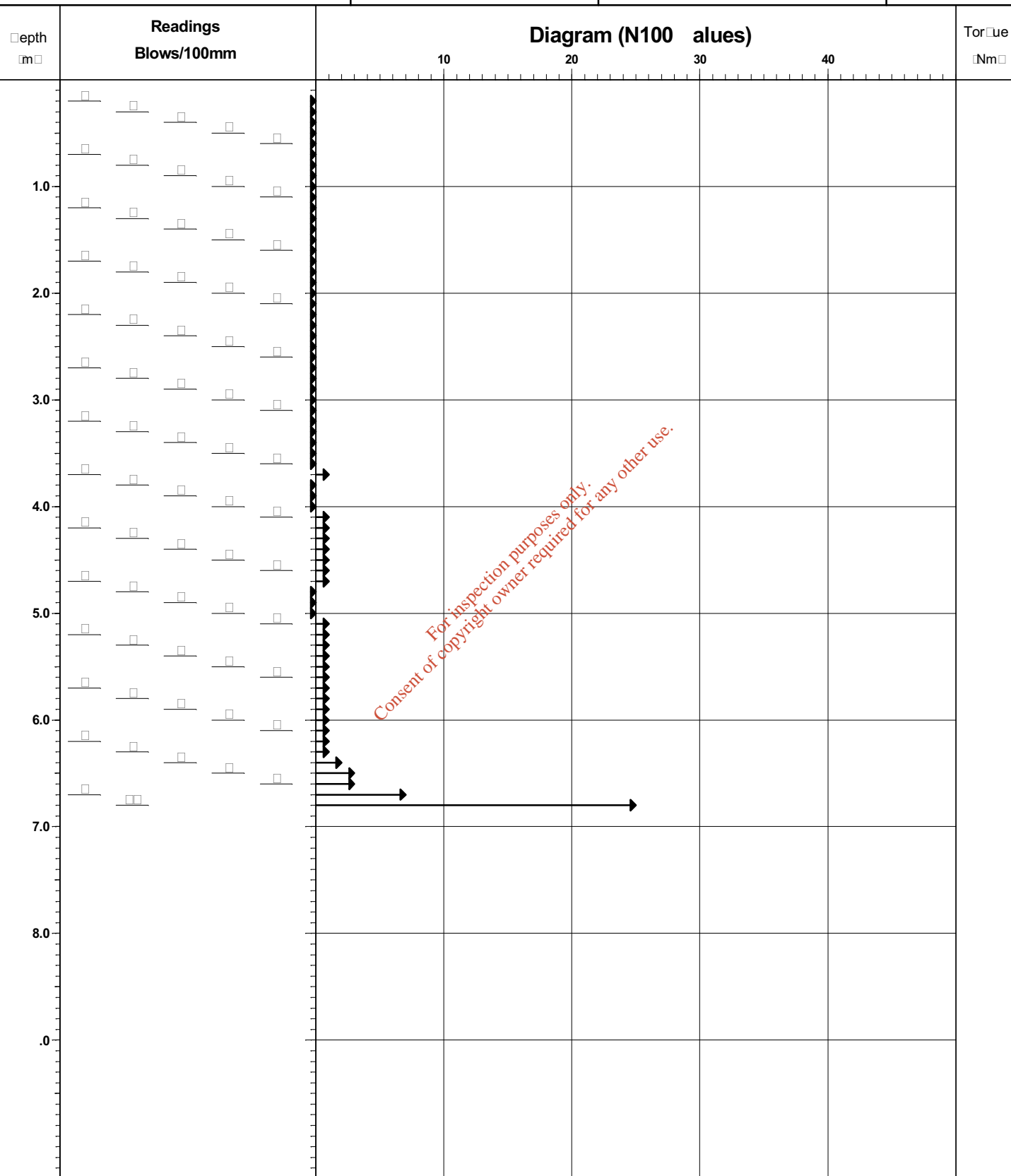
Location: Bantry Co Cork

N: [ ] [ ] [ ] [ ]

Client: Bantry Bay Harbour Commissioners

Project No: PC [ ] [ ] [ ] [ ]

Level: - [ ] [ ] [ ] m AO



Remarks: Water level [ ] [ ] [ ] m

Fall Height: [ ] [ ]

Cone Base Diameter: [ ] [ ]

Hammer Wt: [ ] [ ] [ ] [ ]

Final Depth: [ ] [ ] [ ]

Probe Type: [ ] PS [ ]

Log Scale: [ ] [ ] [ ]

Project Name: Bantry Bay Inner Harbour

E: [ ] [ ] [ ] [ ]

Date: [ ] [ ] [ ] [ ] [ ] [ ]

Location: Bantry Co Cork

N: [ ] [ ] [ ] [ ]

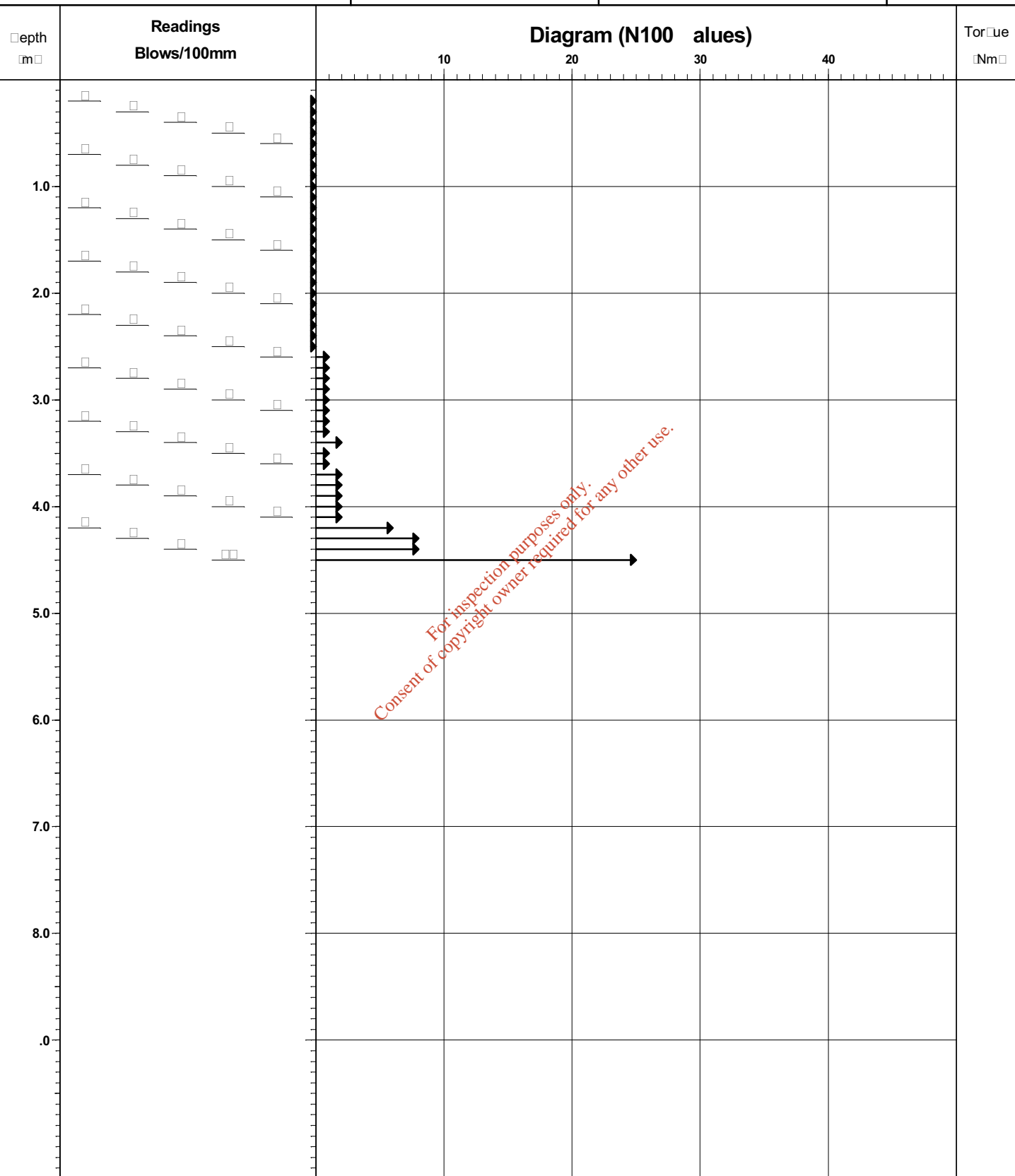
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Client: Bantry Bay Harbour Commissioners

Project No: PC [ ] [ ] [ ] [ ]

Level: - [ ] [ ] [ ] m AO

L [ ]



Remarks: Water level [ ] [ ] [ ] [ ] m

Fall Height: [ ] [ ]

Cone Base Diameter: [ ] [ ]

Hammer Wt: [ ] [ ] [ ] [ ]

Final Depth: [ ] [ ] [ ] [ ]

Probe Type: [ ] PS [ ]

Log Scale: [ ] [ ] [ ] [ ]

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**APPENDIX B**

**BATHYMETRIC SUB-BOTTOM PROFILE**

Bantry Inner Harbour Bathymetric  
Sub-bottom Profile Survey

Report prepared August

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**Bantry Inner Harbour  
Bathymetric & Sub-bottom Profile  
Survey Report**

**August –6<sup>th</sup> 2009**

**PH9012**

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**Client:**

Priority Geotechnical Ltd.  
Unit 12B  
Owenacurra Business Park  
Midleton, Co. Cork

**Prepared By:**

Hydrographic Surveys Ltd.,  
The Cobbles,  
Crosshaven,  
Co. Cork.

