APPENDIX 8.16 Trial Pit Logs

Trial Pit Logs

Entire Recting Recting to the Property of Congression of Congress

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 1

Excavat	tor Type:			Client:						
						Bord na	Mona/She	II E&P		
Grid Re			Elevation (mOD):	Site:	6 1	Б	- •	o 14	
	E084643, N324121			<u> </u>		Sranmo	re, Bangor-			
Depth	Description of	Strat	a	Legend	OD Level		mples	Water	Pit Com	pletion
m		Sirui	u	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0										
	PEAT Soft, medium light medium brown, occ fragments of bog w moist. Yellowish brown to brown gravelly, cla	al slightly vellowish .ND, with		outdoses only	Vane Test	TP1				
	some angular subc	ingula	r							
	cobbles of schist a	t base	•			Disturbed Sample	TP1			
3.0	END OF TRIAL PIT									
-		den.								
ogged P.K	(1169 ^{1. She}	ar vane t					btained for Part	icle Size D	istribution te	esting.
Scale:	Rev.: 2. No s					ring excavation n/compaction				
1.2	,5			==== 10		.,				



TRIAL PIT LOG

Trial Pit No. 2

Excavator Type: Date: 23/10 Grid Reference: Elevation			07/10/1	. 7	Client:		\					
Grid Reference: Elevation					Site:	Bord na	Mona/She	II F&P				
Gria Ket		e: 34646, N323	870		Elevation	(mob):	Site:	Srahmo	re, Bangor-	-Erris.(Co. Mavo	
Depth							OD Level		mples	Water	Pit Com	
m	D	escription	n of	Strat	a	Legend	m m	Type	Ref. No.	Inflows	Lining:	Backfill:
											Lilling.	Duckiii.
0.0												
	PEA											
		t, medium			n to							
		k brown, oo gments of b										
- 0.65	maç	gillellis Ol I	Jog v	voou.				Vane Test	TP2			
0.65												
3.0	gre slig Gra	dium light q enish grey, htly micace vels are plo angular Qu	grav eous atey,	to ligh velly, c SAND. angul tes.	t Elayey The ar to	or inspection	and sering to	Disturbed Sample	TP2			
	EN	D OF TRIAL	PIT									
-												
-												
Logged		Job No.:	Remar 1. She		est undertak	en on peat	, disturbed	soil sample o	btained for Part	icle Size D	istribution te	esting.
P.K Scale:		1169 Rev.:						ing excavation				-
1:2	5											

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 3

Excavat	or Type:	/ /-	_	Client:		/				
0.11.0	.	23/10/0		611	Bord na	Mona/She	II E&P			
Grid Re	ference: E084890, N323700		Elevation (mob):	Site:	Srahmo	re, Bangor-	Erris,	Co. Mayc),
Depth	December of	C11	L_	l	OD Level	Sar	mples	Water	Pit Com	npletion
m	Description of	Sirai	a	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0										
- 1.8	PEAT Soft, medium brow brown, fragments of and rootlets, slightl	of bog	wood st.		ooses only	Vane Test	TP3			
- 3.45	Greenish grey to lig grey to light grey S some angular to so gravels and cobble	ubang	eenish ^{ore} with ular	of inspection	putposes only of the putpose of the putposes o	Disturbed Sample	TP3			
-	END OF TRIAL PIT									
ogged P.K	1169 1. She	ar vane					btained for Part	icle Size D	istribution te	esting.
Scale:	Rev.: 2. Slig						ing excavation. soil at 3.45m.			
1:2	ວ									

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 4

Excavat	for Type:	Date:			Client:					
			23/10/0			Bord na	Mona/She	II E&P		
Grid Re	ference: E084164, N323332		Elevation (m0D):	Site:	Srahmo	re, Bangor-	-Erris,	Co. Mayo	o.
Depth	D	~ 1			OD Level	Sar	mples	Water	Pit Con	npletion
m	Description of	Stra	ta	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
									Linning.	Duokiii.
0.0										
	DEAT									
_	PEAT	19								
	Soft to very soft, m									
	to medium dark br									
	fragments of bog v roolets, moist.	wood	unu					-		
_	rooleis, moisi.					Vane Test	TP4			
1.1										
	Medium greenish gr					Disturbed		_		
1.4	clayey, fine grained					Sample	TP4			
	occasional subround	аеа то	rounaea			other				
- 1.65	\gravel and cobbles.				Klin	any				
1.03	, Medium grey to no				362 9 60					
	grey GRAVEL with s				airpo direc					
	rounded to subang	jular c	copples.	ion	outgost outg					
-	END OF TRIAL PIT		Consent of	357° 04	N.					
			♦	of Wildly						
			Ş.	.os,						
			ant or							
-			Conse							
-										
-										
-										
_										
_ogged	by: Job No.: Remai	rks:		<u> </u>	<u> </u>	<u> </u>				<u> </u>
P.K	′ 1169 ^{1. She}	ar vane					btained for Part			
Scale:	Rev.:	.uvulions	ieiiiiiiuiea a	i i.oom bg	ji uu u 10 UN	aidbie Ground	and pit wall co	npase cau	seu by wate	a millow.
1:2	ا د.									



TRIAL PIT LOG

Trial Pit No. 5

Excavator Type: Date: 23/10 Grid Reference: Elevatio			07/40/6	. 7	Client:	ъ .	V /CI	U			
Grid Reference: Elevation					Site:	Bord na	Mona/She	II E&P			
oria itei	E084474, N323	382		Lievalion (11100).	3116.	Srahmo	re, Bangor-	-Erris, (Co. Mayo	
Depth						OD Level		mples	Water	•	pletion
m	Description	n of	Strat	a	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0										J	
0.0											
0.9	PEAT Soft, medium fragments of b rootlets, moist	og w					Vane Test	TP5			
	Yellowish brow brown, gravell SAND. The gra to subrounded	greyis bbley s are su	SILT/	of inspection	and septical control of the septical se	Disturbed Sample	TP5				
3.0	END OF TRIAL	PIT									
Logged P.K			ar vane t	est undertak derate ground				btained for Part	cle Size D	istribution te	esting.
Scale: 1:2	Rev.:	Jiig	11100	-5. a.o ground		- n - wi	-9"				



1:25

Second Floor, Unit 4B/5
Blanchardstown Corporate Park
Blanchardstown
Dublin 15

TRIAL PIT LOG

Trial Pit No. 6

Sheet No. 1 of 1

Excavator Type: Date: Client: 23/10/03 Bord na Mona/Shell E&P Grid Reference: Elevation (mOD): Site: E084852, N323176 Srahmore, Bangor-Erris, Co. Mayo. OD Level Pit Completion Depth Samples Water Description of Strata Legend Type Ref. No. Inflows m Lining: Backfill: 0.0 **PEAT** Soft, dark brown to brownish black, fragments of bog wood, moist. Vane Test TP6 0.95 Light yellowish brown clayey, fine grained SAND with occasional gravels that are subrounded to rounded 1.9 Medium brown to dark brown subangular to subrounded GRAVELS, with some Cobbles. Disturbed TP6 Sample 2.5 END OF TRIAL PIT Logged by: Job No.: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. P.K. 1169 2. No significant groundwater inflows noted during excavation. Rev.: Scale:



TRIAL PIT LOG

Trial Pit No. 7

Excavator Type: Date: 23/10 Grid Reference: Elevatio				07/40/6	. 7	Client:	ъ .	V /CI	U			
Grid Reference: Elevation					Site:	Bora na	Mona/She	II E&P				
Grid Kei		e. 34001, N323	3713		Elevation (mob):	Sile:	Srahmo	re, Bangor-	-Erris, (Co. Mayo	
Depth							OD Level		mples	Water	Pit Com	
m		escription	n of	Strat	a	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0												
0.0												
0.85	bla mo	T t, dark bro ck, fragme ist. Occurar nt material	nts o nce o	f bog f mor	wood, e recent			Vane Test	TP7			
	yell occ sub	ht yellowish owish grey casional gro prounded to	claye ıvels rour	ey SAN that a nded.	ID with		Se ^s offi	any other use.				
- - -	wit	n depth and pase.		angular	of its pection	outlose outly						
2.5					eentof			Disturbed Sample	TP7			
	EN	ID OF TRIAL	PIT		Con							
Logged P.K	•	Job No.: 1169		ar vane i					btained for Parti	icle Size D	stribution te	esting.
Scale: 1:2		Rev.:	Z. NO	ərymiricdi	nt groundwate	er IIITIOWS I	notea auring	y excavation.				



TRIAL PIT LOG

Trial Pit No. 8

Excavator Type: Date: 23/10 Grid Reference: Elevation				23/10/0)3	Client:	Rord na	Mona/She	F&P			
Grid Re		402 NZ2Z	000		Elevation (Site:				Ca. Mayra	
	EU044	402, N323	900						re, Bangor-			
Depth m	Des	scriptior	of	Strat	a	Legend	OD Level m	Type Sar	mples Ref. No.	Water Inflows	Pit Com	pletion Backfill:
0.0												
0.2	Mediu	m dark,	soft	PEAT								
	Mediu grey, SAND to sub well r occas Slate.	ım light g gravelly, . The grav orounded ounded Q sional Red	rey t cobb /els (and uart; San		enish LT/ bangular sionally with es and	of inspection of the principal of the pr	pulose only	any other use.				
Logged	bv: Jol	b No.:	Remar	ks:								
P.K	(.	1169										
Scale: 1:2	Rei	v.:										



TRIAL PIT LOG

Trial Pit No. 9

Sheet No. 1 of 1

Excavator Type: Date: Client: 23/10/03 Bord na Mona/Shell E&P Elevation (mOD): Site: Grid Reference: E084402, N323988 Srahmore, Bangor-Erris, Co. Mayo. OD Level Pit Completion Depth Samples Water Description of Strata Legend Type Ref. No. Inflows m Lining: Backfill: 0.0 Medium dark, soft PEAT 0.4 Medium light grey to greenish grey, gravelly, cobbley SILT/SAND. The gravels are subangular subrounded and occasionally well rounded Quartites, with occasional Red Sandstone and Slate. 2.5 **END OF TRIAL PIT** Logged by: Job No.: Remarks: P.K. 1169 Scale: Rev.: 1:25

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 10

					18/11/0	13	Client:	Rord na	Mona/She	II F&P		
Grid Re			707		Elevation (Site:				20 14	
	E08	3780, N323	5/9/						re, Bangor-		·	
Depth m	D	escription	n of	Strat	a	Legend	OD Level m	Sar Type	mples Ref. No.	Water Inflows	Pit Com	pletion Backfill:
0.0											-	
0.1	Med	c brown, peny cobbles over subancy relations. Schill distance ium brown, grained SA	clay	ey, gr Gravel	avelly, s are							
0.7	sub	angular to	subro	ounae	9							
1.45	to li grav SAN to s	Medium grey to greenish grey to light brownish grey, clayey, gravelly, fine to medium grained SAND, with occasional subangula to subrounded cobbles. Medium light grey, sandy, slightly clayey, subangular GRAVEL, with						Bulk Sample	TP10			
3.2	SAND, with occasional subangula				slightly L, with ngular and nist and Consent	of inspection confidence	philoses only	BET O				
Logged		Job No.:	Remar				ankler, b					
P.k Scale:		1169 Rev.:	1. Sur	face wate	er running int	to pit exca	ration beca	use of heavy (rain			
1:2	.o											

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 11

Excava	tor Type:			Client:			•			
18/11/ Grid Reference: Elevation						Bord na	Mona/She	II E&P		
Grid Re	ference: E083837, N323823		Elevation (mOD):	Site:	Srahmo	re, Bangor-	-Erris, (Co. Mayo	
Depth			!		OD Level	Sar	mples	Water	Pit Com	pletion
m	Description o	Stra ⁻	ta	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0										
0.2	Medium brown, sa clayey, peaty GRAV cobbles. Gravel is angular Quartzite, Schist and Sandsto	ndy, sli EL, wit subang with oc one	ghtly h some jular to ccasional							
-	Light brown to yell slightly clayey, gra SAND. Subangular Quartzite and occo boulders of bande	owish c velly, f gravels sional d Gneis	grey, ine s of angular ss	of inspection	outloses outly	Bulk Sample	TP11			
3.0	END OF TRIAL PIT									
-										
ogged P.K Scale:	(. 1169 1. No		lows to pit, d	ry.						
1:2	25									

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 12

						_	Client:					
Grid Reference: Elevation				18/11/0			Bord na	Mona/She	II E&P			
Grid Re		e: 3925, N323	806		Elevation (mOD):	Site:	Srahmo	re, Bangor-	-Erris, (Co. Mayo	٠.
Depth							OD Level		mples	Water	•	pletion
m	D	escription	n of	Strat	a	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0												
0.3	Medi fine laye	ium brown, grained SA rs of peat o	sligi ND, on to	ntly clowith the	ayey nin							
-	Medi sligh SANI cobb	Medium light grey, gravelly, slightly clayey, slightly micaceous SAND with some subangular cobbles and occasional					outlose out	any other tise.				
-	Medi grav som boul subr well	Medium grey to medium light grey gravelly, fine grained SAND with some cobbles and some blocky boulders of Gneiss. Gravels are subrounded and occasionally well rounded					i de la companya de	Bulk Sample	TP12A			
								Bulk Sample	TP12B			
	END OF TRIAL PIT						Sumple					
P.K Scale:	P.K. 1169 1. Increae in moisture conte				nt at 3m b	gl.						
	-											

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 13

Excava	tor Type:			Client:						
Grid Re	ference:		18/11/0 Elevation (Site:	Bord na	Mona/She	II E&P		
oria no	E084417, N3240	02	Lievanon	11100).	3110.	Srahmo	re, Bangor-	-Erris, (Co. Mayo	•
Depth	D	- f Cl	L		OD Level	Sar	mples	Water	Pit Com	pletion
m	Description	ot Stra	та	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0										
0.25	Medium dark bro black, soft PEAT, subrounded grav of Quartzite and	own to br , with any rels and	ownish gular and boulders							
	<u>\of Quartzite and</u>	Schist								
-	Medium dark bro brown, Firm CLA		edium							
0.75										
_										
						.01*				
						od other use.				
-	Light grey to med	dium ligh	nt grey		Kli	Bulk Bulk				
	and light greyish silty, fine grained	w DNAS b	gravelly, ⁄ith		anses of for	Sample	TP13A			
	occasional subar subrounded bloc	ngular to	ers of		Dutpose outs					
-	Gneiss. Gravels a	ıre subaı	ngular to	Dection	let,					
	subrounded, occ rounded, compos	asionally sed of Qi	y well)uartzite 🕎	of itight o						
	Schist, Red Sand	stone an	d Slate.	POSS						
_			consent of							
			Cor			Bulk	TD17D			
						Sample	TP13B			
-										
3.2	END OF TRIAL P	·IT								
-										
-										
_										
	1 11 12									
ogged_ P.K		emarks:								
Scale: 1:2	Rev.:									
1.2										

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

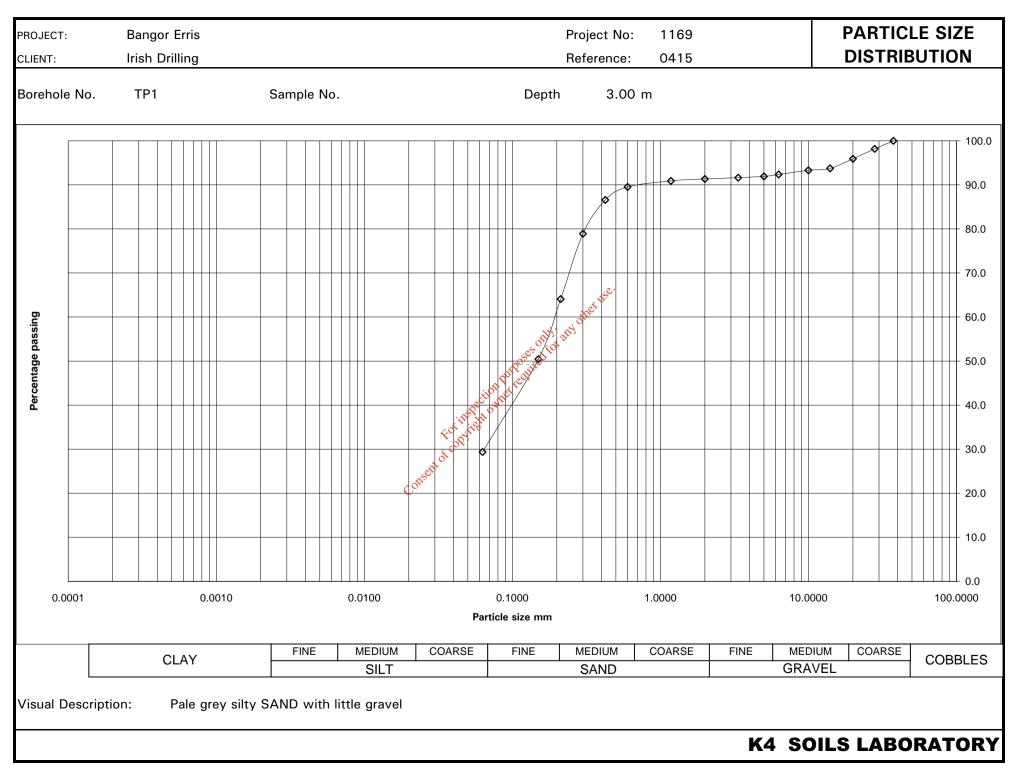
Trial Pit No. 14

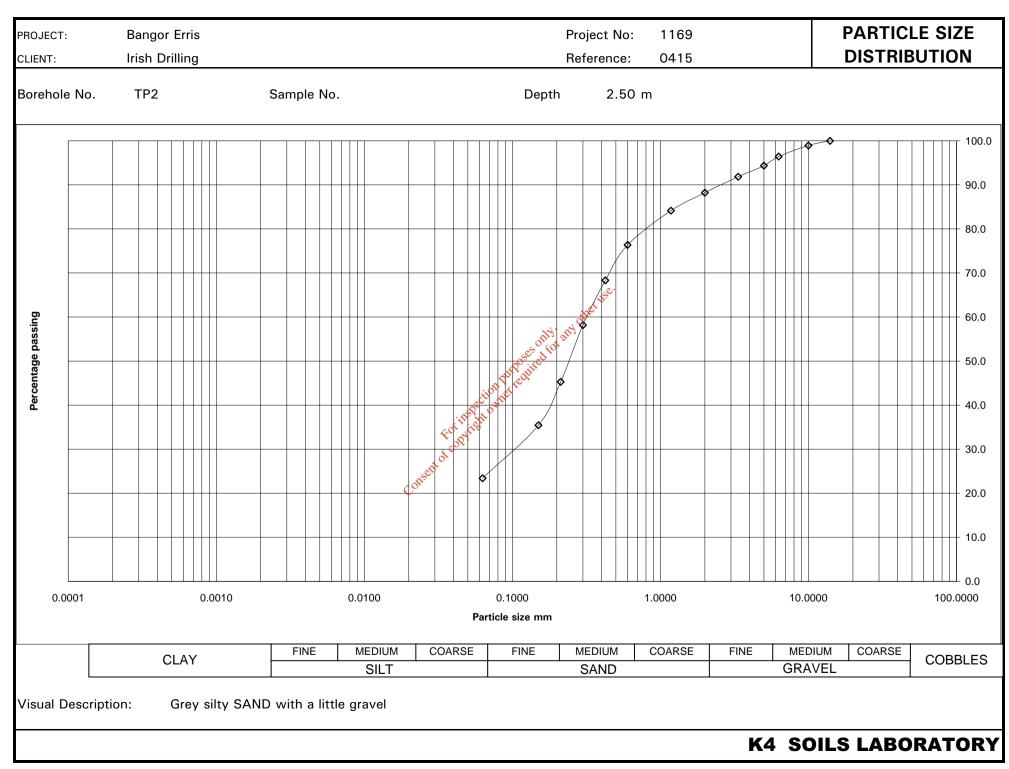
Excavat	or Type:			Client:						
-			18/11/0			Bord na	Mona/She	II E&P		
Grid Re	ference: E084647, N324207		Elevation (mOD):	Site:	Srahma	re Banaar-	-Erris (Co Mayo	
	LUU404/, N3Z4ZU/						re, Bangor-			
Depth	Description of	Strat	a	Legend	OD Level		mples Ref. No.	Water Inflows	Pit Com	•
m					m	Туре	Ret. No.	intiows	Lining:	Backfill:
0.0										
	Medium brown, grav clayey, fine grained some angular cobbl boulders of Quartzii	elly, s SAND	slightly . with							
· ·	some angular cobbl	es an	d Wolo are							
· - ·	subangular to angu	lar.	iveis die							
0.75					<u> </u>					
· ·										
-	Light grey to light ye	ellowis	sh							
	grey, gravelly, cobb	ley, sli	ightly							
	clayey SAND with so boulders of Gneiss.	me ar Grave	igular Is are			any other use.				
• •	subangular to subro	unde	t			other				
•	Quartzite and Red S	andst	one.		only	ally				
·					oses of to	,				
					Dritt China					
2.0				cion	puroses only perfective dec	Bulk Sample	TP14A			
: :				of itspection		Sumple				
			Ŷ	OBALLE OF ALLE						
	Medium grey, grave	llv eli	abtly 🕉	0-						
· -	clayey, slightly micc	ceouc	is SAND							
•	with some subangul subrounded cobbles	ar to	ıartzite							
	Gravels are subangi									
· ·	subrounded Quartzi	te.								
-										
• •						Dulle				
3.5						Bulk Sample	TP14B			
	END OF TRIAL PIT									
· -										
-										
										_
Logged P.K			noisture cont	ent at 1.5r	m bgl.					
Scale:	Rev.:									
1:2	5									

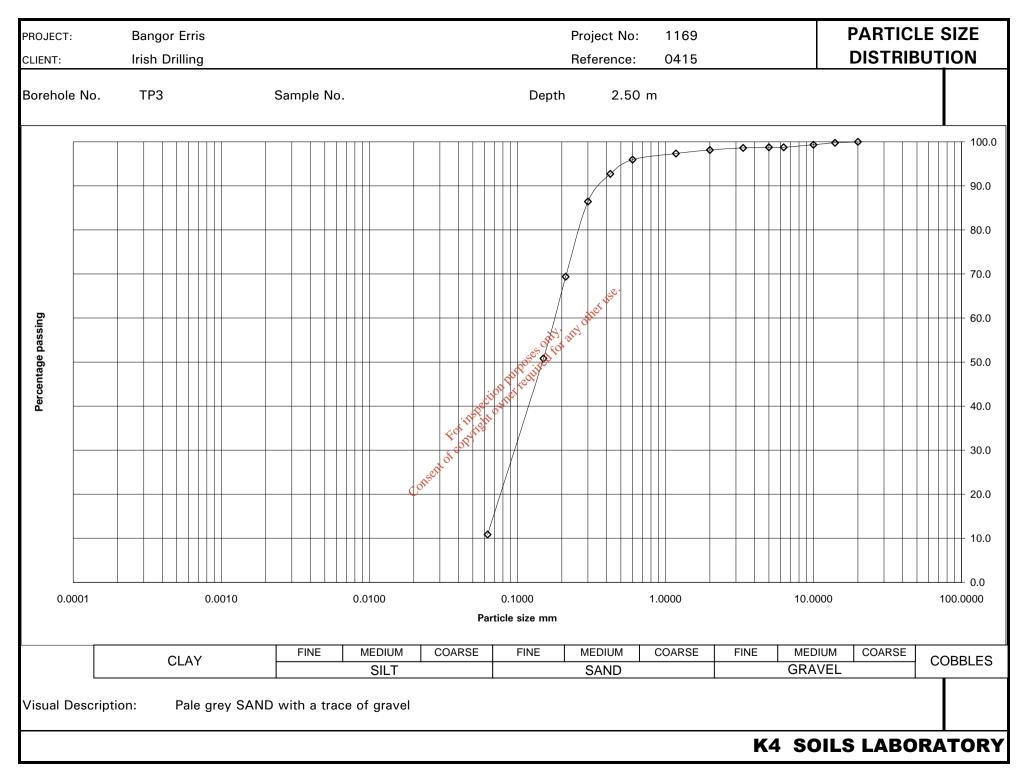
APPENDIX 8.2 145. Particle Size Distribution Curves

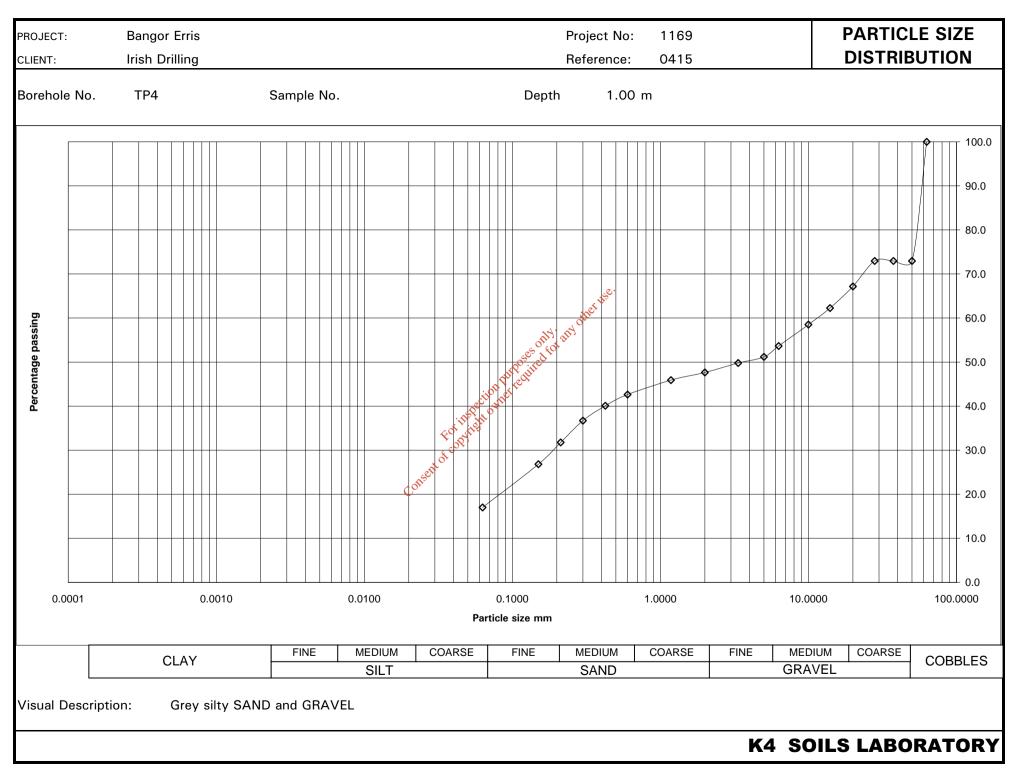
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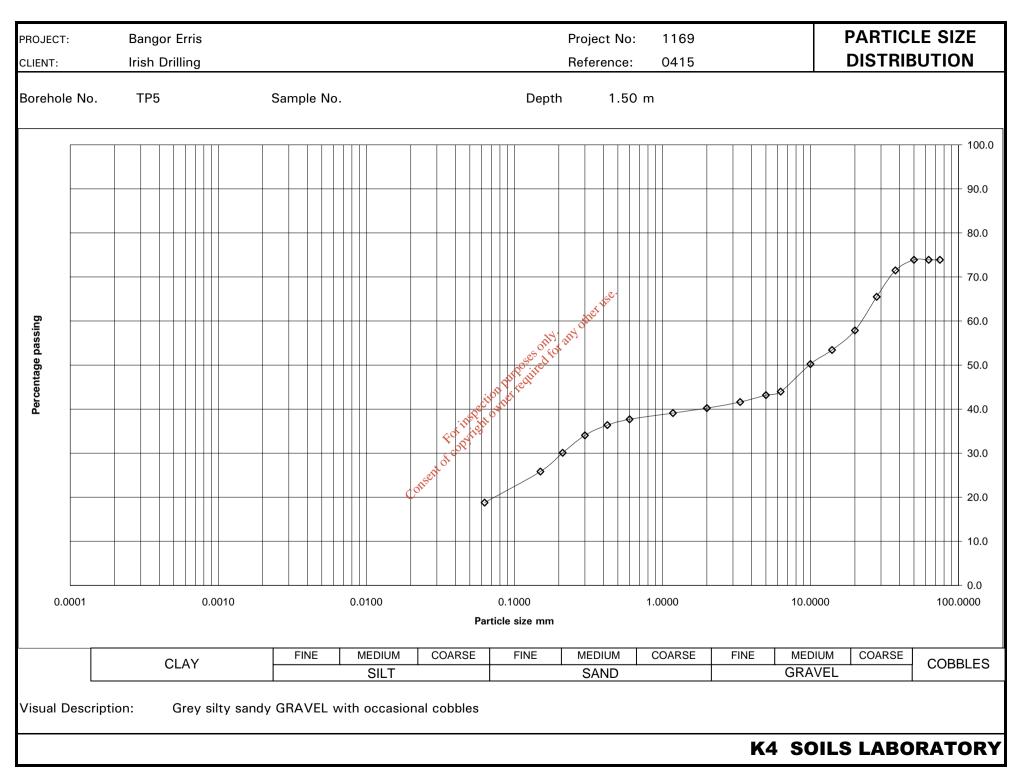
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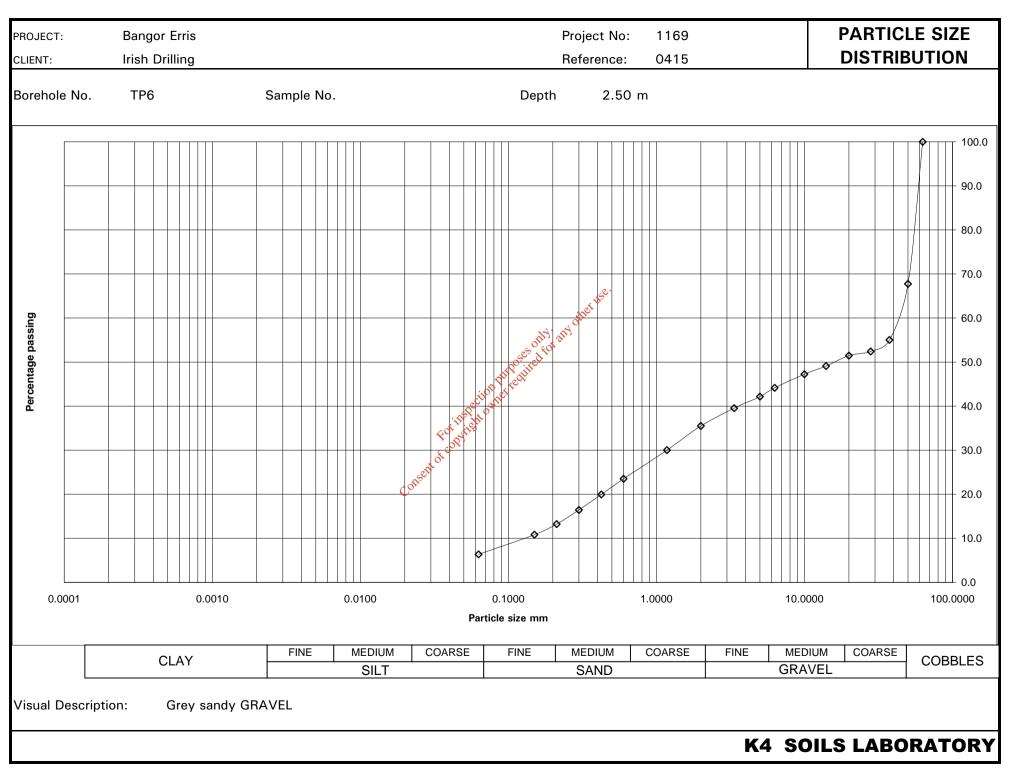












APPENDIX 8.3 TUSE Borehole Logs

Borehole Logs

Erringsget



Client:

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH1A

Sheet No. 1 of 1

Site: Job No.: Scale: Bord na Mona/Shell E&P Srahmore, Bangor-Erris, Co. Mayo. 1169 1:50

Elevation (mOD): 17.56m Grid Reference Date Started: 22/10/03

Drill Contractor: Irish Drilling Ltd. Drill Method: Coring

Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Easting: E084463 Northing: N323049 Date Completed: 22/10/03

Northi	ng: N323049	Borehole Diameter (Rock) Borehole Depth (m): 13.5	m						Logged by		
Depth		tion of Strata	Legend	OD	Level	Static Water		mples	BH Tests	Completio	
m	Describ	non or siruid	Legend		m	Level 4/11/03	Type	Ref. No.	Type & Ref.	Lining:	Backfill:
GL											
0.55	PEAT										CEMEN.
										50MM	
										50MM uPVC CASING	BENT ONITE
_						_				CASING	ONITE
				15	.09						
•											
										Z Ы	
-										uPVC SCREEN	8
-										SC	- G
-										ပ	g
-							350	·		₫	a
-	Fine arained SA	ND, with clay/silt					ther the				٤
-	matrix, medium	light grey to greenish	For ite 8			14. 5	Jon			50MM	3–7mm Pea Gravel
•	grey.					Soft of dr				100	1
•					نممخ	ned,				",	"
				_ <	Dilled						
- -				cito,	Met						
-			insp	MO.	•						
			FOLOVÍ	b						END OF C	ASING
-			of cox								
		ع و	ente								
-		Con									
-											
-											
- 12.5											
- 12.3	SAND with fragi	ments of Schist									
	and Quartzite. l greenish grey.	ight grey to light									
- 13.3 -	END OF BOREH	DLE									
-											
-											
-											
·											
- 18											
Rema	rke.		'				1				•



Client:

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH1B

Sheet No. 1 of 2

Job No.: Scale: Srahmore, Bangor-Erris, County Mayo. 1169 1:50 Bord na Mona/Shell E&P

Elevation (mOD): 17.524 Date Started: 23/10/03 Grid Reference

Drill Contractor: Irish Drilling Ltd.

