DISTINGTON -BIG LOCAL

27/02/2020

DRAINAGE STRATEGY REPORT

The Alan Johnston Partnership LLP

Job Ref: 218-252

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Project Closure Report Version Control

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P01	02.03.2020	John Marshall	Initial Issue

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Originator	Approved	Date
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1.0 INTRODUCTION

This Drainage Strategy Report (DRA) has been prepared on behalf of the Big Local community group by the Alan Johnston Partnership (AJP) for the development of nine new domestic dwellings and an fifty four apartment building off Church Road in Distington, on a site that is Brownfield, and shall be submitted in support of the planning application to the local authority; Cumbria County Council.

The site is located within Flood Zone 1, with a total site area under 1.0ha. Therefore, in accordance with DEFRA guidance, a Flood Risk Assessment is not required in support of a planning application. This DSR shall provide the necessary information for the support of a planning application, as set out within the Cumbria County Council Development Design Guide.

The purpose of this report is to present the surface water and foul water outline drainage strategy for the site, which has been designed by the Alan Johnston Partnership, to demonstrate how the specific drainage planning requirements are to be met in accordance with the National Planning Policy Framework (NPFF), the report should be read in conjunction with the relevant drawings and supporting information included within the appendices.

The drainage strategy outlined within this report, has been prepared in accordance with BS EN 752:2017 (Drain and sewer systems outside buildings), Sewers for Adoption 6th Edition, Building Regulations Approved Document H (Drainage and waste disposal), the Cumbria Local Flood Risk Management Strategy and the Technical Guidance to the National Planning Policy Framework document (Department for Communities and Local Government, March 2012).

2.0 SITE DESCRIPTION

The proposed development site is located off Church Road in Distington and located at National Grid Reference NY 00567 23509 The location of the existing site is illustrated in Appendix A and the extent of the area to which the application relates is also shown on the aerial photo enclosed in Appendix B. The site area is bounded by existing housing to the north, east and south; which lie off the existing highway network. To the west of the site is the new Distington Community centre.

The proposed development site covers a total area of approximately 0.732 ha and is currently a Brownfield site with the site previous community centre that occupied the site having been demolished beyond the last twelve months; leaving behind the actively drained car parking area.

The site consists of a relatively shallow sloping area with an average grade of 1:55, with levels falling from circa 75.30m AOD at Church Road to it's lowest point on the southern boundary at circa 73.0m AOD. The site is accessed off Church Road, with a narrow route between existing housing leading to the site. The site also falls from west to east from Circa 75.20m AOD to 74.05m AOD, with some existing minor structures lying on the eastern boundary; this is evidenced in the Topographical survey in Appendix C.

3.0 PROPOSED DEVELOPMENT

The proposed development consists of 63 new dwellings; the proposed bungalows are accessed off a newly proposed highway that feeds off Church Road, further into the development site there shall be an a large apartment building that will consist of 54 private apartments. The total impermeable area from the proposed development is 0.530 Ha, encompassing the proposed, domestic houses, the apartment building and associated highways and other hardstanding.

To enable a viable scheme, the proposed site levels are constrained by the existing highway levels off Church Road and the existing boundary levels, the proposed highway and finished floor levels shall attempt the marry the two levels and be constrained by its proximity to both. The proposed highway shall connect to Church Road, under a Section 278 Agreement to accommodate the new extent of highway. The proposed site plan is attached in Appendix D.

4.0 DEVELOPMENT AND DRAINAGE STRATEGY

4.1 Effect of Proposed Development

As previously outlined in Section 2.0, the existing site covers a total area of 0.732ha, and is a Brownfield site with areas amounting to 0.270ha having positive connectivity to the UU sewers within the last 12 months.

A plan detailing the proposed impermeable areas is included in Appendix E, as can be seen it indicates that with the introduction of the new; roof area and private driveways, the development in its totality will lead to an increase in impermeable areas.

Therefore, the changes to the existing site will increase the volume of impermeable areas and as such, the proposed development will lead to an increase in the;

- Volume of surface water ponding on the site
- Volume of surface water runoff leaving the site or discharging into surrounding areas
- Peak discharge rate from the site.

Accordingly, site-wide drainage systems are required to drain the foul and surface water flows arising from the proposed development, allowing for the impacts of Climate Change. Where possible, any existing drainage networks should be utilised. Appropriate design and construction of these systems as set out in Section 4.3 should ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

4.2 Existing Drainage Systems

As shown in the United Utilities map, attached in Appendix H, there is an existing 225mm diameter C.W Sewer in Church Road with manhole 5501 identified as the likely point of discharge; the sewer is running at circa 2.0m deep. There is also an existing 150mm diameter C.W Sewer at the Southern boundary of the site, identified with MH 5401 at the head of the run, this existing SCW sewers are running at circa 1.20m deep

4.3 Proposed Drainage Strategy

As outlined above in section 4.1, site-wide drainage systems are required to drain the foul and surface water flows arising from the proposed development. The proposed drainage systems must ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

4.3.1 Surface Water Drainage

The Building Regulations - Approved Document H (2002) details a hierarchy of potential methods for disposing of surface water as shown below in order of preference:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to sewer

Considering the hierarchy above, the surface water network for the proposed site should infiltrate where possible.

The local geology as identified within the Phase II Desktop report executive summary in Appendix I as clay deposits which will would be of no viable interest for infiltration and discharge of the S.W flows from the development to ground. This has been further confirmed by the production of infiltration testing that demonstrated the infiltration capacity of the ground to be negligible; therefore the initial option of discharge to ground can be dismissed.

The nearest Watercourse is the Distington Brook located 0.25km to the east of the development, due to the distance and the need to transverse across various plots of third-party land and the B5306, discharging to watercourse has been deemed impractical and dismissed as an option for discharge.

As previously mentioned there appears to be a CW sewer running within the existing highway accessing the site, therefore due to the site conditions and in accordance with Approved Document H and the guidance from the NPPF, the development shall positively discharge to the C.W sewers within Church Road.

While every effort to utilise, any suitable existing systems should be made, the drainage systems should be designed to suit the proposed site layout and topography which aims to provide an efficient design.

In line with Sewers for Adoption (6th Edition), the requirements for the design of a new surface water drainage system are as follows:

- Below ground piped drainage to be sized to accommodate the 1 in 2-year (50% AEP) design storm without surcharge.
- System to be designed not to flood any part of the site in a 1 in 30-year (3% AEP) design storm.

- For events in exceedance of the 1 in 30-year design storm and up to and including the 1 in 100-year event, site drainage and topography should be designed where practicable to route surface water run-off away from buildings to safe above-ground storage areas on site such as highways.

For each design case described above, the design storm is the critical storm duration for the site conditions. In the case of the 1 in 100-year design storm, a 40% increase in the peak rainfall intensity is applied to allow for the estimated worst-case impacts of climate change. This is in accordance with Table 5 of the Technical Guidance to the National Planning Policy Framework.

Suitable systems of below ground drainage will be required to contain as a minimum requirement, the 1 in 30-year event. Additionally, any surface water run-off from events that exceed the design capacity of the new drainage system, up to and including the 1 in 100-year event, will be retained on-site in highways. A further consideration for the 1 in 100yr + CC event discharging to a surcharged outfall should be taken into account, to ensure it does not present a flood risk to any proposed or existing properties.

Should they be required, measures to prevent oil and other contaminants being passed forward to the existing surface water sewer should also be incorporated into the design of the surface water system, through the use of appropriate oil separators or other appropriate pre-treatment methods.

In line with common practice, it is proposed the surface water discharge from the proposed development should mimic that from the existing site or what is practicable, whichever is the greater of the two.

As a brownfield site, the existing flows are positively draining into the existing Combined manhole in Church Road. AJP have modelled these flows for the existing hardstanding area (see Appendix H) and determined the 2yr return period existing flows to be 30.7l/s. In accordance with general guidance it is standard practise to offer a 50% betterment for proposed flows from the development for all return periods; which would limit flows from the development for a return periods to 15.3l/s. While we've received no correspondence from the Local Lead Flood Authority (LLFA) confirming this discharge rate.

Correspondence has been obtained from United Utilities as shown in Appendix H, for discharge rates allowable from the development; which outlays their position that a maximum pass forward flow rate of 5l/s shall be allowed into their sewerage network.

it has been determined therefore that the allowable surface water discharge rate from the proposed development will be restricted to 5l/s run off rate for all return periods; this discharge rate is equivalent to the minimum practical discharge rate from the development for reasons of compliance with maintenance requirements.

The proposed surface water drainage systems shall be designed to restrict the discharge to the required rate, up to and including the 1 in 100 year return period plus 40% climate change design storm.

The network shall require an attenuation volume to ensure that the S.W flows do not discharge more than the limiting flow rates of 5l/s for the 1 in 100 year return period with an allowance for 40% climate change impact. This network shall be have its flow rate restricted by the use of a vortex flow control unit with oversized pipes, large manholes and online crate storage tanks; that shall provide effective attenuation volume equivalent to 314m^3.

The Crate storage tanks cannot be placed above the 30yr water level in the oversized pipes due to the shallow inverts of outfall, as there would be insufficient cover to the tanks. It is therefore proposes that the tanks will form part of the adopted sewerage network under the new Codes for Adoption standards to be adopted by UU in April 2020. Early discussions should be held with UU to ensure their compliance with this measure.

The proposed drainage scheme to satisfy the requirements of Approved document H and the NPPF and United Utilities discharge rates, can be seen within the Outline Drainage Layout plan within Appendix G. The outline drainage plan also demonstrates a S.W outfall point on the S.W sewer within Church Street, with the construction of a new connection to the existing manhole and the abandonment of the upstream sewer to suit the proposed development.

The depth of the receiving existing receiving manhole 5501 shall be confirmed on site prior to the start of any works.

The surface water drainage strategy and discharge rates are subject to approval from United Utilities and the Lead Local Flood Authority prior to the commencement of any works.

4.3.2 Foul Water Drainage

Foul water drainage disposal is set out in Part H of the Building Regulations in order of priority the preferred methods are;

1. Public sewer
2. Septic tank
3. Cesspool.

The foul water system shall be designed in accordance with;

- BS EN 752:2017 (Drain and sewer systems outside buildings)
- Sewers for Adoption (7th Edition)
- Technical Guidance to the National Planning Policy Framework document (Department for Communities and Local Government, March 2012).
- BS EN 12056-2:2000 (Drainage systems inside buildings)
- Building Regulations Approved Document H, Drainage and waste disposal. (Office of the Deputy Prime Minister, December 2010).

As can be seen in the Outline Drainage Strategy Drawing , attached in Appendix G, it is anticipated that the foul water will be collected and conveyed to the CW sewer in Church Road with the S.W & F.W systems combining prior to exiting the site development area. The F.W flows from the site shall discharge at an unrestricted rate.

The depth of the receiving existing receiving manhole 5501 shall be confirmed on site prior to the start of any works.

The foul water drainage strategy should be confirmed via more detailed discussions with United Utilities and the Lead Local Flood Authority prior to the commencement of any works.

4.4 Compliance with LASOO Non-Statutory Technical Standards for SUDS

In compliance with the runoff destinations guidance within the LASOO Non-Statutory Technical Standards for Sustainable Drainage: Best Practice Guidance, infiltration is not feasible; therefore the surface water runoff is designed to discharge to the public sewer.

S1. Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control Standards (S2 and S3) and volume control Standards (S4 to S5) need not apply.

The site does not discharge to a surface water body that can accommodate uncontrolled surface water discharges and therefore Standards S2 – S5 shall apply.

4.4.1 Peak Flow Control

S2. For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.

The site is considered Brownfield and this standard does not apply.

S3. For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

The proposed discharge rate has been limited to 5l/s for the 100yr return period with an allowance for climate change; as close as is practicably possible to the greenfield run off rate and is less than the respective return periods for the existing S.W run off from the development site.

4.4.2 Volume Control

S4. Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6. Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

While other SuDS components such as green roofs or rainwater harvesting may assist in constraining the volume of surface water runoff, this has not been feasible due to proposed construction methods and space considerations for the development. The run off volume shall be discharged at a maximum of 5l/s with no flooding within the attenuation system, reducing the rate of run off to not adversely affect the flood risk in accordance with standard S6.

4.5 Future Maintenance

The proposed drainage solution uses no SUDS techniques in accordance with the CIRIA SUDS Manual C753, due to considerations with regards to appropriate space and ground conditions for their viable use. The surface water run-off is restricted using a vortex flow control device and the attenuated run-off stored using oversized pipes and large manholes.

It is proposed that the surface and foul water drainage systems and Surface water systems will be adopted and therefore will be the responsibility of United Utilities.

The remaining drainage systems (Hydrobrake unit) will be maintained in accordance with manufacturer's requirements which will be provided within the O&M manual which will be issued as a compliance requirement to the maintenance contractor on completion of the works.

The hard surfaces proposed for the development shall require regular annual sweep and suction brush following leaf fall in autumn. An annual inspection of control chamber, ACO channels and the inspection chambers shall be necessary to remove any silt build up and check the free flow use of the hydrobrake.

4.6 Managing Residual Flood Risk

There is a finite risk that the design flood conditions required by current design standards are exceeded by an extreme and rare event. However, with the design measures reported such a risk is low and the exceedance flow path routes required to channel flows around the development buildings will be such that no specific flood risk management procedures are envisaged to be necessary.

5.0 CONCLUSIONS

- The site is located within flood zone 1 and is less than 1ha in area; therefore no Flood Risk Assessment is required to support the planning application.
- The surface water discharge from the proposed site should discharge to the United Utilities 225mm C.W Sewer within Church Road at a rate not exceeding 5l/s.
- The Surface water shall be contained within the attenuation system for the 1 in 30 year return period and the 1 in 100 year return period (+ 40% climate Change), ensuring that no properties are at risk of flooding and all flows are contained on site.
- The proposed drainage systems comply with Standards contained within the LASOO Non-Statutory Technical Standards for Sustainable Drainage: Best Practice Guidance.
- Foul water discharge from the proposed site should discharge, at unrestricted rate to the existing United Utilities C.W Sewers

6.0 RECOMMENDATIONS

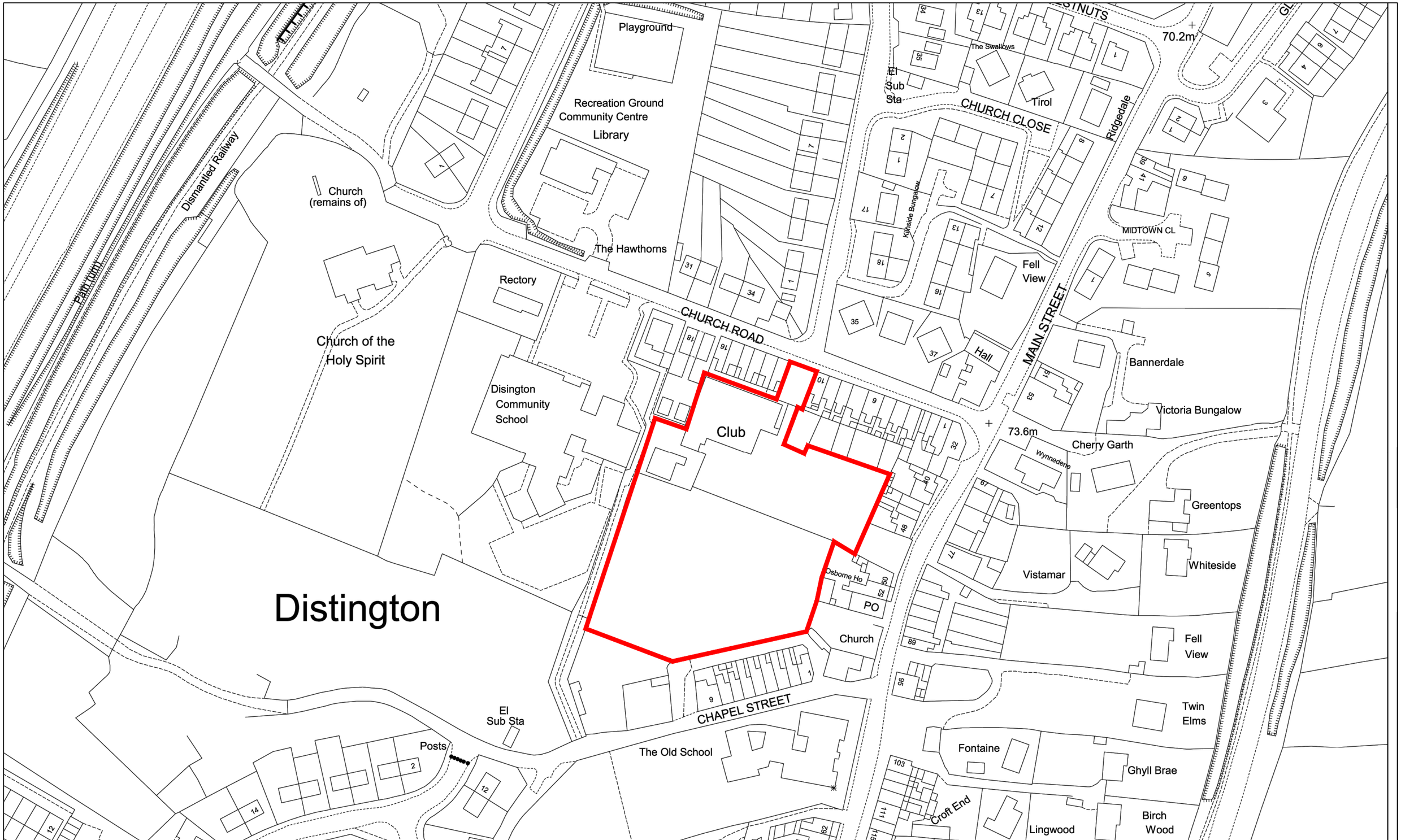
- Oversized pipes, Large manholes and crate storage tanks shall be used in conjunction with a vortex flow control device to restrict the surface water runoff and prevent any flooding for rainfall events up to and including the 1 in 100yr+40% climate change event.