## Contents

<b>1. Introduction</b>	<b>3</b>
<b>2. Methodology</b>	<b>4</b>
<b>2.1 Horizontal Control</b>	<b>4</b>
<b>2.2 Vertical Datum</b>	<b>4</b>
<b>2.3 Bathymetric Survey</b>	<b>4</b>
<b>2.4 Sub-bottom Profile Survey</b>	<input type="checkbox"/>
<b>3. Results</b>	<input type="checkbox"/>
<b>3.1 Bathymetric Results</b>	<input type="checkbox"/>
<b>3.2 Sub-bottom Profiling Results</b>	<input type="checkbox"/>
<b>Appendix One</b>	<input type="checkbox"/>
<b>Equipment List and Specifications</b>	<input type="checkbox"/>
<b>List of Drawings</b>	
<b>HS 3000 Bathymetry</b>	<b>Scale 1:1000</b>
<b>HS 301A Tracé plot and Cross-section Location Plot</b>	<b>Scale 1:1000</b>
<b>HS 301B Interpreted Sediment Thickness</b>	<b>Scale 1:1000</b>
<b>HS 301C Interpreted Rock Head levels (CD)</b>	<b>Scale 1:1000</b>
<b>HS 301D Sub-bottom Cross-sections</b>	<b>Scale 1:1000</b>



## **1. Introduction:**

Hydrographic Surveys Ltd. was instructed by Priority Geotechnical Ltd, to undertake a bathymetric and sub-bottom profiling survey in Bantry Bay Inner Harbour. See drawing HS83\_A/09 for survey line locations. The survey was undertaken on 6<sup>th</sup> August 2009.

The main objectives of the geophysical survey were:

- To determine bathymetric levels to Chart Datum.
- To determine the depth to rock and overburden thickness

Results of the survey are presented in this report and associated drawings

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## **2. Methodology**

### **Horizontal Control:**

Horizontal control and grid was provided by DGPS using satellite broadcast corrections. The navigation unit used was the Trimble DGPS 132 model which provides sub-metre accuracy. The DGPS position was interfaced and logged to Hypack survey software which provides real-time line guidance and continuous logging of position.

The weather conditions were good throughout the acquisition period. Health and safety standards were adhered to at all times.

### **2.2 Vertical Datum**

Datum for the survey is Chart Datum as specified by the Client.

Tides were measured at Bantry Harbour using a Valeport 740 model vented tide gauge. This was installed on the pier in Bantry and recorded tidal height every 5 minutes for the duration of the survey. The tidal height results were reduced to Chart datum using a TBM of +4.31m CD.

### **2.3 Bathymetric Survey**

The ODOM hydrotrac digital echo sounder, used in high frequency mode, was used to record seabed levels in both digital and analogue form. The echosounder has a resolution of 0.01m and is calibrated on site by the bar-check method. The sounder was also interfaced into the Hypack 2008 survey software thereby providing a digital record with related position fixes.

Survey lines were undertaken along predetermined survey lines as specified by the client in drawing IBM0188\_T\_02\_REVA.dwg.

## **2.4 Sub-bottom Profile Survey**

The sub-bottom profiling survey was carried out using the Tritech Seanet System-SeaKing Sub-bottom Profiler. The SeaKing System utilizes CHIRP pulses as it wave source.

Positioning and line guidance were provided using the trimble DGPS unit and Hypack survey software as outlined in sections 2.1 above.

The bathymetric and sub-bottom profile surveys were undertaken concurrently.

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### 3. Results

#### 3.1 Bathymetric Result

The results from the bathymetric survey are plotted in Drawing HS: 83/09.

Contours have been added at 0.5m interval.

From the results it is clear the seabed deepens north and west of the pier outside the harbour. As one would expect much of the inner harbour is very shallow, lying above CD and dries out at Low Tide. The -1.5m contour covers the entire eastern section of the harbour. The southern survey line adjacent to the southern bank/wall ranges from -0.3m to -1.9 m CD. The northern bank ranges from 0m to -1.7m CD with a raised embankment extending out towards the centre of the harbour at the corner adjacent to the north section of XS9 (See HS: 83\_A/09).

#### 3.2 Sub-bottom Profiling Results

As requested by the client, survey line track plots with interpreted depth of sediment above rock level have been plotted in drawing HS: 83\_B/09. Due to a number of possible reasons a reflector representing rockhead was not identified in all of the survey lines. This may be due to reduced signal penetration and/or noise in some areas of the survey, signal absorption in the dense clay/peat layers or insufficient property contrast between two layers.

Where rockhead has not been identified, the depth of the deepest interpreted reflector has been plotted on Drawing HS: 83\_B/09.

The interpreted rockhead levels were reduced to Chart Datum and plotted on Drawing HS: 83\_C/09. It appears rock is closest to the surface along the eastern boundary of the

survey. In the rest of the harbour, where rock was interpreted it generally lies 4.1m-7.1m below the seabed surface. Rock levels appear to deepen moving towards the mouth and outside the harbour lying upto 11.7m below the seabed surface.

As requested, the results of this survey are also presented in cross-section form in chart: HS: 83\_D/09. Sub-bottom profile interpretation was undertaken with the aid of Borehole information provided by Priority Geotechnical Ltd. Logs were provided for the following Boreholes: BH05, BH08, BH09, BH10 and BH15. Boreholes that were crossed by/ or were adjacent to surveys lines have been added to the cross-sections.

A total of five independent reflectors were interpreted in the profiles. A near surface reflector has been marked in red and generally lies within 1m of the surface. This is likely to represent unconsolidated, seawater saturated sediments.

Silt, Sand and Clay layers have been interpreted underlying the surface layer with a Silt/Peat and Cobble layer present on Cross section 13 to the east of the survey boundary. Rockhead has been interpreted directly below this Silt/peat and cobble layer on Cross-section 13.

Generally on the other cross-sections additional layers of Silts and Peats were interpreted before a rockhead layer.

The interpretative nature and the non-invasive survey methods must be taken into account when considering the results of this survey and Hydrographic Surveys Ltd., while using appropriate practice to execute, interpret and present the data, give no guarantees in relation to the existing subsurface.

## Appendix One

### Equipment List and Specifications

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## **Equipment List and Technical Specifications**

### **Navigation**

Trimble AgDGPS 132. This unit provides sub-metre differential position accuracy. The L-band satellite receiver uses a Trimble developed, sensitive design to provide coverage across the entire satellite footprint.

### **Bathymetry**

ODOM Hydrotrac digital echosounder

Hypack 2008 survey software.

The navigation can be interfaced into this software package to provide real-time line guidance and continuous logging of position in both Latitude and Longitude and Irish National Grid.

### **Tide Gauge:**

Valeport model 740 with vented transducer

### **Sub-Bottom Profiler**

Tritech Seanet System-SeaKing Sub-bottom Profiler. The SeaKing System utilizes CHIRP pulses as its wave source. SeaNet Pro was utilized as Data acquisition software and interfaced with the Trimble AgDGPS 132 output.