Eastin Northi		Borehole Diameter (Subso Borehole Diameter (Rock) Borehole Depth (m): 23.7	: 65mm		Date	Comple		10/03	Drill Metho Logged by	: PK	_
Depth	.		l	OD	Level	Static Water	Sar	nples	BH Tests	Completio	n Details
m	Descrip	ption of Strata	Legend		m	Level 4/11/03	Туре	Ref. No.	Type & Ref.	Lining:	Backfill:
GL						4/11/03					
-	PEAT										
0.65	PEAI										
	matrix. Medium light ç		For its of		.09m	souly, and	other tise			50mm uPVC CASING	BENTONITE
Ė		ments of Schist and									
- - 13.7		t grey to light greenish									
- 13.7 - - - - - - - - - - - - - - - - - - -	Moderately wed narrowly bands 75 degrees), go to medium groextremely mice PSAMMITE, mo Large (2mm) exhibiting prorparallel prefer Discontinuities; schistosity pare	: Closely spaced, mainly aller, sub—planar to h surfaced, tight to									



TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH1B

Sheet No. 2 of 2

Site: Client: Job No.: Scale: Bord na Mona/Shell E&P 1:50 Srahmore, Bangor-Erris, County Mayo. 1169

Grid Reference Easting: 084463

Elevation (mOD): 17.254 Borehole Diameter (Subsoil): 65mm

Date Started: 23/10/03 Date Completed: 24/10/03

Drill Contractor: Irish Drilling Ltd. Drill Method: Corina

Northing: 323049	Borehole Depth (m): 23.7	m		ı						
		OD	ا میما	Water	Sar	nples	Logged by BH Tests	Completio	n Details	
Descrip Descrip	ption of Strata	Legend	1		Inflows			Type & Ref.	•	Backfill:
_18m										
Strong to very banded, (dippi very pale grey micaceous QU/, weathered. Mic orientated flak described narr Discontinuities: spaced, generalso steeply diporientations), g	: Closely to medium ally banding parallel (but oping in at least 2 other							Packet Test Ref.: BH1B Test section: 15.5—23.7m bgl	50mm uPVC Screen	3–7mm Pea Gravel
	. •					1150		Р est	٦,	
23.7 END OF BORE	TUOI F					atter		Ţ		
	Can	For inst	ction How	Philos Street Lead	s only and					



Client:

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TEL: (01) 8030401 FAX: (01) 8030410

Borehole BH2A

BOREHOLE LOG

Sheet No. 1 of 1

Site: Job No.: Scale:

Bord na Mona/Shell E&P Srahmore, Bangor-Erris, Co. Mayo. 1169 1:50 Elevation (mOD): 17.20m Grid Reference Date Started: 28/10/03 Drill Contractor: Irish Drilling Ltd. Borehole Diameter (Subsoil): 65mm Easting: E083092 Date Completed: 28/10/03 Drill Method: Coring

Northi	: 65mm	••	Date	Comple	eted: 28	3/10/03	Drill Metho Logged by				
Depth	Б.			OD	Level	Static Water	Sar	nples	BH Tests	Completio	n Details
m	Descri	ption of Strata	Legend		m	Wdier Level 4/11/03	Туре	Ref. No.	Type & Ref.	Lining:	Backfill:
GL						4/11/03					
0.55	PEAT										CEMENT
	Fine grained S matrix, mediu grey.	AND, with clay/silt m light grey to greenish	For its S		.10	souly at	otheriuse	,		50MM UPYC CASING	BENTONITE
12.3	SAND with frag Quartzite, San grey.	gments of eroded dstone and Schist.	For opti	rt O						50MM UPVČ SCREEN	3–7mm Pea Gravel
- 14.0											
	END OF BORE	HOLE									
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_ _ 18											
Rema	rks:					•	•	•		•	



TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH2B

Sheet No. 1 of 2

Client:
Bord na Mona/Shell E&P
Site:
Srahmore, Bangor—Erris, County Mayo.
Job No.:
1169
1:50

Grid Reference
Easting: 083092

Elevation (m0D): 17.17m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm

Date Started: 27/10/03
Date Completed: 27/10/03

Drill Contractor: Irish Drilling Ltd.
Drill Method: Coring

Eastin Northi		Borehole Diameter (Subs Borehole Diameter (Rock Borehole Depth (m): 23.5): 65mm	m	Date	Comple	ted: 27	//10/03	Drill Metho Logged by		-
Depth				OD	Level	Static Water	Sai	nples	BH Tests	Completio	n Details
m	Descri	ption of Strata	Legend		m	water Level 4/11/03			Type & Ref.	Lining:	Backfill:
GL						4/11/03	, ,				
0.55	PEAT										
	Fine grained S matrix.	AND with clay/silt grey to greenish grey.	For inst		.09	souly and	other use			50mm uPVC CASING	BENTONITE
- - - - - - - - - 14.3	SAND with frag Quartzite, San	gments/cobbles of eroded dstone and Schist.	1								
-	thinly bedded/sdegrees), green brown below 21 grained micace weathered. Occ highly weather Discontinuities: schistosity parc smooth to slight	Very closely spaced, allel, generally planar atly rough , thick to an, strongly discoloured	y n)								



TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH2B

Sheet No. 2 of 2

Client: Site: Job No.: Scale: Srahmore, Bangor-Erris, County Mayo. 1169 1:50

Grid Reference Easting: 083092 Northing: 323519 Elevation (mOD): 17.17m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm

Date Started: 27/10/03
Date Completed: 27/10/03

Drill Contractor: Iirsh Drilling Ltd.
Drill Method: Coring

Northing: 323519 Borehole		le Di le De	ameter (Rock epth (m): 23.5): 65mm					, ,	Logged by	: PK		
Depth	Descri					OD		Water		mples	BH Tests	Completio	
m	Descri	piloli	O1	Siruiu	Legend		m	Inflows	Туре	Ref. No.	Type & Ref.	Lining:	Backfill:
-18m	As above										Packet Test Ref.: BH2B Test section: 15.75—23.5m	/C Screen	3—7mm Pea Gravel
23.5	540 OF DOD!								, ilse	,	Packet Test Ref.: BH2B Test section: 15.75—23.	50mm uPVC Screen	3–7mm
	END OF BOR	EHOLE		Cari	For its of	citor Hor	Aphred Arter ted	souly, and	other				



Borehole BH3A

BOREHOLE LOG

Sheet No. 1 of 1

TEL: (01) 8030401 FAX: (01) 8030410 Client: Job No.: Scale: Srahmore, Bangor-Erris, Co. Mayo. 1169 1:50 Bord na Mona/Shell E&P

Elevation (mOD): 20.29m Date Started: 28/10/03 **Grid Reference**

Drill Contractor: Irish Drilling Ltd.

Easting Northi		Borehole Diameter (Subso Borehole Diameter (Rock): Borehole Depth (m): 12.5r	il): 65mi : 65mm n		Date	•	ted: 28	/10/03	Drill Metho Logged by	: P.K.	
Depth	ъ.			OD	Level	Static Water	Sar	nples	BH Tests	Completio	n Details
m	Descri	ption of Strata	Legend		m	Level 4/11/03	Туре	Ref. No.	Type & Ref.	Lining:	Backfill:
				_		4/11/03			, ,		+
GL											
E l											CEMENT
- I	PEAT									50MM	
Fassi										50MM uPVC CASING	BENT
<u>- 1.55</u>				18	.52					CASING	ONITE
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FI											15
FΙ											-
ĻΙ	Fine grained S	AND, with clay/silt									6
E I		m light grey to greenish								E01414	_
⊢ ∣	grey.									50MM uPVC SCREEN	8
FI										SCRÉEN	\(\overline{E}\)
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TEL: (01) 8030401 FAX: (01) 8030410

Borehole BH3B

Sheet No. 1 of 2

BOREHOLE LOG

Client: Site: Job No.: Scale: Srahmore, Bangor—Erris, County Mayo. Bord na Mona/Shell E&P 1169 1:50

Grid Reference Easting: 084908

Elevation (mOD): 20.26m Borehole Diameter (Subsoil): 65mm

Date Started: 29/10/03 Date Completed: 29/10/03

Drill Contractor: Irish Drilling Ltd. Drill Method: Corina

Northi	: 65mm	•••	Date	Comple	ted: 29	/10/03	Logged by: PK				
Depth	Descri	Borehole Depth (m): 16m ption of Strata	Legend			Static Water		nples	BH Tests	Completio	
m	D 00011		Logona		m	Level 4/11/03	Туре	Ref. No.	Type & Ref.	Lining:	Backfill:
GL - - - - - 1.55	PEAT									(0)	
6.0	matrix.	SAND with clay/silt grey to greenish grey.			.02	ally all	other use	r		50mm uPVC CASING	BENTONITE
- - - -	dipping circa 3 Discontinuities:	strong, massive but locally ed (dipping 35 degrees), she grey, fine grained ARTZITE, fresh to slightly occurring as close spaced bands/laminae 35 degrees. Between non—intact zones closely to very closely no parallel, (dipping about enerally sub—planar, ntly rough, generally clean.		ction those	Tairpost	s of for the			Packet Test Ref.: BH3B lest section: 11.75—16.0m	50mm uPVC SCREEN	3—7mm Pea Gravel
- 16 -	END OF BOREH	IOLE							Te Te		
- - -											



BOREHOLE LOG

Borehole BH3B

Sheet No. 2 of 2 TEL: (01) 8030401 FAX: (01) 8030410 Client: Site: Job No.: Scale: Bord na Mona/Shell E&P 1:50 Srahmore, Bangor-Erris, County Mayo. 1169 Elevation (mOD): 20.26m **Grid Reference** Date Started: 27/10/03 Drill Contractor: Glovers SI Ltd. Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Easting: 084908 Date Completed: 27/10/03 Drill Method: Air Rotary Northing: 323745 Logged by: KM (TES) Borehole Depth (m): 23.5 OD Level Water BH Tests **Completion Details** Samples Depth Description of Strata Legend Ref. No. Type & Ref. Backfill: Inflows Type Lining: m -18m As above



FAX: (01) 8030410

TEL: (01) 8030401

BOREHOLE LOG

Borehole BH4

Sheet No. 1 of 2

Client: Site: Job No.: Scale: Bord na Mona/Shell E&P Srahmore, Bangor-Erris, County Mayo. 1169 1:50 Elevation (mOD): 17.22 **Grid Reference** Date Started: 01/11/03 Drill Contractor: Irish Drilling Ltd. Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Easting: 084489 Date Completed: 01/11/03 Drill Method: Coring Northing: 323373 Logged by: PK Borehole Depth (m): 30m OD Level Static Water Level 4/11/03 BH Tests **Completion Details** Samples Depth Description of Strata Legend Backfill: Ref. No. Type & Ref. Lining: m Type GL PEAT 14.81 3.1 Fine grained SAND with clay/silt 50mm uPVC CASING Medium light grey to greenish grey. BENTONITE Consent of copyright of the feet of the copyright of the 3—7mm Pea Gravel 18 Remarks:



TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Sheet No. 2 of 2

Borehole BH4

Client: Site: Job No.: Scale: Bord na Mona/Shell E&P 1:50 Srahmore, Bangor-Erris, County Mayo. 1169 Grid Reference

Easting: 084489

Elevation (mOD): 17.22m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm

Date Started: 01/11/03 Date Completed: 01/11/03 Drill Contractor: Glovers SI Ltd. Drill Method: Air Rotary

Northing: 323373		Borehole Diameter (Rock): Borehole Depth (m): 30m		: 65mm			•			Logged by			
epth	Dagawi					OD		Water	Sar	mples	BH Tests	Completio	n Details
m	Descri	ption	OT .	Strata	Legend		m	Inflows	Type	Ref. No.	Type & Ref.	Lining:	Backfill
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	As above												
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APPENDIX 8.4 Let use Packer Test Results

Packer Test Results

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PACKER TEST RESULTS

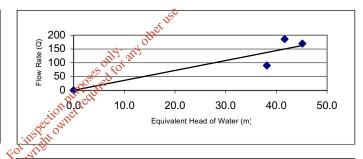
Contract: Peat Deposit site at Bangor Erris Top of test section (m bgl) 15.5 Client: Enterprise Oil Bottom of test section (m bgl) 23.7 Engineer: TES Centre of test section (m bgl) 19.6 Borehole: 1B Length of test section (m bgl) 8.2 Bh. size: HQ Pressure gauge height (m agl) 0.95 Date: 24.10.'03 Initial depth to G.W. (m bgl) 19.6 Packer inflation pressure (psi) 120

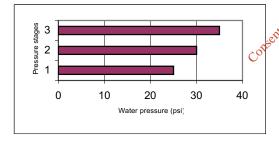
1. Site Records

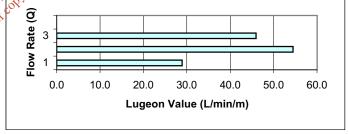
Pressure	Water	Flow meter	readings			Water take	n over time	period (gal))
stage	pressure	start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min
	(psi)								gals
1	25	157265	157377	157468	157563	112	91	95	298
2	30	157563	157838	158010	158176	275	172	166	613
3	35	158176	158388	158563	158737	212	175	174	561

2. Calculations

Pressure	Equiv.	Flow	Lugeon
stage	head of	rate (Q)	Value
	water		
	(m)	l/min	l/min/m
1	38.1	90.3	28.9
2	41.6	185.8	54.4
3	45.1	170.0	45.9
5	0	0	0







3. Permeability (k) analysis

Lugeon Value Used (I/min) 32.3

k (m/sec) 3.23E-06 k (m/day) 2.79E-01

PACKER TEST RESULTS

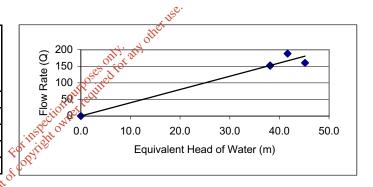
Contract: Peat Deposit site at Bangor Erris Top of test section (m bgl) 15.75 Client: Enterprise Oil Bottom of test section (m bgl) 23.5 Engineer: TES Centre of test section (m bgl) 19.625 Borehole: 2B Length of test section (m bgl) 7.75 Bh. size: HQ Pressure gauge height (m agl) 0.95 Date: 31.10.'03 Initial depth to G.W. (m bgl) 19.625

1. Site Records

Pressure	Water	Flow meter readings			Water taken over time period (gal)				
stage	pressure	start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min
	(psi)								gals
1	25	159215	159382	159550	159718	167	168	168	503
2	30	159718	159925	160133	160340	207	208	207	622
3	35	160430	160546	160753	160960	116	207	207	530
4	25	160960	161128	161295	161461	168	167	166	501

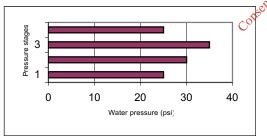
2. Calculations

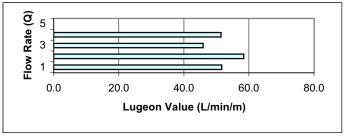
Pressure	Equiv.	Flow	Lugeon	
stage	head of	rate (Q)	Value	
	water	, ,		
	(m)	l/min	l/min/m	
1	38.1	152.4	51.6	
2	41.7	188.5	58.4	
3	45.2	160.6	45.9	
4	38.1	151.8	51.4	
5	0	0	0	



Packer inflation pressure (psi)

150





3. Permeability (k) analysis

Lugeon Value Used (I/min) 51.8

k (m/sec) 5.18E-06 k (m/day) 4.48E-01

PACKER TEST RESULTS

Contract: Peat Deposit site at Bangor Erris Client: Enterprise Oil

Engineer: TES

Borehole: 3B

Bh. size: HQ

Date: 31.10.'03

Top of test section (m bgl)

Bottom of test section (m bgl)

Centre of test section (m bgl)

Length of test section (m bgl)

Pressure gauge height (m agl)

Initial depth to G.W. (m bgl)

Packer inflation pressure (psi)

11.75

13.875

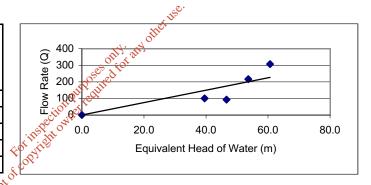
13.875

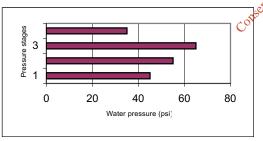
1. Site Records

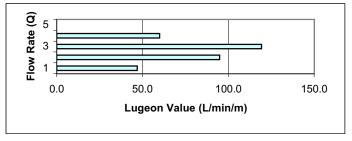
Pressure	Water	Flow meter readings				Water take	Water taken over time period (gal)		
stage	pressure	start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min
	(psi)								gals
1	45	162315	162402	162511	162621	87	109	110	306
2	55	162621	162851	163091	163334	230	240	243	713
3	65	163582	163929	164206	164596	347	277	390	1014
4	35	164596	164708	164820	164928	112	112	108	332

2. Calculations

Pressure	Equiv.	Flow	Lugeon
stage	head of	rate (Q)	Value
	water		
	(m)	l/min	l/min/m
1	46.6	92.7	46.8
2	53.6	216.1	94.8
3	60.7	307.3	119.2
4	39.6	100.6	59.8
5	0	0	0







3. Permeability (k) analysis

Lugeon Value Used (I/min) 80.1

k (m/sec) 8.01E-06 k (m/day) 0.69 APPENDIX 8.5 Lee.

Hydraulic Permeability Test Results

Leeting Recording to the Leeting Recordi

Report on Groundwater Sampling and Permeability Testing at Srahmore Bog, Bangor, Co. Mayo

TES Consulting Engineers

MEL Brief 1322-Q1 MEL Doc. Ref.:1322-2546

Monday, 17 November 2003

Confidential Report To:

Report submitted by:

Minerex Environmental Ltd.

Taney Hall, Eglinton Terrace, Dundrum Dublin 14 Ireland

Tel.: +353-(0)1-2964435 Fax.: +353-(0)1-2964436 Email: www.minerex.ie

Leo Duffy B.Sc. **Project Scientist**

Reviewed by:

Eileen McCarthy M.Sc. **Project Director**



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4	l.1	Purpose		2
4	l.2	Locations		2
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Appendices

Appendix	Title	Pages	MEL Doc. Ref.
Appendix A	Summary of Pre-Sampling Borehole Purging Results	1 x A4	1322-028.xls
Appendix B	Summary of Permeability Test Results	1 x A4	1322-019.xls
Appendix C	Aqtesolv Curve Fitted Graphs	12 x A4	1322-2548.aqt

1. Introduction

On 30th October 2003 Minerex Environmental Limited (MEL) were commissioned by Morgan Burke of TES Consulting Engineers to undertake groundwater sampling and permeability testing at Srahmore Bog, Bangor, Co Mayo. A detailed work specification was drafted up and agreed. The main elements of this specification are outlined below. MEL carried out site work over a three day period from the 4th to the 6th of November 2003. This report outlines the methodologies and equipment used, the results obtained and the software used for data analysis and presentation.

2. Work Specification

The following outlines the main elements of the site work undertaken at Srahmore Co. Mayo. The work is subdivided into two sections.

A. Water sampling:

A total of seven (7) monitoring wells (four overburden and three bedrock) were purged and sampled. The samples were analysed by Alcontrol Laboratories Limited.

B. Permeability testing:

Permeability tests were undertaken following sampling of the four overburden boreholes. Field data was used to determine K-values for the overburden sands and gravels.

to determine K-values for the overburden sands and gravels.

3. Groundwater Sampling

3.1 Purpose

The installation of monitoring points allows for water levels and water samples to be taken. Seven (7) monitoring wells were drilled and installed in the week purpose. The wells were drilled in four nested couples: the first wells were drilled and installed in the week prior to sampling. The wells were drilled in four nested couples; the first three (1A/1B, 2A/2B, 3A/3B) consisting of a shallow overburden well and a deep bedrock well; and the fourth consisting of a deep overburden well (4A). The purpose of the sampling is to provide baseline data with respect to the investigation area.

3.2 Locations

Water samples were taken from the following boreholes: 1A, 1B, 2A, 2B, 3A, 3B and 4A. The locations of these boreholes were supplied to MEL by TES prior to fieldwork. MEL does not possess a map in electronic format for the site, and the production / reproduction of same is not included in the scope of this work item.

Methods and Materials 3.3

In the context of MEL's investigations, static water levels were taken in both wells within each couple prior to any purging of the groundwater. Borehole volumes were calculated to include the annulus volume and assuming an annulus porosity of 35%. At least 2 borehole volumes were removed from each monitoring point prior to sampling. Appendix A outlines a summary of borehole volumes removed prior to sampling.

A standard dipmeter was used to record water levels. All measurements were recorded in metres to the top of steel plinth (tosp) which is MEL's reference point. It should be noted that MEL was not commissioned to survey the monitoring points installed at Srahmore and does not possess reduced levels for any of the investigation points. A 2" Honda pump was used to purge the monitoring points. Due to adverse weather conditions and poor access to the monitoring points at the site, it was not possible to purge and sample all monitoring wells within one working day. 1A and 1B were purged on the 4th of November, while 2A, 2B, 3A, 3B and 4A were purged on the morning of 5th of

November. During purging of the first borehole volume an attempt made to remove silt from the bottom of the overburden wells using the Honda pump. This was unsuccessful as the purged water continued to have a high silt content throughout purging. All monitoring wells except 4A were sampled on the evening of the 5th of November using a 1litre designated, disposable bailer. Borehole 4A was subsequently sampled on the morning of the 6th of November. Before sampling, one borehole volume was removed from each overburden well using a disposable bailer and 5 litres were removed from each of the bedrock wells. This was undertaken to remove any stagnant water within the well 24 hours post-purging, prior to sampling. Samples taken from overburden wells had a high silt content and the laboratory was requested to filter as required for analysis.

Sample containers were supplied by Alcontrol Laboratories Ltd. These were filled directly from the disposable bailer without filtering. The samples were then placed in a battery operated coolbox for transportation to the Laboratory. The samples were received by the laboratory on the evening of the 6th of November. A chain of custody was completed during the transport of the samples to the laboratory.

4. Permeability Testing

4.1 Purpose

Permeability tests were undertaken at Srahmore to produce K-values (hydraulic conductivity) for each of the overburden monitoring points installed.

4.2 Locations

The permeability tests were carried out at each of the established overburden wells: 1A, 2A, 3A and 4A. Four tests were undertaken in total.

4.3 Methods and Materials

Both rising head permeability tests and single post-purging recovery tests were undertaken on the four overburden boreholes. The methodology for rising head tests involves the sudden removal of a small volume of water "slug" from the well after which the rise in recovering water level is measured. This displacement of water should not exceed 10% of the equilibrium piezometric head (Ref. 1). MEL used a bailer to perform these slug tests.

A second method of permeability testing was undertaken on most of the overburden boreholes on site. This involved the manipulation of the borehole purging procedure prior to sampling. Immediately after the purging was completed (by means of a 2" Honda pump) borehole water level recovery was monitored. This recovery data was used to provide a K-value for the aquifer and is likely to represent a larger volume of aquifer around the monitoring well than for the slug test results (scale factor). A summary of all permeability testing is provided in Appendix B.

The data collected was processed using aquifer analysing software, AQTESOLV. This software provides a suite of analytical solutions for determining aquifer properties from pumping tests and slug tests. From the data supplied on borehole installation design and from the static water levels recorded during fieldwork, an unconfined sands and gravel aquifer is identified at the site. In this context, two analytical solutions were used to derive K-values for the overburden aquifer. These are Hvorslev (1951) and Bouwer-Rice (1976) (Ref. 2).

5. Results

Results of the MEL's investigation work are presented in the Appendices A (summary of pre-sampling borehole purging results), Appendix B (summary of permeability test results), Appendix C (aqtesolv cuve fitted graphs) at the back of this report.

6. References

- 1. British Standards Institution (1999). Code of Practice for Site Investigations BS 5930.
- 2. Kruseman, G. P., and de Ridder, N. A., (1992). *Analysis and Evaluation of Pumping Test Data*. ILRI Publication 47, The Netherlands.

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Appendix A

Summary of Pre-Sampling Borehole Purging Results



VARIA	VARIABLE DATA									
Seasona	al monitoring d	lata								
General				Water levels		Pre-Sampling	Purging			
Site ID	Weather	MEL operatives	Date (dd/mm/yy)	Static Water level (mbRef)	Depth (mbRef)	volume (BHV) (Litres)	Three (3) borehole volume for purging	Volume withdrawn (Litres)	BHV's withdrawn	
BH 1A	Wet and Windy	LD	11/04/2003	2.57	8.40	24.8	74.25	103.00	4.16	
BH 1B	Wet and Windy	LD	11/04/2003	2.85	23.655 OILUT ABU	79.5	238.41	275.00	3.46	
BH 2A	Wet and Windy	LD	11/05/2003	3.25	6.04 Cuit	10.6	31.74	42.00	3.97	
BH 2B	Wet and Windy	LD	11/05/2003	3.23 TEST	23.50	78.0	234.00	165.00	2.12	
BH 3A	Wet and Windy	LD	11/05/2003	2.02, 000 1186	5.56	11.5	34.38	52.00	4.54	
ВН 3В	Wet and Windy	LD	11/05/2003	2.24	15.78	53.0	158.85	155.00	2.93	
BH 4A	Wet and Windy	LD	11/05/2003	2.51	29.00	105.8	317.37	384.00	3.63	

Appendix B

Summary of Permeability Test Results



Report on Groundwater Sampling and Permeability Testing at Srahmore Bog, Bangor, Co. Mayo

Summary of Permeability Tests

Borehole & Aqui	fer Details	* ² K Values according to Methodology Used (up to 3 types)					
Borehole ID	Aquifer* ¹	Rising Head Test (Hvorslev)	Rising Head Test (Bouwer- Rice)	Recovery (Hvorslev)	Recovery (Bouwer-Rice	Average	
BH-1/A	Unconfined	N/a	N/a	3.654E-07	2.553E-07	3.104E-07	
BH-2/A	Unconfined	2.030E-07	1.143E-07	7.092E-07	4.130E-07	3.599E-07	
BH-3/A	Unconfined	1.210E-06	7.194E-07	N/aller L	N/a	9.647E-07	
BH-4/A	Unconfined	2.632E-06	2.273E-06	eson N/a	N/a	2.453E-06	

Average	1.348E-06	1.036E-06	5.373E-07	3.342E-07	1.022E-06
Max	2.632E-06	2.273E-06	7.092E-07	4.130E-07	2.453E-06
Min	2.030E-07	1.143E-07	3.654E-07	2.553E-07	3.104E-07

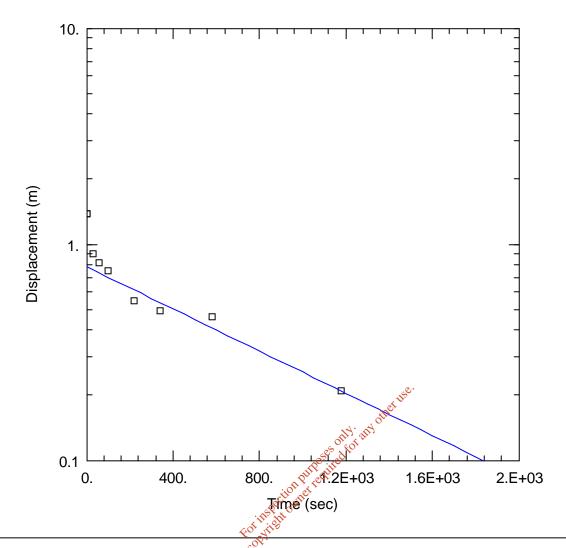
^{*1} The aquifer is identified as being unconfined <u>based</u> on well installation data supplied (MEL Doc. Ref. 1322-2543) and from water levels recorded on 04-06/11/03.