- The external ground levels around the proposed building shall fall away from the proposed building with any new levels being designed to ensure any overland flood routes, for events in excess of the 1 in 100yr+40% climate change event are directed towards the highway for use in exceptional circumstances.

- The proposed S.W & F.W networks shall be put forward for adoption by United Utilities, who shall assume responsibility for their future maintenance and operation.

- The existing Combined Water manhole 5501 within Church Road shall be investigated and its invert level fully determined; prior to the start of any works on site.

Appendix A Site Location Plan



REV	DATE	DESCRIPTION	BY	APP

SCALE @ A3:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:1250	JCM	JCM	JLS	JLS	FEB 2020

PROJECT: DISTINGTON - BIG LOCAL

TITLE: SITE LOCATION PLAN

STATUS:	PROJECT No:	DRAWING No:	REV:
S2	218-252	**APP A**	.

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ajp structural & civil engineers

Appendix B Aerial Photograph

REV	DATE	DESCRIPTION	BY	APP

SCALE @ A3:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
NTS	JCM	JCM	JLS	JLS	FEB 2020

PROJECT: DISTINGTON - BIG LOCAL

TITLE: SITE AERIAL PHOTOGRAPH

STATUS:	PROJECT No:	DRAWING No:	REV:
S2	218-252	**APP B**	.

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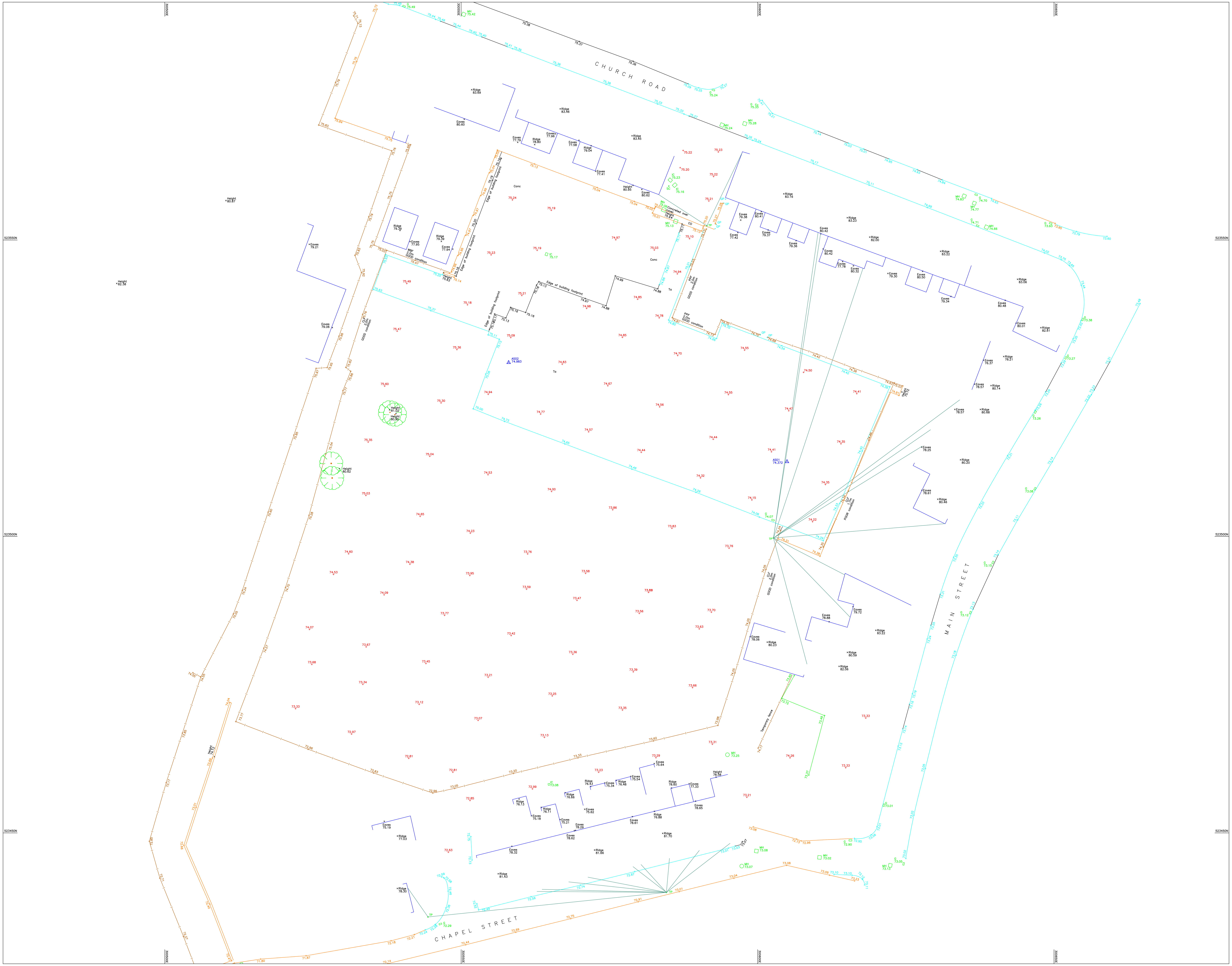
Appendix C Topographic Survey



ABBREVIATIONS

AB	Automatic Barrier	Ht	Height	SkBR	Stake Blue/Red
AC	Air Conditioning	IB	Illuminated Bollard	SkBY	Stake Blue/Yellow
Apx	Approximate	IC	Inspection Cover	SkBWY	Stake Blue/White/Yellow
B	Bollard	IL	Invert Level	SkG	Stake Green
BB	Belisha Beacon	Im	Intercom	SkO	Stake Orange
Bh	Borehole	IRF	Iron Rail Fence	SkR	Stake Red
BL	Bed / Beam Level	KO	Kerb Outlet	SkRWY	Stake Red/White/Yellow
BP	Block Paving	KT	Kerb Top	SkRY	Stake Red/Yellow
BRW	Brick Retaining Wall	L	Light	SkW	Stake White
BS	Bus Stop/Shelter	LH	Lamp Hole	SkWY	Stake White/Yellow
BT	British Telecom	LP	Lamp Post	SkY	Stake Yellow
BW	Brick Wall	m	Metres	SL	Soffit Level
BWF	Barb Wire Fence	MC	Motorway Comms	Sn	Sign
C	Column	MH	Manhole	SOS	Emergency telephone
CB	Call Box	Mk	Marker	Sp	Stump
CBa	Crash Barrier	MG	Multiple Girth tree	SPF	Steel Palisade Fence
CBF	Close Board Fence	MP	Marker Post	SPS	Stone Paving Slabs
CCTV	Closed Circuit TV	MRF	Metal Railing Fence	SRF	Steel Railing Fence
CIC	Cable Inspection Chamber	MW	Monitoring Well	SRW	Stone Retaining Wall
CIF	Corrugated Iron Fence	NP	Name Plate	St	Stay
CLF	Chain Link Fence	OhL	Overhead Line	SV	Stop Valve
Conc	Concrete surface	OhP	Overhead Power	SW	Surface Water
CPF	Concrete Panel Fence	OhT	Overhead Telecoms	Ta	Tarmac surface
CPS	Concrete Paving Slabs	OP	Ornamental Planting	TL	Threshold Level
CTV	Cable Television	P	Post	Tk	Tank
CW	Combined Water	PB	Post Box	TM	Ticket Machine
D	Diameter	PCF	Post & Chain Fence	TP	Telephone Pole
DK	Dropped Kerb	Pe	Pipe	TPS	Tactile Paving Slabs
Dp	Downpipe	PM	Parking Meter	TS	Traffic Signal
DRF	Diamond Rail Fence	PPF	Post & Panel Fence	TSC	Traffic Signal Cover
Ea	Eaves level	PRF	Post & Rail Fence	UB	Utility Box
EB	Electricity Box	PWF	Post & Wire Fence	Us	Underside
EL	Electricity cover	RE	Rodding Eye	UTL	Unable To Lift
EP	Electricity Pole	Ri	Ridge Level	VC	Vitrified Clay
FB	Flower Bed	RM	Road Marking	WB	Water Box
FH	Fire Hydrant	RS	Road Sign	WBF	Wooden Board Fence
FL	Floor Level	RSI	Road Sign Illuminated	WL	Water Level
FP	Flag Pole	Ri	Ridge Level	WM	Water Meter
FW	Foul Water	RS	Road Sign	WMF	Welded Mesh Fence
G	Gulley	RW	Retaining Wall	WPF	Wooden Panel Fence
Ga	Gravel surface	SC	Stop Cock	Wo	Washout
GP	Gate Post	SH	Speed Hump	ø	Diameter in mm
GV	Gas Valve	Sk	Stake	←	Direction of flow
HR	Hand Rail	SkB	Stake Blue		

NOTES

PLAN GRID IS LOCAL, BASED UPON O.S. NATIONAL GRID SITE CENTRED ON SURVEY STATION AS02. SCALE FACTOR=1.

ALL LEVELS RELATE TO ORDNANCE DATUM, (OSGM15) ESTABLISHED USING THE O.S. NATIONAL ACTIVE GPS NETWORK

SURVEY STATIONS

Name	Easting	Northing	Height
AS01	300604.961	523512.613	74.372
AS02	300558.010	523529.329	74.983

Issue	Details	By	Chk'd	Date
00	Original Issue	BJ	SA	17/01/18

SHEET LAYOUT

N

Scale 1:200

0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0

metres

SURVEYED BY	DRAWN BY	SCALE
AS/CD	BJ	1:500
DATE OF ISSUE	JANUARY 2018	@ A0

TITLE

LAND OFF CHURCH ROAD DISTINGTON, WORKINGTON CA14 5TN

TOPOGRAPHICAL SURVEY 3D

DRAWING No.	ISSUE
PS–1668–TS–3D	00
SHEET 1 OF 1	

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Appendix D Proposed Site Plan

DATUM LEVEL:
74.500m ASL

Rev.	Date	Description	Drwn.

Note:
Do not scale off this drawing. Do not rely on this drawing for purposes other than the recorded 'Status'. Constructors must be familiar with the client's building asbestos register ahead of facilitating any work contained on this drawing.

North

Scale

0 10 20 30 40m

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Drawing Title
Proposed Site Plan
Project
Distington Big Local
Client
Big Local
Scales @ A0 Date Drawn Check
1:200
Job Number Drg. No - Revision Status
2808 GA_100_03 Preliminary

Halsall Lloyd Partnership
ARCHITECTS & DESIGNERS

Appendix E S.W Catchment Plans

EX MH 5502
C.L 75.42m
I.L 74.22m

Existing 225mmØ Combined Sewer

EX MH 5507
C.L 75.24m
I.L TBC

EX MH 5501
C.L 75.28m
I.L 73.43m

Existing 225mmØ Combined Sewer

EX MH 6508
C.L 74.83m
I.L TBC

EX MH 6508
C.L 74.66m
I.L 72.90m

Existing 225m

EX MH 5508
C.L 75.16m
I.L TBC

Existing 225mmØ Combined Sewer

EX MH 5504
C.L 75.13m
I.L TBC

EXISTING AREA = 0.27 Ha

EX MH 6401
C.L 73.41m
I.L 72.02m

EX MH 6410
C.L TBC
I.L TBC

Existing 225mmØ Combined Sewer

EX MH 5401
C.L 73.28m
I.L 72.16m

Existing 150mmØ Combined Sewer

EX MH 6404
C.L 73.08m
I.L 71.74m

Existing 225mmØ Combined Sewer

EX MH 6402
C.L 73.08m
I.L 71.80m

Existing 225mmØ Combined Sewer

Existing 225mmØ Combined Sewer

EX MH 6402
C.L 73.22m
I.L 71.72m

REV	DATE	DESCRIPTION	BY	CHK	APP

DRAWING STATUS:
PRELIMINARY

CLIENT:
BIG LOCAL

ARCHITECT:
HLP ARCHITECTS

PROJECT:
DISTINGTON
BIG LOCAL

TITLE:
EXISTING BROWNFIELD
CATCHMENT

STATUS:	PROJECT No.	PROJECT	ORIGINATOR	VOL/SYS	LEVEL	TYPE	ROLE	DRAWING No.	REV:
S2	218-252	DIS	AJP	ZZ	00	DR	C	0001	P01

SCALE @ A1:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:250	JCM	JCM	JLS	JLS	SEPT 2019

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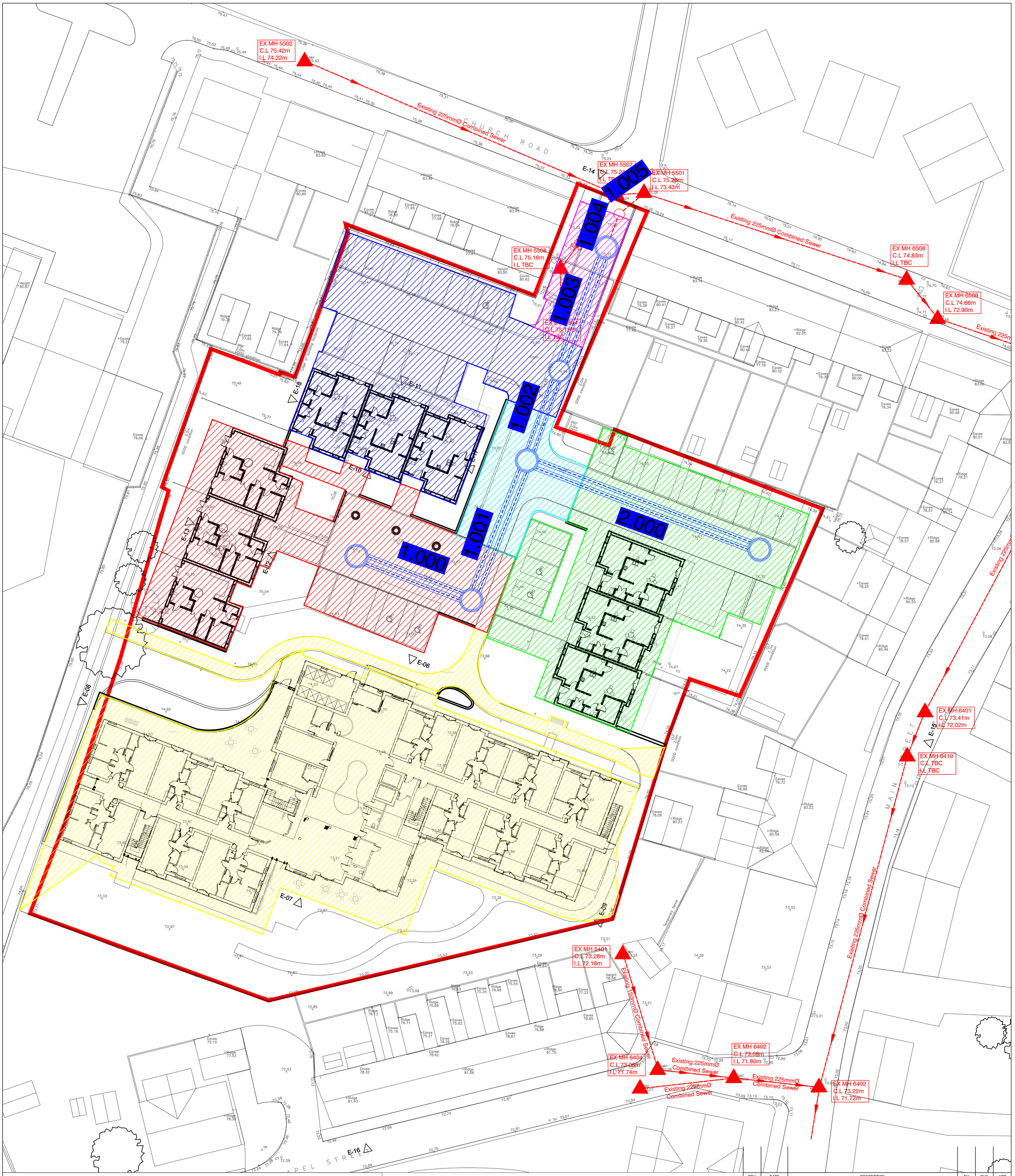