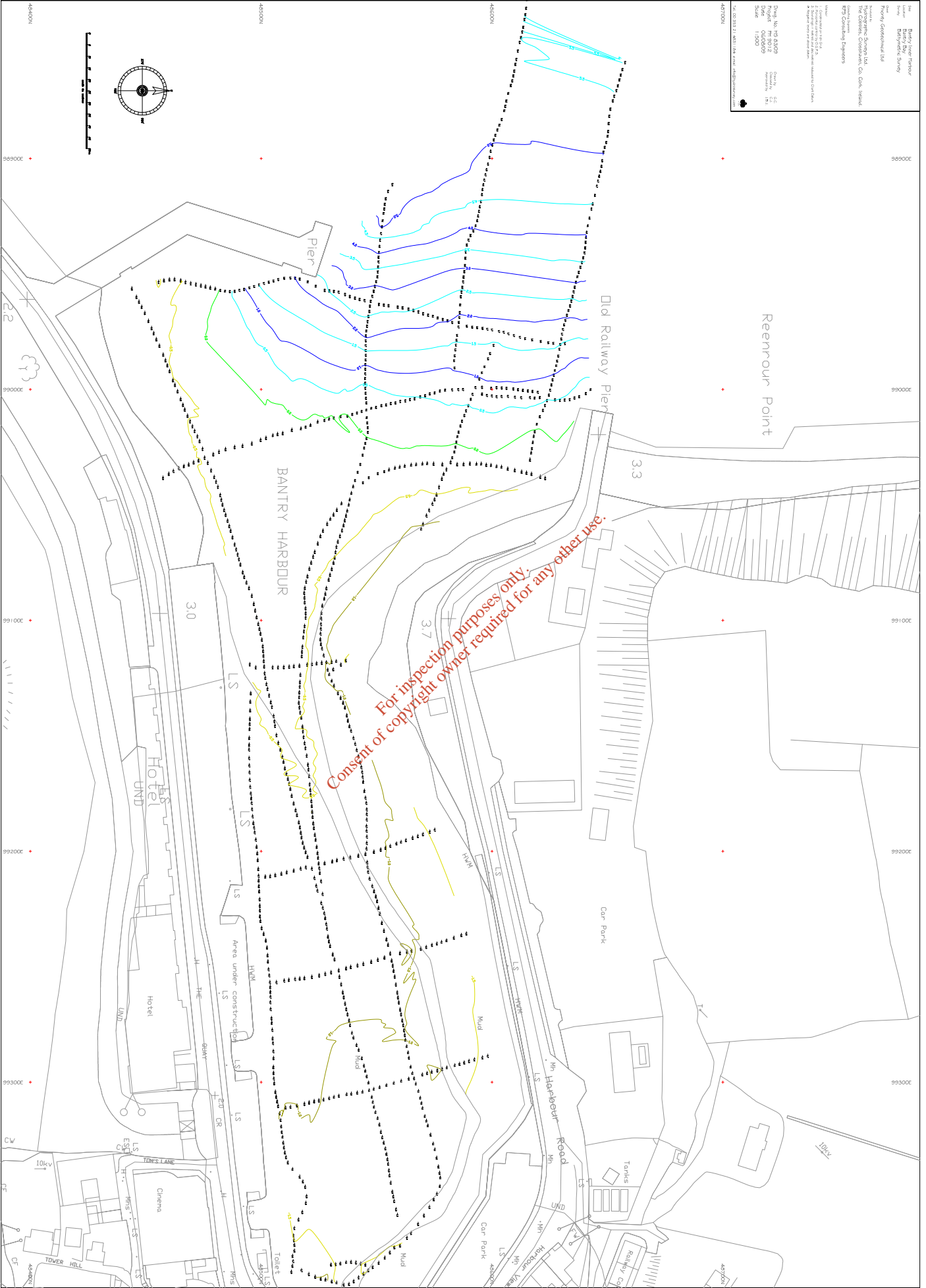
All charts are produced in Autocad Format.

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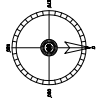
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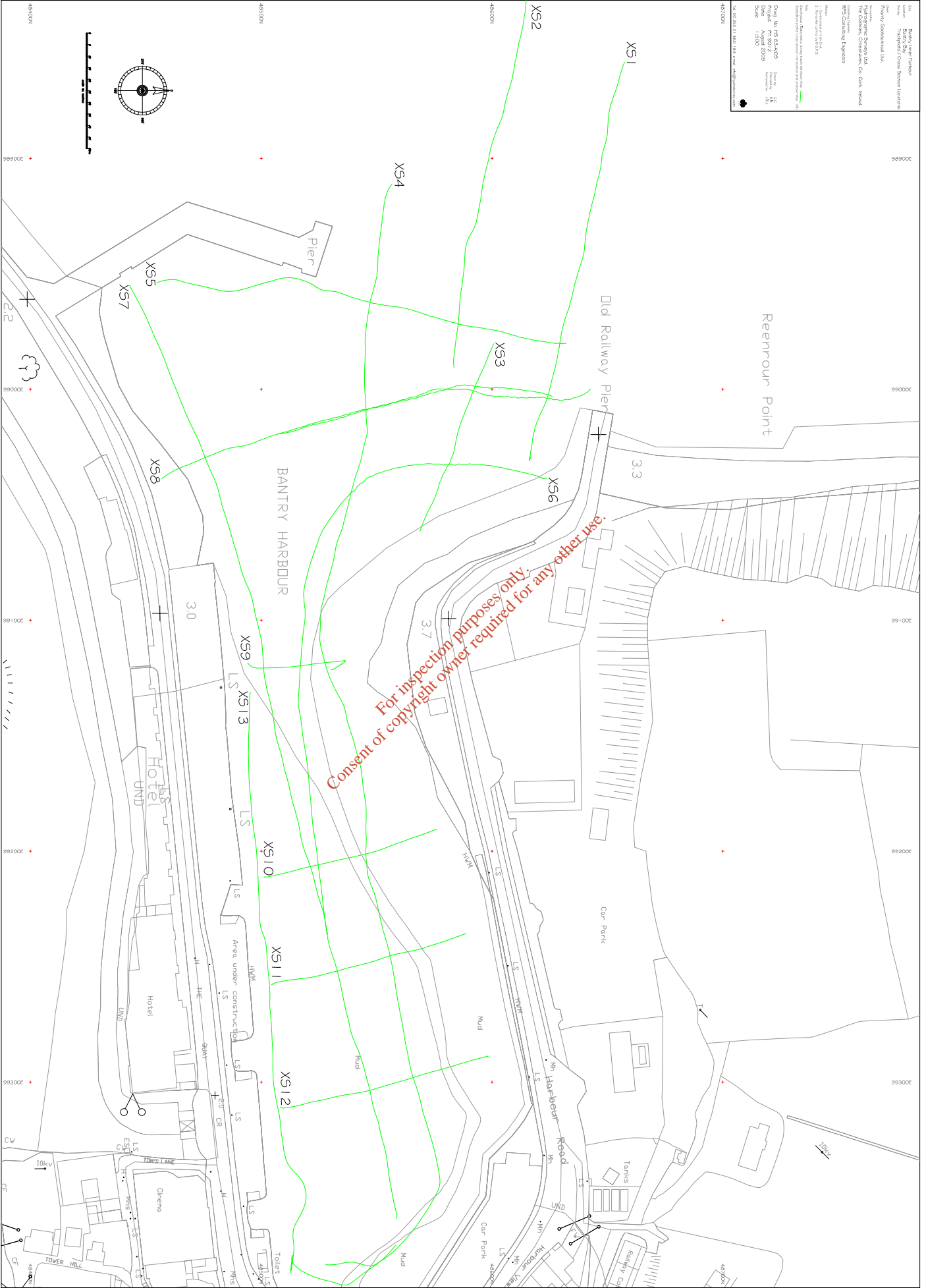
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 User: Bantry Bay  
 Title: Bathymetric Survey  
 Priority: Generalist Ltd  
 Surveyed: 2015  
 Project: 15000  
 Date: 15/06/15  
 Drawn: 15/06/15  
 Project: 15000  
 Date: 15/06/15  
 Scale: 1:5000  
 Project: 15000  
 Date: 15/06/15  
 Scale: 1:5000



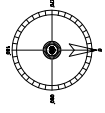
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 User: Bantry Bay  
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 Priority: Generalist List  
 Drawn: 11/05/09  
 Checked: 11/05/09  
 Project: PM 5012009  
 Scale: 1:5000  
 Date: 11/05/09  
 Drawing No: MS 63.4/09  
 Project: PM 5012009  
 Scale: 1:5000  
 Date: 11/05/09  
 Drawing No: MS 63.4/09  
 Project: PM 5012009  
 Scale: 1:5000  
 Date: 11/05/09