^{*2} Where duplicate tests were undertaken, an average is provided per analytical solution

Appendix C

Aqtesolv Curve Fitted Graphs





Data Set: P:\1322 (Shell)\aqt\1322-2548\1A\1A data Recovery.aqt

Date: 11/18/03 Time: <u>16:55:53</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: 1A Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

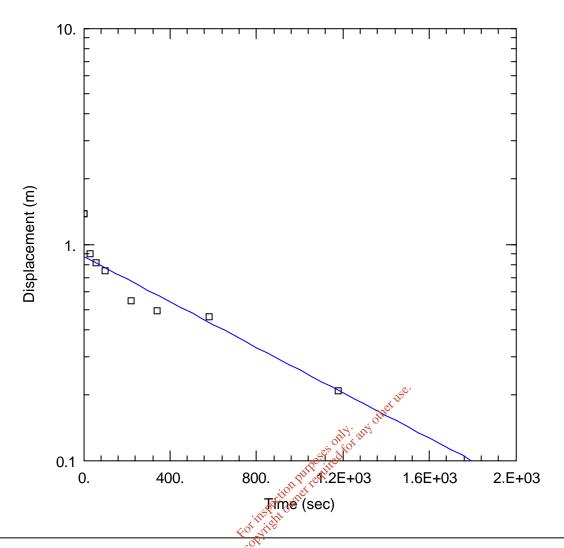
WELL DATA (1A)

Initial Displacement: 1.38 m Water Column Height: 6.28 m Casing Radius: 0.026 m Wellbore Radius: 0.05 m Screen Length: 8. m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 4.687E-07 m/secy0 = 0.7864 m



Data Set: P:\1322 (Shell)\aqt\1322-2548\1A Data Recovery 1.aqt

Date: <u>11/18/03</u> Time: <u>17:00:02</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: 1A Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (1A)

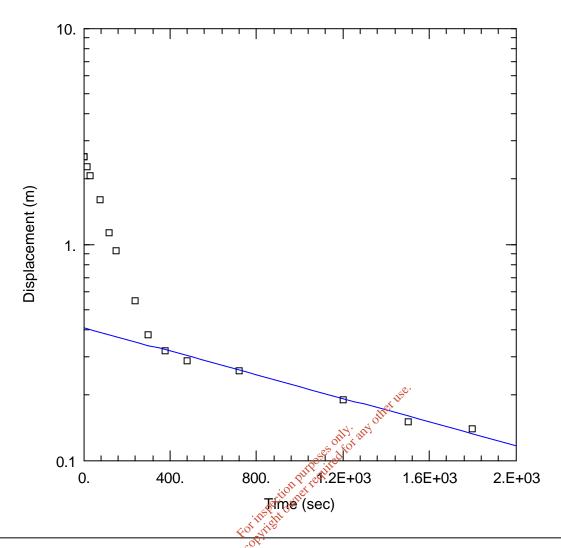
Initial Displacement: 1.38 m Casing Radius: 0.026 m Screen Length: 8. m

Water Column Height: 6.28 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 3.443E-07 m/sec y0 = 0.8784 m



Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\1A Data Recovery 2.aqt

Date: <u>11/18/03</u> Time: <u>17:05:15</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: <u>1322-Q1</u>

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: 1A Test Date: 04-11-03

AQUIFER DATA

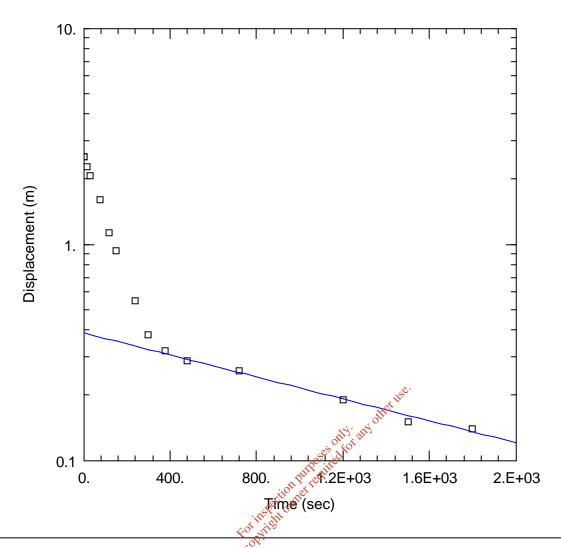
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (1A)

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 2.621E-07 m/sec y0 = 0.4114 m



Data Set: P:\1322 (Shell)\aqt\1322-2548\7A - FINAL\1A Data Recovery 2.aqt
Date: 11/18/03 Time: 17:04:50

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: <u>1322-Q1</u>

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: 1A Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 1.

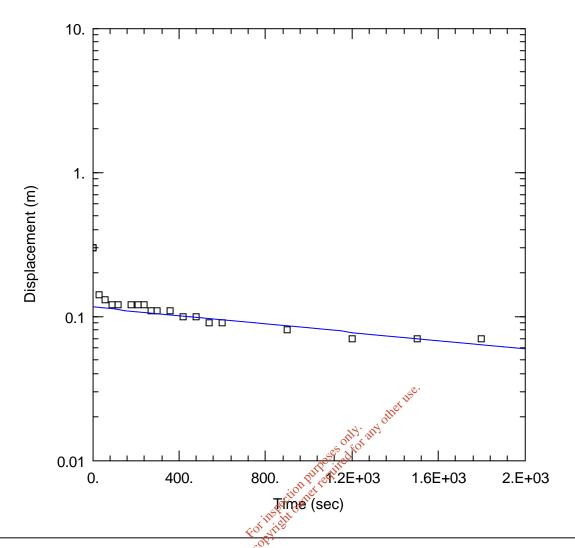
WELL DATA (1A)

Initial Displacement: 2.53 m Casing Radius: 0.026 m Screen Length: 8. m Water Column Height: 6.28 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.663E-07 m/sec y0 = 0.3884 m



SZA - SLUG TEST

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\2A SLUG.aqt

Date: <u>11/18/03</u> Time: <u>17:17:45</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>2A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: 7. m Anisotropy Ratio (Kz/Kr): 1.

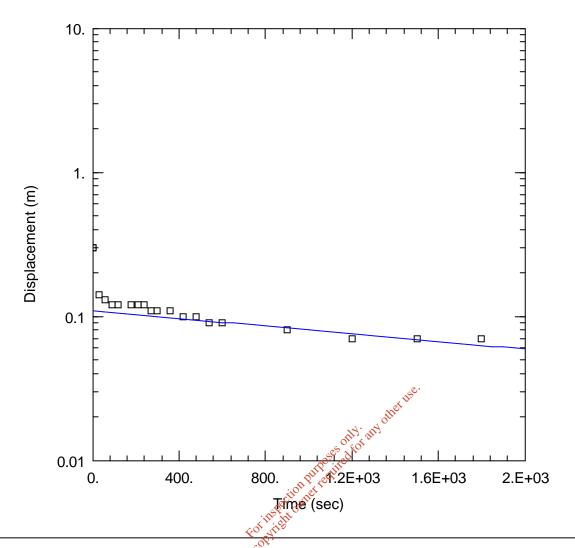
WELL DATA (2A)

Initial Displacement: 0.3 m Casing Radius: 0.026 m Screen Length: 5. m Water Column Height: 2.64 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 2.03E-07 m/sec y0 = 0.1157 m



SZA - SLUG TEST

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\2A SLUG.aqt

Date: <u>11/18/03</u> Time: <u>17:18:43</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: <u>1322-Q1</u>

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>2A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: 7. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (2A)

Initial Displacement: 0.3 m

Casing Radius: 0.026 m

Screen Length: 5. m

Water Column Height: 2.64 m

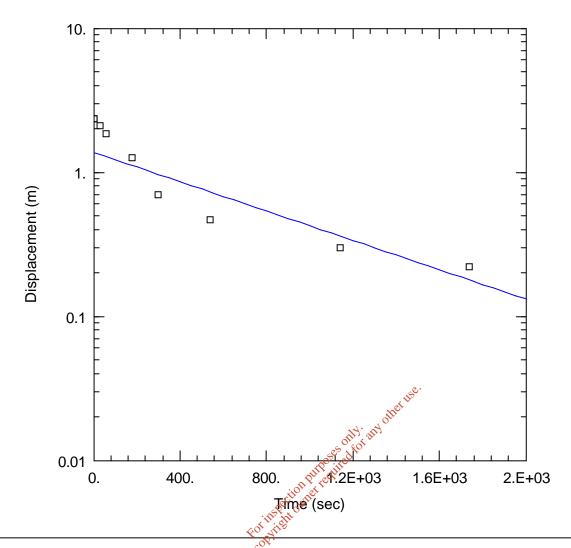
Wellbore Radius: 0.05 m

Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.143E-07 m/sec y0 = 0.1093 m



<u>ॐA - RECOVERY</u>

Data Set: P:\1322 (Shell)\aqt\1322-2548\7A - FINAL\2A Recovery.aqt
Date: 11/18/03 Time: 17:24:58

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>2A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: 7. m Anisotropy Ratio (Kz/Kr): 1.

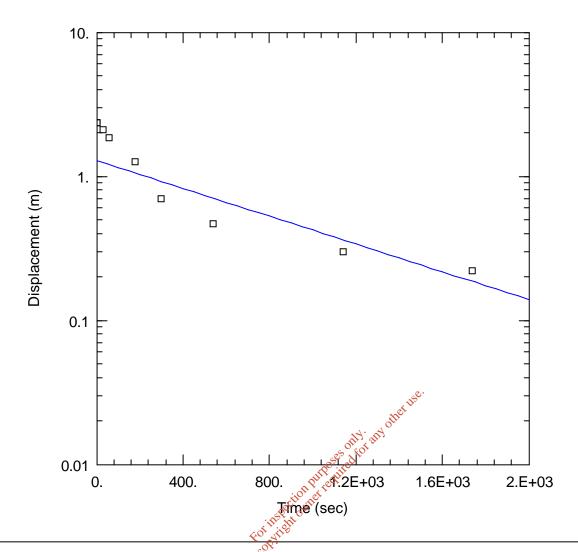
WELL DATA (2A)

Initial Displacement: 2.34 m Casing Radius: 0.026 m Screen Length: 5. m Water Column Height: 2.64 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 7.092E-07 m/sec y0 = 1.371 m



<u> XA - RECOVERY</u>

Data Set: P:\1322 (Shell)\aqt\1322-2548\7A - FINAL\2A Recovery.aqt
Date: 11/18/03 Time: 17:24:19

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>2A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: 7. m Anisotropy Ratio (Kz/Kr): 1.

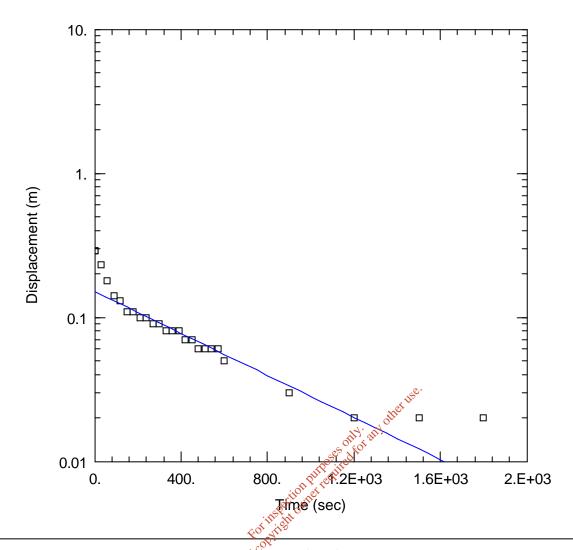
WELL DATA (2A)

Initial Displacement: 2.34 m Casing Radius: 0.026 m Screen Length: 5. m Water Column Height: 2.64 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 4.13E-07 m/sec y0 = 1.284 m



3A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\3A SLUG.aqt

Date: <u>11/18/03</u> Time: <u>17:33:49</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: <u>1322-Q1</u>

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>3A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: <u>5.</u> m Anisotropy Ratio (Kz/Kr): <u>1.</u>

WELL DATA (3A)

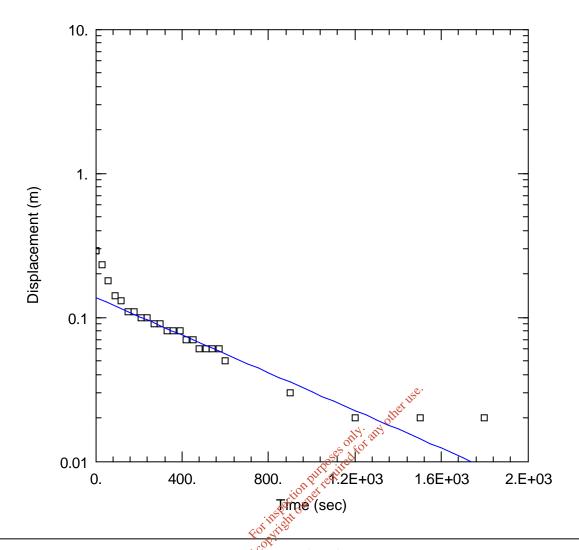
Initial Displacement: <u>0.29</u> m Casing Radius: <u>0.026</u> m Screen Length: <u>4</u>. m

Water Column Height: 3.12 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.21E-06 m/sec y0 = 0.1515 m



<u>3A - S</u>LUG

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\3A SLUG.aqt

Date: <u>11/18/03</u> Time: <u>17:34:25</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>3A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: <u>5.</u> m Anisotropy Ratio (Kz/Kr): <u>1.</u>

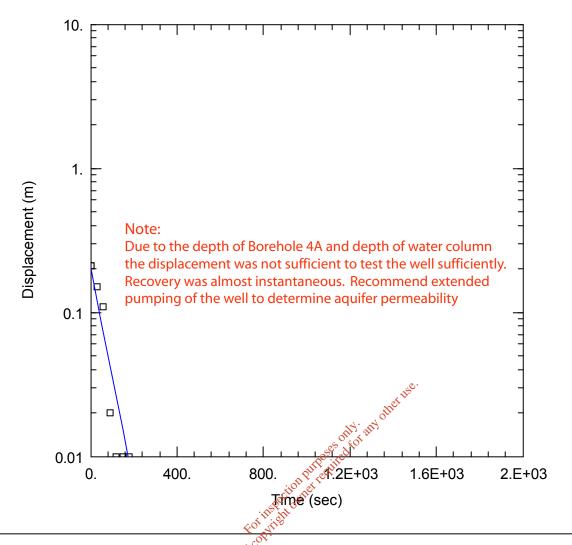
WELL DATA (3A)

Initial Displacement: 0.29 m Water Column Height: 3.12 m Casing Radius: 0.026 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 7.194E-07 m/sec y0 = 0.1373 m



4A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-25487A - FINAL\4A SLUG (erroneous).aqt

Date: <u>11/18/03</u> Time: <u>18:00:36</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: <u>4A</u> Test Date: <u>04-11-03</u>

AQUIFER DATA

Saturated Thickness: 28. m Anisotropy Ratio (Kz/Kr): 1.

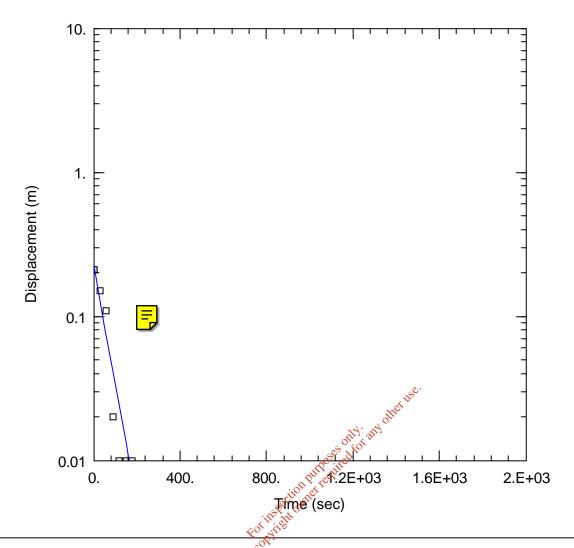
WELL DATA (4A)

Initial Displacement: 0.21 m Water Column Height: 27.3 m Casing Radius: 0.026 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 2.632E-06 m/sec y0 = 0.2015 m



4A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-25487A - FINAL\4A SLUG (erroneous).aqt

Date: <u>11/18/03</u> Time: <u>17:58:52</u>

PROJECT INFORMATION

Company: Minerex Environmental Limited

Client: TES Consulting Engineers

Project: 1322-Q1

Test Location: Srahmore, Bangor, Co. Mayo

Test Well: 4A Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 28. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (4A)

Initial Displacement: <u>0.21</u> m Casing Radius: <u>0.026</u> m Screen Length: <u>27</u>. m Water Column Height: 27.3 m Wellbore Radius: 0.05 m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.273E-06 m/sec y0 = 0.2239 m

APPENDIX 8.66 CONTROL ASSESSMENT Report AGEC Geotechnical Assessment Report Consent Georgiagh Confidence of Consent of



CORRIB FIELD DEVELOPMENT

PRELIMINARY GEOTECHNICAL DESIGN FOR SRAHMORE PEAT DEPOSITION SITE

Prepared for:
TES Consulting Engineers

AGEC Ltd

5 Kilcarrig Street

Bagenalstown

Co. Carlow

DOCUMENT APPROVAL FORM

Document title:	P	reliminary	Geotechnical Design for Srahm	nore Peat Deposition Site		
File reference Number: 3		382_044 Document Revision No		2		
Note: Amendme	ents marked w	vith line in	right-hand margin			
File Reference Number	Document Revision No		Amendment/Comment			

Task Nominated authority		Approved (signature and date)			
Prepared by	Authors: Paul Jennings	Jam Jamys 11.12.03			
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Approved by	Geotechnical Project Director: Turlough Johnston	8. Johns 11-12-03			
Quality check	Quality Manager: Marion English	H. Englih 11/12/03			

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Table 3	Adopted Design Parameters for Mineral Soil
Table 4	Summary of Slope Factor of Safety in Area 6

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Figure 1	Site Location
Figure 2	Site Layout Plan
E. 3	D CI CII I : 101 Ct th

Profile of Undrained Shear Strength (c_u) of Peat with Depth from CPT Results Figure 3

Figure 4 Factor of Safety for Global Stability - Case (1) Factor of Safety for Localised Stability - Case (2) Figure 5

APPENDICES

Phase 1 Ground Investigation Results Appendix A Appendix B Phase 2 Ground investigation Results

Appendix C Review of Effective Stress Parameters for Peat

Appendix D Risk Register

DRAWINGS

Drawing No. 382_001	Preliminary Design Ground Profile for Areas 5 & 6 – Section 1-1
Drawing No. 382_002	Preliminary Design Ground Profile for Areas 5 & 6 – Section 2-2
Drawing No. 382 003	Preliminary Design Ground Profile for Areas 5 & 6 – Section 3-3



1 INTRODUCTION

The Srahmore Peat Deposition Area is located about 1 km west of Bangor, County Mayo. The site is situated between the R313 and Bangor to Gweesalia roads in an area formerly used for peat harvesting by Bórd na Mona (Figure 1).

It is proposed to use the site as a deposition area for peat arisings from the excavation for the proposed gas terminal platform located at Bellanaboy, County Mayo.

Applied Ground Engineering Consultants Ltd (AGEC) was engaged in November 2003 by Shell E&P Ireland Ltd to carry out a preliminary geotechnical design of the site, which included the following.

- (1) Procurement of ground investigation data at site for design.
- (2) Interpretation of ground investigation data and selection of appropriate design parameters.
- (3) Assess and clearly demonstrate that the following elements of the proposed works have an acceptable factor of safety with respect to global and local stability in the temporary as well as permanent condition.
 - (a) Access Roads
 - (b) Deposition Areas
 - (c) Peat Transfer Area and Car park
- (4) A geotechnical risk register prepared for all activities relating to the site and the deposition activities envisaged, with the appropriate corrective and control features identified.
- (5) Observation and instrumentation requirements. The long and short-term requirements, if any, for observation and instrumentation of the site.

Details of site hydrology and drainage together with a summary of soils and geology are addressed in the main Environmental Impact Statement (TES, 2003).



2 SITE DESCRIPTION

The proposed Srahmore Peat Deposition Site (SPDS) is located to the south of the R313 (Figure 1) in an area of relatively flat to gently sloping ground. The natural ground surface at the site slopes gently from northeast to southwest with a fall about 0.2°, that is 5m fall over a distance of 1500m.

Several minor streams drain the site. These streams feed into the Munkin River to the west and the Owenmore River to the south.

The SPDS is in two parts, referred to as Area 5 and Area 6 (Figure 2). Each of these areas originally comprised natural blanket peat which has since been largely cutaway. The depth of peat cutting is some 1.5 to 2.5m.

Peat has been cutaway from Area 5 and 6 leaving a series of high- and lowfields.

- (1) Lowfields comprise areas where peat has been cut-away to near the top of the underlying mineral soil, typically a depth of 1.5 to 2.5m. In places the mineral soil can be seen exposed in the base of the low field. Lowfields are typically 120 to 150m wide and are separated by high fields.
- (2) Highfields comprise a strip of intact peat that has been left upstanding between low fields. The strip is some 15m wide, and has typically been used to facilitate vehicular and train access during peat harvesting operations.

The cutaway areas form an excavated basin within and surrounded by existing peat land. The highfields form internal divides within the cutaway areas which further compartmentalise the cutaway areas into rectangular excavated basins (Figure 2).

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3 PROPOSED WORKS

Within the SPDS it is proposed to use Area 5 as a reception area for peat arriving on site. The proposed work in Area 5 will include an access road from the R313. A hardstanding for peat transfer will be constructed at the end of the access road for peat handling and car parking.

Area 6 is proposed to be used as the deposition area for peat excavated from the proposed gas terminal site at Bellanaboy. The proposed average depth of placed peat within the deposition area is given as 1.04m.

The proposed sequence of placing peat in Area 6 is given in the main Environmental Impact Statement (TES, 2003). A summary is given below.

- (1) Low ground bearing pressure (Haku) trailers will transport the peat from the reception area to highfields in Area 6 via internal haul roads constructed on existing peat.
- (2) Haku trailers will travel along internal roadways which will be constructed on highfields in Area 6 and empty the peat by tipping onto the side of the highfield.
- (3) Excavators will remove the peat from the highfield and place the peat onto the lowfield. Peat will then be bulldozed towards the centre of the lowfield to create a cambered surface with highest point in the centre sloping back toward the highfields.
- (4) The height of placed peat will generally be of the order of 1.4 to 1.8m at the highest point in the centre above the existing ground levels, with a fall towards the highfields. The edge of the placed peat will be offset from the bottom toe of each of the highfields where drainage ditches are to be constructed.



4 SUPERFICIAL DEPOSITS

The superficial deposits within the SPDS can be briefly classified into the following main types.

- (1) Peat
- (2) Glacial Till
- (3) Weathered Rock

In general terms all superficial deposit types other than peat may be referred to as mineral soils. Exposures below the base of the peat are limited to trial pits, which indicate till underlying peat. The extent of weathered rock below till is not known, as boreholes were open-holed to top of competent rock.

4.1 Peat

Blanket peat originally covered the site. Most of the peat has been removed from the lowfields, leaving typically less than 1m thickness of peat. Original peat depth was estimated as typically 3 to 4m. Locally deeper areas of peat, up to 6m adjacent to R313, were recorded.

Based on a general soil map of Ireland (An Foras Taluntais, 1980), the site is shown to be covered in low-level blanket/basin peat.

The upper about 1m of peat is generally very fibrous and possibly desiccated which results in a relatively stronger and stiffer upper layer. Peat was described using BS: 5930 (BSI, 1999) as soft slightly moist brown PEAT with occasional fragments and large pieces of bogwood. Peat appeared to lie directly on glacial till.

4.2 Glacial Till

Till, typically derived from focal bedrock, underlies the peat. The thickness of till in Area 6 is estimated to vary from 6 to 14m based on the depth of superficial deposits given in borehole logs. Borehole logs do not distinguish between till and weathered rock, and it is possible that weathered rock is present in the lower part of the superficial deposits.

Based on trial pit logs, till is present at some locations as an upper cohesive deposit underlain by a granular deposit. Till was described from trial pits using BS: 5930 as follows.

- (1) Upper cohesive deposit. Described as generally firm brown sandy CLAY. Given the presence of bogwood in the peat, this suggests that prior to peat formation the site was formerly forested, and therefore a buried soil surface layer is likely present. The upper cohesive deposit possibly represents the remnants of a buried soil surface layer. This layer does not appear to be widespread.
- (2) Lower granular layer. Described as generally grey to yellow/brown clayey to slightly clayey occasionally silty gravelly fine- to medium-grained SAND with occasional to some sub-angular to sub-rounded gravels, cobbles and boulders of quartzite, schist and red sandstone. The till is layered, with occasional GRAVEL layers also recorded, though no clear stratification between trial pits was recognisable. The lower granular till layer is widespread and is more commonly found immediately below peat.



4.3 Weathered Rock

Extent and character of weathered rock is not known as borehole logs do not distinguish between till and weathered rock, and it is possible that weathered rock is present at depth. No weathered rock was identified from trial pits which were excavated to about 3m.





5 SOLID BEDROCK GEOLOGY

The bedrock geology of the area of the SPDS consists of rocks of the Dalradian Supergroup Series (GSI, 1992), which comprises essentially metamorphosed sedimentary rock. Boreholes within Area 6 show the depth to rockhead is variable and ranged from about 6 m bgl in BH3B to 14.3m bgl (BH2B).

The dominant rock type below the site is the Inver Schist Formation, which is a pelitic to semi-pelitic schist. Several sub-ordinate rock types also crop below the site along a northwest to southeast axis. These rock types are generally separated by a fault line and include marble, quartzite and psammitic schist.

Borehole records identified both psammite and quartzite bedrock. Psammite was described as moderately weak to moderately strong, narrowly banded, schistose (dipping 75°), fine- to coarse-grained micaceous to extremely micaceous PSAMMITE. In places the psammite was underlain by quartzite (BH1B) or quartzite was recorded at the top of rockhead (BH3B). Quartzite was described as strong to very strong, massive to narrowly banded (dipping 35° and 60°), fine- to medium-grained micaceous QUARTZITE.

Minor folding has been identified within the schists with cleavage/schistocity dipping towards the northeast at between 35° and 75°.

**Expring towards the northeast at between the cleavage of the cleavage

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6 GROUND INVESTIGATION

6.1 Fieldwork

Ground investigation work at the SPDS was carried out in 2 phases. Phase 1 was carried out in October/November 2003 on behalf of TES Consulting Engineers (TES) to determine the nature and extent of geological and hydrological characteristics at the site. Phase 2 was carried out in November/December 2003 on behalf of TES by AGEC to provide further information for a geotechnical assessment of the site.

Ground investigation works were carried out by Irish Drilling Ltd (IDL) and Fugro Engineering Services Ltd.

The following ground investigation has been carried out at the SPDS.

- (1) Boreholes (7 nos.),
- (2) Trial pits (14 nos.),
- (3) In situ shear vane testing using handheld vane (7 nos.),
- (4) In situ shear vane using rig-mounted mechanical vane, (up to 40 nos.), and
- (5) Cone penetration testing (CPT) (up to 80 nos.).

The above boreholes, and some trial pits, together with permeability/pumping tests within rock were carried out in Phase 1 (Appendix A). The results of permeability/pumping tests are not included in this report.

Trial pits were carried out to a depth of typically 3m using a tracked excavator.

Hand-held shear vanes were generally carried out in trial pits by IDL using a Geonor H-60, 50.8mm diameter vane.

Cone penetration testing (CPT) was carried out by Fugro Ltd using both a 3 tonne mini crawler and 15 tonne mounted CPT rig. The rigs were also used to carry out shear vane testing using a mechanical Geonor H-10, 55mm diameter vane.

Ground investigation results for Phase 1 and 2 are given in Appendix A and B respectively.

6.2 Laboratory Testing

Phase 1 laboratory test results included particle size distribution, five-point compaction and index testing (Appendix A).

Previous experience of laboratory strength testing for peat using a range of triaxial, simple and direct simple shear (DSS) testing apparatus has shown that results can be scattered and difficult to interpret. This is due to the excessive deformations that peat undergoes and the difficulty in defining the resulting failure limit. In situ strength testing possibly provides the most realistic indication of peat strength.



7 TOPOGRAPHIC SURVEY

A topographic survey of the SPDS was carried out on behalf of TES by Bórd na Mona as part of the Phase 1 investigation. This survey has been used to generate the elevation contours used to generate the geological cross-sections (See Drawing Nos. 382_001 to 003).

Additional detailed level survey was carried out by AGEC at specific locations to supplement the topographic survey.





8 GEOTECHNICAL ASSESSMENT

8.1 General

A preliminary geotechnical design and assessment of the following elements of the SPDS has been carried out.

- (1) Global stability of the deposition area (Area 6) prior to and following peat placement,
- (2) Local stability of highfield/lowfield in deposition area (Area 6), and
- (3) Assessment of access road, peat transfer area and car park in Area 5

8.2 Factor of Safety for Earthworks Stability

The code of practice for earthworks BS 6031:1981 (BSI, 1981) provides advice on design of both temporary and permanent earthworks. It states that for a first time failure with a good standard of site investigation the design factor of safety (FoS) of should be 1.3 to 1.4.

For the purpose of peat stability a minimum FoS of 3.3 is required.

8.3 Stability Analysis

Stability analysis was carried out using slope stability computer program Talren (Terrasol, 1997) applying Bishop's rigorous method.

Both total and effective stress analysis were examined. Total stress analysis applies to short-term conditions occurring during construction and for a time following construction until construction induced pore water pressures dissipate. Undrained shear strength values, c_u are used for total stress analysis. Effective stress analysis applies to long-term conditions where construction induced excess pore water pressure has dissipated. Effective strength parameters, c' and ϕ' , are used together with assessed groundwater conditions.



9 DESIGN PARAMETERS

9.1 Peat

Undrained shear strength (c_u) of in situ peat was determined using cautious estimates of c_u . Vane results are presented in Appendix A. The following sources were used to assess c_u for peat:

- (1) In situ vane testing using both hand-held and mechanical,
- (2) In situ cone penetration testing (CPT), and
- (3) Results from neighbouring sites.

In situ vane test results are included in Appendix A. Results indicate that strength ranges typically from about $c_{u \text{ vane}}$ of 10 to 23kPa for unfactored vane results.

Vane results from several works on Irish peat have used unfactored vanes (see for example Hanrahan, 1964, Piggott et al., 1992 and AGEC, 2002). These works back-analysed failures and found that unfactored vane results provided a reasonable estimate of the operating shear strength. Furthermore several of the highfields in Area 6 are upstanding by 1.5m to 2.0m with a sub-vertical face. Back-analysis of these faces shows that a minimum $c_{u \, back}$ of about 10kPa is required for stability.

CPT's were carried out across the site to establish cone resistance (q_c) and hence undrained strength $(c_{u \ CPT})$ with depth in peat (Appendix B). The relationship between $c_{u \ CPT}$ and q_c is based on an approximation of the bearing capacity equation (Sanglerat, 1972) which requires cone factor (No) to be determined.

Based on previous experience 15 was adopted. Previous work (AGEC, 2002 and 2003) indicates that, whilst there is a scatter of data, this provides a reasonable cautious estimate of undrained strength of peat.

Depth profile of peat c_u with depth using CPT results is shown in Figure 3. This shows a stronger and stiffer layer within the upper 1m associated with more fibrous material overlying weaker more amorphous peat. At greater depth, the profile indicates little strength gain with depth. Inspection of exposed peat in the low field areas by AGEC estimated c_u of 10 to 15kPa.

Previous work on blanket peat in North Mayo (AGEC, 2002) determined effective strength parameters (c' and ϕ ') for peat from DSS and DS tests. Results showed a lower bound c' = 3kPa and ϕ ' = 32°. A review of effective strength parameters for peat from Irish and international publications showed that these results are comparative to values used elsewhere (Appendix C).

Adopted design parameters for in situ peat are given in Table 1. These parameters are based on site specific results or results from neighbouring peat sites. In general, the design parameters for peat are within the range reported in the literature.

	Parameter/Characteristic	Design Value	Comments
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Bulk unit weight, γ (kN/m³)	10		-
Effective friction angle, \$\phi'\$ (degrees)	32		-
Effective cohesion, c' (kN/m ²)	3		-
Undrained shear strength	<u>Highfield</u>		-
	Upper 1m:	15kPa	
	Peat below 1m:	5kPa	
	Lowfield		
	Upper 1m:	10kPa	
	Peat below 1m:	5kPa	

Table 1 Adopted Design Parameters for In Situ Peat

9.2 Ex situ Peat

The parameters for peat excavated from the gas terminal site are based on several previous site investigations (AGEC, 2002). All peat beneath the terminal is to be removed and placed at the SPDS.

Adopted design parameters for ex situ peat are given in Table 2. These parameters are based on site specific results or results from neighbouring peat sites

Parameter/Characteristic	Design Value	Comments
Bulk unit weight, γ (kN/m ³)	305° (200	-
Effective friction angle, φ' (degrees)	n pur cour.	Not used
Effective cohesion, c' (kPa)	Milet -	Not used
Undrained shear strength, c _u (kPa)	2	Remoulded strength. Based on
Follylib		investigations results presented in
A COX		AGEC (2002)
Slope inclination	>1v:10h	For long-term stability surface
COUS		profile of peat to be constructed
		with the shallowest gradients
		practicable based on previous
		experience.

Table 2 Adopted Design Parameters for Ex Situ Peat

9.3 Mineral Soil (Glacial Till)

Mineral soil considered to be glacial till underlies the peat and has a variable thickness. Till consists of two layers, an upper cohesive layer and a lower granular layer. The upper layer is not always present and for preliminary design till is modelled as a granular layer only.

Adopted design parameters are given in Table 3.



