FERNBROOK
CONSULTING ENGINEERS

Sustainable Drainage Strategy

Courtlands Riding Centre, Todds Green

April 2024

Prepared for

S J M & Co

Sustainable Drainage Strategy
Courtlands Riding Centre, Todds Green

Project Number: 21100
Doc Number: 21100-FCE-XX-XX-RP-D-0004

Rev	Issue Purpose	Author	Checked	Approved	Date
P01	Issued for information	DR	CR	DR	06.06.23
P02	Issued for information	DR	CR	DR	12.04.24

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1. Introduction

1.1 Fernbrook Consulting Engineers has been appointed by S J M & Co to provide a Sustainable Drainage Strategy for the proposed residential development at Courtlands Riding Centre, Todds Green.

1.2 This report has been prepared with specific reference to the requirements of National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG). This report also takes into consideration the requirements of the Local Flood Risk Management Strategy, the Non-Statutory Technical Standards for Sustainable Drainage Systems and CIRIA C753 The SuDS Manual.

Site Characteristics

1.3 Refer to **Table 1-1** below for details of the site and the site location plan shown in **Figure 1.1** below.

Table 1-1 Site Details

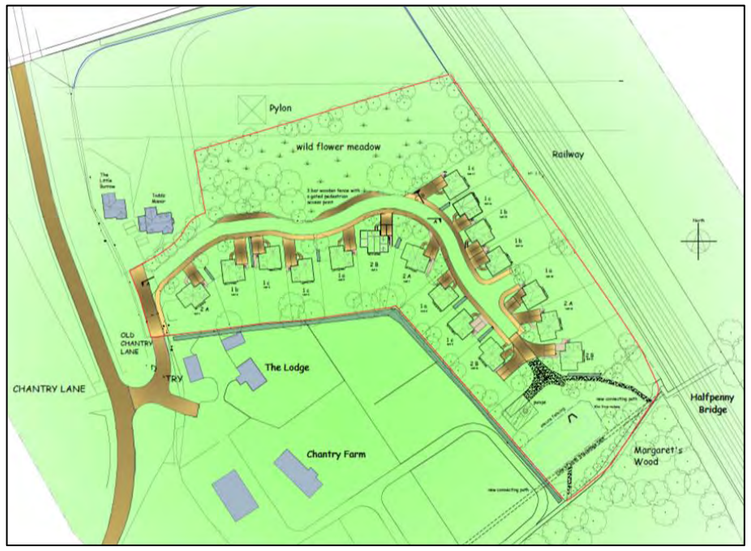
Site Address	Old Chantry Ln, Todds Green, Stevenage SG1 2JE
Grid reference	522065mE, 226825mN (TL 22065 26825)
Topography	Generally falling north to south
Geology	Clay, Sand & Gravel over Chalk bedrock
Site Area	1.82 ha
Existing Use	Riding Stables
Boundaries	North – A602
	East – Railway
	South – Woodland
	West – Old Chantry Lane
Access	Old Chantry Lane

Figure 1.1 Site Location Plan

Development Proposals

1.4 The development proposals are comprised of the demolition of ancillary farm buildings and to provide 17no. residential dwellings. An excerpt of the proposed development plan is included in **Figure 1.2** below, and the full plan is included in **Appendix A**.

Figure 1.2 Proposed Development Plan



2. Baseline Conditions

Topography

2.1 Based on the Topographical survey by Kempston Surveys, the site appears to fall from north to south. Refer to **Appendix B** for the Site Survey drawing.

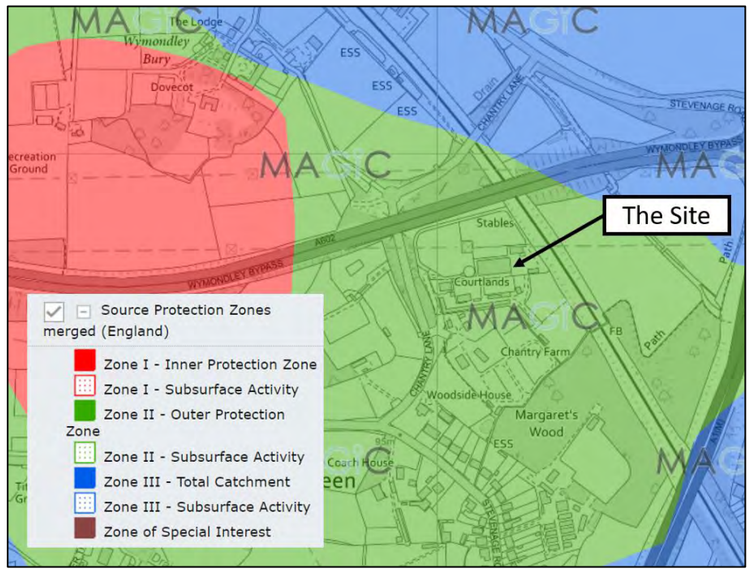
Geology

2.2 Based on the British Geology Survey (BGS) online data, the site appears to be underlain by Glaciofluvial Deposits, Mid Pleistocene (Sand and Gravel) over Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated) (Chalk) bedrock.

2.3 Based on the site investigation by HESI in September 2021, the site appears to be underlain by Clay above and Sand Gravel over the anticipated Chalk bedrock. Refer to **Appendix C** for Geotechnical data.

2.4 Based on Defra's Magic Map application, the site appears to be located in Source Protection Zone 2 (Outer Protection Zone). Refer to **Figure 2.1** below.

Figure 2.1 Source Protection Zone



2.5 Zone 2 is defined by the 400-day travel time from a point below the water table. Additionally, this zone has a minimum radius of 250 or 500 metres, depending on the size of the abstraction. The travel time is derived from consideration of the minimum time required to provide delay, dilution and attenuation of slowly degrading pollutants.

2.6 Any potential risk of groundwater contamination will be mitigated through a robust surface water management train approach as part of the proposed sustainable drainage systems (SuDS) post-development.

2.7 Refer to **Appendix C** for the Remediation Strategy to ensure that groundwater pollution will be mitigated.

Hydrology

2.8 There are no watercourses or waterbodies in close proximity to the site.

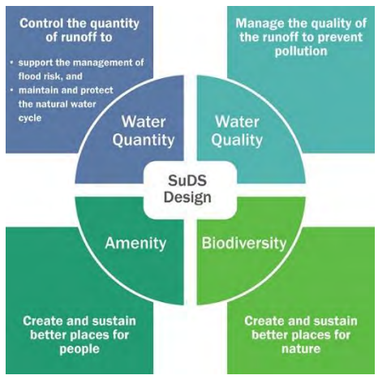
Existing Sewer Infrastructure

2.9 Based on the Anglian Water sewer records there appears to be a foul sewer conveying flows northbound along Old Chantry Lane. Refer to **Figure 2.2** below and **Appendix D** for Anglian Water sewer records.

Figure 2.2 Anglian Water Sewer Record Extract

3. Surface Water Management

3.1 The drainage strategy will follow the principles of Sustainable Drainage Design taking account of water quantity (flooding), water quality (pollution), biodiversity (wildlife and plants) and public amenity.



3.2 Based on the SuDS Hierarchy, the most appropriate sustainable drainage systems for the site are permeable paving and swales to provide inception storage and a stage of water treatment. The proposed attenuation basin in the public open space will increase the biodiversity and provide amenity benefits.

Storage Requirements

3.3 The proposed drainage will be designed to ensure that flooding does not occur on any part of the site for the 1 in 30 year rainfall event, and any flooding up to the 1 in 100 year plus 40% for climate change will be contained on site.

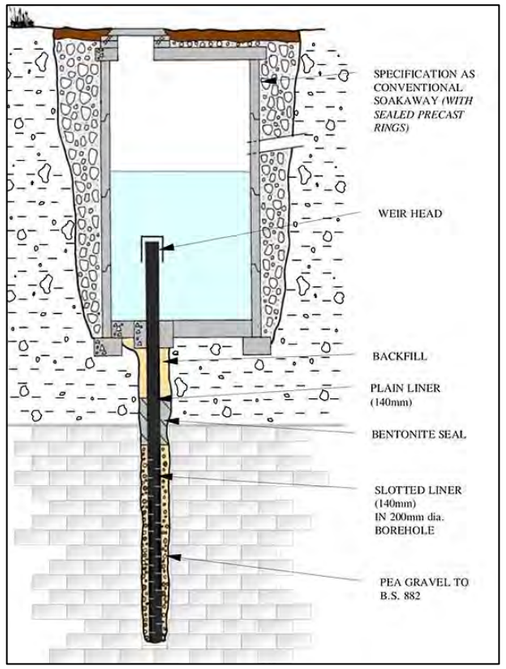
3.4 The site area is 1.82 ha and post-development the proposed development impermeable areas on site will be 0.464 ha (25% PIMP overall).

3.5 An in-situ Falling Head Tests were undertaken in September 2022 and February 2024. The test confirmed that the site is underlain by clay, sand and gravel over the anticipated chalk bedrock. Groundwater was encountered at 19.70m below ground level. The result of the falling head test was 3.6 x 10^{-5} m/s (0.1296 m/hour). Refer to **Appendix C** for the falling head test results.

3.6 Based on historic borehole data and the ground investigation, the chalk bedrock is expected to be approximately 20 -30m below ground level. Therefore, the risk of dissolution features or sinkholes is assessed as low.

3.7 The proposed drainage strategy will seek to convey surface water runoff from the residential units, driveways and access road ss southbound through the site towards a borehole soakaway in the open space along the site's southern boundary. Refer to **Figure 3.1** for an illustration of a borehole soakaway.

Figure 3.1 Borehole Soakaway



3.8 An basin will be provided upstream of the proposed soakaway to attenuate surface water runoff prior to infiltration and to provide a stage of water treatment with sediment forebays at the inlet and outlet. Refer to **Figure 3.2** for an indicative illustration of an attenuation basin.

Figure 3.2 Attenuation Basin

3.9 The proposed attenuation basin will be 2m deep with 1 in 3 side slopes and a total volume of 796m^3. The basin will have a 300mm freeboard.

3.10 The attenuation basin has a half-drain time greater than 24 hours for the 1 in 30 year rainfall event plus climate change. However, there is additional capacity in the system following all rainfall events up to the 1 in 100 year plus climate change scenario.

3.11 Refer to **Table 3-1** for the basin volumes and **Appendix E** for MicroDrainage calculations.

Table 3-1 Attenuation Basin Volumes

Rainfall event	Water Level (m)	Depth (mm)	Volume (m^3)	Capacity (m^3)
1 in 2 year	89.899	899	240	556
1 in 10 year	90.109	1109	322	474
1 in 30 year + 35% CC	90.523	1523	516	280
1 in 100 year + 40% CC	90.727	1727	630	166

3.12 Refer to drawing 21100-FCE-XX-XX-DR-D-0500 in **Appendix E** for the Proposed Drainage Strategy drawings.

Urbanisation & Long Term Storage

3.13 The hydraulic calculations include a 10% increase in impermeable area for building footprints, to allow for urban creep.

3.14 The proposed strategy will infiltrate surface water runoff, therefore there is no requirement to provide long term storage.

Water Quality Management

3.15 The site is located in Groundwater Source Protection Zone 2 and SuDS will be provided to form a management train in line with the best practice. Source control techniques including swales and permeable paving will be provided to treat surface water runoff prior to infiltration to ground.

3.16 The recommended stages of treatment in terms of water quality would be provided through the permeable paving, swales, a vortex separator and an attenuation basin with sediment forebays at the inlet and outfall.

3.17 The permeable paving construction will also include a separation layer above the aggregate to encourage the growth of microbes to biodegrade organic matter found in water run-off. The permeable paving will be lined with an impermeable membrane to ensure runoff can undergo additional stages of treatment prior to discharging via infiltration.

3.18 In line with CIRIA C753 The SuDS Manual, Tables 26.2 and 26.3, the pollution hazards indices associated with a residential development are mitigated by the proposed SuDS Management Train. Refer to **Table 3-2** below for the Simple Index Method assessment, and **Appendix F** for Mitigation data.

Table 3-2 Simple Index Method

Pollution Hazard Indices			
Pollution hazard	**TSS**	**Metals**	**Hydrocarbons**
Low Property driveways, residential car parks, low traffic roads < 300 traffic movements/day	**0.50**	**0.40**	**0.40**
Pollution Mitigation Indices provided			
SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Swale	**0.50**	**0.60**	**0.60**
Downstream Defender	**0.25**	**0.20**	**0.40**
Attenuation basin	**0.25**	**0.25**	**0.30**
Total	***1.00***	***1.05***	***1.30***
Check	***+0.50***	***+0.65***	***+0.9***

3.19 The proposed borehole soakaway will not intercept groundwater and runoff will undergo 3no. stages of treatment prior to discharge, therefore the proposals comply with "Section 3: Groundwater Quality and Contaminated Land" of the Environment Agency's Pre-planning application Guidance Note: HNL Area.

3.20 The Environment Agency were formally consulted on the proposed drainage strategy under advice ref. ENVPAC/1/HNL/00454. Refer to **Appendix G** for EA correspondence.

3.21 The proposed borehole soakaway is as shallow as possible -extending the minimum depth into the sand and gravel in line with best practice and Environment Agency consultation.

3.22 The Phase II Environmental Report (ref. 168859) by Herts & Essex Site Investigations, dated August 2021 also confirmed the following:

3.23 "In the absence of any heavy contamination, risk to groundwater is low."

3.24 Therefore, there is a low risk of the proposals mobilising contaminants or having a detrimental effect on groundwater quality.

3.25 The proposed remediation strategy has also confirmed that any contamination present on site will be remediated to ensure the proposed borehole soakaway does not increase the risk to groundwater.

Maintenance

3.26 The maintenance of all SuDS components will be in accord with the best practices and the CIRIA C753 The SuDS Manual.

3.27 The drainage network could be offered for adoption to Anglian Water or maintained privately by a Management Company. A management company would likely be financed by a yearly maintenance fee chargeable to residents. The name of the Management Company is to be advised.

3.28 The recommended Operation and Maintenance requirements for the proposed permeable paving, swale and basin are outlined in **Table 3-3**. Refer to document **21100-FCE-XX-XX-RP-D-0005** for a recommended SuDS Management Plan.

Table 3-3 SuDS Management Plan

Maintenance Task	Description	Frequency
Regular Maintenance		
Litter management	Pick up all litter in SuDS and landscape areas and remove from site	Monthly
Tree / Grass maintenance	Mow all grass verges, paths and amenity at 35-50mm with 75mm max. Leaving grass in situ.	As required or monthly
Inlets and outlets	Inspect monthly, remove silt from slab aprons and debris. Strim 1m round for access	Monthly
Hard surfaces	Sweep all paving regularly.	As required
Occasional tasks		
Inspection and control chambers	Annual inspection, remove silt and check free flow	Annually
Silt management	Inspect swales for silt accumulation	Annually
	Excavate silt, stack and dry within 10m of the SuDS feature, but outside the design profile where water flows, spread, rake and overseed.	As required
Remedial work		
Repairs	Inspect SuDS system regularly to check for damage or failure. Undertake remedial work as required.	As required

4. Conclusion

4.1 Fernbrook Consulting Engineers has been appointed by S J M & Co to provide a Sustainable Drainage Strategy for the proposed development at Courtlands Riding Centre, Todds Green, Stevenage, SG1 2JE.

4.2 The development proposals are comprised of the demolition of stables and ancillary buildings to provide 17no. residential dwellings.

4.3 The proposed drainage strategy will seek to dispose of surface water runoff via infiltration to the underlying chalk geology via a borehole soakaway.

4.4 The drainage strategy will provide 796m^3 attenuation storage within a basin in southern half of the site, in addition to swales and permeable paving to provide inception storage and water quality benefits.

4.5 The proposed drainage system can accommodate all rainfall events up to the 1 in 100 year rainfall event plus 40% climate change allowance scenario.

4.6 The proposed borehole soakaway will not intercept groundwater and surface water runoff will undergo 3no. stages of treatment prior to discharge, therefore the proposals comply with "Section 3: Groundwater Quality" of the Environment Agency's HNL Pre-application Guidance Note.

4.7 The Phase II Environmental Report by Herts & Essex Site Investigations confirmed that the "risk to groundwater is low."

4.8 In conclusion, this report demonstrates that the proposals are consistent with the aims of the NPPF and its Planning Practice Guidance, along with the aims of the Local Flood Risk Management Strategy. Surface water runoff can be adequately managed without increasing the risk of flooding on site or elsewhere.

APPENDIX A – PROPOSED DEVELOPMENT PLAN

info@fernbrook.co

A 602 (Road)

A 602

Pylon

wild flower meadow

Railway

The Little Burrow

Todds Manor

3 bar wooden fence with a gated pedestrian access point

MP 0.5

North

1 c Unit 17

1 c Unit 16

1 b Unit 15

1 b Unit 14

1 a Unit 13

2 A Unit 12

2 B Unit 11

1 c Unit 9

2 B Unit 10

1 a Unit 8

2 A Unit 7

2 B Unit 6

1 a Unit 5

1 c Unit 4

1 c Unit 3

1 b Unit 2

2 A Unit 1

OLD CHANTRY LANE

CHANTRY LANE

The Lodge

Chantry Farm

pumps

secure fencing

new connecting path

30m from railway

new connecting path

Halfpenny Bridge

Margaret's Wood

Brick

1650 ft2 153.400m2

11 x 1650 Sq ft's
6 x 2000 Sq ft's

Brick

2000 ft2 185.900m2

Site Plan 1;500 Scale

1:2500 0 50m 100m 200m
1:1250 0 25m 50m 100m
1:500 0 5m 10m 20m 40m
1:200 0 2m 4m 8m 16m
1:100 0 1m 2m 4m 8m
1:50 0 0.5m 1m 2m 4m

notes:

any discrepancies should be reported immediately

all dimensions should be checked on site prior to commencement of work

site/survey based on ordnance survey information provided by prodat systems plc, (www.promap.co.uk) prodat does not guarantee that all past or current uses or features will be identified in the product

the product does not give details about the actual state or condition of the site nor should it be used or taken to indicate or exclude actual suitability or unsuitability of the site for any particular purpose, or relied upon for determining salability or value, or used as a substitute for any physical investigation or inspection.

drawings to be read in accordance with the dwelling emission rate (der/ter) calculation. the building must be built 'as designed' meeting the criteria set for air permeability.

note
when printing off pdf's.
it is the responsibility of the user to verify that the resulting prints are to scale on the appropriate sized sheet.
also that the scale bars on the plan measure correctly.

Date	Description	Rev
Aug	road width	Q/R
Aug	pump added / centre line rev	J,M,N,P
Aug	all detached	K

hps Architecture & Planning
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Chartered Institute of Architectural Technologists

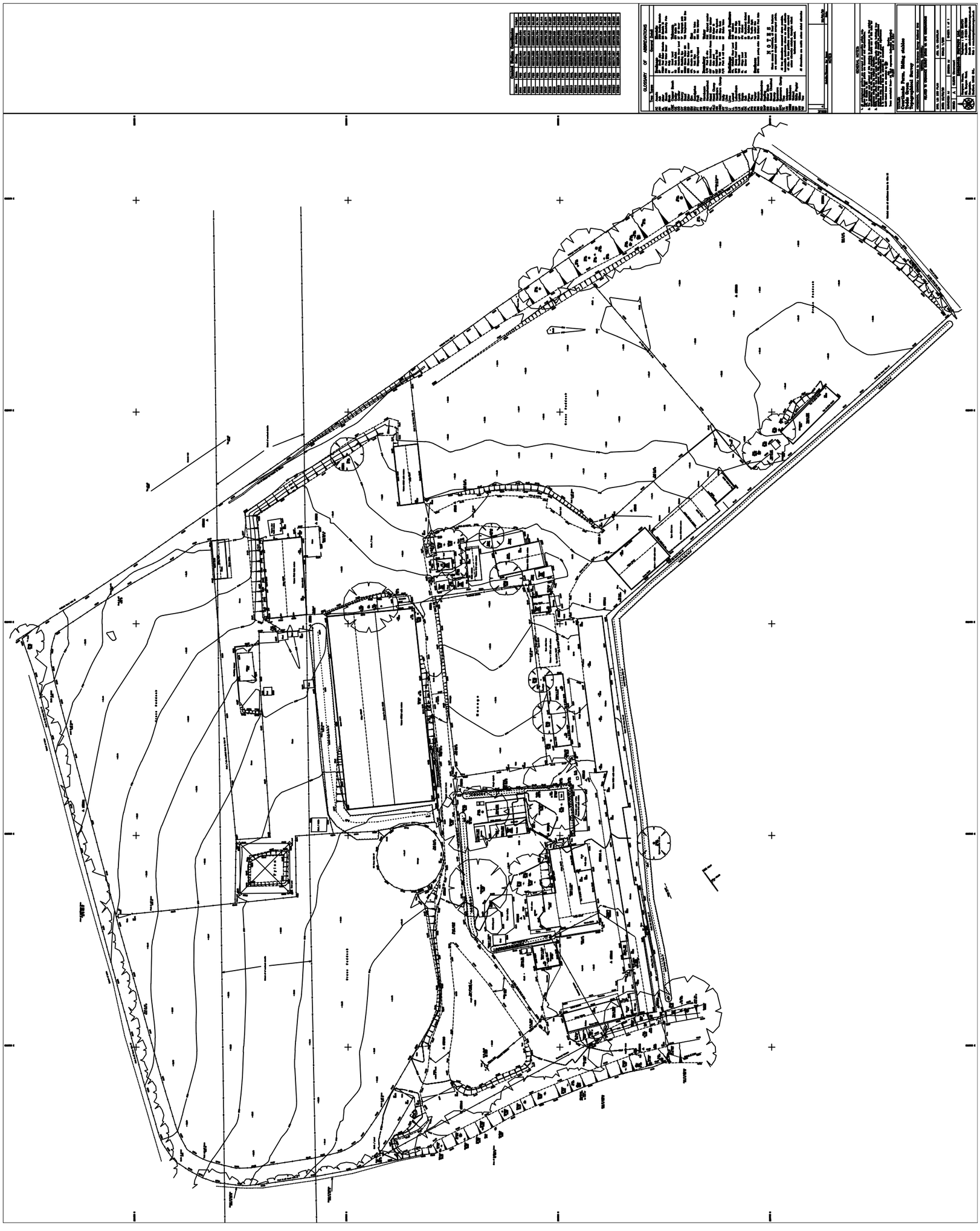
Description

Project	Courtlands Stevenage SG1 2JE
Drawing	Site Plan
Date	23/08/2021
Scale	1:500
Sheet size	A1
Drawn	mRn

14043-P030-R

APPENDIX B – TOPOGRAPHICAL SURVEY

info@fernbrook.co



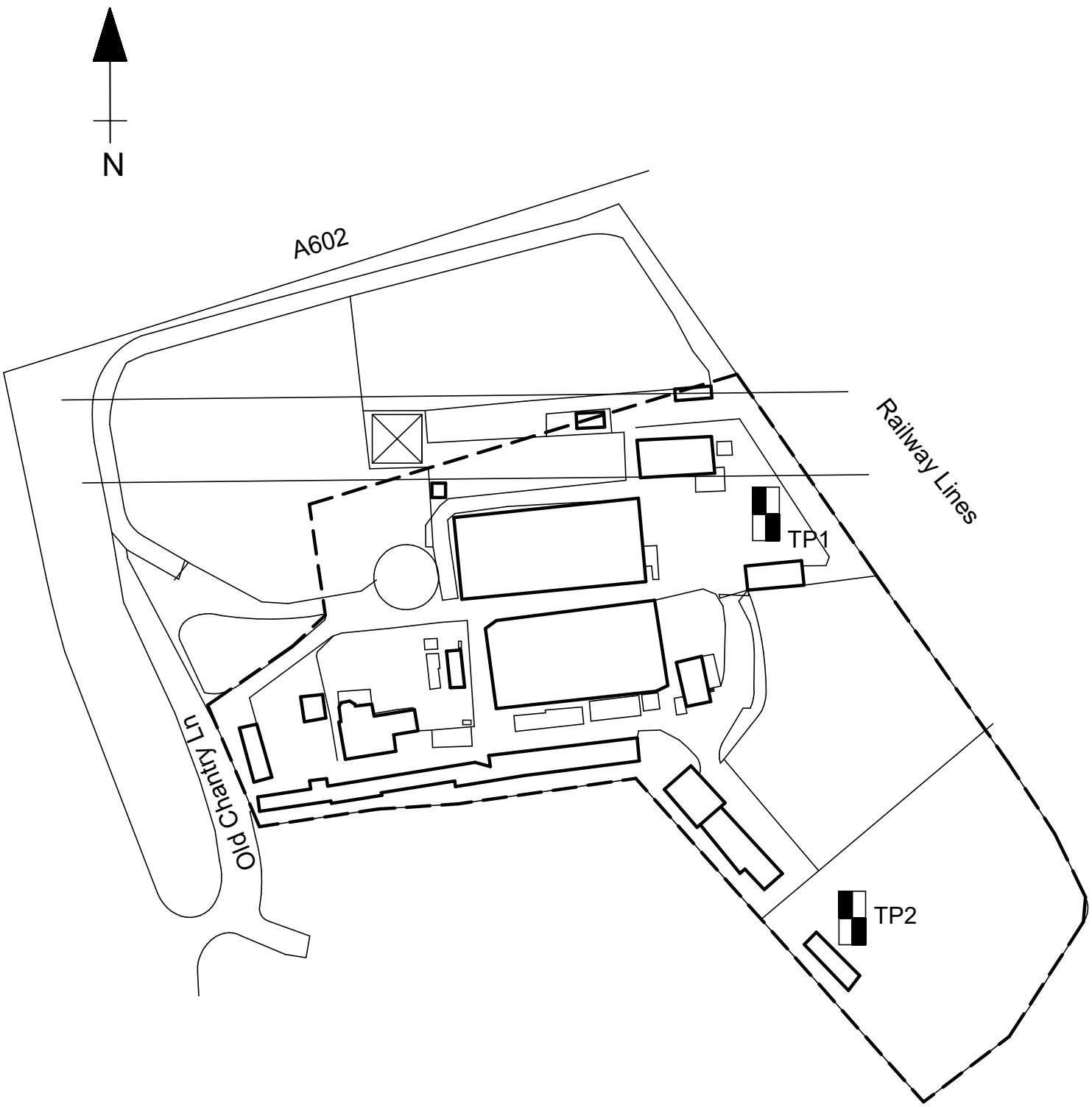
APPENDIX C – GEOTECHNICAL DATA

HERTS & ESSEX SITE INVESTIGATIONS
The Old Post Office, Wellpond Green
Standon, Ware, Herts. SG11 1NJ
Telephone: 01920 822233
e-mail info@hesi.co.uk

Appendix No	2
Sheet No	2
Job No	16885
Date	July 2021

Courtland Riding Stables, Old Chantry Lane, Todds Green, Stevenage SG1 2JE

Existing Site Plan



Not to Scale
Sketch No. : DTS / 16885 / 02 / 02

HERTS & ESSEX SITE INVESTIGATIONS

The Old Post Office, Wellpond Green, Herts, SG11 1NJ
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Email: info@hesi.co.uk

Appendix No.: 3
Sheet No.: 1
Job No.: 16886
Date: August 2021

Courtland Riding Stables, Old Chantry Lane, Todds Green, Stevenage, SG1 2JE

Soakaway No.: One

Description of Strata	Depth B.G.L. (m)	Reduced Level	Legend	Strata Thickness (m)	Water Level (m)	Samples			S.P.T. N - Value or Vane Strength	Shooring Depth (m)
						Number	Type	Depth (m)		
Loose - compact crushed brick and concrete with much gravel and a dark brown sandy infill - MADE GROUND	0.70			0.70						
Firm - stiff dark grey black very sandy slightly organic CLAY with much brick and gravel fragments - MADE GROUND	1.00			0.30						
Compact dark brown slightly clayey SAND with brick, gravel and plastic fragments - MADE GROUND	2.10			1.10	DRY					
Stiff dark grey brown very sandy CLAY	2.25			0.15						
Stiff orange brown very sandy CLAY	3.10									
Borehole closed at 3.10m b.g.l. Roots 1.10m bgl										

Remarks:

Scale 1:20

Key:
U - Undisturbed Sample
W - Water Sample
B - Bulk Sample
D - Disturbed Sample
▼ - Water Strike
▽ - Standing Water
V - Shear Vane Test (kN/m²)
N - SPT 'N' Value

HERTS & ESSEX SITE INVESTIGATIONS

The Old Post Office, Wellpond Green, Herts, SG11 1NJ
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Appendix No.: 3
Sheet No.: 2
Job No.: 16886
Date: August 2021

Courtland Riding Stables, Old Chantry Lane, Todds Green, Stevenage, SG1 2JE

Soakaway No.: Two

Description of Strata	Depth B.G.L. (m)	Reduced Level	Legend	Strata Thickness (m)	Water Level (m)	Samples			S.P.T. N - Value or Vane Strength	Casing Depth (m)
						Number	Type	Depth (m)		
Stiff mottled orange brown slightly silty CLAY FILL with some brick and gravel fragments - MADE GROUND	0.45			0.45	DRY					
Tarmac - MADE GROUND	0.60			0.15						
Stiff brown sandy CLAY with occasional brick and gravel fragments - MADE GROUND	0.90			0.30						
Stiff brown mottled light brown CLAY with very sandy clay pockets										
Borehole closed at 2.40m b.g.l. Roots to 0.45m bgl										

Remarks:

Scale 1:20

Key:
U - Undisturbed Sample
W - Water Sample
B - Bulk Sample
D - Disturbed Sample
▼ - Water Strike
▽ - Standing Water
V - Shear Vane Test (kN/m²)
N - SPT 'N' Value

HESI Soakaway Test Log

Location : Courtland Riding Stables, Old Chantry Lane, Todds Green, Stevenage, SG1 2JE

Weather : Dry and Overcast

Soil : Stiff orange brown very sandy CLAY

Test Pit No. 1

Size of Test Pit : 1.40 m Long 0.60 m Wide 3.10 m Deep

Time at start of Test : 10:24am Time at end of Test : 13:24pm

Date : 12/08/2021 Date : 12/08/2021

Water level before filling : DRY m Below Ground Level

Water level at commencement of test : 2.40 m Below Ground Level

Water Level Below Ground Level (m)	Elapsed Time (mins)
2.40	0
2.40	5
2.40	10
2.40	15
2.40	20
2.41	25
2.41	30
2.41	40
2.41	50
2.41	60
2.41	90
2.41	120
2.41	150
2.41	180

Water Level Below Ground Level (m)	Elapsed Time (mins)

Remarks : TEST ABANDONED AFTER THREE HOURS DUE TO STATIC WATER

HESI Soakaway Test Log

Location : Courtland Riding Stables, Old Chantry Lane, Todds Green, Stevenage, SG1 2JE

Weather : Dry and Overcast

Soil : Stiff brown mottled light brown CLAY with very sandy clay pockets

Test Pit No. 2

Size of Test Pit : 1.40 m Long 0.60 m Wide 2.40 m Deep

Time at start of Test : 10:15am Time at end of Test : 13:15pm

Date : 12/08/2021 Date : 12/08/2021

Water level before filling : DRY m Below Ground Level

Water level at commencement of test : 1.23 m Below Ground Level

Water Level Below Ground Level (m)	Elapsed Time (mins)
1.23	0
1.23	5
1.24	10
1.24	15
1.24	20
1.24	25
1.24	30
1.24	40
1.24	50
1.24	60
1.24	90
1.24	120
1.24	150
1.24	180

Water Level Below Ground Level (m)	Elapsed Time (mins)

Remarks : TEST ABANDONED DUE TO STATIC WATER AFTER THREE HOURS

HESI
Herts & Essex Site Investigations
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01920 822233 | www.hesi.co.uk | info@hesi.co.uk
Geotechnical Assessments | Environmental Assessments | Desktop Studies | Contamination Analysis

29TH September 2022 Our ref : CSG/16885

Clovercourt Ltd
Vault Design Studio
R/O 144 High Street
Rickmansworth
Herts
WD3 1AB

For the attention of G.Sewel Esq.,

Dear Sir,

Re: Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE: Site Investigation

1.01 In accordance with your instructions, we visited the above site during September 2021.

1.02 The purpose of our visit was to carry out an investigation into the subsoil conditions in order to aid the design of a piled foundation.

1.03 The comments and opinions expressed are based purely on the conditions encountered and the subsequent laboratory testing. The locations of the excavations have been assessed on site.

1.04 Some special condition may be present on site that, to date, has not been encountered within the scope of the site investigation works and therefore will not have been taken into account within this report.

1.05 All ground water recordings or their absence relate to short term observations and do not allow for fluctuations due to seasonal or other effects.

SECTION 2 DESCRIPTION OF SITE

2.01 The site is formed by an existing block of stables, barns and menage areas. The site also includes some grazing and pasture land.

2.02 The site is surrounded by open arable land and a railway line at a reduced elevation to the site.

SECTION 3 FIELDWORK

3.01 In order to assess the site, the proposals have been made to assess both the deeper soils profiles in order to enable the design of potentially traditional foundations or piled foundations should this option become unviable. In order to complete these works, the following site investigation works were implemented.

- 1 No Shell and Auger Borehole sunk to depths of between 25.00meters - Date of Works – 15th September 2022.
- Falling head test.
- Laboratory Testing – August 2021.

3.02 The location of these works is indicated on the site plan-forming appendix one.

3.03 The various strata encountered were noted and are recorded on the borehole logs forming appendix two.

3.04 Full ranges of samples were recovered as noted and retained for subsequent laboratory testing the results of which are recorded within appendix 3 of the report.

SECTION 4 FALLING HEAD TEST

Within the borehole a falling head test was completed. The result of the falling head test was 6.8×10^{-1}

I hope the foregoing is sufficient for your requirements, although please do not hesitate to contact us should require any further information regarding the above.