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## APPENDIX C

### LABORATOR RESULTS

Key to Laboratory Results

Key

Natural Moisture Content

Atterberg Limit

Grading analysis

Loss on Ignition

Organic Content

Undrained Triaxial Compression

Shear Box

Triaxial Compression - CU

Oedometer consolidation

Marine Sediment Analysis

UCS

Point Load

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## KEY TO SYMBOLS ON LABORATORY TEST RESULTS SHEETS

U	Undisturbed Sample	
P	Piston Sample	
TWS	Thin Wall Sample	
B	Bulk Sample - Disturbed	
D	Jar Sample - Disturbed	
W	Water Sample	
pH	Acidity/Alkalinity Index	
SO <sub>3</sub>	% - Total Sulphate Content (acid soluble)	
SO <sub>3</sub>	g/ltr - Water Soluble Sulphate (Water or 2:1 Aqueous Soil Extract)	
+	Calcareous Reaction	
Cl	Chloride Content	
PI	Plasticity Index	
<425	% of material in sample passing 425 micron sieve	
LL	Liquid Limit	
PL	Plastic Limit	
MC	Water Content	
NP	Non Plastic	
γ <sub>b</sub>	Bulk Density	
γ <sub>d</sub>	Dry Density	
P <sub>s</sub>	Particle Density	
U/D	Undrained/Drained Triaxial	
U/C	Unconsolidated/Consolidated Triaxial	
T/M	Single Stage/Multistage Triaxial	
100/38	Sample Diameter (mm)	
REM	Remoulded Triaxial Test Specimen	
TST	Triaxial Suction Test	
V	Vane Test	
DSB	Drained Shear Box	
RSB	Residual Shear Box	
RS	Ring Shear	
σ <sub>3</sub>	Cell Pressure	
σ <sub>1</sub> -σ <sub>3</sub>	Deviator Stress	
c	Cohesion	
c <sub>-</sub>	Effective Cohesion Intercept	
φ	Angle of Shearing Resistance - Degrees	
φ <sub>-</sub>	Effective Angle of Shearing Resistance	
ε <sub>f</sub>	Strain at Failure	
*	Failed under 1st Load	
**	Failed under 2nd Load	
#	Untestable	
##	Excessive Strain	
p <sub>o</sub>	Effective Overburden Pressure	
m <sub>v</sub>	Coefficient of Volume Decrease	
c <sub>v</sub>	Coefficient of Consolidation	
Opt	Optimum	
Nat	Natural	
Std	Standard Compaction - 2.5kg Rammer	(¶ CBR)
Hvy	Heavy Compaction - 4.5kg Rammer	(§ CBR)
Vib	Vibratory Compaction	
CBR	California Bearing Ratio	
Sat m.c.	Saturation Moisture Content	
MCV	Moisture Condition Value	

Laboratory Symbols	Project	Contract
		Figure





# Natural Moisture Content/Atterberg Limits Summary

Job Ref

BS 1377 : Part 2 : 1990 : Clause 3

Location

Bantry Bay Inner Harbour

PC9030

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH01	8	1.5	D	Very sandy very silty GRAVEL with occasional cobbles	28				
BH01	11	2	B	Very sandy very silty GRAVEL with occasional cobbles		72	47	25	76.2
BH01	12	2.5	D	Slightly gravelly sandy organic SILT	79				
BH01	14	3	B	Slightly gravelly sandy SILT		73	41	32	88.8
BH01	16	3.5	D	Slightly sandy gravelly SILT with some cobbles	60				
BH01	18	4	B	Slightly sandy gravelly SILT with some cobbles		96	55	41	44.9
BH01	20	4.5	D	Slightly gravelly organic SILT	22				
BH01	23	5.5	D	Slightly sandy slightly gravelly organic SILT	76				
BH01	24	6	B	Very silty very sandy GRAVEL		135	88	47	82.5
BH01	26	6.5	D	Slightly gravelly organic SILT	119				
BH01	27	7	B	Slightly gravelly organic SILT		131	79	52	67.8
BH01	29	7.5	D	Slightly gravelly organic SILT	73				
BH01	31	8	B	Very sandy very silty GRAVEL		72	48	24	67.6
BH02	1	0	B	Very silty very gravelly SAND		64	38	26	70.7
BH02	2	0.5	D	Very silty very gravelly SAND	30				
BH03	1	0	B	Very silty very sandy GRAVEL		72	49	23	67
BH03	3	0.35	D	Slightly sandy slightly organic SILT	52				
BH04	1	0	B	Slightly gravelly sandy SILT		84	53	31	96.6
BH04	3	0.5	D	Slightly gravelly sandy organic SILT	73				
BH04	11	2.5	B	Slightly gravelly slightly sandy CLAY		47	27	20	96.1
BH04	12	2.5	D	Slightly gravelly slightly sandy CLAY	33				
BH04	16	3.5	D	Slightly sandy gravelly CLAY	13				



# Natural Moisture Content/Atterberg Limits Summary

Job Ref

BS 1377 : Part 2 : 1990 : Clause 3

Location

Bantry Bay Inner Harbour

PC9030

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH05	1	0	B	Slightly gravelly SILT		44	NP	NP	77.1
BH05	4	1	D	Slightly gravelly slightly sandy CLAY	29				
BH05	5	1.5	B	Slightly gravelly slightly sandy SILT		42	27	15	98.1
BH05	7	2	D	Slightly gravelly slightly sandy CLAY	35				
BH05	10	3	D	COBBLES with much gravel	32				
BH05	11	3.5	B	COBBLES with much gravel		35	21	14	55.5
BH05	12	4	D	COBBLES with much gravel	17				
BH06	2	1.5	B	Slightly gravelly sandy CLAY with some cobbles	21				
BH07	2	1.5	B	Silty SILT	33	72	45	27	51
BH07	10	3.5	B	Very silty very gravelly SAND	48	67	42	25	68.7
BH07	13	4.15	D	Silty very gravelly SAND	81				
BH07	23	8	D	Slightly sandy SILT	39				
BH07	25	8.5	B	Slightly sandy SILT	37	45	29	16	100
BH07	28	9.45	D	Slightly sandy SILT	39				
BH08	9	2	D	Slightly sandy gravelly CLAY with some cobbles	34				
BH08	10	2.5	D	Slightly sandy slightly gravelly organic SILT	90				
BH08	12	3	B	Slightly sandy slightly gravelly organic SILT		105	73	32	88.3
BH08	14	3.5	D	Slightly sandy slightly gravelly organic SILT	85				
BH08	17	4.5	D	Slightly sandy slightly gravelly organic SILT	26				
BH08	19	5	B	Slightly sandy slightly gravelly organic SILT		42	28	14	84.4
BH08	20	5.5	D	CLAY	29				
BH08	22	6	B	CLAY		41	23	18	41.3



# Natural Moisture Content/Atterberg Limits Summary

Job Ref

BS 1377 : Part 2 : 1990 : Clause 3

Location

Bantry Bay Inner Harbour

PC9030

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH11	5	1	B	Slightly sandy slightly gravelly CLAY		39	22	17	67.9
BH11	7	6	B	Slightly sandy slightly gravelly CLAY		34	21	13	62.9
BH12	2	1.5	B	Slightly gravelly sandy SILT	65	67	44	23	90.4
BH12	3	2	D	Slightly gravelly sandy SILT	73				
BH12	9	3	D	Sandy organic SILT	91				
BH12	10	3.5	B	Sandy organic SILT	118	117	81	36	97.8
BH12	19	7	B	Slightly sandy slightly gravelly SILT	28	38	24	14	93.1
BH12	20	7.5	D	Slightly sandy slightly gravelly CLAY	29				
BH12	21	7.5	D	Slightly sandy slightly gravelly CLAY	30				
BH13	2	1.5	B	Slightly sandy gravelly CLAY with some cobbles	17	31	19	12	65
BH14	2	1.5	B	Very silty very gravelly SAND with many cobbles	32	38	NP	NP	85.3
BH14	6	5	D	Slightly gravelly sandy organic SILT	65				
BH14	8	5.95	D	Slightly gravelly sandy organic SILT	93				
BH14	9	6	B	Slightly gravelly sandy organic SILT	100	111	72	39	95.4
BH14	17	9	B	Slightly gravelly slightly sandy CLAY	33	43	26	17	93.2
BH15	4	1.5	D	Slightly gravelly slightly sandy SILT	24				
BH15	7	2.5	B	Slightly sandy organic SILT		90	48	42	90.1
BH15	8	2.5	D	Slightly sandy slightly organic SILT	49				
BH15	13	3.5	D	Slightly sandy organic SILT	78				
BH15	3	4	B	Slightly gravelly slightly sandy SILT		62	41	21	92
BH15	17	4.5	D	Silty PEAT	132				
BH15	20	5.5	B	Slightly gravelly sandy organic SILT		111	66	45	91.7