Parameter/Characteristic	Design Value	Comments
Bulk unit weight, γ (kN/m ³)	20	-
Effective friction angle, φ' (degrees)	32	Assumed medium dense
Effective cohesion, c' (kPa)	0	-
Undrained shear strength, c _u (kPa)	0	-

Table 3 Adopted Design Parameters for Mineral Soil





10 PRELIMINARY DESIGN GROUND PROFILE

10.1 General

Preliminary design ground profile Area 6 is presented in Drawings Nos. 382_001 and 382_002, and preliminary design profile for Area 5 is presented in Drawing No. 382_003.

The drawings show both an exact scaled profile and a profile with an exaggerated vertical scale which highlights more clearly the geometry.

10.2 Peat Layer

Bórd na Mona undertook a peat depth survey of the Srahmore site in 1998, using a 'Hiller Borer' sampler, which is a hollow stem sampler. This sampler was pushed into the peat material and the hollow stem used to indicate depth to mineral soil.

Within Area 5, the survey indicated peat thickness varied from about 0.34m to 0.7m in the zone where it is proposed to construct the peat reception hardstand. The peat thickness along the access road from the R313 to the reception hardstand varied from 0.34m to 6m. The peat thickness being greatest immediately adjacent to the R313, where no peat extraction has been undertaken.

With respect to Area 6, the Hiller Borer survey indicates that between 0.1m and 2.16m of peat overlies the mineral subsoil in the tow fields.

10.3 Mineral Soil (Glacial Till) Layer

Mineral soil underlies the peat. The top surface of the mineral soil is variable with ground investigation results indicating a depth varying between about 3 and 6m. The thickness of mineral soil is estimated as between 6 and 14 m bgl.



11 GEOTECHNICAL DESIGN AND STABILITY RESULTS

11.1 Area 6

Peat is to be placed within the lowfields of Area 6. Stability of lowfields during and following placement of peat has been assessed for the following cases.

- (1) Global stability of the deposition area (Area 6) prior to and following peat placement.
- (2) Local stability of highfield/lowfield in deposition area (Area 6).

Stability results are presented in Table 4 and Figures 4 and 5. A surcharge of 10 kPa is assumed to represent construction traffic for Case (2).

Case		Minimum	Factor of Safety		Comments			
	Total Stre	ess Analysis	Effective Str	ess Analysis				
	Existing	Filled	Existing	Filled				
(1)	5.76	>20	3.21	چ ^{ە.} >20	See Figure 4			
(2)	1.39	4	uposes ally any of	1.46	See Figure 5			

Table 4 Summary of Slope Factor of Safety in Area 6

For Case (1) the FoS is high, as would be expected given the geometry of the area. The minimum FoS of 3.21 is prior to filling for global failure along perimeter of deposition (Figure 4a and b). This is greater than the required minimum of 1.3.

Where peat is placed within Area 6, global stability analyses were carried out assuming potential translational failure below deposition area. Stability along Section 2-2 (Drawing No. 382_002) was examined together with stability along the lowfield to the south of Section 1-1 (Drawing No. 382_001). The calculated FoS is greater than 20 (Figure 4c to h). The high FoS indicates that such a failure mode is inapplicable.

Case (2) examined local stability within Area 6. The minimum FoS of 1.37 for local stability was found for potential side-slope failure of highfield (Figure 5a and b). Where a surcharge load is placed up to the edge of the highfield the FoS reduces to less than 1.3 within about 2m of the edge of the highfield. Siting of concentrated loads close to the edge of the highfield, may result in localised side slope failure of highfield, and is to be avoided.

Local stability of placed peat in the western end of the lowfield was examined. This shows a minimum FoS of 1.46 (Figure 5d) and assumes failure surface passes through intact peat below placed peat. Some minor slippage of placed peat may occur from the face of the peat until such time as plant cover can be established on the placed peat surface.



Further analyses examined potential failure of placed peat between highfields (Figure 5e and f). This shows minimum FoS of 11. 62.

11.2 Area 5

Within Area 5 it is proposed to construct an access road from the R313 to a hardstanding area for peat transfer. The hardstanding will be used for transferring peat received from the Bellanaboy site on to onto specialist low ground bearing machinery for transport to deposition in Area 6.

A geotechnical assessment of access road and peat transfer area was carried out.

11.2.1 Access Road from R313

The peat thickness along the access road from the R313 to the reception hardstand varies from 0.34m to 6m based on Bórd na Mona's peat depth survey. The peat thickness is greatest immediately adjacent to the R313, where no peat extraction took place (Drawing No. 382 003).

Where peat is to remain below the access road, then estimated settlements up to 1m would be expected. This settlement is likely to be differential varying with applied loading and thickness of peat.

Bearing failure of the road has been as seed. This indicates that where peat is left below the road, the road foundation requires a biaxial geotextile, such as Tensar SS30/40 or similar, laid within a suitable granular fill. Whilst this may reduce the potential for bearing failure and limit localised differential settlement, the total predicted settlement is likely to disrupt the running surface.

Preliminary design options are as follows.

- (1) Peat should be removed from below the road where it is proposed to construct a metalled road surface. Where there is significant depth of peat then excavations need to be fully supported. Partial removal of peat may be a viable option where it can be shown that significant settlement and bearing failure do not adversely affect the road. Alternatively stabilising peat in situ is an option, see below
- (2) Where there is a significant depth of peat, modification of peat in situ can be carried out using for example vibro-compacted concrete columns, stone columns, in situ mixing of peat with cement and lime.
- (3) Where no metalled road surface is required then peat can be left in place. Road construction would then consist of a suitable granular fill reinforced with a biaxial geogrid, such as Tensar SS30/40 or similar. This construction would require periodic re-levelling and grading to maintain an acceptable running surface.



11.2.2 Peat Transfer Area

Trial pit (TP2) was excavated in the area of the proposed hardstanding for the peat transfer area (Drawing No. 382_003). The depth of peat encountered was 0.65m underlain by mineral soil. These ground conditions do not represent any great difficulty with respect the proposed construction.

Where peat is to remain below the hardstanding, then settlements of the order of about 200mm would be expected. This settlement is likely to be differential varying with applied loading and thickness of peat.

Preliminary design options are as follows.

- (1) Peat should be removed from below the hardstanding where it is proposed to construct a metalled surface to the hardstanding.
- (2) Where no surface to the hardstanding is proposed then a suitable granular fill reinforced with a biaxial geogrid, such as Tensar \$830/40 or similar, would suffice. This construction would require periodic re-levelling and grading of hardstanding surface.

 This construction would require periodic re-levelling and grading of hardstanding surface.

 This construction would require periodic re-levelling and grading of hardstanding surface.

 This construction would require periodic re-levelling and grading of hardstanding surface.

 This construction would require periodic re-levelling and grading of hardstanding surface.

 This construction would require periodic re-levelling and grading of hardstanding surface.

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12 CONSTRUCTION

12.1 General

An assessment of geotechnical hazard and associated risk for the proposed construction is presented in Appendix D. The risk assessment identified no significant risks with respect to major failure or instability associated with the proposed works.

All geotechnical hazards were classified as trivial risk. Of the 6 likely geotechnical hazards identified for the works (see Table in Appendix D), 5 of these hazards affect the site work only and have no impact beyond the site boundary. The highest risk is associated with possible settlement and bearing failure of the access road from the R313. Where this road is constructed on peat then monitoring of road performance is required. Disruption of this road would have a high impact on the works.

12.2 Geotechnical Instrumentation

Geotechnical instrumentation is required to monitor key performance criteria and validate the design. Instrumentation is usually required to monitor horizontal and vertical displacement of the ground or construction access road embankments.

Given the low geotechnical risk associated with the proposed works, at the preliminary stage no requirement for geotechnical monitoring is envisaged.

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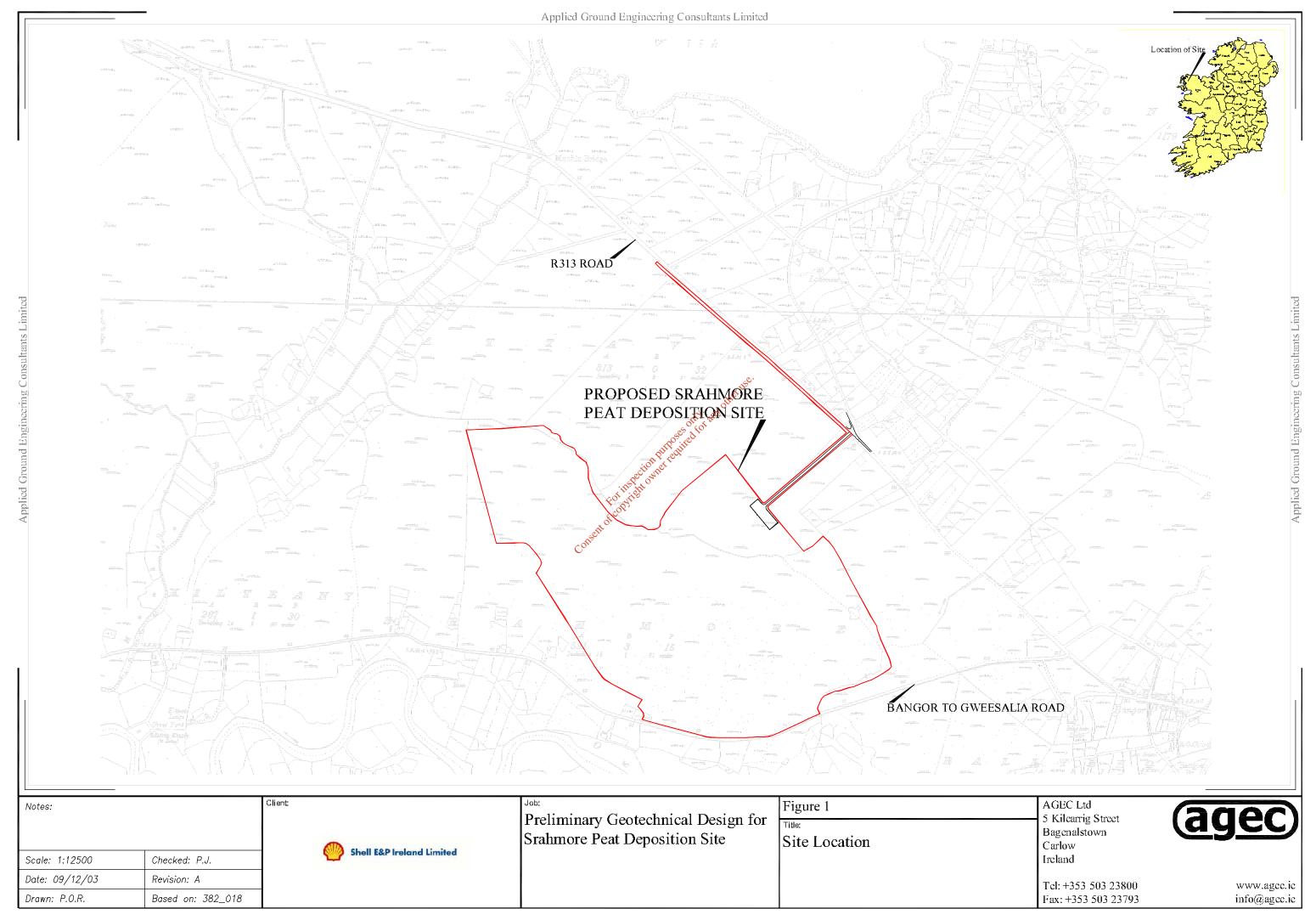
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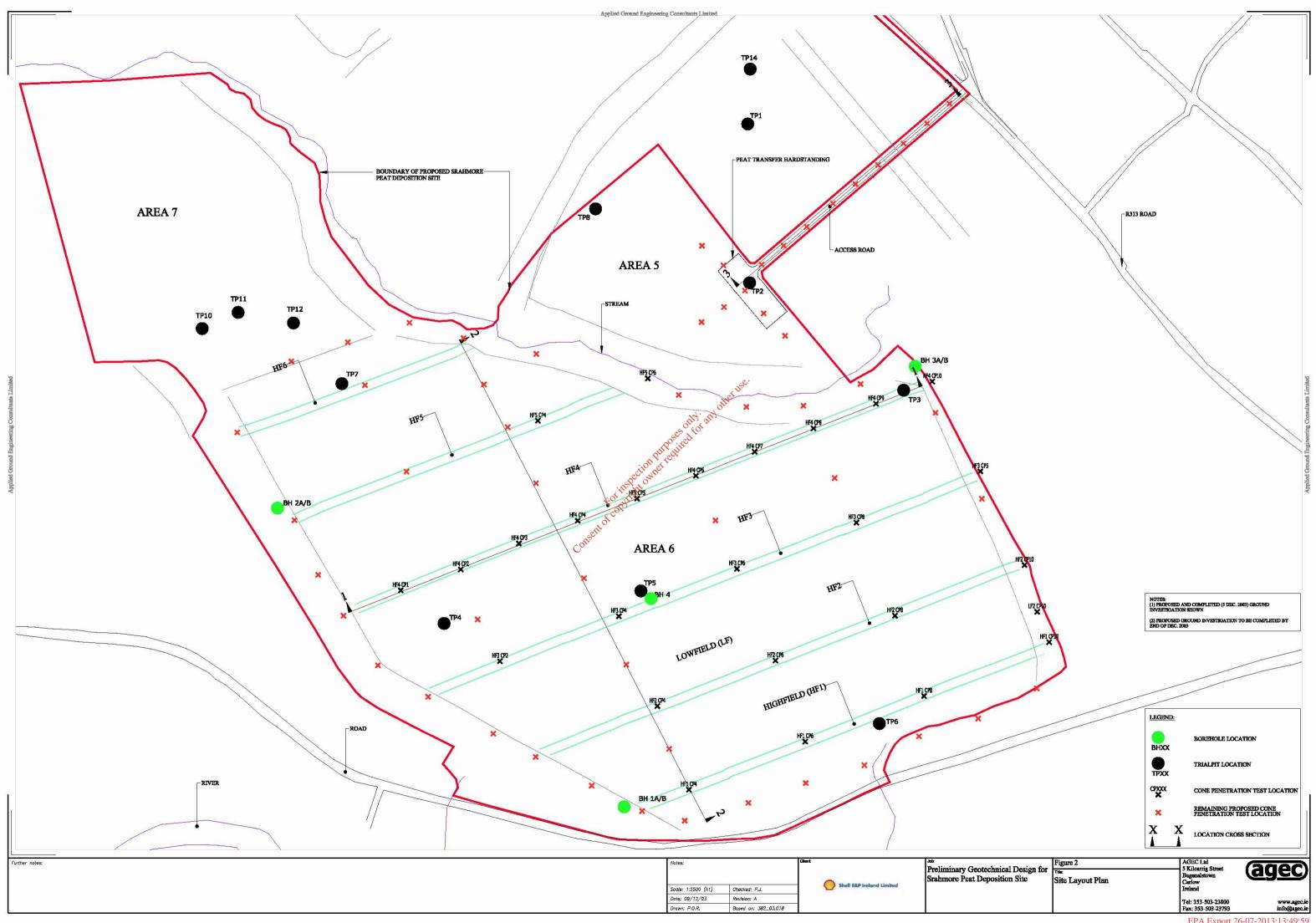


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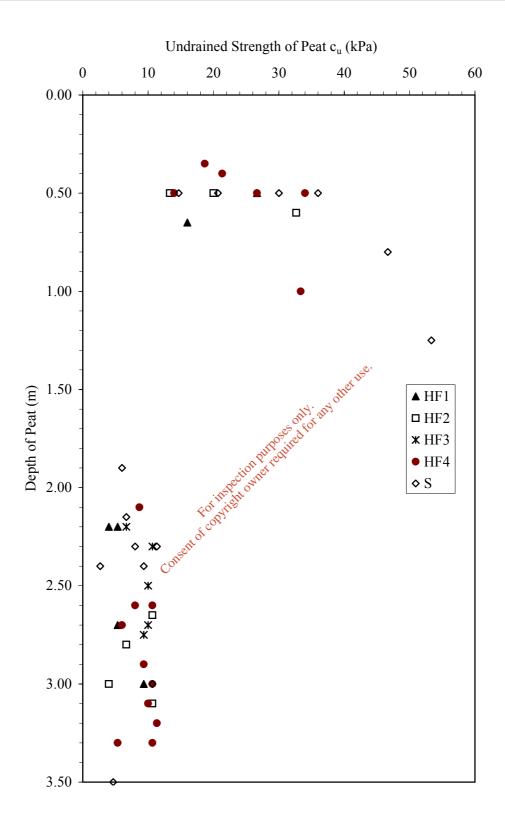
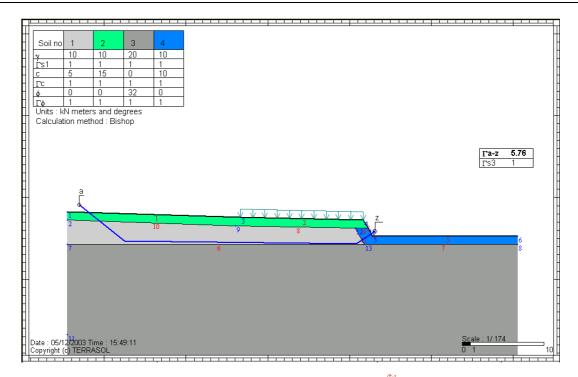


Figure 3 Profile of Undrained Shear Strength (c_u) of Peat with Depth from CPT Results

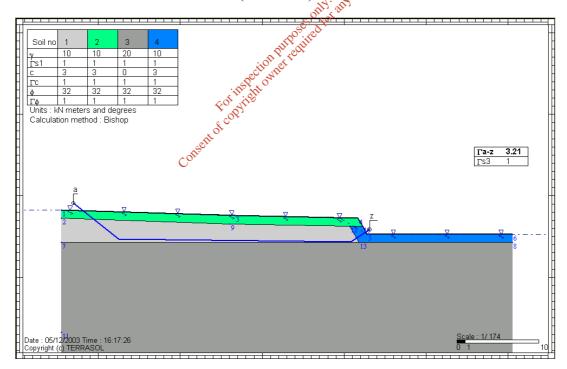
Notes

- (1) Results are for highfield (HF) and southern (S) perimeter areas
- (2) CPT converted to $c_{u CPT}$ using $N_k = 15$
- (3) Results based on 30 CPT locations throughout the site





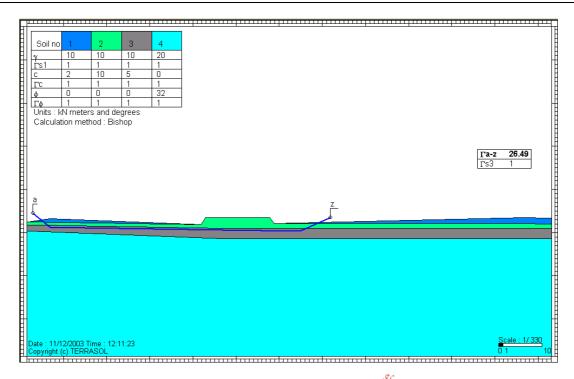
(a) Showing global stability of perimeter assuming translational slide for total stress (undrained) analysis



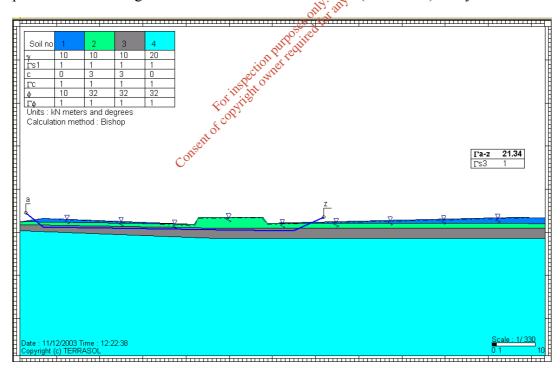
(b) Showing global stability of perimeter assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.





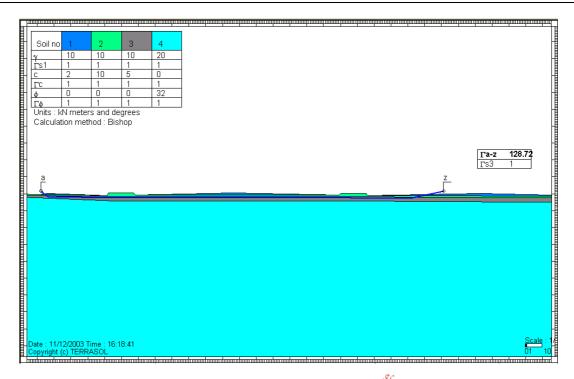
(c) Example of global stability of under highfield along Section 2-2 following peat placement assuming translational slide for total stress (undrained) analysis



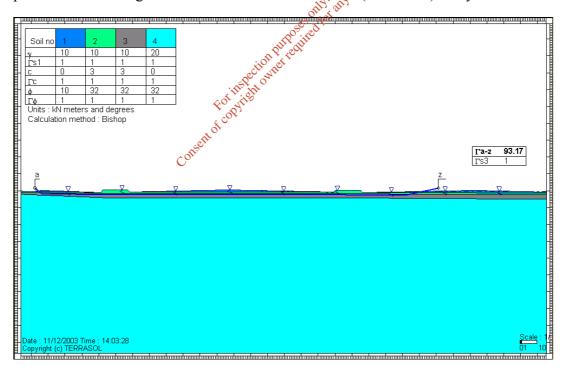
(d) Example of global stability of under highfield along Section 2-2 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.





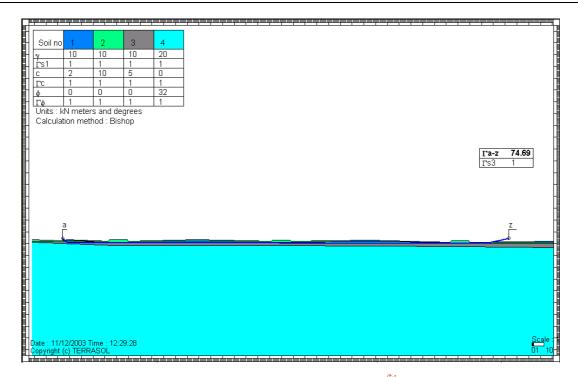
(e) Example of global stability under 2 highfields along Section 2-2 following peat placement assuming translational slide for total stress (undrained) analysis



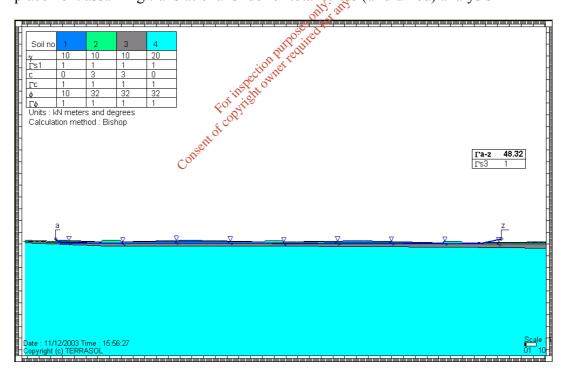
(f) Example of global stability under 2 highfields along Section 2-2 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.





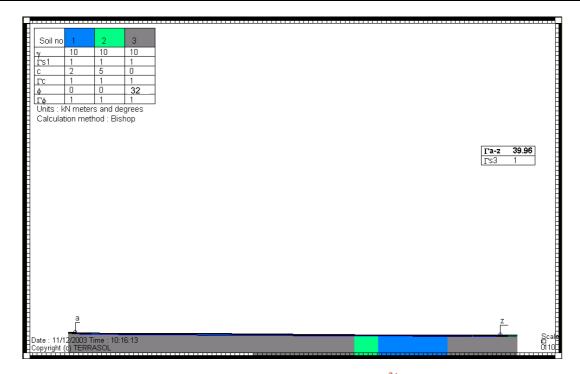
(g) Example of global stability under 3 highfields along Section 2-2 following peat placement assuming translational slide for total stress (undrained) analysis



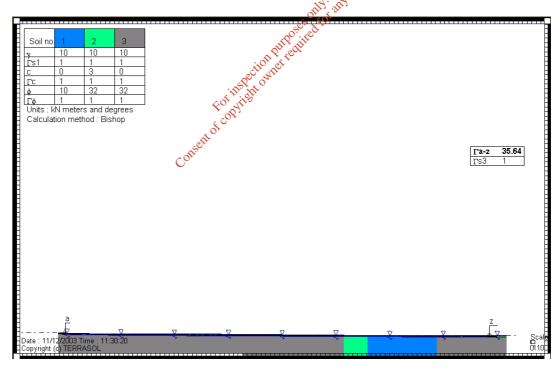
(h) Example of global stability under 3 highfields along Section 2-2 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.





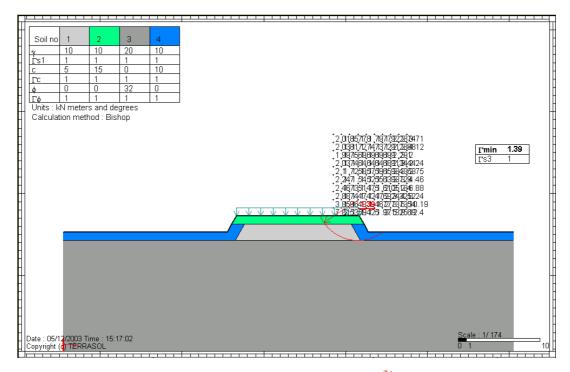
(i) Example of global stability under lowfield to south of Section 1-1 following peat placement assuming translational slide for total stress (undrained) analysis



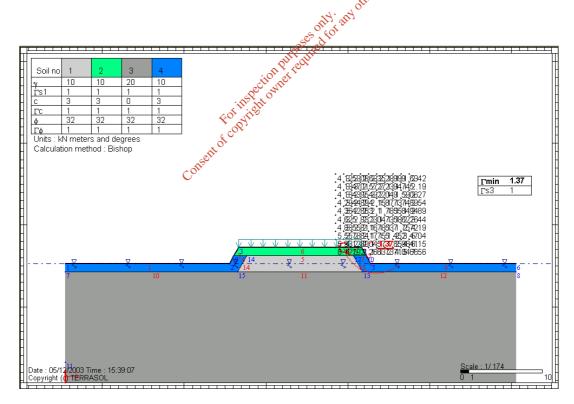
(j) Example of global stability under lowfield to south of Section 1-1 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1)





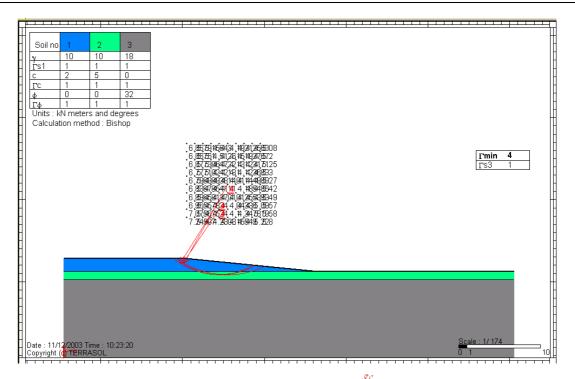
(a) Showing locally stability of highfield for total stress (undrained) analysis



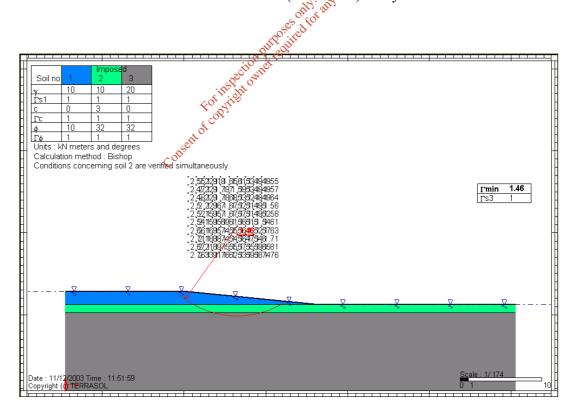
(b) Showing locally stability of highfield for effective stress (drained) analysis

Figure 5 Factor of Safety for Localised Stability - Case (2) Cont.



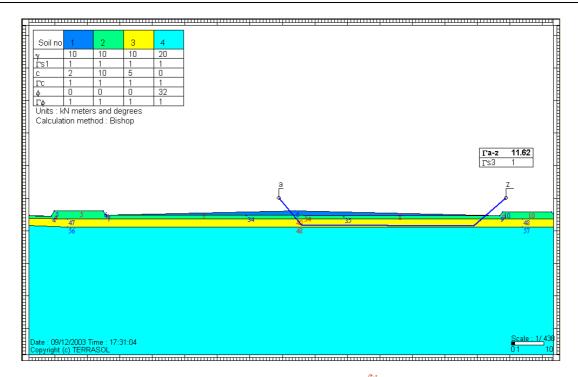


(c) Example of stability of placed peat at western end of lowfield assuming rotational slide for total stress (undrained) analysis.

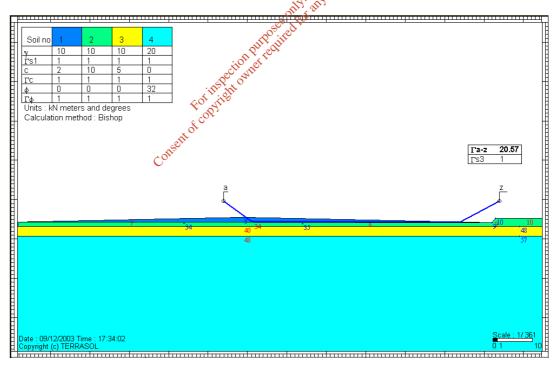


(d) Example of stability of placed peat at western end of lowfield assuming rotational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 5 Factor of Safety for Localised Stability - Case (2) Cont.



(e) Example of stability of underlying intact peat below placed peat between highfields assuming translational slide for total stress (undrained) analysis.