S.W Catchment Table		
Pipe No.	Area (ha)	Hatch
1.000	0.088	
1.001	0.227	
2.000	0.097	
1.002	0.021	
1.003	0.083	
1.004	0.014	
1.005	0.000	
TOTAL	0.530	

REV	DATE	DESCRIPTION	BY	CHK	APP

DRAWING STATUS: **PRELIMINARY**

CLIENT: BIG LOCAL

ARCHITECT: HLP ARCHITECTS

PROJECT: DISTINGTON BIG LOCAL

TITLE: PROPOSED S.W CATCHMENT

STATUS:	PROJECT No.	PROJECT	ORIGINATOR	VOL/SYS	LEVEL	TYPE	ROLE	DRAWING No.	REV:
S2	218-252	DIS	AJP	ZZ	00	DR	C	0002	P01

SCALE @ A1:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:250	JCM	JCM	JLS	JLS	FEB 2020

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Appendix F Hydraulic Calculations

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
S1.000	6.000	0.060	100.0	0.100	4.00	0.600	o	150	Pipe/Conduit
S1.001	12.800	0.128	100.0	0.170	0.00	0.600	o	225	Pipe/Conduit
S1.002	39.000	0.390	100.0	0.000	0.00	0.600	o	225	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
S1.000	1	75.150	73.693	1.307	75.160	73.633	1.377		1200
S1.001	2	75.160	73.558	1.377	75.280	73.430	1.625		1200
S1.002	3	75.280	73.430	1.625	74.830	73.040	1.565		1200

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.250		

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	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.250
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	2	+0%	30/15 Summer				73.804
S1.001	S2	15 Winter	2	+0%	30/15 Summer				73.697
S1.002	S3	15 Winter	2	+0%	30/15 Summer				73.560

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.039	0.000	0.89		13.2	OK	
S1.001	S2	-0.086	0.000	0.69		30.8	OK	
S1.002	S3	-0.095	0.000	0.62		30.7	OK	

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	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.250
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				74.097
S1.001	S2	15 Winter	30	+0%	30/15 Summer				73.978
S1.002	S3	15 Winter	30	+0%	30/15 Summer				73.771

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.254	0.000	1.41		20.9	SURCHARGED	
S1.001	S2	0.195	0.000	1.27		56.9	SURCHARGED	
S1.002	S3	0.116	0.000	1.14		56.2	SURCHARGED	

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	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.250
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+0%	30/15 Summer				74.469
S1.001	S2	15 Winter	100	+0%	30/15 Summer				74.296
S1.002	S3	15 Winter	100	+0%	30/15 Summer				73.996

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.626	0.000	1.69		25.1	SURCHARGED	
S1.001	S2	0.513	0.000	1.52		68.1	SURCHARGED	
S1.002	S3	0.341	0.000	1.37		67.3	SURCHARGED	

Existing Network Details for 218-252 PROPOSED S.W NETWORK.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	17.189	0.043	400.0	0.088	5.00	0.600	oo	-1	Pipe/Conduit
1.001	21.022	0.053	400.0	0.227	0.00	0.600	oo	-1	Pipe/Conduit
2.000	34.817	0.087	400.0	0.097	5.00	0.600	oo	-1	Pipe/Conduit
1.002	13.322	0.033	403.7	0.021	0.00	0.600	oo	-1	Pipe/Conduit
1.003	18.450	0.046	400.0	0.083	0.00	0.600	oo	-1	Pipe/Conduit
1.004	5.000	0.029	172.4	0.014	0.00	0.600	o	225	Pipe/Conduit
1.005	4.556	0.027	170.0	0.000	0.00	0.600	o	225	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	7	75.200	73.661	0.939	75.125	73.618	0.907		2700
1.001	6	75.125	73.618	0.907	75.150	73.565	0.985		2700
2.000	8	75.200	73.652	0.948	75.150	73.565	0.985		2700
1.002	5	75.150	73.565	0.985	75.050	73.532	0.918		3000
1.003	4	75.050	73.532	0.918	75.224	73.486	1.138		2700
1.004	3	75.224	73.486	1.513	75.249	73.457	1.567	Hydro-Brake®	2700
1.005	2	75.249	73.457	1.567	75.272	73.430	1.617		1500

Free Flowing Outfall Details for 218-252 PROPOSED S.W NETWORK.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005	1	75.272	73.430	73.430	1200	0

Simulation Criteria for 218-252 PROPOSED S.W NETWORK.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.251		

Online Controls for 218-252 PROPOSED S.W NETWORK.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.004, Volume (m³): 18.9

Unit Reference	MD-SHE-0100-5000-1350-5000
Design Head (m)	1.350
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	73.486
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	5.0
Flush-Flo™	0.400	5.0
Kick-Flo®	0.829	4.0
Mean Flow over Head Range	-	4.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.3	1.200	4.7	3.000	7.3	7.000	10.9
0.200	4.6	1.400	5.1	3.500	7.8	7.500	11.2
0.300	4.9	1.600	5.4	4.000	8.3	8.000	11.6
0.400	5.0	1.800	5.7	4.500	8.8	8.500	11.9
0.500	5.0	2.000	6.0	5.000	9.2	9.000	12.2
0.600	4.8	2.200	6.3	5.500	9.7	9.500	12.6
0.800	4.2	2.400	6.5	6.000	10.1		
1.000	4.4	2.600	6.8	6.500	10.5		

Storage Structures for 218-252 PROPOSED S.W NETWORK.SWS

Cellular Storage Manhole: 6, DS/PN: 1.001

Invert Level (m) 73.700 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	105.0	0.0	0.500	105.0	0.0
0.100	105.0	0.0	0.600	105.0	0.0
0.200	105.0	0.0	0.700	105.0	0.0
0.300	105.0	0.0	0.800	105.0	0.0
0.400	105.0	0.0	0.810	0.2	0.0

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 74.150 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	300.0	0.0	0.500	0.0	0.0
0.100	300.0	0.0	0.600	0.0	0.0
0.200	300.0	0.0	0.700	0.0	0.0
0.300	300.0	0.0	0.800	0.0	0.0
0.400	300.0	0.0	0.810	0.0	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 218-252 PROPOSED S.W NETWORK.SWS

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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.252
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

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	7	180 Winter	1	+0%	100/60 Winter				73.813
1.001	6	180 Winter	1	+0%	100/60 Summer				73.813
2.000	8	180 Winter	1	+0%	100/60 Winter				73.813
1.002	5	180 Winter	1	+0%	30/240 Winter				73.813
1.003	4	180 Winter	1	+0%	30/180 Winter				73.813
1.004	3	180 Winter	1	+0%	1/15 Summer				73.812
1.005	2	240 Winter	1	+0%					73.519

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	7	-0.448	0.000	0.01		2.4	OK	
1.001	6	-0.405	0.000	0.01		6.1	OK	
2.000	8	-0.439	0.000	0.00		2.7	OK	
1.002	5	-0.352	0.000	0.01		5.9	OK	
1.003	4	-0.319	0.000	0.01		5.7	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 218-252 PROPOSED S.W NETWORK.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.004	3	0.101	0.000	0.17		4.9	SURCHARGED	
1.005	2	-0.162	0.000	0.17		4.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 218-252 PROPOSED S.W NETWORK.SWS

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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.252
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

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	7	360 Winter	30	+0%	100/60 Winter				74.172
1.001	6	360 Winter	30	+0%	100/60 Summer				74.172
2.000	8	360 Winter	30	+0%	100/60 Winter				74.169
1.002	5	360 Winter	30	+0%	30/240 Winter				74.169
1.003	4	360 Winter	30	+0%	30/180 Winter				74.169
1.004	3	360 Winter	30	+0%	1/15 Summer				74.166
1.005	2	960 Summer	30	+0%					73.520

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	7	-0.089	0.000	0.01		3.6	OK	
1.001	6	-0.046	0.000	0.01		5.8	OK	
2.000	8	-0.083	0.000	0.01		4.0	OK	
1.002	5	0.004	0.000	0.02		6.9	SURCHARGED	
1.003	4	0.037	0.000	0.01		6.4	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 218-252 PROPOSED S.W NETWORK.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.004	3	0.455	0.000	0.17		5.0	SURCHARGED	
1.005	2	-0.162	0.000	0.18		5.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 218-252 PROPOSED S.W NETWORK.SWS

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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.252
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

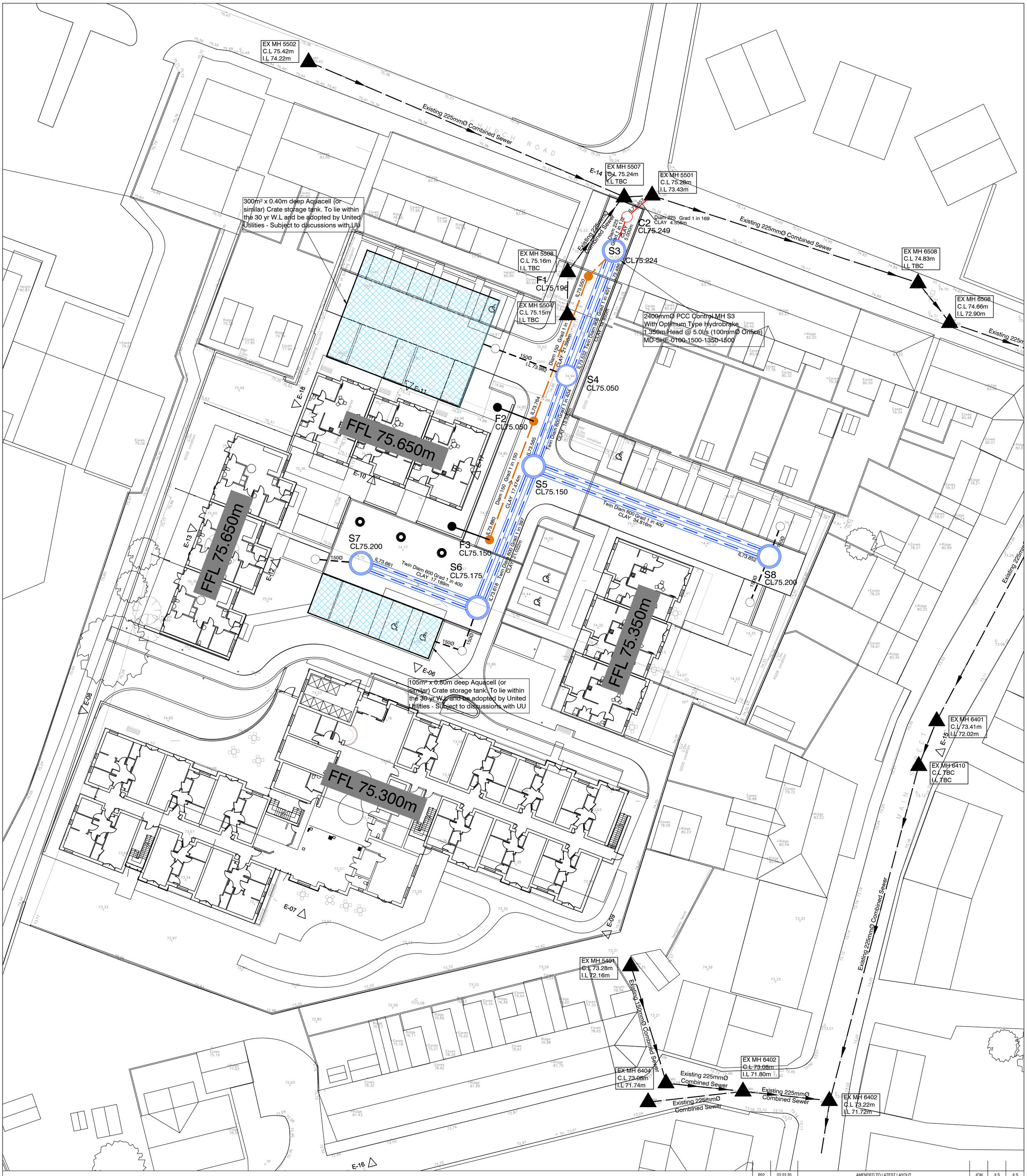
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	7	480 Winter	100	+40%	100/60 Winter				74.605
1.001	6	480 Winter	100	+40%	100/60 Summer				74.605
2.000	8	480 Winter	100	+40%	100/60 Winter				74.605
1.002	5	480 Winter	100	+40%	30/240 Winter				74.605
1.003	4	480 Winter	100	+40%	30/180 Winter				74.604
1.004	3	480 Winter	100	+40%	1/15 Summer				74.614
1.005	2	960 Summer	100	+40%					73.520

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	7	0.344	0.000	0.01		6.1	SURCHARGED	
1.001	6	0.387	0.000	0.04		22.1	SURCHARGED	
2.000	8	0.353	0.000	0.01		6.7	SURCHARGED	
1.002	5	0.440	0.000	0.07		27.4	SURCHARGED	
1.003	4	0.472	0.000	0.02		9.8	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 218-252 PROPOSED S.W NETWORK.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.004	3	0.903	0.000	0.17		5.0	SURCHARGED	
1.005	2	-0.162	0.000	0.18		5.0	OK	

Appendix G Outline Drainage Strategy Drawing



GENERAL NOTES

1. SETTING OUT SHALL BE UNDERTAKEN USING ONLY THE INFORMATION GIVEN. DISTANCES SHOULD NOT BE SCALED FROM THIS DRAWING.
2. ALL SEWERS SHALL BE CONSTRUCTED IN ACCORDANCE WITH SEWERS FOR ADOPTION 6TH EDITION AND UNITED UTILITIES DETAILS & GUIDELINES.
3. THE MINIMUM GRAVITY PIPE DIAMETER UNDER ADOPTABLE HIGHWAYS SHALL BE 150MM
4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY ALL INFORMATION GIVEN WITH REGARDS TO EXISTING SERVICES AND DRAINAGE CONNECTIONS ETC. PRIOR TO COMMENCING THE WORKS. THE RATES SHALL INCLUDE FOR HAND DIG AROUND SERVICES WHERE NECESSARY. THE CONTRACTOR SHALL ADHERE TO THE CDM REGULATIONS AT ALL TIMES
5. THE OUTSIDES OF ALL SEWERS SHALL BE A MINIMUM OF 1.0M FROM KERB LINES AND THE OUTSIDE OF MANHOLES SHALL BE A MINIMUM OF 0.5M FROM KERB LINES
6. EXISTING FLOWS IN WATERCOURSES, SEWERS AND LAND DRAINS SHALL BE MAINTAINED AT ALL TIMES 7. ONLY TRAINED PERSONNEL SHALL BE PERMITTED TO ENTER CONFINED SPACES
7. ALL MATERIALS TO BEAR THE RELEVANT B.S. KITEMARK AND COMPLY FULLY WITH THE SPECIFICATIONS. ALL CONCRETE & CONCRETE PRODUCTS MUST USE SULPHATE RESISTANT CEMENT (UNLESS THE SITE INVESTIGATION REPORT PROVES THAT SULPHATE ATTACK FROM SOILS AND GROUNDWATER WILL NOT OCCUR TO WITHSTAND A CLASS
8. ALL OPENING NOTICES ETC. AS REQUIRED UNDER HIGHWAYS ACTS ETC. ARE TO BE OBTAINED PRIOR TO COMMENCEMENT OF WORKS. ALL WORKS ARE TO BE INSPECTED BY L.A., NHBC OR THE NETWORK OPERATOR AS APPLICABLE.
9. WHERE "ULTRA RIB" UPVC PIPES (OR SIMILAR APPROVED) ARE USED IN ADOPTABLE DRAINAGE THEY SHALL STILL BE HANDLED AND LAID IN ACCORDANCE WITH THE SPECIFICATION AND GUIDANCE ISSUED BY THE HIGH PERFORMANCE PIPE ASSOCIATION.
10. A CLASS S BED AND SURROUND MUST BE USED FOR SUCH PIPES. TRENCH BACKFILL IN HIGHWAYS TO WITHIN 1M OF HIGHWAY SHALL, AS DIRECTED BY THE HIGHWAY AUTHORITY BE A SUITABLE GRANULAR MATERIAL ALL IN ACCORDANCE WITH SEWERS FOR ADOPTION CL. 4.3.4. 12. SLAB LEVELS SHALL NOT BE VARIED WITHOUT REFERENCE TO THE ENGINEER FOR GUIDANCE
11. DOMESTIC DRAINAGE SHALL BE TO BUILDING REGULATIONS APPROVED DOCUMENT H. 110MM U.P.V.C. PIPES LAID TO THE FOLLOWING MINIMUM FALLS UNLESS OTHERWISE SHOWN.