Yours Faithfully

C.S.Gray M.Sc
Contract Engineer

HESI
Herts & Essex Site Investigations
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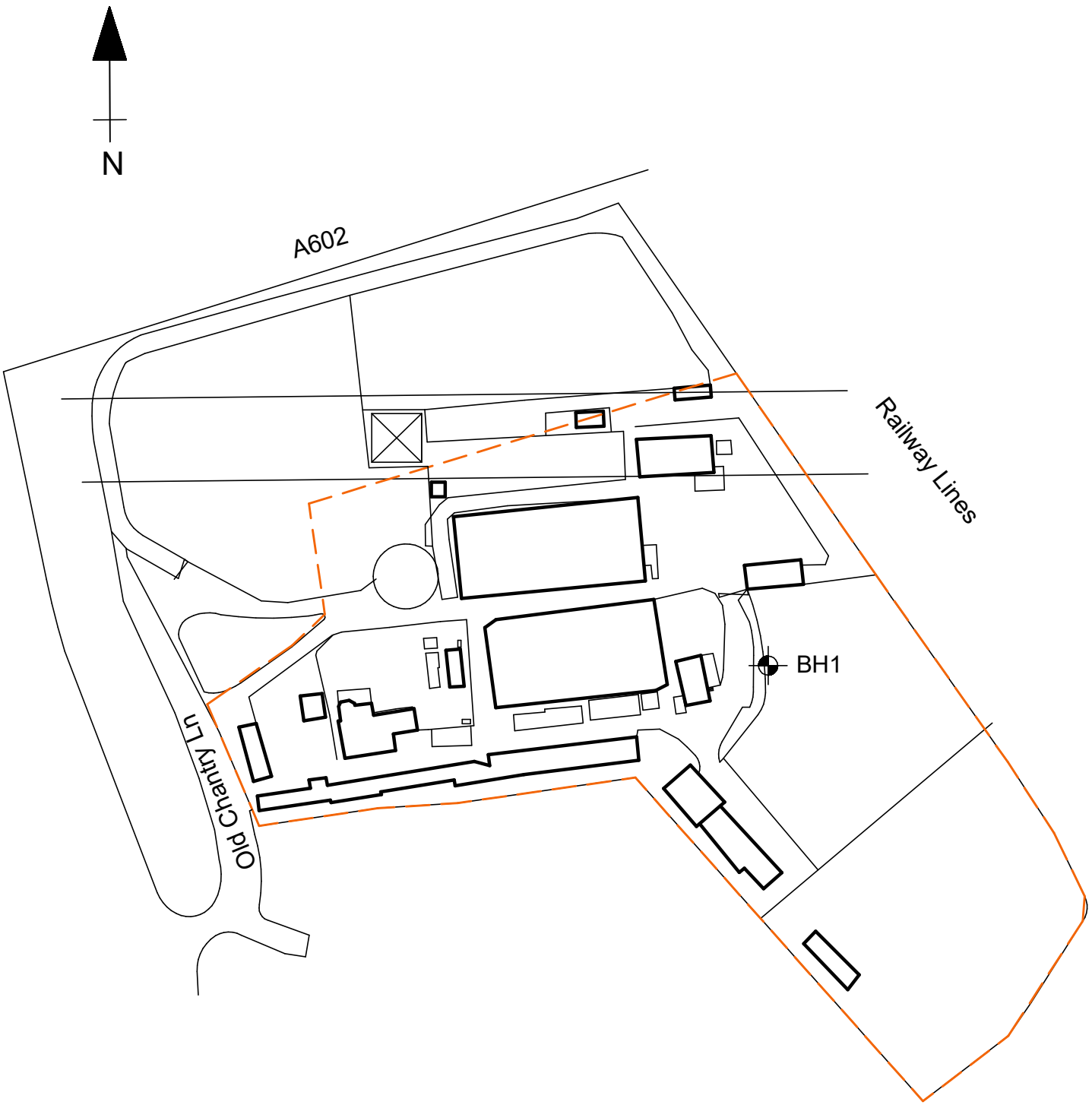
Geotechnical Assessments | Environmental Assessments | Desktop Studies | Contamination Analysis

Appendix No	1
Sheet No	1
Job No	16885
Date	Sept 2022

Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Existing Site Plan



Not to Scale

Sketch No. : GEO / 16885 / 01 / 01

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Herts & Essex Site Investigations
Unit J8 | Peek Business Park | Woodside | Bishops Stortford | CM23 5RG
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Appendix No	2
Sheet No	1
Job No	16885
Date	Sept 2022

Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Borehole One

Description Of Stratum	Legend	Depth	Thickness (m)	Water Level	Samples No	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC's (ppm)	Installations	Casing Depth, (m)
Loose brown topsoil		0.30	0.30								
Brown orange clayey SAND with flint gravel		0.60	0.30		1	D	0.50				
Firm light brown mottled grey CLAY					2	D	0.80				
1.0			0.90		3	D	1.00	N=15			
		1.50									
Firm to stiff brown CLAY with occasional medium to course flint					1	B	2.00	N=8			
2.0			1.20								
		2.70									
Firm to stiff brown CLAY with occasional fine to medium chalk fragments and flint gravel					2	B	3.00	N=19			
3.0			0.90								
		3.60									
Stiff grey slightly silty CLAY with occasional fine to medium chalk fragments and flint gravel					3	B	4.00				
4.0											
			2.00								
5.0					4	D	5.00	N=37			
		5.60			4	B	5.60	N=28			
Medium dense to dense brown SAND & GRAVEL											
6.0			1.10								
		6.50									
Medium dense brown slightly clayey SAND & GRAVEL with chalk fragments					5	B	7.00	N=32			
7.0											
8.0					6	B	8.50	N=32			
9.0											
10					7	B	10.00	N=36			

Remarks

Scale 1 : 50

Key : U - Undisturbed Sample (100mm diameter) B - Bulk Sample ▼ - Water Struck D - Disturbed Sample ▽ - Water Standing W - Water Sample T - Chemical Tub N - SPT N-Value V - Vane Test, (kN.m²)

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Appendix No	2
Sheet No	2
Job No	16885
Date	Sept 2022

Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Borehole One

Description Of Stratum	Legend	Depth	Thickness (m)	Water Level	Samples No	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC's (ppm)	Installations	Casing Depth, (m)
Continuing on			8.50	Fast Inflow rose to 15.60 in 5 mins. Standing at 19.50m on completion	8	B	11.50	N=40			
					9	B	13.00	N=44			
					10	B	14.50	N=49			
		15.00									
Dense brown SAND & GRAVEL			1.20								
		16.20			5	D	16.20	N=50+			
Stiff brown mottled grey slightly to moderately silty CLAY with chalk fragments			1.50								
		16.70									
Stiff grey moderatley silty CLAY with chalk			0.30								
		17.00		17.00	11	B	17.00	N=50+			
Dense brown slightly clayey SAND & GRAVEL with chalk fragments			2.70								
					6	D	18.50	N=50+			
		19.70									
Dense brown moderately sandy CLAY			5.30		7	D	20.00	N=50+			

Remarks

Scale 1 : 50

Key : U - Undisturbed Sample (100mm diameter) | B - Bulk Sample | - Water Struck | D - Disturbed Sample | - Water Standing | W - Water Sample | T - Chemical Tub | N - SPT N-Value | V - Vane Test, (kN.m²)

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Appendix No	2
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Date	Sept 2022

Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Borehole One

Description Of Stratum	Legend	Depth	Thickness (m)	Water Level	Samples No	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC's (ppm)	Installations	Casing Depth, (m)
Continuing on											
			5.30		8	D	21.50	N=50+			
					9	D	23.00	N=50+			
					10	D	24.50	N=50+			24.50
		25.00									
Borehole closed at 25.00m											

Remarks

Scale 1 : 50

Key : U - Undisturbed Sample (100mm diameter) | B - Bulk Sample | - Water Struck | D - Disturbed Sample | - Water Standing | W - Water Sample | T - Chemical Tub | N - SPT N-Value | V - Vane Test, (kN.m²)

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APPENDIX	3
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LOCATION Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

ATTERBERG LIMITS TEST DATA

Excavation Location Number	Depth (m)	Sample	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Group Symbol	Ammended Plasticity Index (%)	Desiccation Profile	Percentage Retained on 425 Micron Sieve (%)
BH1	2.00	B1	22	35	14	21	MI	13		40
BH1	3.00	B2	17							
BH1	4.00	B3	16	38	14	24	CI	21		13
BH1	16.20	D5	15	38	12	26	CI	25		3
BH1	20.00	D7	22							
BH1	21.50	D8	23	28	18	10	CL	10		0
BH1	23.00	D9	21							
BH1	24.50	D10	17							

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APPENDIX	3
SHEET	2
JOB NUMBER	16885
DATE	Sep-22

LOCATION Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2

SULPHATE ANALYSIS

Excavation Location Number	Depth (m)	Sample	Concentrations of Soluble Sulphate			Classification	pH
			Soil		Groundwater		
			Total SO4 (%)	SO4 in 2:1 Water:soil (g/l)			
BH1	2.00	B1		0.44		DS-1 / AC-1s	8.16
BH1	16.20	D5		0.19		DS-1 / AC-1s	7.92

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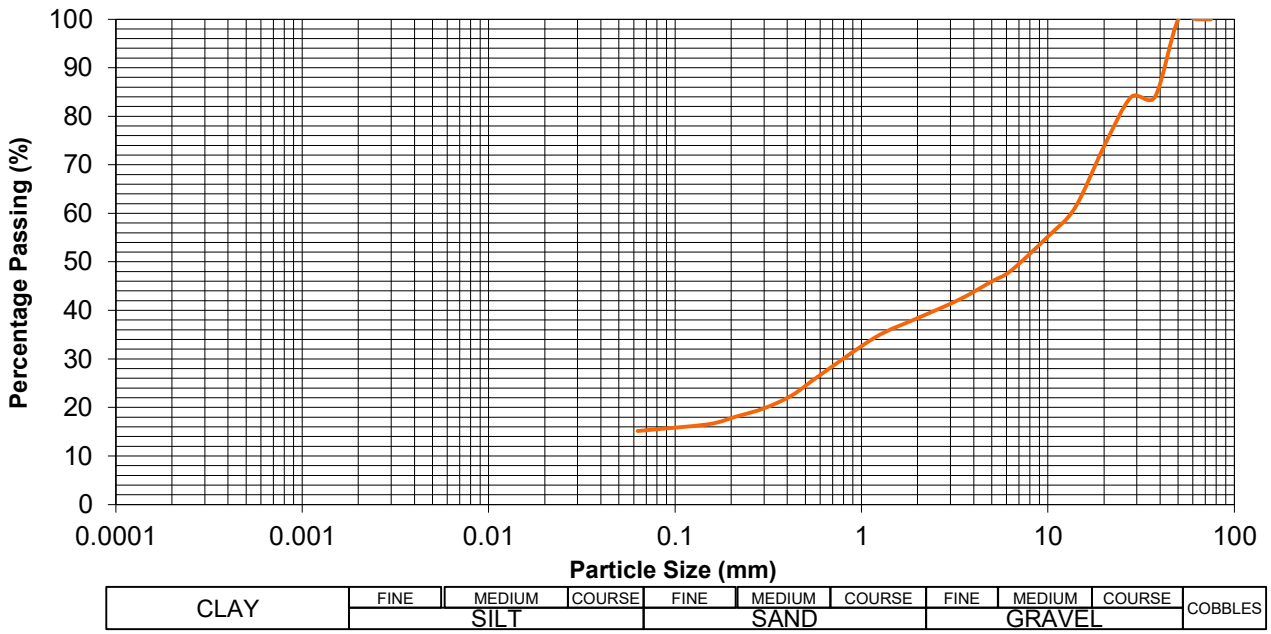
Date	Sep-22

LOCATION **Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE**

Location : **BH1** Depth : **5.60 m** Sample No: **B** Initial Mass: 700 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50	112	16	84
28.00	0	0	84
20.00	71	10	74
14.00	88	13	61
10.00	42	6	55
6.30	50	7	48
5.00	15	2	46
3.35	26	4	42
2.00	27	4	38
1.180	28	4	34
0.600	54	8	27
0.425	29	4	23
0.300	19	3	20
0.212	12	2	18
0.150	11	2	17
0.063	10	1	15

PARTICLE SIZE DISTRIBUTION



Fines (%) = **15** Sands (%) = **23** Gravels (%) = **62** Cobbles (%) = **0**

British Standard Sieve Test 5930:1990 as Per Test 7a

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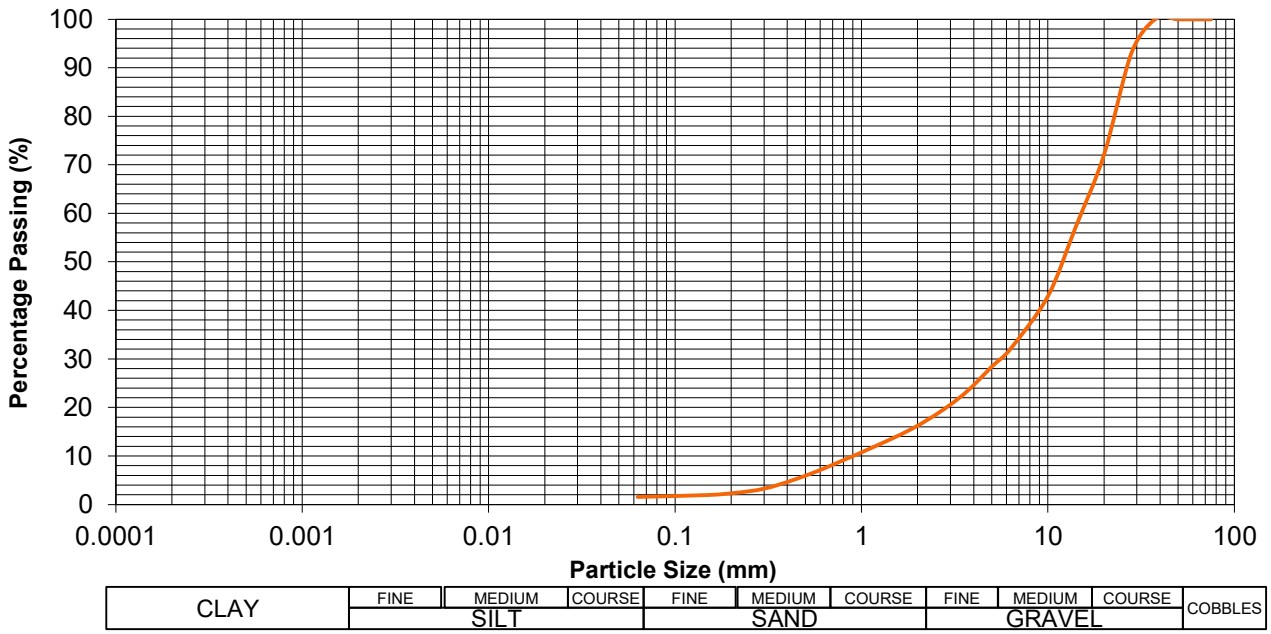
LOCATION **Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE**

Location : **BH1** Depth : **7.00 m** Sample No: **B** Initial Mass: 700 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50		0	100
28.00	49	7	93
20.00	146	21	72
14.00	106	15	57
10.00	98	14	43
6.30	76	11	32
5.00	26	4	28
3.35	45	6	22
2.00	40	6	16
1.180	30	4	12
0.600	34	5	7
0.425	15	2	5
0.300	12	2	3
0.212	6	1	2
0.150	3	0	2
0.063	3	0	2

PARTICLE SIZE DISTRIBUTION



Fines (%) = **2** Sands (%) = **15** Gravels (%) = **84** Cobbles (%) = **0**

British Standard Sieve Test 5930:1990 as Per Test 7a

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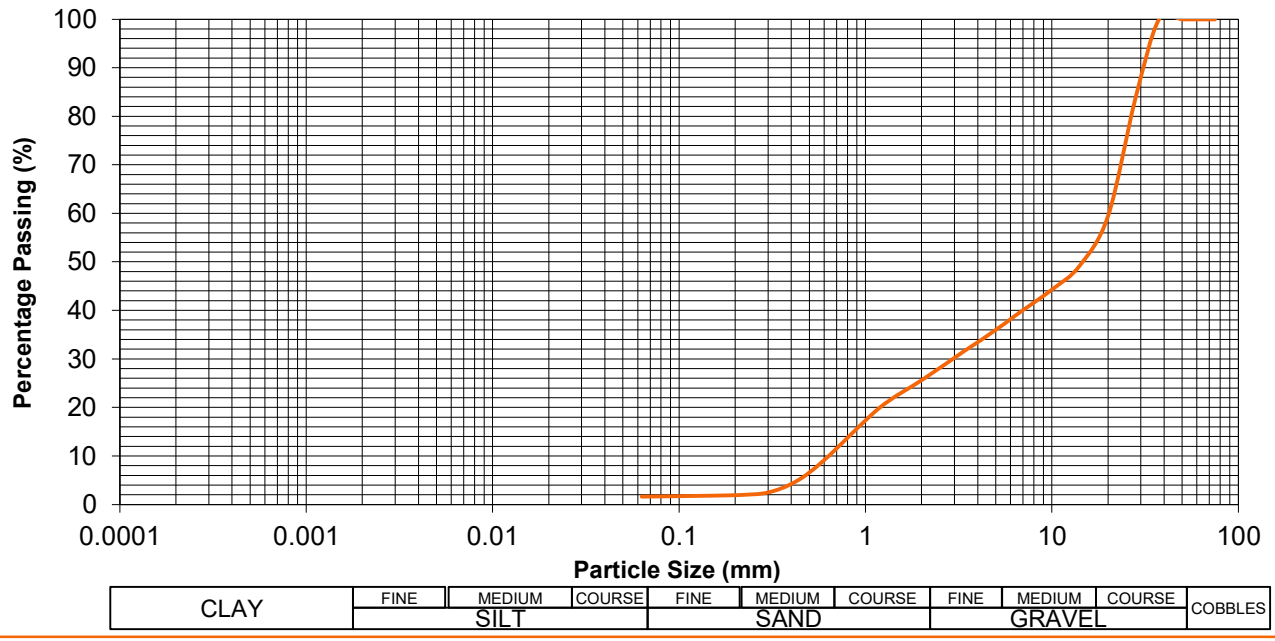
LOCATION **Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE**

Location : **BH1** Depth : **14.50 m** Sample No: **B** Initial Mass: 600 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50		0	100
28.00	98	16	84
20.00	145	24	60
14.00	62	10	49
10.00	29	5	44
6.30	33	6	39
5.00	17	3	36
3.35	27	5	32
2.00	35	6	26
1.180	35	6	20
0.600	64	11	9
0.425	26	4	5
0.300	14	2	2
0.212	3	1	2
0.150	1	0	2
0.063	1	0	2

PARTICLE SIZE DISTRIBUTION



Fines (%) = **2** Sands (%) = **24** Gravels (%) = **74** Cobbles (%) = **0**

British Standard Sieve Test 5930:1990 as Per Test 7a

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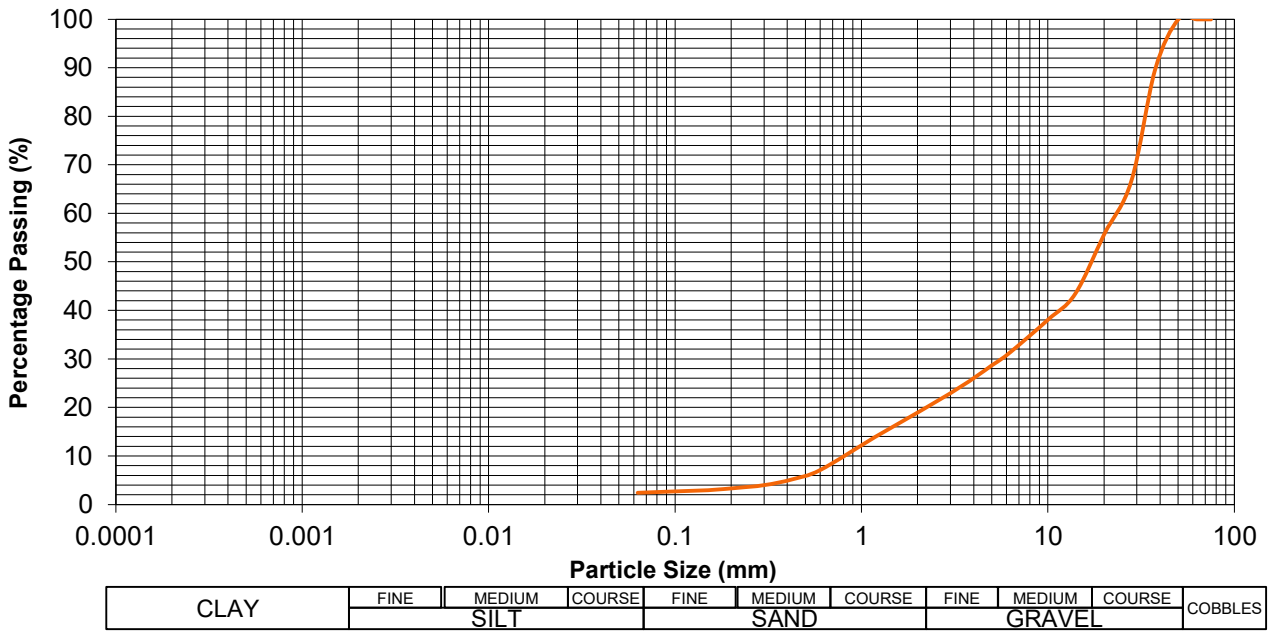
LOCATION **Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE**

Location : **BH1** Depth : **18.50 m** Sample No: **B** Initial Mass: 900 g

Sieve Size (mm)	Weight Retained (g)	Percent Retained (%)	Total Passing (%)
75		0	100
63		0	100
50		0	100
37.50	94	10	90
28.00	206	23	67
20.00	99	11	56
14.00	110	12	43
10.00	48	5	38
6.30	60	7	31
5.00	25	3	29
3.35	41	5	24
2.00	46	5	19
1.180	46	5	14
0.600	61	7	7
0.425	17	2	5
0.300	11	1	4
0.212	5	1	3
0.150	4	0	3
0.063	5	1	2

PARTICLE SIZE DISTRIBUTION



Fines (%) = **2** Sands (%) = **17** Gravels (%) = **81** Cobbles (%) = **0**

British Standard Sieve Test 5930:1990 as Per Test 7a

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20th February 2024 Our ref : CSG/16885

SJM & Co Ltd
3 Sheepcote Drive
Watford
Herts
WD25 0DZ

Dear Sir,

Re: Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE: Site Investigation

Please find enclosed details of the borehole sunk at the above site which records the profile of the soils in place.

The geological profile records made ground which was identified to a depth of 4.00 meters deep where a sandy silty CLAY was identified. Below this and present to a depth of 8.00 meters where SAND & GRAVEL has been identified and present to 9.50 meters. Below this and present to the close was a sandy Silty CLAY.

No groundwater was identified within the excavation based on the short-term scope of the works.

A 100mm diameter standpipe was installed within the borehole to the close of the excavation.

A return inspection has been completed on 5th February 2024 to complete a falling head test at the site.

To consider permeability, a falling head test was completed within the borehole and the results were used to calculate a permeability rate. Based on the testing completed, a permeability rate of 3.6×10^{-5} m/sec. This would indicate a good drainage rate, although consideration to direct discharge to water may be an issue in terms of pollution direct to groundwater. The site is recorded within a Source Zone II protection zone.

Human Health Risk

As part of a generic assessment of the subsoil conditions, a comparison has initially been made using Generic Quantitative Assessment Criteria, (GQRA), values for contaminants derived by LQM / CIEH, (2nd Edition), and Atkins 'AtRiskSoils' to evaluate whether the levels of contamination measured at the site exceed the human health risk levels which have been derived for the site. For the proposed land use of this site, we can confirm that Generic Quantitative Assessment Criteria have been identified for the site as follows: -

- ***GQRA Levels : Residential Land Use Standard with Home Grown Produce***

The definition of the site which includes residential land use has been carefully selected based on the guidance and information provided by the client.

We are aware that the proposed land use of residential land can be classed as sensitive land use and as such, this has been chosen.

It is possible that where excedance of these values are recorded, a more Detailed, Qualitative Risk Assessment, (DQRA), could be completed using site specific scenarios and toxicological properties of the subsoil and site conditions to derive Site Specific Assessment Criteria, (SSAC), for the site. The assessment of testing has been completed as follows and reports the initial risks considered in place compared to GQRA.

The testing completed and the levels of contamination risk have been shown in Table 2 when compared to Residential Land Use Standards with home ground produce.

Table 2 Sampling and Testing Schedule

Existing Site Use	Proposed Site Use	Chemical Testing Date	Sample Location	Sample Depth (m)	HESI Suite 1	PAH's, (Speciated)	Benzo[b]fluoranthene (mg/kg)	Benzo(a)pyrene (mg/kg)	Dibenz(a,h)Anthracene (mg/kg)
Former Stables.	Residential Land	7th February 2024	HA1	0.30 - 0.35		✓			0.44
			HA2	0.40 - 0.45		✓			0.79
			HA3	0.60 - 0.65		✓			
			HA4	0.40 - 0.45		✓	14	15	3.5
			HA5	0.50 - 0.55		✓			
			HA6	0.30 - 0.35		✓			
			HA7	0.25 - 0.30		✓	2.8		0.58
			HA8	0.20 - 0.25		✓			
EXPOSURE LEVELS			ORGANIC MATTER			1%	2.6	2.2	0.24
						2.5%	3.3	2.7	0.28
						6%	3.7	3	0.3

5.10 Based on the information gained, we can confirm that one area of the site has recorded contamination in place above a human health risk level which can be confirmed as follows: -

- Contamination has been identified at locations which include HA2, HA3, HA5 & HA8 which record contamination from Polycyclic Aromatic Hydrocarbons, (in the form of Benzo[b]fluoranthene, Benzo[a]pyrene and Dibenz(ah)anthracene).
    - No contamination was identified in HA1, HA4, HA6 and HA7.

Visual Record

From a visual review of the site condition, areas of the site had been stripped which had removed superficial made ground from areas of the site and created stockpiles of resultant spoil in areas around the original source location. It is identified from a visual inspection of the site that the site includes a lot of anthropogenic materials which would not be appropriate for placement within the residential gardens. These materials included brick, slate, concrete, and wood.

Based on the above, it is likely that the stockpiled materials which include this debris, (unless otherwise segregated appropriately), should be removed off site and not reused.

Table 1 Soil Contamination Risks

Risk Factor	*Risks in place*	*Remediation*
Targeted Risks	***Asbestos – Amosite, (<0.001%)*** WS7 at 1.20 metres ***Asbestos – Crocidolite, (<0.001%)*** WS8 at 1.00 metres	Area defined as remediation cell.
	PAHs – WS7, WS8, HA2, HA3, HA5 & HA8	Remediation works required to defined areas
	STOCKPILES	Segregation of anthropogenic materials.
Spatial Risks	NONE	NONE

SECTION 7 CONCLUSIONS

HUMAN HEALTH RISK

The site has identified made ground and potentially contaminated ground. These risks form the following layers and associated contamination: -

FILL: - Isolated contamination from PAHs – WS7, WS8, HA2, HA3, HA5 & HA8– Remediation works will be required to this area.

FILL: - Asbestos – Amosite, (<0.001%), WS7 at 1.20 metres, Asbestos – Crocidolite, (<0.001%), WS8 at 1.00m.

Based on the above, remedial measures will likely be required areas where pathways to receptors are in place.

WORKFORCE

The above human health risk is in place within the site area, will promote a low risk on a short-term bases to any workforce within the areas. ***Appropriate PPE / RPE should be worn, and the soil contamination risk should be noted within any site inductions. This is particularly relevant to the Asbestos risks.***

GROUNDWATER RISKS

We have not been asked to consider ground water risks.

VAPOUR RISKS

Chemical testing of the soils show that low risks are in place. Vapour risk is not in place.

GAS RISKS

Install and complete a Land Gas assessment of the site.

CONSTRUCTION MATERIALS

Construction materials have been considered and no risk has been identified directly to any water main pipework developed at the site.

Water main pipework can be laid in a conventional protective pipework system.

Any water main pipework should be laid in clean corridors in order to prevent future risk to workforce used in the maintenance and repair of any water main system.

FURTHER WORKS

Submit reports to Local Authority and Environment Agency for review and confirm the risks identified in this report along with the further works proposed are suitable and acceptable.

The exact details of remediation required for the site should be assessed and reported in a Remediation Strategy Report in order to comply with current best practice, (BS 10175 & CLR 11).

I hope the foregoing is sufficient for your requirements, although please do not hesitate to contact us should require any further information regarding the above.

Yours Faithfully

C.S.Gray PG.Cert, PG.Dip, M.Sc.
Managing Director

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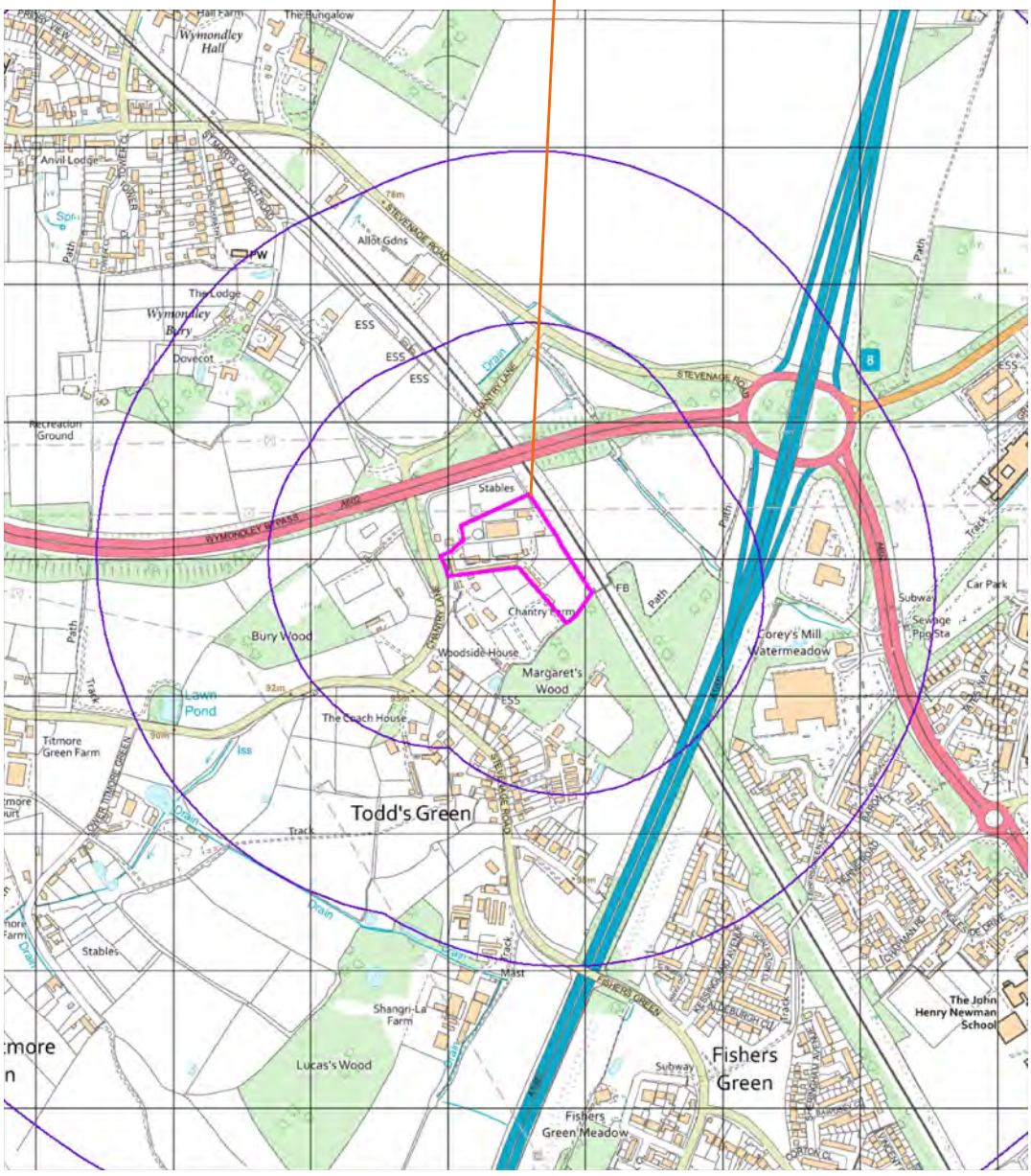
Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Location Plan

N

The Site



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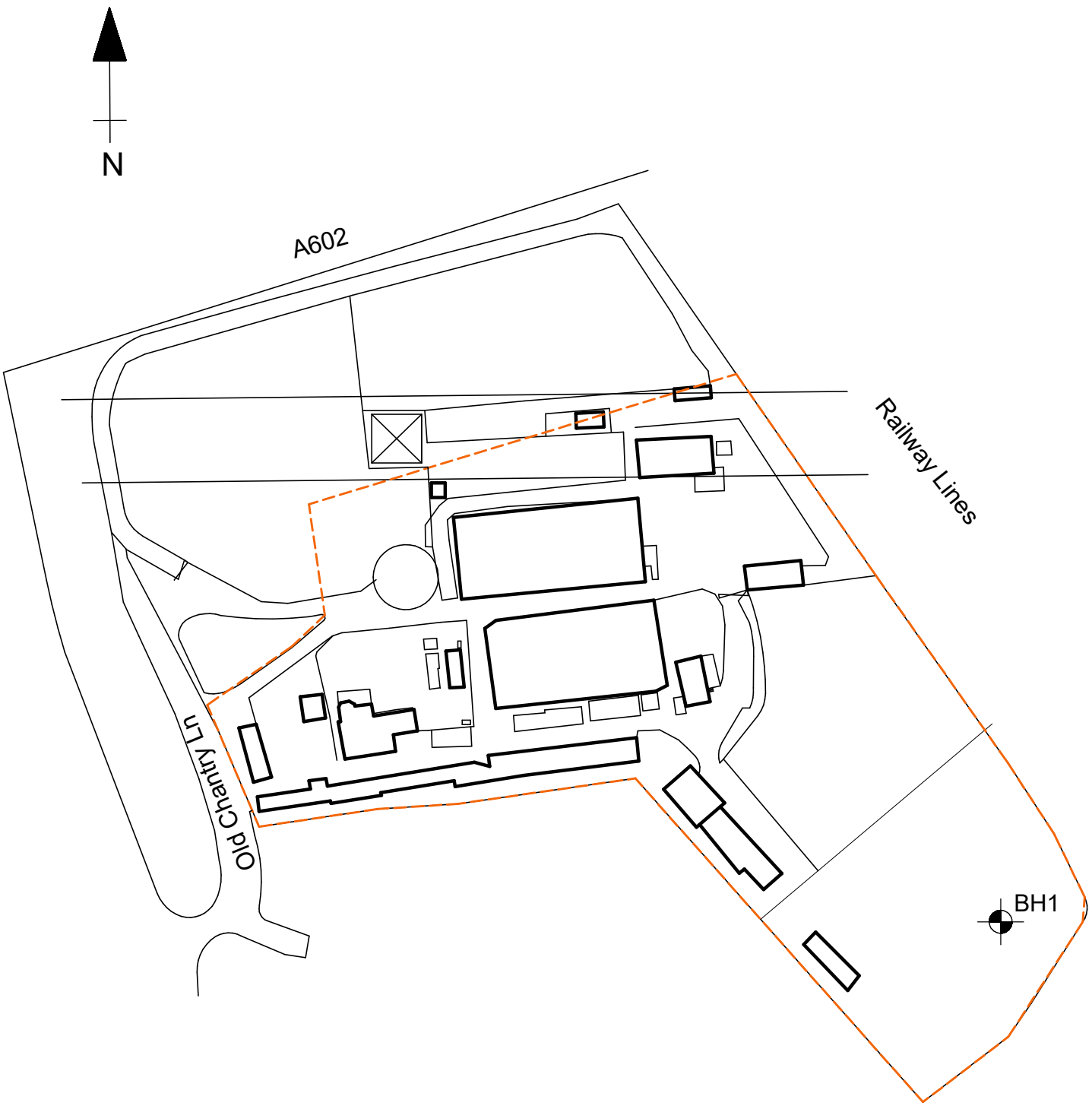
Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Existing Site Plan



Not to Scale

Sketch No. : SA /16885 / 01 / 02

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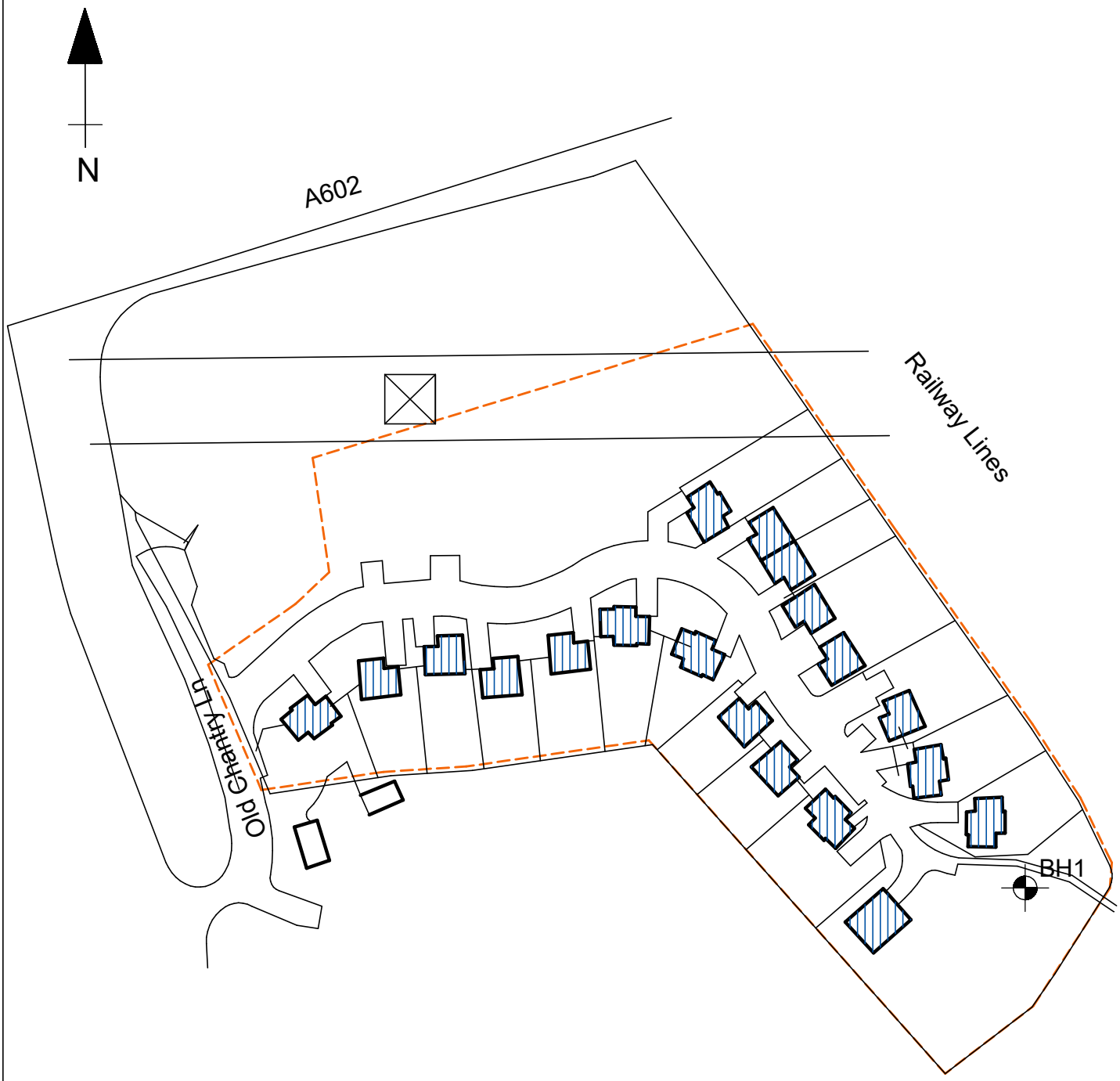
Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Proposed Site Plan