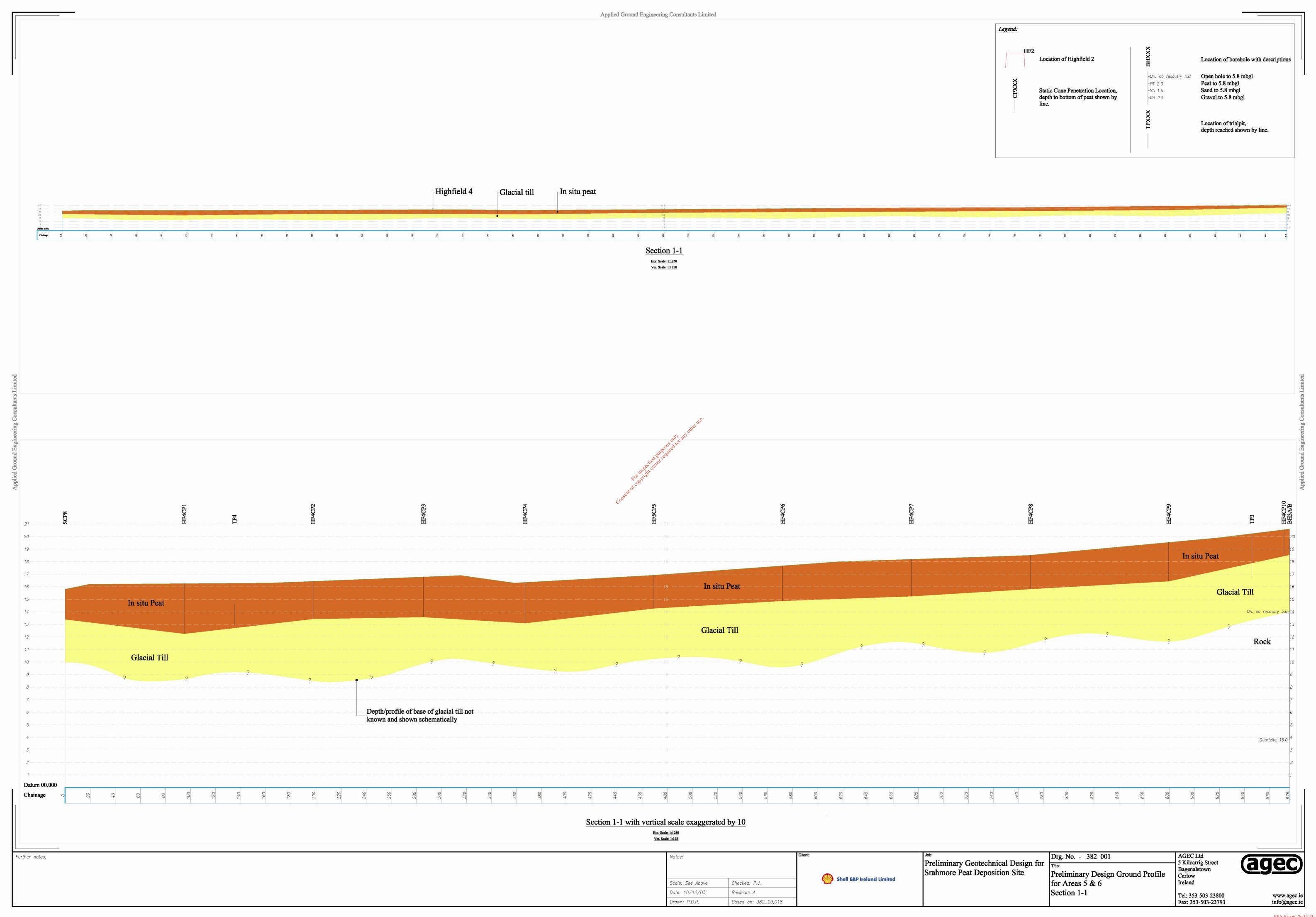


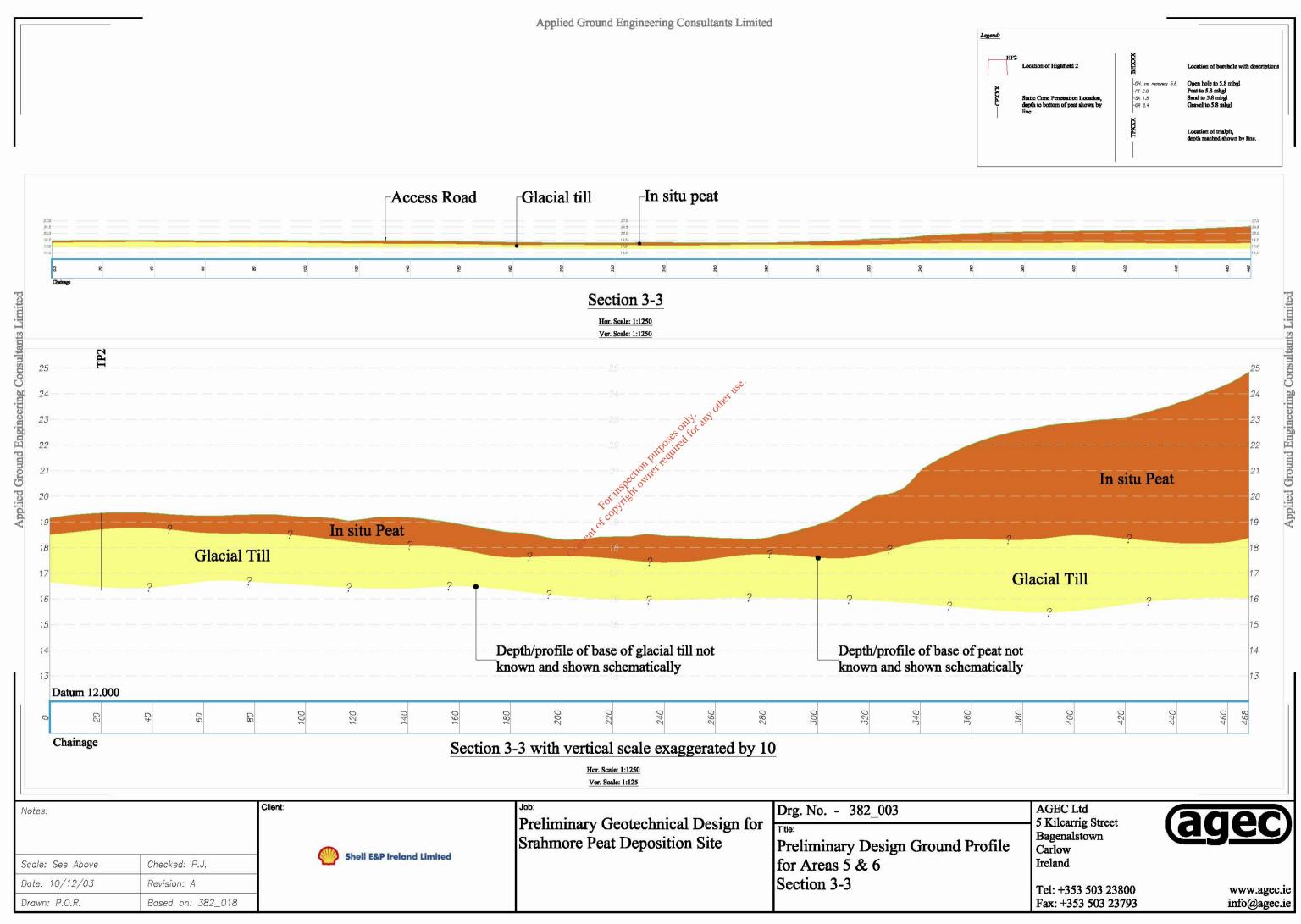
(f) Example of stability within placed peat between highfields assuming translational slide for total stress (undrained) analysis.

Figure 5 Factor of Safety for Localised Stability - Case (2)



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APPENDIX A PHASE 1 GROUND IN VESTIGATION RESULTS

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Second Floor, Unit 4B/5
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Dublin 15
TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH1A

Sheet No. 1 of 1

Client:	Bord na Mo	na/Shell E&P	Site: Src	ihmore,	Ban	gor-	Erris, C	o. Mayo		Job	No.: 1169	Scale: 1:50)
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Depth m	Descri	ption of Strate		Legend		Level n	Static Water Level 4/11/03		nples Ref.		BH Tests Type & Ref.	Completio Uning:	n Details Backfill:
GL	PEAT				 								CEMENT
0.55	, <u></u>				15.0	09	V					50MM UPVC CASING	BENT ONITE
	Fine grained S matrix, medius grey.	AND, with clay/silt m light grey to green	nish	Çonsent of Consent of	ine of	zzilot Militori	piloses of	र्धं क्ष्में के	er use			SOMM UPVC SCREEN	Security Secure Security Securi
12.5	SAND with frag	gments of Schist Light grey to light											
13.5	greenish grey. END OF BOREH												
-18	END OF BOKER	IULE											
Remai	rks:		•										

TES

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Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown

Dublin 15

TEL: (01) 8030401 FAX: (01) 8030410

BOREHOLE LOG

Borehole BH1B

Sheet No. 2 of 2

Client:	Bord na Mona,	Site:	hmore, l	Bango	or-E	rris, Co	unty Mo	1 1 2 1	ob No.: 1169	Scale: 1:50		
Easting	eference g: 084463 ng: 323049	Elevation (m0D): Borehole Diameter Borehole Diameter Borehole Depth (m	(Subso	II): 65mr			Started Comple			THE ASSAULT STREET STREET		rilling Ltd.
Depth m	Descri	ption of Strat		Legend	OD L		Water Inflows		nples Ref. N	BH Tests o. Type & Ref.	Completic Lining:	n Details Backfill:
18m 18.5	As above									bgl		
	banded, (dipp very pale gre- micaceous Qi weathered. Mi orientated fla described na Discontinuities spaced, gene- also steeply di orientations),	v strong, faintly name ing 60 degrees), when the medium grown occurs as strong likes, producing previous banding. Stroke to medium the control of the contr	ite to ained, ghtly lously I (but ther ightly						nge.	Packet Test Ref.: BH1B Test section: 15.5-23.7m b	50mm uPVC Screen	3-7mm Pea Gravel
23.7	END OF BOR							. 30 ²	et use.	80		
				Consental	i Itspel	tion for the state of the state	ard reduit					

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

Borehole BH2A

BOREHOLE LOG

TEL: (01) 8030401 FAX: (01) 8030410

Sheet No. 1 of 1

Client:	Bord na Mo	Site: Sro	Site: Srahmore, Bangor—Erris, Co. Mayo.							Job No.: Scale: 1:50			
Easting	eference g: E083092 ng: N323519	Elevation (mOD): 1 Borehole Diameter (Borehole Diameter (Borehole Depth (m)	(Subsoi (Rock):	il): 65mı 65mm		Date	Started Comple				Drill Contr Drill Metho Logged by		rilling Ltd.
Depth m	Descri	otion of Strate		Legend	OD	Levei m	Static Water Level		nples		BH Tests Type & Ref.	Completic Lining:	n Details Backfill:
GL							4/11/03						
0.55	Fine grained S matrix, medius grey.	AND, with clay/silt m light grey to green				.10		त्र क्षेत्र क्ष	Kuse.			50MM UPVC CASING	BENTONITE
12.3	SAND with frag Quartzite, Sand grey.	ments of eroded distone and Schist.	Ç	Ço' onsent oc	Note of the state	ection of the control	stregite street					50MM UPVČ SCREEN	3–7mm Pea Gravel
14.0	END OF BOREH	OLE											
- 18 Remai	rks:							.		-1			

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BOREHOLE LOG

Borehole BH2B

Sheet No. 1 of 2

Client:	Bord na Mone	g/Shell E&P	Site: Srahmore, Bangor-Erris, County Mayo.							Job No.: Scale: 1:50			
Eastin	eference	Elevation (mOD): 1 Borehole Diameter (Borehole Diameter (Borehole Depth (m)	7.17m Subsoi Rock):	i): 65mi 65mm	5mm		Started Comple	i: 27/10/0 eted: 27/10			Drill Contr Drill Metho Logged by		rilling Ltd.
Depth	Descri	otion of Strate	ו	Legend			Static Water		nples		BH Tests	Completio	
m Cl						m	Level 4/11/03	Туре	Ket.	NO.	Type & Ref.	Lining:	Backfill:
GL 0.55	PEAT								 				
12.0	matrix.	AND with clay/silt grey to greenish grey	·-	Consent of	14.		Outposes of the feet required	य. खेत्र १००	k et lise			50mm uPVC CASING	BENTONITE
14.3	SAND with frag Quartzite, Sand	ments/cobbles of e istone and Schist.	roded										
	thinly bedded/s degrees), green brown below 21 grained micaced weathered. Occi highly weathere Discontinuities: Schistosity para	to moderately stronchistose (dipping 30 ish grey (changing to the changing to the changing to the changing to the changing	-45 o n rately (Omm)										
- 18 - Remar	Moderately oper	n.											

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BOREHOLE LOG

Borehole BH2B

Sheet No. 2 of 2

Client:	Bord na Mona/	Site: Srahmore, Bangor—Erris, County Mayo.								lo.: 1169	Scale: 1:50	Scale: 1:50	
Grid Re Easting	eference g: 083092 g: 323519	7.17m (Subso	7.17m Subsoil): 65mm Rock): 65mm : 23.5			Started: Comple	27/10	0/03	03 Drill Contract 10/03 Drill Method: Logged by: P		d: Coring : PK		
Depth m	Descri	ption of Strate		Legend	j .	Level m	Water Inflows		nples Ref. N	lo. T	BH Tests ype & Ref.	Completion Lining:	n Details Backfill:
-18m	As above								et like.		Packet Test Ref.: BH2B Test section: 15.75-23.5m	50mm uPVC Screen	3-7mm Pea Gravel
	END OF BOR	EHOLE		Consent	d in the constitution of t	Spection Spectron Spe	Putposes of Putpos	M. Co.					

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BOREHOLE LOG

Borehole BH3A

Sheet No. 1 of 1

Client:	Dood no Vo	na/Shell E&P	Site:	hmore	Ban	005-	Erris, Co	n Mayo		No.: 1169	Scale:	,
Grid Ro Easting	eference	Elevation (mOD): 2	0.29m Subsoi	1): 65mi		Date	Started	: 28/10		Drill Contr	actor: Irish D	
Northi	ng: N323745	Borehole Diameter (Borehole Depth (m)	(Rock): : 12.5n	65mm n			•	16u. 20	<i>y</i> 10/05	Logged by		
Depth m		otion of Strate		Legend		Levei m	Static Water Level 4/11/03		nples Ref. No.	BH Tests Type & Ref.	Completio Lining:	n Details Backfill:
GL												
	PEAT										50MM	CEMENT
- 1.55 -					18	.52	▼				50MM UPVC CASING	BENT ONITE
_ - -												3-7mm Pea Grave
	Fine grained S matrix, mediu	AND, with clay/silt m light grey to gree	nish									Pea
	grey.			:							50MM UPVČ SCREEN	E
-							uroses on uroses ted et redited		er use.			3-7
- 5.5	END OF BOREH	IOLE					3	H. Oth of			END OF C	ASING
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BOREHOLE LOG

Borehole BH3B

Client:	Bord na Mon		Site: Sral	nmore, E	Banç	jor–E	r ris, Co	unty Mo		lob 1	lo.: 1 1 69	Scale: 1:50	1
Eastin	eference g: 084908 ng: 323745	Elevation (mOD): 2 Borehole Diameter (Borehole Diameter (Borehole Depth (m)	(Subso (Rock):	il): 65mı : 65mm		Date	Started Comple	ted: 29	•	03	Drill Contr Drill Metho Logged by	-	rilling Lfd.
Depth m	Descri	otion of Strate	3	Legend	OD	Level m	Static Water Level 4/11/03	Sar Type	nples Ref. I	ło. T	BH Tests ype & Ref.	Completio Lining:	n Details Backfill:
GL - 1.55	PEAT												
6.0	matrix.	AND with clay/silt grey to greenish grey	<i>1</i> -			.02		14. 184	net use.			50mm uPVC CASING	BENTONITE
	dipping circa 3 Discontinuities: fractures are ci	trong, massive but I d (dipping 35 degre h grey, fine grained RTZITE, fresh to sligh i locally occurring a spaced bands/lamir 5 degrees. Between non—intact osely to very closely g parallel, (dipping onerally inerally sub—planar, tly rough, generally	zones		dili copy	Reditor of the state of the sta	Putposes Refrequire	TO THE PERSON OF			Packet Test Ref.: BH3B est section: 11.75–16.0m	50mm uPVC SCREEN	3-7mm Pea Gravel
- 16	END OF BOREH	OLE								\perp	Pac Test		
Rema	rks:											<u> </u>	

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BOREHOLE LOG

Borehole BH3B

Client	: Bord na Mona/	Shell E&P	Site:	hmore	D				Job	No.:	Scale: 1:50	
Eastin	deference g: 084908 ng: 323745	Elevation (mOD): Borehole Diameter Borehole Diameter Borehole Depth (m	20.26m (Subso (Rock):	il): 65mı : 65mm	m	Date Date	Started Comple	: 27/1		Drill Metho	ractor: Glovers od: Air Rotar r: KM (TES)	SI Ltd.
Depth m	Descri	ption of Strat	a	Legend	1		Water Inflows		nples	BH Tests Type & Ref.	Completio Lining:	n Details Backfill:
-18m								1796	Nei. No.	Type & Ker.	Citary.	Buckini:
	As above								સ્પા ^{ક્ર} .	Packet Test Ref.: BH2B Test section: 15.75—23.5m	50mm uPVC Screen	3-7mm Pea Gravel
- 23.5				Consent of	insolite opytie	Ection (urposes of streduced	of of the state of				

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BOREHOLE LOG

Borehole BH4

Client:	Bord na Mon	a/Shell E&P	Site: Sral	nmore, E	Bang	jor-E	rris, Co	unty Ma	ıyo.	Job I	No.: 1169	Scale: 1:50	
Easting	eference	Elevation (mOD): Borehole Diameter Borehole Diameter Borehole Depth (m)	(Subso (Rock):	65mm		Date	Started Comple	ted: 01		03	Drill Metho Logged by	: PK	
Depth m	Descri	ption of Strate	a	Legend	OD	Level m	Static Water Level 4/11/03	Sar Type	nples Ref. I	No.	BH Tests ype & Ref.	Completio Lining:	n Details Backfill:
GL							7/11/00			7			
3.1	PEAT				14		•						
	matrix.	AND with clay/silt	y.	¢ Consent of	in the copy	Decitor of the control of the contro	outoses of purposes of the purpose o	M. My	retuse.			50mm uPVC CASING	BENTONITE
												50mm uPVC SCREEN	3–7mm Pea Gravel
Rema	rks:												

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BOREHOLE LOG

Borehole BH4

Client:	Bord na Mona/	Shell E&P		Site: Sra	hmore,	Ban	gor-E	Erris, Co	unty Mo		No.: 1169	Scale: 1:50)
Easting	eference g: 084489 ng: 323373	Elevation (I Borehole Di Borehole Di Borehole D	iameter (iameter (7.22m Subso Rock):	il): 65mı 65mm	m	Date Date	Started Comple	: 01/11 ted: 01	1/03 /11/03	Drill Metho Logged by		y
Depth m	Descri	ption of	Strato	1	Legend	ł		Water Inflows		nples Ref. No.	BH Tests Type & Ref.	Completio Lining:	n Details Backfill:
-18m	As above				gasent de	inspire				tuse.		50mm uPVC Screen	3–7mm Pea Gravel
	END OF BOR	REHOLE											

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TRIAL PIT LOG

Trial Pit No. 1

		1			1000					
Excavat	tor Type: HITACHI	Dat	e: 23/10/0	13	Client:		Mona/She	ll F&P		
Gಗೆd ₽≏	ference:		Elevation (Site:	טטים ווע	mondy sile	ii LUI		
JIIU NO	E084643, N324	1121		, , -		Srahmo	re, Bangor-	-Erris, (Co. Mayo) .
Depth					OD Level	1	mples	Water		pletion
Debiu	Description	n of Sti	rata	Legend	m	Туре	Ref. No.	Inflows		
									Lining:	Backfill:
0.0				ļ						
2.4	PEAT Soft, medium medium brown fragments of t moist.	, occasi	ional d, slightly	& cox	petion purpo petion purpor	Vanie Tast	et use. TP1			
-	Yellowish brow brown gravelly some angular	, clayey	SAND, with	ASEL.						
:	cobbles of sch					Disturbed	TP1			
3.0						Sample	171			
	END OF TRIAL	PH								
:			:							
:									Ī	
-										
:										
			ļ					}		
·	L 11 t N.	Dam							<u> </u>	
ogged P.K		Remarks: 1. Shear va	ne test undertake	n on peat,	disturbed :	soil sample oi	otained for Parti	cle Size Di	stribution te	sting.
Scale:	10		icant groundwate							
1:2		o. Excavatio	on terminated at .	om due to	optstruction	n/compaction	ot subsoil.			

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Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 2

						******				She	eet No.	1 of 1
Excavo	itor Ty	pe:		Date:	23/10/	03	Client:		ı Mona/She	II F&P		
Grid Re		e: 84646, N32	797A		Elevation		Site:				0- 14	
	T EU	04040, NJZ.	3670		<u> </u>	I	100	T T	re, Bangor-	1		
Depth m	1	Description	n of	Stra	ła	Legend	OD Level m	Type	mples Ref. No.	Water Inflows		npletion
	ļ			 		 		1700	Nei. No.	IIIIOWS	Lining:	Backfill:
0.0												
Ē	PE] :	
	1	ft, medium			n to							
-		rk brown, o gments of l										
0.65	ł	gillollio ot i	og .					Vane Test	TP2			
												
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-	ĺ								15°C.			
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-								व्याप्त व्याप				
		dium light o			† .!==		205e	ody, and one				
- -		enish grey, ghtly micac			The		ection purposes	,				
-	Gre	ovels are pla	atey,	angul	ar to	S	ection ner					
-	sui	oangular Qu	ıarızı	res.		COT 105	ht					1
-						tody,						- [
						entor		Disturbed		Ì		
-					Con			Sample	TP2	•		
										1		
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3.0	FN	ID OF TRIAL	PIT				l			Ī		
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P.K	P.K. 1169 1. Shear vane test undertake					n on peat, r inflow re	disturbed s corded durin	o <mark>il sample ob</mark> ng excavation	tained for Partic	le Size Dis	tribution tes	iting.
Scale: 1:2		Rev.:			.				-			
		1										1

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TRIAL PIT LOG

Trial Pit No. 3

Excavator Type: Dat											
Excava	tor Type:		Date:	23/10/	03_	Client:		Mona/She	li E&P		
Grid Re	ference: E084890, N323	700		Elevation		Site:		re, Bangor-		Co. Mayo).
Depth	Description		Ctrat	~		OD Level		mples	Water	Pit Con	pletion
m	Description		Sirui	<u> </u>	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0											
	PEAT Soft, medium to brown, fragme and rootlets, sl	nts o	f bog	wood st.		ge co:	Vane Test	TP3			
3.45	Greenish grey grey to light gr some angular gravels and co	ey SA to su	AND, v bangı	viin U ilar	for itest for copyri	ction furthering to the state of the state o	Disturbed Sample	TP3			
	END OF TRIAL										
Logged		s: r vane to	st undertok	en on pect	disturbed	soil sample of	otained for Parti	cie Size Di	stribution te	sting.	
P.K Scale:	. 1105	2. Sligh	t to mod	erate groun	dwater infl	ow recorded	at 2.5m duri	ng excavation.			·
1.2	1 1.	J. EXCO	AGIIOU IS	ub berounn:	e to obstru	enon/comp	action of sub	soil at 3.45m.			ł

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TRIAL PIT LOG

Trial Pit No. 4

Even	cavator Type: Date:						Clie	nt-		······			
FXCGAG	or type	7.		Dale:	23/10/0	13	Cuel	•11.	Bord na	Mona/Shel	I F&P		
Grid Re	forese				Elevation (Site	:	Dord IId	morita/ Site			
OFIG KO		: 4164, N323	332		_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			•	Srahmo	re, Bangor-	Erris. (Co. Mavo	
		7.0.,			L	[OD Lev				Water		
Depth	D	escriptior	of	Strat	a	Legend	OD FeA	′° ′ -	Type	nples Ref. No.	inflows	Pit Com	
m					 			\perp	iype	Kei. NO.	MILIONS	Lining:	Backfill:
0.0													
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11								1					ļ
-									ļ				
:	PEA	T											
-	1	to very so											
: }		nedium dar											
:		ments of b	og w	ood c	ind								1
:	rool	ets, moist.						Ŀ	Vane Test	TP4			
- 1.1								Γ					
	Medi	um greenis	h gre	ey to g	grey,					01			
:	clayey, fine grained SAND with occasional subrounded to round				with				Disturbed Sample	ΨP4			
1.4	dravel and cobbles.								Sample Sample				
	. 65							- [Only, any				Ī
1.65	1.65 Medium grey to light brownish							2090	edito				
-	grey GRAVEL with some sub-						Pili	is on	,				į
-	rounded to subangular cobble						choliner	, Y					
- [EN	D OF TRIAL	PIT			For ins	ecitor pur ght owner						
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Logged		lob No.:	Remar		ant undastab	n on nect	distant		all sample of	otained for Parti	cle Size Di	etribution te	sting.
P.K		1169								and pit wall col			
Scale:		Rev.:											1

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TRIAL PIT LOG

Trial Pit No. 5

										3110	sei No.	1 01 1
Excava	xcavator Type: Date: 23/10 rid Reference: Elevatio						Client:		Mona/She	II E&P		
Grid Re		474, N323	3382	:	Elevation	(m0D):	Site:		re, Bangor-		Co. Mayo) .
Depth				<u> </u>			OD Level	Sai	mples	Water	Pit Con	npletion
m	De	scriptio	n ot	Strat	'a	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0			 									
0.9	fragn	medium nents of l ets, moist	bog w					Vane Test	TP5			
	brow SAND	wish brow n, gravell . The gra brounded	y, col vels d	bley	h SILT/ bangular	rody Fordion	edion difference of the state o	Disturbed Sample	TP5			
- 3.0											•	ŀ
		OF TRIAL										
Logged P.K	· .	1169	Remark 1. Shea	r vane to	est undertake	n on peat,	disturbed s	oil sample ob	tained for Partic	ele Size Dia	stribution te	sting.
Scale:	Re		z. Sligh	t to mod	erate ground	iwater infla	w at 2.5m i	bgi.				
1:2	.J											- 1

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TRIAL PIT LOG

Trial Pit No. 6

Excavat	xcavator Type: Date:				07/10/0		Client		M /Cl 1			
			l		23/10/0 Elevation (Site:	Bord na	Mona/She	II E&P		
Grid Re		: 4852, N323 [.]	176		Elevation (illob).	3	Srahmo	re, Bangor-	-Erris, (Co. Mayo	.
D41							OD Level	1	nples	Water	Pit Com	
Depth m	D	escription	of	Strat	a	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0												
0.95		, dark brow k, fragmen			wood,			Vane Test				
1.9	gra gra	nt yellowish ined SAND v vels that are nded	with	occas	yey, fine ional ded to		ico puro	Bold and dis	Mge.			
2.5	sub GRA	Medium brown to dark brown subangular to subrounded GRAVELS, with some Cobbles.					ect own	Disturbed Sample	TP6			
	EN	D OF TRIAL	PIT									
Logged			Remar	ks:	test undertak	en on pea	, disturbed	soil sample o	btained for Pari	icle Size D	istribution t	esting.
P.k Scale:		1169 Rev.:	2. No	significa	nt groundwat	er inflows	noted duri	ng excavation.		_		-
1												1

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TRIAL PIT LOG

Trial Pit No. 7

Excavator Type: Date: 23/10				13	Client:	Rord na	Mona/She	II E&P		Ī
Grid Ref	eranca.		Elevation (Site:	Bora na	monay one			
Grid Kei	E084001, N3237	713				Srahmo	re, Bangor-	-Erris,	Co. Mayo).
Depth					OD Level	Sar	nples	Water	Pit Con	pletion
m	Description	of Stro	ata	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0								'		
-	DEAT						i			
:	PEAT Soft, dark brow	n to bro	wnish	Ì						
-	black fraamen	ts of boo	a wood.							
-	moist. Occuran	ce of mo	her.	ļ						
	plain maioriai (Vane Test	TP7			
0.85 -				†						
-										
-						sould and oth	~ ⊘ •		1	
	Light yellowish	brown to	o light			~	etuse	}		
-	yellowish grey occasional gra	vels that	are			14. 104 of				
-	subrounded to	rounded			_	is a for a		İ		
	Gravel content				autpo	died				
Ė I	with depth and	become	s angular	1	ection purpo extramper tec	Î				
	at base.			. 8	ect only					
-				FOLI						
				For its		Disturbed		-		
2.5				ent		Sample	TP7	-		
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P.I	<. 1169	1. Shear va	ne test underta Icant groundwa	ken on ped Her inflows	it, disturbed : noted durfi	i soil sample on a excavation.	obtained for Pai	TICIE SIZE	DISTRIBUTION	192111]Å•
Scale:	Rev.:		<u> </u>							

CONSULTING ENGINEERS

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15 TRIAL PIT LOG

Trial Pit No. 8

					· · · · · · · · · · · · · · · · · · ·			1		
Excava	tor Type:	Date:	23/10/0		Client:		Mona/She	II E&P		
Grid Re	ference: E084402, N32398	 8	Elevation (Site:	-	re, Bangor		Co. Mayo	h_
Donath			<u> </u>	Γ	OD Level	T T		1	I	
Depth m	Description o	f Strai	ta	Legend	m Cevel	Туре	mples Ref. No.	Water Inflows	Lining:	pletion Backfill:
0.0										
	Medium dark, sof	PEAT								
2.6	Medium light grey grey, gravelly, col SAND. The gravels to subrounded an well rounded Qua occasional Red So Slate.	to gree obley SI are su d occas tzites, indston	enish LT/ bangular sionally with es and	to de constitue	John Dirlose, John Brief Period	office and officer				
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	- Itala Mara									
ogged l P.K.		1f K3 :								
Scale: 1:25	Rev.:									

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Second Floor, Unit 4B/5
Blanchardstown Corporate Park
Blanchardstown
Dublin 15

TRIAL PIT LOG

Trial Pit No. 9

								17 1.					
Excavat	or Type:	•		Date:	07/40/0		٦٢	lient:	David na	Mana /Shal	I E&D		į
			1	<u> </u>	23/10/0 Elevation (00):	1	ite:	bora na	Mona/Shel	LOI		
Grid Ref	erence:		100		Lievation (inob):	٦	.	Srahmo	re, Bangor-	·Erris. (Co. Mavo	. 1
т	E084	1402, N3239	00								Water	Pit Com	
Depth	n _e	scription	οf	Strat	a	Legend	1	Level	Type Sar	nples Ref. No.	Inflows		-
m		,301 ip/10/1					<u> </u>	m	1700	Wei. 140.		Lining:	Backfill:
0.0										:			
	Medi	um dark, s	oft	PEAT									
0.4							1						
-													ŀ
:							1						
:													
							İ						
]		
: I	Medi	um light gr	ey to	o gree	nish					.01*			
:	grey,	gravelly, c	obb	ley Sil	LT/ bangular	ļ			6	1150			
:	SUDE	um light gr , gravelly, c). The grave ounded and ded Quartit Sandstone	i oc	casior	nally well				only any other		1		
-	roun	ded Quartit	es,	with o	ccásiona	(only all,				
[]	Red	Sandstone (and	Slate.	•			موجود	odie		1		
:								Driedi	•				
-							ction	ner					
-						1757	\$102	•					
- 1						FOLYI	9						
-						of cot.					}	ļ	
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Logged	- 1	Job No.: 1169	Remo	irks:									
P.I Scale:		1109 Rev.:											
1:	25												

CONSULTING ENGINEERS

Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15 TRIAL PIT LOG

Trial Pit No. 10

			· · · · · · · · · · · · · · · · · · ·							
Excava	tor Type:	Date:	18/11/0	03	Client:		Mona/She	II E&P		
Grid Re	ference:		Elevation (Site:					
	E083780, N32379	97	<u> </u>	.		Srahmo	re, Bangor-	-Erris,	Co. Mayo) .
Depth	n	. (()			OD Level	Sa	mples	Water	Pit Con	npletion
m	Description	ot Strat	ra	Legend	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
						 				
0.0 - 0.1	Dark brown, peat	y GRAVE	L, with							
-	Dark brown, peat many cobbles an Gravels subangul Quartzite, Schist, Sandstone	d boulde	rs.							
-	Quartzite, Schist,	Slate ar	nd Red							
	Medium brown c	lavey ar	ravelly							
	Medium brown, c fine grained SAN	D. Grave	s are		-					
0.7	subangular to su	brounde	d!							
	Medium grey to g to light brownish	reenish	grey							
	gravelly, fine to r	nedium (grained			D. U				
	ŠAND, with occas to subrounded co	ional sul	bangular			Bulk Sample	ৣ₹P10			
1.45	io suprounded CO	oppies.				ner	<u>~</u>			
						97. 317 of				
=	Medium light grey	v. sandv	slightly		رفي	offor a				
	clayey, subangula	ar GRAVE	L, with		altPositi	Sample Sample	,			
- 1	occasional angula	ar, subai	ngular and		tion of rely					
-	boulders of Quart		nist and	يجرو	OWITE					ĺ
<u> </u>	Red Sandstone.			For itte	ju.					
-				£ 005,						
-			ء ،	ator or						1
-			Course					1	1	İ
-			_						1	1
_										ĺ
: _			J						j	ļ
3.2	END OF TRIAL PI	Т								
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- 1				1						
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			İ			1		l		
Logged	by: Job No.: Ren	marks:								
P.K	. 1169 1.5		r running Into	pit excav	ation becau	ise of heavy r	ain			[
Scale:	Rev.:									-
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Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 11