	FOUL	S.W.
HEAD RUN	1 IN 40	1 IN 60
ELSEWHERE	1 IN 80	1 IN 100

12. POLYPROPYLENE INSPECTION CHAMBERS TO BE PROVIDED TO ALL PRIVATE DRAINAGE LESS THAN 1.10m DEEP. WHERE PRIVATE DRAINAGE RUNS ARE DEEPER THAN 1.10m, REDUCED ACCESS CHAMBERS TO BE PROVIDED.
13. WHEREVER PLASTIC PIPES ARE TO BE USED FOR THE CONSTRUCTION OF ADOPTABLE DRAINAGE, STRUCTURED WALL PLASTIC PIPES MUST BE USED WHICH MUST COMPLY WITH BS EN 13476-1 AND WIS 4-35-01

LEGEND

- PROPOSED SURFACE WATER SEWER MANHOLE
- PROPOSED FOUL WATER SEWER MANHOLE
- PROPOSED COMBINED WATER SEWER MANHOLE
- EXISTING SURFACE WATER MANHOLE
- EXISTING COMBINED WATER MANHOLE
- PROPOSED FOUL 1050MMØ PCC DRAG OUT MH (TO BE AGREED WITH UU FIELD INSPECTOR)
- PROPOSED SURFACE WATER 1050MMØ PCC DRAG OUT MH (TO BE AGREED WITH UU FIELD INSPECTOR)
- PROPOSED FOUL WATER SEWER
- PROPOSED SURFACE WATER SEWER
- PROPOSED COMBINED SEWER
- PROPOSED SURFACE WATER DRAIN WITH 450mmØ INSPECTION CHAMBER
- PROPOSED FOUL WATER DRAIN WITH 450mmØ INSPECTION CHAMBER
- HIGHWAY GULLY
- 53.000 FINISHED FLOOR LEVEL
- ACO CHANNEL (OR SIMILAR)

S.W DRAINAGE STRATEGY PRELIMINARY SUBJECT TO ACCEPTANCE BY UNITED UTILITIES OF DISCHARGE RATES & OUTFALL LOCATION - SYSTEM BASED ON 5l/S FOR 1 IN 100 YR RETURN PERIOD + 40% CLIMATE CHANGE

REV	DATE	DESCRIPTION	BY	CHK	APP
P02	02.03.20	AMENDED TO LATEST LAYOUT	JCM	JLS	JLS
P01	09.12.19	INITIAL ISSUE	JCM	JLS	JLS

DRAWING STATUS: **PRELIMINARY**

CLIENT: BIG LOCAL

ARCHITECT: HLP ARCHITECTS

PROJECT: DISTINGTON BIG LOCAL

TITLE: OUTLINE DRAINAGE PLAN

STATUS:	PROJECT No.	PROJECT	ORIGINATOR	VOL/SYS	LEVEL	TYPE	ROLE	DRAWING No.	REV:
S2	218-252	DIS	AJP	ZZ	00	DR	C	1000	P02

SCALE @ A1:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:250	JCM	JCM	JLS	JLS	DEC 2019

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Appendix H United Utilities Sewer Records & Correspondence

Distington

Church (remains of)

Church of the Holy Spirit

Library

The Hawthorns

Rectory

Disington Community School

CHURCH ROAD

CHAPEL STREET

MAIN STREET

Club

Hall

Fell View

Kilnside Bungalow

MIDTOWN CL

Bannerdale

Victoria Bungalow

Cherry Garth

Wynnedene

Greentops

Vistamar

Whiteside

Osborne Ho

PO

Church

Fell View

Twin Elms

Fontaine

Ghyll Brae

The Old School

El Sub Sta

Posts

4601 5601 5502 5507 5501 6508 6501 5509 5503 5510 5508 5504 6504 5505 5506 6505 6507 6506 6502 73.6m 7605 6401 6410 6409 6408 6411 6407 5401 5402 5403 6404 6412 6403 6402 6406 6405 6413 6308

225 VC 150 VC 100 VC

REV	DATE	DESCRIPTION	BY	APP

SCALE @ A3:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:1000	JCM	JCM	JLS	JLS	FEB 2020

PROJECT: DISTINGTON - BIG LOCAL

TITLE: UNITED UTILITIES SEWER RECORDS

STATUS:	PROJECT No:	DRAWING No:	REV:
S2	218-252	**APP H**	.

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Appendix I Phase II SI Executive Summary

GEO Environmental Engineering

PHASE 2: GROUND INVESTIGATION REPORT

PROPOSED RESIDENTIAL DEVELOPMENT

BRITISH LEGION SITE, CHURCH ROAD

DISTINGTON, CUMBRIA

FOR:

DISTINGTON BIG LOCAL

GEO Environmental Engineering

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DOCUMENT CONTROL SHEET

Report Ref:	2019-4032
Report Date:	31.01.2020
Report Type:	PRELIMINARY DRAFT - Ground Investigation Report (GIR)
Report Tracking:	06.02.2020 – Preliminary Draft Report Issued
Prepared By:	James Brock *BSc. MSc.* – Geo Environmental Engineer/Associate
Author Signature:	
Checked By:	Curtis Evans *B.Sc. (Hons), FGS* – Geo Environmental Engineer/Director
Client Title:	Distington Big Local
Consultant:	~

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Appendix I:	Site Location Plan Exploratory Hole Location Plan Proposed Sita Layout Plan
Appendix II:	Exploratory Hole Logs DCP Calculation Sheets Ground Gas Monitoring Sheets
Appendix III:	Laboratory Test Results
Appendix IV:	GEO Contaminant Analysis Sheets

1.0 Introduction

1.1 Brief

GEO Environmental Engineering Ltd (GEO) were commissioned by Distington Big Local, herein referred to as the "Client", to carry out a ground investigation on land off Church Road in Distington near Workington in Cumbria as indicated on the site location plan included in appendix I. The site was formerly used by the British Legion.

The investigation was carried out to determine ground conditions across the site to aid the design of foundations, roads and drainage and to assess the risk to human health and environmental receptors from possible contamination and ground gas.

1.2 Site Location and Description

The site, occupying an area of c.0.74ha is located in the central part of Distington, c.5km south east of Workington town centre in Cumbria as indicated on the site location plan included in Appendix I. Access to the site is from Church Road to the north.

- National Grid Reference: 300565, 523506
- Post Code: CA14 5TG (approximate only)

It is understood that the site was previously used by the British Legion, however, the former building in the north of the site has been demolished and the land cleared. The northern part of the site comprises a former car park and evidence of the former building (concrete floor slabs). Elsewhere, the land is surfaced with grass which was noted as particularly soft underfoot in places.

There was no evidence of any significant contamination sources noted on the site during the walkover.

Overall, the site appears generally level with no retaining structures and only minor undulations. Topographical survey data has been provided by the Client which indicates that the lowest part is in the south west at c.72.8m AOD, rising gradually to 75.4m AOD in the north west.

Existing residential properties and private gardens are present to the north, south and east. A primary school is present to the west.

1.3 Proposed Development

It is understood that the site will be developed for residential end use. A proposed site layout has been provided by the Client and a copy is included in Appendix I. The plan indicates that the development will comprise 9 No. bungalows and 39 No. apartments as well as private gardens, communal soft landscaping, access roads, car parking and other associated infrastructure. It is also understood that the Client is considering the use of a soak-away drainage system should the ground conditions prove suitable. Further details relating to the proposed development should be obtained from the Consultant.

1.4 Other Reports/Studies

GEO completed a Phase 1: Desk Top Study (DTS) Report, details of which are included below:

- Phase I Desk Top Study (Preliminary Environmental Risk Assessment), ref: 2019-4032, dated: 31.01.2020.

It is recommended that the DTS is read in conjunction with this report.

2.0 Ground Investigation Report

2.1 Ground Investigation Aims and Objectives

The overall objective of this Ground Investigation is to provide information relating to the geotechnical and environmental properties of the ground and groundwater across the development area in order to facilitate foundation and drainage design and determine any risks to human health or the surrounding environment.

2.2 Guidelines, Codes of Practice and Third Part Accreditations

This report contains information relating to the geotechnical properties of the soils encountered on site to aid foundation and highway design by a Structural Engineer. The report also incorporates a Level 1 Ground Contamination and Ground Gas Risk Assessment for Human Health (Generic Quantitative Risk Assessment – GQRA).

The laboratory testing (geotechnical and chemical) was completed by UKAS and MCERTS accredited laboratories with details given in Sections 6, with copies of the test reports contained within Appendix III.

This Ground Investigation Report has generally been completed in accordance with the following documents:

- CLR11: Model Procedures for the Management of Land Contamination. DEFRA/EA, 2004.
- BS10175: 2011: Code of Practice for the Investigation of Potentially Contaminated Sites.
- BS5930: 2015: Code of Practice for Site Investigations.
- BS1377: 1990: Methods of test for soils for civil engineering purposes.
- BS8485: 2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- BS8576: 2013: Guidance on Ground Gas Investigations.
- CIRIA Report C665: 2015.
- Eurocode 7 – Geotechnical Design (Part 1: General Rules and; Part 2: Ground Investigation and Testing).
- UK Specification for Ground Investigation, 2nd Edition. Site Investigation Steering Group, 2011.
- Effective Site Investigation. Site Investigation Steering Group, 2013.
- SP1010 Development of Category 4 Screening Levels Main Report, 2014.
- The LQM/CIEH S4UL's for Human Health Risk Assessment, 2015.

2.3 Ground Investigation Limitations of Use

Although every effort is made to ensure a full and comprehensive investigation has been completed, it should always be borne in mind that ground conditions have the potential to vary between exploratory hole locations and it is recommended that a prudent developer adopt a "watching brief" during the redevelopment works, to ensure that any potential variations encountered are identified and dealt with in an appropriate manner.

In addition, this Ground Investigation Report and its contents are limited to the boundaries of the site, as indicated on the Plans in Appendix I. No reliance, copying or use of this report (in part or whole) by any Third Party is permitted without prior written approval from Geo Environmental Engineering Ltd, with intellectual copyright remaining the sole property of the author. Reliance on the report and its associated information is strictly in accordance with Geo Environmental Engineering Ltd Terms and Conditions, copies of which are available on request.

2.4 Consideration for Residential End Use

It is understood that the site will be developed for residential end use with houses, gardens, car parking, access roads, and other associated infrastructure. Consequently, when considering the intended development, the site is considered suitable for assessment using a Level 1 Generic Quantitative Risk Assessment (GQRA).

A GQRA provides details of potential future risks to Human Health (proposed end users) from any contamination which may be identified on site in made ground or natural soils. For the Human Health Risk Assessment, it is considered that the future residents will be subjected to the greatest exposure periods and consequently the most risk. Therefore, in accordance with current guidance and legislation a CLEA end use classification of *residential* has been considered most appropriate.

3.0 Ground Investigation Fieldwork

3.1 Intrusive Investigation Fieldworks Summary

The ground investigation works were completed during December 2019. The exploratory holes were located across the site to provide general site coverage taking into consideration the locations of buried utilities and surface obstructions.

The exploratory hole location plan is provided in Appendix I.

The ground investigation works comprised:

- 3 No. Dynamic (Windowless) Sampling Boreholes (BH01 to BH03) to depths of between c.0.95m and c.4.00m bgl.
- 9 No. Mechanically Excavated Trial Pits (TP01 to TP09) to depths of between c.1.50m and c.1.80m bgl.
- Gas and groundwater monitoring (3 visits completed to date).
- 3 No. In-situ ground Infiltration Tests (soak away tests).
- 3 No. In-Situ Dynamic Cone Penetrometer (DCP) Tests.
- In-situ geotechnical testing (Hand Shear Vane Tests and Standard Penetration Tests - SPTs).
- Site supervision by a suitably qualified and experienced Geo-Environmental Engineer.
- Laboratory based geotechnical testing.
- Laboratory chemical screening of soil samples.
- Level 1 Generic Quantitative Risk Assessment (GQRA) to determine potential ground contamination and ground gas risks to the proposed end users.

The investigation fieldworks were undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II).

At each exploratory hole location, the surfacing type, made ground, natural ground and groundwater conditions were observed, with in-situ testing undertaken and samples recovered. Details of the ground conditions are included on the exploratory hole logs which are included in Appendix II together with other relevant ground investigation data (Gas and Groundwater Monitoring results).

The results of the in-situ SPT tests are presented on the borehole logs included in Appendix II.

The results of the in-situ hand shear vane tests are presented on the trial pit logs which are included in Appendix II.

The results of the Dynamic Cone Penetrometer (DCP) tests and the calculated CBR values are presented in Appendix II.

The results of the geotechnical and chemical laboratory results are provided in Appendix III.

All depths included in the report are in metres below ground level (m bgl), unless stated otherwise.

4.0 Ground and Groundwater Conditions

4.1 General

The following section provides a summary of the ground conditions encountered across the site during the investigation. Reference should be made to the exploratory hole logs included in Appendix II for detailed descriptions of the strata and groundwater conditions.

4.1.2 Made Ground and Topsoil

Made ground was encountered across the site to depths of between c.0.37m and c.0.75m bgl. The made ground was predominantly encountered across the northern part of the site associated with the area of hardstand and the former building, however, sporadic areas of ashy loam (topsoil) were encountered sporadically across the area of soft landscaping, possible associated with the former allotments. Elsewhere, topsoil was encountered to depths of between c.0.26m and c.0.37m bgl. Further details are included below:

Exploratory holes located within the former car park (TP03 and TP09) encountered asphalt (0.08m thick) overlying angular gravel of aggregate, slag and concrete over relict (buried) topsoil to depths of between c.0.48m and c.0.68m bgl.

Exploratory holes within the vicinity of the former building (BH03, TP04 and TP05) encountered made ground to depths of between c.0.40m and c.0.75m bgl. This comprised gravelly loam with occasional mixed aggregate, brick, concrete and timber over a granular layer of mixed aggregate, brick, concrete and slate. Occasional relict (buried) topsoil was also encountered. Trial pit TP05 was located adjacent to a concrete slab which was present to a depth of c.0.60m bgl.

Exploratory holes located across the area of soft landscaping (TP01, 02, 06, 07, 08, BH01 and BH02) encountered sporadic made ground comprising gravelly loam with occasional glass, plastic, concrete, asphalt, clinker, wire and timber, possibly associated with the historical land use (allotment gardens) and previous site activities. The loamy made ground occasionally appeared similar to the topsoil (TP08), however, the presence of occasional asphalt and clinker indicated that it is not from a natural source.

Topsoil was encountered to depths of between c.0.33m and c.0.40m bgl and comprised dark grey brown sandy gravelly loam with occasional rare fragments of glass.

The made ground materials did not appear suitable for re-use within a private garden, however, consideration could be given to re-using the suitable granular fraction beneath roads, hardstand and buildings where it will not pose a risk to human health.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) or any landfill type waste such as potentially biodegradable, decomposable or putrescible materials.

4.1.3 Natural Drift Deposits

Natural drift deposits were encountered directly beneath the topsoil and made ground in all of the exploratory holes. The drift deposits typically comprised firm, firm to stiff and stiff brown silty, sandy, very gravelly clay with occasional lenses/pockets of sand. This was proved to a maximum depth of c.3.0m bgl. Occasional soft to firm clay was encountered at shallow depth (less than 1m bgl). Occasional boulders were also noted.

Hand shear vane tests were carried out where feasible and safe to do so in the trial pits to confirm field descriptions and aid foundation design. The tests were completed at depths of between c.0.50m and c.1.60m bgl and gave undrained shear strengths of between 60kN/m2 and 100kN/m^2 (typically between 70kN/m^2 and 80kN/m^2), indicative of clays of medium and high strength.

In-situ Standard Penetration Tests (SPTs) were completed in boreholes BH01 and BH02 at depths of between c.1.00m and c.4.00m bgl. The tests gave 'N' values of between 12 and 42, indicative of clays of medium to very high strength. SPT N values of in excess of 50 were recorded at the base of boreholes BH01 and BH02 indicating refusal (further penetration not possible, probably due to encountering a large cobble of boulder).

4.1.4 Solid Geological Deposits (Bedrock)

Solid strata/bedrock was not encountered during the ground investigation.

4.2 Groundwater

During the intrusive ground investigation works, occasional slight seepages of groundwater were encountered in the trial pits at depths of between c.0.30m and c.1.60m bgl. The ingress appeared to be associated with perched (trapped) water rather than a continuous shallow groundwater table. The boreholes were all noted as dry, however, the drilling process can mask slight groundwater ingress.

Groundwater monitoring of installations placed in the boreholes has been carried out on 3 No. occasions between December 2019 and January 2020. Standing groundwater levels have been recorded between c.0.54m and c.1.07m bgl. Given the ground conditions (stiff clay), it is likely that the water has resulted from surface ingress which has been trapped/perched within the boreholes rather than a continuous groundwater table.

Based on the results of the ground investigation, significant groundwater ingress is not anticipated. However, it is recommended that allowance be made for some groundwater control measures (i.e. pumping equipment) particularly during wetter periods of the year, as the materials encountered may deteriorate following exposure to surface water.

5.0 Exploratory Hole Testing

In-situ site testing and monitoring was generally undertaken in accordance with BS5930:1999, BS1377:1990 and Eurocode 7 (Part I and II).

