

Appendix A Extracts of Relevant BGS Archive Exploratory Holes



RECORD OF BOREHOLE No: 20 / 1

Location : HAMPSHIRE RESERVOIRS III

Contract No. : CF 659 / 1640

Type of Boring : Cable Percussion

Date (started) : 15.11.77

SHEET 1 OF 3

Borehole Dia : 200 mm to 4.70 m

Casing : 200 mm to 4.70 m

Ground Level : +14.65 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	
15.11.77			0.30 - 0.75	U	1		14.65	
0.20								
0.40								
0.60								
0.80								
1.00			1.00	D	2		13.80	
1.20			(2.29)	B	3			
1.40								
1.60			1.75	D	4			
1.80			(2.00)	B	5			
2.00			(2.64)					
2.20								
2.40			2.75	D	6			
2.60								
2.80			(3.00)	B	7			
3.00			(2.32)					
3.20								
3.40			3.75	D	8			
3.60								
3.80			(4.00)	B	9			
4.00			(2.32)					
4.20								
4.40			4.50 - 4.90	U	10		10.20	
4.60								
4.80								
5.00			5.10	D	11			
5.20			5.15 - 5.55	U	12			
5.40								
5.60			5.75	D	13			
5.80			5.80 - 6.20	U	14			
6.00								
6.20								
6.40			6.40	D	15			
6.60			6.45 - 6.80	U	16			
6.80								
7.00			7.05	D	17			
7.20			7.10 - 7.50	U	18			
7.40								
7.60	13.00	5.70 Dry	7.70	D	19			
7.80	14.00	5.70 Dry	7.75 - 8.05	U	20			
8.00								
8.20			8.35	D	21			
8.40			8.40 - 8.75	U	22			
8.60								
8.80								
9.00			9.00	D	23			
9.20			9.05	D	24			
9.40								
9.60			9.50 - 9.90	U	25			
9.80								
10.00								

REMARKS: Piezometer details - See sheet 2.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/1

Location : HAMPSHIRE RESERVOIRS III
SITE 20

Contract No. : CF 669/1640

Type of Boring : Cable Percussion

Date (started) : 15.11.77

SHEET 2 OF 3

Borehole Dia : 200mm to 4.70m
150mm to 30.00m

Casing : 200mm to 4.70m
150mm to 17.50m

Ground Level : +14.65m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA			DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	Thickness	
0.20			10.10	D	26	x x	4.65		
0.40			10.20-10.60	U	27	x x x			
0.60						x x x			
0.80			10.80	D	28	x x x			
1.00			10.85-11.25	U	29	x x x			
1.20						x x x			
1.40			11.45	D	30	x x x			
1.60			11.50-11.90	U	31	x x x			
1.80						x x x			
2.00			12.10	D	32	x x x			
2.20			12.15-12.45	U	33	x x x			
2.40						x x x			
2.60			12.75	D	34	x x x			
2.80			12.80-13.20	U	35	x x x			
3.00						x x x			
3.20			13.40	D	36	x x x			
3.40			13.45-13.85	U	37	x x x			
3.60						x x x			
3.80						x x x			
4.00	15.11.77	11.10	14.05	D	38	x x x			
4.20	12.35		14.10	U * D	39	x x x			
4.40	12.35	1.80	14.50	D	40	x x x			
4.60						x x x			
4.80						x x x			
5.00			15.30	B	41	x x x			
5.20			15.35-15.70	U	42	x x x			
5.40						x x x			
5.60			15.95	D	43	x x x			
5.80			16.00-16.40	U	44	x x x			
6.00						x x x			
6.20						x x x			
6.40			16.60	D	45	x x x			
6.60			16.70-17.05	U	46	x x x			
6.80						x x x			
7.00			17.30	D	47	x x x			
7.20			17.35-17.65	U	48	x x x			
7.40						x x x			
7.60			17.95	D	49	x x x			
7.80			18.00-18.40	U	50	x x x			
8.00						x x x			
8.20						x x x			
8.40			18.60	D	51	x x x			
8.60			18.70-19.00	U	52	x x x			
8.80						x x x			
9.00			19.30	D	53	x x x			
9.20			19.35-19.65	U	54	x x x			
9.40						x x x			
9.60			19.95	D	55	x x x			
9.80						x x x			
10.00						x x x			

REMARKS: Water sample taken on 16.11.77 at 0800
U * D = U4 failed disturbed sample taken.
Piezometer installed tip depth 13.00m and response zone
6.00 - 15.00m.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/1

Location : HAMPSHIRE RESERVOIRS III

SHEET 3 OF 3

Contract No. : CF 669/1640

Borehole Dia : 200 mm to 4.70 m
150 mm to 30.00 m

Type of Boring : Cable Percussion

Casing : 200 mm to 4.70 m

Date (started) : 15.11.77

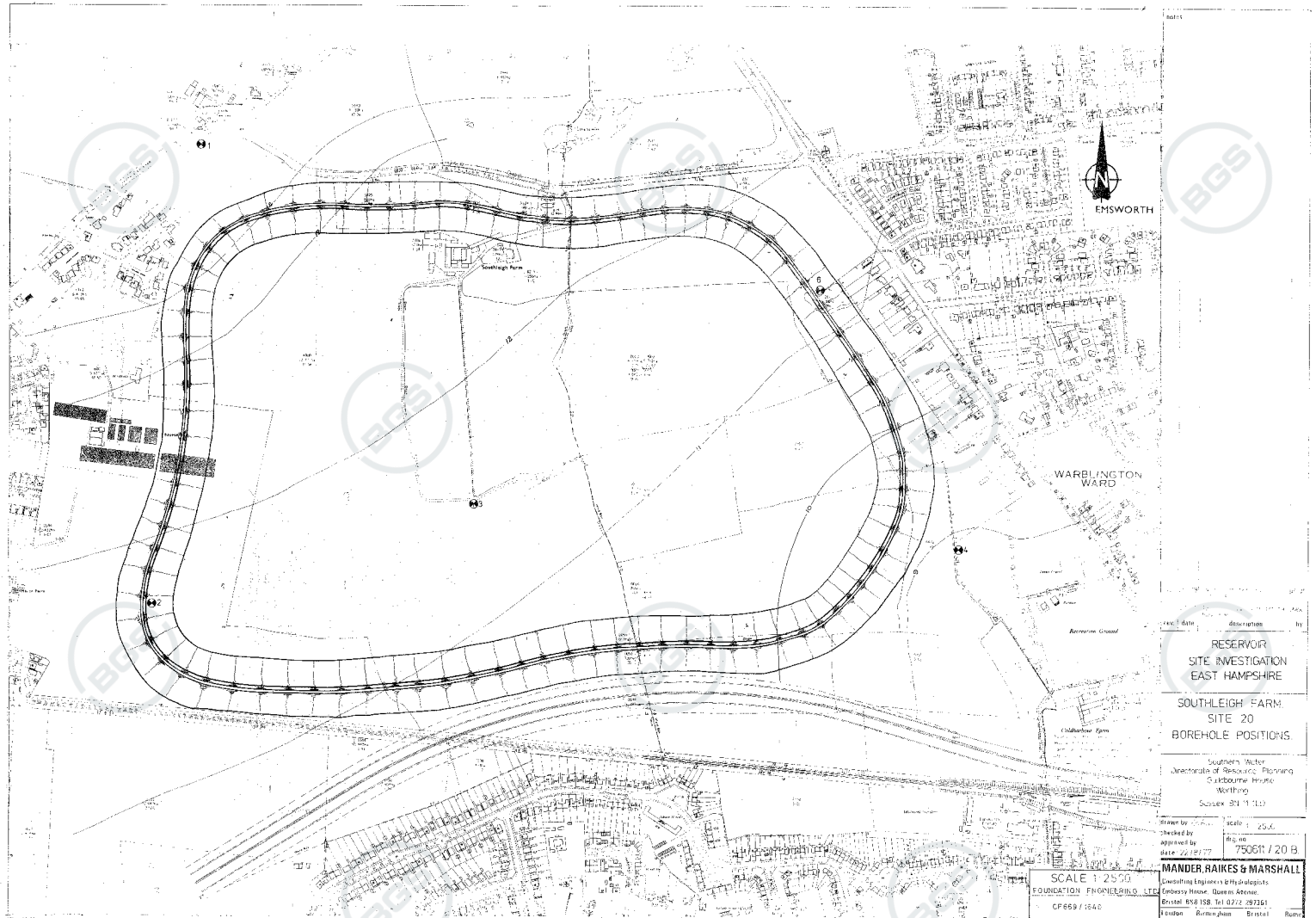
Ground Level : 150 mm to 17.50 m
+14.65 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m.O.D.	
0.20			20.00-20.35	U	56		-5.35	
0.40								
0.60			20.60	D	57	x		
0.80			20.65-21.00	U	58			Clay appears fissured from 20.60 m.
1.00								
1.20			21.25	D	59			
1.40			21.30-21.60	U	60	x x		
1.60	16.11.77							
1.80	18.00	13.88	21.90	D	61			
2.00			22.00-22.40	U	62			Hard grey very silty laminated CLAY with shell fragments, gypsum crystals small silty sand lenses and thin sandy layers
2.20	17.11.77	13.88					5.90	
2.40	08.00							
2.60			22.60	D	63	x		
2.80			22.65-23.05	U	64			
3.00								
3.20			23.25	D	65	x x		
3.40			23.35-23.75	U	66	x x		
3.60								
3.80			23.95	D	67			
4.00			24.00-24.40	U	68			
4.20								
4.40			24.60	D	69		-9.85	
4.60			24.70-25.05	U	70			
4.80								
5.00								
5.20			25.30	D	71			
5.40			25.40-25.75	U	72			
5.60								
5.80	13.00	17.50	26.00	D	73	x x		
6.00	14.00	17.50	26.10-26.50	U	74			
6.20		18.00						
6.40			26.70	D	75			
6.60			26.75-27.15	U	76	x	5.50	Hard grey silty slightly fissured CLAY with a shelly band between 27.25 m. and 28.00 m. approx.
6.80							+	
7.00			27.35	D	77			
7.20			27.40-27.70	U	78			
7.40								
7.60						x x		
7.80			28.00	D	79			
8.00			28.10-28.40	U	80			
8.20								
8.40								
8.60			28.70	D	81	x		
8.80			28.75-29.10	U	82			
9.00								
9.20			29.35	D	83			
9.40			29.40-29.70	U	84	x x		
9.60	17.11.77							
9.80	18.00	17.50	30.00	D	85		-15.35	
10.00		21.60						

REMARKS: Piezometer details - See sheet 2.

SCALE: 1 : 50

Foundation Engineering Ltd.





RECORD OF BOREHOLE No: 20/3

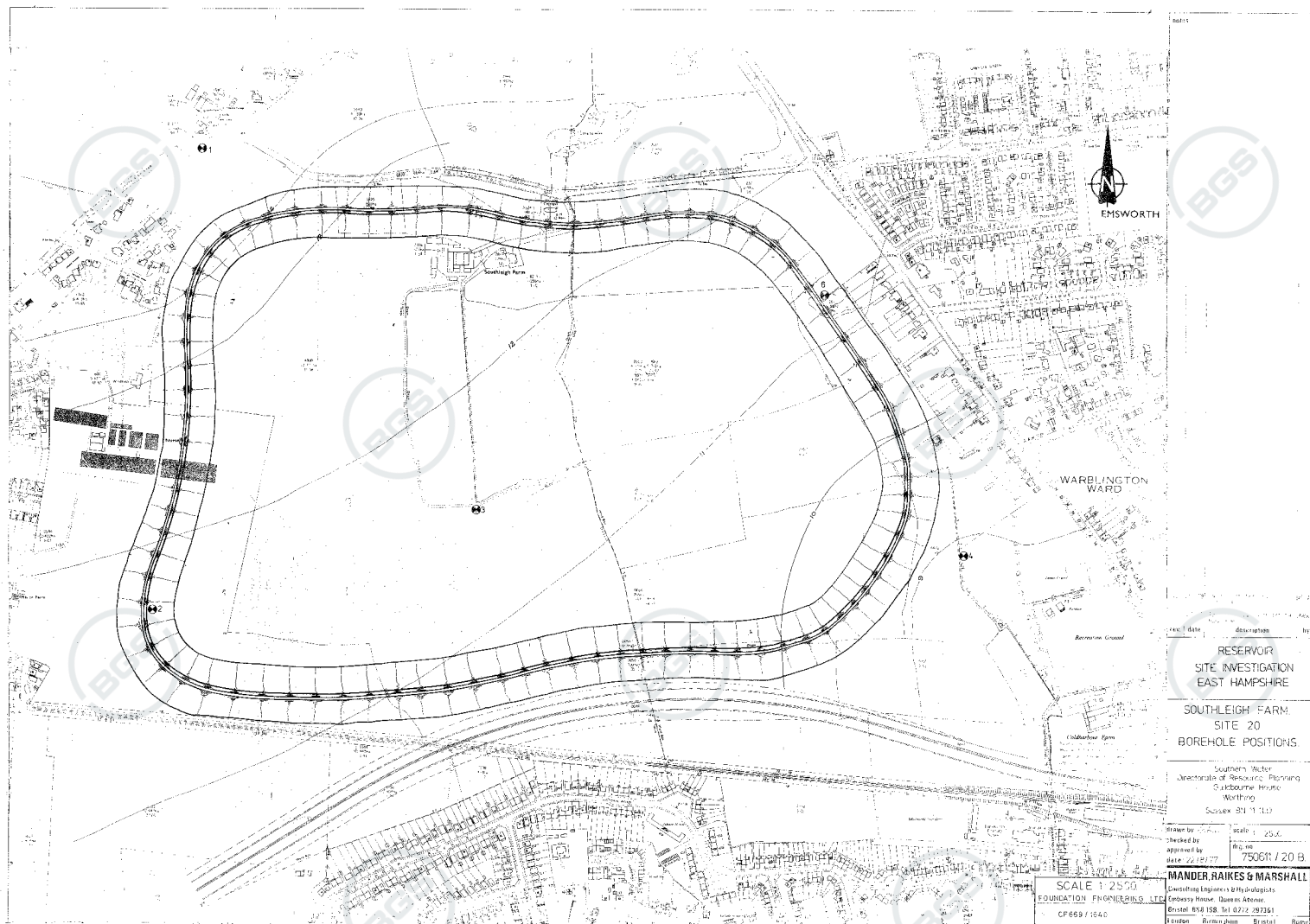
Location : HAMPSHIRE RESERVOIRS III SHEET .1.... OF .1.....
Contract No. : CF 669/1640 Borehole Dia : 150 mm
Type of Boring : Cable Percussion Casing : 150 mm
Date (started) : 31. 10. 77 Ground Level : +12. 35 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	Thickness
31.10.77							(12.35)	
0.20								0.50 Black stony TOPSOIL.
0.40			0.50 - 0.90	U	1		11.85	
0.60						x		
0.80						x x		
1.00			1.10	D	2			
1.20			1.10 - 1.50	U	3			1.20 Stiff light brown/orange mottled silty CLAY with organic smell.
1.40						x		
1.60			1.70	D	4		10.65	
1.80			1.70 - 2.05	U	5			
2.00						x		
2.20			2.30	D	6			
2.40			2.30 - 2.50	U	7			1.20 Stiff light brown and dark red silty CLAY with much angular medium flints and occasional chalk
2.60						x x		
2.80			2.90	D	8		9.45	
3.00			2.90	U*B	9			
3.20						x		
3.40			3.50	D	10			0.80 Soft to firm light brown creamy coloured silty CLAY with very much fine weathered chalk; "putty chalk" Some flint present
3.60			3.50 - 3.90	U	11		8.65	
3.80						x		
4.00	31.10.77							0.40 Firm light brown clayey silty fine SAND/sandy SILT. Clay content decreasing with depth.
4.20	18.00	4.10	4.10	D	12		9.10	
4.40	1.11.77	4.10	4.10	U*D	13			
4.60	08.00					x		
4.80			4.70 - 5.00	U	14			1.20 Stiff grey and dark brown silty CLAY with fine medium angular calcareous gravel and occasional silt lenses.
5.00						x x		
5.20			5.30	D	15		7.05	
5.40			5.30 - 5.70	U	16			
5.60						x		
5.80	1.11.77	4.10	6.00	D	17		6.25	0.70 + Stiff grey silty fissured CLAY with brown silt on the fissures. A few very fine gypsum crystals present.
6.00						x x		
6.20						Eo.B.		
6.40								
6.60								
6.80								
7.00								
7.20								
7.40								
7.60								
7.80								
8.00								
8.20								
8.40								
8.60								
8.80								
9.00								
9.20								
9.40								
9.60								
9.80								
10.00								

REMARKS: Water seepage at 4.10m. Water made 0.05m in 20 minutes
U*B, D U4 failed bulk, disturbed sample taken.
Piezometer installed in borehole, tip depth 4.85m. and response zone from 3.50 - 5.50m.

SCALE, 1 : 50

Foundation Engineering Ltd.





RECORD OF BOREHOLE 18

SU 70 NW 23
73920652
1" 3/16

Ground level: 11.30m above O.D.

Diameter of boring: 0.20m

Method of boring: Shell and Auger

Lining tubes: 0.20m to 3.85m

Daily Progress	Depth to Water m	Depth of Lining Tubes m	Samples		Legend	Depth m	Reduced level m	Description of Strata
			Depth	Type				
			0.30 - 0.75 0.75	U(4) D		0.40	10.90	TOPSOIL
			1.55 - 1.85 1.85	U(4) D		1.40	9.90	Firm orange-brown slightly sandy silty CLAY
			3.55 - 3.85 3.85	S(12) D		3.85	7.45	Medium dense orange-brown silty fine SAND
			3.85 - 4.30 4.30	U(4) D				Stiff fissured grey silty CLAY with occasional partings of silt
			5.30	D				
			5.85 - 6.30 6.30	U(4) D				
			7.30	D				
			7.85 - 8.30 8.30	U(4) D				
27.6.72	1.40	NONE	9.30 9.55 - 10.00 10.00	D U(4) D		10.00	1.30	
Key to type of sample: U(4) - 102mm (4in) diameter undisturbed sample. D - disturbed sample. BD - bulk disturbed sample. V - vane test. S - standard penetration test. C() - dynamic cone penetration test. Figure in brackets is No. of blows for penetration given in depth column. See Notes, page 1.					Remarks: Ground-water was encountered at a depth of 1.40m and was cut off by the lining tubes at 3.85m.			
Lab. Ref. No. S/8974					A27 HAVANT - CHICHESTER			

R.F.W.
18.10.83



RECORD OF BOREHOLE 23

SU 70 NW 27
74350648
1" 316.

Ground level: 8.75m above O.D.

Diameter of boring: 0.20m

Method of boring: Shell and Auger

Lining tubes: 0.20m to 1.50m

Daily Progress	Depth to Water m	Depth of Lining Tubes m	Samples		Legend	Depth m	Reduced level m	Description of Strata	
			Depth	Type					
			0.50 - 0.95 0.95	U(4) D		0.30 0.50	8.45 8.25	TOP SOIL Firm brown sandy silty CLAY with traces of gravel	BE
			1.50 - 1.95 1.60	U(4)† D				Firm to stiff mottled grey and brown silty CLAY	LC
			2.00 - 2.45 2.45	U(4) D		2.00	6.75		
30.6.72	DRY	1.50	3.00 - 3.45 3.45	U(4) D		3.50	5.25	Stiff fissured grey silty CLAY	
<p>Key to type of sample:</p> <p>U(4) - 102mm 4in diameter undisturbed sample. D - disturbed sample. BD - bulk disturbed sample. V - vane test. S - standard penetration test. C - dynamic cone penetration test. Figure in brackets is No. of blows for penetration given in depth column, see Notes, page 1.</p> <p>Remarks:</p> <p>Ground-water was not encountered during boring.</p> <p>† Unable to recover sample.</p>									
Lab. Ref. No. S-8974		A27 HAVANT - CHICHESTER							



SU70NW/153
7302 0795

CONTRACT No. 4394

BOREHOLE RECORD

TRACT HAVANT (BRIDGE 106) DATE STARTED 26/8 FINISHED 27/8/69
OLE No. 2 Bortons Road OPERATOR D. ROBB
ANCE DATUM LEVEL +26m TYPE OF PENETRATION TEST —
OF BORING SHELL & AUGER WEIGHT — DROP —
ETER OF BORING 6" STANDING WATER LEVEL NIL
ARKS

Depth feet	O.D. Level	Type & No. of Sample	Boring Details			Legend	Description of Material and Observations
			Penetration	Lining	Water		
							TOP SOIL
		U4/5'0"-6'6"					SOFT BROWN/BLUE CLAY WITH PEAT TRACES
		U4/10'0"-11'6"					FIRM BROWN CLAY WITH DEPOSITS OF
		U4/15'6"-16'6"					SAND.
		U4/21'0"-21'6"					
		U4/25'0"-26'6"					HARD GREY CLAY.
		U4/30'6"-31'6"					
							Bore at 36' (11.0m)

R.J.W.
2.1.83

SU 70 NW / 154

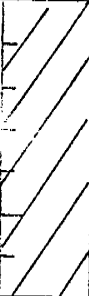
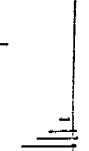
7301 0792

STATE NO. 5 OF 5

CONTRACT No. 4394.

BOREHOLE RECORD

TRACT HAYANT (BRIDGE 106) DATE STARTED 22/8 FINISHED 23/8/69
 HOLE No. 4 Bartons Road OPERATOR D. ROSE
 ANCE DATUM LEVEL ca +26m TYPE OF PENETRATION TEST C.P.T./S.P.T.
 OF BORING SHELL AND AUGER WEIGHT 140 LBS DROP 2' 0"
 METER OF BORING 6" STANDING WATER LEVEL 23' 0"
 MARKS

Depth Feet	O.D. Level	Type & No. of Sample	Boring Details			Legend	Description of Material and Observations	
			Penetration	Lining	Water			
		C.P.T.	36 FOR 12'				FILL, CLAY AND CHALK	0 Made 5' 2-1m.
		U4 / 8'0"-9'6"					FIRM BROWN / BLUE CLAY	10'
		U4 / 13'0"-14'6"						15'
		U4 / 15'0"-16'6"					FIRM GREY CLAY	LC 20'
		U4 / 20'0"-21'6"						25'
		S.F.T	120 FOR 12'		S.W.L.		HARD BROWN CLAY WITH INSERTS OF GRAVEL.	30' Base at 36' (11.0m)



S.242.

HAMPSHIRE COUNTY COUNCIL—COUNTY ROADS LABORATORY

Copies to:
The County Surveyor.

BORING RECORD

200mm DIAMETER
PERCUSSION BORING

Division S.E.R.C.U.

Lab. No.

Road No. A27

Date Sampled

Location HAVANT TO CHICHESTER

Date Received in Lab.

20, 23, 24/10/78

Sheet No. 1 OF 3

Ground Level 11.77

Formation Level

BORE HOLE 505

Position

Cut or fill

O.D. Level	Depth	Sample Type	Depth	Description
	m			
0.3	0.25			TOPSOIL
	0.5			
	0.75	U100	0.5-0.8	Firm orange brown silty fine sandy CLAY.
	1.0			
1.3	1.25			
	1.5	D	1.5	
	1.75	S.P.T. N=13	1.5	Medium dense orange brown silty sandy very clayey GRAVEL
	2.0			- becoming less dense and less clayey with depth
	2.25	D	2.2	
	2.5			
2.7	2.75			
	3.0			Loose and very wet clayey silty fine SAND
	3.25	D	3.0-4.0	
	3.5	S.P.T. S.M.R. value		
	3.75	own weight 3.5		
	4.0			
4.2	4.25			
	4.5	S.P.T. N=12	4.5	Medium dense grey clayey f.m.c GRAVEL
4.6	4.75			Large flints in a matrix of firm grey silty CLAY
5.1	5.0	D	4.5-5.5	
	5.25			Very stiff grey silty CLAY.
	5.5			
	5.75	U100	5.5-6.0	
	6.0			
	6.25			
	6.5			
	6.75	U100	6.5-7.0	
	7.0			

Sample Type:

- U — undisturbed
- D — disturbed
- W — water
- Dt — tin

..... Manager.



S.243.

HAMPSHIRE COUNTY COUNCIL—COUNTY ROADS LABORATORY

Copies to:
The County Surveyor.

BORING RECORD

Division S.E.R.C.U.

200mm DIAMETER
PERCUSSION BORING

Lab. No.

Road No. A27

Date Sampled

Location HAVANT TO CHICHESTER

Date Received in Lab.

Sheet No. 2 OF 3

Ground Level 11.171

BORE HOLE 505

Formation Level

Position

Cut or fill

20, 23, 24/10/78

O.D. Level	Depth	Sample Type	Depth	Description
x x x	m			
—	7.0			Very stiff grey silty CLAY.
—	7.25			
x x	7.5			
—	7.75	4100	7.5-8.0	— heavily fissured
x x x	8.0			
—	8.25			
x x	8.50			
—	8.75			
x x	9.0			
—	9.25			
x x	9.50			
—	9.75	4100	9.5-10.0	
x x x	10.0			
—	10.25			
x x	10.5			
—	10.75			
x x	11.0			
—	11.25	4100	11.0-11.5	
x x	11.5			
—	11.75			
x x x	12.0			
—	12.25			
x x	12.5			
—	12.75	4100	12.5-13.0	
x x	13.0			
—	13.25			
x x	13.5			
—	13.75			
x x	14.0			

Sample Type:

U — undisturbed
D — disturbed
W — water
Dt — tin

..... Manager.