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Job No	18
Date	Jan 2024

Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Borehole A

Description Of Stratum	Legend	Depth	Thickness (m)	Water Level	Samples No	Samples Type	Samples Depth (m)	S.P.T N-Value or Vane Strength	VOC's (ppm)	Installations	Casing Depth, (m)
Loose dark brown silty, sandy FILL with occasional flint gravel.		0.60	0.50	?????						Bentonite Seal	
Loose light brown silty sandy CLAY with flint gravel		0.80	0.50								
Loose light brown silty sandy, chalk FILL with occasional flint gravel		1.60	0.50		1	N	1.00	10		Solid Pipework	1.00
Loose dark brown silty sandy CLAY FILL with flint gravel		1.90	0.50								
Tarmac FILL		2.30	0.50		2	N	2.00	10			
Medium dense grey, silty, sandy CLAY FILL with much Chalk		2.50	0.50								
Brick FILL		3.30	0.50		3	N	3.00	10			
Loose grey black silty sandy CLAY FILL with occasional flint gravel		4.00	0.50		4	N	4.00	10		50 mmø Slotted Pipework	
Loose dark grey brown slightly silty CLAY		6.50	2.50		5	N	5.00	10		Pea Shingle	
Medium dense grey moderately silty CLAY		7.50	1.00		6	N	6.50	10			
Medium dense brown very silty, sandy CLAY with occasional flint gravel		8.00	0.50								
MeMedium dense orange brown SAND & GRAVEL		9.50	1.50		7	N	8.00	10			
Medium dense brown very silty, sandy CLAY with occasional flint gravel		10.00	0.50		8	N	9.50	10			

Remarks

1 Hour Chiselling Pits

Scale 1 : 50

Key : U - Undisturbed Sample (100mm diameter) | B - Bulk Sample | - Water Struck | D - Disturbed Sample | - Water Standing | W - Water Sample | T - Chemical Tub | N - SPT N-Value | V - Vane Test, (kN.m²)

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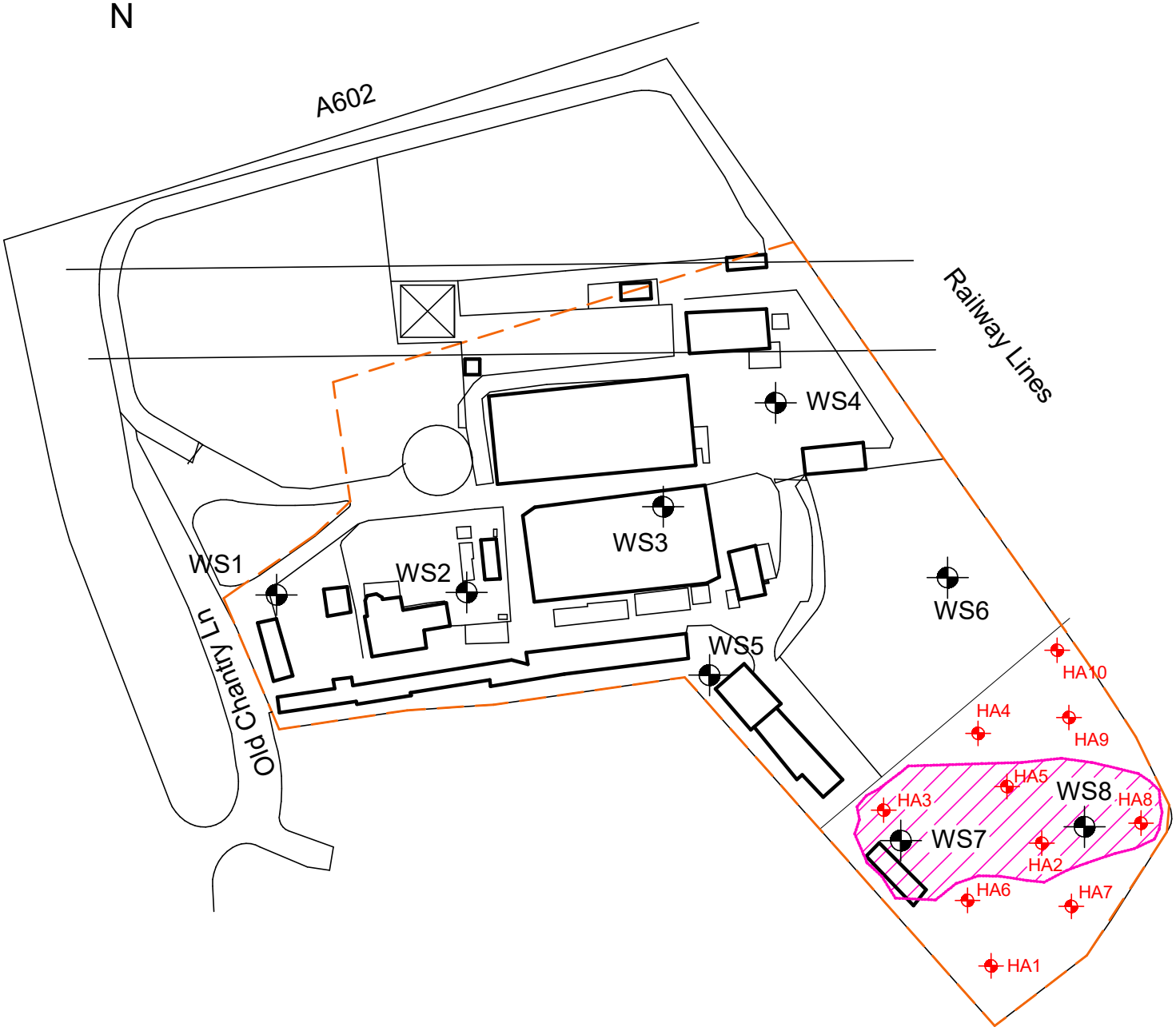
Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Existing Site Plan

Area of PAH's and Asbestos Risk

Complete a land gas assessment OR install mitigation measures

Use protective pipework



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REMEDIATION STRATEGY REPORT

Site Address:	Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE
Report Date:	March 2024
Project No.:	16885
Prepared for:	EHP Land & Development Ltd and Stevenage Borough Council
Planning Application	Stevenage Borough Council 21/00971/FPM

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TABLES AND FIGURES

REFERENCES

BRE Report BR211: Radon: Protective measures for new dwellings, 2015. BRE, Watford.

BRE Digest 365 (2016): Soakaway design. BRE, Watford.

BRE Special Digest 1: Concrete in Aggressive Ground, 2005.

BRE, Watford. British Standards Institution (2004) Eurocode 7 – Geotechnical design - Part 1: General rules. BS EN 1997 1. Incorporating Corrigendum No.1. BSI, London

British Standards Institution (2007) Eurocode 7 – Geotechnical design - Part 2: Geotechnical investigation and testing. BS EN 1997-2. BSI, London

British Standards Institution (2015) BS 3882 Specification for topsoil and requirements for use. BSI, London

British Standards Institution (2011) BS 10175 Code of practice for the investigation of potentially contaminated sites. BSI, London

British Standards Institution (2013) BS 8576 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOC's), BSI, London

British Standards Institution BS 5930:2015+A1:2020 Code of practice for ground investigations. BSI, London

British Standards Institution (2015) BS 8485:2015 Incorporating corrigendum No.1 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BSI, London

CIEH & CL:AIRE (2008) Guidance on comparing soil contamination data with a critical concentration. London: Chartered Institute of Environmental Health (CIEH) and CL:AIRE

CIRIA C665 (2007) Assessing risks posed by hazardous ground gases to buildings.

CIRIA, London CIRIA Report R143 (1995): The Standard Penetration Test (SPT): Methods and use. CIRIA, London.

CL:AIRE (2020) Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration. CL:AIRE, Buckinghamshire

Environment Agency (2020) Land contamination risk management (LCRM)

Environment Agency, NHBC & CIEH (2008) Guidance for the safe development of housing on land affected by contamination. R & D Publication 66. London: Environment Agency

Environment Agency (2006) Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination Environment Agency

LQM/CIEH S4ULs. LQM, 2014

Ministry of Housing, Communities & Local Government: National Planning Policy Framework. February 2019.

NHBC Standards 2022. NHBC, Milton Keynes

Tomlinson M.J (2001): Foundation Design and Construction: 7th Edition. Pearson Prentice Hall, Harlow. UFST.

GENERAL NOTES

This report has been prepared based on the findings of investigations into the site's conditions using current available data which has been recovered from Envirocheck to provide environmental data in relation to the site and surrounding area. Where possible, local sources have been researched to gain a better understanding of the site's conditions. As part of this review, research has been undertaken with the Local Authority and the Environment Agency to the site's condition.

We can confirm that this report has been prepared based on the information gained and that this information is not exhaustive, and that subsequent research may reveal additional facts that may influence the reporting. Where possible, this information has been researched.

All geological information has been researched using the British Geological Society website, (the geology viewer). The disclaimer associated with this portal confirms 'The British Geological Society accept no responsibility for omissions or misinterpretations of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation.

The accuracy of map extracts cannot be guaranteed, and it should be recognized that different conditions on site may have existed after the various map surveys.

We can confirm that within the assessment of the site, various websites have been visited and as such, we cannot confirm the validity of these sites and as such, this information is accepted de facto and without prejudice. Anyone relying on these sources does so at their own risk, however, Herts & Essex Site Investigations does undertake all reasonable care to ensure this data is relevant and correct.

It should be confirmed that the extent of review of this report has undertaken a broad review of on-site features which would promote a contamination ground risk, however, this does not include ecological features and in particular Japanese Knotweed which should be reviewed under separate cover.

A review of the site will be made to confirm the extent of obvious Asbestos product or sheet materials either on the surface of the site soils or evident above ground, however, does not constitute a full Asbestos Survey by any means. This should be sought under separate cover.

DOCUMENT INFORMATION AND CONTROL SHEET

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Document Status and Approval Schedule

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1	Final	March 2024		

REMEDIATION STRATEGY REPORT - PHASE 3

1 Context and Objectives of this report

1.1 Introduction

At the request of EHP Land & Development Ltd and Stevenage Borough Council, Herts & Essex Site Investigations have been asked to further assess and consider the site for the preparation of this Site Remediation Strategy Report to define, where appropriate, a strategy for the remediation and validation of the site to enable a fit for use classification upon completion of the development and hand over for sale.

The principal aim of this report is to provide a source document for regulatory authorities and other interested parties to review, the Environment Agency, Planning and Country and the client. Agreement from regulatory authorities will be required to satisfy planning conditions and to ensure that the site does not present a significant risk to potentially vulnerable receptors including future site users, controlled waters and the environment.

The main objectives of this Remediation Method Statement are as follows:

- To comply with the requirements of the Regulatory Authority requirements.
- To provide a summary of the remedial works, and specific methodology for removal of elevated Asbestos and PAHs concentrations have been recorded in the made ground at the Site.
- Assess the Land Gas risk to the site area.
- To provide details of good working practices during site remediation works, in accordance with current legislation and guidance.

1.2 Current Planning Status

This report has been prepared with following application with Stevenage Borough Council in mind.

Application Number : 21/00971/FPM.

Proposal: Redevelopment of existing riding stables to provide 11no. three bedroom and 6no. four-bedroom dwellings with associated access road, parking, landscaping, footpath connections, infiltration basin and pump station.

Decision: Awaiting decision Thu 02 Sep 2021.

1.3 Remediation Requirements

The preparation of this remediation strategy and any future verification plan is to ensure the site is suitable for future use when completed and habitable. The proposals laid out in this report have been proposed based on the plans provided to us by the client and submitted to the council and are in place to mitigate against future risk being in place.

This remediation strategy is based upon the findings of all previous reporting and assessments which should be read in conjunction with, the Phase 1 Desk Top Study and the Phase 2 Environmental Report – August 2021. completed by Herts and Essex Site Investigation.

The remediation strategy and verification plan have been developed for the site in accordance with guidance documents :-

- Land contamination risk management (LCRM)

- BS 10175:2011+A2:2017, Investigation of potentially contaminated sites. Code of practice. Code of practice
- Environment Agency, (2010) GPLC1 Guidance Principles for Land Contamination.
- PPS23 Pollution and Planning, (ODPM 2004)
- Environment Agency, (2010) Science Report SC030114/R1 Verification of Remediation of Land Contamination.
- CL:AIRE, (2010) Framework for Assessing the Sustainability of Soil and Groundwater Remediation.
- CL:AIRE, (2008) The definition of Waste. Development Industry Code of Practice.

2 Background and Environmental Settings

2.1 Site Details

The site is located within a rural area of Todds Green to the northwest of Stevenage in Hertfordshire, the details of which are summarised in Table 1 with the location plan of the site shown in Appendix 2, Sheet 1.

Table 1 Site Detail

Site Address:	Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE.
Site assessed under	Site Owners Request - Aid as part of planning and warranties.
Current use of land:	Riding Stables.
Previous use of site, (if known)	As above.
Grid Reference	NGR 522100, 226790.
Site Area	1.8 Hectares.
Local Authority	Stevenage Borough Council.
Gradient of the site	The site slopes down to the northeast of the site. From the eastern boundary there is a steeper slope down onto the farmland off site to the railway.
Proximity of Controlled Waters, (if known)	The nearest surface water feature is recorded as 125 meters to the north of the site area, where ditches are in place.

2.2 Site Description

The existing site is recorded as a riding stable, car park, and open land.

2.3 Brief Site History

The site area is recorded as a section of open land from the earliest map reference in 1881 until 1987 when Courtlands is recorded in place with building to the southeast of the site area, from 1993 the site area is recorded as a riding School with additional building in place, it remains like date.

Surrounding the site open land is in place, to the east of the site railway lines area recorded in place and remain to date. To the southeast of the site about 20 meters there is an area recorded as a spoil bank from the earliest map reference in 1881, this area currently forms an area of woodland.

2.4 Desk Top Study Findings

The nearest surface water feature is recorded as 125 meters to the north of the site which is recorded as ditches. The nearest abstraction well is located 48 meters to the southwest of the site which is recorded as General Agriculture: Spray Irrigation – Direct. The nearest Potable Water Supply is recorded 528 meters to the west of the site.

The site is recorded within a Zone 2 Source Protection Zone.

The ground conditions based on geological maps and BGS information shows the site to be located within an area of Glaciofluvial Deposits with Holywell Nodular Chalk Formation and New Pit Chalk Formation recorded below. To the east of the site area Lowestoft Formation is recorded in place which may encroach on the site area.

2.5 Desk Top Study Conclusions

Considering the assessment of the site to incorporate the walk over survey we have completed we can confirm that risks identified in place form :-

On Site

- Stables / Riding School
  - Muck Heap
  - Storage Barns
- Courtlands (Former Buildings) Asbestos.

Off Site

- Spoil Bank - SE 20m
- Railway Lines - E
- Chantry Farm - S

Table 1 *Pollutant Risk*

Risk Assessment	Land Use	Pollutant	
A	***Stables / Riding School - Muck Heap - Storage Barns*** ***Courtlands (Former Buildings)*** ***Asbestos***	***Soil, Groundwater & Vapour Risk*** Moisture Content, pH, Electrical Conductivity, Cyanide, (Free), Cyanide, (Total), Organic Matter, Boron, Sulfate, (2:1 water soluble), Chromium, (Hexavalent), Sulfate, (Total), Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, Speciated PAH's, (EPA Priority 16), Phenols, Asbestos, Total Petroleum Hydrocarbons (aliphatic/ aromatic 8-Band), Naphthalene, Land Gases CO_2, CH_4 ***Soil Sampling Groundwater & Vapour Assessment***	
B	***Spoil Bank*** - SE 20m	***Soil, Groundwater & Vapour Risk*** Moisture Content, pH, Electrical Conductivity, Cyanide, (Free), Cyanide, (Total), Organic Matter, Boron, Sulfate, (2:1 water soluble), Chromium, (Hexavalent), Sulfate, (Total), Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, Speciated PAH's, (EPA Priority 16), Phenols, Asbestos, Total Petroleum Hydrocarbons (aliphatic/ aromatic 8-Band), Naphthalene, VOCs Land Gases CO_2, CH_4 ***Soil Sampling Groundwater & Vapour Assessment***	
C	***Railway Lines*** - E ***Chantry Farm*** - S	***Soil, Groundwater & Vapour Risk*** Moisture Content, pH, Electrical Conductivity, Cyanide, (Free), Cyanide, (Total), Organic Matter, Boron, Sulfate, (2:1 water soluble), Chromium, (Hexavalent), Sulfate, (Total), Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, Speciated PAH's, (EPA Priority 16), Phenols, Asbestos, Total Petroleum Hydrocarbons (aliphatic/ aromatic 8-Band), Naphthalene, VOC's ***Soil Sampling Groundwater & Vapour Assessment***	
Spatial Sampling, (General Assessment)		Moisture Content, pH, Electrical Conductivity, Cyanide, (Free), Cyanide, (Total), Organic Matter, Boron, Sulphate, (2:1 water soluble), Chromium, (Hexavalent), Sulphate, (Total), Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc, Speciated PAH's, (EPA Priority 16), Phenols.	25-meter Centres In accordance with BS10175: 2011+A2:2017.
		Asbestos	5-10-meter Centres In accordance with BS10175: 2011+A2:2017.

2.6 Environmental Report Conclusions

2.6.1 Scope of site investigation works completed.

The scope of works completed within the site investigation are recorded in the Site Investigation Reports and can be reviewed within this report. This confirms the following source data:-

Initial Investigation

- 8 No competitor rig boreholes were sunk to depths of between 3.00-4.00m meters - Date of Works – 12th August 2021.
- Chemical Sampling recovered from samples and sent to analytical chemist, (13th August 2021). All samples stored in appropriate cool boxes during transport to chemist.
- BRE 365 Testing, (Including JCB Excavator and Water Tanker).

Secondary Investigations

- 1 No Shell and Auger Borehole sunk to depths of between 25.00 meters - Date of Works – 15th September 2022.
- Falling head test to deep borehole.
- Laboratory Testing – September 2022.
- Installation of a deep borehole soakaway to a depth of 9.50 meters with appropriate falling head test to base.
- Engineer & assistant to complete hand sampling around pollution identified area to delineate risk to isolated risk from PAH's to WS7 and WS8 and Asbestos identified slightly at depth to these same locations, (1.00 and 1.20 meters).

2.6.2 Geology

Based on the investigation completed by HESI the site has been reviewed and we can confirm that the geology within the site is as follows:-

Table 2 Geological Profile

Stratum	*Description*	*Depth, Range*	*Thickness, Range*
Made Ground	Loose dark brown sandy TOPSOIL with occasional fine brick and gravel fragments - MADE GROUND	0.50-3.40m	0.50-3.40m
	Firm brown sandy silty CLAY with brick, gravel, and ash fragments - MADE GROUND		
	Firm - stiff brown mottled orange, brown becoming dark grey, brown REWORKED CLAY		
Glaciofluvial Deposits	Firm - stiff orange, brown mottled CLAY with bands of gravel	3.00m	3.00m
	Medium dense claybound SAND & GRAVEL with sandier pockets		
Holywell Nodular Chalk	NOT ENCOUNTERED		
Ground Water : NO GROUNDWATER WAS IDENTIFIED WITHIN THE SCOPE OF THE WORKS.			

2.6.3 Soil Contamination Risks

Risk based on assessments of the site with a proposed use of residential land use with plant uptake confirms that risk is in place as follows :-

Risk based on assessments of the site confirm that risk is in place as follows :-

Table 3 Soil Contamination Risks

Risk Factor	Risks in place	Remediation
Targeted Risks	***Asbestos – Amosite, (<0.001%)*** WS7 at 1.20 metres ***Asbestos – Crocidolite, (<0.001%)*** WS8 at 1.00 metres	Area defined as remediation cell.
	PAHs – WS7, WS8, HA2, HA3, HA5 & HA8	Remediation works required to defined areas
	STOCKPILES	Segregation of anthropogenic materials.
Spatial Risks	NONE	NONE

2.6.4 Ground and Surface Water Risks

No risk is in place to groundwater.

2.6.5 Land Gas Risks

Considering the potential for Land Gas risks due to the use of the site as stables with potential made ground and muck heaps as well as the spoil bank in place to the southeast of the site area Land Gas risk assessments must be completed. These will include the potential for contamination migration from on and off-site sources which may be present in concentrations where risk is recorded.

Land gas monitoring should be specifically targeting the following land uses.

Table 6 Land Gas Assessment - Response Zone

Feature	Targeted Response Zone	Location to Target	Gas risk
Stables / Riding School - Muck Heap	Made Ground	Site Wide	Land Gases - CO_2, CH_4.
Spoil Bank - SE 20m	Made Ground & Granular soils	Migration onto the south of the site	

Infilled land is recorded in place off site, although, we would suggest that an assessment of risk could be completed using RB17 A Pragmatic Approach to Ground Gas Risk Assessment (2012). The surrounding land is primarily residential and as such, a pragmatic approach is deemed most suitable for the site and if risk confirmed, additional more intrusive assessments completed.

Considering the above, we would suggest a standpipe should be installed within the site with response zones placed within the upper made ground solely, and the following assessments completed as follows :-

- Install standpipes to allow vapour and Land Gas risk to be considered from the upper made ground.
- Assess vapour risk over a minimum of six monitoring rounds to comply with CIRIA C665 to consider risks to buildings, BS8485:2015+A1:2019 - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings and R & D Publication 66.
- Monitoring should be completed over falling or low atmospheric pressures or in periods where ground conditions are frozen to provide the worst-case scenario for the site, although, the site is laid to hard cover which will restrict natural ventilation of any gases.

2.6.6 Vapour Risks

Chemical testing has been completed and no elevated level of these vaporous contamination have been recorded in place also when logging and sub-sampling a visual and olfactoral assessment of the soils have been completed, and no contamination that promotes a vapour risk has been encountered within the assessment completed to date.

2.6.7 Water Main Pipework

An assessment of risk in relation to water main pipework has been considered within the scope of the works and considering the pollution measured at the site. Based on a comparison of the WRAS Data and UKWIR, (Guidance for the selection of water supply pipework on brownfield sites), elevated levels of contamination have been identified and RISK IS IN PLACE to water main pipework. This would suggest that any new water main pipework SHOULD BE INSTALLED USING PROTECTIVE BARRIER PIPEWORK SYSTEM.

Considering the risk to the workforce used in the construction and possible future maintenance of water main pipework, no risk is in place. To confirm :-

- Water main pipework should be laid in a PROTECTIVE BARRIER PIPEWORK SYSTEM.
- Any water main pipework should be laid in clean corridors to prevent future risk to workforce used in the maintenance and repair of any water main system.

2.6.8 Building Risks

Concrete has been identified as a risk and as such, any cement used within the development of the site should be a DS1-AC1s classification sulphate resisting cement.

2.7 Conceptual Site Model

In order to assess the potential risks posed to human health and the surrounding environment from the site condition, a Generic Quantitative Risk Assessment has been used to consider whether risk is in place. This uses Source Pathway Receptor risk assessment methodology in accordance with BS 10175:2011+A2:2017 Investigation of potentially contaminated sites.

The summary conceptual site model developed within the ground investigation reports has been re-created below:-

Table 4 *Risk Assessment A*

Source	Receptors	Pathway	Mitigation / Discussion
PAH's	Site Users, (current and future); Construction Workers; Adjacent Site Users, Fauna.	Direct contact	Risk is likely to be isolated to WS7, WS8, HA2, HA3, HA5 & HA8.
		Ingestion dust and soil	Remediation required.
		Ingestion of soils attached to vegetation	Additional testing recommended.
		Inhalation of vapours, (gas and organic)	No vapour risk from PAH contamination identified.
		Ingestion of contaminated water through water main pipework	No risk in place from PAH contamination identified.
		Inhalation of vapours through contaminated ground waters	No vapour risk from PAH.
		Direct contact with contaminated ground waters	Groundwater risk has been identified as low based on the information gained.
	Surface Water.	Lateral migration of shallow groundwater to a target receptor.	
	Ground Water. Abstraction Well.	Migration through fissures / cracks which may migrate to a groundwater receptor.	
	Plants. Vegetation.	Plant uptake. Direct contact.	No specific risks identified above BS3882 : 2015 levels.
	Buildings. Construction Materials.	Direct contact with contaminated soils;	PAH's pose a low risk to the built environment.
		Direct contact with contaminated groundwater	Groundwater risk has been identified as low based on the information gained.

Table 5 *Risk Assessment B*

Source	Receptors	Pathway	Mitigation / Discussion
Asbestos	Site Users, (current and future) Construction Workers; Adjacent Site Users, Fauna.	Inhalation of asbestos fibers	Risk is likely to be isolated to WS7 & WS8 Remediation required. Additional testing recommended.

Table 6 *Risk Assessment C*

Source	Receptors	Pathway	Mitigation / Discussion
Land Gases	Site Users, (current and future) Construction Workers; Adjacent Site Users, Fauna.	Inhalation of vapours, (gas and organic) Explosive risk from Land Gas	Install gas proof membrane in all habitable structures.

3 Remedial Strategy

3.1 Additional Site Investigation Works to Complete

In lieu of the above, PAH's and Asbestos risk is identified in place across the southeast of the site area as defined by this report and associated chemical analysis, remediation works will be required, and a watching brief maintained throughout the entire site should be kept. Additionally, land gas risks have not been fully assessed and as such, mitigation measure will be required.

3.2 Source Pathway Receptor Risk

The conceptual site model developed for the site confirms that Source-Pathway-Receptor links are in place within the site which may require mitigation or remediation works in order to develop a suitable development. The methods of control or reducing the unacceptable risks are defined as follows :-

- Remove or treat the contamination at source to remove the risk.
- Remove the pathway in which contamination can impact on a receptor.
- Remove the receptor from the environment.

If the pollution chain is broken, the risk associated with pollution can be removed. If the source is removed or treated, the pollution has been removed and as such, risk is removed. If the pathway is broken, the contamination cannot impact on the receptor as no pathway is in place. If the receptor is removed, (however unlikely this is), features / receptors cannot be impacted on.

As such, if the pollution chain is broken, risk is removed.

Considering the development of the site a combination of remediation options are proposed for the site which will be detailed as follows:-

3.2.1 Source Removal

The removal of source risk can be completed to include both removal of near surface soils to provide a capping system across the site where contaminated soils are placed directly over the underlying low-level contamination and provides a barrier between the human being and the underlying contamination. The depth of capping which is generally considered viable to remove risk is 0.60 metres.

A further source removal technique will form the removal of all contamination where contamination is identified as shallow. If the depth of capping is a minimum of 0.60 metres and the contaminated layer only extends to a depth of say 0.45 metres, if the full depth of contamination is removed and this exposes clean ground underlying this depth, clean soil will then overlie clean soil.

Confirmation will be required to confirm the level and extent of contamination which is in place within the base of any remediation cell.

3.2.2 Pathway Removal

A combination of factors will be employed in the development of the site. This will incorporate placement of permanent hard surfaces over the contamination a mechanism to remove interaction with the contamination. Dermal contact, inhalation and ingestion pathways will be removed through the placement of hard cover across the site. These will include roads, pavements, and driveways, although will not include patio areas where future excavation may occur.

Protective pipework may be required to remove risk to the water mains.

3.2.3 Receptor Removal

Receptors relate to the presence of human health interaction in the site upon completion of the development. This cannot change through the development.

Based on the above, the soils remediation process will comprise the following.

3.3 Possible Remediation Options - Human Health Risk

This section recorded the general remediation options for the site area which are defined as follows :

3.3.1 Ground Gases

In lieu of any land gases assessments being completed and there being a land gases risk in place within the site the following may be required.

A number of possible remediation options may be in place when completing remediation of the site. These options are ***ONLY REQUIRED IN HABILTABLE BUILDINGS.***

This will include one of the following scenarios :-

House Type

The construction and use of the building, together with the control of future structural changes to the building and its maintenance (the building's management) should be assessed, since potential risks posed by ground gases are strongly influenced by these factors. The assessment should lead to the categorization of the building as a whole, or each different part of the building, into one of four building types: Type A, Type B, Type C or Type D.

New buildings should be categorized in accordance with Table 3 and the descriptions that follow.

Table 7 Building Type – Land Gas Assessment

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial / Public	Commercial / Industrial
Control, (Change of use, Structural Alterations, Ventilation	None	Some but not all	Full	Full
Room Sizes	Small	Small / Medium	Small to large	Large Industrial, Retail park style

- **Type A building**: private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.

- **Type B building**: private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.

- **Type C building**: commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

- **Type D building**: industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

NOTE 2 Type A buildings are those where the risk of failure of the gas protection measures is likely to be most significant to the safety of the occupants and Type D buildings are those where this same risk is likely to be least significant. From the design CS and the type of building (A, B, C or D) the minimum level of gas protection (score) in the range 0 to 7.5 should be determined in accordance with Table 4.

Table 8 Gas Protection Score by CS and Building Type

CS	Minimum gas protection score (points)			
	High Risk		Medium Risk	Low Risk
	Type A Building	Type B Building	Type C Building	Type D Building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5(A)	5.5(A)	4.5	3.5
5	—(B)	6.5(A)	5.5	4.5
6	—(B)	—(B)	7.5	6.5

A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.

B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

NOTE 3 The NHBC has published guidance [8] for use on residential developments, which utilizes an alternative classification ("traffic light") system. This guidance typically applies to Type A buildings utilizing beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilizing this system would therefore need to refer to the NHBC [8] to assess compliance for specific recommendations.

When the minimum gas protection score has been determined for the building as a whole, or for each part of the building, then a combination of two or more of the following three types of protection measures should be used to achieve that score:

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present.
- ventilation measures. and
- gas resistant membrane.

NOTE 4 The method of selecting the combination of these types of protection measures for a particular building type given in Table 10 and solution score required in Table 11

Once the types of protection measures have been decided, the detailed design and specification of the measures should be undertaken.

NOTE 5 In some cases, the designer might be of the opinion at this stage that the extent of the protection measures is potentially more than is needed, because of limitations in the scope of the site investigation [these limitations having led to a more conservative GSV and CS than is likely from the conceptual site model. In this case, further site investigation could be carried out to check the GSV. Only if there is sufficient time to carry out additional site investigation and gas monitoring would this step be useful.

The detailed design and specification of the protection measures should be recorded in a design report.

Structural Barrier Notes

The first step in the methodology should be the assessment of the gas protection score of the structural barrier, since the construction of the floor slab has usually already been decided at the time the gas protection measures are being designed.

NOTE The floor slab design, and any basement design, are usually determined by geotechnical and constructability factors.

The common types of floor slab and substructure design and their relative performance as a structural barrier to ground gas ingress are described in Annex A. The structural barrier score should be assigned in accordance with Table 5. further guidance is given in Annex A.

Table 9 Structural Barrier Design

Floor and substructure design (see Annex A)	Score(A)
Precast suspended segmental subfloor (i.e. beam and block) 0	**0**
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	**0.5**
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	**1 or 1.5(B)**
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing(C)	**2**
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing(C)	**2.5**
A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed. B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in. C) The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (Note 4).	

Ventilation Notes

Ventilation protection measures should be one of the following five types, and points can only be scored for one of these measures:

a) pressure relief pathway only (no effective dispersal layer).

b) passive dispersal layer.

c) active dispersal layer (fan suction).

d) active positive pressurisation (air blanket). and

e) ventilated basement substructure present.

NOTE 1 For Type A buildings active ventilation measures are inappropriate.

The applicability and design of ventilation protection measures and selection of an appropriate score should be carried out in accordance with Annex B. A ventilation protection measure should have a design with a defined level of performance and supporting dilution calculations. Recommendations on both design and performance criteria for methane and carbon dioxide are provided in Annex B and should be followed.

NOTE 2 There are a wide range of different media used to form the gas dispersal layer for both passive and active systems, and more are likely to be developed.

Designs should use a gas permeability value which is representative of the media in its as-built condition, taking into account the continuity of the media beneath the floor slab, loss of volume due to compression, the pressure differences that apply across the media, and head losses in the terminals.

NOTE 3 The types of media include expanded polystyrene void formers, geocomposite void formers, no (or low) fines gravel, and drains formed by perforated pipes or geocomposite strips.

NOTE 4 The continuity of the media beneath the floor slab might be interrupted by ground beams, pile caps, edge beams and other intrusions extending below the level of the media blanket, which might significantly reduce the effectiveness of the dispersal layer.

NOTE 5 The effective volume of the gas dispersal layer might be reduced by its placement on a soft layer (for example, sand blinding) which reduces its gas permeability and dispersal effectiveness. The effective volume would also be reduced, or eliminated, if the media became flooded with groundwater or clay heave occurred.

NOTE 6 The performance of passive systems can be significantly affected by the number and type of side ventilation terminals. Common side terminals are airbricks, low level vents and high level vent stacks. Guidance on side ventilation is given in Annex B.

In certain circumstances passive ventilation is difficult to achieve, such as where there is a very large building footprint, basement or complex ground beam arrangement. In such cases, a system might be designed as "pressure relief" alone and this should be detailed accordingly in the design. As a bare minimum all gas protection systems should include at least pressure relief (a preferential pathway to atmosphere) for gases which might otherwise build up under the building footprint.

The gas protection scores applicable to different types of passive and active ventilation systems are given in Table 6. The selected score should be assigned in accordance with Annex B and be compatible with gas dispersal performance of the system.

Table 10 Gas protection scores for ventilation protection measures

Protection element/system	Score	Comments
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.
Passive sub floor dispersal layer: Very Good Performance Good Performance Media used to provide dispersal later are: • Clear Void • Polystyrene void former blanket	2.5 1.5	Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation

• Geocomposite void former blanket • No fines gravel layer with gas drains ○ No fines layer		should be designed to meet at least "good performance", see Annex B.
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5-2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex B.
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5-2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000*, *Approved Document F* [9].

Membrane Notes

Gas resistant membranes should be:

a) sufficiently impervious to methane and carbon dioxide.

b) capable after installation of providing a complete barrier to the entry of the relevant gas.

c) sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions.

d) sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below a floor slab).

e) sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools). and

f) chemically resistant to degradation by other contaminants that might be

present.

NOTE 1 A methane gas transmission rate of <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with the manometric method in BS ISO 15105-1) is usually considered sufficient

NOTE 2 Guidance on the relevant properties relating to a), c) and e) is provided in CIRIA C748 [10].

There are many gas resistant membrane types available and membrane choice should be made according to the resistance of the material to the passage of the challenge gas and the resistance to site damage during and after installation in the designed position. The designer specifying the membrane should consider the combination of a particular membrane's properties to assess whether it is suitable in any given situation. The specified membrane and the reasons for its selection should be described in the design stage report.