5.1 Standard Penetration Tests

5.1.1 Standard Penetration Test Methodology

To determine the relative density and strength of the underlying soils, Standard Penetration Tests (SPT's) were completed within the boreholes. The test uses a "split spoon" sample tube (external diameter of c.50mm, internal diameter of c.35mm and a length of around c.650mm) driven from the base of the borehole as it is progressed, usually at c.1.00m spacing's/intervals.

The sample tube is driven by blows of a slide hammer with a weight of c.63.5kg falling over a c.760mm drop. The sample tube is driven c.150mm into the ground (seating blows) and then the number of blows needed for the tube to penetrate each c.75mm increment up to a depth of c.450mm is recorded.

The number of blows for the final c.300mm of penetration is referred to as the "standard penetration resistance" or "N" value, which are presented on the exploratory hole logs adjacent to each sample depth. Where 50 blows are insufficient to advance the test through a c.75mm interval the amount of penetration after 50 blows is recorded and the test is referred to as a "refusal".

5.1.2 Standard Penetration Test Results

In-situ Standard Penetration Tests (SPTs) were completed in boreholes BH01 and BH02 at depths of between c.1.00m and c.4.00m bgl. The tests gave 'N' values of between 12 and 42, indicative of clays of medium to very high strength. SPT N values of in excess of 50 were recorded at the base of boreholes BH01 and BH02 indicating refusal (further penetration not possible, probably due to encountering a large cobble of boulder).

The results of the standard penetration tests are presented on the borehole logs which are included in Appendix II.

5.2 Hand Shear Vane Tests

Hand shear vane tests were carried out where feasible and safe to do so in the trial pits to confirm field descriptions and aid foundation design. The tests were completed at depths of between c.0.50m and c.1.60m bgl and gave undrained shear strengths of between 60kN/m2 and 100kN/m2 (typically between 70kN/m2 and 80kN/m2), indicative of clays of medium and high strength.

The results of the hand shear vane tests are presented on the trial pit logs which are included in Appendix II.

5.3 Dynamic Cone Penetrometer Tests (DCP)

The Dynamic Cone Penetration (DCP) Test provides a measure of a material's in-situ resistance to penetration. The test is performed by driving a metal cone into the ground by repeated striking it with an 8kg weight dropped from a distance of 575 mm. The penetration of the cone is measured after each blow and is recorded to provide a continuous measure of shearing resistance up to c.0.85m below the ground surface. Test results can be correlated to California Bearing Ratio to aid pavement design by a Civil Engineer.

The results of the Dynamic Cone Penetrometer tests and the calculations of the equivalent CBR values are included in Appendix II (Dynamic Cone Penetrometer Calculation Sheet).

It should be borne in mind that the results of the Dynamic Cone Penetrometer tests can be influenced by the coarse content (gravel, cobbles, etc…) within the materials tested, therefore, it is always recommended that the appropriate CBR value is confirmed by way of plate load testing at formation level.

5.4 Ground Permeability Analysis

It is understood that the Client is considering using soak-away style drainage (Sustainable Drainage System - SUDs) as part of the proposed development.

In order to facilitate the soak-away design, soil infiltration tests were completed in trial pits TP01 to TP03. The tests involved excavating a trial pit to the appropriate depth (c.1.50m to c.1.70m bgl) and partially filling with water. The water level was monitored at regular intervals.

During the test, the water level either remained static or rose within the pit, possibly due to the shallow groundwater ingress. The tests were terminated after a maximum duration of 240 minutes (4 hours). Based on the results of the tests, the ground conditions are not considered suitable for soak-away drainage.

5.5 Ground Gas Monitoring

To assess the on-site potential for hazardous ground gases (carbon dioxide and methane), the boreholes (BH01 to BH03) were installed with ground gas monitoring wells to facilitate a period of ground gas monitoring.

The boreholes were installed to depths of between c.0.95m and c.4.00m bgl with a 50mm diameter HDPE standpipe with a bentonite seal for the upper section and a gravel surround for the remainder of the pipe, finished with a plastic end cap and rubber gas bung. The installation details presented on each borehole log in Appendix II.

The monitoring and assessment has been completed in accordance with BS8485: 2007: Code of practice for the characterisation and remediation from ground gas affected developments, CIRIA Report C665, November 2007 and the NHBC Document; Guidance on the evaluation of development proposals on site where methane and carbon dioxide are present, March 2007.

As it is the intention of the Client to develop the site for Residential end use, the monitoring of ground gas monitoring must comprise at least 6 No. site visits over a minimum period of 3 No. months.

To date, the wells have been monitored on 3 No. occasions between the 17th December 2019 and 15th January 2020, in general accordance with CIRIA C665 (Table 5.5a and 5.5b) using a GA2000 Ground Gas Analyser with external flow pod.

The results of monitoring are included on the Ground Gas Monitoring Record Sheets included in Appendix II. The ground gas risk assessment is presented in Section 8.5 of this report.

3 No. additional gas monitoring visits are planned.

6.0 Laboratory Testing

6.1 Geotechnical Testing

Geotechnical testing was completed in general accordance with BS1377:1990: Part 1 to 4 by the following UKAS and MCERTS accredited laboratory:

- Professional Soil Laboratories (PSL) of Doncaster, Yorkshire.

Samples of the natural drift deposits recovered from the exploratory holes at depths of between c.1.00m and c.1.50m bgl were subjected to tests to determine the moisture content and liquid and plastic Limits.

6.2 Chemical Screening

6.2.1 Determination of pH and Water-Soluble Sulphate

In order to determine the correct concrete classification for buried structures (foundations), laboratory testing was undertaken for pH and water-soluble sulphate (SO_4) on the following samples:

- 3 No. samples of topsoil (0.20m bgl)
- 5 No. samples of made ground (c.0.10m to c.0.30m bgl)
- 3 No. samples of natural drift deposits (c.1.00m to c.1.50m bgl)

The testing was completed in general accordance with BS1377:1990: Part 1 to 4 by the following UKAS and MCERTS accredited laboratory:

- Chemtech Environmental Testing of Stanley, County Durham.
- Derwentside Environmental Testing Services Limited (DETS) of Consett, County Durham.

The results of the testing are summarised in section 10 and presented in the Chemtech report (ref: 83238) and DETS report (20-00214), contained in Appendix III.

6.2.2 Contamination Testing for Human Health

To enable the completion of a Level 1 Generic Quantitative Risk Assessment (GQRA) for Human Health, the following samples were scheduled for chemical laboratory screening:

- 3 No. samples of topsoil (0.20m bgl)
- 5 No. samples of made ground (c.0.10m to c.0.30m bgl)

The samples were subjected to analysis at Chemtech Environmental Testing of Stanley, County Durham which is UKAS and MCERTS accredited.

Potential Contaminants of Concern (PCOC's) have been determined for the development area based on the descriptions of the materials encountered within the exploratory holes as indicated below:

- **Inorganic Soil Suite (Human Health Risk Assessment):** Metal and Metalloids, Cyanide, Asbestos and Total Organic Carbon.
- **Organic Soil Suite (Human Health Risk Assessment):** Speciated Polycyclic Aromatic Hydrocarbons (PAH – USEPA 16).

The full catalogue of soil screening results and test detection limits can be seen in the Chemtech report (ref: 83238) contained in Appendix III.

7.0 Geotechnical Analysis

7.1 Testing for Moisture Content, Liquid and Plastic Limits

3 No. samples of the natural clay deposits recovered from the exploratory holes at depths of between c.1.00m and c.1.50m bgl were scheduled for classification tests to determine their moisture content, liquid and plastic limits. The results of the testing are contained in the PSL report (ref: PSL19/7765) presented in Appendix III and summarised below.

Natural moisture contents of 14% and 22% were observed with liquid limits between 36% and 47% and plasticity indices of between 19% and 26% being recorded. The results indicate clays of intermediate plasticity and a medium volume change potential.

8.0 Generic Quantitative Risk Assessment (GQRA)

8.1 Methodology for Assessing Risks to Human Health

Within the UK, the current framework for assessing potential ground contamination is utilising the Contaminated Land Exposure Assessment (CLEA) model as set out by the Department of the Environment, Farming and Rural Affairs (DEFRA). This comprises the established pollutant linkage model of *Source – Pathway – Receptor*. For a risk to be present to the proposed end user (*Receptor*) there must be an identified *Source* and a plausible *Pathway*. Where one or more of the links are missing then risk is negated. In order for the land to be classified as contaminated under Part IIa of the Environmental Protection Act (EPA) 1990 all three elements of the pollutant linkage must be present.

A human health risk assessment can completed using the contamination levels recorded in the soils by comparing the values against published Generic Assessment Criteria (GAC), such as CLEA Soil Guideline Values (SGV's), Category 4 Screening Levels (C4SLs), Land Quality Management (LQM), Chartered Institute of Environmental Health (CIEH) S4UL Values and Atkins ATRISK^{SOIL} Soil Screening Values (SSV's). The guidelines are generally based on three main land uses as outlined below:

- *Residential (with or without plant uptake)*
- *Allotments*
- *Commercial*

Where these land uses are not deemed appropriate, other land use values can be considered with the DEFRA C4SLs, LQM S4UL's values and the ATRISK^{SOIL} SSV's (i.e. parks/playing fields/Public Open Space). Alternatively, it is possible to determine site specific intervention values as part of a Detailed Quantitative Risk Assessment (DQRA).

It is anticipated that the proposed development will incorporate a residential development with private gardens and areas of communal soft landscaping. Therefore, for the purposes of this basic Human Health ground contamination risk assessment, the maximum site recorded values for the soil samples have been compared to GAC for a CLEA end use classification of: *Residential with plant uptake end use* to determine if a potential risk is present to the proposed end users.

Contaminant Analysis Sheets that include the results of the relevant Human Health Risk Assessment and the Generic Assessment Criteria (GAC) values are presented in Appendix IV.

8.2 Human Health Risk Assessment – Comparison with Guidance Levels

8.2.1 Generic Contaminants – Soil

The maximum concentration values for each inorganic analyte have been compared to the most relevant published Generic Assessment Criteria (GAC) as part of the Maximum Value Test. The GAC have been selected using the following guidance documents:

- LQM CIEH S4UL 2014 (Residential with Plant Uptake End Use).
- Category 4 Screening Levels C4SL (Residential with Plant Uptake End Use).
- Atkins ATRISK Soil Screening Values (Residential with Plant Uptake End Use)

As discussed in section 8.1, the contaminant concentrations have been assessed against GAC for a residential with plant uptake end use as it is anticipated that the proposed development will incorporate private gardens and areas of communal soft landscaping.

Based on the results of the contaminant analysis sheet contained in Appendix IV none of the inorganic contaminant concentrations exceed the assessment criteria and as such do not pose a risk to human health.

In addition, phytotoxic elements (copper, nickel and zinc) are within the acceptable limits for topsoil (BS3882: Specification for Topsoil, 2015).

8.4.2 Organic Contaminants – Soil

The maximum concentration values for the organic analytes tested for (i.e. Speciated PAH) have been compared to the most relevant and appropriate published generic assessment criteria (GAC) as part of the Maximum Value Test. The GAC have been selected using the following guidance documents:

- LQM CIEH S4UL 2014 (Residential with Plant Uptake End Use).

Taking in to account the average TOC of the soils on the site, this assessment has been completed utilising a 2.5% SOM.

Based on the results of the contaminant analysis sheet contained in Appendix IV it can be seen that elevated concentrations of PAH compounds have been identified in the made ground at three locations (TP03, TP07 and TP08). The made ground at these locations comprised angular gravel of aggregate, slag concrete and occasional asphalt (TP03), sandy gravelly loam with occasional mixed aggregate, brick concrete and timber adjacent to the former building (TP05) and dark grey to black sandy gravelly loam with occasional glass, clicker and asphalt (TP08).

The elevated PAH compounds included banzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(123cd)pyrene and dibenz(ah)anthracene. It is likely that the presence of anthropogenic material including ash, clinker, asphalt present within the made ground materials will have resulted in the elevated PAH concentrations.

As such, the made ground materials are not considered suitable for re-use in a private garden due to the risk to human health (residents). However, the granular material may be suitable for re-use beneath areas of proposed hardstanding such as roads and pavements or buildings where it will not pose a risk to human health as the pathway will be broken.

This is discussed further in Section 10.3

8.4.3 Asbestos Containing Materials (ACM's) – Soil

8No. samples of the topsoil and made ground have been subjected to laboratory microscopic analysis to determine the presence or not of Asbestos Containing Materials (ACM's) in accordance with the methodology within HSG 248.

Of the samples tested, all returned a negative result for ACM's and were recorded as NAD (no asbestos detected), i.e. no asbestos was encountered.

8.4.4 Human Health Risk Assessment – Summary

The following is a summary of the Human Health risk assessment based on a *Residential End Use with Consumption of Home Produce*:

- **Generic Contamination:** None.
- **Organic Contamination:** Elevated PAH recorded in the made ground samples.
- **Other Contamination:** None.

Based on the Human Health risk assessment above, elevated concentrations of PAH compounds have been identified in the made ground which could potentially pose a risk to human health. As such it is recommended that further risk assessment (Detailed Quantitative Risk Assessment – DQRA), remediation or protection measures should be considered where private gardens and soft landscaping are planned to ensure the future suitability of the site for proposed residential development.

No elevated contaminants were recorded within the samples of topsoil which appeared suitable for re-use during the intrusive site works. Furthermore, phytotoxic elements (copper, nickel and zinc) are within the acceptable limits for topsoil (BS3882: Specification for Topsoil, 2015). As such, the topsoil materials noted on site are considered suitable for re use in a residential context in accordance with BS3882: Specification for Topsoil, 2015. The topsoil should be carefully screened and inspected as localised areas of made ground were noted within the topsoil.

The contamination assessment and consideration for possible remedial options is discussed in Section 10.3.

8.5 Ground Gas Risk Assessment

As indicated in section 5.5, gas and groundwater monitoring wells have been installed in all three boreholes (BH01 to BH03) and monitoring has been completed on 3 No. occasions, primarily for carbon dioxide and methane.

During the monitoring, atmospheric air pressures varied between 990mb and 1018mb and included both rising and falling pressure trends.

A maximum Carbon Dioxide (CO_2) concentration of 2.8%v/v has been recorded. No Methane (CH_4) was detected and flow rates were generally low, reaching a maximum value of 0.5l/h on one occasion, probably due to pressure equalisation as opposed to a continuous steady flow. The minimum Oxygen (O_2) concentration was 16.6%.

In accordance with CIRIA C665 the maximum recorded CO_2 concentration has been converted to a Gas Screening Value (GSV), summarised as follows.

In this instance, the CO_2 GSV is:

- **CO_2 GSV = (Max CO_2 (%) / 100) x Max Flow (l/hr),**

- **Therefore; (2.8 / 100) x 0.5 = 0.0014 l/hr GSV**

Since no Methane have been detected a GSV cannot be formulated.

Therefore, in accordance with CIRIA C665 Table 8.5, taking into consideration the GSV for CO_2 and the maximum gas concentrations, the site falls into Characteristic Situation 1 (CS1) or the Green Classification when utilising the NHBC Characterisation System. This indicates that gas precautions are not necessary at this stage.

However, 3 No. additional gas monitoring visits are planned, therefore the recommendations included above are preliminary and subject to change depending on the results of the remaining gas monitoring. Upon completion of the monitoring, this report will be revised to reflect the full set of gas monitoring results.

The development site is currently identified as being located within a Radon Affected Area as defined by the Health Protection Agency (HPA), as between 10% and 30% of properties are above the Action Level. Consequently, in accordance with BR211, full radon protection measures are necessary within the proposed structures.

8.6 Determination of pH and Water-Soluble Sulphate

As indicated in Section 6, selected samples of topsoil, made ground and the natural drift deposits have been screened to determine their pH and soluble sulphate potential to aid the design of buried concrete. The results of the chemical screening are presented in the Chemtech report (ref: 8328) and DETS report (19-00214) contained in Appendix III.

From the results, the following observations can be seen:

- pH values in the soils ranged from 6.1 to 9.1 (slightly acidic to slightly alkali).
- Water Soluble Sulphate (SO_4) levels were recorded as ranging from 16mg/l to 948mg/l.

In accordance with BRE Special Digest 1: 2005 the results recorded equate to a Design Sulphate classification of DS-2 (for brownfield land).

With respect to the pH levels, the results equate to a slightly acidic to slightly alkali chemical environment. In view of this, an (ACEC) classification of AC-3z should be adopted (for mobile groundwater on brownfield land).

9.0 Construction Related Excavations and Off-Site Disposal

During the construction works it is likely that materials will be excavated on site (i.e. future foundations and buried utilities, etc.) that will not be able to be accommodated on site during to space and level constraints, ultimately requiring removal off site.

During the construction works different materials should be kept separate, as it may be the case that uncontaminated natural materials can be classified as Inert and transferred to an Inert Landfill site. A separate assessment will be required for any topsoil (naturally occurring organic materials) that may be encountered as they cannot be classified as inert due to their natural organic content.