S. 244.

HAMPSHIRE COUNTY COUNCIL—COUNTY ROADS LABORATORY

Copies to:
The County Surveyor.

BORING RECORD

200mm DIAMETER
PERCUSSION BORING

Division S.E.R.C.U.

Lab. No.

Road No. A27

Date Sampled

Location HAVANT TO CHICHESTER

Date Received in Lab.

Sheet No. 3 OF 3

Ground Level 11.71

BORE HOLE 505

Formation Level

Position

Cut or fill

20, 23, 24/10/78

O.D. Level	Depth	Sample Type	Depth	Description
	m			
	14.0			Very stiff grey silty CLAY.
	14.25			
	14.5			
14.8	14.75	U100	14.5-14.8	
15.0	15.0	D	14.8-15.0	Hard grey MUDSTONE
E.C.B.	15.25			
	15.5			
	15.75			
	16.0			
	16.25			
	16.5			
	16.75			
	17.0			
	17.25			
	17.5			
	17.75			
	18.0			
	18.25			
	18.5			
	18.75			
	19.0			
	19.25			
	19.5			
	19.75			
	20.0			
	20.25			
	20.5			
	20.75			
	21.0			

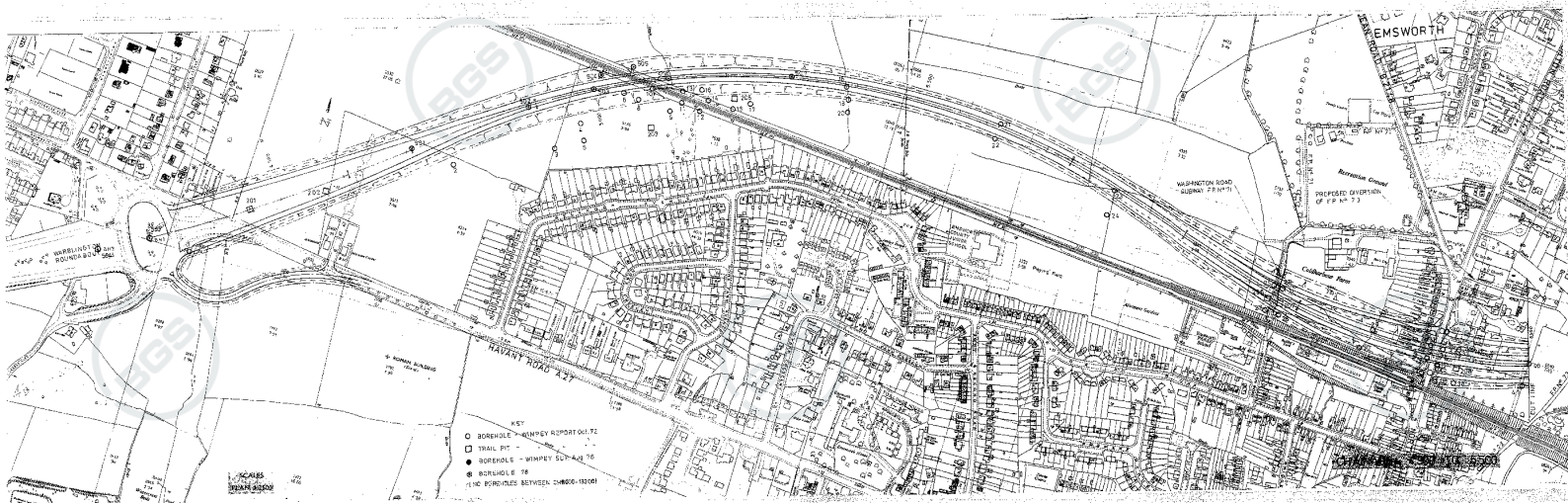
WATER

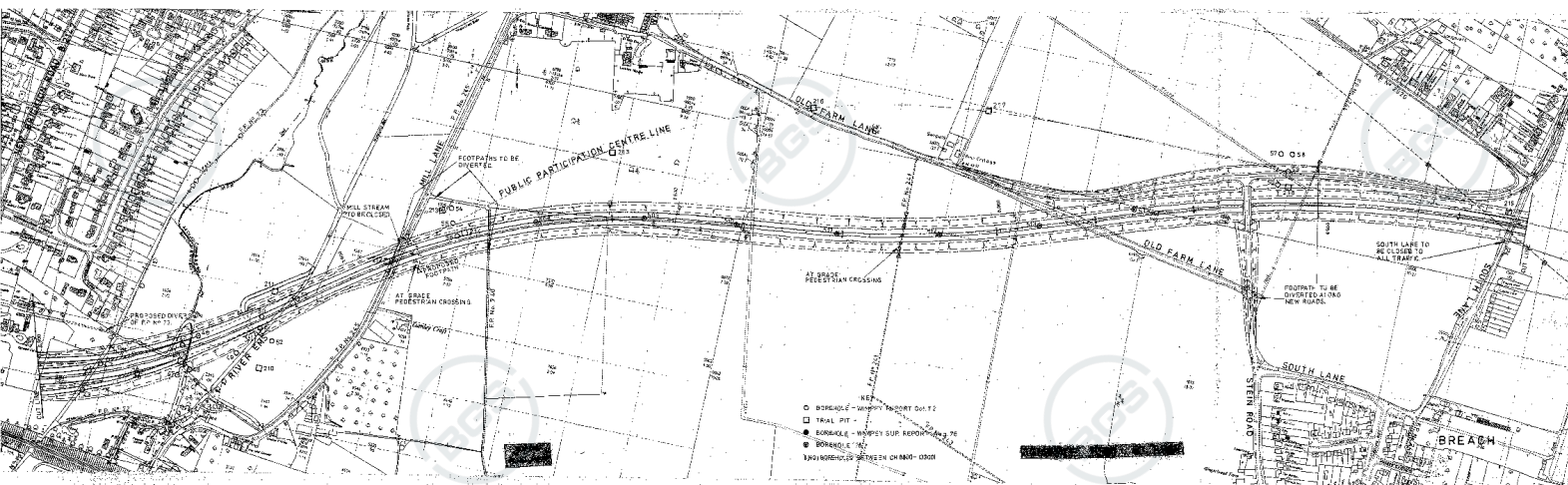
DATE	23/10	23/10	24/10
TIME	1600	1615	1600
DEPTH TO WATER	2.0	0.4	0.4
DEPTH OF CASING	3.0	5.0	5.0
DEPTH OF HOLE	2.7	8.6	15.0

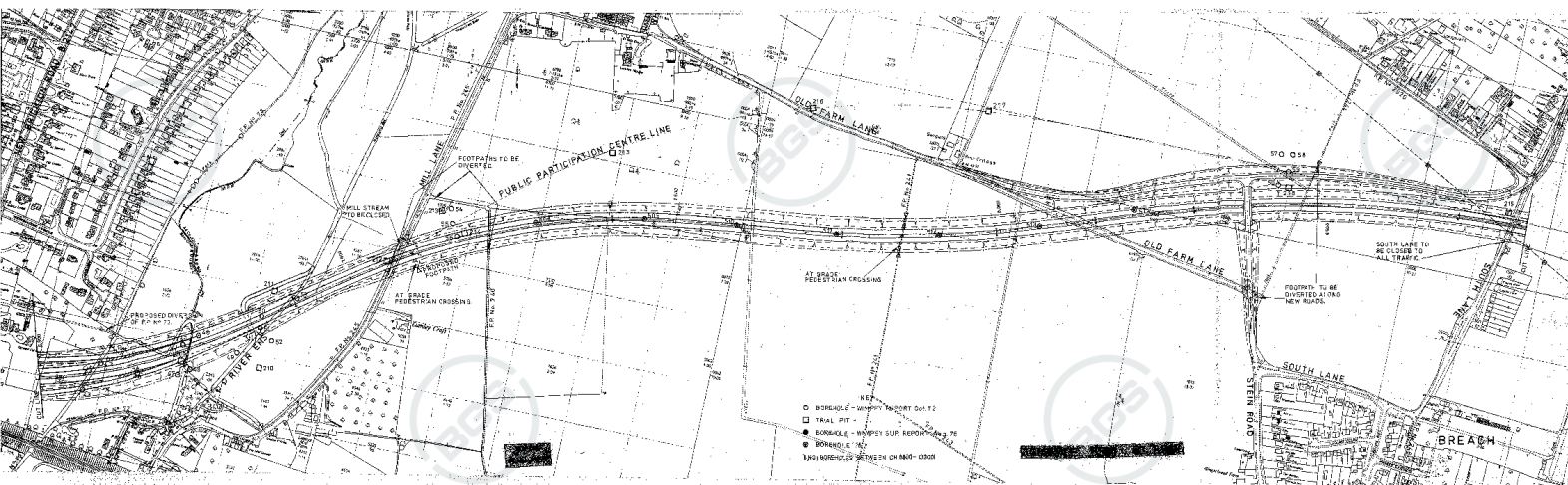
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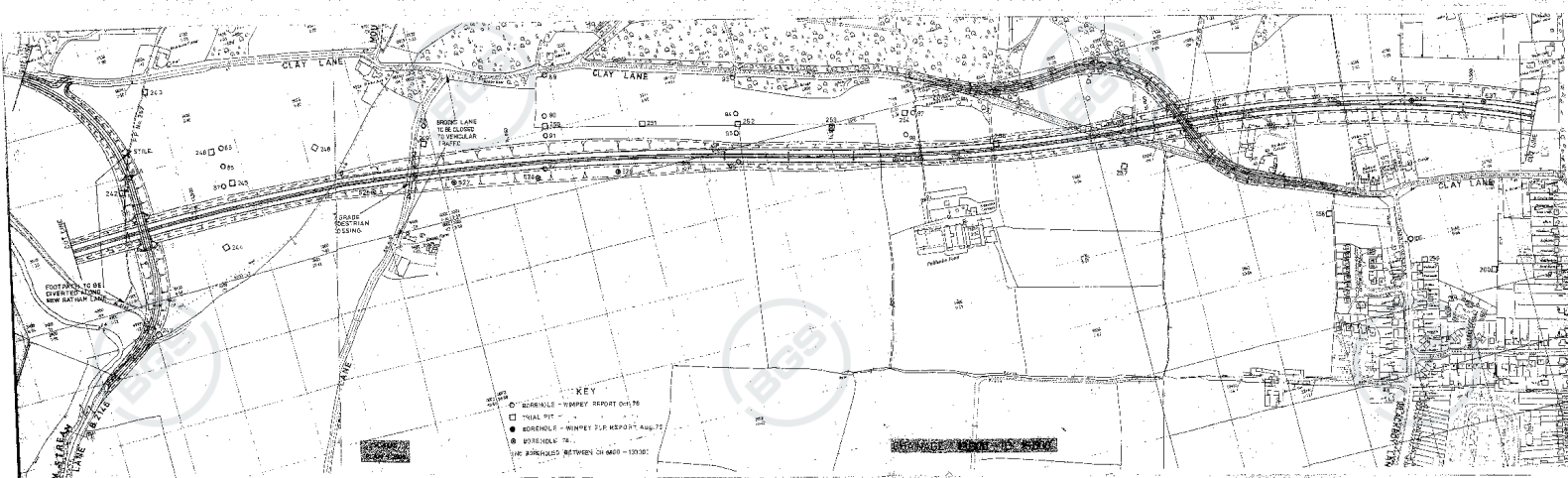
U — undisturbed
D — disturbed
W — water
Dt — tin

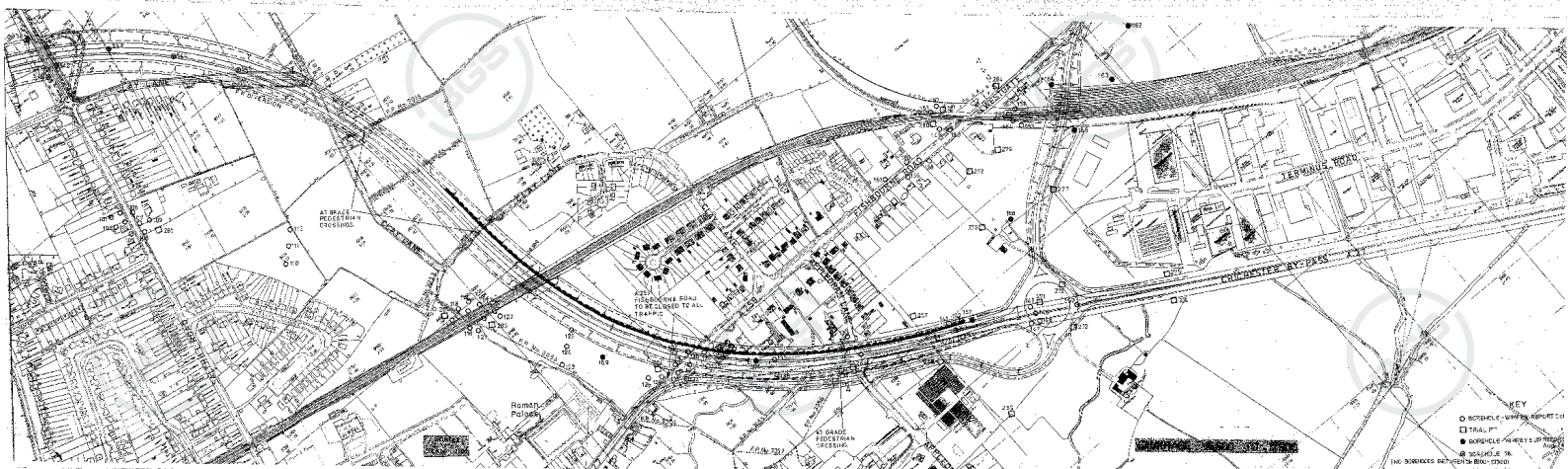
..... Manager.













S. 243.

HAMPSHIRE COUNTY COUNCIL—COUNTY ROADS LABORATORY

BORING RECORD

Copies to:
The County Surveyor.

Division S.E.R.C.U.

Road No. A27

Location HAVANT TO CHICHESTER

Sheet No. 2 of 3

BORE HOLE 506

Lab. No.

Date Sampled

Date Received in Lab.

Ground Level 10.986

Formation Level

Position

Cut or fill

} 28.30/10/78

O.D. Level	Depth	Sample Type	Depth	Description
	m			
	7.0			
	7.25	U100	7.0-7.5	Very stiff dark grey fissured silty CLAY
	7.5			
	7.75			
	8.0			
	8.25			
	8.50			
	8.75	U100	8.5-8.9	
	9.0			
	9.25			
	9.50			
	9.75			
	10.0			
	10.25	U100	10.0-10.5	— with occasional mudstone bands from 10 metres.
	10.5			
	10.75			
	11.0			
	11.25			
	11.5			
	11.75	U100	11.5-12.0	
	12.0			
	12.25			
	12.5			
	12.75			
	13.0			
	13.25	U100	13.0-13.5	
	13.5			
	13.75			
	14.0			

Sample Type:

U — undisturbed
D — disturbed
W — water
Dt — tin

..... Manager.



S. 244.

HAMPSHIRE COUNTY COUNCIL—COUNTY ROADS LABORATORY

Copies to:
The County Surveyor.

BORING RECORD

Division S. E. R. C. U.

Lab. No.

Road No. A 27

Date Sampled

Location HAVANT TO CHICHESTER

Date Received in Lab.

Sheet No. 3 OF 3.

Ground Level 10.986

BORE HOLE 506

Formation Level

Position

Cut or fill

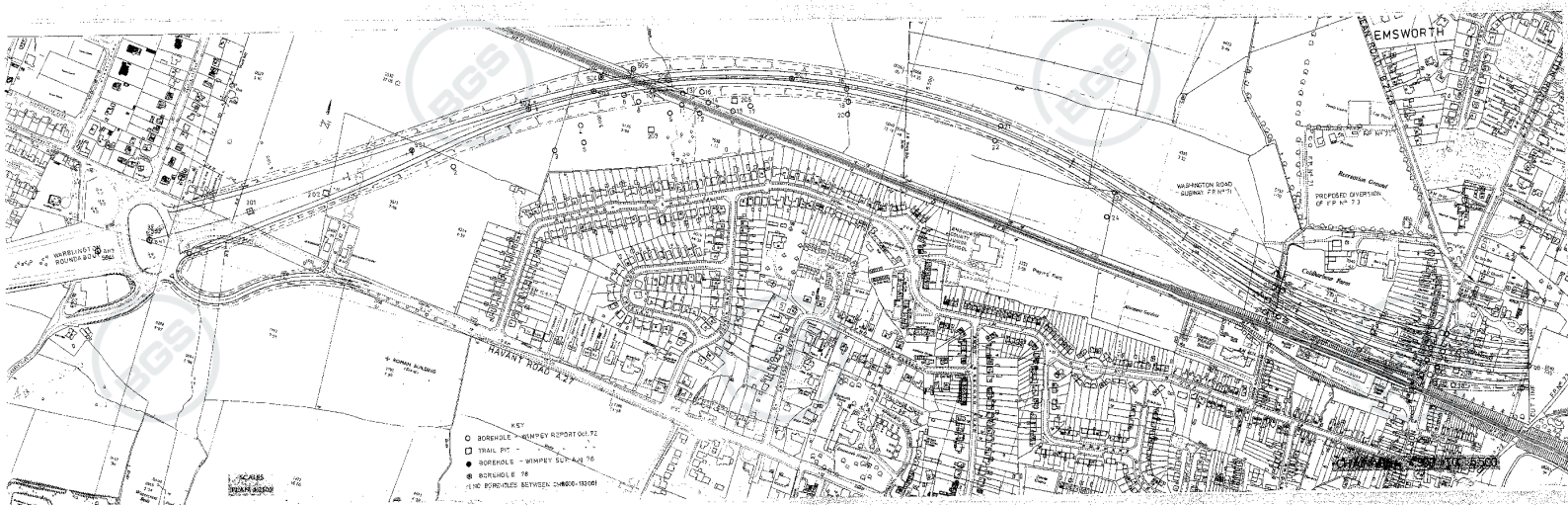
O.D. Level	Depth m	Sample Type	Depth	Description
	14.0			Very stiff dark grey fissured silty CLAY. with occasional mudstone bands.
	14.25			
	14.5			
	14.75	U100	14.5-15.0	
E.O.B.	15.0			WATER
	15.25			
	15.5			
	15.75			
	16.0			
	16.25			
	16.5			
	16.75			
	17.0			
	17.25			
	17.5			
	17.75			
	18.0			
	18.25			
	18.5			
	18.75			
	19.0			
	19.25			
	19.5			
	19.75			
	20.0			
	20.25			
	20.5			
	20.75			
	21.0			

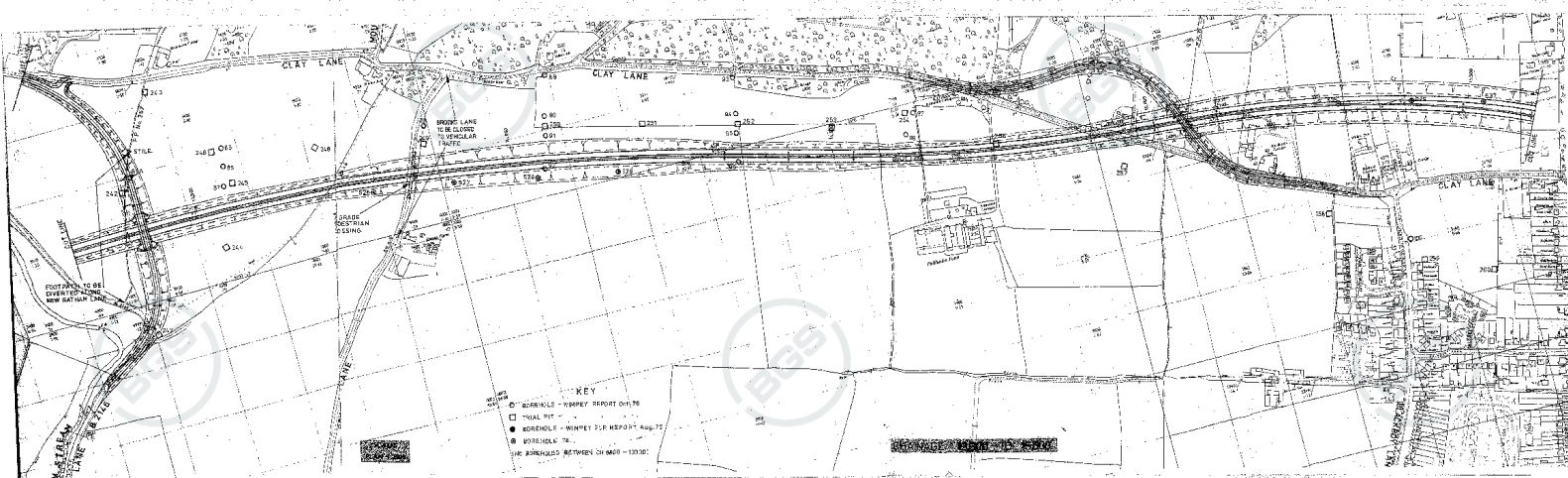
DATE	28/10	30/10	30/10	30/10
TIME	1230	0800	1230	1315
DEPTH TO WATER	1.5	1.7	DRY	DRY
DEPTH CASED	1.7	2.9	4.0	4.0
DEPTH OF HOLE	2.2	3.0	8.9	8.9

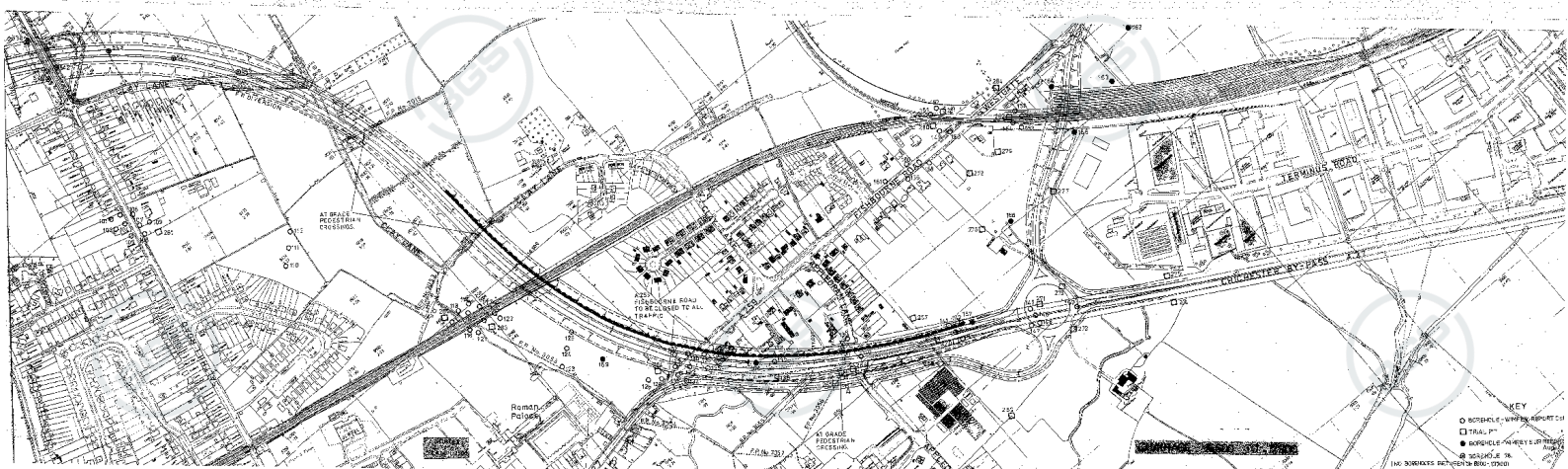
Sample Type:

U — undisturbed
D — disturbed
W — water
Dt — tin

..... Manager.









S. 242.

HAMPSHIRE COUNTY COUNCIL—COUNTY ROADS LABORATORY

Copies to:

The County Surveyor.

BORING RECORD
200mm. DIAMETER

Division S.E.R.C.U. PERCUSSION BORING

Lab. No.

Road No. A 27

Date Sampled

Location HAVANT TO CHICHESTER

Date Received in Lab.