NOTE 3 Advice on membrane selection is given in Annex C.

NOTE 4 The installation and subsequent protection of the membrane are key factors in its performance. A poorly installed membrane cannot perform, however well detailed and irrespective of the performance of the material. Historically, reference has been made to verification and integrity testing without having any referenced documents against which to judge. The verification process is now described in CIRIA C735 [N1] and as such, confidence in the installed solution can be measured. The process removes the uncertainty of unqualified or inexperienced installation operatives by requiring a verification plan to be drawn up prior to the installation, with frequency and type of verification being dependent upon the

qualifications of the installation operatives, site risk and design criteria. A verification plan for the installation of the membrane should be part of the detailed design.

NOTE 5 Current guidance on verification recommendations takes into account the risk of the overall design and confidence in its installation and sets a frequency and level of verification appropriate.

A gas protection score (see Table 10) should only be assigned to a membrane which is formed of a material with suitably low gas permeability, and which has been installed so it completely seals the foundation (including effective seals around all penetrations) and does not sustain damage from in-service stresses. The criteria which should be met to assign a gas protection score of two points is set out in Table 11

Table 11 Gas protection score for the gas resistant membrane

Protection element/system	Score	Comments
Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method). • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions. • • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab). • • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc) • capable, after installation, of providing a complete barrier to the entry of the relevant gas. and • verified in accordance with CIRIA C735 [N1]	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m2 for polyethelene) reinforced membrane (virgin polymer) meets the performance criteria in Table 7 (see **C.3**). If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.

The above has been taken from BS8485 : 2015, (CODE OF PRACTICE FOR THE DESIGN OF PROTECTIVE MEASURES FOR METHANE AND CARBON DIOXIDE GROUND GASES FOR NEW BUILDINGS). Refences within the above guidance may relate to elements in this document.

3.4 Specific Remediation Works

General Contamination Risks Brought Forward

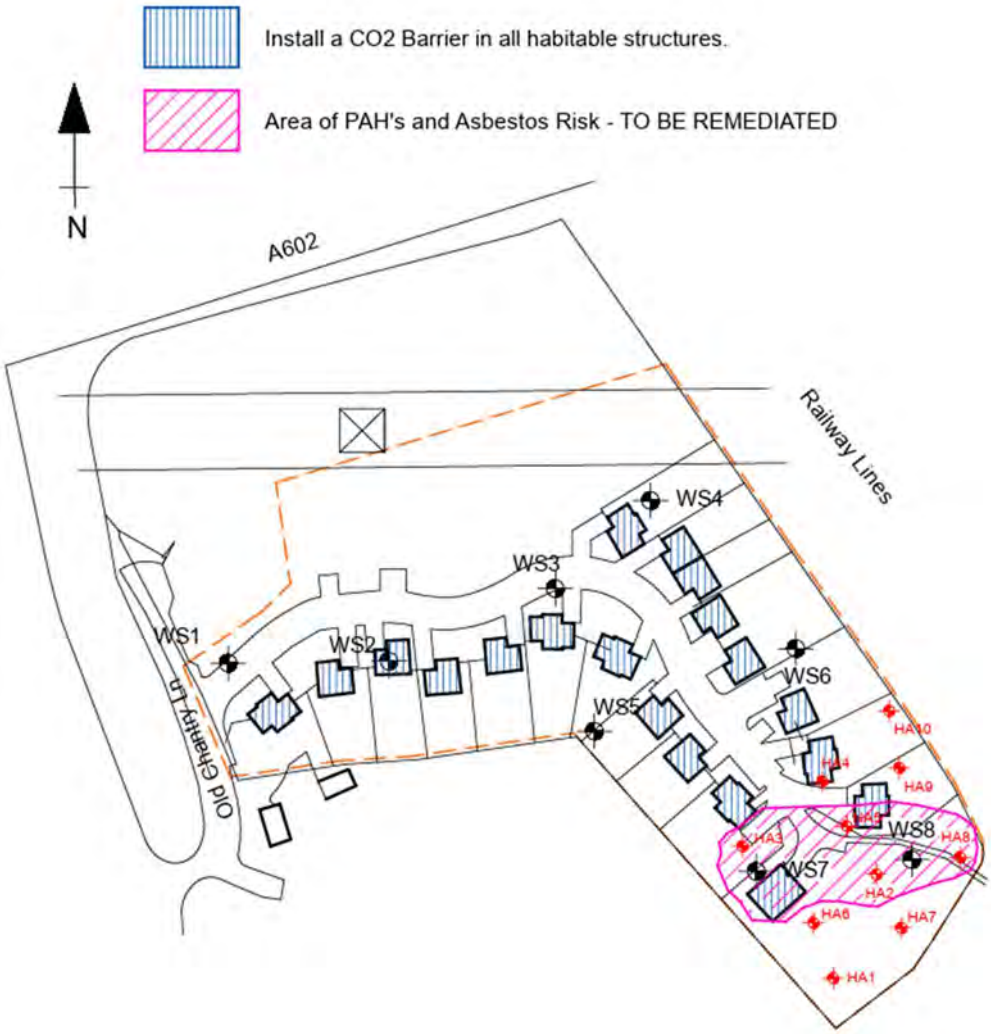
Targeted Risks

- Based on the data in place to date, the risk is noted as WS7, WS8, HA2, HA3, HA5 & HA8.

Spatial Risks

- Land Gases

Figure 6 Remediation Plan



The broad proposal for the site is as follows :-

3.4.1 Remediation Cell 1 – ASBESTOS and PAH's

- Considering the nature of the contamination identified as being both PAH's and Asbestos, we would suggest that the depth of capping should extend to at least 1.00 metres and include at least a 0.20 meter no dig barrier and geotextile as defined within ***Scenario 4*** attached to this document.
- The depth of the contaminated layer in this location is identified as between 0.60-1.25m and as such, based on the contamination identified, full removal of the contaminated layer is likely to be required which will extend the remediation cell into clean natural soils.

- Additional testing has been completed which has provided a good scope for delineation of the area defined as contaminated and has been included in Figure 1 above.
- It is likely that due to the depth of capping, full removal of all soils which would be classed as contaminated will be completed and as such, verification sampling across the base of these areas should be undertaken to confirm this removal.
- If Asbestos is still identified in place, extend the remediation cell to depth to fully remove the Asbestos risk with appropriate validation testing, (as detailed above) until such time as the Asbestos risk is removed.
- Replace soils within remediation cell with a clean and inert soil tested to fall below residential land use standards.
- Undertake appropriate due diligence for muck away and segregation of inert waste soils and Asbestos Identified risk through sorting, sifting and hand picking.
- The remediation cell and any validation works should define strictly as to where Asbestos has been removed and over what area and provide a plan indicating this area.
- A Materials Management Plan, (MMP), will be required to provide adequate confidence that cross contamination from both the demolition process of existing site features and structures and also the potential for soils to become cross contaminated to other areas of the site which may increase costs for site remediation does not occur. The groundworks contractor / remediation contractor will be required to provide adequate reporting that cross contamination has been fully prevented and validation that the proposals have worked.

3.4.2 Watermain Pipework

- Construction materials have been considered and risk has been identified directly to any water main pipework developed at the site.
- An assessment of risk in relation to water main pipework has been considered within the scope of the works and considering the pollution measured at the site. Based on a comparison of the WRAS Data and UKWIR, (Guidance for the selection of water supply pipework on brownfield sites), elevated levels of contamination have been identified and risk IS IN PLACE to water main pipework. This would suggest that any new water main pipework SHOULD BE INSTALLED USING BARRIER PIPEWORK.
- Considering the risk to the workforce used in the construction and possible future maintenance of water main pipework, no risk is in place. To confirm :-
    - Water main pipework should be laid in a BARRIER PIPEWORK system.
    - Any water main pipework should be laid in clean corridors to prevent future risk to workforce used in the maintenance and repair of any water main system.

General

Detailed notes will be required through the development to confirm the extent of options above and where contamination extends to depth and where full contamination has been removed and different scenarios as recorded. This should be documented on detailed plans by the onsite contractor for use in a verification plan.

Validation of these remediation cells is required see section 4.1.

The remediation of the area could either be undertaken :-

- At the start of the development so that all contamination is removed from the site prior to any other ground works being undertaken. This is sometimes completed at the time of the demolition and clearance of the feature currently within the site area.

Or

- At the end of the development when all the areas of the proposed gardens and communal landscaping within this remediation cell will need to be remediated as above. This scenario is likely to incur cross contamination and as such, is not recommended.

We recommend that the Asbestos contamination within the area of Remediation Cells 1 is removed at an early stage of the development so that risk of the contamination spreading to elsewhere on the site is reduced.

A method statement for the movement of soils around the site for offsite disposal must be developed and submitted to us for approval for the movement and offsite disposal of the remediation cells at the site.

It should be noted that a significant cause of cross contamination forms the mixing of site based remediation cells with clean areas of soils, particularly in the case of Asbestos which can spread to clean areas. As such, a defined Materials Movement Plan should be developed and followed to avoid cross contamination risks. This should be designed in accordance with Definition of Waste – Code of Practice.

3.4.3 Semi Permanent Landscaping, (Patio Areas)

Treat as Soft Landscaping if in defined remediation cells.

3.4.4 Permanent Hard Landscaping, (Main Driveway)

Permanent hard landscaping could form the main driveway and parking area which is laid to tarmac and cannot be removed by the residents.

The hard standing will cap off any contamination and removed the pathway, no additional works are required.

If these areas of permanent hard landscaping fall within areas of Asbestos, a file note should be made to confirm that this is the case and potential future risk is in place within this area.

3.4.5 Construction Features

Considering the risk from Sulphates to concrete we can confirm that the chemical testing completed confirms the sulphate levels in the ground which can identify risk to concrete and whether special sulphate resisting cement may be required.

Based on the information gained, concrete has been identified as a risk and as such, any cement used within the development of the site should be a DS1-AC1s classification sulphate resisting cement.

3.4.6 Below Habitable Buildings - Vapour Risk

In lieu of any land gas assessments a Land Gas (CO_2) Barrier should be installed within all habitable buildings as noted in section 3.3.1.

3.5 Workforce

- All Site Staff and visitors to the site should be made aware of the contamination risk within the site area (PAH's and Asbestos).
- Appropriate PPE and RPE should always be worn.

- Washing facilities should be made available for washing hands prior to consumption of any food or water within the site area.
- Appropriate disposal facilities should be provided for all temporary Asbestos suits or disposable equipment.

Overalls

- Disposable overalls – Type 5 (BS EN ISO 13982-1+A1) are suitable.
- You may need waterproof overalls for outdoor work.
- Wear one size too big to help to prevent ripping at the seams.
- If the cuffs are loose, seal them with tape.
- Avoid wearing a long-sleeved shirt – these are difficult to cover properly.
- Wear the overall legs over footwear. Tucking them in lets dust into footwear.
- Wear the hood over RPE straps.
- Dispose of used overalls as asbestos waste.

Gloves

- If you wear protective gloves, use single-use disposable gloves. If you must use latex gloves, use only 'low-protein powder-free' gloves.
- Dispose of used gloves as asbestos waste.

Footwear

- Boots are preferable to disposable overshoes which can cause a slipping risk.
- Choose boots without laces as these are easier to clean.

Respiratory protective equipment

- Use suitable RPE with a UK-assigned protection factor (APF) of 20 or more.
- Suitable types of RPE:
    - disposable respirator to standards EN 149 (type FFP3) or EN 1827 (type FMP3).
    - half-mask respirator (to standard EN 140) with P3 filter.
    - semi-disposable respirator (to EN 405) with P3 filter.
- This equipment should be suitable for most short-duration non licensed work. Workers should select a make and size that fits them.
- This equipment is not suitable for people with beards or stubble – hooded respirators are required for these situations.
- The equipment is also unsuitable for long periods of continuous use; you need power-assisted equipment for such situations.

Planning and preparation

- Plan for and practise emergency procedures such as failure or damage to RPE.
- Workers need to be fit tested to make sure that the RPE fits them properly.
- Arrange fit testing and training on use and inspection of RPE before the work starts. Ask the supplier for help or contact fit2fit.org for details of accredited fit test providers.
- Workers must be medically fit to wear RPE – seek medical advice if you are not sure.

Training

- Make sure that RPE users know:
    - how to check their equipment is working properly before they put it on.
    - how to check that it fits; ˜ how to identify and replace worn or defective parts.
    - about the limitations of the RPE they are using.
    - Instruct users to throw away disposable RPE/PPE as asbestos waste after one use.
    - Tell workers to stop work and leave the area if they think their RPE is not working properly.

Using RPE

- All types of RPE restrict what the wearer can do. It is uncomfortable to wear for long periods, but it is important that you protect yourself.
- RPE has to be worn all the time and until the worker is away from the contaminated air.
- Put on and wear the respirator in accordance with your training and the manufacturer's instructions.
- Carry out a fit check in accordance with your training and the manufacturer's instructions.
- If the worker wears spectacles, they should ensure they do not create a gap between the mask and face.
- Put the overall hood over the straps.
- At the end of the shift, take off RPE last and, if it is disposable, put it in the asbestos waste.
- For non-disposable RPE, clean after use and store in a safe place away from contamination. ˜ With half-mask respirators, change filters regularly – your supplier may be able to advise you how often. Dispose of used filters as asbestos waste.

Maintenance of non-disposable equipment

- Keep RPE clean and in good working order – follow the manufacturer's instructions.
- Inspect and check RPE for damage every time. Carry out thorough checks monthly (or every three months if used infrequently). Inspect all parts including valves and seals. Replace the respirator as appropriate.

3.6 Groundwater Risk

Groundwater is identified as a low risk.

3.7 Process of Remediation

The development of the site is anticipated to incorporate the following phases :-

- Materials Movement Plan to be developed and approved.
- Evidence of implementation of MMP and validation of works completed.
- Demolition of all features within the site.
- Site Strip in preparation for the development of the site.
- Full soil remediation works implemented.
- Full remediation and validation of Asbestos and PAHs contamination.
- Foundation Construction.
- Main development.
- Installation of Barrier Water Main Pipework or Protect-Aline Pipework.
- Installation and validation of Gas Proof Membrane installation.

- Placement of hard standing.
- Install clean and certified topsoil within soft landscaping (if not completed within an earlier phase).
- Landscaping and installation of clean capping layer.
- Verification Reporting.

4 Validation requirements

No permanent monitoring proposals are in place in relation to the site.

Soils which fail the human health criteria will not be permitted to be re-used within the site development. Any soils which fail the criteria should be removed from the site with appropriate waste tickets retained.

4.1 Validation Requirements for Remediation Cells

The extent of validation works which should be implemented will incorporate the following details which should be completed, retained, and reported as evidence of appropriate validation within any validation reporting:

- Validation that the excavation and removal of the Asbestos contaminated soils has been completed, by an external environmental engineer and recover photographic evidence and validation samples of the excavation for use in a validation report.
- Validation that the excavation and removal of contaminated soils has been completed or that a sufficient clean capping has been installed, to all areas of soft landscaping by an external environmental engineer and recover photographic evidence of the excavation for use in a validation report OR provide evidence and plans where full removal has taken place and no capping is present, (i.e. clean natural soils overlain by clean imported soils.
- Retain all 'Muck Away Certificates' which have been received because of the excavation of remediation cells only. Muck away certificates relating to muck away for say pile arisings will not be required under validation criteria.
- Where the depth of made ground extends to depths below the capping system and a demarcation barrier has been placed in areas of soft landscaping, a file note and plan should be completed of these locations. Recover photographic evidence of the membrane installation.
- Replace the remediation cell void with fully certified and tested topsoil or subsoil, (as required), to make up the required minimum depth of 0.60 meters of 'Clean Capping'.
- Provide confirmation that where Asbestos is identified to depth, a cobblestone layer has been installed with all works validated by an external environmental engineer and recover photographic evidence of the excavation for use in a validation report.
- Evidence of specific segregation of waste product must be completed along with all lines of evidence to confirm that cross contamination has not taken place, (as should be designed within a materials management plan).

Table 12 Remediation & Validation Requirements

Location	Remediation Cell No	Validation Sampling	Testing Criteria
REMEDIATION CELL 1	Remediation Cell 1	5-7 Samples from the base of each remediation cell	***Asbestos and PAH's***
Sitewide	Habitable spaces	• Photographic evidence. • Any structural barriers installed. • Any ventilation system installed. • Any gas resistant membrane installed.	***N/A***
Sitewide	Water Main	• Photographic evidence of pipework. • Photographic evidence of clean corridors.	***N/A***

4.2 Validation Requirements of Gas Mitigation Measures

Validation of the land gas risk should be made upon completion of the installation, through photos and certification of its installation and integrity. This is more recently completed by air testing under NVQ4 qualification.

4.3 Photographs

Photographs will be required at key stages of the development which should be included within a validation report. Specifically, these will need to include :-

- Photos should also be taken of the key stages of the development and any contamination encountered, including unexpected contamination.
- Photographs of any reduced digs carried out within the site area, especially if natural soils are encountered. This is imperative to provide lines of evidence that the contaminated soils have been removed.
- Photographs of the exposed remediation cell to soft landscaping which exposes the underlying soils and includes measuring staff.
- Photographs of the remediation cell to soft landscaping which exposes the demarcation barrier.
- Photographs of the finished final site condition.
- Photos through the installation of the gas mitigation measures.
- Photos of the protective pipework installed within the site area.

4.4 Removal of Contaminated Soils

- Contaminated soils should be removed from site via a licensed haulier.
- All waste consignment notices should be retained as evidence that the soils have been removed from site.

- No WAC Testing has been completed at the site. For full classification of the materials for muck away purposes. In line with best practice, we can confirm that the classification and correct disposal of waste should be adhered to in line with Waste Framework Directive. This will include the classification of the waste, appropriate paperwork to be recorded for disposal routes, confirmation of waste classification upon excavation of the waste and validation of its removal.

4.5 Validation of Imported Soils

- Upon importing of subsoil, (if any), and topsoil, samples will be required for chemical analysis. It should be noted that soils which are placed in the site are recommended for pre-validation such that confirmation that these soils will form clean and acceptable materials based on the validation criteria shown within Table 13 and 14 well as BS3882:2015 Specification for topsoil and BS8601:2013 Specification for Subsoil and Requirements for Use. It is often the case that soils are manufactured in landfill sites or waste management facilities which still promote an unacceptable risk based on an end use of residential land uses. This should be noted within the importing status of any soils to the site.
- In accordance with guidance produced by Essex Local Authorities, 'Land Affected by Contamination 2nd Edition – Technical Guidance for Applicants and Developers', we would recommend that a single sample should be recovered per 15m³ of imported soils and tested for full Standard Environmental Suite including Speciated Poly Aromatic Hydrocarbons and Speciated Total Petroleum Hydrocarbons.
- As a minimum over and above the previous bullet point, we would confirm that per source of delivered topsoil, a minimum of three samples must be recovered and tested for a standard suite of environmental pollutants to ensure source compliance of risk.
- Validation of imported soil should also consist of testing the imported topsoil for BS3882:2015 (Specification for topsoil) and the subsoil in accordance BS8601:2013 (Specification for Subsoil and Requirements for Use).
- The above along with a current certificate from the supplier, if available, will confirm the topsoil or subsoil to confirm that the contamination status for confirm the material is suitable for use in a residential land use scenario, (Sensitive Land Use).
- Verification sampling of imported uncontaminated soils should be carried out independently of the supplier, as will their despatch for laboratory analysis for the listed contaminants.
- It is strongly recommended that Imported topsoil should not be laid to the soft-landscaping/ gardens until construction is complete, to avoid cross-contamination of this material.

4.6 Validation Protocol

HESI have derived soil remediation targets for the principal contaminants of concern in for materials which are proposed to be brought onto the site. These conform to current UK residential land use standards for contaminated soils and as such are stringent levels. As a result of these levels, we would suggest that initial pre-validation of soils is undertaken prior to placement or even bringing the soils on site such that confirmation is gained that the soils are suitable.

We would suggest that for validation of both subsoil and topsoil, the parameters below are met:-

Table 13 Imported soils criteria - Residential Land Use Standards

Pollutant	Allowable Level (mg/kg^{-1})	Source
Asbestos	Absent /Present	
Inorganic Arsenic	37	S4UL
Beryllium	1.7	S4UL
Cadmium	11	S4UL
Chromium, (III)	910	S4UL
Chromium, (VI)	6	S4UL
Copper	2400	S4UL
Lead	200	At Risk Soils
Mercury, (Elemental)	1.2	S4UL
Mercury, (Inorganic)	40	S4UL
Mercury, (Methyl)	11	S4UL
Nickel	180	S4UL
Selenium	250	S4UL
Vanadium	410	S4UL
Zinc	2700	S4UL
Boron	290	S4UL
TPH, (Total)	>20 required Speciated assessment	

Pollutant	Allowable Level (mg/kg-1)			Source
	1% SOM	2.5% SOM	6% SOM	
Naphthalene	2.3	5.6	440	S4UL
Acenapthylene	170	420	920	
Acenapthene	210	510	1100	
Flourene	170	400	860	
Phenanthrene	95	220	440	
Anthracene	2400	5400	11000	
Flouranthene	280	560	890	
Pyrene	620	1200	2000	
Benzo(a)anthracene	7.2	11	13	
Chrysene	15	22	27	
Benzo(b)flouranthene	2.6	3.3	3.7	
Benzo(k)flouranthene	77	93	100	
Benzo(a)pyrene	2.2	2.7	3	
Indeno(1,2,3-cd)pyrene	27	36	41	
Dibenzo(ah)anthracene	0.24	0.28	0.3	
Benzo(g,h,i)perylene	320	340	350	
Phenols	120	200	380	S4UL

Table 14 Imported soils criteria – Residential Land Use with home grown produce Standards - TPHs

Pollutant	1% Soil Organic Matter	2.5% Soil Organic Matter	6% Soil Organic Matter	Source
Total Petroleum Hydrocarbons				
Aliphatic Fractions				
EC > 5-6	42	78	160	
EC > 6-8	100	230	530	
EC > 8-10	27	65	150	
EC > 10-12	130	330	760	*S4UL*
EC > 12-16	1100	2400	4300	
EC > 16-35	65000	92000	110000	
EC > 35-44	65000	92000	110000	
Aromatic Fractions				
EC > 5-7	70	140	300	
EC > 7-8	130	290	660	
EC > 8-10	34	83	190	
EC > 10-12	74	180	380	*S4UL*
EC > 12-16	140	330	660	
EC > 16-21	260	540	930	
EC > 21-35	1100	1500	1700	

5 Implementation Process

5.1 Remediation Team

This report confirms the required level of remediation needed to remediate the site to a suitable and fit for purposes standard. We can confirm that at this time, the following parties are involved in the remediation proposals at this site :-

The Client: *the client will ultimately be responsible for the remediation of the site and appointing appropriate personnel to provide lines of evidence that remediation works have been undertaken and that validation works have been completed sufficiently to provide the relevant Local Authority, with documentary evidence that works have been completed to a suitable standard.*

Consultant : *the consultant will undertake validation that the remediation works have been undertaken to a suitable standard although, will require instruction from 'the client' as and when appropriate levels of remediation have been achieved.*

Principle Contractor: *The principle contractor will likely undertake initial site works which will remove contamination from the site as part of the initial site development. It is possible that these works may remove the depths of made ground, (contamination), to remove any and all risk within the site.*

5.2 Watching Brief

During the course of the development it will be the responsibility of the on-site manger to ensure watching briefs are kept. A watching brief consists of a record of:

- Any observations of contamination made during the course of development by any member of site staff, contractor or visitor
- A photographic record of the key stages of development and key occurrences including any contamination found during the course of the development, the formation levels of excavations, any reduced level dig/mass excavation, formation of landscaped or garden areas, etc.
- Contact the Environmental Engineer and strategic points within the development of the site where contamination validation elements will be required.

In areas of the site where there is a greater chance of finding contaminated soil and/or water an area specific watching brief will need to be kept. Such a brief will need to be completed by an appropriately qualified site manager and/or an environmental consultant. The following table specifies works in specific parts of the site that require an area specific watching brief, identifying who must complete the watching brief.

Table 15 Watching Brief – Targeted areas for observation

Area of site	*Works to be observed*	*Person to observe works*
Sitewide	Watching brief for Asbestos.	Site Agent / Groundworker / Environmental Engineer.
Southeast (WS7 & WS8)	Any excavations completed within the area of contamination	
Foundation Excavations	General watching brief through foundation excavations.	

Upon completion of associated works, a written and signed statement will be obtained by the following parties:

- Ground works contractor(s) upon completion of foundations and ground works
- On site manager upon completion of groundworks and landscaping work
- Environmental Consultant upon completion of groundworks and landscaping works

The written statement must clearly state whether or not evidence of contamination was identified during the course of the development and the action that was taken. An example statement is provided below.

“I am [insert name] from [insert company]. We undertook [insert works undertaken] between the [start date] and [finish date]. During the course of work at [insert site name and address] we observed [delete were not applicable: no potential contamination / evidence of contamination / significant evidence of contamination].

Where contamination is identified

The contamination identified:

[include a description of the observations of the contamination]

[identify the location of the observations of contamination and mark the locations on a plan]

[Who was notified of the observations]

[What action was taken to mitigate/clear up contamination]”

The on site manager statement must include confirmation of whether all site staff and contractors received an appropriate brief regarding the potential presence of contamination.

5.3 Site Staff Training / Briefing

All site staff, site contractors and, where significant contamination is expected site visitors, will be briefed on the potential presence of land, water or air bourn contamination before commencing work on the site. Apart from any standard Health & Safety practices this will include the following information:

- Health & Safety considerations;
- Asbestos Awareness course;
- The type of land, water or air bourn contamination expected at the development site based on previous use and available site investigation information.
- Any particular areas of the site which are likely to be affected.
- Staff responsibilities under the discovery strategy.

The on-site manager will need to provide written confirmation that site staff were briefed about contaminated land in line with these recommendations.

5.4 Discovery Strategy

The discovery strategy sets out the actions that must be taken if contamination is encountered during the course of a development.

A significant observation includes any observation of contamination. Examples of the types of observations that would be considered significant are set out in the following table.

Table 16 Discovery Strategy – Examples of Observations

Evidence	Description
Visual	• Fuel or oil like substances mixed in with or smeared on the soil or floating on perched, groundwater or surface waters. • Waste materials (refuse, barrels, industrial wastes, ash, tar, etc.) buried at specific location or across the site. • Marked variation in colour. For example red, orange, yellow, green, light or dark blue, etc. may indicate contamination from a variety of contaminants. • Soils including large amounts of ash and clinker where such contamination of soils wasn't expected.
Odours	• Fuel, oil and chemical type odours • Unusual odours such as sweet odours or fishy odours
Wellbeing	• Light headedness and/or nausea when in excavations, at the working face of an excavation, when visual or olfactory evidence of contamination exists, etc. • Burning of nasal passages, throat, lungs or skin. • Blistering or reddening of skin due to contact with soil

Note: The examples provided in this table are not exhaustive.

The following table sets out the actions that must be taken if significant or suspected land, water or air contamination is observed by site staff, contractors or visitors.

Table 17 Discovery Strategy – Action to be taken if risks are encountered

Person observing contamination	To be reported to:	Action to be taken
Site visitor	Must report observations to the site manager	None
Contractor	Must report observations to the site manager	Stop work and where possible make area safe and secure area before reporting to site manager
On site manager	Must report observations to their direct manager, the appointed Environmental Consultant, the Planning Authority and Contaminated Land Officer at the Local Authority	Stop work and where possible make area safe and secure area before reporting to others
Environmental Consultant	Must report observations to the site manager, the Planning Authority and Contaminated Land Officer at the Local Authority	Advise that work stops and where possible that the area is made safe before reporting to others

The following table identifies other organisations that may need to be contacted in an emergency or where pollution of controlled waters or nuisance is occurring.

Table 18 Discovery Strategy – Organisations to be contacted if risks are encountered

Occurrence	Description	Contact
Risk to the public	If at any point residents, the public or others may be at risk as a result of contamination found during the course of investigation, remediation or development works	· Contact the emergency services if there is a risk to life · Contaminated Land Officer/Planning Authority · Health & Safety Executive
Nuisance to residents/the public	If a nuisance has been or is likely to be caused to nearby residents, the public and others – for example odours, dust, noise, vibration, etc.	· Pollution Control Team at the Local Authority (and other council's where necessary)
Pollution of controlled waters	If any surface, culverted or groundwater has been polluted – for example slurry, contaminated soil/water or a chemical spillage entering a river or canal.	· Environment Agency · Planning Authority and Contaminated Land Officer at the Local Authority
Pollution of adjoining land	If land outside the boundary of the development site is polluted from site activities – for example slurry, contaminated soil/water or a chemical spillage	· The owner of the land · Planning Authority and Contaminated Land Officer at the Local Authority

5.5 Validation Report

The following forms the verification requirements that will be needed in order to prepare and complete a Verification Report for the site and as such, where 'the client' does not provide suitable evidence, further testing may be required.

- Appropriate method of waste management of soils on site to avoid cross contamination
- Provide Method Statement for management of waste and segregation of contaminated soils
- Volumes of soils disposed off site
- Waste Consignment Notices (muck away tickets) and Disposal Register for Duty of Care
- Validation testing of the base of the Remediation cells, where required
- Topsoil Suppliers certificate to show the soil falls below the Human Health criteria
- Results of analysis on subsoil/topsoil within the capping layer
- Volumes of soils imported to site
- Plan showing where full depth of fill was removed. where a capping layer was installed (inc depths) where demarcation barriers were installed within the site area
- Plans showing verification sample locations, if completed
- Confirmation that the appropriate water main pipework has been installed within the site
- Plans showing the route of the protective water main pipework
- Validation of the Land Gas Barrier installation
- Documentation of variations and unforeseen conditions
- Written signed statements to confirm the watching brief was completed
- Consents, permits and approvals gained
- 'As built' drawings
- Photos completed through out the development as noted within section 4.3
- Other records, (e.g. correspondence, photographs etc)

It should be noted that this list may vary dependent upon conditions met on site and therefore is not complete. Upon completion of any and all remediation works which comply with this strategy and a risk assessment and site conceptual model can be completed to confirm no risk is in place to the future user or environment, a site verification report should be completed for submission to the Local Authority and any other interested parties to confirm the site status.

Should the quality of remediation data not be completed in accordance with this report, reasonable attempts to confirm that the works have been undertaken retrospectively should be made. This may involve further more detailed site assessments and testing, monitoring and evidence which will likely incur additional costs.

A validation report will be compiled by HESI or others to document the remediation works undertaken.

5.5 Collection of all necessary Validation Data

The above forms a method of remediation and validation works which will be required as part of the process of discharging of planning conditions. Failure to collect this information in part or in full will result in a failure to discharge conditions relating to contaminated lane and lead to potentially significant retrospective site investigation works to enable the collection of this data.

It is the responsibility of the developer to action all necessary remediation works on site and inform the remediation contractor of the need to obtain any and all relevant validation data.

It is possible that the sourcing of this validation data could be recovered by the developer, the main contractor, groundworks contractor, a specific remediation contractor or an external environmental engineer. The selection of the right person to collect the validation data should be carefully selected to ensure that no validation bias in relation to the works is in place upon completion of the development and we would always recommend that the validation data is collected by either a separate remediation contractor or external environmental engineer.

PLEASE BE AWARE THAT THE SOURCING OF VALIDATION DATA AFTER COMPLETION OF THE DEVELOPMENT IS NOT SOMETHING THAT CAN BE EASILY OBTAINED AND AS SUCH, MAY LEAD TO A FAILURE IN DISCHARGING OF ANY PLANNING CONDITIONS ASSOCIATED WITH TE SITE AND THEREFORE THE ABILILTY TO SELL THE DEVELOPMENT ON.

6 GENERAL REMEDIATION SCENARIOS

6.1 SOFT LANDSCAPING AREAS (private gardens and communal area)

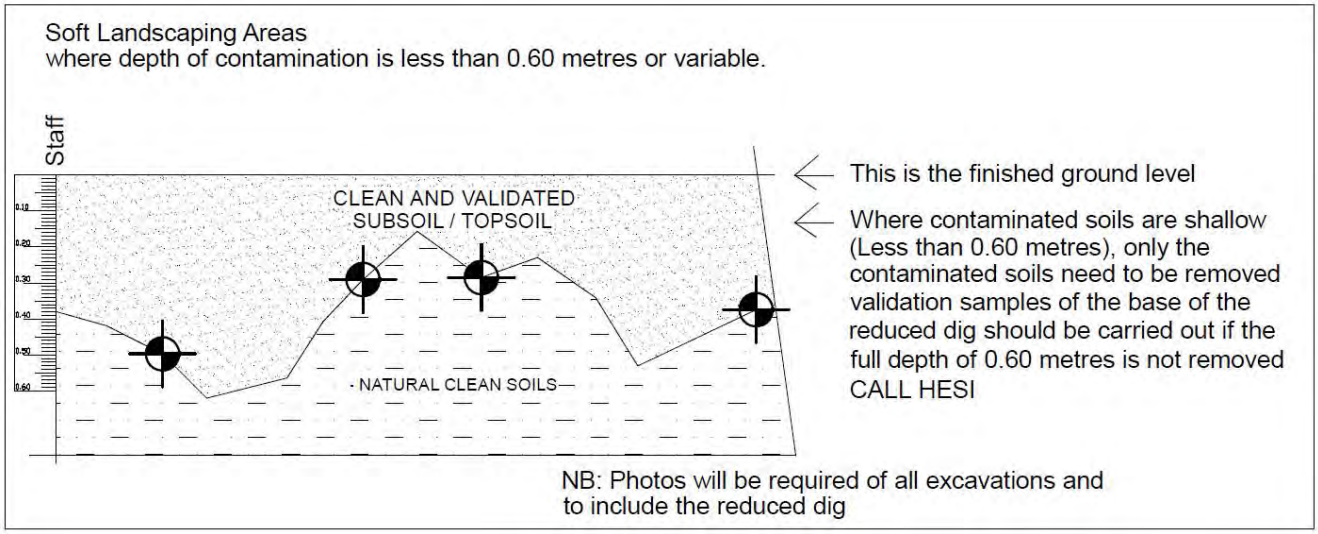
Scenario One **Shallow Contamination, (>0.60m) with Validation Samples**

When the depth of made ground in locations across the remediation cell in full or part does not extend to the depth of proposed capping system. Therefore, removal of shallower depths of made ground, (say 0.30m), may remove all the contamination and expose clean ground, (either natural or made ground).

If this scenario occurs in full or part, validation sampling will be required at the base of the remediation cell to confirm that whilst the minimum capping depth has not been achieved, in fact no capping system is in place as the cell will ultimately form clean soil over natural or clean soils from the original site. In this scenario, the following assessments must be completed :-

- A review of the site must be completed to ensure that hotspots, (large or small), do not remain in place amongst clean underlying soils which are proposed to remain in place. Full removal of contaminated soils should be completed and provided as part of a visual and olfactoral assessments completed by an external environmental engineer. This should also include photographic evidence of these remediation cells confirm the above does not take place.
- A visual appraisal of the base and sides of the remediation cell to consider any visual or olfactoral evidence that risks outside that defined in the environmental reporting completed to date are in place.
- Validation sampling from the sides of the excavation to confirm that the defined contamination originally identified in the remediation cell has been removed.
- Backfill the excavation with at least 0.60 metres, (or whatever depth has been removed to identify clean soil) of clean and inert soil, (tested to confirm its suitability for use within residential land uses with plant uptake).