Where made ground materials or disturbed natural strata is to be removed, the results of the soil testing undertaken within this report can be used as a preliminary assessment and the anticipated waste disposal facility should be provided with a copy of the results for review. It may be the case that the waste facility requires additional contamination screening to aid the characterisation of the made ground for off-site disposal (i.e. Waste Acceptance Criteria – WAC) and it is recommended that this be confirmed by the design team prior to commencing on site.

During the construction phase, it may be the case that WAC screening is required to aid classification for disposal and it is recommended that all materials are classified prior to excavation and disposal off site.

Conversely, if materials are required to be brought to site to raise site levels or as part of a clean cover system then certification and/or soil testing results should be reviewed by a suitably experienced and qualified geo-environmental engineer to ensure that potentially contaminated materials are not being brought to site.

Any material movements may require a Material Management Plan (MMP) in accordance with CL:AIRE.

10.0 Discussion and Recommendations

10.1 Ground and Groundwater Conditions Summary

The ground investigation encountered granular made ground associated with the former development over occasional relict (buried) topsoil. Localised areas of gravelly loam with anthropogenic material was also encountered sporadically across the area of soft landscaping. It is likely that the anthropogenic material is associated with the former allotment gardens and previous on-site activities. The made ground was encountered to a maximum depth of c.0.75m bgl.

Elsewhere, the site was surfaced with topsoil with occasional rare fragments of glass to a maximum depth of c.0.40m bgl.

The made ground and topsoil was underlain by natural drift deposits typically comprising firm, firm to stiff and stiff sandy, gravelly clay with occasional pockets of sand. In-situ testing typically indicated medium and high strength deposits. Bedrock was not encountered.

Occasional minor groundwater ingress was noted at depths of between 0.30m and c.1.60m bgl in the trial pits, however, the boreholes were all noted as dry on completion. Groundwater has been recorded at depths of between c.0.56m and c.1.07m bgl during the groundwater monitoring to date, however, this is likely to be perched rather than a shallow groundwater table.

Based on the results of the ground investigation, significant groundwater ingress is not anticipated. However, it is recommended that allowance be made for some groundwater control measures (i.e. pumping equipment) particularly during wetter periods of the year, as the materials encountered may deteriorate following exposure to surface water.

During the investigation, GEO did not identify any visual or olfactory evidence of fuel/oil type contamination (no staining, odour or free product) or any landfill type waste, with no potentially biodegradable, decomposable or putrescible materials.

Ground permeability tests indicate that the ground conditions (firm to stiff and stiff clays) are not suitable for a Sustainable Drainage System (SUDs - soak-away drainage).

10.2 Future Foundations, Pavements and Buried Structures

It is understood that the proposed development will incorporate residential housing. Based on the results of the ground investigation, conventional strip foundations are considered appropriate. The foundations should be at least 0.90m deep and extend through the topsoil and made ground into the firm or stiff sandy gravelly clay. Some localised deepening may be required where made ground or soft deposits are encountered at formation level.

Given the presence of existing mature trees along the eastern boundary, it is recommended that the foundations are designed in accordance with NHBC Standards (Chapter 4.2, “Building Near Trees”).

An allowable bearing capacity for the firm to stiff and stiff sandy gravelly clays of 90kN/m^2 is considered appropriate for the ground conditions observed.

Foundations should be designed by a suitably qualified and experienced Structural Engineer.

With respect to buried structures (concrete), the pH levels and soluble sulphate concentrations in the soils equate to a Design Sulphate classification of DS-2 and an ACEC classification of AC-3z (BRE Special Digest 1: 2005.

Based on the ground conditions and the results of the DCP tests, conventional road and pavement construction techniques should be suitable. However, it is always recommended that the appropriate CBR value is confirmed by way of plate load testing at formation level prior to construction.

10.3 Ground Contamination

10.3.1 Ground Contamination – Human Health

Following the results of the contamination assessment it can be seen that elevated concentrations of PAH compounds are present in the made ground that exceed the generic assessment criteria for a residential development with plant uptake. The concentrations of PAH compounds within the loamy made ground only marginally exceeded the assessment criteria, however, given the presence of occasional clinker and asphalt, the material is not considered suitable for re-use in a private garden.

Chemical screening of the topsoil indicated low contaminant concentrations which did not exceed the GAC and is considered suitable for re-use within private gardens.

The made ground was generally encountered across the northern part of the site associated with the previous development (British Legion Hall), however, localised pockets of loamy made ground with fragments of anthropogenic material (clinker, asphalt, etc..) were also encountered elsewhere on site. The loamy made ground appeared very much like topsoil, however, the presence of occasional asphalt and clinker indicates that it is not from a natural source. Care will be required during any remedial works to avoid mixing topsoil and made ground materials.

In view of the elevated concentrations of PAH compounds, there is a potential risk to the end user where private gardens are planned due to possible inhalation, ingestion and direct contact with the contaminated soils. It is also feasible that home grown produce (vegetables) will be grown in the gardens for human consumption and there is a plausible risk to human health through ingestion of contaminants that have been taken up through the plants.

Where private gardens are not proposed, such as areas of hard standing and buildings, the risk from contamination is negligible as the pathway to the end user will be broken. As such, consideration could be given to re-using suitable granular material for use beneath proposed roads, hardstand and buildings.

In view of the above, remediation is considered necessary to reduce the risk to the end user to acceptable levels and to provide a suitable medium within the proposed gardens for plants. It is out-with the scope of this report to fully detail suitable remediation strategies, however, the most suitable form of remediation at this stage, based on the results of the investigation would be to excavate the contaminated made ground from the proposed private gardens so that the material is removed entirely or to a sufficient depth so that a robust clean cover system can be accommodated.

For proposed private gardens, it is generally accepted that a robust clean cover layer of 600mm is required to protect the end user from contamination in the made ground including uptake by any vegetables grown for human consumption. This would typically comprise a suitably compacted “no-dig layer” (comprising 150mm of compacted virgin quarry stone / gravel) underlain by a geotextile marker layer and at least 450mm of suitable sub-soil/topsoil (minimum 150mm of topsoil) at the surface. Where plants will not be grown for human consumption such as area of general soft landscaping/public open space, the thickness of the Clean Cover could be reduced to 300mm.

As well as providing a barrier between the contaminated material and the end user, the clean cover layer also provides a suitable growing medium for plants, shrubs and trees. Deepening of the clean cover is recommended where large plants and trees are proposed.

Any remediation works would be subject to the approval of the Local Authority. It is recommended that a Remediation Strategy be agreed with the Planning Authority prior to implementation on site. Once the remedial works have been agreed and implemented on site, the Planning Authority will require the completion of Validation/Verification works and reporting to confirm the remedial works have been completed in accordance with the agreed remedial strategy.

Based on the results of the investigation, it is likely that the water supply pipes will be located within the underlying made ground materials. Based on the results of the site history, the ground conditions and the results of the laboratory screening, standard supply pipes are likely to be suitable. However, it is recommended that the relevant utility suppliers are contacted in this respect, as a site-specific risk assessment may be required.

10.4 Ground Gas

The results of the preliminary ground gas monitoring indicate no methane, low concentrations of carbon dioxide and low flow rates. Therefore, gas protection measures are not considered necessary at this stage.

3 No. additional gas monitoring visits are planned, therefore the recommendations included above are preliminary and subject to change depending on the results of the remaining gas monitoring. Upon completion of the monitoring, this report will be revised to reflect the full set of results.

In accordance with BR211, full radon protection measures are necessary. A Remediation Strategy is required to detail the protection measures to be put in place and a Verification Plan to determine the appropriate installation and validation of the measures.

10.5 General Comments

Consideration must be made for variations to occur in the ground conditions between the exploratory hole locations for which GEO holds no responsibility and areas where limited access was available. It is therefore recommended that a “watching brief” and “observational technique” be applied to this site to ensure that if ground conditions appear to vary from those identified within this investigation report then advice should be sought from a suitably qualified and experienced Engineering Geologist, Geotechnical or Geo-Environmental Engineer.

The recommendations and opinions expressed in this report are based on the strata observed within the exploratory holes in addition to the results of the site and laboratory tests commissioned by GEO. Consequently, GEO takes no responsibility for conditions that have not been revealed or which occur between them. GEO takes no responsibility for the accuracy of third party information provided by sub-contract drillers or laboratories.

The conclusions and recommendations presented within this report are considered reasonable based on the available information. However, these cannot be guaranteed to gain regulatory approval. Therefore, the report should be passed to the appropriate regulatory authorities and/ or other key stakeholders in order to seek their approval of the findings prior to undertaking any works on site.

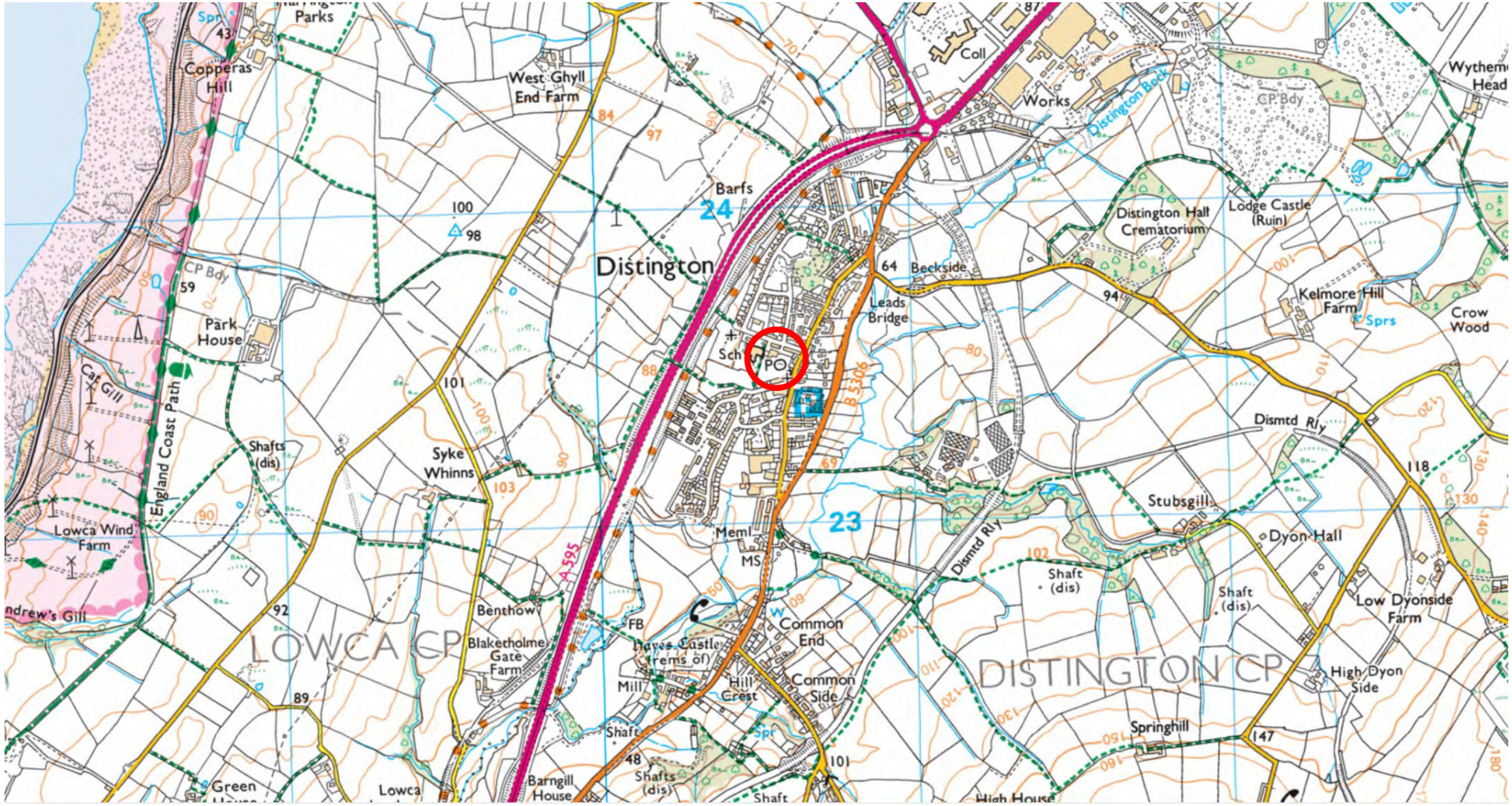
End of Report

Appendix I

- Site Location Plan
- Exploratory Hole Location Plan
- Proposed Sita Layout Plan

GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – Site Location



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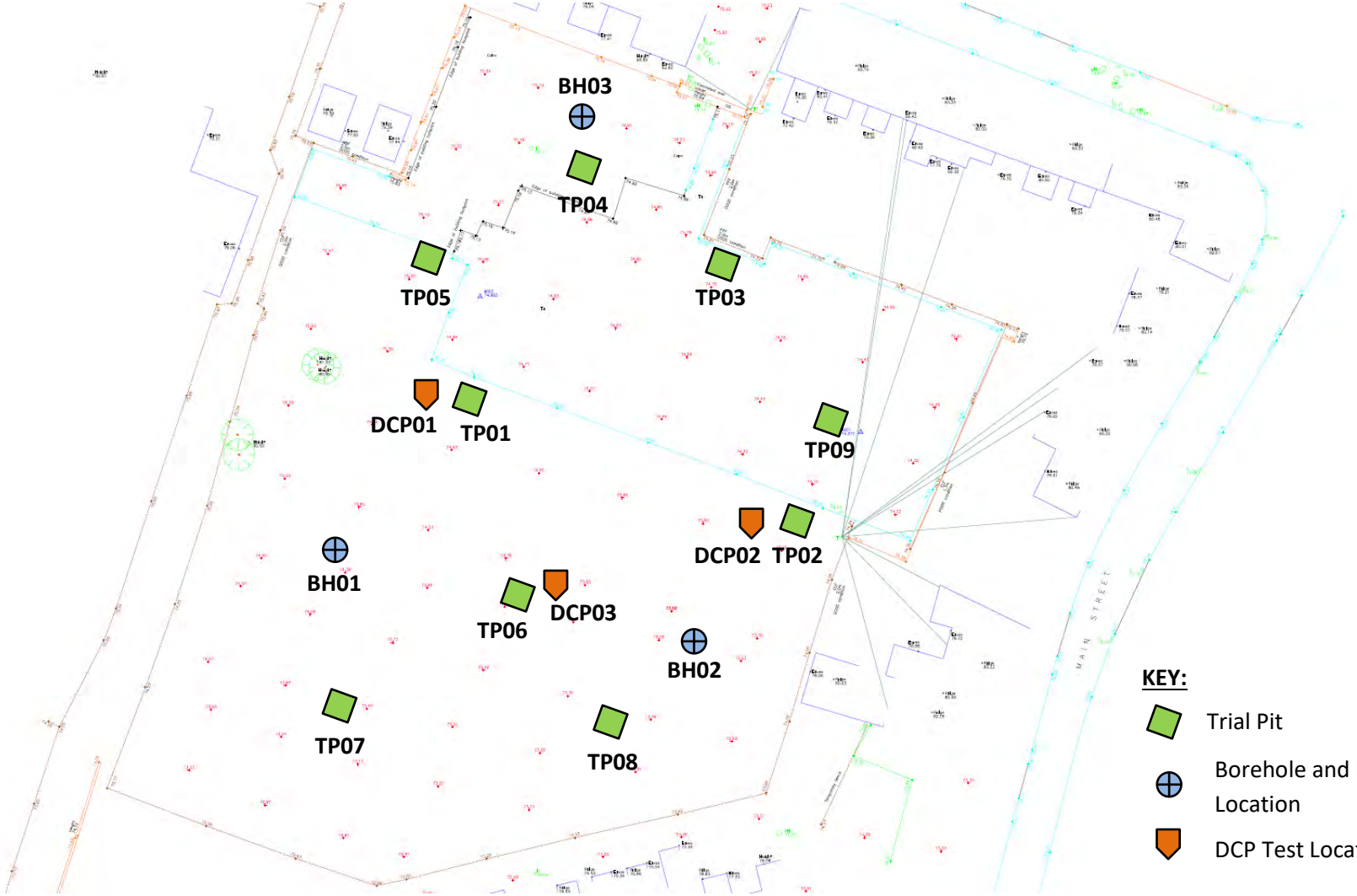
GEO2019-4032: Land off Church Road, Distington, Cumbria – Exploratory Hole Location Plan



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Proposed New Vehicle and Pedestrian access point off Church Road

Shared parking area with existing residents along Church Road

Central court - Arrival point / Village Square

Controlled secure access to 'fairy Path'

Secondary Entrance / Exit point to garden area
Upper levels within building provide views over countryside

Patio Area And Conservatory - South Facing

Sensory well being garden space

Shared parking area with existing residents along Church Road

Bin Collection point - used only on bin collection day
Additional Storage arrangements within building

All 9 Bungalows have private rear gardens

Proposed Main Entrance point into building

43m vision splay

43m vision splay

CHURCH ROAD

DISTINGTON COMMUNITY SCHOOL

MAIN STREET

CHAPEL STREET

7400

N

0 5 10 15 20

HOUSING MIX

BUNGALOWS

3no 2 Bed 3Person Bungalows
M(4) 3 Wheelchair standard with Dementia adaptations - 81msq

6no 2 Bed 3Person Bungalows
M(4) 3 Wheelchair standard - 76msq

9 no Bungalows

APARTMENTS

28no 1 Bed 2Person Apartments
M(4) 2 Adaptable standard - 50msq

8no 2 Bed 3Person Apartments
M(4) 2 Adaptable standard - 62msq

3no 2 Bed 3Person Apartments
M(4) 3 wheelchair standard - 63msq

39 no Apartments

All 9no Bungalows have incurtilage parking provided
26no Shared Parking Spaces provided

0 5 10 15 20 25

Rev.	Date	Description	Drwn.