Sheet No. 1 OF 3

Ground Level 10.986

BORE HOLE 506

Formation Level

Position

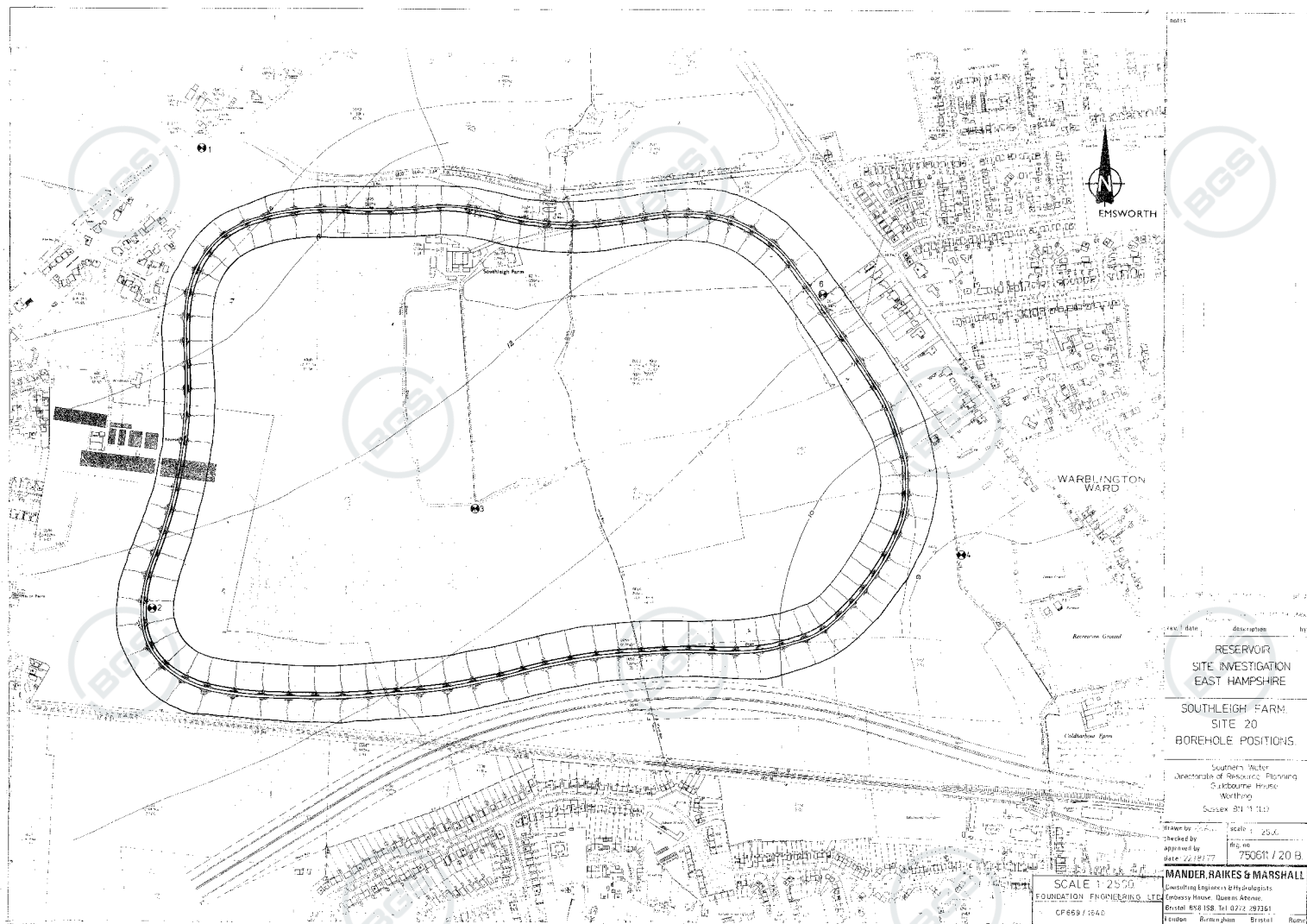
Cut or fill

O.D. Level	Depth	Sample Type	Depth	Description
0.3	m 0.25			TOP SOIL
	0.5			Firm to stiff orange grey brown mottled: silty CLAY with some f.m gravel.
	0.75			
	1.0			
	1.25			
1.5	1.5	U 100	1.4-1.7	
	1.75	D	1.6-2.0	Dense orange brown f.m.c clayey sandy
	2.0	W	1.7	GRAVEL - becoming very loose from 2.0m.
	2.25	S.P.T. N=10	2.5	
	2.5	D	2.0-3.0	
	2.75	S.P.T. N=20	3.0	
	3.0			
	3.25			
3.4	3.5			Medium dense grey brown very gravelly clayey fine SAND.
3.8	3.75			
	4.0	S.P.T. N=11	4.2	Firm grey sandy CLAY with many large flints
4.4	4.25			
	4.5			
	4.75			Stiff dark grey silty CLAY with silty fine sand laminations
	5.0	U 100	5.0-5.5	
	5.25			
	5.5			
	5.75			
	6.0			-becoming very stiff and fissured
	6.25	U 100	6.0-6.5	
	6.5			
	6.75			
	7.0			

Sample Type:

U — undisturbed
D — disturbed
W — water
Dt — tin

..... Manager.





RECORD OF BOREHOLE No: 20/6

Location : HAMPSHIRE RESERVOIRS III
SITE 20

SHEET 1... OF 4.....

Contract No. : CF 669/1640

Borehole Dia : 150 mm

Type of Boring : Cable Percussion

Casing : 150mm to 9.00m

Date (started) : 26. 10. 77

Ground Level : +10.15m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m.O.D. Thickness	
26.10.77			0.20 - 0.50 (N = 18)	B	1		(10.15) 9.95	0.20 TOPSOIL
0.20								
0.40								
0.60								
0.80			0.80 - 1.15	U	2		9.35	0.60 Medium dense c.m.f. siliceous GRAVEL
1.00						x x		
1.20						x x		
1.40			1.40	U	3	x x	8.70	0.60 Soft mottled brown and grey fine sandy SILT.
1.60			1.45 - 1.85	U	4			
1.80								
2.00			2.05	U	5			
2.20			2.10 - 2.50	U	6			
2.40								
2.60			2.70	U	7			
2.80			3.10 - 3.50	U	8			
3.00								
3.20								
3.40								
3.60			3.70	U	9			
3.80			3.75 - 4.15	U	10			
4.00								
4.20			4.35	U	11			
4.40			4.40 - 4.80	U	12			
4.60								
4.80								
5.00			5.00	U	13			
5.20			5.05 - 5.45	U	14			
5.40								
5.60			5.65	U	15			
5.80			5.70 - 6.10	U	16			
6.00								
6.20			6.30	U	17			
6.40			6.25 - 6.75	U	18			
6.60								
6.80			6.95	U	19			
7.00			7.00 - 7.40	U	20			
7.20								
7.40			7.60	U	21			
7.60			7.65 - 8.05	U	22			
7.80								
8.00			8.25	U	23			
8.20			8.20 - 8.60	U	24			
8.40								
8.60			8.90	U	25			
8.80			8.95 - 9.35	U	26			
9.00								
9.20								
9.40			9.55	U	27			
9.60			9.60 - 10.00	U	28			
9.80								
10.00								

REMARKS: Seepage at 2.80m. water rose 0.2m in 20min.

SCALE 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/6

Location : HAMPSHIRE RESERVOIRS III

SHEET 2 OF 4

Contract No. : SITE 20

Type of Boring : CF 669/1640

Borehole Dia : 150 mm

Date (started) : Cable Percussion

Casing : 150 mm to 9.00 m

Date (started) : 26.10.77

Ground Level : +10.15 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m.O.D	
0.20			10.20	D	29		(0.15)	
0.40			10.25-10.65	U	30	x		
0.60								
0.80			10.85	D	31			
1.00			10.90-11.30	U	32	x		
1.20								
1.40			11.50	D	33	x x		
1.60			11.55-11.95	U	34	x x		
1.80								
2.00			12.15	D	35			
2.20			12.20-12.50	U	36	x		
2.40								
2.60	26.10.77							
2.80	1800	7.50 Dry	12.80	D	37	x		
3.00	27.10.77		12.85-13.25	U	38	x x		
3.20	0800	7.50 Dry						
3.40			13.45	D	39	x x		
3.60			13.50-13.90	U	40	x x		
3.80								
4.00			14.10	D	41	x		
4.20			14.15-14.55	U	42	x		
4.40								
4.60			14.75	D	43	x		
4.80			14.80-15.20	U	44	x x		
5.00	27.10.77							
5.20	10.30	15.40 Dry	15.40	D	45	x x		
5.40	28.10.77		15.45-15.80	U	46	x x		
5.60	0800	9.00 Dry						
5.80								
6.00			16.05	D	47	x		
6.20			16.10-16.45	U	48	x		
6.40								
6.60			16.70	D	49	x x		
6.80			16.75-17.10	U	50	x x		
7.00								
7.20			17.35	D	51	x		
7.40			17.40-17.75	U	52	x		
7.60								
7.80			18.00	D	53	x		
8.00			18.05-18.40	U	54	x		
8.20								
8.40								
8.60			18.65	D	55	x x		
8.80			18.70-19.10	U	56	x x		
9.00								
9.20			19.30	D	57	x		
9.40			19.35-19.75	U	58	x		
9.60								
9.80			19.95	D	59	x x	(-9.85)	
10.00								

REMARKS: API thread on U4 hammer broke off at 10.30 on 27.10.77
Unable to recover hammer so moved rig slightly 0.6 m.
and rebored to 15.40m

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/2

Location : HAMPSHIRE RESERVOIRS III
Contract No. : CF 669/1640
Type of Boring : Cable Percussion
Date (started) : 31-10-77

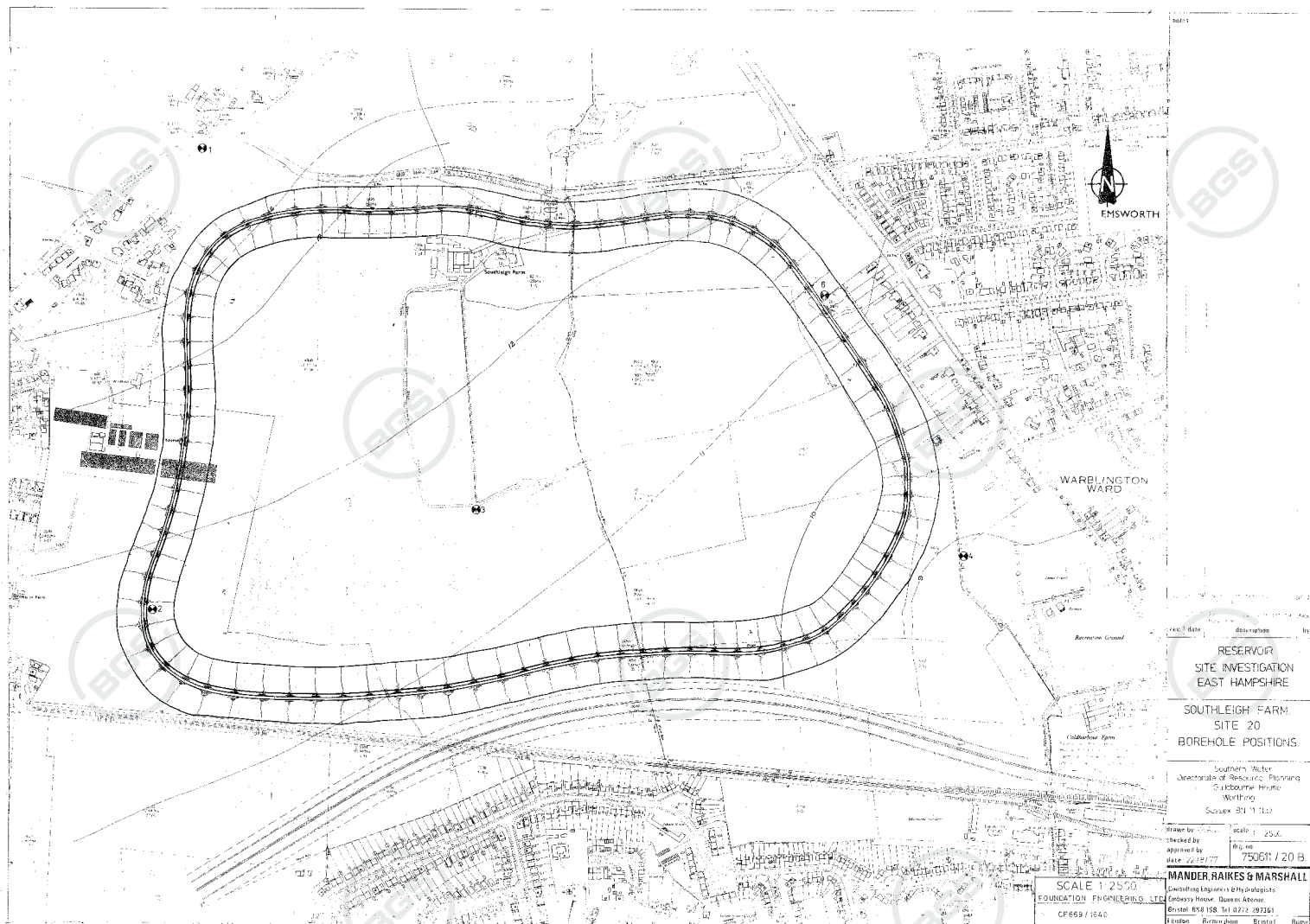
SHEET OF
Borehole Dia : 150 mm
Casing : 150mm to 24.95m
Ground Level : +12.05 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D. Thickness	
1-11-77	13.00	7.60	18.20				-7.95	
0.20			20.45	D	59	x		Medium dense grey very silty fine SAND becoming clayey with shell fragments
0.40			20.50	D	60	x x		
0.60	12-11-77	21.00	(N: 36)					
0.80	13.00	8.50						
1.00	14.00	4.70	21.00	D	61	x	-8.95	
1.20						x x		
1.40			21.50	D	62	x x		
1.60			(N: 30)			x x		Grey clayey fine sandy SILT with shell fragments.
1.80			22.00	D	63	x x		
2.00						x x		
2.20			22.50	D	64	x x	-10.45	
2.40			(N: 32)					
2.60			23.00-23.30	U	65	x		
2.80								
3.00			23.60	D	66			
3.20			23.65-24.05	U	67	x x		
3.40								
3.60			24.25	D	68			
3.80			24.30-24.60	U	69			
4.00								
4.20			24.90	D	70	x		
4.40			25.00-25.30	U	71			
4.60								
4.80			25.60	D	72	x x		Stiff becoming hard grey fine sandy very silty CLAY with shell fragments with layers of clayey silt.
5.00			25.65-26.05	U	73	x x	6.40 +	
5.20								
5.40			26.25	D	74			
5.60			26.30-26.70	U	75	x		
5.80								
6.00			26.90	D	76			
6.20			26.95-27.35	U	77	x x		
6.40								
6.60			27.55	D	78	x x		
6.80			27.60-27.90	U	79			
7.00								
7.20			28.20	D	80	x		
7.40			28.30-28.60	U	81	x		
7.60								
7.80			28.90	D	82	x x	-16.85	
8.00	2-11-77	18.00						
8.20		24.95	12.10					
8.40								
8.60								
8.80								
9.00								
9.20								
9.40								
9.60								
9.80								
10.00								

REMARKS: Rising head permeability test carried out at 21.00m.
 $k = 6 \times 10^{-4}$ cm/s approx.
Piezometer installed tip depth 21.00m. with response zone from 20.35 - 21.35m.

SCALE. 1 : 50

Foundation Engineering Ltd.





RECORD OF BOREHOLE No: 20/3

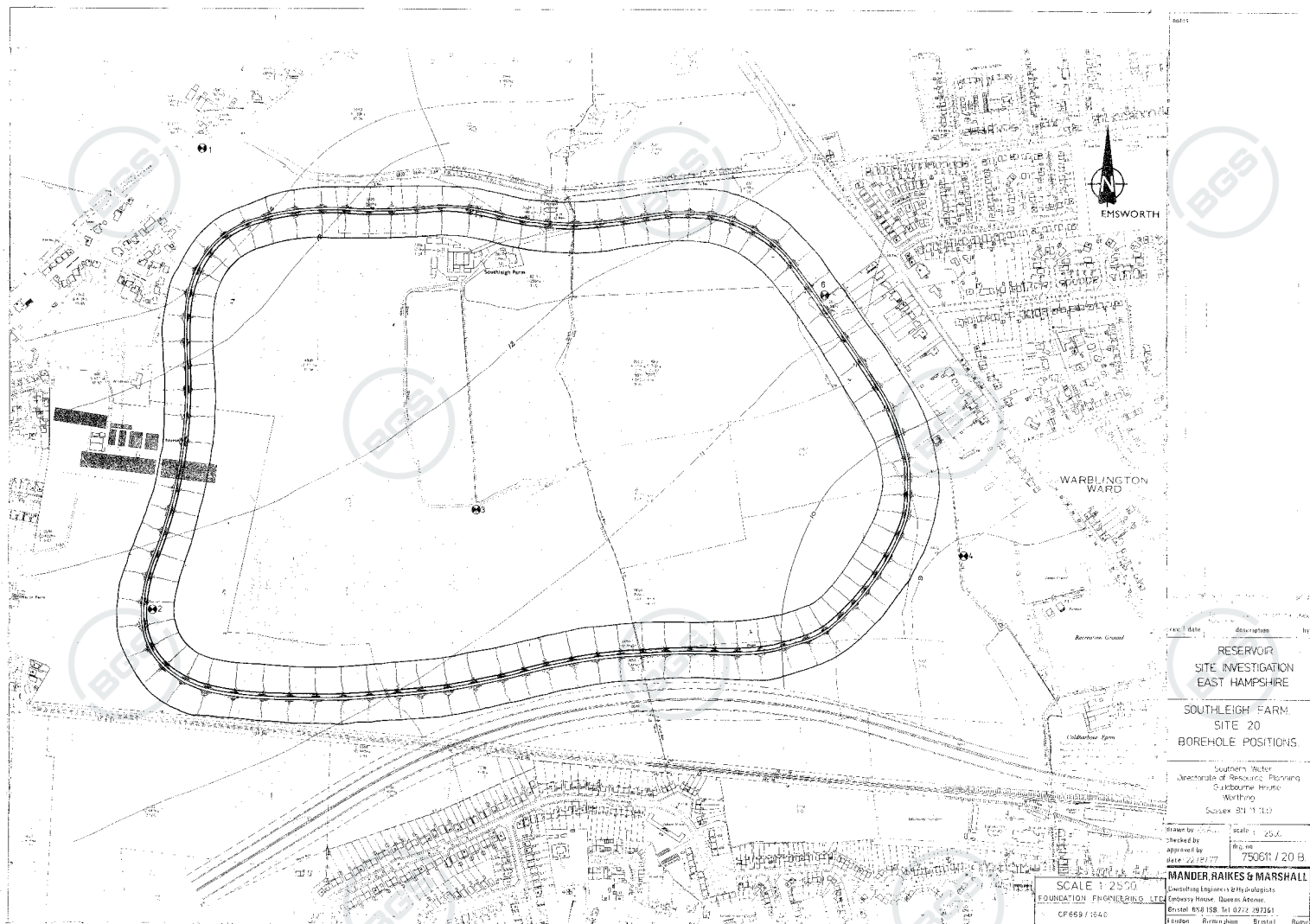
Location : HAMPSHIRE RESERVOIRS III SHEET .1.... OF .1.....
Contract No. : CF 669/1640 Borehole Dia : 150 mm
Type of Boring : Cable Percussion Casing : 150 mm
Date (started) : 31. 10. 77 Ground Level : +12. 35 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA	
			Depth	Type	No.	Legend	Level m O.D.	Thickness	
31.10.77							(12.35)		
0.20								0.50	Black stony TOPSOIL.
0.40			0.50 - 0.90	U	1		11.85		
0.60						x			
0.80						x x		1.20	Stiff light brown/orange mottled silty CLAY with organic smell.
1.00			1.10	D	2				
1.20			1.10 - 1.50	U	3				
1.40						x			
1.60			1.70	D	4		10.65		
1.80			1.70 - 2.05	U	5				
2.00						x			
2.20			2.30	D	6			1.20	Stiff light brown and dark red silty CLAY with much angular medium flints and occasional chalk
2.40			2.30 - 2.50	U	7				
2.60						x x			
2.80			2.90	D	8		9.45		
3.00			2.90	U*B	9				
3.20						x		0.80	Soft to firm light brown creamy coloured silty CLAY with very much fine weathered chalk; "putty chalk" Some flint present
3.40			3.50	D	10				
3.60			3.50 - 3.90	U	11		8.65		
3.80						x			
4.00	31.10.77							0.40	Firm light brown clayey silty fine SAND/sandy SILT. Clay content decreasing with depth.
4.20	18.00	4.10	4.10	D	12		9.10		
4.40	1.11.77	4.10	4.10	U*D	13				
4.60	08.00					x		1.20	Stiff grey and dark brown silty CLAY with fine medium angular calcareous gravel and occasional silt lenses.
4.80			4.70 - 5.00	U	14				
5.00						x x			
5.20			5.30	D	15		7.05		
5.40			5.30 - 5.70	U	16				
5.60						x			
5.80	1.11.77	4.10	6.00	D	17		6.25	0.70 +	Stiff grey silty fissured CLAY with brown silt on the fissures. A few very fine gypsum crystals present.
6.00						x x			
6.20						Eo.B.			
6.40									
6.60									
6.80									
7.00									
7.20									
7.40									
7.60									
7.80									
8.00									
8.20									
8.40									
8.60									
8.80									
9.00									
9.20									
9.40									
9.60									
9.80									
10.00									

REMARKS: Water seepage at 4.10m. Water made 0.05m in 20 minutes
U*B, D U4 failed bulk, disturbed sample taken.
Piezometer installed in borehole, tip depth 4.85m. and response zone from 3.50 - 5.50m.

SCALE, 1 : 50

Foundation Engineering Ltd.





RECORD OF BOREHOLE No: 20/2

Location : HAMPSHIRE RESERVOIRS III

SHEET 1 OF 3

Contract No. : SITE 20

Borehole Dia : 150 mm

Type of Boring : CF 669/1640

Casing : 150 mm to 24.95 m

Date (started) : Cable Percussion

Ground Level : +12.05 m O.D.

Date (started) : 31.10.77

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D. Thickness	
31.10.77 0800			0.20-0.70	U	1	x	(12.05)	0.95 Firm brown silty CLAY with rootlets.
0.20						x		
0.40						x		
0.60						x		2.25 Medium dense brown slightly clayey silty sandy c.m.f. siliceous GRAVEL.
0.80			0.90	D	2	x	11.10	
1.00			1.00-1.40	U	3	x		
1.20						x		
1.40						x		
1.60			1.60	D	4	x		
1.80			1.75	B	5	x		
2.00			(2.28)			x		
2.20			2.25	D	6	x		
2.40						x		
2.60			2.75	B	7	x		1.30 Medium dense light brown clayey silty SAND
2.80			(2.24)			x		
3.00						x		
3.20			3.25	U	8	x	8.75	
3.40			3.35-3.75	U	9	x		
3.60						x		0.15 Med dense grey clayey silty SAND
3.80			3.90	D	10	x	7.55	
4.00			4.00-4.40	U	11	x	7.30	
4.20						x		0.20 Dr. grey clayey silty GRAVEL
4.40			4.60	D	12	x	7.10	
4.60			4.70-4.95	B	13	x		14.25 Stiff dark grey fissured very silty slightly sandy CLAY with shell fragments.
4.80			4.95-5.25	U	14	x		
5.00						x		
5.20						x		
5.40			5.55	D	15	x		
5.60			5.60-6.00	U	16	x		
5.80						x		
6.00						x		
6.20			6.25	D	17	x		
6.40			6.30-6.70	U	18	x		
6.60						x		(2.05)
6.80			6.90	D	19	x		
7.00	1300	6.30 Dry	7.00-7.40	U	20	x		
7.20						x		
7.40			7.60	D	21	x		
7.60			7.65-8.05	U	22	x		
7.80						x		
8.00			8.25	D	23	x		
8.20			8.30-8.70	U	24	x		
8.40						x		
8.60			8.90	D	25	x		
8.80			8.95-9.25	U	26	x		
9.00						x		
9.20						x		
9.40			9.55	D	27	x		
9.60						x		
9.80						x		
10.00						x		

REMARKS:

Seepage at 3.20m water rose to 2.85m after 20min.
Piezometer details - See sheet 3.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/2

Location : HAMPSHIRE RESERVOIRS III

SHEET 2 OF 3

Contract No. : SITE 20

Type of Boring : Cable Percussion

Date (started) : 31-10-77

Borehole Dia : 150 mm

Casing : 150 mm to 24.95m

Ground Level : +12.05 m O.D.

0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
2.20
2.40
2.60
2.80
3.00
3.20
3.40
3.60
3.80
4.00
4.20
4.40
4.60
4.80
5.00
5.20
5.40
5.60
5.80
6.00
6.20
6.40
6.60
6.80
7.00
7.20
7.40
7.60
7.80
8.00
8.20
8.40
8.60
8.80
9.00
9.20
9.40
9.60
9.80
10.00

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	
			10.00-10.40	U	28		(2.05)	
			10.60	D	29	x		
			10.65-11.05	U	30			
			11.25	D	31			
			11.30-11.70	U	32			
			11.90	D	33	x x		
			12.00-12.40	U	34			
			12.60	D	35			
			12.65-12.05	U	36	x		
			13.25	D	37			
			13.30-13.70	U	38			
			13.90	D	39			
			13.95-14.35	U	40	x x		
31-10-77 1800	7.60	Dry	14.55	D	41			Very stiff grey fissured, very silty slightly sandy CLAY with shell fragments and fine layers of fine silty sand. Claystone at 19.10m.
1-11-77 0800	7.60	Dry	14.60-15.00	U	42			
			15.20	D	43			
			15.25-15.65	U	44			
			15.85	D	45	x x		
			15.90-16.25	U	46			
			16.50	D	47			
			16.55-16.95	U	48			
			17.15	D	49			
			17.20-17.60	U	50			
			17.80	D	51	x x		
			17.85-18.25	U	52			
			18.45	D	53			
			18.50-18.80	U	54			
			19.10	D	55			
			19.20-19.60	U	56		-7.15	
			19.80	B	57			
			19.85-20.25	U	60		-7.80	
							(7.95)	
								Stiff grey silty CLAY with black pebbles.
								See sheet 3.