# Natural Moisture Content/Atterberg Limits Summary

Job Ref

BS 1377 : Part 2 : 1990 : Clause 3

Location

Bantry Bay Inner Harbour

PC9030

Hole ID	Sample Ref	Depth (m)	Sample Type	Sample Description	MC	LL	PL	PI	% Pass 425
BH15	21	5.5	D	Slightly gravelly sandy organic SILT	82				
BH15	23	6.5	D	Slightly gravelly CLAY	26				
BH15	25	7.5	B	Slightly gravelly slightly sandy SILT with many cobbles		44	29	15	96.1
BH15	26	7.5	D	Slightly gravelly slightly sandy CLAY with many cobbles	31				
BH17	7	7.1	B	Slightly sandy gravelly CLAY with some cobbles		35	23	12	53
BH17	8	7.4	D	Slightly sandy gravelly SILT with some cobbles	24				

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# PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

**Job Ref**                      **PC9030**

Borehole / Pit No            **BH01**

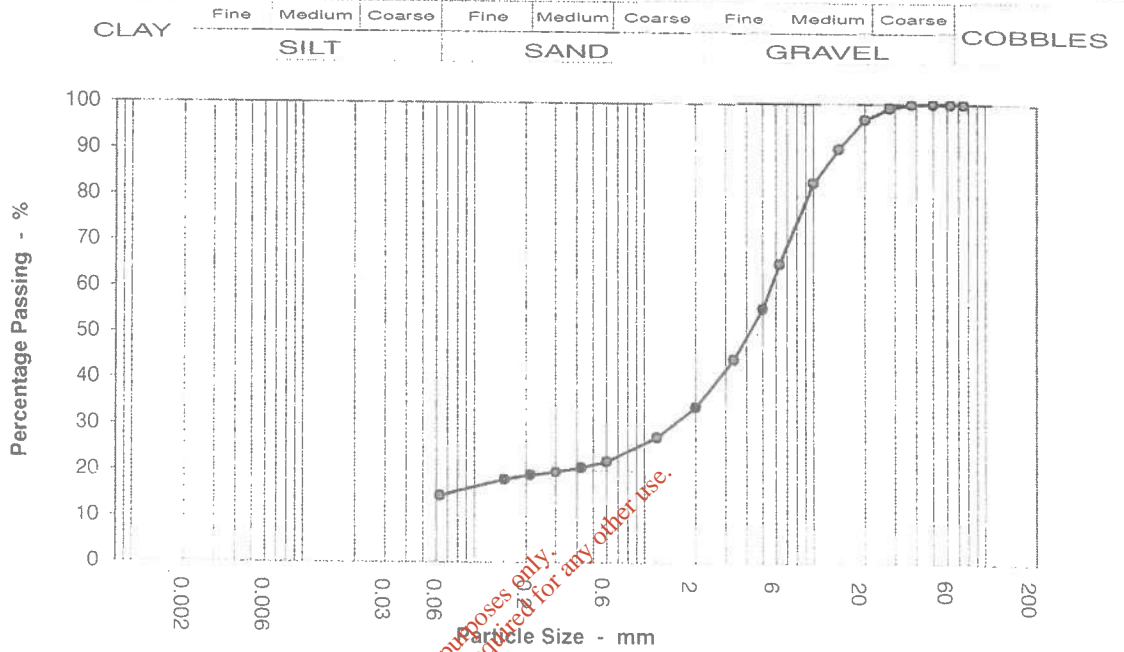
**Location**                      **Bantry Bay Inner Harbour**

Sample No                      **6**

**Soil Description**            **Silty very sandy GRAVEL**

Depth                            **1.00 m**

Sample type                    **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	97		
14	90		
10	83		
6.3	65		
5	55		
3.35	44		
2	34		
1.18	27		
0.6	22		
0.425	21		
0.3	20		
0.212	19		
0.15	18		
0.063	14		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	66.1
Sand	19.5
Silt & Clay	14.4

Grading Analysis	
D100	125.000
D60	5.617
D10	
Uniformity Coefficient	N/A

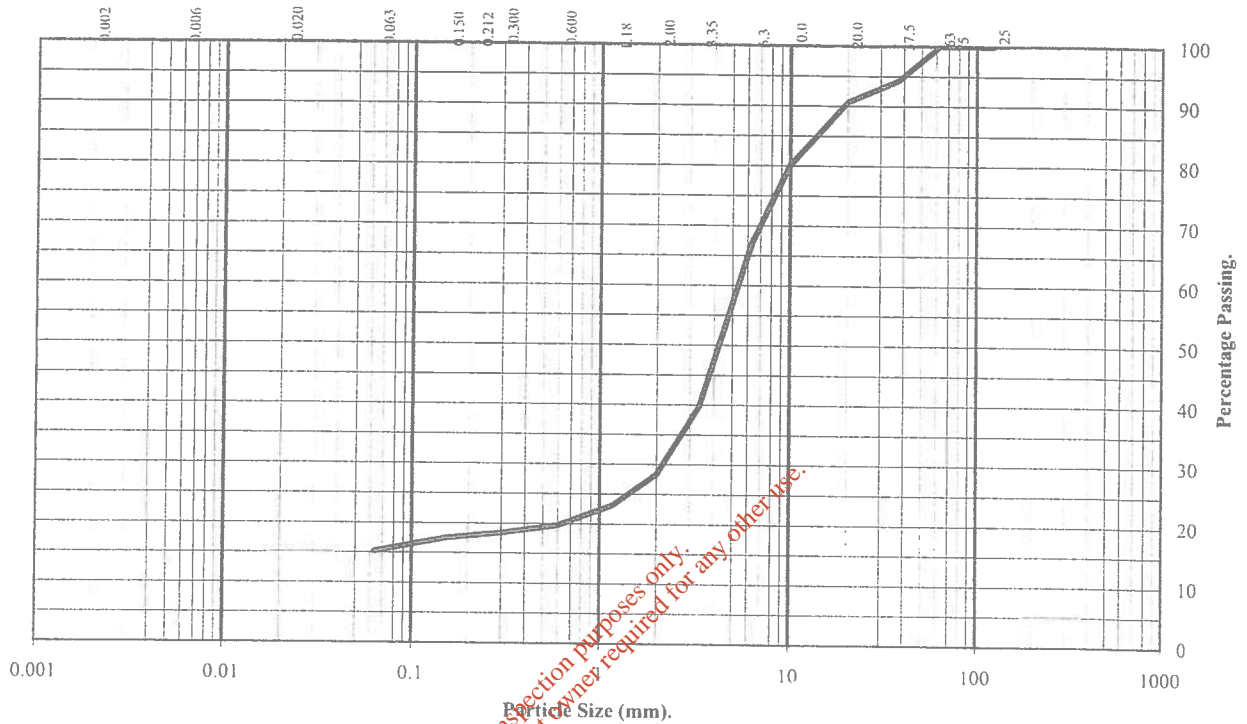
# PARTICLE SIZE DISTRIBUTION TEST

BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Hole Number: **BH01**

Depth (m): **1.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
38	94
20	91
10	80
6.3	67
3.35	40
2.00	28
1.18	23
0.60	20
0.30	18
0.21	18
0.15	17
0.06	15