Note

North

Scale

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Liverpool
Address
98-100 Duke Street
Post Code
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0151 708 8944
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Drawing Title
SITE PLAN DRAFT LAYOUT
Project
Distington Big Local
Client
Big Local
Scales @ A2 — Date — Drawn — Check
1:200
Job Number — Dwg. No / Revision — Status
2808 SK018 Preliminary

Halsall Lloyd Partnership
ARCHITECTS & DESIGNERS

Appendix II

- Exploratory Hole Logs
- DCP Calculation Sheets
- Ground Gas Monitoring Sheets

GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – BH01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.24	TOPSOIL: Dark grey brown sandy gravelly LOAM with occasional glass.		0.2 - J
0.24	1.20	Firm dark brown sandy very gravelly CLAY.		1.0 SPT = N20
1.20	2.00	Stiff dark brown very gravelly CLAY.		1.5 - T
2.00	3.20	Firm to stiff dark brown very silty sandy CLAY.		2.0 SPT = N12 3.0 SPT = N42
3.20	4.00	Stiff dark brown very gravelly CLAY.		4.0 SPT = N>50
		End of borehole at 4.00m due to sample tube and SPT refusal. Borehole remained open and dry on completion. Borehole installed: GL to 1.0 – Plain pipe and bentonite seal 1.0 to 4.0 – Slotted pipe and gravel filter		Hand dug to 1.00m

Site: Land off Church Road, Distington, Cumbria
Engineer: J. Brock
Site Works Date: 12/12/2019
Plant: Archway Competitor C130 Superheavy

Log Notes:
SPT = Standard Penetration test (N value)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – BH02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	TOPSOIL: Dark grey brown sandy gravelly LOAM with occasional glass.		
0.30	0.60	Soft dark brown very sandy gravelly CLAY with pockets of silty gravelly sand.		
0.60	2.10	Firm to stiff dark brown very gravelly CLAY.		1.0 SPT = N12 2.0 SPT = N13
2.10	3.00	Firm dark brown very silty sandy CLAY.		3.0 SPT = N>50
		End of borehole at 3.00m due to sample tube and SPT refusal. Borehole remained open and dry on completion. Borehole installed: GL to 1.0 – Plain pipe and bentonite seal 1.0 to 3.0 – Slotted pipe and gravel filter		Hand dug to 1.00m

Site: Land off Church Road, Distington, Cumbria
Engineer: J. Brock
Site Works Date: 12/12/2019
Plant: Archway Competitor C130 Superheavy

Log Notes:
SPT = Standard Penetration test (N value)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – BH03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.10	TOPSOIL: Dark grey brown sandy gravelly LOAM with occasional mixed aggregate, brick, concrete and timber.		
0.10	0.20	MADE GROUND: Grey coarse angular GRAVEL of brick, concrete and slate.		
0.20	0.45	RELICT TOPSOIL: Dark grey brown very clayey sandy gravelly LOAM.		
0.45	0.95	Stiff dark brown very gravelly CLAY with many cobbles and occasional boulders.		
		End of borehole at 0.95m due to sample tube and SPT refusal. Borehole remained open and dry on completion. Borehole installed: GL to 0.5 – Plain pipe and bentonite seal 0.50 to 0.95 – Slotted pipe and gravel filter		Hand dug to 0.95m

Site: Land off Church Road, Distington, Cumbria
Engineer: J. Brock
Site Works Date: 12/12/2019
Plant: Archway Competitor C130 Superheavy

Log Notes:
SPT = Standard Penetration test (N value)
LP = Limited Penetration (HSV/CBR)
NP = No penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

GEO Environmental Engineering

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GEO2019-4032: Land off Church Road, Distington, Cumbria – TP01

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.33	TOPSOIL: Dark grey brown sandy gravelly LOAM with occasional glass.		0.2 - J
0.33	0.90	Firm to stiff brown silty, sandy very gravelly CLAY.		
0.90	1.50	Stiff, locally firm to stiff dark brown very gravelly CLAY.		1.0 – T 1.0 HSV = 100
		End of trial hole at 1.50m – Soil Infiltration Test Completed. Slight groundwater ingress at c.1.50m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Soil Infiltration Test Pit Dimensions: 0.30 x 1.80m	
Duration (mins)	Water Level (m bgl)
0	0.40
20	0.41
80	0.39
120	0.38

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GEO2019-4032: Land off Church Road, Distington, Cumbria – TP02

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.40	MADE GROUND: Dark grey brown sandy gravelly LOAM with occasional glass, plastic, concrete, wire and timber.		0.3 - J
0.40	1.20	Firm to stiff, locally firm brown silty, very sandy gravelly CLAY with pockets of medium to coarse sand.		0.9 HSV = 75
1.20	1.70	Stiff, locally firm to stiff dark brown very gravelly CLAY.		1.5 - T
		End of trial hole at 1.70m – Soil Infiltration Test Completed. Slight groundwater ingress at c.0.40m and c.1.50m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Soil Infiltration Test Pit Dimensions: 0.35 x 1.90m	
Duration (mins)	Water Level (m bgl)
0	0.70
60	0.56
120	0.54

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP03

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.08	MADE GROUND: Asphalt.		
0.08	0.20	MADE GROUND: Grey fine to coarse angular GRAVEL of mixed aggregate, slag, concrete. Occasional asphalt.		0.1 - J
0.20	0.48	RELICT TOPSOIL: Dark grey brown very clayey sandy gravelly LOAM.		
0.48	0.80	Firm brown silty, very sandy gravelly CLAY with pockets of medium to coarse sand.		
0.80	1.60	Stiff, locally firm to stiff dark brown very gravelly CLAY.		1.0 - T
		End of trial hole at 1.60m – Soil Infiltration Test Completed. Slight groundwater ingress at c.1.00m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

Soil Infiltration Test Pit Dimensions: 0.35 x 1.80m	
Duration (mins)	Water Level (m bgl)
0	0.45
40	0.45
75	0.45
120	0.45
240	0.45

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP04

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.26	MADE GROUND: Dark grey brown sandy gravelly LOAM with occasional mixed aggregate, brick, concrete and timber.		0.1 - J
0.26	0.31	MADE GROUND: Whole Bricks		
0.31	0.75	RELICT TOPSOIL: Dark grey brown very clayey sandy gravelly LOAM.		
0.75	0.93	Firm to stiff, locally firm brown silty, very sandy gravelly CLAY with pockets of medium to coarse sand.		
0.93	1.50	Stiff dark brown very gravelly CLAY with many cobbles and occasional boulders. Very large boulder at 1.40m bgl.		
		End of trial hole at 1.50m. Trial pit dry on completion. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP05

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.22	MADE GROUND: Dark grey brown sandy gravelly LOAM with occasional mixed aggregate, brick, concrete and timber.		0.1 - J
0.26	0.40	MADE GROUND: Coarse angular quarry aggregate with occasional whole brick and concrete.		Concrete Slab extends to 0.60m bgl
0.40	0.80	Soft to firm brown very sandy, gravelly CLAY with pockets of medium to coarse sand.		
0.80	1.80	Firm to stiff dark brown very gravelly CLAY with many cobbles and occasional boulders.		1.1 HSV = 70 1.6 HSV = 75
		End of trial hole at 1.80m. Slight groundwater ingress at c.0.80m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP06

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.37	TOPSOIL: Dark grey brown sandy gravelly LOAM with occasional glass.		
0.37	1.00	Firm to stiff brown very sandy, gravelly CLAY with pockets of medium to coarse sand.		0.5 HSV = 60
1.00	1.80	Firm to stiff dark brown very gravelly CLAY with occasional cobbles.		1.0 HSV = 75 1.3 HSV = 80
		End of trial hole at 1.80m. Slight groundwater ingress at c.1.60m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP07

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.26	TOPSOIL: Dark grey brown sandy gravelly LOAM with occasional glass.		0.2 - J
0.26	0.80	Soft to firm brown very sandy, gravelly CLAY with pockets of medium to coarse sand.		
0.80	1.70	Stiff dark brown very gravelly CLAY with occasional cobbles.		1.0 - T
		End of trial hole at 1.70m. Slight groundwater ingress at c.1.60m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP08

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.30	MADE GROUND: Dark grey to black very sandy gravelly LOAM with occasional glass and gravel of clinker and asphalt.		0.2 - J
0.30	1.00	Soft to firm brown very sandy, gravelly CLAY with pockets of medium to coarse sand.		
1.00	1.50	Stiff dark brown very gravelly CLAY with occasional cobbles.		
		End of trial hole at 1.50m. Slight groundwater ingress at c.0.30m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
LP = Limited Penetration (HSV/CBR)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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GEO Environmental Engineering

GEO2019-4032: Land off Church Road, Distington, Cumbria – TP09

Depth From (m)	Depth To (m)	Strata Description	Legend	Testing / Samples
0.00	0.08	MADE GROUND: Asphalt.		
0.08	0.12	MADE GROUND: Grey fine to coarse angular GRAVEL.		
0.12	0.18	MADE GROUND: Fused SLAG.		
0.18	0.40	MADE GROUND: Grey fine to coarse angular GRAVEL.		
0.40	0.68	RELICT TOPSOIL: Dark grey brown very clayey sandy gravelly LOAM.		0.5 - J
0.68	1.10	Firm brown silty, very sandy gravelly CLAY with pockets of medium to coarse sand.		
1.10	1.60	Stiff, locally firm to stiff dark brown very gravelly CLAY.		
		End of trial hole at 1.60m. Slight groundwater ingress at c.0.40m bgl. Trial hole backfilled with arisings on completion.		

Site: Land off Church Road, Distington, Cumbria
Engineer: J.Brock
Site Works Date: 12/12/2019
Plant: Tracked 360 Excavator

Log Notes:
HSV = Hand Shear Vane (kN/m^2)
B = Bulk Bag, J = Amber Glass Jar, T = Plastic Tub

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Dynamic Cone Penetrometer Calculation Sheet

Location:	**DCP01 - Land off Chruch Road, Distington, Cumbria**
Test Depth (mm):	**0**
Zero Blow Reading:	**80**

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value[1] $CBR=10^{(2.48-1.057.Log(DCP))}$
2	325	245	245	2	122.5	1.9
3	500	420	175	5	58.3	4.1
5	680	600	180	10	36.0	6.8
7	890	810	210	17	30.0	8.3

Location:	**DCP02 - Land off Chruch Road, Distington, Cumbria**
Test Depth (mm):	**0**
Zero Blow Reading:	**80**

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value[1] $CBR=10^{(2.48-1.057.Log(DCP))}$
2	380	300	300	2	150.0	1.5
2	510	430	130	4	65.0	3.7
10	660	580	150	14	15.0	17.3
10	785	705	125	24	12.5	20.9
10	855	775	70	34	7.0	38.6

1 - TRRL Equation, $Log_{10}(CBR) = 2.48 - 1.057Log_{10}$ (mm/blow)

Dynamic Cone Penetrometer Calculation Sheet

Location:	**DCP03 - Land off Chruch Road, Distington, Cumbria**
Test Depth (mm):	**0**
Zero Blow Reading:	**80**

Blows	Pentration Reading (mm)	Depth BGL (mm)	Actual Penetration (mm)	Cumulative Blows	DCP (mm/blow)	CBR Value[1] $CBR=10^{(2.48-1.057.Log(DCP))}$
2	380	300	300	2	150.0	1.5
4	600	520	220	6	55.0	4.4
5	750	670	150	11	30.0	8.3
8	930	850	180	19	22.5	11.2

1 - TRRL Equation, $Log_{10}(CBR) = 2.48 - 1.057Log_{10}$ (mm/blow)

GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 01

Site: Land off Church Road, Distington, Cumbria

Project No: 2019-4032

Date: 17/12/2019

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	990 R	0	0	1.6	1.6	18.4	18.4	<0.1	1.07	4.0	
BH02	990 R	0	0	1.4	1.4	19.5	19.5	+0.5	0.87	3.0	
BH03	990 R	0	0	0.5	0.5	19.7	19.7	<0.1	0.72	0.95	

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Sunny and Dry. Temperature 8.0°C.

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GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 02

Site: Land off Church Road, Distington, Cumbria

Project No: 2019-4032

Date: 03.01.2020

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	1018 R	0	0	2.2	2.2	16.7	16.7	<0.1	0.99	4.0	
BH02	1018 R	0	0	2.3	2.4	18.8	18.5	<0.1	0.63	3.0	
BH03	1018 R	0	0	1.4	1.5	19.1	19.0	<0.1	0.54	0.95	

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry. Temperature 7.0°C.

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GEO Environmental Engineering

Ground Gas & Groundwater Monitoring Record Sheet 03

Site: Land off Church Road, Distington, Cumbria

Project No: 2019-4032

Date: 15.01.2020

Borehole	Pressure (mb)	Methane Initial (% v/v)	Methane Residual (% v/v)	Carbon Dioxide Initial (% v/v)	Carbon Dioxide Residual (% v/v)	Oxygen Initial (% v/v)	Oxygen Residual (% v/v)	Flow Rate (l/h)	Water Level (m)	Depth of base (m)	Water Sample Recovered?
BH01	991 F	0	0	2.3	2.3	17.8	16.6	<0.1	0.98	4.0	-
BH02	991 F	0	0	2.7	2.8	18.4	16.3	<0.1	0.57	3.0	-
BH03	991 F	0	0	1.2	1.2	18.5	18.5	<0.1	0.56	0.95	-

Notes:
Initial Value = First recorded concentration taken immediately upon opening the gas valve; Residual Value = Constant or "steady" reading following peak.
Monitoring undertaken for a minimum of three minutes. Where high concentrations are initially noted then the monitoring should be increased to five minutes.
F = Falling Atmosphreic Pressure, R = Rising Atmosphreic Pressure, S = Steady Atmospheric Pressure

Monitoring Completed By: JB

Equipment Used: GA2000 Gas Analyser with External Flow Pod. Geotechnical Instruments Dipmeter.

Weather Conditions: Dry. Temperature 8.0°C.