REMARKS:

Seepage noted at 19.80m. Water level rose to 18.20m. after 20min.
Piezometer details - See sheet 3.

SCALE 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20 / 1

Location : HAMPSHIRE RESERVOIRS III

Contract No. : CF 659 / 1640

Type of Boring : Cable Percussion

Date (started) : 15.11.77

SHEET 1 OF 3

Borehole Dia : 200 mm to 4.70 m

Casing : 200 mm to 4.70 m

Ground Level : +14.65 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	
15.11.77			0.30 - 0.75	U	1		14.65	Firm brown silty sandy CLAY - TOPSOIL
0.20								
0.40								
0.60								
0.80								
1.00			1.00	D	2		13.80	Dense dark brown slightly clayey silty sandy siliceous c.m.f. GRAVEL becoming predominantly coarse gravel from 2.00 - 2.75 m.
1.20			(2.29)	B	3			
1.40								
1.60			1.75	D	4			
1.80			(2.00)	B	5			
2.00			(2.64)					
2.20								
2.40			2.75	D	6			
2.60								
2.80			3.00	B	7			
3.00			(2.32)					
3.20								Soft grey / brown becoming grey fine sandy clayey SILT becoming stiff with gypsum crystals from approx 6.40 m with shell fragments from approx. 7.00 m and with occasional hard claystones and friable siltstones from 8.00 m approx.
3.40			3.75	D	8			
3.60								
3.80			4.00	B	9			
4.00			(2.33)					
4.20								
4.40			4.50 - 4.90	U	10		10.20	
4.60								
4.80								
5.00			5.10	D	11			
5.20			5.15 - 5.55	U	12			Several more clayey bands throughout stratum.
5.40								
5.60			5.75	D	13			
5.80			5.80 - 6.20	U	14			
6.00								
6.20								
6.40			6.40	D	15			
6.60			6.45 - 6.80	U	16			
6.80								
7.00			7.05	D	17			
7.20			7.10 - 7.50	U	18			Band of hard sandy very silty CLAY / clayey SILT with shell fragments at 8.35 m.
7.40								
7.60			7.70	D	19			
7.80			7.75 - 8.05	U	20			
8.00								
8.20			8.35	D	21			
8.40			8.40 - 8.75	U	22			
8.60								
8.80								
9.00			9.00	D	23			
9.20			9.05	D	24			
9.40								
9.60			9.50 - 9.90	U	25			
9.80								
10.00								

REMARKS: Piezometer details - See sheet 2.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/1

Location : HAMPSHIRE RESERVOIRS III
SITE 20

Contract No. : CF 669/1640

Type of Boring : Cable Percussion

Date (started) : 15.11.77

SHEET 2 OF 3

Borehole Dia : 200mm to 4.70m
150mm to 30.00m

Casing : 200mm to 4.70m
150mm to 17.50m

Ground Level : +14.65m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA			DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	Thickness	
0.20			10.10	D	26	x x	4.65		
0.40			10.20-10.60	U	27	x x x			
0.60						x x x			
0.80			10.80	D	28	x x x			
1.00			10.85-11.25	U	29	x x x			
1.20						x x x			
1.40			11.45	D	30	x x x			
1.60			11.50-11.90	U	31	x x x			
1.80						x x x			
2.00			12.10	D	32	x x x			
2.20			12.15-12.45	U	33	x x x			
2.40						x x x			
2.60			12.75	D	34	x x x			
2.80			12.80-13.20	U	35	x x x			
3.00						x x x			
3.20			13.40	D	36	x x			
3.40			13.45-13.85	U	37	x x			
3.60						x x			
3.80						x x			
4.00	15.11.77	11.10	14.05	D	38	x x			
4.20	12.35		14.10	U * D	39	x x			
4.40	12.35	1.80	14.50	D	40	x x			
4.60						x x			
4.80						x x			
5.00			15.30	B	41	x x			
5.20			15.35-15.70	U	42	x x			
5.40						x x			
5.60			15.95	D	43	x x			
5.80			16.00-16.40	U	44	x x			
6.00						x x			
6.20			16.60	D	45	x x			
6.40			16.70-17.05	U	46	x x			
6.60						x x			
6.80			17.30	D	47	x x			
7.00			17.35-17.65	U	48	x x			
7.20						x x			
7.40			17.95	D	49	x x			
7.60			18.00-18.40	U	50	x x			
7.80						x x			
8.00			18.60	D	51	x x			
8.20			18.70-19.00	U	52	x x			
8.40						x x			
8.60			19.30	D	53	x x			
8.80			19.35-19.65	U	54	x x			
9.00						x x			
9.20			19.95	D	55	x x			
9.40						x x			
9.60						x x			
9.80						x x			
10.00						x x			

REMARKS: Water sample taken on 16.11.77 at 0800

U * D = U4 failed disturbed sample taken.

Piezometer installed tip depth 13.00m and response zone 6.00 - 15.00m.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/1

Location : HAMPSHIRE RESERVOIRS III

SHEET 3 OF 3

Contract No. : CF 669/1640

Borehole Dia : 200 mm to 4.70 m
150 mm to 30.00 m

Type of Boring : Cable Percussion

Casing : 200 mm to 4.70 m

Date (started) : 15.11.77

Ground Level : 150 mm to 17.50 m
+14.65 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m.O.D.	
0.20			20.00-20.35	U	56		-5.35	
0.40								
0.60			20.60	D	57	x		
0.80			20.65-21.00	U	58			Clay appears fissured from 20.60 m.
1.00								
1.20			21.25	D	59			
1.40			21.30-21.60	U	60	x x		
1.60	16.11.77							
1.80	18.00	13.88	21.90	D	61			
2.00			22.00-22.40	U	62			Hard grey very silty laminated CLAY with shell fragments, gypsum crystals small silty sand lenses and thin sandy layers
2.20	17.11.77	13.88					5.90	
2.40	08.00							
2.60			22.60	D	63	x		
2.80			22.65-23.05	U	64			
3.00								
3.20			23.25	D	65	x x		
3.40			23.35-23.75	U	66	x x		
3.60								
3.80			23.95	D	67			
4.00			24.00-24.40	U	68			
4.20								
4.40			24.60	D	69		-9.85	
4.60			24.70-25.05	U	70			
4.80								
5.00								
5.20			25.30	D	71			
5.40			25.40-25.75	U	72			
5.60								
5.80	13.00	17.50	26.00	D	73	x x		
6.00	14.00	17.50	26.10-26.50	U	74			
6.20		18.00						
6.40			26.70	D	75			
6.60			26.75-27.15	U	76	x	5.50	Hard grey silty slightly fissured CLAY with a shelly band between 27.25 m. and 28.00 m. approx.
6.80							+	
7.00			27.35	D	77			
7.20			27.40-27.70	U	78			
7.40								
7.60						x x		
7.80			28.00	D	79			
8.00			28.10-28.40	U	80			
8.20								
8.40								
8.60			28.70	D	81	x		
8.80			28.75-29.10	U	82			
9.00								
9.20			29.35	D	83			
9.40			29.40-29.70	U	84	x x		
9.60	17.11.77							
9.80	18.00	17.50	30.00	D	85		-15.35	
10.00		21.60						

REMARKS: Piezometer details - See sheet 2.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/4

Location : HAMPSHIRE RESERVOIRS III

SHEET 3 OF 4

Contract No. : CF 669/1640

Borehole Dia : 150 mm

Type of Boring : Cable Percussion

Casing : 150 mm to 27.00 m

Date (started) : 4.11.77

Ground Level : +7.15 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA			DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	Thickness	
7.11.77			20.15	D	61		(-12.85)		As above
0.20			20.20-20.60	U	62				
0.40									
0.60			20.80	D	63				
0.80			20.85-21.25	U	64	x x			
1.00									
1.20			21.45	D	65				
1.40			21.50-21.90	U	66				
1.60									
1.80			22.10	D	67				
2.00			22.15-22.55	U	68	x			
2.20									
2.40			22.75	D	69				
2.60			22.80-23.20	U	70				
2.80									
3.00			23.40	D	71				
3.20			23.45-23.85	U	72	x x			
3.40									
3.60			24.05	D	73	x x x			
3.80			24.10-24.50	U	74				
4.00									
4.20			24.70	D	75				29.85 + Claystone at 26.05m
4.40	7.11.77		24.75-25.15	U	76	x			
4.60	18.00	18.40 Dry							
4.80	8.11.77	18.40 1.60	25.35	D	77				
5.00	08.00		25.40-25.80	U	78				
5.20									
5.40			26.00	D	79	x x			
5.60			26.05-26.25	U	80				
5.80									
6.00			26.65	D	81				
6.20			26.70-27.10	U	82	x			
6.40									
6.60			27.30	D	83	x x x			
6.80			27.35-27.75	U	84				
7.00									
7.20			27.95	D	85	x x			
7.40			28.00-28.40	U	86				
7.60									
7.80			28.60	D	87				
8.00	13.00	27.00 26.00	28.65-29.05	U	88				
8.20	14.00	23.60							
8.40			29.25	D	89				(22.85)
8.60			29.30-29.70	U	90				
8.80									
9.00			29.90	D	91				
9.20			29.95-30.25	U	92				
9.40									
9.60									
9.80									
10.00									

REMARKS: Piezometer Details - See Sheet 4.

SCALE: 1:50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/4

Location : HAMPSHIRE RESERVOIRS III
SITE 20

Contract No. : CF 669 / 1460

Type of Boring : Cable Percussion

Date (started) : 4 . 11 . 77

SHEET . 4 . . OF . 4

Borehole Dia : 150 mm

Casing : 150 mm to 27.00 m

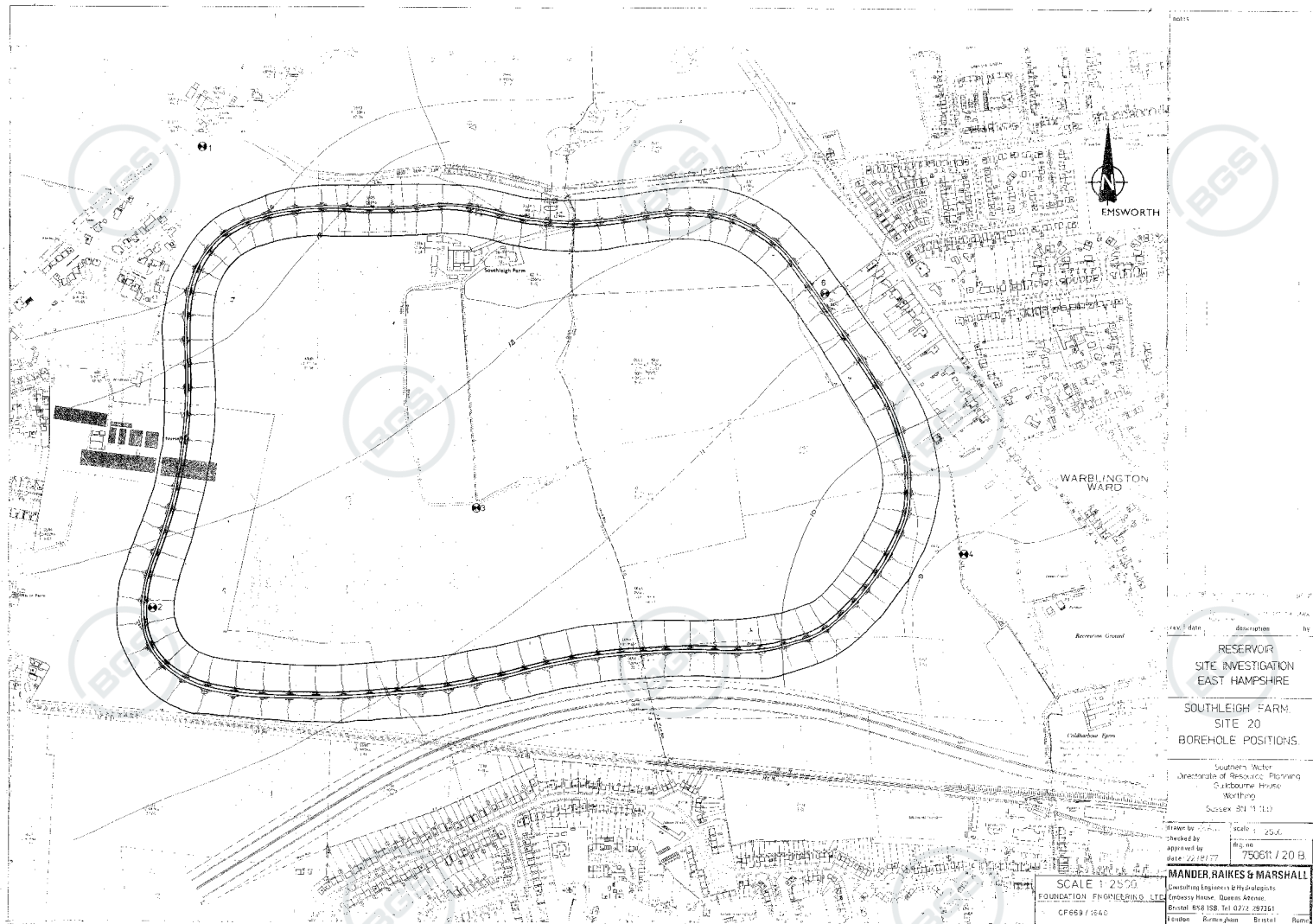
Ground Level : +7.15 m O.D.

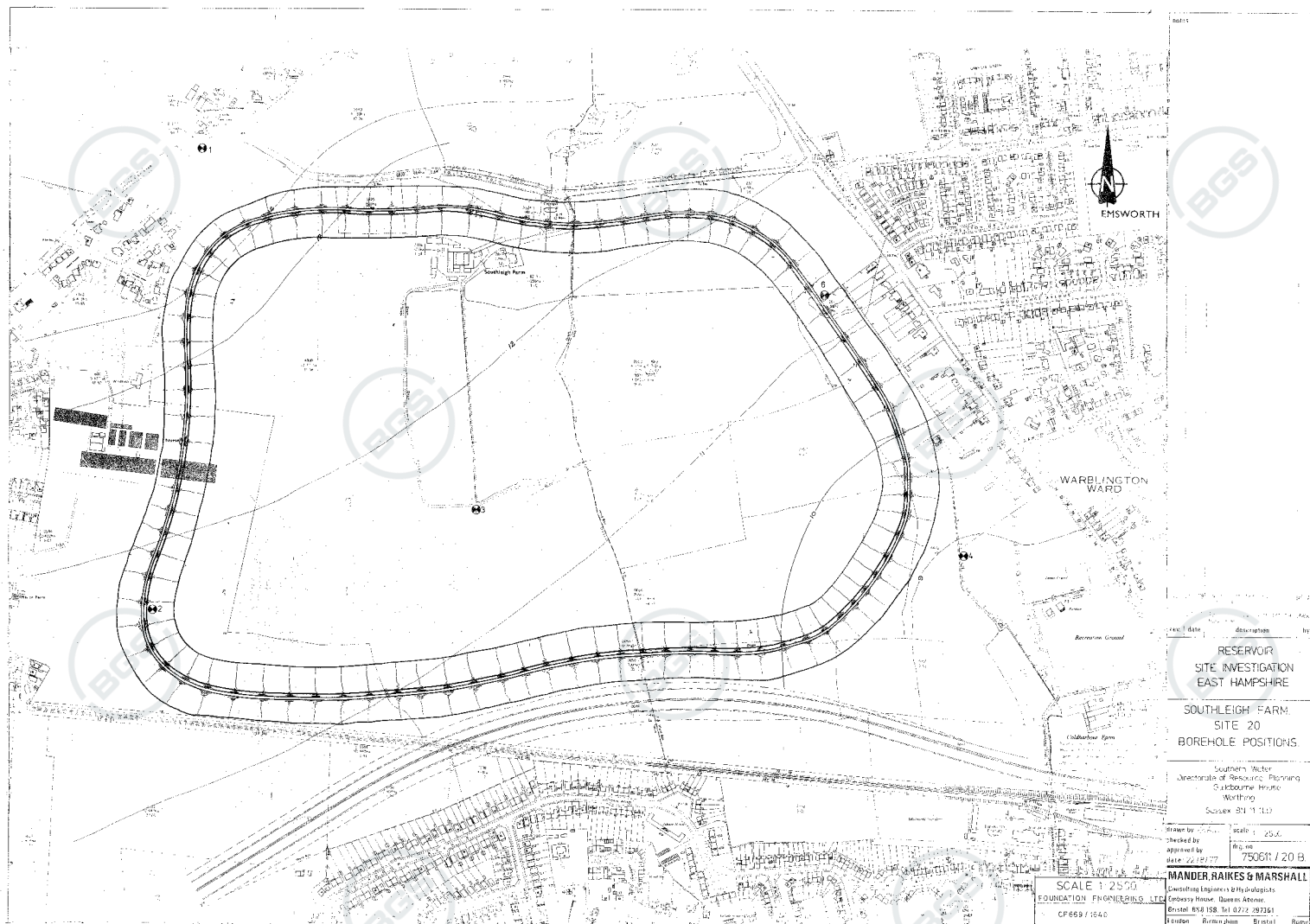
Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m.O.D	
0.20							(22.85)	As above.
0.40			30.55	D	93	x		
0.60			30.60-31.00	U	94	x		
0.80								
1.00			31.20	D	95	x		
1.20			31.25-31.55	U	96	x x		
1.40								
1.60			31.85	D	97	x		
1.80			31.90-32.20	U	98	x		29.85
2.00								+
2.20			32.50	D	99	x		
2.40			32.55-32.85	U	100	x x		
2.60								
2.80								
3.00	8.11.77		33.15	D	101	x x		
3.20	18.00	27.00					-26.00	
3.40		29.00						
3.60								
3.80								
4.00								
4.20								
4.40								
4.60								
4.80								
5.00								
5.20								
5.40								
5.60								
5.80								
6.00								
6.20								
6.40								
6.60								
6.80								
7.00								
7.20								
7.40								
7.60								
7.80								
8.00								
8.20								
8.40								
8.60								
8.80								
9.00								
9.20								
9.40								
9.60								
9.80								
10.00								

REMARKS: Piezometer installed to depth 32.50m with response zone from 8.00m to 33.00m.

SCALE: 1 : 50

Foundation Engineering Ltd.







RECORD OF BOREHOLE No: 20/4

Location : HAMPSHIRE RESERVOIRS III
SITE 20

SHEET...1...OF...4...

Contract No. : CF 669/1640

Borehole Dia : 150 mm

Type of Boring : Cable Percussion

Casing : 150 mm to 27.00 m

Date (started) : 4.11.77

Ground Level : +7.15m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA			DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m O.D.	Thickness	
0800 4.11.77			0.20 - 0.25	U	1		(7.15)	1.30	Firm brown silty CLAY with many gypsum crystals, medium gravel rootlets and occasional black crystals.
0.20									
0.40									
0.60			0.80	D	2				
0.80			0.85 - 1.10	U	3				
1.00									
1.20			1.25	D	4		5.85		
1.40			1.20 - 1.70	U	5				
1.60									
1.80			1.90	D	6				
2.00			2.00	B	7			2.00	Firm to stiff brown and grey very silty CLAY becoming slightly sandy with depth.
2.20									
2.40									
2.60			2.65 - 3.05	U	8				
2.80									
3.00			3.25	D	9		3.85		
3.20			3.20 - 3.70	U	10				
3.40									
3.60									
3.80			3.90	D	11				
4.00			3.95 - 4.35	U	12				
4.20									
4.40									
4.60			4.55	D	13				
4.80			4.60 - 5.00	U	14				
5.00									
5.20			5.20	D	15				
5.40			5.25 - 5.65	U	16				
5.60									
5.80			5.85	D	17				
6.00			5.90 - 6.30	U	18				
6.20									
6.40									
6.60			6.50	D	19		29.85		Stiff grey very silty fissure CLAY with occasional shell fragments and some thin layers and pockets of very silty fine sand and sandy silt.
6.80			6.55 - 6.95	U	20		+		
7.00	3.00	Dry	7.15	D	21				
7.20	3.00	1.60	7.20 - 7.60	U	22				
7.40									
7.60			7.80	D	23				
7.80			7.85 - 8.25	U	24				
8.00									
8.20									
8.40			8.45	D	25				
8.60			8.50 - 8.85	U	26				
8.80									
9.00									
9.20			9.10	D	27				
9.40			9.15 - 9.45	U	28				
9.60									
9.80			9.75	D	29				
10.00			9.80 - 10.20	U	30		(-2.85)		

REMARKS: Piezometer Details - see sheet 4.

SCALE 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20/4

Location : HAMPSHIRE RESERVOIRS III
SITE 20

SHEET ...2... OF ...4....

Contract No. : CF 669/1640

Borehole Dia : 150 mm

Type of Boring : Cable Percussion

Casing : 150 mm to 27.00 m

Date (started) : 4.11.77

Ground Level : +7.15 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA			DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m.O.D.	Thickness	
7.11.77							(-2.85)		As above.
0.20			10.40	D	31				
0.40			10.45-10.85	U	32	x			
0.60									
0.80									
1.00			11.05	D	33				
1.20			11.10-11.45	U	34				
1.40						x x			
1.60			11.70	D	35				
1.80			11.75-12.15	U	36				
2.00						x x			
2.20			12.35	D	37				
2.40			12.40-12.80	U	38				Clay becomes very stiff and laminated around 12.35m.
2.60									
2.80			13.00	D	39				
3.00			13.05-13.45	U	40	x			
3.20									
3.40									
3.60			13.65	D	41				
3.80			13.70-14.10	U	42				
4.00						x x			
4.20			14.30	D	43				
4.40			14.35-14.75	U	44				
4.60									
4.80			14.95	D	45	x		29.85	
5.00			15.00-15.35	U	46			+	
5.20									
5.40			15.60	D	47	x x			
5.60			15.65-15.90	U	48				
5.80									
6.00	13.00	14.80							
6.20	14.00	12.10	16.25	D	49				
6.40			16.30-16.60	U	50	x			
6.60									
6.80			16.90	D	51				
7.00			16.95-17.35	U	52				
7.20						x x			
7.40			17.55	D	53				
7.60			17.60-18.00	U	54				
7.80						x x			
8.00			18.20	D	55	x			
8.20			18.25-18.65	U	56				
8.40									
8.60			18.85	D	57	x			
8.80			18.90-19.30	U	58	x x			
9.00									
9.20			19.50	D	59				
9.40			19.55-19.95	U	60				
9.60									
9.80									
10.00						x	(-12.85)		

REMARKS: Piezometer Details - See sheet 4.

SCALE: 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20 / 6

Location : HAMPSHIRE RESERVOIRS III
Contract No. : CF 669 / 1640
Type of Boring : Cable Percussion
Date (started) : 26. 10. 77

SHEET . 3 . . OF . 4

Borehole Dia : 150 mm
Casing : 150 mm to 9. 00 m
Ground Level : +10. 15m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m. O.D.	
0.20			20.00-20.40	U	60	(-9.85)		
0.40								
0.60			20.60	D	61			
0.80			20.65-21.05	U	62			
1.00								
1.20			21.25	D	63			
1.40			21.20-21.70	U	64			
1.60								
1.80			21.90	D	65			
2.00			22.00-22.40	U	66			Claystone at 21.90m
2.20								
2.40								
2.60			22.60	D	67			
2.80			22.65-23.05	U	68			
3.00								
3.20			23.25	D	69			
3.40			23.20-23.70	U	70			
3.60			23.70	D	71			
3.80			23.90	D	72			
4.00			23.95-24.35	U	73			
4.20								
4.40			24.55	D	74			
4.60			14.60-25.00	U	75			
4.80								
5.00	13.00	9.00	25.20	D	76			
5.20	14.00		25.25-25.60	U	77			
5.40								
5.60			25.85	D	78			
5.80			25.90-26.30	U	79			
6.00								
6.20								
6.40			26.50	D	80			
6.60			26.55-26.95	U	81			
6.80								
7.00			27.15	D	82			
7.20			27.20-27.60	U	83			
7.40								
7.60			27.80	D	84			
7.80			27.85-28.25	U	85			
8.00								
8.20			28.45	D	86			
8.40			28.50-28.90	U	87			
8.60								
8.80								
9.00			29.10	D	88			
9.20			29.15-29.55	U	89			
9.40								
9.60			29.75	D	90			
9.80			29.80-30.20	U	91			
10.00								

REMARKS:

SCALE 1 : 50

Foundation Engineering Ltd.



RECORD OF BOREHOLE No: 20 / 6

Location : HAMPSHIRE RESERVOIRS III

SHEET...4...OF...4...

Contract No. : CF 669 / 1640

Borehole Dia : 150 mm

Type of Boring : Cable Percussion

Casing : 150mm to 9.00 m

Date (started) : 26.10.77

Ground Level : +10.15 m O.D.

Date & Time	Depth of Casing	Water Level	SAMPLES			STRATA		DESCRIPTION OF STRATA
			Depth	Type	No.	Legend	Level m. O.D.	Thickness
0.20	28.11.77 18.00	9.00	20.40	D	92		(19.85)	29.00
0.40							20.25	+
0.60								
0.80								
1.00								
1.20								
1.40								
1.60								
1.80								
2.00								
2.20								
2.40								
2.60								
2.80								
3.00								
3.20								
3.40								
3.60								
3.80								
4.00								
4.20								
4.40								
4.60								
4.80								
5.00								
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Foundation Engineering Ltd.