Figure 1 Shallow Contamination – Validation Sampling – Scenario 1

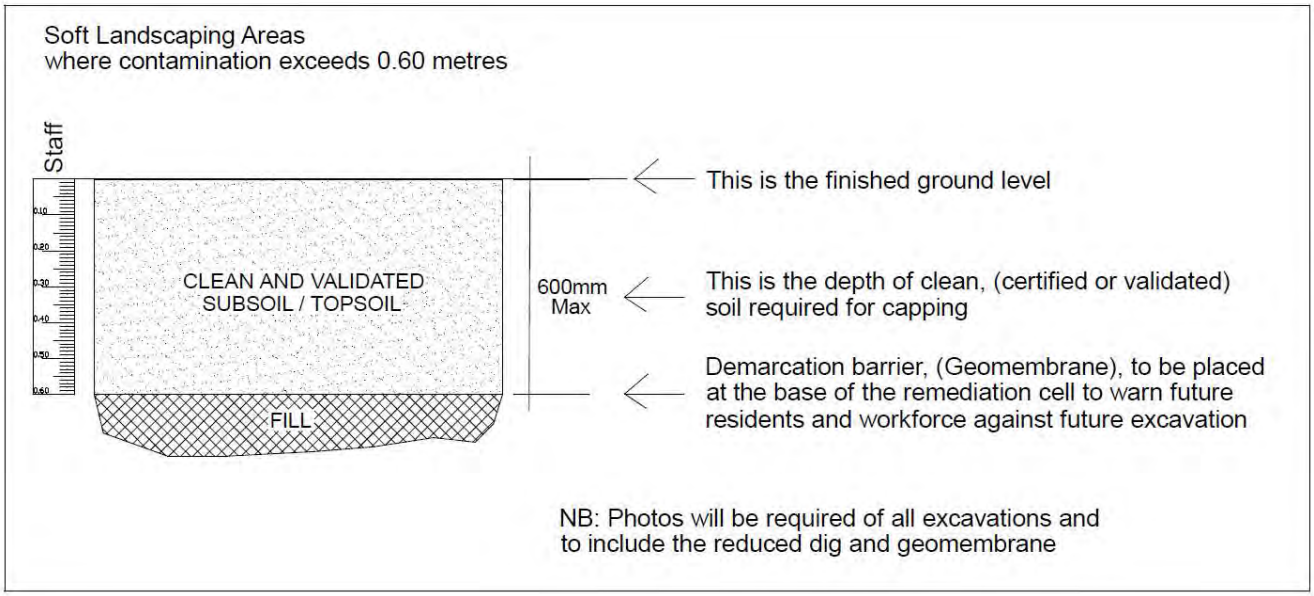


Scenario Two Full 0.60m Capping Layer with Geotextile

When the full depth of capping is required to be removed as the depth of made ground is in excess of 0.60 metres which will need to implement a Geotextile at the base of the remediation cell as shown in Figure 2. In this scenario, the following assessments must be completed :-

- If the density of Asbestos sampling has not been completed to a suitable density based on BS10175:2011+A2:2017, (Investigation of potentially contaminated sites. Code of practice. Code of practice), sampling should be completed across the base of the remediation cell to confirm the absence of Asbestos.
- A visual appraisal of the base and sides of the remediation cell to consider any visual or olfactoral evidence that risks outside that defined in the environmental reporting completed to date are in place.
- Validation sampling from the sides of the excavation to confirm that the defined contamination originally identified in the remediation cell has been removed.
- Backfill the excavation with at least 0.60 metres of clean and inert soil, (tested to confirm its suitability for use within residential land uses with plant uptake).

Figure 2 Capping System – 0.60m Cap & Geotextile Barrier – Scenario 2

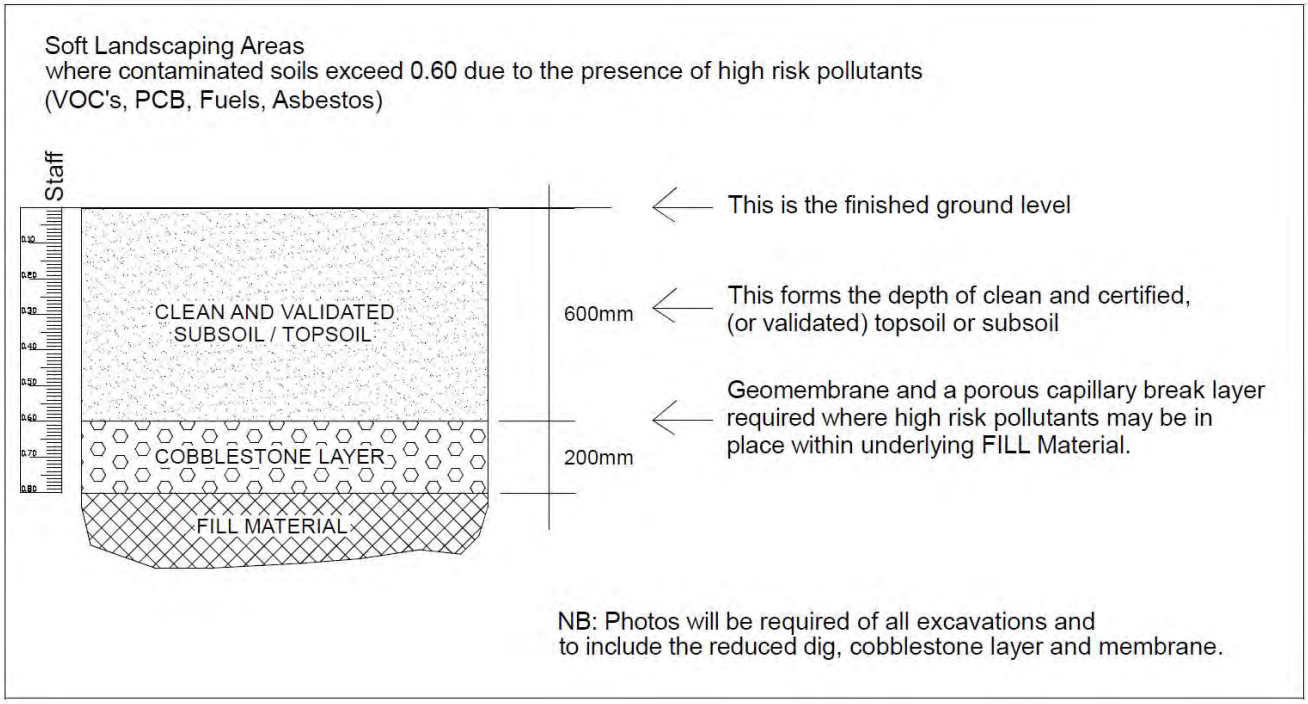


Scenario Three - Full 0.60m Capping layer with Capillary Break Layer

When the full depth of capping is required to be removed as the depth of made ground is in excess of 0.60 metres. In addition to this, the underlying contamination will be shown to be elevated above a commercial level or in a form in which capillary rise has a potential to occur and warrant the need for a capillary break layer and also de-clogging / warning layer, as shown in Figure 4. In this scenario, the following assessments must be completed :-

- Excavation of the required minimum capping layer depth of 0.60m within the remediation cell
- Additionally, excavate a further 0.20 metres within the remediation cell such that the remediation cell totals a depth of 0.80 metres.
- If the density of Asbestos sampling has not been completed to a suitable density based on BS10175:2011+A2:2017, (Investigation of potentially contaminated sites. Code of practice. Code of practice), sampling should be completed across the base of the remediation cell to confirm the absence of Asbestos.
- Validation sampling from the sides of the excavation to confirm that the defined contamination originally identified in the remediation cell has been removed.x
- Backfill the excavation with at least 0.20 metres of crushed concrete, (tested to confirm that the material does not contain Asbestos)
- Place a geotextile across base of the remediation cell, (on top of the crushed concrete) such that a capping layer of at least 0.60 metres can be placed within the remediation cell as a completion layer.

Figure 3 Capping System – 0.60m Cap & Geotextile Barrier – Scenario 3

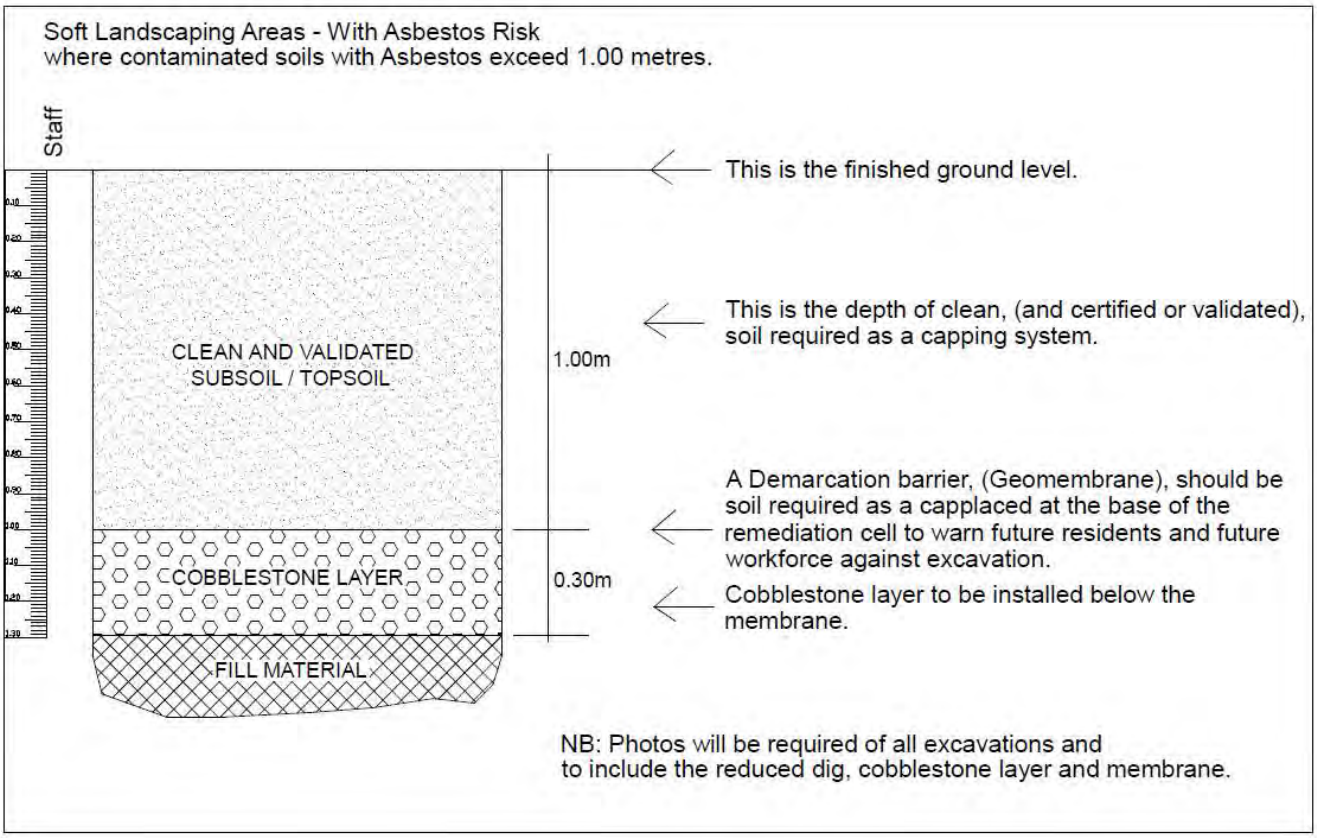


Scenario Four Extended Capping System – High Risk Pollutants - Asbestos

When high risk pollutants are identified within a site, additional depths of capping are required to provide in ground barriers between future residents and the high-risk pollution. In these scenarios, at least 1.00 metre of clean cap will be required with the addition of an additional no dig barrier developed at the base of the remediation cell. This should form at least 0.20 metres of compacted and crushed concrete with a geotextile barrier laid over the top, as shown in Figure 5. In this scenario, the following assessments must be completed :-

- Excavation of the required minimum capping layer depth of 1.00m within the remediation cell.
- Additionally, excavate a further 0.20 metres within the remediation cell such that the remediation cell totals a depth of 1.20 metres.
- Validation sampling from the sides of the excavation to confirm that the defined contamination originally identified in the remediation cell has been removed.
- Backfill the excavation with at least 0.20 metres of well compacted crushed concrete.
- Place a geotextile across base of the remediation cell, (on top of the crushed concrete) such that a capping layer of at least 1.00 metres can be placed within the remediation cell as a completion layer.

Figure 4 Capping System – 1.00m Cap & No Dig Barrier – Scenario 4 – High Risk



Scenario Five – Where TPOs are in place

When the remediation is to be completed in an area where tree preservation orders are in place and therefore root protection areas exist in the remediation cell, we can confirm that where the protection of the tree will take precedence over human health, a shallow strip of soil should take place as shown in Figure 6 below. In this scenario, the following assessments must be completed :-

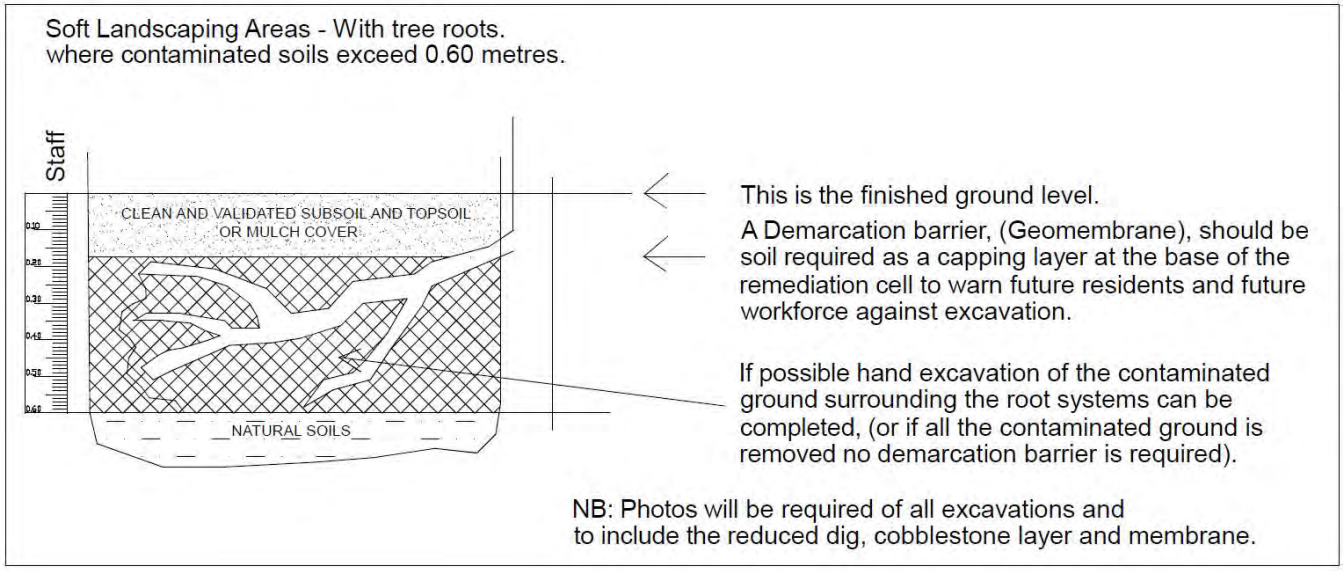
- Excavation should take place by hand until roots are identified using hand dug means of excavations. Roots should be protected in this scenario and maintained in all circumstances.
- If through service trenches, foundation excavations or similar, root systems extend away from the source tree which are broken through these trenches, it is deemed that anything beyond the trench, (unless another tree takes precedence), no longer has ties with the tree and full remediation can take place, as required in other scenarios.

- If the density of Asbestos sampling has not been completed to a suitable density based on BS10175:2011+A2:2017, (Investigation of potentially contaminated sites. Code of practice. Code of practice), sampling should be completed across the base of the remediation cell to confirm the absence of Asbestos.

- Validation sampling from the sides of the excavation to confirm that the defined contamination originally identified in the remediation cell has been removed.

- Place a geotextile across base of the remediation cell, (on top of the crushed concrete) such that a capping layer to cap the remediation cell is completed.

Figure 5 Capping System – 0.60m Cap & Geotextile Barrier – Scenario 5



6.3 LAND GAS - Possible Scenarios and Mitigation Measures Requirements

A number of possible remediation options may be in place when completing remediation of the site. These options are ***ONLY REQUIRED IN HABILTABLE BUILDINGS.***

This will include one of the following scenarios :-

House Type

The construction and use of the building, together with the control of future structural changes to the building and its maintenance (the building's management) should be assessed, since potential risks posed by ground gases are strongly influenced by these factors. The assessment should lead to the categorization of the building as a whole, or each different part of the building, into one of four building types: Type A, Type B, Type C or Type D.

New buildings should be categorized in accordance within the table and the descriptions that follow.

Table 19 Building Type – Land Gas Assessment

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial / Public	Commercial / Industrial
Control, (Change of use, Structural Alterations, Ventilation	None	Some but not all	Full	Full
Room Sizes	Small	Small / Medium	Small to large	Large Industrial, Retail park style

- **Type A building**: private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.
- **Type B building**: private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels.
- **Type C building**: commercial building with central building management control of any alterations to the building or its uses and central building management control of the maintenance of the building, including the gas protection measures. Single occupancy of ground floor and basement areas. Small to large size rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas. Probably civil engineering construction. Examples include offices, some retail premises, and parts of some public buildings (such as schools, hospitals, leisure centres and parts of hotels).

- **Type D building**: industrial style building having large volume internal space(s) that are well ventilated. Corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures. Probably civil engineering construction. Examples are retail park sales buildings, factory shop floor areas, warehouses. (Small rooms within these style buildings should be separately categorized as Type B or Type C).

NOTE 2 Type A buildings are those where the risk of failure of the gas protection measures is likely to be most significant to the safety of the occupants and Type D buildings are those where this same risk is likely to be least significant. From the design CS and the type of building (A, B, C or D) the minimum level of gas protection (score) in the range 0 to 7.5 should be determined in accordance with Table 4.

Table 20 Gas Protection Score by CS and Building Type

CS	Minimum gas protection score (points)			
	High Risk		Medium Risk	Low Risk
	Type A Building	Type B Building	Type C Building	Type D Building
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5(A)	5.5(A)	4.5	3.5
5	—(B)	6.5(A)	5.5	4.5
6	—(B)	—(B)	7.5	6.5

A) Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations.
B) The gas hazard is too high for this empirical method to be used to define the gas protection measures.

NOTE 3 The NHBC has published guidance [8] for use on residential developments, which utilizes an alternative classification ("traffic light") system. This guidance typically applies to Type A buildings utilizing beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilizing this system would therefore need to refer to the NHBC [8] to assess compliance for specific recommendations.

When the minimum gas protection score has been determined for the building as a whole, or for each part of the building, then a combination of two or more of the following three types of protection measures should be used to achieve that score:

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present.
- ventilation measures. and
- gas resistant membrane.

NOTE 4 The method of selecting the combination of these types of protection measures for a particular building type given in Table 10 and solution score required in Table 11

Once the types of protection measures have been decided, the detailed design and specification of the measures should be undertaken.

NOTE 5 In some cases, the designer might be of the opinion at this stage that the extent of the protection measures is potentially more than is needed, because of limitations in the scope of the site investigation [these limitations having led to a more conservative GSV and CS than is likely from the conceptual site model. In this case, further site investigation could be carried out to check the GSV. Only if there is sufficient time to carry out additional site investigation and gas monitoring would this step be useful.

The detailed design and specification of the protection measures should be recorded in a design report.

Structural Barrier Notes

The first step in the methodology should be the assessment of the gas protection score of the structural barrier, since the construction of the floor slab has usually already been decided at the time the gas protection measures are being designed.

NOTE The floor slab design, and any basement design, are usually determined by geotechnical and constructability factors.

The common types of floor slab and substructure design and their relative performance as a structural barrier to ground gas ingress are described in Annex A. The structural barrier score should be assigned in accordance with Table 5. further guidance is given in Annex A.

Table 21 Structural Barrier Design

Floor and substructure design (see Annex A)	Score(A)
Precast suspended segmental subfloor (i.e. beam and block) 0	**0**
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	**0.5**
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations	**1 or 1.5(B)**
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing(C)	**2**
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing(C)	**2.5**
A) The scores are conditional on breaches of floor slabs, etc., being effectively sealed. B) To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast in. C) The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product (Note 4).	

Ventilation Notes

Ventilation protection measures should be one of the following five types, and points can only be scored for one of these measures:

a) pressure relief pathway only (no effective dispersal layer).

b) passive dispersal layer.

c) active dispersal layer (fan suction).

d) active positive pressurisation (air blanket). and

e) ventilated basement substructure present.

NOTE 1 For Type A buildings active ventilation measures are inappropriate.

The applicability and design of ventilation protection measures and selection of an appropriate score should be carried out in accordance with Annex B. A ventilation protection measure should have a design with a defined level of performance and supporting dilution calculations. Recommendations on both design and performance criteria for methane and carbon dioxide are provided in Annex B and should be followed.

NOTE 2 There are a wide range of different media used to form the gas dispersal layer for both passive and active systems, and more are likely to be developed.

Designs should use a gas permeability value which is representative of the media in its as-built condition, taking into account the continuity of the media beneath the floor slab, loss of volume due to compression, the pressure differences that apply across the media, and head losses in the terminals.

NOTE 3 The types of media include expanded polystyrene void formers, geocomposite void formers, no (or low) fines gravel, and drains formed by perforated pipes or geocomposite strips.

NOTE 4 The continuity of the media beneath the floor slab might be interrupted by ground beams, pile caps, edge beams and other intrusions extending below the level of the media blanket, which might significantly reduce the effectiveness of the dispersal layer.

NOTE 5 The effective volume of the gas dispersal layer might be reduced by its placement on a soft layer (for example, sand blinding) which reduces its gas permeability and dispersal effectiveness. The effective volume would also be reduced, or eliminated, if the media became flooded with groundwater or clay heave occurred.

NOTE 6 The performance of passive systems can be significantly affected by the number and type of side ventilation terminals. Common side terminals are airbricks, low level vents and high level vent stacks. Guidance on side ventilation is given in Annex B.

In certain circumstances passive ventilation is difficult to achieve, such as where there is a very large building footprint, basement or complex ground beam arrangement. In such cases, a system might be designed as “pressure relief” alone and this should be detailed accordingly in the design. As a bare minimum all gas protection systems should include at least pressure relief (a preferential pathway to atmosphere) for gases which might otherwise build up under the building footprint.

The gas protection scores applicable to different types of passive and active ventilation systems are given in the table below. The selected score should be assigned in accordance with Annex B and be compatible with gas dispersal performance of the system.

Table 22 Gas protection scores for ventilation protection measures

Protection element/system	Score	Comments
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and/or is not terminated in a venting trench (or similar), then the score is zero.
Passive sub floor dispersal layer: Very Good Performance Good Performance Media used to provide dispersal later are: • Clear Void • Polystyrene void former blanket • Geocomposite void former blanket • No fines gravel layer with gas drains ○ No fines layer	2.5 1.5	Performance criteria for methane and carbon dioxide are shown in Figure B.6 and Figure B.7, respectively. The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B. Passive ventilation should be designed to meet at least "good performance", see Annex B.
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5-2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance", as described in Annex B.
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5-2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000*, *Approved Document F* [9].

Membrane Notes

Gas resistant membranes should be:

a) sufficiently impervious to methane and carbon dioxide.

b) capable after installation of providing a complete barrier to the entry of the relevant gas.

c) sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions.

d) sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below a floor slab).

e) sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools). and

f) chemically resistant to degradation by other contaminants that might be

present.

NOTE 1 A methane gas transmission rate of <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with the manometric method in BS ISO 15105-1) is usually considered sufficient

NOTE 2 Guidance on the relevant properties relating to a), c) and e) is provided in CIRIA C748 [10].

There are many gas resistant membrane types available and membrane choice should be made according to the resistance of the material to the passage of the challenge gas and the resistance to site damage during and after installation in the designed position. The designer specifying the membrane should consider the combination of a particular membrane's properties to assess whether it is suitable in any given situation. The specified membrane and the reasons for its selection should be described in the design stage report.

NOTE 3 Advice on membrane selection is given in Annex C.

NOTE 4 The installation and subsequent protection of the membrane are key factors in its performance. A poorly installed membrane cannot perform, however well detailed and irrespective of the performance of the material. Historically, reference has been made to verification and integrity testing without having any referenced documents against which to judge. The verification process is now described in CIRIA C735 [N1] and as such, confidence in the installed solution can be measured. The process removes the uncertainty of unqualified or inexperienced installation operatives by requiring a verification plan to be drawn up prior to the installation, with frequency and type of verification being dependent upon the

qualifications of the installation operatives, site risk and design criteria. A verification plan for the installation of the membrane should be part of the detailed design.

NOTE 5 Current guidance on verification recommendations takes into account the risk of the overall design and confidence in its installation, and sets a frequency and level of verification appropriate.

A gas protection score should only be assigned to a membrane which is formed of a material with suitably low gas permeability and which has been installed so it completely seals the foundation (including effective seals around all penetrations) and does not sustain damage from in-service stresses. The criteria which should be met to assign a gas protection score of two points is set out in the table above.

Table 23 Gas protection score for the gas resistant membrane

Protection element/system	Score	Comments
Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method). • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions. • • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab). • • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc) • capable, after installation, of providing a complete barrier to the entry of the relevant gas. and • verified in accordance with CIRIA C735 [N1]	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.4 mm thickness (equivalent to 370 g/m2 for polyethelene) reinforced membrane (virgin polymer) meets the performance criteria in Table 7 (see **C.3**). If a membrane is installed that does not meet all the criteria in column 1 then the score is zero.

The above has been taken from BS8485 : 2015, (CODE OF PRACTICE FOR THE DESIGN OF PROTECTIVE MEASURES FOR METHANE AND CARBON DIOXIDE GROUND GASES FOR NEW BUILDINGS). Refences within the above guidance may relate to elements in this document.

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Herts & Essex Site Investigations
Unit J8 | Peek Business Park | Woodside | Bishops Stortford | CM23 5RG
01920 822233 | www.hesi.co.uk | info@hesi.co.uk
Geotechnical Assessments | Environmental Assessments | Desktop Studies | Contamination Analysis

Appendix No	2
Sheet No	1
Job No	16885
Date	Mar 2024

Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

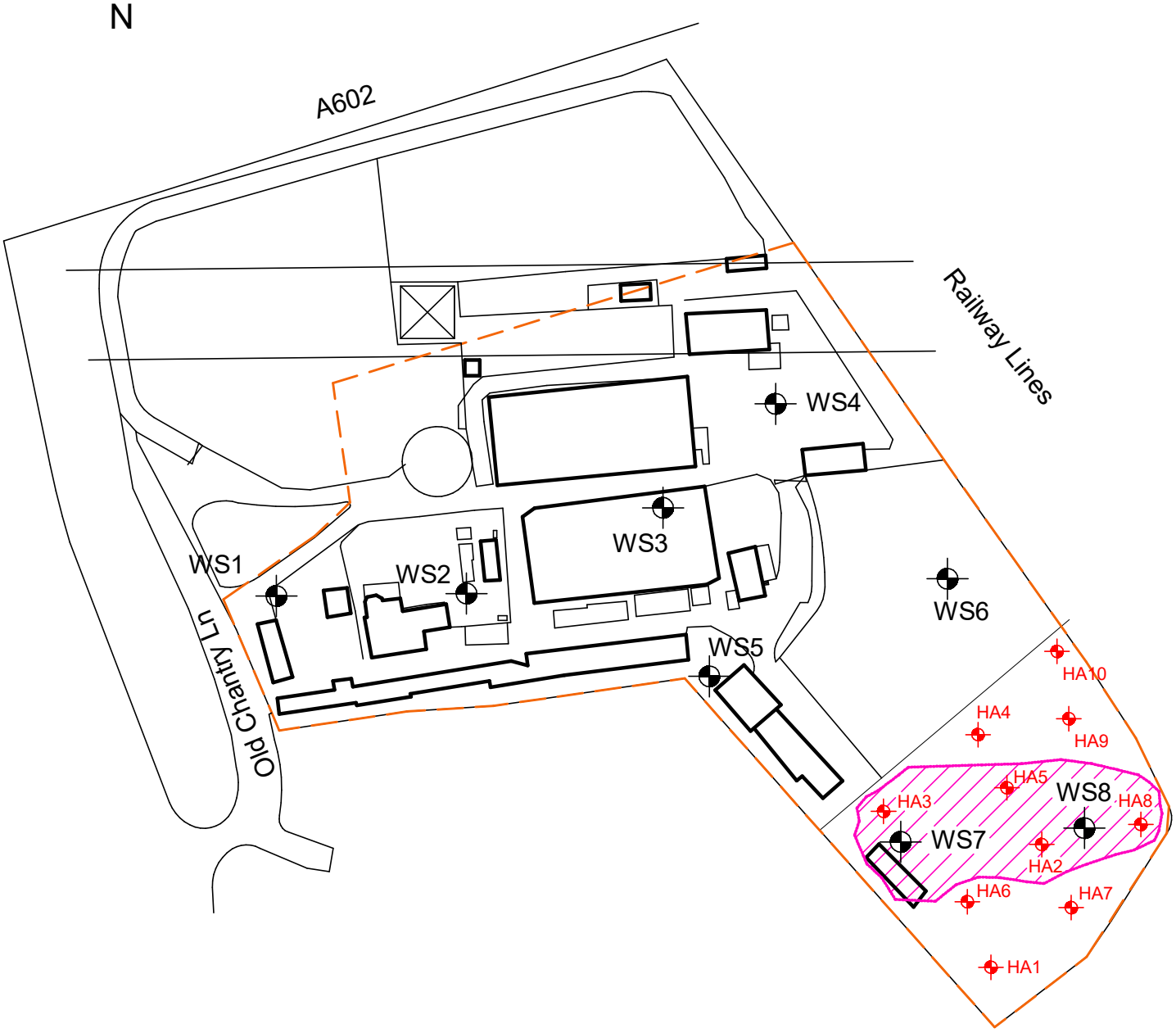
Existing Site Plan

REMEDIATION CELL 1

Area of PAH's and Asbestos Risk

Complete a land gas assessment OR install mitigation measures

Use protective pipework



Not to Scale

Sketch No. : REM /16885 / 01 / 02

HESI
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Appendix No	2
Sheet No	2
Job No	16885
Date	Mar 2024

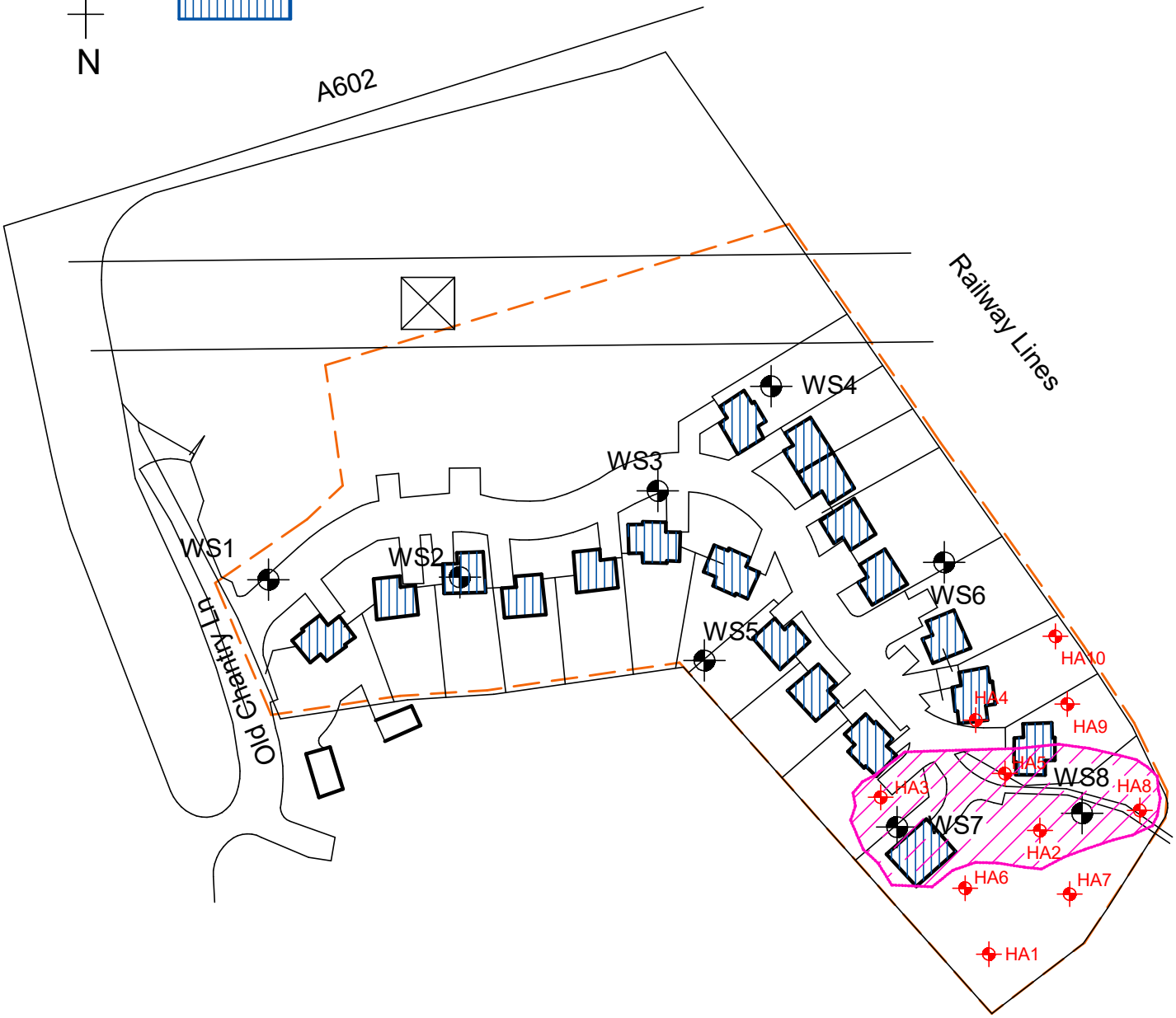
Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE

Proposed Site Plan

REMEDIATION CELL 1

Area of PAH's and Asbestos Risk - TO BE REMEDIATED

Install a CO2 Barrier in all habitable structures.



Not to Scale

Sketch No. : REM /16885 / 01 / 02

Sampling Chain of Custody (CoC)

eurofins | Chemtest

Please note that any testing scheduled where a matrix option is not selected may be subject to Non-Conformance.
Failure to complete all sections of this form may delay analysis.

Required Information

Company Name:	Herts and Essex Site Investigations
Company Address:	
	Unit J8, Peek Business Park, Woodside, Bishop's Stortford CM23 5RG
Site Location:	Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE
Project Reference:	16885
PO Number:	As above
Quote Number:	
Project Contact Name(s)	Chris Gray
Project Contact Email(s)	csgray@hesi.co.uk bmccullock@hesi.co.uk
	rchamberlain@hesi.co.uk dhudd@hesi.co.uk
Main Contact:	Chris Gray
Secondary Contact:	Rebecca Chamberlain

Lab Contact Information

Delivery Information:	Eurofins Chemtest Ltd
	12 Depot Road
	Newmarket. CB8 0AL
Contact Information:	Phone: 01638 606070
	Email: cs.team@chemtest.com
	Web: www.chemtest.com

Water Matrix Codes

Ground Water (**GW**)
Surface Water (**SW**)
Drinking Water (**DW**)
Land Leachate (**LE**)
Prepared Leachate (**PL**)
Untreated Sewage (**US**)

Treated Sewage (**TS**)
Trade Effluent (**TE**)
Saline Water (**SA**)
Process Water (**PR**)
Recreational Water (**RE**)
Unspecified Liquid (**UNL**)

Other Codes

Soils (**S**)
Gas (**G**)
Product (**P**)
Sludge (**SL**)
Unspecified Solid (**UNS**)

Type of Analysis

Suite / Determinand

PAH Specated | Organic matter | Asbestos (+ quant if found)

Sample Information

Sample Date	Sample Time	Location	AGS Type	Sample Ref	Sample ID	Top Depth	Bottom Depth	MATRIX CODE	Container Type (see key below)	PLEASE DETAIL BELOW ANY POTENTIAL HAZARDS THAT MAY BE ASSOCIATED WITH THESE SAMPLES *example; Anthrax, Radioactive, Explosives*	ANALYSIS REQUIRED (please tick appropriately)		
SAMP_DATE	SAMP_TIME	LOCA_ID	SAMP_TYPE	SAMP_REF	SAMP_ID	SAMP_TOP	SAMP_BASE						
05/02/2024		HA1				0.30		S	PT		X	X	X
05/02/2024		HA2				0.40		S	PT		X	X	X
05/02/2024		HA3				0.60		S	PT		X	X	X
05/02/2024		HA4				0.40		S	PT		X	X	X
05/02/2024		HA5				0.50		S	PT		X	X	X
05/02/2024		HA6				0.30		S	PT		X	X	X
05/02/2024		HA7				0.25		S	PT		X	X	X
05/02/2024		HA8				0.2		S	PT		X	X	X
05/02/2024		HA9				0.35		S	PT		X	X	X
05/02/2024		HA10				0.5		S	PT		X	X	X
05/02/2024		HA11				0.5		S	PT		X	X	X
05/02/2024		HA12				0.45		S	PT		X	X	X

Client's signature:

Date of Collection

Container Key:

PB - 1L Plastic Bottle	V - 40ml Vial
AB - 1L Winchester	PT - Plastic Tub
AJ - 60/250 Amber Jar	TT - Tenax Tube

Lab Use Only

Consignment Condition:	Received by:
Arriving Temperature:	Date and time:

Turnaround Time Agreed:

3	5	7	10
WAC 5	WAC 7	Other:	

Sampling Chain of Custody (CoC)

eurofins | Chemtest

Please note that any testing scheduled where a matrix option is not selected may be subject to Non-Conformance.
Failure to complete all sections of this form may delay analysis.