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Appendix III

- Laboratory Test Results

2531

ANALYTICAL TEST REPORT

Contract no:	83238
Contract name:	Distington
Client reference:	GEO2019-4032
Clients name:	Geo Environmental Engineering
Clients address:	4 Culgarth Avenue Cockermouth Cumbria CA13 9PL
Samples received:	16 December 2019
Analysis started:	16 December 2019
Analysis completed:	23 December 2019
Report issued:	23 December 2019

Notes:

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:

U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by:

Dave Bowerbank
Customer Support Hero

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
83238-1	BH01	0.20	Clayey Sand with Gravel	-	-	29.3
83238-2	TP01	0.20	Sandy Clay with Gravel	-	-	21.7
83238-3	TP02	0.30	Sandy Clay with Gravel	-	-	27.5
83238-4	TP03	0.10	Sand with Gravel	-	-	17.2
83238-5	TP04	0.10	Clayey Sand with Gravel & Roots	-	-	9.8
83238-6	TP05	0.10	Sandy Clay with Gravel	-	-	21.4
83238-7	TP07	0.20	Sandy Clay with Gravel	-	-	21.4
83238-8	TP08	0.20	Sandy Clay with Gravel	-	-	26.1

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SOILS

Lab number			83238-1	83238-2	83238-3	83238-4	83238-5	83238-6
Sample id			BH01	TP01	TP02	TP03	TP04	TP05
Depth (m)			0.20	0.20	0.30	0.10	0.10	0.10
Date sampled			16/12/2019	16/12/2019	16/12/2019	16/12/2019	16/12/2019	16/12/2019
Test	Method	Units						
Arsenic (total)	CE127 M	mg/kg As	19	19	21	9.4	10	16
Cadmium (total)	CE127 M	mg/kg Cd	0.3	0.3	0.2	<0.2	0.3	0.2
Chromium (total)	CE127 M	mg/kg Cr	80	87	95	29	34	67
Chromium (III)	CE208	mg/kg CrIII	80	87	95	29	34	67
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	40	43	45	19	9.1	34
Lead (total)	CE127 M	mg/kg Pb	104	107	121	37	14	69
Mercury (total)	CE127 M	mg/kg Hg	1.1	1.2	0.8	<0.5	<0.5	0.8
Nickel (total)	CE127 M	mg/kg Ni	29	29	31	9.8	6.9	27
Selenium (total)	CE127 M	mg/kg Se	1.0	1.1	1.3	2.3	1.0	1.0
Zinc (total)	CE127 M	mg/kg Zn	71	80	95	31	44	105
pH	CE004 M	units	6.1	7.0	6.9	9.1	8.1	7.4
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	37	23	44	948	143	25
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	6.3	4.3	5.1	2.4	1.3	3.4
PAH								
Naphthalene	CE087 M	mg/kg	0.05	0.09	0.05	0.36	0.03	0.04
Acenaphthylene	CE087 M	mg/kg	0.03	0.02	<0.02	0.93	0.04	0.08
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02	0.02	2.08	<0.02	0.12
Fluorene	CE087 U	mg/kg	<0.02	0.02	0.03	1.19	0.03	0.18
Phenanthrene	CE087 M	mg/kg	0.41	0.57	0.49	23.75	0.34	3.57
Anthracene	CE087 U	mg/kg	0.10	0.12	0.09	10.96	0.11	0.76
Fluoranthene	CE087 M	mg/kg	1.02	1.31	1.14	182.40	0.72	8.16
Pyrene	CE087 M	mg/kg	0.79	1.02	0.91	170.89	0.58	6.25
Benzo(a)anthracene	CE087 U	mg/kg	0.56	0.65	0.61	116.10	0.42	3.27
Chrysene	CE087 M	mg/kg	0.62	0.71	0.65	102.09	0.37	3.24
Benzo(b)fluoranthene	CE087 M	mg/kg	0.73	0.78	0.80	150.69	0.56	3.76
Benzo(k)fluoranthene	CE087 M	mg/kg	0.26	0.35	0.29	58.88	0.23	1.53
Benzo(a)pyrene	CE087 U	mg/kg	0.49	0.57	0.51	92.98	0.38	2.53
Indeno(123cd)pyrene	CE087 M	mg/kg	0.37	0.40	0.43	58.14	0.31	2.06
Dibenz(ah)anthracene	CE087 M	mg/kg	0.09	0.08	0.09	13.61	0.07	0.41
Benzo(ghi)perylene	CE087 M	mg/kg	0.34	0.36	0.37	44.78	0.29	1.73
PAH (total of USEPA 16)	CE087	mg/kg	5.85	7.05	6.48	1030	4.47	37.7
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD

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SOILS

Lab number			83238-7	83238-8
Sample id			TP07	TP08
Depth (m)			0.20	0.20
Date sampled			16/12/2019	16/12/2019
Test	Method	Units		
Arsenic (total)	CE127 M	mg/kg As	19	24
Cadmium (total)	CE127 M	mg/kg Cd	0.2	0.3
Chromium (total)	CE127 M	mg/kg Cr	78	81
Chromium (III)	CE208	mg/kg CrIII	78	81
Chromium (VI)	CE146	mg/kg CrVI	<1	<1
Copper (total)	CE127 M	mg/kg Cu	43	57
Lead (total)	CE127 M	mg/kg Pb	77	172
Mercury (total)	CE127 M	mg/kg Hg	1.3	1.9
Nickel (total)	CE127 M	mg/kg Ni	27	37
Selenium (total)	CE127 M	mg/kg Se	1.0	1.3
Zinc (total)	CE127 M	mg/kg Zn	80	109
pH	CE004 M	units	6.4	6.5
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	21	25
Cyanide (total)	CE077	mg/kg CN	<1	<1
Total Organic Carbon (TOC)	CE072 M	% w/w C	3.6	5.2
PAH				
Naphthalene	CE087 M	mg/kg	0.04	0.12
Acenaphthylene	CE087 M	mg/kg	<0.02	0.42
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02
Fluorene	CE087 U	mg/kg	<0.02	0.25
Phenanthrene	CE087 M	mg/kg	0.31	3.30
Anthracene	CE087 U	mg/kg	0.03	1.22
Fluoranthene	CE087 M	mg/kg	0.42	6.62
Pyrene	CE087 M	mg/kg	0.32	4.54
Benzo(a)anthracene	CE087 U	mg/kg	0.22	3.23
Chrysene	CE087 M	mg/kg	0.26	3.07
Benzo(b)fluoranthene	CE087 M	mg/kg	0.32	3.54
Benzo(k)fluoranthene	CE087 M	mg/kg	0.10	1.68
Benzo(a)pyrene	CE087 U	mg/kg	0.20	2.53
Indeno(123cd)pyrene	CE087 M	mg/kg	0.14	1.52
Dibenz(ah)anthracene	CE087 M	mg/kg	0.03	0.37
Benzo(ghi)perylene	CE087 M	mg/kg	0.13	1.33
PAH (total of USEPA 16)	CE087	mg/kg	2.53	33.8
Subcontracted analysis				
Asbestos (qualitative)	$	-	NAD	NAD

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
CE208	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
83238-1	BH01	0.20	N	
83238-2	TP01	0.20	N	
83238-3	TP02	0.30	N	
83238-4	TP03	0.10	N	
83238-5	TP04	0.10	N	
83238-6	TP05	0.10	N	
83238-7	TP07	0.20	N	
83238-8	TP08	0.20	N	

LABORATORY REPORT

4043

Contract Number: PSL19/7765

Report Date: 14 January 2020

Client's Reference: 2019-4032

Client Name: Geo Environmental Engineering
4 Culgarth Avenue
Cockermouth
Cumbria
CA13 9PL

For the attention of: James Brock

Contract Title: Distington

Date Received: 18/12/2019
Date Commenced: 18/12/2019
Date Completed: 14/1/2020

Notes: Opinions and Interpretations are outside the UKAS Accreditation

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
R Berriman (Quality Manager)

S Royle (Laboratory Manager)
S Eyre (Senior Technician)
L Knight (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH01		TUB	1.50		Brown gravelly sandy CLAY.
TP01		TUB	1.00		Brown gravelly sandy CLAY.
TP02		TUB	1.50		Brown gravelly sandy CLAY.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH01		TUB	1.50		14			36	17	19	82	Intermediate plasticity CI.
TP01		TUB	1.00		16			38	18	20	84	Intermediate plasticity CI.
TP02		TUB	1.50		22			47	21	26	97	Intermediate plasticity CI.

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

Distington

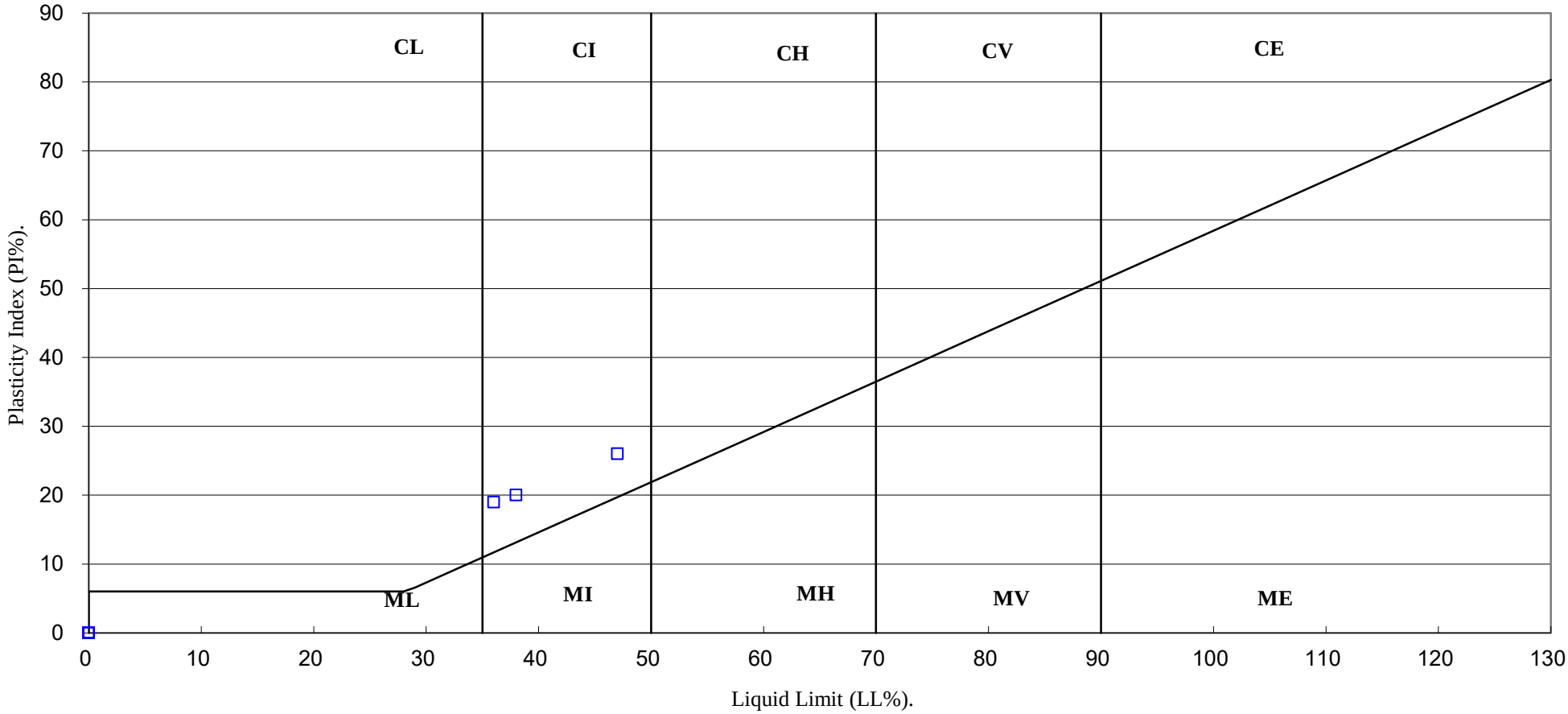
Contract No:

PSL19/7765

Client Ref:

GEO2019-4032

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Distington**	**Contract No:** PSL19/7765 **Client Ref:** GEO2019-4032

Certificate of Analysis

Certificate Number 20-00214

09-Jan-20

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 20-00214

Client Reference PSL19/7765

Order No (not supplied)

Contract Title Distington

Description 3 Soil samples.

Date Received 07-Jan-20

Date Started 07-Jan-20

Date Completed 09-Jan-20

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager

Summary of Chemical Analysis

Soil Samples

Our Ref 20-00214
Client Ref PSL19/7765
Contract Title Distington

			Lab No	1620302	1620303	1620304
			Sample ID	BH01	TP01	TP02
			Depth	1.50	1.00	1.50
			Other ID			
			Sample Type	SOIL	SOIL	SOIL
			Sampling Date	n/s	n/s	n/s
			Sampling Time	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
Inorganics						
pH	DETSC 2008#		pH	7.8	7.8	7.6
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	22	16	19

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 20-00214
Client Ref PSL19/7765
Contract Distington

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1620302	BH01 1.50 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1620303	TP01 1.00 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1620304	TP02 1.50 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Appendix IV

- GEO Chemical Assessment Sheet

Geo Environmental Engineering Ltd

Chemical Assessment Sheet - Soils

Lab number			83238-1	83238-2	83238-3	83238-4	83238-5	83238-6	83238-7	83238-8	Generic Assessment Criteria Residential With Plant Uptake 2.5% SOM		
Sample id			BH01	TP01	TP02	TP03	TP04	TP05	TP07	TP08			
Depth (m)			0.20	0.20	0.30	0.10	0.10	0.10	0.20	0.20	GAC	GAC Exceeded?	GAC Ref:
Date sampled			16/12/2019	16/12/2019	16/12/2019	16/12/2019	16/12/2019	16/12/2019	16/12/2019	16/12/2019			
Test	Method	Units											
Arsenic (total)	CE127 M	mg/kg As	19	19	21	9.4	10	16	19	24	37	No	LQM S4UL
Cadmium (total)	CE127 M	mg/kg Cd	0.3	0.3	0.2	<0.2	0.3	0.2	0.2	0.3	11	No	LQM S4UL
Chromium (III)	CE208	mg/kg CrIII	80	87	95	29	34	67	78	81	910	No	LQM S4UL
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1	<1	<1	6	No	LQM S4UL
Copper (total)	CE127 M	mg/kg Cu	40	43	45	19	9.1	34	43	57	2400	No	LQM S4UL
Lead (total)	CE127 M	mg/kg Pb	104	107	121	37	14	69	77	172	200	No	CL:AIRE C4SL
Mercury (total)	CE127 M	mg/kg Hg	1.1	1.2	0.8	<0.5	<0.5	0.8	1.3	1.9	40	No	LQM S4UL
Nickel (total)	CE127 M	mg/kg Ni	29	29	31	9.8	6.9	27	27	37	130	No	LQM S4UL
Selenium (total)	CE127 M	mg/kg Se	1.0	1.1	1.3	2.3	1.0	1.0	1.0	1.3	250	No	LQM S4UL
Zinc (total)	CE127 M	mg/kg Zn	71	80	95	31	44	105	80	109	3700	No	LQM S4UL
pH	CE004 M	units	6.1	7.0	6.9	9.1	8.1	7.4	6.4	6.5	<6.5	No	BRE
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	37	23	44	948	143	25	21	25	>500	No	BRE
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1	<1	<1	34	No	ATRISK SSV
Total Organic Carbon (TOC)	CE072 M	% w/w C	6.3	4.3	5.1	2.4	1.3	3.4	3.6	5.2	-	-	-
PAH													
Naphthalene	CE087 M	mg/kg	0.05	0.09	0.05	0.36	0.03	0.04	0.04	0.12	5.6	No	LQM S4UL
Acenaphthylene	CE087 M	mg/kg	0.03	0.02	<0.02	0.93	0.04	0.08	<0.02	0.42	420	No	LQM S4UL
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02	0.02	2.08	<0.02	0.12	<0.02	<0.02	510	No	LQM S4UL
Fluorene	CE087 U	mg/kg	<0.02	0.02	0.03	1.19	0.03	0.18	<0.02	0.25	400	No	LQM S4UL
Phenanthrene	CE087 M	mg/kg	0.41	0.57	0.49	23.75	0.34	3.57	0.31	3.30	220	No	LQM S4UL
Anthracene	CE087 U	mg/kg	0.10	0.12	0.09	10.96	0.11	0.76	0.03	1.22	5400	No	LQM S4UL
Fluoranthene	CE087 M	mg/kg	1.02	1.31	1.14	182.40	0.72	8.16	0.42	6.62	560	No	LQM S4UL
Pyrene	CE087 M	mg/kg	0.79	1.02	0.91	170.89	0.58	6.25	0.32	4.54	1200	No	LQM S4UL
Benzo(a)anthracene	CE087 U	mg/kg	0.56	0.65	0.61	116.10	0.42	3.27	0.22	3.23	11	YES	LQM S4UL
Chrysene	CE087 M	mg/kg	0.62	0.71	0.65	102.09	0.37	3.24	0.26	3.07	22	YES	LQM S4UL
Benzo(b)fluoranthene	CE087 M	mg/kg	0.73	0.78	0.80	150.69	0.56	3.76	0.32	3.54	3.3	YES	LQM S4UL
Benzo(k)fluoranthene	CE087 M	mg/kg	0.26	0.35	0.29	58.88	0.23	1.53	0.10	1.68	93	No	LQM S4UL
Benzo(a)pyrene	CE087 U	mg/kg	0.49	0.57	0.51	92.98	0.38	2.53	0.20	2.53	2.7	YES	LQM S4UL
Indeno(123cd)pyrene	CE087 M	mg/kg	0.37	0.40	0.43	58.14	0.31	2.06	0.14	1.52	36	YES	LQM S4UL
Dibenz(ah)anthracene	CE087 M	mg/kg	0.09	0.08	0.09	13.61	0.07	0.41	0.03	0.37	0.28	YES	LQM S4UL
Benzo(ghi)perylene	CE087 M	mg/kg	0.34	0.36	0.37	44.78	0.29	1.73	0.13	1.33	340	No	LQM S4UL
PAH (total of USEPA 16)	CE087	mg/kg	5.85	7.05	6.48	1030	4.47	37.7	2.53	33.8	-	-	-
Subcontracted analysis													
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	Present	No	Presence
Soil Type (TP- Topsoil, MG - Made Ground, NAT - Natural Drift)			TP	TP	TP	MG	MG	MG	TP	MG			

Notes:
GAC = Generic Assessment Criteria
YES = GAC Exceeded
CLEA SGV = Clea Soil Guideline Value (Residential End Use based on 2.5% SOM)
LQM S4UL = LQM/CIEH 'Suitable 4 Use Levels' S4ULs (Residential End Use based on 2.5% SOM)
CL:AIRE C4SL = Category 4 Screening Levels
ATRISK SSV = Atkins Soil Screening Values (Residential End Use based on 2.5% SOM)

GEO Environmental Engineering

GEO Environmental Engineering Ltd
Geotechnical
&
Environmental Drilling Experts
&
Consultants