Appendix B Stantec Methodology for Assessment of Land Contamination (England) and Stantec Rationale for Selection of Evaluation Criteria for Generic Quantitative Risk Assessment (England)

Stantec Guide: Methodology for Assessment of Land Contamination (England)

1 INTRODUCTION

This document defines the approach adopted by Stantec in relation to the assessment of land contamination in England. The aim is for the approach to (i) be systematic and objective, (ii) provide for the assessment of uncertainty and (iii) provide a rational, consistent, transparent framework.

When preparing our methodology, we have made reference to various technical guidance documents and legislation referenced in Section 7 of which the principal documents are (i) Contaminated Land Statutory Guidance (Defra 2012), (ii) online guidance Land Contamination Risk Management (LCRM) accessed from GOV.UK which has replaced Contaminated Land Research (CLR) Report 11: Model Procedures for the Management of Contamination (EA 2004). LCRM has been revised (July 2023) and CLR 11 is archived, (iii) Contaminated land risk assessment: A guide to good practice (C552) (CIRIA 2001) (iv) National Planning Policy Framework (NPPF, 2019) (v) BS 10175 Investigation of potentially contaminated sites - Code of Practice (BSI 2017) and (vi) The series of British Standards on Soil Quality BS 18400.

2 DEALING WITH LAND CONTAMINATION

Government policy on land contamination aims to prevent new contaminated land from being created and promotes a risk-based approach to addressing historical contamination. For historical contamination, regulatory intervention is held in reserve for land that meets the legal definition and cannot be dealt with through any other means, including through planning. Land is only considered to be “contaminated land” in the legal sense if it poses an unacceptable risk.

UK legislation on contaminated land is principally contained in Part 2A of the Environmental Protection Act, 1990 (which was inserted into the 1990 Act by section 57 of the Environment Act 1995). Part 2A was introduced in England on 1 April 2000 and provides a risk-based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment.

The Model Procedures for the Management of Land Contamination (CLR 11), were developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK. The approach, concepts and principles for land contamination management promoted by LCRM (and its predecessor CLR 11) are applied to the determination of planning applications. The guidance given in LCRM follows the same principles.

Other legislative regimes may also provide a means of dealing with land contamination issues, such as the regimes for waste, water, environmental permitting, and environmental damage. Further, the law of statutory nuisance may result in contaminants being unacceptable to third parties whilst not attracting action under Part 2A or other environmental legislation.

2.1 Part 2A

The Regulations and Statutory Guidance that accompanied the Act, including the Contaminated Land (England) Regulations 2006, has been revised with the issue of The Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263) and the Contaminated Land Statutory Guidance for England 2012.

Part 2A defines contaminated land as “*land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such significant harm (SPOSH) could be caused, or significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution (SPOSP) being caused*”.

Harm is defined as “*harm to the health of living organisms or other interference with the ecological systems of which they form part, and in the case of man, includes harm to his property*”.

Part 2A provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment, and under the guidance enforcing authorities should seek to find and deal with such land. It states that “*under Part 2A the starting point should be that land is not contaminated land unless there is reason to consider otherwise. Only land where unacceptable risks are clearly identified, after a risk assessment has been undertaken in accordance with the Guidance, should be considered as meeting the Part 2A definition of contaminated land*”. Further, the guidance makes it clear that “*regulatory decisions should be based on what is reasonably likely, not what is hypothetically possible*”.

The overarching objectives of the Government’s policy on contaminated land and the Part 2A regime are:

- “(a) To identify and remove unacceptable risks to human health and the environment.
- (a) To seek to ensure that contaminated land is made suitable for its current use.
- (b) To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development”.

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The enforcing authority may need to decide whether and how to act in situations where decisions are not straight forward, and where there is uncertainty. *“In so doing, the authority should use its judgement to strike a reasonable balance between: (a) dealing with risks raised by contaminants in land and the benefits of remediating land to remove or reduce those risks; and (b) the potential impacts of regulatory intervention including financial costs to whoever will pay for remediation, health and environmental impacts of taking action, property blight, and burdens on affected people”.*

The authority is required to *“take a precautionary approach to the risks raised by contamination, whilst avoiding a disproportionate approach given the circumstances of each case”.* The aim is *“that the regime produces net benefits, taking account of local circumstances”.*

The guidance recognises that *“normal levels of contaminants in soils should not be considered to cause land to qualify as contaminated land, unless there is a particular reason to consider otherwise”.* Normal levels are quoted as:

- “a) natural presence of contaminants’ such as from underlying geology ‘that have not been shown to pose an unacceptable risk to health and the environment*
- b) ...low level diffuse pollution, and common human activity...”*

Similarly the guidance states that significant pollution or significant possibility of significant pollution of controlled waters is required for land to be considered contaminated and the *“fact that substances are merely entering water”* or *“where discharge from land is not discernible at a location immediately downstream”* does not constitute contaminated land.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised Statutory Guidance presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high.

For land that cannot be readily placed into Categories 1 or 4 further assessment is required. If there is sufficient concern that the risks could cause significant harm or have the significant possibility of significant harm the land is to be placed into Category 2. If the concern is not met land is considered Category 3.

The technical guidance clearly states that the currently published Soil Guidance Values (SGV's) and Generic Assessment Criteria (GAC's)

represent *“cautious estimates of level of contaminants in soils”* which should be considered *“no risk to health or, at most, a minimal risk”.* These values do not represent the boundary between categories 3 and 4 and *“should be considered to be comfortably within Category 4”.*

At the end of 2013 technical guidance in support of Defra's revised Statutory Guidance (SG) was published and then revised in 2014 (CL: AIRE 2014) with further publications in 2021, 2023 and 2024 which provided:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- A demonstration of the methodology, via the derivation of C4SLs for twelve substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI), lead, vinyl chloride, trichloroethene, tetrachloroethene, trans-1,2-dichloroethene, cis-1,2-dichloroethene, 1,2-dichloroethane and naphthalene.

For controlled waters, the revised Statutory Guidance states that the following types of pollution should be considered to constitute significant pollution of controlled waters:

- “(a) Pollution equivalent to “environmental damage” to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.*
- (b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.*
- (c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway.*
- (d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)).”*

The guidance also states that, in some circumstances, significant concentrations at a compliance point (in groundwater or surface water) may constitute pollution of controlled waters.

As with SPOSH for human health, the revised Statutory Guidance presents a four-category system for Significant Pollution of controlled waters. Category 1 covers land where there is a strong and compelling case for SPOSP, for example where significant pollution would almost certainly occur if no action was taken to avoid it. Category 4 covers

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land where there is no risk or the risk is low, for example, where the land contamination is having no discernible impact on groundwater or surface water quality. Category 2 is for land where the risks posed to controlled waters are not high enough to consider the land as Category 1 but nonetheless are of sufficient concern to constitute SPOSP, Category 3 is for land where the risks posed to controlled waters are higher than low but not of sufficient concern to constitute SPOSP.

2.2 Planning

The Local Planning Authority (LPA) is responsible for the control of development, and in doing so it has a duty to take account of all material considerations, including contamination.

The principal planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks.

The National Planning Policy Framework (NPPF, 2023), includes the following.

Paragraph 124 states that planning policies and decisions should “(c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land.”

Paragraph 190 states “Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner”.

Paragraph 180 states “planning policies and decisions should contribute to and enhance the natural and local environment by:

- (e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and
- (f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.”

Paragraph 189 describes the policy considerations the Government expects LPA's to have in regard to land affected by contamination when preparing policies for development plans and in taking decisions on applications.

Paragraph 189 states “planning policies and decisions should ensure that:

- (a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);
- (b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
- c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.”

Paragraph 194 states “The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.”

The Glossary in Annex 2 provides the following:

Brownfield land registers: Registers of previously developed land that local planning authorities consider to be appropriate for residential development, having regard to criteria in the Town and Country Planning (Brownfield Land Registers) Regulations 2017. Local planning authorities will be able to trigger a grant of permission in principle for residential development on suitable sites in their registers where they follow the required procedures.

Competent person (to prepare site investigation information): A person with a recognised relevant qualification, sufficient experience in dealing with the type(s) of pollution or land instability, and membership of a relevant professional organisation.

Previously developed land: Land which is or was occupied by a permanent structure, including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be developed) and any associated fixed surface infrastructure. This excludes: land that is or was last occupied by agricultural or forestry buildings; land that has been developed for minerals extraction or waste disposal by landfill, where provision for restoration has been made through development management procedures; land in built-up areas such as residential gardens, parks, recreation grounds and allotments; and land that was previously developed but where the

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remains of the permanent structure or fixed surface structure have blended into the landscape.

Site investigation information: *Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175 Investigation of Potentially Contaminated Sites – Code of Practice).*

Stantec adopt the principle that a Preliminary Investigation (Desk Study and Site Reconnaissance) and Preliminary Risk Assessment (see below) is the minimum assessment requirement to support a planning application.

The level at which contamination is deemed to be unacceptable, or, gives rise to adverse effects under a planning context has not been identified but is envisaged to be more precautionary than the level required to determine land as contaminated under Part 2A.

2.3 Building Control

The building control department of the local authority or private sector approved inspectors are responsible for the operation and enforcement of the Building Regulations (DCLG 2010) to protect the health, safety and welfare of people in and around buildings. Approved Document C requires the protection of buildings and associated land from the effects of contamination, to be applied (non-exclusively) in all changes of use from commercial or industrial premises, to residential property.

3 APPROACH

As with CLR11 the guidance given in LCRM presents three stages of land contamination management: -

- (a) Stage 1 - Risk Assessment;
- (b) Stage 2 - Options Appraisal; and
- (c) Stage 3 - Remediation.

Each stage has three tiers. The three tiers of Stage 1 Risk Assessment are: -

- Tier 1 - Preliminary Risk Assessment (PRA) - first tier of RA that develops the outline conceptual model (CM) and establishes whether there are any potentially unacceptable risks.
- Tier 2 - Generic Quantitative Risk Assessment (GQRA) - carried out using generic assessment criteria and assumptions to estimate risk.
- Tier 3 - Detailed Quantitative Risk Assessment (DQRA) - carried out using detailed site-specific information to generate Site Specific

Assessment Criteria (SSAC) as risk evaluation criteria.

For each tier of a Stage 1 - Risk Assessment you must:

1. Identify the hazard - establish contaminant sources.
2. Assess the hazard - use a source-pathway-receptor (S-P-R) pollutant linkage approach to find out if there is the potential for unacceptable risk.
3. Estimate the risk - predict what degree of harm or pollution might result and how likely it is to occur.
4. Evaluate the risk - decide whether a risk is unacceptable.

A Stantec Preliminary Investigation report normally comprises a desk study, walkover site reconnaissance and preliminary risk assessment (PRA). The project specific proposal defines the actual scope of work which might include review of ground investigation data in which case the report includes a GQRA.

Risk estimation involves identifying the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

For a PRA, Stantec's approach is that if a pollution linkage is identified then it represents a potentially unacceptable risk which either (1) remediation / direct risk management or (2) progression to further tiers of risk assessment (GQRA and GQRA) requiring additional data collection and enabling refinement of the CM using the site specific data.

4 IDENTIFICATION OF POLLUTANT LINKAGES AND DEVELOPMENT OF A CONCEPTUAL MODEL (CM)

For all Tiers of a Stage 1 Risk Assessment, the underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements: -

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

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The *Conceptual Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s). The CM is refined through progression to further tiers of risk assessment (GQRA and GQRA) requiring additional data collection.

4.1 Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical.

In a PRA the potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Based on the land use information Contaminants of Potential Concern (COPC) are identified. The COPC direct the scope of the collection of site-specific data and the analytical testing selected for subsequent Tiers.

At Tier 2 the site-specific data is evaluated using appropriate published assessment criteria (refer to Stantec document entitled *Rationale for the Selection of Evaluation Criteria for a Generic Quantitative Risk Assessment (GQRA)*). In general, published criteria have been developed using highly conservative assumptions and therefore if the screening criterion is not exceeded (and if enough samples from appropriate locations have been analysed) then the COPC is eliminated as a potential Hazard. It should be noted that exceedance does not necessarily indicate that a site is contaminated and/or unsuitable for use only that the COPC is retained as a potential Hazard. Published criteria are generated using models based on numerous and complex assumptions. Whether or not these assumptions are appropriate or sufficiently protective requires confirmation on a project by project basis. Manipulation of the default assumptions would normally form part of a Tier 3 Detailed Quantitative Risk Assessment (DQRA).

When reviewing or assessing site specific data Stantec utilise published guidance on comparing contamination data with a critical concentration (CL:AIRE/CIEH 2008) which presents a structured

process for employing statistical techniques for data assessment purposes.

4.2 Receptor and Pathway Identification

For all Tiers the potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological Systems; ¹
- Controlled Waters ² – Under section 78A(9) of Part 2A the term “pollution of controlled waters” means the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter. The term “controlled waters” in relation to England has the same meaning as in Part 3 of the Water Resources Act 1991, except that “ground waters” does not include waters contained in underground strata but above the saturation zone.
- Property - Animal or Crop (including timber; produce grown domestically, or on allotments, for consumption; livestock; other owned or domesticated animals; wild animals which are the subject of shooting or fishing rights); and
- Property - Buildings (any structure or erection, and any part of a building including any part below ground level, but does not include plant or machinery comprised in a building, or buried services such as sewers, water pipes or electricity cables including archaeological sites and ancient monuments).

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are presented in **Table 2**. Table 2 has been generated using descriptions of environmental receptor importance/value given in various guidance documents including R&D 66 (NHBC 2008), EA 2017 and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by Stantec using the attribute description for each class. Surface water sensitivity is classified using the Water Framework Directive (WFD) status for the River Basin obtained from: <https://environment.data.gov.uk/catchment-planning/>

¹ International or nationally designated sites (as defined in the statutory guidance (Defra Circular 04/12)) “*in the local area*” will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site-specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces) consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be considered if a Phase 1 habitat survey, undertaken in accordance with guidance (JNCC 1993), is commissioned and the data provided to Stantec. It should be noted that

without such a survey a Land Contamination risk assessment may conclude that the identification of potential ecological receptors is inconclusive (refer to Stantec Specification for a Preliminary Investigation (Desk Study and Site Reconnaissance)).

² The definition of “pollution of controlled water” was amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

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The exposure pathway and modes of transport that will be considered are presented in **Table 3**.

4.3 Note regarding Ecological Systems

The Environment Agency (EA) has developed an ecological risk assessment framework which aims to provide a structured approach for assessing the risks to ecology from chemical contaminants in soils (EA 2008). In circumstances where contaminants in water represent a potential risk to aquatic ecosystems then risk assessors will need to consider this separately.

The framework consists of a three-tiered process: -

- Tier 1 is a screening step where the site soils chemical data is compared to a soil screening value (SSV)
- Tier 2 uses various tools (including surveys and biological testing) to gather evidence for any harm to the ecological receptors
- Tier 3 seeks to attribute the harm to the chemical contamination

Tier 1 is preceded by a desk study to collate information about the site and the nature of the contamination to assess whether pollutant linkages are feasible. The framework presents ten steps for ecological desk studies and development of a conceptual model as follows.

1. Establish Regulatory Context
2. Collate and Assess Documentary Information
3. Summarise Documentary Information
4. Identify Contaminants of Potential Concern
5. Identify Likely Fate Transport of Contaminants
6. Identify Potential Receptors of Concern
7. Identify Potential Pathways of Concern
8. Create a Conceptual Model
9. Identify Assessment and Measurement Endpoints
10. Identify Gaps and Uncertainties

The information in a standard PRA report covers Steps 1 to 4 inclusive. Step 5 considers fate and transport of contaminants and it should be noted that our standard report adopts a simplified approach considering only transport mechanisms. A simplified approach has also been adopted in respect of Steps 6 and 7 receptors (a detailed review of the ecological attributes has not been undertaken) and pathways (a food chain assessment has not been undertaken). Step 9 is outside the scope of our standard PRA report.

It should be noted that the PRA report will present an assessment for ecological systems (where identified as a receptor for a land contamination assessment) considering the viability of the mode of transport given the site-specific circumstances and not specific pathways. The PRA may conclude that the risk to potential ecological receptors is inconclusive.

4.4 Note regarding controlled waters

Controlled waters are rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters.

The EU Water Framework Directive (WFD) 2000/60/EC provides for the protection of sub-surface, surface, coastal and territorial waters through a framework of river basin management. The EU Updated Water Framework Standards Directive 2014/101/EU amended the EU WFD to update the international standards therein; it entered into force on 20 November 2014 with the requirements for its provisions to be transposed in Member State law by 20 May 2016. Other EU Directives in the European water management framework include:

- the EU Priority Substances Directive 2013/39/EU;
- EU Groundwater Pollutants Threshold Values Directive 2014/80/EU amending the EU Groundwater Directive 2006/118/EC; and
- EU Biological Monitoring Directive 2014/101/EU.

The Ground Water Daughter Directive (GWDD) was enacted by the Groundwater Regulations (2009), which were subsumed by the Environmental Permitting Regulations (2010) which provide essential clarification including on the four objectives specifically for groundwater quality in the WFD: -

Achieve 'Good' groundwater chemical status by 2015, commonly referred to as 'status objective';
Achieve Drinking Water Protected Area Objectives;
Implement measures to reverse any significant and sustained upward trend in groundwater quality, referred to as 'trend objective'; and

Prevent or limit the inputs of pollutants into groundwater, commonly referred to as 'prevent or limit' objectives

The Water Act 2003 (Commencement No.11) Order 2012 amends the test for 'contaminated land' which relates to water pollution so that pollution of controlled waters must now be "significant" to meet the definition of contaminated land.

The Water Framework Directive (WFD) requires the preparation, implementation and review of River Basin Management Plans (RBMP) on a six-year cycle. River basins are made up of lakes, rivers, groundwaters, estuaries and coastal waters, together with the land they drain. River Basin Districts (RBD) and the WFD Waterbodies that they comprise are important spatial management units, regularly used in catchment management studies. River Basin Management Plans (RBMP) have been developed for the 11 River Basin Districts in England and Wales.

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These were released by Defra in 2009 (Defra 2009) and updated in 2015.

These RBMP's establish the current status of waters within the catchments of the respective Districts and the current status of adjoining waters identified. As part of a Tier 2 risk assessment water quality data is screened against the WFD assessment criteria. Comparison with the RBMP's current status of waters for the catchment under consideration would form part of a Tier 3 assessment.

5 RISK ESTIMATION

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability).

At Tier 1 the consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008).

The criteria for classifying probability are set out in **Table 4** and have been taken directly from Table 6.4 CIRIA C552 (CIRIA 2001). Probability considers the integrity of the exposure pathway.

The consequence classifications detailed in **Table 5** have been adapted from Table 6.3 presented in C552 and R&D 66 (Annex 4 Table A4.3).

The Tier 1 risk classification is estimated for each pollutant linkage using the matrix given in **Table 6** which is taken directly from C552 (Table 6.5).

Subsequent Tiers refine the CM through retention or elimination of potential hazards and pollutant linkages.

6 RISK EVALUATION

Evaluation criteria are the parameters used to judge whether harm or pollution needs further assessment or is unacceptable. The evaluation criteria used will depend on:

- the reasons for doing the RA and the regulatory context such as Part 2A or planning;
- the CM and pollutant linkages present;
- any criteria set by regulators;
- any advisory requirements such as from Public Health England;
- the degree of confidence and precaution required;
- the level of confidence required to judge whether a risk is unacceptable;
- how you've used or developed more detailed assessment criteria in the later tiers of RA;
- the availability of robust scientific data;
- how much is known - for example, about the pathway mechanism and how the contaminants affect receptors; and

- any practical reasons such as being able to measure or predict against the criteria.

In order to put the Tier 1 risk classification into context the likely actions are described in **Table 7** which is taken directly from Table 6.6 of C552 (CIRIA 2001).

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Table 1: Criteria for Classifying Hazards / Potential for Generating Contamination

Classification/Score	Potential for generating contamination/gas based on land use
Very Low 1	Land Use: Residential, retail or office use, agriculture Contamination: Limited. Gas generation potential: Soils with low organic content
Low 2	Land Use: Recent small scale industrial and light industry Contamination: locally slightly elevated concentrations. Gas generation potential: Soils with high organic content (limited thickness)
Moderate 3	Land Use: Railway yards, collieries, scrap yards, engineering works. Contamination: Possible widespread slightly elevated concentrations and locally elevated concentrations. Gas generation potential: Dock silt and substantial thickness of organic alluvium/peat
High 4	Land Use: Heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential: Shallow mine workings Pre 1960s landfill
Very High 5	Land Use: Hazardous waste landfills, gas works, chemical works, Contamination: Likely widespread elevated concentrations. Gas generation potential: Landfill post 1960

"Greenfield" is land which has not been developed and there has been no use of agrochemicals

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification	Definition
Very Low 1	Receptor of limited importance <ul style="list-style-type: none"> Groundwater: Unproductive strata (Strata with negligible significance for water supply or river baseflow) (previously Non-aquifer), Secondary B (water-bearing parts of non-aquifers), Secondary undifferentiated (previously minor or non-aquifer, but information insufficient to classify as secondary A or B) Surface water: WFD Surface Water status Bad Ecology: No local designation Buildings: Replaceable Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement <ul style="list-style-type: none"> Groundwater: Secondary A aquifer Surface water: WFD Surface Water status Poor Ecology: local habitat resources Buildings: Local value Human health: Minimum score 4 where human health identified as potential receptor
Moderate 3	Receptor of local or county importance with potential for replacement <ul style="list-style-type: none"> Groundwater: Principal aquifer Surface water: WFD Surface Water status Moderate Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) Buildings: Area of Historic Character Human health: Minimum score 4 where human health identified as potential receptor
High 4	Receptor of county or regional importance with limited potential for replacement <ul style="list-style-type: none"> Groundwater: Source Protection Zone 2 or 3 Surface water: WFD Surface Water status Good Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) Buildings: Conservation Area Human health: Minimum score 4 where human health identified as potential receptor
Very High 5	Receptor of national or international importance <ul style="list-style-type: none"> Groundwater: Source Protection Zone (SPZ) 1 Surface water: WFD Surface Water status High Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) Buildings: World Heritage site Human health: Residential, open spaces and uses where children are present

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Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of windblown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Windblown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Table 4: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.

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Table 5: Classification of Consequence (score = magnitude of hazard and sensitivity of receptor)

Classification Score	Examples
Severe 17-25 (3 out of 25 outcomes)	<p>Human health effect - exposure likely to result in "significant harm" as defined in the Defra (2012) Part 2A Statutory Guidance ¹.</p> <p>Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill.</p> <p>Ecological effect - short-term exposure likely to result in a substantial adverse effect.</p> <p>Catastrophic damage to crops, buildings or property</p>
Medium 10-16 (7 out of 25 outcomes)	<p>Human health effect - exposure could result in "significant harm" ¹.</p> <p>Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor</p> <p>Ecological effect - short-term exposure may result in a substantial adverse effect.</p> <p>Damage to crops, buildings or property</p>
Mild 5-9 (7 out of 25 outcomes)	<p>Human health effect - exposure may result in "significant harm" ¹.</p> <p>Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality).</p> <p>Ecological effect - unlikely to result in a substantial adverse effect.</p> <p>Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).</p>
Minor 1-4 (8 out of 25 outcomes)	<p>No measurable effect on humans. Protective equipment is not required during site works.</p> <p>Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems.</p> <p>Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.</p>

¹ Significant harm includes death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. The local authority may also consider other health effects to constitute significant harm such as physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. Whether or not these would constitute significant harm would depend on the seriousness of harm including impact on health, quality of life and scale of impact.

Table 6: Classification of Risk (Combination of Consequence Table 5 and Probability Table 4)

	Consequence			
Probability	Severe	Medium	Mild	Minor
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/	Low
Low likelihood	Moderate	Moderate	Low	Very low
Unlikely	Low	Low	Very low	Very low

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Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
<i>Very high risk</i>	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation is likely to be required in the short term.
<i>High risk</i>	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
<i>Moderate risk</i>	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
<i>Low risk</i>	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
<i>Very low risk</i>	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Stantec/UK/I&B: Evaluation Criteria for Generic Quantitative Risk Assessment (England)

1 INTRODUCTION

The aim of this document is to present an explanation for the selection of the evaluation criteria routinely used by Stantec UK Ltd when undertaking a land contamination Tier 2 Generic Quantitative Risk Assessment (GQRA).

A GQRA uses published criteria to screen the site-specific contamination testing data and identify potential hazards to specific receptors. Generic criteria are typically conservative in derivation and exceedance does not indicate that a site is statutorily contaminated and/or unsuitable for use in the planning context. These criteria are used to identify situations where further assessment and/or action may be required. This document is divided into general introductory text and sections on soils, waters and gases.

2 GENERAL NOTES

This document should be read in conjunction with another entitled "Stantec Methodology for Assessment of Land Contamination" which summarises the legislative regime and our approach to ground contamination and risk assessment.

Any Stantec interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any tables included in this document are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

Generic criteria provide an aid to decision-making, but they do not replace the need for sound professional judgement in risk assessment (EA, 2006). The criteria are based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis. Our interpretative report will comment on the appropriateness of the routine criteria for project objectives or ground conditions. In some cases the published criteria whilst typically conservative may in some circumstances not be suitable for the site being assessed, either because they do not address the identified pollutant linkages or because they may not be sufficiently precautionary in the context of the site. Under these circumstances it may be necessary to recommend deriving site-specific assessment criteria. Any deviation from the routine criteria and/or selection of criteria for parameters not covered in this document will be described in the report text.