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#

Soil Fraction	Total Percentage
Cobbles	0
Gravel	72
Sand	13
Silt and Clay	15

**Remarks:**

#- not determined

*Alan Walters* 14/01/10  
Checked by Date

*[Signature]* 14/01/10  
Approved by Date



**Bantry Inner Harbour**

Contract No.:  
8847/09  
Client Ref No:  
PC9030







# PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

**Job Ref**                    **PC9030**

Borehole / Pit No            **BH01**

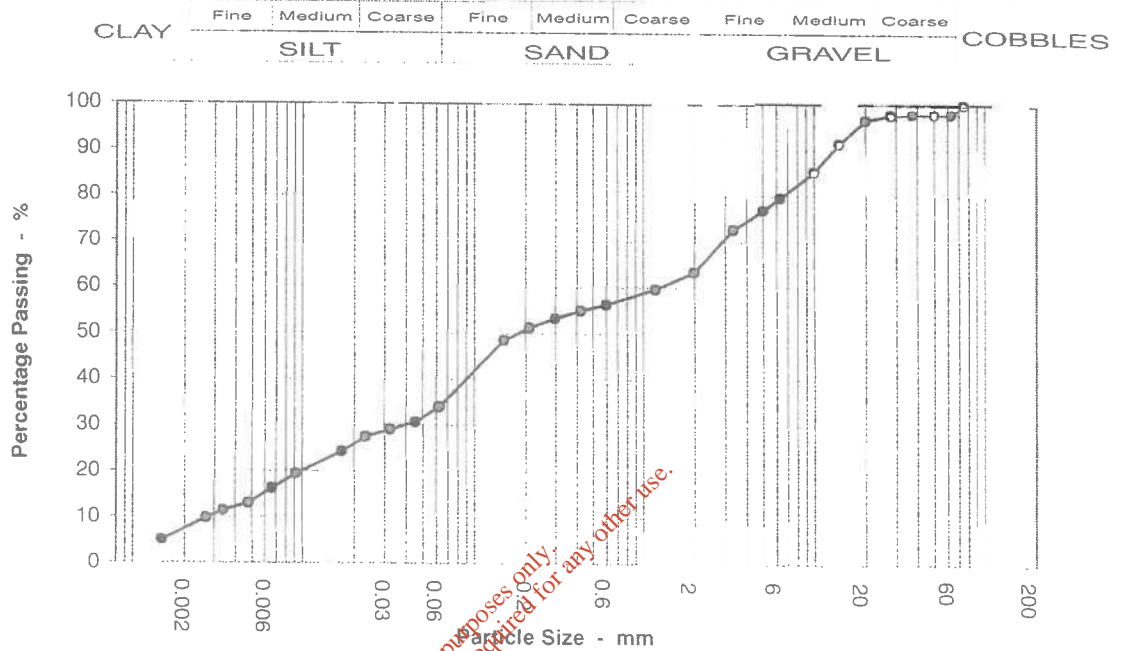
**Location**                    **Bantry Bay Inner Harbour**

Sample No                    **11**

**Soil Description**            **Very sandy very silty GRAVEL with occasional cobbles**

Depth                         **2.00 m**

Sample type                 **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.062	34
90	100	0.045	31
75	100	0.033	29
63	98	0.023	27
50	98	0.017	24
37.5	98	0.009	19
28	98	0.007	16
20	97	0.005	13
14	91	0.003	11
10	85	0.003	10
6.3	79	0.002	5
5	77		
3.35	73		
2	63		
1.18	59		
0.6	56		
0.425	55		
0.3	53		
0.212	51		
0.15	48		
0.063	34		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	2.0
Gravel	34.8
Sand	29.8
Silt	26.5
Clay	6.8

Grading Analysis	
D100	125.000
D60	1.292
D10	0.003
Uniformity Coefficient	453



# PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

**Job Ref**

**PC9030**

Borehole / Pit No

BH01

Location

**Bantry Bay Inner Harbour**

Sample No

14

Soil Description

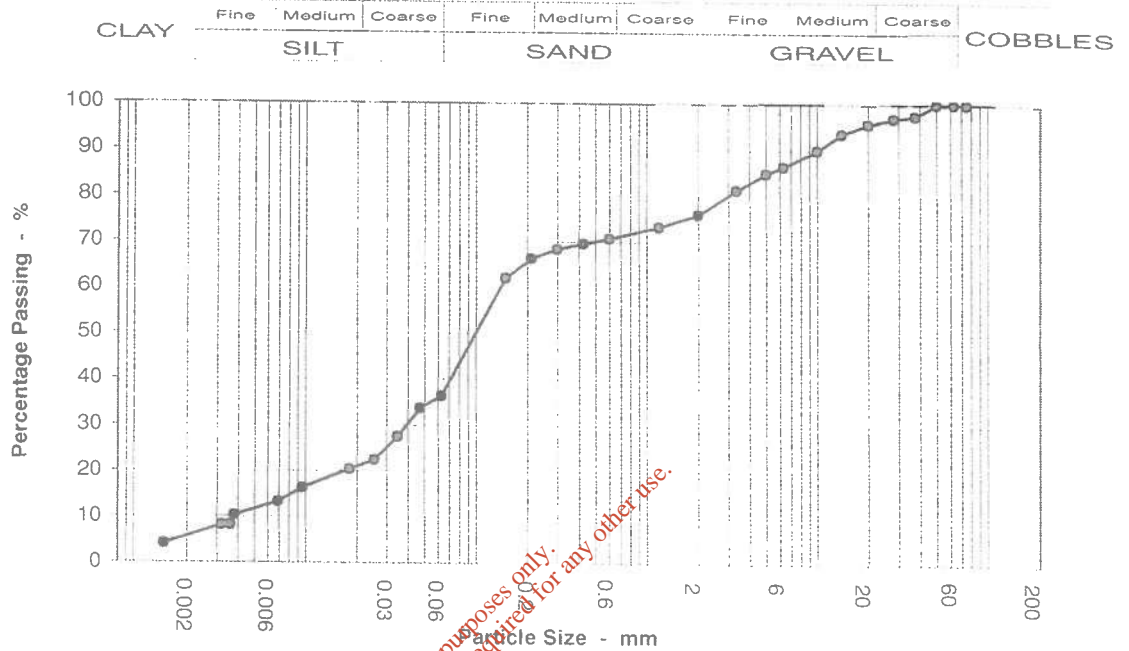
Slightly gravelly sandy SILT

Depth

3.00 m

Sample type

B



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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	36
90	100	0.047	34
75	100	0.035	28
63	100	0.025	22
50	100	0.018	20
37.5	98	0.010	16
28	97	0.007	13
20	96	0.004	10
14	94	0.004	8
10	90	0.003	8
6.3	86	0.002	4
5	85		
3.35	81		
2	76		
1.18	73		
0.6	71		
0.425	70		
0.3	68		
0.212	66		
0.15	62		
0.063	36		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	24.1
Sand	40.1
Silt	30.5
Clay	5.3

Grading Analysis	
D100	125.000
D60	0.143
D10	0.004
Uniformity Coefficient	38





# PARTICLE SIZE DISTRIBUTION

**BS 1377 : Part 2 : 1990 : Clause 9**

**Job Ref**                      **PC9030**

Borehole / Pit No            **BH01**

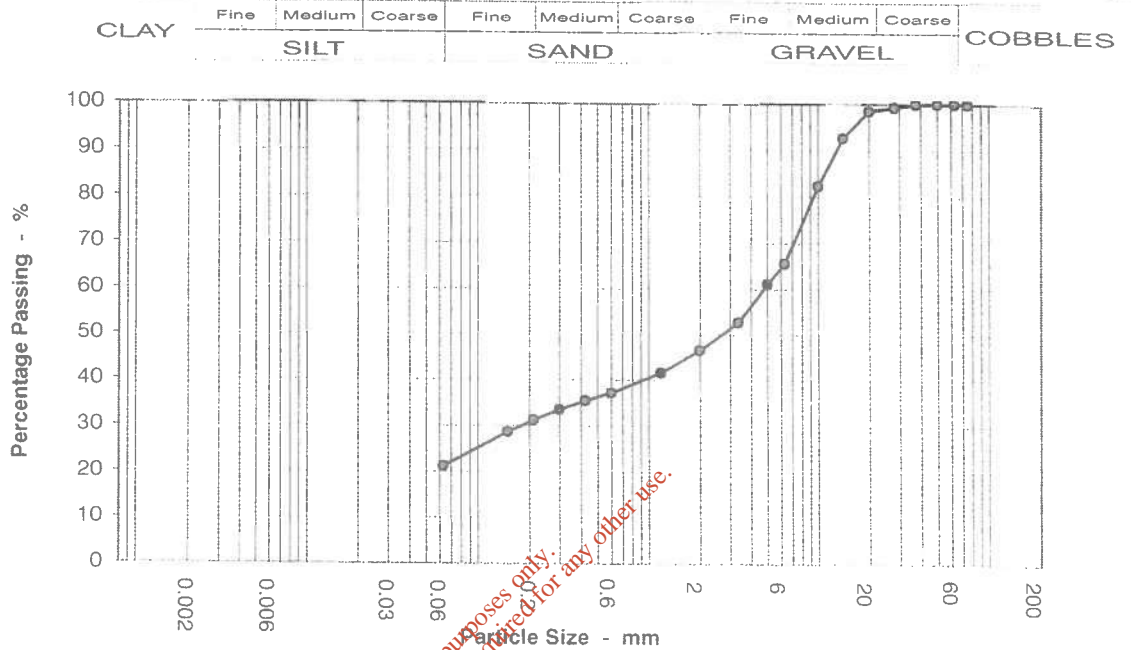
Location                                      **Bantry Bay Inner Harbour**

Sample No                                  **24**

Soil Description                              **Very silty very sandy GRAVEL**

Depth    **6.00      m**

Sample type                                      **B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	99		
14	93		
10	82		
6.3	65		
5	61		
3.35	53		
2	46		
1.18	41		
0.6	37		
0.425	35		
0.3	33		
0.212	31		
0.15	29		
0.063	21		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	53.5
Sand	25.3
Silt & Clay	21.2