									311	eel NO.	1 01 1
	tor Type:		Date:	18/11/0		Client		a Mona/She	II E&P		
Grid Re	ference: E083837, N323	823		Elevation ((mOD):	Site:		ore, Bangor		Co. Mayo) .
Depth	Description	n of	Strat	ď	Legend	OD Level		ımples	Water	Pit Con	npietion
m					Logona	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0 - 0.2	Medium brown, clayey, peaty G cobbles. Gravel angular Quartz Schist and Sand Sand Sand Sand Sand Sand Sand	yellov grave lar g ccasi nded	vish g illy, fii ravels onal c Gneiss	rey,		ion purpose il ion per recui	Bulk Sample	TP11			
P.K.		. No wo	iter inflo	ws to pit, dry	'.						
1:25											
	<u></u>										1

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Second Floor, Unit 4B/5
Blanchardstown Corporate Park
Blanchardstown
Dublin 15

TRIAL PIT LOG

Trial Pit No. 12

Excavat	ator Type: Date:				Client:								
					18/11/0		_		Bord na	Mona/She	I E&P		
Grid Re		s: 3925, N323	806		Elevation (mOD):		Site:	Srahmo	re, Bangor-	-Erris, (Co. Mayo	•
Depth				6 1 1			OD	Levei	Sar	mples	Water	Pit Com	pletion
m	D	escriptior 	1 01	Strat	a	Legend		m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0													
0.3	Medi fine laye	ium brown, grained SA rs of peat o	sligi ND, on to	htly clowith the P	ayey nin								
	Medi sligh SAN cobb subo	ium light gr ntly clayey, D with som oles and oc angular bou angular to s rtzite.	rey, ç sligh e sul casic	gravell tly mi cangu cnal s. Gra	y, caceous lar vels are d		dis	n dudder	ond and one bed for the bed for a few and the few and the bed for a few and the bed for a few and the bed for	TP12A			
-	grav som boul subi	elly, fine g e cobbles of ders of Gno	raine and s eiss.	edium light grey ned SAND with I some blocky s. Gravels are occasionally		at of copy.	it co	A .					
3.0									Bulk Sample	TP12B		:	
		D OF TRIAL	PIT										
Logged P.K	- 1	1169			oisture conte	nt at 3m b	ıgi.						
Scale:		Rev.:											
1:2	.၁		L					······					

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Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 13

Excava	itor Type	:		Date:	18/11/0	03	Client:		Mona/She	II E&P		
Grid Re	ference):			Elevation (Site:					
		4417, N32	4002			•		Srahmo	re, Bangor-	-Erris,	Co. Mayo	.
Depth	I				·		OD Level	1	mples	Water	l	pletion
•	D	escriptio	n of	Strat	a	Legend	m m	Type	Ref. No.	inflows		r *
m	<u> </u>	•						1700	Rei. No.	IIIIIOWS	Lining:	Backfill:
0.0								}				
	Medi	um dark t	prown	to br	ownish							
- 0.25	Subr	k, soft PE/ ounded gr uartzite ar	AI, WI raveis	in and and b	juiar and Soulders	1						
-	of Q	<u>uartzite ar</u>	nd Sc	hist			į					
-		um dark t		to me	edium							
		n, Firm C	LAI									
0.75 -						<u> </u>						
-												
-												
-												
-									de.			
- 1								es	(I)			
-	17-6-4	.		I?b-	.			office.				
-	Light	l grey to n light greyi	neaiui sh hr	n ligh own c	r grey			of Bulk	TP13A			
	silty.	fine grain	ned Sa	AND w	ith		Sec.	Sample	IFISA			
	occa	sional sub	anau	lar to	_		DUTPOLI					
	Subr	ounded blacks. Gravels	ocky i	boulde	ers of		tion to te					
-	subr	ounded, o	ccasi	onally	well	250	X ONLY					
:	roun	ded, comp	oosed	of Qu	artzite	COT THE	tion purpose tion to what to w					
	Schi	st, Red Sa	ndsto	ne and	d Slate.	500						l
:						ator						
-					a OIIS	,						
:					C			Bulk	TP13B	j	Ĭ	
								Sample	105			
:												
-												
3.2												Ì
 _	ENI	OF TRIAL	. PIT							1		
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P.K		1169										
Scale: 1:2		ev.:										
1:2	<u> </u>		<u> </u>									

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Second Floor, Unit 4B/5 Blanchardstown Corporate Park Blanchardstown Dublin 15

TRIAL PIT LOG

Trial Pit No. 14

Excava	tor Type:	Date:	Client: 18/11/03 Bord na Mona/Shell E&P							
Grid Re	eference:		Elevation (Site:	Bora no	mona/She	II E&P		
	E084647, N3242	07		·		Srahmo	re, Bangor-	-Erris,	Co. Mayo).
Depth	Description	of Strat	a	Legend	OD Level		mples	Water	Pit Com	pletion
m	Bescription			Logona	m	Туре	Ref. No.	Inflows	Lining:	Backfill:
0.0										
0.75	Medium brown, g clayey, fine grair some angular co boulders of Quar subangular to an	gravelly, s ned SAND bbles and tzite. Gra ngular.	lightly , with d vels are							
	Light grey to ligh grey, gravelly, co clayey SAND with boulders of Gneis subangular to su Quartzite and Rec	obbley, sli some an ss. Gravel brounded	ghtly gular is are i one.		on purposes	Bulk Sample	ç.			
2.0		.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			OMILET	Sample	TP14A			
	Medium grey, gro clayey, slightly m with some suban subrounded cobb Gravels are suba subrounded Quar	icaceoua gular to bles of Qu naular to	s SAND artzite.	FOLOGYIER COLORY		Bulk				
3.5						Sample	TP14B			-
	END OF TRIAL PI									
Logged P.K	-/-	marks: Increase in m	oisture conte	ent at 1.5m	bgi.					
Scale: 1:2	Rev.:									



TEST RESULATE TEST RESULATED TO THE TEST RESULATED TO THE TEST RESULATED THE TEST RESULTS RESULT

I:\2003\382.Shramore, Co Mayo\Reports\Rpt2 Dec 2003\Preliminary Geotechnical Design of Srahmore Site(Rev2).doc

IRISH DRILLING LTD. Loughrea Co. Galway	Contract:	Peat Deposit Site at Bangor Erris	
Tel: (091) 841274 Fax: (091) 847687	Date: Eng.:	23.10.'03 DJ	

In-situ Shear Vane

Trial Pit	Depth m	Co-ordinates	Undrained Shear strength Uncorrected kN/m ²	Undrained Shear strength *Corrected (based on plasticity) kN/m ²	
1	1.5	84643, 24121	12	6	1
2	0.5	84646, 23870	12	6	: 7
3	1.0	84890, 23700	23	12	₽IF
4	0.9	84164, 23332	10 614 617 618	5	
5	0.7	84474, 23382	etigh pird red 0	5	LF
6	0.6	84852, 23173 For His	19	9.5	15
7	0.8	84001, 23713 CIRSERIA	10 kkg into other tage. 10 kkg into other tage. 10 kkg into other tage. 10 kg into other tage. 19 14	7	٤٦

^{*} Correction factor based on Bjerrum's (1972,1973) correction factor for field vane strength as a function of Plasticity Index

IRISH DRILLING LTD. Loughrea Co. Galway.

Contract: Peat deposit site at Bangor Erris Client: Enterprise Oil Engineer: TES

Date:

20/11/2003 DD C Tested By:

Tel: (091)841274 Fax: (091) 847687

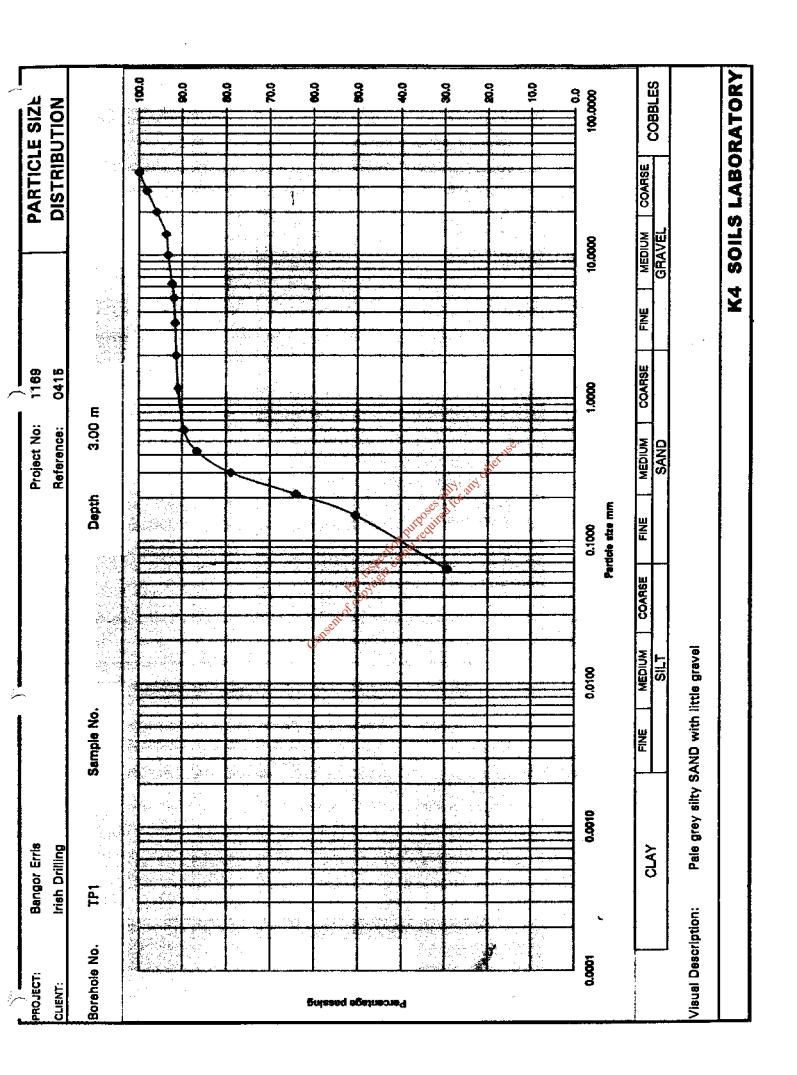
Checked:

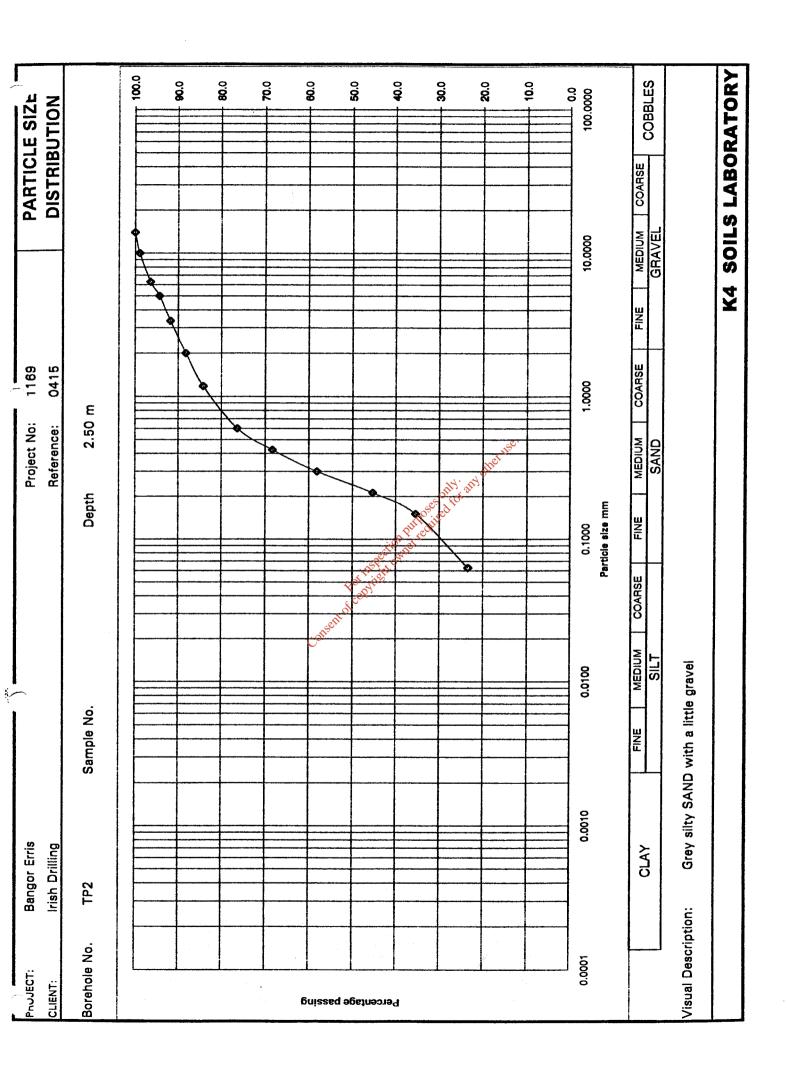
2

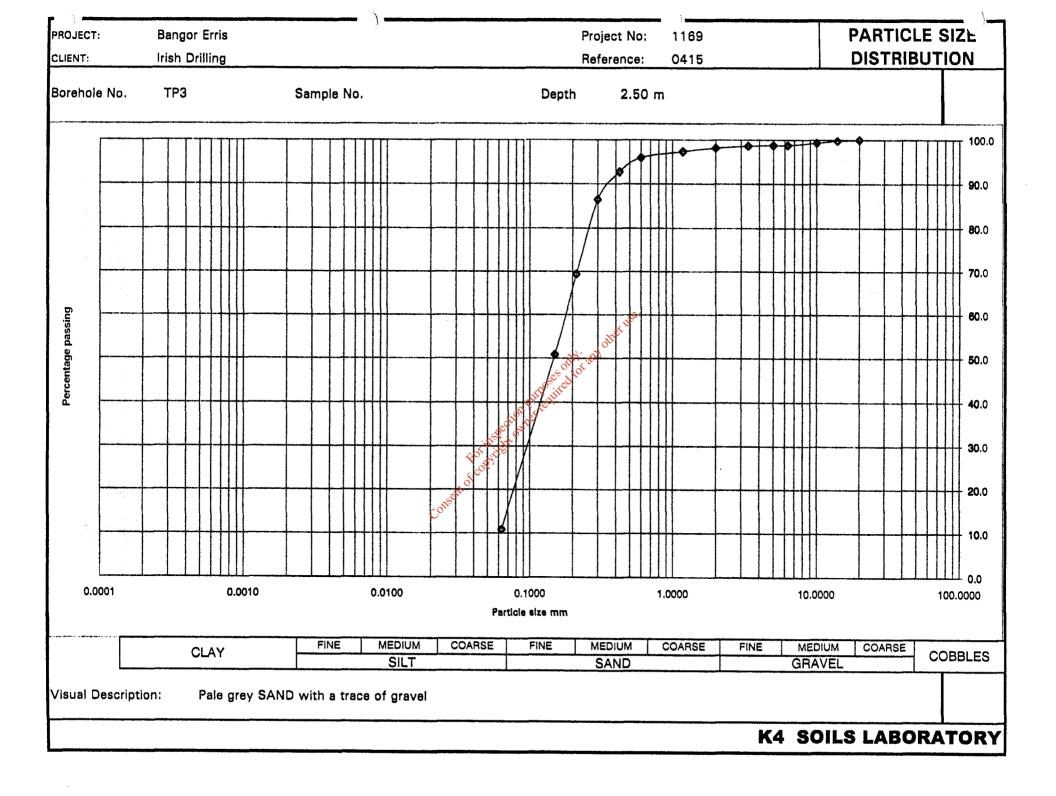
Summary of Soil Classification Tests BS1377: Part 2: 1990

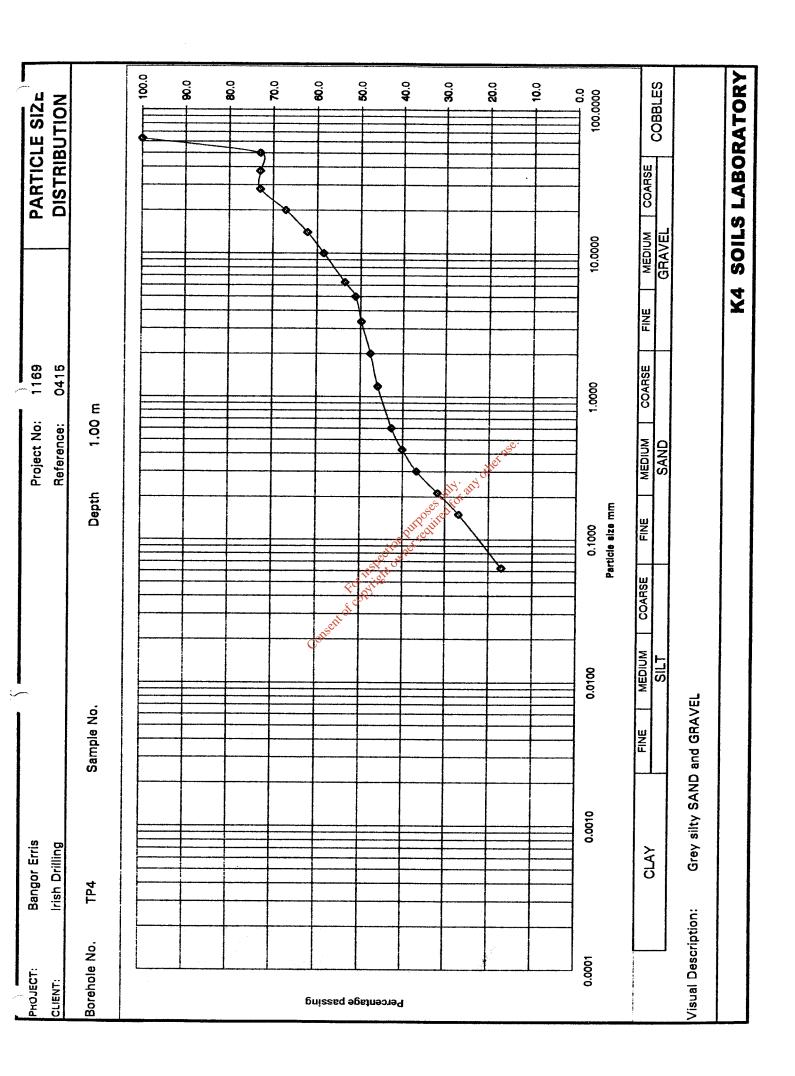
	Γ														
	Description of fraction	passing 425 micron sleve.													
	% passing	425 micron	%				93			94			95		
	Plasticity	ndex	%		Š	.01	ly.	any	other	115°C					
	Liquid % & Plastic	TIE OYL	of the state of th	ON PO	stre street	B.	Non plastic			Non plastic			Non plastic		
Consent	Liquid &	Limit	%												
	Particle	Density	Mg/m3												
	Moisture	Content	%		840	877.8	20.8		448.1	14	14.3	343.6	23.8	23.7	
	Bulk	Density	Mg/m3												
2	Depth		Ε		1.0	2.0	3.0		0.5	1.5	2.5	1.0	2.5	3.5	
i	Туре														
	Borehole/	Trialpit			TP 1				TP 2			ТР 3			

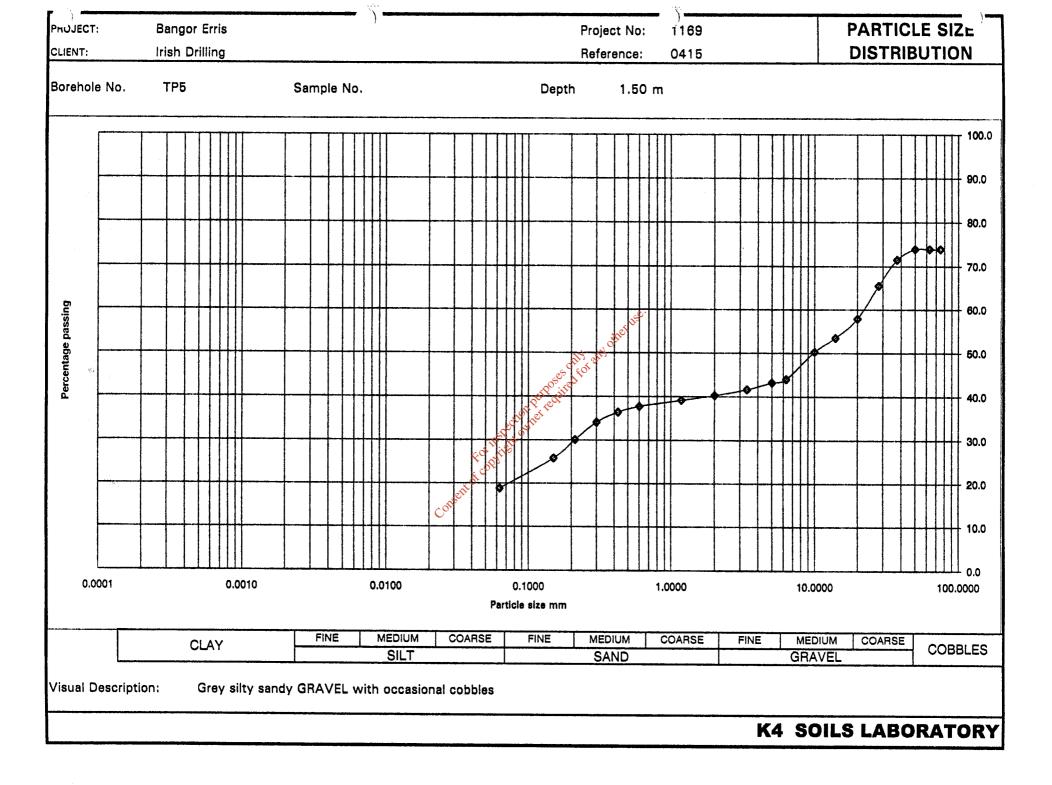
Borehole/	Туре	Depth	Bulk	Moisture	Particle	Liquid	Plastic	Plasticity	% passing	Description of fraction
Trialpit			Density	Content	Density	Limit	Limit	index	425 micron	passing 425 micron sieve.
		m	Mg/m3	%	Mg/m3	%	%	%	%	
TP 4		0.5		205						
		1.0		12.5			Non plastic		32	
		1.5		16.1						
TP 5		0.5		984.1						
		1.5		39.2			Non plastic		40	
		2.5		10						
TP 6		0.0		1005.9						
		1.5		14.7			Non plastic		20	
		2.5		19					Š.	
								other		
TP 7		0.5		286.1				914. 3114		
		1.5		19				Safor		
		2.5		23.2			Non plastic	Hele	75	
							in Pried			

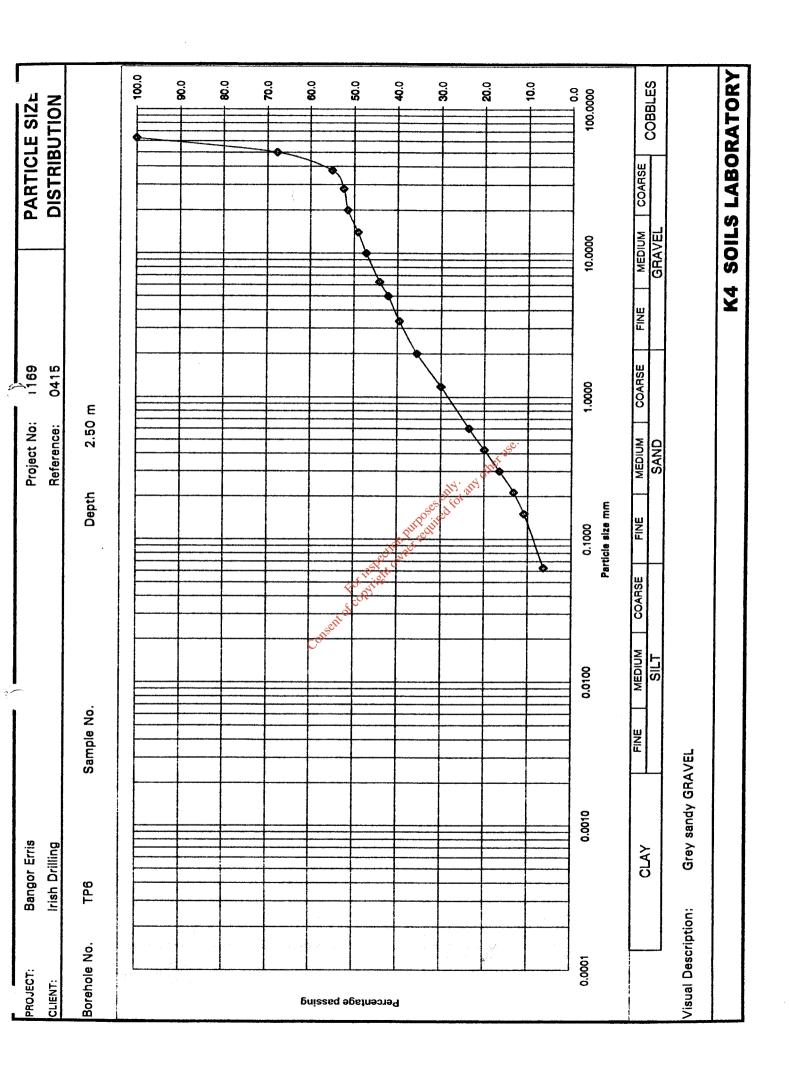












2.5kg rammer BS1377:1990; Part 4, Clause 3.4, 7

IRISH DRILLING LTD.	Contract:	Peat Depos	it Site at Bar	gor Erris (1169)	Location:	TP 2
Loughrea, Co. Galway	Client:	Enterprise of	oil			
	Engineer:	TES				1
}	Date:	20/11/2003			Depth:	1.5 m
	Tested:	DD	Chckd:	DJ		l

Description:

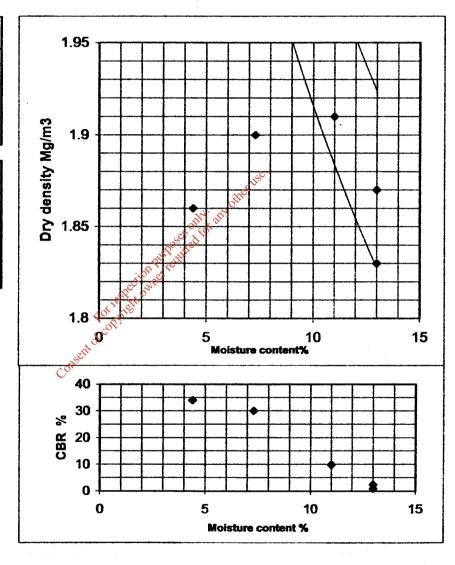
Grey slighlty clayey fine to medium SAND.

Moisture Content Dry Density						
%	Mg/m³					
4.4	1.86					
7.3	1.9					
11	1.91					
13	1.83					
13	1.87					

moisture content	CBR
%	%
4.4	34
7.3	30
11	9.8
13	2.4
13	0.9

Gs assumed:

2.55



RESULTS:

Maximum dry density:

1.91 Mg/m³

Optimum moisture content:

11.00 %

Natural moisture content *:

13.00 %

Retained on 20mm Sieve:

0/

Natural moisture content **:

%

%

** refers to sample after removal of coarse particles

* refers to bulk sample before removal of coarse particles

2.5kg rammer

BS1377:1990; Part 4, Clause 3.4, 7

IRISH DRILLING LTD.	Contract:	Peat Depos	it Site at Ban	gor Erris (1169)	Location:	TP3
Loughrea, Co. Galway	Client:	Enterprise of	oil			
	Engineer:	TES			·	1
	Date:	20/11/2003	1		Depth:	2.5 m
	Tested:	DD	Chckd:	DJ		

Description:

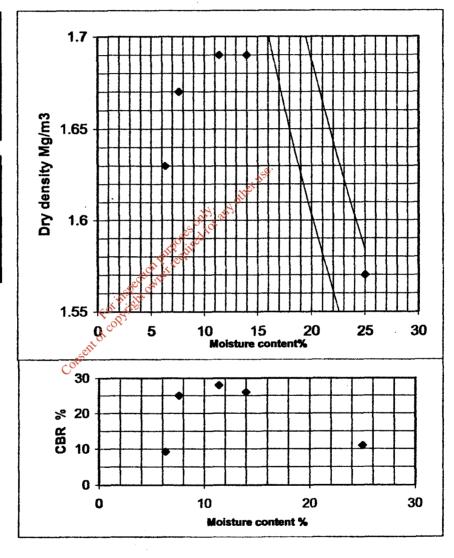
Dark grey-green SAND with occasional peat pockets.

Moisture Content Dry Density		
%	Mg/m³	
6.3	1.63	
7.6	1.67	
11.4	1.69	
14	1.69	
25	1.57	

moisture content	CBR
%	%
6.3	9.2
7.6	25
11.4	28
14	26
25	11

Gs assumed:

2.55



RESULTS:

Maximum dry density: Optimum moisture content: 11.50 %

Natural moisture content *: Retained on 20mm Sieve:

Natural moisture content **:

1.69 Mg/m³

25.00 %

%

%

** refers to sample after removal of coarse particles

* refers to bulk sample before removal of coarse particles

2.5kg rammer

BS1377:1990; Part 4, Clause 3.4, 7

Contract: Peat Deposit Site at Bangor Erris (1169) Location: TP 5 IRISH DRILLING LTD. Client: Enterprise oil Loughrea, Co. Galway Engineer: TES Depth: Date: 20/11/2003 1.5 m

DJ Tested: DD Chckd:

Description:

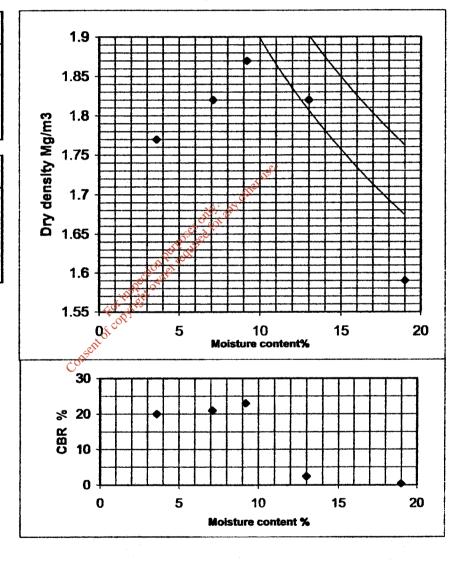
Dark grey very sandy CLAY with fine, medium to coarse gravel.

Moisture Content	Dry Density
%	Mg/m³
3.6	1.77
7.1	1.82
9.2	1.87
13	1.82
19	1.59

moisture content	CBR
%	%
3.6	20
7.1	21
9.2	23
13	2.4
19	0.36

Gs assumed:

2.55



RESULTS:

Maximum dry density:

Optimum moisture content:

Natural moisture content *: Retained on 20mm Sieve:

Natural moisture content **:

1.87 Mg/m³

9.20 %

19.00 %

% %

** refers to sample after removal of coarse particles

2.5kg rammer

BS1377:1990; Part 4, Clause 3.4, 7

IRISH DRILLING LTD.	Contract:	Peat Depos	it Site at Ba	ngor Erris (1169)	Location:	TP 6
Loughrea, Co. Galway	Client:	Enterprise of	il			
	Engineer:	TES				
1	Date:	20/11/2003			Depth:	1.5 m
-	Tested:	DD	Chckd:	DJ		

Description:

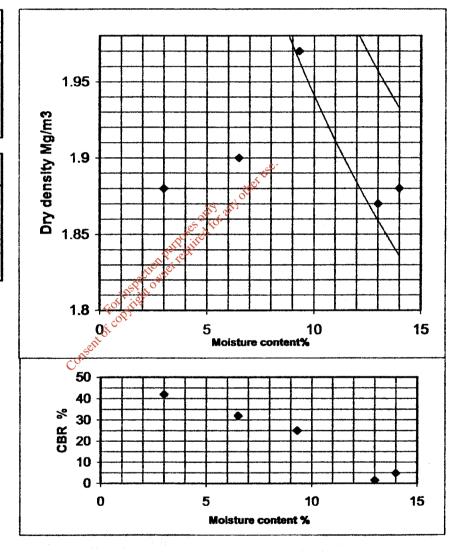
Grey SAND with a little gravel.