3 CRITERIA FOR EVALUATING SOIL RESULTS

3.1 Potential Harm to Human Health

The criteria used by Stantec UK Ltd to assess the potential for harm to human health are:-

- Category 4 Screening Levels (C4SLs) (Phase 1 substances DEFRA, 2014 and Phase 2 substances CLAIRE, 2021, 2023, 2024).
- Suitable 4 Use Levels (S4ULs) (Nathanail *et al*, 2015).
- CL:AIRE/EIC/AGS Generic Assessment Criteria (GAC) (CL:AIRE, 2010).
- Soil Guideline Values (SGVs) (EA, 2009a).

These criteria have been generated using the Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009b, 2009c, 2009d, 2009e). The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment and a generic conceptual model for site conditions and human behaviour to estimate child and adult exposures to soil contaminants for those potentially living, working, and/or playing on contaminated sites over long time periods (EA, 2009c).

The S4ULs, SGVs and GACs are all based on use of minimal/tolerable risk Health Criteria Values (HCVs) as the toxicological benchmark whereas the C4SL are based on use of a "low level of toxicological concern" (LLTC) as the toxicological benchmark. The LLTC represents a slightly higher level of risk than the HCV.

An update to the software (1.071) was published on 04/09/2015 (the handbook (EA 2009f) referring to version 1.05 is still valid). The update includes the library data sets from the DEFRA research project SP1010 (Development of Category 4 Screening Levels for assessment of land affected by contamination).

The CLEA model uses ten exposure pathways (Ingestion (outdoor soil, indoor dust, homegrown vegetables and soil attached to homegrown vegetables), Dermal Contact (outdoor soil and indoor dust) and Inhalation (outdoor dust, indoor dust, outdoor vapours and indoor vapours)). There are exposure pathways not included in the CLEA model such as the permeation of organics into plastic water supply pipes.

The presence and/or significance of each of the potential exposure pathways is dependent on the land use being considered. The model uses standard land use scenarios as follows:-

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Residential – habitation of a dwelling up to two storeys high with various default material and design parameters, access to either private or nearby community open space with soil track back to form indoor dust. Assumes ingestion of homegrown produce.

Allotments – the model has default parameters for use and consumption of vegetables but not animals or their products (eggs).

Industrial/Commercial – assumes office or light physical work in a permanent three storey structure with breaks taken outside and that the site is NOT covered in hardstanding.

Public Open Space – two public open space (POS) scenarios are considered: POS_{resi} is shared communal space within a residential development where tracking back of soil into the home is assumed to occur. POS_{park} is intended for a public park sufficiently distant from housing (i.e. not adjacent to housing) such that tracking back of soil into the home is negligible. Note that the POS assessment criteria may not be appropriate for assessing sports fields.

The assessment criteria generated using CLEA can be used as a conservative starting point for evaluating long-term risks to human health from chemicals in soil.

It is important to note that the model does not assess all the potential exposure scenarios, for example risk to workers in excavations (short term exposure) or diffusion of contaminants through drinking water pipes.

Recent guidance (DEFRA 2012) introduces a four stage classification system where Category 1 sites are clearly contaminated land and Category 4 sites are definitely not contaminated land as defined by EPA 1990. Outside of these categories further specific risk assessment is required to determine if the site should fall into Category 2 (contaminated land) or Category 3 (not contaminated land). Category 4 screening values are considered to be more pragmatic than the current published SGV/GAC criteria but still strongly precautionary with the aim of allowing rapid identification of sites where the risk is above minimal but still low/acceptable.

Category 4 Screening Levels (C4SLs)

At the end of 2013, technical guidance in support of DEFRA's revised Statutory Guidance (SG) was published and then revised in 2014 (CL:AIRE 2014) which provided:

- A methodology for deriving C4SLs for the standard land-uses and two new public open space scenarios using the updated assumptions relating to the modelling of

- human exposure to soil contaminants; and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

Following issue of an Erratum in December 2014, a Policy Companion Document was published (DEFRA 2014).

A letter from Lord de Mauley dated 3rd September 2014 provides more explicit direction to local authorities on the use of the C4SL in a planning context. The letter identifies four key points:

- 1) that the screening values were developed expressly with the planning regime in mind
- 2) their use is recommended in DCLG's planning guidance
- 3) soil concentrations below a C4SL limit are considered to be 'definitely not contaminated' under Part IIA of the 1990 Environmental Protection Act and pose at most a 'low level of toxicological concern' and,
- 4) exceedance of a C4SL screening value does not mean that land is definitely contaminated land, just that further investigation may be warranted.

Stantec use the C4SLs as the Tier 2 soil screening criteria protective of human health for substances with C4SL available. Table 1 summarises the C4SL for each of the published substances.

Note that, with the exception of benzene, the DEFRA published C4SL are not dependent on soil organic matter content (SOM) (*"Given that BaP is non volatile and that empirical soil to plant concentration factors have been used, soil organic matter content has a negligible influence on the C4SLs for this chemical"*). The DEFRA published C4SL for benzene is based on an SOM of 6%. Stantec has used the CLEA model (v1.071) to derive C4SL for benzene for 1% and 2.5% SOM which are also shown in Table 1.

Note that an industry led project to derive C4SL for a further 20 substances has commenced (CL:AIRE, 2018). The project is being project managed by CL:AIRE and is funded by the Soil and Groundwater Technology Association (SAGTA), the Society of Brownfield Briefing (SoBRA) and others. A dedicated steering group, made up of representatives from SAGTA, DEFRA, Welsh Government, Public Health England, Environment Agency, Natural Resources Wales, Food Standards Agency, Homes England and further Land Forum representatives, has been set up to oversee the project. The new C4SL will be added to this document as they are published.

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Suitable 4 Use Levels (S4ULs)

In July 2009, Generic Assessment Criteria (GACs) for 82 substances were published (LQM and CIEH, 2009) using the then current version of the CLEA software v1.04 and replaced those generated in 2006 using the original version of the model CLEA UK *beta*. In 2015 S4ULs were published by LQM/CIEH (Nathanail *et al*, 2015) to replace the second edition GACs. Table 2 summarises the S4ULs which are reproduced with permission; Publication Number S4UL3202.

Soil Guideline Values (SGVs) and Generic Assessment Criteria (GAC)

In 2009, Soil Guideline Values (SGVs) were published by the Environment Agency for arsenic, cadmium, mercury, nickel, selenium, benzene, toluene, ethyl benzene, xylenes, phenol and dioxins, furans and dioxin-like PCBs. These were derived using the CLEA model for residential, allotments and commercial land-uses.

These SGVs have now largely been superseded by the C4SLs and the S4ULs, with the exception of the SGVs for dioxins, furans and dioxin-like PCBs which are shown in Table 3.

In January 2010, Generic Assessment Criteria (GAC) derived using CLEA were published by CL:AIRE for 35 substances. These GAC are listed in Table 4.

Note that the SGVs for dioxins, furans and dioxin like PCBs and CL:AIRE GAC were derived using an older version of CLEA (v1.06) than used to derive the S4UL and C4SL (v1.07). This older version used slightly more conservative values for some exposure parameters and therefore the derived SGVs/GAC are still considered suitably precautionary for use as screening criteria.

Note on Mercury, Chromium and Arsenic

The analytical testing routinely undertaken by Stantec determines total concentration, however, the toxicity depends on the form of the contaminant.

If a source of Mercury, Chromium or Arsenic is identified or the total concentration exceeds the relevant worst case speciated criteria it will be desirable/necessary to undertake additional speciated testing and further assessment.

Note on Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are a family of hundreds of different congeners whose chemical structures contain two or more fused aromatic rings. Whilst it is recognised that there is an ongoing debate on the most appropriate method to assess health effects of PAH mixtures, in 2010

the Health Protection Agency recommended the use of benzo[a]pyrene (BaP) as a surrogate marker approach in the assessment of carcinogenic risks posed by PAHs in soils (HPA, 2010).

In most cases, BaP is chosen as the surrogate marker (SM) due to its ubiquitous nature and the vast amount of data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. The SM approach estimates the carcinogenic toxicity of a mixture of PAHs in an environmental matrix by using toxicity data for a PAH mixture for which the composition is known.

Exposure to the SM is assumed to represent exposure to all PAHs in that matrix therefore the toxicity of the SM represents the toxicity of the mixture. The SM approach relies on a number of assumptions (HPA, 2010).

- The SM (BaP) must be present in all the samples.
- The profile of the different PAH relative to BaP should be similar in all samples.
- The PAH profile in the soil samples should be sufficiently similar to that used in the pivotal toxicity study on which HBGV was based i.e. the Culp study (Culp *et al.* (1998)).

In order to justify the use of a surrogate marker assessment criterion (C4SL for benzo(a)pyrene and S4UL coal tar) the LQM PAH Profiling Tool is used by Stantec to assess the similarity of the PAH profile in a soil sample to that of the toxicity study. The spreadsheet calculates the relative proportions of the genotoxic PAHs and plots them relative to the composition of the two coal mixtures used by Culp *et al.* Provided that the relative proportions are within an order of magnitude of those from the Culp Study (as suggested by HPA) Stantec will use the C4SL for benzo(a)pyrene as a surrogate marker for the carcinogenic PAHs, i.e. benzo(a)pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(ah)anthracene, indeno(123-cd)pyrene and benzo(ghi)perylene. For projects where this approach is appropriate the results will be assessed using the Coal Tar criterion (BAP C4SL) and the criteria for non-carcinogenic PAHs (S4ULs), i.e. naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene and pyrene.

Note on Total Petroleum Hydrocarbons

The S4UL for Total Petroleum Hydrocarbon (TPH) fractions are based on 'threshold' health effects. In accordance with Environment Agency guidance (EA, 2005) and the S4UL report (Nathanail *et al*, 2015) the potential for additivity of toxicological effects between fractions should be considered. Practically, to address this issue the hazard quotient (HQ) for each fraction should be calculated by

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dividing the measured concentration of the fraction by the GAC. The HQs are then added to form a hazard index (HI) for that sample. An HI greater than 1 indicates an exceedance.

Note on Dioxins, Furans and Dioxin-like PCBs

The SGVs for dioxins, furans and dioxin-like PCBs are based on an assumed congener profile for urban soils. The total measured concentration of dioxin, furan and dioxin-like PCB congeners listed in the SGV report (EA, 2009a) should be compared with the SGVs to make an initial assessment of risk. A more accurate assessment can be made using the Environment Agency's site specific worksheet for dioxins, furans and dioxin like PCBs available from <https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/77-risk-assessment-info-ra/199-dioxins-site-specific-worksheets>.

Note on Asbestos

Asbestos in soil and made ground is currently under review by a number of bodies. There are no current published guidance values for asbestos in soil other than the waste classification values given in the EA's Technical Guidance WM3, Hazardous Waste – Interpretation of the definition and classification of hazard waste (EA, 2015). This guidance is only appropriate for soils that are being discarded as waste.

Testing for asbestos will be carried out on selected samples of made ground encountered during investigation, initially samples will be subjected to an asbestos screen and, if asbestos is found to be present, subjected to quantification depending on the project specific requirements. The reader is directed to the report text for guidance on the approach adopted in respect to any asbestos found to be present.

Further guidance is also available in publication C733, Asbestos in soil and made ground: a guide to understanding and managing risks (CIRIA 2014).

Note on Soil Saturation Concentration

The soil saturation concentration is the concentration of an organic constituent in soil at which either the pore water or soil vapour has theoretically become saturated with the substance, i.e. the substance concentration has reached its maximum aqueous solubility or vapour pressure. The soil saturation concentration is related to the properties of the substance as well as the properties of the soil (including soil organic matter content).

The soil saturation concentrations are shown in Table 2 in brackets where exceeded by the assessment criteria and in Table 4 for all substances. Measured concentrations in excess of the soil saturation concentration have various potential implications as discussed below.

Firstly, where measured concentrations exceed the soil saturation concentration, the risk from vapour inhalation and/or consumption of produce may be limited. The CLEA model calculates the soil saturation concentration but it does not limit exposure where this concentration is exceeded. This adds an additional level of conservatism for CLEA derived assessment criteria where these exceed the calculated soil saturation concentration. Secondly, the soil saturation concentration is sometimes used to flag the potential presence of non-aqueous phase liquid (NAPL, a.k.a. free phase) in soil. The presence of NAPL is an important consideration in the Tier 2 assessment because, where present, the risks from NAPL may need to be considered separately. Theoretically, where a measured concentration exceeds the soil saturation concentration NAPL could be present. However, using theoretical saturation values is not always reliable for the following reasons: The soil saturation concentration is based on the aqueous solubility and vapour pressure of a pure substance and not a mixture, of which NAPLs are often comprised; and

The soil saturation concentration does not account for the sorption capacity of the soil. As a result, exceedance of the soil saturation concentration does not necessarily imply that NAPL is present. This is particularly the case for longer chain hydrocarbons such as PAHs which have low solubility and vapour pressure and hence a low soil saturation concentration but that are strongly sorbed to soil.

The measured concentrations will be compared to the soil saturation concentrations shown in Tables 2 and 4. Where exceeded Stantec will use additional lines of evidence (such as visual evidence and concentration of total TPH) to determine whether or not NAPL is likely to be present. If the presence of NAPL is deemed plausible the implications will be considered in the risk assessment.

3.2 Potential Harm to the Built Environment

Land contamination can pose risks to buildings, building materials and services (BBM&S) in a number of ways. Volatile contaminants and gases can accumulate and cause explosion or fire. Foundations and buried services can be damaged by corrosive substances and contaminants such as steel slags can create unstable ground conditions through expansion causing structural damage.

Stantec use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

- i) Approved Document C - Site Preparation and Resistance to Contaminants and Moisture. (DCLG, 2013);

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- ii) Concrete in aggressive ground SD1 (BRE 2005);
- iii) Guidance for the selection of water supply pipes to be used in brownfield sites (UK WIR 2011);
- iv) Protocols published by agreement between Water UK and the Home Builders Federation providing supplementary guidance which includes the Risk Assessment for Water Pipes (the 'RA') (Water UK 2014).
- v) Performance of Building Materials in Contaminated Land report BR255 (BRE 1994).
- vi) Risks of Contaminated Land to Buildings, Building Materials and Services. A Literature Review - Technical Report P331 (EA, 2000).
- vii) Guidance on assessing and managing risks to buildings from land contamination - Technical Report P5 035/TR/01 (EA, 2001).

3.3 Potential to Harm Ecosystems, Animals, Crops etc

The criteria routinely used by Stantec as Tier 2 screening values to assess the potential of soil chemistry to harm ecosystems are taken from the following guidance and are summarised in Table 5.

- i) Derivation and Use of Soil Screening Values for assessing ecological risks (EA, 2017a);
- ii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990);
- iii) Sewage sludge on farmland: code of practice for England, Wales and Northern Ireland (DEFRA, 2018); and
- iv) BS 3882:2015 Specification for topsoil and requirements for use (BSI, 2015).

Unless stated in the report the assessment is solely for phytotoxic parameters and additional assessment is required to determine suitability as a growing medium.

4 CRITERIA FOR EVALUATING LIQUID RESULTS

4.1 Potential Harm to Human Health via Ingestion

The Tier 2 water screening values routinely adopted by Stantec for assessing the potential for harm to human health via ingestion (presented as Table 6) are taken from The Water Supply (Water Quality) Regulations (S.I. 2018/647) unless otherwise indicated.

It should be noted that some of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of iron and manganese are

controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in water supply pipes.

4.2 Potential Harm to Human Health via Inhalation of Vapours

The Tier 2 water screening values adopted by Stantec for assessing the potential for chronic human health risk from the inhalation of vapours from volatile contaminants in groundwater are presented in Table 7. These generic assessment criteria have been taken from a report published by the Society of Brownfield Risk Assessment (SoBRA) (SoBRA, 2017). The methodology adopted in their generation is considered compatible with the UK approach to deriving GAC and adopts a precautionary approach. As with all published GAC the suitability for use on the site being assessed has to be decided by the assessor based on a thorough understanding of the methodology and assumptions used in their derivation. Note, that the SoBRA groundwater vapour GAC are not intended for assessing risks to ground workers from short-term exposure.

Note that Table 7 shows the theoretical maximum aqueous solubility for each contaminant and indicates the GAC that exceed solubility. Measured concentrations in excess of solubility may be an indication that NAPL is present. As for the assessment of soils, if the presence of NAPL is deemed plausible the implications will be considered in the risk assessment.

4.3 Potential to Harm Controlled Waters

When assessing ground condition data and the potential to harm Controlled Waters Stantec uses the approach presented in the groundwater protection position statements published 14.03.17 (EA, 2017b) which describe the Environment Agency's approach to managing and protecting groundwater. They update and replace Groundwater Protection: principles and practice (GP3). Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters. Water in the unsaturated zone is not groundwater but does come within the scope of the term "ground waters" as used and defined in the Water Resources Act 1991. It will continue to be a technical decision for the Environment Agency to determine what is groundwater in certain circumstances for the purposes of the Regulations. As discussed in our Methodology for Assessment of Land Contamination perched water is not considered a receptor in Stantec assessments.

The EU Water Framework Directive (WFD) 2000/60/EC provides for the protection of sub-surface, surface, coastal and territorial waters through a framework of river basin management.

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The EU Updated Water Framework Standards Directive 2014/101/EU amended the EU WFD to update the international standards therein; it entered into force on 20 November 2014 with the requirement for its provisions to be transposed in Member State law by 20 May 2016.

Member States are required under the EU WFD to update their river basin management plans every six years. The first river basin management plans for England and Wales, Scotland and Northern Ireland were published in December 2009, and these were updated in 2015.

Other EU Directives in the European water management framework include:

- the EU Priority Substances Directive 2013/39/EU;
- EU Groundwater Pollutants Threshold Values Directive 2014/80/EU amending the EU Groundwater Daughter Directive (GWDD) 2006/118/EC; and
- the EU Biological Monitoring Directive 2014/101/EU.

The Priority Substances Directive set environmental quality standards (EQS) for the substances in surface waters (river, lake, transitional and coastal) and confirmed their designation as priority or priority hazardous substances (PS), the latter being a subset of particular concern. Environmental Quality Standards for PS are determined at the European level and apply to all Member States. Member States identify and develop standards for 'Specific Pollutants'. Specific Pollutants (SP) are defined as substances that can have a harmful effect on biological quality.

The Water Framework Directive (Standards and Classification) Directions (England and Wales) (DEFRA, 2015) were issued to the Environment Agency as an associated document of the Water Environment (WFD) (England and Wales) Regulations 2015 (S.I. 2015/1623) and provide directions for the classification of surface water and groundwater bodies. Schedule 3 parts 2 and 3 relate to surface water standards for specific pollutants in fresh or salt water bodies and priority substances in inland (rivers, lakes and related modified/artificial bodies) or other surface waters respectively. Although Schedule 5 presents threshold values for groundwater the Direction specifically excludes their use as part of site-specific investigations.

Table 6 presents the criteria routinely used by Stantec as Tier 2 screening values. This table only presents a selection of the more commonly analysed parameters and the source documents should be consulted for other chemicals. For screening groundwater the criteria selected are the standards for surface water and/or human consumption as appropriate together with the following:-

For a **hazardous substance** Stantec adopts the approach that, if the concentration in a discharge to groundwater is less than the Minimum Reporting Value (MRV), the input is regarded as automatically meeting the Article 2 (b) 'de-minimus' requirement of exemption 6 (3) (b) of the GWDD. Stantec has selected hazardous substances from the latest list published by the Joint Agencies Groundwater Directive Advisory Group (JAGDAG, 2018). MRV is the lowest concentration of a substance that can be routinely determined with a known degree of confidence, and may not be equivalent to limit of detection. MRVs have been identified from DEFRA's guidance on Hazardous Substances to Groundwater: Minimum Reporting Values (DEFRA, 2017), and are shown in Table 6.

Note that for land contamination assessments, where hazardous substances have already entered groundwater, remediation targets would typically be based on achieving appropriate water quality standards (e.g. drinking water standard or EQS) at a compliance point rather than an MRV. For this reason, when assessing measured groundwater or soil leachate concentrations, the values for human consumption, fresh water and salt water shown in Table 6 (whichever is appropriate for the context of the site) will be used as the Tier 2 assessment criteria rather than MRV. For hazardous substances with no water quality standard the laboratory method detection limit will be used as the assessment criteria.

For **non-hazardous substances** the GWDD requires that inputs be limited to avoid deterioration. UKTAG guidance equates deterioration with pollution. Non-hazardous substances are all substances not classified as hazardous. For Stantec assessments the values for human consumption, fresh water and salt water shown in Table 6 (whichever is appropriate for the context of the site) are used as the assessment criteria for non-hazardous substances.

Note on Copper, Lead, Manganese, Nickel and Zinc

EQS_{bioavailable} have been developed for UK Specific Pollutants copper, zinc and manganese and the EU priority substances lead and nickel. An EQS is the concentration of a chemical in the environment below which there is not expected to be an adverse effect on the specific endpoint being considered, e.g. the protection of aquatic life.

It is very difficult to measure the bioavailable concentration of a metal directly. The UK has developed simplified Metal Bioavailability Assessment Tool (M-BAT) for copper, zinc, nickel and manganese which uses local water chemistry data, specifically pH, dissolved organic carbon (DOC) (mg/L) and Calcium (Ca) (mg/L).

Where the recorded total dissolved concentration exceeds the screening criteria for these parameters

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(EQS_{bioavailable}) further assessment will be undertaken using the tools downloaded from <http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat>

The models calculate a risk characterisation ratio (RCR) and where this is greater than 1 this indicates the bioavailable concentration is above the EQS and the parameter is then identified as a potential hazard. The report will discuss this identified hazard noting that the pH, calcium and, in particular, the dissolved organic carbon (DOC) in groundwater may be quite different to the receiving water (e.g. due to the presence to leaf litter or organic sediments dissolving in the water).

5 CRITERIA FOR EVALUATING GAS RESULTS

Stantec use the following primary guidance on gas monitoring methods and investigation, the assessment of risk posed by soil gases (including Volatile Organic Compounds (VOCs)) and mitigation measures/risk reduction during site development.

- i) BS 8576:2013 – Guidance on Ground Gas Investigations: Permanent gases and Volatile Organic Compounds (VOCs) (BSI, 2013);
- ii) TB18 Continuous Ground-Gas Monitoring and the Lines of Evidence Approach to Risk Assessment CL:AIRE Technical Bulletin TB18 (CL:AIRE 2019)
- iii) RB17 A pragmatic approach to Ground Gas Risk Assessment. CL:AIRE Research Bulletin RB17 (Card et al, 2012);
- iv) The VOCs Handbook. C682 (CIRIA, 2009).
- v) Assessing risks posed by hazardous gases to buildings C665 (CIRIA, 2007);
- vi) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC, 2007); and
- vii) BS 8485:2015+A1:2019- Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2019).

Gas and borehole flow data are used to obtain the gas screening value (GSV) for methane and carbon dioxide. The GSV is used to establish the characteristic situation and to make recommendations for gas protection measures for buildings if required.

Radon

Stantec use the following primary guidance to assess the significance of the radon content of soil gas.

- i) Radon: guidance on protective measures for

- new dwellings. Report BR211 (BRE, 2015); and
- ii) Indicative Atlas of Radon in England and Wales (HPA & BGS, 2007).

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Table 1: Category 4 Screening Levels (C4SL)

	Allotments	Residential (with home-grown produce)	Residential (without home-grown produce)	Commercial	POS _{resi}	POS _{park}
Arsenic	49	37	40	640	79	170
Benzene - 1% SOM*	0.039	0.20	0.89	27	140	190
- 2.5% SOM*	0.081	0.41	1.6	50	140	210
- 6% SOM	0.18	0.87	3.3	98	140	230
Benzo(a)pyrene (as a surrogate marker for carcinogenic PAHs)	5.7	5.0	5.3	77	10	21
Naphthalene	65 130 200	15 36 85	15 36 85	1,600 3,700 8,400	11,000 15,000 17,000	800 1,200 1,900
Cadmium	3.9	22	150	410	220	880
Chromium VI	170	21	21	49	21	250
Lead	80	200	310	2300	630	1300
Vinyl Chloride/ Chloroethene/ Chloroethylene, (CAS No. 75-01-4)	0.0017 0.0031 0.0058	0.0064 0.010 0.017	0.015 0.019 0.029	1.1 1.4 2.2	7.8 7.8 7.8	18 19 19
Trichloroethene / Trichloroethylene/ TCE or 'Trike' (CAS No. 79-01-06)	0.032 0.072 0.16	0.0093 0.020 0.043	0.0097 0.020 0.045	0.73 1.5 3.4	76 78 79	41 54 69
Tetrachloroethene/ Tetrachloroethylene/ Perchloroethylene, PCE or 'perc', (CAS No. 127-18-4)	2.0 4.8 11.0	0.31 0.70 1.60	0.32 0.71 1.60	24 55 130	3,200 3,300 3,400	1,400 1,900 2,500
1,2-Dichloroethane	0.054 0.100 0.190	0.11 0.18 0.31	0.16 0.24 0.41	12 17 29	300 310 310	300 330 380
Trans-1,2- Dichloroethene	3.7 7.5 16.0	0.9 1.6 3.3	0.93 1.70 3.40	69 120 260	13,000 13,000 13,000	5,600 7,000 9,000
Cis-1,2- Dichloroethene	0.89 1.70 3.60	0.46 0.78 1.50	0.50 0.84 1.60	38 64 120	3,800 3,800 3,900	2,000 2,400 3,100

Units mg/kg dry weight

Values taken from SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (Department for Environment, Food and Rural Affairs December 2014), unless stated otherwise Based on a sandy loam as defined in SR3 (Environment Agency, 2009b)

Note that the C4SLs are SOM dependent with the exception of arsenic, benzo(a)pyrene, cadmium, chromium IV and lead.