Grading Analysis	
D100	125.000
D60	4.809
D10	
Uniformity Coefficient	N/A



# PARTICLE SIZE DISTRIBUTION

**BS 1377 : Part 2 : 1990 : Clause 9**

**Job Ref**                      **PC9030**

Borehole / Pit No                      BH01

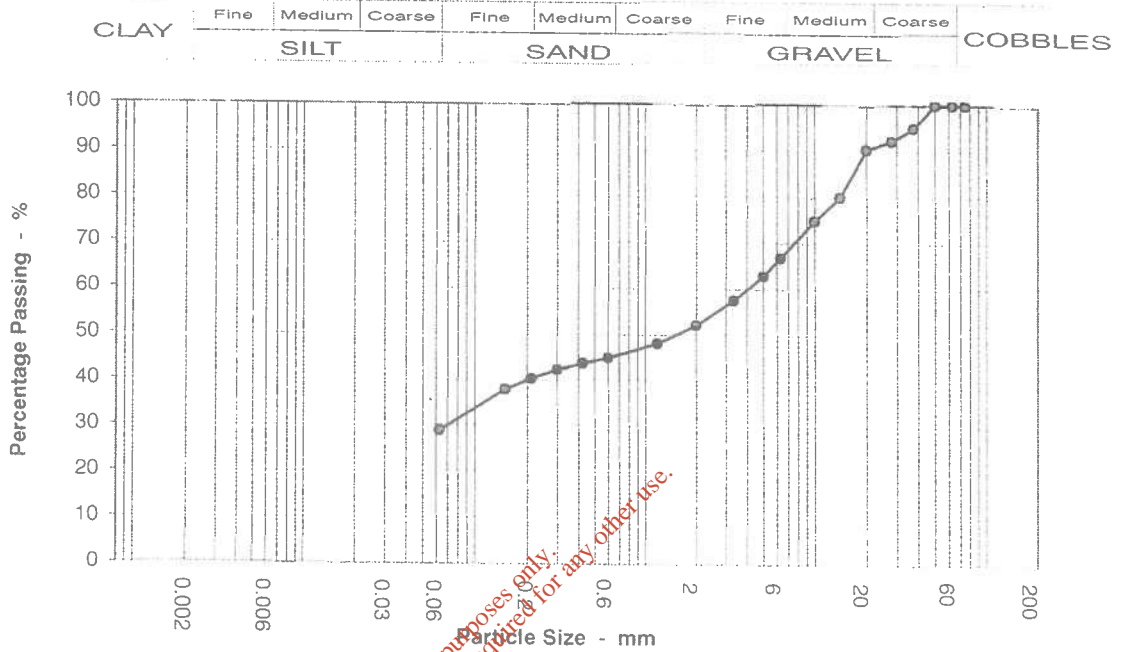
Location                      **Bantry Bay Inner Harbour**

Sample No                      31

Soil Description                      **Very sandy very silty GRAVEL**

Depth                      8.00      m

Sample type                      B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	95		
28	92		
20	90		
14	80		
10	75		
6.3	67		
5	63		
3.35	57		
2	52		
1.18	48		
0.6	45		
0.425	44		
0.3	42		
0.212	40		
0.15	38		
0.063	29		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	48.1
Sand	23.1
Silt & Clay	28.8

Grading Analysis	
D100	125.000
D60	4.181
D10	
Uniformity Coefficient	N/A



# PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

Job Ref

PC9030

Borehole / Pit No

BH02

Location

Bantry Bay Inner Harbour

Sample No

1

Soil Description

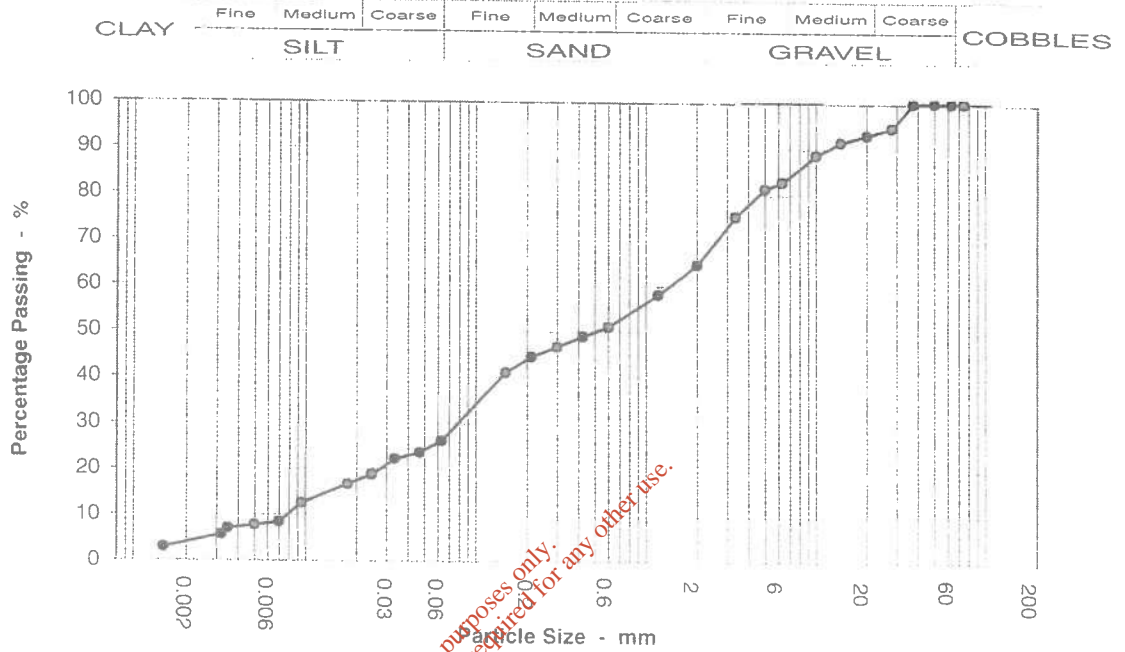
Very silty very gravelly SAND

Depth

0.00 m

Sample type

B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.063	26
90	100	0.047	24
75	100	0.034	22
63	100	0.025	19
50	100	0.018	17
37.5	100	0.010	12
28	95	0.007	8
20	93	0.005	8
14	91	0.004	7
10	89	0.003	6
6.3	83	0.002	3
5	81		
3.35	75		
2	65		
1.18	58		
0.6	51		
0.425	49		
0.3	47		
0.212	44		
0.15	41		
0.063	26		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	Clause 9.5

Sample Proportions	
Cobbles	0.0
Gravel	35.4
Sand	38.9
Silt	22.1
Clay	3.6

Grading Analysis	
D100	125.000
D60	1.425
D10	0.008
Uniformity Coefficient	178

# PARTICLE SIZE DISTRIBUTION TEST

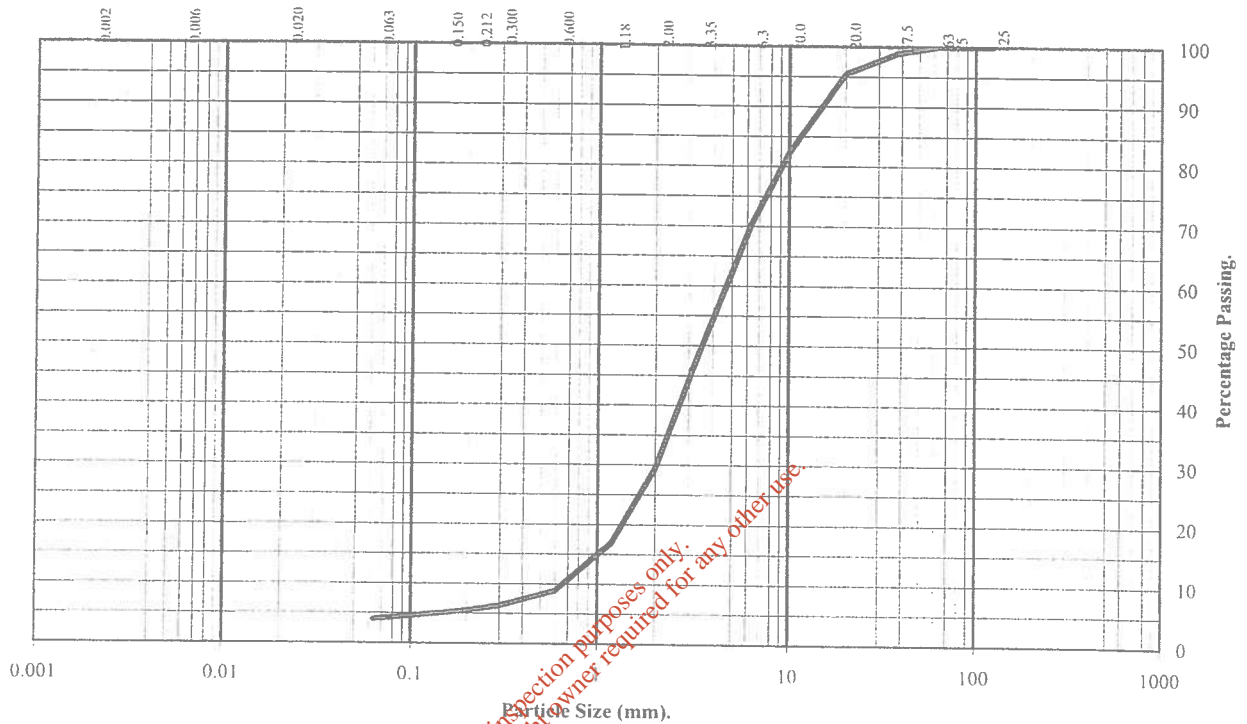
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Hole Number:

**BH02**

Depth (m): **1.00**



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BS Test Sieve	Percentage Passing
125	100
75	100
63	100
38	99
20	95
10	82
6.3	70
3.35	48
2.00	29
1.18	17
0.60	9
0.30	6
0.21	6
0.15	5
0.06	4

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#

Soil Fraction	Total Percentage
Cobbles	0
Gravel	71
Sand	25
Silt and Clay	4

**Remarks:**

#- not determined

*Alan Walker* 14/01/10  
Checked by Date

*[Signature]* 14/01/10  
Approved by Date



**Bantry Inner Harbour**

Contract No.:  
8847/09  
Client Ref No:  
PC9030



# PARTICLE SIZE DISTRIBUTION TEST

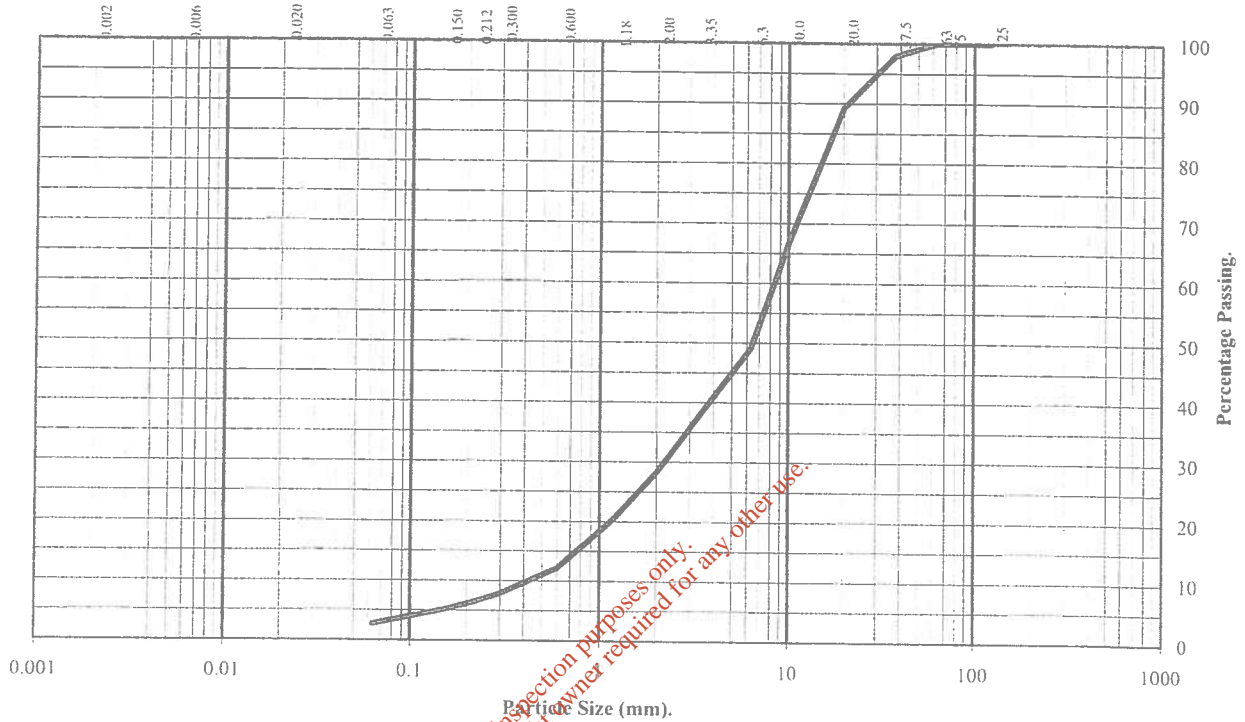
BS 1377 Part 2:1990.

Wet Sieve, Clause 9.2

Hole Number:

**BH02**

Depth (m): **3.00**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
38	98
20	89
10	67
6.3	49
3.35	38
2.00	28
1.18	20
0.60	12
0.30	8
0.21	6
0.15	5
0.06	3

Particle Diameter	Percentage Passing
0.02	#
0.006	#
0.002	#

Soil Fraction	Total Percentage
Cobbles	0
Gravel	72
Sand	25
Silt and Clay	3

**Remarks:**

#- not determined

*Alan Walker* 14/01/10  
Checked by Date

*[Signature]* 14/01/10  
Approved by Date



**Bantry Inner Harbour**

Contract No.:  
**8847/09**  
Client Ref No:  
**PC9030**







# PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

**Job Ref**                      **PC9030**

Borehole / Pit No                      BH02

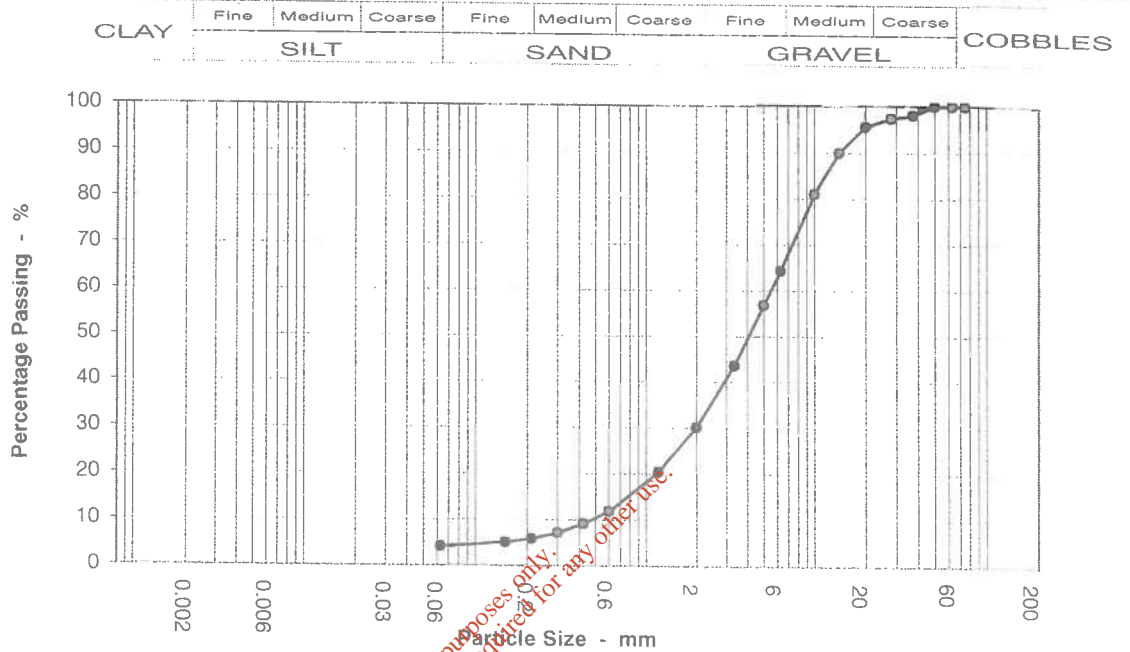
**Location**                                      **Bantry Bay Inner Harbour**

Sample No                                      12

**Soil Description**                              **Slightly silty very sandy GRAVEL**

Depth    6.00      m

Sample type                                      B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	98		
28	97		
20	96		
14	90		
10	81		
6.3	64		
5	57		
3.35	43		
2	30		
1.18	20		
0.6	12		
0.425	9		
0.3	7		
0.212	6		
0.15	5		
0.063	4		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	70.0
Sand	26.0
Silt & Clay	4.0

Grading Analysis	
D100	125.000
D60	5.573
D10	0.482
Uniformity Coefficient	12