Moisture Conte	ent Dry Density
%	Mg/m³
3	1.88
6.5	1.9
9.3	1.97
13	1.87
14	1.88

moisture content	CBR
%	%
3	42
6.5	32
9.3	25
13	1.4
14	4.79

Gs assumed:

2.60



RESULTS:

Maximum dry density:

Optimum moisture content:

Natural moisture content *:

Retained on 20mm Sieve: Natural moisture content **: 1.97 Mg/m³

9.30 %

14.00 %

%

%

** refers to sample after removal of coarse particles

* refers to bulk sample before removal of coarse particles

2.5kg rammer

BS1377:1990; Part 4, Clause 3.4, 7

IRISH DRILLING LTD.	Contract:	Peat Deposi	it Site at Ban	gor Erris (1169)	Location:	TP 7
Loughrea, Co. Galway	Client:	Enterprise o	il			
	Engineer:	TES				
	Date:	20/11/2003			Depth:	2.5 m
	Tested:	DD	Chckd:	DJ		

Description:

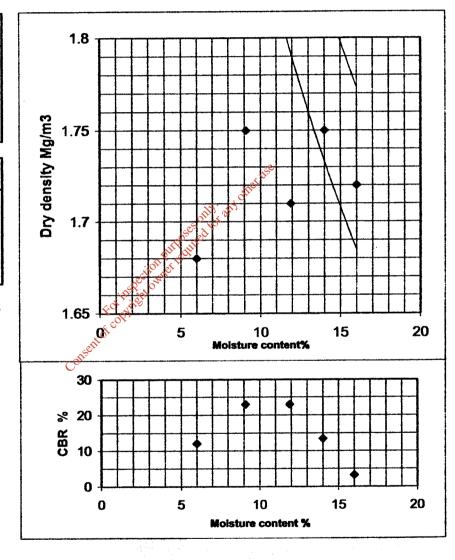
Grey SAND with a little gravel.

Moisture Conte	nt Dry Density
%	Mg/m³
6	1.68
9.1	1.75
11.9	1.71
14	1.75
16	1.72

moisture content	CBR
%	%
6	12
9.1	23
11.9	23
14	13.4
16	3.2

Gs assumed:

2.45



RESULTS:

Maximum dry density:

Optimum moisture content: Natural moisture content * :

Retained on 20mm Sieve: Natural moisture content **:

1.97 Mg/m³

9.30 %

14.00 %

%

%

* refers to bulk sample before removal of coarse particles

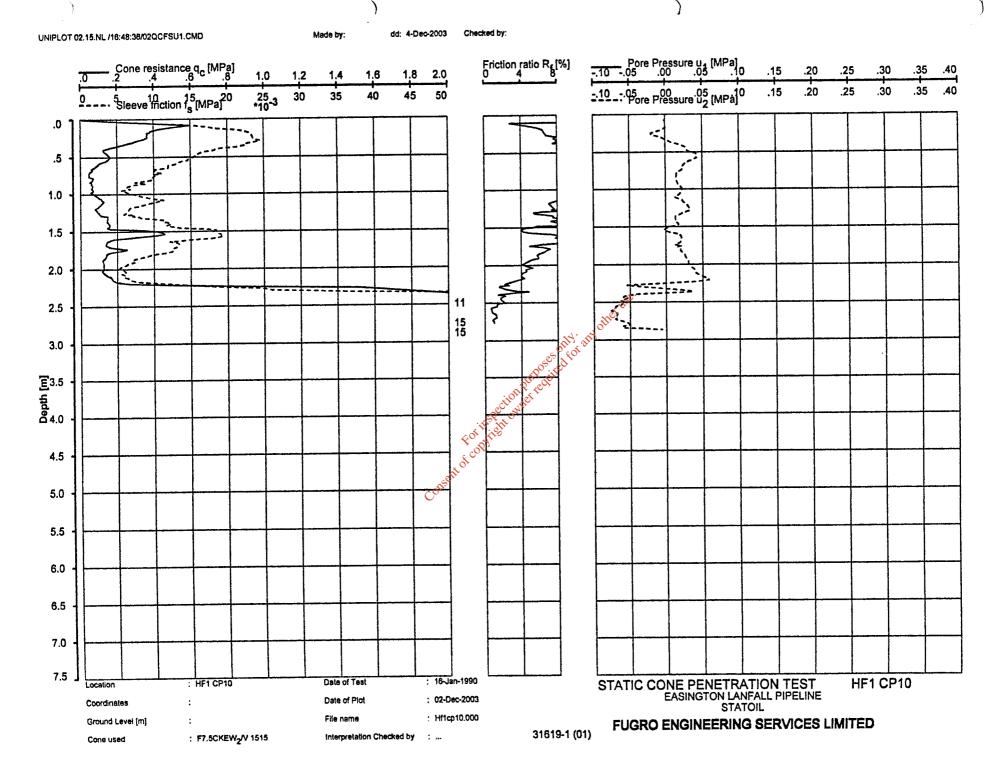
** refers to sample after removal of coarse particles

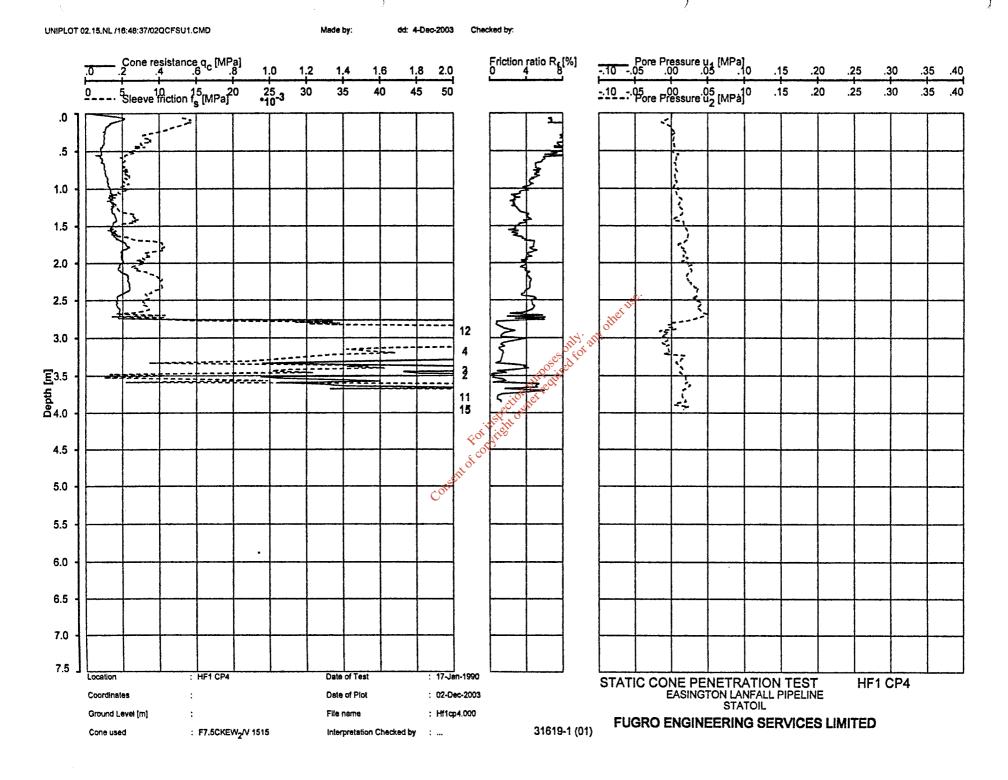


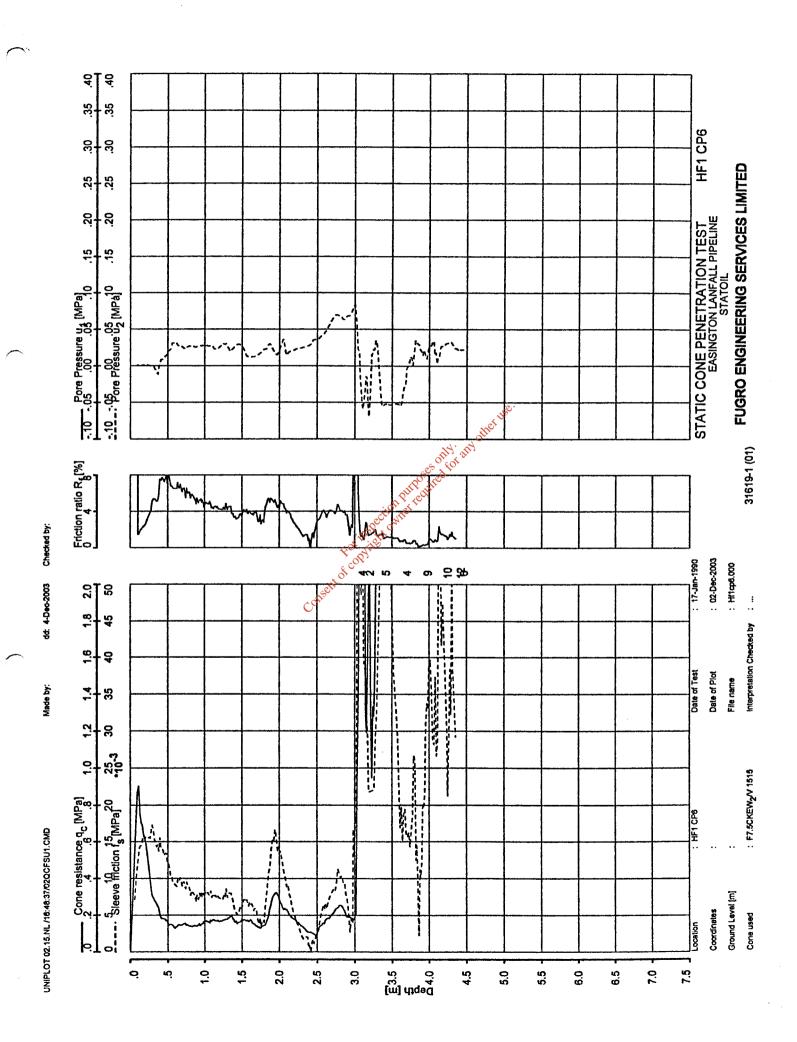
APPENDIX B PHASE 2 GROUND IN ESTIGATION RESULTS

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Date of Plot

Interpretation Checked by

: 02-Dec-2003

: Hf1cp8.000

31619-1 (01)

Coordinates

Cone used

Ground Level [m]

: F7.5CKEW2/V 1515

Date of Plot

Interpretation Checked by : ...

: 02-Dec-2003 : Hf2cp10.000

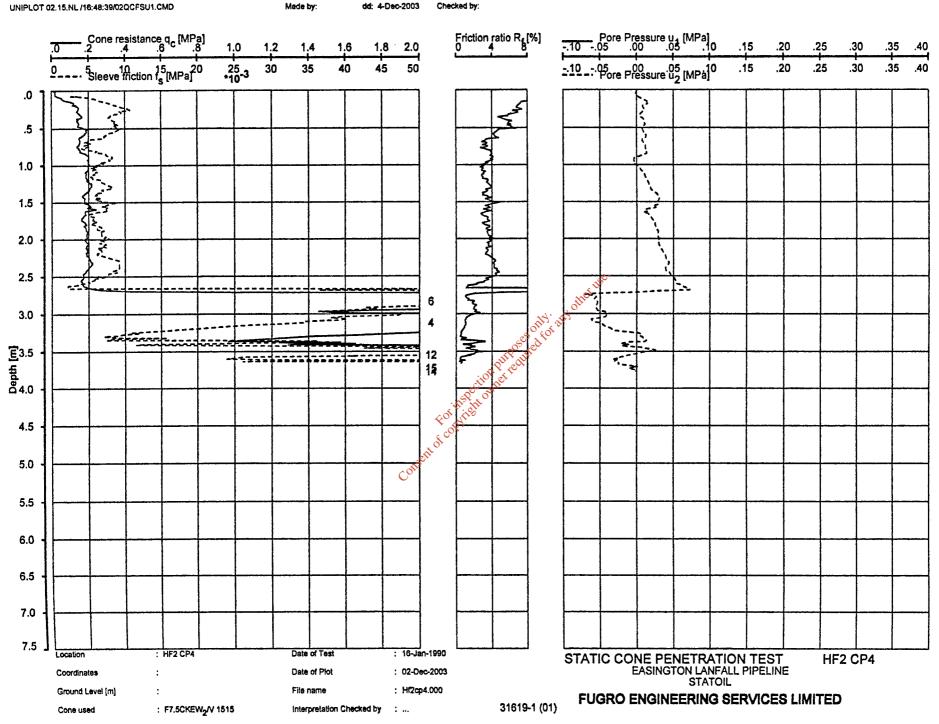
31619-1 (01)

Coordinates

Cone used

Ground Level [m]

: F7.5CKEW2/V 1515



7.0

7.5

Location

Coordinates

Cone used

Ground Level [m]

: HF2 CP6

: F7.5CKEW2/V 1515

Date of Test

Date of Plot

Interpretation Checked by : ...

: 16-Jan-1990

: 02-Dec-2003

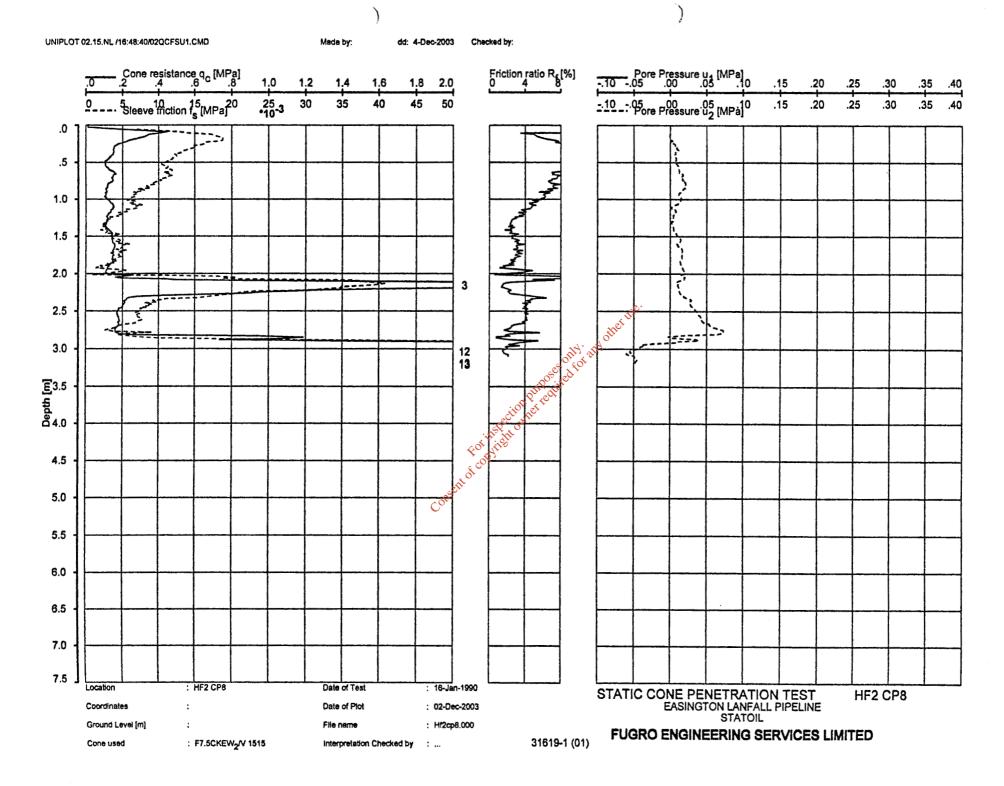
: Hf2cp6.000

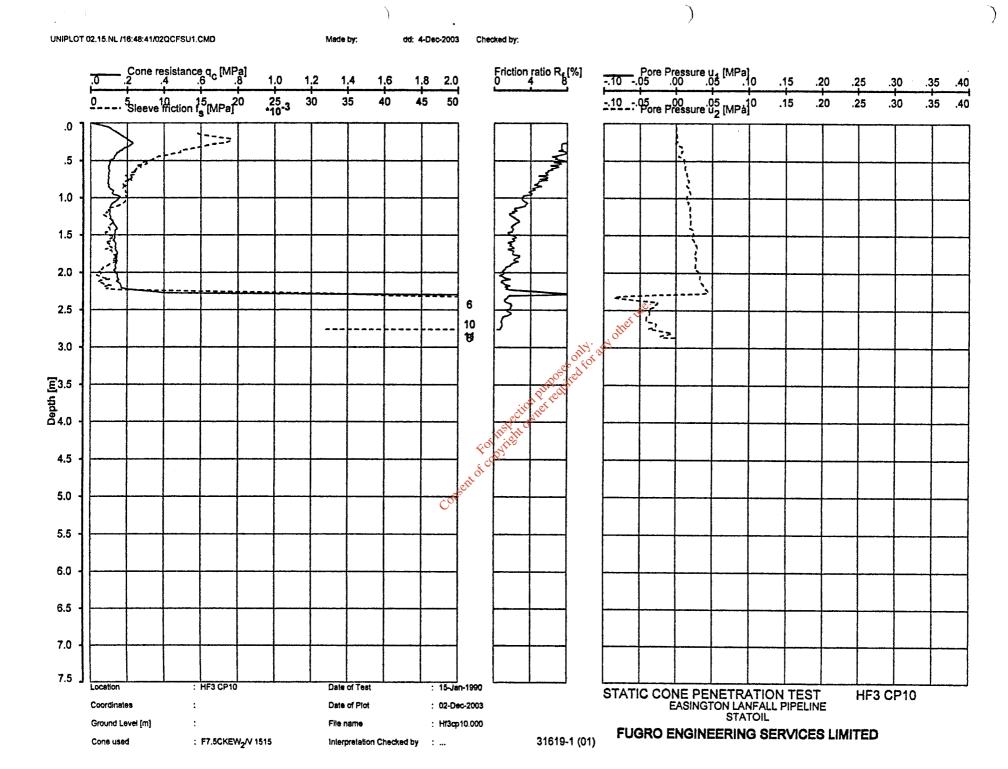
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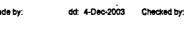
STATIC CONE PENETRATION TEST EASINGTON LANFALL PIPELINE STATOIL

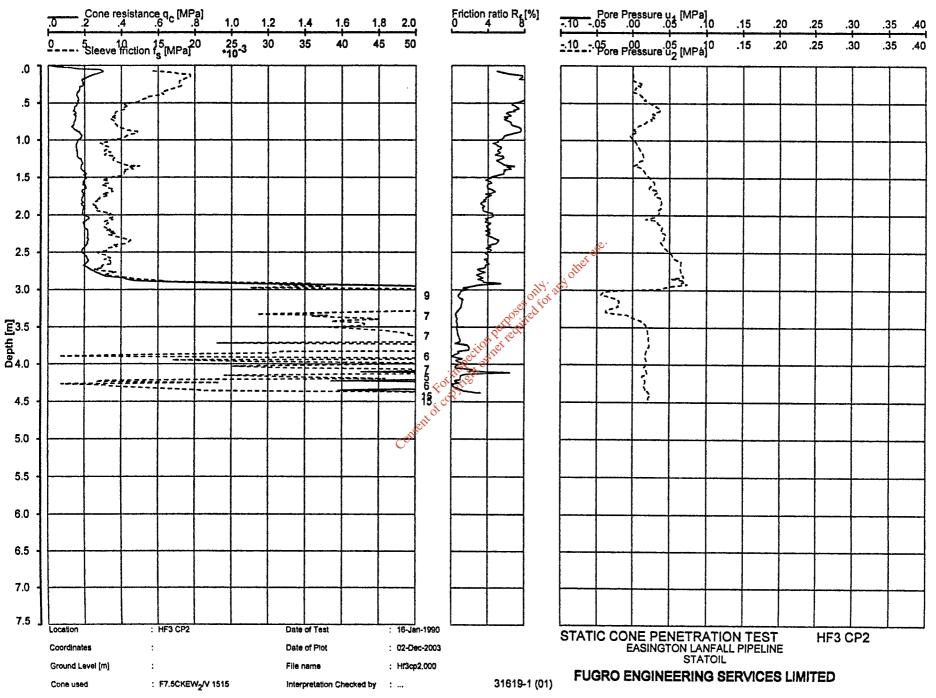
FUGRO ENGINEERING SERVICES LIMITED

HF2 CP6









.5

1.0

1.5

2.0

2.5

3.0

[ii] 3.5 Qebth (iii) 3.5

4.5

5.0

5.5

6.0

6.5

7.0

7.5

Location

Coordinates

Cone used

Ground Level [m]

: HF3 CP4

: F7.5CKEW2/V 1515

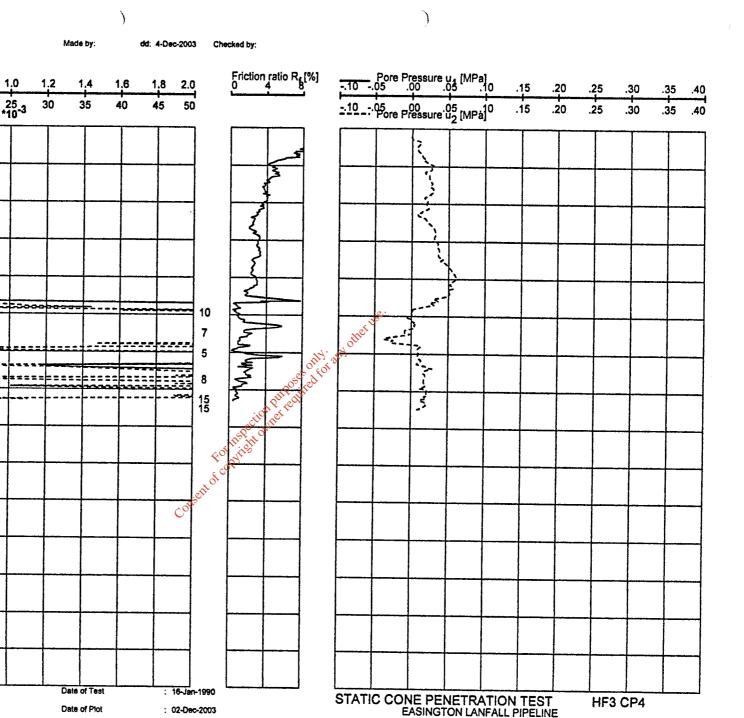
: Hf3cp4.000

Interpretation Checked by

31619-1 (01)

Cone resistance q_c [MPa]

0____ 5leeve friction 15 [MPa] 20



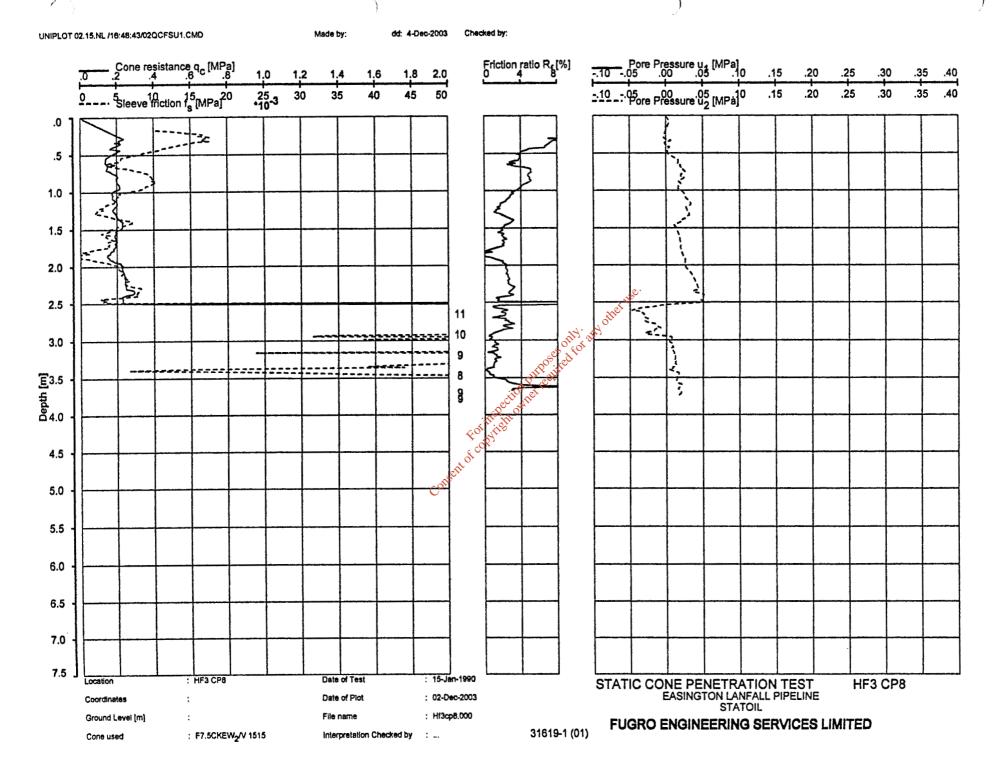
STATOIL

31619-1 (01)

: F7.5CKEW2/V 1515

Cone used

Interpretation Checked by : ...



Ground Level [m]

Cone used

: F7.5CKEW2/V 1515

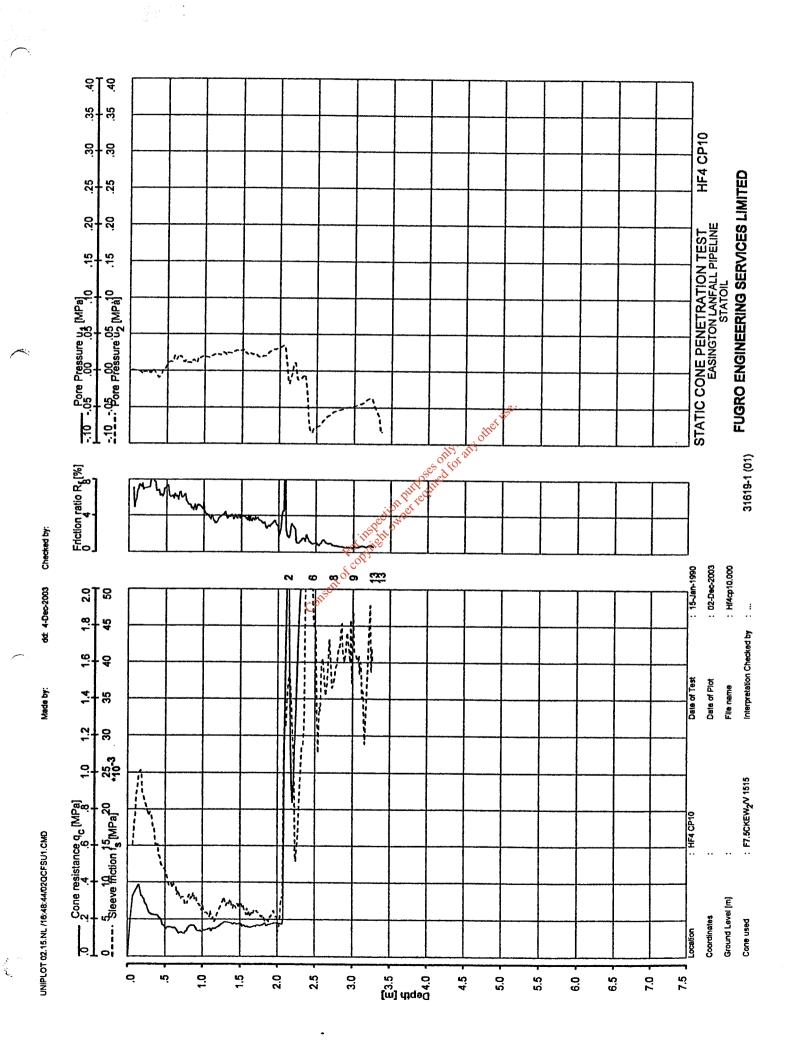
File name

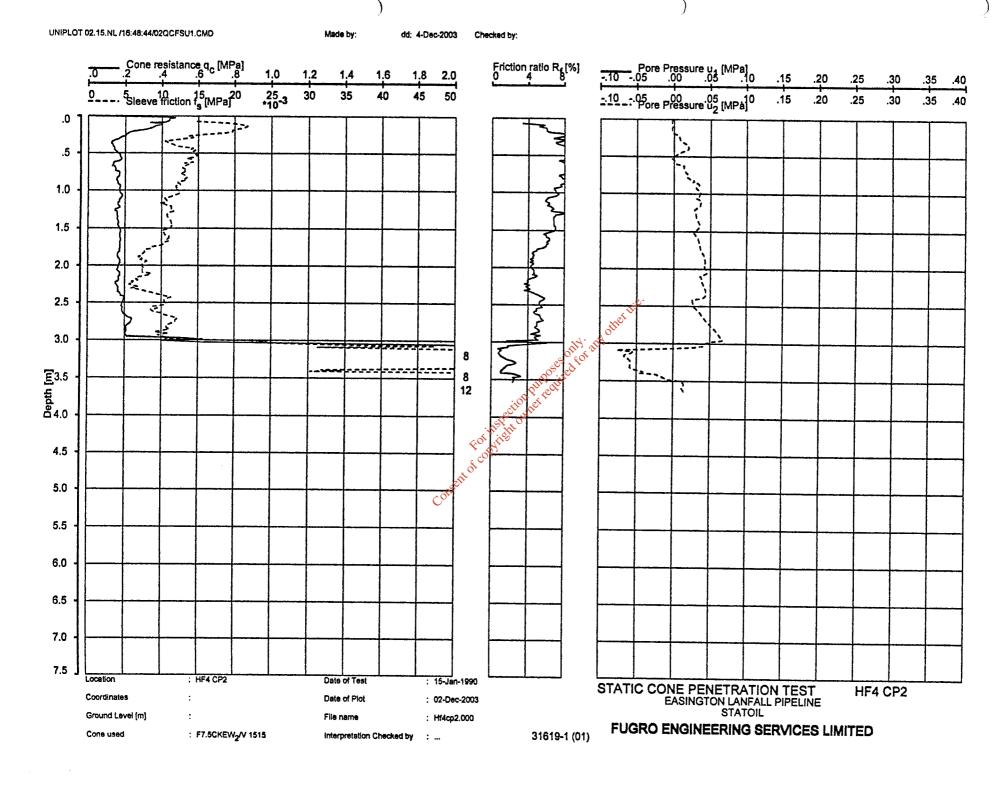
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: Hf4cp1.000

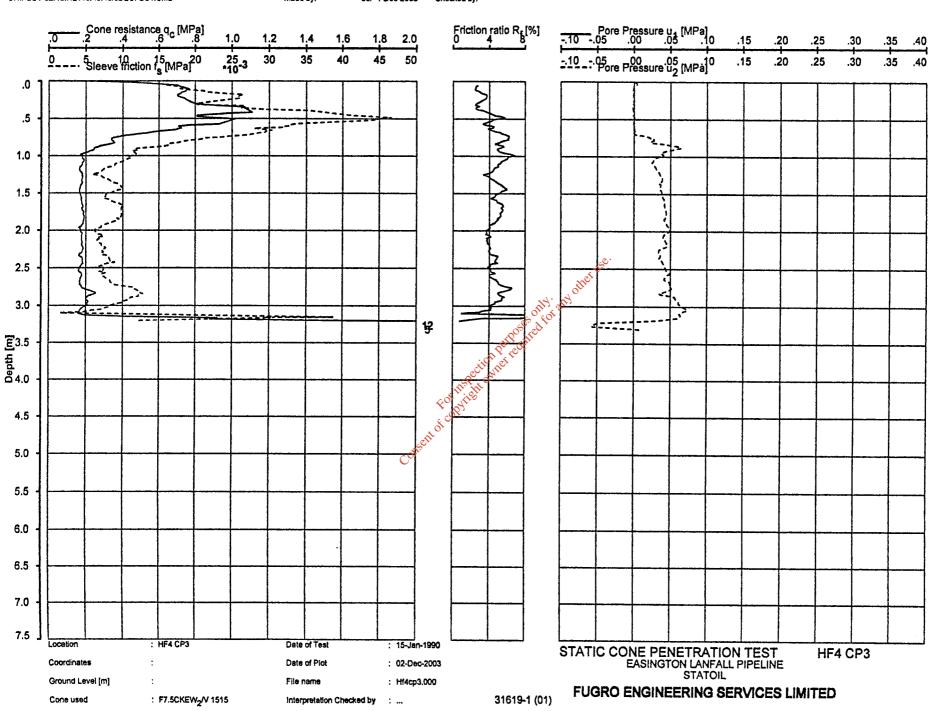
31619-1 (01)