* - Stantec derived C4SL using CLEA v1.071

Table 2: Suitable 4 Use Levels (S4UL)

Determinand	Allotment	R _w HP	R _w HP	Commercial/ Industrial	POS _{resi}	POS _{park}
Metals						
Arsenic (Inorganic) ^{a, b, c}	43	37	40	640	79	170
Beryllium ^{a, b, d, e}	35	1.7	1.7	12	2.2	63
Boron ^{a, b, d}	45	290	11000	240000	21000	46000
Cadmium (pH6-8) ^{a, b, d, f}	1.9	11	85	190	120	560
Chromium (trivalent) ^{a, b, d, g}	18000	910	910	8600	1500	33000
Chromium (hexavalent) ^{a, b, c}	1.8 ^h	6 ⁱ	6 ⁱ	33 ^j	7.7 ^j	220 ^j
Copper ^{a, b, c}	520	2400	7100	68000	12000	44000
Mercury (elemental) ^{a, b, c, j}	21	1.2	1.2	58 ^{vap} (25.8)	16	30 ^{vap} (25.8)
Mercury (inorganic) ^{a, b, c}	19	40	56	1100	120	240
Methylmercury ^{a, b, c}	6	11	15	320	40	68
Nickel ^{a, b, c}	53 ^k	130 ^e	180 ^e	980 ^e	230 ^e	800 ^k
Selenium ^{a, b, c}	88	250	430	12000	1100	1800
Vanadium ^{a, b, c, i, j}	91	410	1200	9000	2000	5000
Zinc ^{a, b, c}	620	3700	40000	730000	81000	170000
BTEX Compounds (SOM 1%/ 2.5%/ 6%)						
Benzene ^{a, b, l, m}	0.017/0.034/ 0.075	0.087/0.17/ 0.37	0.38/0.7/1.4	27 / 47 / 90	72 / 72 / 73	90 / 100 / 110
Toluene ^{a, b, l, m}	22 / 51 / 120	130 / 290 / 660	880 ^{vap} (869) /1900/3900	56000 ^{vap} (869) / 110000 ^{vap} (1920)/ 180000 ^{vap} (4360)	56000 / 56000 / 56000	87000 ^{vap} (869)/ 95000 ^{vap} (1920)/ 100000 ^{vap} (4360)

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Determinand	Allotment	R _w HP	R _w HP	Commercial/ Industrial	POSresi	POSpark
Ethylbenzene ^{a, b, l, m}	16 / 39 / 91	47 / 110 / 260	83 / 190 / 440	5700 ^{vap} (518) / 13000 ^{vap} (1220) / 27000 ^{vap} (2840)	24000 / 24000 / 25000	17000 ^{vap} (518) / 22000 ^{vap} (1220) / 27000 ^{vap} (2840)
O – Xylene ^{a, b, l, m, n}	28 / 67 / 160	60 / 140 / 330	88 / 210 / 480	6600 ^{sol} (478) / 15000 ^{sol} (1120) / 33000 ^{sol} (2620)	41000 / 42000 / 43000	17000 ^{sol} (478) / 24000 ^{sol} (1120) / 33000 ^{sol} (2620)
M – Xylene ^{a, b, l, m, n}	31 / 74 / 170	59 / 140 / 320	82 / 190 / 450	6200 ^{vap} (625) / 14000 ^{vap} (1470) / 31000 ^{vap} (3460)	41000 / 42000 / 43000	17000 ^{vap} (625) / 24000 ^{vap} (1470) / 32000 ^{vap} (3460)
P – Xylene ^{a, b, l, m, n}	29 / 69 / 160	56 / 130 / 310	79 / 180 / 430	5900 ^{sol} (576) / 14000 ^{sol} (1350) / 30000 ^{sol} (3170)	41000 / 42000 / 43000	17000 ^{sol} (576) / 23000 ^{sol} (1350) / 31000 ^{sol} (3170)
Total xylenes ^t	28 / 67 / 160	56 / 130 / 310	79 / 180 / 430	5900 ^{sol} (576) / 14000 ^{sol} (1350) / 30000 ^{sol} (3170)	41000 / 42000 / 43000	17000 ^{sol} (576) / 23000 ^{sol} (1350) / 31000 ^{sol} (3170)
Polycyclic Aromatic Hydrocarbons (SOM 1%/ 2.5%/ 6%) ^{a, b, l, p}						
Acenaphthene	34 / 85 / 200	210 / 510 / 1100	3000 ^{sol} (57.0) / 4700 ^{sol} (141) / 6000 ^{sol} (336)	84000 ^{sol} (57.0) / 97000 ^{sol} (141) / 100000	15000 / 15000 / 15000	29000 / 30000 / 30000
Acenaphthylene	28 / 69 / 160	170 / 420 / 920	2900 ^{sol} (86.1) / 4600 ^{sol} (212) / 6000 ^{sol} (506)	83000 ^{sol} (86.1) / 97000 ^{sol} (212) / 100000	15000 / 15000 / 15000	29000 / 30000 / 30000
Anthracene	380 / 950 / 2200	2400 / 5400 / 11000	31000 ^{sol} (1.17) / 35000 / 37000	520000 / 540000 / 540000	74000 / 74000 / 74000	150000 / 150000 / 150000
Benzo(a)anthracene	2.9 / 6.5 / 13	7.2 / 11 / 13	11 / 14 / 15	170 / 170 / 180	29 / 29 / 29	49 / 56 / 62
Benzo(a)pyrene (Bap) ^u	0.97 / 2.0 / 3.5	2.2 / 2.7 / 3.0	3.2 / 3.2 / 3.2	35 / 35 / 36	5.7 / 5.7 / 5.7	11 / 12 / 13
Benzo(b)fluoranthene	0.99 / 2.1 / 3.9	2.6 / 3.3 / 3.7	3.9 / 4.0 / 4.0	44 / 44 / 45	7.1 / 7.2 / 7.2	13 / 15 / 16
Benzo(g,h,i)perylene	290 / 470 / 640	320 / 340 / 350	360 / 360 / 360	3900 / 4000 / 4000	640 / 640 / 640	1400 / 1500 / 1600
Benzo(k)fluoranthene	37 / 75 / 130	77 / 93 / 100	110 / 110 / 110	1200 / 1200 / 1200	190 / 190 / 190	370 / 410 / 440
Chrysene	4.1 / 9.4 / 19	15 / 22 / 27	30 / 31 / 32	350 / 350 / 350	57 / 57 / 57	93 / 110 / 120
Dibenzo(ah)anthracene	0.14 / 0.27 / 0.43	0.24 / 0.28 / 0.3	0.31 / 0.32 / 0.32	3.5 / 3.6 / 3.6	0.57 / 0.57 / 0.58	1.1 / 1.3 / 1.4
Fluoranthene	52 / 130 / 290	280 / 560 / 890	1500 / 1600 / 1600	23000 / 23000 / 23000	3100 / 3100 / 3100	6300 / 6300 / 6400
Fluorene	27 / 67 / 160	170 / 400 / 860	2800 ^{sol} (30.9) / 3800 ^{sol} (76.5) / 4500 ^{sol} (183)	63000 ^{sol} (30.9) / 68000 / 71000	9900 / 9900 / 9900	20000 / 20000 / 20000
Indeno(1,2,3-cd)pyrene	9.5 / 21 / 39	27 / 36 / 41	45 / 46 / 46	500 / 510 / 510	82 / 82 / 82	150 / 170 / 180
Naphthalene ^q	4.1 / 10 / 24	2.3 / 5.6 / 13	2.3 / 5.6 / 13	190 ^{sol} (76.4) / 460 ^{sol} (183) / 1100 ^{sol} (432)	4900 / 4900 / 4900	1200 ^{sol} (76.4) / 1900 ^{sol} (183) / 3000
Phenanthrene	15 / 38 / 90	95 / 220 / 440	1300 ^{sol} (36.0) / 1500 / 1500	22000 / 22000 / 23000	3100 / 3100 / 3100	6200 / 6200 / 6300
Pyrene	110 / 270 / 620	620 / 1200 / 2000	3700 / 3800 / 3800	54000 / 54000 / 54000	7400 / 7400 / 7400	15000 / 15000 / 15000
Coal Tar (Bap as surrogate marker) ^u	0.32 / 0.67 / 1.2	0.79 / 0.98 / 1.1	1.2 / 1.2 / 1.2	15 / 15 / 15	2.2 / 2.2 / 2.2	4.4 / 4.7 / 4.8
Explosives ^{a, b, l, p}						
2, 4, 6 Trinitrotoluene	0.24 / 0.58 / 1.40	1.6 / 3.7 / 8.0	65 / 66 / 66	1000 / 1000 / 1000	130 / 130 / 130	260 / 270 / 270
RDX (Royal Demolition Explosive C ₃ H ₆ N ₆ O ₆)	17 / 38 / 85	120 / 250 / 540	13000 / 13000 / 13000	210000 / 210000 / 210000	26000 / 26000 / 27000	49000 ^{sol} (18.7) / 51000 / 53000
HMX (High Melting Explosive C ₄ H ₈ N ₈ O ₈)	0.86 / 1.9 / 3.9	5.7 / 13 / 26	6700 / 6700 / 6700	110000 / 110000 / 110000	13000 / 13000 / 13000	23000 ^{vap} (0.35) / 23000 ^{vap} (0.39) / 24000 ^{vap} (0.48)
Petroleum Hydrocarbons (SOM 1%/ 2.5%/ 6%) ^{a, b, l, m}						
Aliphatic EC 5-6	730 / 1700 / 3900	42 / 78 / 160	42 / 78 / 160	3200 ^{sol} (304) / 5900 ^{sol} (558) / 12000 ^{sol} (1150)	570000 ^{sol} (304)) 590000 / 600000	95000 ^{sol} (304) / 130000 ^{sol} (558) / 180000 ^{sol} (1150)
Aliphatic EC >6-8	2300 / 5600 / 13000	100 / 230 / 530	100 / 230 / 530	7800 ^{sol} (144) / 17000 ^{sol} (322) / 40000 ^{sol} (736)	600000 / 610000 / 620000	150000 ^{sol} (144) / 220000 ^{sol} (322) / 320000 ^{sol} (736)
Aliphatic EC >8-10	320 / 770 / 1700	27 / 65 / 150	27 / 65 / 150	2000 ^{sol} (78) / 4800 ^{vap} (190) / 11000 ^{vap} (451)	13000 / 13000 / 13000	14000 ^{sol} (78) / 18000 ^{vap} (190) / 21000 ^{vap} (451)
Aliphatic EC >10-12	2200 / 4400 / 7300	130 ^{vap} (48) / 330 ^{vap} (118) / 760 ^{vap} (283)	130 ^{vap} (48) / 330 ^{vap} (118) / 770 ^{vap} (283)	9700 ^{sol} (48) / 23000 ^{vap} (118) / 47000 ^{vap} (283)	13000 / 13000 / 13000	21000 ^{sol} (48) / 23000 ^{vap} (118) / 24000 ^{vap} (283)
Aliphatic EC >12-16	11000 / 13000 / 13000	1100 ^{sol} (24) / 2400 ^{sol} (59) / 4300 ^{sol} (142)	1100 ^{sol} (24) / 2400 ^{sol} (59) / 4400 ^{sol} (142)	59000 ^{sol} (24) / 82000 ^{sol} (59) / 90000 ^{sol} (142)	13000 / 13000 / 13000	25000 ^{sol} (24) / 25000 ^{sol} (59) / 26000 ^{sol} (142)
Aliphatic EC >16-35 ^o	260000 / 270000 / 270000	65000 ^{sol} (8.48) / 92000 ^{sol} (21) / 110000	65000 ^{sol} (8.48) / 92000 ^{sol} (21) / 110000	1600000 / 1700000 / 1800000	250000 / 250000 / 250000	450000 / 480000 / 490000

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Determinand	Allotment	R _w HP	R _w HP	Commercial/ Industrial	POSresi	POSpark
Aliphatic EC >35-44 °	260000 / 270000 / 270000	65000 ^{sol} /8.48 92000 ^{sol} (21) / 110000	65000 ^{sol} /8.48 92000 ^{sol} (21) 110000	1600000 / 1700000 / 1800000	250000 / 250000 / 250000	450000 / 480000 / 490000
Aromatic EC 5-7 (benzene)	13 / 27 / 57	70 / 140 / 300	370 / 690 / 1400	26000 ^{sol} (1220) / 46000 ^{sol} (2260) / 86000 ^{sol} (4710)	56000 / 56000 / 56000	76000 ^{sol} (1220) /84000 ^{sol} (2260)/ 92000 ^{sol} (4710)
Aromatic EC >7-8 (toluene)	22 / 51 / 120	130 / 290 / 660	860 / 1800 / 3900	56000 ^{vap} (869)/ 110000 ^{sol} (1920)/ 180000 ^{vap} (4360)	56000 / 56000 / 56000	87000 ^{vap} (869) / 95000 ^{sol} (1920)/ 100000 ^{vap} (4360)
Aromatic EC >8-10	8.6 / 21 / 51	34 / 83 / 190	47 / 110 / 270	3500 ^{vap} (613) / 8100 ^{vap} (1500) / 17000 ^{vap} (3580)	5000 / 5000 / 5000	7200 ^{vap} (613) / 8500 ^{vap} (1500) / 9300 ^{vap} (3580)
Aromatic EC >10-12	13 / 31 / 74	74 / 180 / 380	250 / 590 / 1200	16000 ^{sol} (364) / 28000 ^{sol} (899) / 34000 ^{sol} (2150)	5000 / 5000 / 5000	9200 ^{sol} (364) / 9700 ^{sol} (899) / 10000
Aromatic EC >12-16	23 / 57 / 130	140 / 330 / 660	1800 / 2300 ^{sol} (419) / 2500	36000 ^{sol} (169) / 37000 / 38000	5100 / 5100 / 5000	10000 / 10000 / 10000
Aromatic EC >16-21 °	46 / 110 / 260	260 / 540 / 930	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7600 / 7700 / 7800
Aromatic EC >21-35 °	370 / 820 / 1600	1100 / 1500 / 1700	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Aromatic EC >35-44 °	370 / 820 / 1600	1100 / 1500 / 1700	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Aliphatic + Aromatic EC >44-70 °	1200 / 2100 / 3000	1600 / 1800 / 1900	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Chloroalkanes & Chloroalkenes (SOM 1%/ 2.5%/ 6%) a, b, l, p						
1,2-Dichloroethane	0.0046 / 0.0083 / 0.016	0.0071 / 0.011 / 0.019	0.0092 / 0.013 / 0.023	0.67 / 0.97 / 1.7	29 / 29 / 29	21 / 24 / 28
1,1,1 Trichloroethane (TCA)	48 / 110 / 240	8.8 / 18 / 39	9.0 / 18 / 40	660 / 1300 / 3000	140000 / 140000 / 140000	57000 ^{vap} (1425) 76000 ^{vap} (2915)/ 100000 ^{vap} (6392)
1,1,1,2 Tetrachloroethane	0.79 / 1.9 / 4.4	1.2 / 2.8 / 6.4	1.5 / 3.5 / 8.2	110 / 250 / 560	1400 / 1400 / 1400	1500 / 1800 / 2100
1,1,1,2 Tetrachloroethane	0.41 / 0.89 / 2.0	1.6 / 3.4 / 7.5	3.9 / 8.0 / 17	270 / 550 / 1100	1400 / 1400 / 1400	1800 / 2100 / 2300
Tetrachloromethane (Carbon Tetrachloride)	0.45 / 1.0 / 2.4	0.026 / 0.056 / 0.13	0.026 / 0.056 / 0.13	2.9 / 6.3 / 14	890 / 920 / 950	190 / 270 / 400
Trichloromethane (Chloroform)	0.42 / 0.83 / 1.7	0.91 / 1.7 / 3.4	1.2 / 2.1 / 4.2	99 / 170 / 350	2500 / 2500 / 2500	2600 / 2800 / 3100
Phenol & Chlorophenols a, b, l, p						
Phenol	23 / 42 / 83	120 / 200 / 380	440 / 690 / 1200	440 ^{dir} (26000) / 690 ^{dir} (30000) / 1300 ^{dir} (34000)	440 ^{dir} (10000)/ 690 ^{dir} (10000) 1300 ^{dir} (10000)	440 ^{dir} (7600) / 690 ^{dir} (8300) / 1300 ^{dir} (93000)
Chlorophenols (excluding PCP) *	0.13 ^s / 0.3 / 0.7	0.87 ^s / 2.0 / 4.5	94 / 150 / 210	3500 / 4000 / 4300	620 / 620 / 620	1100 / 1100 / 1100
Pentachlorophenol (PCP)	0.03 / 0.08 / 0.19	0.22/ 0.52 / 1.2	27 ^{vap} (16.4) / 29 / 31	400 / 400 / 400	60 / 60 / 60	110 / 120 / 120
Other a, b, l, p						
Carbon Disulphide	4.8 / 10 / 23	0.14 / 0.29 / 0.62	0.14 / 0.29 / 0.62	11 / 22 / 47	11000 / 11000 / 12000	1300 / 1900 / 2700
Hexachlorobutadiene (HCBD)	0.25 / 0.61 / 1.4	0.29 / 0.7 / 1.6	0.32 / 0.78 / 1.8	31 / 66 / 120	25 / 25 / 25	48 / 50 / 51
Pesticides (SOM 1%/ 2.5%/ 6%) a, b, l, p						
Aldrin	3.2 / 6.1 / 9.6	5.7/ 6.6 / 7.1	7.3 / 7.4 / 7.5	170 / 170 / 170	18 / 18 / 18	30 / 31 / 31
Atrazine	0.5 / 1.2 / 2.7	3.3 / 7.6 / 17.4	610 / 620 / 620	9300 / 9400 / 9400	1200 / 1200 / 1200	2300 / 2400 / 2400
Dichlorvos	0.0049 / 0.010 / 0.022	0.032 / 0.066 / 0.14	6.4 / 6.5 / 6.6	140 / 140 / 140	16 / 16 / 16	26 / 26 / 27
Dieldrin	0.17/0.41/0.96	0.97/ 2 / 3.5	7.0 / 7.3 / 7.4	170 / 170 / 170	18 / 18 / 18	30 / 30 / 31
Alpha - Endosulfan	1.2 / 2.9 / 6.8	7.4 / 18 / 41	160 ^{vap} (0.003)/ 280 ^{vap} (0.007)/ 410 ^{vap} (0.016)	5600 ^{vap} (0.003) / 7400 ^{vap} (0.007) / 8400 ^{vap} (0.016)	1200 / 1200 / 1200	2400 / 2400 / 2500
Beta - Endosulfan	1.1 / 2.7 / 6.4	7.0 / 17 / 39	190 ^{vap} (0.00007) /320 ^{vap} (0.0002) /440 ^{vap} (0.0004)	6300 ^{vap} (0.00007) /7800 ^{vap} (0.0002) / 8700	1200 / 1200 / 1200	2400 / 2400 / 2500
Alpha-Hexachlorocyclohexane	0.035/0.087/ 0.21	0.23/0.55 / 1.2	6.9 / 9.2 / 11	170 / 180 / 180	24 / 24 / 24	47 / 48 / 48
Beta - Hexachlorocyclohexane	0.013 / 0.032 / 0.077	0.085 / 0.2 / 0.46	3.7 / 3.8 / 3.8	65 / 65 / 65	8.1 / 8.1 / 8.1	15 / 15 / 16
Gamma – Hexachlorocyclohexane	0.0092 / 0.023 / 0.054	0.06 / 0.14 / 0.33	2.9 / 3.3 / 3.5	67 / 69 / 70	8.2 / 8.2 / 8.2	14 / 15 / 15
Chlorobenzenes a, b, l, p						
Chlorobenzene	5.9 / 14 / 32	0.46 / 1.0 / 2.4	0.46 / 1.0 / 2.4	56 / 130 / 290	11000 / 13000 / 14000	1300 ^{sol} (675)/ 2000 ^{sol} (1520)/ 2900
1,2-dichlorobenzene (1,2-DCB)	94 / 230 / 540	23 / 55 / 130	24 / 57 / 130	2000 ^{sol} (571) / 4800 ^{sol} (1370) / 11000 ^{sol} (3240)	90000 / 95000 / 98000	24000 ^{sol} (571) / 36000 ^{sol} (1370) /51000 ^{sol} (3240)

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Determinand	Allotment	R _W HP	R _{WO} HP	Commercial/ Industrial	POSresi	POSpark
1,3-dichlorobenzene (1,3-DCB)	0.25 / 0.6 / 1.5	0.4 / 1.0 / 2.3	0.44 / 1.1 / 2.5	30 / 73 / 170	300 / 300 / 300	390 / 440 / 470
1-4-dichlorobenzene (1,4-DCB)	15 ⁱ / 37 ⁱ / 88 ⁱ	61 ^a / 150 ^a / 350 ^a	61 ^a / 150 ^a / 350 ^a	4400 ^{vap,q} (224) / 10000 ^{vap,q} (540) / 25000 ^{vap,q} (1280)	17000 ⁱ / 17000 ⁱ / 17000 ⁱ	36000 ^{vap,i} (224) / 36000 ^{vap,i} (540) / 36000 ^{vap,i} (1280)
1,2,3-Trichlorobenzene	4.7 / 12 / 28	1.5 / 3.6 / 8.6	1.5 / 3.7 / 8.8	102 / 250 / 590	1800 / 1800 / 1800	770 ^{vap} (134) / 1100 ^{vap} (330) / 1600 ^{vap} (789)
1,2,4- Trichlorobenzene	55 / 140 / 320	2.6 / 6.4 / 15	2.6 / 6.4 / 15	220 / 530 / 1300	15000 / 17000 / 19000	1700 ^{vap} (318) / 2600 ^{vap} (786) / 4000 ^{vap} (1880)
1,3,5- Trichlorobenzene	4.7 / 12 / 28	0.33 / 0.81 / 1.9	0.33 / 0.81 / 1.9	23 / 55 / 130	1700 / 1700 / 1800	380 ^{vap} (36.7) / 580 ^{vap} (90.8) / 860 ^{vap} (217)
1,2,3,4-Tetrachlorobenzene	4.4 / 11 / 26	15 / 36 / 78	24 / 56 / 120	1700 ^{vap} (122) / 3080 ^{vap} (304) / 4400 ^{vap} (728)	830 / 830 / 830	1500 ^{vap} (122) / 1600 / 1600
1,2,3,5- Tetrachlorobenzene	0.38 / 0.90 / 2.2	0.66 / 1.6 / 3.7	0.75 / 1.9 / 4.3	49 ^{vap} (39.4) / 120 ^{vap} (98.1) / 240 ^{vap} (235)	78 / 79 / 79	110 ^{vap} (39.4) / 120 / 130
1,2,4,5- Tetrachlorobenzene	0.06 / 0.16 / 0.37	0.33 / 0.77 / 1.6	0.73 / 1.7 / 3.5	42 ^{sol} (19.7) / 72 ^{sol} (49.1) / 96	13 / 13 / 13	25 / 26 / 26
Pentachlorobenzene (P ₅ CB)	1.2 / 3.1 / 7.0	5.8 / 12 / 22	19 / 30 / 38	640 ^{sol} (43.0) / 770 ^{sol} (107) / 830	100 / 100 / 100	190 / 190 / 190
Hexachlorobenzene (HCB)	0.47 / 1.1 / 2.5	1.8 ^{vap} (0.20) / 3.3 ^{vap} (0.5) / 4.9	4.1 ^{vap} (0.20) / 5.7 ^{vap} (0.5) / 6.7 ^{vap} (1.2)	110 ^{vap} (0.20) / 120 / 120	16 / 16 / 16	30 / 30 / 30

Units are mg/kg Dry Weight

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R_WHP Residential with homegrown produce
R_{WO}HP Residential without homegrown produce
POSresi public open spaces near residential housing
POSpark public open space for recreational use but not dedicated sports pitches
SOM Soil Organic Matter – **the S4UL for all organic compounds will vary according to SOM**