Required Information

Company Name:	Herts and Essex Site Investigations
Company Address:	
	Unit J8, Peek Business Park, Woodside, Bishop's Stortford CM23 5RG
Site Location:	Courtland Riding Stables, Old Chantry Ln, Todds Green, Stevenage SG1 2JE
Project Reference:	16885
PO Number:	As above
Quote Number:	
Project Contact Name(s)	Chris Gray
Project Contact Email(s)	csgray@hesi.co.uk bmccullock@hesi.co.uk
	rchamberlain@hesi.co.uk dhudd@hesi.co.uk
Main Contact:	Chris Gray
Secondary Contact:	Rebecca Chamberlain

Lab Contact Information

Delivery Information:	Eurofins Chemtest Ltd
	12 Depot Road
	Newmarket. CB8 0AL
Contact Information:	Phone: 01638 606070
	Email: cs.team@chemtest.com
	Web: www.chemtest.com

Water Matrix Codes

Ground Water (**GW**)	Treated Sewage (**TS**)	Soils (**S**)
Surface Water (**SW**)	Trade Effluent (**TE**)	Gas (**G**)
Drinking Water (**DW**)	Saline Water (**SA**)	Product (**P**)
Land Leachate (**LE**)	Process Water (**PR**)	Sludge (**SL**)
Prepared Leachate (**PL**)	Recreational Water (**RE**)	Unspecified Solid (**UNS**)
Untreated Sewage (**US**)	Unspecified Liquid (**UNL**)	

Other Codes

Type of Analysis

Suite / Determinand

PAH Specated | Organic matter | Asbestos (+ quant if found)

Sample Information

PLEASE DETAIL BELOW ANY POTENTIAL HAZARDS THAT MAY BE ASSOCIATED WITH THESE SAMPLES
example; Anthrax, Radioactive, Explosives

ANALYSIS REQUIRED (please tick appropriately)

Sample Date	Sample Time	Location	AGS Type	Sample Ref	Sample ID	Top Depth	Bottom Depth	MATRIX CODE	Container Type (see key below)	PAH Specated	Organic matter	Asbestos (+ quant if found)
SAMP_DATE	SAMP_TIME	LOCA_ID	SAMP_TYPE	SAMP_REF	SAMP_ID	SAMP_TOP	SAMP_BASE					
05/02/2024		HA13				0.60		S	PT	X	X	X
05/02/2024		HA14				0.40		S	PT	X	X	X

Client's signature:

Date of Collection

Container Key:

PB - 1L Plastic Bottle	V - 40ml Vial
AB - 1L Winchester	PT - Plastic Tub
AJ - 60/250 Amber Jar	TT - Tenax Tube

Lab Use Only

Consignment Condition:	Received by:
Arriving Temperature:	Date and time:

Turnaround Time Agreed:

3	5	7	10
WAC 5	WAC 7	Other:	

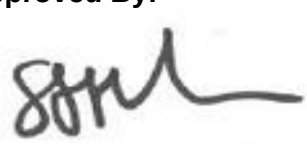
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	24-03727-1
Initial Date of Issue:	12-Feb-2024
Re-Issue Details:	
Client	Herts & Essex Site Investigations
Client Address:	Unit J8 Peek Business Park Woodside Bishops Stortford Hertfordshire CM23 5RG
Contact(s):	Chris Gray Dafydd Hudd Rebecca Chamberlain Ben McCullock
Project	16885 Courtland Riding Stables, Old Chantry Ln, Todds Green

Quotation No.:		**Date Received:**	08-Feb-2024
Order No.:	16885	**Date Instructed:**	08-Feb-2024
No. of Samples:	14		
Turnaround (Wkdays):	5	**Results Due:**	14-Feb-2024
Date Approved:	12-Feb-2024		

Approved By:



Details: Stuart Henderson, Technical Manager

For details about application of accreditation to specific matrix types, please refer to the Table at the back of this report

Results - Soil

Project: 16885 Courtland Riding Stables, Old Chantry Ln, Todds Green

Client: Herts & Essex Site Investigations			**Chemtest Job No.:**			24-03727	24-03727	24-03727	24-03727	24-03727	24-03727	24-03727	24-03727
Quotation No.:			**Chemtest Sample ID.:**			1763867	1763868	1763869	1763870	1763871	1763872	1763873	1763874
			Sample Location:			HA1	HA2	HA3	HA4	HA5	HA6	HA7	HA8
			Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):			0.30	0.40	0.60	0.40	0.50	0.30	0.25	0.2
			Date Sampled:			05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024
			Asbestos Lab:			NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**								
ACM Type		U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification		U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture		N	2030	%	0.020	17	12	10	16	14	16	16	14
Soil Colour		N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material		N	2040		N/A	Stones and Roots	Stones and Roots	Stones and Roots	Stones and Roots	Roots and Stones	Stones	Stones and Roots	Stones and Roots
Soil Texture		N	2040		N/A	Clay	Loam	Loam	Clay	Clay	Clay	Clay	Clay
Organic Matter		U	2625	%	0.40	1.5	5.7	5.2	0.60	4.3	1.1	2.6	1.8
Naphthalene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.20	< 0.10	< 0.10	< 0.10
Acenaphthylene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.35	< 0.10	< 0.10	0.13
Acenaphthene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.99	< 0.10	< 0.10	0.29
Fluorene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.80	< 0.10	< 0.10	0.18
Phenanthrene		U	2700	mg/kg	0.10	< 0.10	0.66	0.48	< 0.10	7.2	< 0.10	< 0.10	2.0
Anthracene		U	2700	mg/kg	0.10	< 0.10	0.51	0.36	< 0.10	2.5	< 0.10	< 0.10	0.75
Fluoranthene		U	2700	mg/kg	0.10	< 0.10	1.6	1.6	< 0.10	18	< 0.10	0.38	4.8
Pyrene		U	2700	mg/kg	0.10	< 0.10	1.4	1.8	< 0.10	18	< 0.10	0.72	5.8
Benzo[a]anthracene		U	2700	mg/kg	0.10	< 0.10	0.61	1.3	< 0.10	9.1	< 0.10	< 0.10	1.9
Chrysene		U	2700	mg/kg	0.10	< 0.10	0.77	1.2	< 0.10	10	< 0.10	< 0.10	1.8
Benzo[b]fluoranthene		U	2700	mg/kg	0.10	< 0.10	2.3	2.1	< 0.10	14	< 0.10	< 0.10	2.8
Benzo[k]fluoranthene		U	2700	mg/kg	0.10	< 0.10	1.5	0.96	< 0.10	5.9	< 0.10	< 0.10	1.3
Benzo[a]pyrene		U	2700	mg/kg	0.10	< 0.10	3.8	1.7	< 0.10	15	< 0.10	< 0.10	2.8
Indeno(1,2,3-c,d)Pyrene		U	2700	mg/kg	0.10	< 0.10	1.2	1.1	< 0.10	7.6	< 0.10	< 0.10	1.1
Dibenz(a,h)Anthracene		U	2700	mg/kg	0.10	< 0.10	0.44	0.79	< 0.10	3.5	< 0.10	< 0.10	0.58
Benzo[g,h,i]perylene		U	2700	mg/kg	0.10	< 0.10	1.3	1.5	< 0.10	8.4	< 0.10	< 0.10	1.2
Total Of 16 PAH's		U	2700	mg/kg	2.0	< 2.0	16	15	< 2.0	120	< 2.0	< 2.0	27

Results - Soil

Project: 16885 Courtland Riding Stables, Old Chantry Ln, Todds Green

Client: Herts & Essex Site Investigations			**Chemtest Job No.:**			24-03727	24-03727	24-03727	24-03727	24-03727	24-03727
Quotation No.:			**Chemtest Sample ID.:**			1763875	1763876	1763877	1763878	1763879	1763880
			Sample Location:			HA9	HA10	HA11	HA12	HA13	HA14
			Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):			0.35	0.5	0.5	0.45	0.60	0.40
			Date Sampled:			05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024	05-Feb-2024
			Asbestos Lab:			NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**HWOL Code**	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type		U	2192		N/A	-	-	-	-	-	-
Asbestos Identification		U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture		N	2030	%	0.020	16	14	16	14	17	16
Soil Colour		N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown
Other Material		N	2040		N/A	Stones	Stones and Roots	Stones and Roots	Stones	Stones and Roots	Stones and Roots
Soil Texture		N	2040		N/A	Clay	Clay	Clay	Clay	Clay	Clay
Organic Matter		U	2625	%	0.40	0.42	2.1	2.1	1.5	1.7	1.6
Naphthalene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene		U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene		U	2700	mg/kg	0.10	< 0.10	0.78	0.24	< 0.10	0.60	< 0.10
Anthracene		U	2700	mg/kg	0.10	< 0.10	0.26	< 0.10	< 0.10	0.18	< 0.10
Fluoranthene		U	2700	mg/kg	0.10	< 0.10	1.7	0.66	0.50	1.5	< 0.10
Pyrene		U	2700	mg/kg	0.10	< 0.10	1.7	0.73	0.60	1.6	< 0.10
Benzo[a]anthracene		U	2700	mg/kg	0.10	< 0.10	0.88	0.42	0.31	1.1	< 0.10
Chrysene		U	2700	mg/kg	0.10	< 0.10	0.83	< 0.10	0.16	0.97	< 0.10
Benzo[b]fluoranthene		U	2700	mg/kg	0.10	< 0.10	1.1	< 0.10	0.61	1.5	< 0.10
Benzo[k]fluoranthene		U	2700	mg/kg	0.10	< 0.10	0.37	< 0.10	0.20	0.57	< 0.10
Benzo[a]pyrene		U	2700	mg/kg	0.10	< 0.10	1.8	< 0.10	1.8	2.0	< 0.10
Indeno(1,2,3-c,d)Pyrene		U	2700	mg/kg	0.10	< 0.10	0.57	< 0.10	0.24	0.86	< 0.10
Dibenz(a,h)Anthracene		U	2700	mg/kg	0.10	< 0.10	0.36	< 0.10	< 0.10	0.47	< 0.10
Benzo[g,h,i]perylene		U	2700	mg/kg	0.10	< 0.10	0.78	< 0.10	0.48	1.1	< 0.10
Total Of 16 PAH's		U	2700	mg/kg	2.0	< 2.0	11	2.1	4.9	13	< 2.0

Test Methods

SOP	Title	Parameters included	Method summary	Water Accred.
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.	
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930	
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry	
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.	
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)	

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

Water Sample Category Key for Accreditation

DW - Drinking Water
GW - Ground Water
LE - Land Leachate
NA - Not Applicable
PL - Prepared Leachate
PW - Processed Water

Report Information

RE - Recreational Water
SA - Saline Water
SW - Surface Water
TE - Treated Effluent
TS - Treated Sewage
UL - Unspecified Liquid

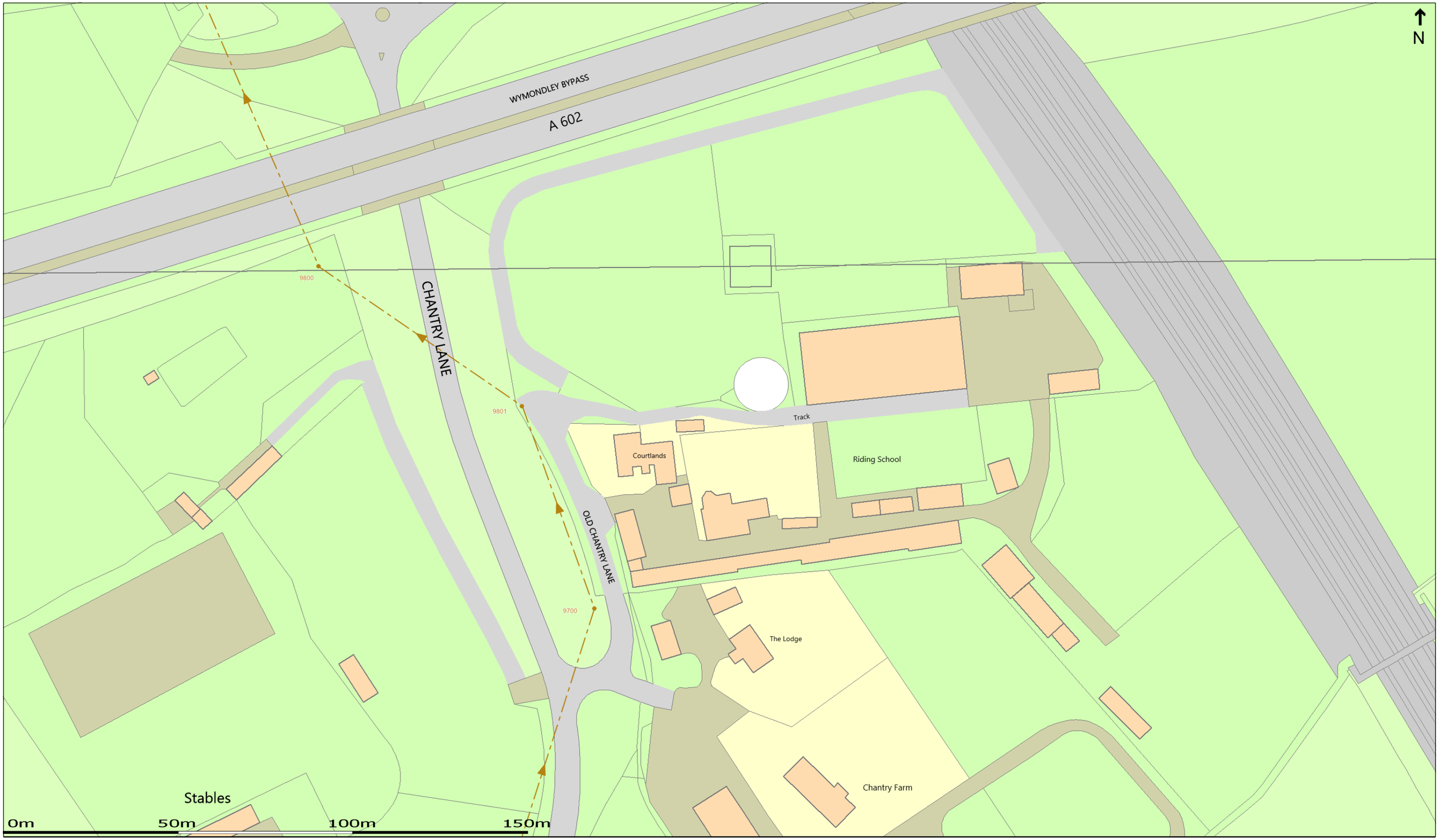
Clean Up Codes

NC - No Clean Up
MC - Mathematical Clean Up
FC - Florisil Clean Up

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

APPENDIX D – EXISTING DRAINAGE DATA

info@fernbrook.co



Date: 30/07/20 Scale: 1:1000 Map Centre: 522033,226825 Title: G2536573-3

COMMERCIALDW
DRAINAGE AND WATER ENQUIRY

- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Decommissioned Sewer (colour denotes effluent type)
- Private Sewer (colour denotes effluent type)
- Rising Main (colour denotes effluent type)
- Manhole (colour denotes effluent type)
- Public Pumping Station
- Private Pumping Station
- Decommissioned Pumping Station
- Public Sewage Treatment Works
- Private Sewage Treatment Works
- Outfall
- Inlet

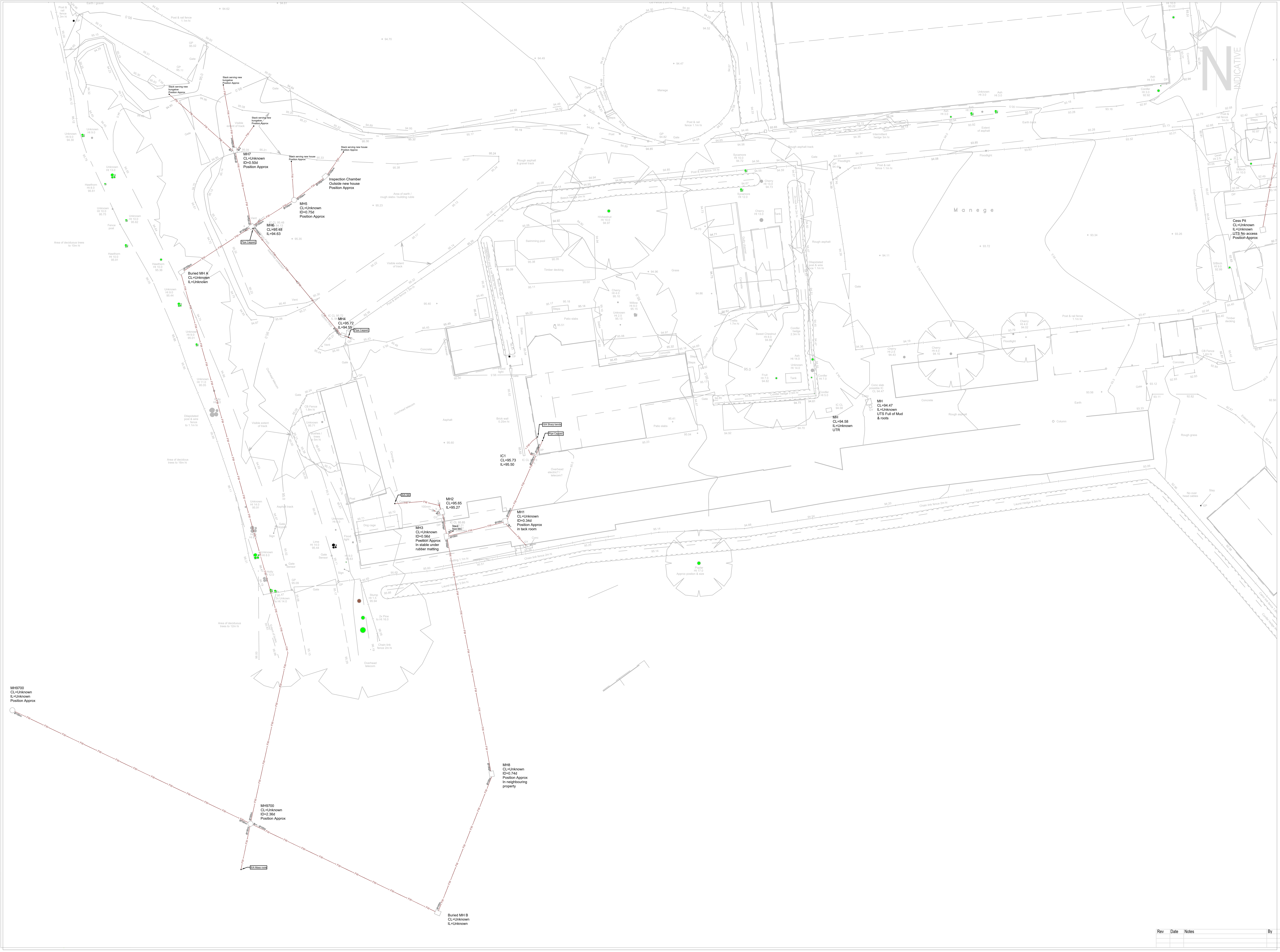
GEODESYS
Land and property information

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
9700	F	-	-	-
9800	F	-	-	-
9801	F	-	-	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Title: G2536573-3



Rev	Date	Notes	By

Notes:

Utilities may continue outside of the survey area. Any paint marks outside of the area are for investigative purposes only and may not represent the full extent of the sub-surface utilities.

Only sub-surface utility information is provided. Above ground utility information may be shown where it assists with positional referencing.

Where logic indicates a utility exists but which cannot be positively confirmed with the technology, an assumed route (AR) is recorded.

ClearView Surveys does not procure statutory or private source utility information (Unless requested at time of order) as part of its detection service nor does it record any such information in a utility survey unless otherwise requested. Statutory plans should be consulted to supplement this survey.

Vertical & Horizontal Position - Vertical position (depth) is indicative to the top of the utility/feature and is recorded as DTS (depth to top of service) and should not be taken as exact. Where depth information from the technology is unclear, depth is not shown. Drains may have been detected using threading and the depth indicated could be between the top and the bottom of the drain. Horizontal position is indicative to the centre of the utility/feature and should not be taken as exact.

Warranty - Biodegradable paints are used to mark-out the position of the utilities. Before long paint markings may become illegible depending on ground, weather and traffic conditions. No warranty is given in respect of the durability of the paint markings and that they are a complete representation of the sub-surface utilities therefore this drawing should be used as the primary reference for the survey results.

This drawing does not provide an absolute representation of the sub-surface. Utilities have been detected using non-invasive technologies only and the performance can be adversely affected by ground, weather and site conditions outside of ClearView Surveys control therefore some utilities may be undetectable. While ClearView Surveys uses reasonable endeavours to detect all utilities, it does not warrant that 100% detection will be achieved and that approximate depth penetration of the technologies will be greater than two metres.

Sewer and manhole details shown on this drawing have been obtained by observation and measurement from the surface and as such cannot be guaranteed. Where precise sewer details will be critical to the project design ClearView Surveys would recommend that entry into the chamber be undertaken using a specialist team, appropriately qualified for confined space entry. These teams can be supplied on request.

Irrespective of the information provided by a utility survey and statutory plans, excavation work should be undertaken with extreme caution and in accordance with HSE Guidelines - HSG47 Avoiding Danger from Underground Services

Additional Notes:

1. The correct identification of the utility types can not be 100% guaranteed, therefore these should be independently verified prior to use in any design or building works.
2. All pipe diameters and levels are assumed to be correct, but due to non entry of the inspection chambers, these should be verified before any works commence.
3. All utility depths are in metres.
4. All pipe/duct sizes are in millimetres.
5. Information provided should not be altered. It should not be used for any purpose other than for which it was intended and should not be issued to other parties without prior agreement from ClearView Surveys.
6. All dimensions should be checked on site before any fabrication,construction or excavation.
7. CCTV Drainage Pipe positions are indicative only and are in an approximate position.
8. Base Topo Supplied By Client. Accuracy of this cannot be guaranteed as it was not undertaken by ClearView Surveys.
9. Utility Survey has been fitted to OS

Key:

STREET FURNITURE
BB Belisha Beacon
BL Basement Light
Bin Litter Bin
BO Bollard
BS Bus Stop
CPO Concrete Post
EC Electric Cupboard
EFP Electric Feeder Pillar
EP Electric Pole
FB Flower Bed
FHM Fire Hydrant Marker
FL Flood Light
FP Flag Pole
FPO Fence Post
JB Junction Box
GB Grit Box
GMK Gas Marker Post
GPO Gate Post
IBO Illuminated Bollard
LH Lamp Hole
LP Lamp Post
LPO Lockable Post
MK Marker
MPO Metal Post
NP Name Plate
PB Post Box
PM Parking Meter
RPO Reflector Post
RS Road Sign
SI Sign
STN Survey Station
Tap Attached to Wall/Building etc
TCB Telephone Call Box
TL Traffic Light
TLCB Traffic Light Control Box
TP Telegraph Pole
TPO Timber Post

PIPES & CABLES
CIG Cable In Ground
DBC Directly Buried Cable
DP Down Pipe
eot End Of Trace
FWP Foul Water Pipe
GP Gas Pipe
ONV Outlet Not Visible
PIG Pipe In Ground
RWP Rain Water Pipe
SP Stand Pipe
SVP Soil Vent Pipe
UTS Unable To Survey
UTT Unable To Trace
VP Vent Pipe
WP Waste Pipe

LEVELS & DEPTHS
A Approximate
BD Back Drop Depth
BDL Back Drop Level
CD Chamber Depth
CL Cover Level
DPC Damp Proof Course
EL Eaves Level
FFL Finished Floor Level
FRL Flat Roof Level
IBDL Internal Back Drop
ID Invert Depth
IL Invert Level
OD Outlet Depth
OL Outlet Level
PWL Parapet Wall Level
RL Ridge Level
SD Sump Depth
SFD Soffit Depth
SFL Soffit Level
SiltL Silt Level
SL Sump Level
SSL Structural Slab Level
TFL Top Of Fence Level
THL Threshold Level
TWL Top Of Wall Level
WL Water Level

FENCES & WALLS
BW Block Wall
BRP Brick Pier
BRTW Brick Retaining Wall
BRW Brick Wall
BWF Barbed Wire Fence
CBF Close Board Fence
CIF Corrugated Iron Fence
CLF Chain Link Fence
CPF Chestnut Paling Fence
CRW Concrete Retaining Wall
CW Concrete Wall
CWF Chicken Wire Fence
DIL Dilapidated
HR Hand Rail
IWF Interwoven Fence
LF Lattice Fence
MF Miscellaneous Fence
MRF Metal Railing Fence
OBF Open Board Fence
PCF Post & Chain Fence
PNF Panel Fence
PRF Post & Rail Fence
PWF Post & Wire Fence
RTW Retaining Wall
STW Stone Wall
SRTW Stone Retaining Wall
WMF Wire Mesh Fence

INSPECTION CHAMBERS
AC Access Cover
BH Borehole
CDC Concrete Drainage Channel
EIC Electric Inspection Cover
ER Earth Rod
FWIC Foul Water Inspection Cover
FWPS Foul Water Pumping Station
FH Fire Hydrant
GIC Gas Inspection Cover
GM Gas Meter
GV Gas Valve
G Gully
IC Inspection Cover
KI Kerb Inlet
LHP London Hydraulic Power
MDC Metal Drainage Channel
MW Monitoring Well
NFI No Further Information
RE Rodding Eye
SDIC Service Duct Inspection Cover
SV Stop Valve
SWCP Surface Water Catch Pit
SWIC Surface Water Inspection Cover
SWSA Surface Water Soakaway
TCIC Traffic Control Inspection Cover
TIC Telecom Inspection Cover
UIC Unidentified Inspection Cover
UTR Unable To Raise
WIC Water Inspection Cover
WM Water Meter
WWO Water Wash Out
WSV Water Stop Valve

SURFACES
BPav Brick Paving
Conc Concrete
CPav Crazy Paving
CPS Concrete Paving Slabs
FB Flower / Shrub Border
KFC Kidney Flint Cobbles
T Tiles
Tmac Tarmac
TPav Tactile Paving
TS Trench Scar

MEASUREMENTS
d Depth (m)
Ø Diameter (mm)
Ext.Ø External Diameter (mm)
H Object Height (m)

Linetype Key:

UTILITY KEY
FW > Foul Drainage
FW Foul Drainage (Assumed)
SW > Storm Drainage
SW Storm Drainage (Assumed)
CW > Combined Drainage
C Combine Drainage (Assumed)

THIS AREA IS ALLOCATED TO SHOW SHEET LOCATION OF THE WHOLE SITE IF BROKEN DOWN INTO MULTIPLE SHEETS

CLIENT
EHP Land & Developments Ltd

SITE
Courtlands Riding School
Old Chantry Lane
Stevenage, SG1 2JE

DRAWING TITLE
CCTV Drainage Survey

PROJECT NUMBER	DRAWING NUMBER	DATE
13433	13433_F	November 2021
SURVEYED BY	DRAWN BY	CHECKED BY
MR	MR	AG
SCALE	SHEET SIZE	SHEET
1:200	A1	1 OF 1

UNIT 301, OLD BARN FARM ROAD
WOOLSBRIDGE INDUSTRIAL PARK
THREE LEGGED CROSS, WIMBORNE, BH21 6SP
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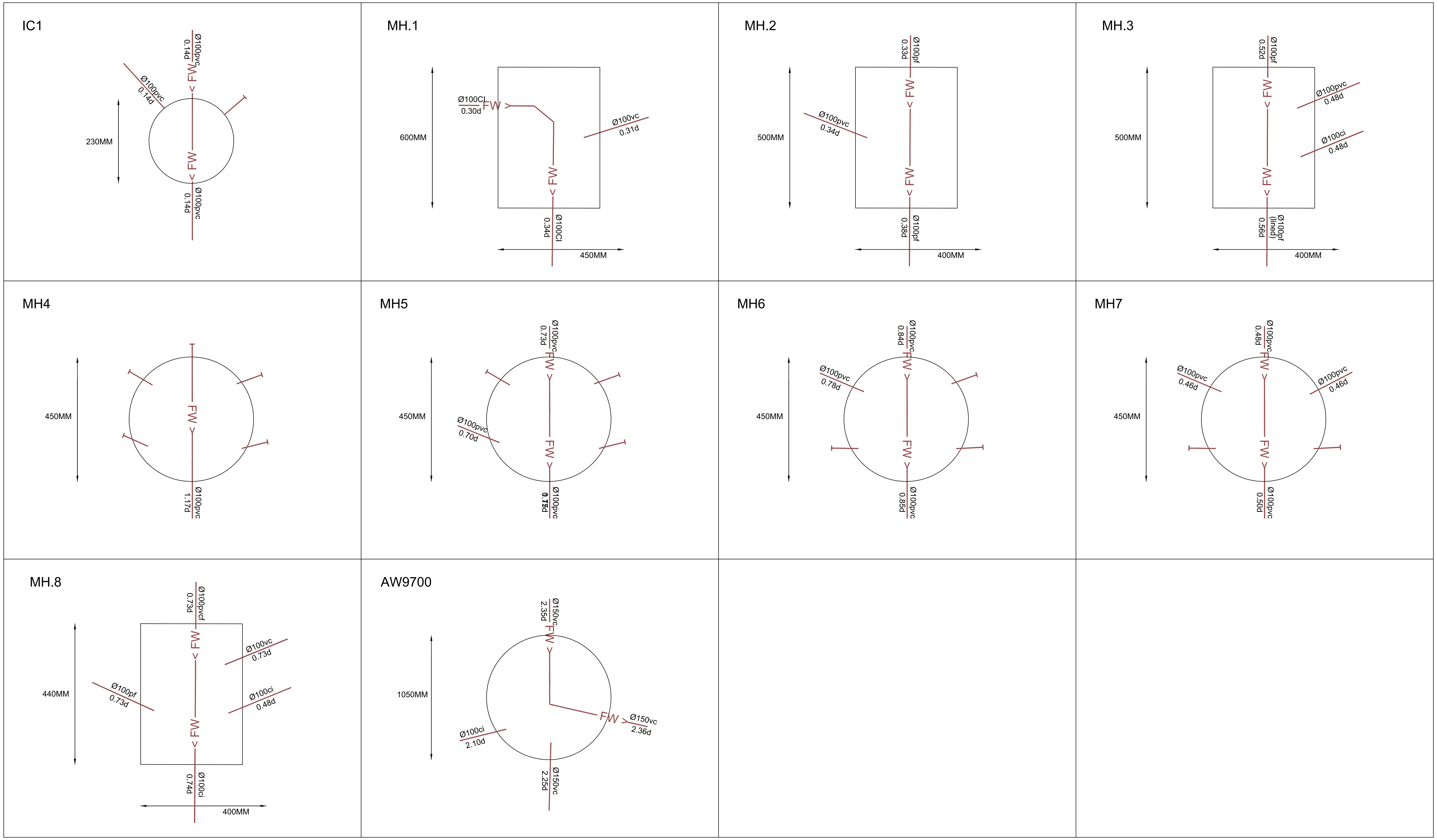
W www.clearviewsurveys.co.uk

CLEARVIEW SURVEYS LTD, UNIT 301 OLD BARN FARM ROAD, WIMBOURNE, Tel: 01202 828281

13433 Recommendations						
Section	Upstream Node	Downstream Node	Dia/Height [mm]	Upstream Pipe Depth [m]	Downstream Pipe Depth [m]	Recommendations
1	IC.1 MAIN	IC.1	100	0	0.23	None
2	IC.1 BR1	IC.1	100	0	0.23	None
3	IC.1	IC.1 MAIN	100	0.23	0.34	SCALE CUTTING
4	MH.1	MH.1 MAIN	100	0.34	0.56	LIGHT SCALE CUT
5	MH.1 BR1	MH.1	100	0	0.34	REMEDIALS
6	MH.2	MH.3	100	0.38	0.56	JETTING
7	MH.3 BR1	MH.3	100	0	0.56	None
8	MH.3	MH.3 MAIN	100	0.56	0	REMEDIALS
9	MH.2 MAIN	MH.2	100	0	0.38	JETTING
10	MH.2 BR1	MH.2	100	0	0.38	None
11	MH.4 MAIN	MH.4	100	0	1.17	None
12	MH.4	MH.4 MAIN	100	1.17	0	None
13	MH.5 MAIN	MH.5	100	0	0.75	None
14	MH.5 BR1	MH.5	100	0	0.75	None
15	MH.5	MH.6	100	0.75	0.85	None
16	MH.6	MH.6 MAIN	150	0.85	0	REMEDIALS
17	MH.7	MH.6	100	0.5	0.85	None
18	MH.7 MAIN	MH.7	100	0	0.55	None
19	MH.7 BR1	MH.7	100	0	0.5	None
20	MH.7 BR2	MH.7	100	0	0.5	None
21	MH.8	MH.8 MAIN	100	0.74	0	REMEDIALS
22	MH.9700BR1	AW.MH.9700	100	0		REMEDIALS
23	BURIED MHA	AW.9700	150	0	2.36	LORRY JETTING
24	AW9700MAIN	AW.MH.9700	150	0		REMEDIALS
25	AW.MH.9700	AW9700MAIN	150	2.36	0	REMEDIALS



N INDICATIVE

Notes:

Utilities may continue outside of the survey area. Any paint marks outside of the area are for investigative purposes only and may not represent the full extent of the sub-surface utilities.

Only sub-surface utility information is provided. Above ground utility information may be shown where it assists with positional referencing.

Where logic indicates a utility exists but which cannot be positively confirmed with the technology, an assumed route (AR) is recorded.

ClearView Surveys does not procure statutory or private source utility information (Unless requested at time of order) as part of its detection service nor does it record any such information in a utility survey unless otherwise requested. Statutory plans should be consulted to supplement this survey.

Vertical & Horizontal Position - Vertical position (depth) is indicative to the top of the utility/feature and is recorded as DTS (depth to top of service) and should not be taken as exact. Where depth information from the technology is unclear, depth is not shown. Drains may have been detected using threading and the depth indicated could be between the top and the bottom of the drain. Horizontal position is indicative to the centre of the utility/feature and should not be taken as exact.

Warranty - Biodegradable paints are used to mark-out the position of the utilities. Before long paint markings may become illegible depending on ground, weather and traffic conditions. No warranty is given in respect of the durability of the paint markings and that they are a complete representation of the sub-surface utilities therefore this drawing should be used as the primary reference for the survey results.

This drawing does not provide an absolute representation of the sub-surface. Utilities have been detected using non-invasive technologies only and the performance can be adversely affected by ground, weather and site conditions outside of ClearView Surveys control therefore some utilities may be undetectable. While ClearView Surveys uses reasonable endeavours to detect all utilities, it does not warrant that 100% detection will be achieved and that approximate depth penetration of the technologies will be greater than two metres.

Sewer and manhole details shown on this drawing have been obtained by observation and measurement from the surface and as such cannot be guaranteed. Where precise sewer details will be critical to the project design ClearView Surveys would recommend that entry into the chamber be undertaken using a specialist team, appropriately qualified for confined space entry. These teams can be supplied on request.