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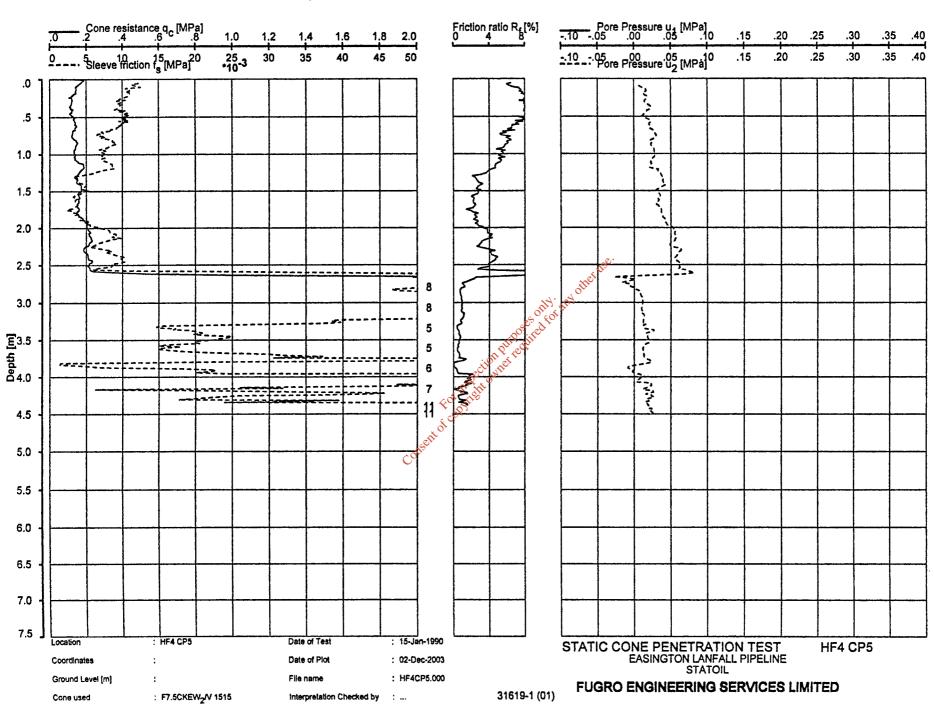
dd: 4-Dec-2003 Checked by:



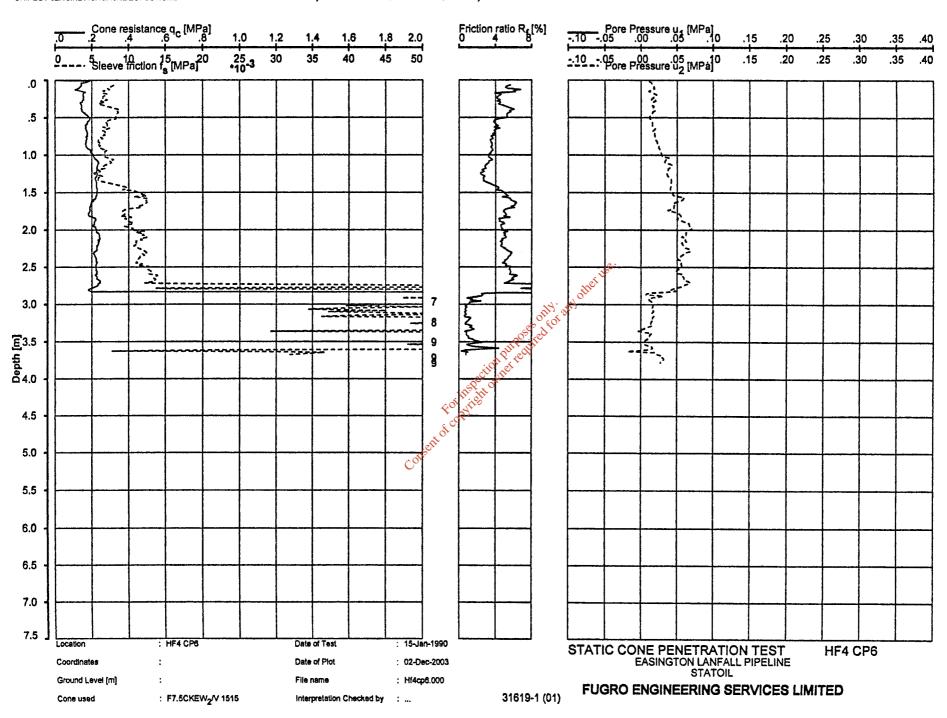
: F7.5CKEW2/V 1515

interpretation Checked by : ...

Cone used



Checked by:



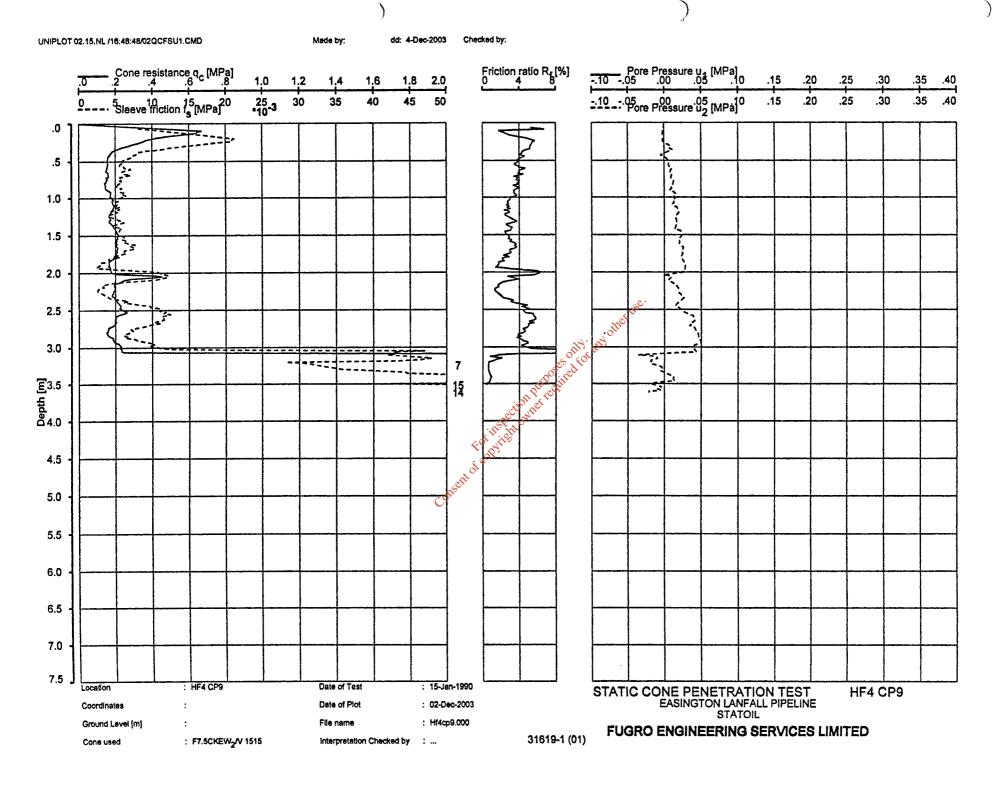
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Interpretation Checked by

31619-1 (01)

Cone used

: F7.5CKEW2/V 1515



: Lf2cp10.000

31619-1 (01)

File name

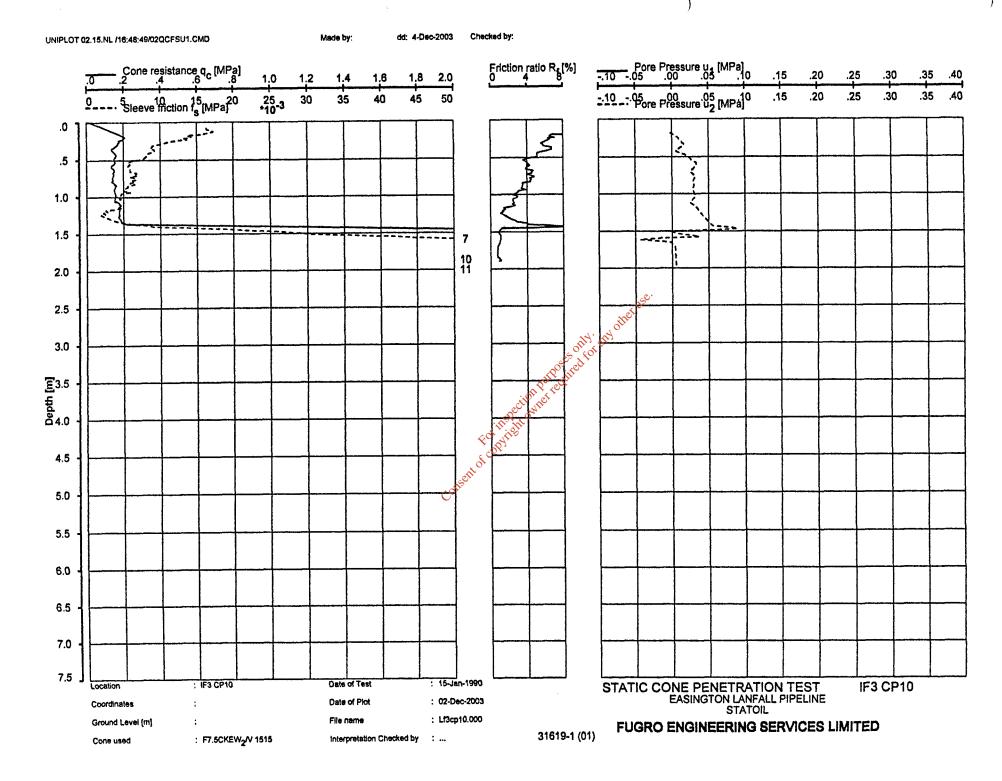
Interpretation Checked by : ...

Ground Level [m]

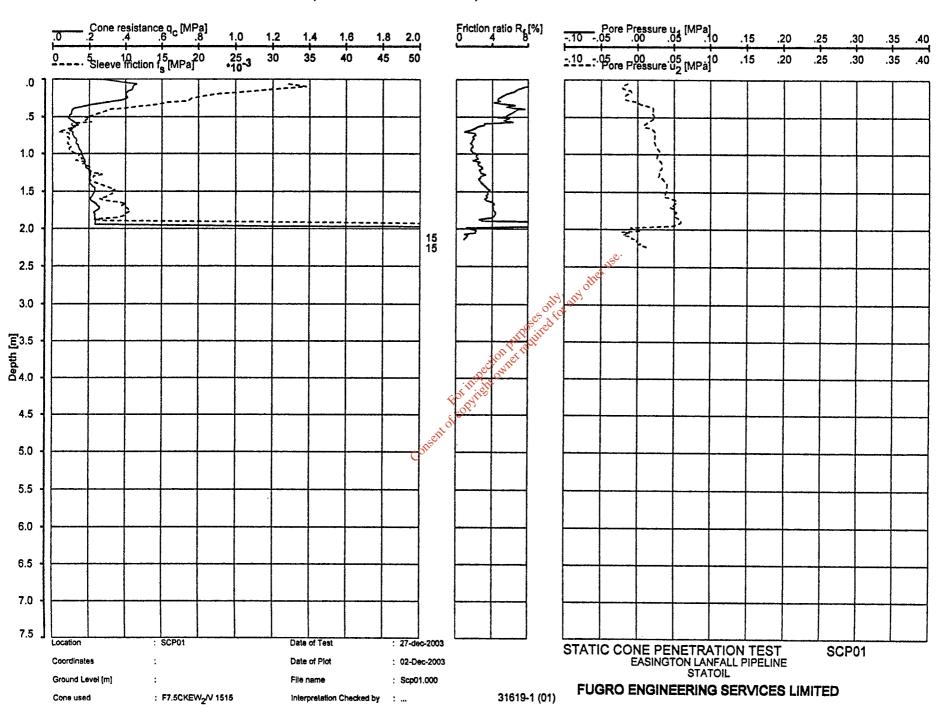
Cone used

: F7.5CKEW2/V 1515

STATOIL



dd: 4-Dec-2003 Checked by:



Ground Level [m]

: F7.5CKEW2/V 1515

Cone used

File name

Interpretation Checked by : ...

: Scp02.000

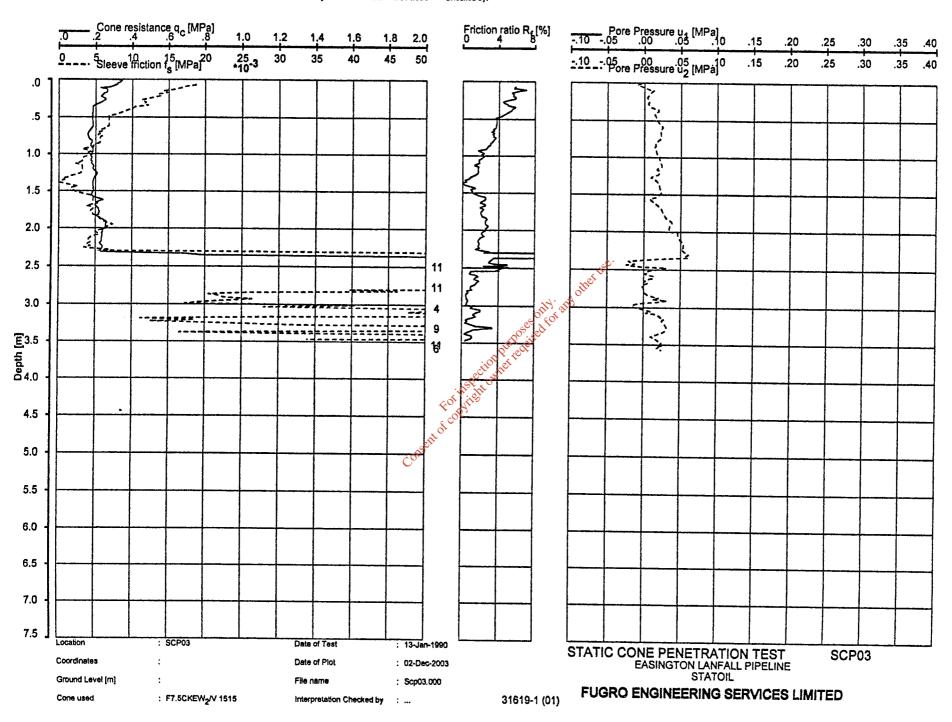
31619-1 (01)





dd: 4-Dec-2003

Checked by:



٥.

.5

1.0

1.5

2.0

2.5

3.0

(E) 3.5 Debth (A) 4.0

4.5

5.0

5.5

6.0

6.5

7.0

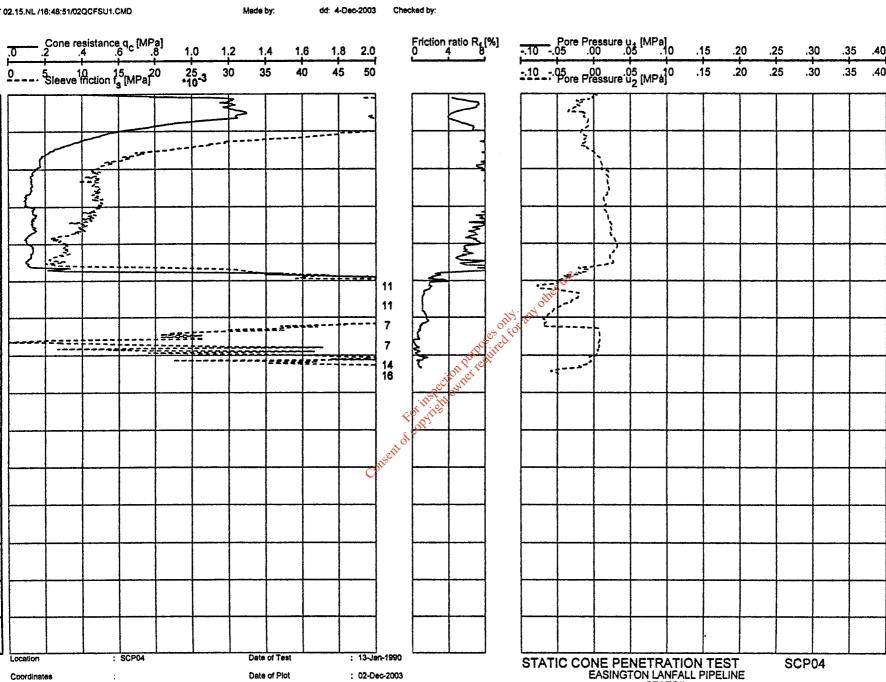
7.5

Coordinates

Cone used

Ground Level [m]

: F7.5CKEW2/V 1515



Date of Plot

File name

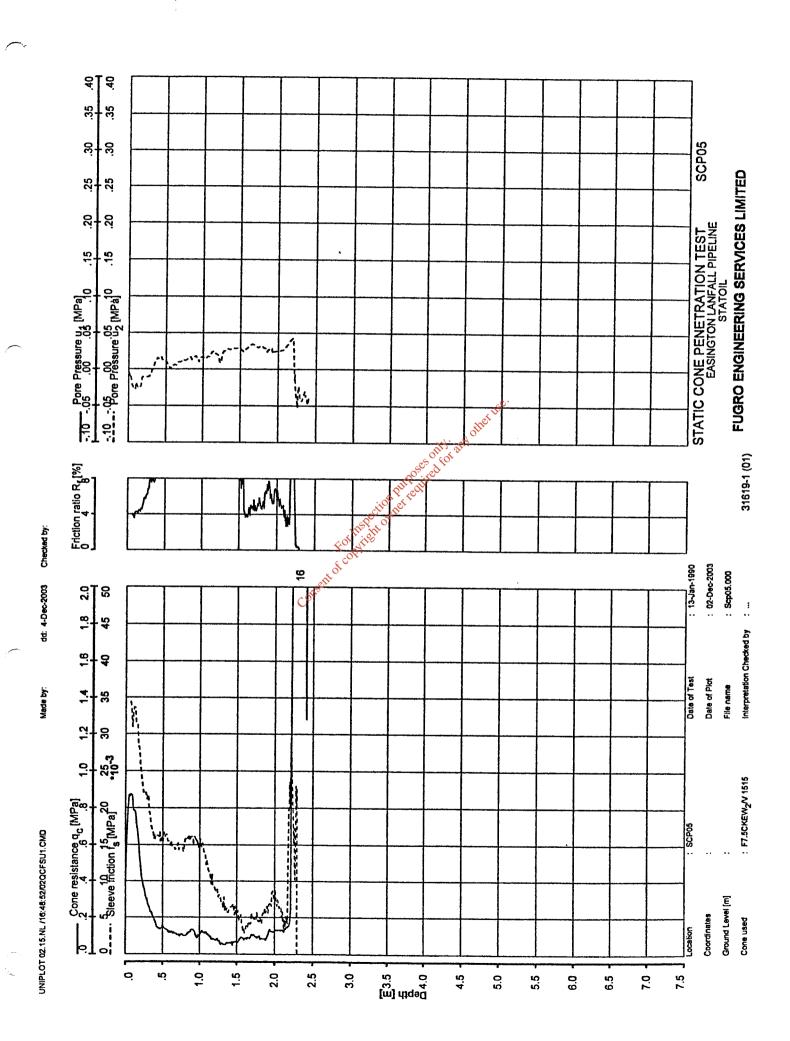
Interpretation Checked by : ...

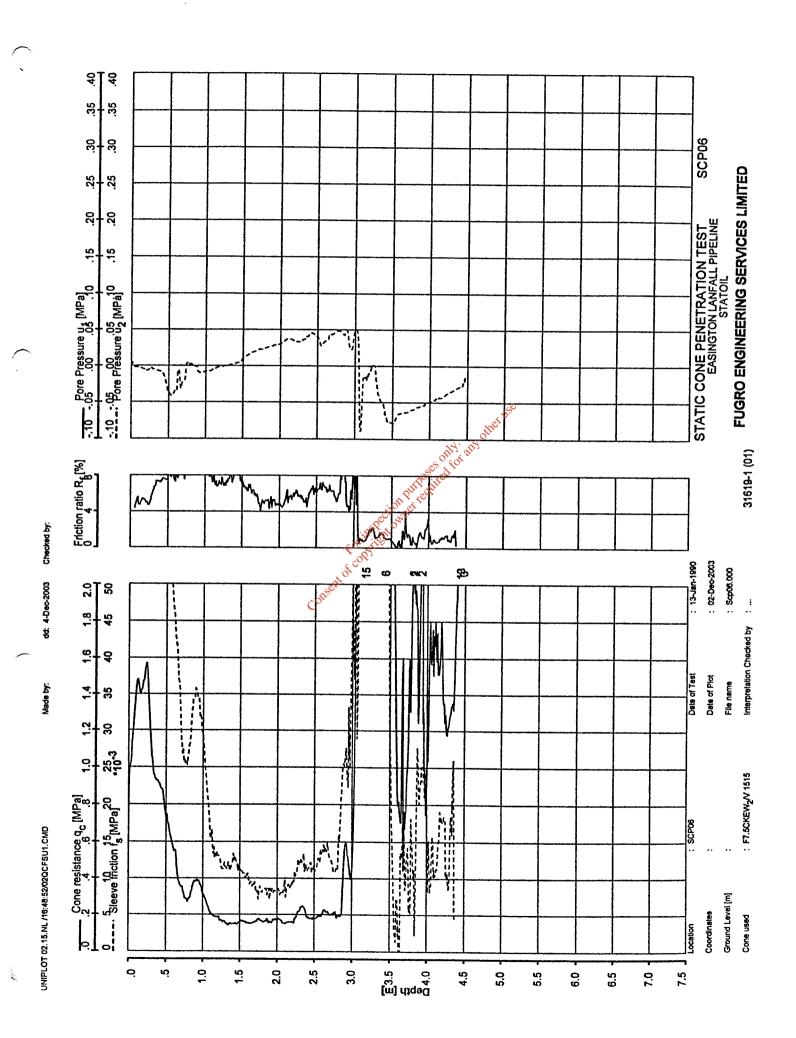
: 02-Dec-2003

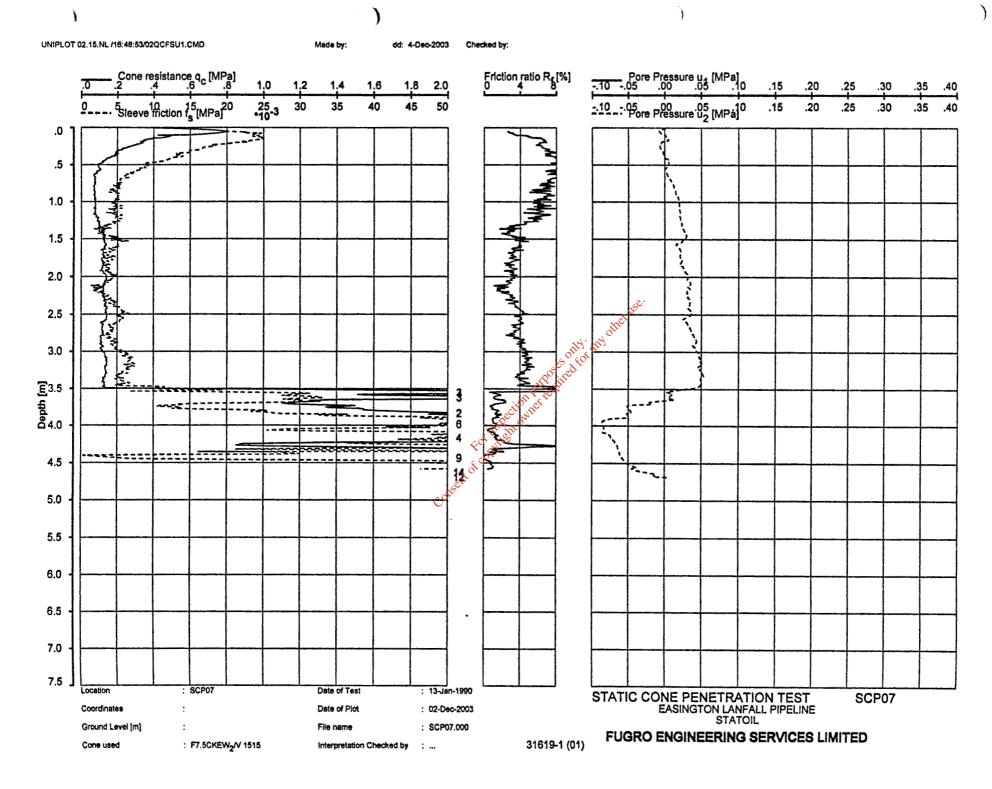
: Scp04.000

31619-1 (01)

STATOIL









APPENDIX C REVIEW OF EFFECTIVE STREETS PARAMETERS FOR PEAT

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Reference	Cohesion, c' (kPa)	Friction angle, φ' (degs.)	Testing Apparatus/ Comments	
Hanrahan et al (1967)	5 to 7	36 to 43	From triaxial apparatus	
Rowe and Mylleville (1996)	2.5	28	From simple shear apparatus	
Landva (1980)	2.4	27.1 to 32.5	Mainly ring shear apparatus for normal stress greater than 13kPa	
	5 to 6	-	At zero normal stress	
Farrell and Hebib (1998)	0	38	From ring shear and shear box	
			apparatus	
	0.61	31 gally atty office 128	From DSS apparatus. Result	
		othe	considered too low therefore DSS not	
		न्त्रीत्रं आत्र	considered appropriate	
Rowe, Maclean and	1.1	£ 3 86	From simple shear apparatus	
Soderman (1984)	3	itto ite 27	From DSS apparatus	
Sandorini et al (1984)	4.5	10 10 28	From triaxial apparatus	
McGreever and Farrell (1988)	6 cities	38	From triaxial apparatus using soil with 20% organic content	
	6 of Wright	31	From shear box apparatus using soil with 20% organic content	
Hungr and Evans (1985)	33.3	-	Back-analysed from failure	
Madison et al (1996)	10	23	-	

Table: Review of Effective Stress Parameters for Peat



APPENDIX D RISK REGISTER

APPENDIX D RISK REGISTER

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D.1 Geotechnical Risk Register

A Geotechnical Risk Register has been compiled to show the degree of risk attached to various elements of the design. The purpose of the register is to provide an outline description of the hazard, identify the potential likely cause, describe the consequence or impact of the hazard and identify the design and construction controls to be implemented in order to reduce the probability to a tolerable level. The overall application of the risk register will allow the management of geotechnical risk.

Whilst probability of a hazard occurring can be reduced to a minimum by geotechnical design, the probability cannot be reduced below Negligible. The likelihood of a hazard occurring has been judged on a qualitative scale. The scale has been derived from Clayton (2001) as follows:

Scale	Probability	Chance, per section of Works		
>1	Negligible	< 10 %		
2	Unlikely	10 – 30 %		
3	Likely	30 – 50 %		
4	Probable	50 – 70 %		
5	Very Likely	> 70 %		

Table of Qualitative Probability Scales

The severity of the risk is also assessed qualitatively and depends on the risk tolerance. The risk results from the combination of the hazard and the impact/consequence. A similar qualitative scale has been derived for the impact of the hazard as follows:

Scalenser	Impact	
5	Very High	
4	High	
3	Medium	
2	Low	
1	Very Low	

Table of Qualitative Impact Scales

The impact of a hazard manifesting itself can be either financial, health & safety or environmental or combinations of all three.

The degree of risk is determined by combining the probability and impact assessments and has been judged against a third qualitative scale, the Risk Rating which includes a descriptive response as follows:



Risk	Risk Rating	Response
1 to 4	Trivial	Monitor
5 to 8	Tolerable	Regular Attention
9 to 12	Substantial	Early Attention
13 to 25	Intolerable	Unacceptable

Table of Qualitative Risk Scales

The probability of a hazard manifesting itself can be reduced by geotechnical design but the impact cannot be influenced. Whilst a high impact event with low probability may have a similar risk rating as a low impact event with a high probability, the net effect of these separate hypothetical events may be viewed differently by the different parties involved with the project.

During construction, the ground conditions will be observed, monitored and recorded as appropriate. This will allow methods of construction and revision in design to be appropriately amended whilst the risks highlighted in the Geotechnical Risk Register are continuously monitored.



CONTINGENCY MEASURES	Install additional geotextile, increase thickness of haul road, import selected granular material, switch to lighter construction plant, reduce traffickine.	Peat must be allowed to regain sufficient strength either by ceasing operations or some artificial means. Increased windrowing time for ex-situ peat prior to transport from gas terminal site.	Import selected granular material for improved strength & drainage, relocate access road.	Cease operations, remove displaced material, provide check barriers to impede/contain slide.	Import selected granular fill, flatten slope, use granular haunch.	Cease traffic operations. Excavate failed area and replace with selected granular fill.
ROL	0.75	1.3	~	125	-	4
AFTER CONTROL	1.5	~	~	40	-	+
AFT	0.5	0.75	-	0.25	-	year
Construction Controls	Place geotextile and drainage layer material where necessary.	Adopt construction measures to minimise disturbance of ex-situ peat. Provide adequate drainage and also maintain existing drainage. Adopt observational approach	Limit plant weight & spacing of plant. Limit loading on roadway. Adopt observational approach	Adopt observational approach to the property of the property o	Adopt observational approach	Install geotechnical instrumentation prior to construction where road is o peat. Establish thresholdfrigger values and engage appropriate personnel to monitor and interpret geotechnical instrumentation during and post construction. Where road is not founded on peat/weak material then no requirement for instrumentation and monitoring
Design Controls	Impede operations and/or loss of Incorporate geotextile with drainage layer ground. material where required. Design appropriate geotechnical instrumentation for monitoring.	Review the site investigation of ex-situ peat and use conservative values for geotechnical parameters. Ensure no overfilling of placed peat.	Undertake conservative ground investigation & adopt conservative design strength.	site.	Undertake comprehensive ground investigation, adopt conservative design parameters. Undertake stability analysis for design proposal.	Undertake comprehensive ground investigation, interpret and adopt conservative design parameters. Provide design that avoids weak founding material.
IMPACT	Impede operations and/or loss of ground.	Overtopping could allow movement of peat within deposition area blocking construction traffic. Loss of strength of placed material.	Loss of plant, closure of access, danger to operatives	Movement of placed and in-situ peat form deposition area. Cessation of works, Loss of ground. Existing and proposed drainage inundated.	Movement of placed and in-situ peat form deposition area. Cessation of works. Loss of ground. Existing and proposed drainage inundated.	Movement of ground below access road with loss of ground strength.
CAUSE	Over trafficking of previously unknown weaker surface areas.	 Movement of Overestimating the geotechnical placed peat over properties of the ex-situ peat and/or the top of highfield allowing the peat to be reworked to low shear strenghts. Drainage not provided or impeded. 	Inadequate shear strength. Overloading of wagons. Too close spacing of wagons. Piling fill materials too high. Severe dynamic effects, e.g., imposing speed limits and requiring fills to be spread as trucks are emptied.	Insufficient understanding of the mechanisms of failure and inadequate design. Presnce of weak peat.	Ground too weak.	6. Bearing failure Inadequate strength in ground. Excess 10 access road from water in retained peat and access frack. 2 Inadequate drainage provisions. 8313
HAZARD	 Rutting of haul road from transfer area to deposition area. 	2. Movement of placed peat over the top of highfield	nfield	4. Bog slide	5. Failure of perimeter highfield	6. Bearing failure Of access road from NR313

Table: Preliminary Geotechnical Design for Srahmore Peat Deposition Site - Geotechnical Risk Register