- a Based on a sandy loam soil as defined in SR3 (Environment Agency, 2009b) and 6% soil organic matter (SOM)
- b Figures rounded to two significant figures
- c Based only on a comparison of oral and dermal soil exposure with oral Index Dose
- d The background ADE is limited to being no larger than the contribution from the relevant soil ADE
- e Based on comparison of inhalation exposure with inhalation TDI only
- f Based on a lifetime exposure via the oral, dermal and inhalation pathways
- g Based on localised effects comparing inhalation exposure with inhalation ID only
- h Based on comparison of inhalation exposure with inhalation ID
- i Based on comparison of oral and dermal exposure with oral TDI
- j Based on comparison of oral, dermal and inhalation exposure with inhalation TDI
- k Based on comparison of all exposure pathways with oral TDI
- l S4ULs assume that free phase contamination is not present
- m S4ULs based on a sub-surface soil to indoor air correction factor of 10
- n The HCV applied is based on the intake of total Xylene and therefore exposure should not consider an isomer in isolation
- o Oral, dermal and inhalation exposure compared with oral HCV
- p S4ULs based on a sub-surface soil to indoor air correction factor of 1
- q Based on a comparison of inhalation exposure with the inhalation TDI for localised effects
- r Based on 2,4-dichlorophenol unless otherwise stated
- s Based on 2,3,4,6-tetrachlorophenol
- t Based on lowest GAC for all three xylene isomers
- u Measured concentrations of benzo(a)pyrene should be compared to the S4UL for benzo(a)pyrene as a single compound and to the S4UL for benzo(a)pyrene as a surrogate marker of genotoxic PAHs.
- vap S4UL presented exceeded the vapour saturation limit, which is presented in brackets
- sol S4UL presented exceeds the solubility saturation limit, which is presented in brackets
- dir S4ULs based on a threshold protective of direct skin contact, guideline in brackets based on the health effects following long term exposure provided for illustration only

Table 3: Soil Guideline Values (SGVs) for dioxins, furans and dioxin like PCBs

Determinand	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial
Sum of PCDDs, PCDFs and dioxin-like PCBs	0.008	0.008	0.008	0.24

Units are mg/kg Dry Weight

Stantec Guide: Criteria Used in Generic Quantitative Risk Assessment (England)

Table 4: EIC/AGS/CL:AIRE Generic Assessment Criteria (GAC)

	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial	Soil Saturation Concentration
Metals					
Antimony	ND	ND	550	7500	NA
Barium	ND	ND	1300	22000	NA
Molybdenum	ND	ND	670	17000	NA
Organics (SOM 1%/ 2.5%/ 6%)					
1,1,2 Trichloroethane	0.28 / 0.61 / 1.4	0.6 / 1.2 / 2.7	0.88 / 1.8 / 3.9	94 / 190 / 400	4030 / 8210 / 18000
1,1-Dichloroethane	9.2 / 17 / 35	2.4 / 3.9 / 7.4	2.5 / 4.1 / 7.7	280 / 450 / 850	1830 / 2960 / 5600
1,1-Dichloroethene	2.8 / 5.6 / 12	0.23 / 0.4 / 0.82	0.23 / 0.41 / 0.82	26 / 46 / 92	2230 / 3940 / 7940
1,2,4-Trimethylbenzene	0.38 / 0.93 / 2.2	0.35 / 0.85 / 2	0.41 / 0.99 / 2.3	42 / 99 / 220	557 / 1360 / 3250
1,2-Dichloropropane	0.62 / 1.2 / 2.6	0.024 / 0.042 / 0.084	0.024 / 0.042 / 0.085	3.3 / 5.9 / 12	1190 / 2110 / 4240
2,4-Dimethylphenol	3.1 / 7.2 / 17	19 / 43 / 97	210 / 410 / 730	16000 / 24000 / 30000	1380 / 3140 / 7240
2,4-Dinitrotoluene	0.22 / 0.49 / 1.1	1.5 / 3.2 / 7.2	170 / 170 / 170	3700 / 3700 / 3800	141 / 299 / 669
2,6-Dinitrotoluene	0.12 / 0.27 / 0.61	0.78 / 1.7 / 3.9	78 / 84 / 87	1900 / 1900 / 1900	287 / 622 / 1400
2-Chloronaphthalene	40 / 98 / 230	3.7 / 9.2 / 22	3.8 / 9.3 / 22	390 / 960 / 2200	114 / 280 / 669
Biphenyl	14 / 35 / 83	66 / 160 / 360	220 / 500 / 980	18000 / 33000 / 48000	34.4 / 84.3 / 201
Bis (2-ethylhexyl) phthalate	47 / 120 / 280	280 / 610 / 1100	2700 / 2800 / 2800	85000 / 86000 / 86000	8.68 / 21.6 / 51.7
Bromobenzene	3.2 / 7.6 / 18	0.87 / 2 / 4.7	0.91 / 2.1 / 4.9	97 / 220 / 520	853 / 1970 / 4580
Bromodichloromethane	0.016 / 0.032 / 0.068	0.016 / 0.03 / 0.061	0.019 / 0.034 / 0.07	2.1 / 3.7 / 7.6	1790 / 3220 / 6570
Bromoform	0.95 / 2.1 / 4.6	2.8 / 5.9 / 13	5.2 / 11 / 23	760 / 1500 / 3100	2690 / 5480 / 12000
Butyl benzyl phthalate	220 / 550 / 1300	1400 / 3300 / 7200	42000 / 44000 / 44000	940000 / 940000 / 950000	26.3 / 64.7 / 154
Chloroethane	110 / 200 / 380	8.3 / 11 / 18	8.4 / 11 / 18	960 / 1300 / 2100	2610 / 3540 / 5710
Chloromethane	0.066 / 0.13 / 0.23	0.0083 / 0.0098 / 0.013	0.0085 / 0.0099 / 0.013	1 / 1.2 / 1.6	1910 / 2240 / 2990
Cis 1,2 Dichloroethene	0.26 / 0.5 / 1	0.11 / 0.19 / 0.37	0.12 / 0.2 / 0.39	14 / 24 / 47	3940 / 6610 / 12900
Dichloromethane	0.1 / 0.19 / 0.34	0.58 / 0.98 / 1.7	2.1 / 2.8 / 4.5	270 / 360 / 560	7270 / 9680 / 15300
Diethyl Phthalate	19 / 41 / 94	120 / 260 / 570	1800 / 3500 / 6300	150000 / 220000 / 290000	13.7 / 29.1 / 65
Di-n-butyl phthalate	2 / 5 / 12	13 / 31 / 67	450 / 450 / 450	15000 / 15000 / 15000	4.65 / 11.4 / 27.3
Di-n-octyl phthalate	940 / 2100 / 3900	2300 / 2800 / 3100	3400 / 3400 / 3400	89000 / 89000 / 89000	32.6 / 81.5 / 196
Hexachloroethane	0.27 / 0.67 / 1.6	0.2 / 0.48 / 1.1	0.22 / 0.54 / 1.3	22 / 53 / 120	8.17 / 20.1 / 48.1
Isopropylbenzene	32 / 79 / 190	11 / 27 / 64	12 / 28 / 67	1400 / 3300 / 7700	390 / 950 / 2250
Methyl tert-butyl ether (MTBE)	23 / 44 / 90	49 / 84 / 160	73 / 120 / 220	7900 / 13000 / 24000	20400 / 33100 / 62700
Propylbenzene	34 / 83 / 200	34 / 82 / 190	40 / 97 / 230	4100 / 9700 / 21000	402 / 981 / 2330
Styrene	1.6 / 3.7 / 8.7	8.1 / 19 / 43	35 / 78 / 170	3300 / 6500 / 11000	626 / 1440 / 3350
Total Cresols (2-, 3- and 4-methylphenol)	12 / 27 / 63	80 / 180 / 400	3700 / 5400 / 6900	160000 / 180000 / 180000	15000 / 32500 / 73300
Trans 1,2 Dichloroethene	0.93 / 1.9 / 4	0.19 / 0.34 / 0.7	0.19 / 0.35 / 0.71	22 / 40 / 81	3420 / 6170 / 12600
Tributyl tin oxide	0.042 / 0.1 / 0.24	0.25 / 0.59 / 1.3	1.4 / 3.1 / 5.7	130 / 180 / 200	41.3 / 101 / 241

Units are mg/kg Dry Weight

Table 5: Tier 2 Criteria for the Assessment of Soils – Protection of Flora and Fauna

Parameter	ICRCL 70/90 ^a		SSVs ^b	Code of Practice for Agricultural Use of Sewage Sludge ^c	BS 3882:2015 Specification for topsoil and requirements for use
	Maximum				Phytotoxic contaminants
	Livestock	Crop Growth			
	mg/kgDW	mg/kgDW			
Antimony			37		
Arsenic	500	1000		50	
Cadmium	30	50	0.6	3	
Chromium				400	
Cobalt			4.2		
Copper	500	250	35.1	80/ 100/ 135/ 200 ^d	<100/<135/<200 ^e
Fluoride	1000			500	
Lead	1000			300	
Mercury				1	
Molybdenum			5.1	4	
Nickel			28.2	50/ 60/ 75/ 110 ^d	<60/<75/<110 ^e
Selenium				3	
Silver			0.3		
Vanadium			2.0		

Stantec Guide: Criteria Used in Generic Quantitative Risk Assessment (England)

Parameter	ICRCL 70/90 ^a		SSVs ^b	Code of Practice for Agricultural Use of Sewage Sludge ^c	BS 3882:2015 Specification for topsoil and requirements for use Phytotoxic contaminants
	Maximum				
	Livestock	Crop Growth			
	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW
Zinc	3000	1000	35.6	200/200/200/300 ^d	<200/<200/<300 ^e
Benzo(a)pyrene			0.15		
Bis(2-ethylhexyl) phthalate			13		
Hexachlorobenzene			0.002		
Pentachlorobenzene					
Pentachlorophenol			0.6		
Perfluorooctanoic acid			0.022		
Perfluorooctane sulfonate			0.014		
Polychlorinated alkanes medium chain			11.9		
Tetrachloroethene					
Toluene					
Triclosan			0.13		
Tris(2-chloroethyl)phosphate			1.1		
Tris(2-chloro-1-methylethyl) phosphate			1.8		

a. Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.

b. Soil screening values for assessing ecological risks, EA 2017a Report – ShARE id26

c. Maximum permissible concentration of potentially toxic elements for Arable land from the Sewage sludge in agriculture: code of practice.. There are also criteria for Grassland which are higher than for Arable.

d. Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0 (and the soils contain more than 5% calcium carbonate)

e. Where three values are presented, concentrations are for soils with pH values <6.0/ 6.0-7.0/ >7.0

Table 6: Tier 2 Criteria for Screening Liquids

	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Arsenic SP	-	0.01	0.05 ⁽²⁾	0.025 ⁽²⁾
Boron	-	1	-	-
Cadmium PS	0.0001	0.005	≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 ⁽¹⁴⁾	0.0002
Chromium (total)	-	0.05	-	-
Chromium (III) SP	-	-	0.0047	-
Chromium (VI) SP	-	-	0.0034	0.0006
Copper SP	-	2	0.001 bioavailable	0.00376 bioavailable
Iron SP	-	0.2	1	1
Lead PS	-	0.01	0.0012 bioavailable	0.0013 bioavailable
Mercury compounds PS	0.00001	0.001	0.00007 max	0.00007 max
Manganese SP	-	0.05	0.123 bioavailable	-
Nickel PS	-	0.02	0.004 bioavailable	0.0086 bioavailable
Selenium	-	0.01	-	-
Zinc SP	-	5 ⁽³⁾	0.0109bioavailable ⁽¹³⁾	0.0068bioavailable ⁽¹³⁾
Chlorinated Compounds				
C10-13 chloroalkanes PS short chain chlorinated paraffins	-	-	0.0004	0.0004
Dichloromethane PS	-	-	0.02	0.02

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	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
1,2-Dichloroethane PS	0.001	0.003	0.01	0.01
Trichloroethene PS	0.0001	0.01 ⁽⁵⁾	0.01	0.01
1,1,1-Trichloroethane	0.0001	-	-	-
1,1,2-Trichloroethane	0.0001	-	-	-
Trichloromethanes PS	-	0.1 ⁽¹⁾	0.0025	0.0025
1, 2, 4-Trichlorobenzene	0.00001			
Tetrachloroethene PS	0.0001	0.01 ⁽⁵⁾	0.01	0.01
Tetrachloromethane/ Carbon tetrachloride PS	0.0001	0.003	0.012	0.012
Tetrachloroethane SP	-		0.140	
Vinyl chloride	-	0.0005	-	-
Trichlorobenzene (TCB) PS	-	-	0.0004	0.0004
Chloroform	0.0001			
Chloronitrotoluenes(CNT) ⁽¹¹⁾	0.001	-	-	-
Hexachlorobutadiene PS	0.000005	-	0.0006 max	0.0006 max
Hexachlorocyclohexanes (HCH) PS	0.000001	-	0.00002	0.000002
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	-	-	-	-
Acenaphthylene	-	-	-	-
Anthracene PS	-	-	0.0001	0.0001
Benzo(a)anthracene	-	-	-	-
Benzo(b)fluoranthene PS	-	0.0001 ⁽¹⁰⁾	0.000017 max ⁽¹²⁾	0.000017 max ⁽¹²⁾
Benzo(a)pyrene PS	-	0.00001	0.00000017	0.00000017
Benzo(k)fluoranthene PS	-	0.0001 ⁽¹⁰⁾	0.000017 max ⁽¹²⁾	0.000017 max ⁽¹²⁾
Benzo(g,h,i)perylene PS	-	0.0001 ⁽¹⁰⁾	0.0000082 max ⁽¹²⁾	0.00000082 max ⁽¹²⁾
Indeno(1,2,3-cd)pyrene PS	-	0.0001 ⁽¹⁰⁾	- ⁽¹²⁾	- ⁽¹²⁾
Chrysene		-	-	-
Dibenzo(a,h)anthracene		-	-	-
Fluoranthene PS	-	-	0.0000063	0.0000063
Fluorene	-	-	-	-
Phenanthrene	-	-	-	-
Pyrene	-	-	-	-
Naphthalene PS	-	-	0.002	0.002
Polycyclic Aromatic Hydrocarbons		0.0001 ⁽¹⁰⁾		
Petroleum hydrocarbons				
Petroleum hydrocarbons/Mineral oil	-	0.01 ⁽³⁾	-	-
Benzene PS	0.001	0.001	0.01	0.008
Toluene SP	0.004	0.7 ⁽⁹⁾	0.074	0.074
Ethylbenzene	-	0.3 ⁽⁹⁾	-	-
Xylenes	0.003 ⁽⁴⁾	0.5 ⁽⁹⁾		
Methyl tert-butyl ether (MTBE)	-	0.015 ⁽⁷⁾	-	-
Pesticides and Herbicides				
Alachlor PS	-	-	0.0003	0.0003
Aldrin PS	0.000003	0.00003	0.00001 ⁽⁸⁾	0.000005 ⁽⁸⁾
Dieldrin PS	0.000003	0.00003		
Endrin PS	0.000003	0.0006 ⁽⁹⁾		
Isodrin	0.000003	-	-	-
2,4 dichlorophenol SP	0.0001	-	0.0042	0.00042
2,4 D ester SP	0.0001	-	0.0003	0.0003
op and pp DDT (each) PS	0.000002	0.001 ⁽⁶⁾	0.000025 ⁽⁶⁾	0.000025 ⁽⁶⁾
op and pp DDE (each)	0.000002			
op and pp TDE (each)	0.000002			
Dimethoate SP	0.00001	-	0.00048	0.00048
Endosulfan PS	0.000005	-	0.000005	0.0000005
Hexachlorobenzene PS	0.000001		0.00005 max	0.00005 max
Permethrin SP	0.000001	-	0.000001	0.0000002
Atrazine PS	0.00003	-	0.0006	0.0006
Simazine PS	0.00003	-	0.001	0.001
Linuron SP	-	-	0.0005	0.0005
Mecoprop SP		-	0.018	0.018

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	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Trifluralin PS	0.00001	-	0.00003	0.00003
Total pesticides	-	0.0005		
Miscellaneous				
Ammoniacal nitrogen (as NH ₄ ⁺)	-	0.5	0.26 ¹⁶ 0.39 ¹⁷	-
Ammoniacal nitrogen (as N)	-	0.39	0.2 ¹⁶ 0.3 ¹⁷	-
Unionised Ammonia (NH ₃) SP	-	-	-	0.021
Chloride	-	250		
Chlorine SP			0.002	0.01 max
Cyanide SP (hydrogen cyanide)	-	0.05	0.001	0.001
Nitrate (as NO ₃)	-	50	-	-
Nitrite (as NO ₂)	-	0.1	-	-
Phenol SP	-	0.005 ⁽³⁾	0.0077	0.0077
Pentachlorophenol PS	0.0001	-	0.0004	0.0004
PCBs (individual congeners)	0.000001	-	-	-
Sodium	-	200	-	-
Sulphate	-	250		
Tributyl and triphenyl tin compounds (each) PS	0.000001	-	0.0000002	0.0000002
Di(2-ethylhexyl)-phthalate PS	-	-	0.0013	0.0013

Substances highlighted in **yellow** are hazardous substances, PS = Priority Substances, SP = Specific Pollutants, ‘-’ screening concentration is not available, ‘max’ – maximum allowable concentration used where no annual average provided

Notes:

- Concentration for trihalomethanes is the sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
- Concentration is the dissolved fraction of a water sample obtained by filtration through a 0.45µm filter.
- Concentration is taken from Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
- Concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
- Concentration is the Sum of TCE and PCE.
- Concentration is for Total DDT. Para DDT on its own has a target concentration of 0.00001mg/l.
- Concentration for MTBE is taken from Environment Agency guidance, dated 2006.
- Concentration is the sum of aldrin, dieldrin, endrin.
- Concentration is taken from WHO (2004) guidelines for drinking-water quality.
- Sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene
- Concentration is for 2,6-CNT, 4,2-CNT, 4,3-CNT, 2,4-CNT, 2,5-CNT
- BAP can be considered as a marker of the other PAHs for comparison with the annual average
- Concentration plus ambient background concentration (dissolved)
- For cadmium and its compounds the EQS depends on the hardness of the water (Class 1: < 40 mg CaCO₃/l, Class 2: 40 to < 50 mg CaCO₃/l, Class 3: 50 to < 100 mg CaCO₃/l, Class 4: 100 to < 200 mg CaCO₃/l and Class 5: ≥ 200 mg CaCO₃/l).
- Manufactured and used in industrial applications, such as flame retardants and plasticisers, as additives in metal working fluids, in sealants, paints, adhesives, textiles, leather fat and coatings. Persistent, bioaccumulate and toxic to aquatic life (carcinogen in rat studies). Candidate Persistent Organic Pollutant (POP).
- Acceptable 90th percentile concentration for a freshwater lake/river with “High” chemical quality standard and alkalinity (as mg/l CaCO₃) < 50 mg/L or alkalinity < 200 mg/L where river elevation > 80 m above Ordnance Datum (mAOD). See the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 for further details.
- Acceptable 90th percentile concentration for a freshwater lake/river with “High” chemical quality standard and alkalinity (as mg/l CaCO₃) ≥ 50 mg/L where river elevation < 80 m mAOD or > 200 mg/l where river elevation > 80 mAOD. See the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 for further details.

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Table 7: Tier 2 Criteria for Screening Groundwater Vapour Generation Hazard

Chemical	CAS	GAC _{gw} vap(µg/l) ^{1,2}		Aqueous Solubility (µg/l)
		Residential	Commercial	
Petroleum Hydrocarbons				
1,2,4-Trimethylbenzene	95-63-6	24	2,200	559,000
Benzene ³	71-43-2	210	20,000	1,780,000
Ethylbenzene ³	100-41-4	10,000	960,000 (sol)	180,000
Isopropylbenzene	98-82-8	850	86,000 (sol)	56,000
Propylbenzene	103-65-1	2,700	240,000 (sol)	54,100
Styrene	100-42-5	8,800	810,000 (sol)	290,000
Toluene ³	108-88-3	230,000	21,000,000 (sol)	590,000
TPH Aliphatic EC5-EC6 ³		1,900	190,000 (sol)	35,900
TPH Aliphatic >EC6-EC8 ³		1,500	150,000 (sol)	5,370
TPH Aliphatic >EC8-EC10 ³		57	5,700 (sol)	427
TPH Aliphatic >EC10-EC12 ³		37	3,600 (sol)	34
TPH Aromatic >EC5-EC7 ^{2,3}		210,000	20,000,000 (sol)	1,780,000
TPH Aromatic >EC7-EC8 ³		220,000	21,000,000 (sol)	590,000
TPH Aromatic >EC8-EC10 ³		1,900	190,000 (sol)	64,600
TPH Aromatic >EC10-EC12 ³		6,800	660,000 (sol)	24,500
TPH Aromatic >EC12-EC16 ³		39,000	3,700,000 (sol)	5,750
meta-Xylene ^{3,5}	108-38-3	9,500	940,000 (sol)	200,000
ortho-Xylene ^{3,5}	95-47-6	12,000	1,100,000 (sol)	173,000
para-Xylene ^{3,5}	106-42-3	9,900	980,000 (sol)	200,000
Polycyclic Aromatic Hydrocarbons (PAH)				
Acenaphthene	83-32-9	170,000 (sol)	15,000,000 (sol)	4,110
Acenaphthylene	208-96-8	220,000 (sol)	20,000,000 (sol)	7,950
Fluorene	86-73-7	210,000 (sol)	18,000,000 (sol)	1,860
Naphthalene	91-20-3	220	23,000 (sol)	19,000
Pesticides				
Aldrin	309-00-2	47 (sol)	3,700 (sol)	20
alpha-Endosulfan	959-98-8	7,400 (sol)	590,000 (sol)	530
beta-Endosulfan	33213-65-9	7,500 (sol)	600,000 (sol)	280
Halogenated Organics				
1,1,1,2-Tetrachloroethane	79-34-5	240	22,000	1,110,000
1,1,1-Trichloroethane	71-55-6	3,000	290,000	1,300,000
1,1,2,2-Tetrachloroethane	79-35-4	1,600	150,000	2,930,000
1,1,2-Trichloroethane	79-00-5	520	49,000	4,491,000
1,1-Dichloroethane	75-34-3	2,700	260,000	3,666,000
1,1-Dichloroethene	75-35-4	160	1,6000	3,100,000
1,2,3,4-Tetrachlorobenzene	634-66-2	240	31,000 (sol)	7,800
1,2,3,5-Tetrachlorobenzene	634-90-2	7.0	600	3,500
1,2,3-Trichlorobenzene	87-61-7	35	3,100	21,000
1,2,4,5-Tetrachlorobenzene	95-94-3	8.1	700 (sol)	600
1,2,4-Trichlorobenzene	120-82-1	68	7,200	41,400
1,2-Dichlorobenzene	95-50-1	2,000	220,000 (sol)	133,000
1,2-Dichloroethane	107-06-2	8.9	850	8,680,000
1,2-Dichloropropane	78-87-5	22	2,600	2,050,000
1,3,5-Trichlorobenzene	108-70-3	7.4	660	6,000
1,3-Dichlorobenzene	541-73-1	31	2,800	103,000
1,4-Dichlorobenzene	106-46-7	5,000	460,000 (sol)	51,200
Bromobenzene	108-86-1	220	20,000	388,040
Bromodichloromethane	75-27-4	17	1,600	3,000,000
Bromoform (Tribromomethane)	75-25-2	3,100	400,000	3,000,000
Chlorobenzene	108-90-7	98	15,000	387,000
Chloroethane	75-00-3	10,000	1,000,000	5,742,000
Chloroethene (Vinyl Chloride)	75-01-4	0.62	63	2,760,000
Chloromethane	74-87-3	14	1,400	5,350,000
cis-1,2-Dichloroethene	156-59-2	130	13,000	7,550,000
Dichloromethane	75-09-2	3,300	370,000	20,080,000
Hexachlorobenzene	118-74-1	16 (sol)	1,400 (sol)	10
Hexachlorobutadiene	87-68-3	1.7	230	4,800
Hexachloroethane	67-72-1	8.5	740	49,900

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Chemical	CAS	GAC _{gwvap} (µg/l) ^{1,2}		Aqueous Solubility (µg/l)
		Residential	Commercial	
Pentachlorobenzene	608-93-5	140	12,000 (sol)	500
Tetrachloroethene	127-18-4	34	4,600	225,000
Tetrachloromethane (Carbon Tetrachloride)	56-23-5	5.3	770	846,000
<i>trans</i> -1,2-Dichloroethene	156-60-5	160	16,000	5,250,000
Trichloroethene	79-01-6	5.7	530	1,370,000
Trichloromethane (Chloroform)	67-66-3	790	85,000	8,950,000
Others (organic and inorganic)				
2-Chloronaphthalene	91-58-7	160	14,000 (sol)	11,700
Biphenyl (Limonene)	92-52-4	15,000 (sol)	1,300,000 (sol)	4,060
Carbon Disulphide	75-15-0	56	5,600	2,100,000
Mercury, elemental	7439-97-6	1.1	95 (sol)	56
Methyl tertiary butyl ether (MTBE)	1634-04-4	83,000	7,800,000	48,000,000

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility.
2. GAC rounded to two significant figures.
3. The GAC for these petroleum hydrocarbon contaminants have been calculated using a sub-surface soil to indoor air correction factor of 10 in line with the physical-chemical data sources.
4. The GAC for TPH fractions do not account for genotoxic mutagenic effects. Concentrations of TPH Aromatic >EC5-EC7 should therefore also be compared with the GAC for benzene to ensure that such effects are also assessed.
5. The Health Criteria Value used for each xylene isomer was for total xylene. If site specific additivity assessments are not completed, as a conservative measure the sum of isomer concentrations should be compared to the lowest xylene GAC (as is the case for soil GAC).

Appendix C Table Summarising Geoenvironmental Laboratory Analysis Results (Soils)

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This table should be read in conjunction with the accompanying guide on the selection of evaluation criteria and the project specific note presenting the justification for selection.