Irrespective of the information provided by a utility survey and statutory plans, excavation work should be undertaken with extreme caution and in accordance with HSE Guidelines - HSG47 Avoiding Danger from Underground Services

Additional Notes:

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9. Utility Survey has been fitted to OS

Key:

Linetype Key:

THIS AREA IS ALLOCATED TO SHOW SHEET LOCATION OF THE WHOLE SITE IF BROKEN DOWN INTO MULTIPLE SHEETS

Rev	Date	Notes	By

CLIENT
EHP Land & Developments Ltd

SITE
Courtlands Riding School
Old Chantry Lane
Stevenage SG1 2JE

DRAWING TITLE
MH Diagrams

PROJECT NUMBER	DRAWING NUMBER	DATE
13433	13433_MH_F	November 2021
SURVEYED BY	DRAWN BY	CHECKED BY
MR	MR	AG
SCALE	SHEET SIZE	SHEET
NTS	A1	1 OF 1

UNIT 301, OLD BARN FARM ROAD
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APPENDIX E – DRAINAGE STRATEGY CALCULATIONS & DRAWINGS

info@fernbrook.co

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 522101 226829 TL 22101 26829
Data Type	Point
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	60
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	1.000
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.339	4-8	0.121	8-12	0.011	12-16	0.011	16-20	0.006

Total Area Contributing (ha) = 0.489

Total Pipe Volume (m³) = 185.849

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	13.473	0.150	89.8	0.043	15.00	0.0	0.600		o	150	Pipe/Conduit	
1.001	8.023	0.100	80.2	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
1.002	72.192	1.100	65.6	0.071	0.00	0.0		0.060	1 _/	600	1:1 Ditch	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	34.28	15.21	94.000	0.043	0.0	0.0	0.0	1.06	18.7	5.3
1.001	34.12	15.33	93.850	0.043	0.0	0.0	0.0	1.12	19.8	5.3
1.002	31.85	17.12	93.750	0.114	0.0	0.0	0.0	0.67	181.3	13.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	6.187	1.150	5.4	0.077	0.00	0.0	0.600		o	300	Pipe/Conduit	
1.004	16.589	0.250	66.4	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
1.005	9.203	0.500	18.4	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
1.006	9.119	0.100	91.2	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
1.007	12.734	0.450	28.3	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.008	8.357	0.050	167.1	0.130	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.009	23.907	0.400	59.8	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.010	11.385	0.250	45.5	0.100	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.011	16.883	0.200	84.4	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.012	12.186	0.050	243.7	0.068	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.013	8.227	0.100	82.3	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.014	4.542	0.025	181.7	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	31.84	17.14	92.650	0.191	0.0	0.0	0.0	6.82	482.2	22.0
1.004	31.67	17.28	91.500	0.191	0.0	0.0	0.0	1.93	136.6	22.0
1.005	31.62	17.32	91.000	0.191	0.0	0.0	0.0	3.68	260.3	22.0
1.006	31.51	17.42	90.500	0.191	0.0	0.0	0.0	1.65	116.4	22.0
1.007	31.45	17.47	90.400	0.191	0.0	0.0	0.0	3.83	609.7	22.0
1.008	31.35	17.56	89.950	0.321	0.0	0.0	0.0	1.57	249.7	36.3
1.009	31.18	17.71	89.900	0.321	0.0	0.0	0.0	2.63	418.9	36.3
1.010	31.11	17.77	89.500	0.421	0.0	0.0	0.0	3.02	480.2	47.3
1.011	30.97	17.90	89.250	0.421	0.0	0.0	0.0	2.21	352.1	47.3
1.012	30.79	18.06	89.050	0.489	0.0	0.0	0.0	1.30	206.4	54.4
1.013	30.73	18.12	89.000	0.489	0.0	0.0	0.0	2.24	356.7	54.4
1.014	30.67	18.17	88.900	0.489	0.0	0.0	0.0	1.51	239.4	54.4

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014		90.500	88.875	0.000	0	0

Online Controls for Storm

Orifice Manhole: BASIN, DS/PN: 1.013, Volume (m³): 4.6

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 89.000

Depth/Flow Relationship Manhole: SOAKAWAY, DS/PN: 1.014, Volume (m³): 1.1

Invert Level (m) 88.900

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.200	0.0000	1.800	0.0000	3.400	0.0000	5.000	0.0000
0.400	0.0000	2.000	0.0000	3.600	0.0000	5.200	0.0000
0.600	0.0000	2.200	0.0000	3.800	0.0000	5.400	0.0000
0.800	0.0000	2.400	0.0000	4.000	0.0000	5.600	0.0000
1.000	0.0000	2.600	0.0000	4.200	0.0000	5.800	0.0000
1.200	0.0000	2.800	0.0000	4.400	0.0000	6.000	0.0000
1.400	0.0000	3.000	0.0000	4.600	0.0000		
1.600	0.0000	3.200	0.0000	4.800	0.0000		

Storage Structures for Storm

Tank or Pond Manhole: BASIN, DS/PN: 1.013

Invert Level (m) 89.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	178.0	2.000	671.0

Deep Bore Soakaway Manhole: SOAKAWAY, DS/PN: 1.014

Chamber Invert Level (m)	79.650	Infiltration Coefficient Base (m/hr)	0.12960
Chamber Diameter/Length (m)	1.200	Safety Factor	5.0
Borehole Diameter (m)	0.250		
Borehole Depth (m)	9.250		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.12960	1.000	0.12960	1.001	0.00000	9.250	0.00000

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 522101 226829 TL 22101 26829
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760
Return Period(s) (years)	2, 10, 30, 100
Climate Change (%)	0, 0, 35, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	30 Summer	2	+0%					94.050
1.001	2	30 Summer	2	+0%					93.900
1.002	HW1	15 Summer	2	+0%					93.822
1.003	HW2	15 Summer	2	+0%					92.714
1.004	3	15 Summer	2	+0%	100/15 Summer				91.599
1.005	4	15 Summer	2	+0%	100/15 Summer				91.079
1.006	5	15 Summer	2	+0%	30/15 Summer				90.622
1.007	6	15 Summer	2	+0%	100/15 Summer				90.479
1.008	7	15 Summer	2	+0%	30/15 Summer				90.115
1.009	8	15 Summer	2	+0%	30/2880 Summer				90.011
1.010	9	5760 Summer	2	+0%	10/2880 Summer				89.899
1.011	10	5760 Summer	2	+0%	2/2160 Summer				89.899

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.100	0.000	0.24			4.2	OK	
1.001	2	-0.100	0.000	0.24			4.2	OK	
1.002	HW1	-1.178	0.000	0.00			15.2	OK	
1.003	HW2	-0.236	0.000	0.10			27.5	OK*	
1.004	3	-0.201	0.000	0.24			27.5	OK	
1.005	4	-0.221	0.000	0.15			27.4	OK	
1.006	5	-0.178	0.000	0.35			27.3	OK	
1.007	6	-0.371	0.000	0.07			27.3	OK	
1.008	7	-0.285	0.000	0.29			47.3	OK	
1.009	8	-0.339	0.000	0.13			46.9	OK	
1.010	9	-0.051	0.000	0.01			2.5	OK	
1.011	10	0.199	0.000	0.01			2.6	SURCHARGED	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.012	11	5760 Summer	2	+0%	2/240 Summer			
1.013	BASIN	5760 Summer	2	+0%	2/180 Summer			
1.014	SOAKAWAY	5760 Summer	2	+0%	2/120 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	11	89.899	0.399	0.000	0.02			3.2	SURCHARGED
1.013	BASIN	89.899	0.449	0.000	0.00			0.1	SURCHARGED
1.014	SOAKAWAY	89.899	0.549	0.000	0.00			0.0	SURCHARGED

PN	US/MH Name	Level Exceeded
1.012	11	
1.013	BASIN	
1.014	SOAKAWAY	

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 522101 226829 TL 22101 26829
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760
Return Period(s) (years)	2, 10, 30, 100
Climate Change (%)	0, 0, 35, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	30 Summer	10	+0%					94.069
1.001	2	30 Summer	10	+0%					93.918
1.002	HW1	15 Summer	10	+0%					93.865
1.003	HW2	15 Summer	10	+0%					92.748
1.004	3	15 Summer	10	+0%	100/15 Summer				91.657
1.005	4	15 Summer	10	+0%	100/15 Summer				91.123
1.006	5	15 Summer	10	+0%	30/15 Summer				90.703
1.007	6	15 Summer	10	+0%	100/15 Summer				90.521
1.008	7	15 Summer	10	+0%	30/15 Summer				90.219
1.009	8	5760 Summer	10	+0%	30/2880 Summer				90.109
1.010	9	5760 Summer	10	+0%	10/2880 Summer				90.109
1.011	10	5760 Summer	10	+0%	2/2160 Summer				90.109

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.081	0.000	0.43			7.4	OK	
1.001	2	-0.082	0.000	0.43			7.4	OK	
1.002	HW1	-1.135	0.000	0.01			33.0	OK	
1.003	HW2	-0.202	0.000	0.23			61.4	OK*	
1.004	3	-0.143	0.000	0.52			60.4	OK	
1.005	4	-0.177	0.000	0.34			60.8	OK	
1.006	5	-0.097	0.000	0.78			61.7	OK	
1.007	6	-0.329	0.000	0.16			61.9	OK	
1.008	7	-0.181	0.000	0.64			105.4	OK	
1.009	8	-0.241	0.000	0.01			2.5	OK	
1.010	9	0.159	0.000	0.01			3.4	SURCHARGED	
1.011	10	0.409	0.000	0.01			3.4	SURCHARGED	

10 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.012	11	5760 Summer	10	+0%	2/240 Summer			
1.013	BASIN	5760 Summer	10	+0%	2/180 Summer			
1.014	SOAKAWAY	5760 Summer	10	+0%	2/120 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	11	90.109	0.609	0.000	0.03			3.9	SURCHARGED
1.013	BASIN	90.109	0.659	0.000	0.00			0.2	SURCHARGED
1.014	SOAKAWAY	90.109	0.759	0.000	0.00			0.0	SURCHARGED

PN	US/MH Name	Level Exceeded
1.012	11	
1.013	BASIN	
1.014	SOAKAWAY	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 522101 226829 TL 22101 26829
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760
Return Period(s) (years)	2, 10, 30, 100
Climate Change (%)	0, 0, 35, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	30 Summer	30	+35%					94.099
1.001	2	30 Summer	30	+35%					93.949
1.002	HW1	15 Summer	30	+35%					93.906
1.003	HW2	15 Summer	30	+35%					92.783
1.004	3	15 Summer	30	+35%	100/15 Summer				91.730
1.005	4	15 Summer	30	+35%	100/15 Summer				91.171
1.006	5	15 Summer	30	+35%	30/15 Summer				90.872
1.007	6	15 Summer	30	+35%	100/15 Summer				90.563
1.008	7	5760 Summer	30	+35%	30/15 Summer				90.523
1.009	8	5760 Summer	30	+35%	30/2880 Summer				90.523
1.010	9	5760 Summer	30	+35%	10/2880 Summer				90.523
1.011	10	5760 Summer	30	+35%	2/2160 Summer				90.524

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.051	0.000	0.77			13.2	OK	
1.001	2	-0.051	0.000	0.76			13.2	OK	
1.002	HW1	-1.094	0.000	0.02			56.0	OK	
1.003	HW2	-0.167	0.000	0.40			107.9	OK*	
1.004	3	-0.070	0.000	0.92			107.1	OK	
1.005	4	-0.129	0.000	0.60			106.3	OK	
1.006	5	0.072	0.000	1.36			107.9	SURCHARGED	
1.007	6	-0.287	0.000	0.29			108.2	OK	
1.008	7	0.123	0.000	0.02			4.0	SURCHARGED	
1.009	8	0.173	0.000	0.01			4.0	SURCHARGED	
1.010	9	0.573	0.000	0.02			5.6	SURCHARGED	
1.011	10	0.824	0.000	0.02			5.5	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.012	11	5760 Summer	30	+35%	2/240 Summer			
1.013	BASIN	5760 Summer	30	+35%	2/180 Summer			
1.014	SOAKAWAY	5760 Summer	30	+35%	2/120 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	11	90.523	1.023	0.000	0.04			6.3	SURCHARGED
1.013	BASIN	90.523	1.073	0.000	0.00			0.2	SURCHARGED
1.014	SOAKAWAY	90.523	1.173	0.000	0.00			0.0	SURCHARGED

PN	US/MH Name	Level Exceeded
1.012	11	
1.013	BASIN	
1.014	SOAKAWAY	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 522101 226829 TL 22101 26829
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760
Return Period(s) (years)	2, 10, 30, 100
Climate Change (%)	0, 0, 35, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	30 Summer	100	+40%					94.150
1.001	2	30 Summer	100	+40%					93.998
1.002	HW1	15 Summer	100	+40%					93.932
1.003	HW2	15 Summer	100	+40%					92.806
1.004	3	15 Summer	100	+40%	100/15 Summer				91.910
1.005	4	15 Summer	100	+40%	100/15 Summer				91.439
1.006	5	15 Summer	100	+40%	30/15 Summer				91.172
1.007	6	15 Summer	100	+40%	100/15 Summer				90.910
1.008	7	5760 Summer	100	+40%	30/15 Summer				90.727
1.009	8	5760 Summer	100	+40%	30/2880 Summer				90.727
1.010	9	5760 Summer	100	+40%	10/2880 Summer				90.727
1.011	10	5760 Summer	100	+40%	2/2160 Summer				90.727

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

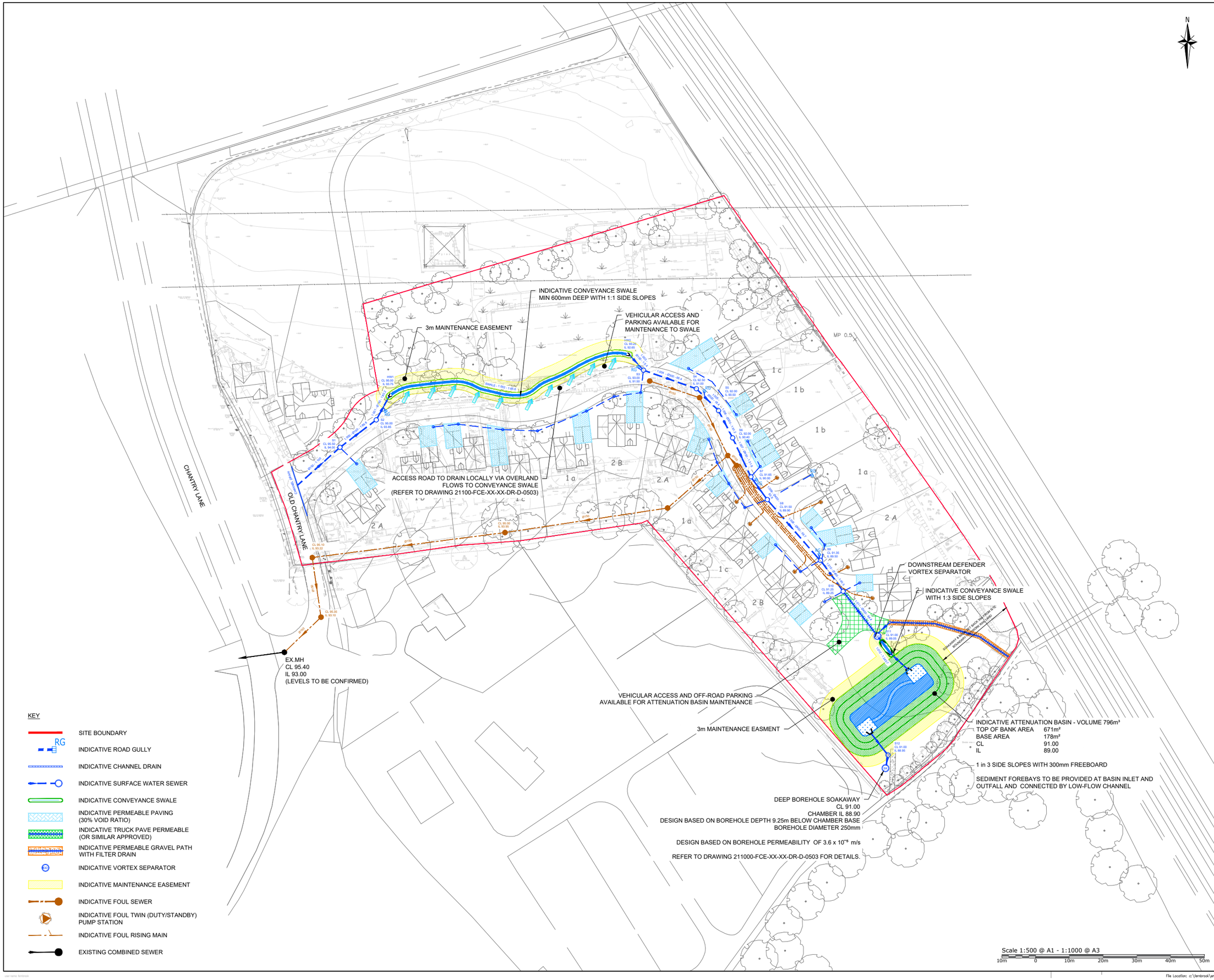
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.000	1.01			17.4	OK	
1.001	2	-0.002	0.000	1.00			17.2	OK	
1.002	HW1	-1.068	0.000	0.02			72.1	OK	
1.003	HW2	-0.144	0.000	0.52			139.1	OK*	
1.004	3	0.110	0.000	1.18			137.4	SURCHARGED	
1.005	4	0.139	0.000	0.75			132.8	SURCHARGED	
1.006	5	0.372	0.000	1.71			135.4	SURCHARGED	
1.007	6	0.060	0.000	0.38			142.4	SURCHARGED	
1.008	7	0.327	0.000	0.03			4.9	SURCHARGED	
1.009	8	0.377	0.000	0.01			4.9	SURCHARGED	
1.010	9	0.777	0.000	0.02			6.7	SURCHARGED	
1.011	10	1.027	0.000	0.03			6.7	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.012	11	5760 Summer	100	+40%	2/240 Summer			
1.013	BASIN	5760 Summer	100	+40%	2/180 Summer			
1.014	SOAKAWAY	5760 Summer	100	+40%	2/120 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.012	11	90.728	1.228	0.000	0.05			7.5	FLOOD RISK
1.013	BASIN	90.727	1.277	0.000	0.00			0.3	FLOOD RISK
1.014	SOAKAWAY	90.727	1.377	0.000	0.00			0.0	FLOOD RISK

PN	US/MH Name	Level Exceeded
1.012	11	
1.013	BASIN	
1.014	SOAKAWAY	



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NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY. TO CHECK THAT THIS DRAWING HAS BEEN PRINTED TO THE INTENDED SCALE THIS BAR SHOULD BE 50mm LONG @ A1 OR 25mm LONG @ A3.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES, UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. DESIGN BASED ON TOPOGRAPHICAL SURVEY BY KEMPSTON SURVEYS LTD, DATED 23.03.2020.
6. DESIGN BASED ON "17 UNIT SCHEME" DRAWING REV Q, BY HERTFORD PLANNING SERVICE, DATED 20.08.2021.

CDM NOTES

THE ATTENTION OF THE CLIENT, PRINCIPAL DESIGNER, PRINCIPAL CONTRACTOR, DESIGNERS AND CONTRACTORS IS DRAWN TO THE FOLLOWING POTENTIAL RISKS IN CONJUNCTION WITH THE PROPOSED ON-SITE AND OFF-SITE WORKS AS DESIGNED FOR THIS PROJECT:

1. WORKS IN THE VICINITY OF LIVE SERVICES INCLUDING GAS, ELECTRICITY AND BT WILL BE NECESSARY AND THE ADVICE OF ALL STATUTORY SERVICE COMPANIES MUST BE SOUGHT BEFORE ANY WORKS COMMENCE.
2. WORKS WITHIN AND ABUTTING THE EXISTING HIGHWAY WILL ENTAIL TRAFFIC HAZARDS AND ALL APPROPRIATE SAFETY MEASURES INCLUDING BARRIERS, SIGNS AND LIGHTING MUST BE UNDERTAKEN TO THE APPROVAL OF THE LOCAL AUTHORITY, THE HIGHWAY AUTHORITY AND THE POLICE DEPARTMENT.
3. HAZARDOUS MATERIALS INCLUDING CEMENT AND BITUMINOUS MATERIALS ARE SPECIFIED AND THE MANUFACTURERS ADVICE ON SAFE HANDLING PROCEDURES MUST BE OBTAINED AND MADE CLEAR TO ALL OPERATIVES.
4. THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL EXISTING SERVICES WITHIN THE VICINITY OF THE WORKS HAND DUG AND ENSURE THESE ARE PROTECTED THROUGHOUT THE DURATION OF THE WORKS. ALL UTILITY PLANT SHOULD BE CLEARLY MARKED ON THE GROUND PRIOR TO COMMENCEMENT OF THE WORKS.
5. THE CONTRACTOR MUST ENSURE ALL WORKING AREAS ARE FULLY SECURE.

KEY

- SITE BOUNDARY
- INDICATIVE ROAD GULLY
- INDICATIVE CHANNEL DRAIN
- INDICATIVE SURFACE WATER SEWER
- INDICATIVE CONVEYANCE SWALE
- INDICATIVE PERMEABLE PAVING (30% VOID RATIO)
- INDICATIVE TRUCK PAVE PERMEABLE (OR SIMILAR APPROVED)
- INDICATIVE PERMEABLE GRAVEL PATH WITH FILTER DRAIN
- INDICATIVE VORTEX SEPARATOR
- INDICATIVE MAINTENANCE EASEMENT
- INDICATIVE FOUL SEWER
- INDICATIVE FOUL TWIN (DUTY/STANDBY) PUMP STATION
- INDICATIVE FOUL RISING MAIN
- EXISTING COMBINED SEWER

Scale 1:500 @ A1 - 1:1000 @ A3

10m 0 10m 20m 30m 40m 50m

FOR INFORMATION ONLY

P05	FOR INFORMATION	DR	CR	DR	12.04.24
P04	FOR INFORMATION – BASIN & SOAKAWAY REVISED	DR	CR	DR	13.06.23
P03	FOR INFORMATION	DR	CR	DR	06.06.23
P02	FOR INFORMATION	DR	CR	DR	18.10.22
P02.1	FOR COORDINATION	DR	CR	DR	07.10.22
P01	FOR INFORMATION	DR	CR	DR	31.08.21
P01.2	FOR COORDINATION	DR	CR	DR	25.08.21
P01.1	FOR COORDINATION	DR	CR	DR	23.08.21
Rev	Description	Drn	Chk	App	Date

FERNBROOK

Fernbrook Consulting Engineers
40 Bowling Green Lane
London
EC1R 0NE

info@fernbrook.co

Client

S J M & CO

Project Title:

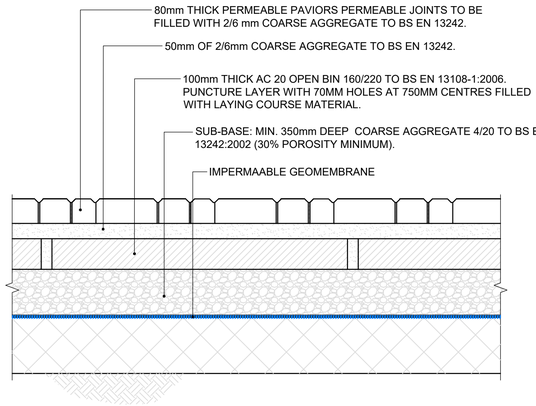
COURTLANDS RIDING CENTRE
STEVENAGE, SG1 2JE

Drawing Title:

PROPOSED DRAINAGE STRATEGY

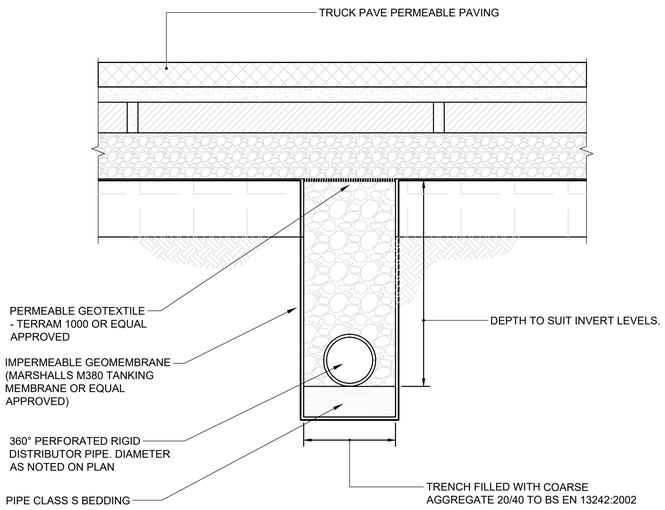
Scale at A1	Date	Designed by
1:500	AUG 21	DR
Drawn by	**Checked by**	**Approved by**
DR	CR	DR

Drawing Number: 21100-FCE-XX-XX-DR-D-0500 Rev P05



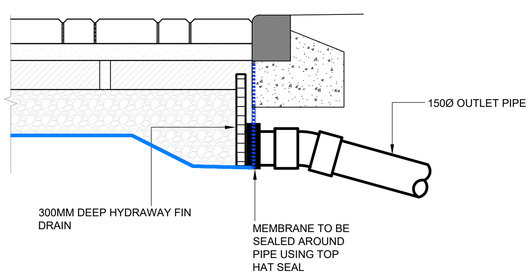
INDICATIVE LINED PERMEABLE PAVING (TYPE C) DETAIL

(SCALE 1:10)



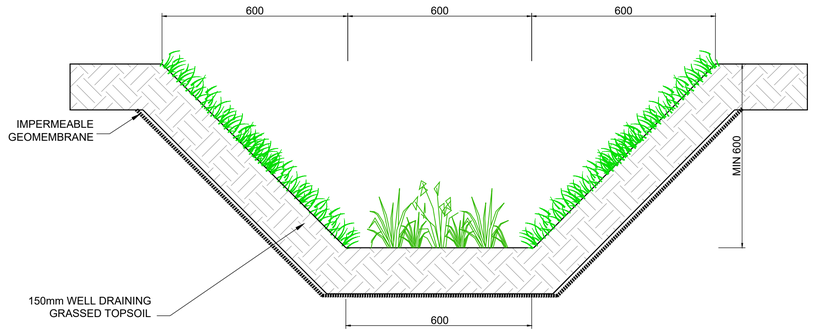
INDICATIVE TRUCKPAVE PERMEABLE PAVING WITH FILTER DRAIN

(SCALE 1:10)



PERMEABLE PAVEMENT OUTLET PIPE DETAIL

(SCALE 1:10)



INDICATIVE CONVEYANCE SWALE

SCALE 1:10

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
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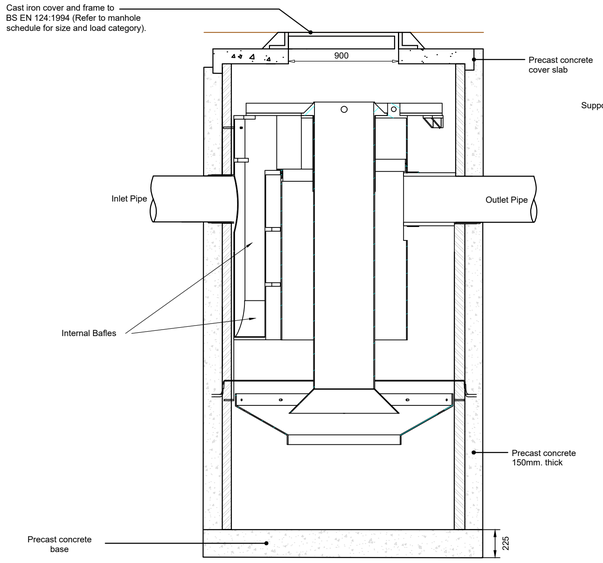
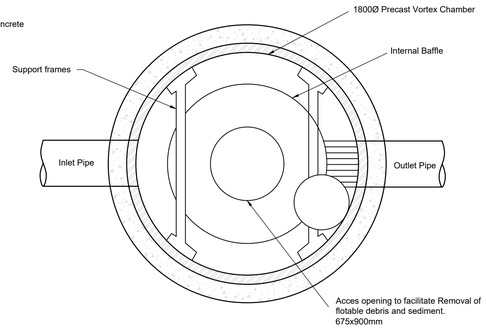


DOWNSTREAM DEFENDER MANHOLE

SCALE 1:25



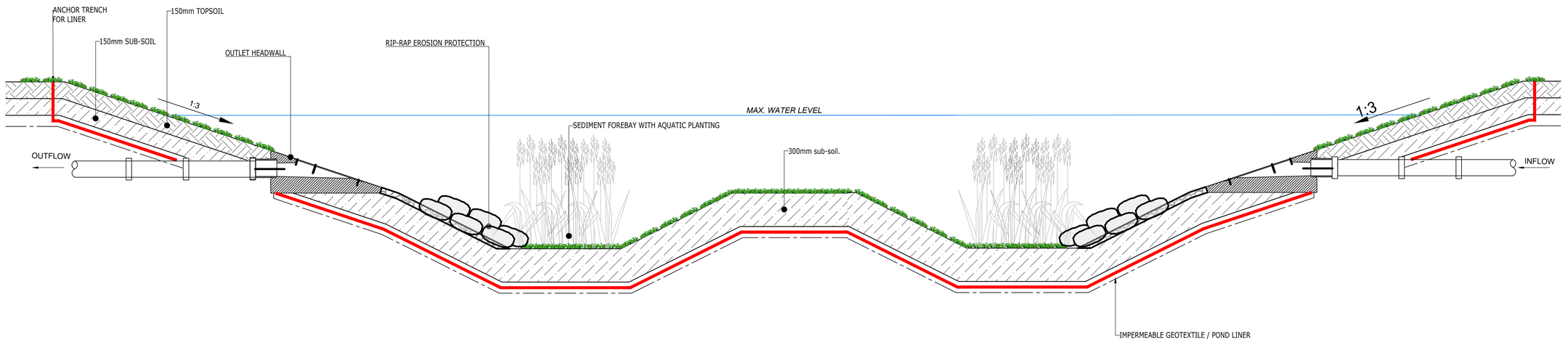
SPECIFICATION REQUIREMENTS:

1. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
2. The treatment system shall remove 80% or greater of TSS at the WQF.
3. The treatment system shall treat all flows up to PTFR without bypass or loss stored pollutants.
4. The Max. Headloss shall not be exceeded at PTFR with max. inlet pipe diameter.

DETAIL NOTES:

1. A acceptable pipe coupler shall be used to connect the Downstream Defender's internal outlet stub to the storm drain.
2. The diameter of the Downstream Defender's outlet stub is not adjustable. Any reducers required to match different stormdrain diameter must occur outside of the vortex chamber.
3. The inlet pipe diameter must not be larger than the outlet pipe diameter.
4. The tangential inlet pipe angle is not site specific. Refer to manhole schedules drawing.

FOR INFORMATION ONLY



INDICATIVE ATTENUATION BASIN

(NOT TO SCALE)

Rev	Description	Drn	Chk	App	Date
P02	FOR INFORMATION	DR	CR	DR	06.06.23
P01	FOR INFORMATION	DR	CR	DR	18.10.22

FERNBROOK
Fernbrook Consulting Engineers
40 Bowling Green Lane
London
EC1R 0NE
info@fernbrook.co

Client: S J M & CO

Project Title: COURTLANDS RIDING CENTRE STEVENAGE, SG1 2JE

Drawing Title: DRAINAGE DETAILS - SHEET 1

Scale at A1	Date	Designed by
AS NOTED	OCT 22	DR
Drawn by	**Checked by**	**Approved by**
DR	CR	DR

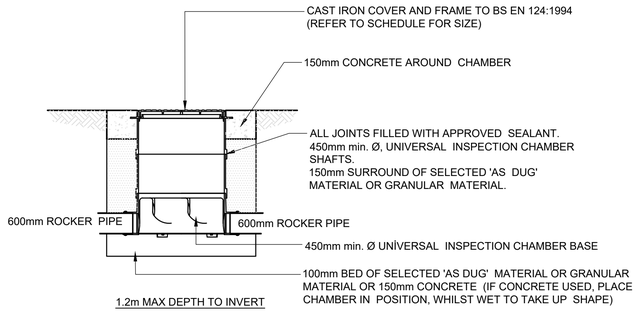
Drawing Number: 21100-FCE-XX-XX-DR-D-0501 Rev P02

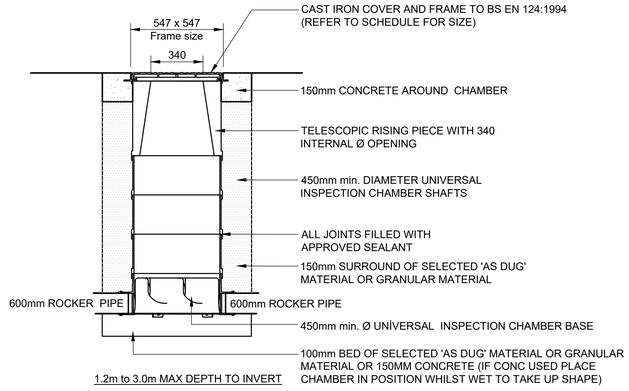
TABLE 11 MIN. DIMENSIONS FOR ACCESS FITTINGS AND INSPECTION CHAMBERS					
Type	Depth to invert from cover level (m)	Internal sizes		Cover sizes	
		Rectangular length and width	Circular diameter	Rectangular length and width	Circular diameter
Rodding Eye		As drain but min 100			Same size as pipework (1)
Access Fittings					
small 150 dia	0.6 or less, except where situated in a chamber				
150x100		150x100	150	150x100 (1)	Same size as access fitting
large 225x100		225x100	225	225x100 (1)	
Inspection Chamber					
Shallow	0.6 or less	225x100	190 (2)	-	190 (1)
	1.2 or less	450x450	450	Min 430x430	430
Deep	>1.2 but <3.0	450x450	450	max 300x300 (3)	Access restricted to max 350 (3)

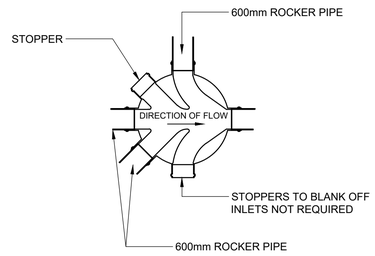
NOTES:
(1) THE CLEAR OPENING MAY BE REDUCED BY 20MM IN ORDER TO PROVIDE PROPER SUPPORT FOR THE COVER AND FRAME.
(2) DRAINS UPTO 150mm.
(3) A LARGER CLEAR OPENING MAY BE USED IN CONJUNCTION WITH A RESTRICTED ACCESS. THE SIZE IS RESTRICTED FOR HEALTH AND SAFETY REASONS TO DETER ENTRY.

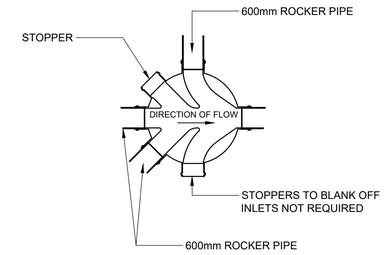
TABLE 12 MINIMUM DIMENSIONS FOR MANHOLES					
Type	Size of largest pipe (DN)	Min. internal dimensions (1) Rectangular length and width	Circular diameter	Min. clear opening size (1) Rectangular length and width	Circular diameter
Manhole					
<1.5m deep to soffit	<= 150	750 x 675 (7)	1000 (7)	750 x 675 (2)	na (3)
	225	1200 x 675	1200	1200 x 675 (2)	
	300	1200 x 750	1200		
	>300	1800 x (DN+450)	The larger of 1800 or (DN+450)		
>1.5m deep to soffit	<= 225	1200 x 1000	1200	600 x 600	600
	300	1200 x 1075	1200		
	375-450	1350 x 1225	1200		
	>450	1800 x (DN+775)	The larger of 1800 or (DN+775)		
Manhole shaft (4) >3.0m deep to soffit of pipe	Steps (5)	1050 x 800	1050	600 x 600	600
	Ladder (5)	1200 x 800	1200		
	Winch (6)	900 x 800	900	600 x 600	600

NOTES:
(1) LARGER SIZES MAY BE REQUIRED FOR MANHOLES ON BENDS OR WHERE THERE ARE JUNCTIONS.
(2) MAY BE REDUCED TO 600 BY 600 WHERE REQUIRED BY HIGHWAY LOADING CONSIDERATIONS, SUBJECT TO A SAFE SYSTEM OF WORK BEING SPECIFIED.
(3) NOT APPLICABLE DUE TO WORKING SPACE NEEDED.
(4) MINIMUM HEIGHT OF CHAMBER IN SHAFTED MANHOLE 2m FROM BENCHING TO UNDERSIDE OF REDUCING SLAB.
(5) MIN CLEAR SPACE BETWEEN LADDER OR STEPS AND THE OPPOSITE FACE OF THE SHAFT SHOULD BE APPROXIMATELY 900mm.
(6) WINCH ONLY - NO STEPS OF LADDERS, PERMANENT OR REMOVABLE.
(7) THE MINIMUM SIZE OF ANY MANHOLE SERVING A SEWER (I.E. ANY DRAIN SERVING MORE THAN ONE PROPERTY) SHOULD BE 1200x675mm RECTANGULAR OR 1200mm Ø.



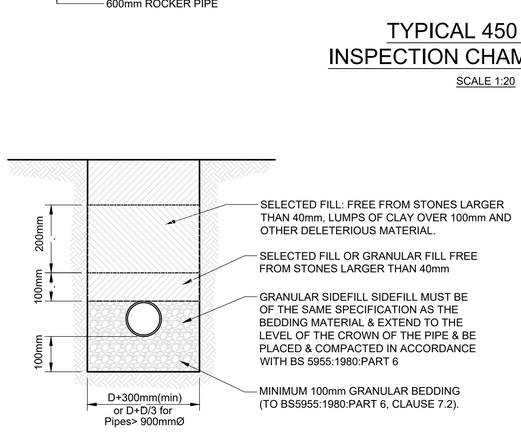






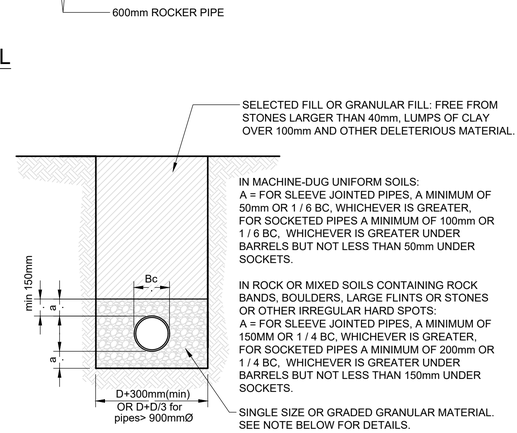
TYPICAL 450 Ø PPIC INSPECTION CHAMBER DETAIL

SCALE 1:20



BEDDING DETAIL FOR FLEXIBLE PIPES

SCALE 1:20



NOTE:
GRANULAR MATERIAL - GRANULAR MATERIAL SHOULD CONFORM TO BS EN 1610 ANNEX B TABLE B.15 AND SHOULD BE SINGLE SIZE MATERIAL OR GRADED MATERIAL FROM 5MM UP TO A MAXIMUM SIZE 10mm FOR 100mm PIPES, 14mm FOR 150mm PIPES, 20mm FOR PIPES FROM 150mm UP TO 600mm DIAMETER. COMPACTION FRACTION MAXIMUM 0.3 FOR CLASS N OR B AND 0.15 FOR CLASS F.

BEDDING TYPES DETAILS FOR RIGID PIPES

SCALE 1:20

NOTES

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5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.

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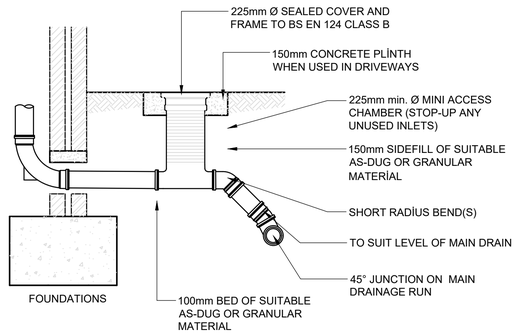
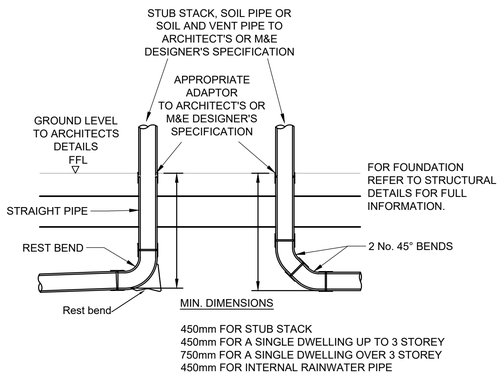


TYPICAL 250 Ø PPIC INSPECTION CHAMBER DETAIL

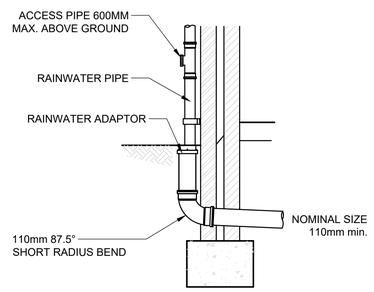
FOR USE IN SOFT AREAS & FOOTPATHS ONLY

SCALE 1:20



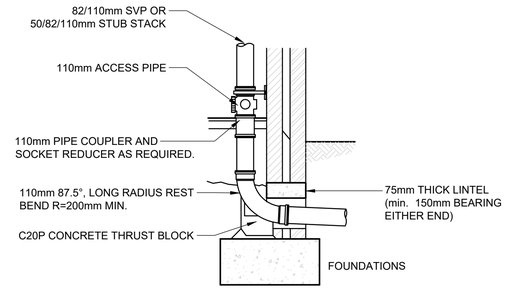
STUB STACK, SOIL VENT PIPE & INTERNAL RAINWATER PIPE DETAIL

SCALE 1:20



EXTERNAL RAINWATER PIPE TO DRAIN

SCALE 1:20



SOIL & VENT PIPE CONNECTION & STUB STACK CONNECTION

SCALE 1:20

Rev	Description	Drn	Chk	App	Date
P01	FOR INFORMATION	DR	CR	DR	06.06.23

FERNBROOK
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EC1R 0NE
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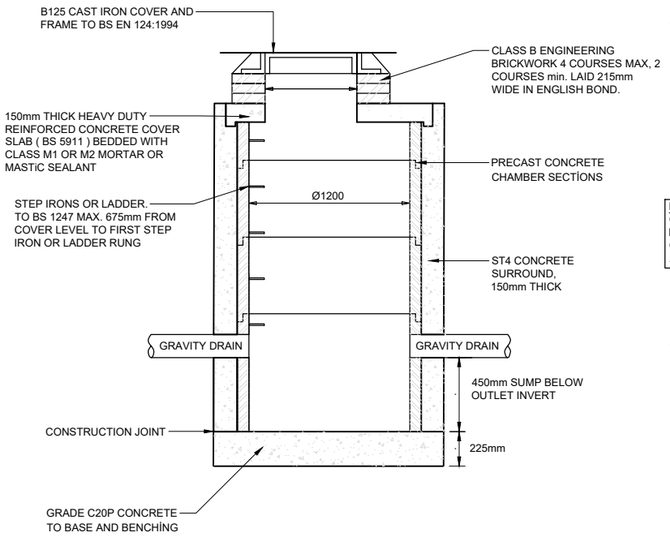
Client: S J M & CO

Project Title: COURTLANDS RIDING CENTRE STEVENAGE, SG1 2JE

Drawing Title: DRAINAGE DETAILS - SHEET 2

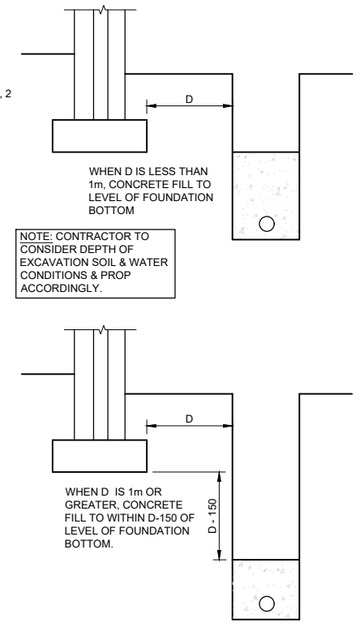
Scale at A1	Date	Designed by
AS NOTED	JUN 23	DR
Drawn by	Checked by	Approved by
DR	CR	DR

Drawing Number: 21100-FCE-XX-XX-DR-D-0502 Rev P01



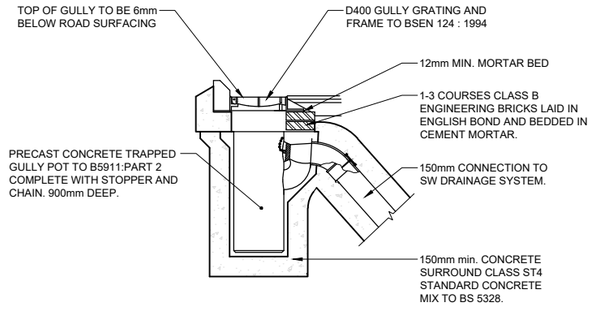
CATCHPIT MANHOLE

Scale 1:20



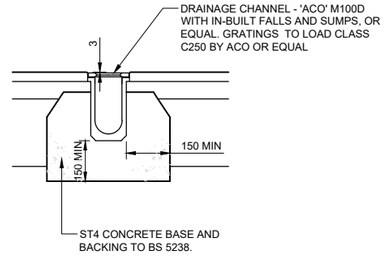
PIPES NEAR BUILDINGS

SCALE NTS



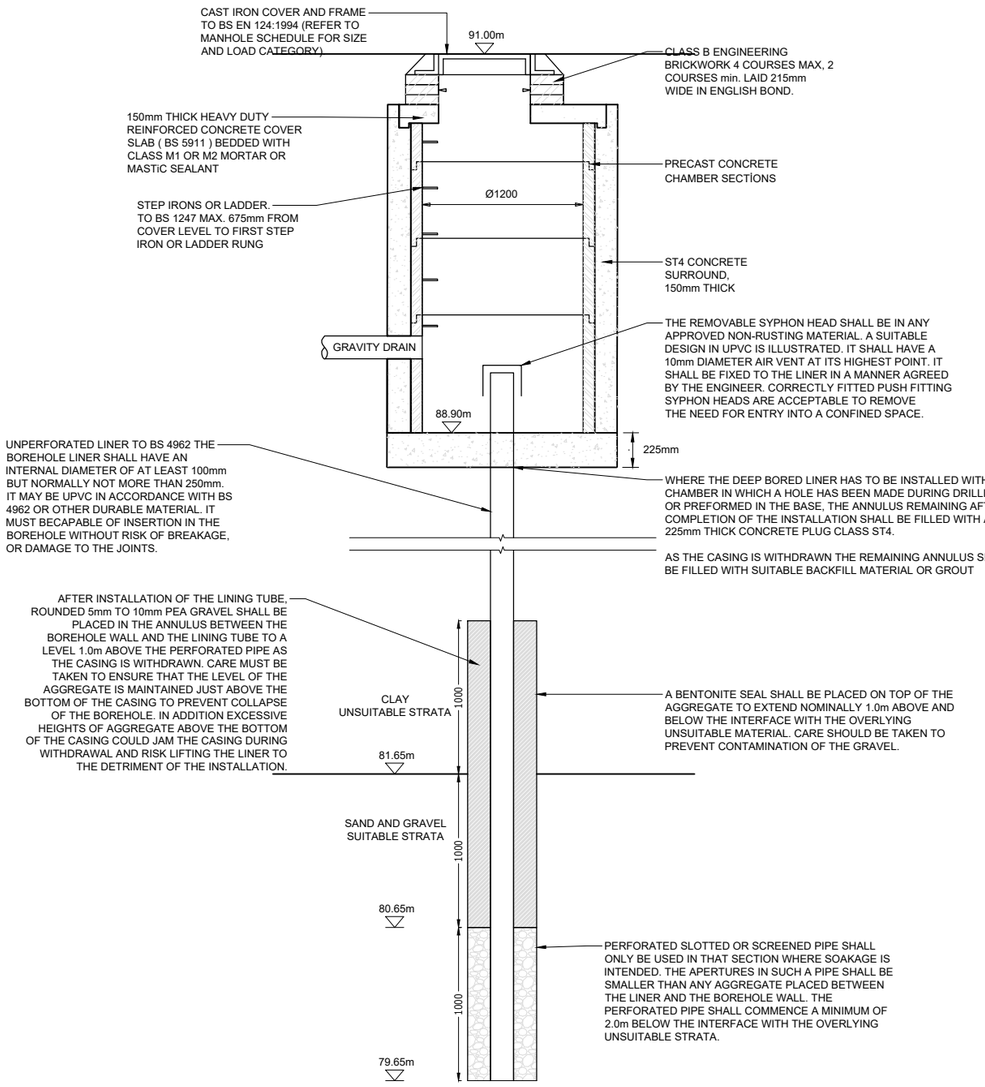
ROAD GULLY

SCALE 1:20



LINEAR DRAINAGE CHANNEL

SCALE 1:20



TYPICAL BOREHOLE SOAKAWAY DETAIL

Scale 1:20

NOTES

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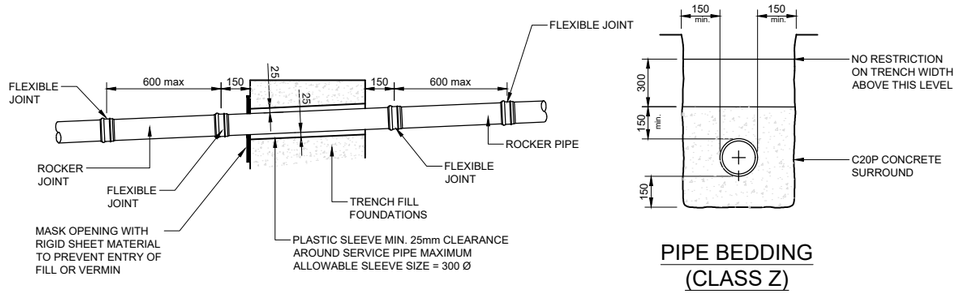
FOR INFORMATION ONLY

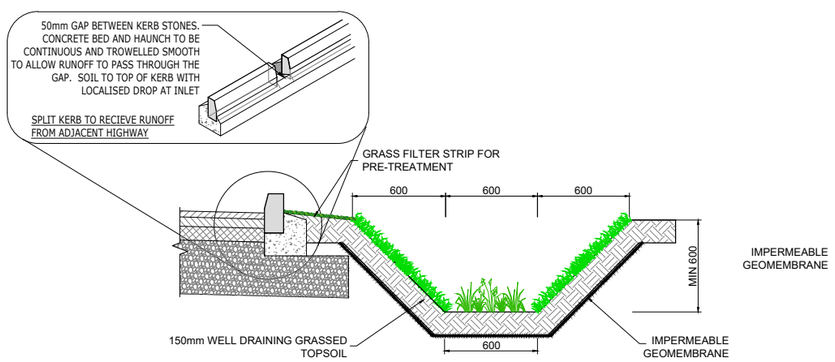


PIPE BEDDING (CLASS Z)

(FLEXIBLE JOINTS AT NOT GREATER THAN 8M CENTRES TO COINCIDE WITH OUTER FACE OF PIPE SOCKET)

CONCRETE PROTECTION FOR PIPES

SCALE 1:20



INDICATIVE CONVEYANCE SWALE ADJACENT TO HIGHWAY

SCALE 1:10

Rev	Description	Drn	Chk	App	Date
P02	FOR INFORMATION	DR	CR	DR	12.04.24
P01	FOR INFORMATION	DR	CR	DR	06.06.23

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Client: S J M & CO

Project Title: COURTLANDS RIDING CENTRE STEVENAGE, SG1 2JE

Drawing Title: DRAINAGE DETAILS - SHEET 3

Scale at A1	Date	Designed by
AS NOTED	JUN 23	DR
Drawn by	**Checked by**	**Approved by**
DR	CR	DR

Drawing Number: 21100-FCE-XX-XX-DR-D-0503 Rev P02

APPENDIX F – WATER TREATMENT MITIGATION INFORMATION

info@fernbrook.co

Product Data Sheet

Inbitex™ Geotextile

TERRAM
Geosynthetics you can trust

PDS012 Issue 2—June 2021

DESCRIPTION:

Inbitex™* is a specialist nonwoven geotextile designed for use within PPS (pervious pavement systems) or SUDS (sustainable urban drainage systems) to provide separation, filtration and removal of pollutants from water runoff. Inbitex™ geotextile is manufactured using advanced bico technology from UV stabilised virgin polyolefin that have been thermally bonded to provide high mechanical strength with excellent hydraulic characteristics.

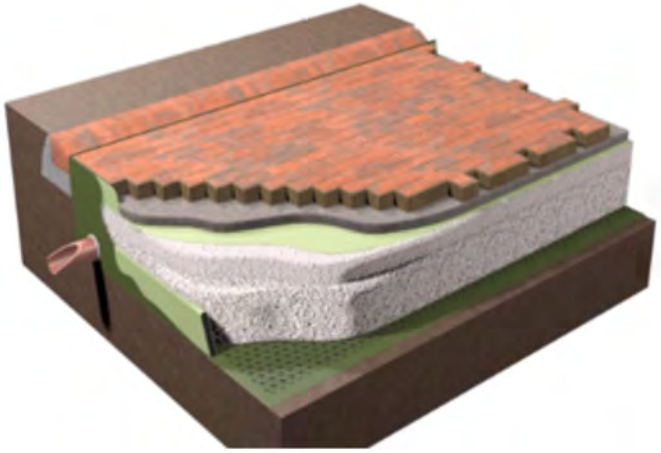
APPLICATIONS:

Inbitex™ was developed to enhance the performance of Formpave Aquaflow permeable concrete block paving systems and can be used with Terram Bodpave or any other PPS (pervious pavement systems). With 20 years of extensive research, testing and thousands of installations, Inbitex™ geotextile has been proven to be a key component in the removal of pollutants in water run off in a PPS.

- Formpave Aquaflow permeable concrete block paving system
- Terram Bodpave pervious pavement system
- Terram Truckpave pervious pavement system
- Porous/pervious paving systems (PPS)
- Filter wrap to geocellular attenuation/infiltration tanks
- Filter wrap for diffuser boxes
- Sustainable Drainage Systems (SuDS) filtration

FEATURES & BENEFITS:

- Attracts & traps hydrocarbons (oil) - prevents pollution
- Unique fibre matrix provides perfect habitat for microbial film - breaks down up to 400g oil/SQM/year
- Nonwoven material with isotropic properties—same strength in all directions extending pavement life
- High permeability and low pore sizes—effectively filters silts and other pollutants
- Chemically inert and durable—service life in excess of 100 years
- Lightweight and easy to handle - low risk of manual handling injury



*Inbitex is a licensed trademark of Forterra (Hanson) Building Products Ltd

Inbitex™ Geotextile

Product Data Sheet

PDS012 Issue 2 —June 2021

INTENDED USE/FUNCTION:

INTENDED APPLICATION:

MECHANICAL PROPERTIES	TEST METHOD	UNIT	MEAN VALUE
Tensile Strength	EN ISO 10319	kN/m	8.5
Tensile Elongation	EN ISO 10319	%	30
CBR Puncture Resistance	EN ISO 12236	kN	1.575
Cone Drop	EN ISO 13433	mm	38
HYDRAULIC PROPERTIES			
Pore Size - Mean AOS	EN ISO 12956	µm	145
Permeability	EN ISO 11058	Litres/m²s	80
DURABILITY PROPERTIES			
Weathering (UV Exposure)	EN 12224	Days	30
Combined ageing (Oxidation, temperature & moisture)	EN ISO 13438	Service Life (Yrs)	100
PHYSCIAL PROPERTIES			
Thickness (Nominal)	EN ISO 9863-1	mm	0.7
Composition			Polypropylene core (70%)/polyethylene sheath (30%)
MATERIAL DIMENSIONS			
Width		m	4.5
Length		m	100
Gross Roll Weight (Nominal)		kg	63

PACKAGING & IDENTIFICATION
Terram geosynthetics are supplied on cardboard cores and wrapped in Polyethylene sheeting with identification labels in accordance with ISO 10320.

STORAGE
The rolls of geosynthetics shall be stored on stable/ level ground and stacked not more than two rolls high and no other materials shall be stacked on top. The rolls can be stored outdoors when packaged, but should be protected from exposure to UV. All materials should be stored in accordance with good health and safety practice and in accordance with local laws. For additional information please refer to Terram Geotextiles MSDS.

QUALITY
Terram geosynthetics are supplied having met internal quality requirements in accordance with our Quality Management system which is certified to BS EN ISO 9001:2015.

NOTES
Reported values are arithmetic mean values unless otherwise stated. For further details on physical parameters please refer to the individual Declaration of Performance certificates available for download from www.terram.com

Reported values related to durability testing are generally based on the lowest grade product within a family.

A Nominal value indicates that the value is not part of the performance specification and is provided for guidance only.

Gross roll weights are provided for lifting guidance only and does not form part of quality control.

ADDITIONAL INFORMATION
Refer to the Terram Jointing Methods (downloadable from www.terram.com) for when simple overlaps are required for subsequent and adjacent roll lengths. However, pegging, sewing, stapling or gluing can also be used depending upon the application, the sub-grade conditions, the loading, the convenience and the cost.

These figures relate to standard product weights and roll sizes. Other weights, sizes and colours may be available on request.

For further information please contact Terram Technical Support.

Design Data

Downstream Defender®

Advanced Hydrodynamic Vortex Separator

The Downstream Defender® is an advanced hydrodynamic vortex separator for the effective and reliable removal of fine particles, oils and other floatable debris from surface water runoff.

Its innovative design delivers high efficienc across a wide range of flows in a much smaller footprint than conventional or other swirl-type devices and it is the perfect choice for any catchment likely to convey high quantities of contamination.

1. Access for removal of floatables and sediments
2. Inlet pipe.
3. Inlet chute.
4. Centre shaft.
5. Dip plate.
6. Centre cone.
7. Benching skirt.
8. Floatables and oil storage.
9. Isolated sediment storage zone.
10. Outlet pipe.

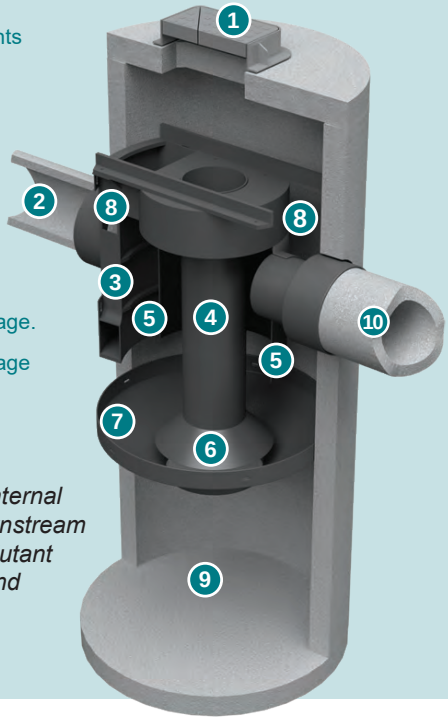


Figure 1 - The unique internal components of the Downstream Defender® enhance pollutant removal performance and prevent wash out.

Unique Flow Modifying Components

The Downstream Defender® consists of a choice of concrete or HDPE chamber with unique flow modifying internal components. It is these internal components that differentiate the Downstream Defender® from catchpits, sedimentation basins or sedimentation sumps. They facilitate advanced hydrodynamic vortex separation by reducing turbulence, lengthening the flow path to increase chamber residence time and introducing shear planes.

The internal components also ensure that the pollutant storage zones are isolated and protected from high flows that could cause pollutant re-entrainment or wash out.

Compared to devices that have poorly designed internal components, the Downstream Defender® captures and retains more of the annual pollutant load.

Watch a short video showing the Downstream Defender® components and operation at:

http://www.hydro-int.com/en-gb/products/downstream-defender-0

Repeatable, Reliable Performance

The Downstream Defender® delivers high removal of pollutants through advanced, hydrodynamic separation across a wide range of flows. The device has a proven track record of tackling an assortment of pollutants including:

Sediment (or Total Suspended Solids)

The Downstream Defender® is a highly effective sediment/TSS removal device. It can be sized in a number of ways to suit the application and level of protection required (see Table 1). **SuDS Mitigation Index = 0.5.**

Gross Pollutants

100% removal of floatable debris, such as food wrappers, Styrofoam cups and drinks cartons

Liquid Hydrocarbons

Effective spill containment device that meets the BS EN 858-1:2002 Class I and Class II effluent targets a low flow rates. Note these systems are not considered oil separators according to the BS EN 858-1 and must not be used in applications where full certification is required. **SuDS Mitigation Index = 0.8.**

Sediment Bound Hydrocarbons (including Polycylic Aromatic Hydrocarbons - PAHs)

PAHs have low solubility in water and are readily adsorbed onto sediment particles. Effective removal of sediment particles will also ensure the removal of many PAHs.

Sediment Bound Heavy Metals and Nutrients

Heavy Metals

Nutrients

As an efficient device for removal of fine sediment, t Downstream Defender® is also effective for the removal of sediment bound pollutants. **SuDS Mitigation Index (Metals) = 0.4.**

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stormtrain@hydro-int.com

hydro-int.com/stormtrain

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

No Risk of Pollutant Wash Out

The Downstream Defender® has been specially designed to isolate the pollutant storage zones and is proven to prevent pollutant wash out.

Sizing

The Downstream Defender® can be sized for different treatment goals and objectives.

For design purposes, the selected model's Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.

The hydraulic capacity of the selected model should be considered with respect to the peak discharge flow rate from the site

Model Diameter (m)	Treatment Flow Rate - Fine (l/s) [a]	Treatment Flow Rate - Coarse (l/s) [b]	Hydraulic Capacity (l/s) [c]	Minimum Oil Storage Capacity (l)	Minimum Sediment Storage Capacity (m^3) [e]	Maximum Headloss at Treatment Flow Rate - Coarse (mm)
1.2	30	38	120	270	0.38	150
1.8	69	85	270	1300	1.04	225
2.55	138	171	542	2450	3.23	300
3.0	190	237	750	4550	3.81	375

Notes:
a) Treatment Flow Rate - Fine is based on an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particl size (D_{50}) of 75 microns and a specific gravity of 2.65
b) Treatment Flow Rate - Coarse is based on an annualised removal efficiency of >80% of all particles between 50 and 1000 microns with a mas median particle size (D_{50}) of 146 microns and a specific gravity of 2.65
c) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm
d) Alternative sizing based on different sediment grades available on request
e) Additional sediment storage capacity can be provided to extend maintenance intervals if required.

Table 1 - Downstream Defender® design information.

Expert Design Service

Hydro International's professional engineers are on hand to provide free support with the correct sizing and selection of the Downstream Defender® within each drainage design.

We can also provide estimated maintenance intervals, whole life cost estimates and predicted pollutant removal performance.

Call the StormTrain® Hotline on: 01275 337955 or email stormtrain@hydro-int.com

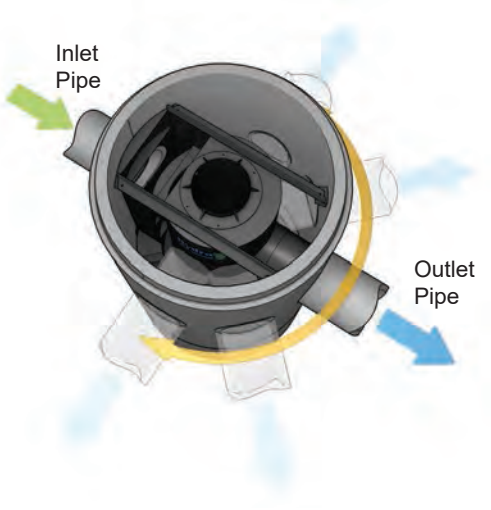
Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

Setting Out

The Downstream Defender® can accommodate a change in pipe direction to suit site specific requirements. Combined with the high rate internal bypass, this helps to avoid the need for additional manholes on site. Head loss across the chamber is kept to a minimum (see Table 1). The inlet and outlet pipes should be sized in accordance with Table 2 (opposite), and a minimum of 90 degrees between inlet and outlet is required.

Inlet and outlet pipe connections are at the same invert level.

Additional manhole sections can be provided to extend the chamber to meet site cover and invert levels or provide additional pollutant storage where required.



Easy to Install

The Downstream Defender® is delivered to site as a near finished manhole with internal components already installed. Installation is therefore similar to any other manhole installation on site. Full installation guidelines are available.

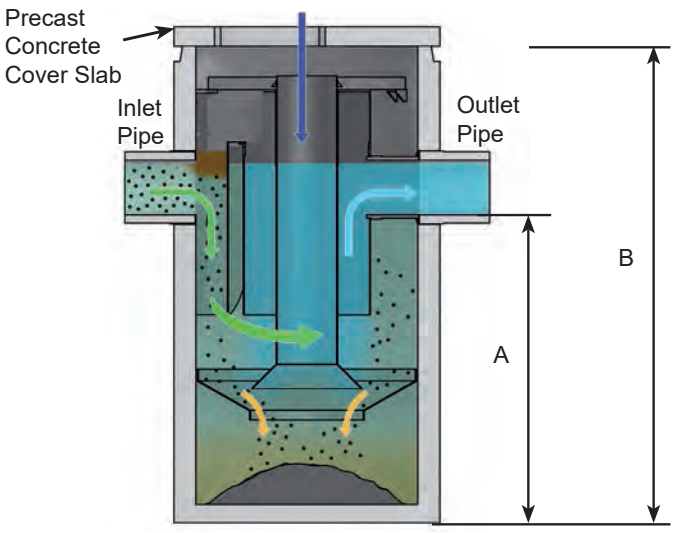
We can provide structural concrete systems for simple plug-and-play installation or choice of lightweight single and twin wall plastic chambers.

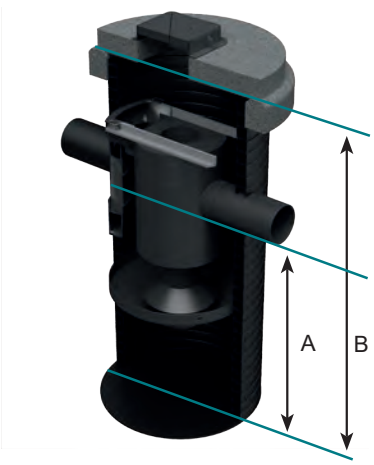
Easy to Maintain

Maintenance of the Downstream Defender® is simple, safe and cost-effective. Maintenance is carried out from the surface, using a standard vacuum tanker and personnel are not required to enter the device.

With a large capacity to store sediments and oils (see Table 1), and with a proven ability to prevent wash out, maintenance intervals can be years rather than months - depending on site conditions. The unit can also be fitted with a Hydro-Logic™ Smart Monitoring system to alert the site operator when maintenance is required and provide peace of mind that the unit is operating normally at other times.

Additional pollutant storage can be built into the chamber to extend maintenance intervals if required.





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stormtrain@hydro-int.com

Design Data
Downstream Defender®
Advanced Hydrodynamic Vortex Separator

Dimensions and Weights

General arrangement drawings of all units are available for download from:
http://www.hydro-int.com/en-gb/products/downstream-defender-0

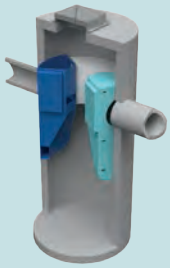
Model	Material	Chamber Diameter - Internal (mm)	Chamber Diameter - External (mm)	Inlet and Outlet ID (mm)	Depth to invert (m) (A) (1)	Chamber Depth (m) (B) (2)	Max Component Lift Weight (kg)
PQL1320.1000	Concrete	1200	1460	300	1.92	2.80	2500
PQL1320.1030	Concrete	1800	2160	450	2.51	4.05	8000
PQL1320.1060	Concrete	2550	2850	600	2.84	4.95	9500
PQL1320.1090	Concrete	3000	3350	750	3.10	5.20	14000
PQL1320.1020	HDPE Single Wall	1200	1360	300	1.41	2.20	200
PQL1320.1050	HDPE Single Wall	1800	1950	450	2.11	3.41	400
PQL1320.1080	HDPE Single Wall	2550	2770	600	2.94	4.78	900
PQL1320.1110	HDPE Single Wall	3000	3220	750	3.13	5.3	1300
PQL1320.1025	HDPE Twin Wall	1200	1500	300	1.57	2.25	400
PQL1320.1055	HDPE Twin Wall	1800	2200	450	2.33	3.80	700

Notes:
1) Minimum depth to invert shown. Depth to invert can be increased if required.
2) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required.

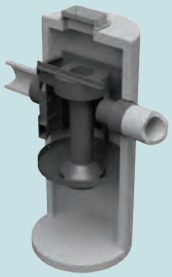
Table 2 - Downstream Defender® unit types, dimensions and weights.

The Hydro StormTrain® Series of Surface Water Treatment Devices

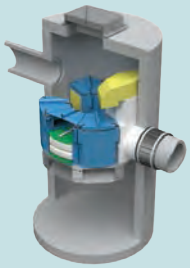
The Downstream Defender® is one of the Hydro StormTrain® Series of surface water treatment devices. Each device delivers proven, measurable and repeatable surface water treatment performance. Each can be used independently to meet the specific needs of a site or combined to form a management train. They can be used alongside natural SuDS features to protect, enable or enhance them.



First Defense®
Vortex Separator



Downstream Defender®
Advanced Hydrodynamic
Vortex Separator



Up-Flo™ Filter
Fluidised Bed Up Flow
Filtration System

Hydro Biofilter
Biofiltration Syste

Tel: +44 (0)1275 337955 stormtrain@hydro-int.com

Hydro International
Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD

hydro-int.com/stormtrain

APPENDIX G – ENVIRONMENT AGENCY CORRESSPONDENCE

creating a better place

Environment Agency

Dominic Ramdeem
Fernbrook Consulting Engineers
40 Bowling Green Lane
London
EC1R 0NE

Our ref: NE/2023/135727/02-L01
Your ref: 21100

Date: 29 June 2023

Dear Dominic

COURTLANDS RIDING CENTRE, TODDS GREEN, STEVENAGE HERTS SG1 2JE

Thank you for providing further clarification and information on the above site.

We have reviewed the following documents for this consultation:

- E-mail from FERNBROOK to HNL Sustainable Places dated 13 June 2023
- Phase II Environmental Report, 16885, August 2021
- E-mail From Anglian Water re PPE-0129776 Courtlands, 31 March 2022
- Soakage Test Report, 16885, July 2021
- Proposed Drainage Strategy, Dwg No. 21100-FCE-XX-XX-DR-D-0500 P04, June 2023

We have the following comments:

1. We note that Anglian Water have advised that the discharge of surface water to sewer would not be allowed for this development. Please can you confirm that discharge to watercourse is also not possible.

2. We have previously advised that deep infiltration would only be acceptable if the system is designed to be no deeper than absolutely necessary. We understand that the current proposals for a 10m deep system are based upon the ground conditions and infiltration characteristics in BH1 in the central part of the site; whereas the deepest exploratory hole in the southernmost part of the site where borehole infiltration is proposed terminated at 3.0m. Supplementary intrusive investigations to greater depths in the southern part of the site are therefore required to inform a robust assessment of the minimum depth required for sufficient soakage in this part of the site.

3. The site investigation report that has been provided is incomplete as laboratory certificates have not been appended. However, we note that shallow soils in the southernmost part of the site where infiltration is proposed showed PAH impacts. On a precautionary basis the supplementary investigations in this part of the site should include testing of soils to depth to confirm that infiltration would not occur into ground affected by contamination.

4. Full details for the proposed design and construction of the borehole should be provided once these have been finalised.

Cont/d..

Our comments are based on our available records and the information submitted to us. Please quote our reference number in any future correspondence. Please note that the views expressed by the Environment Agency, is a response to an enquiry only and does not represent our final view in relation to any future planning submission made in relation to this site. We reserve the right to change our position in relation to any such application

Please let me know if you have any questions.

Yours sincerely

Deborah Simons
Planning Advisor
Direct e-mail HNLSustainablePlaces@environment-agency.gov.uk